My Project

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Chapter 1

Namespace Index

1.1 Namespace List

Here is a list of all namespaces with brief descriptions:

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 3

Class Index

3.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 4

File Index

4.1 File List

Here is a list of all files with brief descriptions:

Chapter 5

Namespace Documentation

5.1 Catch Namespace Reference

Namespaces

- namespace Detail
- namespace detail
- namespace Generators
- namespace literals
- namespace Matchers

Classes

- struct always_false
- class AssertionHandler
- struct AssertionInfo
- struct AssertionReaction
- struct AutoReg
- class BinaryExpr
- class Capturer
- struct CaseSensitive
- struct Counts
- struct Decomposer
- class ExceptionTranslatorRegistrar
- class ExprLhs
- class GeneratorException
- struct IConfig
- struct IContext
- struct IExceptionTranslator
- struct IExceptionTranslatorRegistry
- struct IGeneratorTracker
- struct IMutableContext
- struct IMutableEnumValuesRegistry
- struct IMutableRegistryHub
- struct IRegistryHub
- struct IResultCapture
- struct IRunner

- struct is_callable
- struct is_callable< Fun(Args...)>
- struct is_callable_tester
- struct is_range
- struct IStream
- struct ITestCaseRegistry
- struct ITestInvoker
- struct ITransientExpression
- class LazyExpression
- class MatchExpr
- struct MessageBuilder
- struct MessageInfo
- struct MessageStream
- struct NameAndTags
- class NonCopyable
- class Option
- struct pluralise
- struct RegistrarForTagAliases
- struct ResultDisposition
- struct ResultWas
- class ReusableStringStream
- struct RunTests
- class ScopedMessage
- class Section
- struct SectionEndInfo
- struct SectionInfo
- struct ShowDurations
- class SimplePcg32
- struct SourceLineInfo
- struct StreamEndStop
- struct StringMaker
- struct StringMaker< bool >
- struct StringMaker< Catch::Detail::Approx >
- struct StringMaker< char * >
- struct StringMaker< char >
- struct StringMaker< char const * >
- struct StringMaker< char[SZ]>
- struct StringMaker< double >
- struct StringMaker< float >
- struct StringMaker< int >
- struct StringMaker< long >
- struct StringMaker< long long >
- struct StringMaker< R C::* >
- struct StringMaker< R, typename std::enable_if< is_range< R >::value &&!::Catch::Detail::IsStreamInsertable< R >::value >
- struct StringMaker< signed char >
- struct StringMaker< signed char[SZ]>
- struct StringMaker< std::nullptr_t >
- struct StringMaker< std::string >
- struct StringMaker< std::wstring >
- struct StringMaker< T * >
- struct StringMaker< T[SZ]>
- struct StringMaker< unsigned char >
- struct StringMaker< unsigned char[SZ]>
- struct StringMaker< unsigned int >
- struct StringMaker< unsigned long >

- struct StringMaker< unsigned long long >
- struct StringMaker< wchar_t * >
- struct StringMaker< wchar_t const * >
- class StringRef
- class TestCase
- struct TestCaseInfo
- struct TestFailureException
- class TestInvokerAsMethod
- class Timer
- struct Totals
- struct true_given
- class UnaryExpr
- struct UseColour
- struct WaitForKeypress
- struct WarnAbout

Typedefs

- template<typename Func , typename... U>
  using FunctionReturnType = typename std::remove_reference<typename std::remove_cv<typename std↩
  ::result_of<Func(U...)>::type>::type>::type
- using IReporterFactoryPtr = std::shared_ptr<IReporterFactory>
- using exceptionTranslateFunction = std::string(*)()
- using ExceptionTranslators = std::vector<std::unique_ptr<IExceptionTranslator const>>
- using StringMatcher = Matchers::Impl::MatcherBase<std::string>
- using IConfigPtr = std::shared_ptr<IConfig const>

Enumerations

- enum class Verbosity { Quiet = 0 , Normal , High }

Functions

- unsigned int rngSeed ()
- std::ostream & operator<< (std::ostream &os, SourceLineInfo const &info)
- template<typename T >
  T const & operator+ (T const &value, StreamEndStop)
- bool isThrowSafe (TestCase const &testCase, IConfig const &config)
- bool matchTest (TestCase const &testCase, TestSpec const &testSpec, IConfig const &config)
- std::vector< TestCase > filterTests (std::vector< TestCase > const &testCases, TestSpec const &testSpec, IConfig const &config)
- std::vector< TestCase > const & getAllTestCasesSorted (IConfig const &config)
- auto operator+= (std::string &lhs, StringRef const &sr) -> std::string &
- auto operator<< (std::ostream &os, StringRef const &sr) -> std::ostream &
- constexpr auto operator""_sr (char const *rawChars, std::size_t size) noexcept -> StringRef
- auto makeTestInvoker (void(*testAsFunction)()) noexcept -> ITestInvoker *
- template<typename C >
  auto makeTestInvoker (void(C::*testAsMethod)()) noexcept -> ITestInvoker *
- bool isOk (ResultWas::OfType resultType)
- bool isJustInfo (int flags)
- ResultDisposition::Flags operator| (ResultDisposition::Flags lhs, ResultDisposition::Flags rhs)
- bool shouldContinueOnFailure (int flags)

- bool isFalseTest (int flags)
- bool shouldSuppressFailure (int flags)
- std::ostream & cout ()
- std::ostream & cerr ()
- std::ostream & clog ()
- auto makeStream (StringRef const &filename) -> IStream const *
- template<typename Range >
  std::string rangeToString (Range const &range)
- template<typename Allocator >
  std::string rangeToString (std::vector< bool, Allocator > const &v)
- void formatReconstructedExpression (std::ostream &os, std::string const &lhs, StringRef op, std::string const &rhs)
- template<typename LhsT , typename RhsT >
  auto compareEqual (LhsT const &lhs, RhsT const &rhs) -> bool
- template<typename T >
  auto compareEqual (T *const &lhs, int rhs) -> bool
- template<typename T >
  auto compareEqual (T *const &lhs, long rhs) -> bool
- template<typename T >
  auto compareEqual (int lhs, T *const &rhs) -> bool
- template<typename T >
  auto compareEqual (long lhs, T *const &rhs) -> bool
- template<typename LhsT , typename RhsT >
  auto compareNotEqual (LhsT const &lhs, RhsT &&rhs) -> bool
- template<typename T >
  auto compareNotEqual (T *const &lhs, int rhs) -> bool
- template<typename T >
  auto compareNotEqual (T *const &lhs, long rhs) -> bool
- template<typename T >
  auto compareNotEqual (int lhs, T *const &rhs) -> bool
- template<typename T >
  auto compareNotEqual (long lhs, T *const &rhs) -> bool
- void handleExpression (ITransientExpression const &expr)
- template<typename T >
  void handleExpression (ExprLhs< T > const &expr)
- IResultCapture & getResultCapture ()
- void handleExceptionMatchExpr (AssertionHandler &handler, std::string const &str, StringRef const &matcherString)
- auto getCurrentNanosecondsSinceEpoch () -> uint64_t
- auto getEstimatedClockResolution () -> uint64_t
- IRegistryHub const & getRegistryHub ()
- IMutableRegistryHub & getMutableRegistryHub ()
- void cleanUp ()
- std::string translateActiveException ()
- bool startsWith (std::string const &s, std::string const &prefix)
- bool startsWith (std::string const &s, char prefix)
- bool endsWith (std::string const &s, std::string const &suffix)
- bool endsWith (std::string const &s, char suffix)
- bool contains (std::string const &s, std::string const &infix)
- void toLowerInPlace (std::string &s)
- std::string toLower (std::string const &s)
- std::string trim (std::string const &str)

  Returns a new string without whitespace at the start/end.
- StringRef trim (StringRef ref)

  Returns a substring of the original ref without whitespace. Beware lifetimes!

- std::vector< StringRef > splitStringRef (StringRef str, char delimiter)
- bool replaceInPlace (std::string &str, std::string const &replaceThis, std::string const &withThis)
- void handleExceptionMatchExpr (AssertionHandler &handler, StringMatcher const &matcher, StringRef const &matcherString)
- template<typename ArgT , typename MatcherT >
  auto makeMatchExpr (ArgT const &arg, MatcherT const &matcher, StringRef const &matcherString) -> MatchExpr< ArgT, MatcherT >
- void throw_exception (std::exception const &e)
- void throw_logic_error (std::string const &msg)
- void throw_domain_error (std::string const &msg)
- void throw_runtime_error (std::string const &msg)
- IMutableContext & getCurrentMutableContext ()
- IContext & getCurrentContext ()
- void cleanUpContext ()
- SimplePcg32 & rng ()
- TestCase makeTestCase (ITestInvoker *testCase, std::string const &className, NameAndTags const &nameAndTags, SourceLineInfo const &lineInfo)

5.1.1 Typedef Documentation

5.1.1.1 exceptionTranslateFunction

```
using Catch::exceptionTranslateFunction = std::string(*)()
```

Definition at line 3005 of file catch.h.

5.1.1.2 ExceptionTranslators

```
using Catch::ExceptionTranslators = std::vector<std::unique_ptr<IExceptionTranslator const>>
```

Definition at line 3008 of file catch.h.

5.1.1.3 FunctionReturnType

```
template<typename Func , typename... U>
using Catch::FunctionReturnType = typename std::remove_reference<typename std::remove_cv<typename
std::result_of<Func(U...)>::type>::type>::type
```

Definition at line 949 of file catch.h.

5.1.1.4 IConfigPtr

```
typedef std::shared_ptr< IConfig const > Catch::IConfigPtr = std::shared_ptr<IConfig const>
```

Definition at line 4356 of file catch.h.

5.1.1.5 IReporterFactoryPtr

```
using Catch::IReporterFactoryPtr = std::shared_ptr<IReporterFactory>
```

Definition at line 2963 of file catch.h.

5.1.1.6 StringMatcher

```
using Catch::StringMatcher = Matchers::Impl::MatcherBase<std::string>
```

Definition at line 3792 of file catch.h.

5.1.2 Enumeration Type Documentation

5.1.2.1 Verbosity

```
enum class Catch::Verbosity  [strong]
```

Enumerator

Quiet	
Normal	
High	

Definition at line 4476 of file catch.h.

5.1.3 Function Documentation

5.1.3.1 cerr()

```
std::ostream & Catch::cerr ( )
```

5.1.3.2 cleanUp()

```
void Catch::cleanUp ( )
```

5.1.3.3 cleanUpContext()

```
void Catch::cleanUpContext ( )
```

5.1.3.4 clog()

```
std::ostream & Catch::clog ( )
```

5.1.3.5 compareEqual() [1/5]

```
template<typename T >
auto Catch::compareEqual (
             int lhs,
             T *const & rhs ) -> bool
```

Definition at line 2322 of file catch.h.

5.1.3.6 compareEqual() [2/5]

```
template<typename LhsT , typename RhsT >
auto Catch::compareEqual (
             LhsT const & lhs,
             RhsT const & rhs ) -> bool
```

Definition at line 2316 of file catch.h.

5.1.3.7 compareEqual() [3/5]

```
template<typename T >
auto Catch::compareEqual (
             long lhs,
             T *const & rhs ) -> bool
```

Definition at line 2324 of file catch.h.

5.1.3.8 compareEqual() [4/5]

```
template<typename T >
auto Catch::compareEqual (
             T *const & lhs,
             int rhs ) -> bool
```

Definition at line 2318 of file catch.h.

5.1.3.9 compareEqual() [5/5]

```
template<typename T >
auto Catch::compareEqual (
             T *const & lhs,
             long rhs ) -> bool
```

Definition at line 2320 of file catch.h.

5.1.3.10 compareNotEqual() [1/5]

```
template<typename T >
auto Catch::compareNotEqual (
             int lhs,
             T *const & rhs ) -> bool
```

Definition at line 2333 of file catch.h.

5.1.3.11 compareNotEqual() [2/5]

```
template<typename LhsT , typename RhsT >
auto Catch::compareNotEqual (
            LhsT const & lhs,
            RhsT && rhs ) -> bool
```

Definition at line 2327 of file catch.h.

5.1.3.12 compareNotEqual() [3/5]

```
template<typename T >
auto Catch::compareNotEqual (
            long lhs,
            T *const & rhs ) -> bool
```

Definition at line 2335 of file catch.h.

5.1.3.13 compareNotEqual() [4/5]

```
template<typename T >
auto Catch::compareNotEqual (
            T *const & lhs,
            int rhs ) -> bool
```

Definition at line 2329 of file catch.h.

5.1.3.14 compareNotEqual() [5/5]

```
template<typename T >
auto Catch::compareNotEqual (
            T *const & lhs,
            long rhs ) -> bool
```

Definition at line 2331 of file catch.h.

5.1.3.15 contains()

```
bool Catch::contains (
            std::string const & s,
            std::string const & infix )
```

5.1.3.16 cout()

```
std::ostream & Catch::cout ( )
```

5.1.3.17 endsWith() [1/2]

```
bool Catch::endsWith (
            std::string const & s,
            char suffix )
```

5.1.3.18 endsWith() [2/2]

```
bool Catch::endsWith (
            std::string const & s,
            std::string const & suffix )
```

5.1.3.19 filterTests()

```
std::vector< TestCase > Catch::filterTests (
            std::vector< TestCase > const & testCases,
            TestSpec const & testSpec,
            IConfig const & config )
```

5.1.3.20 formatReconstructedExpression()

```
void Catch::formatReconstructedExpression (
            std::ostream & os,
            std::string const & lhs,
            StringRef op,
            std::string const & rhs )
```

5.1.3.21 getAllTestCasesSorted()

```
std::vector< TestCase > const & Catch::getAllTestCasesSorted (
            IConfig const & config )
```

5.1.3.22 getCurrentContext()

```
IContext & Catch::getCurrentContext ( )  [inline]
```

Definition at line 4389 of file catch.h.

5.1.3.23 getCurrentMutableContext()

```
IMutableContext & Catch::getCurrentMutableContext ( )  [inline]
```

Definition at line 4381 of file catch.h.

5.1.3.24 getCurrentNanosecondsSinceEpoch()

```
auto Catch::getCurrentNanosecondsSinceEpoch ( ) -> uint64_t
```

5.1.3.25 getEstimatedClockResolution()

```
auto Catch::getEstimatedClockResolution ( ) -> uint64_t
```

5.1.3.26 getMutableRegistryHub()

```
IMutableRegistryHub & Catch::getMutableRegistryHub ( )
```

5.1.3.27 getRegistryHub()

```
IRegistryHub const & Catch::getRegistryHub ( )
```

5.1.3.28 getResultCapture()

```
IResultCapture & Catch::getResultCapture ( )
```

5.1.3.29 handleExceptionMatchExpr() [1/2]

```
void Catch::handleExceptionMatchExpr (
            AssertionHandler & handler,
            std::string const & str,
            StringRef const & matcherString )
```

5.1.3.30 handleExceptionMatchExpr() [2/2]

```
void Catch::handleExceptionMatchExpr (
            AssertionHandler & handler,
            StringMatcher const & matcher,
            StringRef const & matcherString )
```

5.1.3.31 handleExpression() [1/2]

```
template<typename T >
void Catch::handleExpression (
            ExprLhs< T > const & expr )
```

Definition at line 2410 of file catch.h.

5.1.3.32 handleExpression() [2/2]

```
void Catch::handleExpression (
            ITransientExpression const & expr )
```

5.1.3.33 isFalseTest()

```
bool Catch::isFalseTest (
            int flags )  [inline]
```

Definition at line 1388 of file catch.h.

5.1.3.34 isJustInfo()

```
bool Catch::isJustInfo (
            int flags )
```

5.1.3.35 isOk()

```
bool Catch::isOk (
            ResultWas::OfType resultType )
```

5.1.3.36 isThrowSafe()

```
bool Catch::isThrowSafe (
            TestCase const & testCase,
            IConfig const & config )
```

5.1.3.37 makeMatchExpr()

```
template<typename ArgT , typename MatcherT >
auto Catch::makeMatchExpr (
            ArgT const & arg,
            MatcherT const & matcher,
            StringRef const & matcherString ) -> MatchExpr<ArgT, MatcherT>
```

Definition at line 3797 of file catch.h.

5.1.3.38 makeStream()

```
auto Catch::makeStream (
            StringRef const & filename ) -> IStream const *
```

5.1.3.39 makeTestCase()

```
TestCase Catch::makeTestCase (
            ITestInvoker * testCase,
            std::string const & className,
            NameAndTags const & nameAndTags,
            SourceLineInfo const & lineInfo )
```

5.1.3.40 makeTestInvoker() [1/2]

```
auto Catch::makeTestInvoker (
            void(*)() testAsFunction ) -> ITestInvoker *  [noexcept]
```

5.1.3.41 makeTestInvoker() [2/2]

```
template<typename C >
auto Catch::makeTestInvoker (
            void(C::*)() testAsMethod ) -> ITestInvoker*   [noexcept]
```

Definition at line 976 of file catch.h.

5.1.3.42 matchTest()

```
bool Catch::matchTest (
            TestCase const & testCase,
            TestSpec const & testSpec,
            IConfig const & config )
```

5.1.3.43 operator"""_sr()

```
constexpr auto Catch::operator""_sr (
            char const * rawChars,
            std::size_t size ) -> StringRef   [constexpr], [noexcept]
```

Definition at line 680 of file catch.h.

5.1.3.44 operator+()

```
template<typename T >
T const & Catch::operator+ (
            T const & value,
            StreamEndStop  )
```

Definition at line 538 of file catch.h.

5.1.3.45 operator+=()

```
auto Catch::operator+= (
            std::string & lhs,
            StringRef const & sr ) -> std::string &
```

5.1.3.46 operator<<() [1/2]

```
std::ostream & Catch::operator<< (
            std::ostream & os,
            SourceLineInfo const & info )
```

5.1.3.47 operator<<() [2/2]

```
auto Catch::operator<< (
            std::ostream & os,
            StringRef const & sr ) -> std::ostream &
```

5.1.3.48 operator"|()

```
ResultDisposition::Flags Catch::operator| (
            ResultDisposition::Flags lhs,
            ResultDisposition::Flags rhs )
```

5.1.3.49 rangeToString() [1/2]

```
template<typename Range >
std::string Catch::rangeToString (
            Range const & range )
```

Definition at line 2018 of file catch.h.

5.1.3.50 rangeToString() [2/2]

```
template<typename Allocator >
std::string Catch::rangeToString (
            std::vector< bool, Allocator > const & v )
```

Definition at line 2024 of file catch.h.

5.1.3.51 replaceInPlace()

```
bool Catch::replaceInPlace (
            std::string & str,
            std::string const & replaceThis,
            std::string const & withThis )
```

5.1.3.52 rng()

```
SimplePcg32 & Catch::rng ( )
```

5.1.3.53 rngSeed()

```
unsigned int Catch::rngSeed ( )
```

5.1.3.54 shouldContinueOnFailure()

```
bool Catch::shouldContinueOnFailure (
            int flags )
```

5.1.3.55 shouldSuppressFailure()

```
bool Catch::shouldSuppressFailure (
            int flags )
```

5.1.3.56 splitStringRef()

```
std::vector< StringRef > Catch::splitStringRef (
            StringRef str,
            char delimiter )
```

5.1.3.57 startsWith() [1/2]

```
bool Catch::startsWith (
            std::string const & s,
            char prefix )
```

5.1.3.58 startsWith() [2/2]

```
bool Catch::startsWith (
            std::string const & s,
            std::string const & prefix )
```

5.1.3.59 throw_domain_error()

```
void Catch::throw_domain_error (
            std::string const & msg )
```

5.1.3.60 throw_exception()

```
void Catch::throw_exception (
            std::exception const & e )
```

5.1.3.61 throw_logic_error()

```
void Catch::throw_logic_error (
            std::string const & msg )
```

5.1.3.62 throw_runtime_error()

```
void Catch::throw_runtime_error (
            std::string const & msg )
```

5.1.3.63 toLower()

```
std::string Catch::toLower (
            std::string const & s )
```

5.1.3.64 toLowerInPlace()

```
void Catch::toLowerInPlace (
            std::string & s )
```

5.1.3.65 translateActiveException()

```
std::string Catch::translateActiveException ( )
```

5.1.3.66 trim() [1/2]

```
std::string Catch::trim (
            std::string const & str )
```

Returns a new string without whitespace at the start/end.

5.1.3.67 trim() [2/2]

```
StringRef Catch::trim (
            StringRef ref )
```

Returns a substring of the original ref without whitespace. Beware lifetimes!

5.2 Catch::Detail Namespace Reference

Classes

- class Approx
- struct EnumInfo
- class IsStreamInsertable

Functions

- std::string rawMemoryToString (const void *object, std::size_t size)
- template<typename T >
  std::string rawMemoryToString (const T &object)
- template<typename E >
  std::string convertUnknownEnumToString (E e)
- template<typename T >
  std::enable_if<!std::is_enum< T >::value &&!std::is_base_of< std::exception, T >::value, std::string >::type convertUnstreamable (T const &)
- template<typename T >
  std::enable_if<!std::is_enum< T >::value &&std::is_base_of< std::exception, T >::value, std::string >::type convertUnstreamable (T const &ex)
- template<typename T >
  std::enable_if< std::is_enum< T >::value, std::string >::type convertUnstreamable (T const &value)
- template<typename T >
  std::string stringify (const T &e)
- template<typename InputIterator , typename Sentinel = InputIterator>
  std::string rangeToString (InputIterator first, Sentinel last)

Variables

- const std::string unprintableString

5.2.1 Function Documentation

5.2.1.1 convertUnknownEnumToString()

```
template<typename E >
std::string Catch::Detail::convertUnknownEnumToString (
            E e )
```

Definition at line 1649 of file catch.h.

5.2.1.2 convertUnstreamable() [1/3]

```
template<typename T >
std::enable_if<!std::is_enum< T >::value &&!std::is_base_of< std::exception, T >::value,
std::string >::type Catch::Detail::convertUnstreamable (
            T const &  )
```

Definition at line 1582 of file catch.h.

5.2.1.3 convertUnstreamable() [2/3]

```
template<typename T >
std::enable_if<!std::is_enum< T >::value &&std::is_base_of< std::exception, T >::value, std↩
::string >::type Catch::Detail::convertUnstreamable (
            T const & ex )
```

Definition at line 1588 of file catch.h.

5.2.1.4 convertUnstreamable() [3/3]

```
template<typename T >
std::enable_if< std::is_enum< T >::value, std::string >::type Catch::Detail::convertUnstreamable
(
            T const & value )
```

Definition at line 1595 of file catch.h.

5.2.1.5 rangeToString()

```
template<typename InputIterator , typename Sentinel = InputIterator>
std::string Catch::Detail::rangeToString (
            InputIterator first,
            Sentinel last )
```

Definition at line 1829 of file catch.h.

5.2.1.6 rawMemoryToString() [1/2]

```
template<typename T >
std::string Catch::Detail::rawMemoryToString (
            const T & object )
```

Definition at line 1559 of file catch.h.

5.2.1.7 rawMemoryToString() [2/2]

```
std::string Catch::Detail::rawMemoryToString (
            const void * object,
            std::size_t size )
```

5.2.1.8 stringify()

```
template<typename T >
std::string Catch::Detail::stringify (
            const T & e )
```

Definition at line 1644 of file catch.h.

5.2.2 Variable Documentation

5.2.2.1 unprintableString

```
const std::string Catch::Detail::unprintableString  [extern]
```

5.3 Catch::detail Namespace Reference

Classes

- struct is_range_impl
- struct is_range_impl< T, typename void_type< decltype(begin(std::declval< T >()))>::type >
- struct void_type

5.4 Catch::Generators Namespace Reference

Namespaces

- namespace pf

Classes

- struct as
- class ChunkGenerator
- class FilterGenerator
- class FixedValuesGenerator
- class Generators
- class GeneratorUntypedBase
- class GeneratorWrapper
- struct IGenerator
- class IteratorGenerator
- class MapGenerator
- class RandomFloatingGenerator
- class RandomIntegerGenerator
- class RangeGenerator
- class RepeatGenerator
- class SingleValueGenerator
- class TakeGenerator

Typedefs

- using GeneratorBasePtr = std::unique_ptr<GeneratorUntypedBase>

Functions

- template<typename T >
  GeneratorWrapper< T > value (T &&value)
- template<typename T >
  GeneratorWrapper< T > values (std::initializer_list< T > values)
- template<typename... Ts>
  GeneratorWrapper< std::tuple< Ts... > > table (std::initializer_list< std::tuple< typename std::decay< Ts >::type... > > tuples)
- template<typename T , typename... Gs>
  auto makeGenerators (GeneratorWrapper< T > &&generator, Gs &&... moreGenerators) -> Generators< T >
- template<typename T >
  auto makeGenerators (GeneratorWrapper< T > &&generator) -> Generators< T >
- template<typename T , typename... Gs>
  auto makeGenerators (T &&val, Gs &&... moreGenerators) -> Generators< T >
- template<typename T , typename U , typename... Gs>
  auto makeGenerators (as< T >, U &&val, Gs &&... moreGenerators) -> Generators< T >
- auto acquireGeneratorTracker (StringRef generatorName, SourceLineInfo const &lineInfo) -> IGeneratorTracker &
- template<typename L >
  auto generate (StringRef generatorName, SourceLineInfo const &lineInfo, L const &generatorExpression) -> decltype(std::declval< decltype(generatorExpression())>().get())
- template<typename T >
  GeneratorWrapper< T > take (size_t target, GeneratorWrapper< T > &&generator)
- template<typename T , typename Predicate >
  GeneratorWrapper< T > filter (Predicate &&pred, GeneratorWrapper< T > &&generator)
- template<typename T >
  GeneratorWrapper< T > repeat (size_t repeats, GeneratorWrapper< T > &&generator)
- template<typename Func , typename U , typename T = FunctionReturnType<Func, U>>
  GeneratorWrapper< T > map (Func &&function, GeneratorWrapper< U > &&generator)
- template<typename T >
  GeneratorWrapper< std::vector< T > > chunk (size_t size, GeneratorWrapper< T > &&generator)
- template<typename T >
  std::enable_if< std::is_integral< T >::value &&!std::is_same< T, bool >::value, GeneratorWrapper< T > >::type random (T a, T b)
- template<typename T >
  std::enable_if< std::is_floating_point< T >::value, GeneratorWrapper< T > >::type random (T a, T b)
- template<typename T >
  GeneratorWrapper< T > range (T const &start, T const &end, T const &step)
- template<typename T >
  GeneratorWrapper< T > range (T const &start, T const &end)
- template<typename InputIterator , typename InputSentinel , typename ResultType = typename std::iterator_traits<InputIterator>::value_type>
  GeneratorWrapper< ResultType > from_range (InputIterator from, InputSentinel to)
- template<typename Container , typename ResultType = typename Container::value_type>
  GeneratorWrapper< ResultType > from_range (Container const &cnt)

5.4.1 Typedef Documentation

5.4.1.1 GeneratorBasePtr

```
using Catch::Generators::GeneratorBasePtr = std::unique_ptr<GeneratorUntypedBase>
```

Definition at line 3855 of file catch.h.

5.4.2 Function Documentation

5.4.2.1 acquireGeneratorTracker()

```
auto Catch::Generators::acquireGeneratorTracker (
            StringRef generatorName,
            SourceLineInfo const & lineInfo ) -> IGeneratorTracker &
```

5.4.2.2 chunk()

```
template<typename T >
GeneratorWrapper< std::vector< T > > Catch::Generators::chunk (
            size_t size,
            GeneratorWrapper< T > && generator )
```

Definition at line 4333 of file catch.h.

5.4.2.3 filter()

```
template<typename T , typename Predicate >
GeneratorWrapper< T > Catch::Generators::filter (
            Predicate && pred,
            GeneratorWrapper< T > && generator )
```

Definition at line 4195 of file catch.h.

5.4.2.4 from_range() [1/2]

```
template<typename Container , typename ResultType = typename Container::value_type>
GeneratorWrapper< ResultType > Catch::Generators::from_range (
            Container const & cnt )
```

Definition at line 4746 of file catch.h.

5.4.2.5 from_range() [2/2]

```
template<typename InputIterator , typename InputSentinel , typename ResultType = typename
std::iterator_traits<InputIterator>::value_type>
GeneratorWrapper< ResultType > Catch::Generators::from_range (
            InputIterator from,
            InputSentinel to )
```

Definition at line 4740 of file catch.h.

5.4.2.6 generate()

```
template<typename L >
auto Catch::Generators::generate (
            StringRef generatorName,
            SourceLineInfo const & lineInfo,
            L const & generatorExpression ) -> decltype(std::declval<decltype(generatorExpression())>().get(
```

Definition at line 4085 of file catch.h.

5.4.2.7 makeGenerators() [1/4]

```
template<typename T , typename U , typename...  Gs>
auto Catch::Generators::makeGenerators (
            as< T > ,
            U && val,
            Gs &&...  moreGenerators ) -> Generators<T>
```

Definition at line 4075 of file catch.h.

5.4.2.8 makeGenerators() [2/4]

```
template<typename T >
auto Catch::Generators::makeGenerators (
            GeneratorWrapper< T > && generator ) -> Generators<T>
```

Definition at line 4067 of file catch.h.

5.4.2.9 makeGenerators() [3/4]

```
template<typename T , typename...  Gs>
auto Catch::Generators::makeGenerators (
            GeneratorWrapper< T > && generator,
            Gs &&...  moreGenerators ) -> Generators<T>
```

Definition at line 4063 of file catch.h.

5.4.2.10 makeGenerators() [4/4]

```
template<typename T , typename...  Gs>
auto Catch::Generators::makeGenerators (
            T && val,
            Gs &&...  moreGenerators ) -> Generators<T>
```

Definition at line 4071 of file catch.h.

5.4.2.11 map()

```
template<typename Func , typename U , typename T = FunctionReturnType<Func, U>>
GeneratorWrapper< T > Catch::Generators::map (
            Func && function,
            GeneratorWrapper< U > && generator )
```

Definition at line 4283 of file catch.h.

5.4.2.12 random() [1/2]

```
template<typename T >
std::enable_if< std::is_integral< T >::value &&!std::is_same< T, bool >::value, GeneratorWrapper<
T > >::type Catch::Generators::random (
            T a,
            T b )
```

Definition at line 4651 of file catch.h.

5.4.2.13 random() [2/2]

```
template<typename T >
std::enable_if< std::is_floating_point< T >::value, GeneratorWrapper< T > >::type Catch::↩
Generators::random (
            T a,
            T b )
```

Definition at line 4660 of file catch.h.

5.4.2.14 range() [1/2]

```
template<typename T >
GeneratorWrapper< T > Catch::Generators::range (
            T const & start,
            T const & end )
```

Definition at line 4706 of file catch.h.

5.4.2.15 range() [2/2]

```
template<typename T >
GeneratorWrapper< T > Catch::Generators::range (
            T const & start,
            T const & end,
            T const & step )
```

Definition at line 4700 of file catch.h.

5.4.2.16 repeat()

```
template<typename T >
GeneratorWrapper< T > Catch::Generators::repeat (
            size_t repeats,
            GeneratorWrapper< T > && generator )
```

Definition at line 4251 of file catch.h.

5.4.2.17 table()

```
template<typename... Ts>
GeneratorWrapper< std::tuple< Ts... > > Catch::Generators::table (
            std::initializer_list< std::tuple< typename std::decay< Ts >::type... > >
tuples )
```

Definition at line 4054 of file catch.h.

5.4.2.18 take()

```
template<typename T >
GeneratorWrapper< T > Catch::Generators::take (
            size_t target,
            GeneratorWrapper< T > && generator )
```

Definition at line 4151 of file catch.h.

5.4.2.19 value()

```
template<typename T >
GeneratorWrapper< T > Catch::Generators::value (
            T && value )
```

Definition at line 4001 of file catch.h.

5.4.2.20 values()

```
template<typename T >
GeneratorWrapper< T > Catch::Generators::values (
            std::initializer_list< T > values )
```

Definition at line 4005 of file catch.h.

5.5 Catch::Generators::pf Namespace Reference

Functions

- template<typename T , typename... Args>
  std::unique_ptr< T > make_unique (Args &&... args)

5.5.1 Function Documentation

5.5.1.1 make_unique()

```
template<typename T , typename...  Args>
std::unique_ptr< T > Catch::Generators::pf::make_unique (
            Args &&...  args )
```

Definition at line 3935 of file catch.h.

5.6 Catch::literals Namespace Reference

Functions

- Detail::Approx operator""_a (long double val)
- Detail::Approx operator""_a (unsigned long long val)

5.6.1 Function Documentation

5.6.1.1 operator""_a() [1/2]

```
Detail::Approx Catch::literals::operator""_a (
            long double val )
```

5.6.1.2 operator""_a() [2/2]

```
Detail::Approx Catch::literals::operator""_a (
            unsigned long long val )
```

5.7 Catch::Matchers Namespace Reference

Namespaces

- namespace Exception
- namespace Floating
- namespace Generic
- namespace Impl
- namespace StdString
- namespace Vector

Functions

- Exception::ExceptionMessageMatcher Message (std::string const &message)
- Floating::WithinUlpsMatcher WithinULP (double target, uint64_t maxUlpDiff)
- Floating::WithinUlpsMatcher WithinULP (float target, uint64_t maxUlpDiff)
- Floating::WithinAbsMatcher WithinAbs (double target, double margin)
- Floating::WithinRelMatcher WithinRel (double target, double eps)
- Floating::WithinRelMatcher WithinRel (double target)
- Floating::WithinRelMatcher WithinRel (float target, float eps)
- Floating::WithinRelMatcher WithinRel (float target)
- template<typename T >
  Generic::PredicateMatcher< T > Predicate (std::function< bool(T const &)> const &predicate, std::string const &description="")
- StdString::EqualsMatcher Equals (std::string const &str, CaseSensitive::Choice caseSensitivity=CaseSensitive::Yes)
- StdString::ContainsMatcher Contains (std::string const &str, CaseSensitive::Choice caseSensitivity=CaseSensitive::Yes)
- StdString::EndsWithMatcher EndsWith (std::string const &str, CaseSensitive::Choice caseSensitivity=CaseSensitive::Yes)
- StdString::StartsWithMatcher StartsWith (std::string const &str, CaseSensitive::Choice caseSensitivity=CaseSensitive::Yes)
- StdString::RegexMatcher Matches (std::string const &regex, CaseSensitive::Choice caseSensitivity=CaseSensitive::Yes)
- template<typename T , typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
  Vector::ContainsMatcher< T, AllocComp, AllocMatch > Contains (std::vector< T, AllocComp > const &comparator)
- template<typename T , typename Alloc = std::allocator<T>>
  Vector::ContainsElementMatcher< T, Alloc > VectorContains (T const &comparator)
- template<typename T , typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
  Vector::EqualsMatcher< T, AllocComp, AllocMatch > Equals (std::vector< T, AllocComp > const &comparator)
- template<typename T , typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
  Vector::ApproxMatcher< T, AllocComp, AllocMatch > Approx (std::vector< T, AllocComp > const &comparator)
- template<typename T , typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
  Vector::UnorderedEqualsMatcher< T, AllocComp, AllocMatch > UnorderedEquals (std::vector< T, AllocComp > const &target)

5.7.1 Function Documentation

5.7.1.1 Approx()

```
template<typename T , typename AllocComp = std::allocator<T>, typename AllocMatch = Alloc↩
Comp>
Vector::ApproxMatcher< T, AllocComp, AllocMatch > Catch::Matchers::Approx (
            std::vector< T, AllocComp > const & comparator )
```

Definition at line 3754 of file catch.h.

5.7.1.2 Contains() [1/2]

```
StdString::ContainsMatcher Catch::Matchers::Contains (
            std::string const & str,
            CaseSensitive::Choice caseSensitivity = CaseSensitive::Yes )
```

5.7.1.3 Contains() [2/2]

```
template<typename T , typename AllocComp = std::allocator<T>, typename AllocMatch = Alloc↩
Comp>
Vector::ContainsMatcher< T, AllocComp, AllocMatch > Catch::Matchers::Contains (
            std::vector< T, AllocComp > const & comparator )
```

Definition at line 3739 of file catch.h.

5.7.1.4 EndsWith()

```
StdString::EndsWithMatcher Catch::Matchers::EndsWith (
            std::string const & str,
            CaseSensitive::Choice caseSensitivity = CaseSensitive::Yes )
```

5.7.1.5 Equals() [1/2]

```
StdString::EqualsMatcher Catch::Matchers::Equals (
            std::string const & str,
            CaseSensitive::Choice caseSensitivity = CaseSensitive::Yes )
```

5.7.1.6 Equals() [2/2]

```
template<typename T , typename AllocComp = std::allocator<T>, typename AllocMatch = Alloc↩
Comp>
Vector::EqualsMatcher< T, AllocComp, AllocMatch > Catch::Matchers::Equals (
            std::vector< T, AllocComp > const & comparator )
```

Definition at line 3749 of file catch.h.

5.7.1.7 Matches()

```
StdString::RegexMatcher Catch::Matchers::Matches (
            std::string const & regex,
            CaseSensitive::Choice caseSensitivity = CaseSensitive::Yes )
```

5.7.1.8 Message()

```
Exception::ExceptionMessageMatcher Catch::Matchers::Message (
            std::string const & message )
```

5.7.1.9 Predicate()

```
template<typename T >
Generic::PredicateMatcher< T > Catch::Matchers::Predicate (
            std::function< bool(T const &)> const & predicate,
            std::string const & description = "" )
```

Definition at line 3521 of file catch.h.

5.7.1.10 StartsWith()

```
StdString::StartsWithMatcher Catch::Matchers::StartsWith (
            std::string const & str,
            CaseSensitive::Choice caseSensitivity = CaseSensitive::Yes )
```

5.7.1.11 UnorderedEquals()

```
template<typename T , typename AllocComp = std::allocator<T>, typename AllocMatch = Alloc↩
Comp>
Vector::UnorderedEqualsMatcher< T, AllocComp, AllocMatch > Catch::Matchers::UnorderedEquals (
            std::vector< T, AllocComp > const & target )
```

Definition at line 3759 of file catch.h.

5.7.1.12 VectorContains()

```
template<typename T , typename Alloc = std::allocator<T>>
Vector::ContainsElementMatcher< T, Alloc > Catch::Matchers::VectorContains (
            T const & comparator )
```

Definition at line 3744 of file catch.h.

5.7.1.13 WithinAbs()

```
Floating::WithinAbsMatcher Catch::Matchers::WithinAbs (
            double target,
            double margin )
```

5.7.1.14 WithinRel() [1/4]

```
Floating::WithinRelMatcher Catch::Matchers::WithinRel (
            double target )
```

5.7.1.15 WithinRel() [2/4]

```
Floating::WithinRelMatcher Catch::Matchers::WithinRel (
            double target,
            double eps )
```

5.7.1.16 WithinRel() [3/4]

```
Floating::WithinRelMatcher Catch::Matchers::WithinRel (
            float target )
```

5.7.1.17 WithinRel() [4/4]

```
Floating::WithinRelMatcher Catch::Matchers::WithinRel (
            float target,
            float eps )
```

5.7.1.18 WithinULP() [1/2]

```
Floating::WithinUlpsMatcher Catch::Matchers::WithinULP (
            double target,
            uint64_t maxUlpDiff )
```

5.7.1.19 WithinULP() [2/2]

```
Floating::WithinUlpsMatcher Catch::Matchers::WithinULP (
            float target,
            uint64_t maxUlpDiff )
```

5.8 Catch::Matchers::Exception Namespace Reference

Classes

- class ExceptionMessageMatcher

5.9 Catch::Matchers::Floating Namespace Reference

Classes

- struct WithinAbsMatcher
- struct WithinRelMatcher
- struct WithinUlpsMatcher

5.10 Catch::Matchers::Generic Namespace Reference

Namespaces

- namespace Detail

Classes

- class PredicateMatcher

5.11 Catch::Matchers::Generic::Detail Namespace Reference

Functions

- std::string finalizeDescription (const std::string &desc)

5.11.1 Function Documentation

5.11.1.1 finalizeDescription()

```
std::string Catch::Matchers::Generic::Detail::finalizeDescription (
            const std::string & desc )
```

5.12 Catch::Matchers::Impl Namespace Reference

Classes

- struct MatchAllOf
- struct MatchAnyOf
- struct MatcherBase
- struct MatcherMethod
- class MatcherUntypedBase
- struct MatchNotOf

5.13 Catch::Matchers::StdString Namespace Reference

Classes

- struct CasedString
- struct ContainsMatcher
- struct EndsWithMatcher
- struct EqualsMatcher
- struct RegexMatcher
- struct StartsWithMatcher
- struct StringMatcherBase

5.14 Catch::Matchers::Vector Namespace Reference

Classes

- struct ApproxMatcher
- struct ContainsElementMatcher
- struct ContainsMatcher
- struct EqualsMatcher
- struct UnorderedEqualsMatcher

5.15 mpl_ Namespace Reference

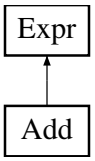
Chapter 6

Class Documentation

6.1 Add Class Reference

`#include <Expr.h>`

Inheritance diagram for Add:



Public Member Functions

- Add (Expr *lhs, Expr *rhs)
- bool equals (Expr *e) override
- int interp () override
- bool hasVariable () override
- Expr * subst (std::string stringInput, Expr *e) override
- void print (std::ostream &stream) override

Public Member Functions inherited from Expr

- virtual ~Expr ()=default
- std::string to_string ()
- std::string to_pp_string ()
- void pretty_print_at (std::ostream &ot)

Public Attributes

- Expr * lhs
- Expr * rhs

Protected Member Functions

- void pretty_print (std::ostream &ot, precedence_t prec) override

6.1.1 Detailed Description

Definition at line 59 of file Expr.h.

6.1.2 Constructor & Destructor Documentation

6.1.2.1 Add()

```
Add::Add (
            Expr * lhs,
            Expr * rhs )
```

Constructs an Add object with left and right expressions.

Parameters

lhs	Pointer to the left-hand side expression.
rhs	Pointer to the right-hand side expression.

Definition at line 17 of file Expr.cpp.

6.1.3 Member Function Documentation

6.1.3.1 equals()

```
bool Add::equals (
            Expr * e )  [override], [virtual]
```

Checks if this Add object is equal to another expression.

Parameters

e	Pointer to the expression to compare with.

Returns

true if the expressions are equivalent, false otherwise.

Implements Expr.

Definition at line 54 of file Expr.cpp.

6.1.3.2 hasVariable()

```
bool Add::hasVariable ( )  [override], [virtual]
```

Checks if the Add expression contains a variable.

Returns

true if either the left or right expressions contain a variable, false otherwise.

Implements Expr.

Definition at line 125 of file Expr.cpp.

6.1.3.3 interp()

```
int Add::interp ( )  [override], [virtual]
```

Evaluates the addition expression.

Returns

The sum of the left and right expressions.

Implements Expr.

Definition at line 93 of file Expr.cpp.

6.1.3.4 pretty_print()

```
void Add::pretty_print (
            std::ostream & ot,
            precedence_t prec )  [override], [protected], [virtual]
```

Pretty prints the Add expression with appropriate precedence.

Parameters

ot	The output stream to print to.
prec	The precedence context in which this expression is being printed.

Implements Expr.

Definition at line 247 of file Expr.cpp.

6.1.3.5 print()

```
void Add::print (
            std::ostream & stream )  [override], [virtual]
```

Prints the Add expression to a given output stream.

Parameters

stream	The output stream to print to.

Implements Expr.

Definition at line 205 of file Expr.cpp.

6.1.3.6 subst()

```
Expr * Add::subst (
            std::string stringInput,
            Expr * e )  [override], [virtual]
```

Substitutes a variable with another expression in an Add object.

Parameters

stringInput	The name of the variable to substitute.
e	The expression to substitute the variable with.

Returns

A new Add object with the substituted expressions.

Implements Expr.

Definition at line 161 of file Expr.cpp.

6.1.4 Member Data Documentation

6.1.4.1 lhs

```
Expr* Add::lhs
```

Definition at line 61 of file Expr.h.

6.1.4.2 rhs

```
Expr* Add::rhs
```

Definition at line 62 of file Expr.h.

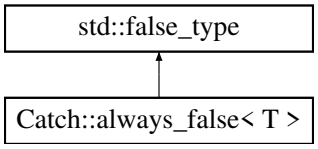
The documentation for this class was generated from the following files:

- /Users/samanthapope/msdscriptRepo/msdScript/Expr.h
- /Users/samanthapope/msdscriptRepo/msdScript/Expr.cpp

6.2 Catch::always_false< T > Struct Template Reference

`#include <catch.h>`

Inheritance diagram for Catch::always_false< T >:



6.2.1 Detailed Description

template<typename T>
struct Catch::always_false< T >

Definition at line 925 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.3 Catch::Detail::Approx Class Reference

`#include <catch.h>`

Public Member Functions

- Approx (double value)
- Approx operator- () const
- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> Approx operator() (T const &value) const
- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> Approx (T const &value)
- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> Approx & epsilon (T const &newEpsilon)
- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> Approx & margin (T const &newMargin)
- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> Approx & scale (T const &newScale)
- std::string toString () const

Static Public Member Functions

- static Approx custom ()

Friends

- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> bool operator== (const T &lhs, Approx const &rhs)
- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> bool operator== (Approx const &lhs, const T &rhs)
- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> bool operator!= (T const &lhs, Approx const &rhs)
- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> bool operator!= (Approx const &lhs, T const &rhs)
- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> bool operator<= (T const &lhs, Approx const &rhs)
- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> bool operator<= (Approx const &lhs, T const &rhs)
- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> bool operator>= (T const &lhs, Approx const &rhs)
- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> bool operator>= (Approx const &lhs, T const &rhs)

6.3.1 Detailed Description

Definition at line 3078 of file catch.h.

6.3.2 Constructor & Destructor Documentation

6.3.2.1 Approx() [1/2]

```
Catch::Detail::Approx::Approx (
            double value )  [explicit]
```

6.3.2.2 Approx() [2/2]

```
template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>↩
::value>::type>
Catch::Detail::Approx::Approx (
            T const & value )  [inline], [explicit]
```

Definition at line 3105 of file catch.h.

6.3.3 Member Function Documentation

6.3.3.1 custom()

```
static Approx Catch::Detail::Approx::custom ( )  [static]
```

6.3.3.2 epsilon()

```
template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>↩
::value>::type>
Approx & Catch::Detail::Approx::epsilon (
            T const & newEpsilon )  [inline]
```

Definition at line 3150 of file catch.h.

6.3.3.3 margin()

```
template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>↩
::value>::type>
Approx & Catch::Detail::Approx::margin (
            T const & newMargin )  [inline]
```

Definition at line 3157 of file catch.h.

6.3.3.4 operator()()

```
template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>↩
::value>::type>
Approx Catch::Detail::Approx::operator() (
            T const & value ) const  [inline]
```

Definition at line 3096 of file catch.h.

6.3.3.5 operator-()

```
Approx Catch::Detail::Approx::operator- ( ) const
```

6.3.3.6 scale()

```
template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>↩
::value>::type>
Approx & Catch::Detail::Approx::scale (
            T const & newScale )  [inline]
```

Definition at line 3164 of file catch.h.

6.3.3.7 toString()

```
std::string Catch::Detail::Approx::toString ( ) const
```

6.3.4 Friends And Related Symbol Documentation

6.3.4.1 operator"!= [1/2]

```
template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>↩
::value>::type>
bool operator!= (
            Approx const & lhs,
            T const & rhs )  [friend]
```

Definition at line 3125 of file catch.h.

6.3.4.2 operator"!= [2/2]

```
template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>↩
::value>::type>
bool operator!= (
            T const & lhs,
            Approx const & rhs )  [friend]
```

Definition at line 3120 of file catch.h.

6.3.4.3 operator<= [1/2]

```
template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>↩
::value>::type>
bool operator<= (
            Approx const & lhs,
            T const & rhs )  [friend]
```

Definition at line 3135 of file catch.h.

6.3.4.4 operator<= [2/2]

```
template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>↩
::value>::type>
bool operator<= (
            T const & lhs,
            Approx const & rhs )  [friend]
```

Definition at line 3130 of file catch.h.

6.3.4.5 operator== [1/2]

```
template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>↩
::value>::type>
bool operator== (
            Approx const & lhs,
            const T & rhs )  [friend]
```

Definition at line 3115 of file catch.h.

6.3.4.6 operator== [2/2]

```
template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>↩
::value>::type>
bool operator== (
            const T & lhs,
            Approx const & rhs )  [friend]
```

Definition at line 3109 of file catch.h.

6.3.4.7 operator>= [1/2]

```
template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>↩
::value>::type>
bool operator>= (
            Approx const & lhs,
            T const & rhs )  [friend]
```

Definition at line 3145 of file catch.h.

6.3.4.8 operator>= [2/2]

```
template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>↩
::value>::type>
bool operator>= (
            T const & lhs,
            Approx const & rhs )  [friend]
```

Definition at line 3140 of file catch.h.

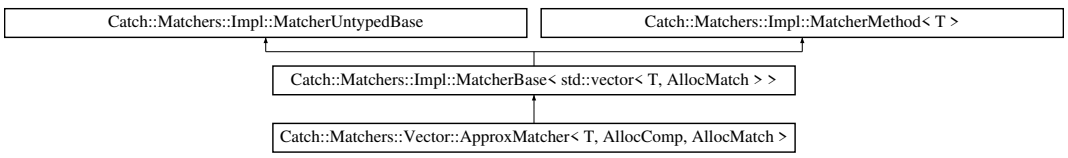
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.4 Catch::Matchers::Vector::ApproxMatcher< T, AllocComp, AllocMatch > Struct Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Matchers::Vector::ApproxMatcher< T, AllocComp, AllocMatch >:



Public Member Functions

- ApproxMatcher (std::vector< T, AllocComp > const &comparator)
- bool match (std::vector< T, AllocMatch > const &v) const override
- std::string describe () const override
- template<typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> ApproxMatcher & epsilon (T const &newEpsilon)
- template<typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> ApproxMatcher & margin (T const &newMargin)
- template<typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> ApproxMatcher & scale (T const &newScale)

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Public Attributes

- std::vector< T, AllocComp > const & m_comparator
- Catch::Detail::Approx approx = Catch::Detail::Approx::custom()

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.4.1 Detailed Description

template<typename T, typename AllocComp, typename AllocMatch>
struct Catch::Matchers::Vector::ApproxMatcher< T, AllocComp, AllocMatch >

Definition at line 3681 of file catch.h.

6.4.2 Constructor & Destructor Documentation

6.4.2.1 ApproxMatcher()

```
template<typename T , typename AllocComp , typename AllocMatch >
Catch::Matchers::Vector::ApproxMatcher< T, AllocComp, AllocMatch >::ApproxMatcher (
            std::vector< T, AllocComp > const & comparator )  [inline]
```

Definition at line 3683 of file catch.h.

6.4.3 Member Function Documentation

6.4.3.1 describe()

```
template<typename T , typename AllocComp , typename AllocMatch >
std::string Catch::Matchers::Vector::ApproxMatcher< T, AllocComp, AllocMatch >::describe ( )
const  [inline], [override], [virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

Definition at line 3693 of file catch.h.

6.4.3.2 epsilon()

```
template<typename T , typename AllocComp , typename AllocMatch >
template<typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
ApproxMatcher & Catch::Matchers::Vector::ApproxMatcher< T, AllocComp, AllocMatch >::epsilon (
            T const & newEpsilon )  [inline]
```

Definition at line 3697 of file catch.h.

6.4.3.3 margin()

```
template<typename T , typename AllocComp , typename AllocMatch >
template<typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
ApproxMatcher & Catch::Matchers::Vector::ApproxMatcher< T, AllocComp, AllocMatch >::margin (
            T const & newMargin )  [inline]
```

Definition at line 3702 of file catch.h.

6.4.3.4 match()

```
template<typename T , typename AllocComp , typename AllocMatch >
bool Catch::Matchers::Vector::ApproxMatcher< T, AllocComp, AllocMatch >::match (
            std::vector< T, AllocMatch > const & v ) const  [inline], [override]
```

Definition at line 3685 of file catch.h.

6.4.3.5 scale()

```
template<typename T , typename AllocComp , typename AllocMatch >
template<typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
ApproxMatcher & Catch::Matchers::Vector::ApproxMatcher< T, AllocComp, AllocMatch >::scale (
            T const & newScale )  [inline]
```

Definition at line 3707 of file catch.h.

6.4.4 Member Data Documentation

6.4.4.1 approx

```
template<typename T , typename AllocComp , typename AllocMatch >
Catch::Detail::Approx Catch::Matchers::Vector::ApproxMatcher< T, AllocComp, AllocMatch >↩
::approx = Catch::Detail::Approx::custom()  [mutable]
```

Definition at line 3713 of file catch.h.

6.4.4.2 m_comparator

```
template<typename T , typename AllocComp , typename AllocMatch >
std::vector<T, AllocComp> const& Catch::Matchers::Vector::ApproxMatcher< T, AllocComp, AllocMatch
>::m_comparator
```

Definition at line 3712 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.5 Catch::Generators::as< T > Struct Template Reference

```
#include <catch.h>
```

6.5.1 Detailed Description

template<typename T>
struct Catch::Generators::as< T >

Definition at line 4060 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.6 Catch::AssertionHandler Class Reference

`#include <catch.h>`

Public Member Functions

- AssertionHandler (StringRef const &macroName, SourceLineInfo const &lineInfo, StringRef captured↩ Expression, ResultDisposition::Flags resultDisposition)
- ~AssertionHandler ()
- template<typename T >
  void handleExpr (ExprLhs< T > const &expr)
- void handleExpr (ITransientExpression const &expr)
- void handleMessage (ResultWas::OfType resultType, StringRef const &message)
- void handleExceptionThrownAsExpected ()
- void handleUnexpectedExceptionNotThrown ()
- void handleExceptionNotThrownAsExpected ()
- void handleThrowingCallSkipped ()
- void handleUnexpectedInflightException ()
- void complete ()
- void setCompleted ()
- auto allowThrows () const -> bool

6.6.1 Detailed Description

Definition at line 2548 of file catch.h.

6.6.2 Constructor & Destructor Documentation

6.6.2.1 AssertionHandler()

```
Catch::AssertionHandler::AssertionHandler (
            StringRef const & macroName,
            SourceLineInfo const & lineInfo,
            StringRef capturedExpression,
            ResultDisposition::Flags resultDisposition )
```

6.6.2.2 ~AssertionHandler()

```
Catch::AssertionHandler::~AssertionHandler ( )  [inline]
```

Definition at line 2560 of file catch.h.

6.6.3 Member Function Documentation

6.6.3.1 allowThrows()

```
auto Catch::AssertionHandler::allowThrows ( ) const -> bool
```

6.6.3.2 complete()

```
void Catch::AssertionHandler::complete ( )
```

6.6.3.3 handleExceptionNotThrownAsExpected()

```
void Catch::AssertionHandler::handleExceptionNotThrownAsExpected ( )
```

6.6.3.4 handleExceptionThrownAsExpected()

```
void Catch::AssertionHandler::handleExceptionThrownAsExpected ( )
```

6.6.3.5 handleExpr() [1/2]

```
template<typename T >
void Catch::AssertionHandler::handleExpr (
            ExprLhs< T > const & expr )  [inline]
```

Definition at line 2567 of file catch.h.

6.6.3.6 handleExpr() [2/2]

```
void Catch::AssertionHandler::handleExpr (
            ITransientExpression const & expr )
```

6.6.3.7 handleMessage()

```
void Catch::AssertionHandler::handleMessage (
            ResultWas::OfType resultType,
            StringRef const & message )
```

6.6.3.8 handleThrowingCallSkipped()

```
void Catch::AssertionHandler::handleThrowingCallSkipped ( )
```

6.6.3.9 handleUnexpectedExceptionNotThrown()

```
void Catch::AssertionHandler::handleUnexpectedExceptionNotThrown ( )
```

6.6.3.10 handleUnexpectedInflightException()

```
void Catch::AssertionHandler::handleUnexpectedInflightException ( )
```

6.6.3.11 setCompleted()

```
void Catch::AssertionHandler::setCompleted ( )
```

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.7 Catch::AssertionInfo Struct Reference

```
#include <catch.h>
```

Public Attributes

- StringRef macroName
- SourceLineInfo lineInfo
- StringRef capturedExpression
- ResultDisposition::Flags resultDisposition

6.7.1 Detailed Description

Definition at line 1396 of file catch.h.

6.7.2 Member Data Documentation

6.7.2.1 capturedExpression

```
StringRef Catch::AssertionInfo::capturedExpression
```

Definition at line 1400 of file catch.h.

6.7.2.2 lineInfo

```
SourceLineInfo Catch::AssertionInfo::lineInfo
```

Definition at line 1399 of file catch.h.

6.7.2.3 macroName

```
StringRef Catch::AssertionInfo::macroName
```

Definition at line 1398 of file catch.h.

6.7.2.4 resultDisposition

```
ResultDisposition::Flags Catch::AssertionInfo::resultDisposition
```

Definition at line 1401 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.8 Catch::AssertionReaction Struct Reference

```
#include <catch.h>
```

Public Attributes

- bool shouldDebugBreak = false
- bool shouldThrow = false

6.8.1 Detailed Description

Definition at line 2543 of file catch.h.

6.8.2 Member Data Documentation

6.8.2.1 shouldDebugBreak

```
bool Catch::AssertionReaction::shouldDebugBreak = false
```

Definition at line 2544 of file catch.h.

6.8.2.2 shouldThrow

```
bool Catch::AssertionReaction::shouldThrow = false
```

Definition at line 2545 of file catch.h.

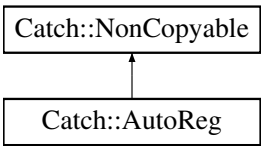
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.9 Catch::AutoReg Struct Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::AutoReg:



Public Member Functions

- AutoReg (ITestInvoker *invoker, SourceLineInfo const &lineInfo, StringRef const &classOrMethod, NameAndTags const &nameAndTags) noexcept
- ~AutoReg ()

Additional Inherited Members

Protected Member Functions inherited from Catch::NonCopyable

- NonCopyable ()
- virtual ~NonCopyable ()

6.9.1 Detailed Description

Definition at line 986 of file catch.h.

6.9.2 Constructor & Destructor Documentation

6.9.2.1 AutoReg()

```
Catch::AutoReg::AutoReg (
            ITestInvoker * invoker,
            SourceLineInfo const & lineInfo,
            StringRef const & classOrMethod,
            NameAndTags const & nameAndTags )  [noexcept]
```

6.9.2.2 ~AutoReg()

```
Catch::AutoReg::~AutoReg ( )
```

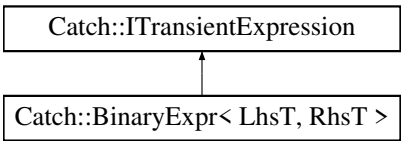
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.10 Catch::BinaryExpr< LhsT, RhsT > Class Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::BinaryExpr< LhsT, RhsT >:



Public Member Functions

- BinaryExpr (bool comparisonResult, LhsT lhs, StringRef op, RhsT rhs)
- template<typename T >
  auto operator&& (T) const -> BinaryExpr< LhsT, RhsT const & > const
- template<typename T >
  auto operator|| (T) const -> BinaryExpr< LhsT, RhsT const & > const
- template<typename T >
  auto operator== (T) const -> BinaryExpr< LhsT, RhsT const & > const
- template<typename T >
  auto operator!= (T) const -> BinaryExpr< LhsT, RhsT const & > const
- template<typename T >
  auto operator> (T) const -> BinaryExpr< LhsT, RhsT const & > const
- template<typename T >
  auto operator< (T) const -> BinaryExpr< LhsT, RhsT const & > const
- template<typename T >
  auto operator>= (T) const -> BinaryExpr< LhsT, RhsT const & > const
- template<typename T >
  auto operator<= (T) const -> BinaryExpr< LhsT, RhsT const & > const

Public Member Functions inherited from Catch::ITransientExpression

- auto isBinaryExpression () const -> bool
- auto getResult () const -> bool
- ITransientExpression (bool isBinaryExpression, bool result)
- virtual ~ITransientExpression ()

Additional Inherited Members

Public Attributes inherited from Catch::ITransientExpression

- bool m_isBinaryExpression
- bool m_result

6.10.1 Detailed Description

template<typename LhsT, typename RhsT>
class Catch::BinaryExpr< LhsT, RhsT >

Definition at line 2224 of file catch.h.

6.10.2 Constructor & Destructor Documentation

6.10.2.1 BinaryExpr()

```
template<typename LhsT , typename RhsT >
Catch::BinaryExpr< LhsT, RhsT >::BinaryExpr (
            bool comparisonResult,
            LhsT lhs,
            StringRef op,
            RhsT rhs )  [inline]
```

Definition at line 2235 of file catch.h.

6.10.3 Member Function Documentation

6.10.3.1 operator"!=()

```
template<typename LhsT , typename RhsT >
template<typename T >
auto Catch::BinaryExpr< LhsT, RhsT >::operator!= (
            T  ) const -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2264 of file catch.h.

6.10.3.2 operator&&()

```
template<typename LhsT , typename RhsT >
template<typename T >
auto Catch::BinaryExpr< LhsT, RhsT >::operator&& (
            T  ) const -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2243 of file catch.h.

6.10.3.3 operator<()

```
template<typename LhsT , typename RhsT >
template<typename T >
auto Catch::BinaryExpr< LhsT, RhsT >::operator< (
            T  ) const -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2278 of file catch.h.

6.10.3.4 operator<=()

```
template<typename LhsT , typename RhsT >
template<typename T >
auto Catch::BinaryExpr< LhsT, RhsT >::operator<= (
            T  ) const -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2292 of file catch.h.

6.10.3.5 operator==()

```
template<typename LhsT , typename RhsT >
template<typename T >
auto Catch::BinaryExpr< LhsT, RhsT >::operator== (
            T  ) const -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2257 of file catch.h.

6.10.3.6 operator>()

```
template<typename LhsT , typename RhsT >
template<typename T >
auto Catch::BinaryExpr< LhsT, RhsT >::operator> (
            T  ) const -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2271 of file catch.h.

6.10.3.7 operator>=()

```
template<typename LhsT , typename RhsT >
template<typename T >
auto Catch::BinaryExpr< LhsT, RhsT >::operator>= (
            T  ) const -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2285 of file catch.h.

6.10.3.8 operator" | " | ()

```
template<typename LhsT , typename RhsT >
template<typename T >
auto Catch::BinaryExpr< LhsT, RhsT >::operator|| (
            T  ) const -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2250 of file catch.h.

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.11 Catch::Capturer Class Reference

```
#include <catch.h>
```

Public Member Functions

- Capturer (StringRef macroName, SourceLineInfo const &lineInfo, ResultWas::OfType resultType, StringRef names)
- ~Capturer ()
- void captureValue (size_t index, std::string const &value)
- template<typename T >
  void captureValues (size_t index, T const &value)
- template<typename T , typename... Ts>
  void captureValues (size_t index, T const &value, Ts const &... values)

6.11.1 Detailed Description

Definition at line 2652 of file catch.h.

6.11.2 Constructor & Destructor Documentation

6.11.2.1 Capturer()

```
Catch::Capturer::Capturer (
            StringRef macroName,
            SourceLineInfo const & lineInfo,
            ResultWas::OfType resultType,
            StringRef names )
```

6.11.2.2 ~Capturer()

```
Catch::Capturer::~Capturer ( )
```

6.11.3 Member Function Documentation

6.11.3.1 captureValue()

```
void Catch::Capturer::captureValue (
            size_t index,
            std::string const & value )
```

6.11.3.2 captureValues() [1/2]

```
template<typename T >
void Catch::Capturer::captureValues (
            size_t index,
            T const & value )  [inline]
```

Definition at line 2663 of file catch.h.

6.11.3.3 captureValues() [2/2]

```
template<typename T , typename...  Ts>
void Catch::Capturer::captureValues (
            size_t index,
            T const & value,
            Ts const &...  values )  [inline]
```

Definition at line 2668 of file catch.h.

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.12 Catch::Matchers::StdString::CasedString Struct Reference

```
#include <catch.h>
```

Public Member Functions

- CasedString (std::string const &str, CaseSensitive::Choice caseSensitivity)
- std::string adjustString (std::string const &str) const
- std::string caseSensitivitySuffix () const

Public Attributes

- CaseSensitive::Choice m_caseSensitivity
- std::string m_str

6.12.1 Detailed Description

Definition at line 3538 of file catch.h.

6.12.2 Constructor & Destructor Documentation

6.12.2.1 CasedString()

```
Catch::Matchers::StdString::CasedString::CasedString (
            std::string const & str,
            CaseSensitive::Choice caseSensitivity )
```

6.12.3 Member Function Documentation

6.12.3.1 adjustString()

```
std::string Catch::Matchers::StdString::CasedString::adjustString (
            std::string const & str ) const
```

6.12.3.2 caseSensitivitySuffix()

```
std::string Catch::Matchers::StdString::CasedString::caseSensitivitySuffix ( ) const
```

6.12.4 Member Data Documentation

6.12.4.1 m_caseSensitivity

```
CaseSensitive::Choice Catch::Matchers::StdString::CasedString::m_caseSensitivity
```

Definition at line 3544 of file catch.h.

6.12.4.2 m_str

```
std::string Catch::Matchers::StdString::CasedString::m_str
```

Definition at line 3545 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.13 Catch::CaseSensitive Struct Reference

```
#include <catch.h>
```

Public Types

- enum Choice { Yes , No }

6.13.1 Detailed Description

Definition at line 486 of file catch.h.

6.13.2 Member Enumeration Documentation

6.13.2.1 Choice

`enum Catch::CaseSensitive::Choice`

Enumerator

Yes	
No	

Definition at line 486 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.14 Catch_global_namespace_dummy Struct Reference

`#include <catch.h>`

6.14.1 Detailed Description

Definition at line 481 of file catch.h.

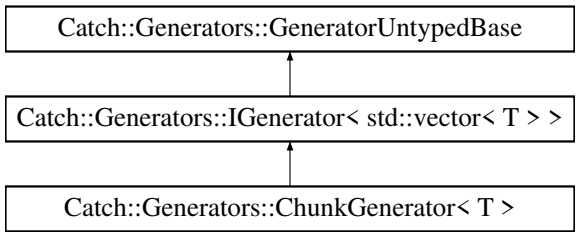
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.15 Catch::Generators::ChunkGenerator< T > Class Template Reference

`#include <catch.h>`

Inheritance diagram for Catch::Generators::ChunkGenerator< T >:



Public Member Functions

- ChunkGenerator (size_t size, GeneratorWrapper< T > generator)
- std::vector< T > const & get () const override
- bool next () override

Public Member Functions inherited from Catch::Generators::IGenerator< std::vector< T > >

- virtual ~IGenerator ()=default

Public Member Functions inherited from Catch::Generators::GeneratorUntypedBase

- GeneratorUntypedBase ()=default
- virtual ~GeneratorUntypedBase ()

Additional Inherited Members

Public Types inherited from Catch::Generators::IGenerator< std::vector< T > >

- using type

6.15.1 Detailed Description

template<typename T>
class Catch::Generators::ChunkGenerator< T >

Definition at line 4297 of file catch.h.

6.15.2 Constructor & Destructor Documentation

6.15.2.1 ChunkGenerator()

```
template<typename T >
Catch::Generators::ChunkGenerator< T >::ChunkGenerator (
            size_t size,
            GeneratorWrapper< T > generator )  [inline]
```

Definition at line 4303 of file catch.h.

6.15.3 Member Function Documentation

6.15.3.1 get()

```
template<typename T >
std::vector< T > const & Catch::Generators::ChunkGenerator< T >::get ( ) const  [inline],
[override], [virtual]
```

Implements Catch::Generators::IGenerator< std::vector< T > >.

Definition at line 4317 of file catch.h.

6.15.3.2 next()

```
template<typename T >
bool Catch::Generators::ChunkGenerator< T >::next ( )  [inline], [override], [virtual]
```

Implements Catch::Generators::GeneratorUntypedBase.

Definition at line 4320 of file catch.h.

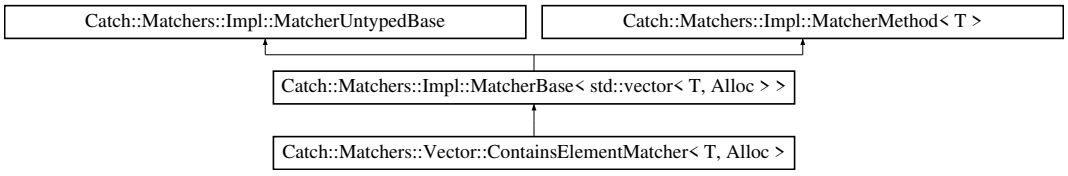
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.16 Catch::Matchers::Vector::ContainsElementMatcher< T, Alloc > Struct Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Matchers::Vector::ContainsElementMatcher< T, Alloc >:



Public Member Functions

- ContainsElementMatcher (T const &comparator)
- bool match (std::vector< T, Alloc > const &v) const override
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Public Attributes

- T const & m_comparator

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.16.1 Detailed Description

template<typename T, typename Alloc>
struct Catch::Matchers::Vector::ContainsElementMatcher< T, Alloc >

Definition at line 3607 of file catch.h.

6.16.2 Constructor & Destructor Documentation

6.16.2.1 ContainsElementMatcher()

```
template<typename T , typename Alloc >
Catch::Matchers::Vector::ContainsElementMatcher< T, Alloc >::ContainsElementMatcher (
            T const & comparator )  [inline]
```

Definition at line 3609 of file catch.h.

6.16.3 Member Function Documentation

6.16.3.1 describe()

```
template<typename T , typename Alloc >
std::string Catch::Matchers::Vector::ContainsElementMatcher< T, Alloc >::describe ( ) const
[inline], [override], [virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

Definition at line 3620 of file catch.h.

6.16.3.2 match()

```
template<typename T , typename Alloc >
bool Catch::Matchers::Vector::ContainsElementMatcher< T, Alloc >::match (
            std::vector< T, Alloc > const & v ) const  [inline], [override]
```

Definition at line 3611 of file catch.h.

6.16.4 Member Data Documentation

6.16.4.1 m_comparator

```
template<typename T , typename Alloc >
T const& Catch::Matchers::Vector::ContainsElementMatcher< T, Alloc >::m_comparator
```

Definition at line 3624 of file catch.h.

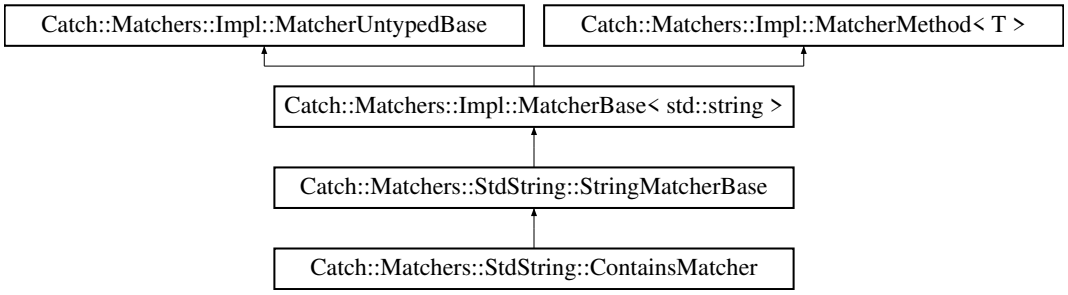
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.17 Catch::Matchers::StdString::ContainsMatcher Struct Reference

`#include <catch.h>`

Inheritance diagram for Catch::Matchers::StdString::ContainsMatcher:



Public Member Functions

- ContainsMatcher (CasedString const &comparator)
- bool match (std::string const &source) const override

Public Member Functions inherited from Catch::Matchers::StdString::StringMatcherBase

- StringMatcherBase (std::string const &operation, CasedString const &comparator)
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Additional Inherited Members

Public Attributes inherited from Catch::Matchers::StdString::StringMatcherBase

- CasedString m_comparator
- std::string m_operation

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.17.1 Detailed Description

Definition at line 3560 of file catch.h.

6.17.2 Constructor & Destructor Documentation

6.17.2.1 ContainsMatcher()

```
Catch::Matchers::StdString::ContainsMatcher::ContainsMatcher (
            CasedString const & comparator )
```

6.17.3 Member Function Documentation

6.17.3.1 match()

```
bool Catch::Matchers::StdString::ContainsMatcher::match (
            std::string const & source ) const  [override]
```

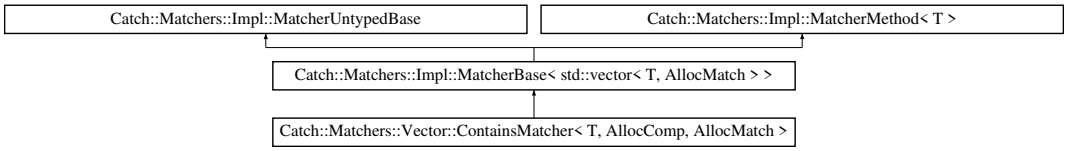
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.18 Catch::Matchers::Vector::ContainsMatcher< T, AllocComp, AllocMatch > Struct Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Matchers::Vector::ContainsMatcher< T, AllocComp, AllocMatch >:



Public Member Functions

- ContainsMatcher (std::vector< T, AllocComp > const &comparator)
- bool match (std::vector< T, AllocMatch > const &v) const override
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Public Attributes

- std::vector< T, AllocComp > const & m_comparator

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.18.1 Detailed Description

template<typename T, typename AllocComp, typename AllocMatch>
struct Catch::Matchers::Vector::ContainsMatcher< T, AllocComp, AllocMatch >

Definition at line 3628 of file catch.h.

6.18.2 Constructor & Destructor Documentation

6.18.2.1 ContainsMatcher()

```
template<typename T , typename AllocComp , typename AllocMatch >
Catch::Matchers::Vector::ContainsMatcher< T, AllocComp, AllocMatch >::ContainsMatcher (
            std::vector< T, AllocComp > const & comparator )  [inline]
```

Definition at line 3630 of file catch.h.

6.18.3 Member Function Documentation

6.18.3.1 describe()

```
template<typename T , typename AllocComp , typename AllocMatch >
std::string Catch::Matchers::Vector::ContainsMatcher< T, AllocComp, AllocMatch >::describe ( )
const  [inline], [override], [virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

Definition at line 3650 of file catch.h.

6.18.3.2 match()

```
template<typename T , typename AllocComp , typename AllocMatch >
bool Catch::Matchers::Vector::ContainsMatcher< T, AllocComp, AllocMatch >::match (
            std::vector< T, AllocMatch > const & v ) const  [inline], [override]
```

Definition at line 3632 of file catch.h.

6.18.4 Member Data Documentation

6.18.4.1 m_comparator

```
template<typename T , typename AllocComp , typename AllocMatch >
std::vector<T, AllocComp> const& Catch::Matchers::Vector::ContainsMatcher< T, AllocComp,
AllocMatch >::m_comparator
```

Definition at line 3654 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.19 Catch::Counts Struct Reference

```
#include <catch.h>
```

Public Member Functions

- Counts operator- (Counts const &other) const
- Counts & operator+= (Counts const &other)
- std::size_t total () const
- bool allPassed () const
- bool allOk () const

Public Attributes

- std::size_t passed = 0
- std::size_t failed = 0
- std::size_t failedButOk = 0

6.19.1 Detailed Description

Definition at line 2829 of file catch.h.

6.19.2 Member Function Documentation

6.19.2.1 allOk()

```
bool Catch::Counts::allOk ( ) const
```

6.19.2.2 allPassed()

```
bool Catch::Counts::allPassed ( ) const
```

6.19.2.3 operator+=()

```
Counts & Catch::Counts::operator+= (
            Counts const & other )
```

6.19.2.4 operator-()

```
Counts Catch::Counts::operator- (
            Counts const & other ) const
```

6.19.2.5 total()

```
std::size_t Catch::Counts::total ( ) const
```

6.19.3 Member Data Documentation

6.19.3.1 failed

```
std::size_t Catch::Counts::failed = 0
```

Definition at line 2838 of file catch.h.

6.19.3.2 failedButOk

```
std::size_t Catch::Counts::failedButOk = 0
```

Definition at line 2839 of file catch.h.

6.19.3.3 passed

```
std::size_t Catch::Counts::passed = 0
```

Definition at line 2837 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.20 Catch::Decomposer Struct Reference

```
#include <catch.h>
```

Public Member Functions

- template<typename T >
  auto operator<= (T const &lhs) -> ExprLhs< T const & >
- auto operator<= (bool value) -> ExprLhs< bool >

6.20.1 Detailed Description

Definition at line 2414 of file catch.h.

6.20.2 Member Function Documentation

6.20.2.1 operator<=() [1/2]

```
auto Catch::Decomposer::operator<= (
            bool value ) -> ExprLhs<bool>   [inline]
```

Definition at line 2420 of file catch.h.

6.20.2.2 operator<=() [2/2]

```
template<typename T >
auto Catch::Decomposer::operator<= (
            T const & lhs ) -> ExprLhs<T const&>   [inline]
```

Definition at line 2416 of file catch.h.

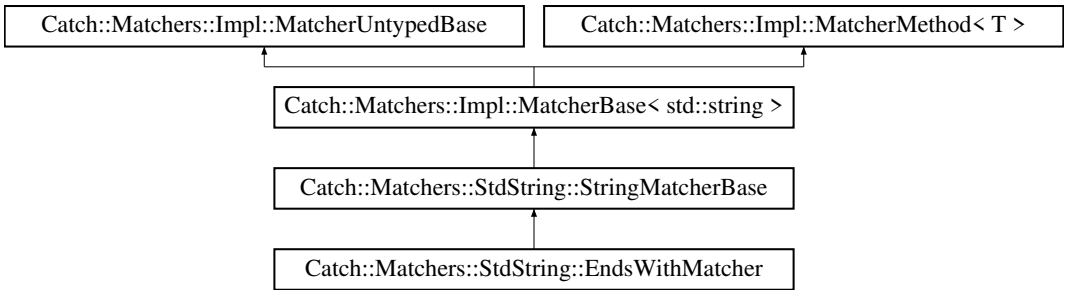
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.21 Catch::Matchers::StdString::EndsWithMatcher Struct Reference

`#include <catch.h>`

Inheritance diagram for Catch::Matchers::StdString::EndsWithMatcher:



Public Member Functions

- EndsWithMatcher (CasedString const &comparator)
- bool match (std::string const &source) const override

Public Member Functions inherited from Catch::Matchers::StdString::StringMatcherBase

- StringMatcherBase (std::string const &operation, CasedString const &comparator)
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Additional Inherited Members

Public Attributes inherited from Catch::Matchers::StdString::StringMatcherBase

- CasedString m_comparator
- std::string m_operation

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.21.1 Detailed Description

Definition at line 3568 of file catch.h.

6.21.2 Constructor & Destructor Documentation

6.21.2.1 EndsWithMatcher()

```
Catch::Matchers::StdString::EndsWithMatcher::EndsWithMatcher (
            CasedString const & comparator )
```

6.21.3 Member Function Documentation

6.21.3.1 match()

```
bool Catch::Matchers::StdString::EndsWithMatcher::match (
            std::string const & source ) const  [override]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.22 Catch::Detail::EnumInfo Struct Reference

```
#include <catch.h>
```

Public Member Functions

- ~EnumInfo ()
- StringRef lookup (int value) const

Public Attributes

- StringRef m_name
- std::vector< std::pair< int, StringRef > > m_values

6.22.1 Detailed Description

Definition at line 1466 of file catch.h.

6.22.2 Constructor & Destructor Documentation

6.22.2.1 ~EnumInfo()

```
Catch::Detail::EnumInfo::~EnumInfo ( )
```

6.22.3 Member Function Documentation

6.22.3.1 lookup()

```
StringRef Catch::Detail::EnumInfo::lookup (
            int value ) const
```

6.22.4 Member Data Documentation

6.22.4.1 m_name

```
StringRef Catch::Detail::EnumInfo::m_name
```

Definition at line 1467 of file catch.h.

6.22.4.2 m_values

```
std::vector<std::pair<int, StringRef> > Catch::Detail::EnumInfo::m_values
```

Definition at line 1468 of file catch.h.

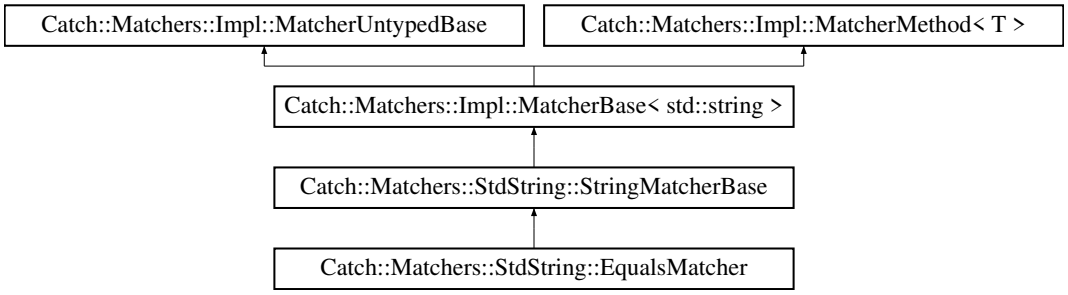
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.23 Catch::Matchers::StdString::EqualsMatcher Struct Reference

`#include <catch.h>`

Inheritance diagram for Catch::Matchers::StdString::EqualsMatcher:



Public Member Functions

- EqualsMatcher (CasedString const &comparator)
- bool match (std::string const &source) const override

Public Member Functions inherited from Catch::Matchers::StdString::StringMatcherBase

- StringMatcherBase (std::string const &operation, CasedString const &comparator)
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Additional Inherited Members

Public Attributes inherited from Catch::Matchers::StdString::StringMatcherBase

- CasedString m_comparator
- std::string m_operation

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.23.1 Detailed Description

Definition at line 3556 of file catch.h.

6.23.2 Constructor & Destructor Documentation

6.23.2.1 EqualsMatcher()

```
Catch::Matchers::StdString::EqualsMatcher::EqualsMatcher (
            CasedString const & comparator )
```

6.23.3 Member Function Documentation

6.23.3.1 match()

```
bool Catch::Matchers::StdString::EqualsMatcher::match (
            std::string const & source ) const  [override]
```

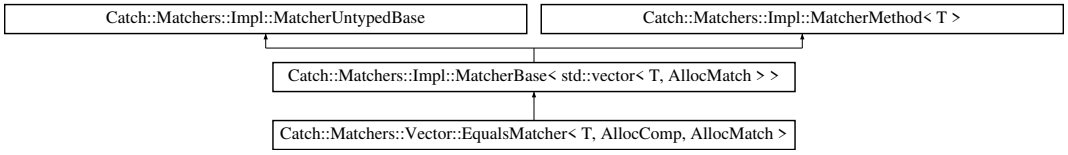
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.24 Catch::Matchers::Vector::EqualsMatcher< T, AllocComp, AllocMatch > Struct Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Matchers::Vector::EqualsMatcher< T, AllocComp, AllocMatch >:



Public Member Functions

- EqualsMatcher (std::vector< T, AllocComp > const &comparator)
- bool match (std::vector< T, AllocMatch > const &v) const override
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Public Attributes

- std::vector< T, AllocComp > const & m_comparator

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.24.1 Detailed Description

template<typename T, typename AllocComp, typename AllocMatch>
struct Catch::Matchers::Vector::EqualsMatcher< T, AllocComp, AllocMatch >

Definition at line 3658 of file catch.h.

6.24.2 Constructor & Destructor Documentation

6.24.2.1 EqualsMatcher()

```
template<typename T , typename AllocComp , typename AllocMatch >
Catch::Matchers::Vector::EqualsMatcher< T, AllocComp, AllocMatch >::EqualsMatcher (
            std::vector< T, AllocComp > const & comparator )  [inline]
```

Definition at line 3660 of file catch.h.

6.24.3 Member Function Documentation

6.24.3.1 describe()

```
template<typename T , typename AllocComp , typename AllocMatch >
std::string Catch::Matchers::Vector::EqualsMatcher< T, AllocComp, AllocMatch >::describe ( )
const  [inline], [override], [virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

Definition at line 3674 of file catch.h.

6.24.3.2 match()

```
template<typename T , typename AllocComp , typename AllocMatch >
bool Catch::Matchers::Vector::EqualsMatcher< T, AllocComp, AllocMatch >::match (
            std::vector< T, AllocMatch > const & v ) const  [inline], [override]
```

Definition at line 3662 of file catch.h.

6.24.4 Member Data Documentation

6.24.4.1 m_comparator

```
template<typename T , typename AllocComp , typename AllocMatch >
std::vector<T, AllocComp> const& Catch::Matchers::Vector::EqualsMatcher< T, AllocComp, AllocMatch
>::m_comparator
```

Definition at line 3677 of file catch.h.

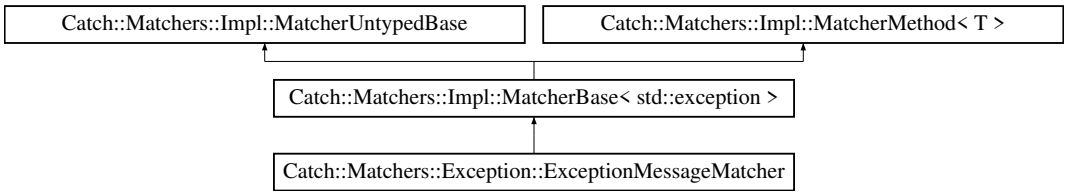
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.25 Catch::Matchers::Exception::ExceptionMessageMatcher Class Reference

`#include <catch.h>`

Inheritance diagram for Catch::Matchers::Exception::ExceptionMessageMatcher:



Public Member Functions

- ExceptionMessageMatcher (std::string const &message)
- bool match (std::exception const &ex) const override
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.25.1 Detailed Description

Definition at line 3399 of file catch.h.

6.25.2 Constructor & Destructor Documentation

6.25.2.1 ExceptionMessageMatcher()

```
Catch::Matchers::Exception::ExceptionMessageMatcher::ExceptionMessageMatcher (
            std::string const & message )  [inline]
```

Definition at line 3403 of file catch.h.

6.25.3 Member Function Documentation

6.25.3.1 describe()

```
std::string Catch::Matchers::Exception::ExceptionMessageMatcher::describe ( ) const  [override],
[virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

6.25.3.2 match()

```
bool Catch::Matchers::Exception::ExceptionMessageMatcher::match (
            std::exception const & ex ) const  [override]
```

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.26 Catch::ExceptionTranslatorRegistrar Class Reference

```
#include <catch.h>
```

Public Member Functions

- template<typename T >
  ExceptionTranslatorRegistrar (std::string(*translateFunction)(T &))

6.26.1 Detailed Description

Definition at line 3021 of file catch.h.

6.26.2 Constructor & Destructor Documentation

6.26.2.1 ExceptionTranslatorRegistrar()

```
template<typename T >
Catch::ExceptionTranslatorRegistrar::ExceptionTranslatorRegistrar (
            std::string(*)(T &) translateFunction )  [inline]
```

Definition at line 3052 of file catch.h.

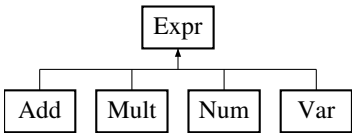
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.27 Expr Class Reference

```
#include <Expr.h>
```

Inheritance diagram for Expr:



Public Member Functions

- virtual ~Expr ()=default
- virtual bool equals (Expr *e)=0
- virtual int interp ()=0
- virtual bool hasVariable ()=0
- virtual Expr * subst (std::string stringInput, Expr *e)=0
- std::string to_string ()
- std::string to_pp_string ()
- virtual void print (std::ostream &stream)=0
- virtual void pretty_print (std::ostream &ot, precedence_t prec)=0
- void pretty_print_at (std::ostream &ot)

6.27.1 Detailed Description

Definition at line 17 of file Expr.h.

6.27.2 Constructor & Destructor Documentation

6.27.2.1 ~Expr()

```
virtual Expr::~Expr ( )  [virtual], [default]
```

6.27.3 Member Function Documentation

6.27.3.1 equals()

```
virtual bool Expr::equals (
            Expr * e )  [pure virtual]
```

Implemented in Num, Add, Mult, and Var.

6.27.3.2 hasVariable()

```
virtual bool Expr::hasVariable ( )  [pure virtual]
```

Implemented in Num, Add, Mult, and Var.

6.27.3.3 interp()

```
virtual int Expr::interp ( )  [pure virtual]
```

Implemented in Num, Add, Mult, and Var.

6.27.3.4 pretty_print()

```
virtual void Expr::pretty_print (
            std::ostream & ot,
            precedence_t prec )  [pure virtual]
```

Implemented in Num, Add, Mult, and Var.

6.27.3.5 pretty_print_at()

```
void Expr::pretty_print_at (
            std::ostream & ot )  [inline]
```

Definition at line 41 of file Expr.h.

6.27.3.6 print()

```
virtual void Expr::print (
            std::ostream & stream )  [pure virtual]
```

Implemented in Num, Add, Mult, and Var.

6.27.3.7 subst()

```
virtual Expr * Expr::subst (
            std::string stringInput,
            Expr * e )  [pure virtual]
```

Implemented in Num, Add, Mult, and Var.

6.27.3.8 to_pp_string()

```
std::string Expr::to_pp_string ( )  [inline]
```

Definition at line 31 of file Expr.h.

6.27.3.9 to_string()

```
std::string Expr::to_string ( )  [inline]
```

Definition at line 25 of file Expr.h.

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/Expr.h

6.28 Catch::ExprLhs< LhsT > Class Template Reference

```
#include <catch.h>
```

Public Member Functions

- ExprLhs (LhsT lhs)
- template<typename RhsT >
  auto operator== (RhsT const &rhs) -> BinaryExpr< LhsT, RhsT const & > const
- auto operator== (bool rhs) -> BinaryExpr< LhsT, bool > const
- template<typename RhsT >
  auto operator!= (RhsT const &rhs) -> BinaryExpr< LhsT, RhsT const & > const
- auto operator!= (bool rhs) -> BinaryExpr< LhsT, bool > const
- template<typename RhsT >
  auto operator> (RhsT const &rhs) -> BinaryExpr< LhsT, RhsT const & > const
- template<typename RhsT >
  auto operator< (RhsT const &rhs) -> BinaryExpr< LhsT, RhsT const & > const
- template<typename RhsT >
  auto operator>= (RhsT const &rhs) -> BinaryExpr< LhsT, RhsT const & > const
- template<typename RhsT >
  auto operator<= (RhsT const &rhs) -> BinaryExpr< LhsT, RhsT const & > const
- template<typename RhsT >
  auto operator| (RhsT const &rhs) -> BinaryExpr< LhsT, RhsT const & > const
- template<typename RhsT >
  auto operator& (RhsT const &rhs) -> BinaryExpr< LhsT, RhsT const & > const
- template<typename RhsT >
  auto operator^ (RhsT const &rhs) -> BinaryExpr< LhsT, RhsT const & > const
- template<typename RhsT >
  auto operator&& (RhsT const &) -> BinaryExpr< LhsT, RhsT const & > const
- template<typename RhsT >
  auto operator|| (RhsT const &) -> BinaryExpr< LhsT, RhsT const & > const
- auto makeUnaryExpr () const -> UnaryExpr< LhsT >

6.28.1 Detailed Description

template<typename LhsT>
class Catch::ExprLhs< LhsT >

Definition at line 2338 of file catch.h.

6.28.2 Constructor & Destructor Documentation

6.28.2.1 ExprLhs()

```
template<typename LhsT >
Catch::ExprLhs< LhsT >::ExprLhs (
            LhsT lhs )  [inline], [explicit]
```

Definition at line 2341 of file catch.h.

6.28.3 Member Function Documentation

6.28.3.1 makeUnaryExpr()

```
template<typename LhsT >
auto Catch::ExprLhs< LhsT >::makeUnaryExpr ( ) const -> UnaryExpr<LhsT>   [inline]
```

Definition at line 2402 of file catch.h.

6.28.3.2 operator"!=() [1/2]

```
template<typename LhsT >
auto Catch::ExprLhs< LhsT >::operator!= (
            bool rhs ) -> BinaryExpr<LhsT, bool> const   [inline]
```

Definition at line 2355 of file catch.h.

6.28.3.3 operator"!=() [2/2]

```
template<typename LhsT >
template<typename RhsT >
auto Catch::ExprLhs< LhsT >::operator!= (
            RhsT const & rhs ) -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2352 of file catch.h.

6.28.3.4 operator&()

```
template<typename LhsT >
template<typename RhsT >
auto Catch::ExprLhs< LhsT >::operator& (
            RhsT const & rhs ) -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2380 of file catch.h.

6.28.3.5 operator&&()

```
template<typename LhsT >
template<typename RhsT >
auto Catch::ExprLhs< LhsT >::operator&& (
            RhsT const &  ) -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2389 of file catch.h.

6.28.3.6 operator<()

```
template<typename LhsT >
template<typename RhsT >
auto Catch::ExprLhs< LhsT >::operator< (
            RhsT const & rhs ) -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2364 of file catch.h.

6.28.3.7 operator<=()

```
template<typename LhsT >
template<typename RhsT >
auto Catch::ExprLhs< LhsT >::operator<= (
            RhsT const & rhs ) -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2372 of file catch.h.

6.28.3.8 operator==() [1/2]

```
template<typename LhsT >
auto Catch::ExprLhs< LhsT >::operator== (
            bool rhs ) -> BinaryExpr<LhsT, bool> const   [inline]
```

Definition at line 2347 of file catch.h.

6.28.3.9 operator==() [2/2]

```
template<typename LhsT >
template<typename RhsT >
auto Catch::ExprLhs< LhsT >::operator== (
            RhsT const & rhs ) -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2344 of file catch.h.

6.28.3.10 operator>()

```
template<typename LhsT >
template<typename RhsT >
auto Catch::ExprLhs< LhsT >::operator> (
            RhsT const & rhs ) -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2360 of file catch.h.

6.28.3.11 operator>=()

```
template<typename LhsT >
template<typename RhsT >
auto Catch::ExprLhs< LhsT >::operator>= (
            RhsT const & rhs ) -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2368 of file catch.h.

6.28.3.12 operator^()

```
template<typename LhsT >
template<typename RhsT >
auto Catch::ExprLhs< LhsT >::operator^ (
            RhsT const & rhs ) -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2384 of file catch.h.

6.28.3.13 operator"|()

```
template<typename LhsT >
template<typename RhsT >
auto Catch::ExprLhs< LhsT >::operator| (
            RhsT const & rhs ) -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2376 of file catch.h.

6.28.3.14 operator"|"|()

```
template<typename LhsT >
template<typename RhsT >
auto Catch::ExprLhs< LhsT >::operator|| (
            RhsT const &  ) -> BinaryExpr<LhsT, RhsT const&> const   [inline]
```

Definition at line 2396 of file catch.h.

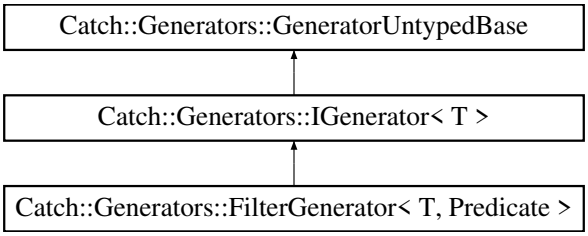
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.29 Catch::Generators::FilterGenerator< T, Predicate > Class Template Reference

`#include <catch.h>`

Inheritance diagram for Catch::Generators::FilterGenerator< T, Predicate >:



Public Member Functions

- template<typename P = Predicate>
  FilterGenerator (P &&pred, GeneratorWrapper< T > &&generator)
- T const & get () const override
- bool next () override

Public Member Functions inherited from Catch::Generators::IGenerator< T >

- virtual ~IGenerator ()=default

Public Member Functions inherited from Catch::Generators::GeneratorUntypedBase

- GeneratorUntypedBase ()=default
- virtual ~GeneratorUntypedBase ()

Additional Inherited Members

Public Types inherited from Catch::Generators::IGenerator< T >

- using type = T

6.29.1 Detailed Description

template<typename T, typename Predicate>
class Catch::Generators::FilterGenerator< T, Predicate >

Definition at line 4156 of file catch.h.

6.29.2 Constructor & Destructor Documentation

6.29.2.1 FilterGenerator()

```
template<typename T , typename Predicate >
template<typename P = Predicate>
Catch::Generators::FilterGenerator< T, Predicate >::FilterGenerator (
            P && pred,
            GeneratorWrapper< T > && generator )  [inline]
```

Definition at line 4161 of file catch.h.

6.29.3 Member Function Documentation

6.29.3.1 get()

```
template<typename T , typename Predicate >
T const & Catch::Generators::FilterGenerator< T, Predicate >::get ( ) const  [inline], [override],
[virtual]
```

Implements Catch::Generators::IGenerator< T >.

Definition at line 4175 of file catch.h.

6.29.3.2 next()

```
template<typename T , typename Predicate >
bool Catch::Generators::FilterGenerator< T, Predicate >::next ( )  [inline], [override], [virtual]
```

Implements Catch::Generators::GeneratorUntypedBase.

Definition at line 4179 of file catch.h.

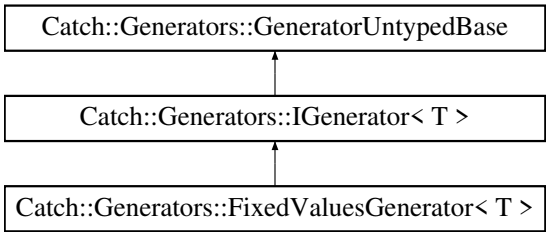
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.30 Catch::Generators::FixedValuesGenerator< T > Class Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Generators::FixedValuesGenerator< T >:



Public Member Functions

- FixedValuesGenerator (std::initializer_list< T > values)
- T const & get () const override
- bool next () override

Public Member Functions inherited from Catch::Generators::IGenerator< T >

- virtual ~IGenerator ()=default

Public Member Functions inherited from Catch::Generators::GeneratorUntypedBase

- GeneratorUntypedBase ()=default
- virtual ~GeneratorUntypedBase ()

Additional Inherited Members

Public Types inherited from Catch::Generators::IGenerator< T >

- using type = T

6.30.1 Detailed Description

template<typename T>
class Catch::Generators::FixedValuesGenerator< T >

Definition at line 3967 of file catch.h.

6.30.2 Constructor & Destructor Documentation

6.30.2.1 FixedValuesGenerator()

```
template<typename T >
Catch::Generators::FixedValuesGenerator< T >::FixedValuesGenerator (
            std::initializer_list< T > values )  [inline]
```

Definition at line 3974 of file catch.h.

6.30.3 Member Function Documentation

6.30.3.1 get()

```
template<typename T >
T const & Catch::Generators::FixedValuesGenerator< T >::get ( ) const  [inline], [override],
[virtual]
```

Implements Catch::Generators::IGenerator< T >.

Definition at line 3976 of file catch.h.

6.30.3.2 next()

```
template<typename T >
bool Catch::Generators::FixedValuesGenerator< T >::next ( )  [inline], [override], [virtual]
```

Implements Catch::Generators::GeneratorUntypedBase.

Definition at line 3979 of file catch.h.

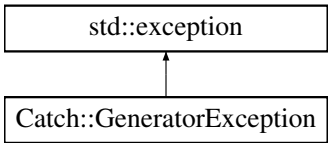
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.31 Catch::GeneratorException Class Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::GeneratorException:



Public Member Functions

- GeneratorException (const char *msg)
- const char * what () const noexcept override final

6.31.1 Detailed Description

Definition at line 3919 of file catch.h.

6.31.2 Constructor & Destructor Documentation

6.31.2.1 GeneratorException()

```
Catch::GeneratorException::GeneratorException (
            const char * msg )  [inline]
```

Definition at line 3923 of file catch.h.

6.31.3 Member Function Documentation

6.31.3.1 what()

```
const char * Catch::GeneratorException::what ( ) const  [final], [override], [noexcept]
```

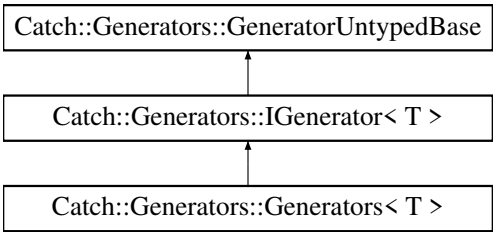
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.32 Catch::Generators::Generators< T > Class Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Generators::Generators< T >:



Public Member Functions

- template<typename... Gs>
  Generators (Gs &&... moreGenerators)
- T const & get () const override
- bool next () override

Public Member Functions inherited from Catch::Generators::IGenerator< T >

- virtual ~IGenerator ()=default

Public Member Functions inherited from Catch::Generators::GeneratorUntypedBase

- GeneratorUntypedBase ()=default
- virtual ~GeneratorUntypedBase ()

Additional Inherited Members

Public Types inherited from Catch::Generators::IGenerator< T >

- using type = T

6.32.1 Detailed Description

template<typename T>
class Catch::Generators::Generators< T >

Definition at line 4010 of file catch.h.

6.32.2 Constructor & Destructor Documentation

6.32.2.1 Generators()

```
template<typename T >
template<typename... Gs>
Catch::Generators::Generators< T >::Generators (
            Gs &&... moreGenerators ) [inline]
```

Definition at line 4032 of file catch.h.

6.32.3 Member Function Documentation

6.32.3.1 get()

```
template<typename T >
T const & Catch::Generators::Generators< T >::get ( ) const [inline], [override], [virtual]
```

Implements Catch::Generators::IGenerator< T >.

Definition at line 4037 of file catch.h.

6.32.3.2 next()

```
template<typename T >
bool Catch::Generators::Generators< T >::next ( ) [inline], [override], [virtual]
```

Implements Catch::Generators::GeneratorUntypedBase.

Definition at line 4041 of file catch.h.

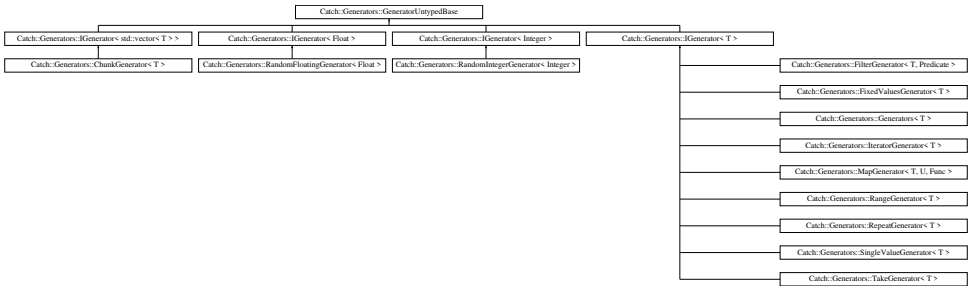
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.33 Catch::Generators::GeneratorUntypedBase Class Reference

`#include <catch.h>`

Inheritance diagram for Catch::Generators::GeneratorUntypedBase:



Public Member Functions

- GeneratorUntypedBase ()=default
- virtual ~GeneratorUntypedBase ()
- virtual bool next ()=0

6.33.1 Detailed Description

Definition at line 3845 of file catch.h.

6.33.2 Constructor & Destructor Documentation

6.33.2.1 GeneratorUntypedBase()

```
Catch::Generators::GeneratorUntypedBase::GeneratorUntypedBase ( )  [default]
```

6.33.2.2 ~GeneratorUntypedBase()

```
virtual Catch::Generators::GeneratorUntypedBase::~GeneratorUntypedBase ( )  [virtual]
```

6.33.3 Member Function Documentation

6.33.3.1 next()

```
virtual bool Catch::Generators::GeneratorUntypedBase::next ( )  [pure virtual]
```

Implemented in Catch::Generators::SingleValueGenerator< T >, Catch::Generators::FixedValuesGenerator< T >, Catch::Generators::Generators< T >, Catch::Generators::TakeGenerator< T >, Catch::Generators::FilterGenerator< T, Predicate >, Catch::Generators::RepeatGenerator< T >, Catch::Generators::MapGenerator< T, U, Func >, Catch::Generators::ChunkGenerator, Catch::Generators::RandomFloatingGenerator< Float >, Catch::Generators::RandomIntegerGenerator< Integer >, Catch::Generators::RangeGenerator< T >, and Catch::Generators::IteratorGenerator< T >.

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.34 Catch::Generators::GeneratorWrapper< T > Class Template Reference

`#include <catch.h>`

Public Member Functions

- GeneratorWrapper (std::unique_ptr< IGenerator< T > > generator)
- T const & get () const
- bool next ()

6.34.1 Detailed Description

template<typename T>
class Catch::Generators::GeneratorWrapper< T >

Definition at line 3986 of file catch.h.

6.34.2 Constructor & Destructor Documentation

6.34.2.1 GeneratorWrapper()

```
template<typename T >
Catch::Generators::GeneratorWrapper< T >::GeneratorWrapper (
            std::unique_ptr< IGenerator< T > > generator )  [inline]
```

Definition at line 3989 of file catch.h.

6.34.3 Member Function Documentation

6.34.3.1 get()

```
template<typename T >
T const & Catch::Generators::GeneratorWrapper< T >::get ( ) const  [inline]
```

Definition at line 3992 of file catch.h.

6.34.3.2 next()

```
template<typename T >
bool Catch::Generators::GeneratorWrapper< T >::next ( )  [inline]
```

Definition at line 3995 of file catch.h.

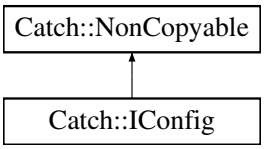
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.35 Catch::IConfig Struct Reference

`#include <catch.h>`

Inheritance diagram for Catch::IConfig:



Public Member Functions

- virtual ~IConfig ()
- virtual bool allowThrows () const =0
- virtual std::ostream & stream () const =0
- virtual std::string name () const =0
- virtual bool includeSuccessfulResults () const =0
- virtual bool shouldDebugBreak () const =0
- virtual bool warnAboutMissingAssertions () const =0
- virtual bool warnAboutNoTests () const =0
- virtual int abortAfter () const =0
- virtual bool showInvisibles () const =0
- virtual ShowDurations::OrNot showDurations () const =0
- virtual double minDuration () const =0
- virtual TestSpec const & testSpec () const =0
- virtual bool hasTestFilters () const =0
- virtual std::vector< std::string > const & getTestsOrTags () const =0
- virtual RunTests::InWhatOrder runOrder () const =0
- virtual unsigned int rngSeed () const =0
- virtual UseColour::YesOrNo useColour () const =0
- virtual std::vector< std::string > const & getSectionsToRun () const =0
- virtual Verbosity verbosity () const =0
- virtual bool benchmarkNoAnalysis () const =0
- virtual int benchmarkSamples () const =0
- virtual double benchmarkConfidenceInterval () const =0
- virtual unsigned int benchmarkResamples () const =0
- virtual std::chrono::milliseconds benchmarkWarmupTime () const =0

Additional Inherited Members

Protected Member Functions inherited from Catch::NonCopyable

- NonCopyable ()
- virtual ~NonCopyable ()

6.35.1 Detailed Description

Definition at line 4512 of file catch.h.

6.35.2 Constructor & Destructor Documentation

6.35.2.1 ~IConfig()

```
virtual Catch::IConfig::~IConfig ( )  [virtual]
```

6.35.3 Member Function Documentation

6.35.3.1 abortAfter()

```
virtual int Catch::IConfig::abortAfter ( ) const  [pure virtual]
```

6.35.3.2 allowThrows()

```
virtual bool Catch::IConfig::allowThrows ( ) const  [pure virtual]
```

6.35.3.3 benchmarkConfidenceInterval()

```
virtual double Catch::IConfig::benchmarkConfidenceInterval ( ) const  [pure virtual]
```

6.35.3.4 benchmarkNoAnalysis()

```
virtual bool Catch::IConfig::benchmarkNoAnalysis ( ) const  [pure virtual]
```

6.35.3.5 benchmarkResamples()

```
virtual unsigned int Catch::IConfig::benchmarkResamples ( ) const  [pure virtual]
```

6.35.3.6 benchmarkSamples()

```
virtual int Catch::IConfig::benchmarkSamples ( ) const  [pure virtual]
```

6.35.3.7 benchmarkWarmupTime()

```
virtual std::chrono::milliseconds Catch::IConfig::benchmarkWarmupTime ( ) const  [pure virtual]
```

6.35.3.8 getSectionsToRun()

```
virtual std::vector< std::string > const & Catch::IConfig::getSectionsToRun ( ) const  [pure
virtual]
```

6.35.3.9 getTestsOrTags()

```
virtual std::vector< std::string > const & Catch::IConfig::getTestsOrTags ( ) const  [pure
virtual]
```

6.35.3.10 hasTestFilters()

```
virtual bool Catch::IConfig::hasTestFilters ( ) const  [pure virtual]
```

6.35.3.11 includeSuccessfulResults()

```
virtual bool Catch::IConfig::includeSuccessfulResults ( ) const  [pure virtual]
```

6.35.3.12 minDuration()

```
virtual double Catch::IConfig::minDuration ( ) const  [pure virtual]
```

6.35.3.13 name()

```
virtual std::string Catch::IConfig::name ( ) const  [pure virtual]
```

6.35.3.14 rngSeed()

```
virtual unsigned int Catch::IConfig::rngSeed ( ) const  [pure virtual]
```

6.35.3.15 runOrder()

```
virtual RunTests::InWhatOrder Catch::IConfig::runOrder ( ) const  [pure virtual]
```

6.35.3.16 shouldDebugBreak()

```
virtual bool Catch::IConfig::shouldDebugBreak ( ) const  [pure virtual]
```

6.35.3.17 showDurations()

```
virtual ShowDurations::OrNot Catch::IConfig::showDurations ( ) const  [pure virtual]
```

6.35.3.18 showInvisibles()

```
virtual bool Catch::IConfig::showInvisibles ( ) const  [pure virtual]
```

6.35.3.19 stream()

```
virtual std::ostream & Catch::IConfig::stream ( ) const  [pure virtual]
```

6.35.3.20 testSpec()

```
virtual TestSpec const & Catch::IConfig::testSpec ( ) const  [pure virtual]
```

6.35.3.21 useColour()

```
virtual UseColour::YesOrNo Catch::IConfig::useColour ( ) const  [pure virtual]
```

6.35.3.22 verbosity()

```
virtual Verbosity Catch::IConfig::verbosity ( ) const  [pure virtual]
```

6.35.3.23 warnAboutMissingAssertions()

```
virtual bool Catch::IConfig::warnAboutMissingAssertions ( ) const  [pure virtual]
```

6.35.3.24 warnAboutNoTests()

```
virtual bool Catch::IConfig::warnAboutNoTests ( ) const  [pure virtual]
```

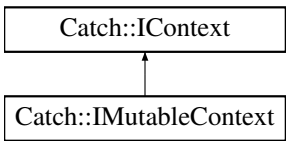
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.36 Catch::IContext Struct Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::IContext:



Public Member Functions

- virtual ~IContext ()
- virtual IResultCapture * getResultCapture ()=0
- virtual IRunner * getRunner ()=0
- virtual IConfigPtr const & getConfig () const =0

6.36.1 Detailed Description

Definition at line 4358 of file catch.h.

6.36.2 Constructor & Destructor Documentation

6.36.2.1 ~IContext()

```
virtual Catch::IContext::~IContext ( )  [virtual]
```

6.36.3 Member Function Documentation

6.36.3.1 getConfig()

```
virtual IConfigPtr const & Catch::IContext::getConfig ( ) const  [pure virtual]
```

6.36.3.2 getResultCapture()

```
virtual IResultCapture * Catch::IContext::getResultCapture ( )  [pure virtual]
```

6.36.3.3 getRunner()

```
virtual IRunner * Catch::IContext::getRunner ( )  [pure virtual]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.37 Catch::IExceptionTranslator Struct Reference

```
#include <catch.h>
```

Public Member Functions

- virtual ~IExceptionTranslator ()
- virtual std::string translate (ExceptionTranslators::const_iterator it, ExceptionTranslators::const_iterator itEnd) const =0

6.37.1 Detailed Description

Definition at line 3010 of file catch.h.

6.37.2 Constructor & Destructor Documentation

6.37.2.1 ~IExceptionTranslator()

```
virtual Catch::IExceptionTranslator::~IExceptionTranslator ( )  [virtual]
```

6.37.3 Member Function Documentation

6.37.3.1 translate()

```
virtual std::string Catch::IExceptionTranslator::translate (
            ExceptionTranslators::const_iterator it,
            ExceptionTranslators::const_iterator itEnd ) const  [pure virtual]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.38 Catch::IExceptionTranslatorRegistry Struct Reference

```
#include <catch.h>
```

Public Member Functions

- virtual ~IExceptionTranslatorRegistry ()
- virtual std::string translateActiveException () const =0

6.38.1 Detailed Description

Definition at line 3015 of file catch.h.

6.38.2 Constructor & Destructor Documentation

6.38.2.1 ~IExceptionTranslatorRegistry()

```
virtual Catch::IExceptionTranslatorRegistry::~IExceptionTranslatorRegistry ( )  [virtual]
```

6.38.3 Member Function Documentation

6.38.3.1 translateActiveException()

```
virtual std::string Catch::IExceptionTranslatorRegistry::translateActiveException ( ) const
[pure virtual]
```

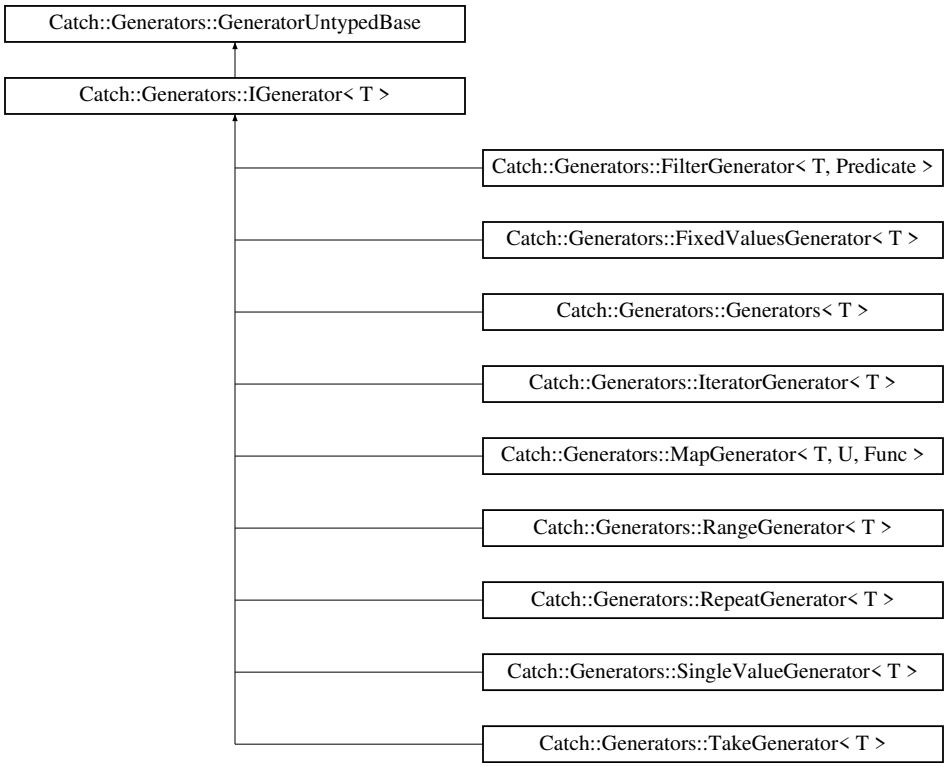
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.39 Catch::Generators::IGenerator< T > Struct Template Reference

`#include <catch.h>`

Inheritance diagram for Catch::Generators::IGenerator< T >:



Public Types

- using type = T

Public Member Functions

- virtual ~IGenerator ()=default
- virtual T const & get () const =0

Public Member Functions inherited from Catch::Generators::GeneratorUntypedBase

- GeneratorUntypedBase ()=default
- virtual ~GeneratorUntypedBase ()
- virtual bool next ()=0

6.39.1 Detailed Description

template<typename T>
struct Catch::Generators::IGenerator< T >

Definition at line 3941 of file catch.h.

6.39.2 Member Typedef Documentation

6.39.2.1 type

```
template<typename T >
using Catch::Generators::IGenerator< T >::type = T
```

Definition at line 3949 of file catch.h.

6.39.3 Constructor & Destructor Documentation

6.39.3.1 ~IGenerator()

```
template<typename T >
virtual Catch::Generators::IGenerator< T >::~IGenerator ( )  [virtual], [default]
```

6.39.4 Member Function Documentation

6.39.4.1 get()

```
template<typename T >
virtual T const & Catch::Generators::IGenerator< T >::get ( ) const  [pure virtual]
```

Implemented in Catch::Generators::SingleValueGenerator< T >, Catch::Generators::FixedValuesGenerator< T >, Catch::Generators::Generators< T >, Catch::Generators::TakeGenerator< T >, Catch::Generators::FilterGenerator< T, Predicate >, Catch::Generators::RepeatGenerator< T >, Catch::Generators::MapGenerator< T, U, Func >, Catch::Generators::ChunkGenerator, Catch::Generators::RandomFloatingGenerator< Float >, Catch::Generators::RandomIntegerGenerator< Integer >, Catch::Generators::RangeGenerator< T >, and Catch::Generators::IteratorGenerator< T >.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.40 Catch::IGeneratorTracker Struct Reference

```
#include <catch.h>
```

Public Member Functions

- virtual ~IGeneratorTracker ()
- virtual auto hasGenerator () const -> bool=0
- virtual auto getGenerator () const -> Generators::GeneratorBasePtr const &=0
- virtual void setGenerator (Generators::GeneratorBasePtr &&generator)=0

6.40.1 Detailed Description

Definition at line 3859 of file catch.h.

6.40.2 Constructor & Destructor Documentation

6.40.2.1 ~IGeneratorTracker()

```
virtual Catch::IGeneratorTracker::~IGeneratorTracker ( )  [virtual]
```

6.40.3 Member Function Documentation

6.40.3.1 getGenerator()

```
virtual auto Catch::IGeneratorTracker::getGenerator ( ) const -> Generators::GeneratorBasePtr
const &  [pure virtual]
```

6.40.3.2 hasGenerator()

```
virtual auto Catch::IGeneratorTracker::hasGenerator ( ) const -> bool  [pure virtual]
```

6.40.3.3 setGenerator()

```
virtual void Catch::IGeneratorTracker::setGenerator (
            Generators::GeneratorBasePtr && generator )  [pure virtual]
```

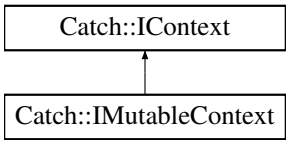
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.41 Catch::IMutableContext Struct Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::IMutableContext:



Public Member Functions

- virtual ~IMutableContext ()
- virtual void setResultCapture (IResultCapture *resultCapture)=0
- virtual void setRunner (IRunner *runner)=0
- virtual void setConfig (IConfigPtr const &config)=0

Public Member Functions inherited from Catch::IContext

- virtual ~IContext ()
- virtual IResultCapture * getResultCapture ()=0
- virtual IRunner * getRunner ()=0
- virtual IConfigPtr const & getConfig () const =0

Friends

- IMutableContext & getCurrentMutableContext ()
- void cleanUpContext ()

6.41.1 Detailed Description

Definition at line 4367 of file catch.h.

6.41.2 Constructor & Destructor Documentation

6.41.2.1 ~IMutableContext()

```
virtual Catch::IMutableContext::~IMutableContext ( )  [virtual]
```

6.41.3 Member Function Documentation

6.41.3.1 setConfig()

```
virtual void Catch::IMutableContext::setConfig (
            IConfigPtr const & config )  [pure virtual]
```

6.41.3.2 setResultCapture()

```
virtual void Catch::IMutableContext::setResultCapture (
            IResultCapture * resultCapture )  [pure virtual]
```

6.41.3.3 setRunner()

```
virtual void Catch::IMutableContext::setRunner (
            IRunner * runner )  [pure virtual]
```

6.41.4 Friends And Related Symbol Documentation

6.41.4.1 cleanUpContext

```
void cleanUpContext ( )  [friend]
```

6.41.4.2 getCurrentMutableContext

```
IMutableContext & getCurrentMutableContext ( )  [friend]
```

Definition at line 4381 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.42 Catch::IMutableEnumValuesRegistry Struct Reference

```
#include <catch.h>
```

Public Member Functions

- virtual ~IMutableEnumValuesRegistry ()
- virtual Detail::EnumInfo const & registerEnum (StringRef enumName, StringRef allEnums, std::vector< int > const &values)=0
- template<typename E >
  Detail::EnumInfo const & registerEnum (StringRef enumName, StringRef allEnums, std::initializer_list< E > values)

6.42.1 Detailed Description

Definition at line 1476 of file catch.h.

6.42.2 Constructor & Destructor Documentation

6.42.2.1 ~IMutableEnumValuesRegistry()

```
virtual Catch::IMutableEnumValuesRegistry::~IMutableEnumValuesRegistry ( )  [virtual]
```

6.42.3 Member Function Documentation

6.42.3.1 registerEnum() [1/2]

```
template<typename E >
Detail::EnumInfo const & Catch::IMutableEnumValuesRegistry::registerEnum (
            StringRef enumName,
            StringRef allEnums,
            std::initializer_list< E > values )  [inline]
```

Definition at line 1482 of file catch.h.

6.42.3.2 registerEnum() [2/2]

```
virtual Detail::EnumInfo const & Catch::IMutableEnumValuesRegistry::registerEnum (
            StringRef enumName,
            StringRef allEnums,
            std::vector< int > const & values )  [pure virtual]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.43 Catch::IMutableRegistryHub Struct Reference

`#include <catch.h>`

Public Member Functions

- virtual ~IMutableRegistryHub ()
- virtual void registerReporter (std::string const &name, IReporterFactoryPtr const &factory)=0
- virtual void registerListener (IReporterFactoryPtr const &factory)=0
- virtual void registerTest (TestCase const &testInfo)=0
- virtual void registerTranslator (const IExceptionTranslator *translator)=0
- virtual void registerTagAlias (std::string const &alias, std::string const &tag, SourceLineInfo const &lineInfo)=0
- virtual void registerStartupException () noexcept=0
- virtual IMutableEnumValuesRegistry & getMutableEnumValuesRegistry ()=0

6.43.1 Detailed Description

Definition at line 2976 of file catch.h.

6.43.2 Constructor & Destructor Documentation

6.43.2.1 ~IMutableRegistryHub()

```
virtual Catch::IMutableRegistryHub::~IMutableRegistryHub ( )  [virtual]
```

6.43.3 Member Function Documentation

6.43.3.1 getMutableEnumValuesRegistry()

```
virtual IMutableEnumValuesRegistry & Catch::IMutableRegistryHub::getMutableEnumValuesRegistry
( )  [pure virtual]
```

6.43.3.2 registerListener()

```
virtual void Catch::IMutableRegistryHub::registerListener (
            IReporterFactoryPtr const & factory )  [pure virtual]
```

6.43.3.3 registerReporter()

```
virtual void Catch::IMutableRegistryHub::registerReporter (
            std::string const & name,
            IReporterFactoryPtr const & factory )  [pure virtual]
```

6.43.3.4 registerStartupException()

```
virtual void Catch::IMutableRegistryHub::registerStartupException ( )  [pure virtual], [noexcept]
```

6.43.3.5 registerTagAlias()

```
virtual void Catch::IMutableRegistryHub::registerTagAlias (
            std::string const & alias,
            std::string const & tag,
            SourceLineInfo const & lineInfo )  [pure virtual]
```

6.43.3.6 registerTest()

```
virtual void Catch::IMutableRegistryHub::registerTest (
            TestCase const & testInfo )  [pure virtual]
```

6.43.3.7 registerTranslator()

```
virtual void Catch::IMutableRegistryHub::registerTranslator (
            const IExceptionTranslator * translator )  [pure virtual]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.44 Catch::IRegistryHub Struct Reference

```
#include <catch.h>
```

Public Member Functions

- virtual ~IRegistryHub ()
- virtual IReporterRegistry const & getReporterRegistry () const =0
- virtual ITestCaseRegistry const & getTestCaseRegistry () const =0
- virtual ITagAliasRegistry const & getTagAliasRegistry () const =0
- virtual IExceptionTranslatorRegistry const & getExceptionTranslatorRegistry () const =0
- virtual StartupExceptionRegistry const & getStartupExceptionRegistry () const =0

6.44.1 Detailed Description

Definition at line 2965 of file catch.h.

6.44.2 Constructor & Destructor Documentation

6.44.2.1 ~IRegistryHub()

```
virtual Catch::IRegistryHub::~IRegistryHub ( )  [virtual]
```

6.44.3 Member Function Documentation

6.44.3.1 getExceptionTranslatorRegistry()

```
virtual IExceptionTranslatorRegistry const & Catch::IRegistryHub::getExceptionTranslator↩
Registry ( ) const  [pure virtual]
```

6.44.3.2 getReporterRegistry()

```
virtual IReporterRegistry const & Catch::IRegistryHub::getReporterRegistry ( ) const  [pure
virtual]
```

6.44.3.3 getStartupExceptionRegistry()

```
virtual StartupExceptionRegistry const & Catch::IRegistryHub::getStartupExceptionRegistry ( )
const  [pure virtual]
```

6.44.3.4 getTagAliasRegistry()

```
virtual ITagAliasRegistry const & Catch::IRegistryHub::getTagAliasRegistry ( ) const  [pure
virtual]
```

6.44.3.5 getTestCaseRegistry()

```
virtual ITestCaseRegistry const & Catch::IRegistryHub::getTestCaseRegistry ( ) const  [pure
virtual]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.45 Catch::IResultCapture Struct Reference

```
#include <catch.h>
```

Public Member Functions

- virtual ~IResultCapture ()
- virtual bool sectionStarted (SectionInfo const &sectionInfo, Counts &assertions)=0
- virtual void sectionEnded (SectionEndInfo const &endInfo)=0
- virtual void sectionEndedEarly (SectionEndInfo const &endInfo)=0
- virtual auto acquireGeneratorTracker (StringRef generatorName, SourceLineInfo const &lineInfo) -> IGeneratorTracker &=0
- virtual void pushScopedMessage (MessageInfo const &message)=0
- virtual void popScopedMessage (MessageInfo const &message)=0
- virtual void emplaceUnscopedMessage (MessageBuilder const &builder)=0
- virtual void handleFatalErrorCondition (StringRef message)=0
- virtual void handleExpr (AssertionInfo const &info, ITransientExpression const &expr, AssertionReaction &reaction)=0
- virtual void handleMessage (AssertionInfo const &info, ResultWas::OfType resultType, StringRef const &message, AssertionReaction &reaction)=0
- virtual void handleUnexpectedExceptionNotThrown (AssertionInfo const &info, AssertionReaction &reaction)=0
- virtual void handleUnexpectedInflightException (AssertionInfo const &info, std::string const &message, AssertionReaction &reaction)=0
- virtual void handleIncomplete (AssertionInfo const &info)=0
- virtual void handleNonExpr (AssertionInfo const &info, ResultWas::OfType resultType, AssertionReaction &reaction)=0
- virtual bool lastAssertionPassed ()=0
- virtual void assertionPassed ()=0
- virtual std::string getCurrentTestName () const =0
- virtual const AssertionResult * getLastResult () const =0
- virtual void exceptionEarlyReported ()=0

6.45.1 Detailed Description

Definition at line 2458 of file catch.h.

6.45.2 Constructor & Destructor Documentation

6.45.2.1 ~IResultCapture()

```
virtual Catch::IResultCapture::~IResultCapture ( )  [virtual]
```

6.45.3 Member Function Documentation

6.45.3.1 acquireGeneratorTracker()

```
virtual auto Catch::IResultCapture::acquireGeneratorTracker (
            StringRef generatorName,
            SourceLineInfo const & lineInfo ) -> IGeneratorTracker &  [pure virtual]
```

6.45.3.2 assertionPassed()

```
virtual void Catch::IResultCapture::assertionPassed ( )  [pure virtual]
```

6.45.3.3 emplaceUnscopedMessage()

```
virtual void Catch::IResultCapture::emplaceUnscopedMessage (
            MessageBuilder const & builder )  [pure virtual]
```

6.45.3.4 exceptionEarlyReported()

```
virtual void Catch::IResultCapture::exceptionEarlyReported ( )  [pure virtual]
```

6.45.3.5 getCurrentTestName()

```
virtual std::string Catch::IResultCapture::getCurrentTestName ( ) const  [pure virtual]
```

6.45.3.6 getLastResult()

```
virtual const AssertionResult * Catch::IResultCapture::getLastResult ( ) const  [pure virtual]
```

6.45.3.7 handleExpr()

```
virtual void Catch::IResultCapture::handleExpr (
            AssertionInfo const & info,
            ITransientExpression const & expr,
            AssertionReaction & reaction )  [pure virtual]
```

6.45.3.8 handleFatalErrorCondition()

```
virtual void Catch::IResultCapture::handleFatalErrorCondition (
            StringRef message )  [pure virtual]
```

6.45.3.9 handleIncomplete()

```
virtual void Catch::IResultCapture::handleIncomplete (
            AssertionInfo const & info )  [pure virtual]
```

6.45.3.10 handleMessage()

```
virtual void Catch::IResultCapture::handleMessage (
            AssertionInfo const & info,
            ResultWas::OfType resultType,
            StringRef const & message,
            AssertionReaction & reaction )  [pure virtual]
```

6.45.3.11 handleNonExpr()

```
virtual void Catch::IResultCapture::handleNonExpr (
            AssertionInfo const & info,
            ResultWas::OfType resultType,
            AssertionReaction & reaction )  [pure virtual]
```

6.45.3.12 handleUnexpectedExceptionNotThrown()

```
virtual void Catch::IResultCapture::handleUnexpectedExceptionNotThrown (
            AssertionInfo const & info,
            AssertionReaction & reaction )  [pure virtual]
```

6.45.3.13 handleUnexpectedInflightException()

```
virtual void Catch::IResultCapture::handleUnexpectedInflightException (
            AssertionInfo const & info,
            std::string const & message,
            AssertionReaction & reaction )  [pure virtual]
```

6.45.3.14 lastAssertionPassed()

```
virtual bool Catch::IResultCapture::lastAssertionPassed ( )  [pure virtual]
```

6.45.3.15 popScopedMessage()

```
virtual void Catch::IResultCapture::popScopedMessage (
            MessageInfo const & message )  [pure virtual]
```

6.45.3.16 pushScopedMessage()

```
virtual void Catch::IResultCapture::pushScopedMessage (
            MessageInfo const & message )  [pure virtual]
```

6.45.3.17 sectionEnded()

```
virtual void Catch::IResultCapture::sectionEnded (
            SectionEndInfo const & endInfo )  [pure virtual]
```

6.45.3.18 sectionEndedEarly()

```
virtual void Catch::IResultCapture::sectionEndedEarly (
            SectionEndInfo const & endInfo )  [pure virtual]
```

6.45.3.19 sectionStarted()

```
virtual bool Catch::IResultCapture::sectionStarted (
            SectionInfo const & sectionInfo,
            Counts & assertions )  [pure virtual]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.46 Catch::IRunner Struct Reference

`#include <catch.h>`

Public Member Functions

- virtual ~IRunner ()
- virtual bool aborting () const =0

6.46.1 Detailed Description

Definition at line 4840 of file catch.h.

6.46.2 Constructor & Destructor Documentation

6.46.2.1 ~IRunner()

```
virtual Catch::IRunner::~IRunner ( )  [virtual]
```

6.46.3 Member Function Documentation

6.46.3.1 aborting()

```
virtual bool Catch::IRunner::aborting ( ) const  [pure virtual]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.47 Catch::is_callable< T > Struct Template Reference

6.47.1 Detailed Description

template<typename T>
struct Catch::is_callable< T >

Definition at line 936 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.48 Catch::is_callable< Fun(Args...)> Struct Template Reference

```
#include <catch.h>
```

6.48.1 Detailed Description

template<typename Fun, typename... Args>
struct Catch::is_callable< Fun(Args...)>

Definition at line 939 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.49 Catch::is_callable_tester Struct Reference

```
#include <catch.h>
```

Static Public Member Functions

- template<typename Fun , typename... Args>
  static true_given< decltype(std::declval< Fun >()(std::declval< Args >()...))> test (int)
- template<typename... >
  static std::false_type test (...)

6.49.1 Detailed Description

Definition at line 928 of file catch.h.

6.49.2 Member Function Documentation

6.49.2.1 test() [1/2]

```
template<typename...  >
static std::false_type Catch::is_callable_tester::test (
              ...  )  [static]
```

6.49.2.2 test() [2/2]

```
template<typename Fun , typename...  Args>
static true_given< decltype(std::declval< Fun >()(std::declval< Args >()...))> Catch::is_↩
callable_tester::test (
            int  )  [static]
```

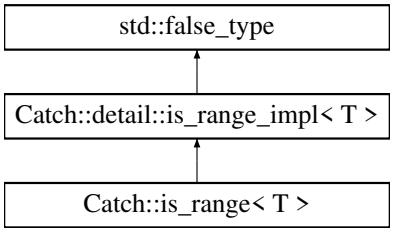
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.50 Catch::is_range< T > Struct Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::is_range< T >:



6.50.1 Detailed Description

template<typename T>
struct Catch::is_range< T >

Definition at line 2007 of file catch.h.

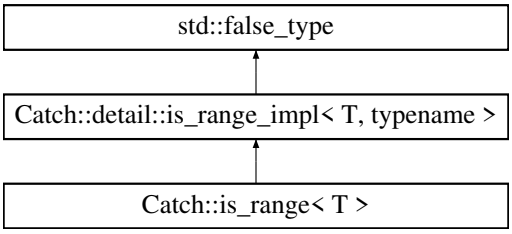
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.51 Catch::detail::is_range_impl< T, typename > Struct Template Reference

`#include <catch.h>`

Inheritance diagram for Catch::detail::is_range_impl< T, typename >:



6.51.1 Detailed Description

template<typename T, typename = void>
struct Catch::detail::is_range_impl< T, typename >

Definition at line 1998 of file catch.h.

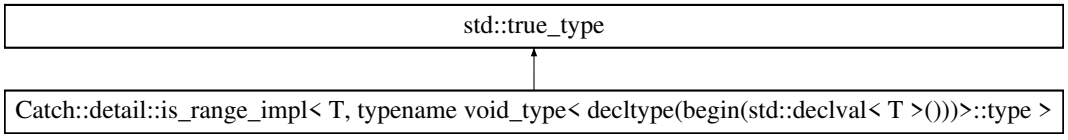
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.52 Catch::detail::is_range_impl< T, typename void_type< decltype(begin(std::declval< T >()))>::type > Struct Template Reference

`#include <catch.h>`

Inheritance diagram for Catch::detail::is_range_impl< T, typename void_type< decltype(begin(std::declval< T >()))>::type >:



6.52.1 Detailed Description

template<typename T>
struct Catch::detail::is_range_impl< T, typename void_type< decltype(begin(std::declval< T >()))>::type >

Definition at line 2002 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.53 Catch::Detail::IsStreamInsertable< T > Class Template Reference

`#include <catch.h>`

Static Public Attributes

- static const bool value = decltype(test<std::ostream, const T&>(0))::value

6.53.1 Detailed Description

template<typename T>
class Catch::Detail::IsStreamInsertable< T >

Definition at line 1564 of file catch.h.

6.53.2 Member Data Documentation

6.53.2.1 value

```
template<typename T >
const bool Catch::Detail::IsStreamInsertable< T >::value = decltype(test<std::ostream, const
T&>(0))::value  [static]
```

Definition at line 1573 of file catch.h.

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.54 Catch::IStream Struct Reference

`#include <catch.h>`

Public Member Functions

- virtual ~IStream ()
- virtual std::ostream & stream () const =0

6.54.1 Detailed Description

Definition at line 1433 of file catch.h.

6.54.2 Constructor & Destructor Documentation

6.54.2.1 ~IStream()

```
virtual Catch::IStream::~IStream ( )  [virtual]
```

6.54.3 Member Function Documentation

6.54.3.1 stream()

```
virtual std::ostream & Catch::IStream::stream ( ) const  [pure virtual]
```

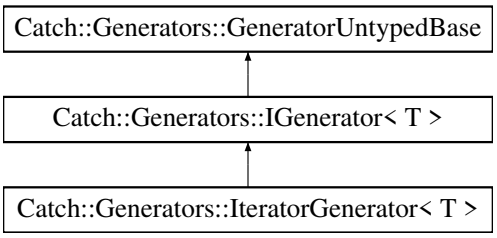
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.55 Catch::Generators::IteratorGenerator< T > Class Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Generators::IteratorGenerator< T >:



Public Member Functions

- template<typename InputIterator , typename InputSentinel >
  IteratorGenerator (InputIterator first, InputSentinel last)
- T const & get () const override
- bool next () override

Public Member Functions inherited from Catch::Generators::IGenerator< T >

- virtual ~IGenerator ()=default

Public Member Functions inherited from Catch::Generators::GeneratorUntypedBase

- GeneratorUntypedBase ()=default
- virtual ~GeneratorUntypedBase ()

Additional Inherited Members

Public Types inherited from Catch::Generators::IGenerator< T >

- using type = T

6.55.1 Detailed Description

template<typename T>
class Catch::Generators::IteratorGenerator< T >

Definition at line 4712 of file catch.h.

6.55.2 Constructor & Destructor Documentation

6.55.2.1 IteratorGenerator()

```
template<typename T >
template<typename InputIterator , typename InputSentinel >
Catch::Generators::IteratorGenerator< T >::IteratorGenerator (
            InputIterator first,
            InputSentinel last )  [inline]
```

Definition at line 4721 of file catch.h.

6.55.3 Member Function Documentation

6.55.3.1 get()

```
template<typename T >
T const & Catch::Generators::IteratorGenerator< T >::get ( ) const  [inline], [override],
[virtual]
```

Implements Catch::Generators::IGenerator< T >.

Definition at line 4727 of file catch.h.

6.55.3.2 next()

```
template<typename T >
bool Catch::Generators::IteratorGenerator< T >::next ( )  [inline], [override], [virtual]
```

Implements Catch::Generators::GeneratorUntypedBase.

Definition at line 4731 of file catch.h.

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.56 Catch::ITestCaseRegistry Struct Reference

```
#include <catch.h>
```

Public Member Functions

- virtual ~ITestCaseRegistry ()
- virtual std::vector< TestCase > const & getAllTests () const =0
- virtual std::vector< TestCase > const & getAllTestsSorted (IConfig const &config) const =0

6.56.1 Detailed Description

Definition at line 580 of file catch.h.

6.56.2 Constructor & Destructor Documentation

6.56.2.1 ~ITestCaseRegistry()

```
virtual Catch::ITestCaseRegistry::~ITestCaseRegistry ( )  [virtual]
```

6.56.3 Member Function Documentation

6.56.3.1 getAllTests()

```
virtual std::vector< TestCase > const & Catch::ITestCaseRegistry::getAllTests ( ) const  [pure
virtual]
```

6.56.3.2 getAllTestsSorted()

```
virtual std::vector< TestCase > const & Catch::ITestCaseRegistry::getAllTestsSorted (
            IConfig const & config ) const  [pure virtual]
```

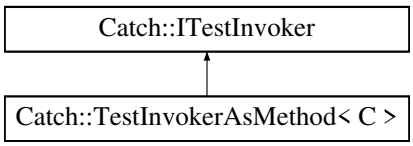
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.57 Catch::ITestInvoker Struct Reference

`#include <catch.h>`

Inheritance diagram for Catch::ITestInvoker:



Public Member Functions

- virtual void invoke () const =0
- virtual ~ITestInvoker ()

6.57.1 Detailed Description

Definition at line 572 of file catch.h.

6.57.2 Constructor & Destructor Documentation

6.57.2.1 ~ITestInvoker()

```
virtual Catch::ITestInvoker::~ITestInvoker ( )  [virtual]
```

6.57.3 Member Function Documentation

6.57.3.1 invoke()

```
virtual void Catch::ITestInvoker::invoke ( ) const  [pure virtual]
```

Implemented in Catch::TestInvokerAsMethod< C >.

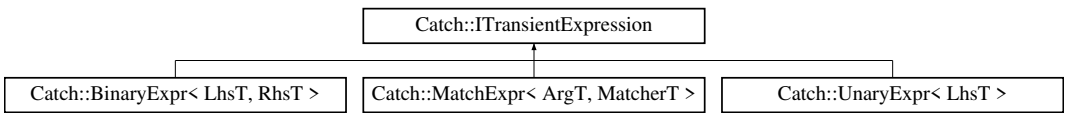
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.58 Catch::ITransientExpression Struct Reference

`#include <catch.h>`

Inheritance diagram for Catch::ITransientExpression:



Public Member Functions

- auto isBinaryExpression () const -> bool
- auto getResult () const -> bool
- virtual void streamReconstructedExpression (std::ostream &os) const =0
- ITransientExpression (bool isBinaryExpression, bool result)
- virtual ~ITransientExpression ()

Public Attributes

- bool m_isBinaryExpression
- bool m_result

6.58.1 Detailed Description

Definition at line 2202 of file catch.h.

6.58.2 Constructor & Destructor Documentation

6.58.2.1 ITransientExpression()

```
Catch::ITransientExpression::ITransientExpression (
            bool isBinaryExpression,
            bool result )  [inline]
```

Definition at line 2207 of file catch.h.

6.58.2.2 ~ITransientExpression()

```
virtual Catch::ITransientExpression::~ITransientExpression ( )  [virtual]
```

6.58.3 Member Function Documentation

6.58.3.1 getResult()

```
auto Catch::ITransientExpression::getResult ( ) const -> bool   [inline]
```

Definition at line 2204 of file catch.h.

6.58.3.2 isBinaryExpression()

```
auto Catch::ITransientExpression::isBinaryExpression ( ) const -> bool   [inline]
```

Definition at line 2203 of file catch.h.

6.58.3.3 streamReconstructedExpression()

```
virtual void Catch::ITransientExpression::streamReconstructedExpression (
            std::ostream & os ) const  [pure virtual]
```

Implemented in Catch::MatchExpr< ArgT, MatcherT >.

6.58.4 Member Data Documentation

6.58.4.1 m_isBinaryExpression

```
bool Catch::ITransientExpression::m_isBinaryExpression
```

Definition at line 2216 of file catch.h.

6.58.4.2 m_result

```
bool Catch::ITransientExpression::m_result
```

Definition at line 2217 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.59 Catch::LazyExpression Class Reference

```
#include <catch.h>
```

Public Member Functions

- LazyExpression (bool isNegated)
- LazyExpression (LazyExpression const &other)
- LazyExpression & operator= (LazyExpression const &)=delete
- operator bool () const

Friends

- class AssertionHandler
- struct AssertionStats
- class RunContext
- auto operator<< (std::ostream &os, LazyExpression const &lazyExpr) -> std::ostream &

6.59.1 Detailed Description

Definition at line 2526 of file catch.h.

6.59.2 Constructor & Destructor Documentation

6.59.2.1 LazyExpression() [1/2]

```
Catch::LazyExpression::LazyExpression (
            bool isNegated )
```

6.59.2.2 LazyExpression() [2/2]

```
Catch::LazyExpression::LazyExpression (
            LazyExpression const & other )
```

6.59.3 Member Function Documentation

6.59.3.1 operator bool()

```
Catch::LazyExpression::operator bool ( ) const  [explicit]
```

6.59.3.2 operator=()

```
LazyExpression & Catch::LazyExpression::operator= (
            LazyExpression const &  )  [delete]
```

6.59.4 Friends And Related Symbol Documentation

6.59.4.1 AssertionHandler

```
friend class AssertionHandler  [friend]
```

Definition at line 2527 of file catch.h.

6.59.4.2 AssertionStats

```
friend struct AssertionStats  [friend]
```

Definition at line 2528 of file catch.h.

6.59.4.3 operator<<

```
auto operator<< (
            std::ostream & os,
            LazyExpression const & lazyExpr ) -> std::ostream &  [friend]
```

6.59.4.4 RunContext

```
friend class RunContext  [friend]
```

Definition at line 2529 of file catch.h.

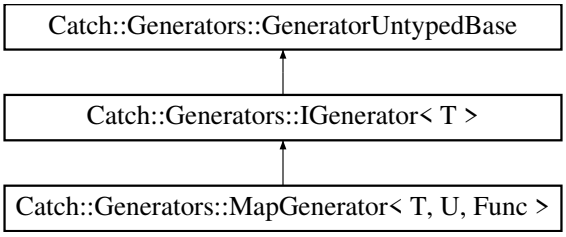
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.60 Catch::Generators::MapGenerator< T, U, Func > Class Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Generators::MapGenerator< T, U, Func >:



Public Member Functions

- template<typename F2 = Func>
  MapGenerator (F2 &&function, GeneratorWrapper< U > &&generator)
- T const & get () const override
- bool next () override

Public Member Functions inherited from Catch::Generators::IGenerator< T >

- virtual ~IGenerator ()=default

Public Member Functions inherited from Catch::Generators::GeneratorUntypedBase

- GeneratorUntypedBase ()=default
- virtual ~GeneratorUntypedBase ()

Additional Inherited Members

Public Types inherited from Catch::Generators::IGenerator< T >

- using type = T

6.60.1 Detailed Description

template<typename T, typename U, typename Func>
class Catch::Generators::MapGenerator< T, U, Func >

Definition at line 4256 of file catch.h.

6.60.2 Constructor & Destructor Documentation

6.60.2.1 MapGenerator()

```
template<typename T , typename U , typename Func >
template<typename F2 = Func>
Catch::Generators::MapGenerator< T, U, Func >::MapGenerator (
            F2 && function,
            GeneratorWrapper< U > && generator )  [inline]
```

Definition at line 4264 of file catch.h.

6.60.3 Member Function Documentation

6.60.3.1 get()

```
template<typename T , typename U , typename Func >
T const & Catch::Generators::MapGenerator< T, U, Func >::get ( ) const  [inline], [override],
[virtual]
```

Implements Catch::Generators::IGenerator< T >.

Definition at line 4270 of file catch.h.

6.60.3.2 next()

```
template<typename T , typename U , typename Func >
bool Catch::Generators::MapGenerator< T, U, Func >::next ( )  [inline], [override], [virtual]
```

Implements Catch::Generators::GeneratorUntypedBase.

Definition at line 4273 of file catch.h.

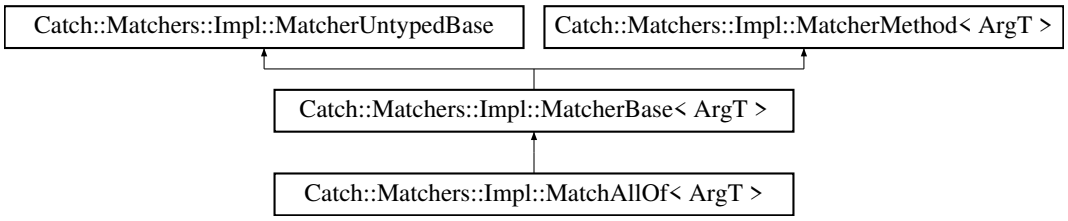
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.61 Catch::Matchers::Impl::MatchAllOf< ArgT > Struct Template Reference

`#include <catch.h>`

Inheritance diagram for Catch::Matchers::Impl::MatchAllOf< ArgT >:



Public Member Functions

- bool match (ArgT const &arg) const override
- std::string describe () const override
- MatchAllOf< ArgT > operator&& (MatcherBase< ArgT > const &other)

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< ArgT >

- MatchAllOf< ArgT > operator&& (MatcherBase const &other) const
- MatchAnyOf< ArgT > operator|| (MatcherBase const &other) const
- MatchNotOf< ArgT > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< ObjectT >

- virtual bool match (ObjectT const &arg) const =0

Public Attributes

- std::vector< MatcherBase< ArgT > const * > m_matchers

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.61.1 Detailed Description

template<typename ArgT>
struct Catch::Matchers::Impl::MatchAllOf< ArgT >

Definition at line 3288 of file catch.h.

6.61.2 Member Function Documentation

6.61.2.1 describe()

```
template<typename ArgT >
std::string Catch::Matchers::Impl::MatchAllOf< ArgT >::describe ( ) const  [inline], [override],
[virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

Definition at line 3296 of file catch.h.

6.61.2.2 match()

```
template<typename ArgT >
bool Catch::Matchers::Impl::MatchAllOf< ArgT >::match (
            ArgT const & arg ) const  [inline], [override]
```

Definition at line 3289 of file catch.h.

6.61.2.3 operator&&()

```
template<typename ArgT >
MatchAllOf< ArgT > Catch::Matchers::Impl::MatchAllOf< ArgT >::operator&& (
            MatcherBase< ArgT > const & other )  [inline]
```

Definition at line 3312 of file catch.h.

6.61.3 Member Data Documentation

6.61.3.1 m_matchers

```
template<typename ArgT >
std::vector<MatcherBase<ArgT> const*> Catch::Matchers::Impl::MatchAllOf< ArgT >::m_matchers
```

Definition at line 3318 of file catch.h.

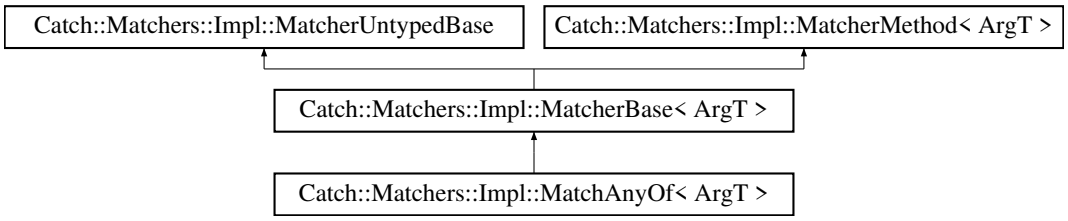
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.62 Catch::Matchers::Impl::MatchAnyOf< ArgT > Struct Template Reference

`#include <catch.h>`

Inheritance diagram for Catch::Matchers::Impl::MatchAnyOf< ArgT >:



Public Member Functions

- bool match (ArgT const &arg) const override
- std::string describe () const override
- MatchAnyOf< ArgT > operator|| (MatcherBase< ArgT > const &other)

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< ArgT >

- MatchAllOf< ArgT > operator&& (MatcherBase const &other) const
- MatchAnyOf< ArgT > operator|| (MatcherBase const &other) const
- MatchNotOf< ArgT > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< ObjectT >

- virtual bool match (ObjectT const &arg) const =0

Public Attributes

- std::vector< MatcherBase< ArgT > const * > m_matchers

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.62.1 Detailed Description

template<typename ArgT>
struct Catch::Matchers::Impl::MatchAnyOf< ArgT >

Definition at line 3321 of file catch.h.

6.62.2 Member Function Documentation

6.62.2.1 describe()

```
template<typename ArgT >
std::string Catch::Matchers::Impl::MatchAnyOf< ArgT >::describe ( ) const  [inline], [override],
[virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

Definition at line 3330 of file catch.h.

6.62.2.2 match()

```
template<typename ArgT >
bool Catch::Matchers::Impl::MatchAnyOf< ArgT >::match (
            ArgT const & arg ) const  [inline], [override]
```

Definition at line 3323 of file catch.h.

6.62.2.3 operator" | " | ()

```
template<typename ArgT >
MatchAnyOf< ArgT > Catch::Matchers::Impl::MatchAnyOf< ArgT >::operator|| (
            MatcherBase< ArgT > const & other )  [inline]
```

Definition at line 3346 of file catch.h.

6.62.3 Member Data Documentation

6.62.3.1 m_matchers

```
template<typename ArgT >
std::vector<MatcherBase<ArgT> const*> Catch::Matchers::Impl::MatchAnyOf< ArgT >::m_matchers
```

Definition at line 3352 of file catch.h.

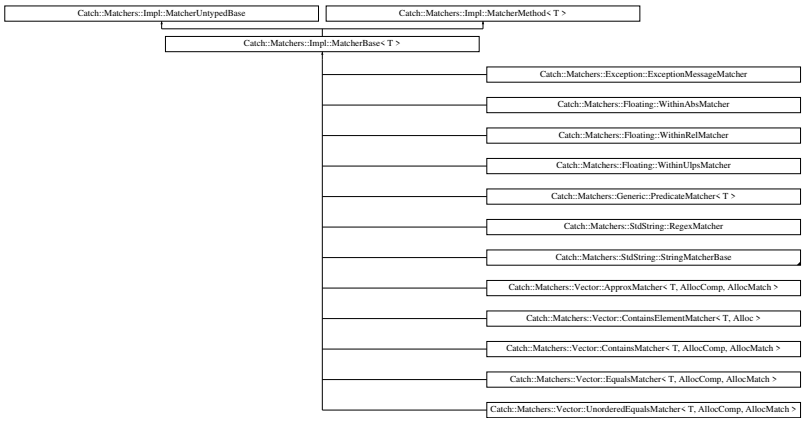
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.63 Catch::Matchers::Impl::MatcherBase< T > Struct Template Reference

`#include <catch.h>`

Inheritance diagram for Catch::Matchers::Impl::MatcherBase< T >:



Public Member Functions

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()
- virtual std::string describe () const =0

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.63.1 Detailed Description

template<typename T>
struct Catch::Matchers::Impl::MatcherBase< T >

Definition at line 3280 of file catch.h.

6.63.2 Member Function Documentation

6.63.2.1 operator"!()

```
template<typename T >
MatchNotOf< T > Catch::Matchers::Impl::MatcherBase< T >::operator!  ( ) const
```

Definition at line 3379 of file catch.h.

6.63.2.2 operator&&()

```
template<typename T >
MatchAllOf< T > Catch::Matchers::Impl::MatcherBase< T >::operator&& (
            MatcherBase< T > const & other ) const
```

Definition at line 3371 of file catch.h.

6.63.2.3 operator" | "()

```
template<typename T >
MatchAnyOf< T > Catch::Matchers::Impl::MatcherBase< T >::operator|| (
            MatcherBase< T > const & other ) const
```

Definition at line 3375 of file catch.h.

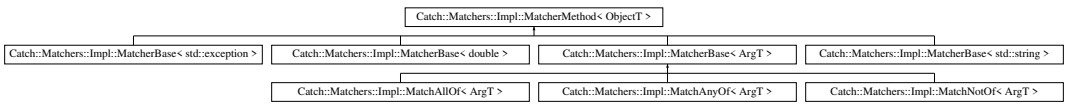
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.64 Catch::Matchers::Impl::MatcherMethod< ObjectT > Struct Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Matchers::Impl::MatcherMethod< ObjectT >:



Public Member Functions

- virtual bool match (ObjectT const &arg) const =0

6.64.1 Detailed Description

template<typename ObjectT>
struct Catch::Matchers::Impl::MatcherMethod< ObjectT >

Definition at line 3262 of file catch.h.

6.64.2 Member Function Documentation

6.64.2.1 match()

```
template<typename ObjectT >
virtual bool Catch::Matchers::Impl::MatcherMethod< ObjectT >::match (
            ObjectT const & arg ) const  [pure virtual]
```

Implemented in Catch::Matchers::Generic::PredicateMatcher< T >.

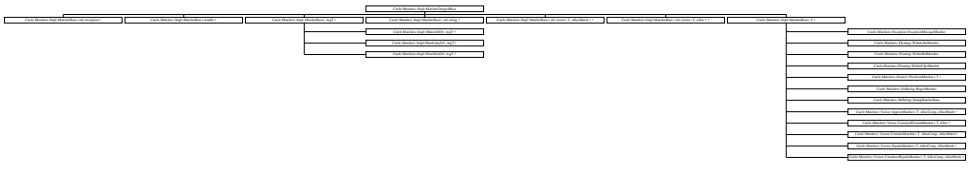
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.65 Catch::Matchers::Impl::MatcherUntypedBase Class Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Matchers::Impl::MatcherUntypedBase:



Public Member Functions

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Protected Member Functions

- virtual ~MatcherUntypedBase ()
- virtual std::string describe () const =0

Protected Attributes

- std::string m_cachedToString

6.65.1 Detailed Description

Definition at line 3243 of file catch.h.

6.65.2 Constructor & Destructor Documentation

6.65.2.1 MatcherUntypedBase() [1/2]

```
Catch::Matchers::Impl::MatcherUntypedBase::MatcherUntypedBase ( )  [default]
```

6.65.2.2 MatcherUntypedBase() [2/2]

```
Catch::Matchers::Impl::MatcherUntypedBase::MatcherUntypedBase (
            MatcherUntypedBase const &  )  [default]
```

6.65.2.3 ~MatcherUntypedBase()

```
virtual Catch::Matchers::Impl::MatcherUntypedBase::~MatcherUntypedBase ( )  [protected], [virtual]
```

6.65.3 Member Function Documentation

6.65.3.1 describe()

```
virtual std::string Catch::Matchers::Impl::MatcherUntypedBase::describe ( ) const  [protected],
[pure virtual]
```

Implemented in Catch::Matchers::Impl::MatchAllOf< ArgT >, Catch::Matchers::Impl::MatchAnyOf< ArgT >, Catch::Matchers::Impl::MatchNotOf< ArgT >, Catch::Matchers::Exception::ExceptionMessageMatcher, Catch::Matchers::Floating::W Catch::Matchers::Floating::WithinUlpsMatcher, Catch::Matchers::Floating::WithinRelMatcher, Catch::Matchers::Generic::PredicateMa Catch::Matchers::StdString::StringMatcherBase, Catch::Matchers::StdString::RegexMatcher, Catch::Matchers::Vector::ContainsElem Catch::Matchers::Vector::ContainsMatcher< T, AllocComp, AllocMatch >, Catch::Matchers::Vector::EqualsMatcher< T, AllocComp, A Catch::Matchers::Vector::ApproxMatcher< T, AllocComp, AllocMatch >, and Catch::Matchers::Vector::UnorderedEqualsMatcher< T,

6.65.3.2 operator=()

```
MatcherUntypedBase & Catch::Matchers::Impl::MatcherUntypedBase::operator= (
            MatcherUntypedBase const &  )  [delete]
```

6.65.3.3 toString()

```
std::string Catch::Matchers::Impl::MatcherUntypedBase::toString ( ) const
```

6.65.4 Member Data Documentation

6.65.4.1 m_cachedToString

```
std::string Catch::Matchers::Impl::MatcherUntypedBase::m_cachedToString  [mutable], [protected]
```

Definition at line 3253 of file catch.h.

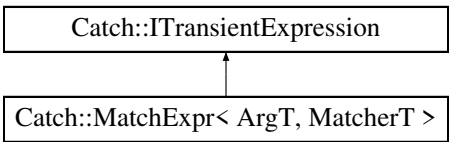
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.66 Catch::MatchExpr< ArgT, MatcherT > Class Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::MatchExpr< ArgT, MatcherT >:



Public Member Functions

- MatchExpr (ArgT const &arg, MatcherT const &matcher, StringRef const &matcherString)
- void streamReconstructedExpression (std::ostream &os) const override

Public Member Functions inherited from Catch::ITransientExpression

- auto isBinaryExpression () const -> bool
- auto getResult () const -> bool
- ITransientExpression (bool isBinaryExpression, bool result)
- virtual ~ITransientExpression ()

Additional Inherited Members

Public Attributes inherited from Catch::ITransientExpression

- bool m_isBinaryExpression
- bool m_result

6.66.1 Detailed Description

template<typename ArgT, typename MatcherT>
class Catch::MatchExpr< ArgT, MatcherT >

Definition at line 3770 of file catch.h.

6.66.2 Constructor & Destructor Documentation

6.66.2.1 MatchExpr()

```
template<typename ArgT , typename MatcherT >
Catch::MatchExpr< ArgT, MatcherT >::MatchExpr (
            ArgT const & arg,
            MatcherT const & matcher,
            StringRef const & matcherString )  [inline]
```

Definition at line 3775 of file catch.h.

6.66.3 Member Function Documentation

6.66.3.1 streamReconstructedExpression()

```
template<typename ArgT , typename MatcherT >
void Catch::MatchExpr< ArgT, MatcherT >::streamReconstructedExpression (
            std::ostream & os ) const  [inline], [override], [virtual]
```

Implements Catch::ITransientExpression.

Definition at line 3782 of file catch.h.

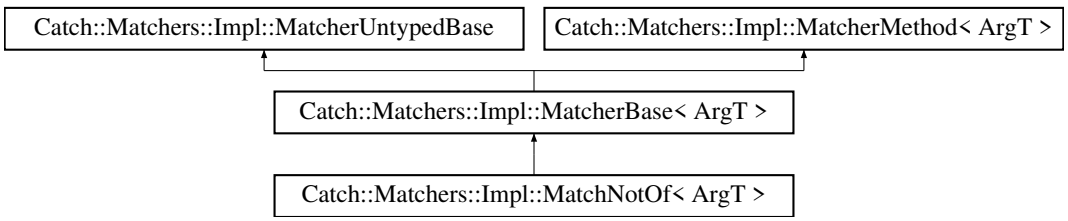
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.67 Catch::Matchers::Impl::MatchNotOf< ArgT > Struct Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Matchers::Impl::MatchNotOf< ArgT >:



Public Member Functions

- MatchNotOf (MatcherBase< ArgT > const &underlyingMatcher)
- bool match (ArgT const &arg) const override
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< ArgT >

- MatchAllOf< ArgT > operator&& (MatcherBase const &other) const
- MatchAnyOf< ArgT > operator|| (MatcherBase const &other) const
- MatchNotOf< ArgT > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< ObjectT >

- virtual bool match (ObjectT const &arg) const =0

Public Attributes

- MatcherBase< ArgT > const & m_underlyingMatcher

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.67.1 Detailed Description

template<typename ArgT>
struct Catch::Matchers::Impl::MatchNotOf< ArgT >

Definition at line 3356 of file catch.h.

6.67.2 Constructor & Destructor Documentation

6.67.2.1 MatchNotOf()

```
template<typename ArgT >
Catch::Matchers::Impl::MatchNotOf< ArgT >::MatchNotOf (
            MatcherBase< ArgT > const & underlyingMatcher )  [inline]
```

Definition at line 3358 of file catch.h.

6.67.3 Member Function Documentation

6.67.3.1 describe()

```
template<typename ArgT >
std::string Catch::Matchers::Impl::MatchNotOf< ArgT >::describe ( ) const  [inline], [override],
[virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

Definition at line 3364 of file catch.h.

6.67.3.2 match()

```
template<typename ArgT >
bool Catch::Matchers::Impl::MatchNotOf< ArgT >::match (
            ArgT const & arg ) const  [inline], [override]
```

Definition at line 3360 of file catch.h.

6.67.4 Member Data Documentation

6.67.4.1 m_underlyingMatcher

```
template<typename ArgT >
MatcherBase<ArgT> const& Catch::Matchers::Impl::MatchNotOf< ArgT >::m_underlyingMatcher
```

Definition at line 3367 of file catch.h.

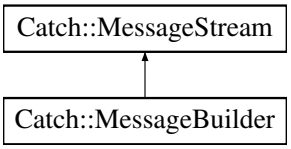
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.68 Catch::MessageBuilder Struct Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::MessageBuilder:



Public Member Functions

- MessageBuilder (StringRef const &macroName, SourceLineInfo const &lineInfo, ResultWas::OfType type)
- template<typename T >
  MessageBuilder & operator<< (T const &value)

Public Member Functions inherited from Catch::MessageStream

- template<typename T >
  MessageStream & operator<< (T const &value)

Public Attributes

- MessageInfo m_info

Public Attributes inherited from Catch::MessageStream

- ReusableStringStream m_stream

6.68.1 Detailed Description

Definition at line 2627 of file catch.h.

6.68.2 Constructor & Destructor Documentation

6.68.2.1 MessageBuilder()

```
Catch::MessageBuilder::MessageBuilder (
            StringRef const & macroName,
            SourceLineInfo const & lineInfo,
            ResultWas::OfType type )
```

6.68.3 Member Function Documentation

6.68.3.1 operator<<()

```
template<typename T >
MessageBuilder & Catch::MessageBuilder::operator<< (
            T const & value )  [inline]
```

Definition at line 2633 of file catch.h.

6.68.4 Member Data Documentation

6.68.4.1 m_info

```
MessageInfo Catch::MessageBuilder::m_info
```

Definition at line 2638 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.69 Catch::MessageInfo Struct Reference

`#include <catch.h>`

Public Member Functions

- MessageInfo (StringRef const &_macroName, SourceLineInfo const &_lineInfo, ResultWas::OfType _type)
- bool operator== (MessageInfo const &other) const
- bool operator< (MessageInfo const &other) const

Public Attributes

- StringRef macroName
- std::string message
- SourceLineInfo lineInfo
- ResultWas::OfType type
- unsigned int sequence

6.69.1 Detailed Description

Definition at line 2599 of file catch.h.

6.69.2 Constructor & Destructor Documentation

6.69.2.1 MessageInfo()

```
Catch::MessageInfo::MessageInfo (
            StringRef const & _macroName,
            SourceLineInfo const & _lineInfo,
            ResultWas::OfType _type )
```

6.69.3 Member Function Documentation

6.69.3.1 operator<()

```
bool Catch::MessageInfo::operator< (
            MessageInfo const & other ) const
```

6.69.3.2 operator==()

```
bool Catch::MessageInfo::operator== (
            MessageInfo const & other ) const
```

6.69.4 Member Data Documentation

6.69.4.1 lineInfo

```
SourceLineInfo Catch::MessageInfo::lineInfo
```

Definition at line 2606 of file catch.h.

6.69.4.2 macroName

```
StringRef Catch::MessageInfo::macroName
```

Definition at line 2604 of file catch.h.

6.69.4.3 message

```
std::string Catch::MessageInfo::message
```

Definition at line 2605 of file catch.h.

6.69.4.4 sequence

```
unsigned int Catch::MessageInfo::sequence
```

Definition at line 2608 of file catch.h.

6.69.4.5 type

```
ResultWas::OfType Catch::MessageInfo::type
```

Definition at line 2607 of file catch.h.

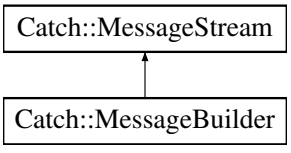
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.70 Catch::MessageStream Struct Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::MessageStream:



Public Member Functions

- template<typename T >
  MessageStream & operator<< (T const &value)

Public Attributes

- ReusableStringStream m_stream

6.70.1 Detailed Description

Definition at line 2616 of file catch.h.

6.70.2 Member Function Documentation

6.70.2.1 operator<<()

```
template<typename T >
MessageStream & Catch::MessageStream::operator<< (
            T const & value )  [inline]
```

Definition at line 2619 of file catch.h.

6.70.3 Member Data Documentation

6.70.3.1 m_stream

```
ReusableStringStream Catch::MessageStream::m_stream
```

Definition at line 2624 of file catch.h.

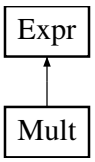
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.71 Mult Class Reference

```
#include <Expr.h>
```

Inheritance diagram for Mult:



Public Member Functions

- Mult (Expr *lhs, Expr *rhs)
- bool equals (Expr *e) override
- int interp () override
- bool hasVariable () override
- Expr * subst (std::string stringInput, Expr *e) override
- void print (std::ostream &stream) override

Public Member Functions inherited from Expr

- virtual ~Expr ()=default
- std::string to_string ()
- std::string to_pp_string ()
- void pretty_print_at (std::ostream &ot)

Public Attributes

- Expr * lhs
- Expr * rhs

Protected Member Functions

- void pretty_print (std::ostream &ot, precedence_t prec) override

6.71.1 Detailed Description

Definition at line 75 of file Expr.h.

6.71.2 Constructor & Destructor Documentation

6.71.2.1 Mult()

```
Mult::Mult (
            Expr * lhs,
            Expr * rhs )
```

Constructs a Mult object with left and right expressions.

Parameters

lhs	Pointer to the left-hand side expression.
rhs	Pointer to the right-hand side expression.

Definition at line 27 of file Expr.cpp.

6.71.3 Member Function Documentation

6.71.3.1 equals()

```
bool Mult::equals (
            Expr * e )  [override], [virtual]
```

Checks if this Mult object is equal to another expression.

Parameters

e	Pointer to the expression to compare with.

Returns

true if the expressions are equivalent, false otherwise.

Implements Expr.

Definition at line 65 of file Expr.cpp.

6.71.3.2 hasVariable()

```
bool Mult::hasVariable ( )  [override], [virtual]
```

Checks if the Mult expression contains a variable.

Returns

true if either the left or right expressions contain a variable, false otherwise.

Implements Expr.

Definition at line 133 of file Expr.cpp.

6.71.3.3 interp()

```
int Mult::interp ( )  [override], [virtual]
```

Evaluates the multiplication expression.

Returns

The product of the left and right expressions.

Implements Expr.

Definition at line 101 of file Expr.cpp.

6.71.3.4 pretty_print()

```
void Mult::pretty_print (
            std::ostream & ot,
            precedence_t prec )  [override], [protected], [virtual]
```

Pretty prints the Mult expression with appropriate precedence.

Parameters

ot	The output stream to print to.
prec	The precedence context in which this expression is being printed.

Implements Expr.

Definition at line 261 of file Expr.cpp.

6.71.3.5 print()

```
void Mult::print (
            std::ostream & stream )  [override], [virtual]
```

Prints the Mult expression to a given output stream.

Parameters

stream	The output stream to print to.

Implements Expr.

Definition at line 217 of file Expr.cpp.

6.71.3.6 subst()

```
Expr * Mult::subst (
            std::string stringInput,
            Expr * e )  [override], [virtual]
```

Substitutes a variable with another expression in a Mult object.

Parameters

stringInput	The name of the variable to substitute.
e	The expression to substitute the variable with.

Returns

A new Mult object with the substituted expressions.

Implements Expr.

Definition at line 173 of file Expr.cpp.

6.71.4 Member Data Documentation

6.71.4.1 lhs

```
Expr* Mult::lhs
```

Definition at line 77 of file Expr.h.

6.71.4.2 rhs

```
Expr* Mult::rhs
```

Definition at line 78 of file Expr.h.

The documentation for this class was generated from the following files:

- /Users/samanthapope/msdscriptRepo/msdScript/Expr.h
- /Users/samanthapope/msdscriptRepo/msdScript/Expr.cpp

6.72 Catch::NameAndTags Struct Reference

```
#include <catch.h>
```

Public Member Functions

- NameAndTags (StringRef const &name_=StringRef(), StringRef const &tags_=StringRef()) noexcept

Public Attributes

- StringRef name
- StringRef tags

6.72.1 Detailed Description

Definition at line 980 of file catch.h.

6.72.2 Constructor & Destructor Documentation

6.72.2.1 NameAndTags()

```
Catch::NameAndTags::NameAndTags (
            StringRef const & name_ = StringRef(),
            StringRef const & tags_ = StringRef() )  [noexcept]
```

6.72.3 Member Data Documentation

6.72.3.1 name

```
StringRef Catch::NameAndTags::name
```

Definition at line 982 of file catch.h.

6.72.3.2 tags

```
StringRef Catch::NameAndTags::tags
```

Definition at line 983 of file catch.h.

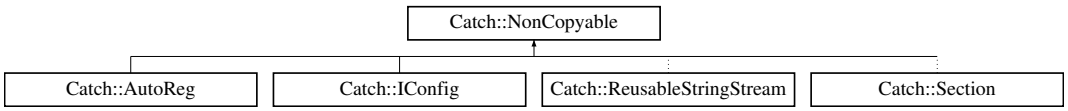
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.73 Catch::NonCopyable Class Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::NonCopyable:



Protected Member Functions

- NonCopyable ()
- virtual ~NonCopyable ()

6.73.1 Detailed Description

Definition at line 491 of file catch.h.

6.73.2 Constructor & Destructor Documentation

6.73.2.1 NonCopyable()

```
Catch::NonCopyable::NonCopyable ( )  [protected]
```

6.73.2.2 ~NonCopyable()

```
virtual Catch::NonCopyable::~NonCopyable ( )  [protected], [virtual]
```

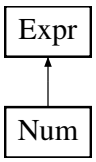
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.74 Num Class Reference

`#include <Expr.h>`

Inheritance diagram for Num:



Public Member Functions

- Num (int val)
- bool equals (Expr ∗e) override
- int interp () override
- bool hasVariable () override
- Expr ∗ subst (std::string stringInput, Expr ∗e) override
- void print (std::ostream &stream) override

Public Member Functions inherited from Expr

- virtual ∼Expr ()=default
- std::string to_string ()
- std::string to_pp_string ()
- void pretty_print_at (std::ostream &ot)

Public Attributes

- int val

Protected Member Functions

- void pretty_print (std::ostream &ot, precedence_t prec) override

6.74.1 Detailed Description

Definition at line 46 of file Expr.h.

6.74.2 Constructor & Destructor Documentation

6.74.2.1 Num()

```
Num::Num (
            int val )
```

Constructs a Num object with a given integer value.

Parameters

val	The integer value to initialize the Num object with.

Definition at line 8 of file Expr.cpp.

6.74.3 Member Function Documentation

6.74.3.1 equals()

```
bool Num::equals (
            Expr * e )  [override], [virtual]
```

Checks if this Num object is equal to another expression.

Parameters

e	Pointer to the expression to compare with.

Returns

true if the expressions are equivalent, false otherwise.

Implements Expr.

Definition at line 44 of file Expr.cpp.

6.74.3.2 hasVariable()

```
bool Num::hasVariable ( )  [override], [virtual]
```

Checks if the Num expression contains a variable.

Returns

false because Num does not contain a variable.

Implements Expr.

Definition at line 117 of file Expr.cpp.

6.74.3.3 interp()

```
int Num::interp ( )  [override], [virtual]
```

Evaluates the numeric expression.

Returns

The integer value of the Num object.

Implements Expr.

Definition at line 85 of file Expr.cpp.

6.74.3.4 pretty_print()

```
void Num::pretty_print (
            std::ostream & ot,
            precedence_t prec )  [override], [protected], [virtual]
```

Pretty prints the Num expression with appropriate precedence.

Parameters

ot	The output stream to print to.
prec	The precedence context in which this expression is being printed.

Implements Expr.

Definition at line 238 of file Expr.cpp.

6.74.3.5 print()

```
void Num::print (
            std::ostream & stream )  [override], [virtual]
```

Prints the Num expression to a given output stream.

Parameters

stream	The output stream to print to.

Implements Expr.

Definition at line 197 of file Expr.cpp.

6.74.3.6 subst()

```
Expr * Num::subst (
            std::string stringInput,
            Expr * e )  [override], [virtual]
```

Substitutes a variable with another expression in a Num object.

Parameters

stringInput	The name of the variable to substitute.
e	The expression to substitute the variable with.

Returns

A new Num object with the same value, since no substitution is needed.

Implements Expr.

Definition at line 151 of file Expr.cpp.

6.74.4 Member Data Documentation

6.74.4.1 val

```
int Num::val
```

Definition at line 48 of file Expr.h.

The documentation for this class was generated from the following files:

- /Users/samanthapope/msdscriptRepo/msdScript/Expr.h
- /Users/samanthapope/msdscriptRepo/msdScript/Expr.cpp

6.75 Catch::Option< T > Class Template Reference

```
#include <catch.h>
```

Public Member Functions

- Option ()
- Option (T const &_value)
- Option (Option const &_other)
- ~Option ()
- Option & operator= (Option const &_other)
- Option & operator= (T const &_value)
- void reset ()
- T & operator* ()
- T const & operator* () const
- T * operator-> ()
- const T * operator-> () const
- T valueOr (T const &defaultValue) const
- bool some () const
- bool none () const
- bool operator! () const
- operator bool () const

6.75.1 Detailed Description

template<typename T>
class Catch::Option< T >

Definition at line 4409 of file catch.h.

6.75.2 Constructor & Destructor Documentation

6.75.2.1 Option() [1/3]

```
template<typename T >
Catch::Option< T >::Option ( )  [inline]
```

Definition at line 4411 of file catch.h.

6.75.2.2 Option() [2/3]

```
template<typename T >
Catch::Option< T >::Option (
            T const & _value )  [inline]
```

Definition at line 4412 of file catch.h.

6.75.2.3 Option() [3/3]

```
template<typename T >
Catch::Option< T >::Option (
            Option< T > const & _other )  [inline]
```

Definition at line 4415 of file catch.h.

6.75.2.4 ~Option()

```
template<typename T >
Catch::Option< T >::~Option ( )  [inline]
```

Definition at line 4419 of file catch.h.

6.75.3 Member Function Documentation

6.75.3.1 none()

```
template<typename T >
bool Catch::Option< T >::none ( ) const  [inline]
```

Definition at line 4453 of file catch.h.

6.75.3.2 operator bool()

```
template<typename T >
Catch::Option< T >::operator bool ( ) const  [inline], [explicit]
```

Definition at line 4456 of file catch.h.

6.75.3.3 operator"!()

```
template<typename T >
bool Catch::Option< T >::operator!  ( ) const  [inline]
```

Definition at line 4455 of file catch.h.

6.75.3.4 operator*() [1/2]

```
template<typename T >
T & Catch::Option< T >::operator* ( )  [inline]
```

Definition at line 4443 of file catch.h.

6.75.3.5 operator*() [2/2]

```
template<typename T >
T const & Catch::Option< T >::operator* ( ) const  [inline]
```

Definition at line 4444 of file catch.h.

6.75.3.6 operator->() [1/2]

```
template<typename T >
T * Catch::Option< T >::operator-> ( )  [inline]
```

Definition at line 4445 of file catch.h.

6.75.3.7 operator->() [2/2]

```
template<typename T >
const T * Catch::Option< T >::operator-> ( ) const  [inline]
```

Definition at line 4446 of file catch.h.

6.75.3.8 operator=() [1/2]

```
template<typename T >
Option & Catch::Option< T >::operator= (
            Option< T > const & _other )  [inline]
```

Definition at line 4423 of file catch.h.

6.75.3.9 operator=() [2/2]

```
template<typename T >
Option & Catch::Option< T >::operator= (
            T const & _value )  [inline]
```

Definition at line 4431 of file catch.h.

6.75.3.10 reset()

```
template<typename T >
void Catch::Option< T >::reset ( )  [inline]
```

Definition at line 4437 of file catch.h.

6.75.3.11 some()

```
template<typename T >
bool Catch::Option< T >::some ( ) const  [inline]
```

Definition at line 4452 of file catch.h.

6.75.3.12 valueOr()

```
template<typename T >
T Catch::Option< T >::valueOr (
            T const & defaultValue ) const  [inline]
```

Definition at line 4448 of file catch.h.

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.76 Catch::pluralise Struct Reference

```
#include <catch.h>
```

Public Member Functions

- pluralise (std::size_t count, std::string const &label)

Public Attributes

- std::size_t m_count
- std::string m_label

Friends

- std::ostream & operator<< (std::ostream &os, pluralise const &pluraliser)

6.76.1 Detailed Description

Definition at line 3216 of file catch.h.

6.76.2 Constructor & Destructor Documentation

6.76.2.1 pluralise()

```
Catch::pluralise::pluralise (
            std::size_t count,
            std::string const & label )
```

6.76.3 Friends And Related Symbol Documentation

6.76.3.1 operator<<

```
std::ostream & operator<< (
            std::ostream & os,
            pluralise const & pluraliser )  [friend]
```

6.76.4 Member Data Documentation

6.76.4.1 m_count

```
std::size_t Catch::pluralise::m_count
```

Definition at line 3221 of file catch.h.

6.76.4.2 m_label

```
std::string Catch::pluralise::m_label
```

Definition at line 3222 of file catch.h.

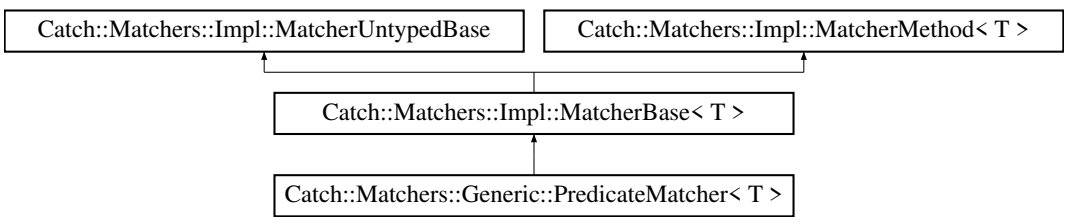
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.77 Catch::Matchers::Generic::PredicateMatcher< T > Class Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Matchers::Generic::PredicateMatcher< T >:



Public Member Functions

- PredicateMatcher (std::function< bool(T const &)> const &elem, std::string const &descr)
- bool match (T const &item) const override
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.77.1 Detailed Description

template<typename T>
class Catch::Matchers::Generic::PredicateMatcher< T >

Definition at line 3495 of file catch.h.

6.77.2 Constructor & Destructor Documentation

6.77.2.1 PredicateMatcher()

```
template<typename T >
Catch::Matchers::Generic::PredicateMatcher< T >::PredicateMatcher (
            std::function< bool(T const &)> const & elem,
            std::string const & descr )  [inline]
```

Definition at line 3500 of file catch.h.

6.77.3 Member Function Documentation

6.77.3.1 describe()

```
template<typename T >
std::string Catch::Matchers::Generic::PredicateMatcher< T >::describe ( ) const  [inline],
[override], [virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

Definition at line 3509 of file catch.h.

6.77.3.2 match()

```
template<typename T >
bool Catch::Matchers::Generic::PredicateMatcher< T >::match (
            T const & item ) const  [inline], [override], [virtual]
```

Implements Catch::Matchers::Impl::MatcherMethod< T >.

Definition at line 3505 of file catch.h.

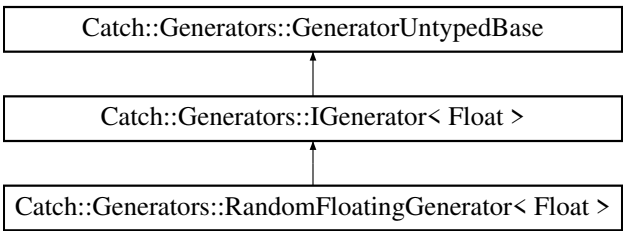
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.78 Catch::Generators::RandomFloatingGenerator< Float > Class Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Generators::RandomFloatingGenerator< Float >:



Public Member Functions

- RandomFloatingGenerator (Float a, Float b)
- Float const & get () const override
- bool next () override

Public Member Functions inherited from Catch::Generators::IGenerator< Float >

- virtual ~IGenerator ()=default

Public Member Functions inherited from Catch::Generators::GeneratorUntypedBase

- GeneratorUntypedBase ()=default
- virtual ~GeneratorUntypedBase ()

Additional Inherited Members

Public Types inherited from Catch::Generators::IGenerator< Float >

- using type

6.78.1 Detailed Description

template<typename Float>
class Catch::Generators::RandomFloatingGenerator< Float >

Definition at line 4603 of file catch.h.

6.78.2 Constructor & Destructor Documentation

6.78.2.1 RandomFloatingGenerator()

```
template<typename Float >
Catch::Generators::RandomFloatingGenerator< Float >::RandomFloatingGenerator (
            Float a,
            Float b )  [inline]
```

Definition at line 4609 of file catch.h.

6.78.3 Member Function Documentation

6.78.3.1 get()

```
template<typename Float >
Float const & Catch::Generators::RandomFloatingGenerator< Float >::get ( ) const  [inline],
[override], [virtual]
```

Implements Catch::Generators::IGenerator< Float >.

Definition at line 4615 of file catch.h.

6.78.3.2 next()

```
template<typename Float >
bool Catch::Generators::RandomFloatingGenerator< Float >::next ( )  [inline], [override],
[virtual]
```

Implements Catch::Generators::GeneratorUntypedBase.

Definition at line 4618 of file catch.h.

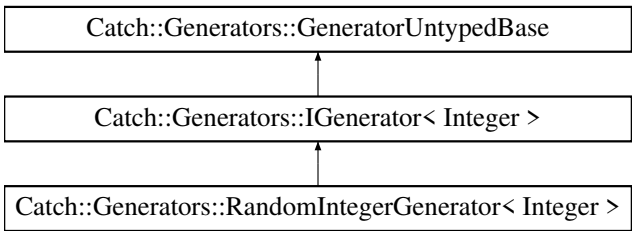
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.79 Catch::Generators::RandomIntegerGenerator< Integer > Class Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Generators::RandomIntegerGenerator< Integer >:



Public Member Functions

- RandomIntegerGenerator (Integer a, Integer b)
- Integer const & get () const override
- bool next () override

Public Member Functions inherited from Catch::Generators::IGenerator< Integer >

- virtual ~IGenerator ()=default

Public Member Functions inherited from Catch::Generators::GeneratorUntypedBase

- GeneratorUntypedBase ()=default
- virtual ~GeneratorUntypedBase ()

Additional Inherited Members

Public Types inherited from Catch::Generators::IGenerator< Integer >

- using type

6.79.1 Detailed Description

template<typename Integer>
class Catch::Generators::RandomIntegerGenerator< Integer >

Definition at line 4625 of file catch.h.

6.79.2 Constructor & Destructor Documentation

6.79.2.1 RandomIntegerGenerator()

```
template<typename Integer >
Catch::Generators::RandomIntegerGenerator< Integer >::RandomIntegerGenerator (
            Integer a,
            Integer b )  [inline]
```

Definition at line 4631 of file catch.h.

6.79.3 Member Function Documentation

6.79.3.1 get()

```
template<typename Integer >
Integer const & Catch::Generators::RandomIntegerGenerator< Integer >::get ( ) const  [inline],
[override], [virtual]
```

Implements Catch::Generators::IGenerator< Integer >.

Definition at line 4637 of file catch.h.

6.79.3.2 next()

```
template<typename Integer >
bool Catch::Generators::RandomIntegerGenerator< Integer >::next ( )  [inline], [override],
[virtual]
```

Implements Catch::Generators::GeneratorUntypedBase.

Definition at line 4640 of file catch.h.

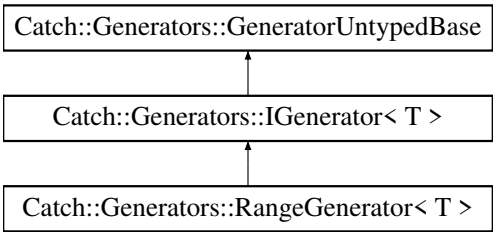
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.80 Catch::Generators::RangeGenerator< T > Class Template Reference

`#include <catch.h>`

Inheritance diagram for Catch::Generators::RangeGenerator< T >:



Public Member Functions

- RangeGenerator (T const &start, T const &end, T const &step)
- RangeGenerator (T const &start, T const &end)
- T const & get () const override
- bool next () override

Public Member Functions inherited from Catch::Generators::IGenerator< T >

- virtual ~IGenerator ()=default

Public Member Functions inherited from Catch::Generators::GeneratorUntypedBase

- GeneratorUntypedBase ()=default
- virtual ~GeneratorUntypedBase ()

Additional Inherited Members

Public Types inherited from Catch::Generators::IGenerator< T >

- using type = T

6.80.1 Detailed Description

template<typename T>
class Catch::Generators::RangeGenerator< T >

Definition at line 4667 of file catch.h.

6.80.2 Constructor & Destructor Documentation

6.80.2.1 RangeGenerator() [1/2]

```
template<typename T >
Catch::Generators::RangeGenerator< T >::RangeGenerator (
            T const & start,
            T const & end,
            T const & step )  [inline]
```

Definition at line 4674 of file catch.h.

6.80.2.2 RangeGenerator() [2/2]

```
template<typename T >
Catch::Generators::RangeGenerator< T >::RangeGenerator (
            T const & start,
            T const & end )  [inline]
```

Definition at line 4685 of file catch.h.

6.80.3 Member Function Documentation

6.80.3.1 get()

```
template<typename T >
T const & Catch::Generators::RangeGenerator< T >::get ( ) const  [inline], [override], [virtual]
```

Implements Catch::Generators::IGenerator< T >.

Definition at line 4689 of file catch.h.

6.80.3.2 next()

```
template<typename T >
bool Catch::Generators::RangeGenerator< T >::next ( )  [inline], [override], [virtual]
```

Implements Catch::Generators::GeneratorUntypedBase.

Definition at line 4693 of file catch.h.

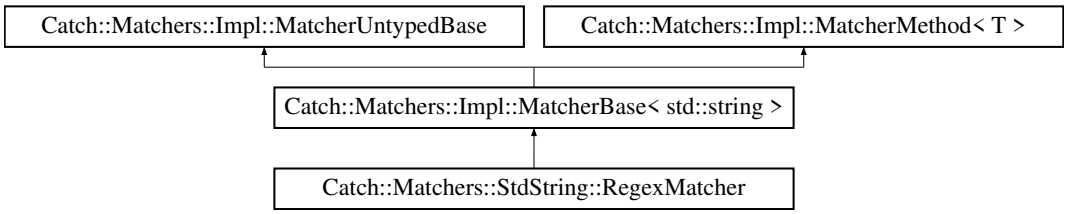
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.81 Catch::Matchers::StdString::RegexMatcher Struct Reference

`#include <catch.h>`

Inheritance diagram for Catch::Matchers::StdString::RegexMatcher:



Public Member Functions

- RegexMatcher (std::string regex, CaseSensitive::Choice caseSensitivity)
- bool match (std::string const &matchee) const override
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.81.1 Detailed Description

Definition at line 3573 of file catch.h.

6.81.2 Constructor & Destructor Documentation

6.81.2.1 RegexMatcher()

```
Catch::Matchers::StdString::RegexMatcher::RegexMatcher (
            std::string regex,
            CaseSensitive::Choice caseSensitivity )
```

6.81.3 Member Function Documentation

6.81.3.1 describe()

```
std::string Catch::Matchers::StdString::RegexMatcher::describe ( ) const  [override], [virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

6.81.3.2 match()

```
bool Catch::Matchers::StdString::RegexMatcher::match (
            std::string const & matchee ) const  [override]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.82 Catch::RegistrarForTagAliases Struct Reference

```
#include <catch.h>
```

Public Member Functions

- RegistrarForTagAliases (char const *alias, char const *tag, SourceLineInfo const &lineInfo)

6.82.1 Detailed Description

Definition at line 549 of file catch.h.

6.82.2 Constructor & Destructor Documentation

6.82.2.1 RegistrarForTagAliases()

```
Catch::RegistrarForTagAliases::RegistrarForTagAliases (
            char const * alias,
            char const * tag,
            SourceLineInfo const & lineInfo )
```

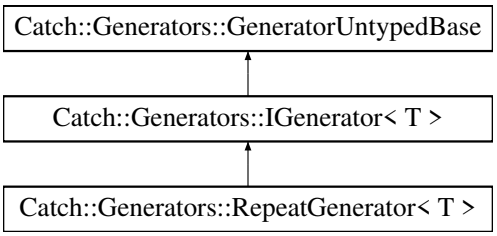
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.83 Catch::Generators::RepeatGenerator< T > Class Template Reference

`#include <catch.h>`

Inheritance diagram for Catch::Generators::RepeatGenerator< T >:



Public Member Functions

- RepeatGenerator (size_t repeats, GeneratorWrapper< T > &&generator)
- T const & get () const override
- bool next () override

Public Member Functions inherited from Catch::Generators::IGenerator< T >

- virtual ~IGenerator ()=default

Public Member Functions inherited from Catch::Generators::GeneratorUntypedBase

- GeneratorUntypedBase ()=default
- virtual ~GeneratorUntypedBase ()

Additional Inherited Members

Public Types inherited from Catch::Generators::IGenerator< T >

- using type = T

6.83.1 Detailed Description

template<typename T>
class Catch::Generators::RepeatGenerator< T >

Definition at line 4200 of file catch.h.

6.83.2 Constructor & Destructor Documentation

6.83.2.1 RepeatGenerator()

```
template<typename T >
Catch::Generators::RepeatGenerator< T >::RepeatGenerator (
            size_t repeats,
            GeneratorWrapper< T > && generator )  [inline]
```

Definition at line 4210 of file catch.h.

6.83.3 Member Function Documentation

6.83.3.1 get()

```
template<typename T >
T const & Catch::Generators::RepeatGenerator< T >::get ( ) const  [inline], [override], [virtual]
```

Implements Catch::Generators::IGenerator< T >.

Definition at line 4217 of file catch.h.

6.83.3.2 next()

```
template<typename T >
bool Catch::Generators::RepeatGenerator< T >::next ( )  [inline], [override], [virtual]
```

Implements Catch::Generators::GeneratorUntypedBase.

Definition at line 4225 of file catch.h.

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.84 Catch::ResultDisposition Struct Reference

```
#include <catch.h>
```

Public Types

- enum Flags { Normal = 0x01 , ContinueOnFailure = 0x02 , FalseTest = 0x04 , SuppressFail = 0x08 }

6.84.1 Detailed Description

Definition at line 1377 of file catch.h.

6.84.2 Member Enumeration Documentation

6.84.2.1 Flags

`enum Catch::ResultDisposition::Flags`

Enumerator

Normal	
ContinueOnFailure	
FalseTest	
SuppressFail	

Definition at line 1377 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.85 Catch::ResultWas Struct Reference

`#include <catch.h>`

Public Types

- enum OfType {
  Unknown = -1 , Ok = 0 , Info = 1 , Warning = 2 ,
  FailureBit = 0x10 , ExpressionFailed = FailureBit | 1 , ExplicitFailure = FailureBit | 2 , Exception = 0x100 | FailureBit ,
  ThrewException = Exception | 1 , DidntThrowException = Exception | 2 , FatalErrorCondition = 0x200 | FailureBit }

6.85.1 Detailed Description

Definition at line 1353 of file catch.h.

6.85.2 Member Enumeration Documentation

6.85.2.1 OfType

`enum Catch::ResultWas::OfType`

Enumerator

Unknown	
Ok	
Info	
Warning	
FailureBit	
ExpressionFailed	
ExplicitFailure	
Exception	
ThrewException	
DidntThrowException	
FatalErrorCondition	

Definition at line 1353 of file catch.h.

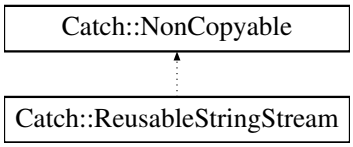
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.86 Catch::ReusableStringStream Class Reference

`#include <catch.h>`

Inheritance diagram for Catch::ReusableStringStream:



Public Member Functions

- ReusableStringStream ()
- ~ReusableStringStream ()
- auto str () const -> std::string
- template<typename T >
  auto operator<< (T const &value) -> ReusableStringStream &
- auto get () -> std::ostream &

6.86.1 Detailed Description

Definition at line 1440 of file catch.h.

6.86.2 Constructor & Destructor Documentation

6.86.2.1 ReusableStringStream()

```
Catch::ReusableStringStream::ReusableStringStream ( )
```

6.86.2.2 ~ReusableStringStream()

```
Catch::ReusableStringStream::~ReusableStringStream ( )
```

6.86.3 Member Function Documentation

6.86.3.1 get()

```
auto Catch::ReusableStringStream::get ( ) -> std::ostream&   [inline]
```

Definition at line 1454 of file catch.h.

6.86.3.2 operator<<()

```
template<typename T >
auto Catch::ReusableStringStream::operator<< (
            T const & value ) -> ReusableStringStream&   [inline]
```

Definition at line 1450 of file catch.h.

6.86.3.3 str()

```
auto Catch::ReusableStringStream::str ( ) const -> std::string
```

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.87 Catch::RunTests Struct Reference

```
#include <catch.h>
```

Public Types

- enum InWhatOrder { InDeclarationOrder , InLexicographicalOrder , InRandomOrder }

6.87.1 Detailed Description

Definition at line 4493 of file catch.h.

6.87.2 Member Enumeration Documentation

6.87.2.1 InWhatOrder

```
enum Catch::RunTests::InWhatOrder
```

Enumerator

InDeclarationOrder	
InLexicographicalOrder	
InRandomOrder	

Definition at line 4493 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.88 Catch::ScopedMessage Class Reference

`#include <catch.h>`

Public Member Functions

- ScopedMessage (MessageBuilder const &builder)
- ScopedMessage (ScopedMessage &duplicate)=delete
- ScopedMessage (ScopedMessage &&old)
- ~ScopedMessage ()

Public Attributes

- MessageInfo m_info
- bool m_moved

6.88.1 Detailed Description

Definition at line 2641 of file catch.h.

6.88.2 Constructor & Destructor Documentation

6.88.2.1 ScopedMessage() [1/3]

```
Catch::ScopedMessage::ScopedMessage (
            MessageBuilder const & builder )  [explicit]
```

6.88.2.2 ScopedMessage() [2/3]

```
Catch::ScopedMessage::ScopedMessage (
            ScopedMessage & duplicate )  [delete]
```

6.88.2.3 ScopedMessage() [3/3]

```
Catch::ScopedMessage::ScopedMessage (
            ScopedMessage && old )
```

6.88.2.4 ~ScopedMessage()

```
Catch::ScopedMessage::~ScopedMessage ( )
```

6.88.3 Member Data Documentation

6.88.3.1 m_info

```
MessageInfo Catch::ScopedMessage::m_info
```

Definition at line 2648 of file catch.h.

6.88.3.2 m_moved

```
bool Catch::ScopedMessage::m_moved
```

Definition at line 2649 of file catch.h.

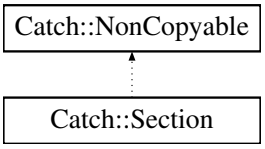
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.89 Catch::Section Class Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Section:



Public Member Functions

- Section (SectionInfo const &info)
- ~Section ()
- operator bool () const

6.89.1 Detailed Description

Definition at line 2911 of file catch.h.

6.89.2 Constructor & Destructor Documentation

6.89.2.1 Section()

```
Catch::Section::Section (
            SectionInfo const & info )
```

6.89.2.2 ~Section()

```
Catch::Section::~Section ( )
```

6.89.3 Member Function Documentation

6.89.3.1 operator bool()

```
Catch::Section::operator bool ( ) const  [explicit]
```

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.90 Catch::SectionEndInfo Struct Reference

```
#include <catch.h>
```

Public Attributes

- SectionInfo sectionInfo
- Counts prevAssertions
- double durationInSeconds

6.90.1 Detailed Description

Definition at line 2876 of file catch.h.

6.90.2 Member Data Documentation

6.90.2.1 durationInSeconds

```
double Catch::SectionEndInfo::durationInSeconds
```

Definition at line 2879 of file catch.h.

6.90.2.2 prevAssertions

```
Counts Catch::SectionEndInfo::prevAssertions
```

Definition at line 2878 of file catch.h.

6.90.2.3 sectionInfo

```
SectionInfo Catch::SectionEndInfo::sectionInfo
```

Definition at line 2877 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.91 Catch::SectionInfo Struct Reference

```
#include <catch.h>
```

Public Member Functions

- SectionInfo (SourceLineInfo const &_lineInfo, std::string const &_name)
- SectionInfo (SourceLineInfo const &_lineInfo, std::string const &_name, std::string const &)

Public Attributes

- std::string name
- std::string description
- SourceLineInfo lineInfo

6.91.1 Detailed Description

Definition at line 2860 of file catch.h.

6.91.2 Constructor & Destructor Documentation

6.91.2.1 SectionInfo() [1/2]

```
Catch::SectionInfo::SectionInfo (
            SourceLineInfo const & _lineInfo,
            std::string const & _name )
```

6.91.2.2 SectionInfo() [2/2]

```
Catch::SectionInfo::SectionInfo (
            SourceLineInfo const & _lineInfo,
            std::string const & _name,
            std::string const &  )  [inline]
```

Definition at line 2866 of file catch.h.

6.91.3 Member Data Documentation

6.91.3.1 description

```
std::string Catch::SectionInfo::description
```

Definition at line 2872 of file catch.h.

6.91.3.2 lineInfo

```
SourceLineInfo Catch::SectionInfo::lineInfo
```

Definition at line 2873 of file catch.h.

6.91.3.3 name

```
std::string Catch::SectionInfo::name
```

Definition at line 2871 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.92 Catch::ShowDurations Struct Reference

```
#include <catch.h>
```

Public Types

- enum OrNot { DefaultForReporter , Always , Never }

6.92.1 Detailed Description

Definition at line 4488 of file catch.h.

6.92.2 Member Enumeration Documentation

6.92.2.1 OrNot

`enum Catch::ShowDurations::OrNot`

Enumerator

DefaultForReporter	
Always	
Never	

Definition at line 4488 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.93 Catch::SimplePcg32 Class Reference

`#include <catch.h>`

Public Types

- using result_type = std::uint32_t

Public Member Functions

- SimplePcg32 ()
- SimplePcg32 (result_type seed_)
- void seed (result_type seed_)
- void discard (uint64_t skip)
- result_type operator() ()

Static Public Member Functions

- static constexpr result_type min ()
- static constexpr result_type max ()

Friends

- bool operator== (SimplePcg32 const &lhs, SimplePcg32 const &rhs)
- bool operator!= (SimplePcg32 const &lhs, SimplePcg32 const &rhs)

6.93.1 Detailed Description

Definition at line 4558 of file catch.h.

6.93.2 Member Typedef Documentation

6.93.2.1 result_type

```
using Catch::SimplePcg32::result_type = std::uint32_t
```

Definition at line 4561 of file catch.h.

6.93.3 Constructor & Destructor Documentation

6.93.3.1 SimplePcg32() [1/2]

```
Catch::SimplePcg32::SimplePcg32 ( )  [inline]
```

Definition at line 4570 of file catch.h.

6.93.3.2 SimplePcg32() [2/2]

```
Catch::SimplePcg32::SimplePcg32 (
            result_type seed_ )  [explicit]
```

6.93.4 Member Function Documentation

6.93.4.1 discard()

```
void Catch::SimplePcg32::discard (
            uint64_t skip )
```

6.93.4.2 max()

```
static constexpr result_type Catch::SimplePcg32::max ( )  [inline], [static], [constexpr]
```

Definition at line 4565 of file catch.h.

6.93.4.3 min()

```
static constexpr result_type Catch::SimplePcg32::min ( )  [inline], [static], [constexpr]
```

Definition at line 4562 of file catch.h.

6.93.4.4 operator()()

```
result_type Catch::SimplePcg32::operator() ( )
```

6.93.4.5 seed()

```
void Catch::SimplePcg32::seed (
            result_type seed_ )
```

6.93.5 Friends And Related Symbol Documentation

6.93.5.1 operator"!=

```
bool operator!= (
            SimplePcg32 const & lhs,
            SimplePcg32 const & rhs )  [friend]
```

6.93.5.2 operator==

```
bool operator== (
            SimplePcg32 const & lhs,
            SimplePcg32 const & rhs )  [friend]
```

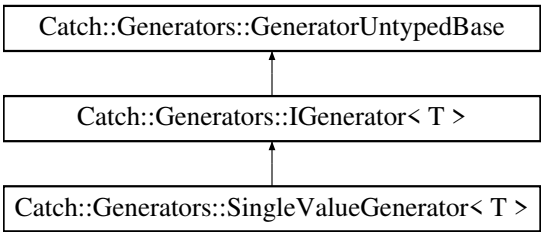
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.94 Catch::Generators::SingleValueGenerator< T > Class Template Reference

`#include <catch.h>`

Inheritance diagram for Catch::Generators::SingleValueGenerator< T >:



Public Member Functions

- SingleValueGenerator (T &&value)
- T const & get () const override
- bool next () override

Public Member Functions inherited from Catch::Generators::IGenerator< T >

- virtual ~IGenerator ()=default

Public Member Functions inherited from Catch::Generators::GeneratorUntypedBase

- GeneratorUntypedBase ()=default
- virtual ~GeneratorUntypedBase ()

Additional Inherited Members

Public Types inherited from Catch::Generators::IGenerator< T >

- using type = T

6.94.1 Detailed Description

template<typename T>
class Catch::Generators::SingleValueGenerator< T >

Definition at line 3953 of file catch.h.

6.94.2 Constructor & Destructor Documentation

6.94.2.1 SingleValueGenerator()

```
template<typename T >
Catch::Generators::SingleValueGenerator< T >::SingleValueGenerator (
            T && value )  [inline]
```

Definition at line 3956 of file catch.h.

6.94.3 Member Function Documentation

6.94.3.1 get()

```
template<typename T >
T const & Catch::Generators::SingleValueGenerator< T >::get ( ) const  [inline], [override],
[virtual]
```

Implements Catch::Generators::IGenerator< T >.

Definition at line 3958 of file catch.h.

6.94.3.2 next()

```
template<typename T >
bool Catch::Generators::SingleValueGenerator< T >::next ( )  [inline], [override], [virtual]
```

Implements Catch::Generators::GeneratorUntypedBase.

Definition at line 3961 of file catch.h.

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.95 Catch::SourceLineInfo Struct Reference

```
#include <catch.h>
```

Public Member Functions

- SourceLineInfo ()=delete
- SourceLineInfo (char const *_file, std::size_t _line) noexcept
- SourceLineInfo (SourceLineInfo const &other)=default
- SourceLineInfo & operator= (SourceLineInfo const &)=default
- SourceLineInfo (SourceLineInfo &&) noexcept=default
- SourceLineInfo & operator= (SourceLineInfo &&) noexcept=default
- bool empty () const noexcept
- bool operator== (SourceLineInfo const &other) const noexcept
- bool operator< (SourceLineInfo const &other) const noexcept

Public Attributes

- char const * file
- std::size_t line

6.95.1 Detailed Description

Definition at line 502 of file catch.h.

6.95.2 Constructor & Destructor Documentation

6.95.2.1 SourceLineInfo() [1/4]

```
Catch::SourceLineInfo::SourceLineInfo ( )  [delete]
```

6.95.2.2 SourceLineInfo() [2/4]

```
Catch::SourceLineInfo::SourceLineInfo (
            char const * _file,
            std::size_t _line )  [inline], [noexcept]
```

Definition at line 505 of file catch.h.

6.95.2.3 SourceLineInfo() [3/4]

```
Catch::SourceLineInfo::SourceLineInfo (
            SourceLineInfo const & other )  [default]
```

6.95.2.4 SourceLineInfo() [4/4]

```
Catch::SourceLineInfo::SourceLineInfo (
            SourceLineInfo &&  )  [default], [noexcept]
```

6.95.3 Member Function Documentation

6.95.3.1 empty()

```
bool Catch::SourceLineInfo::empty ( ) const  [inline], [noexcept]
```

Definition at line 515 of file catch.h.

6.95.3.2 operator<()

```
bool Catch::SourceLineInfo::operator< (
            SourceLineInfo const & other ) const  [noexcept]
```

6.95.3.3 operator=() [1/2]

```
SourceLineInfo & Catch::SourceLineInfo::operator= (
            SourceLineInfo &&  )  [default], [noexcept]
```

6.95.3.4 operator=() [2/2]

```
SourceLineInfo & Catch::SourceLineInfo::operator= (
            SourceLineInfo const &  )  [default]
```

6.95.3.5 operator==()

```
bool Catch::SourceLineInfo::operator== (
            SourceLineInfo const & other ) const  [noexcept]
```

6.95.4 Member Data Documentation

6.95.4.1 file

```
char const* Catch::SourceLineInfo::file
```

Definition at line 519 of file catch.h.

6.95.4.2 line

```
std::size_t Catch::SourceLineInfo::line
```

Definition at line 520 of file catch.h.

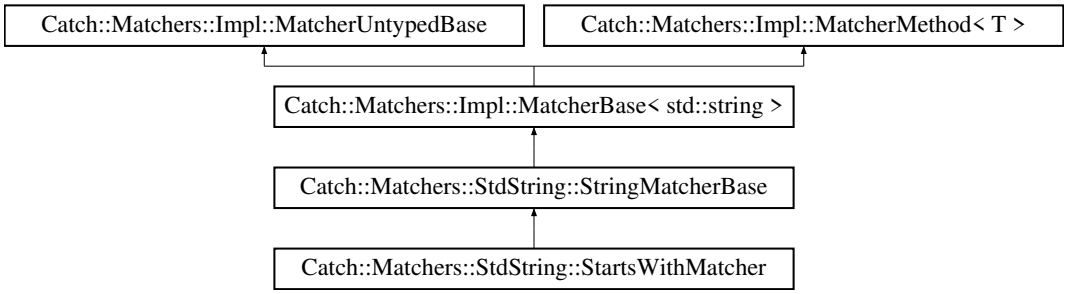
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.96 Catch::Matchers::StdString::StartsWithMatcher Struct Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Matchers::StdString::StartsWithMatcher:



Public Member Functions

- StartsWithMatcher (CasedString const &comparator)
- bool match (std::string const &source) const override

Public Member Functions inherited from Catch::Matchers::StdString::StringMatcherBase

- StringMatcherBase (std::string const &operation, CasedString const &comparator)
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Additional Inherited Members

Public Attributes inherited from Catch::Matchers::StdString::StringMatcherBase

- CasedString m_comparator
- std::string m_operation

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.96.1 Detailed Description

Definition at line 3564 of file catch.h.

6.96.2 Constructor & Destructor Documentation

6.96.2.1 StartsWithMatcher()

```
Catch::Matchers::StdString::StartsWithMatcher::StartsWithMatcher (
            CasedString const & comparator )
```

6.96.3 Member Function Documentation

6.96.3.1 match()

```
bool Catch::Matchers::StdString::StartsWithMatcher::match (
            std::string const & source ) const  [override]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.97 Catch::StreamEndStop Struct Reference

`#include <catch.h>`

Public Member Functions

- std::string operator+ () const

6.97.1 Detailed Description

Definition at line 534 of file catch.h.

6.97.2 Member Function Documentation

6.97.2.1 operator+()

`std::string Catch::StreamEndStop::operator+ ( ) const`

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.98 Catch::StringMaker< T, typename > Struct Template Reference

`#include <catch.h>`

Static Public Member Functions

- template<typename Fake = T>
  static std::enable_if<::Catch::Detail::IsStreamInsertable< Fake >::value, std::string >::type convert (const Fake &value)
- template<typename Fake = T>
  static std::enable_if<!::Catch::Detail::IsStreamInsertable< Fake >::value, std::string >::type convert (const Fake &value)

6.98.1 Detailed Description

template<typename T, typename = void>
struct Catch::StringMaker< T, typename >

Definition at line 1615 of file catch.h.

6.98.2 Member Function Documentation

6.98.2.1 convert() [1/2]

```
template<typename T , typename = void>
template<typename Fake = T>
static std::enable_if<::Catch::Detail::IsStreamInsertable< Fake >::value, std::string >::type
Catch::StringMaker< T, typename >::convert (
            const Fake & value )  [inline], [static]
```

Definition at line 1619 of file catch.h.

6.98.2.2 convert() [2/2]

```
template<typename T , typename = void>
template<typename Fake = T>
static std::enable_if<!::Catch::Detail::IsStreamInsertable< Fake >::value, std::string >↩
::type Catch::StringMaker< T, typename >::convert (
            const Fake & value )  [inline], [static]
```

Definition at line 1630 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.99 Catch::StringMaker< bool > Struct Reference

```
#include <catch.h>
```

Static Public Member Functions

- static std::string convert (bool b)

6.99.1 Detailed Description

Definition at line 1761 of file catch.h.

6.99.2 Member Function Documentation

6.99.2.1 convert()

```
static std::string Catch::StringMaker< bool >::convert (
            bool b )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.100 Catch::StringMaker< Catch::Detail::Approx > Struct Reference

`#include <catch.h>`

Static Public Member Functions

- static std::string convert (Catch::Detail::Approx const &value)

6.100.1 Detailed Description

Definition at line 3185 of file catch.h.

6.100.2 Member Function Documentation

6.100.2.1 convert()

```
static std::string Catch::StringMaker< Catch::Detail::Approx >::convert (
            Catch::Detail::Approx const & value )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.101 Catch::StringMaker< char * > Struct Reference

`#include <catch.h>`

Static Public Member Functions

- static std::string convert (char *str)

6.101.1 Detailed Description

Definition at line 1681 of file catch.h.

6.101.2 Member Function Documentation

6.101.2.1 convert()

```
static std::string Catch::StringMaker< char * >::convert (
            char * str )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.102 Catch::StringMaker< char > Struct Reference

`#include <catch.h>`

Static Public Member Functions

- static std::string convert (char c)

6.102.1 Detailed Description

Definition at line 1766 of file catch.h.

6.102.2 Member Function Documentation

6.102.2.1 convert()

```
static std::string Catch::StringMaker< char >::convert (
            char c )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.103 Catch::StringMaker< char const * > Struct Reference

`#include <catch.h>`

Static Public Member Functions

- static std::string convert (char const *str)

6.103.1 Detailed Description

Definition at line 1677 of file catch.h.

6.103.2 Member Function Documentation

6.103.2.1 convert()

```
static std::string Catch::StringMaker< char const * >::convert (
            char const * str )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.104 Catch::StringMaker< char[SZ]> Struct Template Reference

`#include <catch.h>`

Static Public Member Functions

- static std::string convert (char const *str)

6.104.1 Detailed Description

template<int SZ>
struct Catch::StringMaker< char[SZ]>

Definition at line 1711 of file catch.h.

6.104.2 Member Function Documentation

6.104.2.1 convert()

```
template<int SZ>
static std::string Catch::StringMaker< char[SZ]>::convert (
            char const * str )  [inline], [static]
```

Definition at line 1712 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.105 Catch::StringMaker< double > Struct Reference

`#include <catch.h>`

Static Public Member Functions

- static std::string convert (double value)

Static Public Attributes

- static int precision

6.105.1 Detailed Description

Definition at line 1790 of file catch.h.

6.105.2 Member Function Documentation

6.105.2.1 convert()

```
static std::string Catch::StringMaker< double >::convert (
            double value )  [static]
```

6.105.3 Member Data Documentation

6.105.3.1 precision

```
int Catch::StringMaker< double >::precision  [static]
```

Definition at line 1792 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.106 Catch::StringMaker< float > Struct Reference

```
#include <catch.h>
```

Static Public Member Functions

- static std::string convert (float value)

Static Public Attributes

- static int precision

6.106.1 Detailed Description

Definition at line 1784 of file catch.h.

6.106.2 Member Function Documentation

6.106.2.1 convert()

```
static std::string Catch::StringMaker< float >::convert (
            float value )  [static]
```

6.106.3 Member Data Documentation

6.106.3.1 precision

```
int Catch::StringMaker< float >::precision  [static]
```

Definition at line 1786 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.107 Catch::StringMaker< int > Struct Reference

```
#include <catch.h>
```

Static Public Member Functions

- static std::string convert (int value)

6.107.1 Detailed Description

Definition at line 1736 of file catch.h.

6.107.2 Member Function Documentation

6.107.2.1 convert()

```
static std::string Catch::StringMaker< int >::convert (
            int value )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.108 Catch::StringMaker< long > Struct Reference

```
#include <catch.h>
```

Static Public Member Functions

- static std::string convert (long value)

6.108.1 Detailed Description

Definition at line 1740 of file catch.h.

6.108.2 Member Function Documentation

6.108.2.1 convert()

```
static std::string Catch::StringMaker< long >::convert (
            long value )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.109 Catch::StringMaker< long long > Struct Reference

```
#include <catch.h>
```

Static Public Member Functions

- static std::string convert (long long value)

6.109.1 Detailed Description

Definition at line 1744 of file catch.h.

6.109.2 Member Function Documentation

6.109.2.1 convert()

```
static std::string Catch::StringMaker< long long >::convert (
            long long value )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.110 Catch::StringMaker< R C::* > Struct Template Reference

```
#include <catch.h>
```

Static Public Member Functions

- static std::string convert (R C::*p)

6.110.1 Detailed Description

template<typename R, typename C>
struct Catch::StringMaker< R C::* >

Definition at line 1808 of file catch.h.

6.110.2 Member Function Documentation

6.110.2.1 convert()

```
template<typename R , typename C >
static std::string Catch::StringMaker< R C::* >::convert (
            R C::* p )  [inline], [static]
```

Definition at line 1809 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.111 Catch::StringMaker< R, typename std::enable_if< is_range< R >::value &&!::Catch::Detail::IsStreamInsertable< R >::value >::type > Struct Template Reference

```
#include <catch.h>
```

Static Public Member Functions

- static std::string convert (R const &range)

6.111.1 Detailed Description

template<typename R>
struct Catch::StringMaker< R, typename std::enable_if< is_range< R >::value &&!::Catch::Detail::IsStreamInsertable< R >::value >::type >

Definition at line 2040 of file catch.h.

6.111.2 Member Function Documentation

6.111.2.1 convert()

```
template<typename R >
static std::string Catch::StringMaker< R, typename std::enable_if< is_range< R >::value &&!::Catch::Detail::
R >::value >::type >::convert (
            R const & range )  [inline], [static]
```

Definition at line 2041 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.112 Catch::StringMaker< signed char > Struct Reference

```
#include <catch.h>
```

Static Public Member Functions

- static std::string convert (signed char c)

6.112.1 Detailed Description

Definition at line 1770 of file catch.h.

6.112.2 Member Function Documentation

6.112.2.1 convert()

```
static std::string Catch::StringMaker< signed char >::convert (
            signed char c )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.113 Catch::StringMaker< signed char[SZ]> Struct Template Reference

```
#include <catch.h>
```

Static Public Member Functions

- static std::string convert (signed char const *str)

6.113.1 Detailed Description

template<int SZ>
struct Catch::StringMaker< signed char[SZ]>

Definition at line 1717 of file catch.h.

6.113.2 Member Function Documentation

6.113.2.1 convert()

```
template<int SZ>
static std::string Catch::StringMaker< signed char[SZ]>::convert (
            signed char const * str )  [inline], [static]
```

Definition at line 1718 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.114 Catch::StringMaker< std::nullptr_t > Struct Reference

```
#include <catch.h>
```

Static Public Member Functions

- static std::string convert (std::nullptr_t)

6.114.1 Detailed Description

Definition at line 1779 of file catch.h.

6.114.2 Member Function Documentation

6.114.2.1 convert()

```
static std::string Catch::StringMaker< std::nullptr_t >::convert (
            std::nullptr_t  )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.115 Catch::StringMaker< std::string > Struct Reference

`#include <catch.h>`

Static Public Member Functions

- static std::string convert (const std::string &str)

6.115.1 Detailed Description

Definition at line 1665 of file catch.h.

6.115.2 Member Function Documentation

6.115.2.1 convert()

```
static std::string Catch::StringMaker< std::string >::convert (
            const std::string & str )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.116 Catch::StringMaker< std::wstring > Struct Reference

`#include <catch.h>`

Static Public Member Functions

- static std::string convert (const std::wstring &wstr)

6.116.1 Detailed Description

Definition at line 1687 of file catch.h.

6.116.2 Member Function Documentation

6.116.2.1 convert()

```
static std::string Catch::StringMaker< std::wstring >::convert (
            const std::wstring & wstr )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.117 Catch::StringMaker< T * > Struct Template Reference

`#include <catch.h>`

Static Public Member Functions

- template<typename U >
  static std::string convert (U *p)

6.117.1 Detailed Description

template<typename T>
struct Catch::StringMaker< T * >

Definition at line 1796 of file catch.h.

6.117.2 Member Function Documentation

6.117.2.1 convert()

```
template<typename T >
template<typename U >
static std::string Catch::StringMaker< T * >::convert (
            U * p )  [inline], [static]
```

Definition at line 1798 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.118 Catch::StringMaker< T[SZ]> Struct Template Reference

`#include <catch.h>`

Static Public Member Functions

- static std::string convert (T const(&arr)[SZ])

6.118.1 Detailed Description

template<typename T, int SZ>
struct Catch::StringMaker< T[SZ]>

Definition at line 2047 of file catch.h.

6.118.2 Member Function Documentation

6.118.2.1 convert()

```
template<typename T , int SZ>
static std::string Catch::StringMaker< T[SZ]>::convert (
            T const(&) arr[SZ] )  [inline], [static]
```

Definition at line 2048 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.119 Catch::StringMaker< unsigned char > Struct Reference

```
#include <catch.h>
```

Static Public Member Functions

- static std::string convert (unsigned char c)

6.119.1 Detailed Description

Definition at line 1774 of file catch.h.

6.119.2 Member Function Documentation

6.119.2.1 convert()

```
static std::string Catch::StringMaker< unsigned char >::convert (
            unsigned char c )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.120 Catch::StringMaker< unsigned char[SZ]> Struct Template Reference

```
#include <catch.h>
```

Static Public Member Functions

- static std::string convert (unsigned char const *str)

6.120.1 Detailed Description

template<int SZ>
struct Catch::StringMaker< unsigned char[SZ]>

Definition at line 1723 of file catch.h.

6.120.2 Member Function Documentation

6.120.2.1 convert()

```
template<int SZ>
static std::string Catch::StringMaker< unsigned char[SZ]>::convert (
            unsigned char const * str )  [inline], [static]
```

Definition at line 1724 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.121 Catch::StringMaker< unsigned int > Struct Reference

```
#include <catch.h>
```

Static Public Member Functions

- static std::string convert (unsigned int value)

6.121.1 Detailed Description

Definition at line 1748 of file catch.h.

6.121.2 Member Function Documentation

6.121.2.1 convert()

```
static std::string Catch::StringMaker< unsigned int >::convert (
            unsigned int value )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.122 Catch::StringMaker< unsigned long > Struct Reference

`#include <catch.h>`

Static Public Member Functions

- static std::string convert (unsigned long value)

6.122.1 Detailed Description

Definition at line 1752 of file catch.h.

6.122.2 Member Function Documentation

6.122.2.1 convert()

```
static std::string Catch::StringMaker< unsigned long >::convert (
            unsigned long value )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.123 Catch::StringMaker< unsigned long long > Struct Reference

`#include <catch.h>`

Static Public Member Functions

- static std::string convert (unsigned long long value)

6.123.1 Detailed Description

Definition at line 1756 of file catch.h.

6.123.2 Member Function Documentation

6.123.2.1 convert()

```
static std::string Catch::StringMaker< unsigned long long >::convert (
            unsigned long long value )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.124 Catch::StringMaker< wchar_t * > Struct Reference

`#include <catch.h>`

Static Public Member Functions

- static std::string convert (wchar_t *str)

6.124.1 Detailed Description

Definition at line 1703 of file catch.h.

6.124.2 Member Function Documentation

6.124.2.1 convert()

```
static std::string Catch::StringMaker< wchar_t * >::convert (
            wchar_t * str )  [static]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.125 Catch::StringMaker< wchar_t const * > Struct Reference

`#include <catch.h>`

Static Public Member Functions

- static std::string convert (wchar_t const *str)

6.125.1 Detailed Description

Definition at line 1699 of file catch.h.

6.125.2 Member Function Documentation

6.125.2.1 convert()

```
static std::string Catch::StringMaker< wchar_t const * >::convert (
            wchar_t const * str )  [static]
```

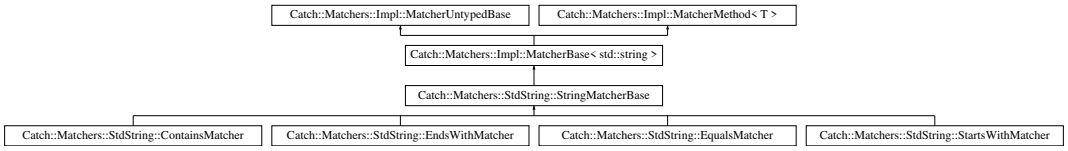
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.126 Catch::Matchers::StdString::StringMatcherBase Struct Reference

`#include <catch.h>`

Inheritance diagram for Catch::Matchers::StdString::StringMatcherBase:



Public Member Functions

- StringMatcherBase (std::string const &operation, CasedString const &comparator)
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Public Attributes

- CasedString m_comparator
- std::string m_operation

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.126.1 Detailed Description

Definition at line 3548 of file catch.h.

6.126.2 Constructor & Destructor Documentation

6.126.2.1 StringMatcherBase()

```
Catch::Matchers::StdString::StringMatcherBase::StringMatcherBase (
            std::string const & operation,
            CasedString const & comparator )
```

6.126.3 Member Function Documentation

6.126.3.1 describe()

```
std::string Catch::Matchers::StdString::StringMatcherBase::describe ( ) const  [override],
[virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

6.126.4 Member Data Documentation

6.126.4.1 m_comparator

```
CasedString Catch::Matchers::StdString::StringMatcherBase::m_comparator
```

Definition at line 3552 of file catch.h.

6.126.4.2 m_operation

```
std::string Catch::Matchers::StdString::StringMatcherBase::m_operation
```

Definition at line 3553 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.127 Catch::StringRef Class Reference

`#include <catch.h>`

Public Types

- using size_type = std::size_t
- using const_iterator = const char*

Public Member Functions

- constexpr StringRef () noexcept=default
- StringRef (char const *rawChars) noexcept
- constexpr StringRef (char const *rawChars, size_type size) noexcept
- StringRef (std::string const &stdString) noexcept
- operator std::string () const
- auto operator== (StringRef const &other) const noexcept -> bool
- auto operator!= (StringRef const &other) const noexcept -> bool
- auto operator[ ] (size_type index) const noexcept -> char
- constexpr auto empty () const noexcept -> bool
- constexpr auto size () const noexcept -> size_type
- auto c_str () const -> char const *
- auto substr (size_type start, size_type length) const noexcept -> StringRef
- auto data () const noexcept -> char const *
- constexpr auto isNullTerminated () const noexcept -> bool
- constexpr const_iterator begin () const
- constexpr const_iterator end () const

6.127.1 Detailed Description

A non-owning string class (similar to the forthcoming std::string_view) Note that, because a StringRef may be a substring of another string, it may not be null terminated.

Definition at line 606 of file catch.h.

6.127.2 Member Typedef Documentation

6.127.2.1 const_iterator

```
using Catch::StringRef::const_iterator = const char*
```

Definition at line 609 of file catch.h.

6.127.2.2 size_type

```
using Catch::StringRef::size_type = std::size_t
```

Definition at line 608 of file catch.h.

6.127.3 Constructor & Destructor Documentation

6.127.3.1 StringRef() [1/4]

```
constexpr Catch::StringRef::StringRef ( )  [constexpr], [default], [noexcept]
```

6.127.3.2 StringRef() [2/4]

```
Catch::StringRef::StringRef (
            char const * rawChars )  [noexcept]
```

6.127.3.3 StringRef() [3/4]

```
constexpr Catch::StringRef::StringRef (
            char const * rawChars,
            size_type size )  [inline], [constexpr], [noexcept]
```

Definition at line 622 of file catch.h.

6.127.3.4 StringRef() [4/4]

```
Catch::StringRef::StringRef (
            std::string const & stdString )  [inline], [noexcept]
```

Definition at line 627 of file catch.h.

6.127.4 Member Function Documentation

6.127.4.1 begin()

```
constexpr const_iterator Catch::StringRef::begin ( ) const  [inline], [constexpr]
```

Definition at line 673 of file catch.h.

6.127.4.2 c_str()

```
auto Catch::StringRef::c_str ( ) const -> char const *
```

6.127.4.3 data()

```
auto Catch::StringRef::data ( ) const -> char const *  [noexcept]
```

6.127.4.4 empty()

```
constexpr auto Catch::StringRef::empty ( ) const -> bool   [inline], [constexpr], [noexcept]
```

Definition at line 648 of file catch.h.

6.127.4.5 end()

```
constexpr const_iterator Catch::StringRef::end ( ) const  [inline], [constexpr]
```

Definition at line 674 of file catch.h.

6.127.4.6 isNullTerminated()

```
constexpr auto Catch::StringRef::isNullTerminated ( ) const -> bool   [inline], [constexpr],
[noexcept]
```

Definition at line 668 of file catch.h.

6.127.4.7 operator std::string()

```
Catch::StringRef::operator std::string ( ) const  [inline], [explicit]
```

Definition at line 632 of file catch.h.

6.127.4.8 operator"!=()

```
auto Catch::StringRef::operator!= (
            StringRef const & other ) const -> bool   [inline], [noexcept]
```

Definition at line 638 of file catch.h.

6.127.4.9 operator==()

```
auto Catch::StringRef::operator== (
            StringRef const & other ) const -> bool  [noexcept]
```

6.127.4.10 operator[]()

```
auto Catch::StringRef::operator[ ] (
            size_type index ) const -> char   [inline], [noexcept]
```

Definition at line 642 of file catch.h.

6.127.4.11 size()

```
constexpr auto Catch::StringRef::size ( ) const -> size_type   [inline], [constexpr], [noexcept]
```

Definition at line 651 of file catch.h.

6.127.4.12 substr()

```
auto Catch::StringRef::substr (
            size_type start,
            size_type length ) const -> StringRef  [noexcept]
```

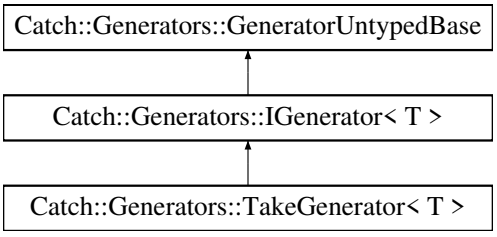
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.128 Catch::Generators::TakeGenerator< T > Class Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Generators::TakeGenerator< T >:



Public Member Functions

- TakeGenerator (size_t target, GeneratorWrapper< T > &&generator)
- T const & get () const override
- bool next () override

Public Member Functions inherited from Catch::Generators::IGenerator< T >

- virtual ~IGenerator ()=default

Public Member Functions inherited from Catch::Generators::GeneratorUntypedBase

- GeneratorUntypedBase ()=default
- virtual ~GeneratorUntypedBase ()

Additional Inherited Members

Public Types inherited from Catch::Generators::IGenerator< T >

- using type = T

6.128.1 Detailed Description

template<typename T>
class Catch::Generators::TakeGenerator< T >

Definition at line 4120 of file catch.h.

6.128.2 Constructor & Destructor Documentation

6.128.2.1 TakeGenerator()

```
template<typename T >
Catch::Generators::TakeGenerator< T >::TakeGenerator (
            size_t target,
            GeneratorWrapper< T > && generator )  [inline]
```

Definition at line 4125 of file catch.h.

6.128.3 Member Function Documentation

6.128.3.1 get()

```
template<typename T >
T const & Catch::Generators::TakeGenerator< T >::get ( ) const  [inline], [override], [virtual]
```

Implements Catch::Generators::IGenerator< T >.

Definition at line 4131 of file catch.h.

6.128.3.2 next()

```
template<typename T >
bool Catch::Generators::TakeGenerator< T >::next ( )  [inline], [override], [virtual]
```

Implements Catch::Generators::GeneratorUntypedBase.

Definition at line 4134 of file catch.h.

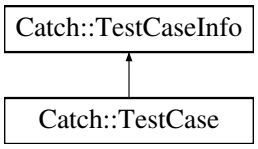
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.129 Catch::TestCase Class Reference

`#include <catch.h>`

Inheritance diagram for Catch::TestCase:



Public Member Functions

- TestCase (ITestInvoker *testCase, TestCaseInfo &&info)
- TestCase withName (std::string const &_newName) const
- void invoke () const
- TestCaseInfo const & getTestCaseInfo () const
- bool operator== (TestCase const &other) const
- bool operator< (TestCase const &other) const

Public Member Functions inherited from Catch::TestCaseInfo

- TestCaseInfo (std::string const &_name, std::string const &_className, std::string const &_description, std::vector< std::string > const &_tags, SourceLineInfo const &_lineInfo)
- bool isHidden () const
- bool throws () const
- bool okToFail () const
- bool expectedToFail () const
- std::string tagsAsString () const

Additional Inherited Members

Public Types inherited from Catch::TestCaseInfo

- enum SpecialProperties {
  None = 0 , IsHidden = 1 << 1 , ShouldFail = 1 << 2 , MayFail = 1 << 3 ,
  Throws = 1 << 4 , NonPortable = 1 << 5 , Benchmark = 1 << 6 }

Public Attributes inherited from Catch::TestCaseInfo

- std::string name
- std::string className
- std::string description
- std::vector< std::string > tags
- std::vector< std::string > lcaseTags
- SourceLineInfo lineInfo
- SpecialProperties properties

6.129.1 Detailed Description

Definition at line 4807 of file catch.h.

6.129.2 Constructor & Destructor Documentation

6.129.2.1 TestCase()

```
Catch::TestCase::TestCase (
            ITestInvoker * testCase,
            TestCaseInfo && info )
```

6.129.3 Member Function Documentation

6.129.3.1 getTestCaseInfo()

```
TestCaseInfo const & Catch::TestCase::getTestCaseInfo ( ) const
```

6.129.3.2 invoke()

```
void Catch::TestCase::invoke ( ) const
```

6.129.3.3 operator<()

```
bool Catch::TestCase::operator< (
            TestCase const & other ) const
```

6.129.3.4 operator==()

```
bool Catch::TestCase::operator== (
            TestCase const & other ) const
```

6.129.3.5 withName()

```
TestCase Catch::TestCase::withName (
            std::string const & _newName ) const
```

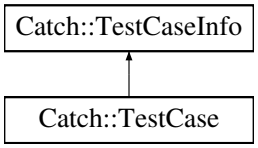
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.130 Catch::TestCaseInfo Struct Reference

`#include <catch.h>`

Inheritance diagram for Catch::TestCaseInfo:



Public Types

- enum SpecialProperties {
  None = 0 , IsHidden = 1 << 1 , ShouldFail = 1 << 2 , MayFail = 1 << 3 ,
  Throws = 1 << 4 , NonPortable = 1 << 5 , Benchmark = 1 << 6 }

Public Member Functions

- TestCaseInfo (std::string const &_name, std::string const &_className, std::string const &_description, std↩
  ::vector< std::string > const &_tags, SourceLineInfo const &_lineInfo)
- bool isHidden () const
- bool throws () const
- bool okToFail () const
- bool expectedToFail () const
- std::string tagsAsString () const

Public Attributes

- std::string name
- std::string className
- std::string description
- std::vector< std::string > tags
- std::vector< std::string > lcaseTags
- SourceLineInfo lineInfo
- SpecialProperties properties

Friends

- void setTags (TestCaseInfo &testCaseInfo, std::vector< std::string > tags)

6.130.1 Detailed Description

Definition at line 4772 of file catch.h.

6.130.2 Member Enumeration Documentation

6.130.2.1 SpecialProperties

`enum Catch::TestCaseInfo::SpecialProperties`

Enumerator

None	
IsHidden	
ShouldFail	
MayFail	
Throws	
NonPortable	
Benchmark	

Definition at line 4773 of file catch.h.

6.130.3 Constructor & Destructor Documentation

6.130.3.1 TestCaseInfo()

```
Catch::TestCaseInfo::TestCaseInfo (
            std::string const & _name,
            std::string const & _className,
            std::string const & _description,
            std::vector< std::string > const & _tags,
            SourceLineInfo const & _lineInfo )
```

6.130.4 Member Function Documentation

6.130.4.1 expectedToFail()

```
bool Catch::TestCaseInfo::expectedToFail ( ) const
```

6.130.4.2 isHidden()

```
bool Catch::TestCaseInfo::isHidden ( ) const
```

6.130.4.3 okToFail()

```
bool Catch::TestCaseInfo::okToFail ( ) const
```

6.130.4.4 tagsAsString()

```
std::string Catch::TestCaseInfo::tagsAsString ( ) const
```

6.130.4.5 throws()

```
bool Catch::TestCaseInfo::throws ( ) const
```

6.130.5 Friends And Related Symbol Documentation

6.130.5.1 setTags

```
void setTags (
            TestCaseInfo & testCaseInfo,
            std::vector< std::string > tags )  [friend]
```

6.130.6 Member Data Documentation

6.130.6.1 className

```
std::string Catch::TestCaseInfo::className
```

Definition at line 4799 of file catch.h.

6.130.6.2 description

```
std::string Catch::TestCaseInfo::description
```

Definition at line 4800 of file catch.h.

6.130.6.3 lcaseTags

```
std::vector<std::string> Catch::TestCaseInfo::lcaseTags
```

Definition at line 4802 of file catch.h.

6.130.6.4 lineInfo

```
SourceLineInfo Catch::TestCaseInfo::lineInfo
```

Definition at line 4803 of file catch.h.

6.130.6.5 name

```
std::string Catch::TestCaseInfo::name
```

Definition at line 4798 of file catch.h.

6.130.6.6 properties

```
SpecialProperties Catch::TestCaseInfo::properties
```

Definition at line 4804 of file catch.h.

6.130.6.7 tags

```
std::vector<std::string> Catch::TestCaseInfo::tags
```

Definition at line 4801 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.131 Catch::TestFailureException Struct Reference

```
#include <catch.h>
```

6.131.1 Detailed Description

Definition at line 2521 of file catch.h.

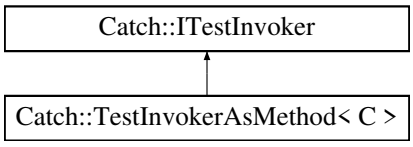
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.132 Catch::TestInvokerAsMethod< C > Class Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::TestInvokerAsMethod< C >:



Public Member Functions

- TestInvokerAsMethod (void(C::*testAsMethod)()) noexcept
- void invoke () const override

Public Member Functions inherited from Catch::ITestInvoker

- virtual ~ITestInvoker ()

6.132.1 Detailed Description

template<typename C>
class Catch::TestInvokerAsMethod< C >

Definition at line 962 of file catch.h.

6.132.2 Constructor & Destructor Documentation

6.132.2.1 TestInvokerAsMethod()

```
template<typename C >
Catch::TestInvokerAsMethod< C >::TestInvokerAsMethod (
            void(C::*)() testAsMethod )  [inline], [noexcept]
```

Definition at line 965 of file catch.h.

6.132.3 Member Function Documentation

6.132.3.1 invoke()

```
template<typename C >
void Catch::TestInvokerAsMethod< C >::invoke ( ) const  [inline], [override], [virtual]
```

Implements Catch::ITestInvoker.

Definition at line 967 of file catch.h.

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.133 Catch::Timer Class Reference

```
#include <catch.h>
```

Public Member Functions

- void start ()
- auto getElapsedNanoseconds () const -> uint64_t
- auto getElapsedMicroseconds () const -> uint64_t
- auto getElapsedMilliseconds () const -> unsigned int
- auto getElapsedSeconds () const -> double

6.133.1 Detailed Description

Definition at line 2894 of file catch.h.

6.133.2 Member Function Documentation

6.133.2.1 getElapsedMicroseconds()

```
auto Catch::Timer::getElapsedMicroseconds ( ) const -> uint64_t
```

6.133.2.2 getElapsedMilliseconds()

```
auto Catch::Timer::getElapsedMilliseconds ( ) const -> unsigned int
```

6.133.2.3 getElapsedNanoseconds()

```
auto Catch::Timer::getElapsedNanoseconds ( ) const -> uint64_t
```

6.133.2.4 getElapsedSeconds()

```
auto Catch::Timer::getElapsedSeconds ( ) const -> double
```

6.133.2.5 start()

```
void Catch::Timer::start ( )
```

The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.134 Catch::Totals Struct Reference

```
#include <catch.h>
```

Public Member Functions

- Totals operator- (Totals const &other) const
- Totals & operator+= (Totals const &other)
- Totals delta (Totals const &prevTotals) const

Public Attributes

- int error = 0
- Counts assertions
- Counts testCases

6.134.1 Detailed Description

Definition at line 2842 of file catch.h.

6.134.2 Member Function Documentation

6.134.2.1 delta()

```
Totals Catch::Totals::delta (
            Totals const & prevTotals ) const
```

6.134.2.2 operator+=()

```
Totals & Catch::Totals::operator+= (
            Totals const & other )
```

6.134.2.3 operator-()

```
Totals Catch::Totals::operator- (
            Totals const & other ) const
```

6.134.3 Member Data Documentation

6.134.3.1 assertions

```
Counts Catch::Totals::assertions
```

Definition at line 2850 of file catch.h.

6.134.3.2 error

```
int Catch::Totals::error = 0
```

Definition at line 2849 of file catch.h.

6.134.3.3 testCases

```
Counts Catch::Totals::testCases
```

Definition at line 2851 of file catch.h.

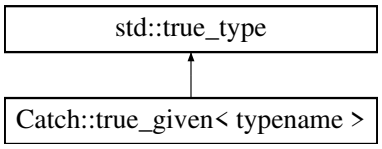
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.135 Catch::true_given< typename > Struct Template Reference

`#include <catch.h>`

Inheritance diagram for Catch::true_given< typename >:



6.135.1 Detailed Description

template<typename>
struct Catch::true_given< typename >

Definition at line 927 of file catch.h.

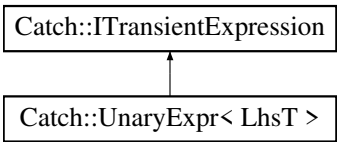
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.136 Catch::UnaryExpr< LhsT > Class Template Reference

`#include <catch.h>`

Inheritance diagram for Catch::UnaryExpr< LhsT >:



Public Member Functions

- UnaryExpr (LhsT lhs)

Public Member Functions inherited from Catch::ITransientExpression

- auto isBinaryExpression () const -> bool
- auto getResult () const -> bool
- ITransientExpression (bool isBinaryExpression, bool result)
- virtual ~ITransientExpression ()

Additional Inherited Members

Public Attributes inherited from Catch::ITransientExpression

- bool m_isBinaryExpression
- bool m_result

6.136.1 Detailed Description

template<typename LhsT>
class Catch::UnaryExpr< LhsT >

Definition at line 2300 of file catch.h.

6.136.2 Constructor & Destructor Documentation

6.136.2.1 UnaryExpr()

```
template<typename LhsT >
Catch::UnaryExpr< LhsT >::UnaryExpr (
            LhsT lhs )  [inline], [explicit]
```

Definition at line 2308 of file catch.h.

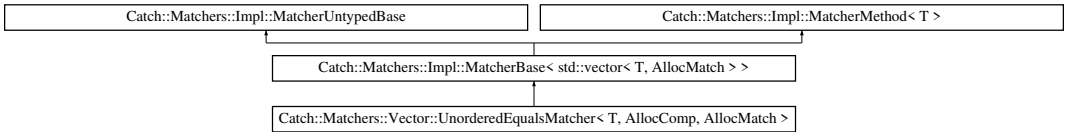
The documentation for this class was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.137 Catch::Matchers::Vector::UnorderedEqualsMatcher< T, AllocComp, AllocMatch > Struct Template Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Matchers::Vector::UnorderedEqualsMatcher< T, AllocComp, AllocMatch >:



Public Member Functions

- UnorderedEqualsMatcher (std::vector< T, AllocComp > const &target)
- bool match (std::vector< T, AllocMatch > const &vec) const override
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.137.1 Detailed Description

template<typename T, typename AllocComp, typename AllocMatch>
struct Catch::Matchers::Vector::UnorderedEqualsMatcher< T, AllocComp, AllocMatch >

Definition at line 3717 of file catch.h.

6.137.2 Constructor & Destructor Documentation

6.137.2.1 UnorderedEqualsMatcher()

```
template<typename T , typename AllocComp , typename AllocMatch >
Catch::Matchers::Vector::UnorderedEqualsMatcher< T, AllocComp, AllocMatch >::UnorderedEquals↩
Matcher (
            std::vector< T, AllocComp > const & target )  [inline]
```

Definition at line 3718 of file catch.h.

6.137.3 Member Function Documentation

6.137.3.1 describe()

```
template<typename T , typename AllocComp , typename AllocMatch >
std::string Catch::Matchers::Vector::UnorderedEqualsMatcher< T, AllocComp, AllocMatch >↩
::describe ( ) const  [inline], [override], [virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

Definition at line 3726 of file catch.h.

6.137.3.2 match()

```
template<typename T , typename AllocComp , typename AllocMatch >
bool Catch::Matchers::Vector::UnorderedEqualsMatcher< T, AllocComp, AllocMatch >::match (
            std::vector< T, AllocMatch > const & vec ) const  [inline], [override]
```

Definition at line 3719 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.138 Catch::UseColour Struct Reference

```
#include <catch.h>
```

Public Types

- enum YesOrNo { Auto , Yes , No }

6.138.1 Detailed Description

Definition at line 4498 of file catch.h.

6.138.2 Member Enumeration Documentation

6.138.2.1 YesOrNo

```
enum Catch::UseColour::YesOrNo
```

Enumerator

Auto	
Yes	
No	

Definition at line 4498 of file catch.h.

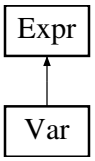
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.139 Var Class Reference

`#include <Expr.h>`

Inheritance diagram for Var:



Public Member Functions

- Var (const std::string &varPassed)
- bool equals (Expr *e) override
- int interp () override
- bool hasVariable () override
- Expr * subst (std::string stringInput, Expr *e) override
- void print (std::ostream &stream) override

Public Member Functions inherited from Expr

- virtual ~Expr ()=default
- std::string to_string ()
- std::string to_pp_string ()
- void pretty_print_at (std::ostream &ot)

Public Attributes

- std::string var

Protected Member Functions

- void pretty_print (std::ostream &ot, precedence_t prec) override

6.139.1 Detailed Description

Definition at line 91 of file Expr.h.

6.139.2 Constructor & Destructor Documentation

6.139.2.1 Var()

```
Var::Var (
            const std::string & varPassed )
```

Constructs a Var object with a given variable name.

Parameters

varPassed	The name of the variable.

Definition at line 36 of file Expr.cpp.

6.139.3 Member Function Documentation

6.139.3.1 equals()

```
bool Var::equals (
            Expr * e )  [override], [virtual]
```

Checks if this Var object is equal to another expression.

Parameters

e	Pointer to the expression to compare with.

Returns

true if the expressions are equivalent, false otherwise.

Implements Expr.

Definition at line 76 of file Expr.cpp.

6.139.3.2 hasVariable()

```
bool Var::hasVariable ( )  [override], [virtual]
```

Checks if the Var expression contains a variable.

Returns

true because Var represents a variable.

Implements Expr.

Definition at line 141 of file Expr.cpp.

6.139.3.3 interp()

```
int Var::interp ( )  [override], [virtual]
```

Evaluates the variable expression. Throws an error because variables cannot be directly evaluated.

Exceptions

std::runtime_error	when trying to evaluate a variable.

Implements Expr.

Definition at line 109 of file Expr.cpp.

6.139.3.4 pretty_print()

```
void Var::pretty_print (
            std::ostream & ot,
            precedence_t prec )  [override], [protected], [virtual]
```

Pretty prints the Var expression with appropriate precedence.

Parameters

ot	The output stream to print to.
prec	The precedence context in which this expression is being printed.

Implements Expr.

Definition at line 275 of file Expr.cpp.

6.139.3.5 print()

```
void Var::print (
            std::ostream & stream )  [override], [virtual]
```

Prints the Var expression to a given output stream.

Parameters

stream	The output stream to print to.

Implements Expr.

Definition at line 229 of file Expr.cpp.

6.139.3.6 subst()

```
Expr * Var::subst (
            std::string stringInput,
            Expr * e )  [override], [virtual]
```

Substitutes a variable with another expression in a Var object.

Parameters

stringInput	The name of the variable to substitute.
e	The expression to substitute the variable with.

Returns

A new Var object with the variable substituted if the names match, otherwise returns a copy of itself.

Implements Expr.

Definition at line 185 of file Expr.cpp.

6.139.4 Member Data Documentation

6.139.4.1 var

```
std::string Var::var
```

Definition at line 93 of file Expr.h.

The documentation for this class was generated from the following files:

- /Users/samanthapope/msdscriptRepo/msdScript/Expr.h
- /Users/samanthapope/msdscriptRepo/msdScript/Expr.cpp

6.140 Catch::detail::void_type<... > Struct Template Reference

```
#include <catch.h>
```

Public Types

- using type = void

6.140.1 Detailed Description

template<typename...>
struct Catch::detail::void_type<... >

Definition at line 1993 of file catch.h.

6.140.2 Member Typedef Documentation

6.140.2.1 type

```
template<typename...  >
using Catch::detail::void_type<...  >::type = void
```

Definition at line 1994 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.141 Catch::WaitForKeypress Struct Reference

```
#include <catch.h>
```

Public Types

- enum When { Never , BeforeStart = 1 , BeforeExit = 2 , BeforeStartAndExit = BeforeStart | BeforeExit }

6.141.1 Detailed Description

Definition at line 4503 of file catch.h.

6.141.2 Member Enumeration Documentation

6.141.2.1 When

```
enum Catch::WaitForKeypress::When
```

Enumerator

Never	
BeforeStart	
BeforeExit	
BeforeStartAndExit	

Definition at line 4503 of file catch.h.

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.142 Catch::WarnAbout Struct Reference

`#include <catch.h>`

Public Types

- enum What { Nothing = 0x00 , NoAssertions = 0x01 , NoTests = 0x02 }

6.142.1 Detailed Description

Definition at line 4482 of file catch.h.

6.142.2 Member Enumeration Documentation

6.142.2.1 What

`enum Catch::WarnAbout::What`

Enumerator

Nothing	
NoAssertions	
NoTests	

Definition at line 4482 of file catch.h.

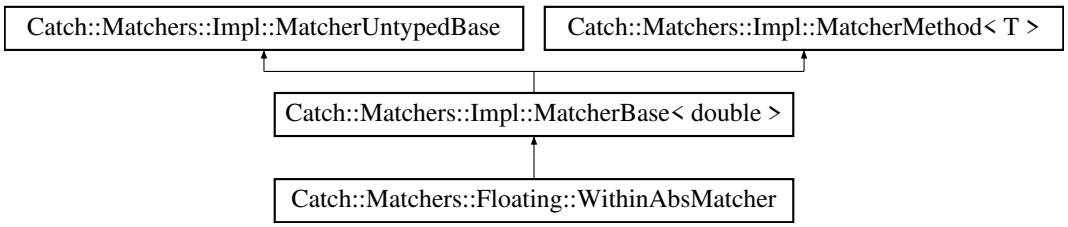
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.143 Catch::Matchers::Floating::WithinAbsMatcher Struct Reference

`#include <catch.h>`

Inheritance diagram for Catch::Matchers::Floating::WithinAbsMatcher:



Public Member Functions

- WithinAbsMatcher (double target, double margin)
- bool match (double const &matchee) const override
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.143.1 Detailed Description

Definition at line 3429 of file catch.h.

6.143.2 Constructor & Destructor Documentation

6.143.2.1 WithinAbsMatcher()

```
Catch::Matchers::Floating::WithinAbsMatcher::WithinAbsMatcher (
            double target,
            double margin )
```

6.143.3 Member Function Documentation

6.143.3.1 describe()

```
std::string Catch::Matchers::Floating::WithinAbsMatcher::describe ( ) const  [override], [virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

6.143.3.2 match()

```
bool Catch::Matchers::Floating::WithinAbsMatcher::match (
            double const & matchee ) const  [override]
```

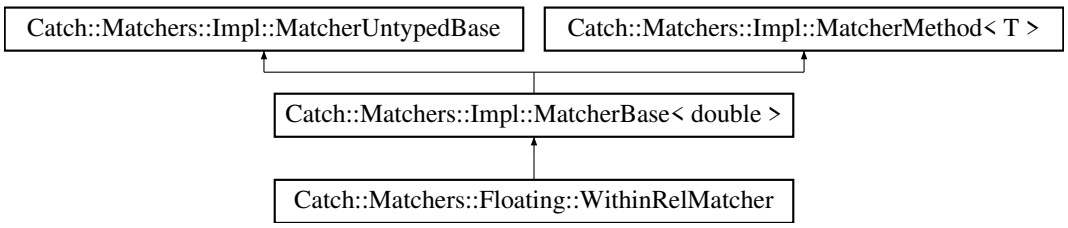
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.144 Catch::Matchers::Floating::WithinRelMatcher Struct Reference

```
#include <catch.h>
```

Inheritance diagram for Catch::Matchers::Floating::WithinRelMatcher:



Public Member Functions

- WithinRelMatcher (double target, double epsilon)
- bool match (double const &matchee) const override
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.144.1 Detailed Description

Definition at line 3454 of file catch.h.

6.144.2 Constructor & Destructor Documentation

6.144.2.1 WithinRelMatcher()

```
Catch::Matchers::Floating::WithinRelMatcher::WithinRelMatcher (
            double target,
            double epsilon )
```

6.144.3 Member Function Documentation

6.144.3.1 describe()

```
std::string Catch::Matchers::Floating::WithinRelMatcher::describe ( ) const  [override], [virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

6.144.3.2 match()

```
bool Catch::Matchers::Floating::WithinRelMatcher::match (
            double const & matchee ) const  [override]
```

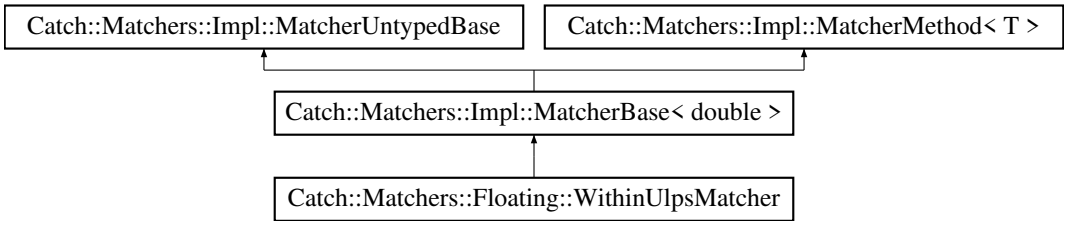
The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

6.145 Catch::Matchers::Floating::WithinUlpsMatcher Struct Reference

`#include <catch.h>`

Inheritance diagram for Catch::Matchers::Floating::WithinUlpsMatcher:



Public Member Functions

- WithinUlpsMatcher (double target, uint64_t ulps, FloatingPointKind baseType)
- bool match (double const &matchee) const override
- std::string describe () const override

Public Member Functions inherited from Catch::Matchers::Impl::MatcherBase< T >

- MatchAllOf< T > operator&& (MatcherBase const &other) const
- MatchAnyOf< T > operator|| (MatcherBase const &other) const
- MatchNotOf< T > operator! () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- MatcherUntypedBase ()=default
- MatcherUntypedBase (MatcherUntypedBase const &)=default
- MatcherUntypedBase & operator= (MatcherUntypedBase const &)=delete
- std::string toString () const

Public Member Functions inherited from Catch::Matchers::Impl::MatcherMethod< T >

- virtual bool match (T const &arg) const=0

Additional Inherited Members

Protected Member Functions inherited from Catch::Matchers::Impl::MatcherUntypedBase

- virtual ~MatcherUntypedBase ()

Protected Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string m_cachedToString

6.145.1 Detailed Description

Definition at line 3438 of file catch.h.

6.145.2 Constructor & Destructor Documentation

6.145.2.1 WithinUlpsMatcher()

```
Catch::Matchers::Floating::WithinUlpsMatcher::WithinUlpsMatcher (
            double target,
            uint64_t ulps,
            FloatingPointKind baseType )
```

6.145.3 Member Function Documentation

6.145.3.1 describe()

```
std::string Catch::Matchers::Floating::WithinUlpsMatcher::describe ( ) const  [override],
[virtual]
```

Implements Catch::Matchers::Impl::MatcherUntypedBase.

6.145.3.2 match()

```
bool Catch::Matchers::Floating::WithinUlpsMatcher::match (
            double const & matchee ) const  [override]
```

The documentation for this struct was generated from the following file:

- /Users/samanthapope/msdscriptRepo/msdScript/catch.h

Chapter 7

File Documentation

7.1 /Users/samanthapope/msdscriptRepo/msdScript/catch.h File Reference

```
#include <iosfwd>
#include <string>
#include <cstdint>
#include <vector>
#include <cstddef>
#include <cassert>
#include <type_traits>
#include <ostream>
#include <chrono>
#include <memory>
#include <exception>
#include <functional>
#include <algorithm>
#include <utility>
#include <random>
```

Classes

- struct Catch_global_namespace_dummy
- struct Catch::CaseSensitive
- class Catch::NonCopyable
- struct Catch::SourceLineInfo
- struct Catch::StreamEndStop
- struct Catch::RegistrarForTagAliases
- struct Catch::ITestInvoker
- struct Catch::ITestCaseRegistry
- class Catch::StringRef
- struct Catch::always_false< T >
- struct Catch::true_given< typename >
- struct Catch::is_callable_tester
- struct Catch::is_callable< Fun(Args...)>
- class Catch::TestInvokerAsMethod< C >
- struct Catch::NameAndTags

- struct Catch::AutoReg
- struct Catch::ResultWas
- struct Catch::ResultDisposition
- struct Catch::AssertionInfo
- struct Catch::IStream
- class Catch::ReusableStringStream
- struct Catch::Detail::EnumInfo
- struct Catch::IMutableEnumValuesRegistry
- class Catch::Detail::IsStreamInsertable< T >
- struct Catch::StringMaker< T, typename >
- struct Catch::StringMaker< std::string >
- struct Catch::StringMaker< char const * >
- struct Catch::StringMaker< char * >
- struct Catch::StringMaker< std::wstring >
- struct Catch::StringMaker< wchar_t const * >
- struct Catch::StringMaker< wchar_t * >
- struct Catch::StringMaker< char[SZ]>
- struct Catch::StringMaker< signed char[SZ]>
- struct Catch::StringMaker< unsigned char[SZ]>
- struct Catch::StringMaker< int >
- struct Catch::StringMaker< long >
- struct Catch::StringMaker< long long >
- struct Catch::StringMaker< unsigned int >
- struct Catch::StringMaker< unsigned long >
- struct Catch::StringMaker< unsigned long long >
- struct Catch::StringMaker< bool >
- struct Catch::StringMaker< char >
- struct Catch::StringMaker< signed char >
- struct Catch::StringMaker< unsigned char >
- struct Catch::StringMaker< std::nullptr_t >
- struct Catch::StringMaker< float >
- struct Catch::StringMaker< double >
- struct Catch::StringMaker< T * >
- struct Catch::StringMaker< R C::* >
- struct Catch::detail::void_type<... >
- struct Catch::detail::is_range_impl< T, typename >
- struct Catch::detail::is_range_impl< T, typename void_type< decltype(begin(std::declval< T >()))>::type >
- struct Catch::is_range< T >
- struct Catch::StringMaker< R, typename std::enable_if< is_range< R >::value &&!::Catch::Detail::IsStreamInsertable< R >::
- struct Catch::StringMaker< T[SZ]>
- struct Catch::ITransientExpression
- class Catch::BinaryExpr< LhsT, RhsT >
- class Catch::UnaryExpr< LhsT >
- class Catch::ExprLhs< LhsT >
- struct Catch::Decomposer
- struct Catch::IResultCapture
- struct Catch::TestFailureException
- class Catch::LazyExpression
- struct Catch::AssertionReaction
- class Catch::AssertionHandler
- struct Catch::MessageInfo
- struct Catch::MessageStream
- struct Catch::MessageBuilder
- class Catch::ScopedMessage
- class Catch::Capturer

- struct Catch::Counts
- struct Catch::Totals
- struct Catch::SectionInfo
- struct Catch::SectionEndInfo
- class Catch::Timer
- class Catch::Section
- struct Catch::IRegistryHub
- struct Catch::IMutableRegistryHub
- struct Catch::IExceptionTranslator
- struct Catch::IExceptionTranslatorRegistry
- class Catch::ExceptionTranslatorRegistrar
- class Catch::Detail::Approx
- struct Catch::StringMaker< Catch::Detail::Approx >
- struct Catch::pluralise
- class Catch::Matchers::Impl::MatcherUntypedBase
- struct Catch::Matchers::Impl::MatcherMethod< ObjectT >
- struct Catch::Matchers::Impl::MatcherBase< T >
- struct Catch::Matchers::Impl::MatchAllOf< ArgT >
- struct Catch::Matchers::Impl::MatchAnyOf< ArgT >
- struct Catch::Matchers::Impl::MatchNotOf< ArgT >
- class Catch::Matchers::Exception::ExceptionMessageMatcher
- struct Catch::Matchers::Floating::WithinAbsMatcher
- struct Catch::Matchers::Floating::WithinUlpsMatcher
- struct Catch::Matchers::Floating::WithinRelMatcher
- class Catch::Matchers::Generic::PredicateMatcher< T >
- struct Catch::Matchers::StdString::CasedString
- struct Catch::Matchers::StdString::StringMatcherBase
- struct Catch::Matchers::StdString::EqualsMatcher
- struct Catch::Matchers::StdString::ContainsMatcher
- struct Catch::Matchers::StdString::StartsWithMatcher
- struct Catch::Matchers::StdString::EndsWithMatcher
- struct Catch::Matchers::StdString::RegexMatcher
- struct Catch::Matchers::Vector::ContainsElementMatcher< T, Alloc >
- struct Catch::Matchers::Vector::ContainsMatcher< T, AllocComp, AllocMatch >
- struct Catch::Matchers::Vector::EqualsMatcher< T, AllocComp, AllocMatch >
- struct Catch::Matchers::Vector::ApproxMatcher< T, AllocComp, AllocMatch >
- struct Catch::Matchers::Vector::UnorderedEqualsMatcher< T, AllocComp, AllocMatch >
- class Catch::MatchExpr< ArgT, MatcherT >
- class Catch::Generators::GeneratorUntypedBase
- struct Catch::IGeneratorTracker
- class Catch::GeneratorException
- struct Catch::Generators::IGenerator< T >
- class Catch::Generators::SingleValueGenerator< T >
- class Catch::Generators::FixedValuesGenerator< T >
- class Catch::Generators::GeneratorWrapper< T >
- class Catch::Generators::Generators< T >
- struct Catch::Generators::as< T >
- class Catch::Generators::TakeGenerator< T >
- class Catch::Generators::FilterGenerator< T, Predicate >
- class Catch::Generators::RepeatGenerator< T >
- class Catch::Generators::MapGenerator< T, U, Func >
- class Catch::Generators::ChunkGenerator< T >
- struct Catch::IContext
- struct Catch::IMutableContext
- class Catch::Option< T >

- struct Catch::WarnAbout
- struct Catch::ShowDurations
- struct Catch::RunTests
- struct Catch::UseColour
- struct Catch::WaitForKeypress
- struct Catch::IConfig
- class Catch::SimplePcg32
- class Catch::Generators::RandomFloatingGenerator< Float >
- class Catch::Generators::RandomIntegerGenerator< Integer >
- class Catch::Generators::RangeGenerator< T >
- class Catch::Generators::IteratorGenerator< T >
- struct Catch::TestCaseInfo
- class Catch::TestCase
- struct Catch::IRunner

Namespaces

- namespace Catch
- namespace mpl_
- namespace Catch::Detail
- namespace Catch::detail
- namespace Catch::literals
- namespace Catch::Matchers
- namespace Catch::Matchers::Impl
- namespace Catch::Matchers::Exception
- namespace Catch::Matchers::Floating
- namespace Catch::Matchers::Generic
- namespace Catch::Matchers::Generic::Detail
- namespace Catch::Matchers::StdString
- namespace Catch::Matchers::Vector
- namespace Catch::Generators
- namespace Catch::Generators::pf

Macros

- #define CATCH_VERSION_MAJOR 2
- #define CATCH_VERSION_MINOR 13
- #define CATCH_VERSION_PATCH 10
- #define CATCH_INTERNAL_CONFIG_POSIX_SIGNALS
- #define CATCH_INTERNAL_CONFIG_COUNTER
- #define CATCH_INTERNAL_CONFIG_GLOBAL_NEXTAFTER
- #define CATCH_CONFIG_COUNTER
- #define CATCH_CONFIG_POSIX_SIGNALS
- #define CATCH_CONFIG_WCHAR
- #define CATCH_CONFIG_CPP11_TO_STRING
- #define CATCH_CONFIG_DISABLE_EXCEPTIONS
- #define CATCH_CONFIG_GLOBAL_NEXTAFTER
- #define CATCH_INTERNAL_START_WARNINGS_SUPPRESSION
- #define CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
- #define CATCH_INTERNAL_SUPPRESS_PARENTHESES_WARNINGS
- #define CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS
- #define CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS
- #define CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS

- #define CATCH_INTERNAL_IGNORE_BUT_WARN(...)
- #define CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS
- #define CATCH_TRY if ((true))
- #define CATCH_CATCH_ALL if ((false))
- #define CATCH_CATCH_ANON(type) if ((false))
- #define INTERNAL_CATCH_UNIQUE_NAME_LINE2(name, line) name##line
- #define INTERNAL_CATCH_UNIQUE_NAME_LINE(name, line) INTERNAL_CATCH_UNIQUE_NAME_LINE2(name, line)
- #define INTERNAL_CATCH_UNIQUE_NAME(name) INTERNAL_CATCH_UNIQUE_NAME_LINE(name, ↩ __COUNTER__)
- #define CATCH_INTERNAL_LINEINFO ::Catch::SourceLineInfo(__FILE__, static_cast<std::size_t>(__↩ LINE__))
- #define CATCH_REGISTER_TAG_ALIAS(alias, spec)
- #define CATCH_RECURSION_LEVEL0(...) __VA_ARGS__
- #define CATCH_RECURSION_LEVEL1(...) CATCH_RECURSION_LEVEL0(CATCH_RECURSION_LEVEL0(CATCH_RECURS __VA_ARGS__)))
- #define CATCH_RECURSION_LEVEL2(...) CATCH_RECURSION_LEVEL1(CATCH_RECURSION_LEVEL1(CATCH_RECURS __VA_ARGS__)))
- #define CATCH_RECURSION_LEVEL3(...) CATCH_RECURSION_LEVEL2(CATCH_RECURSION_LEVEL2(CATCH_RECURS __VA_ARGS__)))
- #define CATCH_RECURSION_LEVEL4(...) CATCH_RECURSION_LEVEL3(CATCH_RECURSION_LEVEL3(CATCH_RECURS __VA_ARGS__)))
- #define CATCH_RECURSION_LEVEL5(...) CATCH_RECURSION_LEVEL4(CATCH_RECURSION_LEVEL4(CATCH_RECURS __VA_ARGS__)))
- #define CATCH_RECURSE(...) CATCH_RECURSION_LEVEL5(__VA_ARGS__)
- #define CATCH_REC_END(...)
- #define CATCH_REC_OUT
- #define CATCH_EMPTY()
- #define CATCH_DEFER(id) id CATCH_EMPTY()
- #define CATCH_REC_GET_END2() 0, CATCH_REC_END
- #define CATCH_REC_GET_END1(...) CATCH_REC_GET_END2
- #define CATCH_REC_GET_END(...) CATCH_REC_GET_END1
- #define CATCH_REC_NEXT0(test, next, ...) next CATCH_REC_OUT
- #define CATCH_REC_NEXT1(test, next) CATCH_DEFER (CATCH_REC_NEXT0) (test, next, 0)
- #define CATCH_REC_NEXT(test, next) CATCH_REC_NEXT1(CATCH_REC_GET_END test, next)
- #define CATCH_REC_LIST0(f, x, peek, ...) , f(x) CATCH_DEFER (CATCH_REC_NEXT(peek, CATCH_REC_LIST1)) (f, peek, __VA_ARGS__)
- #define CATCH_REC_LIST1(f, x, peek, ...) , f(x) CATCH_DEFER (CATCH_REC_NEXT(peek, CATCH_REC_LIST0)) (f, peek, __VA_ARGS__)
- #define CATCH_REC_LIST2(f, x, peek, ...) f(x) CATCH_DEFER (CATCH_REC_NEXT(peek, CATCH_REC_LIST1)) (f, peek, __VA_ARGS__)
- #define CATCH_REC_LIST0_UD(f, userdata, x, peek, ...) , f(userdata, x) CATCH_DEFER (CATCH_REC_NEXT(peek, CATCH_REC_LIST1_UD)) (f, userdata, peek, __VA_ARGS__)
- #define CATCH_REC_LIST1_UD(f, userdata, x, peek, ...) , f(userdata, x) CATCH_DEFER (CATCH_REC_NEXT(peek, CATCH_REC_LIST0_UD)) (f, userdata, peek, __VA_ARGS__)
- #define CATCH_REC_LIST2_UD(f, userdata, x, peek, ...) f(userdata, x) CATCH_DEFER (CATCH_REC_NEXT(peek, CATCH_REC_LIST1_UD)) (f, userdata, peek, __VA_ARGS__)
- #define CATCH_REC_LIST_UD(f, userdata, ...) CATCH_RECURSE(CATCH_REC_LIST2_UD(f, userdata, __VA_ARGS__, ()()(), ()()(), ()()(), 0))
- #define CATCH_REC_LIST(f, ...) CATCH_RECURSE(CATCH_REC_LIST2(f, __VA_ARGS__, ()()(), ()()(), ()()(), 0))
- #define INTERNAL_CATCH_EXPAND1(param) INTERNAL_CATCH_EXPAND2(param)
- #define INTERNAL_CATCH_EXPAND2(...) INTERNAL_CATCH_NO## __VA_ARGS__
- #define INTERNAL_CATCH_DEF(...) INTERNAL_CATCH_DEF __VA_ARGS__
- #define INTERNAL_CATCH_NOINTERNAL_CATCH_DEF
- #define INTERNAL_CATCH_STRINGIZE(...) INTERNAL_CATCH_STRINGIZE2(__VA_ARGS__)

- #define INTERNAL_CATCH_STRINGIZE2(...) #__VA_ARGS__
- #define INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS(param) INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_
- #define INTERNAL_CATCH_MAKE_NAMESPACE2(...) ns_##__VA_ARGS__
- #define INTERNAL_CATCH_MAKE_NAMESPACE(name) INTERNAL_CATCH_MAKE_NAMESPACE2(name)
- #define INTERNAL_CATCH_REMOVE_PARENS(...) INTERNAL_CATCH_EXPAND1(INTERNAL_CATCH_DEF __VA_ARGS__)
- #define INTERNAL_CATCH_MAKE_TYPE_LIST2(...) decltype(get_wrapper<INTERNAL_CATCH_REMOVE_PARENS_GEN(__VA_ARGS__)>())
- #define INTERNAL_CATCH_MAKE_TYPE_LIST(...) INTERNAL_CATCH_MAKE_TYPE_LIST2(INTERNAL_CATCH_REMOVE __VA_ARGS__))
- #define INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES(...) CATCH_REC_LIST(INTERNAL_CATCH_MAKE_TYPE __VA_ARGS__)
- #define INTERNAL_CATCH_REMOVE_PARENS_1_ARG(_0) INTERNAL_CATCH_REMOVE_PARENS(_0)
- #define INTERNAL_CATCH_REMOVE_PARENS_2_ARG(_0, _1) INTERNAL_CATCH_REMOVE_PARENS(↩ _0), INTERNAL_CATCH_REMOVE_PARENS_1_ARG(_1)
- #define INTERNAL_CATCH_REMOVE_PARENS_3_ARG(_0, _1, _2) INTERNAL_CATCH_REMOVE_PARENS(↩ _0), INTERNAL_CATCH_REMOVE_PARENS_2_ARG(_1, _2)
- #define INTERNAL_CATCH_REMOVE_PARENS_4_ARG(_0, _1, _2, _3) INTERNAL_CATCH_REMOVE_PARENS(↩ _0), INTERNAL_CATCH_REMOVE_PARENS_3_ARG(_1, _2, _3)
- #define INTERNAL_CATCH_REMOVE_PARENS_5_ARG(_0, _1, _2, _3, _4) INTERNAL_CATCH_REMOVE_PARENS(↩ _0), INTERNAL_CATCH_REMOVE_PARENS_4_ARG(_1, _2, _3, _4)
- #define INTERNAL_CATCH_REMOVE_PARENS_6_ARG(_0, _1, _2, _3, _4, _5) INTERNAL_CATCH_REMOVE_PARENS(↩ _0), INTERNAL_CATCH_REMOVE_PARENS_5_ARG(_1, _2, _3, _4, _5)
- #define INTERNAL_CATCH_REMOVE_PARENS_7_ARG(_0, _1, _2, _3, _4, _5, _6) INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_6_ARG(_1, _2, _3, _4, _5, _6)
- #define INTERNAL_CATCH_REMOVE_PARENS_8_ARG(_0, _1, _2, _3, _4, _5, _6, _7) INTERNAL_CATCH_REMOVE_PARE _0), INTERNAL_CATCH_REMOVE_PARENS_7_ARG(_1, _2, _3, _4, _5, _6, _7)
- #define INTERNAL_CATCH_REMOVE_PARENS_9_ARG(_0, _1, _2, _3, _4, _5, _6, _7, _8) INTERNAL_CATCH_REMOVE_PA _0), INTERNAL_CATCH_REMOVE_PARENS_8_ARG(_1, _2, _3, _4, _5, _6, _7, _8)
- #define INTERNAL_CATCH_REMOVE_PARENS_10_ARG(_0, _1, _2, _3, _4, _5, _6, _7, _8, _↩ 9) INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_9_ARG(_1, _2, _3, _4, _5, _6, _7, _8, _9)
- #define INTERNAL_CATCH_REMOVE_PARENS_11_ARG(_0, _1, _2, _3, _4, _5, _6, _7, _8, _9, _↩ 10) INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_10_ARG(_1, ↩ _2, _3, _4, _5, _6, _7, _8, _9, _10)
- #define INTERNAL_CATCH_VA_NARGS_IMPL(_0, _1, _2, _3, _4, _5, _6, _7, _8, _9, _10, N, ...) N
- #define INTERNAL_CATCH_TYPE_GEN
- #define INTERNAL_CATCH_NTTP_1(signature, ...)
- #define INTERNAL_CATCH_DECLARE_SIG_TEST0(TestName)
- #define INTERNAL_CATCH_DECLARE_SIG_TEST1(TestName, signature)
- #define INTERNAL_CATCH_DECLARE_SIG_TEST_X(TestName, signature, ...)
- #define INTERNAL_CATCH_DEFINE_SIG_TEST0(TestName)
- #define INTERNAL_CATCH_DEFINE_SIG_TEST1(TestName, signature)
- #define INTERNAL_CATCH_DEFINE_SIG_TEST_X(TestName, signature, ...)
- #define INTERNAL_CATCH_NTTP_REGISTER0(TestFunc, signature)
- #define INTERNAL_CATCH_NTTP_REGISTER(TestFunc, signature, ...)
- #define INTERNAL_CATCH_NTTP_REGISTER_METHOD0(TestName, signature, ...)
- #define INTERNAL_CATCH_NTTP_REGISTER_METHOD(TestName, signature, ...)
- #define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD0(TestName, ClassName)
- #define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD1(TestName, ClassName, signature)
- #define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X(TestName, ClassName, signature, ...)
- #define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD0(TestName)
- #define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD1(TestName, signature)
- #define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X(TestName, signature, ...)
- #define INTERNAL_CATCH_NTTP_0

- #define INTERNAL_CATCH_NTTP_GEN(...) INTERNAL_CATCH_VA_NARGS_IMPL(__VA_ARGS↩ __, INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1(__VA_↩ ARGS__), INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1(__VA_ARGS_↩ _),INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_0)
- #define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD(TestName, ...) INTERNAL_CATCH_VA_NARGS_IMPL("dummy", __VA_ARGS__, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TEST_ INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_C INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD1, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD0)(Test↩ Name, __VA_ARGS__)
- #define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD(TestName, ClassName, ...) INTERNAL_CATCH_VA_NARGS_I "dummy", __VA_ARGS__, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_TE INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNA INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD1, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD0)(Test↩ Name, ClassName, __VA_ARGS__)
- #define INTERNAL_CATCH_NTTP_REG_METHOD_GEN(TestName, ...) INTERNAL_CATCH_VA_NARGS_IMPL("dummy", __VA_ARGS__, INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METH INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD0, INTERNAL_CATCH_NTTP_REGISTER_METHOD0)(TestName, __VA_ARGS__)
- #define INTERNAL_CATCH_NTTP_REG_GEN(TestFunc, ...) INTERNAL_CATCH_VA_NARGS_IMPL("dummy", __VA_ARGS__, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER0, INTERNAL_CATCH_NTTP_REGISTER0)(Func, __VA_ARGS__)
- #define INTERNAL_CATCH_DEFINE_SIG_TEST(TestName, ...) INTERNAL_CATCH_VA_NARGS_IMPL("dummy", __VA_ARGS__, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG INTERNAL_CATCH_DEFINE_SIG_TEST0)(TestName, __VA_ARGS__)
- #define INTERNAL_CATCH_DECLARE_SIG_TEST(TestName, ...) INTERNAL_CATCH_VA_NARGS_IMPL("dummy", __VA_ARGS__, INTERNAL_CATCH_DECLARE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DECLAR INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_ INTERNAL_CATCH_DECLARE_SIG_TEST1, INTERNAL_CATCH_DECLARE_SIG_TEST0)(TestName, ↩ __VA_ARGS__)
- #define INTERNAL_CATCH_REMOVE_PARENS_GEN(...) INTERNAL_CATCH_VA_NARGS_IMPL(__VA↩ _ARGS__, INTERNAL_CATCH_REMOVE_PARENS_11_ARG,INTERNAL_CATCH_REMOVE_PARENS_10_ARG,INTERNAL __VA_ARGS__)
- #define INTERNAL_CATCH_TESTCASE2(TestName, ...)
- #define INTERNAL_CATCH_TESTCASE(...) INTERNAL_CATCH_TESTCASE2(INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_S_T_), __VA_ARGS__)
- #define INTERNAL_CATCH_METHOD_AS_TEST_CASE(QualifiedMethod, ...)
- #define INTERNAL_CATCH_TEST_CASE_METHOD2(TestName, ClassName, ...)
- #define INTERNAL_CATCH_TEST_CASE_METHOD(ClassName, ...) INTERNAL_CATCH_TEST_CASE_METHOD2(INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_S_T_), ClassName, __VA_ARGS__)
- #define INTERNAL_CATCH_REGISTER_TESTCASE(Function, ...)
- #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_2(TestName, TestFunc, Name, Tags, Signature, ...)

- #define INTERNAL_CATCH_TEMPLATE_TEST_CASE(Name, Tags, ...) INTERNAL_CATCH_TEMPLATE_TEST_CASE_2(INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_), INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_), Name, Tags, typename TestType, __VA_ARGS__)
- #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG(Name, Tags, Signature, ...) INTERNAL_CATCH_TEMPLATE_TE INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_), INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_), Name, Tags, Signature, __VA_ARGS__)
- #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2(TestName, TestFuncName, Name, Tags, Signature, TmplTypes, TypesList)
- #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE(Name, Tags, ...) INTERNAL_CATCH_TEMPLATE_PROD C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_), INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_), Name, Tags, typename T,__VA_ARGS__)
- #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG(Name, Tags, Signature, ...) INTERNAL_CATCH_TEM C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_), INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_), Name, Tags, Signature, __VA_ARGS__)
- #define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_2(TestName, TestFunc, Name, Tags, TmplList)
- #define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE(Name, Tags, TmplList) INTERNAL_CATCH_TEMPLATE_LIST_T INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_), INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_), Name, Tags, TmplList)
- #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2(TestNameClass, TestName, ClassName, Name, Tags, Signature, ...)
- #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD(ClassName, Name, Tags, ...) INTERNAL_CATCH_TEMPLA INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_), INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_) , ClassName, Name, Tags, typename T, __VA_ARGS__)
- #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG(ClassName, Name, Tags, Signature, ...) INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2(INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_), INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_) , ClassName, Name, Tags, Signature, __VA_ARGS__)
- #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2(TestNameClass, TestName, ClassName, Name, Tags, Signature, TmplTypes, TypesList)
- #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD(ClassName, Name, Tags, ...) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2(INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_), INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_), ClassName, Name, Tags, typename T, __VA_ARGS__)
- #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG(ClassName, Name, Tags, Signature, ...) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2(INTERNAL_CATCH_UNIQUE_ C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_), INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_), ClassName, Name, Tags, Signature, __VA_ARGS__)
- #define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD_2(TestNameClass, TestName, ClassName, Name, Tags, TmplList)
- #define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD(ClassName, Name, Tags, TmplList) INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD_2(INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_), INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_), ClassName, Name, Tags, TmplList)
- #define INTERNAL_CATCH_REGISTER_ENUM(enumName, ...)
- #define CATCH_REGISTER_ENUM(enumName, ...) INTERNAL_CATCH_REGISTER_ENUM(enumName, __VA_ARGS__)
- #define CATCH_INTERNAL_STRINGIFY(...) #__VA_ARGS__
- #define INTERNAL_CATCH_TRY
- #define INTERNAL_CATCH_CATCH(capturer)
- #define INTERNAL_CATCH_REACT(handler) handler.complete();
- #define INTERNAL_CATCH_TEST(macroName, resultDisposition, ...)
- #define INTERNAL_CATCH_IF(macroName, resultDisposition, ...)
- #define INTERNAL_CATCH_ELSE(macroName, resultDisposition, ...)
- #define INTERNAL_CATCH_NO_THROW(macroName, resultDisposition, ...)

- #define INTERNAL_CATCH_THROWS(macroName, resultDisposition, ...)
- #define INTERNAL_CATCH_THROWS_AS(macroName, exceptionType, resultDisposition, expr)
- #define INTERNAL_CATCH_MSG(macroName, messageType, resultDisposition, ...)
- #define INTERNAL_CATCH_CAPTURE(varName, macroName, ...)
- #define INTERNAL_CATCH_INFO(macroName, log) Catch::ScopedMessage INTERNAL_CATCH_UNIQUE_NAME(scopedMessage)(Catch::MessageBuilder(macroName##_catch_sr, CATCH_INTERNAL_LINEINFO, Catch::ResultWas::Info) << log);
- #define INTERNAL_CATCH_UNSCOPED_INFO(macroName, log) Catch::getResultCapture().emplace↩ UnscopedMessage(Catch::MessageBuilder(macroName##_catch_sr, CATCH_INTERNAL_LINEINFO, Catch::ResultWas::Info) << log)
- #define INTERNAL_CATCH_THROWS_STR_MATCHES(macroName, resultDisposition, matcher, ...)
- #define INTERNAL_CATCH_SECTION(...)
- #define INTERNAL_CATCH_DYNAMIC_SECTION(...)
- #define INTERNAL_CATCH_TRANSLATE_EXCEPTION2(translatorName, signature)
- #define INTERNAL_CATCH_TRANSLATE_EXCEPTION(signature) INTERNAL_CATCH_TRANSLATE_EXCEPTION2(INTERNAL_CATCH_UNIQUE_NAME(catch_internal_ExceptionTranslator), signature)
- #define INTERNAL_CHECK_THAT(macroName, matcher, resultDisposition, arg)
- #define INTERNAL_CATCH_THROWS_MATCHES(macroName, exceptionType, resultDisposition, matcher, ...)
- #define CATCH_MAKE_MSG(...) (Catch::ReusableStringStream() << __VA_ARGS__).str()
- #define CATCH_INTERNAL_ERROR(...) Catch::throw_logic_error(CATCH_MAKE_MSG(CATCH_INTERNAL_LINEINFO << ": Internal Catch2 error: " << __VA_ARGS__))
- #define CATCH_ERROR(...) Catch::throw_domain_error(CATCH_MAKE_MSG(__VA_ARGS__))
- #define CATCH_RUNTIME_ERROR(...) Catch::throw_runtime_error(CATCH_MAKE_MSG(__VA_ARGS↩ __))
- #define CATCH_ENFORCE(condition, ...) do{ if(!(condition)) CATCH_ERROR(__VA_ARGS__); } while(false)
- #define GENERATE(...)
- #define GENERATE_COPY(...)
- #define GENERATE_REF(...)
- #define REQUIRE(...) INTERNAL_CATCH_TEST("REQUIRE", Catch::ResultDisposition::Normal, __VA_↩ ARGS__)
- #define REQUIRE_FALSE(...) INTERNAL_CATCH_TEST("REQUIRE_FALSE", Catch::ResultDisposition::Normal | Catch::ResultDisposition::FalseTest, __VA_ARGS__)
- #define REQUIRE_THROWS(...) INTERNAL_CATCH_THROWS("REQUIRE_THROWS", Catch::ResultDisposition::Normal, __VA_ARGS__)
- #define REQUIRE_THROWS_AS(expr, exceptionType) INTERNAL_CATCH_THROWS_AS("REQUIRE_↩ THROWS_AS", exceptionType, Catch::ResultDisposition::Normal, expr)
- #define REQUIRE_THROWS_WITH(expr, matcher) INTERNAL_CATCH_THROWS_STR_MATCHES("REQUIRE_THROWS_WITH", Catch::ResultDisposition::Normal, matcher, expr)
- #define REQUIRE_THROWS_MATCHES(expr, exceptionType, matcher) INTERNAL_CATCH_THROWS_MATCHES("REQUIRE_THROWS_MATCHES", exceptionType, Catch::ResultDisposition::Normal, matcher, expr)
- #define REQUIRE_NOTHROW(...) INTERNAL_CATCH_NO_THROW("REQUIRE_NOTHROW", Catch::ResultDisposition::Nor __VA_ARGS__)
- #define CHECK(...) INTERNAL_CATCH_TEST("CHECK", Catch::ResultDisposition::ContinueOnFailure, ↩ __VA_ARGS__)
- #define CHECK_FALSE(...) INTERNAL_CATCH_TEST("CHECK_FALSE", Catch::ResultDisposition::ContinueOnFailure | Catch::ResultDisposition::FalseTest, __VA_ARGS__)
- #define CHECKED_IF(...) INTERNAL_CATCH_IF("CHECKED_IF", Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__)
- #define CHECKED_ELSE(...) INTERNAL_CATCH_ELSE("CHECKED_ELSE", Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__)
- #define CHECK_NOFAIL(...) INTERNAL_CATCH_TEST("CHECK_NOFAIL", Catch::ResultDisposition::ContinueOnFailure | Catch::ResultDisposition::SuppressFail, __VA_ARGS__)
- #define CHECK_THROWS(...) INTERNAL_CATCH_THROWS("CHECK_THROWS", Catch::ResultDisposition::ContinueOnFai __VA_ARGS__)

- #define CHECK_THROWS_AS(expr, exceptionType) INTERNAL_CATCH_THROWS_AS("CHECK_THROWS_AS", exceptionType, Catch::ResultDisposition::ContinueOnFailure, expr)
- #define CHECK_THROWS_WITH(expr, matcher) INTERNAL_CATCH_THROWS_STR_MATCHES("CHECK_THROWS_WITH", Catch::ResultDisposition::ContinueOnFailure, matcher, expr)
- #define CHECK_THROWS_MATCHES(expr, exceptionType, matcher) INTERNAL_CATCH_THROWS_MATCHES("CHECK_THROWS_MATCHES", exceptionType, Catch::ResultDisposition::ContinueOnFailure, matcher, expr)
- #define CHECK_NOTHROW(...) INTERNAL_CATCH_NO_THROW("CHECK_NOTHROW", Catch::ResultDisposition::Continue __VA_ARGS__)
- #define CHECK_THAT(arg, matcher) INTERNAL_CHECK_THAT("CHECK_THAT", matcher, Catch::ResultDisposition::Continu arg)
- #define REQUIRE_THAT(arg, matcher) INTERNAL_CHECK_THAT("REQUIRE_THAT", matcher, Catch::ResultDisposition::Normal, arg)
- #define INFO(msg) INTERNAL_CATCH_INFO("INFO", msg)
- #define UNSCOPED_INFO(msg) INTERNAL_CATCH_UNSCOPED_INFO("UNSCOPED_INFO", msg)
- #define WARN(msg) INTERNAL_CATCH_MSG("WARN", Catch::ResultWas::Warning, Catch::ResultDisposition::ContinueOnF msg)
- #define CAPTURE(...) INTERNAL_CATCH_CAPTURE(INTERNAL_CATCH_UNIQUE_NAME(capturer), "CAPTURE",__VA_ARGS__)
- #define TEST_CASE(...) INTERNAL_CATCH_TESTCASE(__VA_ARGS__)
- #define TEST_CASE_METHOD(className, ...) INTERNAL_CATCH_TEST_CASE_METHOD(className, __VA_ARGS__)
- #define METHOD_AS_TEST_CASE(method, ...) INTERNAL_CATCH_METHOD_AS_TEST_CASE(method, __VA_ARGS__)
- #define REGISTER_TEST_CASE(Function, ...) INTERNAL_CATCH_REGISTER_TESTCASE(Function, __VA_ARGS__)
- #define SECTION(...) INTERNAL_CATCH_SECTION(__VA_ARGS__)
- #define DYNAMIC_SECTION(...) INTERNAL_CATCH_DYNAMIC_SECTION(__VA_ARGS__)
- #define FAIL(...) INTERNAL_CATCH_MSG("FAIL", Catch::ResultWas::ExplicitFailure, Catch::ResultDisposition::Normal, __VA_ARGS__)
- #define FAIL_CHECK(...) INTERNAL_CATCH_MSG("FAIL_CHECK", Catch::ResultWas::ExplicitFailure, Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__)
- #define SUCCEED(...) INTERNAL_CATCH_MSG("SUCCEED", Catch::ResultWas::Ok, Catch::ResultDisposition::ContinueOnF __VA_ARGS__)
- #define ANON_TEST_CASE() INTERNAL_CATCH_TESTCASE()
- #define TEMPLATE_TEST_CASE(...) INTERNAL_CATCH_TEMPLATE_TEST_CASE(__VA_ARGS__)
- #define TEMPLATE_TEST_CASE_SIG(...) INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG(__VA_ARGS__)
- #define TEMPLATE_TEST_CASE_METHOD(className, ...) INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD(className, __VA_ARGS__)
- #define TEMPLATE_TEST_CASE_METHOD_SIG(className, ...) INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_ className, __VA_ARGS__)
- #define TEMPLATE_PRODUCT_TEST_CASE(...) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE(__VA_ARGS__)
- #define TEMPLATE_PRODUCT_TEST_CASE_SIG(...) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG(__VA_ARGS__)
- #define TEMPLATE_PRODUCT_TEST_CASE_METHOD(className, ...) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST className, __VA_ARGS__)
- #define TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG(className, ...) INTERNAL_CATCH_TEMPLATE_PRODUCT_T className, __VA_ARGS__)
- #define TEMPLATE_LIST_TEST_CASE(...) INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE(__VA_ARGS__)
- #define TEMPLATE_LIST_TEST_CASE_METHOD(className, ...) INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_MET className, __VA_ARGS__)
- #define STATIC_REQUIRE(...) static_assert(__VA_ARGS__, #__VA_ARGS__); SUCCEED(#__VA_ARGS__)

- #define STATIC_REQUIRE_FALSE(...) static_assert(!(__VA_ARGS__), "!(" #__VA_ARGS__ ")"); SUCCEED("!(" #__VA_ARGS__ ")")
- #define CATCH_TRANSLATE_EXCEPTION(signature) INTERNAL_CATCH_TRANSLATE_EXCEPTION(signature)
- #define SCENARIO(...) TEST_CASE("Scenario: " __VA_ARGS__)
- #define SCENARIO_METHOD(className, ...) INTERNAL_CATCH_TEST_CASE_METHOD(className, "Scenario: " __VA_ARGS__)
- #define GIVEN(desc) INTERNAL_CATCH_DYNAMIC_SECTION(" Given: " << desc)
- #define AND_GIVEN(desc) INTERNAL_CATCH_DYNAMIC_SECTION("And given: " << desc)
- #define WHEN(desc) INTERNAL_CATCH_DYNAMIC_SECTION(" When: " << desc)
- #define AND_WHEN(desc) INTERNAL_CATCH_DYNAMIC_SECTION(" And when: " << desc)
- #define THEN(desc) INTERNAL_CATCH_DYNAMIC_SECTION(" Then: " << desc)
- #define AND_THEN(desc) INTERNAL_CATCH_DYNAMIC_SECTION(" And: " << desc)

Typedefs

- template<typename Func , typename... U>
  using Catch::FunctionReturnType = typename std::remove_reference<typename std::remove_cv<typename std::result_of<Func(U...)>::type>::type>::type
- using Catch::IReporterFactoryPtr = std::shared_ptr<IReporterFactory>
- using Catch::exceptionTranslateFunction = std::string(*)()
- using Catch::ExceptionTranslators = std::vector<std::unique_ptr<IExceptionTranslator const>>
- using Catch::StringMatcher = Matchers::Impl::MatcherBase<std::string>
- using Catch::Generators::GeneratorBasePtr = std::unique_ptr<GeneratorUntypedBase>
- using Catch::IConfigPtr = std::shared_ptr<IConfig const>

Enumerations

- enum class Catch::Verbosity { Catch::Quiet = 0 , Catch::Normal , Catch::High }

Functions

- unsigned int Catch::rngSeed ()
- std::ostream & operator<< (std::ostream &, Catch_global_namespace_dummy)
- std::ostream & Catch::operator<< (std::ostream &os, SourceLineInfo const &info)
- template<typename T >
  T const & Catch::operator+ (T const &value, StreamEndStop)
- bool Catch::isThrowSafe (TestCase const &testCase, IConfig const &config)
- bool Catch::matchTest (TestCase const &testCase, TestSpec const &testSpec, IConfig const &config)
- std::vector< TestCase > Catch::filterTests (std::vector< TestCase > const &testCases, TestSpec const &testSpec, IConfig const &config)
- std::vector< TestCase > const & Catch::getAllTestCasesSorted (IConfig const &config)
- auto Catch::operator+= (std::string &lhs, StringRef const &sr) -> std::string &
- auto Catch::operator<< (std::ostream &os, StringRef const &sr) -> std::ostream &
- constexpr auto Catch::operator""_sr (char const *rawChars, std::size_t size) noexcept -> StringRef
- constexpr auto operator""_catch_sr (char const *rawChars, std::size_t size) noexcept -> Catch::StringRef
- auto Catch::makeTestInvoker (void(*testAsFunction)()) noexcept -> ITestInvoker *
- template<typename C >
  auto Catch::makeTestInvoker (void(C::*testAsMethod)()) noexcept -> ITestInvoker *
- bool Catch::isOk (ResultWas::OfType resultType)
- bool Catch::isJustInfo (int flags)
- ResultDisposition::Flags Catch::operator| (ResultDisposition::Flags lhs, ResultDisposition::Flags rhs)
- bool Catch::shouldContinueOnFailure (int flags)

- bool Catch::isFalseTest (int flags)
- bool Catch::shouldSuppressFailure (int flags)
- std::ostream & Catch::cout ()
- std::ostream & Catch::cerr ()
- std::ostream & Catch::clog ()
- auto Catch::makeStream (StringRef const &filename) -> IStream const *
- std::string Catch::Detail::rawMemoryToString (const void *object, std::size_t size)
- template<typename T >
  std::string Catch::Detail::rawMemoryToString (const T &object)
- template<typename E >
  std::string Catch::Detail::convertUnknownEnumToString (E e)
- template<typename T >
  std::enable_if<!std::is_enum< T >::value &&!std::is_base_of< std::exception, T >::value, std::string >::type Catch::Detail::convertUnstreamable (T const &)
- template<typename T >
  std::enable_if<!std::is_enum< T >::value &&std::is_base_of< std::exception, T >::value, std::string >::type Catch::Detail::convertUnstreamable (T const &ex)
- template<typename T >
  std::enable_if< std::is_enum< T >::value, std::string >::type Catch::Detail::convertUnstreamable (T const &value)
- template<typename T >
  std::string Catch::Detail::stringify (const T &e)
- template<typename InputIterator , typename Sentinel = InputIterator>
  std::string Catch::Detail::rangeToString (InputIterator first, Sentinel last)
- template<typename Range >
  std::string Catch::rangeToString (Range const &range)
- template<typename Allocator >
  std::string Catch::rangeToString (std::vector< bool, Allocator > const &v)
- void Catch::formatReconstructedExpression (std::ostream &os, std::string const &lhs, StringRef op, std::string const &rhs)
- template<typename LhsT , typename RhsT >
  auto Catch::compareEqual (LhsT const &lhs, RhsT const &rhs) -> bool
- template<typename T >
  auto Catch::compareEqual (T *const &lhs, int rhs) -> bool
- template<typename T >
  auto Catch::compareEqual (T *const &lhs, long rhs) -> bool
- template<typename T >
  auto Catch::compareEqual (int lhs, T *const &rhs) -> bool
- template<typename T >
  auto Catch::compareEqual (long lhs, T *const &rhs) -> bool
- template<typename LhsT , typename RhsT >
  auto Catch::compareNotEqual (LhsT const &lhs, RhsT &&rhs) -> bool
- template<typename T >
  auto Catch::compareNotEqual (T *const &lhs, int rhs) -> bool
- template<typename T >
  auto Catch::compareNotEqual (T *const &lhs, long rhs) -> bool
- template<typename T >
  auto Catch::compareNotEqual (int lhs, T *const &rhs) -> bool
- template<typename T >
  auto Catch::compareNotEqual (long lhs, T *const &rhs) -> bool
- void Catch::handleExpression (ITransientExpression const &expr)
- template<typename T >
  void Catch::handleExpression (ExprLhs< T > const &expr)
- IResultCapture & Catch::getResultCapture ()
- void Catch::handleExceptionMatchExpr (AssertionHandler &handler, std::string const &str, StringRef const &matcherString)

- auto Catch::getCurrentNanosecondsSinceEpoch () -> uint64_t
- auto Catch::getEstimatedClockResolution () -> uint64_t
- IRegistryHub const & Catch::getRegistryHub ()
- IMutableRegistryHub & Catch::getMutableRegistryHub ()
- void Catch::cleanUp ()
- std::string Catch::translateActiveException ()
- Detail::Approx Catch::literals::operator""_a (long double val)
- Detail::Approx Catch::literals::operator""_a (unsigned long long val)
- bool Catch::startsWith (std::string const &s, std::string const &prefix)
- bool Catch::startsWith (std::string const &s, char prefix)
- bool Catch::endsWith (std::string const &s, std::string const &suffix)
- bool Catch::endsWith (std::string const &s, char suffix)
- bool Catch::contains (std::string const &s, std::string const &infix)
- void Catch::toLowerInPlace (std::string &s)
- std::string Catch::toLower (std::string const &s)
- std::string Catch::trim (std::string const &str)

  Returns a new string without whitespace at the start/end.
- StringRef Catch::trim (StringRef ref)

  Returns a substring of the original ref without whitespace. Beware lifetimes!
- std::vector< StringRef > Catch::splitStringRef (StringRef str, char delimiter)
- bool Catch::replaceInPlace (std::string &str, std::string const &replaceThis, std::string const &withThis)
- Exception::ExceptionMessageMatcher Catch::Matchers::Message (std::string const &message)
- Floating::WithinUlpsMatcher Catch::Matchers::WithinULP (double target, uint64_t maxUlpDiff)
- Floating::WithinUlpsMatcher Catch::Matchers::WithinULP (float target, uint64_t maxUlpDiff)
- Floating::WithinAbsMatcher Catch::Matchers::WithinAbs (double target, double margin)
- Floating::WithinRelMatcher Catch::Matchers::WithinRel (double target, double eps)
- Floating::WithinRelMatcher Catch::Matchers::WithinRel (double target)
- Floating::WithinRelMatcher Catch::Matchers::WithinRel (float target, float eps)
- Floating::WithinRelMatcher Catch::Matchers::WithinRel (float target)
- std::string Catch::Matchers::Generic::Detail::finalizeDescription (const std::string &desc)
- template<typename T >
  Generic::PredicateMatcher< T > Catch::Matchers::Predicate (std::function< bool(T const &)> const &predicate, std::string const &description="")
- StdString::EqualsMatcher Catch::Matchers::Equals (std::string const &str, CaseSensitive::Choice caseSensitivity=CaseSensitiv
- StdString::ContainsMatcher Catch::Matchers::Contains (std::string const &str, CaseSensitive::Choice caseSensitivity=CaseSensitive::Yes)
- StdString::EndsWithMatcher Catch::Matchers::EndsWith (std::string const &str, CaseSensitive::Choice caseSensitivity=CaseSensitive::Yes)
- StdString::StartsWithMatcher Catch::Matchers::StartsWith (std::string const &str, CaseSensitive::Choice caseSensitivity=CaseSensitive::Yes)
- StdString::RegexMatcher Catch::Matchers::Matches (std::string const &regex, CaseSensitive::Choice caseSensitivity=CaseSensitive::Yes)
- template<typename T , typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
  Vector::ContainsMatcher< T, AllocComp, AllocMatch > Catch::Matchers::Contains (std::vector< T, AllocComp > const &comparator)
- template<typename T , typename Alloc = std::allocator<T>>
  Vector::ContainsElementMatcher< T, Alloc > Catch::Matchers::VectorContains (T const &comparator)
- template<typename T , typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
  Vector::EqualsMatcher< T, AllocComp, AllocMatch > Catch::Matchers::Equals (std::vector< T, AllocComp > const &comparator)
- template<typename T , typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
  Vector::ApproxMatcher< T, AllocComp, AllocMatch > Catch::Matchers::Approx (std::vector< T, AllocComp > const &comparator)
- template<typename T , typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
  Vector::UnorderedEqualsMatcher< T, AllocComp, AllocMatch > Catch::Matchers::UnorderedEquals (std↩
  ::vector< T, AllocComp > const &target)

- void Catch::handleExceptionMatchExpr (AssertionHandler &handler, StringMatcher const &matcher, StringRef const &matcherString)
- template<typename ArgT , typename MatcherT >
  auto Catch::makeMatchExpr (ArgT const &arg, MatcherT const &matcher, StringRef const &matcherString) -> MatchExpr< ArgT, MatcherT >
- void Catch::throw_exception (std::exception const &e)
- void Catch::throw_logic_error (std::string const &msg)
- void Catch::throw_domain_error (std::string const &msg)
- void Catch::throw_runtime_error (std::string const &msg)
- template<typename T , typename... Args>
  std::unique_ptr< T > Catch::Generators::pf::make_unique (Args &&... args)
- template<typename T >
  GeneratorWrapper< T > Catch::Generators::value (T &&value)
- template<typename T >
  GeneratorWrapper< T > Catch::Generators::values (std::initializer_list< T > values)
- template<typename... Ts>
  GeneratorWrapper< std::tuple< Ts... > > Catch::Generators::table (std::initializer_list< std::tuple< typename std::decay< Ts >::type... > > tuples)
- template<typename T , typename... Gs>
  auto Catch::Generators::makeGenerators (GeneratorWrapper< T > &&generator, Gs &&... moreGenerators) -> Generators< T >
- template<typename T >
  auto Catch::Generators::makeGenerators (GeneratorWrapper< T > &&generator) -> Generators< T >
- template<typename T , typename... Gs>
  auto Catch::Generators::makeGenerators (T &&val, Gs &&... moreGenerators) -> Generators< T >
- template<typename T , typename U , typename... Gs>
  auto Catch::Generators::makeGenerators (as< T >, U &&val, Gs &&... moreGenerators) -> Generators< T >
- auto Catch::Generators::acquireGeneratorTracker (StringRef generatorName, SourceLineInfo const &lineInfo) -> IGeneratorTracker &
- template<typename L >
  auto Catch::Generators::generate (StringRef generatorName, SourceLineInfo const &lineInfo, L const &generatorExpression) -> decltype(std::declval< decltype(generatorExpression())>().get())
- template<typename T >
  GeneratorWrapper< T > Catch::Generators::take (size_t target, GeneratorWrapper< T > &&generator)
- template<typename T , typename Predicate >
  GeneratorWrapper< T > Catch::Generators::filter (Predicate &&pred, GeneratorWrapper< T > &&generator)
- template<typename T >
  GeneratorWrapper< T > Catch::Generators::repeat (size_t repeats, GeneratorWrapper< T > &&generator)
- template<typename Func , typename U , typename T = FunctionReturnType<Func, U>>
  GeneratorWrapper< T > Catch::Generators::map (Func &&function, GeneratorWrapper< U > &&generator)
- template<typename T >
  GeneratorWrapper< std::vector< T > > Catch::Generators::chunk (size_t size, GeneratorWrapper< T > &&generator)
- IMutableContext & Catch::getCurrentMutableContext ()
- IContext & Catch::getCurrentContext ()
- void Catch::cleanUpContext ()
- SimplePcg32 & Catch::rng ()
- template<typename T >
  std::enable_if< std::is_integral< T >::value &&!std::is_same< T, bool >::value, GeneratorWrapper< T > >::type Catch::Generators::random (T a, T b)
- template<typename T >
  std::enable_if< std::is_floating_point< T >::value, GeneratorWrapper< T > >::type Catch::Generators::random (T a, T b)
- template<typename T >
  GeneratorWrapper< T > Catch::Generators::range (T const &start, T const &end, T const &step)

- template<typename T >
  GeneratorWrapper< T > Catch::Generators::range (T const &start, T const &end)
- template<typename InputIterator , typename InputSentinel , typename ResultType = typename std::iterator_traits<InputIterator>::value_type>
  GeneratorWrapper< ResultType > Catch::Generators::from_range (InputIterator from, InputSentinel to)
- template<typename Container , typename ResultType = typename Container::value_type>
  GeneratorWrapper< ResultType > Catch::Generators::from_range (Container const &cnt)
- TestCase Catch::makeTestCase (ITestInvoker *testCase, std::string const &className, NameAndTags const &nameAndTags, SourceLineInfo const &lineInfo)

Variables

- const std::string Catch::Detail::unprintableString

7.1.1 Macro Definition Documentation

7.1.1.1 AND_GIVEN

```
#define AND_GIVEN(
              desc ) INTERNAL_CATCH_DYNAMIC_SECTION( "And given:  " << desc )
```

Definition at line 17764 of file catch.h.

7.1.1.2 AND_THEN

```
#define AND_THEN(
              desc ) INTERNAL_CATCH_DYNAMIC_SECTION( " And:  " << desc )
```

Definition at line 17768 of file catch.h.

7.1.1.3 AND_WHEN

```
#define AND_WHEN(
              desc ) INTERNAL_CATCH_DYNAMIC_SECTION( " And when:  " << desc )
```

Definition at line 17766 of file catch.h.

7.1.1.4 ANON_TEST_CASE

```
#define ANON_TEST_CASE( ) INTERNAL_CATCH_TESTCASE()
```

Definition at line 17721 of file catch.h.

7.1.1.5 CAPTURE

```
#define CAPTURE(
              ... ) INTERNAL_CATCH_CAPTURE( INTERNAL_CATCH_UNIQUE_NAME(capturer), "CAPTURE",↩
__VA_ARGS__ )
```

Definition at line 17710 of file catch.h.

7.1.1.6 CATCH_CATCH_ALL

```
#define CATCH_CATCH_ALL if ((false))
```

Definition at line 455 of file catch.h.

7.1.1.7 CATCH_CATCH_ANON

```
#define CATCH_CATCH_ANON(
              type ) if ((false))
```

Definition at line 456 of file catch.h.

7.1.1.8 CATCH_CONFIG_COUNTER

```
#define CATCH_CONFIG_COUNTER
```

Definition at line 354 of file catch.h.

7.1.1.9 CATCH_CONFIG_CPP11_TO_STRING

```
#define CATCH_CONFIG_CPP11_TO_STRING
```

Definition at line 369 of file catch.h.

7.1.1.10 CATCH_CONFIG_DISABLE_EXCEPTIONS

```
#define CATCH_CONFIG_DISABLE_EXCEPTIONS
```

Definition at line 397 of file catch.h.

7.1.1.11 CATCH_CONFIG_GLOBAL_NEXTAFTER

```
#define CATCH_CONFIG_GLOBAL_NEXTAFTER
```

Definition at line 413 of file catch.h.

7.1.1.12 CATCH_CONFIG_POSIX_SIGNALS

```
#define CATCH_CONFIG_POSIX_SIGNALS
```

Definition at line 361 of file catch.h.

7.1.1.13 CATCH_CONFIG_WCHAR

```
#define CATCH_CONFIG_WCHAR
```

Definition at line 365 of file catch.h.

7.1.1.14 CATCH_DEFER

```
#define CATCH_DEFER(
              id ) id CATCH_EMPTY()
```

Definition at line 713 of file catch.h.

7.1.1.15 CATCH_EMPTY

```
#define CATCH_EMPTY( )
```

Definition at line 712 of file catch.h.

7.1.1.16 CATCH_ENFORCE

```
#define CATCH_ENFORCE(
              condition,
              ... )    do{ if( !(condition) ) CATCH_ERROR( __VA_ARGS__ ); } while(false)
```

Definition at line 3906 of file catch.h.

7.1.1.17 CATCH_ERROR

```
#define CATCH_ERROR(
              ... )    Catch::throw_domain_error(CATCH_MAKE_MSG( __VA_ARGS__ ))
```

Definition at line 3900 of file catch.h.

7.1.1.18 CATCH_INTERNAL_CONFIG_COUNTER

```
#define CATCH_INTERNAL_CONFIG_COUNTER
```

Definition at line 298 of file catch.h.

7.1.1.19 CATCH_INTERNAL_CONFIG_GLOBAL_NEXTAFTER

```
#define CATCH_INTERNAL_CONFIG_GLOBAL_NEXTAFTER
```

Definition at line 313 of file catch.h.

7.1.1.20 CATCH_INTERNAL_CONFIG_POSIX_SIGNALS

```
#define CATCH_INTERNAL_CONFIG_POSIX_SIGNALS
```

Definition at line 189 of file catch.h.

7.1.1.21 CATCH_INTERNAL_ERROR

```
#define CATCH_INTERNAL_ERROR(
              ... )   Catch::throw_logic_error(CATCH_MAKE_MSG( CATCH_INTERNAL_LINEINFO << ":
Internal Catch2 error:  " << __VA_ARGS__))
```

Definition at line 3897 of file catch.h.

7.1.1.22 CATCH_INTERNAL_IGNORE_BUT_WARN

```
#define CATCH_INTERNAL_IGNORE_BUT_WARN(
              ... )
```

Definition at line 440 of file catch.h.

7.1.1.23 CATCH_INTERNAL_LINEINFO

```
#define CATCH_INTERNAL_LINEINFO  ::Catch::SourceLineInfo( __FILE__, static_cast<std::size_t>(
__LINE__ ) )
```

Definition at line 543 of file catch.h.

7.1.1.24 CATCH_INTERNAL_START_WARNINGS_SUPPRESSION

```
#define CATCH_INTERNAL_START_WARNINGS_SUPPRESSION
```

Definition at line 419 of file catch.h.

7.1.1.25 CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION

```
#define CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
```

Definition at line 422 of file catch.h.

7.1.1.26 CATCH_INTERNAL_STRINGIFY

```
#define CATCH_INTERNAL_STRINGIFY(
              ... ) #__VA_ARGS__
```

Definition at line 2680 of file catch.h.

7.1.1.27 CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS

```
#define CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS
```

Definition at line 428 of file catch.h.

7.1.1.28 CATCH_INTERNAL_SUPPRESS_PARENTHESES_WARNINGS

```
#define CATCH_INTERNAL_SUPPRESS_PARENTHESES_WARNINGS
```

Definition at line 425 of file catch.h.

7.1.1.29 CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS

```
#define CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS
```

Definition at line 450 of file catch.h.

7.1.1.30 CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS

```
#define CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS
```

Definition at line 431 of file catch.h.

7.1.1.31 CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS

```
#define CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS
```

Definition at line 434 of file catch.h.

7.1.1.32 CATCH_MAKE_MSG

```
#define CATCH_MAKE_MSG(
              ... )   (Catch::ReusableStringStream() << __VA_ARGS__).str()
```

Definition at line 3894 of file catch.h.

7.1.1.33 CATCH_REC_END

```
#define CATCH_REC_END(
              ... )
```

Definition at line 709 of file catch.h.

7.1.1.34 CATCH_REC_GET_END

```
#define CATCH_REC_GET_END(
              ...  ) CATCH_REC_GET_END1
```

Definition at line 717 of file catch.h.

7.1.1.35 CATCH_REC_GET_END1

```
#define CATCH_REC_GET_END1(
              ...  ) CATCH_REC_GET_END2
```

Definition at line 716 of file catch.h.

7.1.1.36 CATCH_REC_GET_END2

```
#define CATCH_REC_GET_END2( ) 0, CATCH_REC_END
```

Definition at line 715 of file catch.h.

7.1.1.37 CATCH_REC_LIST

```
#define CATCH_REC_LIST(
              f,
              ...  ) CATCH_RECURSE(CATCH_REC_LIST2(f, __VA_ARGS__, ()()(), ()()(), ()()(), 0))
```

Definition at line 735 of file catch.h.

7.1.1.38 CATCH_REC_LIST0

```
#define CATCH_REC_LIST0(
              f,
              x,
              peek,
              ...  ) , f(x) CATCH_DEFER ( CATCH_REC_NEXT(peek, CATCH_REC_LIST1) ) ( f, peek, ↩
__VA_ARGS__ )
```

Definition at line 722 of file catch.h.

7.1.1.39 CATCH_REC_LIST0_UD

```
#define CATCH_REC_LIST0_UD(
              f,
              userdata,
              x,
              peek,
              ...  ) , f(userdata, x) CATCH_DEFER ( CATCH_REC_NEXT(peek, CATCH_REC_LIST1_UD) )
( f, userdata, peek, __VA_ARGS__ )
```

Definition at line 726 of file catch.h.

7.1.1.40 CATCH_REC_LIST1

```
#define CATCH_REC_LIST1(
              f,
              x,
              peek,
              ...  ) , f(x) CATCH_DEFER ( CATCH_REC_NEXT(peek, CATCH_REC_LIST0) ) ( f, peek, ↩
__VA_ARGS__ )
```

Definition at line 723 of file catch.h.

7.1.1.41 CATCH_REC_LIST1_UD

```
#define CATCH_REC_LIST1_UD(
              f,
              userdata,
              x,
              peek,
              ...  ) , f(userdata, x) CATCH_DEFER ( CATCH_REC_NEXT(peek, CATCH_REC_LIST0_UD) )
( f, userdata, peek, __VA_ARGS__ )
```

Definition at line 727 of file catch.h.

7.1.1.42 CATCH_REC_LIST2

```
#define CATCH_REC_LIST2(
              f,
              x,
              peek,
              ...  ) f(x) CATCH_DEFER ( CATCH_REC_NEXT(peek, CATCH_REC_LIST1) ) ( f, peek, __↩
VA_ARGS__ )
```

Definition at line 724 of file catch.h.

7.1.1.43 CATCH_REC_LIST2_UD

```
#define CATCH_REC_LIST2_UD(
              f,
              userdata,
              x,
              peek,
              ...  ) f(userdata, x) CATCH_DEFER ( CATCH_REC_NEXT(peek, CATCH_REC_LIST1_UD) ) (
f, userdata, peek, __VA_ARGS__ )
```

Definition at line 728 of file catch.h.

7.1.1.44 CATCH_REC_LIST_UD

```
#define CATCH_REC_LIST_UD(
              f,
              userdata,
              ...  ) CATCH_RECURSE(CATCH_REC_LIST2_UD(f, userdata, __VA_ARGS__, ()()(), ()()(),
()()(), 0))
```

Definition at line 733 of file catch.h.

7.1.1.45 CATCH_REC_NEXT

```
#define CATCH_REC_NEXT(
              test,
              next ) CATCH_REC_NEXT1(CATCH_REC_GET_END test, next)
```

Definition at line 720 of file catch.h.

7.1.1.46 CATCH_REC_NEXT0

```
#define CATCH_REC_NEXT0(
              test,
              next,
              ...  ) next CATCH_REC_OUT
```

Definition at line 718 of file catch.h.

7.1.1.47 CATCH_REC_NEXT1

```
#define CATCH_REC_NEXT1(
              test,
              next ) CATCH_DEFER ( CATCH_REC_NEXT0 ) ( test, next, 0)
```

Definition at line 719 of file catch.h.

7.1.1.48 CATCH_REC_OUT

```
#define CATCH_REC_OUT
```

Definition at line 710 of file catch.h.

7.1.1.49 CATCH_RECURSE

```
#define CATCH_RECURSE(
              ...  ) CATCH_RECURSION_LEVEL5(__VA_ARGS__)
```

Definition at line 706 of file catch.h.

7.1.1.50 CATCH_RECURSION_LEVEL0

```
#define CATCH_RECURSION_LEVEL0(
              ...  ) __VA_ARGS__
```

Definition at line 693 of file catch.h.

7.1.1.51 CATCH_RECURSION_LEVEL1

```
#define CATCH_RECURSION_LEVEL1(
              ...  ) CATCH_RECURSION_LEVEL0(CATCH_RECURSION_LEVEL0(CATCH_RECURSION_LEVEL0(__↩
VA_ARGS__)))
```

Definition at line 694 of file catch.h.

7.1.1.52 CATCH_RECURSION_LEVEL2

```
#define CATCH_RECURSION_LEVEL2(
              ...  ) CATCH_RECURSION_LEVEL1(CATCH_RECURSION_LEVEL1(CATCH_RECURSION_LEVEL1(__↩
VA_ARGS__)))
```

Definition at line 695 of file catch.h.

7.1.1.53 CATCH_RECURSION_LEVEL3

```
#define CATCH_RECURSION_LEVEL3(
              ...  ) CATCH_RECURSION_LEVEL2(CATCH_RECURSION_LEVEL2(CATCH_RECURSION_LEVEL2(__↩
VA_ARGS__)))
```

Definition at line 696 of file catch.h.

7.1.1.54 CATCH_RECURSION_LEVEL4

```
#define CATCH_RECURSION_LEVEL4(
              ...  ) CATCH_RECURSION_LEVEL3(CATCH_RECURSION_LEVEL3(CATCH_RECURSION_LEVEL3(__↩
VA_ARGS__)))
```

Definition at line 697 of file catch.h.

7.1.1.55 CATCH_RECURSION_LEVEL5

```
#define CATCH_RECURSION_LEVEL5(
              ...  ) CATCH_RECURSION_LEVEL4(CATCH_RECURSION_LEVEL4(CATCH_RECURSION_LEVEL4(__↩
VA_ARGS__)))
```

Definition at line 698 of file catch.h.

7.1.1.56 CATCH_REGISTER_ENUM

```
#define CATCH_REGISTER_ENUM(
              enumName,
              ...  ) INTERNAL_CATCH_REGISTER_ENUM( enumName, __VA_ARGS__ )
```

Definition at line 2182 of file catch.h.

7.1.1.57 CATCH_REGISTER_TAG_ALIAS

```
#define CATCH_REGISTER_TAG_ALIAS(
              alias,
              spec )
```

Value:

```
    CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
    CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
    namespace{ Catch::RegistrarForTagAliases INTERNAL_CATCH_UNIQUE_NAME( AutoRegisterTagAlias )( alias,
      spec, CATCH_INTERNAL_LINEINFO ); } \
    CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
```

Definition at line 555 of file catch.h.

7.1.1.58 CATCH_RUNTIME_ERROR

```
#define CATCH_RUNTIME_ERROR(
              ... )   Catch::throw_runtime_error(CATCH_MAKE_MSG( __VA_ARGS__ ))
```

Definition at line 3903 of file catch.h.

7.1.1.59 CATCH_TRANSLATE_EXCEPTION

```
#define CATCH_TRANSLATE_EXCEPTION(
              signature ) INTERNAL_CATCH_TRANSLATE_EXCEPTION( signature )
```

Definition at line 17757 of file catch.h.

7.1.1.60 CATCH_TRY

```
#define CATCH_TRY if ((true))
```

Definition at line 454 of file catch.h.

7.1.1.61 CATCH_VERSION_MAJOR

```
#define CATCH_VERSION_MAJOR 2
```

Definition at line 16 of file catch.h.

7.1.1.62 CATCH_VERSION_MINOR

```
#define CATCH_VERSION_MINOR 13
```

Definition at line 17 of file catch.h.

7.1.1.63 CATCH_VERSION_PATCH

```
#define CATCH_VERSION_PATCH 10
```

Definition at line 18 of file catch.h.

7.1.1.64 CHECK

```
#define CHECK(
              ... ) INTERNAL_CATCH_TEST( "CHECK", Catch::ResultDisposition::ContinueOnFailure,
__VA_ARGS__ )
```

Definition at line 17687 of file catch.h.

7.1.1.65 CHECK_FALSE

```
#define CHECK_FALSE(
              ... ) INTERNAL_CATCH_TEST( "CHECK_FALSE", Catch::ResultDisposition::ContinueOnFailure
| Catch::ResultDisposition::FalseTest, __VA_ARGS__ )
```

Definition at line 17688 of file catch.h.

7.1.1.66 CHECK_NOFAIL

```
#define CHECK_NOFAIL(
              ... ) INTERNAL_CATCH_TEST( "CHECK_NOFAIL", Catch::ResultDisposition::ContinueOnFailure
| Catch::ResultDisposition::SuppressFail, __VA_ARGS__ )
```

Definition at line 17691 of file catch.h.

7.1.1.67 CHECK_NOTHROW

```
#define CHECK_NOTHROW(
              ... ) INTERNAL_CATCH_NO_THROW( "CHECK_NOTHROW", Catch::ResultDisposition::ContinueOnFailure,
__VA_ARGS__ )
```

Definition at line 17699 of file catch.h.

7.1.1.68 CHECK_THAT

```
#define CHECK_THAT(
              arg,
              matcher ) INTERNAL_CHECK_THAT( "CHECK_THAT", matcher, Catch::ResultDisposition::ContinueOnFailur
arg )
```

Definition at line 17702 of file catch.h.

7.1.1.69 CHECK_THROWS

```
#define CHECK_THROWS(
              ... ) INTERNAL_CATCH_THROWS( "CHECK_THROWS", Catch::ResultDisposition::ContinueOnFailure,
__VA_ARGS__ )
```

Definition at line 17693 of file catch.h.

7.1.1.70 CHECK_THROWS_AS

```
#define CHECK_THROWS_AS(
              expr,
              exceptionType ) INTERNAL_CATCH_THROWS_AS( "CHECK_THROWS_AS", exceptionType,
Catch::ResultDisposition::ContinueOnFailure, expr )
```

Definition at line 17694 of file catch.h.

7.1.1.71 CHECK_THROWS_MATCHES

```
#define CHECK_THROWS_MATCHES(
              expr,
              exceptionType,
              matcher ) INTERNAL_CATCH_THROWS_MATCHES( "CHECK_THROWS_MATCHES", exceptionType,
Catch::ResultDisposition::ContinueOnFailure, matcher, expr )
```

Definition at line 17697 of file catch.h.

7.1.1.72 CHECK_THROWS_WITH

```
#define CHECK_THROWS_WITH(
              expr,
              matcher ) INTERNAL_CATCH_THROWS_STR_MATCHES( "CHECK_THROWS_WITH", Catch::ResultDisposition::Cont
matcher, expr )
```

Definition at line 17695 of file catch.h.

7.1.1.73 CHECKED_ELSE

```
#define CHECKED_ELSE(
              ... ) INTERNAL_CATCH_ELSE( "CHECKED_ELSE", Catch::ResultDisposition::ContinueOnFailure,
__VA_ARGS__ )
```

Definition at line 17690 of file catch.h.

7.1.1.74 CHECKED_IF

```
#define CHECKED_IF(
              ... ) INTERNAL_CATCH_IF( "CHECKED_IF", Catch::ResultDisposition::ContinueOnFailure,
__VA_ARGS__ )
```

Definition at line 17689 of file catch.h.

7.1.1.75 DYNAMIC_SECTION

```
#define DYNAMIC_SECTION(
               ...  ) INTERNAL_CATCH_DYNAMIC_SECTION( __VA_ARGS__ )
```

Definition at line 17717 of file catch.h.

7.1.1.76 FAIL

```
#define FAIL(
               ...  ) INTERNAL_CATCH_MSG( "FAIL", Catch::ResultWas::ExplicitFailure, Catch::ResultDisposition::
__VA_ARGS__ )
```

Definition at line 17718 of file catch.h.

7.1.1.77 FAIL_CHECK

```
#define FAIL_CHECK(
               ...  ) INTERNAL_CATCH_MSG( "FAIL_CHECK", Catch::ResultWas::ExplicitFailure,
Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
```

Definition at line 17719 of file catch.h.

7.1.1.78 GENERATE

```
#define GENERATE(
               ...  )
```

Value:

```
    Catch::Generators::generate( INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_UNIQUE_NAME(generator)), \
                                 CATCH_INTERNAL_LINEINFO, \
                                 [ ]{ using namespace Catch::Generators; return makeGenerators( __VA_ARGS__
     ); } )
```

Definition at line 4100 of file catch.h.

7.1.1.79 GENERATE_COPY

```
#define GENERATE_COPY(
               ...  )
```

Value:

```
    Catch::Generators::generate( INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_UNIQUE_NAME(generator)), \
                                 CATCH_INTERNAL_LINEINFO, \
                                 [=]{ using namespace Catch::Generators; return makeGenerators( __VA_ARGS__
     ); } )
```

Definition at line 4104 of file catch.h.

7.1.1.80 GENERATE_REF

```
#define GENERATE_REF(
              ...  )
```

Value:

```
    Catch::Generators::generate( INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_UNIQUE_NAME(generator)), \
                                 CATCH_INTERNAL_LINEINFO, \
                                 [&]{ using namespace Catch::Generators; return makeGenerators( __VA_ARGS__
     ); } )
```

Definition at line 4108 of file catch.h.

7.1.1.81 GIVEN

```
#define GIVEN(
              desc ) INTERNAL_CATCH_DYNAMIC_SECTION( " Given:  " << desc )
```

Definition at line 17763 of file catch.h.

7.1.1.82 INFO

```
#define INFO(
              msg ) INTERNAL_CATCH_INFO( "INFO", msg )
```

Definition at line 17707 of file catch.h.

7.1.1.83 INTERNAL_CATCH_CAPTURE

```
#define INTERNAL_CATCH_CAPTURE(
              varName,
              macroName,
              ...  )
```

Value:

```
    auto varName = Catch::Capturer( macroName, CATCH_INTERNAL_LINEINFO, Catch::ResultWas::Info, #__VA_ARGS__
      ); \
    varName.captureValues( 0, __VA_ARGS__ )
```

Definition at line 2786 of file catch.h.

7.1.1.84 INTERNAL_CATCH_CATCH

```
#define INTERNAL_CATCH_CATCH(
              capturer )
```

Definition at line 2691 of file catch.h.

7.1.1.85 INTERNAL_CATCH_DECLARE_SIG_TEST

```
#define INTERNAL_CATCH_DECLARE_SIG_TEST(
              TestName,
              ... ) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__, INTERNAL_CATCH_DECLARE_SIG_TEST_X,INT
INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DECLARE_SIG_TEST_X,
INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_SIG_TEST_X,INTERNAL
INTERNAL_CATCH_DECLARE_SIG_TEST1, INTERNAL_CATCH_DECLARE_SIG_TEST0)(TestName, __VA_ARGS__)
```

Definition at line 903 of file catch.h.

7.1.1.86 INTERNAL_CATCH_DECLARE_SIG_TEST0

```
#define INTERNAL_CATCH_DECLARE_SIG_TEST0(
              TestName )
```

Definition at line 830 of file catch.h.

7.1.1.87 INTERNAL_CATCH_DECLARE_SIG_TEST1

```
#define INTERNAL_CATCH_DECLARE_SIG_TEST1(
              TestName,
              signature )
```

Value:

```
template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
static void TestName()
```

Definition at line 831 of file catch.h.

7.1.1.88 INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD

```
#define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD(
              TestName,
              ClassName,
              ... ) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__, INTERNAL_CATCH_DECLARE_SIG_TEST_METHO
INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG
INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_
INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD1, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD0)(TestName,
ClassName, __VA_ARGS__)
```

Definition at line 899 of file catch.h.

7.1.1.89 INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD0

```
#define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD0(
              TestName,
              ClassName )
```

Definition at line 874 of file catch.h.

7.1.1.90 INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD1

```
#define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD1(
                TestName,
                ClassName,
                signature )
```

Value:

```
template<typename TestType> \
struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName)<TestType> { \
    void test();\
}
```

Definition at line 875 of file catch.h.

7.1.1.91 INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X

```
#define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X(
                TestName,
                ClassName,
                signature,
                ...  )
```

Value:

```
template<INTERNAL_CATCH_REMOVE_PARENS(signature)> \
struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName)<__VA_ARGS__> { \
    void test();\
}
```

Definition at line 881 of file catch.h.

7.1.1.92 INTERNAL_CATCH_DECLARE_SIG_TEST_X

```
#define INTERNAL_CATCH_DECLARE_SIG_TEST_X(
                TestName,
                signature,
                ...  )
```

Value:

```
template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
static void TestName()
```

Definition at line 834 of file catch.h.

7.1.1.93 INTERNAL_CATCH_DEF

```
#define INTERNAL_CATCH_DEF(
                ...  ) INTERNAL_CATCH_DEF __VA_ARGS__
```

Definition at line 739 of file catch.h.

7.1.1.94 INTERNAL_CATCH_DEFINE_SIG_TEST

```
#define INTERNAL_CATCH_DEFINE_SIG_TEST(
              TestName,
              ... ) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__, INTERNAL_CATCH_DEFINE_SIG_TEST_X,
INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X,
INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X,
INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DEFINE_SIG_TEST1,
INTERNAL_CATCH_DEFINE_SIG_TEST0)(TestName, __VA_ARGS__)
```

Definition at line 902 of file catch.h.

7.1.1.95 INTERNAL_CATCH_DEFINE_SIG_TEST0

```
#define INTERNAL_CATCH_DEFINE_SIG_TEST0(
              TestName )
```

Definition at line 838 of file catch.h.

7.1.1.96 INTERNAL_CATCH_DEFINE_SIG_TEST1

```
#define INTERNAL_CATCH_DEFINE_SIG_TEST1(
              TestName,
              signature )
```

Value:

```
template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
static void TestName()
```

Definition at line 839 of file catch.h.

7.1.1.97 INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD

```
#define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD(
              TestName,
              ... ) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD
INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TE
INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TES
INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD1, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD0)(TestName, __↩
VA_ARGS__)
```

Definition at line 898 of file catch.h.

7.1.1.98 INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD0

```
#define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD0(
              TestName )
```

Definition at line 887 of file catch.h.

7.1.1.99 INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD1

```
#define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD1(
              TestName,
              signature )
```

Value:

```
template<typename TestType> \
void INTERNAL_CATCH_MAKE_NAMESPACE(TestName)::TestName<TestType>::test()
```

Definition at line 888 of file catch.h.

7.1.1.100 INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X

```
#define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X(
              TestName,
              signature,
              ... )
```

Value:

```
template<INTERNAL_CATCH_REMOVE_PARENS(signature)> \
void INTERNAL_CATCH_MAKE_NAMESPACE(TestName)::TestName<__VA_ARGS__>::test()
```

Definition at line 891 of file catch.h.

7.1.1.101 INTERNAL_CATCH_DEFINE_SIG_TEST_X

```
#define INTERNAL_CATCH_DEFINE_SIG_TEST_X(
              TestName,
              signature,
              ... )
```

Value:

```
template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
static void TestName()
```

Definition at line 842 of file catch.h.

7.1.1.102 INTERNAL_CATCH_DYNAMIC_SECTION

```
#define INTERNAL_CATCH_DYNAMIC_SECTION(
              ... )
```

Value:

```
CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS \
if( Catch::Section const& INTERNAL_CATCH_UNIQUE_NAME( catch_internal_Section ) = Catch::SectionInfo(
  CATCH_INTERNAL_LINEINFO, (Catch::ReusableStringStream() << __VA_ARGS__).str() ) ) \
CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
```

Definition at line 2936 of file catch.h.

7.1.1.103 INTERNAL_CATCH_ELSE

```
#define INTERNAL_CATCH_ELSE(
              macroName,
              resultDisposition,
              ...  )
```

Value:

```
    INTERNAL_CATCH_TEST( macroName, resultDisposition, __VA_ARGS__ ); \
    if( !Catch::getResultCapture().lastAssertionPassed() )
```

Definition at line 2722 of file catch.h.

7.1.1.104 INTERNAL_CATCH_EXPAND1

```
#define INTERNAL_CATCH_EXPAND1(
              param ) INTERNAL_CATCH_EXPAND2(param)
```

Definition at line 737 of file catch.h.

7.1.1.105 INTERNAL_CATCH_EXPAND2

```
#define INTERNAL_CATCH_EXPAND2(
              ...  ) INTERNAL_CATCH_NO## __VA_ARGS__
```

Definition at line 738 of file catch.h.

7.1.1.106 INTERNAL_CATCH_IF

```
#define INTERNAL_CATCH_IF(
              macroName,
              resultDisposition,
              ...  )
```

Value:

```
    INTERNAL_CATCH_TEST( macroName, resultDisposition, __VA_ARGS__ ); \
    if( Catch::getResultCapture().lastAssertionPassed() )
```

Definition at line 2717 of file catch.h.

7.1.1.107 INTERNAL_CATCH_INFO

```
#define INTERNAL_CATCH_INFO(
              macroName,
              log )  Catch::ScopedMessage INTERNAL_CATCH_UNIQUE_NAME( scopedMessage )( Catch::MessageBuilder(
macroName##_catch_sr, CATCH_INTERNAL_LINEINFO, Catch::ResultWas::Info ) << log );
```

Definition at line 2791 of file catch.h.

7.1.1.108 INTERNAL_CATCH_MAKE_NAMESPACE

```
#define INTERNAL_CATCH_MAKE_NAMESPACE(
              name ) INTERNAL_CATCH_MAKE_NAMESPACE2(name)
```

Definition at line 753 of file catch.h.

7.1.1.109 INTERNAL_CATCH_MAKE_NAMESPACE2

```
#define INTERNAL_CATCH_MAKE_NAMESPACE2(
              ... ) ns_##__VA_ARGS__
```

Definition at line 752 of file catch.h.

7.1.1.110 INTERNAL_CATCH_MAKE_TYPE_LIST

```
#define INTERNAL_CATCH_MAKE_TYPE_LIST(
              ... ) INTERNAL_CATCH_MAKE_TYPE_LIST2(INTERNAL_CATCH_REMOVE_PARENS(__VA_ARGS__))
```

Definition at line 759 of file catch.h.

7.1.1.111 INTERNAL_CATCH_MAKE_TYPE_LIST2

```
#define INTERNAL_CATCH_MAKE_TYPE_LIST2(
              ... ) decltype(get_wrapper<INTERNAL_CATCH_REMOVE_PARENS_GEN(__VA_ARGS__)>())
```

Definition at line 758 of file catch.h.

7.1.1.112 INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES

```
#define INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES(
              ... )    CATCH_REC_LIST(INTERNAL_CATCH_MAKE_TYPE_LIST,__VA_ARGS__)
```

Definition at line 765 of file catch.h.

7.1.1.113 INTERNAL_CATCH_METHOD_AS_TEST_CASE

```
#define INTERNAL_CATCH_METHOD_AS_TEST_CASE(
              QualifiedMethod,
              ... )
```

Value:

```
    CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
    CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
    namespace{ Catch::AutoReg INTERNAL_CATCH_UNIQUE_NAME( autoRegistrar )( Catch::makeTestInvoker(
  &QualifiedMethod ), CATCH_INTERNAL_LINEINFO, "&" #QualifiedMethod, Catch::NameAndTags{ __VA_ARGS__ }
  ); } /* NOLINT */ \
    CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
```

Definition at line 1058 of file catch.h.

7.1.1.114 INTERNAL_CATCH_MSG

```
#define INTERNAL_CATCH_MSG(
                macroName,
                messageType,
                resultDisposition,
                ...  )
```

Value:

```
    do { \
        Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      Catch::StringRef(), resultDisposition ); \
        catchAssertionHandler.handleMessage( messageType, ( Catch::MessageStream() << __VA_ARGS__ +
      ::Catch::StreamEndStop() ).m_stream.str() ); \
        INTERNAL_CATCH_REACT( catchAssertionHandler ) \
    } while( false )
```

Definition at line 2778 of file catch.h.

7.1.1.115 INTERNAL_CATCH_NO_THROW

```
#define INTERNAL_CATCH_NO_THROW(
                macroName,
                resultDisposition,
                ...  )
```

Value:

```
    do { \
        Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(__VA_ARGS__), resultDisposition ); \
        try { \
            static_cast<void>(__VA_ARGS__); \
            catchAssertionHandler.handleExceptionNotThrownAsExpected(); \
        } \
        catch( ... ) { \
            catchAssertionHandler.handleUnexpectedInflightException(); \
        } \
        INTERNAL_CATCH_REACT( catchAssertionHandler ) \
    } while( false )
```

Definition at line 2727 of file catch.h.

7.1.1.116 INTERNAL_CATCH_NOINTERNAL_CATCH_DEF

```
#define INTERNAL_CATCH_NOINTERNAL_CATCH_DEF
```

Definition at line 740 of file catch.h.

7.1.1.117 INTERNAL_CATCH_NTTP_0

```
#define INTERNAL_CATCH_NTTP_0
```

Definition at line 896 of file catch.h.

7.1.1.118 INTERNAL_CATCH_NTTP_1

```
#define INTERNAL_CATCH_NTTP_1(
              signature,
              ...  )
```

Value:

```
    template<INTERNAL_CATCH_REMOVE_PARENS(signature)> struct Nttp{};\
    template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
    constexpr auto get_wrapper() noexcept -> Nttp<__VA_ARGS__> { return {}; } \
    template<template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class...> struct NttpTemplateTypeList{};\
    template<template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class...Cs>\
    constexpr auto get_wrapper() noexcept -> NttpTemplateTypeList<Cs...> { return {}; } \
    \
    template< template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class Container,
      template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class List,
      INTERNAL_CATCH_REMOVE_PARENS(signature)>\
    struct rewrap<NttpTemplateTypeList<Container>, List<__VA_ARGS__» { using type =
      TypeList<Container<__VA_ARGS__»; };\
    template< template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class Container,
      template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class List, INTERNAL_CATCH_REMOVE_PARENS(signature),
      typename...Elements>\
    struct rewrap<NttpTemplateTypeList<Container>, List<__VA_ARGS__>, Elements...> { using type = typename
      append<TypeList<Container<__VA_ARGS__», typename rewrap<NttpTemplateTypeList<Container>,
      Elements...>::type>::type; };\
    template<template <typename...> class Final, template<INTERNAL_CATCH_REMOVE_PARENS(signature)>
      class...Containers, typename...Types>\
    struct create<Final, NttpTemplateTypeList<Containers...>, TypeList<Types...» { using type = typename
      append<Final<>, typename rewrap<NttpTemplateTypeList<Containers>, Types...>::type...>::type; };
```

Definition at line 815 of file catch.h.

7.1.1.119 INTERNAL_CATCH_NTTP_GEN

```
#define INTERNAL_CATCH_NTTP_GEN(
              ...  ) INTERNAL_CATCH_VA_NARGS_IMPL(__VA_ARGS__, INTERNAL_CATCH_NTTP_1(__VA_↩
ARGS__), INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1(↩
__VA_ARGS__), INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1( __VA_ARGS__), INTERNAL_CATCH_NTTP_1(
__VA_ARGS__), INTERNAL_CATCH_NTTP_1( __VA_ARGS__), INTERNAL_CATCH_NTTP_1( __VA_ARGS__),INTERNAL_CATCH_NTTP_1(
__VA_ARGS__), INTERNAL_CATCH_NTTP_0)
```

Definition at line 897 of file catch.h.

7.1.1.120 INTERNAL_CATCH_NTTP_REG_GEN

```
#define INTERNAL_CATCH_NTTP_REG_GEN(
              TestFunc,
              ...  ) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__, INTERNAL_CATCH_NTTP_REGISTER,
INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER,
INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER,
INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER0,
INTERNAL_CATCH_NTTP_REGISTER0)(TestFunc, __VA_ARGS__)
```

Definition at line 901 of file catch.h.

7.1.1.121 INTERNAL_CATCH_NTTP_REG_METHOD_GEN

```
#define INTERNAL_CATCH_NTTP_REG_METHOD_GEN(
              TestName,
              ...  ) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD0
INTERNAL_CATCH_NTTP_REGISTER_METHOD0)(TestName, __VA_ARGS__)
```

Definition at line 900 of file catch.h.

7.1.1.122 INTERNAL_CATCH_NTTP_REGISTER

```
#define INTERNAL_CATCH_NTTP_REGISTER(
                TestFunc,
                signature,
                ...  )
```

Value:

```
template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
void reg_test(Nttp<__VA_ARGS__>, Catch::NameAndTags nameAndTags)\
{\
    Catch::AutoReg( Catch::makeTestInvoker(&TestFunc<__VA_ARGS__>), CATCH_INTERNAL_LINEINFO,
  Catch::StringRef(), nameAndTags);\
}
```

Definition at line 853 of file catch.h.

7.1.1.123 INTERNAL_CATCH_NTTP_REGISTER0

```
#define INTERNAL_CATCH_NTTP_REGISTER0(
                TestFunc,
                signature )
```

Value:

```
template<typename Type>\
void reg_test(TypeList<Type>, Catch::NameAndTags nameAndTags)\
{\
    Catch::AutoReg( Catch::makeTestInvoker(&TestFunc<Type>), CATCH_INTERNAL_LINEINFO,
  Catch::StringRef(), nameAndTags);\
}
```

Definition at line 846 of file catch.h.

7.1.1.124 INTERNAL_CATCH_NTTP_REGISTER_METHOD

```
#define INTERNAL_CATCH_NTTP_REGISTER_METHOD(
                TestName,
                signature,
                ...  )
```

Value:

```
template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
void reg_test(Nttp<__VA_ARGS__>, Catch::StringRef className, Catch::NameAndTags nameAndTags)\
{\
    Catch::AutoReg( Catch::makeTestInvoker(&TestName<__VA_ARGS__>::test), CATCH_INTERNAL_LINEINFO,
  className, nameAndTags);\
}
```

Definition at line 867 of file catch.h.

7.1.1.125 INTERNAL_CATCH_NTTP_REGISTER_METHOD0

```
#define INTERNAL_CATCH_NTTP_REGISTER_METHOD0(
                TestName,
                signature,
                ...  )
```

Value:

```
template<typename Type>\
void reg_test(TypeList<Type>, Catch::StringRef className, Catch::NameAndTags nameAndTags)\
{\
    Catch::AutoReg( Catch::makeTestInvoker(&TestName<Type>::test), CATCH_INTERNAL_LINEINFO, className,
  nameAndTags);\
}
```

Definition at line 860 of file catch.h.

7.1.1.126 INTERNAL_CATCH_REACT

```
#define INTERNAL_CATCH_REACT(
              handler ) handler.complete();
```

Definition at line 2700 of file catch.h.

7.1.1.127 INTERNAL_CATCH_REGISTER_ENUM

```
#define INTERNAL_CATCH_REGISTER_ENUM(
              enumName,
              ...  )
```

Value:

```
namespace Catch { \
    template<> struct StringMaker<enumName> { \
        static std::string convert( enumName value ) { \
            static const auto& enumInfo =
      ::Catch::getMutableRegistryHub().getMutableEnumValuesRegistry().registerEnum( #enumName, #__VA_ARGS__,
      { __VA_ARGS__ } ); \
            return static_cast<std::string>(enumInfo.lookup( static_cast<int>( value ) )); \
        } \
    }; \
}
```

Definition at line 2172 of file catch.h.

7.1.1.128 INTERNAL_CATCH_REGISTER_TESTCASE

```
#define INTERNAL_CATCH_REGISTER_TESTCASE(
              Function,
              ...  )
```

Value:

```
       CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
       CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
       Catch::AutoReg INTERNAL_CATCH_UNIQUE_NAME( autoRegistrar )( Catch::makeTestInvoker( Function ),
     CATCH_INTERNAL_LINEINFO, Catch::StringRef(), Catch::NameAndTags{ __VA_ARGS__ } ); /* NOLINT */ \
       CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
```

Definition at line 1080 of file catch.h.

7.1.1.129 INTERNAL_CATCH_REMOVE_PARENS

```
#define INTERNAL_CATCH_REMOVE_PARENS(
              ...  ) INTERNAL_CATCH_EXPAND1(INTERNAL_CATCH_DEF __VA_ARGS__)
```

Definition at line 755 of file catch.h.

7.1.1.130 INTERNAL_CATCH_REMOVE_PARENS_10_ARG

```
#define INTERNAL_CATCH_REMOVE_PARENS_10_ARG(
              _0,
              _1,
              _2,
              _3,
              _4,
              _5,
              _6,
              _7,
              _8,
              _9 ) INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_9_ARG(_1, _↩
2, _3, _4, _5, _6, _7, _8, _9)
```

Definition at line 777 of file catch.h.

7.1.1.131 INTERNAL_CATCH_REMOVE_PARENS_11_ARG

```
#define INTERNAL_CATCH_REMOVE_PARENS_11_ARG(
              _0,
              _1,
              _2,
              _3,
              _4,
              _5,
              _6,
              _7,
              _8,
              _9,
              _10 ) INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_10_ARG(_1,
_2, _3, _4, _5, _6, _7, _8, _9, _10)
```

Definition at line 778 of file catch.h.

7.1.1.132 INTERNAL_CATCH_REMOVE_PARENS_1_ARG

```
#define INTERNAL_CATCH_REMOVE_PARENS_1_ARG(
              _0 ) INTERNAL_CATCH_REMOVE_PARENS(_0)
```

Definition at line 768 of file catch.h.

7.1.1.133 INTERNAL_CATCH_REMOVE_PARENS_2_ARG

```
#define INTERNAL_CATCH_REMOVE_PARENS_2_ARG(
              _0,
              _1 ) INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_1_ARG(_1)
```

Definition at line 769 of file catch.h.

7.1.1.134 INTERNAL_CATCH_REMOVE_PARENS_3_ARG

```
#define INTERNAL_CATCH_REMOVE_PARENS_3_ARG(
              _0,
              _1,
              _2 ) INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_2_ARG(_1, _↩
2)
```

Definition at line 770 of file catch.h.

7.1.1.135 INTERNAL_CATCH_REMOVE_PARENS_4_ARG

```
#define INTERNAL_CATCH_REMOVE_PARENS_4_ARG(
              _0,
              _1,
              _2,
              _3 ) INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_3_ARG(_1, _↩
2, _3)
```

Definition at line 771 of file catch.h.

7.1.1.136 INTERNAL_CATCH_REMOVE_PARENS_5_ARG

```
#define INTERNAL_CATCH_REMOVE_PARENS_5_ARG(
              _0,
              _1,
              _2,
              _3,
              _4 ) INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_4_ARG(_1, _↩
2, _3, _4)
```

Definition at line 772 of file catch.h.

7.1.1.137 INTERNAL_CATCH_REMOVE_PARENS_6_ARG

```
#define INTERNAL_CATCH_REMOVE_PARENS_6_ARG(
              _0,
              _1,
              _2,
              _3,
              _4,
              _5 ) INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_5_ARG(_1, _↩
2, _3, _4, _5)
```

Definition at line 773 of file catch.h.

7.1.1.138 INTERNAL_CATCH_REMOVE_PARENS_7_ARG

```
#define INTERNAL_CATCH_REMOVE_PARENS_7_ARG(
              _0,
              _1,
              _2,
              _3,
              _4,
              _5,
              _6 ) INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_6_ARG(_1, _↩
2, _3, _4, _5, _6)
```

Definition at line 774 of file catch.h.

7.1.1.139 INTERNAL_CATCH_REMOVE_PARENS_8_ARG

```
#define INTERNAL_CATCH_REMOVE_PARENS_8_ARG(
              _0,
              _1,
              _2,
              _3,
              _4,
              _5,
              _6,
              _7 ) INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_7_ARG(_1, _↩
2, _3, _4, _5, _6, _7)
```

Definition at line 775 of file catch.h.

7.1.1.140 INTERNAL_CATCH_REMOVE_PARENS_9_ARG

```
#define INTERNAL_CATCH_REMOVE_PARENS_9_ARG(
              _0,
              _1,
              _2,
              _3,
              _4,
              _5,
              _6,
              _7,
              _8 ) INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_8_ARG(_1, _↩
2, _3, _4, _5, _6, _7, _8)
```

Definition at line 776 of file catch.h.

7.1.1.141 INTERNAL_CATCH_REMOVE_PARENS_GEN

```
#define INTERNAL_CATCH_REMOVE_PARENS_GEN(
              ...  ) INTERNAL_CATCH_VA_NARGS_IMPL(__VA_ARGS__, INTERNAL_CATCH_REMOVE_PARENS_11_ARG,INTERNAL_CA
__VA_ARGS__)
```

Definition at line 904 of file catch.h.

7.1.1.142 INTERNAL_CATCH_SECTION

```
#define INTERNAL_CATCH_SECTION(
              ...  )
```

Value:

```
    CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
    CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS \
    if( Catch::Section const& INTERNAL_CATCH_UNIQUE_NAME( catch_internal_Section ) = Catch::SectionInfo(
      CATCH_INTERNAL_LINEINFO, __VA_ARGS__ ) ) \
    CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
```

Definition at line 2930 of file catch.h.

7.1.1.143 INTERNAL_CATCH_STRINGIZE

```
#define INTERNAL_CATCH_STRINGIZE(
              ...  ) INTERNAL_CATCH_STRINGIZE2(__VA_ARGS__)
```

Definition at line 741 of file catch.h.

7.1.1.144 INTERNAL_CATCH_STRINGIZE2

```
#define INTERNAL_CATCH_STRINGIZE2(
              ...  ) #__VA_ARGS__
```

Definition at line 743 of file catch.h.

7.1.1.145 INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS

```
#define INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS(
              param ) INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_REMOVE_PARENS(param))
```

Definition at line 744 of file catch.h.

7.1.1.146 INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE

```
#define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE(
              Name,
              Tags,
              TmplList )  INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_2( INTERNAL_CATCH_UNIQUE_NAME(
C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_↩
T_E_S_T_F_U_N_C_ ), Name, Tags, TmplList )
```

Definition at line 1208 of file catch.h.

7.1.1.147 INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_2

```
#define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_2(
              TestName,
              TestFunc,
              Name,
              Tags,
              TmplList )
```

Value:

```
        CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
        CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
        CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
        template<typename TestType> static void TestFunc();       \
        namespace {\
        namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName){\
        INTERNAL_CATCH_TYPE_GEN\
        template<typename... Types>                               \
        struct TestName {                                         \
            void reg_tests() {                                        \
                int index = 0;                                    \
                using expander = int[];                           \
                (void)expander{(Catch::AutoReg( Catch::makeTestInvoker( &TestFunc<Types> ),
      CATCH_INTERNAL_LINEINFO, Catch::StringRef(), Catch::NameAndTags{ Name " - " +
      std::string(INTERNAL_CATCH_STRINGIZE(TmplList)) + " - " + std::to_string(index), Tags } ), index++)...
      };/* NOLINT */\
            }                                                     \
        };\
        static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){ \
                using TestInit = typename convert<TestName, TmplList>::type; \
                TestInit t;                                           \
                t.reg_tests();                                        \
                return 0;                                             \
            }();                                                      \
        }}\
        CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION                       \
        template<typename TestType>                                   \
        static void TestFunc()
```

Definition at line 1181 of file catch.h.

7.1.1.148 INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD

```
#define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD(
              ClassName,
              Name,
              Tags,
              TmplList )  INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_↩
T_E_S_T_F_U_N_C_ ), ClassName, Name, Tags, TmplList )
```

Definition at line 1338 of file catch.h.

7.1.1.149 INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD_2

```
#define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD_2(
              TestNameClass,
              TestName,
              ClassName,
              Name,
              Tags,
              TmplList )
```

Value:

```
    CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
    CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
    CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
    template<typename TestType> \
    struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName <TestType>) { \
        void test();\
    };\
    namespace {\
    namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName){ \
        INTERNAL_CATCH_TYPE_GEN\
        template<typename...Types>\
        struct TestNameClass{\
            void reg_tests(){\
                int index = 0;\
                using expander = int[];\
                (void)expander{(Catch::AutoReg( Catch::makeTestInvoker( &TestName<Types>::test ),
CATCH_INTERNAL_LINEINFO, #ClassName, Catch::NameAndTags{ Name " - " +
std::string(INTERNAL_CATCH_STRINGIZE(TmplList)) + " - " + std::to_string(index), Tags } ), index++)...
};/* NOLINT */ \
            }\
        };\
        static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){\
            using TestInit = typename convert<TestNameClass, TmplList>::type;\
            TestInit t;\
            t.reg_tests();\
            return 0;\
        }(); \
    }}\
    CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
    template<typename TestType> \
    void TestName<TestType>::test()
```

Definition at line 1308 of file catch.h.

7.1.1.150 INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE

```
#define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE(
              Name,
              Tags,
              ... )   INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2(INTERNAL_CATCH_UNIQUE_NAME(
C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_↩
T_E_S_T_F_U_N_C_ ), Name, Tags, typename T,__VA_ARGS__)
```

Definition at line 1166 of file catch.h.

7.1.1.151 INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2

```
#define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2(
              TestName,
              TestFuncName,
              Name,
              Tags,
              Signature,
              TmplTypes,
              TypesList )
```

Definition at line 1132 of file catch.h.

7.1.1.152 INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD

```
#define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD(
              ClassName,
              Name,
              Tags,
              ... )   INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_↩
T_E_S_T_F_U_N_C_ ), ClassName, Name, Tags, typename T, __VA_ARGS__ )
```

Definition at line 1293 of file catch.h.

7.1.1.153 INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2

```
#define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2(
              TestNameClass,
              TestName,
              ClassName,
              Name,
              Tags,
              Signature,
              TmplTypes,
              TypesList )
```

Definition at line 1256 of file catch.h.

7.1.1.154 INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG

```
#define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG(
              ClassName,
              Name,
              Tags,
              Signature,
              ... )    INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_↩
T_E_S_T_F_U_N_C_ ), ClassName, Name, Tags, Signature, __VA_ARGS__ )
```

Definition at line 1301 of file catch.h.

7.1.1.155 INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG

```
#define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG(
              Name,
              Tags,
              Signature,
              ... )    INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2(INTERNAL_CATCH_UNIQUE_NAME(
C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_↩
T_E_S_T_F_U_N_C_ ), Name, Tags, Signature, __VA_ARGS__)
```

Definition at line 1174 of file catch.h.

7.1.1.156 INTERNAL_CATCH_TEMPLATE_TEST_CASE

```
#define INTERNAL_CATCH_TEMPLATE_TEST_CASE(
              Name,
              Tags,
              ... )    INTERNAL_CATCH_TEMPLATE_TEST_CASE_2( INTERNAL_CATCH_UNIQUE_NAME( C_A_T↩
_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S↩
_T_F_U_N_C_ ), Name, Tags, typename TestType, __VA_ARGS__ )
```

Definition at line 1117 of file catch.h.

7.1.1.157 INTERNAL_CATCH_TEMPLATE_TEST_CASE_2

```
#define INTERNAL_CATCH_TEMPLATE_TEST_CASE_2(
              TestName,
              TestFunc,
              Name,
              Tags,
              Signature,
              ...  )
```

Value:

```
        CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
        CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
        CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS \
        CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
        INTERNAL_CATCH_DECLARE_SIG_TEST(TestFunc, INTERNAL_CATCH_REMOVE_PARENS(Signature));\
        namespace {\
        namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName){\
            INTERNAL_CATCH_TYPE_GEN\
            INTERNAL_CATCH_NTTP_GEN(INTERNAL_CATCH_REMOVE_PARENS(Signature))\
            INTERNAL_CATCH_NTTP_REG_GEN(TestFunc,INTERNAL_CATCH_REMOVE_PARENS(Signature))\
            template<typename...Types> \
            struct TestName{\
                TestName(){\
                    int index = 0;                                      \
                    constexpr char const* tmpl_types[] =
      {CATCH_REC_LIST(INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS, __VA_ARGS__)};\
                    using expander = int[];\
                    (void)expander{(reg_test(Types{}, Catch::NameAndTags{ Name " - " +
      std::string(tmpl_types[index]), Tags } ), index++)... };/* NOLINT */ \
                }\
            };\
            static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){\
            TestName<INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES(__VA_ARGS__)>();\
            return 0;\
          }();\
          }\
          }\
          CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
          INTERNAL_CATCH_DEFINE_SIG_TEST(TestFunc,INTERNAL_CATCH_REMOVE_PARENS(Signature))
```

Definition at line 1087 of file catch.h.

7.1.1.158 INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD

```
#define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD(
              ClassName,
              Name,
              Tags,
              ...  )    INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ), INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_↩
P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, typename T, __VA_ARGS__ )
```

Definition at line 1241 of file catch.h.

7.1.1.159 INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2

```
#define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2(
              TestNameClass,
              TestName,
              ClassName,
              Name,
              Tags,
```

```
            Signature,
            ... )
```

Value:

```
    CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
    CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
    CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS \
    CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
    namespace {\
    namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName){ \
        INTERNAL_CATCH_TYPE_GEN\
        INTERNAL_CATCH_NTTP_GEN(INTERNAL_CATCH_REMOVE_PARENS(Signature))\
        INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD(TestName, ClassName,
INTERNAL_CATCH_REMOVE_PARENS(Signature));\
        INTERNAL_CATCH_NTTP_REG_METHOD_GEN(TestName, INTERNAL_CATCH_REMOVE_PARENS(Signature))\
        template<typename...Types> \
        struct TestNameClass{\
            TestNameClass(){\
                int index = 0;                                      \
                constexpr char const* tmpl_types[] =
{CATCH_REC_LIST(INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS, __VA_ARGS__)};\
                using expander = int[];\
                (void)expander{(reg_test(Types{}, #ClassName, Catch::NameAndTags{ Name " - " +
std::string(tmpl_types[index]), Tags } ), index++)... };/* NOLINT */ \
            }\
        };\
        static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){\
            TestNameClass<INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES(__VA_ARGS__)>();\
            return 0;\
      }();\
      }\
      }\
      CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
      INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD(TestName, INTERNAL_CATCH_REMOVE_PARENS(Signature))
```

Definition at line 1211 of file catch.h.

7.1.1.160 INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG

```
#define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG(
            ClassName,
            Name,
            Tags,
            Signature,
            ... )    INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ), INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_↩
P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, Signature, __VA_ARGS__ )
```

Definition at line 1249 of file catch.h.

7.1.1.161 INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG

```
#define INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG(
            Name,
            Tags,
            Signature,
            ... )    INTERNAL_CATCH_TEMPLATE_TEST_CASE_2( INTERNAL_CATCH_UNIQUE_NAME( C_A_T↩
_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S↩
_T_F_U_N_C_ ), Name, Tags, Signature, __VA_ARGS__ )
```

Definition at line 1125 of file catch.h.

7.1.1.162 INTERNAL_CATCH_TEST

```
#define INTERNAL_CATCH_TEST(
              macroName,
              resultDisposition,
              ...  )
```

Value:

```
    do { \
        CATCH_INTERNAL_IGNORE_BUT_WARN(__VA_ARGS__); \
        Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(__VA_ARGS__), resultDisposition ); \
        INTERNAL_CATCH_TRY { \
            CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
            CATCH_INTERNAL_SUPPRESS_PARENTHESES_WARNINGS \
            catchAssertionHandler.handleExpr( Catch::Decomposer() <= __VA_ARGS__ ); \
            CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
        } INTERNAL_CATCH_CATCH( catchAssertionHandler ) \
        INTERNAL_CATCH_REACT( catchAssertionHandler ) \
    } while( (void)0, (false) && static_cast<bool>( !!(__VA_ARGS__) ) )
```

Definition at line 2703 of file catch.h.

7.1.1.163 INTERNAL_CATCH_TEST_CASE_METHOD

```
#define INTERNAL_CATCH_TEST_CASE_METHOD(
              ClassName,
              ...  )    INTERNAL_CATCH_TEST_CASE_METHOD2( INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_↩
H_T_E_S_T_ ), ClassName, __VA_ARGS__ )
```

Definition at line 1076 of file catch.h.

7.1.1.164 INTERNAL_CATCH_TEST_CASE_METHOD2

```
#define INTERNAL_CATCH_TEST_CASE_METHOD2(
              TestName,
              ClassName,
              ...  )
```

Value:

```
        CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
        CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
        namespace{ \
            struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName) { \
                void test(); \
            }; \
            Catch::AutoReg INTERNAL_CATCH_UNIQUE_NAME( autoRegistrar ) ( Catch::makeTestInvoker(
      &TestName::test ), CATCH_INTERNAL_LINEINFO, #ClassName, Catch::NameAndTags{ __VA_ARGS__ } ); /* NOLINT
      */ \
        } \
        CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
        void TestName::test()
```

Definition at line 1065 of file catch.h.

7.1.1.165 INTERNAL_CATCH_TESTCASE

```
#define INTERNAL_CATCH_TESTCASE(
              ...  )    INTERNAL_CATCH_TESTCASE2( INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_S_↩
T_ ), __VA_ARGS__ )
```

Definition at line 1054 of file catch.h.

7.1.1.166 INTERNAL_CATCH_TESTCASE2

```
#define INTERNAL_CATCH_TESTCASE2(
                TestName,
                ...  )
```

Value:

```
        static void TestName(); \
        CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
        CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
        namespace{ Catch::AutoReg INTERNAL_CATCH_UNIQUE_NAME( autoRegistrar )( Catch::makeTestInvoker(
      &TestName ), CATCH_INTERNAL_LINEINFO, Catch::StringRef(), Catch::NameAndTags{ __VA_ARGS__ } ); } /*
      NOLINT */ \
        CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
        static void TestName()
```

Definition at line 1047 of file catch.h.

7.1.1.167 INTERNAL_CATCH_THROWS

```
#define INTERNAL_CATCH_THROWS(
                macroName,
                resultDisposition,
                ...  )
```

Value:

```
    do { \
        Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(__VA_ARGS__), resultDisposition); \
        if( catchAssertionHandler.allowThrows() ) \
            try { \
                static_cast<void>(__VA_ARGS__); \
                catchAssertionHandler.handleUnexpectedExceptionNotThrown(); \
            } \
            catch( ... ) { \
                catchAssertionHandler.handleExceptionThrownAsExpected(); \
            } \
        else \
            catchAssertionHandler.handleThrowingCallSkipped(); \
        INTERNAL_CATCH_REACT( catchAssertionHandler ) \
    } while( false )
```

Definition at line 2741 of file catch.h.

7.1.1.168 INTERNAL_CATCH_THROWS_AS

```
#define INTERNAL_CATCH_THROWS_AS(
                macroName,
                exceptionType,
                resultDisposition,
                expr )
```

Value:

```
    do { \
        Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(expr) ", " CATCH_INTERNAL_STRINGIFY(exceptionType), resultDisposition ); \
        if( catchAssertionHandler.allowThrows() ) \
            try { \
                static_cast<void>(expr); \
                catchAssertionHandler.handleUnexpectedExceptionNotThrown(); \
            } \
            catch( exceptionType const& ) { \
                catchAssertionHandler.handleExceptionThrownAsExpected(); \
            } \
            catch( ... ) { \
                catchAssertionHandler.handleUnexpectedInflightException(); \
            } \
        else \
            catchAssertionHandler.handleThrowingCallSkipped(); \
        INTERNAL_CATCH_REACT( catchAssertionHandler ) \
    } while( false )
```

Definition at line 2758 of file catch.h.

7.1.1.169 INTERNAL_CATCH_THROWS_MATCHES

```
#define INTERNAL_CATCH_THROWS_MATCHES(
                macroName,
                exceptionType,
                resultDisposition,
                matcher,
                ...  )
```

Value:

```
    do { \
        Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(__VA_ARGS__) ", " CATCH_INTERNAL_STRINGIFY(exceptionType) ", "
      CATCH_INTERNAL_STRINGIFY(matcher), resultDisposition ); \
        if( catchAssertionHandler.allowThrows() ) \
            try { \
                static_cast<void>(__VA_ARGS__ ); \
                catchAssertionHandler.handleUnexpectedExceptionNotThrown(); \
            } \
            catch( exceptionType const& ex ) { \
                catchAssertionHandler.handleExpr( Catch::makeMatchExpr( ex, matcher, #matcher##_catch_sr )
      ); \
            } \
            catch( ... ) { \
                catchAssertionHandler.handleUnexpectedInflightException(); \
            } \
        else \
            catchAssertionHandler.handleThrowingCallSkipped(); \
        INTERNAL_CATCH_REACT( catchAssertionHandler ) \
    } while( false )
```

Definition at line 3814 of file catch.h.

7.1.1.170 INTERNAL_CATCH_THROWS_STR_MATCHES

```
#define INTERNAL_CATCH_THROWS_STR_MATCHES(
                macroName,
                resultDisposition,
                matcher,
                ...  )
```

Value:

```
    do { \
        Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(__VA_ARGS__) ", " CATCH_INTERNAL_STRINGIFY(matcher), resultDisposition ); \
        if( catchAssertionHandler.allowThrows() ) \
            try { \
                static_cast<void>(__VA_ARGS__); \
                catchAssertionHandler.handleUnexpectedExceptionNotThrown(); \
            } \
            catch( ... ) { \
                Catch::handleExceptionMatchExpr( catchAssertionHandler, matcher, #matcher##_catch_sr ); \
            } \
        else \
            catchAssertionHandler.handleThrowingCallSkipped(); \
        INTERNAL_CATCH_REACT( catchAssertionHandler ) \
    } while( false )
```

Definition at line 2800 of file catch.h.

7.1.1.171 INTERNAL_CATCH_TRANSLATE_EXCEPTION

```
#define INTERNAL_CATCH_TRANSLATE_EXCEPTION(
                signature ) INTERNAL_CATCH_TRANSLATE_EXCEPTION2( INTERNAL_CATCH_UNIQUE_NAME(
catch_internal_ExceptionTranslator ), signature )
```

Definition at line 3068 of file catch.h.

7.1.1.172 INTERNAL_CATCH_TRANSLATE_EXCEPTION2

```
#define INTERNAL_CATCH_TRANSLATE_EXCEPTION2(
              translatorName,
              signature )
```

Value:

```
static std::string translatorName( signature ); \
CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
namespace{ Catch::ExceptionTranslatorRegistrar INTERNAL_CATCH_UNIQUE_NAME(
  catch_internal_ExceptionRegistrar )( &translatorName ); } \
CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
static std::string translatorName( signature )
```

Definition at line 3060 of file catch.h.

7.1.1.173 INTERNAL_CATCH_TRY

```
#define INTERNAL_CATCH_TRY
```

Definition at line 2690 of file catch.h.

7.1.1.174 INTERNAL_CATCH_TYPE_GEN

```
#define INTERNAL_CATCH_TYPE_GEN
```

Definition at line 782 of file catch.h.

7.1.1.175 INTERNAL_CATCH_UNIQUE_NAME

```
#define INTERNAL_CATCH_UNIQUE_NAME(
              name ) INTERNAL_CATCH_UNIQUE_NAME_LINE( name, __COUNTER__ )
```

Definition at line 471 of file catch.h.

7.1.1.176 INTERNAL_CATCH_UNIQUE_NAME_LINE

```
#define INTERNAL_CATCH_UNIQUE_NAME_LINE(
              name,
              line ) INTERNAL_CATCH_UNIQUE_NAME_LINE2( name, line )
```

Definition at line 469 of file catch.h.

7.1.1.177 INTERNAL_CATCH_UNIQUE_NAME_LINE2

```
#define INTERNAL_CATCH_UNIQUE_NAME_LINE2(
              name,
              line ) name##line
```

Definition at line 468 of file catch.h.

7.1.1.178 INTERNAL_CATCH_UNSCOPED_INFO

```
#define INTERNAL_CATCH_UNSCOPED_INFO(
              macroName,
              log )  Catch::getResultCapture().emplaceUnscopedMessage( Catch::MessageBuilder(
macroName##_catch_sr, CATCH_INTERNAL_LINEINFO, Catch::ResultWas::Info ) << log )
```

Definition at line 2795 of file catch.h.

7.1.1.179 INTERNAL_CATCH_VA_NARGS_IMPL

```
#define INTERNAL_CATCH_VA_NARGS_IMPL(
              _0,
              _1,
              _2,
              _3,
              _4,
              _5,
              _6,
              _7,
              _8,
              _9,
              _10,
              N,
              ...  ) N
```

Definition at line 780 of file catch.h.

7.1.1.180 INTERNAL_CHECK_THAT

```
#define INTERNAL_CHECK_THAT(
              macroName,
              matcher,
              resultDisposition,
              arg )
```

Value:

```
    do { \
        Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(arg) ", " CATCH_INTERNAL_STRINGIFY(matcher), resultDisposition ); \
        INTERNAL_CATCH_TRY { \
            catchAssertionHandler.handleExpr( Catch::makeMatchExpr( arg, matcher, #matcher##_catch_sr ) ); \
        } INTERNAL_CATCH_CATCH( catchAssertionHandler ) \
        INTERNAL_CATCH_REACT( catchAssertionHandler ) \
    } while( false )
```

Definition at line 3804 of file catch.h.

7.1.1.181 METHOD_AS_TEST_CASE

```
#define METHOD_AS_TEST_CASE(
              method,
              ...  ) INTERNAL_CATCH_METHOD_AS_TEST_CASE( method, __VA_ARGS__ )
```

Definition at line 17714 of file catch.h.

7.1.1.182 REGISTER_TEST_CASE

```
#define REGISTER_TEST_CASE(
              Function,
              ... ) INTERNAL_CATCH_REGISTER_TESTCASE( Function, __VA_ARGS__ )
```

Definition at line 17715 of file catch.h.

7.1.1.183 REQUIRE

```
#define REQUIRE(
              ... ) INTERNAL_CATCH_TEST( "REQUIRE", Catch::ResultDisposition::Normal, __VA_↩
ARGS__ )
```

Definition at line 17676 of file catch.h.

7.1.1.184 REQUIRE_FALSE

```
#define REQUIRE_FALSE(
              ... ) INTERNAL_CATCH_TEST( "REQUIRE_FALSE", Catch::ResultDisposition::Normal |
Catch::ResultDisposition::FalseTest, __VA_ARGS__ )
```

Definition at line 17677 of file catch.h.

7.1.1.185 REQUIRE_NOTHROW

```
#define REQUIRE_NOTHROW(
              ... ) INTERNAL_CATCH_NO_THROW( "REQUIRE_NOTHROW", Catch::ResultDisposition::Normal,
__VA_ARGS__ )
```

Definition at line 17685 of file catch.h.

7.1.1.186 REQUIRE_THAT

```
#define REQUIRE_THAT(
              arg,
              matcher ) INTERNAL_CHECK_THAT( "REQUIRE_THAT", matcher, Catch::ResultDisposition::Normal,
arg )
```

Definition at line 17704 of file catch.h.

7.1.1.187 REQUIRE_THROWS

```
#define REQUIRE_THROWS(
              ... ) INTERNAL_CATCH_THROWS( "REQUIRE_THROWS", Catch::ResultDisposition::Normal,
__VA_ARGS__ )
```

Definition at line 17679 of file catch.h.

7.1.1.188 REQUIRE_THROWS_AS

```
#define REQUIRE_THROWS_AS(
              expr,
              exceptionType ) INTERNAL_CATCH_THROWS_AS( "REQUIRE_THROWS_AS", exceptionType,
Catch::ResultDisposition::Normal, expr )
```

Definition at line 17680 of file catch.h.

7.1.1.189 REQUIRE_THROWS_MATCHES

```
#define REQUIRE_THROWS_MATCHES(
              expr,
              exceptionType,
              matcher ) INTERNAL_CATCH_THROWS_MATCHES( "REQUIRE_THROWS_MATCHES", exception↩
Type, Catch::ResultDisposition::Normal, matcher, expr )
```

Definition at line 17683 of file catch.h.

7.1.1.190 REQUIRE_THROWS_WITH

```
#define REQUIRE_THROWS_WITH(
              expr,
              matcher ) INTERNAL_CATCH_THROWS_STR_MATCHES( "REQUIRE_THROWS_WITH", Catch::ResultDisposition::No
matcher, expr )
```

Definition at line 17681 of file catch.h.

7.1.1.191 SCENARIO

```
#define SCENARIO(
              ...  ) TEST_CASE( "Scenario:  " __VA_ARGS__ )
```

Definition at line 17760 of file catch.h.

7.1.1.192 SCENARIO_METHOD

```
#define SCENARIO_METHOD(
              className,
              ...  ) INTERNAL_CATCH_TEST_CASE_METHOD( className, "Scenario:  " __VA_ARGS__ )
```

Definition at line 17761 of file catch.h.

7.1.1.193 SECTION

```
#define SECTION(
              ...  ) INTERNAL_CATCH_SECTION( __VA_ARGS__ )
```

Definition at line 17716 of file catch.h.

7.1.1.194 STATIC_REQUIRE

```
#define STATIC_REQUIRE(
              ... ) static_assert( __VA_ARGS__, #__VA_ARGS__ ); SUCCEED( #__VA_ARGS__ )
```

Definition at line 17748 of file catch.h.

7.1.1.195 STATIC_REQUIRE_FALSE

```
#define STATIC_REQUIRE_FALSE(
              ... ) static_assert( !(__VA_ARGS__), "!(" #__VA_ARGS__ ")" ); SUCCEED( "!(" #_↩
_VA_ARGS__ ")" )
```

Definition at line 17749 of file catch.h.

7.1.1.196 SUCCEED

```
#define SUCCEED(
              ... ) INTERNAL_CATCH_MSG( "SUCCEED", Catch::ResultWas::Ok, Catch::ResultDisposition::ContinueOn
__VA_ARGS__ )
```

Definition at line 17720 of file catch.h.

7.1.1.197 TEMPLATE_LIST_TEST_CASE

```
#define TEMPLATE_LIST_TEST_CASE(
              ... ) INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE(__VA_ARGS__)
```

Definition at line 17732 of file catch.h.

7.1.1.198 TEMPLATE_LIST_TEST_CASE_METHOD

```
#define TEMPLATE_LIST_TEST_CASE_METHOD(
              className,
              ... ) INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD( className, __VA_ARGS__ )
```

Definition at line 17733 of file catch.h.

7.1.1.199 TEMPLATE_PRODUCT_TEST_CASE

```
#define TEMPLATE_PRODUCT_TEST_CASE(
              ... ) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE( __VA_ARGS__ )
```

Definition at line 17728 of file catch.h.

7.1.1.200 TEMPLATE_PRODUCT_TEST_CASE_METHOD

```
#define TEMPLATE_PRODUCT_TEST_CASE_METHOD(
              className,
              ... ) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, __VA_ARGS__
)
```

Definition at line 17730 of file catch.h.

7.1.1.201 TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG

```
#define TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG(
              className,
              ... ) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, __VA_↩
ARGS__ )
```

Definition at line 17731 of file catch.h.

7.1.1.202 TEMPLATE_PRODUCT_TEST_CASE_SIG

```
#define TEMPLATE_PRODUCT_TEST_CASE_SIG(
              ... ) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG( __VA_ARGS__ )
```

Definition at line 17729 of file catch.h.

7.1.1.203 TEMPLATE_TEST_CASE

```
#define TEMPLATE_TEST_CASE(
              ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ )
```

Definition at line 17724 of file catch.h.

7.1.1.204 TEMPLATE_TEST_CASE_METHOD

```
#define TEMPLATE_TEST_CASE_METHOD(
              className,
              ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD( className, __VA_ARGS__ )
```

Definition at line 17726 of file catch.h.

7.1.1.205 TEMPLATE_TEST_CASE_METHOD_SIG

```
#define TEMPLATE_TEST_CASE_METHOD_SIG(
              className,
              ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ )
```

Definition at line 17727 of file catch.h.

7.1.1.206 TEMPLATE_TEST_CASE_SIG

```
#define TEMPLATE_TEST_CASE_SIG(
              ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG( __VA_ARGS__ )
```

Definition at line 17725 of file catch.h.

7.1.1.207 TEST_CASE

```
#define TEST_CASE(
              ... ) INTERNAL_CATCH_TESTCASE( __VA_ARGS__ )
```

Definition at line 17712 of file catch.h.

7.1.1.208 TEST_CASE_METHOD

```
#define TEST_CASE_METHOD(
              className,
              ... ) INTERNAL_CATCH_TEST_CASE_METHOD( className, __VA_ARGS__ )
```

Definition at line 17713 of file catch.h.

7.1.1.209 THEN

```
#define THEN(
              desc ) INTERNAL_CATCH_DYNAMIC_SECTION( " Then:  " << desc )
```

Definition at line 17767 of file catch.h.

7.1.1.210 UNSCOPED_INFO

```
#define UNSCOPED_INFO(
              msg ) INTERNAL_CATCH_UNSCOPED_INFO( "UNSCOPED_INFO", msg )
```

Definition at line 17708 of file catch.h.

7.1.1.211 WARN

```
#define WARN(
              msg ) INTERNAL_CATCH_MSG( "WARN", Catch::ResultWas::Warning, Catch::ResultDisposition::ContinueC
msg )
```

Definition at line 17709 of file catch.h.

7.1.1.212 WHEN

```
#define WHEN(
              desc ) INTERNAL_CATCH_DYNAMIC_SECTION( " When:  " << desc )
```

Definition at line 17765 of file catch.h.

7.1.2 Function Documentation

7.1.2.1 operator"""_catch_sr()

```
constexpr auto operator""_catch_sr (
            char const * rawChars,
            std::size_t size ) -> Catch::StringRef   [constexpr], [noexcept]
```

Definition at line 685 of file catch.h.

7.1.2.2 operator<<()

```
std::ostream & operator<< (
            std::ostream & ,
            Catch_global_namespace_dummy  )
```

7.2 catch.h

Go to the documentation of this file.

```
00001 /*
00002  *  Catch v2.13.10
00003  *  Generated: 2022-10-16 11:01:23.452308
00004  *  ----------------------------------------------------------
00005  *  This file has been merged from multiple headers. Please don't edit it directly
00006  *  Copyright (c) 2022 Two Blue Cubes Ltd. All rights reserved.
00007  *
00008  *  Distributed under the Boost Software License, Version 1.0. (See accompanying
00009  *  file LICENSE_1_0.txt or copy at http://www.boost.org/LICENSE_1_0.txt)
00010  */
00011 #ifndef TWOBLUECUBES_SINGLE_INCLUDE_CATCH_HPP_INCLUDED
00012 #define TWOBLUECUBES_SINGLE_INCLUDE_CATCH_HPP_INCLUDED
00013 // start catch.hpp
00014
00015
00016 #define CATCH_VERSION_MAJOR 2
00017 #define CATCH_VERSION_MINOR 13
00018 #define CATCH_VERSION_PATH 10
00019
00020 #ifdef __clang__
00021 #    pragma clang system_header
00022 #elif defined __GNUC__
00023 #    pragma GCC system_header
00024 #endif
00025
00026 // start catch_suppress_warnings.h
00027
00028 #ifdef __clang__
00029 #   ifdef __ICC // icpc defines the __clang__ macro
00030 #       pragma warning(push)
00031 #       pragma warning(disable: 161 1682)
00032 #   else // __ICC
00033 #       pragma clang diagnostic push
00034 #       pragma clang diagnostic ignored "-Wpadded"
00035 #       pragma clang diagnostic ignored "-Wswitch-enum"
00036 #       pragma clang diagnostic ignored "-Wcovered-switch-default"
00037 #    endif
00038 #elif defined __GNUC__
00039 // Because REQUIREs trigger GCC's -Wparentheses, and because still
00040      // supported version of g++ have only buggy support for _Pragmas,
00041      // Wparentheses have to be suppressed globally.
00042 #    pragma GCC diagnostic ignored "-Wparentheses" // See #674 for details
00043
00044 #    pragma GCC diagnostic push
00045 #    pragma GCC diagnostic ignored "-Wunused-variable"
00046 #    pragma GCC diagnostic ignored "-Wpadded"
00047 #endif
00048 // end catch_suppress_warnings.h
00049 #if defined(CATCH_CONFIG_MAIN) || defined(CATCH_CONFIG_RUNNER)
00050 #  define CATCH_IMPL
00051 #  define CATCH_CONFIG_ALL_PARTS
```

```
00052 #endif
00053
00054 // In the impl file, we want to have access to all parts of the headers
00055 // Can also be used to sanely support PCHs
00056 #if defined(CATCH_CONFIG_ALL_PARTS)
00057 #  define CATCH_CONFIG_EXTERNAL_INTERFACES
00058 #  if defined(CATCH_CONFIG_DISABLE_MATCHERS)
00059 #    undef CATCH_CONFIG_DISABLE_MATCHERS
00060 #  endif
00061 #  if !defined(CATCH_CONFIG_ENABLE_CHRONO_STRINGMAKER)
00062 #    define CATCH_CONFIG_ENABLE_CHRONO_STRINGMAKER
00063 #  endif
00064 #endif
00065
00066 #if !defined(CATCH_CONFIG_IMPL_ONLY)
00067 // start catch_platform.h
00068
00069 // See e.g.:
00070 // https://opensource.apple.com/source/CarbonHeaders/CarbonHeaders-18.1/TargetConditionals.h.auto.html
00071 #ifdef __APPLE__
00072 #  include <TargetConditionals.h>
00073 #  if (defined(TARGET_OS_OSX) && TARGET_OS_OSX == 1) || \
00074       (defined(TARGET_OS_MAC) && TARGET_OS_MAC == 1)
00075 #    define CATCH_PLATFORM_MAC
00076 #  elif (defined(TARGET_OS_IPHONE) && TARGET_OS_IPHONE == 1)
00077 #    define CATCH_PLATFORM_IPHONE
00078 #  endif
00079
00080 #elif defined(linux) || defined(__linux) || defined(__linux__)
00081 #  define CATCH_PLATFORM_LINUX
00082
00083 #elif defined(WIN32) || defined(__WIN32__) || defined(_WIN32) || defined(_MSC_VER) ||
      defined(__MINGW32__)
00084 #  define CATCH_PLATFORM_WINDOWS
00085 #endif
00086
00087 // end catch_platform.h
00088
00089 #ifdef CATCH_IMPL
00090 #  ifndef CLARA_CONFIG_MAIN
00091 #    define CLARA_CONFIG_MAIN_NOT_DEFINED
00092 #    define CLARA_CONFIG_MAIN
00093 #  endif
00094 #endif
00095
00096 // start catch_user_interfaces.h
00097
00098 namespace Catch {
00099     unsigned int rngSeed();
00100 }
00101
00102 // end catch_user_interfaces.h
00103 // start catch_tag_alias_autoregistrar.h
00104
00105 // start catch_common.h
00106
00107 // start catch_compiler_capabilities.h
00108
00109 // Detect a number of compiler features - by compiler
00110 // The following features are defined:
00111 //
00112 // CATCH_CONFIG_COUNTER : is the __COUNTER__ macro supported?
00113 // CATCH_CONFIG_WINDOWS_SEH : is Windows SEH supported?
00114 // CATCH_CONFIG_POSIX_SIGNALS : are POSIX signals supported?
00115 // CATCH_CONFIG_DISABLE_EXCEPTIONS : Are exceptions enabled?
00116 // ****************
00117 // Note to maintainers: if new toggles are added please document them
00118 // in configuration.md, too
00119 // ****************
00120
00121 // In general each macro has a _NO_<feature name> form
00122 // (e.g. CATCH_CONFIG_NO_POSIX_SIGNALS) which disables the feature.
00123 // Many features, at point of detection, define an _INTERNAL_ macro, so they
00124 // can be combined, en-mass, with the _NO_ forms later.
00125
00126 #ifdef __cplusplus
00127
00128 #  if (__cplusplus >= 201402L) || (defined(_MSVC_LANG) && _MSVC_LANG >= 201402L)
00129 #    define CATCH_CPP14_OR_GREATER
00130 #  endif
00131
00132 #  if (__cplusplus >= 201703L) || (defined(_MSVC_LANG) && _MSVC_LANG >= 201703L)
00133 #    define CATCH_CPP17_OR_GREATER
00134 #  endif
00135
00136 #endif
00137
```

```
00138 // Only GCC compiler should be used in this block, so other compilers trying to
00139 // mask themselves as GCC should be ignored.
00140 #if defined(__GNUC__) && !defined(__clang__) && !defined(__ICC) && !defined(__CUDACC__) &&
      !defined(__LCC__)
00141 #    define CATCH_INTERNAL_START_WARNINGS_SUPPRESSION _Pragma( "GCC diagnostic push" )
00142 #    define CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION  _Pragma( "GCC diagnostic pop" )
00143
00144 #    define CATCH_INTERNAL_IGNORE_BUT_WARN(...) (void)__builtin_constant_p(__VA_ARGS__)
00145
00146 #endif
00147
00148 #if defined(__clang__)
00149
00150 #    define CATCH_INTERNAL_START_WARNINGS_SUPPRESSION _Pragma( "clang diagnostic push" )
00151 #    define CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION  _Pragma( "clang diagnostic pop" )
00152
00153 // As of this writing, IBM XL's implementation of __builtin_constant_p has a bug
00154 // which results in calls to destructors being emitted for each temporary,
00155 // without a matching initialization. In practice, this can result in something
00156 // like `std::string::~string` being called on an uninitialized value.
00157 //
00158 // For example, this code will likely segfault under IBM XL:
00159 // ```
00160 // REQUIRE(std::string("12") + "34" == "1234")
00161 // ```
00162 //
00163 // Therefore, `CATCH_INTERNAL_IGNORE_BUT_WARN` is not implemented.
00164 #  if !defined(__ibmxl__) && !defined(__CUDACC__)
00165 #    define CATCH_INTERNAL_IGNORE_BUT_WARN(...) (void)__builtin_constant_p(__VA_ARGS__) /*
      NOLINT(cppcoreguidelines-pro-type-vararg, hicpp-vararg) */
00166 #  endif
00167
00168 #    define CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
00169         _Pragma( "clang diagnostic ignored \"-Wexit-time-destructors\"" ) \
00170         _Pragma( "clang diagnostic ignored \"-Wglobal-constructors\"")
00171
00172 #    define CATCH_INTERNAL_SUPPRESS_PARENTHESES_WARNINGS \
00173         _Pragma( "clang diagnostic ignored \"-Wparentheses\"" )
00174
00175 #    define CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS \
00176         _Pragma( "clang diagnostic ignored \"-Wunused-variable\"" )
00177
00178 #    define CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS \
00179         _Pragma( "clang diagnostic ignored \"-Wgnu-zero-variadic-macro-arguments\"" )
00180
00181 #    define CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
00182         _Pragma( "clang diagnostic ignored \"-Wunused-template\"" )
00183
00184 #endif // __clang__
00185
00187 // Assume that non-Windows platforms support posix signals by default
00188 #if !defined(CATCH_PLATFORM_WINDOWS)
00189 #define CATCH_INTERNAL_CONFIG_POSIX_SIGNALS
00190 #endif
00191
00193 // We know some environments not to support full POSIX signals
00194 #if defined(__CYGWIN__) || defined(__QNX__) || defined(__EMSCRIPTEN__) || defined(__DJGPP__)
00195 #define CATCH_INTERNAL_CONFIG_NO_POSIX_SIGNALS
00196 #endif
00197
00198 #ifdef __OS400__
00199 #       define CATCH_INTERNAL_CONFIG_NO_POSIX_SIGNALS
00200 #       define CATCH_CONFIG_COLOUR_NONE
00201 #endif
00202
00204 // Android somehow still does not support std::to_string
00205 #if defined(__ANDROID__)
00206 #    define CATCH_INTERNAL_CONFIG_NO_CPP11_TO_STRING
00207 #    define CATCH_INTERNAL_CONFIG_ANDROID_LOGWRITE
00208 #endif
00209
00211 // Not all Windows environments support SEH properly
00212 #if defined(__MINGW32__)
00213 #    define CATCH_INTERNAL_CONFIG_NO_WINDOWS_SEH
00214 #endif
00215
00217 // PS4
00218 #if defined(__ORBIS__)
00219 #    define CATCH_INTERNAL_CONFIG_NO_NEW_CAPTURE
00220 #endif
00221
00223 // Cygwin
00224 #ifdef __CYGWIN__
00225
00226 // Required for some versions of Cygwin to declare gettimeofday
00227 // see: http://stackoverflow.com/questions/36901803/gettimeofday-not-declared-in-this-scope-cygwin
00228 #   define _BSD_SOURCE
```

```
00229 // some versions of cygwin (most) do not support std::to_string. Use the libstd check.
00230 // https://gcc.gnu.org/onlinedocs/gcc-4.8.2/libstdc++/api/a01053_source.html line 2812-2813
00231 # if !((__cplusplus >= 201103L) && defined(_GLIBCXX_USE_C99) \
00232            && !defined(_GLIBCXX_HAVE_BROKEN_VSWPRINTF))
00233
00234 #    define CATCH_INTERNAL_CONFIG_NO_CPP11_TO_STRING
00235
00236 # endif
00237 #endif // __CYGWIN__
00238
00240 // Visual C++
00241 #if defined(_MSC_VER)
00242
00243 // Universal Windows platform does not support SEH
00244 // Or console colours (or console at all...)
00245 #  if defined(WINAPI_FAMILY) && (WINAPI_FAMILY == WINAPI_FAMILY_APP)
00246 #    define CATCH_CONFIG_COLOUR_NONE
00247 #  else
00248 #    define CATCH_INTERNAL_CONFIG_WINDOWS_SEH
00249 #  endif
00250
00251 #  if !defined(__clang__) // Handle Clang masquerading for msvc
00252
00253 // MSVC traditional preprocessor needs some workaround for __VA_ARGS__
00254 // _MSVC_TRADITIONAL == 0 means new conformant preprocessor
00255 // _MSVC_TRADITIONAL == 1 means old traditional non-conformant preprocessor
00256 #    if !defined(_MSVC_TRADITIONAL) || (defined(_MSVC_TRADITIONAL) && _MSVC_TRADITIONAL)
00257 #      define CATCH_INTERNAL_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
00258 #    endif // MSVC_TRADITIONAL
00259
00260 // Only do this if we're not using clang on Windows, which uses `diagnostic push' & `diagnostic pop'
00261 #    define CATCH_INTERNAL_START_WARNINGS_SUPPRESSION __pragma( warning(push) )
00262 #    define CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION  __pragma( warning(pop) )
00263 #  endif // __clang__
00264
00265 #endif // _MSC_VER
00266
00267 #if defined(_REENTRANT) || defined(_MSC_VER)
00268 // Enable async processing, as -pthread is specified or no additional linking is required
00269 # define CATCH_INTERNAL_CONFIG_USE_ASYNC
00270 #endif // _MSC_VER
00271
00273 // Check if we are compiled with -fno-exceptions or equivalent
00274 #if defined(__EXCEPTIONS) || defined(__cpp_exceptions) || defined(_CPPUNWIND)
00275 #  define CATCH_INTERNAL_CONFIG_EXCEPTIONS_ENABLED
00276 #endif
00277
00279 // DJGPP
00280 #ifdef __DJGPP__
00281 #  define CATCH_INTERNAL_CONFIG_NO_WCHAR
00282 #endif // __DJGPP__
00283
00285 // Embarcadero C++Build
00286 #if defined(__BORLANDC__)
00287 #define CATCH_INTERNAL_CONFIG_POLYFILL_ISNAN
00288 #endif
00289
00291
00292 // Use of __COUNTER__ is suppressed during code analysis in
00293 // CLion/AppCode 2017.2.x and former, because __COUNTER__ is not properly
00294 // handled by it.
00295 // Otherwise all supported compilers support COUNTER macro,
00296 // but user still might want to turn it off
00297 #if ( !defined(__JETBRAINS_IDE__) || __JETBRAINS_IDE__ >= 20170300L )
00298 #define CATCH_INTERNAL_CONFIG_COUNTER
00299 #endif
00300
00302
00303 // RTX is a special version of Windows that is real time.
00304 // This means that it is detected as Windows, but does not provide
00305 // the same set of capabilities as real Windows does.
00306 #if defined(UNDER_RTSS) || defined(RTX64_BUILD)
00307 #define CATCH_INTERNAL_CONFIG_NO_WINDOWS_SEH
00308     #define CATCH_INTERNAL_CONFIG_NO_ASYNC
00309     #define CATCH_CONFIG_COLOUR_NONE
00310 #endif
00311
00312 #if !defined(_GLIBCXX_USE_C99_MATH_TR1)
00313 #define CATCH_INTERNAL_CONFIG_GLOBAL_NEXTAFTER
00314 #endif
00315
00316 // Various stdlib support checks that require __has_include
00317 #if defined(__has_include)
00318 // Check if string_view is available and usable
00319 #if __has_include(<string_view>) && defined(CATCH_CPP17_OR_GREATER)
00320 #    define CATCH_INTERNAL_CONFIG_CPP17_STRING_VIEW
00321 #endif
```

```
00322
00323 // Check if optional is available and usable
00324 #  if __has_include(<optional>) && defined(CATCH_CPP17_OR_GREATER)
00325 #    define CATCH_INTERNAL_CONFIG_CPP17_OPTIONAL
00326 #  endif // __has_include(<optional>) && defined(CATCH_CPP17_OR_GREATER)
00327
00328 // Check if byte is available and usable
00329 #  if __has_include(<cstddef>) && defined(CATCH_CPP17_OR_GREATER)
00330 #    include <cstddef>
00331 #    if defined(__cpp_lib_byte) && (__cpp_lib_byte > 0)
00332 #      define CATCH_INTERNAL_CONFIG_CPP17_BYTE
00333 #    endif
00334 #  endif // __has_include(<cstddef>) && defined(CATCH_CPP17_OR_GREATER)
00335
00336 // Check if variant is available and usable
00337 #  if __has_include(<variant>) && defined(CATCH_CPP17_OR_GREATER)
00338 #    if defined(__clang__) && (__clang_major__ < 8)
00339 // work around clang bug with libstdc++ https://bugs.llvm.org/show_bug.cgi?id=31852
00340          // fix should be in clang 8, workaround in libstdc++ 8.2
00341   #      include <ciso646>
00342   #      if defined(__GLIBCXX__) && defined(_GLIBCXX_RELEASE) && (_GLIBCXX_RELEASE < 9)
00343   #        define CATCH_CONFIG_NO_CPP17_VARIANT
00344   #      else
00345   #        define CATCH_INTERNAL_CONFIG_CPP17_VARIANT
00346   #      endif // defined(__GLIBCXX__) && defined(_GLIBCXX_RELEASE) && (_GLIBCXX_RELEASE < 9)
00347 #    else
00348 #      define CATCH_INTERNAL_CONFIG_CPP17_VARIANT
00349 #    endif // defined(__clang__) && (__clang_major__ < 8)
00350 #  endif // __has_include(<variant>) && defined(CATCH_CPP17_OR_GREATER)
00351 #endif // defined(__has_include)
00352
00353 #if defined(CATCH_INTERNAL_CONFIG_COUNTER) && !defined(CATCH_CONFIG_NO_COUNTER) &&
      !defined(CATCH_CONFIG_COUNTER)
00354 #   define CATCH_CONFIG_COUNTER
00355 #endif
00356 #if defined(CATCH_INTERNAL_CONFIG_WINDOWS_SEH) && !defined(CATCH_CONFIG_NO_WINDOWS_SEH) &&
      !defined(CATCH_CONFIG_WINDOWS_SEH) && !defined(CATCH_INTERNAL_CONFIG_NO_WINDOWS_SEH)
00357 #   define CATCH_CONFIG_WINDOWS_SEH
00358 #endif
00359 // This is set by default, because we assume that unix compilers are posix-signal-compatible by
      default.
00360 #if defined(CATCH_INTERNAL_CONFIG_POSIX_SIGNALS) && !defined(CATCH_INTERNAL_CONFIG_NO_POSIX_SIGNALS)
      && !defined(CATCH_CONFIG_NO_POSIX_SIGNALS) && !defined(CATCH_CONFIG_POSIX_SIGNALS)
00361 #   define CATCH_CONFIG_POSIX_SIGNALS
00362 #endif
00363 // This is set by default, because we assume that compilers with no wchar_t support are just rare
      exceptions.
00364 #if !defined(CATCH_INTERNAL_CONFIG_NO_WCHAR) && !defined(CATCH_CONFIG_NO_WCHAR) &&
      !defined(CATCH_CONFIG_WCHAR)
00365 #   define CATCH_CONFIG_WCHAR
00366 #endif
00367
00368 #if !defined(CATCH_INTERNAL_CONFIG_NO_CPP11_TO_STRING) && !defined(CATCH_CONFIG_NO_CPP11_TO_STRING) &&
      !defined(CATCH_CONFIG_CPP11_TO_STRING)
00369 #    define CATCH_CONFIG_CPP11_TO_STRING
00370 #endif
00371
00372 #if defined(CATCH_INTERNAL_CONFIG_CPP17_OPTIONAL) && !defined(CATCH_CONFIG_NO_CPP17_OPTIONAL) &&
      !defined(CATCH_CONFIG_CPP17_OPTIONAL)
00373 #  define CATCH_CONFIG_CPP17_OPTIONAL
00374 #endif
00375
00376 #if defined(CATCH_INTERNAL_CONFIG_CPP17_STRING_VIEW) && !defined(CATCH_CONFIG_NO_CPP17_STRING_VIEW) &&
      !defined(CATCH_CONFIG_CPP17_STRING_VIEW)
00377 #  define CATCH_CONFIG_CPP17_STRING_VIEW
00378 #endif
00379
00380 #if defined(CATCH_INTERNAL_CONFIG_CPP17_VARIANT) && !defined(CATCH_CONFIG_NO_CPP17_VARIANT) &&
      !defined(CATCH_CONFIG_CPP17_VARIANT)
00381 #  define CATCH_CONFIG_CPP17_VARIANT
00382 #endif
00383
00384 #if defined(CATCH_INTERNAL_CONFIG_CPP17_BYTE) && !defined(CATCH_CONFIG_NO_CPP17_BYTE) &&
      !defined(CATCH_CONFIG_CPP17_BYTE)
00385 #  define CATCH_CONFIG_CPP17_BYTE
00386 #endif
00387
00388 #if defined(CATCH_CONFIG_EXPERIMENTAL_REDIRECT)
00389 #  define CATCH_INTERNAL_CONFIG_NEW_CAPTURE
00390 #endif
00391
00392 #if defined(CATCH_INTERNAL_CONFIG_NEW_CAPTURE) && !defined(CATCH_INTERNAL_CONFIG_NO_NEW_CAPTURE) &&
      !defined(CATCH_CONFIG_NO_NEW_CAPTURE) && !defined(CATCH_CONFIG_NEW_CAPTURE)
00393 #  define CATCH_CONFIG_NEW_CAPTURE
00394 #endif
00395
00396 #if !defined(CATCH_INTERNAL_CONFIG_EXCEPTIONS_ENABLED) && !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
```

```
00397 #  define CATCH_CONFIG_DISABLE_EXCEPTIONS
00398 #endif
00399
00400 #if defined(CATCH_INTERNAL_CONFIG_POLYFILL_ISNAN) && !defined(CATCH_CONFIG_NO_POLYFILL_ISNAN) &&
      !defined(CATCH_CONFIG_POLYFILL_ISNAN)
00401 #  define CATCH_CONFIG_POLYFILL_ISNAN
00402 #endif
00403
00404 #if defined(CATCH_INTERNAL_CONFIG_USE_ASYNC)  && !defined(CATCH_INTERNAL_CONFIG_NO_ASYNC) &&
      !defined(CATCH_CONFIG_NO_USE_ASYNC) && !defined(CATCH_CONFIG_USE_ASYNC)
00405 #  define CATCH_CONFIG_USE_ASYNC
00406 #endif
00407
00408 #if defined(CATCH_INTERNAL_CONFIG_ANDROID_LOGWRITE) && !defined(CATCH_CONFIG_NO_ANDROID_LOGWRITE) &&
      !defined(CATCH_CONFIG_ANDROID_LOGWRITE)
00409 #  define CATCH_CONFIG_ANDROID_LOGWRITE
00410 #endif
00411
00412 #if defined(CATCH_INTERNAL_CONFIG_GLOBAL_NEXTAFTER) && !defined(CATCH_CONFIG_NO_GLOBAL_NEXTAFTER) &&
      !defined(CATCH_CONFIG_GLOBAL_NEXTAFTER)
00413 #  define CATCH_CONFIG_GLOBAL_NEXTAFTER
00414 #endif
00415
00416 // Even if we do not think the compiler has that warning, we still have
00417 // to provide a macro that can be used by the code.
00418 #if !defined(CATCH_INTERNAL_START_WARNINGS_SUPPRESSION)
00419 #   define CATCH_INTERNAL_START_WARNINGS_SUPPRESSION
00420 #endif
00421 #if !defined(CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION)
00422 #   define CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
00423 #endif
00424 #if !defined(CATCH_INTERNAL_SUPPRESS_PARENTHESES_WARNINGS)
00425 #   define CATCH_INTERNAL_SUPPRESS_PARENTHESES_WARNINGS
00426 #endif
00427 #if !defined(CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS)
00428 #   define CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS
00429 #endif
00430 #if !defined(CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS)
00431 #   define CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS
00432 #endif
00433 #if !defined(CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS)
00434 #   define CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS
00435 #endif
00436
00437 // The goal of this macro is to avoid evaluation of the arguments, but
00438 // still have the compiler warn on problems inside...
00439 #if !defined(CATCH_INTERNAL_IGNORE_BUT_WARN)
00440 #   define CATCH_INTERNAL_IGNORE_BUT_WARN(...)
00441 #endif
00442
00443 #if defined(__APPLE__) && defined(__apple_build_version__) && (__clang_major__ < 10)
00444 #   undef CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS
00445 #elif defined(__clang__) && (__clang_major__ < 5)
00446 #   undef CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS
00447 #endif
00448
00449 #if !defined(CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS)
00450 #   define CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS
00451 #endif
00452
00453 #if defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
00454 #define CATCH_TRY if ((true))
00455 #define CATCH_CATCH_ALL if ((false))
00456 #define CATCH_CATCH_ANON(type) if ((false))
00457 #else
00458 #define CATCH_TRY try
00459 #define CATCH_CATCH_ALL catch (...)
00460 #define CATCH_CATCH_ANON(type) catch (type)
00461 #endif
00462
00463 #if defined(CATCH_INTERNAL_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR) &&
      !defined(CATCH_CONFIG_NO_TRADITIONAL_MSVC_PREPROCESSOR) &&
      !defined(CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR)
00464 #define CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
00465 #endif
00466
00467 // end catch_compiler_capabilities.h
00468 #define INTERNAL_CATCH_UNIQUE_NAME_LINE2( name, line ) name##line
00469 #define INTERNAL_CATCH_UNIQUE_NAME_LINE( name, line ) INTERNAL_CATCH_UNIQUE_NAME_LINE2( name, line )
00470 #ifdef CATCH_CONFIG_COUNTER
00471 #  define INTERNAL_CATCH_UNIQUE_NAME( name ) INTERNAL_CATCH_UNIQUE_NAME_LINE( name, __COUNTER__ )
00472 #else
00473 #  define INTERNAL_CATCH_UNIQUE_NAME( name ) INTERNAL_CATCH_UNIQUE_NAME_LINE( name, __LINE__ )
00474 #endif
00475
00476 #include <iosfwd>
00477 #include <string>
```

```
00478 #include <cstdint>
00479
00480 // We need a dummy global operator« so we can bring it into Catch namespace later
00481 struct Catch_global_namespace_dummy {};
00482 std::ostream& operator«(std::ostream&, Catch_global_namespace_dummy);
00483
00484 namespace Catch {
00485
00486     struct CaseSensitive { enum Choice {
00487             Yes,
00488             No
00489         }; };
00490
00491     class NonCopyable {
00492         NonCopyable( NonCopyable const& )              = delete;
00493         NonCopyable( NonCopyable && )                  = delete;
00494         NonCopyable& operator = ( NonCopyable const& ) = delete;
00495         NonCopyable& operator = ( NonCopyable && )     = delete;
00496
00497     protected:
00498         NonCopyable();
00499         virtual ~NonCopyable();
00500     };
00501
00502     struct SourceLineInfo {
00503
00504         SourceLineInfo() = delete;
00505         SourceLineInfo( char const* _file, std::size_t _line ) noexcept
00506                 :   file( _file ),
00507                     line( _line )
00508         {}
00509
00510         SourceLineInfo( SourceLineInfo const& other )            = default;
00511         SourceLineInfo& operator = ( SourceLineInfo const& )     = default;
00512         SourceLineInfo( SourceLineInfo&& )              noexcept = default;
00513         SourceLineInfo& operator = ( SourceLineInfo&& ) noexcept = default;
00514
00515         bool empty() const noexcept { return file[0] == '\0'; }
00516         bool operator == ( SourceLineInfo const& other ) const noexcept;
00517         bool operator < ( SourceLineInfo const& other ) const noexcept;
00518
00519         char const* file;
00520         std::size_t line;
00521     };
00522
00523     std::ostream& operator « ( std::ostream& os, SourceLineInfo const& info );
00524
00525     // Bring in operator« from global namespace into Catch namespace
00526     // This is necessary because the overload of operator« above makes
00527     // lookup stop at namespace Catch
00528     using ::operator«;
00529
00530     // Use this in variadic streaming macros to allow
00531     //    » +StreamEndStop
00532     // as well as
00533     //    » stuff +StreamEndStop
00534     struct StreamEndStop {
00535         std::string operator+() const;
00536     };
00537     template<typename T>
00538     T const& operator + ( T const& value, StreamEndStop ) {
00539         return value;
00540     }
00541 }
00542
00543 #define CATCH_INTERNAL_LINEINFO \
00544     ::Catch::SourceLineInfo( __FILE__, static_cast<std::size_t>( __LINE__ ) )
00545
00546 // end catch_common.h
00547 namespace Catch {
00548
00549     struct RegistrarForTagAliases {
00550         RegistrarForTagAliases( char const* alias, char const* tag, SourceLineInfo const& lineInfo );
00551     };
00552
00553 } // end namespace Catch
00554
00555 #define CATCH_REGISTER_TAG_ALIAS( alias, spec ) \
00556     CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
00557     CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
00558     namespace{ Catch::RegistrarForTagAliases INTERNAL_CATCH_UNIQUE_NAME( AutoRegisterTagAlias )(
    alias, spec, CATCH_INTERNAL_LINEINFO ); } \
00559     CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
00560
00561 // end catch_tag_alias_autoregistrar.h
00562 // start catch_test_registry.h
00563
```

```
00564 // start catch_interfaces_testcase.h
00565
00566 #include <vector>
00567
00568 namespace Catch {
00569
00570     class TestSpec;
00571
00572     struct ITestInvoker {
00573         virtual void invoke () const = 0;
00574         virtual ~ITestInvoker();
00575     };
00576
00577     class TestCase;
00578     struct IConfig;
00579
00580     struct ITestCaseRegistry {
00581         virtual ~ITestCaseRegistry();
00582         virtual std::vector<TestCase> const& getAllTests() const = 0;
00583         virtual std::vector<TestCase> const& getAllTestsSorted( IConfig const& config ) const = 0;
00584     };
00585
00586     bool isThrowSafe( TestCase const& testCase, IConfig const& config );
00587     bool matchTest( TestCase const& testCase, TestSpec const& testSpec, IConfig const& config );
00588     std::vector<TestCase> filterTests( std::vector<TestCase> const& testCases, TestSpec const&
    testSpec, IConfig const& config );
00589     std::vector<TestCase> const& getAllTestCasesSorted( IConfig const& config );
00590
00591 }
00592
00593 // end catch_interfaces_testcase.h
00594 // start catch_stringref.h
00595
00596 #include <cstddef>
00597 #include <string>
00598 #include <iosfwd>
00599 #include <cassert>
00600
00601 namespace Catch {
00602
00606     class StringRef {
00607     public:
00608         using size_type = std::size_t;
00609         using const_iterator = const char*;
00610
00611     private:
00612         static constexpr char const* const s_empty = "";
00613
00614         char const* m_start = s_empty;
00615         size_type m_size = 0;
00616
00617     public: // construction
00618         constexpr StringRef() noexcept = default;
00619
00620         StringRef( char const* rawChars ) noexcept;
00621
00622         constexpr StringRef( char const* rawChars, size_type size ) noexcept
00623                 :   m_start( rawChars ),
00624                     m_size( size )
00625         {}
00626
00627         StringRef( std::string const& stdString ) noexcept
00628                 :   m_start( stdString.c_str() ),
00629                     m_size( stdString.size() )
00630         {}
00631
00632         explicit operator std::string() const {
00633             return std::string(m_start, m_size);
00634         }
00635
00636     public: // operators
00637         auto operator == ( StringRef const& other ) const noexcept -> bool;
00638         auto operator != (StringRef const& other) const noexcept -> bool {
00639             return !(*this == other);
00640         }
00641
00642         auto operator[] ( size_type index ) const noexcept -> char {
00643             assert(index < m_size);
00644             return m_start[index];
00645         }
00646
00647     public: // named queries
00648         constexpr auto empty() const noexcept -> bool {
00649             return m_size == 0;
00650         }
00651         constexpr auto size() const noexcept -> size_type {
00652             return m_size;
```

```
00653         }
00654
00655         // Returns the current start pointer. If the StringRef is not
00656         // null-terminated, throws std::domain_exception
00657         auto c_str() const -> char const*;
00658
00659     public: // substrings and searches
00660         // Returns a substring of [start, start + length).
00661         // If start + length > size(), then the substring is [start, size()).
00662         // If start > size(), then the substring is empty.
00663         auto substr( size_type start, size_type length ) const noexcept -> StringRef;
00664
00665         // Returns the current start pointer. May not be null-terminated.
00666         auto data() const noexcept -> char const*;
00667
00668         constexpr auto isNullTerminated() const noexcept -> bool {
00669             return m_start[m_size] == '\0';
00670         }
00671
00672     public: // iterators
00673         constexpr const_iterator begin() const { return m_start; }
00674         constexpr const_iterator end() const { return m_start + m_size; }
00675     };
00676
00677     auto operator += ( std::string& lhs, StringRef const& sr ) -> std::string&;
00678     auto operator << ( std::ostream& os, StringRef const& sr ) -> std::ostream&;
00679
00680     constexpr auto operator "" _sr( char const* rawChars, std::size_t size ) noexcept -> StringRef {
00681         return StringRef( rawChars, size );
00682     }
00683 } // namespace Catch
00684
00685 constexpr auto operator "" _catch_sr( char const* rawChars, std::size_t size ) noexcept ->
    Catch::StringRef {
00686     return Catch::StringRef( rawChars, size );
00687 }
00688
00689 // end catch_stringref.h
00690 // start catch_preprocessor.hpp
00691
00692
00693 #define CATCH_RECURSION_LEVEL0(...) __VA_ARGS__
00694 #define CATCH_RECURSION_LEVEL1(...)
    CATCH_RECURSION_LEVEL0(CATCH_RECURSION_LEVEL0(CATCH_RECURSION_LEVEL0(__VA_ARGS__)))
00695 #define CATCH_RECURSION_LEVEL2(...)
    CATCH_RECURSION_LEVEL1(CATCH_RECURSION_LEVEL1(CATCH_RECURSION_LEVEL1(__VA_ARGS__)))
00696 #define CATCH_RECURSION_LEVEL3(...)
    CATCH_RECURSION_LEVEL2(CATCH_RECURSION_LEVEL2(CATCH_RECURSION_LEVEL2(__VA_ARGS__)))
00697 #define CATCH_RECURSION_LEVEL4(...)
    CATCH_RECURSION_LEVEL3(CATCH_RECURSION_LEVEL3(CATCH_RECURSION_LEVEL3(__VA_ARGS__)))
00698 #define CATCH_RECURSION_LEVEL5(...)
    CATCH_RECURSION_LEVEL4(CATCH_RECURSION_LEVEL4(CATCH_RECURSION_LEVEL4(__VA_ARGS__)))
00699
00700 #ifdef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
00701 #define INTERNAL_CATCH_EXPAND_VARGS(...) __VA_ARGS__
00702 // MSVC needs more evaluations
00703 #define CATCH_RECURSION_LEVEL6(...)
    CATCH_RECURSION_LEVEL5(CATCH_RECURSION_LEVEL5(CATCH_RECURSION_LEVEL5(__VA_ARGS__)))
00704 #define CATCH_RECURSE(...)  CATCH_RECURSION_LEVEL6(CATCH_RECURSION_LEVEL6(__VA_ARGS__))
00705 #else
00706 #define CATCH_RECURSE(...)  CATCH_RECURSION_LEVEL5(__VA_ARGS__)
00707 #endif
00708
00709 #define CATCH_REC_END(...)
00710 #define CATCH_REC_OUT
00711
00712 #define CATCH_EMPTY()
00713 #define CATCH_DEFER(id) id CATCH_EMPTY()
00714
00715 #define CATCH_REC_GET_END2() 0, CATCH_REC_END
00716 #define CATCH_REC_GET_END1(...) CATCH_REC_GET_END2
00717 #define CATCH_REC_GET_END(...) CATCH_REC_GET_END1
00718 #define CATCH_REC_NEXT0(test, next, ...) next CATCH_REC_OUT
00719 #define CATCH_REC_NEXT1(test, next) CATCH_DEFER ( CATCH_REC_NEXT0 ) ( test, next, 0)
00720 #define CATCH_REC_NEXT(test, next)  CATCH_REC_NEXT1(CATCH_REC_GET_END test, next)
00721
00722 #define CATCH_REC_LIST0(f, x, peek, ...) , f(x) CATCH_DEFER ( CATCH_REC_NEXT(peek, CATCH_REC_LIST1) )
    ( f, peek, __VA_ARGS__ )
00723 #define CATCH_REC_LIST1(f, x, peek, ...) , f(x) CATCH_DEFER ( CATCH_REC_NEXT(peek, CATCH_REC_LIST0) )
    ( f, peek, __VA_ARGS__ )
00724 #define CATCH_REC_LIST2(f, x, peek, ...)   f(x) CATCH_DEFER ( CATCH_REC_NEXT(peek, CATCH_REC_LIST1) )
    ( f, peek, __VA_ARGS__ )
00725
00726 #define CATCH_REC_LIST0_UD(f, userdata, x, peek, ...) , f(userdata, x) CATCH_DEFER (
    CATCH_REC_NEXT(peek, CATCH_REC_LIST1_UD) ) ( f, userdata, peek, __VA_ARGS__ )
00727 #define CATCH_REC_LIST1_UD(f, userdata, x, peek, ...) , f(userdata, x) CATCH_DEFER (
    CATCH_REC_NEXT(peek, CATCH_REC_LIST0_UD) ) ( f, userdata, peek, __VA_ARGS__ )
```

```
00728 #define CATCH_REC_LIST2_UD(f, userdata, x, peek, ...)   f(userdata, x) CATCH_DEFER (
      CATCH_REC_NEXT(peek, CATCH_REC_LIST1_UD) ) ( f, userdata, peek, __VA_ARGS__ )
00729
00730 // Applies the function macro `f` to each of the remaining parameters, inserts commas between the
      results,
00731 // and passes userdata as the first parameter to each invocation,
00732 // e.g. CATCH_REC_LIST_UD(f, x, a, b, c) evaluates to f(x, a), f(x, b), f(x, c)
00733 #define CATCH_REC_LIST_UD(f, userdata, ...) CATCH_RECURSE(CATCH_REC_LIST2_UD(f, userdata, __VA_ARGS__,
      ()()(), ()()(), ()()(), 0))
00734
00735 #define CATCH_REC_LIST(f, ...) CATCH_RECURSE(CATCH_REC_LIST2(f, __VA_ARGS__, ()()(), ()()(), ()()(),
      0))
00736
00737 #define INTERNAL_CATCH_EXPAND1(param) INTERNAL_CATCH_EXPAND2(param)
00738 #define INTERNAL_CATCH_EXPAND2(...) INTERNAL_CATCH_NO## __VA_ARGS__
00739 #define INTERNAL_CATCH_DEF(...) INTERNAL_CATCH_DEF __VA_ARGS__
00740 #define INTERNAL_CATCH_NOINTERNAL_CATCH_DEF
00741 #define INTERNAL_CATCH_STRINGIZE(...) INTERNAL_CATCH_STRINGIZE2(__VA_ARGS__)
00742 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
00743 #define INTERNAL_CATCH_STRINGIZE2(...) #__VA_ARGS__
00744 #define INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS(param)
      INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_REMOVE_PARENS(param))
00745 #else
00746 // MSVC is adding extra space and needs another indirection to expand
      INTERNAL_CATCH_NOINTERNAL_CATCH_DEF
00747 #define INTERNAL_CATCH_STRINGIZE2(...) INTERNAL_CATCH_STRINGIZE3(__VA_ARGS__)
00748 #define INTERNAL_CATCH_STRINGIZE3(...) #__VA_ARGS__
00749 #define INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS(param)
      (INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_REMOVE_PARENS(param)) + 1)
00750 #endif
00751
00752 #define INTERNAL_CATCH_MAKE_NAMESPACE2(...) ns_##__VA_ARGS__
00753 #define INTERNAL_CATCH_MAKE_NAMESPACE(name) INTERNAL_CATCH_MAKE_NAMESPACE2(name)
00754
00755 #define INTERNAL_CATCH_REMOVE_PARENS(...) INTERNAL_CATCH_EXPAND1(INTERNAL_CATCH_DEF __VA_ARGS__)
00756
00757 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
00758 #define INTERNAL_CATCH_MAKE_TYPE_LIST2(...)
      decltype(get_wrapper<INTERNAL_CATCH_REMOVE_PARENS_GEN(__VA_ARGS__)>())
00759 #define INTERNAL_CATCH_MAKE_TYPE_LIST(...)
      INTERNAL_CATCH_MAKE_TYPE_LIST2(INTERNAL_CATCH_REMOVE_PARENS(__VA_ARGS__))
00760 #else
00761 #define INTERNAL_CATCH_MAKE_TYPE_LIST2(...)
      INTERNAL_CATCH_EXPAND_VARGS(decltype(get_wrapper<INTERNAL_CATCH_REMOVE_PARENS_GEN(__VA_ARGS__)>()))
00762 #define INTERNAL_CATCH_MAKE_TYPE_LIST(...)
      INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_MAKE_TYPE_LIST2(INTERNAL_CATCH_REMOVE_PARENS(__VA_ARGS__)))
00763 #endif
00764
00765 #define INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES(...)\
00766     CATCH_REC_LIST(INTERNAL_CATCH_MAKE_TYPE_LIST,__VA_ARGS__)
00767
00768 #define INTERNAL_CATCH_REMOVE_PARENS_1_ARG(_0) INTERNAL_CATCH_REMOVE_PARENS(_0)
00769 #define INTERNAL_CATCH_REMOVE_PARENS_2_ARG(_0, _1) INTERNAL_CATCH_REMOVE_PARENS(_0),
      INTERNAL_CATCH_REMOVE_PARENS_1_ARG(_1)
00770 #define INTERNAL_CATCH_REMOVE_PARENS_3_ARG(_0, _1, _2) INTERNAL_CATCH_REMOVE_PARENS(_0),
      INTERNAL_CATCH_REMOVE_PARENS_2_ARG(_1, _2)
00771 #define INTERNAL_CATCH_REMOVE_PARENS_4_ARG(_0, _1, _2, _3) INTERNAL_CATCH_REMOVE_PARENS(_0),
      INTERNAL_CATCH_REMOVE_PARENS_3_ARG(_1, _2, _3)
00772 #define INTERNAL_CATCH_REMOVE_PARENS_5_ARG(_0, _1, _2, _3, _4) INTERNAL_CATCH_REMOVE_PARENS(_0),
      INTERNAL_CATCH_REMOVE_PARENS_4_ARG(_1, _2, _3, _4)
00773 #define INTERNAL_CATCH_REMOVE_PARENS_6_ARG(_0, _1, _2, _3, _4, _5) INTERNAL_CATCH_REMOVE_PARENS(_0),
      INTERNAL_CATCH_REMOVE_PARENS_5_ARG(_1, _2, _3, _4, _5)
00774 #define INTERNAL_CATCH_REMOVE_PARENS_7_ARG(_0, _1, _2, _3, _4, _5, _6)
      INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_6_ARG(_1, _2, _3, _4, _5, _6)
00775 #define INTERNAL_CATCH_REMOVE_PARENS_8_ARG(_0, _1, _2, _3, _4, _5, _6, _7)
      INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_7_ARG(_1, _2, _3, _4, _5, _6, _7)
00776 #define INTERNAL_CATCH_REMOVE_PARENS_9_ARG(_0, _1, _2, _3, _4, _5, _6, _7, _8)
      INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_8_ARG(_1, _2, _3, _4, _5, _6, _7, _8)
00777 #define INTERNAL_CATCH_REMOVE_PARENS_10_ARG(_0, _1, _2, _3, _4, _5, _6, _7, _8, _9)
      INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_9_ARG(_1, _2, _3, _4, _5, _6, _7, _8,
      _9)
00778 #define INTERNAL_CATCH_REMOVE_PARENS_11_ARG(_0, _1, _2, _3, _4, _5, _6, _7, _8, _9, _10)
      INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_10_ARG(_1, _2, _3, _4, _5, _6, _7, _8,
      _9, _10)
00779
00780 #define INTERNAL_CATCH_VA_NARGS_IMPL(_0, _1, _2, _3, _4, _5, _6, _7, _8, _9, _10, N, ...) N
00781
00782 #define INTERNAL_CATCH_TYPE_GEN\
00783     template<typename...> struct TypeList {};\
00784     template<typename...Ts>\
00785     constexpr auto get_wrapper() noexcept -> TypeList<Ts...> { return {}; }\
00786     template<template<typename...> class...> struct TemplateTypeList{};\
00787     template<template<typename...> class...Cs>\
00788     constexpr auto get_wrapper() noexcept -> TemplateTypeList<Cs...> { return {}; }\
00789     template<typename...>\
00790     struct append;\
00791     template<typename...>\
```

```
00792     struct rewrap;\
00793     template<template<typename...> class, typename...>\
00794     struct create;\
00795     template<template<typename...> class, typename>\
00796     struct convert;\
00797     \
00798     template<typename T> \
00799     struct append<T> { using type = T; };\
00800     template< template<typename...> class L1, typename...E1, template<typename...> class L2,
      typename...E2, typename...Rest>\
00801     struct append<L1<E1...>, L2<E2...>, Rest...> { using type = typename append<L1<E1...,E2...>,
      Rest...>::type; };\
00802     template< template<typename...> class L1, typename...E1, typename...Rest>\
00803     struct append<L1<E1...>, TypeList<mpl_::na>, Rest...> { using type = L1<E1...>; };\
00804     \
00805     template< template<typename...> class Container, template<typename...> class List,
      typename...elems>\
00806     struct rewrap<TemplateTypeList<Container>, List<elems...>> { using type =
      TypeList<Container<elems...>>; };\
00807     template< template<typename...> class Container, template<typename...> class List, class...Elems,
      typename...Elements>\
00808     struct rewrap<TemplateTypeList<Container>, List<Elems...>, Elements...> { using type = typename
      append<TypeList<Container<Elems...>>, typename rewrap<TemplateTypeList<Container>,
      Elements...>::type>::type; };\
00809     \
00810     template<template <typename...> class Final, template< typename...> class...Containers,
      typename...Types>\
00811     struct create<Final, TemplateTypeList<Containers...>, TypeList<Types...>> { using type = typename
      append<Final<>, typename rewrap<TemplateTypeList<Containers>, Types...>::type...>::type; };\
00812     template<template <typename...> class Final, template <typename...> class List, typename...Ts>\
00813     struct convert<Final, List<Ts...>> { using type = typename append<Final<>,TypeList<Ts>...>::type;
      };
00814
00815 #define INTERNAL_CATCH_NTTP_1(signature, ...)\
00816     template<INTERNAL_CATCH_REMOVE_PARENS(signature)> struct Nttp{};\
00817     template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
00818     constexpr auto get_wrapper() noexcept -> Nttp<__VA_ARGS__> { return {}; } \
00819     template<template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class...> struct
      NttpTemplateTypeList{};\
00820     template<template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class...Cs>\
00821     constexpr auto get_wrapper() noexcept -> NttpTemplateTypeList<Cs...> { return {}; } \
00822     \
00823     template< template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class Container,
      template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class List,
      INTERNAL_CATCH_REMOVE_PARENS(signature)>\
00824     struct rewrap<NttpTemplateTypeList<Container>, List<__VA_ARGS__>> { using type =
      TypeList<Container<__VA_ARGS__>>; };\
00825     template< template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class Container,
      template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class List, INTERNAL_CATCH_REMOVE_PARENS(signature),
      typename...Elements>\
00826     struct rewrap<NttpTemplateTypeList<Container>, List<__VA_ARGS__>, Elements...> { using type =
      typename append<TypeList<Container<__VA_ARGS__>>, typename rewrap<NttpTemplateTypeList<Container>,
      Elements...>::type>::type; };\
00827     template<template <typename...> class Final, template<INTERNAL_CATCH_REMOVE_PARENS(signature)>
      class...Containers, typename...Types>\
00828     struct create<Final, NttpTemplateTypeList<Containers...>, TypeList<Types...>> { using type =
      typename append<Final<>, typename rewrap<NttpTemplateTypeList<Containers>, Types...>::type...>::type;
      };
00829
00830 #define INTERNAL_CATCH_DECLARE_SIG_TEST0(TestName)
00831 #define INTERNAL_CATCH_DECLARE_SIG_TEST1(TestName, signature)\
00832     template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
00833     static void TestName()
00834 #define INTERNAL_CATCH_DECLARE_SIG_TEST_X(TestName, signature, ...)\
00835     template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
00836     static void TestName()
00837
00838 #define INTERNAL_CATCH_DEFINE_SIG_TEST0(TestName)
00839 #define INTERNAL_CATCH_DEFINE_SIG_TEST1(TestName, signature)\
00840     template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
00841     static void TestName()
00842 #define INTERNAL_CATCH_DEFINE_SIG_TEST_X(TestName, signature,...)\
00843     template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
00844     static void TestName()
00845
00846 #define INTERNAL_CATCH_NTTP_REGISTER0(TestFunc, signature)\
00847     template<typename Type>\
00848     void reg_test(TypeList<Type>, Catch::NameAndTags nameAndTags)\
00849     {\
00850         Catch::AutoReg( Catch::makeTestInvoker(&TestFunc<Type>), CATCH_INTERNAL_LINEINFO,
      Catch::StringRef(), nameAndTags);\
00851     }
00852
00853 #define INTERNAL_CATCH_NTTP_REGISTER(TestFunc, signature, ...)\
00854     template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
00855     void reg_test(Nttp<__VA_ARGS__>, Catch::NameAndTags nameAndTags)\
00856     {\
```

```
00857         Catch::AutoReg( Catch::makeTestInvoker(&TestFunc<__VA_ARGS__>), CATCH_INTERNAL_LINEINFO,
      Catch::StringRef(), nameAndTags);\
00858     }
00859
00860 #define INTERNAL_CATCH_NTTP_REGISTER_METHOD0(TestName, signature, ...)\
00861     template<typename Type>\
00862     void reg_test(TypeList<Type>, Catch::StringRef className, Catch::NameAndTags nameAndTags)\
00863     {\
00864         Catch::AutoReg( Catch::makeTestInvoker(&TestName<Type>::test), CATCH_INTERNAL_LINEINFO,
      className, nameAndTags);\
00865     }
00866
00867 #define INTERNAL_CATCH_NTTP_REGISTER_METHOD(TestName, signature, ...)\
00868     template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
00869     void reg_test(Nttp<__VA_ARGS__>, Catch::StringRef className, Catch::NameAndTags nameAndTags)\
00870     {\
00871         Catch::AutoReg( Catch::makeTestInvoker(&TestName<__VA_ARGS__>::test), CATCH_INTERNAL_LINEINFO,
      className, nameAndTags);\
00872     }
00873
00874 #define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD0(TestName, ClassName)
00875 #define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD1(TestName, ClassName, signature)\
00876     template<typename TestType> \
00877     struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName)<TestType> { \
00878         void test();\
00879     }
00880
00881 #define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X(TestName, ClassName, signature, ...)\
00882     template<INTERNAL_CATCH_REMOVE_PARENS(signature)> \
00883     struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName)<__VA_ARGS__> { \
00884         void test();\
00885     }
00886
00887 #define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD0(TestName)
00888 #define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD1(TestName, signature)\
00889     template<typename TestType> \
00890     void INTERNAL_CATCH_MAKE_NAMESPACE(TestName)::TestName<TestType>::test()
00891 #define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X(TestName, signature, ...)\
00892     template<INTERNAL_CATCH_REMOVE_PARENS(signature)> \
00893     void INTERNAL_CATCH_MAKE_NAMESPACE(TestName)::TestName<__VA_ARGS__>::test()
00894
00895 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
00896 #define INTERNAL_CATCH_NTTP_0
00897 #define INTERNAL_CATCH_NTTP_GEN(...) INTERNAL_CATCH_VA_NARGS_IMPL(__VA_ARGS__,
      INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1(__VA_ARGS__),
      INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1(__VA_ARGS__),
      INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1( __VA_ARGS__), INTERNAL_CATCH_NTTP_1(
      __VA_ARGS__), INTERNAL_CATCH_NTTP_1( __VA_ARGS__), INTERNAL_CATCH_NTTP_1(
      __VA_ARGS__),INTERNAL_CATCH_NTTP_1( __VA_ARGS__), INTERNAL_CATCH_NTTP_0)
00898 #define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD(TestName, ...) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy",
      __VA_ARGS__, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD1, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD0)(TestName, __VA_ARGS__)
00899 #define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD(TestName, ClassName, ...) INTERNAL_CATCH_VA_NARGS_IMPL(
      "dummy", __VA_ARGS__,
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD1, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD0)(TestName, ClassName,
      __VA_ARGS__)
00900 #define INTERNAL_CATCH_NTTP_REG_METHOD_GEN(TestName, ...) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy",
      __VA_ARGS__, INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD0,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD0)(TestName, __VA_ARGS__)
00901 #define INTERNAL_CATCH_NTTP_REG_GEN(TestFunc, ...) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__,
      INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER,
      INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER,
      INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER,
      INTERNAL_CATCH_NTTP_REGISTER0, INTERNAL_CATCH_NTTP_REGISTER0)(TestFunc, __VA_ARGS__)
00902 #define INTERNAL_CATCH_DEFINE_SIG_TEST(TestName, ...) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy",
      __VA_ARGS__, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DEFINE_SIG_TEST1,
      INTERNAL_CATCH_DEFINE_SIG_TEST0)(TestName, __VA_ARGS__)
00903 #define INTERNAL_CATCH_DECLARE_SIG_TEST(TestName, ...) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy",
      __VA_ARGS__, INTERNAL_CATCH_DECLARE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_SIG_TEST_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DECLARE_SIG_TEST_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DECLARE_SIG_TEST_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_SIG_TEST_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST1, INTERNAL_CATCH_DECLARE_SIG_TEST0)(TestName, __VA_ARGS__)
```

```
00904 #define INTERNAL_CATCH_REMOVE_PARENS_GEN(...) INTERNAL_CATCH_VA_NARGS_IMPL(__VA_ARGS__,
      INTERNAL_CATCH_REMOVE_PARENS_11_ARG,INTERNAL_CATCH_REMOVE_PARENS_10_ARG,INTERNAL_CATCH_REMOVE_PARENS_9_ARG,INTERNAL_CATC
00905 #else
00906 #define INTERNAL_CATCH_NTTP_0(signature)
00907 #define INTERNAL_CATCH_NTTP_GEN(...)
      INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL(__VA_ARGS__, INTERNAL_CATCH_NTTP_1,
      INTERNAL_CATCH_NTTP_1, INTERNAL_CATCH_NTTP_1, INTERNAL_CATCH_NTTP_1, INTERNAL_CATCH_NTTP_1,
      INTERNAL_CATCH_NTTP_1, INTERNAL_CATCH_NTTP_1, INTERNAL_CATCH_NTTP_1,
      INTERNAL_CATCH_NTTP_1,INTERNAL_CATCH_NTTP_1, INTERNAL_CATCH_NTTP_0)( __VA_ARGS__))
00908 #define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD(TestName, ...)
      INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__,
      INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD1, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD0)(TestName,
      __VA_ARGS__))
00909 #define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD(TestName, ClassName, ...)
      INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__,
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD1, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD0)(TestName, ClassName,
      __VA_ARGS__))
00910 #define INTERNAL_CATCH_NTTP_REG_METHOD_GEN(TestName, ...)
      INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD0,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD0)(TestName, __VA_ARGS__))
00911 #define INTERNAL_CATCH_NTTP_REG_GEN(TestFunc, ...)
      INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__,
      INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER,
      INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER,
      INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER,
      INTERNAL_CATCH_NTTP_REGISTER0, INTERNAL_CATCH_NTTP_REGISTER0)(TestFunc, __VA_ARGS__))
00912 #define INTERNAL_CATCH_DEFINE_SIG_TEST(TestName, ...)
      INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__,
      INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DEFINE_SIG_TEST1,
      INTERNAL_CATCH_DEFINE_SIG_TEST0)(TestName, __VA_ARGS__))
00913 #define INTERNAL_CATCH_DECLARE_SIG_TEST(TestName, ...)
      INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__,
      INTERNAL_CATCH_DECLARE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_SIG_TEST_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DECLARE_SIG_TEST_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DECLARE_SIG_TEST_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_SIG_TEST_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST1, INTERNAL_CATCH_DECLARE_SIG_TEST0)(TestName, __VA_ARGS__))
00914 #define INTERNAL_CATCH_REMOVE_PARENS_GEN(...)
      INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL(__VA_ARGS__,
      INTERNAL_CATCH_REMOVE_PARENS_11_ARG,INTERNAL_CATCH_REMOVE_PARENS_10_ARG,INTERNAL_CATCH_REMOVE_PARENS_9_ARG,INTERNAL_CATC
00915 #endif
00916
00917 // end catch_preprocessor.hpp
00918 // start catch_meta.hpp
00919
00920
00921 #include <type_traits>
00922
00923 namespace Catch {
00924     template<typename T>
00925     struct always_false : std::false_type {};
00926
00927     template <typename> struct true_given : std::true_type {};
00928     struct is_callable_tester {
00929         template <typename Fun, typename... Args>
00930         true_given<decltype(std::declval<Fun>()(std::declval<Args>()...))> static test(int);
00931         template <typename...>
00932         std::false_type static test(...);
00933     };
00934
00935     template <typename T>
00936     struct is_callable;
00937
00938     template <typename Fun, typename... Args>
00939     struct is_callable<Fun(Args...)> : decltype(is_callable_tester::test<Fun, Args...>(0)) {};
00940
00941 #if defined(__cpp_lib_is_invocable) && __cpp_lib_is_invocable >= 201703
00942     // std::result_of is deprecated in C++17 and removed in C++20. Hence, it is
00943     // replaced with std::invoke_result here.
00944     template <typename Func, typename... U>
00945     using FunctionReturnType = std::remove_reference_t<std::remove_cv_t<std::invoke_result_t<Func,
```

```
    U...»>;
00946 #else
00947     // Keep ::type here because we still support C++11
00948     template <typename Func, typename... U>
00949     using FunctionReturnType = typename std::remove_reference<typename std::remove_cv<typename
    std::result_of<Func(U...)>::type>::type>::type;
00950 #endif
00951
00952 } // namespace Catch
00953
00954 namespace mpl_{
00955     struct na;
00956 }
00957
00958 // end catch_meta.hpp
00959 namespace Catch {
00960
00961     template<typename C>
00962     class TestInvokerAsMethod : public ITestInvoker {
00963         void (C::*m_testAsMethod)();
00964     public:
00965         TestInvokerAsMethod( void (C::*testAsMethod)() ) noexcept : m_testAsMethod( testAsMethod ) {}
00966
00967         void invoke() const override {
00968             C obj;
00969             (obj.*m_testAsMethod)();
00970         }
00971     };
00972
00973     auto makeTestInvoker( void(*testAsFunction)() ) noexcept -> ITestInvoker*;
00974
00975     template<typename C>
00976     auto makeTestInvoker( void (C::*testAsMethod)() ) noexcept -> ITestInvoker* {
00977         return new(std::nothrow) TestInvokerAsMethod<C>( testAsMethod );
00978     }
00979
00980     struct NameAndTags {
00981         NameAndTags( StringRef const& name_ = StringRef(), StringRef const& tags_ = StringRef() )
    noexcept;
00982         StringRef name;
00983         StringRef tags;
00984     };
00985
00986     struct AutoReg : NonCopyable {
00987         AutoReg( ITestInvoker* invoker, SourceLineInfo const& lineInfo, StringRef const&
    classOrMethod, NameAndTags const& nameAndTags ) noexcept;
00988         ~AutoReg();
00989     };
00990
00991 } // end namespace Catch
00992
00993 #if defined(CATCH_CONFIG_DISABLE)
00994 #define INTERNAL_CATCH_TESTCASE_NO_REGISTRATION( TestName, ... ) \
00995         static void TestName()
00996     #define INTERNAL_CATCH_TESTCASE_METHOD_NO_REGISTRATION( TestName, ClassName, ... ) \
00997         namespace{                           \
00998             struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName) { \
00999                 void test();                \
01000             };                              \
01001         }                                   \
01002         void TestName::test()
01003     #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION_2( TestName, TestFunc, Name, Tags,
    Signature, ... )  \
01004         INTERNAL_CATCH_DEFINE_SIG_TEST(TestFunc, INTERNAL_CATCH_REMOVE_PARENS(Signature))
01005     #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION_2( TestNameClass, TestName,
    ClassName, Name, Tags, Signature, ... )    \
01006         namespace{                                                                                \
01007             namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName) {                                   \
01008             INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD(TestName, ClassName,
    INTERNAL_CATCH_REMOVE_PARENS(Signature));\
01009         }                                                                                         \
01010         }                                                                                         \
01011         INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD(TestName, INTERNAL_CATCH_REMOVE_PARENS(Signature))
01012
01013     #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
01014         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION(Name, Tags, ...) \
01015             INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION_2( INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, typename TestType, __VA_ARGS__ )
01016     #else
01017         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION(Name, Tags, ...) \
01018             INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION_2(
    INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, typename TestType, __VA_ARGS__ ) )
01019     #endif
01020
01021     #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
```

```
01022         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG_NO_REGISTRATION(Name, Tags, Signature, ...) \
01023             INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, Signature, __VA_ARGS__ )
01024     #else
01025         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG_NO_REGISTRATION(Name, Tags, Signature, ...) \
01026             INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION_2(
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, Signature, __VA_ARGS__ ) )
01027     #endif
01028
01029     #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
01030         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION( ClassName, Name, Tags,... )
      \
01031             INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, typename T, __VA_ARGS__ )
01032     #else
01033         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION( ClassName, Name, Tags,... )
      \
01034             INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION_2(
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ),
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, typename T,
      __VA_ARGS__ ) )
01035     #endif
01036
01037     #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
01038         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG_NO_REGISTRATION( ClassName, Name, Tags,
      Signature, ... ) \
01039             INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, Signature, __VA_ARGS__ )
01040     #else
01041         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG_NO_REGISTRATION( ClassName, Name, Tags,
      Signature, ... ) \
01042             INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION_2(
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ),
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, Signature,
      __VA_ARGS__ ) )
01043     #endif
01044 #endif
01045
01047 #define INTERNAL_CATCH_TESTCASE2( TestName, ... ) \
01048         static void TestName(); \
01049         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
01050         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
01051         namespace{ Catch::AutoReg INTERNAL_CATCH_UNIQUE_NAME( autoRegistrar )( Catch::makeTestInvoker(
      &TestName ), CATCH_INTERNAL_LINEINFO, Catch::StringRef(), Catch::NameAndTags{ __VA_ARGS__ } ); } /*
      NOLINT */ \
01052         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
01053         static void TestName()
01054 #define INTERNAL_CATCH_TESTCASE( ... ) \
01055         INTERNAL_CATCH_TESTCASE2( INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_S_T_ ), __VA_ARGS__ )
01056
01058 #define INTERNAL_CATCH_METHOD_AS_TEST_CASE( QualifiedMethod, ... ) \
01059         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
01060         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
01061         namespace{ Catch::AutoReg INTERNAL_CATCH_UNIQUE_NAME( autoRegistrar )( Catch::makeTestInvoker(
      &QualifiedMethod ), CATCH_INTERNAL_LINEINFO, "&" #QualifiedMethod, Catch::NameAndTags{ __VA_ARGS__ }
      ); } /* NOLINT */ \
01062         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
01063
01065 #define INTERNAL_CATCH_TEST_CASE_METHOD2( TestName, ClassName, ... )\
01066         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
01067         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
01068         namespace{ \
01069             struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName) { \
01070                 void test(); \
01071             }; \
01072             Catch::AutoReg INTERNAL_CATCH_UNIQUE_NAME( autoRegistrar ) ( Catch::makeTestInvoker(
      &TestName::test ), CATCH_INTERNAL_LINEINFO, #ClassName, Catch::NameAndTags{ __VA_ARGS__ } ); /* NOLINT
      */ \
01073         } \
01074         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
01075         void TestName::test()
01076 #define INTERNAL_CATCH_TEST_CASE_METHOD( ClassName, ... ) \
01077         INTERNAL_CATCH_TEST_CASE_METHOD2( INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_S_T_ ), ClassName,
      __VA_ARGS__ )
01078
01080 #define INTERNAL_CATCH_REGISTER_TESTCASE( Function, ... ) \
01081         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
01082         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
01083         Catch::AutoReg INTERNAL_CATCH_UNIQUE_NAME( autoRegistrar )( Catch::makeTestInvoker( Function
      ), CATCH_INTERNAL_LINEINFO, Catch::StringRef(), Catch::NameAndTags{ __VA_ARGS__ } ); /* NOLINT */ \
01084         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
01085
01087 #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_2(TestName, TestFunc, Name, Tags, Signature, ... )\
```

```
01088         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
01089         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
01090         CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS \
01091         CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
01092         INTERNAL_CATCH_DECLARE_SIG_TEST(TestFunc, INTERNAL_CATCH_REMOVE_PARENS(Signature));\
01093         namespace {\
01094         namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName){\
01095             INTERNAL_CATCH_TYPE_GEN\
01096             INTERNAL_CATCH_NTTP_GEN(INTERNAL_CATCH_REMOVE_PARENS(Signature))\
01097             INTERNAL_CATCH_NTTP_REG_GEN(TestFunc,INTERNAL_CATCH_REMOVE_PARENS(Signature))\
01098             template<typename...Types> \
01099             struct TestName{\
01100                 TestName(){\
01101                     int index = 0;                                      \
01102                     constexpr char const* tmpl_types[] =
      {CATCH_REC_LIST(INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS, __VA_ARGS__)};\
01103                     using expander = int[];\
01104                     (void)expander{(reg_test(Types{}, Catch::NameAndTags{ Name " - " +
      std::string(tmpl_types[index]), Tags } ), index++)... };/* NOLINT */ \
01105                 }\
01106             };\
01107             static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){\
01108             TestName<INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES(__VA_ARGS__)>();\
01109             return 0;\
01110         }();\
01111         }\
01112         }\
01113         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
01114         INTERNAL_CATCH_DEFINE_SIG_TEST(TestFunc,INTERNAL_CATCH_REMOVE_PARENS(Signature))
01115
01116 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
01117 #define INTERNAL_CATCH_TEMPLATE_TEST_CASE(Name, Tags, ...) \
01118         INTERNAL_CATCH_TEMPLATE_TEST_CASE_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, typename TestType, __VA_ARGS__ )
01119 #else
01120 #define INTERNAL_CATCH_TEMPLATE_TEST_CASE(Name, Tags, ...) \
01121         INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, typename TestType, __VA_ARGS__ ) )
01122 #endif
01123
01124 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
01125 #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG(Name, Tags, Signature, ...) \
01126         INTERNAL_CATCH_TEMPLATE_TEST_CASE_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, Signature, __VA_ARGS__ )
01127 #else
01128 #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG(Name, Tags, Signature, ...) \
01129         INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, Signature, __VA_ARGS__ ) )
01130 #endif
01131
01132 #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2(TestName, TestFuncName, Name, Tags, Signature,
      TmplTypes, TypesList) \
01133         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION                       \
01134         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS                        \
01135         CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS                  \
01136         CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS                \
01137         template<typename TestType> static void TestFuncName();         \
01138         namespace {\
01139         namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName) {                                     \
01140             INTERNAL_CATCH_TYPE_GEN                                                 \
01141             INTERNAL_CATCH_NTTP_GEN(INTERNAL_CATCH_REMOVE_PARENS(Signature))        \
01142             template<typename... Types>                                 \
01143             struct TestName {                                           \
01144                 void reg_tests() {                                          \
01145                     int index = 0;                                      \
01146                     using expander = int[];                             \
01147                     constexpr char const* tmpl_types[] =
      {CATCH_REC_LIST(INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS, INTERNAL_CATCH_REMOVE_PARENS(TmplTypes))};\
01148                     constexpr char const* types_list[] =
      {CATCH_REC_LIST(INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS, INTERNAL_CATCH_REMOVE_PARENS(TypesList))};\
01149                     constexpr auto num_types = sizeof(types_list) / sizeof(types_list[0]);\
01150                     (void)expander{(Catch::AutoReg( Catch::makeTestInvoker( &TestFuncName<Types> ),
      CATCH_INTERNAL_LINEINFO, Catch::StringRef(), Catch::NameAndTags{ Name " - " +
      std::string(tmpl_types[index / num_types]) + "<" + std::string(types_list[index % num_types]) + ">",
      Tags } ), index++)... };/* NOLINT */\
01151                 }                                                       \
01152             };                                                          \
01153             static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){ \
01154                 using TestInit = typename create<TestName,
      decltype(get_wrapper<INTERNAL_CATCH_REMOVE_PARENS(TmplTypes)>()),
      TypeList<INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES(INTERNAL_CATCH_REMOVE_PARENS(TypesList))>::type; \
01155                 TestInit t;                                             \
01156                 t.reg_tests();                                          \
```

```
01157                 return 0;                                                   \
01158             }();                                                            \
01159         }                                                                   \
01160         }                                                                   \
01161         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION                             \
01162         template<typename TestType>                                         \
01163         static void TestFuncName()
01164
01165 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
01166 #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE(Name, Tags, ...)\
01167         INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2(INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, typename T,__VA_ARGS__)
01168 #else
01169 #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE(Name, Tags, ...)\
01170         INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2(
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, typename T, __VA_ARGS__ ) )
01171 #endif
01172
01173 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
01174 #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG(Name, Tags, Signature, ...)\
01175         INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2(INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, Signature, __VA_ARGS__)
01176 #else
01177 #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG(Name, Tags, Signature, ...)\
01178         INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2(
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, Signature, __VA_ARGS__ ) )
01179 #endif
01180
01181 #define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_2(TestName, TestFunc, Name, Tags, TmplList)\
01182         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
01183         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
01184         CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
01185         template<typename TestType> static void TestFunc();       \
01186         namespace {\
01187         namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName){\
01188         INTERNAL_CATCH_TYPE_GEN\
01189         template<typename... Types>                                 \
01190         struct TestName {                                           \
01191             void reg_tests() {                                          \
01192                 int index = 0;                                      \
01193                 using expander = int[];                             \
01194                 (void)expander{(Catch::AutoReg( Catch::makeTestInvoker( &TestFunc<Types> ),
      CATCH_INTERNAL_LINEINFO, Catch::StringRef(), Catch::NameAndTags{ Name " - " +
      std::string(INTERNAL_CATCH_STRINGIZE(TmplList)) + " - " + std::to_string(index), Tags } ), index++)...
      };/* NOLINT */\
01195             }                                                       \
01196         };\
01197         static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){ \
01198                 using TestInit = typename convert<TestName, TmplList>::type; \
01199                 TestInit t;                                         \
01200                 t.reg_tests();                                      \
01201                 return 0;                                           \
01202             }();                                                    \
01203         }}\
01204         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION                     \
01205         template<typename TestType>                                 \
01206         static void TestFunc()
01207
01208 #define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE(Name, Tags, TmplList) \
01209         INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, TmplList )
01210
01211 #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2( TestNameClass, TestName, ClassName, Name, Tags,
      Signature, ... ) \
01212         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
01213         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
01214         CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS \
01215         CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
01216         namespace {\
01217         namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName){ \
01218             INTERNAL_CATCH_TYPE_GEN\
01219             INTERNAL_CATCH_NTTP_GEN(INTERNAL_CATCH_REMOVE_PARENS(Signature))\
01220             INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD(TestName, ClassName,
      INTERNAL_CATCH_REMOVE_PARENS(Signature));\
01221             INTERNAL_CATCH_NTTP_REG_METHOD_GEN(TestName, INTERNAL_CATCH_REMOVE_PARENS(Signature))\
01222             template<typename...Types> \
01223             struct TestNameClass{\
01224                 TestNameClass(){\
01225                     int index = 0;                                  \
01226                     constexpr char const* tmpl_types[] =
      {CATCH_REC_LIST(INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS, __VA_ARGS__)};\
01227                     using expander = int[];\
```

```
01228                   (void)expander{(reg_test(Types{}, #ClassName, Catch::NameAndTags{ Name " - " +
    std::string(tmpl_types[index]), Tags } ), index++)... };/* NOLINT */ \
01229               }\
01230           };\
01231           static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){\
01232               TestNameClass<INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES(__VA_ARGS__)>();\
01233               return 0;\
01234       }();\
01235       }\
01236       }\
01237       CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
01238       INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD(TestName, INTERNAL_CATCH_REMOVE_PARENS(Signature))
01239
01240 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
01241 #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD( ClassName, Name, Tags,... ) \
01242       INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ), INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, typename T, __VA_ARGS__ )
01243 #else
01244 #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD( ClassName, Name, Tags,... ) \
01245       INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2(
    INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ),
    INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, typename T,
    __VA_ARGS__ ) )
01246 #endif
01247
01248 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
01249 #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( ClassName, Name, Tags, Signature, ... ) \
01250       INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ), INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, Signature, __VA_ARGS__ )
01251 #else
01252 #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( ClassName, Name, Tags, Signature, ... ) \
01253       INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2(
    INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ),
    INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, Signature,
    __VA_ARGS__ ) )
01254 #endif
01255
01256 #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2(TestNameClass, TestName, ClassName, Name,
    Tags, Signature, TmplTypes, TypesList)\
01257       CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
01258       CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
01259       CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS \
01260       CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
01261       template<typename TestType> \
01262           struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName <TestType>) { \
01263               void test();\
01264           };\
01265       namespace {\
01266       namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestNameClass) {\
01267           INTERNAL_CATCH_TYPE_GEN                     \
01268           INTERNAL_CATCH_NTTP_GEN(INTERNAL_CATCH_REMOVE_PARENS(Signature))\
01269           template<typename...Types>\
01270           struct TestNameClass{\
01271               void reg_tests(){\
01272                   int index = 0;\
01273                   using expander = int[];\
01274                   constexpr char const* tmpl_types[] =
    {CATCH_REC_LIST(INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS, INTERNAL_CATCH_REMOVE_PARENS(TmplTypes))};\
01275                   constexpr char const* types_list[] =
    {CATCH_REC_LIST(INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS, INTERNAL_CATCH_REMOVE_PARENS(TypesList))};\
01276                   constexpr auto num_types = sizeof(types_list) / sizeof(types_list[0]);\
01277                   (void)expander{(Catch::AutoReg( Catch::makeTestInvoker( &TestName<Types>::test ),
    CATCH_INTERNAL_LINEINFO, #ClassName, Catch::NameAndTags{ Name " - " + std::string(tmpl_types[index /
    num_types]) + "<" + std::string(types_list[index % num_types]) + ">", Tags } ), index++)... };/*
    NOLINT */ \
01278               }\
01279           };\
01280           static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){\
01281               using TestInit = typename create<TestNameClass,
    decltype(get_wrapper<INTERNAL_CATCH_REMOVE_PARENS(TmplTypes)>()),
    TypeList<INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES(INTERNAL_CATCH_REMOVE_PARENS(TypesList))»::type;\
01282               TestInit t;\
01283               t.reg_tests();\
01284               return 0;\
01285           }(); \
01286       }\
01287       }\
01288       CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
01289       template<typename TestType> \
01290       void TestName<TestType>::test()
01291
01292 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
01293 #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( ClassName, Name, Tags, ... )\
01294       INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
```

```
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), ClassName, Name, Tags, typename T, __VA_ARGS__ )
01295 #else
01296 #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( ClassName, Name, Tags, ... )\
01297         INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2(
    INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), ClassName, Name, Tags, typename T,__VA_ARGS__ ) )
01298 #endif
01299
01300 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
01301 #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( ClassName, Name, Tags, Signature, ... )\
01302         INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), ClassName, Name, Tags, Signature, __VA_ARGS__ )
01303 #else
01304 #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( ClassName, Name, Tags, Signature, ... )\
01305         INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2(
    INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), ClassName, Name, Tags, Signature,__VA_ARGS__ ) )
01306 #endif
01307
01308 #define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD_2( TestNameClass, TestName, ClassName, Name,
    Tags, TmplList) \
01309         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
01310         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
01311         CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
01312         template<typename TestType> \
01313         struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName <TestType>) { \
01314             void test();\
01315         };\
01316         namespace {\
01317         namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName){ \
01318             INTERNAL_CATCH_TYPE_GEN\
01319             template<typename...Types>\
01320             struct TestNameClass{\
01321                 void reg_tests(){\
01322                     int index = 0;\
01323                     using expander = int[];\
01324                     (void)expander{(Catch::AutoReg( Catch::makeTestInvoker( &TestName<Types>::test ),
    CATCH_INTERNAL_LINEINFO, #ClassName, Catch::NameAndTags{ Name " - " +
    std::string(INTERNAL_CATCH_STRINGIZE(TmplList)) + " - " + std::to_string(index), Tags } ), index++)...
    };/* NOLINT */ \
01325                 }\
01326             };\
01327             static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){\
01328                 using TestInit = typename convert<TestNameClass, TmplList>::type;\
01329                 TestInit t;\
01330                 t.reg_tests();\
01331                 return 0;\
01332             }(); \
01333         }}\
01334         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
01335         template<typename TestType> \
01336         void TestName<TestType>::test()
01337
01338 #define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD(ClassName, Name, Tags, TmplList) \
01339         INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), ClassName, Name, Tags, TmplList )
01340
01341 // end catch_test_registry.h
01342 // start catch_capture.hpp
01343
01344 // start catch_assertionhandler.h
01345
01346 // start catch_assertioninfo.h
01347
01348 // start catch_result_type.h
01349
01350 namespace Catch {
01351
01352     // ResultWas::OfType enum
01353     struct ResultWas { enum OfType {
01354             Unknown = -1,
01355             Ok = 0,
01356             Info = 1,
01357             Warning = 2,
01358
01359             FailureBit = 0x10,
01360
01361             ExpressionFailed = FailureBit | 1,
01362             ExplicitFailure = FailureBit | 2,
01363
01364             Exception = 0x100 | FailureBit,
01365
01366             ThrewException = Exception | 1,
01367             DidntThrowException = Exception | 2,
01368
```

```
01369             FatalErrorCondition = 0x200 | FailureBit
01370
01371         }; };
01372
01373     bool isOk( ResultWas::OfType resultType );
01374     bool isJustInfo( int flags );
01375
01376     // ResultDisposition::Flags enum
01377     struct ResultDisposition { enum Flags {
01378             Normal = 0x01,
01379
01380             ContinueOnFailure = 0x02,   // Failures fail test, but execution continues
01381             FalseTest = 0x04,           // Prefix expression with !
01382             SuppressFail = 0x08         // Failures are reported but do not fail the test
01383         }; };
01384
01385     ResultDisposition::Flags operator | ( ResultDisposition::Flags lhs, ResultDisposition::Flags rhs
      );
01386
01387     bool shouldContinueOnFailure( int flags );
01388     inline bool isFalseTest( int flags ) { return ( flags & ResultDisposition::FalseTest ) != 0; }
01389     bool shouldSuppressFailure( int flags );
01390
01391 } // end namespace Catch
01392
01393 // end catch_result_type.h
01394 namespace Catch {
01395
01396     struct AssertionInfo
01397     {
01398         StringRef macroName;
01399         SourceLineInfo lineInfo;
01400         StringRef capturedExpression;
01401         ResultDisposition::Flags resultDisposition;
01402
01403         // We want to delete this constructor but a compiler bug in 4.8 means
01404         // the struct is then treated as non-aggregate
01405         //AssertionInfo() = delete;
01406     };
01407
01408 } // end namespace Catch
01409
01410 // end catch_assertioninfo.h
01411 // start catch_decomposer.h
01412
01413 // start catch_tostring.h
01414
01415 #include <vector>
01416 #include <cstddef>
01417 #include <type_traits>
01418 #include <string>
01419 // start catch_stream.h
01420
01421 #include <iosfwd>
01422 #include <cstddef>
01423 #include <ostream>
01424
01425 namespace Catch {
01426
01427     std::ostream& cout();
01428     std::ostream& cerr();
01429     std::ostream& clog();
01430
01431     class StringRef;
01432
01433     struct IStream {
01434         virtual ~IStream();
01435         virtual std::ostream& stream() const = 0;
01436     };
01437
01438     auto makeStream( StringRef const &filename ) -> IStream const*;
01439
01440     class ReusableStringStream : NonCopyable {
01441         std::size_t m_index;
01442         std::ostream* m_oss;
01443     public:
01444         ReusableStringStream();
01445         ~ReusableStringStream();
01446
01447         auto str() const -> std::string;
01448
01449         template<typename T>
01450         auto operator << ( T const& value ) -> ReusableStringStream& {
01451             *m_oss << value;
01452             return *this;
01453         }
01454         auto get() -> std::ostream& { return *m_oss; }
```

```
01455     };
01456 }
01457
01458 // end catch_stream.h
01459 // start catch_interfaces_enum_values_registry.h
01460
01461 #include <vector>
01462
01463 namespace Catch {
01464
01465     namespace Detail {
01466         struct EnumInfo {
01467             StringRef m_name;
01468             std::vector<std::pair<int, StringRef>> m_values;
01469
01470             ~EnumInfo();
01471
01472             StringRef lookup( int value ) const;
01473         };
01474     } // namespace Detail
01475
01476     struct IMutableEnumValuesRegistry {
01477         virtual ~IMutableEnumValuesRegistry();
01478
01479         virtual Detail::EnumInfo const& registerEnum( StringRef enumName, StringRef allEnums,
    std::vector<int> const& values ) = 0;
01480
01481         template<typename E>
01482         Detail::EnumInfo const& registerEnum( StringRef enumName, StringRef allEnums,
    std::initializer_list<E> values ) {
01483             static_assert(sizeof(int) >= sizeof(E), "Cannot serialize enum to int");
01484             std::vector<int> intValues;
01485             intValues.reserve( values.size() );
01486             for( auto enumValue : values )
01487                 intValues.push_back( static_cast<int>( enumValue ) );
01488             return registerEnum( enumName, allEnums, intValues );
01489         }
01490     };
01491
01492 } // Catch
01493
01494 // end catch_interfaces_enum_values_registry.h
01495
01496 #ifdef CATCH_CONFIG_CPP17_STRING_VIEW
01497 #include <string_view>
01498 #endif
01499
01500 #ifdef __OBJC__
01501 // start catch_objc_arc.hpp
01502
01503 #import <Foundation/Foundation.h>
01504
01505 #ifdef __has_feature
01506 #define CATCH_ARC_ENABLED __has_feature(objc_arc)
01507 #else
01508 #define CATCH_ARC_ENABLED 0
01509 #endif
01510
01511 void arcSafeRelease( NSObject* obj );
01512 id performOptionalSelector( id obj, SEL sel );
01513
01514 #if !CATCH_ARC_ENABLED
01515 inline void arcSafeRelease( NSObject* obj ) {
01516     [obj release];
01517 }
01518 inline id performOptionalSelector( id obj, SEL sel ) {
01519     if( [obj respondsToSelector: sel] )
01520         return [obj performSelector: sel];
01521     return nil;
01522 }
01523 #define CATCH_UNSAFE_UNRETAINED
01524 #define CATCH_ARC_STRONG
01525 #else
01526 inline void arcSafeRelease( NSObject* ){}
01527 inline id performOptionalSelector( id obj, SEL sel ) {
01528 #ifdef __clang__
01529 #pragma clang diagnostic push
01530 #pragma clang diagnostic ignored "-Warc-performSelector-leaks"
01531 #endif
01532     if( [obj respondsToSelector: sel] )
01533         return [obj performSelector: sel];
01534 #ifdef __clang__
01535 #pragma clang diagnostic pop
01536 #endif
01537     return nil;
01538 }
01539 #define CATCH_UNSAFE_UNRETAINED __unsafe_unretained
```

```
01540 #define CATCH_ARC_STRONG __strong
01541 #endif
01542
01543 // end catch_objc_arc.hpp
01544 #endif
01545
01546 #ifdef _MSC_VER
01547 #pragma warning(push)
01548 #pragma warning(disable:4180) // We attempt to stream a function (address) by const&, which MSVC
      complains about but is harmless
01549 #endif
01550
01551 namespace Catch {
01552     namespace Detail {
01553
01554         extern const std::string unprintableString;
01555
01556         std::string rawMemoryToString( const void *object, std::size_t size );
01557
01558         template<typename T>
01559         std::string rawMemoryToString( const T& object ) {
01560             return rawMemoryToString( &object, sizeof(object) );
01561         }
01562
01563         template<typename T>
01564         class IsStreamInsertable {
01565             template<typename Stream, typename U>
01566             static auto test(int)
01567             -> decltype(std::declval<Stream&>() << std::declval<U>(), std::true_type());
01568
01569             template<typename, typename>
01570             static auto test(...)->std::false_type;
01571
01572         public:
01573             static const bool value = decltype(test<std::ostream, const T&>(0))::value;
01574         };
01575
01576         template<typename E>
01577         std::string convertUnknownEnumToString( E e );
01578
01579         template<typename T>
01580         typename std::enable_if<
01581                 !std::is_enum<T>::value && !std::is_base_of<std::exception, T>::value,
01582                 std::string>::type convertUnstreamable( T const& ) {
01583             return Detail::unprintableString;
01584         }
01585         template<typename T>
01586         typename std::enable_if<
01587                 !std::is_enum<T>::value && std::is_base_of<std::exception, T>::value,
01588                 std::string>::type convertUnstreamable(T const& ex) {
01589             return ex.what();
01590         }
01591
01592         template<typename T>
01593         typename std::enable_if<
01594                 std::is_enum<T>::value
01595                 , std::string>::type convertUnstreamable( T const& value ) {
01596             return convertUnknownEnumToString( value );
01597         }
01598
01599 #if defined(_MANAGED)
01601         template<typename T>
01602         std::string clrReferenceToString( T^ ref ) {
01603             if (ref == nullptr)
01604                 return std::string("null");
01605             auto bytes = System::Text::Encoding::UTF8->GetBytes(ref->ToString());
01606             cli::pin_ptr<System::Byte> p = &bytes[0];
01607             return std::string(reinterpret_cast<char const *>(p), bytes->Length);
01608         }
01609 #endif
01610
01611     } // namespace Detail
01612
01613     // If we decide for C++14, change these to enable_if_ts
01614     template <typename T, typename = void>
01615     struct StringMaker {
01616         template <typename Fake = T>
01617         static
01618         typename std::enable_if<::Catch::Detail::IsStreamInsertable<Fake>::value, std::string>::type
01619         convert(const Fake& value) {
01620             ReusableStringStream rss;
01621             // NB: call using the function-like syntax to avoid ambiguity with
01622             // user-defined templated operator<< under clang.
01623             rss.operator<<(value);
01624             return rss.str();
01625         }
01626
```

```
01627         template <typename Fake = T>
01628         static
01629         typename std::enable_if<!::Catch::Detail::IsStreamInsertable<Fake>::value, std::string>::type
01630         convert( const Fake& value ) {
01631 #if !defined(CATCH_CONFIG_FALLBACK_STRINGIFIER)
01632             return Detail::convertUnstreamable(value);
01633 #else
01634             return CATCH_CONFIG_FALLBACK_STRINGIFIER(value);
01635 #endif
01636         }
01637     };
01638
01639     namespace Detail {
01640
01641         // This function dispatches all stringification requests inside of Catch.
01642         // Should be preferably called fully qualified, like ::Catch::Detail::stringify
01643         template <typename T>
01644         std::string stringify(const T& e) {
01645             return ::Catch::StringMaker<typename std::remove_cv<typename
      std::remove_reference<T>::type>::type>::convert(e);
01646         }
01647
01648         template<typename E>
01649         std::string convertUnknownEnumToString( E e ) {
01650             return ::Catch::Detail::stringify(static_cast<typename std::underlying_type<E>::type>(e));
01651         }
01652
01653 #if defined(_MANAGED)
01654         template <typename T>
01655         std::string stringify( T^ e ) {
01656             return ::Catch::StringMaker<T^>::convert(e);
01657         }
01658 #endif
01659
01660     } // namespace Detail
01661
01662     // Some predefined specializations
01663
01664     template<>
01665     struct StringMaker<std::string> {
01666         static std::string convert(const std::string& str);
01667     };
01668
01669 #ifdef CATCH_CONFIG_CPP17_STRING_VIEW
01670     template<>
01671     struct StringMaker<std::string_view> {
01672         static std::string convert(std::string_view str);
01673     };
01674 #endif
01675
01676     template<>
01677     struct StringMaker<char const *> {
01678         static std::string convert(char const * str);
01679     };
01680     template<>
01681     struct StringMaker<char *> {
01682         static std::string convert(char * str);
01683     };
01684
01685 #ifdef CATCH_CONFIG_WCHAR
01686     template<>
01687     struct StringMaker<std::wstring> {
01688         static std::string convert(const std::wstring& wstr);
01689     };
01690
01691 # ifdef CATCH_CONFIG_CPP17_STRING_VIEW
01692     template<>
01693     struct StringMaker<std::wstring_view> {
01694         static std::string convert(std::wstring_view str);
01695     };
01696 # endif
01697
01698     template<>
01699     struct StringMaker<wchar_t const *> {
01700         static std::string convert(wchar_t const * str);
01701     };
01702     template<>
01703     struct StringMaker<wchar_t *> {
01704         static std::string convert(wchar_t * str);
01705     };
01706 #endif
01707
01708     // TBD: Should we use `strnlen` to ensure that we don't go out of the buffer,
01709     //      while keeping string semantics?
01710     template<int SZ>
01711     struct StringMaker<char[SZ]> {
01712         static std::string convert(char const* str) {
```

```
01713             return ::Catch::Detail::stringify(std::string{ str });
01714         }
01715     };
01716     template<int SZ>
01717     struct StringMaker<signed char[SZ]> {
01718         static std::string convert(signed char const* str) {
01719             return ::Catch::Detail::stringify(std::string{ reinterpret_cast<char const *>(str) });
01720         }
01721     };
01722     template<int SZ>
01723     struct StringMaker<unsigned char[SZ]> {
01724         static std::string convert(unsigned char const* str) {
01725             return ::Catch::Detail::stringify(std::string{ reinterpret_cast<char const *>(str) });
01726         }
01727     };
01728
01729 #if defined(CATCH_CONFIG_CPP17_BYTE)
01730     template<>
01731     struct StringMaker<std::byte> {
01732         static std::string convert(std::byte value);
01733     };
01734 #endif // defined(CATCH_CONFIG_CPP17_BYTE)
01735     template<>
01736     struct StringMaker<int> {
01737         static std::string convert(int value);
01738     };
01739     template<>
01740     struct StringMaker<long> {
01741         static std::string convert(long value);
01742     };
01743     template<>
01744     struct StringMaker<long long> {
01745         static std::string convert(long long value);
01746     };
01747     template<>
01748     struct StringMaker<unsigned int> {
01749         static std::string convert(unsigned int value);
01750     };
01751     template<>
01752     struct StringMaker<unsigned long> {
01753         static std::string convert(unsigned long value);
01754     };
01755     template<>
01756     struct StringMaker<unsigned long long> {
01757         static std::string convert(unsigned long long value);
01758     };
01759
01760     template<>
01761     struct StringMaker<bool> {
01762         static std::string convert(bool b);
01763     };
01764
01765     template<>
01766     struct StringMaker<char> {
01767         static std::string convert(char c);
01768     };
01769     template<>
01770     struct StringMaker<signed char> {
01771         static std::string convert(signed char c);
01772     };
01773     template<>
01774     struct StringMaker<unsigned char> {
01775         static std::string convert(unsigned char c);
01776     };
01777
01778     template<>
01779     struct StringMaker<std::nullptr_t> {
01780         static std::string convert(std::nullptr_t);
01781     };
01782
01783     template<>
01784     struct StringMaker<float> {
01785         static std::string convert(float value);
01786         static int precision;
01787     };
01788
01789     template<>
01790     struct StringMaker<double> {
01791         static std::string convert(double value);
01792         static int precision;
01793     };
01794
01795     template <typename T>
01796     struct StringMaker<T*> {
01797         template <typename U>
01798         static std::string convert(U* p) {
01799             if (p) {
```

```
01800                 return ::Catch::Detail::rawMemoryToString(p);
01801             } else {
01802                 return "nullptr";
01803             }
01804         }
01805     };
01806
01807     template <typename R, typename C>
01808     struct StringMaker<R C::*> {
01809         static std::string convert(R C::* p) {
01810             if (p) {
01811                 return ::Catch::Detail::rawMemoryToString(p);
01812             } else {
01813                 return "nullptr";
01814             }
01815         }
01816     };
01817
01818 #if defined(_MANAGED)
01819     template <typename T>
01820     struct StringMaker<T^> {
01821         static std::string convert( T^ ref ) {
01822             return ::Catch::Detail::clrReferenceToString(ref);
01823         }
01824     };
01825 #endif
01826
01827     namespace Detail {
01828         template<typename InputIterator, typename Sentinel = InputIterator>
01829         std::string rangeToString(InputIterator first, Sentinel last) {
01830             ReusableStringStream rss;
01831             rss << "{ ";
01832             if (first != last) {
01833                 rss << ::Catch::Detail::stringify(*first);
01834                 for (++first; first != last; ++first)
01835                     rss << ", " << ::Catch::Detail::stringify(*first);
01836             }
01837             rss << " }";
01838             return rss.str();
01839         }
01840     }
01841
01842 #ifdef __OBJC__
01843     template<>
01844     struct StringMaker<NSString*> {
01845         static std::string convert(NSString * nsstring) {
01846             if (!nsstring)
01847                 return "nil";
01848             return std::string("@") + [nsstring UTF8String];
01849         }
01850     };
01851     template<>
01852     struct StringMaker<NSObject*> {
01853         static std::string convert(NSObject* nsObject) {
01854             return ::Catch::Detail::stringify([nsObject description]);
01855         }
01856
01857     };
01858     namespace Detail {
01859         inline std::string stringify( NSString* nsstring ) {
01860             return StringMaker<NSString*>::convert( nsstring );
01861         }
01862
01863     } // namespace Detail
01864 #endif // __OBJC__
01865
01866 } // namespace Catch
01867
01869 // Separate std-lib types stringification, so it can be selectively enabled
01870 // This means that we do not bring in
01871
01872 #if defined(CATCH_CONFIG_ENABLE_ALL_STRINGMAKERS)
01873 #  define CATCH_CONFIG_ENABLE_PAIR_STRINGMAKER
01874 #  define CATCH_CONFIG_ENABLE_TUPLE_STRINGMAKER
01875 #  define CATCH_CONFIG_ENABLE_VARIANT_STRINGMAKER
01876 #  define CATCH_CONFIG_ENABLE_CHRONO_STRINGMAKER
01877 #  define CATCH_CONFIG_ENABLE_OPTIONAL_STRINGMAKER
01878 #endif
01879
01880 // Separate std::pair specialization
01881 #if defined(CATCH_CONFIG_ENABLE_PAIR_STRINGMAKER)
01882 #include <utility>
01883 namespace Catch {
01884     template<typename T1, typename T2>
01885     struct StringMaker<std::pair<T1, T2> > {
01886         static std::string convert(const std::pair<T1, T2>& pair) {
01887             ReusableStringStream rss;
```

```
01888             rss « "{ "
01889                 « ::Catch::Detail::stringify(pair.first)
01890                 « ", "
01891                 « ::Catch::Detail::stringify(pair.second)
01892                 « " }";
01893             return rss.str();
01894         }
01895     };
01896 }
01897 #endif // CATCH_CONFIG_ENABLE_PAIR_STRINGMAKER
01898
01899 #if defined(CATCH_CONFIG_ENABLE_OPTIONAL_STRINGMAKER) && defined(CATCH_CONFIG_CPP17_OPTIONAL)
01900 #include <optional>
01901 namespace Catch {
01902     template<typename T>
01903     struct StringMaker<std::optional<T> > {
01904         static std::string convert(const std::optional<T>& optional) {
01905             ReusableStringStream rss;
01906             if (optional.has_value()) {
01907                 rss « ::Catch::Detail::stringify(*optional);
01908             } else {
01909                 rss « "{ }";
01910             }
01911             return rss.str();
01912         }
01913     };
01914 }
01915 #endif // CATCH_CONFIG_ENABLE_OPTIONAL_STRINGMAKER
01916
01917 // Separate std::tuple specialization
01918 #if defined(CATCH_CONFIG_ENABLE_TUPLE_STRINGMAKER)
01919 #include <tuple>
01920 namespace Catch {
01921     namespace Detail {
01922         template<
01923             typename Tuple,
01924             std::size_t N = 0,
01925             bool = (N < std::tuple_size<Tuple>::value)
01926             >
01927             struct TupleElementPrinter {
01928             static void print(const Tuple& tuple, std::ostream& os) {
01929                 os « (N ? ", " : " ")
01930                     « ::Catch::Detail::stringify(std::get<N>(tuple));
01931                 TupleElementPrinter<Tuple, N + 1>::print(tuple, os);
01932             }
01933         };
01934
01935         template<
01936             typename Tuple,
01937             std::size_t N
01938         >
01939             struct TupleElementPrinter<Tuple, N, false> {
01940             static void print(const Tuple&, std::ostream&) {}
01941         };
01942
01943     }
01944
01945     template<typename ...Types>
01946     struct StringMaker<std::tuple<Types...>> {
01947         static std::string convert(const std::tuple<Types...>& tuple) {
01948             ReusableStringStream rss;
01949             rss « '{';
01950             Detail::TupleElementPrinter<std::tuple<Types...>>::print(tuple, rss.get());
01951             rss « " }";
01952             return rss.str();
01953         }
01954     };
01955 }
01956 #endif // CATCH_CONFIG_ENABLE_TUPLE_STRINGMAKER
01957
01958 #if defined(CATCH_CONFIG_ENABLE_VARIANT_STRINGMAKER) && defined(CATCH_CONFIG_CPP17_VARIANT)
01959 #include <variant>
01960 namespace Catch {
01961     template<>
01962     struct StringMaker<std::monostate> {
01963         static std::string convert(const std::monostate&) {
01964             return "{ }";
01965         }
01966     };
01967
01968     template<typename... Elements>
01969     struct StringMaker<std::variant<Elements...>> {
01970         static std::string convert(const std::variant<Elements...>& variant) {
01971             if (variant.valueless_by_exception()) {
01972                 return "{valueless variant}";
01973             } else {
01974                 return std::visit(
```

```
01975                     [](const auto& value) {
01976                         return ::Catch::Detail::stringify(value);
01977                     },
01978                     variant
01979                 );
01980             }
01981         }
01982     };
01983 }
01984 #endif // CATCH_CONFIG_ENABLE_VARIANT_STRINGMAKER
01985
01986 namespace Catch {
01987     // Import begin/ end from std here
01988     using std::begin;
01989     using std::end;
01990
01991     namespace detail {
01992         template <typename...>
01993         struct void_type {
01994             using type = void;
01995         };
01996
01997         template <typename T, typename = void>
01998         struct is_range_impl : std::false_type {
01999         };
02000
02001         template <typename T>
02002         struct is_range_impl<T, typename void_type<decltype(begin(std::declval<T>()))>::type> :
      std::true_type {
02003         };
02004     } // namespace detail
02005
02006     template <typename T>
02007     struct is_range : detail::is_range_impl<T> {
02008     };
02009
02010 #if defined(_MANAGED) // Managed types are never ranges
02011     template <typename T>
02012     struct is_range<T^> {
02013         static const bool value = false;
02014     };
02015 #endif
02016
02017     template<typename Range>
02018     std::string rangeToString( Range const& range ) {
02019         return ::Catch::Detail::rangeToString( begin( range ), end( range ) );
02020     }
02021
02022     // Handle vector<bool> specially
02023     template<typename Allocator>
02024     std::string rangeToString( std::vector<bool, Allocator> const& v ) {
02025         ReusableStringStream rss;
02026         rss << "{ ";
02027         bool first = true;
02028         for( bool b : v ) {
02029             if( first )
02030                 first = false;
02031             else
02032                 rss << ", ";
02033             rss << ::Catch::Detail::stringify( b );
02034         }
02035         rss << " }";
02036         return rss.str();
02037     }
02038
02039     template<typename R>
02040     struct StringMaker<R, typename std::enable_if<is_range<R>::value &&
      !::Catch::Detail::IsStreamInsertable<R>::value>::type> {
02041         static std::string convert( R const& range ) {
02042             return rangeToString( range );
02043         }
02044     };
02045
02046     template <typename T, int SZ>
02047     struct StringMaker<T[SZ]> {
02048         static std::string convert(T const(&arr)[SZ]) {
02049             return rangeToString(arr);
02050         }
02051     };
02052
02053 } // namespace Catch
02054
02055 // Separate std::chrono::duration specialization
02056 #if defined(CATCH_CONFIG_ENABLE_CHRONO_STRINGMAKER)
02057 #include <ctime>
02058 #include <ratio>
02059 #include <chrono>
```

```
02060
02061 namespace Catch {
02062
02063     template <class Ratio>
02064     struct ratio_string {
02065         static std::string symbol();
02066     };
02067
02068     template <class Ratio>
02069     std::string ratio_string<Ratio>::symbol() {
02070         Catch::ReusableStringStream rss;
02071         rss « '[' « Ratio::num « '/'
02072             « Ratio::den « ']';
02073         return rss.str();
02074     }
02075     template <>
02076     struct ratio_string<std::atto> {
02077         static std::string symbol();
02078     };
02079     template <>
02080     struct ratio_string<std::femto> {
02081         static std::string symbol();
02082     };
02083     template <>
02084     struct ratio_string<std::pico> {
02085         static std::string symbol();
02086     };
02087     template <>
02088     struct ratio_string<std::nano> {
02089         static std::string symbol();
02090     };
02091     template <>
02092     struct ratio_string<std::micro> {
02093         static std::string symbol();
02094     };
02095     template <>
02096     struct ratio_string<std::milli> {
02097         static std::string symbol();
02098     };
02099
02101     // std::chrono::duration specializations
02102     template<typename Value, typename Ratio>
02103     struct StringMaker<std::chrono::duration<Value, Ratio» {
02104         static std::string convert(std::chrono::duration<Value, Ratio> const& duration) {
02105             ReusableStringStream rss;
02106             rss « duration.count() « ' ' « ratio_string<Ratio>::symbol() « 's';
02107             return rss.str();
02108         }
02109     };
02110     template<typename Value>
02111     struct StringMaker<std::chrono::duration<Value, std::ratio<1»> {
02112         static std::string convert(std::chrono::duration<Value, std::ratio<1» const& duration) {
02113             ReusableStringStream rss;
02114             rss « duration.count() « " s";
02115             return rss.str();
02116         }
02117     };
02118     template<typename Value>
02119     struct StringMaker<std::chrono::duration<Value, std::ratio<60»> {
02120         static std::string convert(std::chrono::duration<Value, std::ratio<60» const& duration) {
02121             ReusableStringStream rss;
02122             rss « duration.count() « " m";
02123             return rss.str();
02124         }
02125     };
02126     template<typename Value>
02127     struct StringMaker<std::chrono::duration<Value, std::ratio<3600»> {
02128         static std::string convert(std::chrono::duration<Value, std::ratio<3600» const& duration) {
02129             ReusableStringStream rss;
02130             rss « duration.count() « " h";
02131             return rss.str();
02132         }
02133     };
02134
02136     // std::chrono::time_point specialization
02137     // Generic time_point cannot be specialized, only std::chrono::time_point<system_clock>
02138     template<typename Clock, typename Duration>
02139     struct StringMaker<std::chrono::time_point<Clock, Duration» {
02140         static std::string convert(std::chrono::time_point<Clock, Duration> const& time_point) {
02141             return ::Catch::Detail::stringify(time_point.time_since_epoch()) + " since epoch";
02142         }
02143     };
02144     // std::chrono::time_point<system_clock> specialization
02145     template<typename Duration>
02146     struct StringMaker<std::chrono::time_point<std::chrono::system_clock, Duration» {
02147         static std::string convert(std::chrono::time_point<std::chrono::system_clock, Duration> const&
      time_point) {
```

```
02148             auto converted = std::chrono::system_clock::to_time_t(time_point);
02149
02150 #ifdef _MSC_VER
02151             std::tm timeInfo = {};
02152             gmtime_s(&timeInfo, &converted);
02153 #else
02154             std::tm* timeInfo = std::gmtime(&converted);
02155 #endif
02156
02157             auto const timeStampSize = sizeof("2017-01-16T17:06:45Z");
02158             char timeStamp[timeStampSize];
02159             const char * const fmt = "%Y-%m-%dT%H:%M:%SZ";
02160
02161 #ifdef _MSC_VER
02162             std::strftime(timeStamp, timeStampSize, fmt, &timeInfo);
02163 #else
02164             std::strftime(timeStamp, timeStampSize, fmt, timeInfo);
02165 #endif
02166             return std::string(timeStamp);
02167         }
02168     };
02169 }
02170 #endif // CATCH_CONFIG_ENABLE_CHRONO_STRINGMAKER
02171
02172 #define INTERNAL_CATCH_REGISTER_ENUM( enumName, ... ) \
02173 namespace Catch { \
02174     template<> struct StringMaker<enumName> { \
02175         static std::string convert( enumName value ) { \
02176             static const auto& enumInfo =
      ::Catch::getMutableRegistryHub().getMutableEnumValuesRegistry().registerEnum( #enumName, #__VA_ARGS__,
      { __VA_ARGS__ } ); \
02177             return static_cast<std::string>(enumInfo.lookup( static_cast<int>( value ) )); \
02178         } \
02179     }; \
02180 }
02181
02182 #define CATCH_REGISTER_ENUM( enumName, ... ) INTERNAL_CATCH_REGISTER_ENUM( enumName, __VA_ARGS__ )
02183
02184 #ifdef _MSC_VER
02185 #pragma warning(pop)
02186 #endif
02187
02188 // end catch_tostring.h
02189 #include <iosfwd>
02190
02191 #ifdef _MSC_VER
02192 #pragma warning(push)
02193 #pragma warning(disable:4389) // '==' : signed/unsigned mismatch
02194 #pragma warning(disable:4018) // more "signed/unsigned mismatch"
02195 #pragma warning(disable:4312) // Converting int to T* using reinterpret_cast (issue on x64 platform)
02196 #pragma warning(disable:4180) // qualifier applied to function type has no meaning
02197 #pragma warning(disable:4800) // Forcing result to true or false
02198 #endif
02199
02200 namespace Catch {
02201
02202     struct ITransientExpression {
02203         auto isBinaryExpression() const -> bool { return m_isBinaryExpression; }
02204         auto getResult() const -> bool { return m_result; }
02205         virtual void streamReconstructedExpression( std::ostream &os ) const = 0;
02206
02207         ITransientExpression( bool isBinaryExpression, bool result )
02208                 :   m_isBinaryExpression( isBinaryExpression ),
02209                     m_result( result )
02210         {}
02211
02212         // We don't actually need a virtual destructor, but many static analysers
02213         // complain if it's not here :-(
02214         virtual ~ITransientExpression();
02215
02216         bool m_isBinaryExpression;
02217         bool m_result;
02218
02219     };
02220
02221     void formatReconstructedExpression( std::ostream &os, std::string const& lhs, StringRef op,
      std::string const& rhs );
02222
02223     template<typename LhsT, typename RhsT>
02224     class BinaryExpr  : public ITransientExpression {
02225         LhsT m_lhs;
02226         StringRef m_op;
02227         RhsT m_rhs;
02228
02229         void streamReconstructedExpression( std::ostream &os ) const override {
02230             formatReconstructedExpression
02231                     ( os, Catch::Detail::stringify( m_lhs ), m_op, Catch::Detail::stringify( m_rhs )
```

```
    );
02232         }
02233
02234     public:
02235         BinaryExpr( bool comparisonResult, LhsT lhs, StringRef op, RhsT rhs )
02236                 :   ITransientExpression{ true, comparisonResult },
02237                     m_lhs( lhs ),
02238                     m_op( op ),
02239                     m_rhs( rhs )
02240         {}
02241
02242         template<typename T>
02243         auto operator && ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
02244             static_assert(always_false<T>::value,
02245                           "chained comparisons are not supported inside assertions, "
02246                           "wrap the expression inside parentheses, or decompose it");
02247         }
02248
02249         template<typename T>
02250         auto operator || ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
02251             static_assert(always_false<T>::value,
02252                           "chained comparisons are not supported inside assertions, "
02253                           "wrap the expression inside parentheses, or decompose it");
02254         }
02255
02256         template<typename T>
02257         auto operator == ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
02258             static_assert(always_false<T>::value,
02259                           "chained comparisons are not supported inside assertions, "
02260                           "wrap the expression inside parentheses, or decompose it");
02261         }
02262
02263         template<typename T>
02264         auto operator != ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
02265             static_assert(always_false<T>::value,
02266                           "chained comparisons are not supported inside assertions, "
02267                           "wrap the expression inside parentheses, or decompose it");
02268         }
02269
02270         template<typename T>
02271         auto operator > ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
02272             static_assert(always_false<T>::value,
02273                           "chained comparisons are not supported inside assertions, "
02274                           "wrap the expression inside parentheses, or decompose it");
02275         }
02276
02277         template<typename T>
02278         auto operator < ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
02279             static_assert(always_false<T>::value,
02280                           "chained comparisons are not supported inside assertions, "
02281                           "wrap the expression inside parentheses, or decompose it");
02282         }
02283
02284         template<typename T>
02285         auto operator >= ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
02286             static_assert(always_false<T>::value,
02287                           "chained comparisons are not supported inside assertions, "
02288                           "wrap the expression inside parentheses, or decompose it");
02289         }
02290
02291         template<typename T>
02292         auto operator <= ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
02293             static_assert(always_false<T>::value,
02294                           "chained comparisons are not supported inside assertions, "
02295                           "wrap the expression inside parentheses, or decompose it");
02296         }
02297     };
02298
02299     template<typename LhsT>
02300     class UnaryExpr : public ITransientExpression {
02301         LhsT m_lhs;
02302
02303         void streamReconstructedExpression( std::ostream &os ) const override {
02304             os « Catch::Detail::stringify( m_lhs );
02305         }
02306
02307     public:
02308         explicit UnaryExpr( LhsT lhs )
02309                 :   ITransientExpression{ false, static_cast<bool>(lhs) },
02310                     m_lhs( lhs )
02311         {}
02312     };
02313
02314     // Specialised comparison functions to handle equality comparisons between ints and pointers (NULL
    deduces as an int)
02315     template<typename LhsT, typename RhsT>
02316     auto compareEqual( LhsT const& lhs, RhsT const& rhs ) -> bool { return static_cast<bool>(lhs ==
```

```
    rhs); }
02317     template<typename T>
02318     auto compareEqual( T* const& lhs, int rhs ) -> bool { return lhs == reinterpret_cast<void const*>(
    rhs ); }
02319     template<typename T>
02320     auto compareEqual( T* const& lhs, long rhs ) -> bool { return lhs == reinterpret_cast<void
    const*>( rhs ); }
02321     template<typename T>
02322     auto compareEqual( int lhs, T* const& rhs ) -> bool { return reinterpret_cast<void const*>( lhs )
    == rhs; }
02323     template<typename T>
02324     auto compareEqual( long lhs, T* const& rhs ) -> bool { return reinterpret_cast<void const*>( lhs )
    == rhs; }
02325
02326     template<typename LhsT, typename RhsT>
02327     auto compareNotEqual( LhsT const& lhs, RhsT&& rhs ) -> bool { return static_cast<bool>(lhs !=
    rhs); }
02328     template<typename T>
02329     auto compareNotEqual( T* const& lhs, int rhs ) -> bool { return lhs != reinterpret_cast<void
    const*>( rhs ); }
02330     template<typename T>
02331     auto compareNotEqual( T* const& lhs, long rhs ) -> bool { return lhs != reinterpret_cast<void
    const*>( rhs ); }
02332     template<typename T>
02333     auto compareNotEqual( int lhs, T* const& rhs ) -> bool { return reinterpret_cast<void const*>( lhs
    ) != rhs; }
02334     template<typename T>
02335     auto compareNotEqual( long lhs, T* const& rhs ) -> bool { return reinterpret_cast<void const*>(
    lhs ) != rhs; }
02336
02337     template<typename LhsT>
02338     class ExprLhs {
02339         LhsT m_lhs;
02340     public:
02341         explicit ExprLhs( LhsT lhs ) : m_lhs( lhs ) {}
02342
02343         template<typename RhsT>
02344         auto operator == ( RhsT const& rhs ) -> BinaryExpr<LhsT, RhsT const&> const {
02345             return { compareEqual( m_lhs, rhs ), m_lhs, "==", rhs };
02346         }
02347         auto operator == ( bool rhs ) -> BinaryExpr<LhsT, bool> const {
02348             return { m_lhs == rhs, m_lhs, "==", rhs };
02349         }
02350
02351         template<typename RhsT>
02352         auto operator != ( RhsT const& rhs ) -> BinaryExpr<LhsT, RhsT const&> const {
02353             return { compareNotEqual( m_lhs, rhs ), m_lhs, "!=", rhs };
02354         }
02355         auto operator != ( bool rhs ) -> BinaryExpr<LhsT, bool> const {
02356             return { m_lhs != rhs, m_lhs, "!=", rhs };
02357         }
02358
02359         template<typename RhsT>
02360         auto operator > ( RhsT const& rhs ) -> BinaryExpr<LhsT, RhsT const&> const {
02361             return { static_cast<bool>(m_lhs > rhs), m_lhs, ">", rhs };
02362         }
02363         template<typename RhsT>
02364         auto operator < ( RhsT const& rhs ) -> BinaryExpr<LhsT, RhsT const&> const {
02365             return { static_cast<bool>(m_lhs < rhs), m_lhs, "<", rhs };
02366         }
02367         template<typename RhsT>
02368         auto operator >= ( RhsT const& rhs ) -> BinaryExpr<LhsT, RhsT const&> const {
02369             return { static_cast<bool>(m_lhs >= rhs), m_lhs, ">=", rhs };
02370         }
02371         template<typename RhsT>
02372         auto operator <= ( RhsT const& rhs ) -> BinaryExpr<LhsT, RhsT const&> const {
02373             return { static_cast<bool>(m_lhs <= rhs), m_lhs, "<=", rhs };
02374         }
02375         template <typename RhsT>
02376         auto operator | (RhsT const& rhs) -> BinaryExpr<LhsT, RhsT const&> const {
02377             return { static_cast<bool>(m_lhs | rhs), m_lhs, "|", rhs };
02378         }
02379         template <typename RhsT>
02380         auto operator & (RhsT const& rhs) -> BinaryExpr<LhsT, RhsT const&> const {
02381             return { static_cast<bool>(m_lhs & rhs), m_lhs, "&", rhs };
02382         }
02383         template <typename RhsT>
02384         auto operator ^ (RhsT const& rhs) -> BinaryExpr<LhsT, RhsT const&> const {
02385             return { static_cast<bool>(m_lhs ^ rhs), m_lhs, "^", rhs };
02386         }
02387
02388         template<typename RhsT>
02389         auto operator && ( RhsT const& ) -> BinaryExpr<LhsT, RhsT const&> const {
02390             static_assert(always_false<RhsT>::value,
02391                           "operator&& is not supported inside assertions, "
02392                           "wrap the expression inside parentheses, or decompose it");
02393         }
```

```
02394
02395         template<typename RhsT>
02396         auto operator || ( RhsT const& ) -> BinaryExpr<LhsT, RhsT const&> const {
02397             static_assert(always_false<RhsT>::value,
02398                           "operator|| is not supported inside assertions, "
02399                           "wrap the expression inside parentheses, or decompose it");
02400         }
02401
02402         auto makeUnaryExpr() const -> UnaryExpr<LhsT> {
02403             return UnaryExpr<LhsT>{ m_lhs };
02404         }
02405     };
02406
02407     void handleExpression( ITransientExpression const& expr );
02408
02409     template<typename T>
02410     void handleExpression( ExprLhs<T> const& expr ) {
02411         handleExpression( expr.makeUnaryExpr() );
02412     }
02413
02414     struct Decomposer {
02415         template<typename T>
02416         auto operator <= ( T const& lhs ) -> ExprLhs<T const&> {
02417             return ExprLhs<T const&>{ lhs };
02418         }
02419
02420         auto operator <=( bool value ) -> ExprLhs<bool> {
02421             return ExprLhs<bool>{ value };
02422         }
02423     };
02424
02425 } // end namespace Catch
02426
02427 #ifdef _MSC_VER
02428 #pragma warning(pop)
02429 #endif
02430
02431 // end catch_decomposer.h
02432 // start catch_interfaces_capture.h
02433
02434 #include <string>
02435 #include <chrono>
02436
02437 namespace Catch {
02438
02439     class AssertionResult;
02440     struct AssertionInfo;
02441     struct SectionInfo;
02442     struct SectionEndInfo;
02443     struct MessageInfo;
02444     struct MessageBuilder;
02445     struct Counts;
02446     struct AssertionReaction;
02447     struct SourceLineInfo;
02448
02449     struct ITransientExpression;
02450     struct IGeneratorTracker;
02451
02452 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
02453     struct BenchmarkInfo;
02454     template <typename Duration = std::chrono::duration<double, std::nano»
02455     struct BenchmarkStats;
02456 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
02457
02458     struct IResultCapture {
02459
02460         virtual ~IResultCapture();
02461
02462         virtual bool sectionStarted(    SectionInfo const& sectionInfo,
02463                                         Counts& assertions ) = 0;
02464         virtual void sectionEnded( SectionEndInfo const& endInfo ) = 0;
02465         virtual void sectionEndedEarly( SectionEndInfo const& endInfo ) = 0;
02466
02467         virtual auto acquireGeneratorTracker( StringRef generatorName, SourceLineInfo const& lineInfo
      ) -> IGeneratorTracker& = 0;
02468
02469 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
02470         virtual void benchmarkPreparing( std::string const& name ) = 0;
02471         virtual void benchmarkStarting( BenchmarkInfo const& info ) = 0;
02472         virtual void benchmarkEnded( BenchmarkStats<> const& stats ) = 0;
02473         virtual void benchmarkFailed( std::string const& error ) = 0;
02474 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
02475
02476         virtual void pushScopedMessage( MessageInfo const& message ) = 0;
02477         virtual void popScopedMessage( MessageInfo const& message ) = 0;
02478
02479         virtual void emplaceUnscopedMessage( MessageBuilder const& builder ) = 0;
```

```
02480
02481         virtual void handleFatalErrorCondition( StringRef message ) = 0;
02482
02483         virtual void handleExpr
02484                 (   AssertionInfo const& info,
02485                     ITransientExpression const& expr,
02486                     AssertionReaction& reaction ) = 0;
02487         virtual void handleMessage
02488                 (   AssertionInfo const& info,
02489                     ResultWas::OfType resultType,
02490                     StringRef const& message,
02491                     AssertionReaction& reaction ) = 0;
02492         virtual void handleUnexpectedExceptionNotThrown
02493                 (   AssertionInfo const& info,
02494                     AssertionReaction& reaction ) = 0;
02495         virtual void handleUnexpectedInflightException
02496                 (   AssertionInfo const& info,
02497                     std::string const& message,
02498                     AssertionReaction& reaction ) = 0;
02499         virtual void handleIncomplete
02500                 (   AssertionInfo const& info ) = 0;
02501         virtual void handleNonExpr
02502                 (   AssertionInfo const &info,
02503                     ResultWas::OfType resultType,
02504                     AssertionReaction &reaction ) = 0;
02505
02506         virtual bool lastAssertionPassed() = 0;
02507         virtual void assertionPassed() = 0;
02508
02509         // Deprecated, do not use:
02510         virtual std::string getCurrentTestName() const = 0;
02511         virtual const AssertionResult* getLastResult() const = 0;
02512         virtual void exceptionEarlyReported() = 0;
02513     };
02514
02515     IResultCapture& getResultCapture();
02516 }
02517
02518 // end catch_interfaces_capture.h
02519 namespace Catch {
02520
02521     struct TestFailureException{};
02522     struct AssertionResultData;
02523     struct IResultCapture;
02524     class RunContext;
02525
02526     class LazyExpression {
02527         friend class AssertionHandler;
02528         friend struct AssertionStats;
02529         friend class RunContext;
02530
02531         ITransientExpression const* m_transientExpression = nullptr;
02532         bool m_isNegated;
02533     public:
02534         LazyExpression( bool isNegated );
02535         LazyExpression( LazyExpression const& other );
02536         LazyExpression& operator = ( LazyExpression const& ) = delete;
02537
02538         explicit operator bool() const;
02539
02540         friend auto operator << ( std::ostream& os, LazyExpression const& lazyExpr ) -> std::ostream&;
02541     };
02542
02543     struct AssertionReaction {
02544         bool shouldDebugBreak = false;
02545         bool shouldThrow = false;
02546     };
02547
02548     class AssertionHandler {
02549         AssertionInfo m_assertionInfo;
02550         AssertionReaction m_reaction;
02551         bool m_completed = false;
02552         IResultCapture& m_resultCapture;
02553
02554     public:
02555         AssertionHandler
02556                 (   StringRef const& macroName,
02557                     SourceLineInfo const& lineInfo,
02558                     StringRef capturedExpression,
02559                     ResultDisposition::Flags resultDisposition );
02560         ~AssertionHandler() {
02561             if ( !m_completed ) {
02562                 m_resultCapture.handleIncomplete( m_assertionInfo );
02563             }
02564         }
02565
02566         template<typename T>
```

```
02567         void handleExpr( ExprLhs<T> const& expr ) {
02568             handleExpr( expr.makeUnaryExpr() );
02569         }
02570         void handleExpr( ITransientExpression const& expr );
02571
02572         void handleMessage(ResultWas::OfType resultType, StringRef const& message);
02573
02574         void handleExceptionThrownAsExpected();
02575         void handleUnexpectedExceptionNotThrown();
02576         void handleExceptionNotThrownAsExpected();
02577         void handleThrowingCallSkipped();
02578         void handleUnexpectedInflightException();
02579
02580         void complete();
02581         void setCompleted();
02582
02583         // query
02584         auto allowThrows() const -> bool;
02585     };
02586
02587     void handleExceptionMatchExpr( AssertionHandler& handler, std::string const& str, StringRef const&
    matcherString );
02588
02589 } // namespace Catch
02590
02591 // end catch_assertionhandler.h
02592 // start catch_message.h
02593
02594 #include <string>
02595 #include <vector>
02596
02597 namespace Catch {
02598
02599     struct MessageInfo {
02600         MessageInfo(    StringRef const& _macroName,
02601                         SourceLineInfo const& _lineInfo,
02602                         ResultWas::OfType _type );
02603
02604         StringRef macroName;
02605         std::string message;
02606         SourceLineInfo lineInfo;
02607         ResultWas::OfType type;
02608         unsigned int sequence;
02609
02610         bool operator == ( MessageInfo const& other ) const;
02611         bool operator < ( MessageInfo const& other ) const;
02612     private:
02613         static unsigned int globalCount;
02614     };
02615
02616     struct MessageStream {
02617
02618         template<typename T>
02619         MessageStream& operator << ( T const& value ) {
02620             m_stream << value;
02621             return *this;
02622         }
02623
02624         ReusableStringStream m_stream;
02625     };
02626
02627     struct MessageBuilder : MessageStream {
02628         MessageBuilder( StringRef const& macroName,
02629                         SourceLineInfo const& lineInfo,
02630                         ResultWas::OfType type );
02631
02632         template<typename T>
02633         MessageBuilder& operator << ( T const& value ) {
02634             m_stream << value;
02635             return *this;
02636         }
02637
02638         MessageInfo m_info;
02639     };
02640
02641     class ScopedMessage {
02642     public:
02643         explicit ScopedMessage( MessageBuilder const& builder );
02644         ScopedMessage( ScopedMessage& duplicate ) = delete;
02645         ScopedMessage( ScopedMessage&& old );
02646         ~ScopedMessage();
02647
02648         MessageInfo m_info;
02649         bool m_moved;
02650     };
02651
02652     class Capturer {
```

```
02653         std::vector<MessageInfo> m_messages;
02654         IResultCapture& m_resultCapture = getResultCapture();
02655         size_t m_captured = 0;
02656     public:
02657         Capturer( StringRef macroName, SourceLineInfo const& lineInfo, ResultWas::OfType resultType,
      StringRef names );
02658         ~Capturer();
02659
02660         void captureValue( size_t index, std::string const& value );
02661
02662         template<typename T>
02663         void captureValues( size_t index, T const& value ) {
02664             captureValue( index, Catch::Detail::stringify( value ) );
02665         }
02666
02667         template<typename T, typename... Ts>
02668         void captureValues( size_t index, T const& value, Ts const&... values ) {
02669             captureValue( index, Catch::Detail::stringify(value) );
02670             captureValues( index+1, values... );
02671         }
02672     };
02673
02674 } // end namespace Catch
02675
02676 // end catch_message.h
02677 #if !defined(CATCH_CONFIG_DISABLE)
02678
02679 #if !defined(CATCH_CONFIG_DISABLE_STRINGIFICATION)
02680 #define CATCH_INTERNAL_STRINGIFY(...) #__VA_ARGS__
02681 #else
02682 #define CATCH_INTERNAL_STRINGIFY(...) "Disabled by CATCH_CONFIG_DISABLE_STRINGIFICATION"
02683 #endif
02684
02685 #if defined(CATCH_CONFIG_FAST_COMPILE) || defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
02686
02688 // Another way to speed-up compilation is to omit local try-catch for REQUIRE*
02689 // macros.
02690 #define INTERNAL_CATCH_TRY
02691 #define INTERNAL_CATCH_CATCH( capturer )
02692
02693 #else // CATCH_CONFIG_FAST_COMPILE
02694
02695 #define INTERNAL_CATCH_TRY try
02696 #define INTERNAL_CATCH_CATCH( handler ) catch(...) { handler.handleUnexpectedInflightException(); }
02697
02698 #endif
02699
02700 #define INTERNAL_CATCH_REACT( handler ) handler.complete();
02701
02703 #define INTERNAL_CATCH_TEST( macroName, resultDisposition, ... ) \
02704     do { \
02705         CATCH_INTERNAL_IGNORE_BUT_WARN(__VA_ARGS__); \
02706         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(__VA_ARGS__), resultDisposition ); \
02707         INTERNAL_CATCH_TRY { \
02708             CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
02709             CATCH_INTERNAL_SUPPRESS_PARENTHESES_WARNINGS \
02710             catchAssertionHandler.handleExpr( Catch::Decomposer() <= __VA_ARGS__ ); \
02711             CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
02712         } INTERNAL_CATCH_CATCH( catchAssertionHandler ) \
02713         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
02714     } while( (void)0, (false) && static_cast<bool>( !!(__VA_ARGS__) ) )
02715
02717 #define INTERNAL_CATCH_IF( macroName, resultDisposition, ... ) \
02718     INTERNAL_CATCH_TEST( macroName, resultDisposition, __VA_ARGS__ ); \
02719     if( Catch::getResultCapture().lastAssertionPassed() )
02720
02722 #define INTERNAL_CATCH_ELSE( macroName, resultDisposition, ... ) \
02723     INTERNAL_CATCH_TEST( macroName, resultDisposition, __VA_ARGS__ ); \
02724     if( !Catch::getResultCapture().lastAssertionPassed() )
02725
02727 #define INTERNAL_CATCH_NO_THROW( macroName, resultDisposition, ... ) \
02728     do { \
02729         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(__VA_ARGS__), resultDisposition ); \
02730         try { \
02731             static_cast<void>(__VA_ARGS__); \
02732             catchAssertionHandler.handleExceptionNotThrownAsExpected(); \
02733         } \
02734         catch( ... ) { \
02735             catchAssertionHandler.handleUnexpectedInflightException(); \
02736         } \
02737         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
02738     } while( false )
02739
02741 #define INTERNAL_CATCH_THROWS( macroName, resultDisposition, ... ) \
02742     do { \
```

```
02743         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(__VA_ARGS__), resultDisposition); \
02744         if( catchAssertionHandler.allowThrows() ) \
02745             try { \
02746                 static_cast<void>(__VA_ARGS__); \
02747                 catchAssertionHandler.handleUnexpectedExceptionNotThrown(); \
02748             } \
02749             catch( ... ) { \
02750                 catchAssertionHandler.handleExceptionThrownAsExpected(); \
02751             } \
02752         else \
02753             catchAssertionHandler.handleThrowingCallSkipped(); \
02754         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
02755     } while( false )
02756
02758 #define INTERNAL_CATCH_THROWS_AS( macroName, exceptionType, resultDisposition, expr ) \
02759     do { \
02760         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(expr) ", " CATCH_INTERNAL_STRINGIFY(exceptionType), resultDisposition ); \
02761         if( catchAssertionHandler.allowThrows() ) \
02762             try { \
02763                 static_cast<void>(expr); \
02764                 catchAssertionHandler.handleUnexpectedExceptionNotThrown(); \
02765             } \
02766             catch( exceptionType const& ) { \
02767                 catchAssertionHandler.handleExceptionThrownAsExpected(); \
02768             } \
02769             catch( ... ) { \
02770                 catchAssertionHandler.handleUnexpectedInflightException(); \
02771             } \
02772         else \
02773             catchAssertionHandler.handleThrowingCallSkipped(); \
02774         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
02775     } while( false )
02776
02778 #define INTERNAL_CATCH_MSG( macroName, messageType, resultDisposition, ... ) \
02779     do { \
02780         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      Catch::StringRef(), resultDisposition ); \
02781         catchAssertionHandler.handleMessage( messageType, ( Catch::MessageStream() << __VA_ARGS__ +
      ::Catch::StreamEndStop() ).m_stream.str() ); \
02782         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
02783     } while( false )
02784
02786 #define INTERNAL_CATCH_CAPTURE( varName, macroName, ... ) \
02787     auto varName = Catch::Capturer( macroName, CATCH_INTERNAL_LINEINFO, Catch::ResultWas::Info,
      #__VA_ARGS__ ); \
02788     varName.captureValues( 0, __VA_ARGS__ )
02789
02791 #define INTERNAL_CATCH_INFO( macroName, log ) \
02792     Catch::ScopedMessage INTERNAL_CATCH_UNIQUE_NAME( scopedMessage )( Catch::MessageBuilder(
      macroName##_catch_sr, CATCH_INTERNAL_LINEINFO, Catch::ResultWas::Info ) << log );
02793
02795 #define INTERNAL_CATCH_UNSCOPED_INFO( macroName, log ) \
02796     Catch::getResultCapture().emplaceUnscopedMessage( Catch::MessageBuilder( macroName##_catch_sr,
      CATCH_INTERNAL_LINEINFO, Catch::ResultWas::Info ) << log )
02797
02799 // Although this is matcher-based, it can be used with just a string
02800 #define INTERNAL_CATCH_THROWS_STR_MATCHES( macroName, resultDisposition, matcher, ... ) \
02801     do { \
02802         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(__VA_ARGS__) ", " CATCH_INTERNAL_STRINGIFY(matcher), resultDisposition ); \
02803         if( catchAssertionHandler.allowThrows() ) \
02804             try { \
02805                 static_cast<void>(__VA_ARGS__); \
02806                 catchAssertionHandler.handleUnexpectedExceptionNotThrown(); \
02807             } \
02808             catch( ... ) { \
02809                 Catch::handleExceptionMatchExpr( catchAssertionHandler, matcher, #matcher##_catch_sr
      ); \
02810             } \
02811         else \
02812             catchAssertionHandler.handleThrowingCallSkipped(); \
02813         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
02814     } while( false )
02815
02816 #endif // CATCH_CONFIG_DISABLE
02817
02818 // end catch_capture.hpp
02819 // start catch_section.h
02820
02821 // start catch_section_info.h
02822
02823 // start catch_totals.h
02824
02825 #include <cstddef>
02826
```

```
02827 namespace Catch {
02828
02829     struct Counts {
02830         Counts operator - ( Counts const& other ) const;
02831         Counts& operator += ( Counts const& other );
02832
02833         std::size_t total() const;
02834         bool allPassed() const;
02835         bool allOk() const;
02836
02837         std::size_t passed = 0;
02838         std::size_t failed = 0;
02839         std::size_t failedButOk = 0;
02840     };
02841
02842     struct Totals {
02843
02844         Totals operator - ( Totals const& other ) const;
02845         Totals& operator += ( Totals const& other );
02846
02847         Totals delta( Totals const& prevTotals ) const;
02848
02849         int error = 0;
02850         Counts assertions;
02851         Counts testCases;
02852     };
02853 }
02854
02855 // end catch_totals.h
02856 #include <string>
02857
02858 namespace Catch {
02859
02860     struct SectionInfo {
02861         SectionInfo
02862                 (   SourceLineInfo const& _lineInfo,
02863                     std::string const& _name );
02864
02865         // Deprecated
02866         SectionInfo
02867                 (   SourceLineInfo const& _lineInfo,
02868                     std::string const& _name,
02869                     std::string const& ) : SectionInfo( _lineInfo, _name ) {}
02870
02871         std::string name;
02872         std::string description; // !Deprecated: this will always be empty
02873         SourceLineInfo lineInfo;
02874     };
02875
02876     struct SectionEndInfo {
02877         SectionInfo sectionInfo;
02878         Counts prevAssertions;
02879         double durationInSeconds;
02880     };
02881
02882 } // end namespace Catch
02883
02884 // end catch_section_info.h
02885 // start catch_timer.h
02886
02887 #include <cstdint>
02888
02889 namespace Catch {
02890
02891     auto getCurrentNanosecondsSinceEpoch() -> uint64_t;
02892     auto getEstimatedClockResolution() -> uint64_t;
02893
02894     class Timer {
02895         uint64_t m_nanoseconds = 0;
02896     public:
02897         void start();
02898         auto getElapsedNanoseconds() const -> uint64_t;
02899         auto getElapsedMicroseconds() const -> uint64_t;
02900         auto getElapsedMilliseconds() const -> unsigned int;
02901         auto getElapsedSeconds() const -> double;
02902     };
02903
02904 } // namespace Catch
02905
02906 // end catch_timer.h
02907 #include <string>
02908
02909 namespace Catch {
02910
02911     class Section : NonCopyable {
02912     public:
02913         Section( SectionInfo const& info );
```

```
02914         ~Section();
02915
02916         // This indicates whether the section should be executed or not
02917         explicit operator bool() const;
02918
02919     private:
02920         SectionInfo m_info;
02921
02922         std::string m_name;
02923         Counts m_assertions;
02924         bool m_sectionIncluded;
02925         Timer m_timer;
02926     };
02927
02928 } // end namespace Catch
02929
02930 #define INTERNAL_CATCH_SECTION( ... ) \
02931     CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
02932     CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS \
02933     if( Catch::Section const& INTERNAL_CATCH_UNIQUE_NAME( catch_internal_Section ) =
      Catch::SectionInfo( CATCH_INTERNAL_LINEINFO, __VA_ARGS__ ) ) \
02934     CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
02935
02936 #define INTERNAL_CATCH_DYNAMIC_SECTION( ... ) \
02937     CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
02938     CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS \
02939     if( Catch::Section const& INTERNAL_CATCH_UNIQUE_NAME( catch_internal_Section ) =
      Catch::SectionInfo( CATCH_INTERNAL_LINEINFO, (Catch::ReusableStringStream() << __VA_ARGS__).str() ) ) \
02940     CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
02941
02942 // end catch_section.h
02943 // start catch_interfaces_exception.h
02944
02945 // start catch_interfaces_registry_hub.h
02946
02947 #include <string>
02948 #include <memory>
02949
02950 namespace Catch {
02951
02952     class TestCase;
02953     struct ITestCaseRegistry;
02954     struct IExceptionTranslatorRegistry;
02955     struct IExceptionTranslator;
02956     struct IReporterRegistry;
02957     struct IReporterFactory;
02958     struct ITagAliasRegistry;
02959     struct IMutableEnumValuesRegistry;
02960
02961     class StartupExceptionRegistry;
02962
02963     using IReporterFactoryPtr = std::shared_ptr<IReporterFactory>;
02964
02965     struct IRegistryHub {
02966         virtual ~IRegistryHub();
02967
02968         virtual IReporterRegistry const& getReporterRegistry() const = 0;
02969         virtual ITestCaseRegistry const& getTestCaseRegistry() const = 0;
02970         virtual ITagAliasRegistry const& getTagAliasRegistry() const = 0;
02971         virtual IExceptionTranslatorRegistry const& getExceptionTranslatorRegistry() const = 0;
02972
02973         virtual StartupExceptionRegistry const& getStartupExceptionRegistry() const = 0;
02974     };
02975
02976     struct IMutableRegistryHub {
02977         virtual ~IMutableRegistryHub();
02978         virtual void registerReporter( std::string const& name, IReporterFactoryPtr const& factory ) =
      0;
02979         virtual void registerListener( IReporterFactoryPtr const& factory ) = 0;
02980         virtual void registerTest( TestCase const& testInfo ) = 0;
02981         virtual void registerTranslator( const IExceptionTranslator* translator ) = 0;
02982         virtual void registerTagAlias( std::string const& alias, std::string const& tag,
      SourceLineInfo const& lineInfo ) = 0;
02983         virtual void registerStartupException() noexcept = 0;
02984         virtual IMutableEnumValuesRegistry& getMutableEnumValuesRegistry() = 0;
02985     };
02986
02987     IRegistryHub const& getRegistryHub();
02988     IMutableRegistryHub& getMutableRegistryHub();
02989     void cleanUp();
02990     std::string translateActiveException();
02991
02992 }
02993
02994 // end catch_interfaces_registry_hub.h
02995 #if defined(CATCH_CONFIG_DISABLE)
02996 #define INTERNAL_CATCH_TRANSLATE_EXCEPTION_NO_REG( translatorName, signature) \
```

```
02997         static std::string translatorName( signature )
02998 #endif
02999
03000 #include <exception>
03001 #include <string>
03002 #include <vector>
03003
03004 namespace Catch {
03005     using exceptionTranslateFunction = std::string(*)();
03006
03007     struct IExceptionTranslator;
03008     using ExceptionTranslators = std::vector<std::unique_ptr<IExceptionTranslator const»;
03009
03010     struct IExceptionTranslator {
03011         virtual ~IExceptionTranslator();
03012         virtual std::string translate( ExceptionTranslators::const_iterator it,
      ExceptionTranslators::const_iterator itEnd ) const = 0;
03013     };
03014
03015     struct IExceptionTranslatorRegistry {
03016         virtual ~IExceptionTranslatorRegistry();
03017
03018         virtual std::string translateActiveException() const = 0;
03019     };
03020
03021     class ExceptionTranslatorRegistrar {
03022         template<typename T>
03023         class ExceptionTranslator : public IExceptionTranslator {
03024         public:
03025
03026             ExceptionTranslator( std::string(*translateFunction)( T& ) )
03027                     : m_translateFunction( translateFunction )
03028             {}
03029
03030             std::string translate( ExceptionTranslators::const_iterator it,
      ExceptionTranslators::const_iterator itEnd ) const override {
03031 #if defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
03032                 return "";
03033 #else
03034                 try {
03035                     if( it == itEnd )
03036                         std::rethrow_exception(std::current_exception());
03037                     else
03038                         return (*it)->translate( it+1, itEnd );
03039                 }
03040                 catch( T& ex ) {
03041                     return m_translateFunction( ex );
03042                 }
03043 #endif
03044             }
03045
03046         protected:
03047             std::string(*m_translateFunction)( T& );
03048         };
03049
03050     public:
03051         template<typename T>
03052         ExceptionTranslatorRegistrar( std::string(*translateFunction)( T& ) ) {
03053             getMutableRegistryHub().registerTranslator
03054                     ( new ExceptionTranslator<T>( translateFunction ) );
03055         }
03056     };
03057 }
03058
03060 #define INTERNAL_CATCH_TRANSLATE_EXCEPTION2( translatorName, signature ) \
03061     static std::string translatorName( signature ); \
03062     CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
03063     CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
03064     namespace{ Catch::ExceptionTranslatorRegistrar INTERNAL_CATCH_UNIQUE_NAME(
      catch_internal_ExceptionRegistrar )( &translatorName ); } \
03065     CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
03066     static std::string translatorName( signature )
03067
03068 #define INTERNAL_CATCH_TRANSLATE_EXCEPTION( signature ) INTERNAL_CATCH_TRANSLATE_EXCEPTION2(
      INTERNAL_CATCH_UNIQUE_NAME( catch_internal_ExceptionTranslator ), signature )
03069
03070 // end catch_interfaces_exception.h
03071 // start catch_approx.h
03072
03073 #include <type_traits>
03074
03075 namespace Catch {
03076     namespace Detail {
03077
03078         class Approx {
03079         private:
03080             bool equalityComparisonImpl(double other) const;
```

```
03081             // Validates the new margin (margin >= 0)
03082             // out-of-line to avoid including stdexcept in the header
03083             void setMargin(double margin);
03084             // Validates the new epsilon (0 < epsilon < 1)
03085             // out-of-line to avoid including stdexcept in the header
03086             void setEpsilon(double epsilon);
03087
03088         public:
03089             explicit Approx ( double value );
03090
03091             static Approx custom();
03092
03093             Approx operator-() const;
03094
03095
      template <typename T, typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03096             Approx operator()( T const& value ) const {
03097                 Approx approx( static_cast<double>(value) );
03098                 approx.m_epsilon = m_epsilon;
03099                 approx.m_margin = m_margin;
03100                 approx.m_scale = m_scale;
03101                 return approx;
03102             }
03103
03104
      template <typename T, typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03105             explicit Approx( T const& value ): Approx(static_cast<double>(value))
03106             {}
03107
03108
      template <typename T, typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03109             friend bool operator == ( const T& lhs, Approx const& rhs ) {
03110                 auto lhs_v = static_cast<double>(lhs);
03111                 return rhs.equalityComparisonImpl(lhs_v);
03112             }
03113
03114
      template <typename T, typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03115             friend bool operator == ( Approx const& lhs, const T& rhs ) {
03116                 return operator==( rhs, lhs );
03117             }
03118
03119
      template <typename T, typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03120             friend bool operator != ( T const& lhs, Approx const& rhs ) {
03121                 return !operator==( lhs, rhs );
03122             }
03123
03124
      template <typename T, typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03125             friend bool operator != ( Approx const& lhs, T const& rhs ) {
03126                 return !operator==( rhs, lhs );
03127             }
03128
03129
      template <typename T, typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03130             friend bool operator <= ( T const& lhs, Approx const& rhs ) {
03131                 return static_cast<double>(lhs) < rhs.m_value || lhs == rhs;
03132             }
03133
03134
      template <typename T, typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03135             friend bool operator <= ( Approx const& lhs, T const& rhs ) {
03136                 return lhs.m_value < static_cast<double>(rhs) || lhs == rhs;
03137             }
03138
03139
      template <typename T, typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03140             friend bool operator >= ( T const& lhs, Approx const& rhs ) {
03141                 return static_cast<double>(lhs) > rhs.m_value || lhs == rhs;
03142             }
03143
03144
      template <typename T, typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03145             friend bool operator >= ( Approx const& lhs, T const& rhs ) {
03146                 return lhs.m_value > static_cast<double>(rhs) || lhs == rhs;
03147             }
03148
03149
      template <typename T, typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03150             Approx& epsilon( T const& newEpsilon ) {
03151                 double epsilonAsDouble = static_cast<double>(newEpsilon);
03152                 setEpsilon(epsilonAsDouble);
03153                 return *this;
03154             }
03155
03156
```

```
    template <typename T, typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03157             Approx& margin( T const& newMargin ) {
03158                 double marginAsDouble = static_cast<double>(newMargin);
03159                 setMargin(marginAsDouble);
03160                 return *this;
03161             }
03162
03163
    template <typename T, typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03164             Approx& scale( T const& newScale ) {
03165                 m_scale = static_cast<double>(newScale);
03166                 return *this;
03167             }
03168
03169             std::string toString() const;
03170
03171         private:
03172             double m_epsilon;
03173             double m_margin;
03174             double m_scale;
03175             double m_value;
03176         };
03177     } // end namespace Detail
03178
03179     namespace literals {
03180         Detail::Approx operator "" _a(long double val);
03181         Detail::Approx operator "" _a(unsigned long long val);
03182     } // end namespace literals
03183
03184     template<>
03185     struct StringMaker<Catch::Detail::Approx> {
03186         static std::string convert(Catch::Detail::Approx const& value);
03187     };
03188
03189 } // end namespace Catch
03190
03191 // end catch_approx.h
03192 // start catch_string_manip.h
03193
03194 #include <string>
03195 #include <iosfwd>
03196 #include <vector>
03197
03198 namespace Catch {
03199
03200     bool startsWith( std::string const& s, std::string const& prefix );
03201     bool startsWith( std::string const& s, char prefix );
03202     bool endsWith( std::string const& s, std::string const& suffix );
03203     bool endsWith( std::string const& s, char suffix );
03204     bool contains( std::string const& s, std::string const& infix );
03205     void toLowerInPlace( std::string& s );
03206     std::string toLower( std::string const& s );
03208     std::string trim( std::string const& str );
03210     StringRef trim(StringRef ref);
03211
03212     // !!! Be aware, returns refs into original string - make sure original string outlives them
03213     std::vector<StringRef> splitStringRef( StringRef str, char delimiter );
03214     bool replaceInPlace( std::string& str, std::string const& replaceThis, std::string const& withThis
    );
03215
03216     struct pluralise {
03217         pluralise( std::size_t count, std::string const& label );
03218
03219         friend std::ostream& operator << ( std::ostream& os, pluralise const& pluraliser );
03220
03221         std::size_t m_count;
03222         std::string m_label;
03223     };
03224 }
03225
03226 // end catch_string_manip.h
03227 #ifndef CATCH_CONFIG_DISABLE_MATCHERS
03228 // start catch_capture_matchers.h
03229
03230 // start catch_matchers.h
03231
03232 #include <string>
03233 #include <vector>
03234
03235 namespace Catch {
03236     namespace Matchers {
03237         namespace Impl {
03238
03239             template<typename ArgT> struct MatchAllOf;
03240             template<typename ArgT> struct MatchAnyOf;
03241             template<typename ArgT> struct MatchNotOf;
03242
```

```
03243             class MatcherUntypedBase {
03244             public:
03245                 MatcherUntypedBase() = default;
03246                 MatcherUntypedBase ( MatcherUntypedBase const& ) = default;
03247                 MatcherUntypedBase& operator = ( MatcherUntypedBase const& ) = delete;
03248                 std::string toString() const;
03249
03250             protected:
03251                 virtual ~MatcherUntypedBase();
03252                 virtual std::string describe() const = 0;
03253                 mutable std::string m_cachedToString;
03254             };
03255
03256 #ifdef __clang__
03257 #    pragma clang diagnostic push
03258 #    pragma clang diagnostic ignored "-Wnon-virtual-dtor"
03259 #endif
03260
03261             template<typename ObjectT>
03262             struct MatcherMethod {
03263                 virtual bool match( ObjectT const& arg ) const = 0;
03264             };
03265
03266 #if defined(__OBJC__)
03267             // Hack to fix Catch GH issue #1661. Could use id for generic Object support.
03268         // use of const for Object pointers is very uncommon and under ARC it causes some kind of
    signature mismatch that breaks compilation
03269         template<>
03270         struct MatcherMethod<NSString*> {
03271             virtual bool match( NSString* arg ) const = 0;
03272         };
03273 #endif
03274
03275 #ifdef __clang__
03276 #    pragma clang diagnostic pop
03277 #endif
03278
03279             template<typename T>
03280             struct MatcherBase : MatcherUntypedBase, MatcherMethod<T> {
03281
03282                 MatchAllOf<T> operator && ( MatcherBase const& other ) const;
03283                 MatchAnyOf<T> operator || ( MatcherBase const& other ) const;
03284                 MatchNotOf<T> operator ! () const;
03285             };
03286
03287             template<typename ArgT>
03288             struct MatchAllOf : MatcherBase<ArgT> {
03289                 bool match( ArgT const& arg ) const override {
03290                     for( auto matcher : m_matchers ) {
03291                         if (!matcher->match(arg))
03292                             return false;
03293                     }
03294                     return true;
03295                 }
03296                 std::string describe() const override {
03297                     std::string description;
03298                     description.reserve( 4 + m_matchers.size()*32 );
03299                     description += "( ";
03300                     bool first = true;
03301                     for( auto matcher : m_matchers ) {
03302                         if( first )
03303                             first = false;
03304                         else
03305                             description += " and ";
03306                         description += matcher->toString();
03307                     }
03308                     description += " )";
03309                     return description;
03310                 }
03311
03312                 MatchAllOf<ArgT> operator && ( MatcherBase<ArgT> const& other ) {
03313                     auto copy(*this);
03314                     copy.m_matchers.push_back( &other );
03315                     return copy;
03316                 }
03317
03318                 std::vector<MatcherBase<ArgT> const*> m_matchers;
03319             };
03320             template<typename ArgT>
03321             struct MatchAnyOf : MatcherBase<ArgT> {
03322
03323                 bool match( ArgT const& arg ) const override {
03324                     for( auto matcher : m_matchers ) {
03325                         if (matcher->match(arg))
03326                             return true;
03327                     }
03328                     return false;
```

```
03329                 }
03330                 std::string describe() const override {
03331                     std::string description;
03332                     description.reserve( 4 + m_matchers.size()*32 );
03333                     description += "( ";
03334                     bool first = true;
03335                     for( auto matcher : m_matchers ) {
03336                         if( first )
03337                             first = false;
03338                         else
03339                             description += " or ";
03340                         description += matcher->toString();
03341                     }
03342                     description += " )";
03343                     return description;
03344                 }
03345
03346                 MatchAnyOf<ArgT> operator || ( MatcherBase<ArgT> const& other ) {
03347                     auto copy(*this);
03348                     copy.m_matchers.push_back( &other );
03349                     return copy;
03350                 }
03351
03352                 std::vector<MatcherBase<ArgT> const*> m_matchers;
03353             };
03354
03355             template<typename ArgT>
03356             struct MatchNotOf : MatcherBase<ArgT> {
03357
03358                 MatchNotOf( MatcherBase<ArgT> const& underlyingMatcher ) : m_underlyingMatcher(
      underlyingMatcher ) {}
03359
03360                 bool match( ArgT const& arg ) const override {
03361                     return !m_underlyingMatcher.match( arg );
03362                 }
03363
03364                 std::string describe() const override {
03365                     return "not " + m_underlyingMatcher.toString();
03366                 }
03367                 MatcherBase<ArgT> const& m_underlyingMatcher;
03368             };
03369
03370             template<typename T>
03371             MatchAllOf<T> MatcherBase<T>::operator && ( MatcherBase const& other ) const {
03372                 return MatchAllOf<T>() && *this && other;
03373             }
03374             template<typename T>
03375             MatchAnyOf<T> MatcherBase<T>::operator || ( MatcherBase const& other ) const {
03376                 return MatchAnyOf<T>() || *this || other;
03377             }
03378             template<typename T>
03379             MatchNotOf<T> MatcherBase<T>::operator ! () const {
03380                 return MatchNotOf<T>( *this );
03381             }
03382
03383         } // namespace Impl
03384
03385     } // namespace Matchers
03386
03387     using namespace Matchers;
03388     using Matchers::Impl::MatcherBase;
03389
03390 } // namespace Catch
03391
03392 // end catch_matchers.h
03393 // start catch_matchers_exception.hpp
03394
03395 namespace Catch {
03396     namespace Matchers {
03397         namespace Exception {
03398
03399             class ExceptionMessageMatcher : public MatcherBase<std::exception> {
03400                 std::string m_message;
03401             public:
03402
03403                 ExceptionMessageMatcher(std::string const& message):
03404                         m_message(message)
03405                 {}
03406
03407                 bool match(std::exception const& ex) const override;
03408
03409                 std::string describe() const override;
03410             };
03411
03412         } // namespace Exception
03413
03414         Exception::ExceptionMessageMatcher Message(std::string const& message);
```

```
03415
03416     } // namespace Matchers
03417 } // namespace Catch
03418
03419 // end catch_matchers_exception.hpp
03420 // start catch_matchers_floating.h
03421
03422 namespace Catch {
03423     namespace Matchers {
03424
03425         namespace Floating {
03426
03427             enum class FloatingPointKind : uint8_t;
03428
03429             struct WithinAbsMatcher : MatcherBase<double> {
03430                 WithinAbsMatcher(double target, double margin);
03431                 bool match(double const& matchee) const override;
03432                 std::string describe() const override;
03433             private:
03434                 double m_target;
03435                 double m_margin;
03436             };
03437
03438             struct WithinUlpsMatcher : MatcherBase<double> {
03439                 WithinUlpsMatcher(double target, uint64_t ulps, FloatingPointKind baseType);
03440                 bool match(double const& matchee) const override;
03441                 std::string describe() const override;
03442             private:
03443                 double m_target;
03444                 uint64_t m_ulps;
03445                 FloatingPointKind m_type;
03446             };
03447
03448             // Given IEEE-754 format for floats and doubles, we can assume
03449             // that float -> double promotion is lossless. Given this, we can
03450             // assume that if we do the standard relative comparison of
03451             // |lhs - rhs| <= epsilon * max(fabs(lhs), fabs(rhs)), then we get
03452             // the same result if we do this for floats, as if we do this for
03453             // doubles that were promoted from floats.
03454             struct WithinRelMatcher : MatcherBase<double> {
03455                 WithinRelMatcher(double target, double epsilon);
03456                 bool match(double const& matchee) const override;
03457                 std::string describe() const override;
03458             private:
03459                 double m_target;
03460                 double m_epsilon;
03461             };
03462
03463         } // namespace Floating
03464
03465         // The following functions create the actual matcher objects.
03466         // This allows the types to be inferred
03467         Floating::WithinUlpsMatcher WithinULP(double target, uint64_t maxUlpDiff);
03468         Floating::WithinUlpsMatcher WithinULP(float target, uint64_t maxUlpDiff);
03469         Floating::WithinAbsMatcher WithinAbs(double target, double margin);
03470         Floating::WithinRelMatcher WithinRel(double target, double eps);
03471         // defaults epsilon to 100*numeric_limits<double>::epsilon()
03472         Floating::WithinRelMatcher WithinRel(double target);
03473         Floating::WithinRelMatcher WithinRel(float target, float eps);
03474         // defaults epsilon to 100*numeric_limits<float>::epsilon()
03475         Floating::WithinRelMatcher WithinRel(float target);
03476
03477     } // namespace Matchers
03478 } // namespace Catch
03479
03480 // end catch_matchers_floating.h
03481 // start catch_matchers_generic.hpp
03482
03483 #include <functional>
03484 #include <string>
03485
03486 namespace Catch {
03487     namespace Matchers {
03488         namespace Generic {
03489
03490             namespace Detail {
03491                 std::string finalizeDescription(const std::string& desc);
03492             }
03493
03494             template <typename T>
03495             class PredicateMatcher : public MatcherBase<T> {
03496                 std::function<bool(T const&)> m_predicate;
03497                 std::string m_description;
03498             public:
03499
03500                 PredicateMatcher(std::function<bool(T const&)> const& elem, std::string const& descr)
03501                         :m_predicate(std::move(elem)),
```

```
03502                           m_description(Detail::finalizeDescription(descr))
03503                   {}
03504
03505                   bool match( T const& item ) const override {
03506                       return m_predicate(item);
03507                   }
03508
03509                   std::string describe() const override {
03510                       return m_description;
03511                   }
03512               };
03513
03514           } // namespace Generic
03515
03516           // The following functions create the actual matcher objects.
03517           // The user has to explicitly specify type to the function, because
03518           // inferring std::function<bool(T const&)> is hard (but possible) and
03519           // requires a lot of TMP.
03520           template<typename T>
03521           Generic::PredicateMatcher<T> Predicate(std::function<bool(T const&)> const& predicate,
      std::string const& description = "") {
03522               return Generic::PredicateMatcher<T>(predicate, description);
03523           }
03524
03525       } // namespace Matchers
03526 } // namespace Catch
03527
03528 // end catch_matchers_generic.hpp
03529 // start catch_matchers_string.h
03530
03531 #include <string>
03532
03533 namespace Catch {
03534     namespace Matchers {
03535
03536         namespace StdString {
03537
03538             struct CasedString
03539             {
03540                 CasedString( std::string const& str, CaseSensitive::Choice caseSensitivity );
03541                 std::string adjustString( std::string const& str ) const;
03542                 std::string caseSensitivitySuffix() const;
03543
03544                 CaseSensitive::Choice m_caseSensitivity;
03545                 std::string m_str;
03546             };
03547
03548             struct StringMatcherBase : MatcherBase<std::string> {
03549                 StringMatcherBase( std::string const& operation, CasedString const& comparator );
03550                 std::string describe() const override;
03551
03552                 CasedString m_comparator;
03553                 std::string m_operation;
03554             };
03555
03556             struct EqualsMatcher : StringMatcherBase {
03557                 EqualsMatcher( CasedString const& comparator );
03558                 bool match( std::string const& source ) const override;
03559             };
03560             struct ContainsMatcher : StringMatcherBase {
03561                 ContainsMatcher( CasedString const& comparator );
03562                 bool match( std::string const& source ) const override;
03563             };
03564             struct StartsWithMatcher : StringMatcherBase {
03565                 StartsWithMatcher( CasedString const& comparator );
03566                 bool match( std::string const& source ) const override;
03567             };
03568             struct EndsWithMatcher : StringMatcherBase {
03569                 EndsWithMatcher( CasedString const& comparator );
03570                 bool match( std::string const& source ) const override;
03571             };
03572
03573             struct RegexMatcher : MatcherBase<std::string> {
03574                 RegexMatcher( std::string regex, CaseSensitive::Choice caseSensitivity );
03575                 bool match( std::string const& matchee ) const override;
03576                 std::string describe() const override;
03577
03578             private:
03579                 std::string m_regex;
03580                 CaseSensitive::Choice m_caseSensitivity;
03581             };
03582
03583         } // namespace StdString
03584
03585         // The following functions create the actual matcher objects.
03586         // This allows the types to be inferred
03587
```

```
03588         StdString::EqualsMatcher Equals( std::string const& str, CaseSensitive::Choice caseSensitivity
      = CaseSensitive::Yes );
03589         StdString::ContainsMatcher Contains( std::string const& str, CaseSensitive::Choice
      caseSensitivity = CaseSensitive::Yes );
03590         StdString::EndsWithMatcher EndsWith( std::string const& str, CaseSensitive::Choice
      caseSensitivity = CaseSensitive::Yes );
03591         StdString::StartsWithMatcher StartsWith( std::string const& str, CaseSensitive::Choice
      caseSensitivity = CaseSensitive::Yes );
03592         StdString::RegexMatcher Matches( std::string const& regex, CaseSensitive::Choice
      caseSensitivity = CaseSensitive::Yes );
03593
03594     } // namespace Matchers
03595 } // namespace Catch
03596
03597 // end catch_matchers_string.h
03598 // start catch_matchers_vector.h
03599
03600 #include <algorithm>
03601
03602 namespace Catch {
03603     namespace Matchers {
03604
03605         namespace Vector {
03606             template<typename T, typename Alloc>
03607             struct ContainsElementMatcher : MatcherBase<std::vector<T, Alloc>> {
03608
03609                 ContainsElementMatcher(T const &comparator) : m_comparator( comparator) {}
03610
03611                 bool match(std::vector<T, Alloc> const &v) const override {
03612                     for (auto const& el : v) {
03613                         if (el == m_comparator) {
03614                             return true;
03615                         }
03616                     }
03617                     return false;
03618                 }
03619
03620                 std::string describe() const override {
03621                     return "Contains: " + ::Catch::Detail::stringify( m_comparator );
03622                 }
03623
03624                 T const& m_comparator;
03625             };
03626
03627             template<typename T, typename AllocComp, typename AllocMatch>
03628             struct ContainsMatcher : MatcherBase<std::vector<T, AllocMatch>> {
03629
03630                 ContainsMatcher(std::vector<T, AllocComp> const &comparator) : m_comparator(
      comparator ) {}
03631
03632                 bool match(std::vector<T, AllocMatch> const &v) const override {
03633                     // !TBD: see note in EqualsMatcher
03634                     if (m_comparator.size() > v.size())
03635                         return false;
03636                     for (auto const& comparator : m_comparator) {
03637                         auto present = false;
03638                         for (const auto& el : v) {
03639                             if (el == comparator) {
03640                                 present = true;
03641                                 break;
03642                             }
03643                         }
03644                         if (!present) {
03645                             return false;
03646                         }
03647                     }
03648                     return true;
03649                 }
03650                 std::string describe() const override {
03651                     return "Contains: " + ::Catch::Detail::stringify( m_comparator );
03652                 }
03653
03654                 std::vector<T, AllocComp> const& m_comparator;
03655             };
03656
03657             template<typename T, typename AllocComp, typename AllocMatch>
03658             struct EqualsMatcher : MatcherBase<std::vector<T, AllocMatch>> {
03659
03660                 EqualsMatcher(std::vector<T, AllocComp> const &comparator) : m_comparator( comparator
      ) {}
03661
03662                 bool match(std::vector<T, AllocMatch> const &v) const override {
03663                     // !TBD: This currently works if all elements can be compared using !=
03664                     // - a more general approach would be via a compare template that defaults
03665                     // to using !=. but could be specialised for, e.g. std::vector<T, Alloc> etc
03666                     // - then just call that directly
03667                     if (m_comparator.size() != v.size())
```

```
03668                       return false;
03669                   for (std::size_t i = 0; i < v.size(); ++i)
03670                       if (m_comparator[i] != v[i])
03671                           return false;
03672                   return true;
03673               }
03674               std::string describe() const override {
03675                   return "Equals: " + ::Catch::Detail::stringify( m_comparator );
03676               }
03677               std::vector<T, AllocComp> const& m_comparator;
03678           };
03679
03680           template<typename T, typename AllocComp, typename AllocMatch>
03681           struct ApproxMatcher : MatcherBase<std::vector<T, AllocMatch>> {
03682
03683               ApproxMatcher(std::vector<T, AllocComp> const& comparator) : m_comparator( comparator
      ) {}
03684
03685               bool match(std::vector<T, AllocMatch> const &v) const override {
03686                   if (m_comparator.size() != v.size())
03687                       return false;
03688                   for (std::size_t i = 0; i < v.size(); ++i)
03689                       if (m_comparator[i] != approx(v[i]))
03690                           return false;
03691                   return true;
03692               }
03693               std::string describe() const override {
03694                   return "is approx: " + ::Catch::Detail::stringify( m_comparator );
03695               }
03696
      template <typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03697               ApproxMatcher& epsilon( T const& newEpsilon ) {
03698                   approx.epsilon(newEpsilon);
03699                   return *this;
03700               }
03701
      template <typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03702               ApproxMatcher& margin( T const& newMargin ) {
03703                   approx.margin(newMargin);
03704                   return *this;
03705               }
03706
      template <typename = typename std::enable_if<std::is_constructible<double, T>::value>::type>
03707               ApproxMatcher& scale( T const& newScale ) {
03708                   approx.scale(newScale);
03709                   return *this;
03710               }
03711
03712               std::vector<T, AllocComp> const& m_comparator;
03713               mutable Catch::Detail::Approx approx = Catch::Detail::Approx::custom();
03714           };
03715
03716           template<typename T, typename AllocComp, typename AllocMatch>
03717           struct UnorderedEqualsMatcher : MatcherBase<std::vector<T, AllocMatch>> {
03718               UnorderedEqualsMatcher(std::vector<T, AllocComp> const& target) : m_target(target) {}
03719               bool match(std::vector<T, AllocMatch> const& vec) const override {
03720                   if (m_target.size() != vec.size()) {
03721                       return false;
03722                   }
03723                   return std::is_permutation(m_target.begin(), m_target.end(), vec.begin());
03724               }
03725
03726               std::string describe() const override {
03727                   return "UnorderedEquals: " + ::Catch::Detail::stringify(m_target);
03728               }
03729           private:
03730               std::vector<T, AllocComp> const& m_target;
03731           };
03732
03733       } // namespace Vector
03734
03735       // The following functions create the actual matcher objects.
03736       // This allows the types to be inferred
03737
03738       template<typename T, typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
03739       Vector::ContainsMatcher<T, AllocComp, AllocMatch> Contains( std::vector<T, AllocComp> const&
      comparator ) {
03740           return Vector::ContainsMatcher<T, AllocComp, AllocMatch>( comparator );
03741       }
03742
03743       template<typename T, typename Alloc = std::allocator<T>>
03744       Vector::ContainsElementMatcher<T, Alloc> VectorContains( T const& comparator ) {
03745           return Vector::ContainsElementMatcher<T, Alloc>( comparator );
03746       }
03747
03748       template<typename T, typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
03749       Vector::EqualsMatcher<T, AllocComp, AllocMatch> Equals( std::vector<T, AllocComp> const&
```

```
    comparator ) {
03750             return Vector::EqualsMatcher<T, AllocComp, AllocMatch>( comparator );
03751         }
03752
03753         template<typename T, typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
03754         Vector::ApproxMatcher<T, AllocComp, AllocMatch> Approx( std::vector<T, AllocComp> const&
    comparator ) {
03755             return Vector::ApproxMatcher<T, AllocComp, AllocMatch>( comparator );
03756         }
03757
03758         template<typename T, typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
03759         Vector::UnorderedEqualsMatcher<T, AllocComp, AllocMatch> UnorderedEquals(std::vector<T,
    AllocComp> const& target) {
03760             return Vector::UnorderedEqualsMatcher<T, AllocComp, AllocMatch>( target );
03761         }
03762
03763     } // namespace Matchers
03764 } // namespace Catch
03765
03766 // end catch_matchers_vector.h
03767 namespace Catch {
03768
03769     template<typename ArgT, typename MatcherT>
03770     class MatchExpr : public ITransientExpression {
03771         ArgT const& m_arg;
03772         MatcherT m_matcher;
03773         StringRef m_matcherString;
03774     public:
03775         MatchExpr( ArgT const& arg, MatcherT const& matcher, StringRef const& matcherString )
03776                 :   ITransientExpression{ true, matcher.match( arg ) },
03777                     m_arg( arg ),
03778                     m_matcher( matcher ),
03779                     m_matcherString( matcherString )
03780         {}
03781
03782         void streamReconstructedExpression( std::ostream &os ) const override {
03783             auto matcherAsString = m_matcher.toString();
03784             os « Catch::Detail::stringify( m_arg ) « ' ';
03785             if( matcherAsString == Detail::unprintableString )
03786                 os « m_matcherString;
03787             else
03788                 os « matcherAsString;
03789         }
03790     };
03791
03792     using StringMatcher = Matchers::Impl::MatcherBase<std::string>;
03793
03794     void handleExceptionMatchExpr( AssertionHandler& handler, StringMatcher const& matcher, StringRef
    const& matcherString  );
03795
03796     template<typename ArgT, typename MatcherT>
03797     auto makeMatchExpr( ArgT const& arg, MatcherT const& matcher, StringRef const& matcherString  ) ->
    MatchExpr<ArgT, MatcherT> {
03798         return MatchExpr<ArgT, MatcherT>( arg, matcher, matcherString );
03799     }
03800
03801 } // namespace Catch
03802
03804 #define INTERNAL_CHECK_THAT( macroName, matcher, resultDisposition, arg ) \
03805     do { \
03806         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
    CATCH_INTERNAL_STRINGIFY(arg) ", " CATCH_INTERNAL_STRINGIFY(matcher), resultDisposition ); \
03807         INTERNAL_CATCH_TRY { \
03808             catchAssertionHandler.handleExpr( Catch::makeMatchExpr( arg, matcher, #matcher##_catch_sr
    ) ); \
03809         } INTERNAL_CATCH_CATCH( catchAssertionHandler ) \
03810         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
03811     } while( false )
03812
03814 #define INTERNAL_CATCH_THROWS_MATCHES( macroName, exceptionType, resultDisposition, matcher, ... ) \
03815     do { \
03816         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
    CATCH_INTERNAL_STRINGIFY(__VA_ARGS__) ", " CATCH_INTERNAL_STRINGIFY(exceptionType) ", "
    CATCH_INTERNAL_STRINGIFY(matcher), resultDisposition ); \
03817         if( catchAssertionHandler.allowThrows() ) \
03818             try { \
03819                 static_cast<void>(__VA_ARGS__ ); \
03820                 catchAssertionHandler.handleUnexpectedExceptionNotThrown(); \
03821             } \
03822             catch( exceptionType const& ex ) { \
03823                 catchAssertionHandler.handleExpr( Catch::makeMatchExpr( ex, matcher,
    #matcher##_catch_sr ) ); \
03824             } \
03825             catch( ... ) { \
03826                 catchAssertionHandler.handleUnexpectedInflightException(); \
03827             } \
03828         else \
```

```
03829             catchAssertionHandler.handleThrowingCallSkipped(); \
03830         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
03831     } while( false )
03832
03833 // end catch_capture_matchers.h
03834 #endif
03835 // start catch_generators.hpp
03836
03837 // start catch_interfaces_generatortracker.h
03838
03839
03840 #include <memory>
03841
03842 namespace Catch {
03843
03844     namespace Generators {
03845         class GeneratorUntypedBase {
03846         public:
03847             GeneratorUntypedBase() = default;
03848             virtual ~GeneratorUntypedBase();
03849             // Attempts to move the generator to the next element
03850             //
03851             // Returns true iff the move succeeded (and a valid element
03852             // can be retrieved).
03853             virtual bool next() = 0;
03854         };
03855         using GeneratorBasePtr = std::unique_ptr<GeneratorUntypedBase>;
03856
03857     } // namespace Generators
03858
03859     struct IGeneratorTracker {
03860         virtual ~IGeneratorTracker();
03861         virtual auto hasGenerator() const -> bool = 0;
03862         virtual auto getGenerator() const -> Generators::GeneratorBasePtr const& = 0;
03863         virtual void setGenerator( Generators::GeneratorBasePtr&& generator ) = 0;
03864     };
03865
03866 } // namespace Catch
03867
03868 // end catch_interfaces_generatortracker.h
03869 // start catch_enforce.h
03870
03871 #include <exception>
03872
03873 namespace Catch {
03874 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
03875     template <typename Ex>
03876     [[noreturn]]
03877     void throw_exception(Ex const& e) {
03878         throw e;
03879     }
03880 #else // ^^ Exceptions are enabled //  Exceptions are disabled vv
03881     [[noreturn]]
03882     void throw_exception(std::exception const& e);
03883 #endif
03884
03885     [[noreturn]]
03886     void throw_logic_error(std::string const& msg);
03887     [[noreturn]]
03888     void throw_domain_error(std::string const& msg);
03889     [[noreturn]]
03890     void throw_runtime_error(std::string const& msg);
03891
03892 } // namespace Catch;
03893
03894 #define CATCH_MAKE_MSG(...) \
03895     (Catch::ReusableStringStream() << __VA_ARGS__).str()
03896
03897 #define CATCH_INTERNAL_ERROR(...) \
03898     Catch::throw_logic_error(CATCH_MAKE_MSG( CATCH_INTERNAL_LINEINFO << ": Internal Catch2 error: " <<
    __VA_ARGS__))
03899
03900 #define CATCH_ERROR(...) \
03901     Catch::throw_domain_error(CATCH_MAKE_MSG( __VA_ARGS__ ))
03902
03903 #define CATCH_RUNTIME_ERROR(...) \
03904     Catch::throw_runtime_error(CATCH_MAKE_MSG( __VA_ARGS__ ))
03905
03906 #define CATCH_ENFORCE( condition, ... ) \
03907     do{ if( !(condition) ) CATCH_ERROR( __VA_ARGS__ ); } while(false)
03908
03909 // end catch_enforce.h
03910 #include <memory>
03911 #include <vector>
03912 #include <cassert>
03913
03914 #include <utility>
```

```
03915 #include <exception>
03916
03917 namespace Catch {
03918
03919     class GeneratorException : public std::exception {
03920         const char* const m_msg = "";
03921
03922     public:
03923         GeneratorException(const char* msg):
03924                 m_msg(msg)
03925         {}
03926
03927         const char* what() const noexcept override final;
03928     };
03929
03930     namespace Generators {
03931
03932         // !TBD move this into its own location?
03933         namespace pf{
03934             template<typename T, typename... Args>
03935             std::unique_ptr<T> make_unique( Args&&... args ) {
03936                 return std::unique_ptr<T>(new T(std::forward<Args>(args)...));
03937             }
03938         }
03939
03940         template<typename T>
03941         struct IGenerator : GeneratorUntypedBase {
03942             virtual ~IGenerator() = default;
03943
03944             // Returns the current element of the generator
03945             //
03946             // \Precondition The generator is either freshly constructed,
03947             // or the last call to `next()` returned true
03948             virtual T const& get() const = 0;
03949             using type = T;
03950         };
03951
03952         template<typename T>
03953         class SingleValueGenerator final : public IGenerator<T> {
03954             T m_value;
03955         public:
03956             SingleValueGenerator(T&& value) : m_value(std::move(value)) {}
03957
03958             T const& get() const override {
03959                 return m_value;
03960             }
03961             bool next() override {
03962                 return false;
03963             }
03964         };
03965
03966         template<typename T>
03967         class FixedValuesGenerator final : public IGenerator<T> {
03968             static_assert(!std::is_same<T, bool>::value,
03969                           "FixedValuesGenerator does not support bools because of std::vector<bool>"
03970                           "specialization, use SingleValue Generator instead.");
03971             std::vector<T> m_values;
03972             size_t m_idx = 0;
03973         public:
03974             FixedValuesGenerator( std::initializer_list<T> values ) : m_values( values ) {}
03975
03976             T const& get() const override {
03977                 return m_values[m_idx];
03978             }
03979             bool next() override {
03980                 ++m_idx;
03981                 return m_idx < m_values.size();
03982             }
03983         };
03984
03985         template <typename T>
03986         class GeneratorWrapper final {
03987             std::unique_ptr<IGenerator<T>> m_generator;
03988         public:
03989             GeneratorWrapper(std::unique_ptr<IGenerator<T>> generator):
03990                     m_generator(std::move(generator))
03991             {}
03992             T const& get() const {
03993                 return m_generator->get();
03994             }
03995             bool next() {
03996                 return m_generator->next();
03997             }
03998         };
03999
04000         template <typename T>
04001         GeneratorWrapper<T> value(T&& value) {
```

```
04002             return
      GeneratorWrapper<T>(pf::make_unique<SingleValueGenerator<T>>(std::forward<T>(value)));
04003         }
04004         template <typename T>
04005         GeneratorWrapper<T> values(std::initializer_list<T> values) {
04006             return GeneratorWrapper<T>(pf::make_unique<FixedValuesGenerator<T>>(values));
04007         }
04008
04009         template<typename T>
04010         class Generators : public IGenerator<T> {
04011             std::vector<GeneratorWrapper<T>> m_generators;
04012             size_t m_current = 0;
04013
04014             void populate(GeneratorWrapper<T>&& generator) {
04015                 m_generators.emplace_back(std::move(generator));
04016             }
04017             void populate(T&& val) {
04018                 m_generators.emplace_back(value(std::forward<T>(val)));
04019             }
04020             template<typename U>
04021             void populate(U&& val) {
04022                 populate(T(std::forward<U>(val)));
04023             }
04024             template<typename U, typename... Gs>
04025             void populate(U&& valueOrGenerator, Gs &&... moreGenerators) {
04026                 populate(std::forward<U>(valueOrGenerator));
04027                 populate(std::forward<Gs>(moreGenerators)...);
04028             }
04029
04030         public:
04031             template <typename... Gs>
04032             Generators(Gs &&... moreGenerators) {
04033                 m_generators.reserve(sizeof...(Gs));
04034                 populate(std::forward<Gs>(moreGenerators)...);
04035             }
04036
04037             T const& get() const override {
04038                 return m_generators[m_current].get();
04039             }
04040
04041             bool next() override {
04042                 if (m_current >= m_generators.size()) {
04043                     return false;
04044                 }
04045                 const bool current_status = m_generators[m_current].next();
04046                 if (!current_status) {
04047                     ++m_current;
04048                 }
04049                 return m_current < m_generators.size();
04050             }
04051         };
04052
04053         template<typename... Ts>
04054         GeneratorWrapper<std::tuple<Ts...>> table( std::initializer_list<std::tuple<typename
      std::decay<Ts>::type...>> tuples ) {
04055             return values<std::tuple<Ts...>>( tuples );
04056         }
04057
04058         // Tag type to signal that a generator sequence should convert arguments to a specific type
04059         template <typename T>
04060         struct as {};
04061
04062         template<typename T, typename... Gs>
04063         auto makeGenerators( GeneratorWrapper<T>&& generator, Gs &&... moreGenerators ) ->
      Generators<T> {
04064             return Generators<T>(std::move(generator), std::forward<Gs>(moreGenerators)...);
04065         }
04066         template<typename T>
04067         auto makeGenerators( GeneratorWrapper<T>&& generator ) -> Generators<T> {
04068             return Generators<T>(std::move(generator));
04069         }
04070         template<typename T, typename... Gs>
04071         auto makeGenerators( T&& val, Gs &&... moreGenerators ) -> Generators<T> {
04072             return makeGenerators( value( std::forward<T>( val ) ), std::forward<Gs>( moreGenerators
      )... );
04073         }
04074         template<typename T, typename U, typename... Gs>
04075         auto makeGenerators( as<T>, U&& val, Gs &&... moreGenerators ) -> Generators<T> {
04076             return makeGenerators( value( T( std::forward<U>( val ) ) ), std::forward<Gs>(
      moreGenerators )... );
04077         }
04078
04079         auto acquireGeneratorTracker( StringRef generatorName, SourceLineInfo const& lineInfo ) ->
      IGeneratorTracker&;
04080
04081         template<typename L>
04082         // Note: The type after -> is weird, because VS2015 cannot parse
```

```
04083         //       the expression used in the typedef inside, when it is in
04084         //       return type. Yeah.
04085         auto generate( StringRef generatorName, SourceLineInfo const& lineInfo, L const&
      generatorExpression ) -> decltype(std::declval<decltype(generatorExpression())>().get()) {
04086             using UnderlyingType = typename decltype(generatorExpression())::type;
04087
04088             IGeneratorTracker& tracker = acquireGeneratorTracker( generatorName, lineInfo );
04089             if (!tracker.hasGenerator()) {
04090
      tracker.setGenerator(pf::make_unique<Generators<UnderlyingType>>(generatorExpression()));
04091             }
04092
04093             auto const& generator = static_cast<IGenerator<UnderlyingType> const&>(
      *tracker.getGenerator() );
04094             return generator.get();
04095         }
04096
04097     } // namespace Generators
04098 } // namespace Catch
04099
04100 #define GENERATE( ... ) \
04101     Catch::Generators::generate( INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_UNIQUE_NAME(generator)), \
04102                                  CATCH_INTERNAL_LINEINFO, \
04103                                  [ ]{ using namespace Catch::Generators; return makeGenerators(
      __VA_ARGS__ ); } ) //NOLINT(google-build-using-namespace)
04104 #define GENERATE_COPY( ... ) \
04105     Catch::Generators::generate( INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_UNIQUE_NAME(generator)), \
04106                                  CATCH_INTERNAL_LINEINFO, \
04107                                  [=]{ using namespace Catch::Generators; return makeGenerators(
      __VA_ARGS__ ); } ) //NOLINT(google-build-using-namespace)
04108 #define GENERATE_REF( ... ) \
04109     Catch::Generators::generate( INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_UNIQUE_NAME(generator)), \
04110                                  CATCH_INTERNAL_LINEINFO, \
04111                                  [&]{ using namespace Catch::Generators; return makeGenerators(
      __VA_ARGS__ ); } ) //NOLINT(google-build-using-namespace)
04112
04113 // end catch_generators.hpp
04114 // start catch_generators_generic.hpp
04115
04116 namespace Catch {
04117     namespace Generators {
04118
04119         template <typename T>
04120         class TakeGenerator : public IGenerator<T> {
04121             GeneratorWrapper<T> m_generator;
04122             size_t m_returned = 0;
04123             size_t m_target;
04124         public:
04125             TakeGenerator(size_t target, GeneratorWrapper<T>&& generator):
04126                     m_generator(std::move(generator)),
04127                     m_target(target)
04128             {
04129                 assert(target != 0 && "Empty generators are not allowed");
04130             }
04131             T const& get() const override {
04132                 return m_generator.get();
04133             }
04134             bool next() override {
04135                 ++m_returned;
04136                 if (m_returned >= m_target) {
04137                     return false;
04138                 }
04139
04140                 const auto success = m_generator.next();
04141                 // If the underlying generator does not contain enough values
04142                 // then we cut short as well
04143                 if (!success) {
04144                     m_returned = m_target;
04145                 }
04146                 return success;
04147             }
04148         };
04149
04150         template <typename T>
04151         GeneratorWrapper<T> take(size_t target, GeneratorWrapper<T>&& generator) {
04152             return GeneratorWrapper<T>(pf::make_unique<TakeGenerator<T>>(target,
      std::move(generator)));
04153         }
04154
04155         template <typename T, typename Predicate>
04156         class FilterGenerator : public IGenerator<T> {
04157             GeneratorWrapper<T> m_generator;
04158             Predicate m_predicate;
04159         public:
04160             template <typename P = Predicate>
04161             FilterGenerator(P&& pred, GeneratorWrapper<T>&& generator):
04162                     m_generator(std::move(generator)),
```

```
04163                       m_predicate(std::forward<P>(pred))
04164               {
04165                   if (!m_predicate(m_generator.get())) {
04166                       // It might happen that there are no values that pass the
04167                       // filter. In that case we throw an exception.
04168                       auto has_initial_value = nextImpl();
04169                       if (!has_initial_value) {
04170                           Catch::throw_exception(GeneratorException("No valid value found in filtered
      generator"));
04171                       }
04172                   }
04173               }
04174
04175               T const& get() const override {
04176                   return m_generator.get();
04177               }
04178
04179               bool next() override {
04180                   return nextImpl();
04181               }
04182
04183           private:
04184               bool nextImpl() {
04185                   bool success = m_generator.next();
04186                   if (!success) {
04187                       return false;
04188                   }
04189                   while (!m_predicate(m_generator.get()) && (success = m_generator.next()) == true);
04190                   return success;
04191               }
04192           };
04193
04194           template <typename T, typename Predicate>
04195           GeneratorWrapper<T> filter(Predicate&& pred, GeneratorWrapper<T>&& generator) {
04196               return
      GeneratorWrapper<T>(std::unique_ptr<IGenerator<T>>(pf::make_unique<FilterGenerator<T, Predicate>>(std::forward<Predicate
      std::move(generator))));
04197           }
04198
04199           template <typename T>
04200           class RepeatGenerator : public IGenerator<T> {
04201               static_assert(!std::is_same<T, bool>::value,
04202                             "RepeatGenerator currently does not support bools"
04203                             "because of std::vector<bool> specialization");
04204               GeneratorWrapper<T> m_generator;
04205               mutable std::vector<T> m_returned;
04206               size_t m_target_repeats;
04207               size_t m_current_repeat = 0;
04208               size_t m_repeat_index = 0;
04209           public:
04210               RepeatGenerator(size_t repeats, GeneratorWrapper<T>&& generator):
04211                       m_generator(std::move(generator)),
04212                       m_target_repeats(repeats)
04213               {
04214                   assert(m_target_repeats > 0 && "Repeat generator must repeat at least once");
04215               }
04216
04217               T const& get() const override {
04218                   if (m_current_repeat == 0) {
04219                       m_returned.push_back(m_generator.get());
04220                       return m_returned.back();
04221                   }
04222                   return m_returned[m_repeat_index];
04223               }
04224
04225               bool next() override {
04226                   // There are 2 basic cases:
04227                   // 1) We are still reading the generator
04228                   // 2) We are reading our own cache
04229
04230                   // In the first case, we need to poke the underlying generator.
04231                   // If it happily moves, we are left in that state, otherwise it is time to start
      reading from our cache
04232                   if (m_current_repeat == 0) {
04233                       const auto success = m_generator.next();
04234                       if (!success) {
04235                           ++m_current_repeat;
04236                       }
04237                       return m_current_repeat < m_target_repeats;
04238                   }
04239
04240                   // In the second case, we need to move indices forward and check that we haven't run
      up against the end
04241                   ++m_repeat_index;
04242                   if (m_repeat_index == m_returned.size()) {
04243                       m_repeat_index = 0;
04244                       ++m_current_repeat;
```

```
04245                 }
04246                 return m_current_repeat < m_target_repeats;
04247             }
04248         };
04249
04250         template <typename T>
04251         GeneratorWrapper<T> repeat(size_t repeats, GeneratorWrapper<T>&& generator) {
04252             return GeneratorWrapper<T>(pf::make_unique<RepeatGenerator<T>>(repeats,
      std::move(generator)));
04253         }
04254
04255         template <typename T, typename U, typename Func>
04256         class MapGenerator : public IGenerator<T> {
04257             // TBD: provide static assert for mapping function, for friendly error message
04258             GeneratorWrapper<U> m_generator;
04259             Func m_function;
04260             // To avoid returning dangling reference, we have to save the values
04261             T m_cache;
04262         public:
04263             template <typename F2 = Func>
04264             MapGenerator(F2&& function, GeneratorWrapper<U>&& generator) :
04265                     m_generator(std::move(generator)),
04266                     m_function(std::forward<F2>(function)),
04267                     m_cache(m_function(m_generator.get()))
04268             {}
04269
04270             T const& get() const override {
04271                 return m_cache;
04272             }
04273             bool next() override {
04274                 const auto success = m_generator.next();
04275                 if (success) {
04276                     m_cache = m_function(m_generator.get());
04277                 }
04278                 return success;
04279             }
04280         };
04281
04282         template <typename Func, typename U, typename T = FunctionReturnType<Func, U»
04283         GeneratorWrapper<T> map(Func&& function, GeneratorWrapper<U>&& generator) {
04284             return GeneratorWrapper<T>(
04285                     pf::make_unique<MapGenerator<T, U, Func>>(std::forward<Func>(function),
      std::move(generator))
04286             );
04287         }
04288
04289         template <typename T, typename U, typename Func>
04290         GeneratorWrapper<T> map(Func&& function, GeneratorWrapper<U>&& generator) {
04291             return GeneratorWrapper<T>(
04292                     pf::make_unique<MapGenerator<T, U, Func>>(std::forward<Func>(function),
      std::move(generator))
04293             );
04294         }
04295
04296         template <typename T>
04297         class ChunkGenerator final : public IGenerator<std::vector<T» {
04298             std::vector<T> m_chunk;
04299             size_t m_chunk_size;
04300             GeneratorWrapper<T> m_generator;
04301             bool m_used_up = false;
04302         public:
04303             ChunkGenerator(size_t size, GeneratorWrapper<T> generator) :
04304                     m_chunk_size(size), m_generator(std::move(generator))
04305             {
04306                 m_chunk.reserve(m_chunk_size);
04307                 if (m_chunk_size != 0) {
04308                     m_chunk.push_back(m_generator.get());
04309                     for (size_t i = 1; i < m_chunk_size; ++i) {
04310                         if (!m_generator.next()) {
04311                             Catch::throw_exception(GeneratorException("Not enough values to initialize
      the first chunk"));
04312                         }
04313                         m_chunk.push_back(m_generator.get());
04314                     }
04315                 }
04316             }
04317             std::vector<T> const& get() const override {
04318                 return m_chunk;
04319             }
04320             bool next() override {
04321                 m_chunk.clear();
04322                 for (size_t idx = 0; idx < m_chunk_size; ++idx) {
04323                     if (!m_generator.next()) {
04324                         return false;
04325                     }
04326                     m_chunk.push_back(m_generator.get());
04327                 }
```

```
04328                 return true;
04329             }
04330         };
04331
04332         template <typename T>
04333         GeneratorWrapper<std::vector<T>> chunk(size_t size, GeneratorWrapper<T>&& generator) {
04334             return GeneratorWrapper<std::vector<T>>(
04335                     pf::make_unique<ChunkGenerator<T»(size, std::move(generator))
04336             );
04337         }
04338
04339     } // namespace Generators
04340 } // namespace Catch
04341
04342 // end catch_generators_generic.hpp
04343 // start catch_generators_specific.hpp
04344
04345 // start catch_context.h
04346
04347 #include <memory>
04348
04349 namespace Catch {
04350
04351     struct IResultCapture;
04352     struct IRunner;
04353     struct IConfig;
04354     struct IMutableContext;
04355
04356     using IConfigPtr = std::shared_ptr<IConfig const>;
04357
04358     struct IContext
04359     {
04360         virtual ~IContext();
04361
04362         virtual IResultCapture* getResultCapture() = 0;
04363         virtual IRunner* getRunner() = 0;
04364         virtual IConfigPtr const& getConfig() const = 0;
04365     };
04366
04367     struct IMutableContext : IContext
04368     {
04369         virtual ~IMutableContext();
04370         virtual void setResultCapture( IResultCapture* resultCapture ) = 0;
04371         virtual void setRunner( IRunner* runner ) = 0;
04372         virtual void setConfig( IConfigPtr const& config ) = 0;
04373
04374     private:
04375         static IMutableContext *currentContext;
04376         friend IMutableContext& getCurrentMutableContext();
04377         friend void cleanUpContext();
04378         static void createContext();
04379     };
04380
04381     inline IMutableContext& getCurrentMutableContext()
04382     {
04383         if( !IMutableContext::currentContext )
04384             IMutableContext::createContext();
04385         // NOLINTNEXTLINE(clang-analyzer-core.uninitialized.UndefReturn)
04386         return *IMutableContext::currentContext;
04387     }
04388
04389     inline IContext& getCurrentContext()
04390     {
04391         return getCurrentMutableContext();
04392     }
04393
04394     void cleanUpContext();
04395
04396     class SimplePcg32;
04397     SimplePcg32& rng();
04398 }
04399
04400 // end catch_context.h
04401 // start catch_interfaces_config.h
04402
04403 // start catch_option.hpp
04404
04405 namespace Catch {
04406
04407     // An optional type
04408     template<typename T>
04409     class Option {
04410     public:
04411         Option() : nullableValue( nullptr ) {}
04412         Option( T const& _value )
04413                 : nullableValue( new( storage ) T( _value ) )
04414         {}
```

```
04415         Option( Option const& _other )
04416                 : nullableValue( _other ? new( storage ) T( *_other ) : nullptr )
04417         {}
04418
04419         ~Option() {
04420             reset();
04421         }
04422
04423         Option& operator= ( Option const& _other ) {
04424             if( &_other != this ) {
04425                 reset();
04426                 if( _other )
04427                     nullableValue = new( storage ) T( *_other );
04428             }
04429             return *this;
04430         }
04431         Option& operator = ( T const& _value ) {
04432             reset();
04433             nullableValue = new( storage ) T( _value );
04434             return *this;
04435         }
04436
04437         void reset() {
04438             if( nullableValue )
04439                 nullableValue->~T();
04440             nullableValue = nullptr;
04441         }
04442
04443         T& operator*() { return *nullableValue; }
04444         T const& operator*() const { return *nullableValue; }
04445         T* operator->() { return nullableValue; }
04446         const T* operator->() const { return nullableValue; }
04447
04448         T valueOr( T const& defaultValue ) const {
04449             return nullableValue ? *nullableValue : defaultValue;
04450         }
04451
04452         bool some() const { return nullableValue != nullptr; }
04453         bool none() const { return nullableValue == nullptr; }
04454
04455         bool operator !() const { return nullableValue == nullptr; }
04456         explicit operator bool() const {
04457             return some();
04458         }
04459
04460     private:
04461         T *nullableValue;
04462         alignas(alignof(T)) char storage[sizeof(T)];
04463     };
04464
04465 } // end namespace Catch
04466
04467 // end catch_option.hpp
04468 #include <chrono>
04469 #include <iosfwd>
04470 #include <string>
04471 #include <vector>
04472 #include <memory>
04473
04474 namespace Catch {
04475
04476     enum class Verbosity {
04477         Quiet = 0,
04478         Normal,
04479         High
04480     };
04481
04482     struct WarnAbout { enum What {
04483             Nothing = 0x00,
04484             NoAssertions = 0x01,
04485             NoTests = 0x02
04486         }; };
04487
04488     struct ShowDurations { enum OrNot {
04489             DefaultForReporter,
04490             Always,
04491             Never
04492         }; };
04493     struct RunTests { enum InWhatOrder {
04494             InDeclarationOrder,
04495             InLexicographicalOrder,
04496             InRandomOrder
04497         }; };
04498     struct UseColour { enum YesOrNo {
04499             Auto,
04500             Yes,
04501             No
```

```
04502         }; };
04503     struct WaitForKeypress { enum When {
04504             Never,
04505             BeforeStart = 1,
04506             BeforeExit = 2,
04507             BeforeStartAndExit = BeforeStart | BeforeExit
04508         }; };
04509
04510     class TestSpec;
04511
04512     struct IConfig : NonCopyable {
04513
04514         virtual ~IConfig();
04515
04516         virtual bool allowThrows() const = 0;
04517         virtual std::ostream& stream() const = 0;
04518         virtual std::string name() const = 0;
04519         virtual bool includeSuccessfulResults() const = 0;
04520         virtual bool shouldDebugBreak() const = 0;
04521         virtual bool warnAboutMissingAssertions() const = 0;
04522         virtual bool warnAboutNoTests() const = 0;
04523         virtual int abortAfter() const = 0;
04524         virtual bool showInvisibles() const = 0;
04525         virtual ShowDurations::OrNot showDurations() const = 0;
04526         virtual double minDuration() const = 0;
04527         virtual TestSpec const& testSpec() const = 0;
04528         virtual bool hasTestFilters() const = 0;
04529         virtual std::vector<std::string> const& getTestsOrTags() const = 0;
04530         virtual RunTests::InWhatOrder runOrder() const = 0;
04531         virtual unsigned int rngSeed() const = 0;
04532         virtual UseColour::YesOrNo useColour() const = 0;
04533         virtual std::vector<std::string> const& getSectionsToRun() const = 0;
04534         virtual Verbosity verbosity() const = 0;
04535
04536         virtual bool benchmarkNoAnalysis() const = 0;
04537         virtual int benchmarkSamples() const = 0;
04538         virtual double benchmarkConfidenceInterval() const = 0;
04539         virtual unsigned int benchmarkResamples() const = 0;
04540         virtual std::chrono::milliseconds benchmarkWarmupTime() const = 0;
04541     };
04542
04543     using IConfigPtr = std::shared_ptr<IConfig const>;
04544 }
04545
04546 // end catch_interfaces_config.h
04547 // start catch_random_number_generator.h
04548
04549 #include <cstdint>
04550
04551 namespace Catch {
04552
04553     // This is a simple implementation of C++11 Uniform Random Number
04554     // Generator. It does not provide all operators, because Catch2
04555     // does not use it, but it should behave as expected inside stdlib's
04556     // distributions.
04557     // The implementation is based on the PCG family (http://pcg-random.org)
04558     class SimplePcg32 {
04559         using state_type = std::uint64_t;
04560     public:
04561         using result_type = std::uint32_t;
04562         static constexpr result_type (min)() {
04563             return 0;
04564         }
04565         static constexpr result_type (max)() {
04566             return static_cast<result_type>(-1);
04567         }
04568
04569         // Provide some default initial state for the default constructor
04570         SimplePcg32():SimplePcg32(0xed743cc4U) {}
04571
04572         explicit SimplePcg32(result_type seed_);
04573
04574         void seed(result_type seed_);
04575         void discard(uint64_t skip);
04576
04577         result_type operator()();
04578
04579     private:
04580         friend bool operator==(SimplePcg32 const& lhs, SimplePcg32 const& rhs);
04581         friend bool operator!=(SimplePcg32 const& lhs, SimplePcg32 const& rhs);
04582
04583         // In theory we also need operator« and operator»
04584         // In practice we do not use them, so we will skip them for now
04585
04586         std::uint64_t m_state;
04587         // This part of the state determines which "stream" of the numbers
04588         // is chosen -- we take it as a constant for Catch2, so we only
```

```
04589         // need to deal with seeding the main state.
04590         // Picked by reading 8 bytes from `/dev/random` :-)
04591         static const std::uint64_t s_inc = (0x13ed0cc53f939476ULL << 1ULL) | 1ULL;
04592     };
04593
04594 } // end namespace Catch
04595
04596 // end catch_random_number_generator.h
04597 #include <random>
04598
04599 namespace Catch {
04600     namespace Generators {
04601
04602         template <typename Float>
04603         class RandomFloatingGenerator final : public IGenerator<Float> {
04604             Catch::SimplePcg32& m_rng;
04605             std::uniform_real_distribution<Float> m_dist;
04606             Float m_current_number;
04607         public:
04608
04609             RandomFloatingGenerator(Float a, Float b):
04610                     m_rng(rng()),
04611                     m_dist(a, b) {
04612                 static_cast<void>(next());
04613             }
04614
04615             Float const& get() const override {
04616                 return m_current_number;
04617             }
04618             bool next() override {
04619                 m_current_number = m_dist(m_rng);
04620                 return true;
04621             }
04622         };
04623
04624         template <typename Integer>
04625         class RandomIntegerGenerator final : public IGenerator<Integer> {
04626             Catch::SimplePcg32& m_rng;
04627             std::uniform_int_distribution<Integer> m_dist;
04628             Integer m_current_number;
04629         public:
04630
04631             RandomIntegerGenerator(Integer a, Integer b):
04632                     m_rng(rng()),
04633                     m_dist(a, b) {
04634                 static_cast<void>(next());
04635             }
04636
04637             Integer const& get() const override {
04638                 return m_current_number;
04639             }
04640             bool next() override {
04641                 m_current_number = m_dist(m_rng);
04642                 return true;
04643             }
04644         };
04645
04646 // TODO: Ideally this would be also constrained against the various char types,
04647 //       but I don't expect users to run into that in practice.
04648         template <typename T>
04649         typename std::enable_if<std::is_integral<T>::value && !std::is_same<T, bool>::value,
04650                 GeneratorWrapper<T>>::type
04651         random(T a, T b) {
04652             return GeneratorWrapper<T>(
04653                     pf::make_unique<RandomIntegerGenerator<T>>(a, b)
04654             );
04655         }
04656
04657         template <typename T>
04658         typename std::enable_if<std::is_floating_point<T>::value,
04659                 GeneratorWrapper<T>>::type
04660         random(T a, T b) {
04661             return GeneratorWrapper<T>(
04662                     pf::make_unique<RandomFloatingGenerator<T>>(a, b)
04663             );
04664         }
04665
04666         template <typename T>
04667         class RangeGenerator final : public IGenerator<T> {
04668             T m_current;
04669             T m_end;
04670             T m_step;
04671             bool m_positive;
04672
04673         public:
04674             RangeGenerator(T const& start, T const& end, T const& step):
04675                     m_current(start),
```

```
04676                   m_end(end),
04677                   m_step(step),
04678                   m_positive(m_step > T(0))
04679             {
04680                 assert(m_current != m_end && "Range start and end cannot be equal");
04681                 assert(m_step != T(0) && "Step size cannot be zero");
04682                 assert(((m_positive && m_current <= m_end) || (!m_positive && m_current >= m_end)) &&
      "Step moves away from end");
04683             }
04684
04685             RangeGenerator(T const& start, T const& end):
04686                     RangeGenerator(start, end, (start < end) ? T(1) : T(-1))
04687             {}
04688
04689             T const& get() const override {
04690                 return m_current;
04691             }
04692
04693             bool next() override {
04694                 m_current += m_step;
04695                 return (m_positive) ? (m_current < m_end) : (m_current > m_end);
04696             }
04697         };
04698
04699         template <typename T>
04700         GeneratorWrapper<T> range(T const& start, T const& end, T const& step) {
04701             static_assert(std::is_arithmetic<T>::value && !std::is_same<T, bool>::value, "Type must be
      numeric");
04702             return GeneratorWrapper<T>(pf::make_unique<RangeGenerator<T>>(start, end, step));
04703         }
04704
04705         template <typename T>
04706         GeneratorWrapper<T> range(T const& start, T const& end) {
04707             static_assert(std::is_integral<T>::value && !std::is_same<T, bool>::value, "Type must be
      an integer");
04708             return GeneratorWrapper<T>(pf::make_unique<RangeGenerator<T>>(start, end));
04709         }
04710
04711         template <typename T>
04712         class IteratorGenerator final : public IGenerator<T> {
04713             static_assert(!std::is_same<T, bool>::value,
04714                           "IteratorGenerator currently does not support bools"
04715                           "because of std::vector<bool> specialization");
04716
04717             std::vector<T> m_elems;
04718             size_t m_current = 0;
04719         public:
04720             template <typename InputIterator, typename InputSentinel>
04721             IteratorGenerator(InputIterator first, InputSentinel last):m_elems(first, last) {
04722                 if (m_elems.empty()) {
04723                     Catch::throw_exception(GeneratorException("IteratorGenerator received no valid
      values"));
04724                 }
04725             }
04726
04727             T const& get() const override {
04728                 return m_elems[m_current];
04729             }
04730
04731             bool next() override {
04732                 ++m_current;
04733                 return m_current != m_elems.size();
04734             }
04735         };
04736
04737         template <typename InputIterator,
04738                 typename InputSentinel,
04739                 typename ResultType = typename std::iterator_traits<InputIterator>::value_type>
04740         GeneratorWrapper<ResultType> from_range(InputIterator from, InputSentinel to) {
04741             return GeneratorWrapper<ResultType>(pf::make_unique<IteratorGenerator<ResultType>>(from,
      to));
04742         }
04743
04744         template <typename Container,
04745                 typename ResultType = typename Container::value_type>
04746         GeneratorWrapper<ResultType> from_range(Container const& cnt) {
04747             return
      GeneratorWrapper<ResultType>(pf::make_unique<IteratorGenerator<ResultType>>(cnt.begin(), cnt.end()));
04748         }
04749
04750     } // namespace Generators
04751 } // namespace Catch
04752
04753 // end catch_generators_specific.hpp
04754
04755 // These files are included here so the single_include script doesn't put them
04756 // in the conditionally compiled sections
```

```
04757 // start catch_test_case_info.h
04758
04759 #include <string>
04760 #include <vector>
04761 #include <memory>
04762
04763 #ifdef __clang__
04764 #pragma clang diagnostic push
04765 #pragma clang diagnostic ignored "-Wpadded"
04766 #endif
04767
04768 namespace Catch {
04769
04770     struct ITestInvoker;
04771
04772     struct TestCaseInfo {
04773         enum SpecialProperties{
04774             None = 0,
04775             IsHidden = 1 << 1,
04776             ShouldFail = 1 << 2,
04777             MayFail = 1 << 3,
04778             Throws = 1 << 4,
04779             NonPortable = 1 << 5,
04780             Benchmark = 1 << 6
04781         };
04782
04783         TestCaseInfo(   std::string const& _name,
04784                         std::string const& _className,
04785                         std::string const& _description,
04786                         std::vector<std::string> const& _tags,
04787                         SourceLineInfo const& _lineInfo );
04788
04789         friend void setTags( TestCaseInfo& testCaseInfo, std::vector<std::string> tags );
04790
04791         bool isHidden() const;
04792         bool throws() const;
04793         bool okToFail() const;
04794         bool expectedToFail() const;
04795
04796         std::string tagsAsString() const;
04797
04798         std::string name;
04799         std::string className;
04800         std::string description;
04801         std::vector<std::string> tags;
04802         std::vector<std::string> lcaseTags;
04803         SourceLineInfo lineInfo;
04804         SpecialProperties properties;
04805     };
04806
04807     class TestCase : public TestCaseInfo {
04808     public:
04809
04810         TestCase( ITestInvoker* testCase, TestCaseInfo&& info );
04811
04812         TestCase withName( std::string const& _newName ) const;
04813
04814         void invoke() const;
04815
04816         TestCaseInfo const& getTestCaseInfo() const;
04817
04818         bool operator == ( TestCase const& other ) const;
04819         bool operator < ( TestCase const& other ) const;
04820
04821     private:
04822         std::shared_ptr<ITestInvoker> test;
04823     };
04824
04825     TestCase makeTestCase(  ITestInvoker* testCase,
04826                             std::string const& className,
04827                             NameAndTags const& nameAndTags,
04828                             SourceLineInfo const& lineInfo );
04829 }
04830
04831 #ifdef __clang__
04832 #pragma clang diagnostic pop
04833 #endif
04834
04835 // end catch_test_case_info.h
04836 // start catch_interfaces_runner.h
04837
04838 namespace Catch {
04839
04840     struct IRunner {
04841         virtual ~IRunner();
04842         virtual bool aborting() const = 0;
04843     };
```

```
04844 }
04845
04846 // end catch_interfaces_runner.h
04847
04848 #ifdef __OBJC__
04849 // start catch_objc.hpp
04850
04851 #import <objc/runtime.h>
04852
04853 #include <string>
04854
04855 // NB. Any general catch headers included here must be included
04856 // in catch.hpp first to make sure they are included by the single
04857 // header for non obj-usage
04858
04860 // This protocol is really only here for (self) documenting purposes, since
04861 // all its methods are optional.
04862 @protocol OcFixture
04863
04864 @optional
04865
04866 -(void) setUp;
04867 -(void) tearDown;
04868
04869 @end
04870
04871 namespace Catch {
04872
04873     class OcMethod : public ITestInvoker {
04874
04875     public:
04876         OcMethod( Class cls, SEL sel ) : m_cls( cls ), m_sel( sel ) {}
04877
04878         virtual void invoke() const {
04879             id obj = [[m_cls alloc] init];
04880
04881             performOptionalSelector( obj, @selector(setUp)  );
04882             performOptionalSelector( obj, m_sel );
04883             performOptionalSelector( obj, @selector(tearDown)  );
04884
04885             arcSafeRelease( obj );
04886         }
04887     private:
04888         virtual ~OcMethod() {}
04889
04890         Class m_cls;
04891         SEL m_sel;
04892     };
04893
04894     namespace Detail{
04895
04896         inline std::string getAnnotation(   Class cls,
04897                                             std::string const& annotationName,
04898                                             std::string const& testCaseName ) {
04899             NSString* selStr = [[NSString alloc] initWithFormat:@"Catch_%s_%s",
      annotationName.c_str(), testCaseName.c_str()];
04900             SEL sel = NSSelectorFromString( selStr );
04901             arcSafeRelease( selStr );
04902             id value = performOptionalSelector( cls, sel );
04903             if( value )
04904                 return [(NSString*)value UTF8String];
04905             return "";
04906         }
04907     }
04908
04909     inline std::size_t registerTestMethods() {
04910         std::size_t noTestMethods = 0;
04911         int noClasses = objc_getClassList( nullptr, 0 );
04912
04913         Class* classes = (CATCH_UNSAFE_UNRETAINED Class *)malloc( sizeof(Class) * noClasses);
04914         objc_getClassList( classes, noClasses );
04915
04916         for( int c = 0; c < noClasses; c++ ) {
04917             Class cls = classes[c];
04918             {
04919                 u_int count;
04920                 Method* methods = class_copyMethodList( cls, &count );
04921                 for( u_int m = 0; m < count ; m++ ) {
04922                     SEL selector = method_getName(methods[m]);
04923                     std::string methodName = sel_getName(selector);
04924                     if( startsWith( methodName, "Catch_TestCase_" ) ) {
04925                         std::string testCaseName = methodName.substr( 15 );
04926                         std::string name = Detail::getAnnotation( cls, "Name", testCaseName );
04927                         std::string desc = Detail::getAnnotation( cls, "Description", testCaseName );
04928                         const char* className = class_getName( cls );
04929
04930                         getMutableRegistryHub().registerTest( makeTestCase( new OcMethod( cls,
```

```
    selector ), className, NameAndTags( name.c_str(), desc.c_str() ), SourceLineInfo("",0) ) );
04931                       noTestMethods++;
04932                   }
04933               }
04934               free(methods);
04935           }
04936       }
04937       return noTestMethods;
04938   }
04939
04940 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
04941
04942   namespace Matchers {
04943       namespace Impl {
04944       namespace NSStringMatchers {
04945
04946           struct StringHolder : MatcherBase<NSString*>{
04947               StringHolder( NSString* substr ) : m_substr( [substr copy] ){}
04948               StringHolder( StringHolder const& other ) : m_substr( [other.m_substr copy] ){}
04949               StringHolder() {
04950                   arcSafeRelease( m_substr );
04951               }
04952
04953               bool match( NSString* str ) const override {
04954                   return false;
04955               }
04956
04957               NSString* CATCH_ARC_STRONG m_substr;
04958           };
04959
04960           struct Equals : StringHolder {
04961               Equals( NSString* substr ) : StringHolder( substr ){}
04962
04963               bool match( NSString* str ) const override {
04964                   return  (str != nil || m_substr == nil ) &&
04965                           [str isEqualToString:m_substr];
04966               }
04967
04968               std::string describe() const override {
04969                   return "equals string: " + Catch::Detail::stringify( m_substr );
04970               }
04971           };
04972
04973           struct Contains : StringHolder {
04974               Contains( NSString* substr ) : StringHolder( substr ){}
04975
04976               bool match( NSString* str ) const override {
04977                   return  (str != nil || m_substr == nil ) &&
04978                           [str rangeOfString:m_substr].location != NSNotFound;
04979               }
04980
04981               std::string describe() const override {
04982                   return "contains string: " + Catch::Detail::stringify( m_substr );
04983               }
04984           };
04985
04986           struct StartsWith : StringHolder {
04987               StartsWith( NSString* substr ) : StringHolder( substr ){}
04988
04989               bool match( NSString* str ) const override {
04990                   return  (str != nil || m_substr == nil ) &&
04991                           [str rangeOfString:m_substr].location == 0;
04992               }
04993
04994               std::string describe() const override {
04995                   return "starts with: " + Catch::Detail::stringify( m_substr );
04996               }
04997           };
04998           struct EndsWith : StringHolder {
04999               EndsWith( NSString* substr ) : StringHolder( substr ){}
05000
05001               bool match( NSString* str ) const override {
05002                   return  (str != nil || m_substr == nil ) &&
05003                           [str rangeOfString:m_substr].location == [str length] - [m_substr length];
05004               }
05005
05006               std::string describe() const override {
05007                   return "ends with: " + Catch::Detail::stringify( m_substr );
05008               }
05009           };
05010
05011       } // namespace NSStringMatchers
05012       } // namespace Impl
05013
05014       inline Impl::NSStringMatchers::Equals
05015           Equals( NSString* substr ){ return Impl::NSStringMatchers::Equals( substr ); }
05016
```

```
05017         inline Impl::NSStringMatchers::Contains
05018             Contains( NSString* substr ){ return Impl::NSStringMatchers::Contains( substr ); }
05019
05020         inline Impl::NSStringMatchers::StartsWith
05021             StartsWith( NSString* substr ){ return Impl::NSStringMatchers::StartsWith( substr ); }
05022
05023         inline Impl::NSStringMatchers::EndsWith
05024             EndsWith( NSString* substr ){ return Impl::NSStringMatchers::EndsWith( substr ); }
05025
05026     } // namespace Matchers
05027
05028     using namespace Matchers;
05029
05030 #endif // CATCH_CONFIG_DISABLE_MATCHERS
05031
05032 } // namespace Catch
05033
05035 #define OC_MAKE_UNIQUE_NAME( root, uniqueSuffix ) root##uniqueSuffix
05036 #define OC_TEST_CASE2( name, desc, uniqueSuffix ) \
05037 +(NSString*) OC_MAKE_UNIQUE_NAME( Catch_Name_test_, uniqueSuffix ) \
05038 { \
05039 return @ name; \
05040 } \
05041 +(NSString*) OC_MAKE_UNIQUE_NAME( Catch_Description_test_, uniqueSuffix ) \
05042 { \
05043 return @ desc; \
05044 } \
05045 -(void) OC_MAKE_UNIQUE_NAME( Catch_TestCase_test_, uniqueSuffix )
05046
05047 #define OC_TEST_CASE( name, desc ) OC_TEST_CASE2( name, desc, __LINE__ )
05048
05049 // end catch_objc.hpp
05050 #endif
05051
05052 // Benchmarking needs the externally-facing parts of reporters to work
05053 #if defined(CATCH_CONFIG_EXTERNAL_INTERFACES) || defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
05054 // start catch_external_interfaces.h
05055
05056 // start catch_reporter_bases.hpp
05057
05058 // start catch_interfaces_reporter.h
05059
05060 // start catch_config.hpp
05061
05062 // start catch_test_spec_parser.h
05063
05064 #ifdef __clang__
05065 #pragma clang diagnostic push
05066 #pragma clang diagnostic ignored "-Wpadded"
05067 #endif
05068
05069 // start catch_test_spec.h
05070
05071 #ifdef __clang__
05072 #pragma clang diagnostic push
05073 #pragma clang diagnostic ignored "-Wpadded"
05074 #endif
05075
05076 // start catch_wildcard_pattern.h
05077
05078 namespace Catch
05079 {
05080     class WildcardPattern {
05081         enum WildcardPosition {
05082             NoWildcard = 0,
05083             WildcardAtStart = 1,
05084             WildcardAtEnd = 2,
05085             WildcardAtBothEnds = WildcardAtStart | WildcardAtEnd
05086         };
05087
05088     public:
05089
05090         WildcardPattern( std::string const& pattern, CaseSensitive::Choice caseSensitivity );
05091         virtual ~WildcardPattern() = default;
05092         virtual bool matches( std::string const& str ) const;
05093
05094     private:
05095         std::string normaliseString( std::string const& str ) const;
05096         CaseSensitive::Choice m_caseSensitivity;
05097         WildcardPosition m_wildcard = NoWildcard;
05098         std::string m_pattern;
05099     };
05100 }
05101
05102 // end catch_wildcard_pattern.h
05103 #include <string>
05104 #include <vector>
```

```
05105 #include <memory>
05106
05107 namespace Catch {
05108
05109     struct IConfig;
05110
05111     class TestSpec {
05112         class Pattern {
05113         public:
05114             explicit Pattern( std::string const& name );
05115             virtual ~Pattern();
05116             virtual bool matches( TestCaseInfo const& testCase ) const = 0;
05117             std::string const& name() const;
05118         private:
05119             std::string const m_name;
05120         };
05121         using PatternPtr = std::shared_ptr<Pattern>;
05122
05123         class NamePattern : public Pattern {
05124         public:
05125             explicit NamePattern( std::string const& name, std::string const& filterString );
05126             bool matches( TestCaseInfo const& testCase ) const override;
05127         private:
05128             WildcardPattern m_wildcardPattern;
05129         };
05130
05131         class TagPattern : public Pattern {
05132         public:
05133             explicit TagPattern( std::string const& tag, std::string const& filterString );
05134             bool matches( TestCaseInfo const& testCase ) const override;
05135         private:
05136             std::string m_tag;
05137         };
05138
05139         class ExcludedPattern : public Pattern {
05140         public:
05141             explicit ExcludedPattern( PatternPtr const& underlyingPattern );
05142             bool matches( TestCaseInfo const& testCase ) const override;
05143         private:
05144             PatternPtr m_underlyingPattern;
05145         };
05146
05147         struct Filter {
05148             std::vector<PatternPtr> m_patterns;
05149
05150             bool matches( TestCaseInfo const& testCase ) const;
05151             std::string name() const;
05152         };
05153
05154     public:
05155         struct FilterMatch {
05156             std::string name;
05157             std::vector<TestCase const*> tests;
05158         };
05159         using Matches = std::vector<FilterMatch>;
05160         using vectorStrings = std::vector<std::string>;
05161
05162         bool hasFilters() const;
05163         bool matches( TestCaseInfo const& testCase ) const;
05164         Matches matchesByFilter( std::vector<TestCase> const& testCases, IConfig const& config )
    const;
05165         const vectorStrings & getInvalidArgs() const;
05166
05167     private:
05168         std::vector<Filter> m_filters;
05169         std::vector<std::string> m_invalidArgs;
05170         friend class TestSpecParser;
05171     };
05172 }
05173
05174 #ifdef __clang__
05175 #pragma clang diagnostic pop
05176 #endif
05177
05178 // end catch_test_spec.h
05179 // start catch_interfaces_tag_alias_registry.h
05180
05181 #include <string>
05182
05183 namespace Catch {
05184
05185     struct TagAlias;
05186
05187     struct ITagAliasRegistry {
05188         virtual ~ITagAliasRegistry();
05189         // Nullptr if not present
05190         virtual TagAlias const* find( std::string const& alias ) const = 0;
```

```
05191         virtual std::string expandAliases( std::string const& unexpandedTestSpec ) const = 0;
05192
05193         static ITagAliasRegistry const& get();
05194     };
05195
05196 } // end namespace Catch
05197
05198 // end catch_interfaces_tag_alias_registry.h
05199 namespace Catch {
05200
05201     class TestSpecParser {
05202         enum Mode{ None, Name, QuotedName, Tag, EscapedName };
05203         Mode m_mode = None;
05204         Mode lastMode = None;
05205         bool m_exclusion = false;
05206         std::size_t m_pos = 0;
05207         std::size_t m_realPatternPos = 0;
05208         std::string m_arg;
05209         std::string m_substring;
05210         std::string m_patternName;
05211         std::vector<std::size_t> m_escapeChars;
05212         TestSpec::Filter m_currentFilter;
05213         TestSpec m_testSpec;
05214         ITagAliasRegistry const* m_tagAliases = nullptr;
05215
05216     public:
05217         TestSpecParser( ITagAliasRegistry const& tagAliases );
05218
05219         TestSpecParser& parse( std::string const& arg );
05220         TestSpec testSpec();
05221
05222     private:
05223         bool visitChar( char c );
05224         void startNewMode( Mode mode );
05225         bool processNoneChar( char c );
05226         void processNameChar( char c );
05227         bool processOtherChar( char c );
05228         void endMode();
05229         void escape();
05230         bool isControlChar( char c ) const;
05231         void saveLastMode();
05232         void revertBackToLastMode();
05233         void addFilter();
05234         bool separate();
05235
05236         // Handles common preprocessing of the pattern for name/tag patterns
05237         std::string preprocessPattern();
05238         // Adds the current pattern as a test name
05239         void addNamePattern();
05240         // Adds the current pattern as a tag
05241         void addTagPattern();
05242
05243         inline void addCharToPattern(char c) {
05244             m_substring += c;
05245             m_patternName += c;
05246             m_realPatternPos++;
05247         }
05248
05249     };
05250     TestSpec parseTestSpec( std::string const& arg );
05251
05252 } // namespace Catch
05253
05254 #ifdef __clang__
05255 #pragma clang diagnostic pop
05256 #endif
05257
05258 // end catch_test_spec_parser.h
05259 // Libstdc++ doesn't like incomplete classes for unique_ptr
05260
05261 #include <memory>
05262 #include <vector>
05263 #include <string>
05264
05265 #ifndef CATCH_CONFIG_CONSOLE_WIDTH
05266 #define CATCH_CONFIG_CONSOLE_WIDTH 80
05267 #endif
05268
05269 namespace Catch {
05270
05271     struct IStream;
05272
05273     struct ConfigData {
05274         bool listTests = false;
05275         bool listTags = false;
05276         bool listReporters = false;
05277         bool listTestNamesOnly = false;
```

```
05278
05279         bool showSuccessfulTests = false;
05280         bool shouldDebugBreak = false;
05281         bool noThrow = false;
05282         bool showHelp = false;
05283         bool showInvisibles = false;
05284         bool filenamesAsTags = false;
05285         bool libIdentify = false;
05286
05287         int abortAfter = -1;
05288         unsigned int rngSeed = 0;
05289
05290         bool benchmarkNoAnalysis = false;
05291         unsigned int benchmarkSamples = 100;
05292         double benchmarkConfidenceInterval = 0.95;
05293         unsigned int benchmarkResamples = 100000;
05294         std::chrono::milliseconds::rep benchmarkWarmupTime = 100;
05295
05296         Verbosity verbosity = Verbosity::Normal;
05297         WarnAbout::What warnings = WarnAbout::Nothing;
05298         ShowDurations::OrNot showDurations = ShowDurations::DefaultForReporter;
05299         double minDuration = -1;
05300         RunTests::InWhatOrder runOrder = RunTests::InDeclarationOrder;
05301         UseColour::YesOrNo useColour = UseColour::Auto;
05302         WaitForKeypress::When waitForKeypress = WaitForKeypress::Never;
05303
05304         std::string outputFilename;
05305         std::string name;
05306         std::string processName;
05307 #ifndef CATCH_CONFIG_DEFAULT_REPORTER
05308 #define CATCH_CONFIG_DEFAULT_REPORTER "console"
05309 #endif
05310         std::string reporterName = CATCH_CONFIG_DEFAULT_REPORTER;
05311 #undef CATCH_CONFIG_DEFAULT_REPORTER
05312
05313         std::vector<std::string> testsOrTags;
05314         std::vector<std::string> sectionsToRun;
05315     };
05316
05317     class Config : public IConfig {
05318     public:
05319
05320         Config() = default;
05321         Config( ConfigData const& data );
05322         virtual ~Config() = default;
05323
05324         std::string const& getFilename() const;
05325
05326         bool listTests() const;
05327         bool listTestNamesOnly() const;
05328         bool listTags() const;
05329         bool listReporters() const;
05330
05331         std::string getProcessName() const;
05332         std::string const& getReporterName() const;
05333
05334         std::vector<std::string> const& getTestsOrTags() const override;
05335         std::vector<std::string> const& getSectionsToRun() const override;
05336
05337         TestSpec const& testSpec() const override;
05338         bool hasTestFilters() const override;
05339
05340         bool showHelp() const;
05341
05342         // IConfig interface
05343         bool allowThrows() const override;
05344         std::ostream& stream() const override;
05345         std::string name() const override;
05346         bool includeSuccessfulResults() const override;
05347         bool warnAboutMissingAssertions() const override;
05348         bool warnAboutNoTests() const override;
05349         ShowDurations::OrNot showDurations() const override;
05350         double minDuration() const override;
05351         RunTests::InWhatOrder runOrder() const override;
05352         unsigned int rngSeed() const override;
05353         UseColour::YesOrNo useColour() const override;
05354         bool shouldDebugBreak() const override;
05355         int abortAfter() const override;
05356         bool showInvisibles() const override;
05357         Verbosity verbosity() const override;
05358         bool benchmarkNoAnalysis() const override;
05359         int benchmarkSamples() const override;
05360         double benchmarkConfidenceInterval() const override;
05361         unsigned int benchmarkResamples() const override;
05362         std::chrono::milliseconds benchmarkWarmupTime() const override;
05363
05364     private:
```

```
05365
05366         IStream const* openStream();
05367         ConfigData m_data;
05368
05369         std::unique_ptr<IStream const> m_stream;
05370         TestSpec m_testSpec;
05371         bool m_hasTestFilters = false;
05372     };
05373
05374 } // end namespace Catch
05375
05376 // end catch_config.hpp
05377 // start catch_assertionresult.h
05378
05379 #include <string>
05380
05381 namespace Catch {
05382
05383     struct AssertionResultData
05384     {
05385         AssertionResultData() = delete;
05386
05387         AssertionResultData( ResultWas::OfType _resultType, LazyExpression const& _lazyExpression );
05388
05389         std::string message;
05390         mutable std::string reconstructedExpression;
05391         LazyExpression lazyExpression;
05392         ResultWas::OfType resultType;
05393
05394         std::string reconstructExpression() const;
05395     };
05396
05397     class AssertionResult {
05398     public:
05399         AssertionResult() = delete;
05400         AssertionResult( AssertionInfo const& info, AssertionResultData const& data );
05401
05402         bool isOk() const;
05403         bool succeeded() const;
05404         ResultWas::OfType getResultType() const;
05405         bool hasExpression() const;
05406         bool hasMessage() const;
05407         std::string getExpression() const;
05408         std::string getExpressionInMacro() const;
05409         bool hasExpandedExpression() const;
05410         std::string getExpandedExpression() const;
05411         std::string getMessage() const;
05412         SourceLineInfo getSourceInfo() const;
05413         StringRef getTestMacroName() const;
05414
05415         //protected:
05416         AssertionInfo m_info;
05417         AssertionResultData m_resultData;
05418     };
05419
05420 } // end namespace Catch
05421
05422 // end catch_assertionresult.h
05423 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
05424 // start catch_estimate.hpp
05425
05426  // Statistics estimates
05427
05428
05429 namespace Catch {
05430     namespace Benchmark {
05431         template <typename Duration>
05432         struct Estimate {
05433             Duration point;
05434             Duration lower_bound;
05435             Duration upper_bound;
05436             double confidence_interval;
05437
05438             template <typename Duration2>
05439             operator Estimate<Duration2>() const {
05440                 return { point, lower_bound, upper_bound, confidence_interval };
05441             }
05442         };
05443     } // namespace Benchmark
05444 } // namespace Catch
05445
05446 // end catch_estimate.hpp
05447 // start catch_outlier_classification.hpp
05448
05449 // Outlier information
05450
05451 namespace Catch {
```

```
05452     namespace Benchmark {
05453         struct OutlierClassification {
05454             int samples_seen = 0;
05455             int low_severe = 0;     // more than 3 times IQR below Q1
05456             int low_mild = 0;       // 1.5 to 3 times IQR below Q1
05457             int high_mild = 0;      // 1.5 to 3 times IQR above Q3
05458             int high_severe = 0;    // more than 3 times IQR above Q3
05459
05460             int total() const {
05461                 return low_severe + low_mild + high_mild + high_severe;
05462             }
05463         };
05464     } // namespace Benchmark
05465 } // namespace Catch
05466
05467 // end catch_outlier_classification.hpp
05468
05469 #include <iterator>
05470 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
05471
05472 #include <string>
05473 #include <iosfwd>
05474 #include <map>
05475 #include <set>
05476 #include <memory>
05477 #include <algorithm>
05478
05479 namespace Catch {
05480
05481     struct ReporterConfig {
05482         explicit ReporterConfig( IConfigPtr const& _fullConfig );
05483
05484         ReporterConfig( IConfigPtr const& _fullConfig, std::ostream& _stream );
05485
05486         std::ostream& stream() const;
05487         IConfigPtr fullConfig() const;
05488
05489     private:
05490         std::ostream* m_stream;
05491         IConfigPtr m_fullConfig;
05492     };
05493
05494     struct ReporterPreferences {
05495         bool shouldRedirectStdOut = false;
05496         bool shouldReportAllAssertions = false;
05497     };
05498
05499     template<typename T>
05500     struct LazyStat : Option<T> {
05501         LazyStat& operator=( T const& _value ) {
05502             Option<T>::operator=( _value );
05503             used = false;
05504             return *this;
05505         }
05506         void reset() {
05507             Option<T>::reset();
05508             used = false;
05509         }
05510         bool used = false;
05511     };
05512
05513     struct TestRunInfo {
05514         TestRunInfo( std::string const& _name );
05515         std::string name;
05516     };
05517     struct GroupInfo {
05518         GroupInfo(  std::string const& _name,
05519                     std::size_t _groupIndex,
05520                     std::size_t _groupsCount );
05521
05522         std::string name;
05523         std::size_t groupIndex;
05524         std::size_t groupsCounts;
05525     };
05526
05527     struct AssertionStats {
05528         AssertionStats( AssertionResult const& _assertionResult,
05529                         std::vector<MessageInfo> const& _infoMessages,
05530                         Totals const& _totals );
05531
05532         AssertionStats( AssertionStats const& )              = default;
05533         AssertionStats( AssertionStats && )                  = default;
05534         AssertionStats& operator = ( AssertionStats const& ) = delete;
05535         AssertionStats& operator = ( AssertionStats && )     = delete;
05536         virtual ~AssertionStats();
05537
05538         AssertionResult assertionResult;
```

```
05539         std::vector<MessageInfo> infoMessages;
05540         Totals totals;
05541     };
05542
05543     struct SectionStats {
05544         SectionStats(   SectionInfo const& _sectionInfo,
05545                         Counts const& _assertions,
05546                         double _durationInSeconds,
05547                         bool _missingAssertions );
05548         SectionStats( SectionStats const& )              = default;
05549         SectionStats( SectionStats && )                  = default;
05550         SectionStats& operator = ( SectionStats const& ) = default;
05551         SectionStats& operator = ( SectionStats && )     = default;
05552         virtual ~SectionStats();
05553
05554         SectionInfo sectionInfo;
05555         Counts assertions;
05556         double durationInSeconds;
05557         bool missingAssertions;
05558     };
05559
05560     struct TestCaseStats {
05561         TestCaseStats(  TestCaseInfo const& _testInfo,
05562                         Totals const& _totals,
05563                         std::string const& _stdOut,
05564                         std::string const& _stdErr,
05565                         bool _aborting );
05566
05567         TestCaseStats( TestCaseStats const& )              = default;
05568         TestCaseStats( TestCaseStats && )                  = default;
05569         TestCaseStats& operator = ( TestCaseStats const& ) = default;
05570         TestCaseStats& operator = ( TestCaseStats && )     = default;
05571         virtual ~TestCaseStats();
05572
05573         TestCaseInfo testInfo;
05574         Totals totals;
05575         std::string stdOut;
05576         std::string stdErr;
05577         bool aborting;
05578     };
05579
05580     struct TestGroupStats {
05581         TestGroupStats( GroupInfo const& _groupInfo,
05582                         Totals const& _totals,
05583                         bool _aborting );
05584         TestGroupStats( GroupInfo const& _groupInfo );
05585
05586         TestGroupStats( TestGroupStats const& )              = default;
05587         TestGroupStats( TestGroupStats && )                  = default;
05588         TestGroupStats& operator = ( TestGroupStats const& ) = default;
05589         TestGroupStats& operator = ( TestGroupStats && )     = default;
05590         virtual ~TestGroupStats();
05591
05592         GroupInfo groupInfo;
05593         Totals totals;
05594         bool aborting;
05595     };
05596
05597     struct TestRunStats {
05598         TestRunStats(   TestRunInfo const& _runInfo,
05599                         Totals const& _totals,
05600                         bool _aborting );
05601
05602         TestRunStats( TestRunStats const& )              = default;
05603         TestRunStats( TestRunStats && )                  = default;
05604         TestRunStats& operator = ( TestRunStats const& ) = default;
05605         TestRunStats& operator = ( TestRunStats && )     = default;
05606         virtual ~TestRunStats();
05607
05608         TestRunInfo runInfo;
05609         Totals totals;
05610         bool aborting;
05611     };
05612
05613 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
05614     struct BenchmarkInfo {
05615         std::string name;
05616         double estimatedDuration;
05617         int iterations;
05618         int samples;
05619         unsigned int resamples;
05620         double clockResolution;
05621         double clockCost;
05622     };
05623
05624     template <class Duration>
05625     struct BenchmarkStats {
```

```
05626         BenchmarkInfo info;
05627
05628         std::vector<Duration> samples;
05629         Benchmark::Estimate<Duration> mean;
05630         Benchmark::Estimate<Duration> standardDeviation;
05631         Benchmark::OutlierClassification outliers;
05632         double outlierVariance;
05633
05634         template <typename Duration2>
05635         operator BenchmarkStats<Duration2>() const {
05636             std::vector<Duration2> samples2;
05637             samples2.reserve(samples.size());
05638             std::transform(samples.begin(), samples.end(), std::back_inserter(samples2), [](Duration
      d) { return Duration2(d); });
05639             return {
05640                 info,
05641                 std::move(samples2),
05642                 mean,
05643                 standardDeviation,
05644                 outliers,
05645                 outlierVariance,
05646             };
05647         }
05648     };
05649 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
05650
05651     struct IStreamingReporter {
05652         virtual ~IStreamingReporter() = default;
05653
05654         // Implementing class must also provide the following static methods:
05655         // static std::string getDescription();
05656         // static std::set<Verbosity> getSupportedVerbosities()
05657
05658         virtual ReporterPreferences getPreferences() const = 0;
05659
05660         virtual void noMatchingTestCases( std::string const& spec ) = 0;
05661
05662         virtual void reportInvalidArguments(std::string const&) {}
05663
05664         virtual void testRunStarting( TestRunInfo const& testRunInfo ) = 0;
05665         virtual void testGroupStarting( GroupInfo const& groupInfo ) = 0;
05666
05667         virtual void testCaseStarting( TestCaseInfo const& testInfo ) = 0;
05668         virtual void sectionStarting( SectionInfo const& sectionInfo ) = 0;
05669
05670 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
05671         virtual void benchmarkPreparing( std::string const& ) {}
05672         virtual void benchmarkStarting( BenchmarkInfo const& ) {}
05673         virtual void benchmarkEnded( BenchmarkStats<> const& ) {}
05674         virtual void benchmarkFailed( std::string const& ) {}
05675 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
05676
05677         virtual void assertionStarting( AssertionInfo const& assertionInfo ) = 0;
05678
05679         // The return value indicates if the messages buffer should be cleared:
05680         virtual bool assertionEnded( AssertionStats const& assertionStats ) = 0;
05681
05682         virtual void sectionEnded( SectionStats const& sectionStats ) = 0;
05683         virtual void testCaseEnded( TestCaseStats const& testCaseStats ) = 0;
05684         virtual void testGroupEnded( TestGroupStats const& testGroupStats ) = 0;
05685         virtual void testRunEnded( TestRunStats const& testRunStats ) = 0;
05686
05687         virtual void skipTest( TestCaseInfo const& testInfo ) = 0;
05688
05689         // Default empty implementation provided
05690         virtual void fatalErrorEncountered( StringRef name );
05691
05692         virtual bool isMulti() const;
05693     };
05694     using IStreamingReporterPtr = std::unique_ptr<IStreamingReporter>;
05695
05696     struct IReporterFactory {
05697         virtual ~IReporterFactory();
05698         virtual IStreamingReporterPtr create( ReporterConfig const& config ) const = 0;
05699         virtual std::string getDescription() const = 0;
05700     };
05701     using IReporterFactoryPtr = std::shared_ptr<IReporterFactory>;
05702
05703     struct IReporterRegistry {
05704         using FactoryMap = std::map<std::string, IReporterFactoryPtr>;
05705         using Listeners = std::vector<IReporterFactoryPtr>;
05706
05707         virtual ~IReporterRegistry();
05708         virtual IStreamingReporterPtr create( std::string const& name, IConfigPtr const& config )
      const = 0;
05709         virtual FactoryMap const& getFactories() const = 0;
05710         virtual Listeners const& getListeners() const = 0;
```

```
05711     };
05712
05713 } // end namespace Catch
05714
05715 // end catch_interfaces_reporter.h
05716 #include <algorithm>
05717 #include <cstring>
05718 #include <cfloat>
05719 #include <cstdio>
05720 #include <cassert>
05721 #include <memory>
05722 #include <ostream>
05723
05724 namespace Catch {
05725     void prepareExpandedExpression(AssertionResult& result);
05726
05727     // Returns double formatted as %.3f (format expected on output)
05728     std::string getFormattedDuration( double duration );
05729
05731     bool shouldShowDuration( IConfig const& config, double duration );
05732
05733     std::string serializeFilters( std::vector<std::string> const& container );
05734
05735     template<typename DerivedT>
05736     struct StreamingReporterBase : IStreamingReporter {
05737
05738         StreamingReporterBase( ReporterConfig const& _config )
05739                 :   m_config( _config.fullConfig() ),
05740                     stream( _config.stream() )
05741         {
05742             m_reporterPrefs.shouldRedirectStdOut = false;
05743             if( !DerivedT::getSupportedVerbosities().count( m_config->verbosity() ) )
05744                 CATCH_ERROR( "Verbosity level not supported by this reporter" );
05745         }
05746
05747         ReporterPreferences getPreferences() const override {
05748             return m_reporterPrefs;
05749         }
05750
05751         static std::set<Verbosity> getSupportedVerbosities() {
05752             return { Verbosity::Normal };
05753         }
05754
05755         ~StreamingReporterBase() override = default;
05756
05757         void noMatchingTestCases(std::string const&) override {}
05758
05759         void reportInvalidArguments(std::string const&) override {}
05760
05761         void testRunStarting(TestRunInfo const& _testRunInfo) override {
05762             currentTestRunInfo = _testRunInfo;
05763         }
05764
05765         void testGroupStarting(GroupInfo const& _groupInfo) override {
05766             currentGroupInfo = _groupInfo;
05767         }
05768
05769         void testCaseStarting(TestCaseInfo const& _testInfo) override  {
05770             currentTestCaseInfo = _testInfo;
05771         }
05772         void sectionStarting(SectionInfo const& _sectionInfo) override {
05773             m_sectionStack.push_back(_sectionInfo);
05774         }
05775
05776         void sectionEnded(SectionStats const& /* _sectionStats */) override {
05777             m_sectionStack.pop_back();
05778         }
05779         void testCaseEnded(TestCaseStats const& /* _testCaseStats */) override {
05780             currentTestCaseInfo.reset();
05781         }
05782         void testGroupEnded(TestGroupStats const& /* _testGroupStats */) override {
05783             currentGroupInfo.reset();
05784         }
05785         void testRunEnded(TestRunStats const& /* _testRunStats */) override {
05786             currentTestCaseInfo.reset();
05787             currentGroupInfo.reset();
05788             currentTestRunInfo.reset();
05789         }
05790
05791         void skipTest(TestCaseInfo const&) override {
05792             // Don't do anything with this by default.
05793             // It can optionally be overridden in the derived class.
05794         }
05795
05796         IConfigPtr m_config;
05797         std::ostream& stream;
05798
```

```
05799         LazyStat<TestRunInfo> currentTestRunInfo;
05800         LazyStat<GroupInfo> currentGroupInfo;
05801         LazyStat<TestCaseInfo> currentTestCaseInfo;
05802
05803         std::vector<SectionInfo> m_sectionStack;
05804         ReporterPreferences m_reporterPrefs;
05805     };
05806
05807     template<typename DerivedT>
05808     struct CumulativeReporterBase : IStreamingReporter {
05809         template<typename T, typename ChildNodeT>
05810         struct Node {
05811             explicit Node( T const& _value ) : value( _value ) {}
05812             virtual ~Node() {}
05813
05814             using ChildNodes = std::vector<std::shared_ptr<ChildNodeT>>;
05815             T value;
05816             ChildNodes children;
05817         };
05818         struct SectionNode {
05819             explicit SectionNode(SectionStats const& _stats) : stats(_stats) {}
05820             virtual ~SectionNode() = default;
05821
05822             bool operator == (SectionNode const& other) const {
05823                 return stats.sectionInfo.lineInfo == other.stats.sectionInfo.lineInfo;
05824             }
05825             bool operator == (std::shared_ptr<SectionNode> const& other) const {
05826                 return operator==(*other);
05827             }
05828
05829             SectionStats stats;
05830             using ChildSections = std::vector<std::shared_ptr<SectionNode>>;
05831             using Assertions = std::vector<AssertionStats>;
05832             ChildSections childSections;
05833             Assertions assertions;
05834             std::string stdOut;
05835             std::string stdErr;
05836         };
05837
05838         struct BySectionInfo {
05839             BySectionInfo( SectionInfo const& other ) : m_other( other ) {}
05840             BySectionInfo( BySectionInfo const& other ) : m_other( other.m_other ) {}
05841             bool operator() (std::shared_ptr<SectionNode> const& node) const {
05842                 return ((node->stats.sectionInfo.name == m_other.name) &&
05843                         (node->stats.sectionInfo.lineInfo == m_other.lineInfo));
05844             }
05845             void operator=(BySectionInfo const&) = delete;
05846
05847         private:
05848             SectionInfo const& m_other;
05849         };
05850
05851         using TestCaseNode = Node<TestCaseStats, SectionNode>;
05852         using TestGroupNode = Node<TestGroupStats, TestCaseNode>;
05853         using TestRunNode = Node<TestRunStats, TestGroupNode>;
05854
05855         CumulativeReporterBase( ReporterConfig const& _config )
05856                 :   m_config( _config.fullConfig() ),
05857                     stream( _config.stream() )
05858         {
05859             m_reporterPrefs.shouldRedirectStdOut = false;
05860             if( !DerivedT::getSupportedVerbosities().count( m_config->verbosity() ) )
05861                 CATCH_ERROR( "Verbosity level not supported by this reporter" );
05862         }
05863         ~CumulativeReporterBase() override = default;
05864
05865         ReporterPreferences getPreferences() const override {
05866             return m_reporterPrefs;
05867         }
05868
05869         static std::set<Verbosity> getSupportedVerbosities() {
05870             return { Verbosity::Normal };
05871         }
05872
05873         void testRunStarting( TestRunInfo const& ) override {}
05874         void testGroupStarting( GroupInfo const& ) override {}
05875
05876         void testCaseStarting( TestCaseInfo const& ) override {}
05877
05878         void sectionStarting( SectionInfo const& sectionInfo ) override {
05879             SectionStats incompleteStats( sectionInfo, Counts(), 0, false );
05880             std::shared_ptr<SectionNode> node;
05881             if( m_sectionStack.empty() ) {
05882                 if( !m_rootSection )
05883                     m_rootSection = std::make_shared<SectionNode>( incompleteStats );
05884                 node = m_rootSection;
05885             }
```

```
05886             else {
05887                 SectionNode& parentNode = *m_sectionStack.back();
05888                 auto it =
05889                         std::find_if(   parentNode.childSections.begin(),
05890                                         parentNode.childSections.end(),
05891                                         BySectionInfo( sectionInfo ) );
05892                 if( it == parentNode.childSections.end() ) {
05893                     node = std::make_shared<SectionNode>( incompleteStats );
05894                     parentNode.childSections.push_back( node );
05895                 }
05896                 else
05897                     node = *it;
05898             }
05899             m_sectionStack.push_back( node );
05900             m_deepestSection = std::move(node);
05901         }
05902
05903         void assertionStarting(AssertionInfo const&) override {}
05904
05905         bool assertionEnded(AssertionStats const& assertionStats) override {
05906             assert(!m_sectionStack.empty());
05907             // AssertionResult holds a pointer to a temporary DecomposedExpression,
05908             // which getExpandedExpression() calls to build the expression string.
05909             // Our section stack copy of the assertionResult will likely outlive the
05910             // temporary, so it must be expanded or discarded now to avoid calling
05911             // a destroyed object later.
05912             prepareExpandedExpression(const_cast<AssertionResult&>( assertionStats.assertionResult )
    );
05913             SectionNode& sectionNode = *m_sectionStack.back();
05914             sectionNode.assertions.push_back(assertionStats);
05915             return true;
05916         }
05917         void sectionEnded(SectionStats const& sectionStats) override {
05918             assert(!m_sectionStack.empty());
05919             SectionNode& node = *m_sectionStack.back();
05920             node.stats = sectionStats;
05921             m_sectionStack.pop_back();
05922         }
05923         void testCaseEnded(TestCaseStats const& testCaseStats) override {
05924             auto node = std::make_shared<TestCaseNode>(testCaseStats);
05925             assert(m_sectionStack.size() == 0);
05926             node->children.push_back(m_rootSection);
05927             m_testCases.push_back(node);
05928             m_rootSection.reset();
05929
05930             assert(m_deepestSection);
05931             m_deepestSection->stdOut = testCaseStats.stdOut;
05932             m_deepestSection->stdErr = testCaseStats.stdErr;
05933         }
05934         void testGroupEnded(TestGroupStats const& testGroupStats) override {
05935             auto node = std::make_shared<TestGroupNode>(testGroupStats);
05936             node->children.swap(m_testCases);
05937             m_testGroups.push_back(node);
05938         }
05939         void testRunEnded(TestRunStats const& testRunStats) override {
05940             auto node = std::make_shared<TestRunNode>(testRunStats);
05941             node->children.swap(m_testGroups);
05942             m_testRuns.push_back(node);
05943             testRunEndedCumulative();
05944         }
05945         virtual void testRunEndedCumulative() = 0;
05946
05947         void skipTest(TestCaseInfo const&) override {}
05948
05949         IConfigPtr m_config;
05950         std::ostream& stream;
05951         std::vector<AssertionStats> m_assertions;
05952         std::vector<std::vector<std::shared_ptr<SectionNode>>> m_sections;
05953         std::vector<std::shared_ptr<TestCaseNode>> m_testCases;
05954         std::vector<std::shared_ptr<TestGroupNode>> m_testGroups;
05955
05956         std::vector<std::shared_ptr<TestRunNode>> m_testRuns;
05957
05958         std::shared_ptr<SectionNode> m_rootSection;
05959         std::shared_ptr<SectionNode> m_deepestSection;
05960         std::vector<std::shared_ptr<SectionNode>> m_sectionStack;
05961         ReporterPreferences m_reporterPrefs;
05962     };
05963
05964     template<char C>
05965     char const* getLineOfChars() {
05966         static char line[CATCH_CONFIG_CONSOLE_WIDTH] = {0};
05967         if( !*line ) {
05968             std::memset( line, C, CATCH_CONFIG_CONSOLE_WIDTH-1 );
05969             line[CATCH_CONFIG_CONSOLE_WIDTH-1] = 0;
05970         }
05971         return line;
```

```
05972     }
05973
05974     struct TestEventListenerBase : StreamingReporterBase<TestEventListenerBase> {
05975         TestEventListenerBase( ReporterConfig const& _config );
05976
05977         static std::set<Verbosity> getSupportedVerbosities();
05978
05979         void assertionStarting(AssertionInfo const&) override;
05980         bool assertionEnded(AssertionStats const&) override;
05981     };
05982
05983 } // end namespace Catch
05984
05985 // end catch_reporter_bases.hpp
05986 // start catch_console_colour.h
05987
05988 namespace Catch {
05989
05990     struct Colour {
05991         enum Code {
05992             None = 0,
05993
05994             White,
05995             Red,
05996             Green,
05997             Blue,
05998             Cyan,
05999             Yellow,
06000             Grey,
06001
06002             Bright = 0x10,
06003
06004             BrightRed = Bright | Red,
06005             BrightGreen = Bright | Green,
06006             LightGrey = Bright | Grey,
06007             BrightWhite = Bright | White,
06008             BrightYellow = Bright | Yellow,
06009
06010             // By intention
06011             FileName = LightGrey,
06012             Warning = BrightYellow,
06013             ResultError = BrightRed,
06014             ResultSuccess = BrightGreen,
06015             ResultExpectedFailure = Warning,
06016
06017             Error = BrightRed,
06018             Success = Green,
06019
06020             OriginalExpression = Cyan,
06021             ReconstructedExpression = BrightYellow,
06022
06023             SecondaryText = LightGrey,
06024             Headers = White
06025         };
06026
06027         // Use constructed object for RAII guard
06028         Colour( Code _colourCode );
06029         Colour( Colour&& other ) noexcept;
06030         Colour& operator=( Colour&& other ) noexcept;
06031         ~Colour();
06032
06033         // Use static method for one-shot changes
06034         static void use( Code _colourCode );
06035
06036     private:
06037         bool m_moved = false;
06038     };
06039
06040     std::ostream& operator << ( std::ostream& os, Colour const& );
06041
06042 } // end namespace Catch
06043
06044 // end catch_console_colour.h
06045 // start catch_reporter_registrars.hpp
06046
06047
06048 namespace Catch {
06049
06050     template<typename T>
06051     class ReporterRegistrar {
06052
06053         class ReporterFactory : public IReporterFactory {
06054
06055             IStreamingReporterPtr create( ReporterConfig const& config ) const override {
06056                 return std::unique_ptr<T>( new T( config ) );
06057             }
06058
```

```
06059             std::string getDescription() const override {
06060                 return T::getDescription();
06061             }
06062         };
06063
06064     public:
06065
06066         explicit ReporterRegistrar( std::string const& name ) {
06067             getMutableRegistryHub().registerReporter( name, std::make_shared<ReporterFactory>() );
06068         }
06069     };
06070
06071     template<typename T>
06072     class ListenerRegistrar {
06073
06074         class ListenerFactory : public IReporterFactory {
06075
06076             IStreamingReporterPtr create( ReporterConfig const& config ) const override {
06077                 return std::unique_ptr<T>( new T( config ) );
06078             }
06079             std::string getDescription() const override {
06080                 return std::string();
06081             }
06082         };
06083
06084     public:
06085
06086         ListenerRegistrar() {
06087             getMutableRegistryHub().registerListener( std::make_shared<ListenerFactory>() );
06088         }
06089     };
06090 }
06091
06092 #if !defined(CATCH_CONFIG_DISABLE)
06093
06094 #define CATCH_REGISTER_REPORTER( name, reporterType ) \
06095     CATCH_INTERNAL_START_WARNINGS_SUPPRESSION          \
06096     CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS           \
06097     namespace{ Catch::ReporterRegistrar<reporterType> catch_internal_RegistrarFor##reporterType( name
      ); } \
06098     CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
06099
06100 #define CATCH_REGISTER_LISTENER( listenerType ) \
06101     CATCH_INTERNAL_START_WARNINGS_SUPPRESSION   \
06102     CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS    \
06103     namespace{ Catch::ListenerRegistrar<listenerType> catch_internal_RegistrarFor##listenerType; } \
06104     CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
06105 #else // CATCH_CONFIG_DISABLE
06106
06107 #define CATCH_REGISTER_REPORTER(name, reporterType)
06108 #define CATCH_REGISTER_LISTENER(listenerType)
06109
06110 #endif // CATCH_CONFIG_DISABLE
06111
06112 // end catch_reporter_registrars.hpp
06113 // Allow users to base their work off existing reporters
06114 // start catch_reporter_compact.h
06115
06116 namespace Catch {
06117
06118     struct CompactReporter : StreamingReporterBase<CompactReporter> {
06119
06120         using StreamingReporterBase::StreamingReporterBase;
06121
06122         ~CompactReporter() override;
06123
06124         static std::string getDescription();
06125
06126         void noMatchingTestCases(std::string const& spec) override;
06127
06128         void assertionStarting(AssertionInfo const&) override;
06129
06130         bool assertionEnded(AssertionStats const& _assertionStats) override;
06131
06132         void sectionEnded(SectionStats const& _sectionStats) override;
06133
06134         void testRunEnded(TestRunStats const& _testRunStats) override;
06135
06136     };
06137
06138 } // end namespace Catch
06139
06140 // end catch_reporter_compact.h
06141 // start catch_reporter_console.h
06142
06143 #if defined(_MSC_VER)
06144 #pragma warning(push)
```

```
06145 #pragma warning(disable:4061) // Not all labels are EXPLICITLY handled in switch
06146                               // Note that 4062 (not all labels are handled
06147                               // and default is missing) is enabled
06148 #endif
06149
06150 namespace Catch {
06151     // Fwd decls
06152     struct SummaryColumn;
06153     class TablePrinter;
06154
06155     struct ConsoleReporter : StreamingReporterBase<ConsoleReporter> {
06156         std::unique_ptr<TablePrinter> m_tablePrinter;
06157
06158         ConsoleReporter(ReporterConfig const& config);
06159         ~ConsoleReporter() override;
06160         static std::string getDescription();
06161
06162         void noMatchingTestCases(std::string const& spec) override;
06163
06164         void reportInvalidArguments(std::string const&arg) override;
06165
06166         void assertionStarting(AssertionInfo const&) override;
06167
06168         bool assertionEnded(AssertionStats const& _assertionStats) override;
06169
06170         void sectionStarting(SectionInfo const& _sectionInfo) override;
06171         void sectionEnded(SectionStats const& _sectionStats) override;
06172
06173 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
06174         void benchmarkPreparing(std::string const& name) override;
06175         void benchmarkStarting(BenchmarkInfo const& info) override;
06176         void benchmarkEnded(BenchmarkStats<> const& stats) override;
06177         void benchmarkFailed(std::string const& error) override;
06178 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
06179
06180         void testCaseEnded(TestCaseStats const& _testCaseStats) override;
06181         void testGroupEnded(TestGroupStats const& _testGroupStats) override;
06182         void testRunEnded(TestRunStats const& _testRunStats) override;
06183         void testRunStarting(TestRunInfo const& _testRunInfo) override;
06184     private:
06185
06186         void lazyPrint();
06187
06188         void lazyPrintWithoutClosingBenchmarkTable();
06189         void lazyPrintRunInfo();
06190         void lazyPrintGroupInfo();
06191         void printTestCaseAndSectionHeader();
06192
06193         void printClosedHeader(std::string const& _name);
06194         void printOpenHeader(std::string const& _name);
06195
06196         // if string has a : in first line will set indent to follow it on
06197         // subsequent lines
06198         void printHeaderString(std::string const& _string, std::size_t indent = 0);
06199
06200         void printTotals(Totals const& totals);
06201         void printSummaryRow(std::string const& label, std::vector<SummaryColumn> const& cols,
      std::size_t row);
06202
06203         void printTotalsDivider(Totals const& totals);
06204         void printSummaryDivider();
06205         void printTestFilters();
06206
06207     private:
06208         bool m_headerPrinted = false;
06209     };
06210
06211 } // end namespace Catch
06212
06213 #if defined(_MSC_VER)
06214 #pragma warning(pop)
06215 #endif
06216
06217 // end catch_reporter_console.h
06218 // start catch_reporter_junit.h
06219
06220 // start catch_xmlwriter.h
06221
06222 #include <vector>
06223
06224 namespace Catch {
06225     enum class XmlFormatting {
06226         None = 0x00,
06227         Indent = 0x01,
06228         Newline = 0x02,
06229     };
06230
```

```
06231     XmlFormatting operator | (XmlFormatting lhs, XmlFormatting rhs);
06232     XmlFormatting operator & (XmlFormatting lhs, XmlFormatting rhs);
06233
06234     class XmlEncode {
06235     public:
06236         enum ForWhat { ForTextNodes, ForAttributes };
06237
06238         XmlEncode( std::string const& str, ForWhat forWhat = ForTextNodes );
06239
06240         void encodeTo( std::ostream& os ) const;
06241
06242         friend std::ostream& operator « ( std::ostream& os, XmlEncode const& xmlEncode );
06243
06244     private:
06245         std::string m_str;
06246         ForWhat m_forWhat;
06247     };
06248
06249     class XmlWriter {
06250     public:
06251
06252         class ScopedElement {
06253         public:
06254             ScopedElement( XmlWriter* writer, XmlFormatting fmt );
06255
06256             ScopedElement( ScopedElement&& other ) noexcept;
06257             ScopedElement& operator=( ScopedElement&& other ) noexcept;
06258
06259             ~ScopedElement();
06260
06261             ScopedElement& writeText( std::string const& text, XmlFormatting fmt =
      XmlFormatting::Newline | XmlFormatting::Indent );
06262
06263             template<typename T>
06264             ScopedElement& writeAttribute( std::string const& name, T const& attribute ) {
06265                 m_writer->writeAttribute( name, attribute );
06266                 return *this;
06267             }
06268
06269         private:
06270             mutable XmlWriter* m_writer = nullptr;
06271             XmlFormatting m_fmt;
06272         };
06273
06274         XmlWriter( std::ostream& os = Catch::cout() );
06275         ~XmlWriter();
06276
06277         XmlWriter( XmlWriter const& ) = delete;
06278         XmlWriter& operator=( XmlWriter const& ) = delete;
06279
06280         XmlWriter& startElement( std::string const& name, XmlFormatting fmt = XmlFormatting::Newline |
      XmlFormatting::Indent);
06281
06282         ScopedElement scopedElement( std::string const& name, XmlFormatting fmt =
      XmlFormatting::Newline | XmlFormatting::Indent);
06283
06284         XmlWriter& endElement(XmlFormatting fmt = XmlFormatting::Newline | XmlFormatting::Indent);
06285
06286         XmlWriter& writeAttribute( std::string const& name, std::string const& attribute );
06287
06288         XmlWriter& writeAttribute( std::string const& name, bool attribute );
06289
06290         template<typename T>
06291         XmlWriter& writeAttribute( std::string const& name, T const& attribute ) {
06292             ReusableStringStream rss;
06293             rss « attribute;
06294             return writeAttribute( name, rss.str() );
06295         }
06296
06297         XmlWriter& writeText( std::string const& text, XmlFormatting fmt = XmlFormatting::Newline |
      XmlFormatting::Indent);
06298
06299         XmlWriter& writeComment(std::string const& text, XmlFormatting fmt = XmlFormatting::Newline |
      XmlFormatting::Indent);
06300
06301         void writeStylesheetRef( std::string const& url );
06302
06303         XmlWriter& writeBlankLine();
06304
06305         void ensureTagClosed();
06306
06307     private:
06308
06309         void applyFormatting(XmlFormatting fmt);
06310
06311         void writeDeclaration();
06312
```

```
06313         void newlineIfNecessary();
06314
06315         bool m_tagIsOpen = false;
06316         bool m_needsNewline = false;
06317         std::vector<std::string> m_tags;
06318         std::string m_indent;
06319         std::ostream& m_os;
06320     };
06321
06322 }
06323
06324 // end catch_xmlwriter.h
06325 namespace Catch {
06326
06327     class JunitReporter : public CumulativeReporterBase<JunitReporter> {
06328     public:
06329         JunitReporter(ReporterConfig const& _config);
06330
06331         ~JunitReporter() override;
06332
06333         static std::string getDescription();
06334
06335         void noMatchingTestCases(std::string const& /*spec*/) override;
06336
06337         void testRunStarting(TestRunInfo const& runInfo) override;
06338
06339         void testGroupStarting(GroupInfo const& groupInfo) override;
06340
06341         void testCaseStarting(TestCaseInfo const& testCaseInfo) override;
06342         bool assertionEnded(AssertionStats const& assertionStats) override;
06343
06344         void testCaseEnded(TestCaseStats const& testCaseStats) override;
06345
06346         void testGroupEnded(TestGroupStats const& testGroupStats) override;
06347
06348         void testRunEndedCumulative() override;
06349
06350         void writeGroup(TestGroupNode const& groupNode, double suiteTime);
06351
06352         void writeTestCase(TestCaseNode const& testCaseNode);
06353
06354         void writeSection( std::string const& className,
06355                            std::string const& rootName,
06356                            SectionNode const& sectionNode,
06357                            bool testOkToFail );
06358
06359         void writeAssertions(SectionNode const& sectionNode);
06360         void writeAssertion(AssertionStats const& stats);
06361
06362         XmlWriter xml;
06363         Timer suiteTimer;
06364         std::string stdOutForSuite;
06365         std::string stdErrForSuite;
06366         unsigned int unexpectedExceptions = 0;
06367         bool m_okToFail = false;
06368     };
06369
06370 } // end namespace Catch
06371
06372 // end catch_reporter_junit.h
06373 // start catch_reporter_xml.h
06374
06375 namespace Catch {
06376     class XmlReporter : public StreamingReporterBase<XmlReporter> {
06377     public:
06378         XmlReporter(ReporterConfig const& _config);
06379
06380         ~XmlReporter() override;
06381
06382         static std::string getDescription();
06383
06384         virtual std::string getStylesheetRef() const;
06385
06386         void writeSourceInfo(SourceLineInfo const& sourceInfo);
06387
06388     public: // StreamingReporterBase
06389
06390         void noMatchingTestCases(std::string const& s) override;
06391
06392         void testRunStarting(TestRunInfo const& testInfo) override;
06393
06394         void testGroupStarting(GroupInfo const& groupInfo) override;
06395
06396         void testCaseStarting(TestCaseInfo const& testInfo) override;
06397
06398         void sectionStarting(SectionInfo const& sectionInfo) override;
06399
```

```
06400         void assertionStarting(AssertionInfo const&) override;
06401
06402         bool assertionEnded(AssertionStats const& assertionStats) override;
06403
06404         void sectionEnded(SectionStats const& sectionStats) override;
06405
06406         void testCaseEnded(TestCaseStats const& testCaseStats) override;
06407
06408         void testGroupEnded(TestGroupStats const& testGroupStats) override;
06409
06410         void testRunEnded(TestRunStats const& testRunStats) override;
06411
06412 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
06413         void benchmarkPreparing(std::string const& name) override;
06414         void benchmarkStarting(BenchmarkInfo const&) override;
06415         void benchmarkEnded(BenchmarkStats<> const&) override;
06416         void benchmarkFailed(std::string const&) override;
06417 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
06418
06419     private:
06420         Timer m_testCaseTimer;
06421         XmlWriter m_xml;
06422         int m_sectionDepth = 0;
06423     };
06424
06425 } // end namespace Catch
06426
06427 // end catch_reporter_xml.h
06428
06429 // end catch_external_interfaces.h
06430 #endif
06431
06432 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
06433 // start catch_benchmarking_all.hpp
06434
06435 // A proxy header that includes all of the benchmarking headers to allow
06436 // concise include of the benchmarking features. You should prefer the
06437 // individual includes in standard use.
06438
06439 // start catch_benchmark.hpp
06440
06441  // Benchmark
06442
06443 // start catch_chronometer.hpp
06444
06445 // User-facing chronometer
06446
06447
06448 // start catch_clock.hpp
06449
06450 // Clocks
06451
06452
06453 #include <chrono>
06454 #include <ratio>
06455
06456 namespace Catch {
06457     namespace Benchmark {
06458         template <typename Clock>
06459         using ClockDuration = typename Clock::duration;
06460         template <typename Clock>
06461         using FloatDuration = std::chrono::duration<double, typename Clock::period>;
06462
06463         template <typename Clock>
06464         using TimePoint = typename Clock::time_point;
06465
06466         using default_clock = std::chrono::steady_clock;
06467
06468         template <typename Clock>
06469         struct now {
06470             TimePoint<Clock> operator()() const {
06471                 return Clock::now();
06472             }
06473         };
06474
06475         using fp_seconds = std::chrono::duration<double, std::ratio<1>>;
06476     } // namespace Benchmark
06477 } // namespace Catch
06478
06479 // end catch_clock.hpp
06480 // start catch_optimizer.hpp
06481
06482  // Hinting the optimizer
06483
06484
06485 #if defined(_MSC_VER)
06486 #   include <atomic> // atomic_thread_fence
```

```
06487 #endif
06488
06489 namespace Catch {
06490     namespace Benchmark {
06491 #if defined(__GNUC__) || defined(__clang__)
06492         template <typename T>
06493         inline void keep_memory(T* p) {
06494             asm volatile("" : : "g"(p) : "memory");
06495         }
06496         inline void keep_memory() {
06497             asm volatile("" : : : "memory");
06498         }
06499
06500         namespace Detail {
06501             inline void optimizer_barrier() { keep_memory(); }
06502         } // namespace Detail
06503 #elif defined(_MSC_VER)
06504
06505 #pragma optimize("", off)
06506         template <typename T>
06507         inline void keep_memory(T* p) {
06508             // thanks @milleniumbug
06509             *reinterpret_cast<char volatile*>(p) = *reinterpret_cast<char const volatile*>(p);
06510         }
06511         // TODO equivalent keep_memory()
06512 #pragma optimize("", on)
06513
06514         namespace Detail {
06515             inline void optimizer_barrier() {
06516                 std::atomic_thread_fence(std::memory_order_seq_cst);
06517             }
06518         } // namespace Detail
06519
06520 #endif
06521
06522         template <typename T>
06523         inline void deoptimize_value(T&& x) {
06524             keep_memory(&x);
06525         }
06526
06527         template <typename Fn, typename... Args>
06528         inline auto invoke_deoptimized(Fn&& fn, Args&&... args) -> typename
      std::enable_if<!std::is_same<void, decltype(fn(args...))>::value>::type {
06529             deoptimize_value(std::forward<Fn>(fn) (std::forward<Args...>(args...)));
06530         }
06531
06532         template <typename Fn, typename... Args>
06533         inline auto invoke_deoptimized(Fn&& fn, Args&&... args) -> typename
      std::enable_if<std::is_same<void, decltype(fn(args...))>::value>::type {
06534             std::forward<Fn>(fn) (std::forward<Args...>(args...));
06535         }
06536     } // namespace Benchmark
06537 } // namespace Catch
06538
06539 // end catch_optimizer.hpp
06540 // start catch_complete_invoke.hpp
06541
06542 // Invoke with a special case for void
06543
06544
06545 #include <type_traits>
06546 #include <utility>
06547
06548 namespace Catch {
06549     namespace Benchmark {
06550         namespace Detail {
06551             template <typename T>
06552             struct CompleteType { using type = T; };
06553             template <>
06554             struct CompleteType<void> { struct type {}; };
06555
06556             template <typename T>
06557             using CompleteType_t = typename CompleteType<T>::type;
06558
06559             template <typename Result>
06560             struct CompleteInvoker {
06561                 template <typename Fun, typename... Args>
06562                 static Result invoke(Fun&& fun, Args&&... args) {
06563                     return std::forward<Fun>(fun)(std::forward<Args>(args)...);
06564                 }
06565             };
06566             template <>
06567             struct CompleteInvoker<void> {
06568                 template <typename Fun, typename... Args>
06569                 static CompleteType_t<void> invoke(Fun&& fun, Args&&... args) {
06570                     std::forward<Fun>(fun)(std::forward<Args>(args)...);
06571                     return {};
```

```
06572                 }
06573             };
06574
06575             // invoke and not return void :(
06576             template <typename Fun, typename... Args>
06577             CompleteType_t<FunctionReturnType<Fun, Args...» complete_invoke(Fun&& fun, Args&&... args)
    {
06578                 return CompleteInvoker<FunctionReturnType<Fun,
    Args...»::invoke(std::forward<Fun>(fun), std::forward<Args>(args)...);
06579             }
06580
06581             const std::string benchmarkErrorMsg = "a benchmark failed to run successfully";
06582         } // namespace Detail
06583
06584         template <typename Fun>
06585         Detail::CompleteType_t<FunctionReturnType<Fun» user_code(Fun&& fun) {
06586             CATCH_TRY{
06587                 return Detail::complete_invoke(std::forward<Fun>(fun));
06588             } CATCH_CATCH_ALL{
06589                 getResultCapture().benchmarkFailed(translateActiveException());
06590                 CATCH_RUNTIME_ERROR(Detail::benchmarkErrorMsg);
06591             }
06592         }
06593     } // namespace Benchmark
06594 } // namespace Catch
06595
06596 // end catch_complete_invoke.hpp
06597 namespace Catch {
06598     namespace Benchmark {
06599         namespace Detail {
06600             struct ChronometerConcept {
06601                 virtual void start() = 0;
06602                 virtual void finish() = 0;
06603                 virtual ~ChronometerConcept() = default;
06604             };
06605             template <typename Clock>
06606             struct ChronometerModel final : public ChronometerConcept {
06607                 void start() override { started = Clock::now(); }
06608                 void finish() override { finished = Clock::now(); }
06609
06610                 ClockDuration<Clock> elapsed() const { return finished - started; }
06611
06612                 TimePoint<Clock> started;
06613                 TimePoint<Clock> finished;
06614             };
06615         } // namespace Detail
06616
06617         struct Chronometer {
06618         public:
06619             template <typename Fun>
06620             void measure(Fun&& fun) { measure(std::forward<Fun>(fun), is_callable<Fun(int)>()); }
06621
06622             int runs() const { return k; }
06623
06624             Chronometer(Detail::ChronometerConcept& meter, int k)
06625                 : impl(&meter)
06626                 , k(k) {}
06627
06628         private:
06629             template <typename Fun>
06630             void measure(Fun&& fun, std::false_type) {
06631                 measure([&fun](int) { return fun(); }, std::true_type());
06632             }
06633
06634             template <typename Fun>
06635             void measure(Fun&& fun, std::true_type) {
06636                 Detail::optimizer_barrier();
06637                 impl->start();
06638                 for (int i = 0; i < k; ++i) invoke_deoptimized(fun, i);
06639                 impl->finish();
06640                 Detail::optimizer_barrier();
06641             }
06642
06643             Detail::ChronometerConcept* impl;
06644             int k;
06645         };
06646     } // namespace Benchmark
06647 } // namespace Catch
06648
06649 // end catch_chronometer.hpp
06650 // start catch_environment.hpp
06651
06652 // Environment information
06653
06654
06655 namespace Catch {
06656     namespace Benchmark {
```

```
06657         template <typename Duration>
06658         struct EnvironmentEstimate {
06659             Duration mean;
06660             OutlierClassification outliers;
06661
06662             template <typename Duration2>
06663             operator EnvironmentEstimate<Duration2>() const {
06664                 return { mean, outliers };
06665             }
06666         };
06667         template <typename Clock>
06668         struct Environment {
06669             using clock_type = Clock;
06670             EnvironmentEstimate<FloatDuration<Clock>> clock_resolution;
06671             EnvironmentEstimate<FloatDuration<Clock>> clock_cost;
06672         };
06673     } // namespace Benchmark
06674 } // namespace Catch
06675
06676 // end catch_environment.hpp
06677 // start catch_execution_plan.hpp
06678
06679  // Execution plan
06680
06681
06682 // start catch_benchmark_function.hpp
06683
06684  // Dumb std::function implementation for consistent call overhead
06685
06686
06687 #include <cassert>
06688 #include <type_traits>
06689 #include <utility>
06690 #include <memory>
06691
06692 namespace Catch {
06693     namespace Benchmark {
06694         namespace Detail {
06695             template <typename T>
06696             using Decay = typename std::decay<T>::type;
06697             template <typename T, typename U>
06698             struct is_related
06699                 : std::is_same<Decay<T>, Decay<U>> {};
06700
06708             struct BenchmarkFunction {
06709             private:
06710                 struct callable {
06711                     virtual void call(Chronometer meter) const = 0;
06712                     virtual callable* clone() const = 0;
06713                     virtual ~callable() = default;
06714                 };
06715                 template <typename Fun>
06716                 struct model : public callable {
06717                     model(Fun&& fun) : fun(std::move(fun)) {}
06718                     model(Fun const& fun) : fun(fun) {}
06719
06720                     model<Fun>* clone() const override { return new model<Fun>(*this); }
06721
06722                     void call(Chronometer meter) const override {
06723                         call(meter, is_callable<Fun(Chronometer)>());
06724                     }
06725                     void call(Chronometer meter, std::true_type) const {
06726                         fun(meter);
06727                     }
06728                     void call(Chronometer meter, std::false_type) const {
06729                         meter.measure(fun);
06730                     }
06731
06732                     Fun fun;
06733                 };
06734
06735                 struct do_nothing { void operator()() const {} };
06736
06737                 template <typename T>
06738                 BenchmarkFunction(model<T>* c) : f(c) {}
06739
06740             public:
06741                 BenchmarkFunction()
06742                     : f(new model<do_nothing>{ {} }) {}
06743
06744                 template <typename Fun,
06745                     typename std::enable_if<!is_related<Fun, BenchmarkFunction>::value, int>::type =
      0>
06746                     BenchmarkFunction(Fun&& fun)
06747                     : f(new model<typename std::decay<Fun>::type>(std::forward<Fun>(fun))) {}
06748
06749                 BenchmarkFunction(BenchmarkFunction&& that)
```

```
06750                     : f(std::move(that.f)) {}
06751
06752                 BenchmarkFunction(BenchmarkFunction const& that)
06753                     : f(that.f->clone()) {}
06754
06755                 BenchmarkFunction& operator=(BenchmarkFunction&& that) {
06756                     f = std::move(that.f);
06757                     return *this;
06758                 }
06759
06760                 BenchmarkFunction& operator=(BenchmarkFunction const& that) {
06761                     f.reset(that.f->clone());
06762                     return *this;
06763                 }
06764
06765                 void operator()(Chronometer meter) const { f->call(meter); }
06766
06767             private:
06768                 std::unique_ptr<callable> f;
06769             };
06770         } // namespace Detail
06771     } // namespace Benchmark
06772 } // namespace Catch
06773
06774 // end catch_benchmark_function.hpp
06775 // start catch_repeat.hpp
06776
06777 // repeat algorithm
06778
06779
06780 #include <type_traits>
06781 #include <utility>
06782
06783 namespace Catch {
06784     namespace Benchmark {
06785         namespace Detail {
06786             template <typename Fun>
06787             struct repeater {
06788                 void operator()(int k) const {
06789                     for (int i = 0; i < k; ++i) {
06790                         fun();
06791                     }
06792                 }
06793                 Fun fun;
06794             };
06795             template <typename Fun>
06796             repeater<typename std::decay<Fun>::type> repeat(Fun&& fun) {
06797                 return { std::forward<Fun>(fun) };
06798             }
06799         } // namespace Detail
06800     } // namespace Benchmark
06801 } // namespace Catch
06802
06803 // end catch_repeat.hpp
06804 // start catch_run_for_at_least.hpp
06805
06806 // Run a function for a minimum amount of time
06807
06808
06809 // start catch_measure.hpp
06810
06811 // Measure
06812
06813
06814 // start catch_timing.hpp
06815
06816 // Timing
06817
06818
06819 #include <tuple>
06820 #include <type_traits>
06821
06822 namespace Catch {
06823     namespace Benchmark {
06824         template <typename Duration, typename Result>
06825         struct Timing {
06826             Duration elapsed;
06827             Result result;
06828             int iterations;
06829         };
06830         template <typename Clock, typename Func, typename... Args>
06831         using TimingOf = Timing<ClockDuration<Clock>, Detail::CompleteType_t<FunctionReturnType<Func,
      Args...>>>;
06832     } // namespace Benchmark
06833 } // namespace Catch
06834
06835 // end catch_timing.hpp
```

```
06836 #include <utility>
06837
06838 namespace Catch {
06839     namespace Benchmark {
06840         namespace Detail {
06841             template <typename Clock, typename Fun, typename... Args>
06842             TimingOf<Clock, Fun, Args...> measure(Fun&& fun, Args&&... args) {
06843                 auto start = Clock::now();
06844                 auto&& r = Detail::complete_invoke(fun, std::forward<Args>(args)...);
06845                 auto end = Clock::now();
06846                 auto delta = end - start;
06847                 return { delta, std::forward<decltype(r)>(r), 1 };
06848             }
06849         } // namespace Detail
06850     } // namespace Benchmark
06851 } // namespace Catch
06852
06853 // end catch_measure.hpp
06854 #include <utility>
06855 #include <type_traits>
06856
06857 namespace Catch {
06858     namespace Benchmark {
06859         namespace Detail {
06860             template <typename Clock, typename Fun>
06861             TimingOf<Clock, Fun, int> measure_one(Fun&& fun, int iters, std::false_type) {
06862                 return Detail::measure<Clock>(fun, iters);
06863             }
06864             template <typename Clock, typename Fun>
06865             TimingOf<Clock, Fun, Chronometer> measure_one(Fun&& fun, int iters, std::true_type) {
06866                 Detail::ChronometerModel<Clock> meter;
06867                 auto&& result = Detail::complete_invoke(fun, Chronometer(meter, iters));
06868
06869                 return { meter.elapsed(), std::move(result), iters };
06870             }
06871
06872             template <typename Clock, typename Fun>
06873             using run_for_at_least_argument_t = typename
      std::conditional<is_callable<Fun(Chronometer)>::value, Chronometer, int>::type;
06874
06875             struct optimized_away_error : std::exception {
06876                 const char* what() const noexcept override {
06877                     return "could not measure benchmark, maybe it was optimized away";
06878                 }
06879             };
06880
06881             template <typename Clock, typename Fun>
06882             TimingOf<Clock, Fun, run_for_at_least_argument_t<Clock, Fun»
      run_for_at_least(ClockDuration<Clock> how_long, int seed, Fun&& fun) {
06883                 auto iters = seed;
06884                 while (iters < (1 « 30)) {
06885                     auto&& Timing = measure_one<Clock>(fun, iters, is_callable<Fun(Chronometer)>());
06886
06887                     if (Timing.elapsed >= how_long) {
06888                         return { Timing.elapsed, std::move(Timing.result), iters };
06889                     }
06890                     iters *= 2;
06891                 }
06892                 Catch::throw_exception(optimized_away_error{});
06893             }
06894         } // namespace Detail
06895     } // namespace Benchmark
06896 } // namespace Catch
06897
06898 // end catch_run_for_at_least.hpp
06899 #include <algorithm>
06900 #include <iterator>
06901
06902 namespace Catch {
06903     namespace Benchmark {
06904         template <typename Duration>
06905         struct ExecutionPlan {
06906             int iterations_per_sample;
06907             Duration estimated_duration;
06908             Detail::BenchmarkFunction benchmark;
06909             Duration warmup_time;
06910             int warmup_iterations;
06911
06912             template <typename Duration2>
06913             operator ExecutionPlan<Duration2>() const {
06914                 return { iterations_per_sample, estimated_duration, benchmark, warmup_time,
      warmup_iterations };
06915             }
06916
06917             template <typename Clock>
06918             std::vector<FloatDuration<Clock» run(const IConfig &cfg, Environment<FloatDuration<Clock»
      env) const {
```

```
06919                 // warmup a bit
06920
      Detail::run_for_at_least<Clock>(std::chrono::duration_cast<ClockDuration<Clock»(warmup_time),
      warmup_iterations, Detail::repeat(now<Clock>{}));
06921
06922                 std::vector<FloatDuration<Clock» times;
06923                 times.reserve(cfg.benchmarkSamples());
06924                 std::generate_n(std::back_inserter(times), cfg.benchmarkSamples(), [this, env] {
06925                     Detail::ChronometerModel<Clock> model;
06926                     this->benchmark(Chronometer(model, iterations_per_sample));
06927                     auto sample_time = model.elapsed() - env.clock_cost.mean;
06928                     if (sample_time < FloatDuration<Clock>::zero()) sample_time =
      FloatDuration<Clock>::zero();
06929                     return sample_time / iterations_per_sample;
06930                 });
06931                 return times;
06932             }
06933         };
06934     } // namespace Benchmark
06935 } // namespace Catch
06936
06937 // end catch_execution_plan.hpp
06938 // start catch_estimate_clock.hpp
06939
06940  // Environment measurement
06941
06942
06943 // start catch_stats.hpp
06944
06945 // Statistical analysis tools
06946
06947
06948 #include <algorithm>
06949 #include <functional>
06950 #include <vector>
06951 #include <iterator>
06952 #include <numeric>
06953 #include <tuple>
06954 #include <cmath>
06955 #include <utility>
06956 #include <cstddef>
06957 #include <random>
06958
06959 namespace Catch {
06960     namespace Benchmark {
06961         namespace Detail {
06962             using sample = std::vector<double>;
06963
06964             double weighted_average_quantile(int k, int q, std::vector<double>::iterator first,
      std::vector<double>::iterator last);
06965
06966             template <typename Iterator>
06967             OutlierClassification classify_outliers(Iterator first, Iterator last) {
06968                 std::vector<double> copy(first, last);
06969
06970                 auto q1 = weighted_average_quantile(1, 4, copy.begin(), copy.end());
06971                 auto q3 = weighted_average_quantile(3, 4, copy.begin(), copy.end());
06972                 auto iqr = q3 - q1;
06973                 auto los = q1 - (iqr * 3.);
06974                 auto lom = q1 - (iqr * 1.5);
06975                 auto him = q3 + (iqr * 1.5);
06976                 auto his = q3 + (iqr * 3.);
06977
06978                 OutlierClassification o;
06979                 for (; first != last; ++first) {
06980                     auto&& t = *first;
06981                     if (t < los) ++o.low_severe;
06982                     else if (t < lom) ++o.low_mild;
06983                     else if (t > his) ++o.high_severe;
06984                     else if (t > him) ++o.high_mild;
06985                     ++o.samples_seen;
06986                 }
06987                 return o;
06988             }
06989
06990             template <typename Iterator>
06991             double mean(Iterator first, Iterator last) {
06992                 auto count = last - first;
06993                 double sum = std::accumulate(first, last, 0.);
06994                 return sum / count;
06995             }
06996
06997             template <typename URng, typename Iterator, typename Estimator>
06998             sample resample(URng& rng, int resamples, Iterator first, Iterator last, Estimator&
      estimator) {
06999                 auto n = last - first;
07000                 std::uniform_int_distribution<decltype(n)> dist(0, n - 1);
```

```
07001
07002                   sample out;
07003                   out.reserve(resamples);
07004                   std::generate_n(std::back_inserter(out), resamples, [n, first, &estimator, &dist,
        &rng] {
07005                       std::vector<double> resampled;
07006                       resampled.reserve(n);
07007                       std::generate_n(std::back_inserter(resampled), n, [first, &dist, &rng] { return
        first[dist(rng)]; });
07008                       return estimator(resampled.begin(), resampled.end());
07009                   });
07010                   std::sort(out.begin(), out.end());
07011                   return out;
07012               }
07013
07014               template <typename Estimator, typename Iterator>
07015               sample jackknife(Estimator&& estimator, Iterator first, Iterator last) {
07016                   auto n = last - first;
07017                   auto second = std::next(first);
07018                   sample results;
07019                   results.reserve(n);
07020
07021                   for (auto it = first; it != last; ++it) {
07022                       std::iter_swap(it, first);
07023                       results.push_back(estimator(second, last));
07024                   }
07025
07026                   return results;
07027               }
07028
07029               inline double normal_cdf(double x) {
07030                   return std::erfc(-x / std::sqrt(2.0)) / 2.0;
07031               }
07032
07033               double erfc_inv(double x);
07034
07035               double normal_quantile(double p);
07036
07037               template <typename Iterator, typename Estimator>
07038               Estimate<double> bootstrap(double confidence_level, Iterator first, Iterator last, sample
        const& resample, Estimator&& estimator) {
07039                   auto n_samples = last - first;
07040
07041                   double point = estimator(first, last);
07042                   // Degenerate case with a single sample
07043                   if (n_samples == 1) return { point, point, point, confidence_level };
07044
07045                   sample jack = jackknife(estimator, first, last);
07046                   double jack_mean = mean(jack.begin(), jack.end());
07047                   double sum_squares, sum_cubes;
07048                   std::tie(sum_squares, sum_cubes) = std::accumulate(jack.begin(), jack.end(),
        std::make_pair(0., 0.), [jack_mean](std::pair<double, double> sqcb, double x) -> std::pair<double,
        double> {
07049                       auto d = jack_mean - x;
07050                       auto d2 = d * d;
07051                       auto d3 = d2 * d;
07052                       return { sqcb.first + d2, sqcb.second + d3 };
07053                   });
07054
07055                   double accel = sum_cubes / (6 * std::pow(sum_squares, 1.5));
07056                   int n = static_cast<int>(resample.size());
07057                   double prob_n = std::count_if(resample.begin(), resample.end(), [point](double x) {
        return x < point; }) / (double)n;
07058                   // degenerate case with uniform samples
07059                   if (prob_n == 0) return { point, point, point, confidence_level };
07060
07061                   double bias = normal_quantile(prob_n);
07062                   double z1 = normal_quantile((1. - confidence_level) / 2.);
07063
07064                   auto cumn = [n](double x) -> int {
07065                       return std::lround(normal_cdf(x) * n); };
07066                   auto a = [bias, accel](double b) { return bias + b / (1. - accel * b); };
07067                   double b1 = bias + z1;
07068                   double b2 = bias - z1;
07069                   double a1 = a(b1);
07070                   double a2 = a(b2);
07071                   auto lo = (std::max)(cumn(a1), 0);
07072                   auto hi = (std::min)(cumn(a2), n - 1);
07073
07074                   return { point, resample[lo], resample[hi], confidence_level };
07075               }
07076
07077               double outlier_variance(Estimate<double> mean, Estimate<double> stddev, int n);
07078
07079               struct bootstrap_analysis {
07080                   Estimate<double> mean;
07081                   Estimate<double> standard_deviation;
```

```
07082                 double outlier_variance;
07083             };
07084
07085             bootstrap_analysis analyse_samples(double confidence_level, int n_resamples,
    std::vector<double>::iterator first, std::vector<double>::iterator last);
07086         } // namespace Detail
07087     } // namespace Benchmark
07088 } // namespace Catch
07089
07090 // end catch_stats.hpp
07091 #include <algorithm>
07092 #include <iterator>
07093 #include <tuple>
07094 #include <vector>
07095 #include <cmath>
07096
07097 namespace Catch {
07098     namespace Benchmark {
07099         namespace Detail {
07100             template <typename Clock>
07101             std::vector<double> resolution(int k) {
07102                 std::vector<TimePoint<Clock>> times;
07103                 times.reserve(k + 1);
07104                 std::generate_n(std::back_inserter(times), k + 1, now<Clock>{});
07105
07106                 std::vector<double> deltas;
07107                 deltas.reserve(k);
07108                 std::transform(std::next(times.begin()), times.end(), times.begin(),
07109                     std::back_inserter(deltas),
07110                     [](TimePoint<Clock> a, TimePoint<Clock> b) { return static_cast<double>((a -
    b).count()); });
07111
07112                 return deltas;
07113             }
07114
07115             const auto warmup_iterations = 10000;
07116             const auto warmup_time = std::chrono::milliseconds(100);
07117             const auto minimum_ticks = 1000;
07118             const auto warmup_seed = 10000;
07119             const auto clock_resolution_estimation_time = std::chrono::milliseconds(500);
07120             const auto clock_cost_estimation_time_limit = std::chrono::seconds(1);
07121             const auto clock_cost_estimation_tick_limit = 100000;
07122             const auto clock_cost_estimation_time = std::chrono::milliseconds(10);
07123             const auto clock_cost_estimation_iterations = 10000;
07124
07125             template <typename Clock>
07126             int warmup() {
07127                 return
    run_for_at_least<Clock>(std::chrono::duration_cast<ClockDuration<Clock>>(warmup_time), warmup_seed,
    &resolution<Clock>)
07128                     .iterations;
07129             }
07130             template <typename Clock>
07131             EnvironmentEstimate<FloatDuration<Clock>> estimate_clock_resolution(int iterations) {
07132                 auto r =
    run_for_at_least<Clock>(std::chrono::duration_cast<ClockDuration<Clock>>(clock_resolution_estimation_time),
    iterations, &resolution<Clock>)
07133                     .result;
07134                 return {
07135                     FloatDuration<Clock>(mean(r.begin(), r.end())),
07136                     classify_outliers(r.begin(), r.end()),
07137                 };
07138             }
07139             template <typename Clock>
07140             EnvironmentEstimate<FloatDuration<Clock>> estimate_clock_cost(FloatDuration<Clock>
    resolution) {
07141                 auto time_limit = (std::min)(
07142                     resolution * clock_cost_estimation_tick_limit,
07143                     FloatDuration<Clock>(clock_cost_estimation_time_limit));
07144                 auto time_clock = [](int k) {
07145                     return Detail::measure<Clock>([k] {
07146                         for (int i = 0; i < k; ++i) {
07147                             volatile auto ignored = Clock::now();
07148                             (void)ignored;
07149                         }
07150                     }).elapsed;
07151                 };
07152                 time_clock(1);
07153                 int iters = clock_cost_estimation_iterations;
07154                 auto&& r =
    run_for_at_least<Clock>(std::chrono::duration_cast<ClockDuration<Clock>>(clock_cost_estimation_time),
    iters, time_clock);
07155                 std::vector<double> times;
07156                 int nsamples = static_cast<int>(std::ceil(time_limit / r.elapsed));
07157                 times.reserve(nsamples);
07158                 std::generate_n(std::back_inserter(times), nsamples, [time_clock, &r] {
07159                     return static_cast<double>((time_clock(r.iterations) / r.iterations).count());
```

```
07160                 });
07161                 return {
07162                     FloatDuration<Clock>(mean(times.begin(), times.end())),
07163                     classify_outliers(times.begin(), times.end()),
07164                 };
07165             }
07166
07167             template <typename Clock>
07168             Environment<FloatDuration<Clock>> measure_environment() {
07169                 static Environment<FloatDuration<Clock>>* env = nullptr;
07170                 if (env) {
07171                     return *env;
07172                 }
07173
07174                 auto iters = Detail::warmup<Clock>();
07175                 auto resolution = Detail::estimate_clock_resolution<Clock>(iters);
07176                 auto cost = Detail::estimate_clock_cost<Clock>(resolution.mean);
07177
07178                 env = new Environment<FloatDuration<Clock>>{ resolution, cost };
07179                 return *env;
07180             }
07181         } // namespace Detail
07182     } // namespace Benchmark
07183 } // namespace Catch
07184
07185 // end catch_estimate_clock.hpp
07186 // start catch_analyse.hpp
07187
07188  // Run and analyse one benchmark
07189
07190
07191 // start catch_sample_analysis.hpp
07192
07193 // Benchmark results
07194
07195
07196 #include <algorithm>
07197 #include <vector>
07198 #include <string>
07199 #include <iterator>
07200
07201 namespace Catch {
07202     namespace Benchmark {
07203         template <typename Duration>
07204         struct SampleAnalysis {
07205             std::vector<Duration> samples;
07206             Estimate<Duration> mean;
07207             Estimate<Duration> standard_deviation;
07208             OutlierClassification outliers;
07209             double outlier_variance;
07210
07211             template <typename Duration2>
07212             operator SampleAnalysis<Duration2>() const {
07213                 std::vector<Duration2> samples2;
07214                 samples2.reserve(samples.size());
07215                 std::transform(samples.begin(), samples.end(), std::back_inserter(samples2),
    [](Duration d) { return Duration2(d); });
07216                 return {
07217                     std::move(samples2),
07218                     mean,
07219                     standard_deviation,
07220                     outliers,
07221                     outlier_variance,
07222                 };
07223             }
07224         };
07225     } // namespace Benchmark
07226 } // namespace Catch
07227
07228 // end catch_sample_analysis.hpp
07229 #include <algorithm>
07230 #include <iterator>
07231 #include <vector>
07232
07233 namespace Catch {
07234     namespace Benchmark {
07235         namespace Detail {
07236             template <typename Duration, typename Iterator>
07237             SampleAnalysis<Duration> analyse(const IConfig &cfg, Environment<Duration>, Iterator
    first, Iterator last) {
07238                 if (!cfg.benchmarkNoAnalysis()) {
07239                     std::vector<double> samples;
07240                     samples.reserve(last - first);
07241                     std::transform(first, last, std::back_inserter(samples), [](Duration d) { return
    d.count(); });
07242
07243                     auto analysis =
```

```
    Catch::Benchmark::Detail::analyse_samples(cfg.benchmarkConfidenceInterval(), cfg.benchmarkResamples(),
    samples.begin(), samples.end());
07244                   auto outliers = Catch::Benchmark::Detail::classify_outliers(samples.begin(),
    samples.end());
07245
07246                   auto wrap_estimate = [](Estimate<double> e) {
07247                       return Estimate<Duration> {
07248                           Duration(e.point),
07249                               Duration(e.lower_bound),
07250                               Duration(e.upper_bound),
07251                               e.confidence_interval,
07252                           };
07253                   };
07254                   std::vector<Duration> samples2;
07255                   samples2.reserve(samples.size());
07256                   std::transform(samples.begin(), samples.end(), std::back_inserter(samples2),
    [](double d) { return Duration(d); });
07257                   return {
07258                       std::move(samples2),
07259                       wrap_estimate(analysis.mean),
07260                       wrap_estimate(analysis.standard_deviation),
07261                       outliers,
07262                       analysis.outlier_variance,
07263                   };
07264               } else {
07265                   std::vector<Duration> samples;
07266                   samples.reserve(last - first);
07267
07268                   Duration mean = Duration(0);
07269                   int i = 0;
07270                   for (auto it = first; it < last; ++it, ++i) {
07271                       samples.push_back(Duration(*it));
07272                       mean += Duration(*it);
07273                   }
07274                   mean /= i;
07275
07276                   return {
07277                       std::move(samples),
07278                       Estimate<Duration>{mean, mean, mean, 0.0},
07279                       Estimate<Duration>{Duration(0), Duration(0), Duration(0), 0.0},
07280                       OutlierClassification{},
07281                       0.0
07282                   };
07283               }
07284           }
07285       } // namespace Detail
07286   } // namespace Benchmark
07287 } // namespace Catch
07288
07289 // end catch_analyse.hpp
07290 #include <algorithm>
07291 #include <functional>
07292 #include <string>
07293 #include <vector>
07294 #include <cmath>
07295
07296 namespace Catch {
07297     namespace Benchmark {
07298         struct Benchmark {
07299             Benchmark(std::string &&name)
07300                 : name(std::move(name)) {}
07301
07302             template <class FUN>
07303             Benchmark(std::string &&name, FUN &&func)
07304                 : fun(std::move(func)), name(std::move(name)) {}
07305
07306             template <typename Clock>
07307             ExecutionPlan<FloatDuration<Clock>> prepare(const IConfig &cfg,
    Environment<FloatDuration<Clock>> env) const {
07308                 auto min_time = env.clock_resolution.mean * Detail::minimum_ticks;
07309                 auto run_time = std::max(min_time,
    std::chrono::duration_cast<decltype(min_time)>(cfg.benchmarkWarmupTime()));
07310                 auto&& test =
    Detail::run_for_at_least<Clock>(std::chrono::duration_cast<ClockDuration<Clock>>(run_time), 1, fun);
07311                 int new_iters = static_cast<int>(std::ceil(min_time * test.iterations /
    test.elapsed));
07312                 return { new_iters, test.elapsed / test.iterations * new_iters *
    cfg.benchmarkSamples(), fun,
    std::chrono::duration_cast<FloatDuration<Clock>>(cfg.benchmarkWarmupTime()), Detail::warmup_iterations
    };
07313             }
07314
07315             template <typename Clock = default_clock>
07316             void run() {
07317                 IConfigPtr cfg = getCurrentContext().getConfig();
07318
07319                 auto env = Detail::measure_environment<Clock>();
```

```
07320
07321                 getResultCapture().benchmarkPreparing(name);
07322                 CATCH_TRY{
07323                     auto plan = user_code([&] {
07324                         return prepare<Clock>(*cfg, env);
07325                     });
07326
07327                     BenchmarkInfo info {
07328                         name,
07329                         plan.estimated_duration.count(),
07330                         plan.iterations_per_sample,
07331                         cfg->benchmarkSamples(),
07332                         cfg->benchmarkResamples(),
07333                         env.clock_resolution.mean.count(),
07334                         env.clock_cost.mean.count()
07335                     };
07336
07337                     getResultCapture().benchmarkStarting(info);
07338
07339                     auto samples = user_code([&] {
07340                         return plan.template run<Clock>(*cfg, env);
07341                     });
07342
07343                     auto analysis = Detail::analyse(*cfg, env, samples.begin(), samples.end());
07344                     BenchmarkStats<FloatDuration<Clock>> stats{ info, analysis.samples, analysis.mean,
    analysis.standard_deviation, analysis.outliers, analysis.outlier_variance };
07345                     getResultCapture().benchmarkEnded(stats);
07346
07347                 } CATCH_CATCH_ALL{
07348                     if (translateActiveException() != Detail::benchmarkErrorMsg) // benchmark errors
    have been reported, otherwise rethrow.
07349                         std::rethrow_exception(std::current_exception());
07350                 }
07351             }
07352
07353             // sets lambda to be used in fun *and* executes benchmark!
07354             template <typename Fun,
07355                 typename std::enable_if<!Detail::is_related<Fun, Benchmark>::value, int>::type = 0>
07356                 Benchmark & operator=(Fun func) {
07357                 fun = Detail::BenchmarkFunction(func);
07358                 run();
07359                 return *this;
07360             }
07361
07362             explicit operator bool() {
07363                 return true;
07364             }
07365
07366         private:
07367             Detail::BenchmarkFunction fun;
07368             std::string name;
07369         };
07370     }
07371 } // namespace Catch
07372
07373 #define INTERNAL_CATCH_GET_1_ARG(arg1, arg2, ...) arg1
07374 #define INTERNAL_CATCH_GET_2_ARG(arg1, arg2, ...) arg2
07375
07376 #define INTERNAL_CATCH_BENCHMARK(BenchmarkName, name, benchmarkIndex)\
07377     if( Catch::Benchmark::Benchmark BenchmarkName{name} ) \
07378         BenchmarkName = [&](int benchmarkIndex)
07379
07380 #define INTERNAL_CATCH_BENCHMARK_ADVANCED(BenchmarkName, name)\
07381     if( Catch::Benchmark::Benchmark BenchmarkName{name} ) \
07382         BenchmarkName = [&]
07383
07384 // end catch_benchmark.hpp
07385 // start catch_constructor.hpp
07386
07387 // Constructor and destructor helpers
07388
07389
07390 #include <type_traits>
07391
07392 namespace Catch {
07393     namespace Benchmark {
07394         namespace Detail {
07395             template <typename T, bool Destruct>
07396             struct ObjectStorage
07397             {
07398                 ObjectStorage() : data() {}
07399
07400                 ObjectStorage(const ObjectStorage& other)
07401                 {
07402                     new(&data) T(other.stored_object());
07403                 }
07404
```

```
07405                 ObjectStorage(ObjectStorage&& other)
07406                 {
07407                     new(&data) T(std::move(other.stored_object()));
07408                 }
07409
07410                 ~ObjectStorage() { destruct_on_exit<T>(); }
07411
07412                 template <typename... Args>
07413                 void construct(Args&&... args)
07414                 {
07415                     new (&data) T(std::forward<Args>(args)...);
07416                 }
07417
07418                 template <bool AllowManualDestruction = !Destruct>
07419                 typename std::enable_if<AllowManualDestruction>::type destruct()
07420                 {
07421                     stored_object().~T();
07422                 }
07423
07424             private:
07425                 // If this is a constructor benchmark, destruct the underlying object
07426                 template <typename U>
07427                 void destruct_on_exit(typename std::enable_if<Destruct, U>::type* = 0) {
    destruct<true>(); }
07428                 // Otherwise, don't
07429                 template <typename U>
07430                 void destruct_on_exit(typename std::enable_if<!Destruct, U>::type* = 0) { }
07431
07432                 T& stored_object() {
07433                     return *static_cast<T*>(static_cast<void*>(&data));
07434                 }
07435
07436                 T const& stored_object() const {
07437                     return *static_cast<T*>(static_cast<void*>(&data));
07438                 }
07439
07440                 struct { alignas(T) unsigned char data[sizeof(T)]; }  data;
07441             };
07442         }
07443
07444         template <typename T>
07445         using storage_for = Detail::ObjectStorage<T, true>;
07446
07447         template <typename T>
07448         using destructable_object = Detail::ObjectStorage<T, false>;
07449     }
07450 }
07451
07452 // end catch_constructor.hpp
07453 // end catch_benchmarking_all.hpp
07454 #endif
07455
07456 #endif // ! CATCH_CONFIG_IMPL_ONLY
07457
07458 #ifdef CATCH_IMPL
07459 // start catch_impl.hpp
07460
07461 #ifdef __clang__
07462 #pragma clang diagnostic push
07463 #pragma clang diagnostic ignored "-Wweak-vtables"
07464 #endif
07465
07466 // Keep these here for external reporters
07467 // start catch_test_case_tracker.h
07468
07469 #include <string>
07470 #include <vector>
07471 #include <memory>
07472
07473 namespace Catch {
07474     namespace TestCaseTracking {
07475
07476         struct NameAndLocation {
07477             std::string name;
07478             SourceLineInfo location;
07479
07480             NameAndLocation( std::string const& _name, SourceLineInfo const& _location );
07481             friend bool operator==(NameAndLocation const& lhs, NameAndLocation const& rhs) {
07482                 return lhs.name == rhs.name
07483                        && lhs.location == rhs.location;
07484             }
07485         };
07486
07487         class ITracker;
07488
07489         using ITrackerPtr = std::shared_ptr<ITracker>;
07490
```

```
07491         class  ITracker {
07492             NameAndLocation m_nameAndLocation;
07493
07494         public:
07495             ITracker(NameAndLocation const& nameAndLoc) :
07496                     m_nameAndLocation(nameAndLoc)
07497             {}
07498
07499             // static queries
07500             NameAndLocation const& nameAndLocation() const {
07501                 return m_nameAndLocation;
07502             }
07503
07504             virtual ~ITracker();
07505
07506             // dynamic queries
07507             virtual bool isComplete() const = 0; // Successfully completed or failed
07508             virtual bool isSuccessfullyCompleted() const = 0;
07509             virtual bool isOpen() const = 0; // Started but not complete
07510             virtual bool hasChildren() const = 0;
07511             virtual bool hasStarted() const = 0;
07512
07513             virtual ITracker& parent() = 0;
07514
07515             // actions
07516             virtual void close() = 0; // Successfully complete
07517             virtual void fail() = 0;
07518             virtual void markAsNeedingAnotherRun() = 0;
07519
07520             virtual void addChild( ITrackerPtr const& child ) = 0;
07521             virtual ITrackerPtr findChild( NameAndLocation const& nameAndLocation ) = 0;
07522             virtual void openChild() = 0;
07523
07524             // Debug/ checking
07525             virtual bool isSectionTracker() const = 0;
07526             virtual bool isGeneratorTracker() const = 0;
07527         };
07528
07529         class TrackerContext {
07530
07531             enum RunState {
07532                 NotStarted,
07533                 Executing,
07534                 CompletedCycle
07535             };
07536
07537             ITrackerPtr m_rootTracker;
07538             ITracker* m_currentTracker = nullptr;
07539             RunState m_runState = NotStarted;
07540
07541         public:
07542
07543             ITracker& startRun();
07544             void endRun();
07545
07546             void startCycle();
07547             void completeCycle();
07548
07549             bool completedCycle() const;
07550             ITracker& currentTracker();
07551             void setCurrentTracker( ITracker* tracker );
07552         };
07553
07554         class TrackerBase : public ITracker {
07555         protected:
07556             enum CycleState {
07557                 NotStarted,
07558                 Executing,
07559                 ExecutingChildren,
07560                 NeedsAnotherRun,
07561                 CompletedSuccessfully,
07562                 Failed
07563             };
07564
07565             using Children = std::vector<ITrackerPtr>;
07566             TrackerContext& m_ctx;
07567             ITracker* m_parent;
07568             Children m_children;
07569             CycleState m_runState = NotStarted;
07570
07571         public:
07572             TrackerBase( NameAndLocation const& nameAndLocation, TrackerContext& ctx, ITracker* parent
      );
07573
07574             bool isComplete() const override;
07575             bool isSuccessfullyCompleted() const override;
07576             bool isOpen() const override;
```

```
07577             bool hasChildren() const override;
07578             bool hasStarted() const override {
07579                 return m_runState != NotStarted;
07580             }
07581
07582             void addChild( ITrackerPtr const& child ) override;
07583
07584             ITrackerPtr findChild( NameAndLocation const& nameAndLocation ) override;
07585             ITracker& parent() override;
07586
07587             void openChild() override;
07588
07589             bool isSectionTracker() const override;
07590             bool isGeneratorTracker() const override;
07591
07592             void open();
07593
07594             void close() override;
07595             void fail() override;
07596             void markAsNeedingAnotherRun() override;
07597
07598         private:
07599             void moveToParent();
07600             void moveToThis();
07601         };
07602
07603         class SectionTracker : public TrackerBase {
07604             std::vector<std::string> m_filters;
07605             std::string m_trimmed_name;
07606         public:
07607             SectionTracker( NameAndLocation const& nameAndLocation, TrackerContext& ctx, ITracker*
      parent );
07608
07609             bool isSectionTracker() const override;
07610
07611             bool isComplete() const override;
07612
07613             static SectionTracker& acquire( TrackerContext& ctx, NameAndLocation const&
      nameAndLocation );
07614
07615             void tryOpen();
07616
07617             void addInitialFilters( std::vector<std::string> const& filters );
07618             void addNextFilters( std::vector<std::string> const& filters );
07620             std::vector<std::string> const& getFilters() const;
07622             std::string const& trimmedName() const;
07623         };
07624
07625     } // namespace TestCaseTracking
07626
07627     using TestCaseTracking::ITracker;
07628     using TestCaseTracking::TrackerContext;
07629     using TestCaseTracking::SectionTracker;
07630
07631 } // namespace Catch
07632
07633 // end catch_test_case_tracker.h
07634
07635 // start catch_leak_detector.h
07636
07637 namespace Catch {
07638
07639     struct LeakDetector {
07640         LeakDetector();
07641         ~LeakDetector();
07642     };
07643
07644 }
07645 // end catch_leak_detector.h
07646 // Cpp files will be included in the single-header file here
07647 // start catch_stats.cpp
07648
07649 // Statistical analysis tools
07650
07651 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
07652
07653 #include <cassert>
07654 #include <random>
07655
07656 #if defined(CATCH_CONFIG_USE_ASYNC)
07657 #include <future>
07658 #endif
07659
07660 namespace {
07661     double erf_inv(double x) {
07662         // Code accompanying the article "Approximating the erfinv function" in GPU Computing Gems,
      Volume 2
```

```
07663         double w, p;
07664
07665         w = -log((1.0 - x) * (1.0 + x));
07666
07667         if (w < 6.250000) {
07668             w = w - 3.125000;
07669             p = -3.6444120640178196996e-21;
07670             p = -1.685059138182016589e-19 + p * w;
07671             p = 1.2858480715256400167e-18 + p * w;
07672             p = 1.115787767802518096e-17 + p * w;
07673             p = -1.333171662854620906e-16 + p * w;
07674             p = 2.0972767875968561637e-17 + p * w;
07675             p = 6.6376381343583238325e-15 + p * w;
07676             p = -4.0545662729752068639e-14 + p * w;
07677             p = -8.1519341976054721522e-14 + p * w;
07678             p = 2.6335093153082322977e-12 + p * w;
07679             p = -1.2975133253453532498e-11 + p * w;
07680             p = -5.4154120542946279317e-11 + p * w;
07681             p = 1.0512122733215322850e-09 + p * w;
07682             p = -4.1126339803469836976e-09 + p * w;
07683             p = -2.9070369957882005086e-08 + p * w;
07684             p = 4.2347877827932403518e-07 + p * w;
07685             p = -1.3654692000834678645e-06 + p * w;
07686             p = -1.3882523362786468719e-05 + p * w;
07687             p = 0.00018673420803405713520 + p * w;
07688             p = -0.00074070253416626697512 + p * w;
07689             p = -0.00603367087143014905330 + p * w;
07690             p = 0.24015818242558961693 + p * w;
07691             p = 1.6536545626831027356 + p * w;
07692         } else if (w < 16.000000) {
07693             w = sqrt(w) - 3.250000;
07694             p = 2.2137376921775787049e-09;
07695             p = 9.0756561938885390979e-08 + p * w;
07696             p = -2.7517406297064545428e-07 + p * w;
07697             p = 1.8239629214389227755e-08 + p * w;
07698             p = 1.5027403968909827627e-06 + p * w;
07699             p = -4.0138675269815459690e-06 + p * w;
07700             p = 2.9234449089955446044e-06 + p * w;
07701             p = 1.2475304481671778723e-05 + p * w;
07702             p = -4.7318229009055733981e-05 + p * w;
07703             p = 6.8284851459573175448e-05 + p * w;
07704             p = 2.4031110387097893999e-05 + p * w;
07705             p = -0.00035503755203628474796 + p * w;
07706             p = 0.00095328937973738049703 + p * w;
07707             p = -0.00168827555602350473130 + p * w;
07708             p = 0.00249144209610785080660 + p * w;
07709             p = -0.00375120850756924121070 + p * w;
07710             p = 0.00537091455359006361700 + p * w;
07711             p = 1.0052589676941592334 + p * w;
07712             p = 3.0838856104922207635 + p * w;
07713         } else {
07714             w = sqrt(w) - 5.000000;
07715             p = -2.7109920616438573243e-11;
07716             p = -2.5556418169965252055e-10 + p * w;
07717             p = 1.5076572693500548083e-09 + p * w;
07718             p = -3.7894654401267369937e-09 + p * w;
07719             p = 7.6157012080783393804e-09 + p * w;
07720             p = -1.4960026627149240478e-08 + p * w;
07721             p = 2.9147953450901080826e-08 + p * w;
07722             p = -6.7711997758452339498e-08 + p * w;
07723             p = 2.2900482228026654717e-07 + p * w;
07724             p = -9.9298272942317002539e-07 + p * w;
07725             p = 4.5260625972231537039e-06 + p * w;
07726             p = -1.9681778105531670567e-05 + p * w;
07727             p = 7.5995277030017761139e-05 + p * w;
07728             p = -0.00021503011930044477347 + p * w;
07729             p = -0.00013871931833623122026 + p * w;
07730             p = 1.0103004648645343977 + p * w;
07731             p = 4.8499064014085844221 + p * w;
07732         }
07733         return p * x;
07734     }
07735
07736     double standard_deviation(std::vector<double>::iterator first, std::vector<double>::iterator last)
      {
07737         auto m = Catch::Benchmark::Detail::mean(first, last);
07738         double variance = std::accumulate(first, last, 0., [m](double a, double b) {
07739             double diff = b - m;
07740             return a + diff * diff;
07741             }) / (last - first);
07742             return std::sqrt(variance);
07743     }
07744
07745 }
07746
07747 namespace Catch {
07748     namespace Benchmark {
```

```
07749         namespace Detail {
07750
07751             double weighted_average_quantile(int k, int q, std::vector<double>::iterator first,
      std::vector<double>::iterator last) {
07752                 auto count = last - first;
07753                 double idx = (count - 1) * k / static_cast<double>(q);
07754                 int j = static_cast<int>(idx);
07755                 double g = idx - j;
07756                 std::nth_element(first, first + j, last);
07757                 auto xj = first[j];
07758                 if (g == 0) return xj;
07759
07760                 auto xj1 = *std::min_element(first + (j + 1), last);
07761                 return xj + g * (xj1 - xj);
07762             }
07763
07764             double erfc_inv(double x) {
07765                 return erf_inv(1.0 - x);
07766             }
07767
07768             double normal_quantile(double p) {
07769                 static const double ROOT_TWO = std::sqrt(2.0);
07770
07771                 double result = 0.0;
07772                 assert(p >= 0 && p <= 1);
07773                 if (p < 0 || p > 1) {
07774                     return result;
07775                 }
07776
07777                 result = -erfc_inv(2.0 * p);
07778                 // result *= normal distribution standard deviation (1.0) * sqrt(2)
07779                 result *= /*sd * */ ROOT_TWO;
07780                 // result += normal disttribution mean (0)
07781                 return result;
07782             }
07783
07784             double outlier_variance(Estimate<double> mean, Estimate<double> stddev, int n) {
07785                 double sb = stddev.point;
07786                 double mn = mean.point / n;
07787                 double mg_min = mn / 2.;
07788                 double sg = (std::min)(mg_min / 4., sb / std::sqrt(n));
07789                 double sg2 = sg * sg;
07790                 double sb2 = sb * sb;
07791
07792                 auto c_max = [n, mn, sb2, sg2](double x) -> double {
07793                     double k = mn - x;
07794                     double d = k * k;
07795                     double nd = n * d;
07796                     double k0 = -n * nd;
07797                     double k1 = sb2 - n * sg2 + nd;
07798                     double det = k1 * k1 - 4 * sg2 * k0;
07799                     return (int)(-2. * k0 / (k1 + std::sqrt(det)));
07800                 };
07801
07802                 auto var_out = [n, sb2, sg2](double c) {
07803                     double nc = n - c;
07804                     return (nc / n) * (sb2 - nc * sg2);
07805                 };
07806
07807                 return (std::min)(var_out(1), var_out((std::min)(c_max(0.), c_max(mg_min)))) / sb2;
07808             }
07809
07810             bootstrap_analysis analyse_samples(double confidence_level, int n_resamples,
      std::vector<double>::iterator first, std::vector<double>::iterator last) {
07811                 CATCH_INTERNAL_START_WARNINGS_SUPPRESSION
07812                 CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS
07813                 static std::random_device entropy;
07814                 CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
07815
07816                 auto n = static_cast<int>(last - first); // seriously, one can't use integral types
      without hell in C++
07817
07818                 auto mean = &Detail::mean<std::vector<double>::iterator>;
07819                 auto stddev = &standard_deviation;
07820
07821 #if defined(CATCH_CONFIG_USE_ASYNC)
07822                 auto Estimate = [=](double(*f)(std::vector<double>::iterator,
      std::vector<double>::iterator)) {
07823                     auto seed = entropy();
07824                     return std::async(std::launch::async, [=] {
07825                         std::mt19937 rng(seed);
07826                         auto resampled = resample(rng, n_resamples, first, last, f);
07827                         return bootstrap(confidence_level, first, last, resampled, f);
07828                     });
07829                 };
07830
07831                 auto mean_future = Estimate(mean);
```

```
07832                 auto stddev_future = Estimate(stddev);
07833
07834                 auto mean_estimate = mean_future.get();
07835                 auto stddev_estimate = stddev_future.get();
07836 #else
07837                 auto Estimate = [=](double(*f)(std::vector<double>::iterator,
      std::vector<double>::iterator)) {
07838                     auto seed = entropy();
07839                     std::mt19937 rng(seed);
07840                     auto resampled = resample(rng, n_resamples, first, last, f);
07841                     return bootstrap(confidence_level, first, last, resampled, f);
07842                 };
07843
07844                 auto mean_estimate = Estimate(mean);
07845                 auto stddev_estimate = Estimate(stddev);
07846 #endif // CATCH_USE_ASYNC
07847
07848                 double outlier_variance = Detail::outlier_variance(mean_estimate, stddev_estimate, n);
07849
07850                 return { mean_estimate, stddev_estimate, outlier_variance };
07851             }
07852         } // namespace Detail
07853     } // namespace Benchmark
07854 } // namespace Catch
07855
07856 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
07857 // end catch_stats.cpp
07858 // start catch_approx.cpp
07859
07860 #include <cmath>
07861 #include <limits>
07862
07863 namespace {
07864
07865 // Performs equivalent check of std::fabs(lhs - rhs) <= margin
07866 // But without the subtraction to allow for INFINITY in comparison
07867     bool marginComparison(double lhs, double rhs, double margin) {
07868         return (lhs + margin >= rhs) && (rhs + margin >= lhs);
07869     }
07870
07871 }
07872
07873 namespace Catch {
07874     namespace Detail {
07875
07876         Approx::Approx ( double value )
07877                 :   m_epsilon( std::numeric_limits<float>::epsilon()*100 ),
07878                     m_margin( 0.0 ),
07879                     m_scale( 0.0 ),
07880                     m_value( value )
07881         {}
07882
07883         Approx Approx::custom() {
07884             return Approx( 0 );
07885         }
07886
07887         Approx Approx::operator-() const {
07888             auto temp(*this);
07889             temp.m_value = -temp.m_value;
07890             return temp;
07891         }
07892
07893         std::string Approx::toString() const {
07894             ReusableStringStream rss;
07895             rss << "Approx( " << ::Catch::Detail::stringify( m_value ) << " )";
07896             return rss.str();
07897         }
07898
07899         bool Approx::equalityComparisonImpl(const double other) const {
07900             // First try with fixed margin, then compute margin based on epsilon, scale and Approx's
      value
07901             // Thanks to Richard Harris for his help refining the scaled margin value
07902             return marginComparison(m_value, other, m_margin)
07903                     || marginComparison(m_value, other, m_epsilon * (m_scale +
      std::fabs(std::isinf(m_value)? 0 : m_value)));
07904         }
07905
07906         void Approx::setMargin(double newMargin) {
07907             CATCH_ENFORCE(newMargin >= 0,
07908                           "Invalid Approx::margin: " << newMargin << '.'
07909                                                      << " Approx::Margin has to be non-negative.");
07910             m_margin = newMargin;
07911         }
07912
07913         void Approx::setEpsilon(double newEpsilon) {
07914             CATCH_ENFORCE(newEpsilon >= 0 && newEpsilon <= 1.0,
07915                           "Invalid Approx::epsilon: " << newEpsilon << '.'
```

```
07916                                                   « " Approx::epsilon has to be in [0, 1]");
07917             m_epsilon = newEpsilon;
07918         }
07919
07920     } // end namespace Detail
07921
07922     namespace literals {
07923         Detail::Approx operator "" _a(long double val) {
07924             return Detail::Approx(val);
07925         }
07926         Detail::Approx operator "" _a(unsigned long long val) {
07927             return Detail::Approx(val);
07928         }
07929     } // end namespace literals
07930
07931     std::string StringMaker<Catch::Detail::Approx>::convert(Catch::Detail::Approx const& value) {
07932         return value.toString();
07933     }
07934
07935 } // end namespace Catch
07936 // end catch_approx.cpp
07937 // start catch_assertionhandler.cpp
07938
07939 // start catch_debugger.h
07940
07941 namespace Catch {
07942     bool isDebuggerActive();
07943 }
07944
07945 #ifdef CATCH_PLATFORM_MAC
07946
07947 #if defined(__i386__) || defined(__x86_64__)
07948 #define CATCH_TRAP() __asm__("int $3\n" : : ) /* NOLINT */
07949 #elif defined(__aarch64__)
07950 #define CATCH_TRAP()  __asm__(".inst 0xd43e0000")
07951 #endif
07952
07953 #elif defined(CATCH_PLATFORM_IPHONE)
07954
07955 // use inline assembler
07956     #if defined(__i386__) || defined(__x86_64__)
07957         #define CATCH_TRAP()  __asm__("int $3")
07958     #elif defined(__aarch64__)
07959         #define CATCH_TRAP()  __asm__(".inst 0xd4200000")
07960     #elif defined(__arm__) && !defined(__thumb__)
07961         #define CATCH_TRAP()  __asm__(".inst 0xe7f001f0")
07962     #elif defined(__arm__) &&  defined(__thumb__)
07963         #define CATCH_TRAP()  __asm__(".inst 0xde01")
07964     #endif
07965
07966 #elif defined(CATCH_PLATFORM_LINUX)
07967     // If we can use inline assembler, do it because this allows us to break
07968     // directly at the location of the failing check instead of breaking inside
07969     // raise() called from it, i.e. one stack frame below.
07970     #if defined(__GNUC__) && (defined(__i386) || defined(__x86_64))
07971         #define CATCH_TRAP() asm volatile ("int $3") /* NOLINT */
07972     #else // Fall back to the generic way.
07973         #include <signal.h>
07974
07975         #define CATCH_TRAP() raise(SIGTRAP)
07976     #endif
07977 #elif defined(_MSC_VER)
07978     #define CATCH_TRAP() __debugbreak()
07979 #elif defined(__MINGW32__)
07980     extern "C" __declspec(dllimport) void __stdcall DebugBreak();
07981     #define CATCH_TRAP() DebugBreak()
07982 #endif
07983
07984 #ifndef CATCH_BREAK_INTO_DEBUGGER
07985 #ifdef CATCH_TRAP
07986 #define CATCH_BREAK_INTO_DEBUGGER() []{ if( Catch::isDebuggerActive() ) { CATCH_TRAP(); } }()
07987 #else
07988 #define CATCH_BREAK_INTO_DEBUGGER() []{}()
07989 #endif
07990 #endif
07991
07992 // end catch_debugger.h
07993 // start catch_run_context.h
07994
07995 // start catch_fatal_condition.h
07996
07997 #include <cassert>
07998
07999 namespace Catch {
08000
08001     // Wrapper for platform-specific fatal error (signals/SEH) handlers
08002     //
```

```
08003     // Tries to be cooperative with other handlers, and not step over
08004     // other handlers. This means that unknown structured exceptions
08005     // are passed on, previous signal handlers are called, and so on.
08006     //
08007     // Can only be instantiated once, and assumes that once a signal
08008     // is caught, the binary will end up terminating. Thus, there
08009     class FatalConditionHandler {
08010         bool m_started = false;
08011
08012         // Install/disengage implementation for specific platform.
08013         // Should be if-defed to work on current platform, can assume
08014         // engage-disengage 1:1 pairing.
08015         void engage_platform();
08016         void disengage_platform();
08017     public:
08018         // Should also have platform-specific implementations as needed
08019         FatalConditionHandler();
08020         ~FatalConditionHandler();
08021
08022         void engage() {
08023             assert(!m_started && "Handler cannot be installed twice.");
08024             m_started = true;
08025             engage_platform();
08026         }
08027
08028         void disengage() {
08029             assert(m_started && "Handler cannot be uninstalled without being installed first");
08030             m_started = false;
08031             disengage_platform();
08032         }
08033     };
08034
08036     class FatalConditionHandlerGuard {
08037         FatalConditionHandler* m_handler;
08038     public:
08039         FatalConditionHandlerGuard(FatalConditionHandler* handler):
08040                 m_handler(handler) {
08041             m_handler->engage();
08042         }
08043         ~FatalConditionHandlerGuard() {
08044             m_handler->disengage();
08045         }
08046     };
08047
08048 } // end namespace Catch
08049
08050 // end catch_fatal_condition.h
08051 #include <string>
08052
08053 namespace Catch {
08054
08055     struct IMutableContext;
08056
08058
08059     class RunContext : public IResultCapture, public IRunner {
08060
08061     public:
08062         RunContext( RunContext const& ) = delete;
08063         RunContext& operator =( RunContext const& ) = delete;
08064
08065         explicit RunContext( IConfigPtr const& _config, IStreamingReporterPtr&& reporter );
08066
08067         ~RunContext() override;
08068
08069         void testGroupStarting( std::string const& testSpec, std::size_t groupIndex, std::size_t
      groupsCount );
08070         void testGroupEnded( std::string const& testSpec, Totals const& totals, std::size_t
      groupIndex, std::size_t groupsCount );
08071
08072         Totals runTest(TestCase const& testCase);
08073
08074         IConfigPtr config() const;
08075         IStreamingReporter& reporter() const;
08076
08077     public: // IResultCapture
08078
08079         // Assertion handlers
08080         void handleExpr
08081                 (   AssertionInfo const& info,
08082                     ITransientExpression const& expr,
08083                     AssertionReaction& reaction ) override;
08084         void handleMessage
08085                 (   AssertionInfo const& info,
08086                     ResultWas::OfType resultType,
08087                     StringRef const& message,
08088                     AssertionReaction& reaction ) override;
08089         void handleUnexpectedExceptionNotThrown
```

```
08090                 (   AssertionInfo const& info,
08091                     AssertionReaction& reaction ) override;
08092         void handleUnexpectedInflightException
08093                 (   AssertionInfo const& info,
08094                     std::string const& message,
08095                     AssertionReaction& reaction ) override;
08096         void handleIncomplete
08097                 (   AssertionInfo const& info ) override;
08098         void handleNonExpr
08099                 (   AssertionInfo const &info,
08100                     ResultWas::OfType resultType,
08101                     AssertionReaction &reaction ) override;
08102
08103         bool sectionStarted( SectionInfo const& sectionInfo, Counts& assertions ) override;
08104
08105         void sectionEnded( SectionEndInfo const& endInfo ) override;
08106         void sectionEndedEarly( SectionEndInfo const& endInfo ) override;
08107
08108         auto acquireGeneratorTracker( StringRef generatorName, SourceLineInfo const& lineInfo ) ->
      IGeneratorTracker& override;
08109
08110 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
08111         void benchmarkPreparing( std::string const& name ) override;
08112         void benchmarkStarting( BenchmarkInfo const& info ) override;
08113         void benchmarkEnded( BenchmarkStats<> const& stats ) override;
08114         void benchmarkFailed( std::string const& error ) override;
08115 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
08116
08117         void pushScopedMessage( MessageInfo const& message ) override;
08118         void popScopedMessage( MessageInfo const& message ) override;
08119
08120         void emplaceUnscopedMessage( MessageBuilder const& builder ) override;
08121
08122         std::string getCurrentTestName() const override;
08123
08124         const AssertionResult* getLastResult() const override;
08125
08126         void exceptionEarlyReported() override;
08127
08128         void handleFatalErrorCondition( StringRef message ) override;
08129
08130         bool lastAssertionPassed() override;
08131
08132         void assertionPassed() override;
08133
08134     public:
08135         // !TBD We need to do this another way!
08136         bool aborting() const final;
08137
08138     private:
08139
08140         void runCurrentTest( std::string& redirectedCout, std::string& redirectedCerr );
08141         void invokeActiveTestCase();
08142
08143         void resetAssertionInfo();
08144         bool testForMissingAssertions( Counts& assertions );
08145
08146         void assertionEnded( AssertionResult const& result );
08147         void reportExpr
08148                 (   AssertionInfo const &info,
08149                     ResultWas::OfType resultType,
08150                     ITransientExpression const *expr,
08151                     bool negated );
08152
08153         void populateReaction( AssertionReaction& reaction );
08154
08155     private:
08156
08157         void handleUnfinishedSections();
08158
08159         TestRunInfo m_runInfo;
08160         IMutableContext& m_context;
08161         TestCase const* m_activeTestCase = nullptr;
08162         ITracker* m_testCaseTracker = nullptr;
08163         Option<AssertionResult> m_lastResult;
08164
08165         IConfigPtr m_config;
08166         Totals m_totals;
08167         IStreamingReporterPtr m_reporter;
08168         std::vector<MessageInfo> m_messages;
08169         std::vector<ScopedMessage> m_messageScopes; /* Keeps owners of so-called unscoped messages. */
08170         AssertionInfo m_lastAssertionInfo;
08171         std::vector<SectionEndInfo> m_unfinishedSections;
08172         std::vector<ITracker*> m_activeSections;
08173         TrackerContext m_trackerContext;
08174         FatalConditionHandler m_fatalConditionhandler;
08175         bool m_lastAssertionPassed = false;
```

```
08176         bool m_shouldReportUnexpected = true;
08177         bool m_includeSuccessfulResults;
08178     };
08179
08180     void seedRng(IConfig const& config);
08181     unsigned int rngSeed();
08182 } // end namespace Catch
08183
08184 // end catch_run_context.h
08185 namespace Catch {
08186
08187     namespace {
08188         auto operator «( std::ostream& os, ITransientExpression const& expr ) -> std::ostream& {
08189             expr.streamReconstructedExpression( os );
08190             return os;
08191         }
08192     }
08193
08194     LazyExpression::LazyExpression( bool isNegated )
08195             :   m_isNegated( isNegated )
08196     {}
08197
08198     LazyExpression::LazyExpression( LazyExpression const& other ) : m_isNegated( other.m_isNegated )
    {}
08199
08200     LazyExpression::operator bool() const {
08201         return m_transientExpression != nullptr;
08202     }
08203
08204     auto operator « ( std::ostream& os, LazyExpression const& lazyExpr ) -> std::ostream& {
08205         if( lazyExpr.m_isNegated )
08206             os « "!";
08207
08208         if( lazyExpr ) {
08209             if( lazyExpr.m_isNegated && lazyExpr.m_transientExpression->isBinaryExpression() )
08210                 os « "(" « *lazyExpr.m_transientExpression « ")";
08211             else
08212                 os « *lazyExpr.m_transientExpression;
08213         }
08214         else {
08215             os « "{** error - unchecked empty expression requested **}";
08216         }
08217         return os;
08218     }
08219
08220     AssertionHandler::AssertionHandler
08221             (   StringRef const& macroName,
08222                 SourceLineInfo const& lineInfo,
08223                 StringRef capturedExpression,
08224                 ResultDisposition::Flags resultDisposition )
08225             :   m_assertionInfo{ macroName, lineInfo, capturedExpression, resultDisposition },
08226                 m_resultCapture( getResultCapture() )
08227     {}
08228
08229     void AssertionHandler::handleExpr( ITransientExpression const& expr ) {
08230         m_resultCapture.handleExpr( m_assertionInfo, expr, m_reaction );
08231     }
08232     void AssertionHandler::handleMessage(ResultWas::OfType resultType, StringRef const& message) {
08233         m_resultCapture.handleMessage( m_assertionInfo, resultType, message, m_reaction );
08234     }
08235
08236     auto AssertionHandler::allowThrows() const -> bool {
08237         return getCurrentContext().getConfig()->allowThrows();
08238     }
08239
08240     void AssertionHandler::complete() {
08241         setCompleted();
08242         if( m_reaction.shouldDebugBreak ) {
08243
08244             // If you find your debugger stopping you here then go one level up on the
08245             // call-stack for the code that caused it (typically a failed assertion)
08246
08247             // (To go back to the test and change execution, jump over the throw, next)
08248             CATCH_BREAK_INTO_DEBUGGER();
08249         }
08250         if (m_reaction.shouldThrow) {
08251 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
08252             throw Catch::TestFailureException();
08253 #else
08254             CATCH_ERROR( "Test failure requires aborting test!" );
08255 #endif
08256         }
08257     }
08258     void AssertionHandler::setCompleted() {
08259         m_completed = true;
08260     }
08261
```

```
08262     void AssertionHandler::handleUnexpectedInflightException() {
08263         m_resultCapture.handleUnexpectedInflightException( m_assertionInfo,
    Catch::translateActiveException(), m_reaction );
08264     }
08265
08266     void AssertionHandler::handleExceptionThrownAsExpected() {
08267         m_resultCapture.handleNonExpr(m_assertionInfo, ResultWas::Ok, m_reaction);
08268     }
08269     void AssertionHandler::handleExceptionNotThrownAsExpected() {
08270         m_resultCapture.handleNonExpr(m_assertionInfo, ResultWas::Ok, m_reaction);
08271     }
08272
08273     void AssertionHandler::handleUnexpectedExceptionNotThrown() {
08274         m_resultCapture.handleUnexpectedExceptionNotThrown( m_assertionInfo, m_reaction );
08275     }
08276
08277     void AssertionHandler::handleThrowingCallSkipped() {
08278         m_resultCapture.handleNonExpr(m_assertionInfo, ResultWas::Ok, m_reaction);
08279     }
08280
08281     // This is the overload that takes a string and infers the Equals matcher from it
08282     // The more general overload, that takes any string matcher, is in catch_capture_matchers.cpp
08283     void handleExceptionMatchExpr( AssertionHandler& handler, std::string const& str, StringRef const&
    matcherString  ) {
08284         handleExceptionMatchExpr( handler, Matchers::Equals( str ), matcherString );
08285     }
08286
08287 } // namespace Catch
08288 // end catch_assertionhandler.cpp
08289 // start catch_assertionresult.cpp
08290
08291 namespace Catch {
08292     AssertionResultData::AssertionResultData(ResultWas::OfType _resultType, LazyExpression const &
    _lazyExpression):
08293             lazyExpression(_lazyExpression),
08294             resultType(_resultType) {}
08295
08296     std::string AssertionResultData::reconstructExpression() const {
08297
08298         if( reconstructedExpression.empty() ) {
08299             if( lazyExpression ) {
08300                 ReusableStringStream rss;
08301                 rss << lazyExpression;
08302                 reconstructedExpression = rss.str();
08303             }
08304         }
08305         return reconstructedExpression;
08306     }
08307
08308     AssertionResult::AssertionResult( AssertionInfo const& info, AssertionResultData const& data )
08309             :   m_info( info ),
08310                 m_resultData( data )
08311     {}
08312
08313     // Result was a success
08314     bool AssertionResult::succeeded() const {
08315         return Catch::isOk( m_resultData.resultType );
08316     }
08317
08318     // Result was a success, or failure is suppressed
08319     bool AssertionResult::isOk() const {
08320         return Catch::isOk( m_resultData.resultType ) || shouldSuppressFailure(
    m_info.resultDisposition );
08321     }
08322
08323     ResultWas::OfType AssertionResult::getResultType() const {
08324         return m_resultData.resultType;
08325     }
08326
08327     bool AssertionResult::hasExpression() const {
08328         return !m_info.capturedExpression.empty();
08329     }
08330
08331     bool AssertionResult::hasMessage() const {
08332         return !m_resultData.message.empty();
08333     }
08334
08335     std::string AssertionResult::getExpression() const {
08336         // Possibly overallocating by 3 characters should be basically free
08337         std::string expr; expr.reserve(m_info.capturedExpression.size() + 3);
08338         if (isFalseTest(m_info.resultDisposition)) {
08339             expr += "!(";
08340         }
08341         expr += m_info.capturedExpression;
08342         if (isFalseTest(m_info.resultDisposition)) {
08343             expr += ')';
08344         }
```

```
08345         return expr;
08346     }
08347
08348     std::string AssertionResult::getExpressionInMacro() const {
08349         std::string expr;
08350         if( m_info.macroName.empty() )
08351             expr = static_cast<std::string>(m_info.capturedExpression);
08352         else {
08353             expr.reserve( m_info.macroName.size() + m_info.capturedExpression.size() + 4 );
08354             expr += m_info.macroName;
08355             expr += "( ";
08356             expr += m_info.capturedExpression;
08357             expr += " )";
08358         }
08359         return expr;
08360     }
08361
08362     bool AssertionResult::hasExpandedExpression() const {
08363         return hasExpression() && getExpandedExpression() != getExpression();
08364     }
08365
08366     std::string AssertionResult::getExpandedExpression() const {
08367         std::string expr = m_resultData.reconstructExpression();
08368         return expr.empty()
08369                 ? getExpression()
08370                 : expr;
08371     }
08372
08373     std::string AssertionResult::getMessage() const {
08374         return m_resultData.message;
08375     }
08376     SourceLineInfo AssertionResult::getSourceInfo() const {
08377         return m_info.lineInfo;
08378     }
08379
08380     StringRef AssertionResult::getTestMacroName() const {
08381         return m_info.macroName;
08382     }
08383
08384 } // end namespace Catch
08385 // end catch_assertionresult.cpp
08386 // start catch_capture_matchers.cpp
08387
08388 namespace Catch {
08389
08390     using StringMatcher = Matchers::Impl::MatcherBase<std::string>;
08391
08392     // This is the general overload that takes a any string matcher
08393     // There is another overload, in catch_assertionhandler.h/.cpp, that only takes a string and
      infers
08394     // the Equals matcher (so the header does not mention matchers)
08395     void handleExceptionMatchExpr( AssertionHandler& handler, StringMatcher const& matcher, StringRef
      const& matcherString  ) {
08396         std::string exceptionMessage = Catch::translateActiveException();
08397         MatchExpr<std::string, StringMatcher const&> expr( exceptionMessage, matcher, matcherString );
08398         handler.handleExpr( expr );
08399     }
08400
08401 } // namespace Catch
08402 // end catch_capture_matchers.cpp
08403 // start catch_commandline.cpp
08404
08405 // start catch_commandline.h
08406
08407 // start catch_clara.h
08408
08409 // Use Catch's value for console width (store Clara's off to the side, if present)
08410 #ifdef CLARA_CONFIG_CONSOLE_WIDTH
08411 #define CATCH_TEMP_CLARA_CONFIG_CONSOLE_WIDTH CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH
08412 #undef CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH
08413 #endif
08414 #define CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH CATCH_CONFIG_CONSOLE_WIDTH-1
08415
08416 #ifdef __clang__
08417 #pragma clang diagnostic push
08418 #pragma clang diagnostic ignored "-Wweak-vtables"
08419 #pragma clang diagnostic ignored "-Wexit-time-destructors"
08420 #pragma clang diagnostic ignored "-Wshadow"
08421 #endif
08422
08423 // start clara.hpp
08424 // Copyright 2017 Two Blue Cubes Ltd. All rights reserved.
08425 //
08426 // Distributed under the Boost Software License, Version 1.0. (See accompanying
08427 // file LICENSE_1_0.txt or copy at http://www.boost.org/LICENSE_1_0.txt)
08428 //
08429 // See https://github.com/philsquared/Clara for more details
```

```
08430
08431 // Clara v1.1.5
08432
08433
08434 #ifndef CATCH_CLARA_CONFIG_CONSOLE_WIDTH
08435 #define CATCH_CLARA_CONFIG_CONSOLE_WIDTH 80
08436 #endif
08437
08438 #ifndef CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH
08439 #define CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH CATCH_CLARA_CONFIG_CONSOLE_WIDTH
08440 #endif
08441
08442 #ifndef CLARA_CONFIG_OPTIONAL_TYPE
08443 #ifdef __has_include
08444 #if __has_include(<optional>) && __cplusplus >= 201703L
08445 #include <optional>
08446 #define CLARA_CONFIG_OPTIONAL_TYPE std::optional
08447 #endif
08448 #endif
08449 #endif
08450
08451 // ----------- #included from clara_textflow.hpp -----------
08452
08453 // TextFlowCpp
08454 //
08455 // A single-header library for wrapping and laying out basic text, by Phil Nash
08456 //
08457 // Distributed under the Boost Software License, Version 1.0. (See accompanying
08458 // file LICENSE.txt or copy at http://www.boost.org/LICENSE_1_0.txt)
08459 //
08460 // This project is hosted at https://github.com/philsquared/textflowcpp
08461
08462
08463 #include <cassert>
08464 #include <ostream>
08465 #include <sstream>
08466 #include <vector>
08467
08468 #ifndef CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH
08469 #define CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH 80
08470 #endif
08471
08472 namespace Catch {
08473     namespace clara {
08474         namespace TextFlow {
08475
08476             inline auto isWhitespace(char c) -> bool {
08477                 static std::string chars = " \t\n\r";
08478                 return chars.find(c) != std::string::npos;
08479             }
08480             inline auto isBreakableBefore(char c) -> bool {
08481                 static std::string chars = "[({<|";
08482                 return chars.find(c) != std::string::npos;
08483             }
08484             inline auto isBreakableAfter(char c) -> bool {
08485                 static std::string chars = "])}>.,:;*+-=&/\\";
08486                 return chars.find(c) != std::string::npos;
08487             }
08488
08489             class Columns;
08490
08491             class Column {
08492                 std::vector<std::string> m_strings;
08493                 size_t m_width = CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH;
08494                 size_t m_indent = 0;
08495                 size_t m_initialIndent = std::string::npos;
08496
08497             public:
08498                 class iterator {
08499                     friend Column;
08500
08501                     Column const& m_column;
08502                     size_t m_stringIndex = 0;
08503                     size_t m_pos = 0;
08504
08505                     size_t m_len = 0;
08506                     size_t m_end = 0;
08507                     bool m_suffix = false;
08508
08509                     iterator(Column const& column, size_t stringIndex)
08510                             : m_column(column),
08511                               m_stringIndex(stringIndex) {}
08512
08513                     auto line() const -> std::string const& { return
      m_column.m_strings[m_stringIndex]; }
08514
08515                     auto isBoundary(size_t at) const -> bool {
```

```
08516                           assert(at > 0);
08517                           assert(at <= line().size());
08518
08519                           return at == line().size() ||
08520                                  (isWhitespace(line()[at]) && !isWhitespace(line()[at - 1])) ||
08521                                  isBreakableBefore(line()[at]) ||
08522                                  isBreakableAfter(line()[at - 1]);
08523                       }
08524
08525                       void calcLength() {
08526                           assert(m_stringIndex < m_column.m_strings.size());
08527
08528                           m_suffix = false;
08529                           auto width = m_column.m_width - indent();
08530                           m_end = m_pos;
08531                           if (line()[m_pos] == '\n') {
08532                               ++m_end;
08533                           }
08534                           while (m_end < line().size() && line()[m_end] != '\n')
08535                               ++m_end;
08536
08537                           if (m_end < m_pos + width) {
08538                               m_len = m_end - m_pos;
08539                           } else {
08540                               size_t len = width;
08541                               while (len > 0 && !isBoundary(m_pos + len))
08542                                   --len;
08543                               while (len > 0 && isWhitespace(line()[m_pos + len - 1]))
08544                                   --len;
08545
08546                               if (len > 0) {
08547                                   m_len = len;
08548                               } else {
08549                                   m_suffix = true;
08550                                   m_len = width - 1;
08551                               }
08552                           }
08553                       }
08554
08555                       auto indent() const -> size_t {
08556                           auto initial = m_pos == 0 && m_stringIndex == 0 ? m_column.m_initialIndent :
      std::string::npos;
08557                           return initial == std::string::npos ? m_column.m_indent : initial;
08558                       }
08559
08560                       auto addIndentAndSuffix(std::string const &plain) const -> std::string {
08561                           return std::string(indent(), ' ') + (m_suffix ? plain + "-" : plain);
08562                       }
08563
08564                   public:
08565                       using difference_type = std::ptrdiff_t;
08566                       using value_type = std::string;
08567                       using pointer = value_type * ;
08568                       using reference = value_type & ;
08569                       using iterator_category = std::forward_iterator_tag;
08570
08571                       explicit iterator(Column const& column) : m_column(column) {
08572                           assert(m_column.m_width > m_column.m_indent);
08573                           assert(m_column.m_initialIndent == std::string::npos || m_column.m_width >
      m_column.m_initialIndent);
08574                           calcLength();
08575                           if (m_len == 0)
08576                               m_stringIndex++; // Empty string
08577                       }
08578
08579                       auto operator *() const -> std::string {
08580                           assert(m_stringIndex < m_column.m_strings.size());
08581                           assert(m_pos <= m_end);
08582                           return addIndentAndSuffix(line().substr(m_pos, m_len));
08583                       }
08584
08585                       auto operator ++() -> iterator& {
08586                           m_pos += m_len;
08587                           if (m_pos < line().size() && line()[m_pos] == '\n')
08588                               m_pos += 1;
08589                           else
08590                               while (m_pos < line().size() && isWhitespace(line()[m_pos]))
08591                                   ++m_pos;
08592
08593                           if (m_pos == line().size()) {
08594                               m_pos = 0;
08595                               ++m_stringIndex;
08596                           }
08597                           if (m_stringIndex < m_column.m_strings.size())
08598                               calcLength();
08599                           return *this;
08600                       }
```

```
08601                   auto operator ++(int) -> iterator {
08602                       iterator prev(*this);
08603                       operator++();
08604                       return prev;
08605                   }
08606
08607                   auto operator ==(iterator const& other) const -> bool {
08608                       return
08609                               m_pos == other.m_pos &&
08610                               m_stringIndex == other.m_stringIndex &&
08611                               &m_column == &other.m_column;
08612                   }
08613                   auto operator !=(iterator const& other) const -> bool {
08614                       return !operator==(other);
08615                   }
08616               };
08617               using const_iterator = iterator;
08618
08619               explicit Column(std::string const& text) { m_strings.push_back(text); }
08620
08621               auto width(size_t newWidth) -> Column& {
08622                   assert(newWidth > 0);
08623                   m_width = newWidth;
08624                   return *this;
08625               }
08626               auto indent(size_t newIndent) -> Column& {
08627                   m_indent = newIndent;
08628                   return *this;
08629               }
08630               auto initialIndent(size_t newIndent) -> Column& {
08631                   m_initialIndent = newIndent;
08632                   return *this;
08633               }
08634
08635               auto width() const -> size_t { return m_width; }
08636               auto begin() const -> iterator { return iterator(*this); }
08637               auto end() const -> iterator { return { *this, m_strings.size() }; }
08638
08639               inline friend std::ostream& operator « (std::ostream& os, Column const& col) {
08640                   bool first = true;
08641                   for (auto line : col) {
08642                       if (first)
08643                           first = false;
08644                       else
08645                           os « "\n";
08646                       os « line;
08647                   }
08648                   return os;
08649               }
08650
08651               auto operator + (Column const& other)->Columns;
08652
08653               auto toString() const -> std::string {
08654                   std::ostringstream oss;
08655                   oss « *this;
08656                   return oss.str();
08657               }
08658           };
08659
08660           class Spacer : public Column {
08661
08662           public:
08663               explicit Spacer(size_t spaceWidth) : Column("") {
08664                   width(spaceWidth);
08665               }
08666           };
08667
08668           class Columns {
08669               std::vector<Column> m_columns;
08670
08671           public:
08672
08673               class iterator {
08674                   friend Columns;
08675                   struct EndTag {};
08676
08677                   std::vector<Column> const& m_columns;
08678                   std::vector<Column::iterator> m_iterators;
08679                   size_t m_activeIterators;
08680
08681                   iterator(Columns const& columns, EndTag)
08682                           : m_columns(columns.m_columns),
08683                             m_activeIterators(0) {
08684                       m_iterators.reserve(m_columns.size());
08685
08686                       for (auto const& col : m_columns)
08687                           m_iterators.push_back(col.end());
```

```
08688                     }
08689
08690                 public:
08691                     using difference_type = std::ptrdiff_t;
08692                     using value_type = std::string;
08693                     using pointer = value_type * ;
08694                     using reference = value_type & ;
08695                     using iterator_category = std::forward_iterator_tag;
08696
08697                     explicit iterator(Columns const& columns)
08698                             : m_columns(columns.m_columns),
08699                               m_activeIterators(m_columns.size()) {
08700                         m_iterators.reserve(m_columns.size());
08701
08702                         for (auto const& col : m_columns)
08703                             m_iterators.push_back(col.begin());
08704                     }
08705
08706                     auto operator ==(iterator const& other) const -> bool {
08707                         return m_iterators == other.m_iterators;
08708                     }
08709                     auto operator !=(iterator const& other) const -> bool {
08710                         return m_iterators != other.m_iterators;
08711                     }
08712                     auto operator *() const -> std::string {
08713                         std::string row, padding;
08714
08715                         for (size_t i = 0; i < m_columns.size(); ++i) {
08716                             auto width = m_columns[i].width();
08717                             if (m_iterators[i] != m_columns[i].end()) {
08718                                 std::string col = *m_iterators[i];
08719                                 row += padding + col;
08720                                 if (col.size() < width)
08721                                     padding = std::string(width - col.size(), ' ');
08722                                 else
08723                                     padding = "";
08724                             } else {
08725                                 padding += std::string(width, ' ');
08726                             }
08727                         }
08728                         return row;
08729                     }
08730                     auto operator ++() -> iterator& {
08731                         for (size_t i = 0; i < m_columns.size(); ++i) {
08732                             if (m_iterators[i] != m_columns[i].end())
08733                                 ++m_iterators[i];
08734                         }
08735                         return *this;
08736                     }
08737                     auto operator ++(int) -> iterator {
08738                         iterator prev(*this);
08739                         operator++();
08740                         return prev;
08741                     }
08742                 };
08743                 using const_iterator = iterator;
08744
08745                 auto begin() const -> iterator { return iterator(*this); }
08746                 auto end() const -> iterator { return { *this, iterator::EndTag() }; }
08747
08748                 auto operator += (Column const& col) -> Columns& {
08749                     m_columns.push_back(col);
08750                     return *this;
08751                 }
08752                 auto operator + (Column const& col) -> Columns {
08753                     Columns combined = *this;
08754                     combined += col;
08755                     return combined;
08756                 }
08757
08758                 inline friend std::ostream& operator « (std::ostream& os, Columns const& cols) {
08759
08760                     bool first = true;
08761                     for (auto line : cols) {
08762                         if (first)
08763                             first = false;
08764                         else
08765                             os « "\n";
08766                         os « line;
08767                     }
08768                     return os;
08769                 }
08770
08771                 auto toString() const -> std::string {
08772                     std::ostringstream oss;
08773                     oss « *this;
08774                     return oss.str();
```

```
08775                 }
08776             };
08777
08778             inline auto Column::operator + (Column const& other) -> Columns {
08779                 Columns cols;
08780                 cols += *this;
08781                 cols += other;
08782                 return cols;
08783             }
08784         }
08785
08786     }
08787 }
08788
08789 // ----------- end of #include from clara_textflow.hpp -----------
08790 // ........... back in clara.hpp
08791
08792 #include <cctype>
08793 #include <string>
08794 #include <memory>
08795 #include <set>
08796 #include <algorithm>
08797
08798 #if !defined(CATCH_PLATFORM_WINDOWS) && ( defined(WIN32) || defined(__WIN32__) || defined(_WIN32) ||
      defined(_MSC_VER) )
08799 #define CATCH_PLATFORM_WINDOWS
08800 #endif
08801
08802 namespace Catch { namespace clara {
08803         namespace detail {
08804
08805             // Traits for extracting arg and return type of lambdas (for single argument lambdas)
08806             template<typename L>
08807             struct UnaryLambdaTraits : UnaryLambdaTraits<decltype( &L::operator() )> {};
08808
08809             template<typename ClassT, typename ReturnT, typename... Args>
08810             struct UnaryLambdaTraits<ReturnT( ClassT::* )( Args... ) const> {
08811                 static const bool isValid = false;
08812             };
08813
08814             template<typename ClassT, typename ReturnT, typename ArgT>
08815             struct UnaryLambdaTraits<ReturnT( ClassT::* )( ArgT ) const> {
08816                 static const bool isValid = true;
08817                 using ArgType = typename std::remove_const<typename
      std::remove_reference<ArgT>::type>::type;
08818                 using ReturnType = ReturnT;
08819             };
08820
08821             class TokenStream;
08822
08823             // Transport for raw args (copied from main args, or supplied via init list for testing)
08824             class Args {
08825                 friend TokenStream;
08826                 std::string m_exeName;
08827                 std::vector<std::string> m_args;
08828
08829             public:
08830                 Args( int argc, char const* const* argv )
08831                         : m_exeName(argv[0]),
08832                           m_args(argv + 1, argv + argc) {}
08833
08834                 Args( std::initializer_list<std::string> args )
08835                         :   m_exeName( *args.begin() ),
08836                             m_args( args.begin()+1, args.end() )
08837                 {}
08838
08839                 auto exeName() const -> std::string {
08840                     return m_exeName;
08841                 }
08842             };
08843
08844             // Wraps a token coming from a token stream. These may not directly correspond to strings
      as a single string
08845             // may encode an option + its argument if the : or = form is used
08846             enum class TokenType {
08847                 Option, Argument
08848             };
08849             struct Token {
08850                 TokenType type;
08851                 std::string token;
08852             };
08853
08854             inline auto isOptPrefix( char c ) -> bool {
08855                 return c == '-'
08856 #ifdef CATCH_PLATFORM_WINDOWS
08857                     || c == '/'
08858 #endif
```

```
08859                         ;
08860             }
08861
08862             // Abstracts iterators into args as a stream of tokens, with option arguments uniformly
      handled
08863             class TokenStream {
08864                 using Iterator = std::vector<std::string>::const_iterator;
08865                 Iterator it;
08866                 Iterator itEnd;
08867                 std::vector<Token> m_tokenBuffer;
08868
08869                 void loadBuffer() {
08870                     m_tokenBuffer.resize( 0 );
08871
08872                     // Skip any empty strings
08873                     while( it != itEnd && it->empty() )
08874                         ++it;
08875
08876                     if( it != itEnd ) {
08877                         auto const &next = *it;
08878                         if( isOptPrefix( next[0] ) ) {
08879                             auto delimiterPos = next.find_first_of( " :=" );
08880                             if( delimiterPos != std::string::npos ) {
08881                                 m_tokenBuffer.push_back( { TokenType::Option, next.substr( 0,
      delimiterPos ) } );
08882                                 m_tokenBuffer.push_back( { TokenType::Argument, next.substr(
      delimiterPos + 1 ) } );
08883                             } else {
08884                                 if( next[1] != '-' && next.size() > 2 ) {
08885                                     std::string opt = "- ";
08886                                     for( size_t i = 1; i < next.size(); ++i ) {
08887                                         opt[1] = next[i];
08888                                         m_tokenBuffer.push_back( { TokenType::Option, opt } );
08889                                     }
08890                                 } else {
08891                                     m_tokenBuffer.push_back( { TokenType::Option, next } );
08892                                 }
08893                             }
08894                         } else {
08895                             m_tokenBuffer.push_back( { TokenType::Argument, next } );
08896                         }
08897                     }
08898                 }
08899
08900             public:
08901                 explicit TokenStream( Args const &args ) : TokenStream( args.m_args.begin(),
      args.m_args.end() ) {}
08902
08903                 TokenStream( Iterator it, Iterator itEnd ) : it( it ), itEnd( itEnd ) {
08904                     loadBuffer();
08905                 }
08906
08907                 explicit operator bool() const {
08908                     return !m_tokenBuffer.empty() || it != itEnd;
08909                 }
08910
08911                 auto count() const -> size_t { return m_tokenBuffer.size() + (itEnd - it); }
08912
08913                 auto operator*() const -> Token {
08914                     assert( !m_tokenBuffer.empty() );
08915                     return m_tokenBuffer.front();
08916                 }
08917
08918                 auto operator->() const -> Token const * {
08919                     assert( !m_tokenBuffer.empty() );
08920                     return &m_tokenBuffer.front();
08921                 }
08922
08923                 auto operator++() -> TokenStream & {
08924                     if( m_tokenBuffer.size() >= 2 ) {
08925                         m_tokenBuffer.erase( m_tokenBuffer.begin() );
08926                     } else {
08927                         if( it != itEnd )
08928                             ++it;
08929                         loadBuffer();
08930                     }
08931                     return *this;
08932                 }
08933             };
08934
08935             class ResultBase {
08936             public:
08937                 enum Type {
08938                     Ok, LogicError, RuntimeError
08939                 };
08940
08941             protected:
```

```
08942                 ResultBase( Type type ) : m_type( type ) {}
08943                 virtual ~ResultBase() = default;
08944
08945                 virtual void enforceOk() const = 0;
08946
08947                 Type m_type;
08948             };
08949
08950             template<typename T>
08951             class ResultValueBase : public ResultBase {
08952             public:
08953                 auto value() const -> T const & {
08954                     enforceOk();
08955                     return m_value;
08956                 }
08957
08958             protected:
08959                 ResultValueBase( Type type ) : ResultBase( type ) {}
08960
08961                 ResultValueBase( ResultValueBase const &other ) : ResultBase( other ) {
08962                     if( m_type == ResultBase::Ok )
08963                         new( &m_value ) T( other.m_value );
08964                 }
08965
08966                 ResultValueBase( Type, T const &value ) : ResultBase( Ok ) {
08967                     new( &m_value ) T( value );
08968                 }
08969
08970                 auto operator=( ResultValueBase const &other ) -> ResultValueBase & {
08971                     if( m_type == ResultBase::Ok )
08972                         m_value.~T();
08973                     ResultBase::operator=(other);
08974                     if( m_type == ResultBase::Ok )
08975                         new( &m_value ) T( other.m_value );
08976                     return *this;
08977                 }
08978
08979                 ~ResultValueBase() override {
08980                     if( m_type == Ok )
08981                         m_value.~T();
08982                 }
08983
08984                 union {
08985                     T m_value;
08986                 };
08987             };
08988
08989             template<>
08990             class ResultValueBase<void> : public ResultBase {
08991             protected:
08992                 using ResultBase::ResultBase;
08993             };
08994
08995             template<typename T = void>
08996             class BasicResult : public ResultValueBase<T> {
08997             public:
08998                 template<typename U>
08999                 explicit BasicResult( BasicResult<U> const &other )
09000                         :   ResultValueBase<T>( other.type() ),
09001                             m_errorMessage( other.errorMessage() )
09002                 {
09003                     assert( type() != ResultBase::Ok );
09004                 }
09005
09006                 template<typename U>
09007                 static auto ok( U const &value ) -> BasicResult { return { ResultBase::Ok, value }; }
09008                 static auto ok() -> BasicResult { return { ResultBase::Ok }; }
09009                 static auto logicError( std::string const &message ) -> BasicResult { return {
      ResultBase::LogicError, message }; }
09010                 static auto runtimeError( std::string const &message ) -> BasicResult { return {
      ResultBase::RuntimeError, message }; }
09011
09012                 explicit operator bool() const { return m_type == ResultBase::Ok; }
09013                 auto type() const -> ResultBase::Type { return m_type; }
09014                 auto errorMessage() const -> std::string { return m_errorMessage; }
09015
09016             protected:
09017                 void enforceOk() const override {
09018
09019                     // Errors shouldn't reach this point, but if they do
09020                     // the actual error message will be in m_errorMessage
09021                     assert( m_type != ResultBase::LogicError );
09022                     assert( m_type != ResultBase::RuntimeError );
09023                     if( m_type != ResultBase::Ok )
09024                         std::abort();
09025                 }
09026
```

```
09027                 std::string m_errorMessage; // Only populated if resultType is an error
09028
09029                 BasicResult( ResultBase::Type type, std::string const &message )
09030                         :   ResultValueBase<T>(type),
09031                             m_errorMessage(message)
09032                 {
09033                     assert( m_type != ResultBase::Ok );
09034                 }
09035
09036                 using ResultValueBase<T>::ResultValueBase;
09037                 using ResultBase::m_type;
09038             };
09039
09040             enum class ParseResultType {
09041                 Matched, NoMatch, ShortCircuitAll, ShortCircuitSame
09042             };
09043
09044             class ParseState {
09045             public:
09046
09047                 ParseState( ParseResultType type, TokenStream const &remainingTokens )
09048                         : m_type(type),
09049                           m_remainingTokens( remainingTokens )
09050                 {}
09051
09052                 auto type() const -> ParseResultType { return m_type; }
09053                 auto remainingTokens() const -> TokenStream { return m_remainingTokens; }
09054
09055             private:
09056                 ParseResultType m_type;
09057                 TokenStream m_remainingTokens;
09058             };
09059
09060             using Result = BasicResult<void>;
09061             using ParserResult = BasicResult<ParseResultType>;
09062             using InternalParseResult = BasicResult<ParseState>;
09063
09064             struct HelpColumns {
09065                 std::string left;
09066                 std::string right;
09067             };
09068
09069             template<typename T>
09070             inline auto convertInto( std::string const &source, T& target ) -> ParserResult {
09071                 std::stringstream ss;
09072                 ss << source;
09073                 ss >> target;
09074                 if( ss.fail() )
09075                     return ParserResult::runtimeError( "Unable to convert '" + source + "' to
      destination type" );
09076                 else
09077                     return ParserResult::ok( ParseResultType::Matched );
09078             }
09079             inline auto convertInto( std::string const &source, std::string& target ) -> ParserResult
      {
09080                 target = source;
09081                 return ParserResult::ok( ParseResultType::Matched );
09082             }
09083             inline auto convertInto( std::string const &source, bool &target ) -> ParserResult {
09084                 std::string srcLC = source;
09085                 std::transform( srcLC.begin(), srcLC.end(), srcLC.begin(), []( unsigned char c ) {
      return static_cast<char>( std::tolower(c) ); } );
09086                 if (srcLC == "y" || srcLC == "1" || srcLC == "true" || srcLC == "yes" || srcLC ==
      "on")
09087                     target = true;
09088                 else if (srcLC == "n" || srcLC == "0" || srcLC == "false" || srcLC == "no" || srcLC ==
      "off")
09089                     target = false;
09090                 else
09091                     return ParserResult::runtimeError( "Expected a boolean value but did not
      recognise: '" + source + "'" );
09092                 return ParserResult::ok( ParseResultType::Matched );
09093             }
09094 #ifdef CLARA_CONFIG_OPTIONAL_TYPE
09095             template<typename T>
09096             inline auto convertInto( std::string const &source, CLARA_CONFIG_OPTIONAL_TYPE<T>& target
      ) -> ParserResult {
09097                 T temp;
09098                 auto result = convertInto( source, temp );
09099                 if( result )
09100                     target = std::move(temp);
09101                 return result;
09102             }
09103 #endif // CLARA_CONFIG_OPTIONAL_TYPE
09104
09105             struct NonCopyable {
09106                 NonCopyable() = default;
```

```
09107                NonCopyable( NonCopyable const & ) = delete;
09108                NonCopyable( NonCopyable && ) = delete;
09109                NonCopyable &operator=( NonCopyable const & ) = delete;
09110                NonCopyable &operator=( NonCopyable && ) = delete;
09111            };
09112
09113            struct BoundRef : NonCopyable {
09114                virtual ~BoundRef() = default;
09115                virtual auto isContainer() const -> bool { return false; }
09116                virtual auto isFlag() const -> bool { return false; }
09117            };
09118            struct BoundValueRefBase : BoundRef {
09119                virtual auto setValue( std::string const &arg ) -> ParserResult = 0;
09120            };
09121            struct BoundFlagRefBase : BoundRef {
09122                virtual auto setFlag( bool flag ) -> ParserResult = 0;
09123                virtual auto isFlag() const -> bool { return true; }
09124            };
09125
09126            template<typename T>
09127            struct BoundValueRef : BoundValueRefBase {
09128                T &m_ref;
09129
09130                explicit BoundValueRef( T &ref ) : m_ref( ref ) {}
09131
09132                auto setValue( std::string const &arg ) -> ParserResult override {
09133                    return convertInto( arg, m_ref );
09134                }
09135            };
09136
09137            template<typename T>
09138            struct BoundValueRef<std::vector<T>> : BoundValueRefBase {
09139                std::vector<T> &m_ref;
09140
09141                explicit BoundValueRef( std::vector<T> &ref ) : m_ref( ref ) {}
09142
09143                auto isContainer() const -> bool override { return true; }
09144
09145                auto setValue( std::string const &arg ) -> ParserResult override {
09146                    T temp;
09147                    auto result = convertInto( arg, temp );
09148                    if( result )
09149                        m_ref.push_back( temp );
09150                    return result;
09151                }
09152            };
09153
09154            struct BoundFlagRef : BoundFlagRefBase {
09155                bool &m_ref;
09156
09157                explicit BoundFlagRef( bool &ref ) : m_ref( ref ) {}
09158
09159                auto setFlag( bool flag ) -> ParserResult override {
09160                    m_ref = flag;
09161                    return ParserResult::ok( ParseResultType::Matched );
09162                }
09163            };
09164
09165            template<typename ReturnType>
09166            struct LambdaInvoker {
09167                static_assert( std::is_same<ReturnType, ParserResult>::value, "Lambda must return void
     or clara::ParserResult" );
09168
09169                template<typename L, typename ArgType>
09170                static auto invoke( L const &lambda, ArgType const &arg ) -> ParserResult {
09171                    return lambda( arg );
09172                }
09173            };
09174
09175            template<>
09176            struct LambdaInvoker<void> {
09177                template<typename L, typename ArgType>
09178                static auto invoke( L const &lambda, ArgType const &arg ) -> ParserResult {
09179                    lambda( arg );
09180                    return ParserResult::ok( ParseResultType::Matched );
09181                }
09182            };
09183
09184            template<typename ArgType, typename L>
09185            inline auto invokeLambda( L const &lambda, std::string const &arg ) -> ParserResult {
09186                ArgType temp{};
09187                auto result = convertInto( arg, temp );
09188                return !result
09189                       ? result
09190                       : LambdaInvoker<typename UnaryLambdaTraits<L>::ReturnType>::invoke( lambda,
     temp );
09191            }
```

```
09192
09193             template<typename L>
09194             struct BoundLambda : BoundValueRefBase {
09195                 L m_lambda;
09196
09197                 static_assert( UnaryLambdaTraits<L>::isValid, "Supplied lambda must take exactly one
      argument" );
09198                 explicit BoundLambda( L const &lambda ) : m_lambda( lambda ) {}
09199
09200                 auto setValue( std::string const &arg ) -> ParserResult override {
09201                     return invokeLambda<typename UnaryLambdaTraits<L>::ArgType>( m_lambda, arg );
09202                 }
09203             };
09204
09205             template<typename L>
09206             struct BoundFlagLambda : BoundFlagRefBase {
09207                 L m_lambda;
09208
09209                 static_assert( UnaryLambdaTraits<L>::isValid, "Supplied lambda must take exactly one
      argument" );
09210                 static_assert( std::is_same<typename UnaryLambdaTraits<L>::ArgType, bool>::value,
      "flags must be boolean" );
09211
09212                 explicit BoundFlagLambda( L const &lambda ) : m_lambda( lambda ) {}
09213
09214                 auto setFlag( bool flag ) -> ParserResult override {
09215                     return LambdaInvoker<typename UnaryLambdaTraits<L>::ReturnType>::invoke( m_lambda,
      flag );
09216                 }
09217             };
09218
09219             enum class Optionality { Optional, Required };
09220
09221             struct Parser;
09222
09223             class ParserBase {
09224             public:
09225                 virtual ~ParserBase() = default;
09226                 virtual auto validate() const -> Result { return Result::ok(); }
09227                 virtual auto parse( std::string const& exeName, TokenStream const &tokens) const ->
      InternalParseResult  = 0;
09228                 virtual auto cardinality() const -> size_t { return 1; }
09229
09230                 auto parse( Args const &args ) const -> InternalParseResult {
09231                     return parse( args.exeName(), TokenStream( args ) );
09232                 }
09233             };
09234
09235             template<typename DerivedT>
09236             class ComposableParserImpl : public ParserBase {
09237             public:
09238                 template<typename T>
09239                 auto operator|( T const &other ) const -> Parser;
09240
09241                 template<typename T>
09242                 auto operator+( T const &other ) const -> Parser;
09243             };
09244
09245             // Common code and state for Args and Opts
09246             template<typename DerivedT>
09247             class ParserRefImpl : public ComposableParserImpl<DerivedT> {
09248             protected:
09249                 Optionality m_optionality = Optionality::Optional;
09250                 std::shared_ptr<BoundRef> m_ref;
09251                 std::string m_hint;
09252                 std::string m_description;
09253
09254                 explicit ParserRefImpl( std::shared_ptr<BoundRef> const &ref ) : m_ref( ref ) {}
09255
09256             public:
09257                 template<typename T>
09258                 ParserRefImpl( T &ref, std::string const &hint )
09259                         :   m_ref( std::make_shared<BoundValueRef<T»( ref ) ),
09260                             m_hint( hint )
09261                 {}
09262
09263                 template<typename LambdaT>
09264                 ParserRefImpl( LambdaT const &ref, std::string const &hint )
09265                         :   m_ref( std::make_shared<BoundLambda<LambdaT»( ref ) ),
09266                             m_hint(hint)
09267                 {}
09268
09269                 auto operator()( std::string const &description ) -> DerivedT & {
09270                     m_description = description;
09271                     return static_cast<DerivedT &>( *this );
09272                 }
09273
```

```
09274                 auto optional() -> DerivedT & {
09275                     m_optionality = Optionality::Optional;
09276                     return static_cast<DerivedT &>( *this );
09277                 };
09278
09279                 auto required() -> DerivedT & {
09280                     m_optionality = Optionality::Required;
09281                     return static_cast<DerivedT &>( *this );
09282                 };
09283
09284                 auto isOptional() const -> bool {
09285                     return m_optionality == Optionality::Optional;
09286                 }
09287
09288                 auto cardinality() const -> size_t override {
09289                     if( m_ref->isContainer() )
09290                         return 0;
09291                     else
09292                         return 1;
09293                 }
09294
09295                 auto hint() const -> std::string { return m_hint; }
09296             };
09297
09298             class ExeName : public ComposableParserImpl<ExeName> {
09299                 std::shared_ptr<std::string> m_name;
09300                 std::shared_ptr<BoundValueRefBase> m_ref;
09301
09302                 template<typename LambdaT>
09303                 static auto makeRef(LambdaT const &lambda) -> std::shared_ptr<BoundValueRefBase> {
09304                     return std::make_shared<BoundLambda<LambdaT»( lambda) ;
09305                 }
09306
09307             public:
09308                 ExeName() : m_name( std::make_shared<std::string>( "<executable>" ) ) {}
09309
09310                 explicit ExeName( std::string &ref ) : ExeName() {
09311                     m_ref = std::make_shared<BoundValueRef<std::string»( ref );
09312                 }
09313
09314                 template<typename LambdaT>
09315                 explicit ExeName( LambdaT const& lambda ) : ExeName() {
09316                     m_ref = std::make_shared<BoundLambda<LambdaT»( lambda );
09317                 }
09318
09319                 // The exe name is not parsed out of the normal tokens, but is handled specially
09320                 auto parse( std::string const&, TokenStream const &tokens ) const ->
      InternalParseResult override {
09321                     return InternalParseResult::ok( ParseState( ParseResultType::NoMatch, tokens ) );
09322                 }
09323
09324                 auto name() const -> std::string { return *m_name; }
09325                 auto set( std::string const& newName ) -> ParserResult {
09326
09327                     auto lastSlash = newName.find_last_of( "\\/" );
09328                     auto filename = ( lastSlash == std::string::npos )
09329                                     ? newName
09330                                     : newName.substr( lastSlash+1 );
09331
09332                     *m_name = filename;
09333                     if( m_ref )
09334                         return m_ref->setValue( filename );
09335                     else
09336                         return ParserResult::ok( ParseResultType::Matched );
09337                 }
09338             };
09339
09340             class Arg : public ParserRefImpl<Arg> {
09341             public:
09342                 using ParserRefImpl::ParserRefImpl;
09343
09344                 auto parse( std::string const &, TokenStream const &tokens ) const ->
      InternalParseResult override {
09345                     auto validationResult = validate();
09346                     if( !validationResult )
09347                         return InternalParseResult( validationResult );
09348
09349                     auto remainingTokens = tokens;
09350                     auto const &token = *remainingTokens;
09351                     if( token.type != TokenType::Argument )
09352                         return InternalParseResult::ok( ParseState( ParseResultType::NoMatch,
      remainingTokens ) );
09353
09354                     assert( !m_ref->isFlag() );
09355                     auto valueRef = static_cast<detail::BoundValueRefBase*>( m_ref.get() );
09356
09357                     auto result = valueRef->setValue( remainingTokens->token );
```

```
09358                     if( !result )
09359                         return InternalParseResult( result );
09360                     else
09361                         return InternalParseResult::ok( ParseState( ParseResultType::Matched,
    ++remainingTokens ) );
09362                 }
09363             };
09364
09365             inline auto normaliseOpt( std::string const &optName ) -> std::string {
09366 #ifdef CATCH_PLATFORM_WINDOWS
09367                 if( optName[0] == '/' )
09368             return "-" + optName.substr( 1 );
09369         else
09370 #endif
09371                 return optName;
09372             }
09373
09374             class Opt : public ParserRefImpl<Opt> {
09375             protected:
09376                 std::vector<std::string> m_optNames;
09377
09378             public:
09379                 template<typename LambdaT>
09380                 explicit Opt( LambdaT const &ref ) : ParserRefImpl(
    std::make_shared<BoundFlagLambda<LambdaT»( ref ) ) {}
09381
09382                 explicit Opt( bool &ref ) : ParserRefImpl( std::make_shared<BoundFlagRef>( ref ) ) {}
09383
09384                 template<typename LambdaT>
09385                 Opt( LambdaT const &ref, std::string const &hint ) : ParserRefImpl( ref, hint ) {}
09386
09387                 template<typename T>
09388                 Opt( T &ref, std::string const &hint ) : ParserRefImpl( ref, hint ) {}
09389
09390                 auto operator[]( std::string const &optName ) -> Opt & {
09391                     m_optNames.push_back( optName );
09392                     return *this;
09393                 }
09394
09395                 auto getHelpColumns() const -> std::vector<HelpColumns> {
09396                     std::ostringstream oss;
09397                     bool first = true;
09398                     for( auto const &opt : m_optNames ) {
09399                         if (first)
09400                             first = false;
09401                         else
09402                             oss « ", ";
09403                         oss « opt;
09404                     }
09405                     if( !m_hint.empty() )
09406                         oss « " <" « m_hint « ">";
09407                     return { { oss.str(), m_description } };
09408                 }
09409
09410                 auto isMatch( std::string const &optToken ) const -> bool {
09411                     auto normalisedToken = normaliseOpt( optToken );
09412                     for( auto const &name : m_optNames ) {
09413                         if( normaliseOpt( name ) == normalisedToken )
09414                             return true;
09415                     }
09416                     return false;
09417                 }
09418
09419                 using ParserBase::parse;
09420
09421                 auto parse( std::string const&, TokenStream const &tokens ) const ->
    InternalParseResult override {
09422                     auto validationResult = validate();
09423                     if( !validationResult )
09424                         return InternalParseResult( validationResult );
09425
09426                     auto remainingTokens = tokens;
09427                     if( remainingTokens && remainingTokens->type == TokenType::Option ) {
09428                         auto const &token = *remainingTokens;
09429                         if( isMatch(token.token ) ) {
09430                             if( m_ref->isFlag() ) {
09431                                 auto flagRef = static_cast<detail::BoundFlagRefBase*>( m_ref.get() );
09432                                 auto result = flagRef->setFlag( true );
09433                                 if( !result )
09434                                     return InternalParseResult( result );
09435                                 if( result.value() == ParseResultType::ShortCircuitAll )
09436                                     return InternalParseResult::ok( ParseState( result.value(),
    remainingTokens ) );
09437                             } else {
09438                                 auto valueRef = static_cast<detail::BoundValueRefBase*>( m_ref.get()
    );
09439                                 ++remainingTokens;
```

```
09440                                 if( !remainingTokens )
09441                                     return InternalParseResult::runtimeError( "Expected argument
      following " + token.token );
09442                                 auto const &argToken = *remainingTokens;
09443                                 if( argToken.type != TokenType::Argument )
09444                                     return InternalParseResult::runtimeError( "Expected argument
      following " + token.token );
09445                                 auto result = valueRef->setValue( argToken.token );
09446                                 if( !result )
09447                                     return InternalParseResult( result );
09448                                 if( result.value() == ParseResultType::ShortCircuitAll )
09449                                     return InternalParseResult::ok( ParseState( result.value(),
      remainingTokens ) );
09450                             }
09451                             return InternalParseResult::ok( ParseState( ParseResultType::Matched,
      ++remainingTokens ) );
09452                         }
09453                     }
09454                     return InternalParseResult::ok( ParseState( ParseResultType::NoMatch,
      remainingTokens ) );
09455                 }
09456
09457                 auto validate() const -> Result override {
09458                     if( m_optNames.empty() )
09459                         return Result::logicError( "No options supplied to Opt" );
09460                     for( auto const &name : m_optNames ) {
09461                         if( name.empty() )
09462                             return Result::logicError( "Option name cannot be empty" );
09463 #ifdef CATCH_PLATFORM_WINDOWS
09464                         if( name[0] != '-' && name[0] != '/' )
09465                     return Result::logicError( "Option name must begin with '-' or '/'" );
09466 #else
09467                         if( name[0] != '-' )
09468                             return Result::logicError( "Option name must begin with '-'" );
09469 #endif
09470                     }
09471                     return ParserRefImpl::validate();
09472                 }
09473             };
09474
09475             struct Help : Opt {
09476                 Help( bool &showHelpFlag )
09477                         :   Opt([&]( bool flag ) {
09478                     showHelpFlag = flag;
09479                     return ParserResult::ok( ParseResultType::ShortCircuitAll );
09480                 })
09481                 {
09482                     static_cast<Opt &>( *this )
09483                             ("display usage information")
09484                     ["-?"]["-h"]["--help"]
09485                             .optional();
09486                 }
09487             };
09488
09489             struct Parser : ParserBase {
09490
09491                 mutable ExeName m_exeName;
09492                 std::vector<Opt> m_options;
09493                 std::vector<Arg> m_args;
09494
09495                 auto operator|=( ExeName const &exeName ) -> Parser & {
09496                     m_exeName = exeName;
09497                     return *this;
09498                 }
09499
09500                 auto operator|=( Arg const &arg ) -> Parser & {
09501                     m_args.push_back(arg);
09502                     return *this;
09503                 }
09504
09505                 auto operator|=( Opt const &opt ) -> Parser & {
09506                     m_options.push_back(opt);
09507                     return *this;
09508                 }
09509
09510                 auto operator|=( Parser const &other ) -> Parser & {
09511                     m_options.insert(m_options.end(), other.m_options.begin(), other.m_options.end());
09512                     m_args.insert(m_args.end(), other.m_args.begin(), other.m_args.end());
09513                     return *this;
09514                 }
09515
09516                 template<typename T>
09517                 auto operator|( T const &other ) const -> Parser {
09518                     return Parser( *this ) |= other;
09519                 }
09520
09521                 // Forward deprecated interface with '+' instead of '|'
```

```
09522                 template<typename T>
09523                 auto operator+=( T const &other ) -> Parser & { return operator|=( other ); }
09524                 template<typename T>
09525                 auto operator+( T const &other ) const -> Parser { return operator|( other ); }
09526
09527                 auto getHelpColumns() const -> std::vector<HelpColumns> {
09528                     std::vector<HelpColumns> cols;
09529                     for (auto const &o : m_options) {
09530                         auto childCols = o.getHelpColumns();
09531                         cols.insert( cols.end(), childCols.begin(), childCols.end() );
09532                     }
09533                     return cols;
09534                 }
09535
09536                 void writeToStream( std::ostream &os ) const {
09537                     if (!m_exeName.name().empty()) {
09538                         os « "usage:\n" « "  " « m_exeName.name() « " ";
09539                         bool required = true, first = true;
09540                         for( auto const &arg : m_args ) {
09541                             if (first)
09542                                 first = false;
09543                             else
09544                                 os « " ";
09545                             if( arg.isOptional() && required ) {
09546                                 os « "[";
09547                                 required = false;
09548                             }
09549                             os « "<" « arg.hint() « ">";
09550                             if( arg.cardinality() == 0 )
09551                                 os « " ... ";
09552                         }
09553                         if( !required )
09554                             os « "]";
09555                         if( !m_options.empty() )
09556                             os « " options";
09557                         os « "\n\nwhere options are:" « std::endl;
09558                     }
09559
09560                     auto rows = getHelpColumns();
09561                     size_t consoleWidth = CATCH_CLARA_CONFIG_CONSOLE_WIDTH;
09562                     size_t optWidth = 0;
09563                     for( auto const &cols : rows )
09564                         optWidth = (std::max)(optWidth, cols.left.size() + 2);
09565
09566                     optWidth = (std::min)(optWidth, consoleWidth/2);
09567
09568                     for( auto const &cols : rows ) {
09569                         auto row =
09570                                 TextFlow::Column( cols.left ).width( optWidth ).indent( 2 ) +
09571                                 TextFlow::Spacer(4) +
09572                                 TextFlow::Column( cols.right ).width( consoleWidth - 7 - optWidth );
09573                         os « row « std::endl;
09574                     }
09575                 }
09576
09577                 friend auto operator«( std::ostream &os, Parser const &parser ) -> std::ostream& {
09578                     parser.writeToStream( os );
09579                     return os;
09580                 }
09581
09582                 auto validate() const -> Result override {
09583                     for( auto const &opt : m_options ) {
09584                         auto result = opt.validate();
09585                         if( !result )
09586                             return result;
09587                     }
09588                     for( auto const &arg : m_args ) {
09589                         auto result = arg.validate();
09590                         if( !result )
09591                             return result;
09592                     }
09593                     return Result::ok();
09594                 }
09595
09596                 using ParserBase::parse;
09597
09598                 auto parse( std::string const& exeName, TokenStream const &tokens ) const ->
    InternalParseResult override {
09599
09600                     struct ParserInfo {
09601                         ParserBase const* parser = nullptr;
09602                         size_t count = 0;
09603                     };
09604                     const size_t totalParsers = m_options.size() + m_args.size();
09605                     assert( totalParsers < 512 );
09606                     // ParserInfo parseInfos[totalParsers]; // <-- this is what we really want to do
09607                     ParserInfo parseInfos[512];
```

```
09608
09609                       {
09610                           size_t i = 0;
09611                           for (auto const &opt : m_options) parseInfos[i++].parser = &opt;
09612                           for (auto const &arg : m_args) parseInfos[i++].parser = &arg;
09613                       }
09614
09615                       m_exeName.set( exeName );
09616
09617                       auto result = InternalParseResult::ok( ParseState( ParseResultType::NoMatch,
      tokens ) );
09618                       while( result.value().remainingTokens() ) {
09619                           bool tokenParsed = false;
09620
09621                           for( size_t i = 0; i < totalParsers; ++i ) {
09622                               auto&  parseInfo = parseInfos[i];
09623                               if( parseInfo.parser->cardinality() == 0 || parseInfo.count <
      parseInfo.parser->cardinality() ) {
09624                                   result = parseInfo.parser->parse(exeName,
      result.value().remainingTokens());
09625                                   if (!result)
09626                                       return result;
09627                                   if (result.value().type() != ParseResultType::NoMatch) {
09628                                       tokenParsed = true;
09629                                       ++parseInfo.count;
09630                                       break;
09631                                   }
09632                               }
09633                           }
09634
09635                           if( result.value().type() == ParseResultType::ShortCircuitAll )
09636                               return result;
09637                           if( !tokenParsed )
09638                               return InternalParseResult::runtimeError( "Unrecognised token: " +
      result.value().remainingTokens()->token );
09639                       }
09640                       // !TBD Check missing required options
09641                       return result;
09642                   }
09643               };
09644
09645               template<typename DerivedT>
09646               template<typename T>
09647               auto ComposableParserImpl<DerivedT>::operator|( T const &other ) const -> Parser {
09648                   return Parser() | static_cast<DerivedT const &>( *this ) | other;
09649               }
09650           } // namespace detail
09651
09652 // A Combined parser
09653           using detail::Parser;
09654
09655 // A parser for options
09656           using detail::Opt;
09657
09658 // A parser for arguments
09659           using detail::Arg;
09660
09661 // Wrapper for argc, argv from main()
09662           using detail::Args;
09663
09664 // Specifies the name of the executable
09665           using detail::ExeName;
09666
09667 // Convenience wrapper for option parser that specifies the help option
09668           using detail::Help;
09669
09670 // enum of result types from a parse
09671           using detail::ParseResultType;
09672
09673 // Result type for parser operation
09674           using detail::ParserResult;
09675
09676       }} // namespace Catch::clara
09677
09678 // end clara.hpp
09679 #ifdef __clang__
09680 #pragma clang diagnostic pop
09681 #endif
09682
09683 // Restore Clara's value for console width, if present
09684 #ifdef CATCH_TEMP_CLARA_CONFIG_CONSOLE_WIDTH
09685 #define CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH CATCH_TEMP_CLARA_CONFIG_CONSOLE_WIDTH
09686 #undef CATCH_TEMP_CLARA_CONFIG_CONSOLE_WIDTH
09687 #endif
09688
09689 // end catch_clara.h
09690 namespace Catch {
```

```
09691
09692     clara::Parser makeCommandLineParser( ConfigData& config );
09693
09694 } // end namespace Catch
09695
09696 // end catch_commandline.h
09697 #include <fstream>
09698 #include <ctime>
09699
09700 namespace Catch {
09701
09702     clara::Parser makeCommandLineParser( ConfigData& config ) {
09703
09704         using namespace clara;
09705
09706         auto const setWarning = [&]( std::string const& warning ) {
09707             auto warningSet = [&]() {
09708                 if( warning == "NoAssertions" )
09709                     return WarnAbout::NoAssertions;
09710
09711                 if ( warning == "NoTests" )
09712                     return WarnAbout::NoTests;
09713
09714                 return WarnAbout::Nothing;
09715             }();
09716
09717             if (warningSet == WarnAbout::Nothing)
09718                 return ParserResult::runtimeError( "Unrecognised warning: '" + warning + "'" );
09719             config.warnings = static_cast<WarnAbout::What>( config.warnings | warningSet );
09720             return ParserResult::ok( ParseResultType::Matched );
09721         };
09722         auto const loadTestNamesFromFile = [&]( std::string const& filename ) {
09723             std::ifstream f( filename.c_str() );
09724             if( !f.is_open() )
09725                 return ParserResult::runtimeError( "Unable to load input file: '" + filename + "'" );
09726
09727             std::string line;
09728             while( std::getline( f, line ) ) {
09729                 line = trim(line);
09730                 if( !line.empty() && !startsWith( line, '#' ) ) {
09731                     if( !startsWith( line, '"' ) )
09732                         line = '"' + line + '"';
09733                     config.testsOrTags.push_back( line );
09734                     config.testsOrTags.emplace_back( "," );
09735                 }
09736             }
09737             //Remove comma in the end
09738             if(!config.testsOrTags.empty())
09739                 config.testsOrTags.erase( config.testsOrTags.end()-1 );
09740
09741             return ParserResult::ok( ParseResultType::Matched );
09742         };
09743         auto const setTestOrder = [&]( std::string const& order ) {
09744             if( startsWith( "declared", order ) )
09745                 config.runOrder = RunTests::InDeclarationOrder;
09746             else if( startsWith( "lexical", order ) )
09747                 config.runOrder = RunTests::InLexicographicalOrder;
09748             else if( startsWith( "random", order ) )
09749                 config.runOrder = RunTests::InRandomOrder;
09750             else
09751                 return clara::ParserResult::runtimeError( "Unrecognised ordering: '" + order + "'" );
09752             return ParserResult::ok( ParseResultType::Matched );
09753         };
09754         auto const setRngSeed = [&]( std::string const& seed ) {
09755             if( seed != "time" )
09756                 return clara::detail::convertInto( seed, config.rngSeed );
09757             config.rngSeed = static_cast<unsigned int>( std::time(nullptr) );
09758             return ParserResult::ok( ParseResultType::Matched );
09759         };
09760         auto const setColourUsage = [&]( std::string const& useColour ) {
09761             auto mode = toLower( useColour );
09762
09763             if( mode == "yes" )
09764                 config.useColour = UseColour::Yes;
09765             else if( mode == "no" )
09766                 config.useColour = UseColour::No;
09767             else if( mode == "auto" )
09768                 config.useColour = UseColour::Auto;
09769             else
09770                 return ParserResult::runtimeError( "colour mode must be one of: auto, yes or no. '" +
      useColour + "' not recognised" );
09771             return ParserResult::ok( ParseResultType::Matched );
09772         };
09773         auto const setWaitForKeypress = [&]( std::string const& keypress ) {
09774             auto keypressLc = toLower( keypress );
09775             if (keypressLc == "never")
09776                 config.waitForKeypress = WaitForKeypress::Never;
```

```
09777             else if( keypressLc == "start" )
09778                 config.waitForKeypress = WaitForKeypress::BeforeStart;
09779             else if( keypressLc == "exit" )
09780                 config.waitForKeypress = WaitForKeypress::BeforeExit;
09781             else if( keypressLc == "both" )
09782                 config.waitForKeypress = WaitForKeypress::BeforeStartAndExit;
09783             else
09784                 return ParserResult::runtimeError( "keypress argument must be one of: never, start,
      exit or both. '" + keypress + "' not recognised" );
09785             return ParserResult::ok( ParseResultType::Matched );
09786         };
09787         auto const setVerbosity = [&]( std::string const& verbosity ) {
09788             auto lcVerbosity = toLower( verbosity );
09789             if( lcVerbosity == "quiet" )
09790                 config.verbosity = Verbosity::Quiet;
09791             else if( lcVerbosity == "normal" )
09792                 config.verbosity = Verbosity::Normal;
09793             else if( lcVerbosity == "high" )
09794                 config.verbosity = Verbosity::High;
09795             else
09796                 return ParserResult::runtimeError( "Unrecognised verbosity, '" + verbosity + "'" );
09797             return ParserResult::ok( ParseResultType::Matched );
09798         };
09799         auto const setReporter = [&]( std::string const& reporter ) {
09800             IReporterRegistry::FactoryMap const& factories =
      getRegistryHub().getReporterRegistry().getFactories();
09801
09802             auto lcReporter = toLower( reporter );
09803             auto result = factories.find( lcReporter );
09804
09805             if( factories.end() != result )
09806                 config.reporterName = lcReporter;
09807             else
09808                 return ParserResult::runtimeError( "Unrecognized reporter, '" + reporter + "'. Check
      available with --list-reporters" );
09809             return ParserResult::ok( ParseResultType::Matched );
09810         };
09811
09812         auto cli
09813                 = ExeName( config.processName )
09814                   | Help( config.showHelp )
09815                   | Opt( config.listTests )
09816                   ["-l"]["--list-tests"]
09817                           ( "list all/matching test cases" )
09818                   | Opt( config.listTags )
09819                   ["-t"]["--list-tags"]
09820                           ( "list all/matching tags" )
09821                   | Opt( config.showSuccessfulTests )
09822                   ["-s"]["--success"]
09823                           ( "include successful tests in output" )
09824                   | Opt( config.shouldDebugBreak )
09825                   ["-b"]["--break"]
09826                           ( "break into debugger on failure" )
09827                   | Opt( config.noThrow )
09828                   ["-e"]["--nothrow"]
09829                           ( "skip exception tests" )
09830                   | Opt( config.showInvisibles )
09831                   ["-i"]["--invisibles"]
09832                           ( "show invisibles (tabs, newlines)" )
09833                   | Opt( config.outputFilename, "filename" )
09834                   ["-o"]["--out"]
09835                           ( "output filename" )
09836                   | Opt( setReporter, "name" )
09837                   ["-r"]["--reporter"]
09838                           ( "reporter to use (defaults to console)" )
09839                   | Opt( config.name, "name" )
09840                   ["-n"]["--name"]
09841                           ( "suite name" )
09842                   | Opt( [&]( bool ){ config.abortAfter = 1; } )
09843                   ["-a"]["--abort"]
09844                           ( "abort at first failure" )
09845                   | Opt( [&]( int x ){ config.abortAfter = x; }, "no. failures" )
09846                   ["-x"]["--abortx"]
09847                           ( "abort after x failures" )
09848                   | Opt( setWarning, "warning name" )
09849                   ["-w"]["--warn"]
09850                           ( "enable warnings" )
09851                   | Opt( [&]( bool flag ) { config.showDurations = flag ? ShowDurations::Always :
      ShowDurations::Never; }, "yes|no" )
09852                   ["-d"]["--durations"]
09853                           ( "show test durations" )
09854                   | Opt( config.minDuration, "seconds" )
09855                   ["-D"]["--min-duration"]
09856                           ( "show test durations for tests taking at least the given number of
      seconds" )
09857                   | Opt( loadTestNamesFromFile, "filename" )
09858                   ["-f"]["--input-file"]
```

```
09859                           ( "load test names to run from a file" )
09860                   | Opt( config.filenamesAsTags )
09861                   ["-#"]["--filenames-as-tags"]
09862                           ( "adds a tag for the filename" )
09863                   | Opt( config.sectionsToRun, "section name" )
09864                   ["-c"]["--section"]
09865                           ( "specify section to run" )
09866                   | Opt( setVerbosity, "quiet|normal|high" )
09867                   ["-v"]["--verbosity"]
09868                           ( "set output verbosity" )
09869                   | Opt( config.listTestNamesOnly )
09870                   ["--list-test-names-only"]
09871                           ( "list all/matching test cases names only" )
09872                   | Opt( config.listReporters )
09873                   ["--list-reporters"]
09874                           ( "list all reporters" )
09875                   | Opt( setTestOrder, "decl|lex|rand" )
09876                   ["--order"]
09877                           ( "test case order (defaults to decl)" )
09878                   | Opt( setRngSeed, "'time'|number" )
09879                   ["--rng-seed"]
09880                           ( "set a specific seed for random numbers" )
09881                   | Opt( setColourUsage, "yes|no" )
09882                   ["--use-colour"]
09883                           ( "should output be colourised" )
09884                   | Opt( config.libIdentify )
09885                   ["--libidentify"]
09886                           ( "report name and version according to libidentify standard" )
09887                   | Opt( setWaitForKeypress, "never|start|exit|both" )
09888                   ["--wait-for-keypress"]
09889                           ( "waits for a keypress before exiting" )
09890                   | Opt( config.benchmarkSamples, "samples" )
09891                   ["--benchmark-samples"]
09892                           ( "number of samples to collect (default: 100)" )
09893                   | Opt( config.benchmarkResamples, "resamples" )
09894                   ["--benchmark-resamples"]
09895                           ( "number of resamples for the bootstrap (default: 100000)" )
09896                   | Opt( config.benchmarkConfidenceInterval, "confidence interval" )
09897                   ["--benchmark-confidence-interval"]
09898                           ( "confidence interval for the bootstrap (between 0 and 1, default: 0.95)" )
09899                   | Opt( config.benchmarkNoAnalysis )
09900                   ["--benchmark-no-analysis"]
09901                           ( "perform only measurements; do not perform any analysis" )
09902                   | Opt( config.benchmarkWarmupTime, "benchmarkWarmupTime" )
09903                   ["--benchmark-warmup-time"]
09904                           ( "amount of time in milliseconds spent on warming up each test (default:
      100)" )
09905                   | Arg( config.testsOrTags, "test name|pattern|tags" )
09906                           ( "which test or tests to use" );
09907
09908         return cli;
09909     }
09910
09911 } // end namespace Catch
09912 // end catch_commandline.cpp
09913 // start catch_common.cpp
09914
09915 #include <cstring>
09916 #include <ostream>
09917
09918 namespace Catch {
09919
09920     bool SourceLineInfo::operator == ( SourceLineInfo const& other ) const noexcept {
09921         return line == other.line && (file == other.file || std::strcmp(file, other.file) == 0);
09922     }
09923     bool SourceLineInfo::operator < ( SourceLineInfo const& other ) const noexcept {
09924         // We can assume that the same file will usually have the same pointer.
09925         // Thus, if the pointers are the same, there is no point in calling the strcmp
09926         return line < other.line || ( line == other.line && file != other.file && (std::strcmp(file,
      other.file) < 0));
09927     }
09928
09929     std::ostream& operator « ( std::ostream& os, SourceLineInfo const& info ) {
09930 #ifndef __GNUG__
09931         os « info.file « '(' « info.line « ')';
09932 #else
09933         os « info.file « ':' « info.line;
09934 #endif
09935         return os;
09936     }
09937
09938     std::string StreamEndStop::operator+() const {
09939         return std::string();
09940     }
09941
09942     NonCopyable::NonCopyable() = default;
09943     NonCopyable::~NonCopyable() = default;
```

```
09944
09945 }
09946 // end catch_common.cpp
09947 // start catch_config.cpp
09948
09949 namespace Catch {
09950
09951     Config::Config( ConfigData const& data )
09952             :   m_data( data ),
09953                 m_stream( openStream() )
09954     {
09955         // We need to trim filter specs to avoid trouble with superfluous
09956         // whitespace (esp. important for bdd macros, as those are manually
09957         // aligned with whitespace).
09958
09959         for (auto& elem : m_data.testsOrTags) {
09960             elem = trim(elem);
09961         }
09962         for (auto& elem : m_data.sectionsToRun) {
09963             elem = trim(elem);
09964         }
09965
09966         TestSpecParser parser(ITagAliasRegistry::get());
09967         if (!m_data.testsOrTags.empty()) {
09968             m_hasTestFilters = true;
09969             for (auto const& testOrTags : m_data.testsOrTags) {
09970                 parser.parse(testOrTags);
09971             }
09972         }
09973         m_testSpec = parser.testSpec();
09974     }
09975
09976     std::string const& Config::getFilename() const {
09977         return m_data.outputFilename ;
09978     }
09979
09980     bool Config::listTests() const          { return m_data.listTests; }
09981     bool Config::listTestNamesOnly() const  { return m_data.listTestNamesOnly; }
09982     bool Config::listTags() const           { return m_data.listTags; }
09983     bool Config::listReporters() const      { return m_data.listReporters; }
09984
09985     std::string Config::getProcessName() const { return m_data.processName; }
09986     std::string const& Config::getReporterName() const { return m_data.reporterName; }
09987
09988     std::vector<std::string> const& Config::getTestsOrTags() const { return m_data.testsOrTags; }
09989     std::vector<std::string> const& Config::getSectionsToRun() const { return m_data.sectionsToRun; }
09990
09991     TestSpec const& Config::testSpec() const { return m_testSpec; }
09992     bool Config::hasTestFilters() const { return m_hasTestFilters; }
09993
09994     bool Config::showHelp() const { return m_data.showHelp; }
09995
09996     // IConfig interface
09997     bool Config::allowThrows() const                   { return !m_data.noThrow; }
09998     std::ostream& Config::stream() const               { return m_stream->stream(); }
09999     std::string Config::name() const                   { return m_data.name.empty() ?
    m_data.processName : m_data.name; }
10000     bool Config::includeSuccessfulResults() const      { return m_data.showSuccessfulTests; }
10001     bool Config::warnAboutMissingAssertions() const    { return !!(m_data.warnings &
    WarnAbout::NoAssertions); }
10002     bool Config::warnAboutNoTests() const              { return !!(m_data.warnings &
    WarnAbout::NoTests); }
10003     ShowDurations::OrNot Config::showDurations() const { return m_data.showDurations; }
10004     double Config::minDuration() const                 { return m_data.minDuration; }
10005     RunTests::InWhatOrder Config::runOrder() const     { return m_data.runOrder; }
10006     unsigned int Config::rngSeed() const               { return m_data.rngSeed; }
10007     UseColour::YesOrNo Config::useColour() const       { return m_data.useColour; }
10008     bool Config::shouldDebugBreak() const              { return m_data.shouldDebugBreak; }
10009     int Config::abortAfter() const                     { return m_data.abortAfter; }
10010     bool Config::showInvisibles() const                { return m_data.showInvisibles; }
10011     Verbosity Config::verbosity() const                { return m_data.verbosity; }
10012
10013     bool Config::benchmarkNoAnalysis() const                       { return m_data.benchmarkNoAnalysis;
    }
10014     int Config::benchmarkSamples() const                           { return m_data.benchmarkSamples; }
10015     double Config::benchmarkConfidenceInterval() const             { return
    m_data.benchmarkConfidenceInterval; }
10016     unsigned int Config::benchmarkResamples() const                { return m_data.benchmarkResamples;
    }
10017     std::chrono::milliseconds Config::benchmarkWarmupTime() const { return
    std::chrono::milliseconds(m_data.benchmarkWarmupTime); }
10018
10019     IStream const* Config::openStream() {
10020         return Catch::makeStream(m_data.outputFilename);
10021     }
10022
10023 } // end namespace Catch
```

```
10024 // end catch_config.cpp
10025 // start catch_console_colour.cpp
10026
10027 #if defined(__clang__)
10028 #    pragma clang diagnostic push
10029 #    pragma clang diagnostic ignored "-Wexit-time-destructors"
10030 #endif
10031
10032 // start catch_errno_guard.h
10033
10034 namespace Catch {
10035
10036     class ErrnoGuard {
10037     public:
10038         ErrnoGuard();
10039         ~ErrnoGuard();
10040     private:
10041         int m_oldErrno;
10042     };
10043
10044 }
10045
10046 // end catch_errno_guard.h
10047 // start catch_windows_h_proxy.h
10048
10049
10050 #if defined(CATCH_PLATFORM_WINDOWS)
10051
10052 #if !defined(NOMINMAX) && !defined(CATCH_CONFIG_NO_NOMINMAX)
10053 #  define CATCH_DEFINED_NOMINMAX
10054 #  define NOMINMAX
10055 #endif
10056 #if !defined(WIN32_LEAN_AND_MEAN) && !defined(CATCH_CONFIG_NO_WIN32_LEAN_AND_MEAN)
10057 #  define CATCH_DEFINED_WIN32_LEAN_AND_MEAN
10058 #  define WIN32_LEAN_AND_MEAN
10059 #endif
10060
10061 #ifdef __AFXDLL
10062 #include <AfxWin.h>
10063 #else
10064 #include <windows.h>
10065 #endif
10066
10067 #ifdef CATCH_DEFINED_NOMINMAX
10068 #  undef NOMINMAX
10069 #endif
10070 #ifdef CATCH_DEFINED_WIN32_LEAN_AND_MEAN
10071 #  undef WIN32_LEAN_AND_MEAN
10072 #endif
10073
10074 #endif // defined(CATCH_PLATFORM_WINDOWS)
10075
10076 // end catch_windows_h_proxy.h
10077 #include <sstream>
10078
10079 namespace Catch {
10080     namespace {
10081
10082         struct IColourImpl {
10083             virtual ~IColourImpl() = default;
10084             virtual void use( Colour::Code _colourCode ) = 0;
10085         };
10086
10087         struct NoColourImpl : IColourImpl {
10088             void use( Colour::Code ) override {}
10089
10090             static IColourImpl* instance() {
10091                 static NoColourImpl s_instance;
10092                 return &s_instance;
10093             }
10094         };
10095
10096     } // anon namespace
10097 } // namespace Catch
10098
10099 #if !defined( CATCH_CONFIG_COLOUR_NONE ) && !defined( CATCH_CONFIG_COLOUR_WINDOWS ) && !defined(
      CATCH_CONFIG_COLOUR_ANSI )
10100 #   ifdef CATCH_PLATFORM_WINDOWS
10101 #       define CATCH_CONFIG_COLOUR_WINDOWS
10102 #   else
10103 #       define CATCH_CONFIG_COLOUR_ANSI
10104 #   endif
10105 #endif
10106
10107 #if defined ( CATCH_CONFIG_COLOUR_WINDOWS )
10108
10109 namespace Catch {
```

```
10110 namespace {
10111
10112     class Win32ColourImpl : public IColourImpl {
10113     public:
10114         Win32ColourImpl() : stdoutHandle( GetStdHandle(STD_OUTPUT_HANDLE) )
10115         {
10116             CONSOLE_SCREEN_BUFFER_INFO csbiInfo;
10117             GetConsoleScreenBufferInfo( stdoutHandle, &csbiInfo );
10118             originalForegroundAttributes = csbiInfo.wAttributes & ~( BACKGROUND_GREEN | BACKGROUND_RED
      | BACKGROUND_BLUE | BACKGROUND_INTENSITY );
10119             originalBackgroundAttributes = csbiInfo.wAttributes & ~( FOREGROUND_GREEN | FOREGROUND_RED
      | FOREGROUND_BLUE | FOREGROUND_INTENSITY );
10120         }
10121
10122         void use( Colour::Code _colourCode ) override {
10123             switch( _colourCode ) {
10124                 case Colour::None:      return setTextAttribute( originalForegroundAttributes );
10125                 case Colour::White:     return setTextAttribute( FOREGROUND_GREEN | FOREGROUND_RED |
      FOREGROUND_BLUE );
10126                 case Colour::Red:       return setTextAttribute( FOREGROUND_RED );
10127                 case Colour::Green:     return setTextAttribute( FOREGROUND_GREEN );
10128                 case Colour::Blue:      return setTextAttribute( FOREGROUND_BLUE );
10129                 case Colour::Cyan:      return setTextAttribute( FOREGROUND_BLUE | FOREGROUND_GREEN );
10130                 case Colour::Yellow:    return setTextAttribute( FOREGROUND_RED | FOREGROUND_GREEN );
10131                 case Colour::Grey:      return setTextAttribute( 0 );
10132
10133                 case Colour::LightGrey:     return setTextAttribute( FOREGROUND_INTENSITY );
10134                 case Colour::BrightRed:     return setTextAttribute( FOREGROUND_INTENSITY |
      FOREGROUND_RED );
10135                 case Colour::BrightGreen:   return setTextAttribute( FOREGROUND_INTENSITY |
      FOREGROUND_GREEN );
10136                 case Colour::BrightWhite:   return setTextAttribute( FOREGROUND_INTENSITY |
      FOREGROUND_GREEN | FOREGROUND_RED | FOREGROUND_BLUE );
10137                 case Colour::BrightYellow:  return setTextAttribute( FOREGROUND_INTENSITY |
      FOREGROUND_RED | FOREGROUND_GREEN );
10138
10139                 case Colour::Bright: CATCH_INTERNAL_ERROR( "not a colour" );
10140
10141                 default:
10142                     CATCH_ERROR( "Unknown colour requested" );
10143             }
10144         }
10145
10146     private:
10147         void setTextAttribute( WORD _textAttribute ) {
10148             SetConsoleTextAttribute( stdoutHandle, _textAttribute | originalBackgroundAttributes );
10149         }
10150         HANDLE stdoutHandle;
10151         WORD originalForegroundAttributes;
10152         WORD originalBackgroundAttributes;
10153     };
10154
10155     IColourImpl* platformColourInstance() {
10156         static Win32ColourImpl s_instance;
10157
10158         IConfigPtr config = getCurrentContext().getConfig();
10159         UseColour::YesOrNo colourMode = config
10160             ? config->useColour()
10161             : UseColour::Auto;
10162         if( colourMode == UseColour::Auto )
10163             colourMode = UseColour::Yes;
10164         return colourMode == UseColour::Yes
10165             ? &s_instance
10166             : NoColourImpl::instance();
10167     }
10168
10169 } // end anon namespace
10170 } // end namespace Catch
10171
10172 #elif defined( CATCH_CONFIG_COLOUR_ANSI )
10173
10174 #include <unistd.h>
10175
10176 namespace Catch {
10177     namespace {
10178
10179         // use POSIX/ ANSI console terminal codes
10180         // Thanks to Adam Strzelecki for original contribution
10181         // (http://github.com/nanoant)
10182         // https://github.com/philsquared/Catch/pull/131
10183         class PosixColourImpl : public IColourImpl {
10184         public:
10185             void use( Colour::Code _colourCode ) override {
10186                 switch( _colourCode ) {
10187                     case Colour::None:
10188                     case Colour::White:     return setColour( "[0m" );
10189                     case Colour::Red:       return setColour( "[0;31m" );
```

```
10190                     case Colour::Green:     return setColour( "[0;32m" );
10191                     case Colour::Blue:      return setColour( "[0;34m" );
10192                     case Colour::Cyan:      return setColour( "[0;36m" );
10193                     case Colour::Yellow:    return setColour( "[0;33m" );
10194                     case Colour::Grey:      return setColour( "[1;30m" );
10195
10196                     case Colour::LightGrey:     return setColour( "[0;37m" );
10197                     case Colour::BrightRed:     return setColour( "[1;31m" );
10198                     case Colour::BrightGreen:   return setColour( "[1;32m" );
10199                     case Colour::BrightWhite:   return setColour( "[1;37m" );
10200                     case Colour::BrightYellow:  return setColour( "[1;33m" );
10201
10202                     case Colour::Bright: CATCH_INTERNAL_ERROR( "not a colour" );
10203                     default: CATCH_INTERNAL_ERROR( "Unknown colour requested" );
10204                 }
10205             }
10206             static IColourImpl* instance() {
10207                 static PosixColourImpl s_instance;
10208                 return &s_instance;
10209             }
10210
10211         private:
10212             void setColour( const char* _escapeCode ) {
10213                 getCurrentContext().getConfig()->stream()
10214                         << '\033' << _escapeCode;
10215             }
10216         };
10217
10218         bool useColourOnPlatform() {
10219             return
10220 #if defined(CATCH_PLATFORM_MAC) || defined(CATCH_PLATFORM_IPHONE)
10221                     !isDebuggerActive() &&
10222                     #endif
10223                     #if !(defined(__DJGPP__) && defined(__STRICT_ANSI__))
10224                     isatty(STDOUT_FILENO)
10225 #else
10226                 false
10227 #endif
10228                     ;
10229         }
10230         IColourImpl* platformColourInstance() {
10231             ErrnoGuard guard;
10232             IConfigPtr config = getCurrentContext().getConfig();
10233             UseColour::YesOrNo colourMode = config
10234                                             ? config->useColour()
10235                                             : UseColour::Auto;
10236             if( colourMode == UseColour::Auto )
10237                 colourMode = useColourOnPlatform()
10238                              ? UseColour::Yes
10239                              : UseColour::No;
10240             return colourMode == UseColour::Yes
10241                    ? PosixColourImpl::instance()
10242                    : NoColourImpl::instance();
10243         }
10244
10245     } // end anon namespace
10246 } // end namespace Catch
10247
10248 #else  // not Windows or ANSI ///////////////////////////////////////////////
10249
10250 namespace Catch {
10251
10252     static IColourImpl* platformColourInstance() { return NoColourImpl::instance(); }
10253
10254 } // end namespace Catch
10255
10256 #endif // Windows/ ANSI/ None
10257
10258 namespace Catch {
10259
10260     Colour::Colour( Code _colourCode ) { use( _colourCode ); }
10261     Colour::Colour( Colour&& other ) noexcept {
10262         m_moved = other.m_moved;
10263         other.m_moved = true;
10264     }
10265     Colour& Colour::operator=( Colour&& other ) noexcept {
10266         m_moved = other.m_moved;
10267         other.m_moved  = true;
10268         return *this;
10269     }
10270
10271     Colour::~Colour(){ if( !m_moved ) use( None ); }
10272
10273     void Colour::use( Code _colourCode ) {
10274         static IColourImpl* impl = platformColourInstance();
10275         // Strictly speaking, this cannot possibly happen.
10276         // However, under some conditions it does happen (see #1626),
```

```
10277         // and this change is small enough that we can let practicality
10278         // triumph over purity in this case.
10279         if (impl != nullptr) {
10280             impl->use( _colourCode );
10281         }
10282     }
10283
10284     std::ostream& operator << ( std::ostream& os, Colour const& ) {
10285         return os;
10286     }
10287
10288 } // end namespace Catch
10289
10290 #if defined(__clang__)
10291 #    pragma clang diagnostic pop
10292 #endif
10293
10294 // end catch_console_colour.cpp
10295 // start catch_context.cpp
10296
10297 namespace Catch {
10298
10299     class Context : public IMutableContext, NonCopyable {
10300
10301     public: // IContext
10302         IResultCapture* getResultCapture() override {
10303             return m_resultCapture;
10304         }
10305         IRunner* getRunner() override {
10306             return m_runner;
10307         }
10308
10309         IConfigPtr const& getConfig() const override {
10310             return m_config;
10311         }
10312
10313         ~Context() override;
10314
10315     public: // IMutableContext
10316         void setResultCapture( IResultCapture* resultCapture ) override {
10317             m_resultCapture = resultCapture;
10318         }
10319         void setRunner( IRunner* runner ) override {
10320             m_runner = runner;
10321         }
10322         void setConfig( IConfigPtr const& config ) override {
10323             m_config = config;
10324         }
10325
10326         friend IMutableContext& getCurrentMutableContext();
10327
10328     private:
10329         IConfigPtr m_config;
10330         IRunner* m_runner = nullptr;
10331         IResultCapture* m_resultCapture = nullptr;
10332     };
10333
10334     IMutableContext *IMutableContext::currentContext = nullptr;
10335
10336     void IMutableContext::createContext()
10337     {
10338         currentContext = new Context();
10339     }
10340
10341     void cleanUpContext() {
10342         delete IMutableContext::currentContext;
10343         IMutableContext::currentContext = nullptr;
10344     }
10345     IContext::~IContext() = default;
10346     IMutableContext::~IMutableContext() = default;
10347     Context::~Context() = default;
10348
10349     SimplePcg32& rng() {
10350         static SimplePcg32 s_rng;
10351         return s_rng;
10352     }
10353
10354 }
10355 // end catch_context.cpp
10356 // start catch_debug_console.cpp
10357
10358 // start catch_debug_console.h
10359
10360 #include <string>
10361
10362 namespace Catch {
10363     void writeToDebugConsole( std::string const& text );
```

```
10364 }
10365
10366 // end catch_debug_console.h
10367 #if defined(CATCH_CONFIG_ANDROID_LOGWRITE)
10368 #include <android/log.h>
10369
10370     namespace Catch {
10371         void writeToDebugConsole( std::string const& text ) {
10372             __android_log_write( ANDROID_LOG_DEBUG, "Catch", text.c_str() );
10373         }
10374     }
10375
10376 #elif defined(CATCH_PLATFORM_WINDOWS)
10377
10378 namespace Catch {
10379         void writeToDebugConsole( std::string const& text ) {
10380             ::OutputDebugStringA( text.c_str() );
10381         }
10382     }
10383
10384 #else
10385
10386 namespace Catch {
10387     void writeToDebugConsole( std::string const& text ) {
10388         // !TBD: Need a version for Mac/ XCode and other IDEs
10389         Catch::cout() « text;
10390     }
10391 }
10392
10393 #endif // Platform
10394 // end catch_debug_console.cpp
10395 // start catch_debugger.cpp
10396
10397 #if defined(CATCH_PLATFORM_MAC) || defined(CATCH_PLATFORM_IPHONE)
10398
10399 #  include <cassert>
10400 #  include <sys/types.h>
10401 #  include <unistd.h>
10402 #  include <cstddef>
10403 #  include <ostream>
10404
10405 #ifdef __apple_build_version__
10406 // These headers will only compile with AppleClang (XCode)
10407 // For other compilers (Clang, GCC, ... ) we need to exclude them
10408 #  include <sys/sysctl.h>
10409 #endif
10410
10411 namespace Catch {
10412 #ifdef __apple_build_version__
10413     // The following function is taken directly from the following technical note:
10414     // https://developer.apple.com/library/archive/qa/qa1361/_index.html
10415
10416     // Returns true if the current process is being debugged (either
10417     // running under the debugger or has a debugger attached post facto).
10418     bool isDebuggerActive(){
10419         int                 mib[4];
10420         struct kinfo_proc   info;
10421         std::size_t         size;
10422
10423         // Initialize the flags so that, if sysctl fails for some bizarre
10424         // reason, we get a predictable result.
10425
10426         info.kp_proc.p_flag = 0;
10427
10428         // Initialize mib, which tells sysctl the info we want, in this case
10429         // we're looking for information about a specific process ID.
10430
10431         mib[0] = CTL_KERN;
10432         mib[1] = KERN_PROC;
10433         mib[2] = KERN_PROC_PID;
10434         mib[3] = getpid();
10435
10436         // Call sysctl.
10437
10438         size = sizeof(info);
10439         if( sysctl(mib, sizeof(mib) / sizeof(*mib), &info, &size, nullptr, 0) != 0 ) {
10440             Catch::cerr() « "\n** Call to sysctl failed - unable to determine if debugger is active
    **\n" « std::endl;
10441             return false;
10442         }
10443
10444         // We're being debugged if the P_TRACED flag is set.
10445
10446         return ( (info.kp_proc.p_flag & P_TRACED) != 0 );
10447     }
10448 #else
10449     bool isDebuggerActive() {
```

```
10450             // We need to find another way to determine this for non-appleclang compilers on macOS
10451             return false;
10452         }
10453 #endif
10454 } // namespace Catch
10455
10456 #elif defined(CATCH_PLATFORM_LINUX)
10457 #include <fstream>
10458     #include <string>
10459
10460     namespace Catch{
10461         // The standard POSIX way of detecting a debugger is to attempt to
10462         // ptrace() the process, but this needs to be done from a child and not
10463         // this process itself to still allow attaching to this process later
10464         // if wanted, so is rather heavy. Under Linux we have the PID of the
10465         // "debugger" (which doesn't need to be gdb, of course, it could also
10466         // be strace, for example) in /proc/$PID/status, so just get it from
10467         // there instead.
10468         bool isDebuggerActive(){
10469             // Libstdc++ has a bug, where std::ifstream sets errno to 0
10470             // This way our users can properly assert over errno values
10471             ErrnoGuard guard;
10472             std::ifstream in("/proc/self/status");
10473             for( std::string line; std::getline(in, line); ) {
10474                 static const int PREFIX_LEN = 11;
10475                 if( line.compare(0, PREFIX_LEN, "TracerPid:\t") == 0 ) {
10476                     // We're traced if the PID is not 0 and no other PID starts
10477                     // with 0 digit, so it's enough to check for just a single
10478                     // character.
10479                     return line.length() > PREFIX_LEN && line[PREFIX_LEN] != '0';
10480                 }
10481             }
10482
10483             return false;
10484         }
10485     } // namespace Catch
10486 #elif defined(_MSC_VER)
10487     extern "C" __declspec(dllimport) int __stdcall IsDebuggerPresent();
10488     namespace Catch {
10489         bool isDebuggerActive() {
10490             return IsDebuggerPresent() != 0;
10491         }
10492     }
10493 #elif defined(__MINGW32__)
10494     extern "C" __declspec(dllimport) int __stdcall IsDebuggerPresent();
10495     namespace Catch {
10496         bool isDebuggerActive() {
10497             return IsDebuggerPresent() != 0;
10498         }
10499     }
10500 #else
10501     namespace Catch {
10502        bool isDebuggerActive() { return false; }
10503     }
10504 #endif // Platform
10505 // end catch_debugger.cpp
10506 // start catch_decomposer.cpp
10507
10508 namespace Catch {
10509
10510     ITransientExpression::~ITransientExpression() = default;
10511
10512     void formatReconstructedExpression( std::ostream &os, std::string const& lhs, StringRef op,
      std::string const& rhs ) {
10513         if( lhs.size() + rhs.size() < 40 &&
10514             lhs.find('\n') == std::string::npos &&
10515             rhs.find('\n') == std::string::npos )
10516             os « lhs « " " « op « " " « rhs;
10517         else
10518             os « lhs « "\n" « op « "\n" « rhs;
10519     }
10520 }
10521 // end catch_decomposer.cpp
10522 // start catch_enforce.cpp
10523
10524 #include <stdexcept>
10525
10526 namespace Catch {
10527 #if defined(CATCH_CONFIG_DISABLE_EXCEPTIONS) &&
      !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS_CUSTOM_HANDLER)
10528     [[noreturn]]
10529     void throw_exception(std::exception const& e) {
10530         Catch::cerr() « "Catch will terminate because it needed to throw an exception.\n"
10531                       « "The message was: " « e.what() « '\n';
10532         std::terminate();
10533     }
10534 #endif
```

```
10535
10536     [[noreturn]]
10537     void throw_logic_error(std::string const& msg) {
10538         throw_exception(std::logic_error(msg));
10539     }
10540
10541     [[noreturn]]
10542     void throw_domain_error(std::string const& msg) {
10543         throw_exception(std::domain_error(msg));
10544     }
10545
10546     [[noreturn]]
10547     void throw_runtime_error(std::string const& msg) {
10548         throw_exception(std::runtime_error(msg));
10549     }
10550
10551 } // namespace Catch;
10552 // end catch_enforce.cpp
10553 // start catch_enum_values_registry.cpp
10554 // start catch_enum_values_registry.h
10555
10556 #include <vector>
10557 #include <memory>
10558
10559 namespace Catch {
10560
10561     namespace Detail {
10562
10563         std::unique_ptr<EnumInfo> makeEnumInfo( StringRef enumName, StringRef allValueNames,
      std::vector<int> const& values );
10564
10565         class EnumValuesRegistry : public IMutableEnumValuesRegistry {
10566
10567             std::vector<std::unique_ptr<EnumInfo» m_enumInfos;
10568
10569             EnumInfo const& registerEnum( StringRef enumName, StringRef allEnums, std::vector<int>
      const& values) override;
10570         };
10571
10572         std::vector<StringRef> parseEnums( StringRef enums );
10573
10574     } // Detail
10575
10576 } // Catch
10577
10578 // end catch_enum_values_registry.h
10579
10580 #include <map>
10581 #include <cassert>
10582
10583 namespace Catch {
10584
10585     IMutableEnumValuesRegistry::~IMutableEnumValuesRegistry() {}
10586
10587     namespace Detail {
10588
10589         namespace {
10590             // Extracts the actual name part of an enum instance
10591             // In other words, it returns the Blue part of Bikeshed::Colour::Blue
10592             StringRef extractInstanceName(StringRef enumInstance) {
10593                 // Find last occurrence of ":"
10594                 size_t name_start = enumInstance.size();
10595                 while (name_start > 0 && enumInstance[name_start - 1] != ':') {
10596                     --name_start;
10597                 }
10598                 return enumInstance.substr(name_start, enumInstance.size() - name_start);
10599             }
10600         }
10601
10602         std::vector<StringRef> parseEnums( StringRef enums ) {
10603             auto enumValues = splitStringRef( enums, ',' );
10604             std::vector<StringRef> parsed;
10605             parsed.reserve( enumValues.size() );
10606             for( auto const& enumValue : enumValues ) {
10607                 parsed.push_back(trim(extractInstanceName(enumValue)));
10608             }
10609             return parsed;
10610         }
10611
10612         EnumInfo::~EnumInfo() {}
10613
10614         StringRef EnumInfo::lookup( int value ) const {
10615             for( auto const& valueToName : m_values ) {
10616                 if( valueToName.first == value )
10617                     return valueToName.second;
10618             }
10619             return "{** unexpected enum value **}"_sr;
```

```
10620         }
10621
10622         std::unique_ptr<EnumInfo> makeEnumInfo( StringRef enumName, StringRef allValueNames,
      std::vector<int> const& values ) {
10623             std::unique_ptr<EnumInfo> enumInfo( new EnumInfo );
10624             enumInfo->m_name = enumName;
10625             enumInfo->m_values.reserve( values.size() );
10626
10627             const auto valueNames = Catch::Detail::parseEnums( allValueNames );
10628             assert( valueNames.size() == values.size() );
10629             std::size_t i = 0;
10630             for( auto value : values )
10631                 enumInfo->m_values.emplace_back(value, valueNames[i++]);
10632
10633             return enumInfo;
10634         }
10635
10636         EnumInfo const& EnumValuesRegistry::registerEnum( StringRef enumName, StringRef allValueNames,
      std::vector<int> const& values ) {
10637             m_enumInfos.push_back(makeEnumInfo(enumName, allValueNames, values));
10638             return *m_enumInfos.back();
10639         }
10640
10641     } // Detail
10642 } // Catch
10643
10644 // end catch_enum_values_registry.cpp
10645 // start catch_errno_guard.cpp
10646
10647 #include <cerrno>
10648
10649 namespace Catch {
10650     ErrnoGuard::ErrnoGuard():m_oldErrno(errno){}
10651     ErrnoGuard::~ErrnoGuard() { errno = m_oldErrno; }
10652 }
10653 // end catch_errno_guard.cpp
10654 // start catch_exception_translator_registry.cpp
10655
10656 // start catch_exception_translator_registry.h
10657
10658 #include <vector>
10659 #include <string>
10660 #include <memory>
10661
10662 namespace Catch {
10663
10664     class ExceptionTranslatorRegistry : public IExceptionTranslatorRegistry {
10665     public:
10666         ~ExceptionTranslatorRegistry();
10667         virtual void registerTranslator( const IExceptionTranslator* translator );
10668         std::string translateActiveException() const override;
10669         std::string tryTranslators() const;
10670
10671     private:
10672         std::vector<std::unique_ptr<IExceptionTranslator const» m_translators;
10673     };
10674 }
10675
10676 // end catch_exception_translator_registry.h
10677 #ifdef __OBJC__
10678 #import "Foundation/Foundation.h"
10679 #endif
10680
10681 namespace Catch {
10682
10683     ExceptionTranslatorRegistry::~ExceptionTranslatorRegistry() {
10684     }
10685
10686     void ExceptionTranslatorRegistry::registerTranslator( const IExceptionTranslator* translator ) {
10687         m_translators.push_back( std::unique_ptr<const IExceptionTranslator>( translator ) );
10688     }
10689
10690 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
10691     std::string ExceptionTranslatorRegistry::translateActiveException() const {
10692         try {
10693 #ifdef __OBJC__
10694             // In Objective-C try objective-c exceptions first
10695             @try {
10696                 return tryTranslators();
10697             }
10698             @catch (NSException *exception) {
10699                 return Catch::Detail::stringify( [exception description] );
10700             }
10701 #else
10702             // Compiling a mixed mode project with MSVC means that CLR
10703             // exceptions will be caught in (...) as well. However, these
10704             // do not fill-in std::current_exception and thus lead to crash
```

```
10705             // when attempting rethrow.
10706             // /EHa switch also causes structured exceptions to be caught
10707             // here, but they fill-in current_exception properly, so
10708             // at worst the output should be a little weird, instead of
10709             // causing a crash.
10710             if (std::current_exception() == nullptr) {
10711                 return "Non C++ exception. Possibly a CLR exception.";
10712             }
10713             return tryTranslators();
10714 #endif
10715         }
10716         catch( TestFailureException& ) {
10717             std::rethrow_exception(std::current_exception());
10718         }
10719         catch( std::exception& ex ) {
10720             return ex.what();
10721         }
10722         catch( std::string& msg ) {
10723             return msg;
10724         }
10725         catch( const char* msg ) {
10726             return msg;
10727         }
10728         catch(...) {
10729             return "Unknown exception";
10730         }
10731     }
10732
10733     std::string ExceptionTranslatorRegistry::tryTranslators() const {
10734         if (m_translators.empty()) {
10735             std::rethrow_exception(std::current_exception());
10736         } else {
10737             return m_translators[0]->translate(m_translators.begin() + 1, m_translators.end());
10738         }
10739     }
10740
10741 #else // ^^ Exceptions are enabled // Exceptions are disabled vv
10742     std::string ExceptionTranslatorRegistry::translateActiveException() const {
10743         CATCH_INTERNAL_ERROR("Attempted to translate active exception under
      CATCH_CONFIG_DISABLE_EXCEPTIONS!");
10744     }
10745
10746     std::string ExceptionTranslatorRegistry::tryTranslators() const {
10747         CATCH_INTERNAL_ERROR("Attempted to use exception translators under
      CATCH_CONFIG_DISABLE_EXCEPTIONS!");
10748     }
10749 #endif
10750
10751 }
10752 // end catch_exception_translator_registry.cpp
10753 // start catch_fatal_condition.cpp
10754
10755 #include <algorithm>
10756
10757 #if !defined( CATCH_CONFIG_WINDOWS_SEH ) && !defined( CATCH_CONFIG_POSIX_SIGNALS )
10758
10759 namespace Catch {
10760
10761     // If neither SEH nor signal handling is required, the handler impls
10762     // do not have to do anything, and can be empty.
10763     void FatalConditionHandler::engage_platform() {}
10764     void FatalConditionHandler::disengage_platform() {}
10765     FatalConditionHandler::FatalConditionHandler() = default;
10766     FatalConditionHandler::~FatalConditionHandler() = default;
10767
10768 } // end namespace Catch
10769
10770 #endif // !CATCH_CONFIG_WINDOWS_SEH && !CATCH_CONFIG_POSIX_SIGNALS
10771
10772 #if defined( CATCH_CONFIG_WINDOWS_SEH ) && defined( CATCH_CONFIG_POSIX_SIGNALS )
10773 #error "Inconsistent configuration: Windows' SEH handling and POSIX signals cannot be enabled at the
      same time"
10774 #endif // CATCH_CONFIG_WINDOWS_SEH && CATCH_CONFIG_POSIX_SIGNALS
10775
10776 #if defined( CATCH_CONFIG_WINDOWS_SEH ) || defined( CATCH_CONFIG_POSIX_SIGNALS )
10777
10778 namespace {
10780     void reportFatal( char const * const message ) {
10781         Catch::getCurrentContext().getResultCapture()->handleFatalErrorCondition( message );
10782     }
10783
10787     constexpr std::size_t minStackSizeForErrors = 32 * 1024;
10788 } // end unnamed namespace
10789
10790 #endif // CATCH_CONFIG_WINDOWS_SEH || CATCH_CONFIG_POSIX_SIGNALS
10791
10792 #if defined( CATCH_CONFIG_WINDOWS_SEH )
```

```
10793
10794 namespace Catch {
10795
10796     struct SignalDefs { DWORD id; const char* name; };
10797
10798     // There is no 1-1 mapping between signals and windows exceptions.
10799     // Windows can easily distinguish between SO and SigSegV,
10800     // but SigInt, SigTerm, etc are handled differently.
10801     static SignalDefs signalDefs[] = {
10802         { static_cast<DWORD>(EXCEPTION_ILLEGAL_INSTRUCTION),  "SIGILL - Illegal instruction signal" },
10803         { static_cast<DWORD>(EXCEPTION_STACK_OVERFLOW), "SIGSEGV - Stack overflow" },
10804         { static_cast<DWORD>(EXCEPTION_ACCESS_VIOLATION), "SIGSEGV - Segmentation violation signal" },
10805         { static_cast<DWORD>(EXCEPTION_INT_DIVIDE_BY_ZERO), "Divide by zero error" },
10806     };
10807
10808     static LONG CALLBACK handleVectoredException(PEXCEPTION_POINTERS ExceptionInfo) {
10809         for (auto const& def : signalDefs) {
10810             if (ExceptionInfo->ExceptionRecord->ExceptionCode == def.id) {
10811                 reportFatal(def.name);
10812             }
10813         }
10814         // If its not an exception we care about, pass it along.
10815         // This stops us from eating debugger breaks etc.
10816         return EXCEPTION_CONTINUE_SEARCH;
10817     }
10818
10819     // Since we do not support multiple instantiations, we put these
10820     // into global variables and rely on cleaning them up in outlined
10821     // constructors/destructors
10822     static PVOID exceptionHandlerHandle = nullptr;
10823
10824     // For MSVC, we reserve part of the stack memory for handling
10825     // memory overflow structured exception.
10826     FatalConditionHandler::FatalConditionHandler() {
10827         ULONG guaranteeSize = static_cast<ULONG>(minStackSizeForErrors);
10828         if (!SetThreadStackGuarantee(&guaranteeSize)) {
10829             // We do not want to fully error out, because needing
10830             // the stack reserve should be rare enough anyway.
10831             Catch::cerr()
10832                 << "Failed to reserve piece of stack."
10833                 << " Stack overflows will not be reported successfully.";
10834         }
10835     }
10836
10837     // We do not attempt to unset the stack guarantee, because
10838     // Windows does not support lowering the stack size guarantee.
10839     FatalConditionHandler::~FatalConditionHandler() = default;
10840
10841     void FatalConditionHandler::engage_platform() {
10842         // Register as first handler in current chain
10843         exceptionHandlerHandle = AddVectoredExceptionHandler(1, handleVectoredException);
10844         if (!exceptionHandlerHandle) {
10845             CATCH_RUNTIME_ERROR("Could not register vectored exception handler");
10846         }
10847     }
10848
10849     void FatalConditionHandler::disengage_platform() {
10850         if (!RemoveVectoredExceptionHandler(exceptionHandlerHandle)) {
10851             CATCH_RUNTIME_ERROR("Could not unregister vectored exception handler");
10852         }
10853         exceptionHandlerHandle = nullptr;
10854     }
10855
10856 } // end namespace Catch
10857
10858 #endif // CATCH_CONFIG_WINDOWS_SEH
10859
10860 #if defined( CATCH_CONFIG_POSIX_SIGNALS )
10861
10862 #include <signal.h>
10863
10864 namespace Catch {
10865
10866     struct SignalDefs {
10867         int id;
10868         const char* name;
10869     };
10870
10871     static SignalDefs signalDefs[] = {
10872             { SIGINT,  "SIGINT - Terminal interrupt signal" },
10873             { SIGILL,  "SIGILL - Illegal instruction signal" },
10874             { SIGFPE,  "SIGFPE - Floating point error signal" },
10875             { SIGSEGV, "SIGSEGV - Segmentation violation signal" },
10876             { SIGTERM, "SIGTERM - Termination request signal" },
10877             { SIGABRT, "SIGABRT - Abort (abnormal termination) signal" }
10878     };
10879
```

```
10880 // Older GCCs trigger -Wmissing-field-initializers for T foo = {}
10881 // which is zero initialization, but not explicit. We want to avoid
10882 // that.
10883 #if defined(__GNUC__)
10884 #    pragma GCC diagnostic push
10885 #    pragma GCC diagnostic ignored "-Wmissing-field-initializers"
10886 #endif
10887
10888     static char* altStackMem = nullptr;
10889     static std::size_t altStackSize = 0;
10890     static stack_t oldSigStack{};
10891     static struct sigaction oldSigActions[sizeof(signalDefs) / sizeof(SignalDefs)]{};
10892
10893     static void restorePreviousSignalHandlers() {
10894         // We set signal handlers back to the previous ones. Hopefully
10895         // nobody overwrote them in the meantime, and doesn't expect
10896         // their signal handlers to live past ours given that they
10897         // installed them after ours..
10898         for (std::size_t i = 0; i < sizeof(signalDefs) / sizeof(SignalDefs); ++i) {
10899             sigaction(signalDefs[i].id, &oldSigActions[i], nullptr);
10900         }
10901         // Return the old stack
10902         sigaltstack(&oldSigStack, nullptr);
10903     }
10904
10905     static void handleSignal( int sig ) {
10906         char const * name = "<unknown signal>";
10907         for (auto const& def : signalDefs) {
10908             if (sig == def.id) {
10909                 name = def.name;
10910                 break;
10911             }
10912         }
10913         // We need to restore previous signal handlers and let them do
10914         // their thing, so that the users can have the debugger break
10915         // when a signal is raised, and so on.
10916         restorePreviousSignalHandlers();
10917         reportFatal( name );
10918         raise( sig );
10919     }
10920
10921     FatalConditionHandler::FatalConditionHandler() {
10922         assert(!altStackMem && "Cannot initialize POSIX signal handler when one already exists");
10923         if (altStackSize == 0) {
10924             altStackSize = std::max(static_cast<size_t>(SIGSTKSZ), minStackSizeForErrors);
10925         }
10926         altStackMem = new char[altStackSize]();
10927     }
10928
10929     FatalConditionHandler::~FatalConditionHandler() {
10930         delete[] altStackMem;
10931         // We signal that another instance can be constructed by zeroing
10932         // out the pointer.
10933         altStackMem = nullptr;
10934     }
10935
10936     void FatalConditionHandler::engage_platform() {
10937         stack_t sigStack;
10938         sigStack.ss_sp = altStackMem;
10939         sigStack.ss_size = altStackSize;
10940         sigStack.ss_flags = 0;
10941         sigaltstack(&sigStack, &oldSigStack);
10942         struct sigaction sa = { };
10943
10944         sa.sa_handler = handleSignal;
10945         sa.sa_flags = SA_ONSTACK;
10946         for (std::size_t i = 0; i < sizeof(signalDefs)/sizeof(SignalDefs); ++i) {
10947             sigaction(signalDefs[i].id, &sa, &oldSigActions[i]);
10948         }
10949     }
10950
10951 #if defined(__GNUC__)
10952 #    pragma GCC diagnostic pop
10953 #endif
10954
10955     void FatalConditionHandler::disengage_platform() {
10956         restorePreviousSignalHandlers();
10957     }
10958
10959 } // end namespace Catch
10960
10961 #endif // CATCH_CONFIG_POSIX_SIGNALS
10962 // end catch_fatal_condition.cpp
10963 // start catch_generators.cpp
10964
10965 #include <limits>
10966 #include <set>
```

```
10967
10968 namespace Catch {
10969
10970     IGeneratorTracker::~IGeneratorTracker() {}
10971
10972     const char* GeneratorException::what() const noexcept {
10973         return m_msg;
10974     }
10975
10976     namespace Generators {
10977
10978         GeneratorUntypedBase::~GeneratorUntypedBase() {}
10979
10980         auto acquireGeneratorTracker( StringRef generatorName, SourceLineInfo const& lineInfo ) ->
      IGeneratorTracker& {
10981             return getResultCapture().acquireGeneratorTracker( generatorName, lineInfo );
10982         }
10983
10984     } // namespace Generators
10985 } // namespace Catch
10986 // end catch_generators.cpp
10987 // start catch_interfaces_capture.cpp
10988
10989 namespace Catch {
10990     IResultCapture::~IResultCapture() = default;
10991 }
10992 // end catch_interfaces_capture.cpp
10993 // start catch_interfaces_config.cpp
10994
10995 namespace Catch {
10996     IConfig::~IConfig() = default;
10997 }
10998 // end catch_interfaces_config.cpp
10999 // start catch_interfaces_exception.cpp
11000
11001 namespace Catch {
11002     IExceptionTranslator::~IExceptionTranslator() = default;
11003     IExceptionTranslatorRegistry::~IExceptionTranslatorRegistry() = default;
11004 }
11005 // end catch_interfaces_exception.cpp
11006 // start catch_interfaces_registry_hub.cpp
11007
11008 namespace Catch {
11009     IRegistryHub::~IRegistryHub() = default;
11010     IMutableRegistryHub::~IMutableRegistryHub() = default;
11011 }
11012 // end catch_interfaces_registry_hub.cpp
11013 // start catch_interfaces_reporter.cpp
11014
11015 // start catch_reporter_listening.h
11016
11017 namespace Catch {
11018
11019     class ListeningReporter : public IStreamingReporter {
11020         using Reporters = std::vector<IStreamingReporterPtr>;
11021         Reporters m_listeners;
11022         IStreamingReporterPtr m_reporter = nullptr;
11023         ReporterPreferences m_preferences;
11024
11025     public:
11026         ListeningReporter();
11027
11028         void addListener( IStreamingReporterPtr&& listener );
11029         void addReporter( IStreamingReporterPtr&& reporter );
11030
11031     public: // IStreamingReporter
11032
11033         ReporterPreferences getPreferences() const override;
11034
11035         void noMatchingTestCases( std::string const& spec ) override;
11036
11037         void reportInvalidArguments(std::string const&arg) override;
11038
11039         static std::set<Verbosity> getSupportedVerbosities();
11040
11041 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
11042         void benchmarkPreparing(std::string const& name) override;
11043         void benchmarkStarting( BenchmarkInfo const& benchmarkInfo ) override;
11044         void benchmarkEnded( BenchmarkStats<> const& benchmarkStats ) override;
11045         void benchmarkFailed(std::string const&) override;
11046 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
11047
11048         void testRunStarting( TestRunInfo const& testRunInfo ) override;
11049         void testGroupStarting( GroupInfo const& groupInfo ) override;
11050         void testCaseStarting( TestCaseInfo const& testInfo ) override;
11051         void sectionStarting( SectionInfo const& sectionInfo ) override;
11052         void assertionStarting( AssertionInfo const& assertionInfo ) override;
```

```
11053
11054         // The return value indicates if the messages buffer should be cleared:
11055         bool assertionEnded( AssertionStats const& assertionStats ) override;
11056         void sectionEnded( SectionStats const& sectionStats ) override;
11057         void testCaseEnded( TestCaseStats const& testCaseStats ) override;
11058         void testGroupEnded( TestGroupStats const& testGroupStats ) override;
11059         void testRunEnded( TestRunStats const& testRunStats ) override;
11060
11061         void skipTest( TestCaseInfo const& testInfo ) override;
11062         bool isMulti() const override;
11063
11064     };
11065
11066 } // end namespace Catch
11067
11068 // end catch_reporter_listening.h
11069 namespace Catch {
11070
11071     ReporterConfig::ReporterConfig( IConfigPtr const& _fullConfig )
11072             :   m_stream( &_fullConfig->stream() ), m_fullConfig( _fullConfig ) {}
11073
11074     ReporterConfig::ReporterConfig( IConfigPtr const& _fullConfig, std::ostream& _stream )
11075             :   m_stream( &_stream ), m_fullConfig( _fullConfig ) {}
11076
11077     std::ostream& ReporterConfig::stream() const { return *m_stream; }
11078     IConfigPtr ReporterConfig::fullConfig() const { return m_fullConfig; }
11079
11080     TestRunInfo::TestRunInfo( std::string const& _name ) : name( _name ) {}
11081
11082     GroupInfo::GroupInfo(  std::string const& _name,
11083                            std::size_t _groupIndex,
11084                            std::size_t _groupsCount )
11085             :   name( _name ),
11086                 groupIndex( _groupIndex ),
11087                 groupsCounts( _groupsCount )
11088     {}
11089
11090     AssertionStats::AssertionStats( AssertionResult const& _assertionResult,
11091                                     std::vector<MessageInfo> const& _infoMessages,
11092                                     Totals const& _totals )
11093             :   assertionResult( _assertionResult ),
11094                 infoMessages( _infoMessages ),
11095                 totals( _totals )
11096     {
11097         assertionResult.m_resultData.lazyExpression.m_transientExpression =
    _assertionResult.m_resultData.lazyExpression.m_transientExpression;
11098
11099         if( assertionResult.hasMessage() ) {
11100             // Copy message into messages list.
11101             // !TBD This should have been done earlier, somewhere
11102             MessageBuilder builder( assertionResult.getTestMacroName(),
    assertionResult.getSourceInfo(), assertionResult.getResultType() );
11103             builder << assertionResult.getMessage();
11104             builder.m_info.message = builder.m_stream.str();
11105
11106             infoMessages.push_back( builder.m_info );
11107         }
11108     }
11109
11110     AssertionStats::~AssertionStats() = default;
11111
11112     SectionStats::SectionStats(  SectionInfo const& _sectionInfo,
11113                                  Counts const& _assertions,
11114                                  double _durationInSeconds,
11115                                  bool _missingAssertions )
11116             :   sectionInfo( _sectionInfo ),
11117                 assertions( _assertions ),
11118                 durationInSeconds( _durationInSeconds ),
11119                 missingAssertions( _missingAssertions )
11120     {}
11121
11122     SectionStats::~SectionStats() = default;
11123
11124     TestCaseStats::TestCaseStats(  TestCaseInfo const& _testInfo,
11125                                    Totals const& _totals,
11126                                    std::string const& _stdOut,
11127                                    std::string const& _stdErr,
11128                                    bool _aborting )
11129             : testInfo( _testInfo ),
11130               totals( _totals ),
11131               stdOut( _stdOut ),
11132               stdErr( _stdErr ),
11133               aborting( _aborting )
11134     {}
11135
11136     TestCaseStats::~TestCaseStats() = default;
11137
```

```
11138     TestGroupStats::TestGroupStats( GroupInfo const& _groupInfo,
11139                                     Totals const& _totals,
11140                                     bool _aborting )
11141             :   groupInfo( _groupInfo ),
11142                 totals( _totals ),
11143                 aborting( _aborting )
11144     {}
11145
11146     TestGroupStats::TestGroupStats( GroupInfo const& _groupInfo )
11147             :   groupInfo( _groupInfo ),
11148                 aborting( false )
11149     {}
11150
11151     TestGroupStats::~TestGroupStats() = default;
11152
11153     TestRunStats::TestRunStats(   TestRunInfo const& _runInfo,
11154                                   Totals const& _totals,
11155                                   bool _aborting )
11156             :   runInfo( _runInfo ),
11157                 totals( _totals ),
11158                 aborting( _aborting )
11159     {}
11160
11161     TestRunStats::~TestRunStats() = default;
11162
11163     void IStreamingReporter::fatalErrorEncountered( StringRef ) {}
11164     bool IStreamingReporter::isMulti() const { return false; }
11165
11166     IReporterFactory::~IReporterFactory() = default;
11167     IReporterRegistry::~IReporterRegistry() = default;
11168
11169 } // end namespace Catch
11170 // end catch_interfaces_reporter.cpp
11171 // start catch_interfaces_runner.cpp
11172
11173 namespace Catch {
11174     IRunner::~IRunner() = default;
11175 }
11176 // end catch_interfaces_runner.cpp
11177 // start catch_interfaces_testcase.cpp
11178
11179 namespace Catch {
11180     ITestInvoker::~ITestInvoker() = default;
11181     ITestCaseRegistry::~ITestCaseRegistry() = default;
11182 }
11183 // end catch_interfaces_testcase.cpp
11184 // start catch_leak_detector.cpp
11185
11186 #ifdef CATCH_CONFIG_WINDOWS_CRTDBG
11187 #include <crtdbg.h>
11188
11189 namespace Catch {
11190
11191     LeakDetector::LeakDetector() {
11192         int flag = _CrtSetDbgFlag(_CRTDBG_REPORT_FLAG);
11193         flag |= _CRTDBG_LEAK_CHECK_DF;
11194         flag |= _CRTDBG_ALLOC_MEM_DF;
11195         _CrtSetDbgFlag(flag);
11196         _CrtSetReportMode(_CRT_WARN, _CRTDBG_MODE_FILE | _CRTDBG_MODE_DEBUG);
11197         _CrtSetReportFile(_CRT_WARN, _CRTDBG_FILE_STDERR);
11198         // Change this to leaking allocation's number to break there
11199         _CrtSetBreakAlloc(-1);
11200     }
11201 }
11202
11203 #else
11204
11205 Catch::LeakDetector::LeakDetector() {}
11206
11207 #endif
11208
11209 Catch::LeakDetector::~LeakDetector() {
11210     Catch::cleanUp();
11211 }
11212 // end catch_leak_detector.cpp
11213 // start catch_list.cpp
11214
11215 // start catch_list.h
11216
11217 #include <set>
11218
11219 namespace Catch {
11220
11221     std::size_t listTests( Config const& config );
11222
11223     std::size_t listTestsNamesOnly( Config const& config );
11224
```

```
11225     struct TagInfo {
11226         void add( std::string const& spelling );
11227         std::string all() const;
11228
11229         std::set<std::string> spellings;
11230         std::size_t count = 0;
11231     };
11232
11233     std::size_t listTags( Config const& config );
11234
11235     std::size_t listReporters();
11236
11237     Option<std::size_t> list( std::shared_ptr<Config> const& config );
11238
11239 } // end namespace Catch
11240
11241 // end catch_list.h
11242 // start catch_text.h
11243
11244 namespace Catch {
11245     using namespace clara::TextFlow;
11246 }
11247
11248 // end catch_text.h
11249 #include <limits>
11250 #include <algorithm>
11251 #include <iomanip>
11252
11253 namespace Catch {
11254
11255     std::size_t listTests( Config const& config ) {
11256         TestSpec const& testSpec = config.testSpec();
11257         if( config.hasTestFilters() )
11258             Catch::cout() << "Matching test cases:\n";
11259         else {
11260             Catch::cout() << "All available test cases:\n";
11261         }
11262
11263         auto matchedTestCases = filterTests( getAllTestCasesSorted( config ), testSpec, config );
11264         for( auto const& testCaseInfo : matchedTestCases ) {
11265             Colour::Code colour = testCaseInfo.isHidden()
11266                                   ? Colour::SecondaryText
11267                                   : Colour::None;
11268             Colour colourGuard( colour );
11269
11270             Catch::cout() << Column( testCaseInfo.name ).initialIndent( 2 ).indent( 4 ) << "\n";
11271             if( config.verbosity() >= Verbosity::High ) {
11272                 Catch::cout() << Column( Catch::Detail::stringify( testCaseInfo.lineInfo ) ).indent(4)
      << std::endl;
11273                 std::string description = testCaseInfo.description;
11274                 if( description.empty() )
11275                     description = "(NO DESCRIPTION)";
11276                 Catch::cout() << Column( description ).indent(4) << std::endl;
11277             }
11278             if( !testCaseInfo.tags.empty() )
11279                 Catch::cout() << Column( testCaseInfo.tagsAsString() ).indent( 6 ) << "\n";
11280         }
11281
11282         if( !config.hasTestFilters() )
11283             Catch::cout() << pluralise( matchedTestCases.size(), "test case" ) << '\n' << std::endl;
11284         else
11285             Catch::cout() << pluralise( matchedTestCases.size(), "matching test case" ) << '\n' <<
      std::endl;
11286         return matchedTestCases.size();
11287     }
11288
11289     std::size_t listTestsNamesOnly( Config const& config ) {
11290         TestSpec const& testSpec = config.testSpec();
11291         std::size_t matchedTests = 0;
11292         std::vector<TestCase> matchedTestCases = filterTests( getAllTestCasesSorted( config ),
      testSpec, config );
11293         for( auto const& testCaseInfo : matchedTestCases ) {
11294             matchedTests++;
11295             if( startsWith( testCaseInfo.name, '#' ) )
11296                 Catch::cout() << '"' << testCaseInfo.name << '"';
11297             else
11298                 Catch::cout() << testCaseInfo.name;
11299             if ( config.verbosity() >= Verbosity::High )
11300                 Catch::cout() << "\t@" << testCaseInfo.lineInfo;
11301             Catch::cout() << std::endl;
11302         }
11303         return matchedTests;
11304     }
11305
11306     void TagInfo::add( std::string const& spelling ) {
11307         ++count;
11308         spellings.insert( spelling );
```

```
11309     }
11310
11311     std::string TagInfo::all() const {
11312         size_t size = 0;
11313         for (auto const& spelling : spellings) {
11314             // Add 2 for the brackes
11315             size += spelling.size() + 2;
11316         }
11317
11318         std::string out; out.reserve(size);
11319         for (auto const& spelling : spellings) {
11320             out += '[';
11321             out += spelling;
11322             out += ']';
11323         }
11324         return out;
11325     }
11326
11327     std::size_t listTags( Config const& config ) {
11328         TestSpec const& testSpec = config.testSpec();
11329         if( config.hasTestFilters() )
11330             Catch::cout() << "Tags for matching test cases:\n";
11331         else {
11332             Catch::cout() << "All available tags:\n";
11333         }
11334
11335         std::map<std::string, TagInfo> tagCounts;
11336
11337         std::vector<TestCase> matchedTestCases = filterTests( getAllTestCasesSorted( config ),
    testSpec, config );
11338         for( auto const& testCase : matchedTestCases ) {
11339             for( auto const& tagName : testCase.getTestCaseInfo().tags ) {
11340                 std::string lcaseTagName = toLower( tagName );
11341                 auto countIt = tagCounts.find( lcaseTagName );
11342                 if( countIt == tagCounts.end() )
11343                     countIt = tagCounts.insert( std::make_pair( lcaseTagName, TagInfo() ) ).first;
11344                 countIt->second.add( tagName );
11345             }
11346         }
11347
11348         for( auto const& tagCount : tagCounts ) {
11349             ReusableStringStream rss;
11350             rss << "  " << std::setw(2) << tagCount.second.count << "  ";
11351             auto str = rss.str();
11352             auto wrapper = Column( tagCount.second.all() )
11353                     .initialIndent( 0 )
11354                     .indent( str.size() )
11355                     .width( CATCH_CONFIG_CONSOLE_WIDTH-10 );
11356             Catch::cout() << str << wrapper << '\n';
11357         }
11358         Catch::cout() << pluralise( tagCounts.size(), "tag" ) << '\n' << std::endl;
11359         return tagCounts.size();
11360     }
11361
11362     std::size_t listReporters() {
11363         Catch::cout() << "Available reporters:\n";
11364         IReporterRegistry::FactoryMap const& factories =
    getRegistryHub().getReporterRegistry().getFactories();
11365         std::size_t maxNameLen = 0;
11366         for( auto const& factoryKvp : factories )
11367             maxNameLen = (std::max)( maxNameLen, factoryKvp.first.size() );
11368
11369         for( auto const& factoryKvp : factories ) {
11370             Catch::cout()
11371                     << Column( factoryKvp.first + ":" )
11372                                .indent(2)
11373                                .width( 5+maxNameLen )
11374                        +  Column( factoryKvp.second->getDescription() )
11375                                .initialIndent(0)
11376                                .indent(2)
11377                                .width( CATCH_CONFIG_CONSOLE_WIDTH - maxNameLen-8 )
11378                     << "\n";
11379         }
11380         Catch::cout() << std::endl;
11381         return factories.size();
11382     }
11383
11384     Option<std::size_t> list( std::shared_ptr<Config> const& config ) {
11385         Option<std::size_t> listedCount;
11386         getCurrentMutableContext().setConfig( config );
11387         if( config->listTests() )
11388             listedCount = listedCount.valueOr(0) + listTests( *config );
11389         if( config->listTestNamesOnly() )
11390             listedCount = listedCount.valueOr(0) + listTestsNamesOnly( *config );
11391         if( config->listTags() )
11392             listedCount = listedCount.valueOr(0) + listTags( *config );
11393         if( config->listReporters() )
```

```
11394             listedCount = listedCount.valueOr(0) + listReporters();
11395         return listedCount;
11396     }
11397
11398 } // end namespace Catch
11399 // end catch_list.cpp
11400 // start catch_matchers.cpp
11401
11402 namespace Catch {
11403     namespace Matchers {
11404         namespace Impl {
11405
11406             std::string MatcherUntypedBase::toString() const {
11407                 if( m_cachedToString.empty() )
11408                     m_cachedToString = describe();
11409                 return m_cachedToString;
11410             }
11411
11412             MatcherUntypedBase::~MatcherUntypedBase() = default;
11413
11414         } // namespace Impl
11415     } // namespace Matchers
11416
11417     using namespace Matchers;
11418     using Matchers::Impl::MatcherBase;
11419
11420 } // namespace Catch
11421 // end catch_matchers.cpp
11422 // start catch_matchers_exception.cpp
11423
11424 namespace Catch {
11425     namespace Matchers {
11426         namespace Exception {
11427
11428             bool ExceptionMessageMatcher::match(std::exception const& ex) const {
11429                 return ex.what() == m_message;
11430             }
11431
11432             std::string ExceptionMessageMatcher::describe() const {
11433                 return "exception message matches \"" + m_message + "\"";
11434             }
11435
11436         }
11437         Exception::ExceptionMessageMatcher Message(std::string const& message) {
11438             return Exception::ExceptionMessageMatcher(message);
11439         }
11440
11441 // namespace Exception
11442     } // namespace Matchers
11443 } // namespace Catch
11444 // end catch_matchers_exception.cpp
11445 // start catch_matchers_floating.cpp
11446
11447 // start catch_polyfills.hpp
11448
11449 namespace Catch {
11450     bool isnan(float f);
11451     bool isnan(double d);
11452 }
11453
11454 // end catch_polyfills.hpp
11455 // start catch_to_string.hpp
11456
11457 #include <string>
11458
11459 namespace Catch {
11460     template <typename T>
11461     std::string to_string(T const& t) {
11462 #if defined(CATCH_CONFIG_CPP11_TO_STRING)
11463         return std::to_string(t);
11464 #else
11465         ReusableStringStream rss;
11466         rss << t;
11467         return rss.str();
11468 #endif
11469     }
11470 } // end namespace Catch
11471
11472 // end catch_to_string.hpp
11473 #include <algorithm>
11474 #include <cmath>
11475 #include <cstdlib>
11476 #include <cstdint>
11477 #include <cstring>
11478 #include <sstream>
11479 #include <type_traits>
11480 #include <iomanip>
```

```
11481 #include <limits>
11482
11483 namespace Catch {
11484     namespace {
11485
11486         int32_t convert(float f) {
11487             static_assert(sizeof(float) == sizeof(int32_t), "Important ULP matcher assumption
      violated");
11488             int32_t i;
11489             std::memcpy(&i, &f, sizeof(f));
11490             return i;
11491         }
11492
11493         int64_t convert(double d) {
11494             static_assert(sizeof(double) == sizeof(int64_t), "Important ULP matcher assumption
      violated");
11495             int64_t i;
11496             std::memcpy(&i, &d, sizeof(d));
11497             return i;
11498         }
11499
11500         template <typename FP>
11501         bool almostEqualUlps(FP lhs, FP rhs, uint64_t maxUlpDiff) {
11502             // Comparison with NaN should always be false.
11503             // This way we can rule it out before getting into the ugly details
11504             if (Catch::isnan(lhs) || Catch::isnan(rhs)) {
11505                 return false;
11506             }
11507
11508             auto lc = convert(lhs);
11509             auto rc = convert(rhs);
11510
11511             if ((lc < 0) != (rc < 0)) {
11512                 // Potentially we can have +0 and -0
11513                 return lhs == rhs;
11514             }
11515
11516             // static cast as a workaround for IBM XLC
11517             auto ulpDiff = std::abs(static_cast<FP>(lc - rc));
11518             return static_cast<uint64_t>(ulpDiff) <= maxUlpDiff;
11519         }
11520
11521 #if defined(CATCH_CONFIG_GLOBAL_NEXTAFTER)
11522
11523         float nextafter(float x, float y) {
11524             return ::nextafterf(x, y);
11525         }
11526
11527         double nextafter(double x, double y) {
11528             return ::nextafter(x, y);
11529         }
11530
11531 #endif // ^^^ CATCH_CONFIG_GLOBAL_NEXTAFTER ^^^
11532
11533         template <typename FP>
11534         FP step(FP start, FP direction, uint64_t steps) {
11535             for (uint64_t i = 0; i < steps; ++i) {
11536 #if defined(CATCH_CONFIG_GLOBAL_NEXTAFTER)
11537                 start = Catch::nextafter(start, direction);
11538 #else
11539                 start = std::nextafter(start, direction);
11540 #endif
11541             }
11542             return start;
11543         }
11544
11545 // Performs equivalent check of std::fabs(lhs - rhs) <= margin
11546 // But without the subtraction to allow for INFINITY in comparison
11547         bool marginComparison(double lhs, double rhs, double margin) {
11548             return (lhs + margin >= rhs) && (rhs + margin >= lhs);
11549         }
11550
11551         template <typename FloatingPoint>
11552         void write(std::ostream& out, FloatingPoint num) {
11553             out « std::scientific
11554                 « std::setprecision(std::numeric_limits<FloatingPoint>::max_digits10 - 1)
11555                 « num;
11556         }
11557
11558     } // end anonymous namespace
11559
11560     namespace Matchers {
11561         namespace Floating {
11562
11563             enum class FloatingPointKind : uint8_t {
11564                 Float,
11565                 Double
```

```
11566             };
11567
11568             WithinAbsMatcher::WithinAbsMatcher(double target, double margin)
11569                     :m_target{ target }, m_margin{ margin } {
11570                 CATCH_ENFORCE(margin >= 0, "Invalid margin: " « margin « '.'
11571                                                              « " Margin has to be non-negative.");
11572             }
11573
11574             // Performs equivalent check of std::fabs(lhs - rhs) <= margin
11575             // But without the subtraction to allow for INFINITY in comparison
11576             bool WithinAbsMatcher::match(double const& matchee) const {
11577                 return (matchee + m_margin >= m_target) && (m_target + m_margin >= matchee);
11578             }
11579
11580             std::string WithinAbsMatcher::describe() const {
11581                 return "is within " + ::Catch::Detail::stringify(m_margin) + " of " +
      ::Catch::Detail::stringify(m_target);
11582             }
11583
11584             WithinUlpsMatcher::WithinUlpsMatcher(double target, uint64_t ulps, FloatingPointKind
      baseType)
11585                     :m_target{ target }, m_ulps{ ulps }, m_type{ baseType } {
11586                 CATCH_ENFORCE(m_type == FloatingPointKind::Double
11587                                 || m_ulps < (std::numeric_limits<uint32_t>::max)(),
11588                                 "Provided ULP is impossibly large for a float comparison.");
11589             }
11590
11591 #if defined(__clang__)
11592 #pragma clang diagnostic push
11593 // Clang <3.5 reports on the default branch in the switch below
11594 #pragma clang diagnostic ignored "-Wunreachable-code"
11595 #endif
11596
11597             bool WithinUlpsMatcher::match(double const& matchee) const {
11598                 switch (m_type) {
11599                     case FloatingPointKind::Float:
11600                         return almostEqualUlps<float>(static_cast<float>(matchee),
      static_cast<float>(m_target), m_ulps);
11601                     case FloatingPointKind::Double:
11602                         return almostEqualUlps<double>(matchee, m_target, m_ulps);
11603                     default:
11604                         CATCH_INTERNAL_ERROR( "Unknown FloatingPointKind value" );
11605                 }
11606             }
11607
11608 #if defined(__clang__)
11609 #pragma clang diagnostic pop
11610 #endif
11611
11612             std::string WithinUlpsMatcher::describe() const {
11613                 std::stringstream ret;
11614
11615                 ret « "is within " « m_ulps « " ULPs of ";
11616
11617                 if (m_type == FloatingPointKind::Float) {
11618                     write(ret, static_cast<float>(m_target));
11619                     ret « 'f';
11620                 } else {
11621                     write(ret, m_target);
11622                 }
11623
11624                 ret « " ([";
11625                 if (m_type == FloatingPointKind::Double) {
11626                     write(ret, step(m_target, static_cast<double>(-INFINITY), m_ulps));
11627                     ret « ", ";
11628                     write(ret, step(m_target, static_cast<double>( INFINITY), m_ulps));
11629                 } else {
11630                     // We have to cast INFINITY to float because of MinGW, see #1782
11631                     write(ret, step(static_cast<float>(m_target), static_cast<float>(-INFINITY),
      m_ulps));
11632                     ret « ", ";
11633                     write(ret, step(static_cast<float>(m_target), static_cast<float>( INFINITY),
      m_ulps));
11634                 }
11635                 ret « "])";
11636
11637                 return ret.str();
11638             }
11639
11640             WithinRelMatcher::WithinRelMatcher(double target, double epsilon):
11641                     m_target(target),
11642                     m_epsilon(epsilon){
11643                 CATCH_ENFORCE(m_epsilon >= 0., "Relative comparison with epsilon <  0 does not make
      sense.");
11644                 CATCH_ENFORCE(m_epsilon  < 1., "Relative comparison with epsilon >= 1 does not make
      sense.");
11645             }
```

```
11646
11647             bool WithinRelMatcher::match(double const& matchee) const {
11648                 const auto relMargin = m_epsilon * (std::max)(std::fabs(matchee),
      std::fabs(m_target));
11649                 return marginComparison(matchee, m_target,
11650                                         std::isinf(relMargin)? 0 : relMargin);
11651             }
11652
11653             std::string WithinRelMatcher::describe() const {
11654                 Catch::ReusableStringStream sstr;
11655                 sstr « "and " « m_target « " are within " « m_epsilon * 100. « "% of each other";
11656                 return sstr.str();
11657             }
11658
11659         }// namespace Floating
11660
11661         Floating::WithinUlpsMatcher WithinULP(double target, uint64_t maxUlpDiff) {
11662             return Floating::WithinUlpsMatcher(target, maxUlpDiff,
      Floating::FloatingPointKind::Double);
11663         }
11664
11665         Floating::WithinUlpsMatcher WithinULP(float target, uint64_t maxUlpDiff) {
11666             return Floating::WithinUlpsMatcher(target, maxUlpDiff,
      Floating::FloatingPointKind::Float);
11667         }
11668
11669         Floating::WithinAbsMatcher WithinAbs(double target, double margin) {
11670             return Floating::WithinAbsMatcher(target, margin);
11671         }
11672
11673         Floating::WithinRelMatcher WithinRel(double target, double eps) {
11674             return Floating::WithinRelMatcher(target, eps);
11675         }
11676
11677         Floating::WithinRelMatcher WithinRel(double target) {
11678             return Floating::WithinRelMatcher(target, std::numeric_limits<double>::epsilon() * 100);
11679         }
11680
11681         Floating::WithinRelMatcher WithinRel(float target, float eps) {
11682             return Floating::WithinRelMatcher(target, eps);
11683         }
11684
11685         Floating::WithinRelMatcher WithinRel(float target) {
11686             return Floating::WithinRelMatcher(target, std::numeric_limits<float>::epsilon() * 100);
11687         }
11688
11689     } // namespace Matchers
11690 } // namespace Catch
11691 // end catch_matchers_floating.cpp
11692 // start catch_matchers_generic.cpp
11693
11694 std::string Catch::Matchers::Generic::Detail::finalizeDescription(const std::string& desc) {
11695     if (desc.empty()) {
11696         return "matches undescribed predicate";
11697     } else {
11698         return "matches predicate: \"" + desc + '"';
11699     }
11700 }
11701 // end catch_matchers_generic.cpp
11702 // start catch_matchers_string.cpp
11703
11704 #include <regex>
11705
11706 namespace Catch {
11707     namespace Matchers {
11708
11709         namespace StdString {
11710
11711             CasedString::CasedString( std::string const& str, CaseSensitive::Choice caseSensitivity )
11712                     :   m_caseSensitivity( caseSensitivity ),
11713                         m_str( adjustString( str ) )
11714             {}
11715             std::string CasedString::adjustString( std::string const& str ) const {
11716                 return m_caseSensitivity == CaseSensitive::No
11717                        ? toLower( str )
11718                        : str;
11719             }
11720             std::string CasedString::caseSensitivitySuffix() const {
11721                 return m_caseSensitivity == CaseSensitive::No
11722                        ? " (case insensitive)"
11723                        : std::string();
11724             }
11725
11726             StringMatcherBase::StringMatcherBase( std::string const& operation, CasedString const&
      comparator )
11727                     : m_comparator( comparator ),
11728                       m_operation( operation ) {
```

```
11729             }
11730
11731             std::string StringMatcherBase::describe() const {
11732                 std::string description;
11733                 description.reserve(5 + m_operation.size() + m_comparator.m_str.size() +
11734                                     m_comparator.caseSensitivitySuffix().size());
11735                 description += m_operation;
11736                 description += ": \"";
11737                 description += m_comparator.m_str;
11738                 description += "\"";
11739                 description += m_comparator.caseSensitivitySuffix();
11740                 return description;
11741             }
11742
11743             EqualsMatcher::EqualsMatcher( CasedString const& comparator ) : StringMatcherBase(
      "equals", comparator ) {}
11744
11745             bool EqualsMatcher::match( std::string const& source ) const {
11746                 return m_comparator.adjustString( source ) == m_comparator.m_str;
11747             }
11748
11749             ContainsMatcher::ContainsMatcher( CasedString const& comparator ) : StringMatcherBase(
      "contains", comparator ) {}
11750
11751             bool ContainsMatcher::match( std::string const& source ) const {
11752                 return contains( m_comparator.adjustString( source ), m_comparator.m_str );
11753             }
11754
11755             StartsWithMatcher::StartsWithMatcher( CasedString const& comparator ) : StringMatcherBase(
      "starts with", comparator ) {}
11756
11757             bool StartsWithMatcher::match( std::string const& source ) const {
11758                 return startsWith( m_comparator.adjustString( source ), m_comparator.m_str );
11759             }
11760
11761             EndsWithMatcher::EndsWithMatcher( CasedString const& comparator ) : StringMatcherBase(
      "ends with", comparator ) {}
11762
11763             bool EndsWithMatcher::match( std::string const& source ) const {
11764                 return endsWith( m_comparator.adjustString( source ), m_comparator.m_str );
11765             }
11766
11767             RegexMatcher::RegexMatcher(std::string regex, CaseSensitive::Choice caseSensitivity):
      m_regex(std::move(regex)), m_caseSensitivity(caseSensitivity) {}
11768
11769             bool RegexMatcher::match(std::string const& matchee) const {
11770                 auto flags = std::regex::ECMAScript; // ECMAScript is the default syntax option anyway
11771                 if (m_caseSensitivity == CaseSensitive::Choice::No) {
11772                     flags |= std::regex::icase;
11773                 }
11774                 auto reg = std::regex(m_regex, flags);
11775                 return std::regex_match(matchee, reg);
11776             }
11777
11778             std::string RegexMatcher::describe() const {
11779                 return "matches " + ::Catch::Detail::stringify(m_regex) + ((m_caseSensitivity ==
      CaseSensitive::Choice::Yes)? " case sensitively" : " case insensitively");
11780             }
11781
11782         } // namespace StdString
11783
11784         StdString::EqualsMatcher Equals( std::string const& str, CaseSensitive::Choice caseSensitivity
      ) {
11785             return StdString::EqualsMatcher( StdString::CasedString( str, caseSensitivity) );
11786         }
11787         StdString::ContainsMatcher Contains( std::string const& str, CaseSensitive::Choice
      caseSensitivity ) {
11788             return StdString::ContainsMatcher( StdString::CasedString( str, caseSensitivity) );
11789         }
11790         StdString::EndsWithMatcher EndsWith( std::string const& str, CaseSensitive::Choice
      caseSensitivity ) {
11791             return StdString::EndsWithMatcher( StdString::CasedString( str, caseSensitivity) );
11792         }
11793         StdString::StartsWithMatcher StartsWith( std::string const& str, CaseSensitive::Choice
      caseSensitivity ) {
11794             return StdString::StartsWithMatcher( StdString::CasedString( str, caseSensitivity) );
11795         }
11796
11797         StdString::RegexMatcher Matches(std::string const& regex, CaseSensitive::Choice
      caseSensitivity) {
11798             return StdString::RegexMatcher(regex, caseSensitivity);
11799         }
11800
11801     } // namespace Matchers
11802 } // namespace Catch
11803 // end catch_matchers_string.cpp
11804 // start catch_message.cpp
```

```
11805
11806 // start catch_uncaught_exceptions.h
11807
11808 namespace Catch {
11809     bool uncaught_exceptions();
11810 } // end namespace Catch
11811
11812 // end catch_uncaught_exceptions.h
11813 #include <cassert>
11814 #include <stack>
11815
11816 namespace Catch {
11817
11818     MessageInfo::MessageInfo(   StringRef const& _macroName,
11819                                 SourceLineInfo const& _lineInfo,
11820                                 ResultWas::OfType _type )
11821             :   macroName( _macroName ),
11822                 lineInfo( _lineInfo ),
11823                 type( _type ),
11824                 sequence( ++globalCount )
11825     {}
11826
11827     bool MessageInfo::operator==( MessageInfo const& other ) const {
11828         return sequence == other.sequence;
11829     }
11830
11831     bool MessageInfo::operator<( MessageInfo const& other ) const {
11832         return sequence < other.sequence;
11833     }
11834
11835     // This may need protecting if threading support is added
11836     unsigned int MessageInfo::globalCount = 0;
11837
11839
11840     Catch::MessageBuilder::MessageBuilder( StringRef const& macroName,
11841                                            SourceLineInfo const& lineInfo,
11842                                            ResultWas::OfType type )
11843             :m_info(macroName, lineInfo, type) {}
11844
11846
11847     ScopedMessage::ScopedMessage( MessageBuilder const& builder )
11848             : m_info( builder.m_info ), m_moved()
11849     {
11850         m_info.message = builder.m_stream.str();
11851         getResultCapture().pushScopedMessage( m_info );
11852     }
11853
11854     ScopedMessage::ScopedMessage( ScopedMessage&& old )
11855             : m_info( old.m_info ), m_moved()
11856     {
11857         old.m_moved = true;
11858     }
11859
11860     ScopedMessage::~ScopedMessage() {
11861         if ( !uncaught_exceptions() && !m_moved ){
11862             getResultCapture().popScopedMessage(m_info);
11863         }
11864     }
11865
11866     Capturer::Capturer( StringRef macroName, SourceLineInfo const& lineInfo, ResultWas::OfType
      resultType, StringRef names ) {
11867         auto trimmed = [&] (size_t start, size_t end) {
11868             while (names[start] == ',' || isspace(static_cast<unsigned char>(names[start]))) {
11869                 ++start;
11870             }
11871             while (names[end] == ',' || isspace(static_cast<unsigned char>(names[end]))) {
11872                 --end;
11873             }
11874             return names.substr(start, end - start + 1);
11875         };
11876         auto skipq = [&] (size_t start, char quote) {
11877             for (auto i = start + 1; i < names.size() ; ++i) {
11878                 if (names[i] == quote)
11879                     return i;
11880                 if (names[i] == '\\')
11881                     ++i;
11882             }
11883             CATCH_INTERNAL_ERROR("CAPTURE parsing encountered unmatched quote");
11884         };
11885
11886         size_t start = 0;
11887         std::stack<char> openings;
11888         for (size_t pos = 0; pos < names.size(); ++pos) {
11889             char c = names[pos];
11890             switch (c) {
11891                 case '[':
11892                 case '{':
```

```
11893                 case '(':
11894                     // It is basically impossible to disambiguate between
11895                     // comparison and start of template args in this context
11896 //                case '<':
11897                     openings.push(c);
11898                     break;
11899                 case ']':
11900                 case '}':
11901                 case ')':
11902 //                case '>':
11903                     openings.pop();
11904                     break;
11905                 case '"':
11906                 case '\'':
11907                     pos = skipq(pos, c);
11908                     break;
11909                 case ',':
11910                     if (start != pos && openings.empty()) {
11911                         m_messages.emplace_back(macroName, lineInfo, resultType);
11912                         m_messages.back().message = static_cast<std::string>(trimmed(start, pos));
11913                         m_messages.back().message += " := ";
11914                         start = pos;
11915                     }
11916             }
11917         }
11918         assert(openings.empty() && "Mismatched openings");
11919         m_messages.emplace_back(macroName, lineInfo, resultType);
11920         m_messages.back().message = static_cast<std::string>(trimmed(start, names.size() - 1));
11921         m_messages.back().message += " := ";
11922     }
11923     Capturer::~Capturer() {
11924         if ( !uncaught_exceptions() ){
11925             assert( m_captured == m_messages.size() );
11926             for( size_t i = 0; i < m_captured; ++i  )
11927                 m_resultCapture.popScopedMessage( m_messages[i] );
11928         }
11929     }
11930
11931     void Capturer::captureValue( size_t index, std::string const& value ) {
11932         assert( index < m_messages.size() );
11933         m_messages[index].message += value;
11934         m_resultCapture.pushScopedMessage( m_messages[index] );
11935         m_captured++;
11936     }
11937
11938 } // end namespace Catch
11939 // end catch_message.cpp
11940 // start catch_output_redirect.cpp
11941
11942 // start catch_output_redirect.h
11943 #ifndef TWOBLUECUBES_CATCH_OUTPUT_REDIRECT_H
11944 #define TWOBLUECUBES_CATCH_OUTPUT_REDIRECT_H
11945
11946 #include <cstdio>
11947 #include <iosfwd>
11948 #include <string>
11949
11950 namespace Catch {
11951
11952     class RedirectedStream {
11953         std::ostream& m_originalStream;
11954         std::ostream& m_redirectionStream;
11955         std::streambuf* m_prevBuf;
11956
11957     public:
11958         RedirectedStream( std::ostream& originalStream, std::ostream& redirectionStream );
11959         ~RedirectedStream();
11960     };
11961
11962     class RedirectedStdOut {
11963         ReusableStringStream m_rss;
11964         RedirectedStream m_cout;
11965     public:
11966         RedirectedStdOut();
11967         auto str() const -> std::string;
11968     };
11969
11970     // StdErr has two constituent streams in C++, std::cerr and std::clog
11971     // This means that we need to redirect 2 streams into 1 to keep proper
11972     // order of writes
11973     class RedirectedStdErr {
11974         ReusableStringStream m_rss;
11975         RedirectedStream m_cerr;
11976         RedirectedStream m_clog;
11977     public:
11978         RedirectedStdErr();
11979         auto str() const -> std::string;
```

```
11980     };
11981
11982     class RedirectedStreams {
11983     public:
11984         RedirectedStreams(RedirectedStreams const&) = delete;
11985         RedirectedStreams& operator=(RedirectedStreams const&) = delete;
11986         RedirectedStreams(RedirectedStreams&&) = delete;
11987         RedirectedStreams& operator=(RedirectedStreams&&) = delete;
11988
11989         RedirectedStreams(std::string& redirectedCout, std::string& redirectedCerr);
11990         ~RedirectedStreams();
11991     private:
11992         std::string& m_redirectedCout;
11993         std::string& m_redirectedCerr;
11994         RedirectedStdOut m_redirectedStdOut;
11995         RedirectedStdErr m_redirectedStdErr;
11996     };
11997
11998 #if defined(CATCH_CONFIG_NEW_CAPTURE)
11999
12000     // Windows's implementation of std::tmpfile is terrible (it tries
12001     // to create a file inside system folder, thus requiring elevated
12002     // privileges for the binary), so we have to use tmpnam(_s) and
12003     // create the file ourselves there.
12004     class TempFile {
12005     public:
12006         TempFile(TempFile const&) = delete;
12007         TempFile& operator=(TempFile const&) = delete;
12008         TempFile(TempFile&&) = delete;
12009         TempFile& operator=(TempFile&&) = delete;
12010
12011         TempFile();
12012         ~TempFile();
12013
12014         std::FILE* getFile();
12015         std::string getContents();
12016
12017     private:
12018         std::FILE* m_file = nullptr;
12019     #if defined(_MSC_VER)
12020         char m_buffer[L_tmpnam] = { 0 };
12021     #endif
12022     };
12023
12024     class OutputRedirect {
12025     public:
12026         OutputRedirect(OutputRedirect const&) = delete;
12027         OutputRedirect& operator=(OutputRedirect const&) = delete;
12028         OutputRedirect(OutputRedirect&&) = delete;
12029         OutputRedirect& operator=(OutputRedirect&&) = delete;
12030
12031         OutputRedirect(std::string& stdout_dest, std::string& stderr_dest);
12032         ~OutputRedirect();
12033
12034     private:
12035         int m_originalStdout = -1;
12036         int m_originalStderr = -1;
12037         TempFile m_stdoutFile;
12038         TempFile m_stderrFile;
12039         std::string& m_stdoutDest;
12040         std::string& m_stderrDest;
12041     };
12042
12043 #endif
12044
12045 } // end namespace Catch
12046
12047 #endif // TWOBLUECUBES_CATCH_OUTPUT_REDIRECT_H
12048 // end catch_output_redirect.h
12049 #include <cstdio>
12050 #include <cstring>
12051 #include <fstream>
12052 #include <sstream>
12053 #include <stdexcept>
12054
12055 #if defined(CATCH_CONFIG_NEW_CAPTURE)
12056 #if defined(_MSC_VER)
12057     #include <io.h>      //_dup and _dup2
12058     #define dup _dup
12059     #define dup2 _dup2
12060     #define fileno _fileno
12061     #else
12062     #include <unistd.h>  // dup and dup2
12063     #endif
12064 #endif
12065
12066 namespace Catch {
```

```
12067
12068     RedirectedStream::RedirectedStream( std::ostream& originalStream, std::ostream& redirectionStream
      )
12069             :   m_originalStream( originalStream ),
12070                 m_redirectionStream( redirectionStream ),
12071                 m_prevBuf( m_originalStream.rdbuf() )
12072     {
12073         m_originalStream.rdbuf( m_redirectionStream.rdbuf() );
12074     }
12075
12076     RedirectedStream::~RedirectedStream() {
12077         m_originalStream.rdbuf( m_prevBuf );
12078     }
12079
12080     RedirectedStdOut::RedirectedStdOut() : m_cout( Catch::cout(), m_rss.get() ) {}
12081     auto RedirectedStdOut::str() const -> std::string { return m_rss.str(); }
12082
12083     RedirectedStdErr::RedirectedStdErr()
12084             :   m_cerr( Catch::cerr(), m_rss.get() ),
12085                 m_clog( Catch::clog(), m_rss.get() )
12086     {}
12087     auto RedirectedStdErr::str() const -> std::string { return m_rss.str(); }
12088
12089     RedirectedStreams::RedirectedStreams(std::string& redirectedCout, std::string& redirectedCerr)
12090             :   m_redirectedCout(redirectedCout),
12091                 m_redirectedCerr(redirectedCerr)
12092     {}
12093
12094     RedirectedStreams::~RedirectedStreams() {
12095         m_redirectedCout += m_redirectedStdOut.str();
12096         m_redirectedCerr += m_redirectedStdErr.str();
12097     }
12098
12099 #if defined(CATCH_CONFIG_NEW_CAPTURE)
12100
12101     #if defined(_MSC_VER)
12102     TempFile::TempFile() {
12103         if (tmpnam_s(m_buffer)) {
12104             CATCH_RUNTIME_ERROR("Could not get a temp filename");
12105         }
12106         if (fopen_s(&m_file, m_buffer, "w+")) {
12107             char buffer[100];
12108             if (strerror_s(buffer, errno)) {
12109                 CATCH_RUNTIME_ERROR("Could not translate errno to a string");
12110             }
12111             CATCH_RUNTIME_ERROR("Could not open the temp file: '" « m_buffer « "' because: " «
      buffer);
12112         }
12113     }
12114 #else
12115     TempFile::TempFile() {
12116         m_file = std::tmpfile();
12117         if (!m_file) {
12118             CATCH_RUNTIME_ERROR("Could not create a temp file.");
12119         }
12120     }
12121
12122 #endif
12123
12124     TempFile::~TempFile() {
12125          // TBD: What to do about errors here?
12126          std::fclose(m_file);
12127          // We manually create the file on Windows only, on Linux
12128          // it will be autodeleted
12129 #if defined(_MSC_VER)
12130          std::remove(m_buffer);
12131 #endif
12132     }
12133
12134     FILE* TempFile::getFile() {
12135         return m_file;
12136     }
12137
12138     std::string TempFile::getContents() {
12139         std::stringstream sstr;
12140         char buffer[100] = {};
12141         std::rewind(m_file);
12142         while (std::fgets(buffer, sizeof(buffer), m_file)) {
12143             sstr « buffer;
12144         }
12145         return sstr.str();
12146     }
12147
12148     OutputRedirect::OutputRedirect(std::string& stdout_dest, std::string& stderr_dest) :
12149         m_originalStdout(dup(1)),
12150         m_originalStderr(dup(2)),
12151         m_stdoutDest(stdout_dest),
```

```
12152         m_stderrDest(stderr_dest) {
12153         dup2(fileno(m_stdoutFile.getFile()), 1);
12154         dup2(fileno(m_stderrFile.getFile()), 2);
12155     }
12156
12157     OutputRedirect::~OutputRedirect() {
12158         Catch::cout() << std::flush;
12159         fflush(stdout);
12160         // Since we support overriding these streams, we flush cerr
12161         // even though std::cerr is unbuffered
12162         Catch::cerr() << std::flush;
12163         Catch::clog() << std::flush;
12164         fflush(stderr);
12165
12166         dup2(m_originalStdout, 1);
12167         dup2(m_originalStderr, 2);
12168
12169         m_stdoutDest += m_stdoutFile.getContents();
12170         m_stderrDest += m_stderrFile.getContents();
12171     }
12172
12173 #endif // CATCH_CONFIG_NEW_CAPTURE
12174
12175 } // namespace Catch
12176
12177 #if defined(CATCH_CONFIG_NEW_CAPTURE)
12178 #if defined(_MSC_VER)
12179     #undef dup
12180     #undef dup2
12181     #undef fileno
12182     #endif
12183 #endif
12184 // end catch_output_redirect.cpp
12185 // start catch_polyfills.cpp
12186
12187 #include <cmath>
12188
12189 namespace Catch {
12190
12191 #if !defined(CATCH_CONFIG_POLYFILL_ISNAN)
12192     bool isnan(float f) {
12193         return std::isnan(f);
12194     }
12195     bool isnan(double d) {
12196         return std::isnan(d);
12197     }
12198 #else
12199     // For now we only use this for embarcadero
12200     bool isnan(float f) {
12201         return std::_isnan(f);
12202     }
12203     bool isnan(double d) {
12204         return std::_isnan(d);
12205     }
12206 #endif
12207
12208 } // end namespace Catch
12209 // end catch_polyfills.cpp
12210 // start catch_random_number_generator.cpp
12211
12212 namespace Catch {
12213
12214     namespace {
12215
12216 #if defined(_MSC_VER)
12217         #pragma warning(push)
12218 #pragma warning(disable:4146) // we negate uint32 during the rotate
12219 #endif
12220         // Safe rotr implementation thanks to John Regehr
12221         uint32_t rotate_right(uint32_t val, uint32_t count) {
12222             const uint32_t mask = 31;
12223             count &= mask;
12224             return (val >> count) | (val << (-count & mask));
12225         }
12226
12227 #if defined(_MSC_VER)
12228 #pragma warning(pop)
12229 #endif
12230
12231     }
12232
12233     SimplePcg32::SimplePcg32(result_type seed_) {
12234         seed(seed_);
12235     }
12236
12237     void SimplePcg32::seed(result_type seed_) {
12238         m_state = 0;
```

```
12239         (*this)();
12240         m_state += seed_;
12241         (*this)();
12242     }
12243
12244     void SimplePcg32::discard(uint64_t skip) {
12245         // We could implement this to run in O(log n) steps, but this
12246         // should suffice for our use case.
12247         for (uint64_t s = 0; s < skip; ++s) {
12248             static_cast<void>((*this)());
12249         }
12250     }
12251
12252     SimplePcg32::result_type SimplePcg32::operator()() {
12253         // prepare the output value
12254         const uint32_t xorshifted = static_cast<uint32_t>(((m_state >> 18u) ^ m_state) >> 27u);
12255         const auto output = rotate_right(xorshifted, m_state >> 59u);
12256
12257         // advance state
12258         m_state = m_state * 6364136223846793005ULL + s_inc;
12259
12260         return output;
12261     }
12262
12263     bool operator==(SimplePcg32 const& lhs, SimplePcg32 const& rhs) {
12264         return lhs.m_state == rhs.m_state;
12265     }
12266
12267     bool operator!=(SimplePcg32 const& lhs, SimplePcg32 const& rhs) {
12268         return lhs.m_state != rhs.m_state;
12269     }
12270 }
12271 // end catch_random_number_generator.cpp
12272 // start catch_registry_hub.cpp
12273
12274 // start catch_test_case_registry_impl.h
12275
12276 #include <vector>
12277 #include <set>
12278 #include <algorithm>
12279 #include <ios>
12280
12281 namespace Catch {
12282
12283     class TestCase;
12284     struct IConfig;
12285
12286     std::vector<TestCase> sortTests( IConfig const& config, std::vector<TestCase> const&
      unsortedTestCases );
12287
12288     bool isThrowSafe( TestCase const& testCase, IConfig const& config );
12289     bool matchTest( TestCase const& testCase, TestSpec const& testSpec, IConfig const& config );
12290
12291     void enforceNoDuplicateTestCases( std::vector<TestCase> const& functions );
12292
12293     std::vector<TestCase> filterTests( std::vector<TestCase> const& testCases, TestSpec const&
      testSpec, IConfig const& config );
12294     std::vector<TestCase> const& getAllTestCasesSorted( IConfig const& config );
12295
12296     class TestRegistry : public ITestCaseRegistry {
12297     public:
12298         virtual ~TestRegistry() = default;
12299
12300         virtual void registerTest( TestCase const& testCase );
12301
12302         std::vector<TestCase> const& getAllTests() const override;
12303         std::vector<TestCase> const& getAllTestsSorted( IConfig const& config ) const override;
12304
12305     private:
12306         std::vector<TestCase> m_functions;
12307         mutable RunTests::InWhatOrder m_currentSortOrder = RunTests::InDeclarationOrder;
12308         mutable std::vector<TestCase> m_sortedFunctions;
12309         std::size_t m_unnamedCount = 0;
12310         std::ios_base::Init m_ostreamInit; // Forces cout/ cerr to be initialised
12311     };
12312
12314
12315     class TestInvokerAsFunction : public ITestInvoker {
12316         void(*m_testAsFunction)();
12317     public:
12318         TestInvokerAsFunction( void(*testAsFunction)() ) noexcept;
12319
12320         void invoke() const override;
12321     };
12322
12323     std::string extractClassName( StringRef const& classOrQualifiedMethodName );
12324
```

```
12326
12327 } // end namespace Catch
12328
12329 // end catch_test_case_registry_impl.h
12330 // start catch_reporter_registry.h
12331
12332 #include <map>
12333
12334 namespace Catch {
12335
12336     class ReporterRegistry : public IReporterRegistry {
12337
12338     public:
12339
12340         ~ReporterRegistry() override;
12341
12342         IStreamingReporterPtr create( std::string const& name, IConfigPtr const& config ) const
      override;
12343
12344         void registerReporter( std::string const& name, IReporterFactoryPtr const& factory );
12345         void registerListener( IReporterFactoryPtr const& factory );
12346
12347         FactoryMap const& getFactories() const override;
12348         Listeners const& getListeners() const override;
12349
12350     private:
12351         FactoryMap m_factories;
12352         Listeners m_listeners;
12353     };
12354 }
12355
12356 // end catch_reporter_registry.h
12357 // start catch_tag_alias_registry.h
12358
12359 // start catch_tag_alias.h
12360
12361 #include <string>
12362
12363 namespace Catch {
12364
12365     struct TagAlias {
12366         TagAlias(std::string const& _tag, SourceLineInfo _lineInfo);
12367
12368         std::string tag;
12369         SourceLineInfo lineInfo;
12370     };
12371
12372 } // end namespace Catch
12373
12374 // end catch_tag_alias.h
12375 #include <map>
12376
12377 namespace Catch {
12378
12379     class TagAliasRegistry : public ITagAliasRegistry {
12380     public:
12381         ~TagAliasRegistry() override;
12382         TagAlias const* find( std::string const& alias ) const override;
12383         std::string expandAliases( std::string const& unexpandedTestSpec ) const override;
12384         void add( std::string const& alias, std::string const& tag, SourceLineInfo const& lineInfo );
12385
12386     private:
12387         std::map<std::string, TagAlias> m_registry;
12388     };
12389
12390 } // end namespace Catch
12391
12392 // end catch_tag_alias_registry.h
12393 // start catch_startup_exception_registry.h
12394
12395 #include <vector>
12396 #include <exception>
12397
12398 namespace Catch {
12399
12400     class StartupExceptionRegistry {
12401 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
12402     public:
12403         void add(std::exception_ptr const& exception) noexcept;
12404         std::vector<std::exception_ptr> const& getExceptions() const noexcept;
12405     private:
12406         std::vector<std::exception_ptr> m_exceptions;
12407 #endif
12408     };
12409
12410 } // end namespace Catch
12411
```

```
12412 // end catch_startup_exception_registry.h
12413 // start catch_singletons.hpp
12414
12415 namespace Catch {
12416
12417     struct ISingleton {
12418         virtual ~ISingleton();
12419     };
12420
12421     void addSingleton( ISingleton* singleton );
12422     void cleanupSingletons();
12423
12424     template<typename SingletonImplT, typename InterfaceT = SingletonImplT, typename MutableInterfaceT
      = InterfaceT>
12425     class Singleton : SingletonImplT, public ISingleton {
12426
12427         static auto getInternal() -> Singleton* {
12428             static Singleton* s_instance = nullptr;
12429             if( !s_instance ) {
12430                 s_instance = new Singleton;
12431                 addSingleton( s_instance );
12432             }
12433             return s_instance;
12434         }
12435
12436     public:
12437         static auto get() -> InterfaceT const& {
12438             return *getInternal();
12439         }
12440         static auto getMutable() -> MutableInterfaceT& {
12441             return *getInternal();
12442         }
12443     };
12444
12445 } // namespace Catch
12446
12447 // end catch_singletons.hpp
12448 namespace Catch {
12449
12450     namespace {
12451
12452         class RegistryHub : public IRegistryHub, public IMutableRegistryHub,
12453                             private NonCopyable {
12454
12455         public: // IRegistryHub
12456             RegistryHub() = default;
12457             IReporterRegistry const& getReporterRegistry() const override {
12458                 return m_reporterRegistry;
12459             }
12460             ITestCaseRegistry const& getTestCaseRegistry() const override {
12461                 return m_testCaseRegistry;
12462             }
12463             IExceptionTranslatorRegistry const& getExceptionTranslatorRegistry() const override {
12464                 return m_exceptionTranslatorRegistry;
12465             }
12466             ITagAliasRegistry const& getTagAliasRegistry() const override {
12467                 return m_tagAliasRegistry;
12468             }
12469             StartupExceptionRegistry const& getStartupExceptionRegistry() const override {
12470                 return m_exceptionRegistry;
12471             }
12472
12473         public: // IMutableRegistryHub
12474             void registerReporter( std::string const& name, IReporterFactoryPtr const& factory )
      override {
12475                 m_reporterRegistry.registerReporter( name, factory );
12476             }
12477             void registerListener( IReporterFactoryPtr const& factory ) override {
12478                 m_reporterRegistry.registerListener( factory );
12479             }
12480             void registerTest( TestCase const& testInfo ) override {
12481                 m_testCaseRegistry.registerTest( testInfo );
12482             }
12483             void registerTranslator( const IExceptionTranslator* translator ) override {
12484                 m_exceptionTranslatorRegistry.registerTranslator( translator );
12485             }
12486             void registerTagAlias( std::string const& alias, std::string const& tag, SourceLineInfo
      const& lineInfo ) override {
12487                 m_tagAliasRegistry.add( alias, tag, lineInfo );
12488             }
12489             void registerStartupException() noexcept override {
12490 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
12491                 m_exceptionRegistry.add(std::current_exception());
12492 #else
12493                 CATCH_INTERNAL_ERROR("Attempted to register active exception under
      CATCH_CONFIG_DISABLE_EXCEPTIONS!");
12494 #endif
```

```
12495             }
12496             IMutableEnumValuesRegistry& getMutableEnumValuesRegistry() override {
12497                 return m_enumValuesRegistry;
12498             }
12499
12500         private:
12501             TestRegistry m_testCaseRegistry;
12502             ReporterRegistry m_reporterRegistry;
12503             ExceptionTranslatorRegistry m_exceptionTranslatorRegistry;
12504             TagAliasRegistry m_tagAliasRegistry;
12505             StartupExceptionRegistry m_exceptionRegistry;
12506             Detail::EnumValuesRegistry m_enumValuesRegistry;
12507         };
12508     }
12509
12510     using RegistryHubSingleton = Singleton<RegistryHub, IRegistryHub, IMutableRegistryHub>;
12511
12512     IRegistryHub const& getRegistryHub() {
12513         return RegistryHubSingleton::get();
12514     }
12515     IMutableRegistryHub& getMutableRegistryHub() {
12516         return RegistryHubSingleton::getMutable();
12517     }
12518     void cleanUp() {
12519         cleanupSingletons();
12520         cleanUpContext();
12521     }
12522     std::string translateActiveException() {
12523         return getRegistryHub().getExceptionTranslatorRegistry().translateActiveException();
12524     }
12525
12526 } // end namespace Catch
12527 // end catch_registry_hub.cpp
12528 // start catch_reporter_registry.cpp
12529
12530 namespace Catch {
12531
12532     ReporterRegistry::~ReporterRegistry() = default;
12533
12534     IStreamingReporterPtr ReporterRegistry::create( std::string const& name, IConfigPtr const& config
      ) const {
12535         auto it =  m_factories.find( name );
12536         if( it == m_factories.end() )
12537             return nullptr;
12538         return it->second->create( ReporterConfig( config ) );
12539     }
12540
12541     void ReporterRegistry::registerReporter( std::string const& name, IReporterFactoryPtr const&
      factory ) {
12542         m_factories.emplace(name, factory);
12543     }
12544     void ReporterRegistry::registerListener( IReporterFactoryPtr const& factory ) {
12545         m_listeners.push_back( factory );
12546     }
12547
12548     IReporterRegistry::FactoryMap const& ReporterRegistry::getFactories() const {
12549         return m_factories;
12550     }
12551     IReporterRegistry::Listeners const& ReporterRegistry::getListeners() const {
12552         return m_listeners;
12553     }
12554
12555 }
12556 // end catch_reporter_registry.cpp
12557 // start catch_result_type.cpp
12558
12559 namespace Catch {
12560
12561     bool isOk( ResultWas::OfType resultType ) {
12562         return ( resultType & ResultWas::FailureBit ) == 0;
12563     }
12564     bool isJustInfo( int flags ) {
12565         return flags == ResultWas::Info;
12566     }
12567
12568     ResultDisposition::Flags operator | ( ResultDisposition::Flags lhs, ResultDisposition::Flags rhs )
      {
12569         return static_cast<ResultDisposition::Flags>( static_cast<int>( lhs ) | static_cast<int>( rhs
      ) );
12570     }
12571
12572     bool shouldContinueOnFailure( int flags )    { return ( flags &
      ResultDisposition::ContinueOnFailure ) != 0; }
12573     bool shouldSuppressFailure( int flags )      { return ( flags & ResultDisposition::SuppressFail )
      != 0; }
12574
12575 } // end namespace Catch
```

```
12576 // end catch_result_type.cpp
12577 // start catch_run_context.cpp
12578
12579 #include <cassert>
12580 #include <algorithm>
12581 #include <sstream>
12582
12583 namespace Catch {
12584
12585     namespace Generators {
12586         struct GeneratorTracker : TestCaseTracking::TrackerBase, IGeneratorTracker {
12587             GeneratorBasePtr m_generator;
12588
12589             GeneratorTracker( TestCaseTracking::NameAndLocation const& nameAndLocation,
      TrackerContext& ctx, ITracker* parent )
12590                     :   TrackerBase( nameAndLocation, ctx, parent )
12591             {}
12592             ~GeneratorTracker();
12593
12594             static GeneratorTracker& acquire( TrackerContext& ctx, TestCaseTracking::NameAndLocation
      const& nameAndLocation ) {
12595                 std::shared_ptr<GeneratorTracker> tracker;
12596
12597                 ITracker& currentTracker = ctx.currentTracker();
12598                 // Under specific circumstances, the generator we want
12599                 // to acquire is also the current tracker. If this is
12600                 // the case, we have to avoid looking through current
12601                 // tracker's children, and instead return the current
12602                 // tracker.
12603                 // A case where this check is important is e.g.
12604                 //     for (int i = 0; i < 5; ++i) {
12605                 //         int n = GENERATE(1, 2);
12606                 //     }
12607                 //
12608                 // without it, the code above creates 5 nested generators.
12609                 if (currentTracker.nameAndLocation() == nameAndLocation) {
12610                     auto thisTracker = currentTracker.parent().findChild(nameAndLocation);
12611                     assert(thisTracker);
12612                     assert(thisTracker->isGeneratorTracker());
12613                     tracker = std::static_pointer_cast<GeneratorTracker>(thisTracker);
12614                 } else if ( TestCaseTracking::ITrackerPtr childTracker = currentTracker.findChild(
      nameAndLocation ) ) {
12615                     assert( childTracker );
12616                     assert( childTracker->isGeneratorTracker() );
12617                     tracker = std::static_pointer_cast<GeneratorTracker>( childTracker );
12618                 } else {
12619                     tracker = std::make_shared<GeneratorTracker>( nameAndLocation, ctx,
      &currentTracker );
12620                     currentTracker.addChild( tracker );
12621                 }
12622
12623                 if( !tracker->isComplete() ) {
12624                     tracker->open();
12625                 }
12626
12627                 return *tracker;
12628             }
12629
12630             // TrackerBase interface
12631             bool isGeneratorTracker() const override { return true; }
12632             auto hasGenerator() const -> bool override {
12633                 return !!m_generator;
12634             }
12635             void close() override {
12636                 TrackerBase::close();
12637                 // If a generator has a child (it is followed by a section)
12638                 // and none of its children have started, then we must wait
12639                 // until later to start consuming its values.
12640                 // This catches cases where `GENERATE` is placed between two
12641                 // `SECTION`s.
12642                 // **The check for m_children.empty cannot be removed**.
12643                 // doing so would break `GENERATE` _not_ followed by `SECTION`s.
12644                 const bool should_wait_for_child = [&]() {
12645                     // No children -> nobody to wait for
12646                     if ( m_children.empty() ) {
12647                         return false;
12648                     }
12649                     // If at least one child started executing, don't wait
12650                     if ( std::find_if(
12651                             m_children.begin(),
12652                             m_children.end(),
12653                             []( TestCaseTracking::ITrackerPtr tracker ) {
12654                                 return tracker->hasStarted();
12655                             } ) != m_children.end() ) {
12656                         return false;
12657                     }
12658
```

```
12659                   // No children have started. We need to check if they _can_
12660                   // start, and thus we should wait for them, or they cannot
12661                   // start (due to filters), and we shouldn't wait for them
12662                   auto* parent = m_parent;
12663                   // This is safe: there is always at least one section
12664                   // tracker in a test case tracking tree
12665                   while ( !parent->isSectionTracker() ) {
12666                       parent = &( parent->parent() );
12667                   }
12668                   assert( parent &&
12669                                   "Missing root (test case) level section" );
12670
12671                   auto const& parentSection =
12672                           static_cast<SectionTracker&>( *parent );
12673                   auto const& filters = parentSection.getFilters();
12674                   // No filters -> no restrictions on running sections
12675                   if ( filters.empty() ) {
12676                       return true;
12677                   }
12678
12679                   for ( auto const& child : m_children ) {
12680                       if ( child->isSectionTracker() &&
12681                            std::find( filters.begin(),
12682                                       filters.end(),
12683                                       static_cast<SectionTracker&>( *child )
12684                                               .trimmedName() ) !=
12685                            filters.end() ) {
12686                           return true;
12687                       }
12688                   }
12689                   return false;
12690               }();
12691
12692               // This check is a bit tricky, because m_generator->next()
12693               // has a side-effect, where it consumes generator's current
12694               // value, but we do not want to invoke the side-effect if
12695               // this generator is still waiting for any child to start.
12696               if ( should_wait_for_child ||
12697                    ( m_runState == CompletedSuccessfully &&
12698                      m_generator->next() ) ) {
12699                   m_children.clear();
12700                   m_runState = Executing;
12701               }
12702           }
12703
12704           // IGeneratorTracker interface
12705           auto getGenerator() const -> GeneratorBasePtr const& override {
12706               return m_generator;
12707           }
12708           void setGenerator( GeneratorBasePtr&& generator ) override {
12709               m_generator = std::move( generator );
12710           }
12711       };
12712       GeneratorTracker::~GeneratorTracker() {}
12713   }
12714
12715   RunContext::RunContext(IConfigPtr const& _config, IStreamingReporterPtr&& reporter)
12716           :   m_runInfo(_config->name()),
12717               m_context(getCurrentMutableContext()),
12718               m_config(_config),
12719               m_reporter(std::move(reporter)),
12720               m_lastAssertionInfo{ StringRef(), SourceLineInfo("",0), StringRef(),
    ResultDisposition::Normal },
12721               m_includeSuccessfulResults( m_config->includeSuccessfulResults() ||
    m_reporter->getPreferences().shouldReportAllAssertions )
12722   {
12723       m_context.setRunner(this);
12724       m_context.setConfig(m_config);
12725       m_context.setResultCapture(this);
12726       m_reporter->testRunStarting(m_runInfo);
12727   }
12728
12729   RunContext::~RunContext() {
12730       m_reporter->testRunEnded(TestRunStats(m_runInfo, m_totals, aborting()));
12731   }
12732
12733   void RunContext::testGroupStarting(std::string const& testSpec, std::size_t groupIndex,
    std::size_t groupsCount) {
12734       m_reporter->testGroupStarting(GroupInfo(testSpec, groupIndex, groupsCount));
12735   }
12736
12737   void RunContext::testGroupEnded(std::string const& testSpec, Totals const& totals, std::size_t
    groupIndex, std::size_t groupsCount) {
12738       m_reporter->testGroupEnded(TestGroupStats(GroupInfo(testSpec, groupIndex, groupsCount),
    totals, aborting()));
12739   }
12740
```

```
12741     Totals RunContext::runTest(TestCase const& testCase) {
12742         Totals prevTotals = m_totals;
12743
12744         std::string redirectedCout;
12745         std::string redirectedCerr;
12746
12747         auto const& testInfo = testCase.getTestCaseInfo();
12748
12749         m_reporter->testCaseStarting(testInfo);
12750
12751         m_activeTestCase = &testCase;
12752
12753         ITracker& rootTracker = m_trackerContext.startRun();
12754         assert(rootTracker.isSectionTracker());
12755         static_cast<SectionTracker&>(rootTracker).addInitialFilters(m_config->getSectionsToRun());
12756         do {
12757             m_trackerContext.startCycle();
12758             m_testCaseTracker = &SectionTracker::acquire(m_trackerContext,
      TestCaseTracking::NameAndLocation(testInfo.name, testInfo.lineInfo));
12759             runCurrentTest(redirectedCout, redirectedCerr);
12760         } while (!m_testCaseTracker->isSuccessfullyCompleted() && !aborting());
12761
12762         Totals deltaTotals = m_totals.delta(prevTotals);
12763         if (testInfo.expectedToFail() && deltaTotals.testCases.passed > 0) {
12764             deltaTotals.assertions.failed++;
12765             deltaTotals.testCases.passed--;
12766             deltaTotals.testCases.failed++;
12767         }
12768         m_totals.testCases += deltaTotals.testCases;
12769         m_reporter->testCaseEnded(TestCaseStats(testInfo,
12770                                                 deltaTotals,
12771                                                 redirectedCout,
12772                                                 redirectedCerr,
12773                                                 aborting()));
12774
12775         m_activeTestCase = nullptr;
12776         m_testCaseTracker = nullptr;
12777
12778         return deltaTotals;
12779     }
12780
12781     IConfigPtr RunContext::config() const {
12782         return m_config;
12783     }
12784
12785     IStreamingReporter& RunContext::reporter() const {
12786         return *m_reporter;
12787     }
12788
12789     void RunContext::assertionEnded(AssertionResult const & result) {
12790         if (result.getResultType() == ResultWas::Ok) {
12791             m_totals.assertions.passed++;
12792             m_lastAssertionPassed = true;
12793         } else if (!result.isOk()) {
12794             m_lastAssertionPassed = false;
12795             if( m_activeTestCase->getTestCaseInfo().okToFail() )
12796                 m_totals.assertions.failedButOk++;
12797             else
12798                 m_totals.assertions.failed++;
12799         }
12800         else {
12801             m_lastAssertionPassed = true;
12802         }
12803
12804         // We have no use for the return value (whether messages should be cleared), because messages
      were made scoped
12805         // and should be let to clear themselves out.
12806         static_cast<void>(m_reporter->assertionEnded(AssertionStats(result, m_messages, m_totals)));
12807
12808         if (result.getResultType() != ResultWas::Warning)
12809             m_messageScopes.clear();
12810
12811         // Reset working state
12812         resetAssertionInfo();
12813         m_lastResult = result;
12814     }
12815     void RunContext::resetAssertionInfo() {
12816         m_lastAssertionInfo.macroName = StringRef();
12817         m_lastAssertionInfo.capturedExpression = "{Unknown expression after the reported line}"_sr;
12818     }
12819
12820     bool RunContext::sectionStarted(SectionInfo const & sectionInfo, Counts & assertions) {
12821         ITracker& sectionTracker = SectionTracker::acquire(m_trackerContext,
      TestCaseTracking::NameAndLocation(sectionInfo.name, sectionInfo.lineInfo));
12822         if (!sectionTracker.isOpen())
12823             return false;
12824         m_activeSections.push_back(&sectionTracker);
```

```
12825
12826         m_lastAssertionInfo.lineInfo = sectionInfo.lineInfo;
12827
12828         m_reporter->sectionStarting(sectionInfo);
12829
12830         assertions = m_totals.assertions;
12831
12832         return true;
12833     }
12834     auto RunContext::acquireGeneratorTracker( StringRef generatorName, SourceLineInfo const& lineInfo
      ) -> IGeneratorTracker& {
12835         using namespace Generators;
12836         GeneratorTracker& tracker = GeneratorTracker::acquire(m_trackerContext,
12837                                                               TestCaseTracking::NameAndLocation(
      static_cast<std::string>(generatorName), lineInfo ) );
12838         m_lastAssertionInfo.lineInfo = lineInfo;
12839         return tracker;
12840     }
12841
12842     bool RunContext::testForMissingAssertions(Counts& assertions) {
12843         if (assertions.total() != 0)
12844             return false;
12845         if (!m_config->warnAboutMissingAssertions())
12846             return false;
12847         if (m_trackerContext.currentTracker().hasChildren())
12848             return false;
12849         m_totals.assertions.failed++;
12850         assertions.failed++;
12851         return true;
12852     }
12853
12854     void RunContext::sectionEnded(SectionEndInfo const & endInfo) {
12855         Counts assertions = m_totals.assertions - endInfo.prevAssertions;
12856         bool missingAssertions = testForMissingAssertions(assertions);
12857
12858         if (!m_activeSections.empty()) {
12859             m_activeSections.back()->close();
12860             m_activeSections.pop_back();
12861         }
12862
12863         m_reporter->sectionEnded(SectionStats(endInfo.sectionInfo, assertions,
      endInfo.durationInSeconds, missingAssertions));
12864         m_messages.clear();
12865         m_messageScopes.clear();
12866     }
12867
12868     void RunContext::sectionEndedEarly(SectionEndInfo const & endInfo) {
12869         if (m_unfinishedSections.empty())
12870             m_activeSections.back()->fail();
12871         else
12872             m_activeSections.back()->close();
12873         m_activeSections.pop_back();
12874
12875         m_unfinishedSections.push_back(endInfo);
12876     }
12877
12878 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
12879     void RunContext::benchmarkPreparing(std::string const& name) {
12880         m_reporter->benchmarkPreparing(name);
12881     }
12882     void RunContext::benchmarkStarting( BenchmarkInfo const& info ) {
12883         m_reporter->benchmarkStarting( info );
12884     }
12885     void RunContext::benchmarkEnded( BenchmarkStats<> const& stats ) {
12886         m_reporter->benchmarkEnded( stats );
12887     }
12888     void RunContext::benchmarkFailed(std::string const & error) {
12889         m_reporter->benchmarkFailed(error);
12890     }
12891 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
12892
12893     void RunContext::pushScopedMessage(MessageInfo const & message) {
12894         m_messages.push_back(message);
12895     }
12896
12897     void RunContext::popScopedMessage(MessageInfo const & message) {
12898         m_messages.erase(std::remove(m_messages.begin(), m_messages.end(), message),
      m_messages.end());
12899     }
12900
12901     void RunContext::emplaceUnscopedMessage( MessageBuilder const& builder ) {
12902         m_messageScopes.emplace_back( builder );
12903     }
12904
12905     std::string RunContext::getCurrentTestName() const {
12906         return m_activeTestCase
12907                ? m_activeTestCase->getTestCaseInfo().name
```

```
12908                 : std::string();
12909     }
12910
12911     const AssertionResult * RunContext::getLastResult() const {
12912         return &(*m_lastResult);
12913     }
12914
12915     void RunContext::exceptionEarlyReported() {
12916         m_shouldReportUnexpected = false;
12917     }
12918
12919     void RunContext::handleFatalErrorCondition( StringRef message ) {
12920         // First notify reporter that bad things happened
12921         m_reporter->fatalErrorEncountered(message);
12922
12923         // Don't rebuild the result -- the stringification itself can cause more fatal errors
12924         // Instead, fake a result data.
12925         AssertionResultData tempResult( ResultWas::FatalErrorCondition, { false } );
12926         tempResult.message = static_cast<std::string>(message);
12927         AssertionResult result(m_lastAssertionInfo, tempResult);
12928
12929         assertionEnded(result);
12930
12931         handleUnfinishedSections();
12932
12933         // Recreate section for test case (as we will lose the one that was in scope)
12934         auto const& testCaseInfo = m_activeTestCase->getTestCaseInfo();
12935         SectionInfo testCaseSection(testCaseInfo.lineInfo, testCaseInfo.name);
12936
12937         Counts assertions;
12938         assertions.failed = 1;
12939         SectionStats testCaseSectionStats(testCaseSection, assertions, 0, false);
12940         m_reporter->sectionEnded(testCaseSectionStats);
12941
12942         auto const& testInfo = m_activeTestCase->getTestCaseInfo();
12943
12944         Totals deltaTotals;
12945         deltaTotals.testCases.failed = 1;
12946         deltaTotals.assertions.failed = 1;
12947         m_reporter->testCaseEnded(TestCaseStats(testInfo,
12948                                                 deltaTotals,
12949                                                 std::string(),
12950                                                 std::string(),
12951                                                 false));
12952         m_totals.testCases.failed++;
12953         testGroupEnded(std::string(), m_totals, 1, 1);
12954         m_reporter->testRunEnded(TestRunStats(m_runInfo, m_totals, false));
12955     }
12956
12957     bool RunContext::lastAssertionPassed() {
12958         return m_lastAssertionPassed;
12959     }
12960
12961     void RunContext::assertionPassed() {
12962         m_lastAssertionPassed = true;
12963         ++m_totals.assertions.passed;
12964         resetAssertionInfo();
12965         m_messageScopes.clear();
12966     }
12967
12968     bool RunContext::aborting() const {
12969         return m_totals.assertions.failed >= static_cast<std::size_t>(m_config->abortAfter());
12970     }
12971
12972     void RunContext::runCurrentTest(std::string & redirectedCout, std::string & redirectedCerr) {
12973         auto const& testCaseInfo = m_activeTestCase->getTestCaseInfo();
12974         SectionInfo testCaseSection(testCaseInfo.lineInfo, testCaseInfo.name);
12975         m_reporter->sectionStarting(testCaseSection);
12976         Counts prevAssertions = m_totals.assertions;
12977         double duration = 0;
12978         m_shouldReportUnexpected = true;
12979         m_lastAssertionInfo = { "TEST_CASE"_sr, testCaseInfo.lineInfo, StringRef(),
      ResultDisposition::Normal };
12980
12981         seedRng(*m_config);
12982
12983         Timer timer;
12984         CATCH_TRY {
12985             if (m_reporter->getPreferences().shouldRedirectStdOut) {
12986 #if !defined(CATCH_CONFIG_EXPERIMENTAL_REDIRECT)
12987                 RedirectedStreams redirectedStreams(redirectedCout, redirectedCerr);
12988
12989                 timer.start();
12990                 invokeActiveTestCase();
12991 #else
12992                 OutputRedirect r(redirectedCout, redirectedCerr);
12993                 timer.start();
```

```
12994                 invokeActiveTestCase();
12995 #endif
12996             } else {
12997                 timer.start();
12998                 invokeActiveTestCase();
12999             }
13000             duration = timer.getElapsedSeconds();
13001         } CATCH_CATCH_ANON (TestFailureException&) {
13002             // This just means the test was aborted due to failure
13003         } CATCH_CATCH_ALL {
13004             // Under CATCH_CONFIG_FAST_COMPILE, unexpected exceptions under REQUIRE assertions
13005             // are reported without translation at the point of origin.
13006             if( m_shouldReportUnexpected ) {
13007                 AssertionReaction dummyReaction;
13008                 handleUnexpectedInflightException( m_lastAssertionInfo, translateActiveException(),
      dummyReaction );
13009             }
13010         }
13011         Counts assertions = m_totals.assertions - prevAssertions;
13012         bool missingAssertions = testForMissingAssertions(assertions);
13013
13014         m_testCaseTracker->close();
13015         handleUnfinishedSections();
13016         m_messages.clear();
13017         m_messageScopes.clear();
13018
13019         SectionStats testCaseSectionStats(testCaseSection, assertions, duration, missingAssertions);
13020         m_reporter->sectionEnded(testCaseSectionStats);
13021     }
13022
13023     void RunContext::invokeActiveTestCase() {
13024         FatalConditionHandlerGuard _(&m_fatalConditionhandler);
13025         m_activeTestCase->invoke();
13026     }
13027
13028     void RunContext::handleUnfinishedSections() {
13029         // If sections ended prematurely due to an exception we stored their
13030         // infos here so we can tear them down outside the unwind process.
13031         for (auto it = m_unfinishedSections.rbegin(),
13032                   itEnd = m_unfinishedSections.rend();
13033              it != itEnd;
13034              ++it)
13035             sectionEnded(*it);
13036         m_unfinishedSections.clear();
13037     }
13038
13039     void RunContext::handleExpr(
13040             AssertionInfo const& info,
13041             ITransientExpression const& expr,
13042             AssertionReaction& reaction
13043     ) {
13044         m_reporter->assertionStarting( info );
13045
13046         bool negated = isFalseTest( info.resultDisposition );
13047         bool result = expr.getResult() != negated;
13048
13049         if( result ) {
13050             if (!m_includeSuccessfulResults) {
13051                 assertionPassed();
13052             }
13053             else {
13054                 reportExpr(info, ResultWas::Ok, &expr, negated);
13055             }
13056         }
13057         else {
13058             reportExpr(info, ResultWas::ExpressionFailed, &expr, negated );
13059             populateReaction( reaction );
13060         }
13061     }
13062     void RunContext::reportExpr(
13063             AssertionInfo const &info,
13064             ResultWas::OfType resultType,
13065             ITransientExpression const *expr,
13066             bool negated ) {
13067
13068         m_lastAssertionInfo = info;
13069         AssertionResultData data( resultType, LazyExpression( negated ) );
13070
13071         AssertionResult assertionResult{ info, data };
13072         assertionResult.m_resultData.lazyExpression.m_transientExpression = expr;
13073
13074         assertionEnded( assertionResult );
13075     }
13076
13077     void RunContext::handleMessage(
13078             AssertionInfo const& info,
13079             ResultWas::OfType resultType,
```

```
13080             StringRef const& message,
13081             AssertionReaction& reaction
13082     ) {
13083         m_reporter->assertionStarting( info );
13084
13085         m_lastAssertionInfo = info;
13086
13087         AssertionResultData data( resultType, LazyExpression( false ) );
13088         data.message = static_cast<std::string>(message);
13089         AssertionResult assertionResult{ m_lastAssertionInfo, data };
13090         assertionEnded( assertionResult );
13091         if( !assertionResult.isOk() )
13092             populateReaction( reaction );
13093     }
13094     void RunContext::handleUnexpectedExceptionNotThrown(
13095             AssertionInfo const& info,
13096             AssertionReaction& reaction
13097     ) {
13098         handleNonExpr(info, Catch::ResultWas::DidntThrowException, reaction);
13099     }
13100
13101     void RunContext::handleUnexpectedInflightException(
13102             AssertionInfo const& info,
13103             std::string const& message,
13104             AssertionReaction& reaction
13105     ) {
13106         m_lastAssertionInfo = info;
13107
13108         AssertionResultData data( ResultWas::ThrewException, LazyExpression( false ) );
13109         data.message = message;
13110         AssertionResult assertionResult{ info, data };
13111         assertionEnded( assertionResult );
13112         populateReaction( reaction );
13113     }
13114
13115     void RunContext::populateReaction( AssertionReaction& reaction ) {
13116         reaction.shouldDebugBreak = m_config->shouldDebugBreak();
13117         reaction.shouldThrow = aborting() || (m_lastAssertionInfo.resultDisposition &
      ResultDisposition::Normal);
13118     }
13119
13120     void RunContext::handleIncomplete(
13121             AssertionInfo const& info
13122     ) {
13123         m_lastAssertionInfo = info;
13124
13125         AssertionResultData data( ResultWas::ThrewException, LazyExpression( false ) );
13126         data.message = "Exception translation was disabled by CATCH_CONFIG_FAST_COMPILE";
13127         AssertionResult assertionResult{ info, data };
13128         assertionEnded( assertionResult );
13129     }
13130     void RunContext::handleNonExpr(
13131             AssertionInfo const &info,
13132             ResultWas::OfType resultType,
13133             AssertionReaction &reaction
13134     ) {
13135         m_lastAssertionInfo = info;
13136
13137         AssertionResultData data( resultType, LazyExpression( false ) );
13138         AssertionResult assertionResult{ info, data };
13139         assertionEnded( assertionResult );
13140
13141         if( !assertionResult.isOk() )
13142             populateReaction( reaction );
13143     }
13144
13145     IResultCapture& getResultCapture() {
13146         if (auto* capture = getCurrentContext().getResultCapture())
13147             return *capture;
13148         else
13149             CATCH_INTERNAL_ERROR("No result capture instance");
13150     }
13151
13152     void seedRng(IConfig const& config) {
13153         if (config.rngSeed() != 0) {
13154             std::srand(config.rngSeed());
13155             rng().seed(config.rngSeed());
13156         }
13157     }
13158
13159     unsigned int rngSeed() {
13160         return getCurrentContext().getConfig()->rngSeed();
13161     }
13162
13163 }
13164 // end catch_run_context.cpp
13165 // start catch_section.cpp
```

```
13166
13167 namespace Catch {
13168
13169     Section::Section( SectionInfo const& info )
13170             :   m_info( info ),
13171                 m_sectionIncluded( getResultCapture().sectionStarted( m_info, m_assertions ) )
13172     {
13173         m_timer.start();
13174     }
13175
13176     Section::~Section() {
13177         if( m_sectionIncluded ) {
13178             SectionEndInfo endInfo{ m_info, m_assertions, m_timer.getElapsedSeconds() };
13179             if( uncaught_exceptions() )
13180                 getResultCapture().sectionEndedEarly( endInfo );
13181             else
13182                 getResultCapture().sectionEnded( endInfo );
13183         }
13184     }
13185
13186     // This indicates whether the section should be executed or not
13187     Section::operator bool() const {
13188         return m_sectionIncluded;
13189     }
13190
13191 } // end namespace Catch
13192 // end catch_section.cpp
13193 // start catch_section_info.cpp
13194
13195 namespace Catch {
13196
13197     SectionInfo::SectionInfo
13198             (   SourceLineInfo const& _lineInfo,
13199                 std::string const& _name )
13200             :   name( _name ),
13201                 lineInfo( _lineInfo )
13202     {}
13203
13204 } // end namespace Catch
13205 // end catch_section_info.cpp
13206 // start catch_session.cpp
13207
13208 // start catch_session.h
13209
13210 #include <memory>
13211
13212 namespace Catch {
13213
13214     class Session : NonCopyable {
13215     public:
13216
13217         Session();
13218         ~Session() override;
13219
13220         void showHelp() const;
13221         void libIdentify();
13222
13223         int applyCommandLine( int argc, char const * const * argv );
13224 #if defined(CATCH_CONFIG_WCHAR) && defined(_WIN32) && defined(UNICODE)
13225         int applyCommandLine( int argc, wchar_t const * const * argv );
13226 #endif
13227
13228         void useConfigData( ConfigData const& configData );
13229
13230         template<typename CharT>
13231         int run(int argc, CharT const * const argv[]) {
13232             if (m_startupExceptions)
13233                 return 1;
13234             int returnCode = applyCommandLine(argc, argv);
13235             if (returnCode == 0)
13236                 returnCode = run();
13237             return returnCode;
13238         }
13239
13240         int run();
13241
13242         clara::Parser const& cli() const;
13243         void cli( clara::Parser const& newParser );
13244         ConfigData& configData();
13245         Config& config();
13246     private:
13247         int runInternal();
13248
13249         clara::Parser m_cli;
13250         ConfigData m_configData;
13251         std::shared_ptr<Config> m_config;
13252         bool m_startupExceptions = false;
```

```
13253     };
13254
13255 } // end namespace Catch
13256
13257 // end catch_session.h
13258 // start catch_version.h
13259
13260 #include <iosfwd>
13261
13262 namespace Catch {
13263
13264     // Versioning information
13265     struct Version {
13266         Version( Version const& ) = delete;
13267         Version& operator=( Version const& ) = delete;
13268         Version(    unsigned int _majorVersion,
13269                     unsigned int _minorVersion,
13270                     unsigned int _patchNumber,
13271                     char const * const _branchName,
13272                     unsigned int _buildNumber );
13273
13274         unsigned int const majorVersion;
13275         unsigned int const minorVersion;
13276         unsigned int const patchNumber;
13277
13278         // buildNumber is only used if branchName is not null
13279         char const * const branchName;
13280         unsigned int const buildNumber;
13281
13282         friend std::ostream& operator << ( std::ostream& os, Version const& version );
13283     };
13284
13285     Version const& libraryVersion();
13286 }
13287
13288 // end catch_version.h
13289 #include <cstdlib>
13290 #include <iomanip>
13291 #include <set>
13292 #include <iterator>
13293
13294 namespace Catch {
13295
13296     namespace {
13297         const int MaxExitCode = 255;
13298
13299         IStreamingReporterPtr createReporter(std::string const& reporterName, IConfigPtr const&
      config) {
13300             auto reporter = Catch::getRegistryHub().getReporterRegistry().create(reporterName,
      config);
13301             CATCH_ENFORCE(reporter, "No reporter registered with name: '" << reporterName << "'");
13302
13303             return reporter;
13304         }
13305
13306         IStreamingReporterPtr makeReporter(std::shared_ptr<Config> const& config) {
13307             if (Catch::getRegistryHub().getReporterRegistry().getListeners().empty()) {
13308                 return createReporter(config->getReporterName(), config);
13309             }
13310
13311             // On older platforms, returning std::unique_ptr<ListeningReporter>
13312             // when the return type is std::unique_ptr<IStreamingReporter>
13313             // doesn't compile without a std::move call. However, this causes
13314             // a warning on newer platforms. Thus, we have to work around
13315             // it a bit and downcast the pointer manually.
13316             auto ret = std::unique_ptr<IStreamingReporter>(new ListeningReporter);
13317             auto& multi = static_cast<ListeningReporter&>(*ret);
13318             auto const& listeners = Catch::getRegistryHub().getReporterRegistry().getListeners();
13319             for (auto const& listener : listeners) {
13320                 multi.addListener(listener->create(Catch::ReporterConfig(config)));
13321             }
13322             multi.addReporter(createReporter(config->getReporterName(), config));
13323             return ret;
13324         }
13325
13326         class TestGroup {
13327         public:
13328             explicit TestGroup(std::shared_ptr<Config> const& config)
13329                     : m_config{config}
13330                     , m_context{config, makeReporter(config)}
13331             {
13332                 auto const& allTestCases = getAllTestCasesSorted(*m_config);
13333                 m_matches = m_config->testSpec().matchesByFilter(allTestCases, *m_config);
13334                 auto const& invalidArgs = m_config->testSpec().getInvalidArgs();
13335
13336                 if (m_matches.empty() && invalidArgs.empty()) {
13337                     for (auto const& test : allTestCases)
```

```
13338                         if (!test.isHidden())
13339                             m_tests.emplace(&test);
13340                 } else {
13341                     for (auto const& match : m_matches)
13342                         m_tests.insert(match.tests.begin(), match.tests.end());
13343                 }
13344             }
13345
13346             Totals execute() {
13347                 auto const& invalidArgs = m_config->testSpec().getInvalidArgs();
13348                 Totals totals;
13349                 m_context.testGroupStarting(m_config->name(), 1, 1);
13350                 for (auto const& testCase : m_tests) {
13351                     if (!m_context.aborting())
13352                         totals += m_context.runTest(*testCase);
13353                     else
13354                         m_context.reporter().skipTest(*testCase);
13355                 }
13356
13357                 for (auto const& match : m_matches) {
13358                     if (match.tests.empty()) {
13359                         m_context.reporter().noMatchingTestCases(match.name);
13360                         totals.error = -1;
13361                     }
13362                 }
13363
13364                 if (!invalidArgs.empty()) {
13365                     for (auto const& invalidArg: invalidArgs)
13366                         m_context.reporter().reportInvalidArguments(invalidArg);
13367                 }
13368
13369                 m_context.testGroupEnded(m_config->name(), totals, 1, 1);
13370                 return totals;
13371             }
13372
13373         private:
13374             using Tests = std::set<TestCase const*>;
13375
13376             std::shared_ptr<Config> m_config;
13377             RunContext m_context;
13378             Tests m_tests;
13379             TestSpec::Matches m_matches;
13380         };
13381
13382         void applyFilenamesAsTags(Catch::IConfig const& config) {
13383             auto& tests = const_cast<std::vector<TestCase>&>(getAllTestCasesSorted(config));
13384             for (auto& testCase : tests) {
13385                 auto tags = testCase.tags;
13386
13387                 std::string filename = testCase.lineInfo.file;
13388                 auto lastSlash = filename.find_last_of("\\/");
13389                 if (lastSlash != std::string::npos) {
13390                     filename.erase(0, lastSlash);
13391                     filename[0] = '#';
13392                 }
13393                 else
13394                 {
13395                     filename.insert(0, "#");
13396                 }
13397
13398                 auto lastDot = filename.find_last_of('.');
13399                 if (lastDot != std::string::npos) {
13400                     filename.erase(lastDot);
13401                 }
13402
13403                 tags.push_back(std::move(filename));
13404                 setTags(testCase, tags);
13405             }
13406         }
13407
13408     } // anon namespace
13409
13410     Session::Session() {
13411         static bool alreadyInstantiated = false;
13412         if( alreadyInstantiated ) {
13413             CATCH_TRY { CATCH_INTERNAL_ERROR( "Only one instance of Catch::Session can ever be used"
      ); }
13414             CATCH_CATCH_ALL { getMutableRegistryHub().registerStartupException(); }
13415         }
13416
13417         // There cannot be exceptions at startup in no-exception mode.
13418 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
13419         const auto& exceptions = getRegistryHub().getStartupExceptionRegistry().getExceptions();
13420         if ( !exceptions.empty() ) {
13421             config();
13422             getCurrentMutableContext().setConfig(m_config);
13423
```

```
13424             m_startupExceptions = true;
13425             Colour colourGuard( Colour::Red );
13426             Catch::cerr() << "Errors occurred during startup!" << '\n';
13427             // iterate over all exceptions and notify user
13428             for ( const auto& ex_ptr : exceptions ) {
13429                 try {
13430                     std::rethrow_exception(ex_ptr);
13431                 } catch ( std::exception const& ex ) {
13432                     Catch::cerr() << Column( ex.what() ).indent(2) << '\n';
13433                 }
13434             }
13435         }
13436 #endif
13437
13438         alreadyInstantiated = true;
13439         m_cli = makeCommandLineParser( m_configData );
13440     }
13441     Session::~Session() {
13442         Catch::cleanUp();
13443     }
13444
13445     void Session::showHelp() const {
13446         Catch::cout()
13447                 << "\nCatch v" << libraryVersion() << "\n"
13448                 << m_cli << std::endl
13449                 << "For more detailed usage please see the project docs\n" << std::endl;
13450     }
13451     void Session::libIdentify() {
13452         Catch::cout()
13453                 << std::left << std::setw(16) << "description: " << "A Catch2 test executable\n"
13454                 << std::left << std::setw(16) << "category: " << "testframework\n"
13455                 << std::left << std::setw(16) << "framework: " << "Catch Test\n"
13456                 << std::left << std::setw(16) << "version: " << libraryVersion() << std::endl;
13457     }
13458
13459     int Session::applyCommandLine( int argc, char const * const * argv ) {
13460         if( m_startupExceptions )
13461             return 1;
13462
13463         auto result = m_cli.parse( clara::Args( argc, argv ) );
13464         if( !result ) {
13465             config();
13466             getCurrentMutableContext().setConfig(m_config);
13467             Catch::cerr()
13468                     << Colour( Colour::Red )
13469                     << "\nError(s) in input:\n"
13470                     << Column( result.errorMessage() ).indent( 2 )
13471                     << "\n\n";
13472             Catch::cerr() << "Run with -? for usage\n" << std::endl;
13473             return MaxExitCode;
13474         }
13475
13476         if( m_configData.showHelp )
13477             showHelp();
13478         if( m_configData.libIdentify )
13479             libIdentify();
13480         m_config.reset();
13481         return 0;
13482     }
13483
13484 #if defined(CATCH_CONFIG_WCHAR) && defined(_WIN32) && defined(UNICODE)
13485     int Session::applyCommandLine( int argc, wchar_t const * const * argv ) {
13486
13487         char **utf8Argv = new char *[ argc ];
13488
13489         for ( int i = 0; i < argc; ++i ) {
13490             int bufSize = WideCharToMultiByte( CP_UTF8, 0, argv[i], -1, nullptr, 0, nullptr, nullptr
      );
13491
13492             utf8Argv[ i ] = new char[ bufSize ];
13493
13494             WideCharToMultiByte( CP_UTF8, 0, argv[i], -1, utf8Argv[i], bufSize, nullptr, nullptr );
13495         }
13496
13497         int returnCode = applyCommandLine( argc, utf8Argv );
13498
13499         for ( int i = 0; i < argc; ++i )
13500             delete [] utf8Argv[ i ];
13501
13502         delete [] utf8Argv;
13503
13504         return returnCode;
13505     }
13506 #endif
13507
13508     void Session::useConfigData( ConfigData const& configData ) {
13509         m_configData = configData;
```

```
13510         m_config.reset();
13511     }
13512
13513     int Session::run() {
13514         if( ( m_configData.waitForKeypress & WaitForKeypress::BeforeStart ) != 0 ) {
13515             Catch::cout() << "...waiting for enter/ return before starting" << std::endl;
13516             static_cast<void>(std::getchar());
13517         }
13518         int exitCode = runInternal();
13519         if( ( m_configData.waitForKeypress & WaitForKeypress::BeforeExit ) != 0 ) {
13520             Catch::cout() << "...waiting for enter/ return before exiting, with code: " << exitCode <<
      std::endl;
13521             static_cast<void>(std::getchar());
13522         }
13523         return exitCode;
13524     }
13525
13526     clara::Parser const& Session::cli() const {
13527         return m_cli;
13528     }
13529     void Session::cli( clara::Parser const& newParser ) {
13530         m_cli = newParser;
13531     }
13532     ConfigData& Session::configData() {
13533         return m_configData;
13534     }
13535     Config& Session::config() {
13536         if( !m_config )
13537             m_config = std::make_shared<Config>( m_configData );
13538         return *m_config;
13539     }
13540
13541     int Session::runInternal() {
13542         if( m_startupExceptions )
13543             return 1;
13544
13545         if (m_configData.showHelp || m_configData.libIdentify) {
13546             return 0;
13547         }
13548
13549         CATCH_TRY {
13550             config(); // Force config to be constructed
13551
13552             seedRng( *m_config );
13553
13554             if( m_configData.filenamesAsTags )
13555                 applyFilenamesAsTags( *m_config );
13556
13557             // Handle list request
13558             if( Option<std::size_t> listed = list( m_config ) )
13559                 return (std::min) (MaxExitCode, static_cast<int>(*listed));
13560
13561             TestGroup tests { m_config };
13562             auto const totals = tests.execute();
13563
13564             if( m_config->warnAboutNoTests() && totals.error == -1 )
13565                 return 2;
13566
13567             // Note that on unices only the lower 8 bits are usually used, clamping
13568             // the return value to 255 prevents false negative when some multiple
13569             // of 256 tests has failed
13570             return (std::min) (MaxExitCode, (std::max) (totals.error,
      static_cast<int>(totals.assertions.failed)));
13571         }
13572 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
13573         catch( std::exception& ex ) {
13574             Catch::cerr() << ex.what() << std::endl;
13575             return MaxExitCode;
13576         }
13577 #endif
13578     }
13579
13580 } // end namespace Catch
13581 // end catch_session.cpp
13582 // start catch_singletons.cpp
13583
13584 #include <vector>
13585
13586 namespace Catch {
13587
13588     namespace {
13589         static auto getSingletons() -> std::vector<ISingleton*>*& {
13590             static std::vector<ISingleton*>* g_singletons = nullptr;
13591             if( !g_singletons )
13592                 g_singletons = new std::vector<ISingleton*>();
13593             return g_singletons;
13594         }
```

```
13595     }
13596
13597     ISingleton::~ISingleton() {}
13598
13599     void addSingleton(ISingleton* singleton ) {
13600         getSingletons()->push_back( singleton );
13601     }
13602     void cleanupSingletons() {
13603         auto& singletons = getSingletons();
13604         for( auto singleton : *singletons )
13605             delete singleton;
13606         delete singletons;
13607         singletons = nullptr;
13608     }
13609
13610 } // namespace Catch
13611 // end catch_singletons.cpp
13612 // start catch_startup_exception_registry.cpp
13613
13614 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
13615 namespace Catch {
13616     void StartupExceptionRegistry::add( std::exception_ptr const& exception ) noexcept {
13617         CATCH_TRY {
13618             m_exceptions.push_back(exception);
13619         } CATCH_CATCH_ALL {
13620             // If we run out of memory during start-up there's really not a lot more we can do about
      it
13621             std::terminate();
13622         }
13623     }
13624
13625     std::vector<std::exception_ptr> const& StartupExceptionRegistry::getExceptions() const noexcept {
13626         return m_exceptions;
13627     }
13628
13629 } // end namespace Catch
13630 #endif
13631 // end catch_startup_exception_registry.cpp
13632 // start catch_stream.cpp
13633
13634 #include <cstdio>
13635 #include <iostream>
13636 #include <fstream>
13637 #include <sstream>
13638 #include <vector>
13639 #include <memory>
13640
13641 namespace Catch {
13642
13643     Catch::IStream::~IStream() = default;
13644
13645     namespace Detail { namespace {
13646             template<typename WriterF, std::size_t bufferSize=256>
13647             class StreamBufImpl : public std::streambuf {
13648                 char data[bufferSize];
13649                 WriterF m_writer;
13650
13651             public:
13652                 StreamBufImpl() {
13653                     setp( data, data + sizeof(data) );
13654                 }
13655
13656                 ~StreamBufImpl() noexcept {
13657                     StreamBufImpl::sync();
13658                 }
13659
13660             private:
13661                 int overflow( int c ) override {
13662                     sync();
13663
13664                     if( c != EOF ) {
13665                         if( pbase() == epptr() )
13666                             m_writer( std::string( 1, static_cast<char>( c ) ) );
13667                         else
13668                             sputc( static_cast<char>( c ) );
13669                     }
13670                     return 0;
13671                 }
13672
13673                 int sync() override {
13674                     if( pbase() != pptr() ) {
13675                         m_writer( std::string( pbase(), static_cast<std::string::size_type>( pptr() -
      pbase() ) ) );
13676                         setp( pbase(), epptr() );
13677                     }
13678                     return 0;
13679                 }
```

```
13680             };
13681
13682
13683
13684             struct OutputDebugWriter {
13685
13686                 void operator()( std::string const&str ) {
13687                     writeToDebugConsole( str );
13688                 }
13689             };
13690
13691
13692
13693             class FileStream : public IStream {
13694                 mutable std::ofstream m_ofs;
13695             public:
13696                 FileStream( StringRef filename ) {
13697                     m_ofs.open( filename.c_str() );
13698                     CATCH_ENFORCE( !m_ofs.fail(), "Unable to open file: '" << filename << "'" );
13699                 }
13700                 ~FileStream() override = default;
13701             public: // IStream
13702                 std::ostream& stream() const override {
13703                     return m_ofs;
13704                 }
13705             };
13706
13707
13708
13709             class CoutStream : public IStream {
13710                 mutable std::ostream m_os;
13711             public:
13712                 // Store the streambuf from cout up-front because
13713                 // cout may get redirected when running tests
13714                 CoutStream() : m_os( Catch::cout().rdbuf() ) {}
13715                 ~CoutStream() override = default;
13716
13717             public: // IStream
13718                 std::ostream& stream() const override { return m_os; }
13719             };
13720
13721
13722
13723             class DebugOutStream : public IStream {
13724                 std::unique_ptr<StreamBufImpl<OutputDebugWriter>> m_streamBuf;
13725                 mutable std::ostream m_os;
13726             public:
13727                 DebugOutStream()
13728                         :   m_streamBuf( new StreamBufImpl<OutputDebugWriter>() ),
13729                             m_os( m_streamBuf.get() )
13730                 {}
13731
13732                 ~DebugOutStream() override = default;
13733
13734             public: // IStream
13735                 std::ostream& stream() const override { return m_os; }
13736             };
13737
13738         }} // namespace anon::detail
13739
13741
13742     auto makeStream( StringRef const &filename ) -> IStream const* {
13743         if( filename.empty() )
13744             return new Detail::CoutStream();
13745         else if( filename[0] == '%' ) {
13746             if( filename == "%debug" )
13747                 return new Detail::DebugOutStream();
13748             else
13749                 CATCH_ERROR( "Unrecognised stream: '" << filename << "'" );
13750         }
13751         else
13752             return new Detail::FileStream( filename );
13753     }
13754
13755     // This class encapsulates the idea of a pool of ostringstreams that can be reused.
13756     struct StringStreams {
13757         std::vector<std::unique_ptr<std::ostringstream>> m_streams;
13758         std::vector<std::size_t> m_unused;
13759         std::ostringstream m_referenceStream; // Used for copy state/ flags from
13760
13761         auto add() -> std::size_t {
13762             if( m_unused.empty() ) {
13763                 m_streams.push_back( std::unique_ptr<std::ostringstream>( new std::ostringstream ) );
13764                 return m_streams.size()-1;
13765             }
13766             else {
13767                 auto index = m_unused.back();
13768                 m_unused.pop_back();
13769                 return index;
13770             }
13771         }
```

```
13772
13773         void release( std::size_t index ) {
13774             m_streams[index]->copyfmt( m_referenceStream ); // Restore initial flags and other state
13775             m_unused.push_back(index);
13776         }
13777     };
13778
13779     ReusableStringStream::ReusableStringStream()
13780             :   m_index( Singleton<StringStreams>::getMutable().add() ),
13781                 m_oss( Singleton<StringStreams>::getMutable().m_streams[m_index].get() )
13782     {}
13783
13784     ReusableStringStream::~ReusableStringStream() {
13785         static_cast<std::ostringstream*>( m_oss )->str("");
13786         m_oss->clear();
13787         Singleton<StringStreams>::getMutable().release( m_index );
13788     }
13789
13790     auto ReusableStringStream::str() const -> std::string {
13791         return static_cast<std::ostringstream*>( m_oss )->str();
13792     }
13793
13795
13796 #ifndef CATCH_CONFIG_NOSTDOUT // If you #define this you must implement these functions
13797     std::ostream& cout() { return std::cout; }
13798     std::ostream& cerr() { return std::cerr; }
13799     std::ostream& clog() { return std::clog; }
13800 #endif
13801 }
13802 // end catch_stream.cpp
13803 // start catch_string_manip.cpp
13804
13805 #include <algorithm>
13806 #include <ostream>
13807 #include <cstring>
13808 #include <cctype>
13809 #include <vector>
13810
13811 namespace Catch {
13812
13813     namespace {
13814         char toLowerCh(char c) {
13815             return static_cast<char>( std::tolower( static_cast<unsigned char>(c) ) );
13816         }
13817     }
13818
13819     bool startsWith( std::string const& s, std::string const& prefix ) {
13820         return s.size() >= prefix.size() && std::equal(prefix.begin(), prefix.end(), s.begin());
13821     }
13822     bool startsWith( std::string const& s, char prefix ) {
13823         return !s.empty() && s[0] == prefix;
13824     }
13825     bool endsWith( std::string const& s, std::string const& suffix ) {
13826         return s.size() >= suffix.size() && std::equal(suffix.rbegin(), suffix.rend(), s.rbegin());
13827     }
13828     bool endsWith( std::string const& s, char suffix ) {
13829         return !s.empty() && s[s.size()-1] == suffix;
13830     }
13831     bool contains( std::string const& s, std::string const& infix ) {
13832         return s.find( infix ) != std::string::npos;
13833     }
13834     void toLowerInPlace( std::string& s ) {
13835         std::transform( s.begin(), s.end(), s.begin(), toLowerCh );
13836     }
13837     std::string toLower( std::string const& s ) {
13838         std::string lc = s;
13839         toLowerInPlace( lc );
13840         return lc;
13841     }
13842     std::string trim( std::string const& str ) {
13843         static char const* whitespaceChars = "\n\r\t ";
13844         std::string::size_type start = str.find_first_not_of( whitespaceChars );
13845         std::string::size_type end = str.find_last_not_of( whitespaceChars );
13846
13847         return start != std::string::npos ? str.substr( start, 1+end-start ) : std::string();
13848     }
13849
13850     StringRef trim(StringRef ref) {
13851         const auto is_ws = [](char c) {
13852             return c == ' ' || c == '\t' || c == '\n' || c == '\r';
13853         };
13854         size_t real_begin = 0;
13855         while (real_begin < ref.size() && is_ws(ref[real_begin])) { ++real_begin; }
13856         size_t real_end = ref.size();
13857         while (real_end > real_begin && is_ws(ref[real_end - 1])) { --real_end; }
13858
13859         return ref.substr(real_begin, real_end - real_begin);
```

```
13860     }
13861
13862     bool replaceInPlace( std::string& str, std::string const& replaceThis, std::string const& withThis
      ) {
13863         bool replaced = false;
13864         std::size_t i = str.find( replaceThis );
13865         while( i != std::string::npos ) {
13866             replaced = true;
13867             str = str.substr( 0, i ) + withThis + str.substr( i+replaceThis.size() );
13868             if( i < str.size()-withThis.size() )
13869                 i = str.find( replaceThis, i+withThis.size() );
13870             else
13871                 i = std::string::npos;
13872         }
13873         return replaced;
13874     }
13875
13876     std::vector<StringRef> splitStringRef( StringRef str, char delimiter ) {
13877         std::vector<StringRef> subStrings;
13878         std::size_t start = 0;
13879         for(std::size_t pos = 0; pos < str.size(); ++pos ) {
13880             if( str[pos] == delimiter ) {
13881                 if( pos - start > 1 )
13882                     subStrings.push_back( str.substr( start, pos-start ) );
13883                 start = pos+1;
13884             }
13885         }
13886         if( start < str.size() )
13887             subStrings.push_back( str.substr( start, str.size()-start ) );
13888         return subStrings;
13889     }
13890
13891     pluralise::pluralise( std::size_t count, std::string const& label )
13892             :   m_count( count ),
13893                 m_label( label )
13894     {}
13895
13896     std::ostream& operator « ( std::ostream& os, pluralise const& pluraliser ) {
13897         os « pluraliser.m_count « ' ' « pluraliser.m_label;
13898         if( pluraliser.m_count != 1 )
13899             os « 's';
13900         return os;
13901     }
13902
13903 }
13904 // end catch_string_manip.cpp
13905 // start catch_stringref.cpp
13906
13907 #include <algorithm>
13908 #include <ostream>
13909 #include <cstring>
13910 #include <cstdint>
13911
13912 namespace Catch {
13913     StringRef::StringRef( char const* rawChars ) noexcept
13914             : StringRef( rawChars, static_cast<StringRef::size_type>(std::strlen(rawChars) ) )
13915     {}
13916
13917     auto StringRef::c_str() const -> char const* {
13918         CATCH_ENFORCE(isNullTerminated(), "Called StringRef::c_str() on a non-null-terminated
      instance");
13919         return m_start;
13920     }
13921     auto StringRef::data() const noexcept -> char const* {
13922         return m_start;
13923     }
13924
13925     auto StringRef::substr( size_type start, size_type size ) const noexcept -> StringRef {
13926         if (start < m_size) {
13927             return StringRef(m_start + start, (std::min)(m_size - start, size));
13928         } else {
13929             return StringRef();
13930         }
13931     }
13932     auto StringRef::operator == ( StringRef const& other ) const noexcept -> bool {
13933         return m_size == other.m_size
13934                && (std::memcmp( m_start, other.m_start, m_size ) == 0);
13935     }
13936
13937     auto operator « ( std::ostream& os, StringRef const& str ) -> std::ostream& {
13938         return os.write(str.data(), str.size());
13939     }
13940
13941     auto operator+=( std::string& lhs, StringRef const& rhs ) -> std::string& {
13942         lhs.append(rhs.data(), rhs.size());
13943         return lhs;
13944     }
```

```
13945
13946 } // namespace Catch
13947 // end catch_stringref.cpp
13948 // start catch_tag_alias.cpp
13949
13950 namespace Catch {
13951     TagAlias::TagAlias(std::string const & _tag, SourceLineInfo _lineInfo): tag(_tag),
      lineInfo(_lineInfo) {}
13952 }
13953 // end catch_tag_alias.cpp
13954 // start catch_tag_alias_autoregistrar.cpp
13955
13956 namespace Catch {
13957
13958     RegistrarForTagAliases::RegistrarForTagAliases(char const* alias, char const* tag, SourceLineInfo
      const& lineInfo) {
13959         CATCH_TRY {
13960             getMutableRegistryHub().registerTagAlias(alias, tag, lineInfo);
13961         } CATCH_CATCH_ALL {
13962             // Do not throw when constructing global objects, instead register the exception to be
      processed later
13963             getMutableRegistryHub().registerStartupException();
13964         }
13965     }
13966
13967 }
13968 // end catch_tag_alias_autoregistrar.cpp
13969 // start catch_tag_alias_registry.cpp
13970
13971 #include <sstream>
13972
13973 namespace Catch {
13974
13975     TagAliasRegistry::~TagAliasRegistry() {}
13976
13977     TagAlias const* TagAliasRegistry::find( std::string const& alias ) const {
13978         auto it = m_registry.find( alias );
13979         if( it != m_registry.end() )
13980             return &(it->second);
13981         else
13982             return nullptr;
13983     }
13984
13985     std::string TagAliasRegistry::expandAliases( std::string const& unexpandedTestSpec ) const {
13986         std::string expandedTestSpec = unexpandedTestSpec;
13987         for( auto const& registryKvp : m_registry ) {
13988             std::size_t pos = expandedTestSpec.find( registryKvp.first );
13989             if( pos != std::string::npos ) {
13990                 expandedTestSpec =  expandedTestSpec.substr( 0, pos ) +
13991                                     registryKvp.second.tag +
13992                                     expandedTestSpec.substr( pos + registryKvp.first.size() );
13993             }
13994         }
13995         return expandedTestSpec;
13996     }
13997
13998     void TagAliasRegistry::add( std::string const& alias, std::string const& tag, SourceLineInfo
      const& lineInfo ) {
13999         CATCH_ENFORCE( startsWith(alias, "[@") && endsWith(alias, ']'),
14000                        "error: tag alias, '" << alias << "' is not of the form [@alias name].\n" <<
      lineInfo );
14001
14002         CATCH_ENFORCE( m_registry.insert(std::make_pair(alias, TagAlias(tag, lineInfo))).second,
14003                        "error: tag alias, '" << alias << "' already registered.\n"
14004                                              << "\tFirst seen at: " << find(alias)->lineInfo << "\n"
14005                                              << "\tRedefined at: " << lineInfo );
14006     }
14007
14008     ITagAliasRegistry::~ITagAliasRegistry() {}
14009
14010     ITagAliasRegistry const& ITagAliasRegistry::get() {
14011         return getRegistryHub().getTagAliasRegistry();
14012     }
14013
14014 } // end namespace Catch
14015 // end catch_tag_alias_registry.cpp
14016 // start catch_test_case_info.cpp
14017
14018 #include <cctype>
14019 #include <exception>
14020 #include <algorithm>
14021 #include <sstream>
14022
14023 namespace Catch {
14024
14025     namespace {
14026         TestCaseInfo::SpecialProperties parseSpecialTag( std::string const& tag ) {
```

```
14027             if( startsWith( tag, '.' ) ||
14028                 tag == "!hide" )
14029                 return TestCaseInfo::IsHidden;
14030             else if( tag == "!throws" )
14031                 return TestCaseInfo::Throws;
14032             else if( tag == "!shouldfail" )
14033                 return TestCaseInfo::ShouldFail;
14034             else if( tag == "!mayfail" )
14035                 return TestCaseInfo::MayFail;
14036             else if( tag == "!nonportable" )
14037                 return TestCaseInfo::NonPortable;
14038             else if( tag == "!benchmark" )
14039                 return static_cast<TestCaseInfo::SpecialProperties>( TestCaseInfo::Benchmark |
    TestCaseInfo::IsHidden );
14040             else
14041                 return TestCaseInfo::None;
14042         }
14043         bool isReservedTag( std::string const& tag ) {
14044             return parseSpecialTag( tag ) == TestCaseInfo::None && tag.size() > 0 && !std::isalnum(
    static_cast<unsigned char>(tag[0]) );
14045         }
14046         void enforceNotReservedTag( std::string const& tag, SourceLineInfo const& _lineInfo ) {
14047             CATCH_ENFORCE( !isReservedTag(tag),
14048                            "Tag name: [" « tag « "] is not allowed.\n"
14049                                            « "Tag names starting with non alphanumeric characters are
    reserved\n"
14050                                            « _lineInfo );
14051         }
14052     }
14053
14054     TestCase makeTestCase(  ITestInvoker* _testCase,
14055                             std::string const& _className,
14056                             NameAndTags const& nameAndTags,
14057                             SourceLineInfo const& _lineInfo )
14058     {
14059         bool isHidden = false;
14060
14061         // Parse out tags
14062         std::vector<std::string> tags;
14063         std::string desc, tag;
14064         bool inTag = false;
14065         for (char c : nameAndTags.tags) {
14066             if( !inTag ) {
14067                 if( c == '[' )
14068                     inTag = true;
14069                 else
14070                     desc += c;
14071             }
14072             else {
14073                 if( c == ']' ) {
14074                     TestCaseInfo::SpecialProperties prop = parseSpecialTag( tag );
14075                     if( ( prop & TestCaseInfo::IsHidden ) != 0 )
14076                         isHidden = true;
14077                     else if( prop == TestCaseInfo::None )
14078                         enforceNotReservedTag( tag, _lineInfo );
14079
14080                     // Merged hide tags like `[.approvals]` should be added as
14081                     // `[.][approvals]`. The `[.]` is added at later point, so
14082                     // we only strip the prefix
14083                     if (startsWith(tag, '.') && tag.size() > 1) {
14084                         tag.erase(0, 1);
14085                     }
14086                     tags.push_back( tag );
14087                     tag.clear();
14088                     inTag = false;
14089                 }
14090                 else
14091                     tag += c;
14092             }
14093         }
14094         if( isHidden ) {
14095             // Add all "hidden" tags to make them behave identically
14096             tags.insert( tags.end(), { ".", "!hide" } );
14097         }
14098
14099         TestCaseInfo info( static_cast<std::string>(nameAndTags.name), _className, desc, tags,
    _lineInfo );
14100         return TestCase( _testCase, std::move(info) );
14101     }
14102
14103     void setTags( TestCaseInfo& testCaseInfo, std::vector<std::string> tags ) {
14104         std::sort(begin(tags), end(tags));
14105         tags.erase(std::unique(begin(tags), end(tags)), end(tags));
14106         testCaseInfo.lcaseTags.clear();
14107
14108         for( auto const& tag : tags ) {
14109             std::string lcaseTag = toLower( tag );
```

```
14110             testCaseInfo.properties = static_cast<TestCaseInfo::SpecialProperties>(
      testCaseInfo.properties | parseSpecialTag( lcaseTag ) );
14111             testCaseInfo.lcaseTags.push_back( lcaseTag );
14112         }
14113         testCaseInfo.tags = std::move(tags);
14114     }
14115
14116     TestCaseInfo::TestCaseInfo( std::string const& _name,
14117                                 std::string const& _className,
14118                                 std::string const& _description,
14119                                 std::vector<std::string> const& _tags,
14120                                 SourceLineInfo const& _lineInfo )
14121             :   name( _name ),
14122                 className( _className ),
14123                 description( _description ),
14124                 lineInfo( _lineInfo ),
14125                 properties( None )
14126     {
14127         setTags( *this, _tags );
14128     }
14129
14130     bool TestCaseInfo::isHidden() const {
14131         return ( properties & IsHidden ) != 0;
14132     }
14133     bool TestCaseInfo::throws() const {
14134         return ( properties & Throws ) != 0;
14135     }
14136     bool TestCaseInfo::okToFail() const {
14137         return ( properties & (ShouldFail | MayFail ) ) != 0;
14138     }
14139     bool TestCaseInfo::expectedToFail() const {
14140         return ( properties & (ShouldFail ) ) != 0;
14141     }
14142
14143     std::string TestCaseInfo::tagsAsString() const {
14144         std::string ret;
14145         // '[' and ']' per tag
14146         std::size_t full_size = 2 * tags.size();
14147         for (const auto& tag : tags) {
14148             full_size += tag.size();
14149         }
14150         ret.reserve(full_size);
14151         for (const auto& tag : tags) {
14152             ret.push_back('[');
14153             ret.append(tag);
14154             ret.push_back(']');
14155         }
14156
14157         return ret;
14158     }
14159
14160     TestCase::TestCase( ITestInvoker* testCase, TestCaseInfo&& info ) : TestCaseInfo( std::move(info)
      ), test( testCase ) {}
14161
14162     TestCase TestCase::withName( std::string const& _newName ) const {
14163         TestCase other( *this );
14164         other.name = _newName;
14165         return other;
14166     }
14167
14168     void TestCase::invoke() const {
14169         test->invoke();
14170     }
14171
14172     bool TestCase::operator == ( TestCase const& other ) const {
14173         return  test.get() == other.test.get() &&
14174                 name == other.name &&
14175                 className == other.className;
14176     }
14177
14178     bool TestCase::operator < ( TestCase const& other ) const {
14179         return name < other.name;
14180     }
14181
14182     TestCaseInfo const& TestCase::getTestCaseInfo() const
14183     {
14184         return *this;
14185     }
14186
14187 } // end namespace Catch
14188 // end catch_test_case_info.cpp
14189 // start catch_test_case_registry_impl.cpp
14190
14191 #include <algorithm>
14192 #include <sstream>
14193
14194 namespace Catch {
```

```
14195
14196     namespace {
14197         struct TestHasher {
14198             using hash_t = uint64_t;
14199
14200             explicit TestHasher( hash_t hashSuffix ):
14201                     m_hashSuffix{ hashSuffix } {}
14202
14203             uint32_t operator()( TestCase const& t ) const {
14204                 // FNV-1a hash with multiplication fold.
14205                 const hash_t prime = 1099511628211u;
14206                 hash_t hash = 14695981039346656037u;
14207                 for ( const char c : t.name ) {
14208                     hash ^= c;
14209                     hash *= prime;
14210                 }
14211                 hash ^= m_hashSuffix;
14212                 hash *= prime;
14213                 const uint32_t low{ static_cast<uint32_t>( hash ) };
14214                 const uint32_t high{ static_cast<uint32_t>( hash » 32 ) };
14215                 return low * high;
14216             }
14217
14218         private:
14219             hash_t m_hashSuffix;
14220         };
14221     } // end unnamed namespace
14222
14223     std::vector<TestCase> sortTests( IConfig const& config, std::vector<TestCase> const&
      unsortedTestCases ) {
14224         switch( config.runOrder() ) {
14225             case RunTests::InDeclarationOrder:
14226                 // already in declaration order
14227                 break;
14228
14229             case RunTests::InLexicographicalOrder: {
14230                 std::vector<TestCase> sorted = unsortedTestCases;
14231                 std::sort( sorted.begin(), sorted.end() );
14232                 return sorted;
14233             }
14234
14235             case RunTests::InRandomOrder: {
14236                 seedRng( config );
14237                 TestHasher h{ config.rngSeed() };
14238
14239                 using hashedTest = std::pair<TestHasher::hash_t, TestCase const*>;
14240                 std::vector<hashedTest> indexed_tests;
14241                 indexed_tests.reserve( unsortedTestCases.size() );
14242
14243                 for (auto const& testCase : unsortedTestCases) {
14244                     indexed_tests.emplace_back(h(testCase), &testCase);
14245                 }
14246
14247                 std::sort(indexed_tests.begin(), indexed_tests.end(),
14248                           [](hashedTest const& lhs, hashedTest const& rhs) {
14249                               if (lhs.first == rhs.first) {
14250                                   return lhs.second->name < rhs.second->name;
14251                               }
14252                               return lhs.first < rhs.first;
14253                           });
14254
14255                 std::vector<TestCase> sorted;
14256                 sorted.reserve( indexed_tests.size() );
14257
14258                 for (auto const& hashed : indexed_tests) {
14259                     sorted.emplace_back(*hashed.second);
14260                 }
14261
14262                 return sorted;
14263             }
14264         }
14265         return unsortedTestCases;
14266     }
14267
14268     bool isThrowSafe( TestCase const& testCase, IConfig const& config ) {
14269         return !testCase.throws() || config.allowThrows();
14270     }
14271
14272     bool matchTest( TestCase const& testCase, TestSpec const& testSpec, IConfig const& config ) {
14273         return testSpec.matches( testCase ) && isThrowSafe( testCase, config );
14274     }
14275
14276     void enforceNoDuplicateTestCases( std::vector<TestCase> const& functions ) {
14277         std::set<TestCase> seenFunctions;
14278         for( auto const& function : functions ) {
14279             auto prev = seenFunctions.insert( function );
14280             CATCH_ENFORCE( prev.second,
```

```
14281                             "error: TEST_CASE( \"" « function.name « "\" ) already defined.\n"
14282                                                     « "\tFirst seen at " «
    prev.first->getTestCaseInfo().lineInfo « "\n"
14283                                                     « "\tRedefined at " «
    function.getTestCaseInfo().lineInfo );
14284         }
14285     }
14286
14287     std::vector<TestCase> filterTests( std::vector<TestCase> const& testCases, TestSpec const&
    testSpec, IConfig const& config ) {
14288         std::vector<TestCase> filtered;
14289         filtered.reserve( testCases.size() );
14290         for (auto const& testCase : testCases) {
14291             if ((!testSpec.hasFilters() && !testCase.isHidden()) ||
14292                 (testSpec.hasFilters() && matchTest(testCase, testSpec, config))) {
14293                 filtered.push_back(testCase);
14294             }
14295         }
14296         return filtered;
14297     }
14298     std::vector<TestCase> const& getAllTestCasesSorted( IConfig const& config ) {
14299         return getRegistryHub().getTestCaseRegistry().getAllTestsSorted( config );
14300     }
14301
14302     void TestRegistry::registerTest( TestCase const& testCase ) {
14303         std::string name = testCase.getTestCaseInfo().name;
14304         if( name.empty() ) {
14305             ReusableStringStream rss;
14306             rss « "Anonymous test case " « ++m_unnamedCount;
14307             return registerTest( testCase.withName( rss.str() ) );
14308         }
14309         m_functions.push_back( testCase );
14310     }
14311
14312     std::vector<TestCase> const& TestRegistry::getAllTests() const {
14313         return m_functions;
14314     }
14315     std::vector<TestCase> const& TestRegistry::getAllTestsSorted( IConfig const& config ) const {
14316         if( m_sortedFunctions.empty() )
14317             enforceNoDuplicateTestCases( m_functions );
14318
14319         if(  m_currentSortOrder != config.runOrder() || m_sortedFunctions.empty() ) {
14320             m_sortedFunctions = sortTests( config, m_functions );
14321             m_currentSortOrder = config.runOrder();
14322         }
14323         return m_sortedFunctions;
14324     }
14325
14327     TestInvokerAsFunction::TestInvokerAsFunction( void(*testAsFunction)() ) noexcept :
    m_testAsFunction( testAsFunction ) {}
14328
14329     void TestInvokerAsFunction::invoke() const {
14330         m_testAsFunction();
14331     }
14332
14333     std::string extractClassName( StringRef const& classOrQualifiedMethodName ) {
14334         std::string className(classOrQualifiedMethodName);
14335         if( startsWith( className, '&' ) )
14336         {
14337             std::size_t lastColons = className.rfind( "::" );
14338             std::size_t penultimateColons = className.rfind( "::", lastColons-1 );
14339             if( penultimateColons == std::string::npos )
14340                 penultimateColons = 1;
14341             className = className.substr( penultimateColons, lastColons-penultimateColons );
14342         }
14343         return className;
14344     }
14345
14346 } // end namespace Catch
14347 // end catch_test_case_registry_impl.cpp
14348 // start catch_test_case_tracker.cpp
14349
14350 #include <algorithm>
14351 #include <cassert>
14352 #include <stdexcept>
14353 #include <memory>
14354 #include <sstream>
14355
14356 #if defined(__clang__)
14357 #    pragma clang diagnostic push
14358 #    pragma clang diagnostic ignored "-Wexit-time-destructors"
14359 #endif
14360
14361 namespace Catch {
14362     namespace TestCaseTracking {
14363
14364         NameAndLocation::NameAndLocation( std::string const& _name, SourceLineInfo const& _location )
```

```
14365                 :   name( _name ),
14366                     location( _location )
14367         {}
14368
14369         ITracker::~ITracker() = default;
14370
14371         ITracker& TrackerContext::startRun() {
14372             m_rootTracker = std::make_shared<SectionTracker>( NameAndLocation( "{root}",
      CATCH_INTERNAL_LINEINFO ), *this, nullptr );
14373             m_currentTracker = nullptr;
14374             m_runState = Executing;
14375             return *m_rootTracker;
14376         }
14377
14378         void TrackerContext::endRun() {
14379             m_rootTracker.reset();
14380             m_currentTracker = nullptr;
14381             m_runState = NotStarted;
14382         }
14383
14384         void TrackerContext::startCycle() {
14385             m_currentTracker = m_rootTracker.get();
14386             m_runState = Executing;
14387         }
14388         void TrackerContext::completeCycle() {
14389             m_runState = CompletedCycle;
14390         }
14391
14392         bool TrackerContext::completedCycle() const {
14393             return m_runState == CompletedCycle;
14394         }
14395         ITracker& TrackerContext::currentTracker() {
14396             return *m_currentTracker;
14397         }
14398         void TrackerContext::setCurrentTracker( ITracker* tracker ) {
14399             m_currentTracker = tracker;
14400         }
14401
14402         TrackerBase::TrackerBase( NameAndLocation const& nameAndLocation, TrackerContext& ctx,
      ITracker* parent ):
14403                 ITracker(nameAndLocation),
14404                 m_ctx( ctx ),
14405                 m_parent( parent )
14406         {}
14407
14408         bool TrackerBase::isComplete() const {
14409             return m_runState == CompletedSuccessfully || m_runState == Failed;
14410         }
14411         bool TrackerBase::isSuccessfullyCompleted() const {
14412             return m_runState == CompletedSuccessfully;
14413         }
14414         bool TrackerBase::isOpen() const {
14415             return m_runState != NotStarted && !isComplete();
14416         }
14417         bool TrackerBase::hasChildren() const {
14418             return !m_children.empty();
14419         }
14420
14421         void TrackerBase::addChild( ITrackerPtr const& child ) {
14422             m_children.push_back( child );
14423         }
14424
14425         ITrackerPtr TrackerBase::findChild( NameAndLocation const& nameAndLocation ) {
14426             auto it = std::find_if( m_children.begin(), m_children.end(),
14427                                     [&nameAndLocation]( ITrackerPtr const& tracker ){
14428                                         return
14429                                                 tracker->nameAndLocation().location ==
      nameAndLocation.location &&
14430                                                 tracker->nameAndLocation().name ==
      nameAndLocation.name;
14431                                     } );
14432             return( it != m_children.end() )
14433                   ? *it
14434                   : nullptr;
14435         }
14436         ITracker& TrackerBase::parent() {
14437             assert( m_parent ); // Should always be non-null except for root
14438             return *m_parent;
14439         }
14440
14441         void TrackerBase::openChild() {
14442             if( m_runState != ExecutingChildren ) {
14443                 m_runState = ExecutingChildren;
14444                 if( m_parent )
14445                     m_parent->openChild();
14446             }
14447         }
```

```
14448
14449         bool TrackerBase::isSectionTracker() const { return false; }
14450         bool TrackerBase::isGeneratorTracker() const { return false; }
14451
14452         void TrackerBase::open() {
14453             m_runState = Executing;
14454             moveToThis();
14455             if( m_parent )
14456                 m_parent->openChild();
14457         }
14458
14459         void TrackerBase::close() {
14460
14461             // Close any still open children (e.g. generators)
14462             while( &m_ctx.currentTracker() != this )
14463                 m_ctx.currentTracker().close();
14464
14465             switch( m_runState ) {
14466                 case NeedsAnotherRun:
14467                     break;
14468
14469                 case Executing:
14470                     m_runState = CompletedSuccessfully;
14471                     break;
14472                 case ExecutingChildren:
14473                     if( std::all_of(m_children.begin(), m_children.end(), [](ITrackerPtr const& t){
      return t->isComplete(); }) )
14474                         m_runState = CompletedSuccessfully;
14475                     break;
14476
14477                 case NotStarted:
14478                 case CompletedSuccessfully:
14479                 case Failed:
14480                     CATCH_INTERNAL_ERROR( "Illogical state: " « m_runState );
14481
14482                 default:
14483                     CATCH_INTERNAL_ERROR( "Unknown state: " « m_runState );
14484             }
14485             moveToParent();
14486             m_ctx.completeCycle();
14487         }
14488         void TrackerBase::fail() {
14489             m_runState = Failed;
14490             if( m_parent )
14491                 m_parent->markAsNeedingAnotherRun();
14492             moveToParent();
14493             m_ctx.completeCycle();
14494         }
14495         void TrackerBase::markAsNeedingAnotherRun() {
14496             m_runState = NeedsAnotherRun;
14497         }
14498
14499         void TrackerBase::moveToParent() {
14500             assert( m_parent );
14501             m_ctx.setCurrentTracker( m_parent );
14502         }
14503         void TrackerBase::moveToThis() {
14504             m_ctx.setCurrentTracker( this );
14505         }
14506
14507         SectionTracker::SectionTracker( NameAndLocation const& nameAndLocation, TrackerContext& ctx,
      ITracker* parent )
14508                 :   TrackerBase( nameAndLocation, ctx, parent ),
14509                     m_trimmed_name(trim(nameAndLocation.name))
14510         {
14511             if( parent ) {
14512                 while( !parent->isSectionTracker() )
14513                     parent = &parent->parent();
14514
14515                 SectionTracker& parentSection = static_cast<SectionTracker&>( *parent );
14516                 addNextFilters( parentSection.m_filters );
14517             }
14518         }
14519
14520         bool SectionTracker::isComplete() const {
14521             bool complete = true;
14522
14523             if (m_filters.empty()
14524                 || m_filters[0] == ""
14525                 || std::find(m_filters.begin(), m_filters.end(), m_trimmed_name) != m_filters.end()) {
14526                 complete = TrackerBase::isComplete();
14527             }
14528             return complete;
14529         }
14530
14531         bool SectionTracker::isSectionTracker() const { return true; }
14532
```

```
14533         SectionTracker& SectionTracker::acquire( TrackerContext& ctx, NameAndLocation const&
      nameAndLocation ) {
14534             std::shared_ptr<SectionTracker> section;
14535
14536             ITracker& currentTracker = ctx.currentTracker();
14537             if( ITrackerPtr childTracker = currentTracker.findChild( nameAndLocation ) ) {
14538                 assert( childTracker );
14539                 assert( childTracker->isSectionTracker() );
14540                 section = std::static_pointer_cast<SectionTracker>( childTracker );
14541             }
14542             else {
14543                 section = std::make_shared<SectionTracker>( nameAndLocation, ctx, &currentTracker );
14544                 currentTracker.addChild( section );
14545             }
14546             if( !ctx.completedCycle() )
14547                 section->tryOpen();
14548             return *section;
14549         }
14550
14551         void SectionTracker::tryOpen() {
14552             if( !isComplete() )
14553                 open();
14554         }
14555
14556         void SectionTracker::addInitialFilters( std::vector<std::string> const& filters ) {
14557             if( !filters.empty() ) {
14558                 m_filters.reserve( m_filters.size() + filters.size() + 2 );
14559                 m_filters.emplace_back(""); // Root - should never be consulted
14560                 m_filters.emplace_back(""); // Test Case - not a section filter
14561                 m_filters.insert( m_filters.end(), filters.begin(), filters.end() );
14562             }
14563         }
14564         void SectionTracker::addNextFilters( std::vector<std::string> const& filters ) {
14565             if( filters.size() > 1 )
14566                 m_filters.insert( m_filters.end(), filters.begin()+1, filters.end() );
14567         }
14568
14569         std::vector<std::string> const& SectionTracker::getFilters() const {
14570             return m_filters;
14571         }
14572
14573         std::string const& SectionTracker::trimmedName() const {
14574             return m_trimmed_name;
14575         }
14576
14577     } // namespace TestCaseTracking
14578
14579     using TestCaseTracking::ITracker;
14580     using TestCaseTracking::TrackerContext;
14581     using TestCaseTracking::SectionTracker;
14582
14583 } // namespace Catch
14584
14585 #if defined(__clang__)
14586 #    pragma clang diagnostic pop
14587 #endif
14588 // end catch_test_case_tracker.cpp
14589 // start catch_test_registry.cpp
14590
14591 namespace Catch {
14592
14593     auto makeTestInvoker( void(*testAsFunction)() ) noexcept -> ITestInvoker* {
14594         return new(std::nothrow) TestInvokerAsFunction( testAsFunction );
14595     }
14596
14597     NameAndTags::NameAndTags( StringRef const& name_ , StringRef const& tags_ ) noexcept : name( name_
      ), tags( tags_ ) {}
14598
14599     AutoReg::AutoReg( ITestInvoker* invoker, SourceLineInfo const& lineInfo, StringRef const&
      classOrMethod, NameAndTags const& nameAndTags ) noexcept {
14600         CATCH_TRY {
14601             getMutableRegistryHub()
14602                     .registerTest(
14603                             makeTestCase(
14604                                     invoker,
14605                                     extractClassName( classOrMethod ),
14606                                     nameAndTags,
14607                                     lineInfo));
14608         } CATCH_CATCH_ALL {
14609             // Do not throw when constructing global objects, instead register the exception to be
      processed later
14610             getMutableRegistryHub().registerStartupException();
14611         }
14612     }
14613
14614     AutoReg::~AutoReg() = default;
14615 }
```

```
14616 // end catch_test_registry.cpp
14617 // start catch_test_spec.cpp
14618
14619 #include <algorithm>
14620 #include <string>
14621 #include <vector>
14622 #include <memory>
14623
14624 namespace Catch {
14625
14626     TestSpec::Pattern::Pattern( std::string const& name )
14627             : m_name( name )
14628     {}
14629
14630     TestSpec::Pattern::~Pattern() = default;
14631
14632     std::string const& TestSpec::Pattern::name() const {
14633         return m_name;
14634     }
14635
14636     TestSpec::NamePattern::NamePattern( std::string const& name, std::string const& filterString )
14637             : Pattern( filterString )
14638             , m_wildcardPattern( toLower( name ), CaseSensitive::No )
14639     {}
14640
14641     bool TestSpec::NamePattern::matches( TestCaseInfo const& testCase ) const {
14642         return m_wildcardPattern.matches( testCase.name );
14643     }
14644
14645     TestSpec::TagPattern::TagPattern( std::string const& tag, std::string const& filterString )
14646             : Pattern( filterString )
14647             , m_tag( toLower( tag ) )
14648     {}
14649
14650     bool TestSpec::TagPattern::matches( TestCaseInfo const& testCase ) const {
14651         return std::find(begin(testCase.lcaseTags),
14652                          end(testCase.lcaseTags),
14653                          m_tag) != end(testCase.lcaseTags);
14654     }
14655
14656     TestSpec::ExcludedPattern::ExcludedPattern( PatternPtr const& underlyingPattern )
14657             : Pattern( underlyingPattern->name() )
14658             , m_underlyingPattern( underlyingPattern )
14659     {}
14660
14661     bool TestSpec::ExcludedPattern::matches( TestCaseInfo const& testCase ) const {
14662         return !m_underlyingPattern->matches( testCase );
14663     }
14664
14665     bool TestSpec::Filter::matches( TestCaseInfo const& testCase ) const {
14666         return std::all_of( m_patterns.begin(), m_patterns.end(), [&]( PatternPtr const& p ){ return
      p->matches( testCase ); } );
14667     }
14668
14669     std::string TestSpec::Filter::name() const {
14670         std::string name;
14671         for( auto const& p : m_patterns )
14672             name += p->name();
14673         return name;
14674     }
14675
14676     bool TestSpec::hasFilters() const {
14677         return !m_filters.empty();
14678     }
14679
14680     bool TestSpec::matches( TestCaseInfo const& testCase ) const {
14681         return std::any_of( m_filters.begin(), m_filters.end(), [&]( Filter const& f ){ return
      f.matches( testCase ); } );
14682     }
14683
14684     TestSpec::Matches TestSpec::matchesByFilter( std::vector<TestCase> const& testCases, IConfig
      const& config ) const
14685     {
14686         Matches matches( m_filters.size() );
14687         std::transform( m_filters.begin(), m_filters.end(), matches.begin(), [&]( Filter const& filter
      ){
14688             std::vector<TestCase const*> currentMatches;
14689             for( auto const& test : testCases )
14690                 if( isThrowSafe( test, config ) && filter.matches( test ) )
14691                     currentMatches.emplace_back( &test );
14692             return FilterMatch{ filter.name(), currentMatches };
14693         } );
14694         return matches;
14695     }
14696
14697     const TestSpec::vectorStrings& TestSpec::getInvalidArgs() const{
14698         return  (m_invalidArgs);
```

```
14699     }
14700
14701 }
14702 // end catch_test_spec.cpp
14703 // start catch_test_spec_parser.cpp
14704
14705 namespace Catch {
14706
14707     TestSpecParser::TestSpecParser( ITagAliasRegistry const& tagAliases ) : m_tagAliases( &tagAliases
      ) {}
14708
14709     TestSpecParser& TestSpecParser::parse( std::string const& arg ) {
14710         m_mode = None;
14711         m_exclusion = false;
14712         m_arg = m_tagAliases->expandAliases( arg );
14713         m_escapeChars.clear();
14714         m_substring.reserve(m_arg.size());
14715         m_patternName.reserve(m_arg.size());
14716         m_realPatternPos = 0;
14717
14718         for( m_pos = 0; m_pos < m_arg.size(); ++m_pos )
14719             //if visitChar fails
14720             if( !visitChar( m_arg[m_pos] ) ){
14721                 m_testSpec.m_invalidArgs.push_back(arg);
14722                 break;
14723             }
14724         endMode();
14725         return *this;
14726     }
14727     TestSpec TestSpecParser::testSpec() {
14728         addFilter();
14729         return m_testSpec;
14730     }
14731     bool TestSpecParser::visitChar( char c ) {
14732         if( (m_mode != EscapedName) && (c == '\\') ) {
14733             escape();
14734             addCharToPattern(c);
14735             return true;
14736         }else if((m_mode != EscapedName) && (c == ',') )  {
14737             return separate();
14738         }
14739
14740         switch( m_mode ) {
14741             case None:
14742                 if( processNoneChar( c ) )
14743                     return true;
14744                 break;
14745             case Name:
14746                 processNameChar( c );
14747                 break;
14748             case EscapedName:
14749                 endMode();
14750                 addCharToPattern(c);
14751                 return true;
14752             default:
14753             case Tag:
14754             case QuotedName:
14755                 if( processOtherChar( c ) )
14756                     return true;
14757                 break;
14758         }
14759
14760         m_substring += c;
14761         if( !isControlChar( c ) ) {
14762             m_patternName += c;
14763             m_realPatternPos++;
14764         }
14765         return true;
14766     }
14767     // Two of the processing methods return true to signal the caller to return
14768     // without adding the given character to the current pattern strings
14769     bool TestSpecParser::processNoneChar( char c ) {
14770         switch( c ) {
14771             case ' ':
14772                 return true;
14773             case '~':
14774                 m_exclusion = true;
14775                 return false;
14776             case '[':
14777                 startNewMode( Tag );
14778                 return false;
14779             case '"':
14780                 startNewMode( QuotedName );
14781                 return false;
14782             default:
14783                 startNewMode( Name );
14784                 return false;
```

```
14785         }
14786     }
14787     void TestSpecParser::processNameChar( char c ) {
14788         if( c == '[' ) {
14789             if( m_substring == "exclude:" )
14790                 m_exclusion = true;
14791             else
14792                 endMode();
14793             startNewMode( Tag );
14794         }
14795     }
14796     bool TestSpecParser::processOtherChar( char c ) {
14797         if( !isControlChar( c ) )
14798             return false;
14799         m_substring += c;
14800         endMode();
14801         return true;
14802     }
14803     void TestSpecParser::startNewMode( Mode mode ) {
14804         m_mode = mode;
14805     }
14806     void TestSpecParser::endMode() {
14807         switch( m_mode ) {
14808             case Name:
14809             case QuotedName:
14810                 return addNamePattern();
14811             case Tag:
14812                 return addTagPattern();
14813             case EscapedName:
14814                 revertBackToLastMode();
14815                 return;
14816             case None:
14817             default:
14818                 return startNewMode( None );
14819         }
14820     }
14821     void TestSpecParser::escape() {
14822         saveLastMode();
14823         m_mode = EscapedName;
14824         m_escapeChars.push_back(m_realPatternPos);
14825     }
14826     bool TestSpecParser::isControlChar( char c ) const {
14827         switch( m_mode ) {
14828             default:
14829                 return false;
14830             case None:
14831                 return c == '~';
14832             case Name:
14833                 return c == '[';
14834             case EscapedName:
14835                 return true;
14836             case QuotedName:
14837                 return c == '"';
14838             case Tag:
14839                 return c == '[' || c == ']';
14840         }
14841     }
14842
14843     void TestSpecParser::addFilter() {
14844         if( !m_currentFilter.m_patterns.empty() ) {
14845             m_testSpec.m_filters.push_back( m_currentFilter );
14846             m_currentFilter = TestSpec::Filter();
14847         }
14848     }
14849
14850     void TestSpecParser::saveLastMode() {
14851         lastMode = m_mode;
14852     }
14853
14854     void TestSpecParser::revertBackToLastMode() {
14855         m_mode = lastMode;
14856     }
14857
14858     bool TestSpecParser::separate() {
14859         if( (m_mode==QuotedName) || (m_mode==Tag) ){
14860             //invalid argument, signal failure to previous scope.
14861             m_mode = None;
14862             m_pos = m_arg.size();
14863             m_substring.clear();
14864             m_patternName.clear();
14865             m_realPatternPos = 0;
14866             return false;
14867         }
14868         endMode();
14869         addFilter();
14870         return true; //success
14871     }
```

```
14872
14873     std::string TestSpecParser::preprocessPattern() {
14874         std::string token = m_patternName;
14875         for (std::size_t i = 0; i < m_escapeChars.size(); ++i)
14876             token = token.substr(0, m_escapeChars[i] - i) + token.substr(m_escapeChars[i] - i + 1);
14877         m_escapeChars.clear();
14878         if (startsWith(token, "exclude:")) {
14879             m_exclusion = true;
14880             token = token.substr(8);
14881         }
14882
14883         m_patternName.clear();
14884         m_realPatternPos = 0;
14885
14886         return token;
14887     }
14888
14889     void TestSpecParser::addNamePattern() {
14890         auto token = preprocessPattern();
14891
14892         if (!token.empty()) {
14893             TestSpec::PatternPtr pattern = std::make_shared<TestSpec::NamePattern>(token,
      m_substring);
14894             if (m_exclusion)
14895                 pattern = std::make_shared<TestSpec::ExcludedPattern>(pattern);
14896             m_currentFilter.m_patterns.push_back(pattern);
14897         }
14898         m_substring.clear();
14899         m_exclusion = false;
14900         m_mode = None;
14901     }
14902
14903     void TestSpecParser::addTagPattern() {
14904         auto token = preprocessPattern();
14905
14906         if (!token.empty()) {
14907             // If the tag pattern is the "hide and tag" shorthand (e.g. [.foo])
14908             // we have to create a separate hide tag and shorten the real one
14909             if (token.size() > 1 && token[0] == '.') {
14910                 token.erase(token.begin());
14911                 TestSpec::PatternPtr pattern = std::make_shared<TestSpec::TagPattern>(".",
      m_substring);
14912                 if (m_exclusion) {
14913                     pattern = std::make_shared<TestSpec::ExcludedPattern>(pattern);
14914                 }
14915                 m_currentFilter.m_patterns.push_back(pattern);
14916             }
14917
14918             TestSpec::PatternPtr pattern = std::make_shared<TestSpec::TagPattern>(token, m_substring);
14919
14920             if (m_exclusion) {
14921                 pattern = std::make_shared<TestSpec::ExcludedPattern>(pattern);
14922             }
14923             m_currentFilter.m_patterns.push_back(pattern);
14924         }
14925         m_substring.clear();
14926         m_exclusion = false;
14927         m_mode = None;
14928     }
14929
14930     TestSpec parseTestSpec( std::string const& arg ) {
14931         return TestSpecParser( ITagAliasRegistry::get() ).parse( arg ).testSpec();
14932     }
14933
14934 } // namespace Catch
14935 // end catch_test_spec_parser.cpp
14936 // start catch_timer.cpp
14937
14938 #include <chrono>
14939
14940 static const uint64_t nanosecondsInSecond = 1000000000;
14941
14942 namespace Catch {
14943
14944     auto getCurrentNanosecondsSinceEpoch() -> uint64_t {
14945         return std::chrono::duration_cast<std::chrono::nanoseconds>(
      std::chrono::high_resolution_clock::now().time_since_epoch() ).count();
14946     }
14947
14948     namespace {
14949         auto estimateClockResolution() -> uint64_t {
14950             uint64_t sum = 0;
14951             static const uint64_t iterations = 1000000;
14952
14953             auto startTime = getCurrentNanosecondsSinceEpoch();
14954
14955             for( std::size_t i = 0; i < iterations; ++i ) {
```

```
14956
14957                 uint64_t ticks;
14958                 uint64_t baseTicks = getCurrentNanosecondsSinceEpoch();
14959                 do {
14960                     ticks = getCurrentNanosecondsSinceEpoch();
14961                 } while( ticks == baseTicks );
14962
14963                 auto delta = ticks - baseTicks;
14964                 sum += delta;
14965
14966                 // If we have been calibrating for over 3 seconds -- the clock
14967                 // is terrible and we should move on.
14968                 // TBD: How to signal that the measured resolution is probably wrong?
14969                 if (ticks > startTime + 3 * nanosecondsInSecond) {
14970                     return sum / ( i + 1u );
14971                 }
14972             }
14973
14974             // We're just taking the mean, here. To do better we could take the std. dev and exclude
    outliers
14975             // - and potentially do more iterations if there's a high variance.
14976             return sum/iterations;
14977         }
14978     }
14979     auto getEstimatedClockResolution() -> uint64_t {
14980         static auto s_resolution = estimateClockResolution();
14981         return s_resolution;
14982     }
14983
14984     void Timer::start() {
14985         m_nanoseconds = getCurrentNanosecondsSinceEpoch();
14986     }
14987     auto Timer::getElapsedNanoseconds() const -> uint64_t {
14988         return getCurrentNanosecondsSinceEpoch() - m_nanoseconds;
14989     }
14990     auto Timer::getElapsedMicroseconds() const -> uint64_t {
14991         return getElapsedNanoseconds()/1000;
14992     }
14993     auto Timer::getElapsedMilliseconds() const -> unsigned int {
14994         return static_cast<unsigned int>(getElapsedMicroseconds()/1000);
14995     }
14996     auto Timer::getElapsedSeconds() const -> double {
14997         return getElapsedMicroseconds()/1000000.0;
14998     }
14999
15000 } // namespace Catch
15001 // end catch_timer.cpp
15002 // start catch_tostring.cpp
15003
15004 #if defined(__clang__)
15005 #    pragma clang diagnostic push
15006 #    pragma clang diagnostic ignored "-Wexit-time-destructors"
15007 #    pragma clang diagnostic ignored "-Wglobal-constructors"
15008 #endif
15009
15010 // Enable specific decls locally
15011 #if !defined(CATCH_CONFIG_ENABLE_CHRONO_STRINGMAKER)
15012 #define CATCH_CONFIG_ENABLE_CHRONO_STRINGMAKER
15013 #endif
15014
15015 #include <cmath>
15016 #include <iomanip>
15017
15018 namespace Catch {
15019
15020     namespace Detail {
15021
15022         const std::string unprintableString = "{?}";
15023
15024         namespace {
15025             const int hexThreshold = 255;
15026
15027             struct Endianness {
15028                 enum Arch { Big, Little };
15029
15030                 static Arch which() {
15031                     int one = 1;
15032                     // If the lowest byte we read is non-zero, we can assume
15033                     // that little endian format is used.
15034                     auto value = *reinterpret_cast<char*>(&one);
15035                     return value ? Little : Big;
15036                 }
15037             };
15038         }
15039
15040         std::string rawMemoryToString( const void *object, std::size_t size ) {
15041             // Reverse order for little endian architectures
```

```
15042             int i = 0, end = static_cast<int>( size ), inc = 1;
15043             if( Endianness::which() == Endianness::Little ) {
15044                 i = end-1;
15045                 end = inc = -1;
15046             }
15047
15048             unsigned char const *bytes = static_cast<unsigned char const *>(object);
15049             ReusableStringStream rss;
15050             rss << "0x" << std::setfill('0') << std::hex;
15051             for( ; i != end; i += inc )
15052                 rss << std::setw(2) << static_cast<unsigned>(bytes[i]);
15053             return rss.str();
15054         }
15055     }
15056
15057     template<typename T>
15058     std::string fpToString( T value, int precision ) {
15059         if (Catch::isnan(value)) {
15060             return "nan";
15061         }
15062
15063         ReusableStringStream rss;
15064         rss << std::setprecision( precision )
15065             << std::fixed
15066             << value;
15067         std::string d = rss.str();
15068         std::size_t i = d.find_last_not_of( '0' );
15069         if( i != std::string::npos && i != d.size()-1 ) {
15070             if( d[i] == '.' )
15071                 i++;
15072             d = d.substr( 0, i+1 );
15073         }
15074         return d;
15075     }
15076
15078 //
15079 //   Out-of-line defs for full specialization of StringMaker
15080 //
15082
15083     std::string StringMaker<std::string>::convert(const std::string& str) {
15084         if (!getCurrentContext().getConfig()->showInvisibles()) {
15085             return '"' + str + '"';
15086         }
15087
15088         std::string s("\"");
15089         for (char c : str) {
15090             switch (c) {
15091                 case '\n':
15092                     s.append("\\n");
15093                     break;
15094                 case '\t':
15095                     s.append("\\t");
15096                     break;
15097                 default:
15098                     s.push_back(c);
15099                     break;
15100             }
15101         }
15102         s.append("\"");
15103         return s;
15104     }
15105
15106 #ifdef CATCH_CONFIG_CPP17_STRING_VIEW
15107     std::string StringMaker<std::string_view>::convert(std::string_view str) {
15108         return ::Catch::Detail::stringify(std::string{ str });
15109     }
15110 #endif
15111
15112     std::string StringMaker<char const*>::convert(char const* str) {
15113         if (str) {
15114             return ::Catch::Detail::stringify(std::string{ str });
15115         } else {
15116             return{ "{null string}" };
15117         }
15118     }
15119     std::string StringMaker<char*>::convert(char* str) {
15120         if (str) {
15121             return ::Catch::Detail::stringify(std::string{ str });
15122         } else {
15123             return{ "{null string}" };
15124         }
15125     }
15126
15127 #ifdef CATCH_CONFIG_WCHAR
15128     std::string StringMaker<std::wstring>::convert(const std::wstring& wstr) {
15129         std::string s;
15130         s.reserve(wstr.size());
```

```
15131         for (auto c : wstr) {
15132             s += (c <= 0xff) ? static_cast<char>(c) : '?';
15133         }
15134         return ::Catch::Detail::stringify(s);
15135     }
15136
15137 # ifdef CATCH_CONFIG_CPP17_STRING_VIEW
15138     std::string StringMaker<std::wstring_view>::convert(std::wstring_view str) {
15139         return StringMaker<std::wstring>::convert(std::wstring(str));
15140     }
15141 # endif
15142
15143     std::string StringMaker<wchar_t const*>::convert(wchar_t const * str) {
15144         if (str) {
15145             return ::Catch::Detail::stringify(std::wstring{ str });
15146         } else {
15147             return{ "{null string}" };
15148         }
15149     }
15150     std::string StringMaker<wchar_t *>::convert(wchar_t * str) {
15151         if (str) {
15152             return ::Catch::Detail::stringify(std::wstring{ str });
15153         } else {
15154             return{ "{null string}" };
15155         }
15156     }
15157 #endif
15158
15159 #if defined(CATCH_CONFIG_CPP17_BYTE)
15160 #include <cstddef>
15161     std::string StringMaker<std::byte>::convert(std::byte value) {
15162         return ::Catch::Detail::stringify(std::to_integer<unsigned long long>(value));
15163     }
15164 #endif // defined(CATCH_CONFIG_CPP17_BYTE)
15165
15166     std::string StringMaker<int>::convert(int value) {
15167         return ::Catch::Detail::stringify(static_cast<long long>(value));
15168     }
15169     std::string StringMaker<long>::convert(long value) {
15170         return ::Catch::Detail::stringify(static_cast<long long>(value));
15171     }
15172     std::string StringMaker<long long>::convert(long long value) {
15173         ReusableStringStream rss;
15174         rss << value;
15175         if (value > Detail::hexThreshold) {
15176             rss << " (0x" << std::hex << value << ')';
15177         }
15178         return rss.str();
15179     }
15180
15181     std::string StringMaker<unsigned int>::convert(unsigned int value) {
15182         return ::Catch::Detail::stringify(static_cast<unsigned long long>(value));
15183     }
15184     std::string StringMaker<unsigned long>::convert(unsigned long value) {
15185         return ::Catch::Detail::stringify(static_cast<unsigned long long>(value));
15186     }
15187     std::string StringMaker<unsigned long long>::convert(unsigned long long value) {
15188         ReusableStringStream rss;
15189         rss << value;
15190         if (value > Detail::hexThreshold) {
15191             rss << " (0x" << std::hex << value << ')';
15192         }
15193         return rss.str();
15194     }
15195
15196     std::string StringMaker<bool>::convert(bool b) {
15197         return b ? "true" : "false";
15198     }
15199
15200     std::string StringMaker<signed char>::convert(signed char value) {
15201         if (value == '\r') {
15202             return "'\\r'";
15203         } else if (value == '\f') {
15204             return "'\\f'";
15205         } else if (value == '\n') {
15206             return "'\\n'";
15207         } else if (value == '\t') {
15208             return "'\\t'";
15209         } else if ('\0' <= value && value < ' ') {
15210             return ::Catch::Detail::stringify(static_cast<unsigned int>(value));
15211         } else {
15212             char chstr[] = "' '";
15213             chstr[1] = value;
15214             return chstr;
15215         }
15216     }
15217     std::string StringMaker<char>::convert(char c) {
```

```
15218         return ::Catch::Detail::stringify(static_cast<signed char>(c));
15219     }
15220     std::string StringMaker<unsigned char>::convert(unsigned char c) {
15221         return ::Catch::Detail::stringify(static_cast<char>(c));
15222     }
15223
15224     std::string StringMaker<std::nullptr_t>::convert(std::nullptr_t) {
15225         return "nullptr";
15226     }
15227
15228     int StringMaker<float>::precision = 5;
15229
15230     std::string StringMaker<float>::convert(float value) {
15231         return fpToString(value, precision) + 'f';
15232     }
15233
15234     int StringMaker<double>::precision = 10;
15235
15236     std::string StringMaker<double>::convert(double value) {
15237         return fpToString(value, precision);
15238     }
15239
15240     std::string ratio_string<std::atto>::symbol() { return "a"; }
15241     std::string ratio_string<std::femto>::symbol() { return "f"; }
15242     std::string ratio_string<std::pico>::symbol() { return "p"; }
15243     std::string ratio_string<std::nano>::symbol() { return "n"; }
15244     std::string ratio_string<std::micro>::symbol() { return "u"; }
15245     std::string ratio_string<std::milli>::symbol() { return "m"; }
15246
15247 } // end namespace Catch
15248
15249 #if defined(__clang__)
15250 #    pragma clang diagnostic pop
15251 #endif
15252
15253 // end catch_tostring.cpp
15254 // start catch_totals.cpp
15255
15256 namespace Catch {
15257
15258     Counts Counts::operator - ( Counts const& other ) const {
15259         Counts diff;
15260         diff.passed = passed - other.passed;
15261         diff.failed = failed - other.failed;
15262         diff.failedButOk = failedButOk - other.failedButOk;
15263         return diff;
15264     }
15265
15266     Counts& Counts::operator += ( Counts const& other ) {
15267         passed += other.passed;
15268         failed += other.failed;
15269         failedButOk += other.failedButOk;
15270         return *this;
15271     }
15272
15273     std::size_t Counts::total() const {
15274         return passed + failed + failedButOk;
15275     }
15276     bool Counts::allPassed() const {
15277         return failed == 0 && failedButOk == 0;
15278     }
15279     bool Counts::allOk() const {
15280         return failed == 0;
15281     }
15282
15283     Totals Totals::operator - ( Totals const& other ) const {
15284         Totals diff;
15285         diff.assertions = assertions - other.assertions;
15286         diff.testCases = testCases - other.testCases;
15287         return diff;
15288     }
15289
15290     Totals& Totals::operator += ( Totals const& other ) {
15291         assertions += other.assertions;
15292         testCases += other.testCases;
15293         return *this;
15294     }
15295
15296     Totals Totals::delta( Totals const& prevTotals ) const {
15297         Totals diff = *this - prevTotals;
15298         if( diff.assertions.failed > 0 )
15299             ++diff.testCases.failed;
15300         else if( diff.assertions.failedButOk > 0 )
15301             ++diff.testCases.failedButOk;
15302         else
15303             ++diff.testCases.passed;
15304         return diff;
```

```
15305     }
15306
15307 }
15308 // end catch_totals.cpp
15309 // start catch_uncaught_exceptions.cpp
15310
15311 // start catch_config_uncaught_exceptions.hpp
15312
15313 //             Copyright Catch2 Authors
15314 // Distributed under the Boost Software License, Version 1.0.
15315 //   (See accompanying file LICENSE_1_0.txt or copy at
15316 //        https://www.boost.org/LICENSE_1_0.txt)
15317
15318 // SPDX-License-Identifier: BSL-1.0
15319
15320 #ifndef CATCH_CONFIG_UNCAUGHT_EXCEPTIONS_HPP
15321 #define CATCH_CONFIG_UNCAUGHT_EXCEPTIONS_HPP
15322
15323 #if defined(_MSC_VER)
15324 #  if _MSC_VER >= 1900 // Visual Studio 2015 or newer
15325 #    define CATCH_INTERNAL_CONFIG_CPP17_UNCAUGHT_EXCEPTIONS
15326 #  endif
15327 #endif
15328
15329 #include <exception>
15330
15331 #if defined(__cpp_lib_uncaught_exceptions) \
15332     && !defined(CATCH_INTERNAL_CONFIG_CPP17_UNCAUGHT_EXCEPTIONS)
15333
15334 #  define CATCH_INTERNAL_CONFIG_CPP17_UNCAUGHT_EXCEPTIONS
15335 #endif // __cpp_lib_uncaught_exceptions
15336
15337 #if defined(CATCH_INTERNAL_CONFIG_CPP17_UNCAUGHT_EXCEPTIONS) \
15338     && !defined(CATCH_CONFIG_NO_CPP17_UNCAUGHT_EXCEPTIONS) \
15339     && !defined(CATCH_CONFIG_CPP17_UNCAUGHT_EXCEPTIONS)
15340
15341 #  define CATCH_CONFIG_CPP17_UNCAUGHT_EXCEPTIONS
15342 #endif
15343
15344 #endif // CATCH_CONFIG_UNCAUGHT_EXCEPTIONS_HPP
15345 // end catch_config_uncaught_exceptions.hpp
15346 #include <exception>
15347
15348 namespace Catch {
15349     bool uncaught_exceptions() {
15350 #if defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
15351         return false;
15352 #elif defined(CATCH_CONFIG_CPP17_UNCAUGHT_EXCEPTIONS)
15353         return std::uncaught_exceptions() > 0;
15354 #else
15355         return std::uncaught_exception();
15356 #endif
15357     }
15358 } // end namespace Catch
15359 // end catch_uncaught_exceptions.cpp
15360 // start catch_version.cpp
15361
15362 #include <ostream>
15363
15364 namespace Catch {
15365
15366     Version::Version
15367             (   unsigned int _majorVersion,
15368                 unsigned int _minorVersion,
15369                 unsigned int _patchNumber,
15370                 char const * const _branchName,
15371                 unsigned int _buildNumber )
15372             :   majorVersion( _majorVersion ),
15373                 minorVersion( _minorVersion ),
15374                 patchNumber( _patchNumber ),
15375                 branchName( _branchName ),
15376                 buildNumber( _buildNumber )
15377     {}
15378
15379     std::ostream& operator « ( std::ostream& os, Version const& version ) {
15380         os  « version.majorVersion « '.'
15381             « version.minorVersion « '.'
15382             « version.patchNumber;
15383         // branchName is never null -> 0th char is \0 if it is empty
15384         if (version.branchName[0]) {
15385             os « '-' « version.branchName
15386                « '.' « version.buildNumber;
15387         }
15388         return os;
15389     }
15390
15391     Version const& libraryVersion() {
```

```
15392         static Version version( 2, 13, 10, "", 0 );
15393         return version;
15394     }
15395
15396 }
15397 // end catch_version.cpp
15398 // start catch_wildcard_pattern.cpp
15399
15400 namespace Catch {
15401
15402     WildcardPattern::WildcardPattern( std::string const& pattern,
15403                                       CaseSensitive::Choice caseSensitivity )
15404             :   m_caseSensitivity( caseSensitivity ),
15405                 m_pattern( normaliseString( pattern ) )
15406     {
15407         if( startsWith( m_pattern, '*' ) ) {
15408             m_pattern = m_pattern.substr( 1 );
15409             m_wildcard = WildcardAtStart;
15410         }
15411         if( endsWith( m_pattern, '*' ) ) {
15412             m_pattern = m_pattern.substr( 0, m_pattern.size()-1 );
15413             m_wildcard = static_cast<WildcardPosition>( m_wildcard | WildcardAtEnd );
15414         }
15415     }
15416
15417     bool WildcardPattern::matches( std::string const& str ) const {
15418         switch( m_wildcard ) {
15419             case NoWildcard:
15420                 return m_pattern == normaliseString( str );
15421             case WildcardAtStart:
15422                 return endsWith( normaliseString( str ), m_pattern );
15423             case WildcardAtEnd:
15424                 return startsWith( normaliseString( str ), m_pattern );
15425             case WildcardAtBothEnds:
15426                 return contains( normaliseString( str ), m_pattern );
15427             default:
15428                 CATCH_INTERNAL_ERROR( "Unknown enum" );
15429         }
15430     }
15431
15432     std::string WildcardPattern::normaliseString( std::string const& str ) const {
15433         return trim( m_caseSensitivity == CaseSensitive::No ? toLower( str ) : str );
15434     }
15435 }
15436 // end catch_wildcard_pattern.cpp
15437 // start catch_xmlwriter.cpp
15438
15439 #include <iomanip>
15440 #include <type_traits>
15441
15442 namespace Catch {
15443
15444     namespace {
15445
15446         size_t trailingBytes(unsigned char c) {
15447             if ((c & 0xE0) == 0xC0) {
15448                 return 2;
15449             }
15450             if ((c & 0xF0) == 0xE0) {
15451                 return 3;
15452             }
15453             if ((c & 0xF8) == 0xF0) {
15454                 return 4;
15455             }
15456             CATCH_INTERNAL_ERROR("Invalid multibyte utf-8 start byte encountered");
15457         }
15458
15459         uint32_t headerValue(unsigned char c) {
15460             if ((c & 0xE0) == 0xC0) {
15461                 return c & 0x1F;
15462             }
15463             if ((c & 0xF0) == 0xE0) {
15464                 return c & 0x0F;
15465             }
15466             if ((c & 0xF8) == 0xF0) {
15467                 return c & 0x07;
15468             }
15469             CATCH_INTERNAL_ERROR("Invalid multibyte utf-8 start byte encountered");
15470         }
15471
15472         void hexEscapeChar(std::ostream& os, unsigned char c) {
15473             std::ios_base::fmtflags f(os.flags());
15474             os << "\\x"
15475                << std::uppercase << std::hex << std::setfill('0') << std::setw(2)
15476                << static_cast<int>(c);
15477             os.flags(f);
15478         }
```

```
15479
15480         bool shouldNewline(XmlFormatting fmt) {
15481             return !!(static_cast<std::underlying_type<XmlFormatting>::type>(fmt &
      XmlFormatting::Newline));
15482         }
15483
15484         bool shouldIndent(XmlFormatting fmt) {
15485             return !!(static_cast<std::underlying_type<XmlFormatting>::type>(fmt &
      XmlFormatting::Indent));
15486         }
15487
15488     } // anonymous namespace
15489
15490     XmlFormatting operator | (XmlFormatting lhs, XmlFormatting rhs) {
15491         return static_cast<XmlFormatting>(
15492                 static_cast<std::underlying_type<XmlFormatting>::type>(lhs) |
15493                 static_cast<std::underlying_type<XmlFormatting>::type>(rhs)
15494         );
15495     }
15496
15497     XmlFormatting operator & (XmlFormatting lhs, XmlFormatting rhs) {
15498         return static_cast<XmlFormatting>(
15499                 static_cast<std::underlying_type<XmlFormatting>::type>(lhs) &
15500                 static_cast<std::underlying_type<XmlFormatting>::type>(rhs)
15501         );
15502     }
15503
15504     XmlEncode::XmlEncode( std::string const& str, ForWhat forWhat )
15505             :   m_str( str ),
15506                 m_forWhat( forWhat )
15507     {}
15508
15509     void XmlEncode::encodeTo( std::ostream& os ) const {
15510         // Apostrophe escaping not necessary if we always use " to write attributes
15511         // (see: http://www.w3.org/TR/xml/#syntax)
15512
15513         for( std::size_t idx = 0; idx < m_str.size(); ++ idx ) {
15514             unsigned char c = m_str[idx];
15515             switch (c) {
15516                 case '<':   os << "&lt;"; break;
15517                 case '&':   os << "&amp;"; break;
15518
15519                 case '>':
15520                     // See: http://www.w3.org/TR/xml/#syntax
15521                     if (idx > 2 && m_str[idx - 1] == ']' && m_str[idx - 2] == ']')
15522                         os << "&gt;";
15523                     else
15524                         os << c;
15525                     break;
15526
15527                 case '\"':
15528                     if (m_forWhat == ForAttributes)
15529                         os << "&quot;";
15530                     else
15531                         os << c;
15532                     break;
15533
15534                 default:
15535                     // Check for control characters and invalid utf-8
15536
15537                     // Escape control characters in standard ascii
15538                     // see
      http://stackoverflow.com/questions/404107/why-are-control-characters-illegal-in-xml-1-0
15539                     if (c < 0x09 || (c > 0x0D && c < 0x20) || c == 0x7F) {
15540                         hexEscapeChar(os, c);
15541                         break;
15542                     }
15543
15544                     // Plain ASCII: Write it to stream
15545                     if (c < 0x7F) {
15546                         os << c;
15547                         break;
15548                     }
15549
15550                     // UTF-8 territory
15551                     // Check if the encoding is valid and if it is not, hex escape bytes.
15552                     // Important: We do not check the exact decoded values for validity, only the
      encoding format
15553                     // First check that this bytes is a valid lead byte:
15554                     // This means that it is not encoded as 1111 1XXX
15555                     // Or as 10XX XXXX
15556                     if (c <  0xC0 ||
15557                         c >= 0xF8) {
15558                         hexEscapeChar(os, c);
15559                         break;
15560                     }
15561
```

```
15562                     auto encBytes = trailingBytes(c);
15563                     // Are there enough bytes left to avoid accessing out-of-bounds memory?
15564                     if (idx + encBytes - 1 >= m_str.size()) {
15565                         hexEscapeChar(os, c);
15566                         break;
15567                     }
15568                     // The header is valid, check data
15569                     // The next encBytes bytes must together be a valid utf-8
15570                     // This means: bitpattern 10XX XXXX and the extracted value is sane (ish)
15571                     bool valid = true;
15572                     uint32_t value = headerValue(c);
15573                     for (std::size_t n = 1; n < encBytes; ++n) {
15574                         unsigned char nc = m_str[idx + n];
15575                         valid &= ((nc & 0xC0) == 0x80);
15576                         value = (value << 6) | (nc & 0x3F);
15577                     }
15578
15579                     if (
15580                         // Wrong bit pattern of following bytes
15581                             (!valid) ||
15582                             // Overlong encodings
15583                             (value < 0x80) ||
15584                             (0x80 <= value && value < 0x800   && encBytes > 2) ||
15585                             (0x800 < value && value < 0x10000 && encBytes > 3) ||
15586                             // Encoded value out of range
15587                             (value >= 0x110000)
15588                             ) {
15589                         hexEscapeChar(os, c);
15590                         break;
15591                     }
15592
15593                     // If we got here, this is in fact a valid(ish) utf-8 sequence
15594                     for (std::size_t n = 0; n < encBytes; ++n) {
15595                         os << m_str[idx + n];
15596                     }
15597                     idx += encBytes - 1;
15598                     break;
15599                 }
15600             }
15601         }
15602
15603         std::ostream& operator << ( std::ostream& os, XmlEncode const& xmlEncode ) {
15604             xmlEncode.encodeTo( os );
15605             return os;
15606         }
15607
15608         XmlWriter::ScopedElement::ScopedElement( XmlWriter* writer, XmlFormatting fmt )
15609                 :   m_writer( writer ),
15610                     m_fmt(fmt)
15611         {}
15612
15613         XmlWriter::ScopedElement::ScopedElement( ScopedElement&& other ) noexcept
15614                 :   m_writer( other.m_writer ),
15615                     m_fmt(other.m_fmt)
15616         {
15617             other.m_writer = nullptr;
15618             other.m_fmt = XmlFormatting::None;
15619         }
15620         XmlWriter::ScopedElement& XmlWriter::ScopedElement::operator=( ScopedElement&& other ) noexcept {
15621             if ( m_writer ) {
15622                 m_writer->endElement();
15623             }
15624             m_writer = other.m_writer;
15625             other.m_writer = nullptr;
15626             m_fmt = other.m_fmt;
15627             other.m_fmt = XmlFormatting::None;
15628             return *this;
15629         }
15630
15631         XmlWriter::ScopedElement::~ScopedElement() {
15632             if (m_writer) {
15633                 m_writer->endElement(m_fmt);
15634             }
15635         }
15636
15637         XmlWriter::ScopedElement& XmlWriter::ScopedElement::writeText( std::string const& text,
      XmlFormatting fmt ) {
15638             m_writer->writeText( text, fmt );
15639             return *this;
15640         }
15641
15642         XmlWriter::XmlWriter( std::ostream& os ) : m_os( os )
15643         {
15644             writeDeclaration();
15645         }
15646
15647         XmlWriter::~XmlWriter() {
```

```
15648         while (!m_tags.empty()) {
15649             endElement();
15650         }
15651         newlineIfNecessary();
15652     }
15653
15654     XmlWriter& XmlWriter::startElement( std::string const& name, XmlFormatting fmt ) {
15655         ensureTagClosed();
15656         newlineIfNecessary();
15657         if (shouldIndent(fmt)) {
15658             m_os << m_indent;
15659             m_indent += "  ";
15660         }
15661         m_os << '<' << name;
15662         m_tags.push_back( name );
15663         m_tagIsOpen = true;
15664         applyFormatting(fmt);
15665         return *this;
15666     }
15667
15668     XmlWriter::ScopedElement XmlWriter::scopedElement( std::string const& name, XmlFormatting fmt ) {
15669         ScopedElement scoped( this, fmt );
15670         startElement( name, fmt );
15671         return scoped;
15672     }
15673
15674     XmlWriter& XmlWriter::endElement(XmlFormatting fmt) {
15675         m_indent = m_indent.substr(0, m_indent.size() - 2);
15676
15677         if( m_tagIsOpen ) {
15678             m_os << "/>";
15679             m_tagIsOpen = false;
15680         } else {
15681             newlineIfNecessary();
15682             if (shouldIndent(fmt)) {
15683                 m_os << m_indent;
15684             }
15685             m_os << "</" << m_tags.back() << ">";
15686         }
15687         m_os << std::flush;
15688         applyFormatting(fmt);
15689         m_tags.pop_back();
15690         return *this;
15691     }
15692
15693     XmlWriter& XmlWriter::writeAttribute( std::string const& name, std::string const& attribute ) {
15694         if( !name.empty() && !attribute.empty() )
15695             m_os << ' ' << name << "=\"" << XmlEncode( attribute, XmlEncode::ForAttributes ) << '"';
15696         return *this;
15697     }
15698
15699     XmlWriter& XmlWriter::writeAttribute( std::string const& name, bool attribute ) {
15700         m_os << ' ' << name << "=\"" << ( attribute ? "true" : "false" ) << '"';
15701         return *this;
15702     }
15703
15704     XmlWriter& XmlWriter::writeText( std::string const& text, XmlFormatting fmt) {
15705         if( !text.empty() ){
15706             bool tagWasOpen = m_tagIsOpen;
15707             ensureTagClosed();
15708             if (tagWasOpen && shouldIndent(fmt)) {
15709                 m_os << m_indent;
15710             }
15711             m_os << XmlEncode( text );
15712             applyFormatting(fmt);
15713         }
15714         return *this;
15715     }
15716
15717     XmlWriter& XmlWriter::writeComment( std::string const& text, XmlFormatting fmt) {
15718         ensureTagClosed();
15719         if (shouldIndent(fmt)) {
15720             m_os << m_indent;
15721         }
15722         m_os << "<!--" << text << "-->";
15723         applyFormatting(fmt);
15724         return *this;
15725     }
15726
15727     void XmlWriter::writeStylesheetRef( std::string const& url ) {
15728         m_os << "<?xml-stylesheet type=\"text/xsl\" href=\"" << url << "\"?>\n";
15729     }
15730
15731     XmlWriter& XmlWriter::writeBlankLine() {
15732         ensureTagClosed();
15733         m_os << '\n';
15734         return *this;
```

```
15735     }
15736
15737     void XmlWriter::ensureTagClosed() {
15738         if( m_tagIsOpen ) {
15739             m_os « '>' « std::flush;
15740             newlineIfNecessary();
15741             m_tagIsOpen = false;
15742         }
15743     }
15744
15745     void XmlWriter::applyFormatting(XmlFormatting fmt) {
15746         m_needsNewline = shouldNewline(fmt);
15747     }
15748
15749     void XmlWriter::writeDeclaration() {
15750         m_os « "<?xml version=\"1.0\" encoding=\"UTF-8\"?>\n";
15751     }
15752
15753     void XmlWriter::newlineIfNecessary() {
15754         if( m_needsNewline ) {
15755             m_os « std::endl;
15756             m_needsNewline = false;
15757         }
15758     }
15759 }
15760 // end catch_xmlwriter.cpp
15761 // start catch_reporter_bases.cpp
15762
15763 #include <cstring>
15764 #include <cfloat>
15765 #include <cstdio>
15766 #include <cassert>
15767 #include <memory>
15768
15769 namespace Catch {
15770     void prepareExpandedExpression(AssertionResult& result) {
15771         result.getExpandedExpression();
15772     }
15773
15774     // Because formatting using c++ streams is stateful, drop down to C is required
15775     // Alternatively we could use stringstream, but its performance is... not good.
15776     std::string getFormattedDuration( double duration ) {
15777         // Max exponent + 1 is required to represent the whole part
15778         // + 1 for decimal point
15779         // + 3 for the 3 decimal places
15780         // + 1 for null terminator
15781         const std::size_t maxDoubleSize = DBL_MAX_10_EXP + 1 + 1 + 3 + 1;
15782         char buffer[maxDoubleSize];
15783
15784         // Save previous errno, to prevent sprintf from overwriting it
15785         ErrnoGuard guard;
15786 #ifdef _MSC_VER
15787         sprintf_s(buffer, "%.3f", duration);
15788 #else
15789         std::sprintf(buffer, "%.3f", duration);
15790 #endif
15791         return std::string(buffer);
15792     }
15793
15794     bool shouldShowDuration( IConfig const& config, double duration ) {
15795         if ( config.showDurations() == ShowDurations::Always ) {
15796             return true;
15797         }
15798         if ( config.showDurations() == ShowDurations::Never ) {
15799             return false;
15800         }
15801         const double min = config.minDuration();
15802         return min >= 0 && duration >= min;
15803     }
15804
15805     std::string serializeFilters( std::vector<std::string> const& container ) {
15806         ReusableStringStream oss;
15807         bool first = true;
15808         for (auto&& filter : container)
15809         {
15810             if (!first)
15811                 oss « ' ';
15812             else
15813                 first = false;
15814
15815             oss « filter;
15816         }
15817         return oss.str();
15818     }
15819
15820     TestEventListenerBase::TestEventListenerBase(ReporterConfig const & _config)
15821             :StreamingReporterBase(_config) {}
```

```
15822
15823     std::set<Verbosity> TestEventListenerBase::getSupportedVerbosities() {
15824         return { Verbosity::Quiet, Verbosity::Normal, Verbosity::High };
15825     }
15826
15827     void TestEventListenerBase::assertionStarting(AssertionInfo const &) {}
15828
15829     bool TestEventListenerBase::assertionEnded(AssertionStats const &) {
15830         return false;
15831     }
15832
15833 } // end namespace Catch
15834 // end catch_reporter_bases.cpp
15835 // start catch_reporter_compact.cpp
15836
15837 namespace {
15838
15839 #ifdef CATCH_PLATFORM_MAC
15840     const char* failedString() { return "FAILED"; }
15841     const char* passedString() { return "PASSED"; }
15842 #else
15843     const char* failedString() { return "failed"; }
15844     const char* passedString() { return "passed"; }
15845 #endif
15846
15847     // Colour::LightGrey
15848     Catch::Colour::Code dimColour() { return Catch::Colour::FileName; }
15849
15850     std::string bothOrAll( std::size_t count ) {
15851         return count == 1 ? std::string() :
15852                count == 2 ? "both " : "all " ;
15853     }
15854
15855 } // anon namespace
15856
15857 namespace Catch {
15858     namespace {
15859 // Colour, message variants:
15860 // - white: No tests ran.
15861 // -   red: Failed [both/all] N test cases, failed [both/all] M assertions.
15862 // - white: Passed [both/all] N test cases (no assertions).
15863 // -   red: Failed N tests cases, failed M assertions.
15864 // - green: Passed [both/all] N tests cases with M assertions.
15865         void printTotals(std::ostream& out, const Totals& totals) {
15866             if (totals.testCases.total() == 0) {
15867                 out « "No tests ran.";
15868             } else if (totals.testCases.failed == totals.testCases.total()) {
15869                 Colour colour(Colour::ResultError);
15870                 const std::string qualify_assertions_failed =
15871                         totals.assertions.failed == totals.assertions.total() ?
15872                         bothOrAll(totals.assertions.failed) : std::string();
15873                 out «
15874                     "Failed " « bothOrAll(totals.testCases.failed)
15875                     « pluralise(totals.testCases.failed, "test case") « ", "
15876                                                                       "failed " «
qualify_assertions_failed «
15877                     pluralise(totals.assertions.failed, "assertion") « '.';
15878             } else if (totals.assertions.total() == 0) {
15879                 out «
15880                     "Passed " « bothOrAll(totals.testCases.total())
15881                     « pluralise(totals.testCases.total(), "test case")
15882                     « " (no assertions).";
15883             } else if (totals.assertions.failed) {
15884                 Colour colour(Colour::ResultError);
15885                 out «
15886                     "Failed " « pluralise(totals.testCases.failed, "test case") « ", "
15887                                                                         "failed " «
pluralise(totals.assertions.failed, "assertion") « '.';
15888             } else {
15889                 Colour colour(Colour::ResultSuccess);
15890                 out «
15891                     "Passed " « bothOrAll(totals.testCases.passed)
15892                     « pluralise(totals.testCases.passed, "test case") «
15893                     " with " « pluralise(totals.assertions.passed, "assertion") « '.';
15894             }
15895         }
15896
15897 // Implementation of CompactReporter formatting
15898         class AssertionPrinter {
15899         public:
15900             AssertionPrinter& operator= (AssertionPrinter const&) = delete;
15901             AssertionPrinter(AssertionPrinter const&) = delete;
15902             AssertionPrinter(std::ostream& _stream, AssertionStats const& _stats, bool
_printInfoMessages)
15903                     : stream(_stream)
15904                     , result(_stats.assertionResult)
15905                     , messages(_stats.infoMessages)
```

```
15906                     , itMessage(_stats.infoMessages.begin())
15907                     , printInfoMessages(_printInfoMessages) {}
15908
15909             void print() {
15910                 printSourceInfo();
15911
15912                 itMessage = messages.begin();
15913
15914                 switch (result.getResultType()) {
15915                     case ResultWas::Ok:
15916                         printResultType(Colour::ResultSuccess, passedString());
15917                         printOriginalExpression();
15918                         printReconstructedExpression();
15919                         if (!result.hasExpression())
15920                             printRemainingMessages(Colour::None);
15921                         else
15922                             printRemainingMessages();
15923                         break;
15924                     case ResultWas::ExpressionFailed:
15925                         if (result.isOk())
15926                             printResultType(Colour::ResultSuccess, failedString() + std::string(" -
      but was ok"));
15927                         else
15928                             printResultType(Colour::Error, failedString());
15929                         printOriginalExpression();
15930                         printReconstructedExpression();
15931                         printRemainingMessages();
15932                         break;
15933                     case ResultWas::ThrewException:
15934                         printResultType(Colour::Error, failedString());
15935                         printIssue("unexpected exception with message:");
15936                         printMessage();
15937                         printExpressionWas();
15938                         printRemainingMessages();
15939                         break;
15940                     case ResultWas::FatalErrorCondition:
15941                         printResultType(Colour::Error, failedString());
15942                         printIssue("fatal error condition with message:");
15943                         printMessage();
15944                         printExpressionWas();
15945                         printRemainingMessages();
15946                         break;
15947                     case ResultWas::DidntThrowException:
15948                         printResultType(Colour::Error, failedString());
15949                         printIssue("expected exception, got none");
15950                         printExpressionWas();
15951                         printRemainingMessages();
15952                         break;
15953                     case ResultWas::Info:
15954                         printResultType(Colour::None, "info");
15955                         printMessage();
15956                         printRemainingMessages();
15957                         break;
15958                     case ResultWas::Warning:
15959                         printResultType(Colour::None, "warning");
15960                         printMessage();
15961                         printRemainingMessages();
15962                         break;
15963                     case ResultWas::ExplicitFailure:
15964                         printResultType(Colour::Error, failedString());
15965                         printIssue("explicitly");
15966                         printRemainingMessages(Colour::None);
15967                         break;
15968                         // These cases are here to prevent compiler warnings
15969                     case ResultWas::Unknown:
15970                     case ResultWas::FailureBit:
15971                     case ResultWas::Exception:
15972                         printResultType(Colour::Error, "** internal error **");
15973                         break;
15974                 }
15975             }
15976
15977         private:
15978             void printSourceInfo() const {
15979                 Colour colourGuard(Colour::FileName);
15980                 stream « result.getSourceInfo() « ':';
15981             }
15982
15983             void printResultType(Colour::Code colour, std::string const& passOrFail) const {
15984                 if (!passOrFail.empty()) {
15985                     {
15986                         Colour colourGuard(colour);
15987                         stream « ' ' « passOrFail;
15988                     }
15989                     stream « ':';
15990                 }
15991             }
```

```
15992
15993           void printIssue(std::string const& issue) const {
15994               stream « ' ' « issue;
15995           }
15996
15997           void printExpressionWas() {
15998               if (result.hasExpression()) {
15999                   stream « ';';
16000                   {
16001                       Colour colour(dimColour());
16002                       stream « " expression was:";
16003                   }
16004                   printOriginalExpression();
16005               }
16006           }
16007
16008           void printOriginalExpression() const {
16009               if (result.hasExpression()) {
16010                   stream « ' ' « result.getExpression();
16011               }
16012           }
16013
16014           void printReconstructedExpression() const {
16015               if (result.hasExpandedExpression()) {
16016                   {
16017                       Colour colour(dimColour());
16018                       stream « " for: ";
16019                   }
16020                   stream « result.getExpandedExpression();
16021               }
16022           }
16023
16024           void printMessage() {
16025               if (itMessage != messages.end()) {
16026                   stream « " '" « itMessage->message « '\'';
16027                   ++itMessage;
16028               }
16029           }
16030
16031           void printRemainingMessages(Colour::Code colour = dimColour()) {
16032               if (itMessage == messages.end())
16033                   return;
16034
16035               const auto itEnd = messages.cend();
16036               const auto N = static_cast<std::size_t>(std::distance(itMessage, itEnd));
16037
16038               {
16039                   Colour colourGuard(colour);
16040                   stream « " with " « pluralise(N, "message") « ':';
16041               }
16042
16043               while (itMessage != itEnd) {
16044                   // If this assertion is a warning ignore any INFO messages
16045                   if (printInfoMessages || itMessage->type != ResultWas::Info) {
16046                       printMessage();
16047                       if (itMessage != itEnd) {
16048                           Colour colourGuard(dimColour());
16049                           stream « " and";
16050                       }
16051                       continue;
16052                   }
16053                   ++itMessage;
16054               }
16055           }
16056
16057       private:
16058           std::ostream& stream;
16059           AssertionResult const& result;
16060           std::vector<MessageInfo> messages;
16061           std::vector<MessageInfo>::const_iterator itMessage;
16062           bool printInfoMessages;
16063       };
16064
16065   } // anon namespace
16066
16067   std::string CompactReporter::getDescription() {
16068       return "Reports test results on a single line, suitable for IDEs";
16069   }
16070
16071   void CompactReporter::noMatchingTestCases( std::string const& spec ) {
16072       stream « "No test cases matched '" « spec « '\'' « std::endl;
16073   }
16074
16075   void CompactReporter::assertionStarting( AssertionInfo const& ) {}
16076
16077   bool CompactReporter::assertionEnded( AssertionStats const& _assertionStats ) {
16078       AssertionResult const& result = _assertionStats.assertionResult;
```

```
16079
16080         bool printInfoMessages = true;
16081
16082         // Drop out if result was successful and we're not printing those
16083         if( !m_config->includeSuccessfulResults() && result.isOk() ) {
16084             if( result.getResultType() != ResultWas::Warning )
16085                 return false;
16086             printInfoMessages = false;
16087         }
16088
16089         AssertionPrinter printer( stream, _assertionStats, printInfoMessages );
16090         printer.print();
16091
16092         stream << std::endl;
16093         return true;
16094     }
16095
16096     void CompactReporter::sectionEnded(SectionStats const& _sectionStats) {
16097         double dur = _sectionStats.durationInSeconds;
16098         if ( shouldShowDuration( *m_config, dur ) ) {
16099             stream << getFormattedDuration( dur ) << " s: " << _sectionStats.sectionInfo.name <<
      std::endl;
16100         }
16101     }
16102
16103     void CompactReporter::testRunEnded( TestRunStats const& _testRunStats ) {
16104         printTotals( stream, _testRunStats.totals );
16105         stream << '\n' << std::endl;
16106         StreamingReporterBase::testRunEnded( _testRunStats );
16107     }
16108
16109     CompactReporter::~CompactReporter() {}
16110
16111     CATCH_REGISTER_REPORTER( "compact", CompactReporter )
16112
16113 } // end namespace Catch
16114 // end catch_reporter_compact.cpp
16115 // start catch_reporter_console.cpp
16116
16117 #include <cfloat>
16118 #include <cstdio>
16119
16120 #if defined(_MSC_VER)
16121 #pragma warning(push)
16122 #pragma warning(disable:4061) // Not all labels are EXPLICITLY handled in switch
16123  // Note that 4062 (not all labels are handled and default is missing) is enabled
16124 #endif
16125
16126 #if defined(__clang__)
16127 #  pragma clang diagnostic push
16128 // For simplicity, benchmarking-only helpers are always enabled
16129 #  pragma clang diagnostic ignored "-Wunused-function"
16130 #endif
16131
16132 namespace Catch {
16133
16134     namespace {
16135
16136 // Formatter impl for ConsoleReporter
16137         class ConsoleAssertionPrinter {
16138         public:
16139             ConsoleAssertionPrinter& operator= (ConsoleAssertionPrinter const&) = delete;
16140             ConsoleAssertionPrinter(ConsoleAssertionPrinter const&) = delete;
16141             ConsoleAssertionPrinter(std::ostream& _stream, AssertionStats const& _stats, bool
      _printInfoMessages)
16142                     : stream(_stream),
16143                       stats(_stats),
16144                       result(_stats.assertionResult),
16145                       colour(Colour::None),
16146                       message(result.getMessage()),
16147                       messages(_stats.infoMessages),
16148                       printInfoMessages(_printInfoMessages) {
16149                 switch (result.getResultType()) {
16150                     case ResultWas::Ok:
16151                         colour = Colour::Success;
16152                         passOrFail = "PASSED";
16153                         //if( result.hasMessage() )
16154                         if (_stats.infoMessages.size() == 1)
16155                             messageLabel = "with message";
16156                         if (_stats.infoMessages.size() > 1)
16157                             messageLabel = "with messages";
16158                         break;
16159                     case ResultWas::ExpressionFailed:
16160                         if (result.isOk()) {
16161                             colour = Colour::Success;
16162                             passOrFail = "FAILED - but was ok";
16163                         } else {
```

```
16164                           colour = Colour::Error;
16165                           passOrFail = "FAILED";
16166                       }
16167                       if (_stats.infoMessages.size() == 1)
16168                           messageLabel = "with message";
16169                       if (_stats.infoMessages.size() > 1)
16170                           messageLabel = "with messages";
16171                       break;
16172                   case ResultWas::ThrewException:
16173                       colour = Colour::Error;
16174                       passOrFail = "FAILED";
16175                       messageLabel = "due to unexpected exception with ";
16176                       if (_stats.infoMessages.size() == 1)
16177                           messageLabel += "message";
16178                       if (_stats.infoMessages.size() > 1)
16179                           messageLabel += "messages";
16180                       break;
16181                   case ResultWas::FatalErrorCondition:
16182                       colour = Colour::Error;
16183                       passOrFail = "FAILED";
16184                       messageLabel = "due to a fatal error condition";
16185                       break;
16186                   case ResultWas::DidntThrowException:
16187                       colour = Colour::Error;
16188                       passOrFail = "FAILED";
16189                       messageLabel = "because no exception was thrown where one was expected";
16190                       break;
16191                   case ResultWas::Info:
16192                       messageLabel = "info";
16193                       break;
16194                   case ResultWas::Warning:
16195                       messageLabel = "warning";
16196                       break;
16197                   case ResultWas::ExplicitFailure:
16198                       passOrFail = "FAILED";
16199                       colour = Colour::Error;
16200                       if (_stats.infoMessages.size() == 1)
16201                           messageLabel = "explicitly with message";
16202                       if (_stats.infoMessages.size() > 1)
16203                           messageLabel = "explicitly with messages";
16204                       break;
16205                       // These cases are here to prevent compiler warnings
16206                   case ResultWas::Unknown:
16207                   case ResultWas::FailureBit:
16208                   case ResultWas::Exception:
16209                       passOrFail = "** internal error **";
16210                       colour = Colour::Error;
16211                       break;
16212               }
16213           }
16214
16215           void print() const {
16216               printSourceInfo();
16217               if (stats.totals.assertions.total() > 0) {
16218                   printResultType();
16219                   printOriginalExpression();
16220                   printReconstructedExpression();
16221               } else {
16222                   stream << '\n';
16223               }
16224               printMessage();
16225           }
16226
16227       private:
16228           void printResultType() const {
16229               if (!passOrFail.empty()) {
16230                   Colour colourGuard(colour);
16231                   stream << passOrFail << ":\n";
16232               }
16233           }
16234           void printOriginalExpression() const {
16235               if (result.hasExpression()) {
16236                   Colour colourGuard(Colour::OriginalExpression);
16237                   stream << "  ";
16238                   stream << result.getExpressionInMacro();
16239                   stream << '\n';
16240               }
16241           }
16242           void printReconstructedExpression() const {
16243               if (result.hasExpandedExpression()) {
16244                   stream << "with expansion:\n";
16245                   Colour colourGuard(Colour::ReconstructedExpression);
16246                   stream << Column(result.getExpandedExpression()).indent(2) << '\n';
16247               }
16248           }
16249           void printMessage() const {
16250               if (!messageLabel.empty())
```

```
16251                   stream « messageLabel « ':' « '\n';
16252               for (auto const& msg : messages) {
16253                   // If this assertion is a warning ignore any INFO messages
16254                   if (printInfoMessages || msg.type != ResultWas::Info)
16255                       stream « Column(msg.message).indent(2) « '\n';
16256               }
16257           }
16258           void printSourceInfo() const {
16259               Colour colourGuard(Colour::FileName);
16260               stream « result.getSourceInfo() « ": ";
16261           }
16262
16263           std::ostream& stream;
16264           AssertionStats const& stats;
16265           AssertionResult const& result;
16266           Colour::Code colour;
16267           std::string passOrFail;
16268           std::string messageLabel;
16269           std::string message;
16270           std::vector<MessageInfo> messages;
16271           bool printInfoMessages;
16272       };
16273
16274       std::size_t makeRatio(std::size_t number, std::size_t total) {
16275           std::size_t ratio = total > 0 ? CATCH_CONFIG_CONSOLE_WIDTH * number / total : 0;
16276           return (ratio == 0 && number > 0) ? 1 : ratio;
16277       }
16278
16279       std::size_t& findMax(std::size_t& i, std::size_t& j, std::size_t& k) {
16280           if (i > j && i > k)
16281               return i;
16282           else if (j > k)
16283               return j;
16284           else
16285               return k;
16286       }
16287
16288       struct ColumnInfo {
16289           enum Justification { Left, Right };
16290           std::string name;
16291           int width;
16292           Justification justification;
16293       };
16294       struct ColumnBreak {};
16295       struct RowBreak {};
16296
16297       class Duration {
16298           enum class Unit {
16299               Auto,
16300               Nanoseconds,
16301               Microseconds,
16302               Milliseconds,
16303               Seconds,
16304               Minutes
16305           };
16306           static const uint64_t s_nanosecondsInAMicrosecond = 1000;
16307           static const uint64_t s_nanosecondsInAMillisecond = 1000 * s_nanosecondsInAMicrosecond;
16308           static const uint64_t s_nanosecondsInASecond = 1000 * s_nanosecondsInAMillisecond;
16309           static const uint64_t s_nanosecondsInAMinute = 60 * s_nanosecondsInASecond;
16310
16311           double m_inNanoseconds;
16312           Unit m_units;
16313
16314       public:
16315           explicit Duration(double inNanoseconds, Unit units = Unit::Auto)
16316                   : m_inNanoseconds(inNanoseconds),
16317                     m_units(units) {
16318               if (m_units == Unit::Auto) {
16319                   if (m_inNanoseconds < s_nanosecondsInAMicrosecond)
16320                       m_units = Unit::Nanoseconds;
16321                   else if (m_inNanoseconds < s_nanosecondsInAMillisecond)
16322                       m_units = Unit::Microseconds;
16323                   else if (m_inNanoseconds < s_nanosecondsInASecond)
16324                       m_units = Unit::Milliseconds;
16325                   else if (m_inNanoseconds < s_nanosecondsInAMinute)
16326                       m_units = Unit::Seconds;
16327                   else
16328                       m_units = Unit::Minutes;
16329               }
16330
16331           }
16332
16333           auto value() const -> double {
16334               switch (m_units) {
16335                   case Unit::Microseconds:
16336                       return m_inNanoseconds / static_cast<double>(s_nanosecondsInAMicrosecond);
16337                   case Unit::Milliseconds:
```

```
16338                       return m_inNanoseconds / static_cast<double>(s_nanosecondsInAMillisecond);
16339                   case Unit::Seconds:
16340                       return m_inNanoseconds / static_cast<double>(s_nanosecondsInASecond);
16341                   case Unit::Minutes:
16342                       return m_inNanoseconds / static_cast<double>(s_nanosecondsInAMinute);
16343                   default:
16344                       return m_inNanoseconds;
16345               }
16346           }
16347           auto unitsAsString() const -> std::string {
16348               switch (m_units) {
16349                   case Unit::Nanoseconds:
16350                       return "ns";
16351                   case Unit::Microseconds:
16352                       return "us";
16353                   case Unit::Milliseconds:
16354                       return "ms";
16355                   case Unit::Seconds:
16356                       return "s";
16357                   case Unit::Minutes:
16358                       return "m";
16359                   default:
16360                       return "** internal error **";
16361               }
16362
16363           }
16364           friend auto operator << (std::ostream& os, Duration const& duration) -> std::ostream& {
16365               return os << duration.value() << ' ' << duration.unitsAsString();
16366           }
16367       };
16368   } // end anon namespace
16369
16370   class TablePrinter {
16371       std::ostream& m_os;
16372       std::vector<ColumnInfo> m_columnInfos;
16373       std::ostringstream m_oss;
16374       int m_currentColumn = -1;
16375       bool m_isOpen = false;
16376
16377   public:
16378       TablePrinter( std::ostream& os, std::vector<ColumnInfo> columnInfos )
16379               :   m_os( os ),
16380                   m_columnInfos( std::move( columnInfos ) ) {}
16381
16382       auto columnInfos() const -> std::vector<ColumnInfo> const& {
16383           return m_columnInfos;
16384       }
16385
16386       void open() {
16387           if (!m_isOpen) {
16388               m_isOpen = true;
16389               *this << RowBreak();
16390
16391               Columns headerCols;
16392               Spacer spacer(2);
16393               for (auto const& info : m_columnInfos) {
16394                   headerCols += Column(info.name).width(static_cast<std::size_t>(info.width - 2));
16395                   headerCols += spacer;
16396               }
16397               m_os << headerCols << '\n';
16398
16399               m_os << Catch::getLineOfChars<'-'>() << '\n';
16400           }
16401       }
16402       void close() {
16403           if (m_isOpen) {
16404               *this << RowBreak();
16405               m_os << std::endl;
16406               m_isOpen = false;
16407           }
16408       }
16409
16410       template<typename T>
16411       friend TablePrinter& operator << (TablePrinter& tp, T const& value) {
16412           tp.m_oss << value;
16413           return tp;
16414       }
16415
16416       friend TablePrinter& operator << (TablePrinter& tp, ColumnBreak) {
16417           auto colStr = tp.m_oss.str();
16418           const auto strSize = colStr.size();
16419           tp.m_oss.str("");
16420           tp.open();
16421           if (tp.m_currentColumn == static_cast<int>(tp.m_columnInfos.size() - 1)) {
16422               tp.m_currentColumn = -1;
16423               tp.m_os << '\n';
16424           }
```

```
16425             tp.m_currentColumn++;
16426
16427             auto colInfo = tp.m_columnInfos[tp.m_currentColumn];
16428             auto padding = (strSize + 1 < static_cast<std::size_t>(colInfo.width))
16429                            ? std::string(colInfo.width - (strSize + 1), ' ')
16430                            : std::string();
16431             if (colInfo.justification == ColumnInfo::Left)
16432                 tp.m_os << colStr << padding << ' ';
16433             else
16434                 tp.m_os << padding << colStr << ' ';
16435             return tp;
16436         }
16437
16438         friend TablePrinter& operator << (TablePrinter& tp, RowBreak) {
16439             if (tp.m_currentColumn > 0) {
16440                 tp.m_os << '\n';
16441                 tp.m_currentColumn = -1;
16442             }
16443             return tp;
16444         }
16445     };
16446
16447     ConsoleReporter::ConsoleReporter(ReporterConfig const& config)
16448             : StreamingReporterBase(config),
16449               m_tablePrinter(new TablePrinter(config.stream(),
16450                                               [&config]() -> std::vector<ColumnInfo> {
16451                                                   if (config.fullConfig()->benchmarkNoAnalysis())
16452                                                   {
16453                                                       return{
16454                                                               { "benchmark name",
      CATCH_CONFIG_CONSOLE_WIDTH - 43, ColumnInfo::Left },
16455                                                               { "     samples", 14, ColumnInfo::Right
      },
16456                                                               { "  iterations", 14, ColumnInfo::Right
      },
16457                                                               { "        mean", 14, ColumnInfo::Right
      }
16458                                                       };
16459                                                   }
16460                                                   else
16461                                                   {
16462                                                       return{
16463                                                               { "benchmark name",
      CATCH_CONFIG_CONSOLE_WIDTH - 43, ColumnInfo::Left },
16464                                                               { "samples      mean       std dev", 14,
      ColumnInfo::Right },
16465                                                               { "iterations   low mean   low std dev",
      14, ColumnInfo::Right },
16466                                                               { "estimated    high mean  high std
      dev", 14, ColumnInfo::Right }
16467                                                       };
16468                                                   }
16469                                               }())) {}
16470     ConsoleReporter::~ConsoleReporter() = default;
16471
16472     std::string ConsoleReporter::getDescription() {
16473         return "Reports test results as plain lines of text";
16474     }
16475
16476     void ConsoleReporter::noMatchingTestCases(std::string const& spec) {
16477         stream << "No test cases matched '" << spec << '\'' << std::endl;
16478     }
16479
16480     void ConsoleReporter::reportInvalidArguments(std::string const&arg){
16481         stream << "Invalid Filter: " << arg << std::endl;
16482     }
16483
16484     void ConsoleReporter::assertionStarting(AssertionInfo const&) {}
16485
16486     bool ConsoleReporter::assertionEnded(AssertionStats const& _assertionStats) {
16487         AssertionResult const& result = _assertionStats.assertionResult;
16488
16489         bool includeResults = m_config->includeSuccessfulResults() || !result.isOk();
16490
16491         // Drop out if result was successful but we're not printing them.
16492         if (!includeResults && result.getResultType() != ResultWas::Warning)
16493             return false;
16494
16495         lazyPrint();
16496
16497         ConsoleAssertionPrinter printer(stream, _assertionStats, includeResults);
16498         printer.print();
16499         stream << std::endl;
16500         return true;
16501     }
16502
16503     void ConsoleReporter::sectionStarting(SectionInfo const& _sectionInfo) {
```

```
16504         m_tablePrinter->close();
16505         m_headerPrinted = false;
16506         StreamingReporterBase::sectionStarting(_sectionInfo);
16507     }
16508     void ConsoleReporter::sectionEnded(SectionStats const& _sectionStats) {
16509         m_tablePrinter->close();
16510         if (_sectionStats.missingAssertions) {
16511             lazyPrint();
16512             Colour colour(Colour::ResultError);
16513             if (m_sectionStack.size() > 1)
16514                 stream << "\nNo assertions in section";
16515             else
16516                 stream << "\nNo assertions in test case";
16517             stream << " '" << _sectionStats.sectionInfo.name << "'\n" << std::endl;
16518         }
16519         double dur = _sectionStats.durationInSeconds;
16520         if (shouldShowDuration(*m_config, dur)) {
16521             stream << getFormattedDuration(dur) << " s: " << _sectionStats.sectionInfo.name << std::endl;
16522         }
16523         if (m_headerPrinted) {
16524             m_headerPrinted = false;
16525         }
16526         StreamingReporterBase::sectionEnded(_sectionStats);
16527     }
16528
16529 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
16530     void ConsoleReporter::benchmarkPreparing(std::string const& name) {
16531     lazyPrintWithoutClosingBenchmarkTable();
16532
16533     auto nameCol = Column(name).width(static_cast<std::size_t>(m_tablePrinter->columnInfos()[0].width
      - 2));
16534
16535     bool firstLine = true;
16536     for (auto line : nameCol) {
16537         if (!firstLine)
16538             (*m_tablePrinter) << ColumnBreak() << ColumnBreak() << ColumnBreak();
16539         else
16540             firstLine = false;
16541
16542         (*m_tablePrinter) << line << ColumnBreak();
16543     }
16544 }
16545
16546 void ConsoleReporter::benchmarkStarting(BenchmarkInfo const& info) {
16547     (*m_tablePrinter) << info.samples << ColumnBreak()
16548         << info.iterations << ColumnBreak();
16549     if (!m_config->benchmarkNoAnalysis())
16550         (*m_tablePrinter) << Duration(info.estimatedDuration) << ColumnBreak();
16551 }
16552 void ConsoleReporter::benchmarkEnded(BenchmarkStats<> const& stats) {
16553     if (m_config->benchmarkNoAnalysis())
16554     {
16555         (*m_tablePrinter) << Duration(stats.mean.point.count()) << ColumnBreak();
16556     }
16557     else
16558     {
16559         (*m_tablePrinter) << ColumnBreak()
16560             << Duration(stats.mean.point.count()) << ColumnBreak()
16561             << Duration(stats.mean.lower_bound.count()) << ColumnBreak()
16562             << Duration(stats.mean.upper_bound.count()) << ColumnBreak() << ColumnBreak()
16563             << Duration(stats.standardDeviation.point.count()) << ColumnBreak()
16564             << Duration(stats.standardDeviation.lower_bound.count()) << ColumnBreak()
16565             << Duration(stats.standardDeviation.upper_bound.count()) << ColumnBreak() << ColumnBreak() <<
      ColumnBreak() << ColumnBreak() << ColumnBreak();
16566     }
16567 }
16568
16569 void ConsoleReporter::benchmarkFailed(std::string const& error) {
16570     Colour colour(Colour::Red);
16571     (*m_tablePrinter)
16572         << "Benchmark failed (" << error << ')'
16573         << ColumnBreak() << RowBreak();
16574 }
16575 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
16576
16577     void ConsoleReporter::testCaseEnded(TestCaseStats const& _testCaseStats) {
16578         m_tablePrinter->close();
16579         StreamingReporterBase::testCaseEnded(_testCaseStats);
16580         m_headerPrinted = false;
16581     }
16582     void ConsoleReporter::testGroupEnded(TestGroupStats const& _testGroupStats) {
16583         if (currentGroupInfo.used) {
16584             printSummaryDivider();
16585             stream << "Summary for group '" << _testGroupStats.groupInfo.name << "':\n";
16586             printTotals(_testGroupStats.totals);
16587             stream << '\n' << std::endl;
16588         }
```

```
16589         StreamingReporterBase::testGroupEnded(_testGroupStats);
16590     }
16591     void ConsoleReporter::testRunEnded(TestRunStats const& _testRunStats) {
16592         printTotalsDivider(_testRunStats.totals);
16593         printTotals(_testRunStats.totals);
16594         stream « std::endl;
16595         StreamingReporterBase::testRunEnded(_testRunStats);
16596     }
16597     void ConsoleReporter::testRunStarting(TestRunInfo const& _testInfo) {
16598         StreamingReporterBase::testRunStarting(_testInfo);
16599         printTestFilters();
16600     }
16601
16602     void ConsoleReporter::lazyPrint() {
16603
16604         m_tablePrinter->close();
16605         lazyPrintWithoutClosingBenchmarkTable();
16606     }
16607
16608     void ConsoleReporter::lazyPrintWithoutClosingBenchmarkTable() {
16609
16610         if (!currentTestRunInfo.used)
16611             lazyPrintRunInfo();
16612         if (!currentGroupInfo.used)
16613             lazyPrintGroupInfo();
16614
16615         if (!m_headerPrinted) {
16616             printTestCaseAndSectionHeader();
16617             m_headerPrinted = true;
16618         }
16619     }
16620     void ConsoleReporter::lazyPrintRunInfo() {
16621         stream « '\n' « getLineOfChars<'~'>() « '\n';
16622         Colour colour(Colour::SecondaryText);
16623         stream « currentTestRunInfo->name
16624                « " is a Catch v" « libraryVersion() « " host application.\n"
16625                « "Run with -? for options\n\n";
16626
16627         if (m_config->rngSeed() != 0)
16628             stream « "Randomness seeded to: " « m_config->rngSeed() « "\n\n";
16629
16630         currentTestRunInfo.used = true;
16631     }
16632     void ConsoleReporter::lazyPrintGroupInfo() {
16633         if (!currentGroupInfo->name.empty() && currentGroupInfo->groupsCounts > 1) {
16634             printClosedHeader("Group: " + currentGroupInfo->name);
16635             currentGroupInfo.used = true;
16636         }
16637     }
16638     void ConsoleReporter::printTestCaseAndSectionHeader() {
16639         assert(!m_sectionStack.empty());
16640         printOpenHeader(currentTestCaseInfo->name);
16641
16642         if (m_sectionStack.size() > 1) {
16643             Colour colourGuard(Colour::Headers);
16644
16645             auto
16646                     it = m_sectionStack.begin() + 1, // Skip first section (test case)
16647             itEnd = m_sectionStack.end();
16648             for (; it != itEnd; ++it)
16649                 printHeaderString(it->name, 2);
16650         }
16651
16652         SourceLineInfo lineInfo = m_sectionStack.back().lineInfo;
16653
16654         stream « getLineOfChars<'-'>() « '\n';
16655         Colour colourGuard(Colour::FileName);
16656         stream « lineInfo « '\n';
16657         stream « getLineOfChars<'.'>() « '\n' « std::endl;
16658     }
16659
16660     void ConsoleReporter::printClosedHeader(std::string const& _name) {
16661         printOpenHeader(_name);
16662         stream « getLineOfChars<'.'>() « '\n';
16663     }
16664     void ConsoleReporter::printOpenHeader(std::string const& _name) {
16665         stream « getLineOfChars<'-'>() « '\n';
16666         {
16667             Colour colourGuard(Colour::Headers);
16668             printHeaderString(_name);
16669         }
16670     }
16671
16672 // if string has a : in first line will set indent to follow it on
16673 // subsequent lines
16674     void ConsoleReporter::printHeaderString(std::string const& _string, std::size_t indent) {
16675         std::size_t i = _string.find(": ");
```

```
16676         if (i != std::string::npos)
16677             i += 2;
16678         else
16679             i = 0;
16680         stream « Column(_string).indent(indent + i).initialIndent(indent) « '\n';
16681     }
16682
16683     struct SummaryColumn {
16684
16685         SummaryColumn( std::string _label, Colour::Code _colour )
16686                 :   label( std::move( _label ) ),
16687                     colour( _colour ) {}
16688         SummaryColumn addRow( std::size_t count ) {
16689             ReusableStringStream rss;
16690             rss « count;
16691             std::string row = rss.str();
16692             for (auto& oldRow : rows) {
16693                 while (oldRow.size() < row.size())
16694                     oldRow = ' ' + oldRow;
16695                 while (oldRow.size() > row.size())
16696                     row = ' ' + row;
16697             }
16698             rows.push_back(row);
16699             return *this;
16700         }
16701
16702         std::string label;
16703         Colour::Code colour;
16704         std::vector<std::string> rows;
16705
16706     };
16707
16708     void ConsoleReporter::printTotals( Totals const& totals ) {
16709         if (totals.testCases.total() == 0) {
16710             stream « Colour(Colour::Warning) « "No tests ran\n";
16711         } else if (totals.assertions.total() > 0 && totals.testCases.allPassed()) {
16712             stream « Colour(Colour::ResultSuccess) « "All tests passed";
16713             stream « " ("
16714                    « pluralise(totals.assertions.passed, "assertion") « " in "
16715                    « pluralise(totals.testCases.passed, "test case") « ')'
16716                    « '\n';
16717         } else {
16718
16719             std::vector<SummaryColumn> columns;
16720             columns.push_back(SummaryColumn("", Colour::None)
16721                                     .addRow(totals.testCases.total())
16722                                     .addRow(totals.assertions.total()));
16723             columns.push_back(SummaryColumn("passed", Colour::Success)
16724                                     .addRow(totals.testCases.passed)
16725                                     .addRow(totals.assertions.passed));
16726             columns.push_back(SummaryColumn("failed", Colour::ResultError)
16727                                     .addRow(totals.testCases.failed)
16728                                     .addRow(totals.assertions.failed));
16729             columns.push_back(SummaryColumn("failed as expected", Colour::ResultExpectedFailure)
16730                                     .addRow(totals.testCases.failedButOk)
16731                                     .addRow(totals.assertions.failedButOk));
16732
16733             printSummaryRow("test cases", columns, 0);
16734             printSummaryRow("assertions", columns, 1);
16735         }
16736     }
16737     void ConsoleReporter::printSummaryRow(std::string const& label, std::vector<SummaryColumn> const&
      cols, std::size_t row) {
16738         for (auto col : cols) {
16739             std::string value = col.rows[row];
16740             if (col.label.empty()) {
16741                 stream « label « ": ";
16742                 if (value != "0")
16743                     stream « value;
16744                 else
16745                     stream « Colour(Colour::Warning) « "- none -";
16746             } else if (value != "0") {
16747                 stream « Colour(Colour::LightGrey) « " | ";
16748                 stream « Colour(col.colour)
16749                        « value « ' ' « col.label;
16750             }
16751         }
16752         stream « '\n';
16753     }
16754
16755     void ConsoleReporter::printTotalsDivider(Totals const& totals) {
16756         if (totals.testCases.total() > 0) {
16757             std::size_t failedRatio = makeRatio(totals.testCases.failed, totals.testCases.total());
16758             std::size_t failedButOkRatio = makeRatio(totals.testCases.failedButOk,
      totals.testCases.total());
16759             std::size_t passedRatio = makeRatio(totals.testCases.passed, totals.testCases.total());
16760             while (failedRatio + failedButOkRatio + passedRatio < CATCH_CONFIG_CONSOLE_WIDTH - 1)
```

```
16761                 findMax(failedRatio, failedButOkRatio, passedRatio)++;
16762             while (failedRatio + failedButOkRatio + passedRatio > CATCH_CONFIG_CONSOLE_WIDTH - 1)
16763                 findMax(failedRatio, failedButOkRatio, passedRatio)--;
16764
16765             stream << Colour(Colour::Error) << std::string(failedRatio, '=');
16766             stream << Colour(Colour::ResultExpectedFailure) << std::string(failedButOkRatio, '=');
16767             if (totals.testCases.allPassed())
16768                 stream << Colour(Colour::ResultSuccess) << std::string(passedRatio, '=');
16769             else
16770                 stream << Colour(Colour::Success) << std::string(passedRatio, '=');
16771         } else {
16772             stream << Colour(Colour::Warning) << std::string(CATCH_CONFIG_CONSOLE_WIDTH - 1, '=');
16773         }
16774         stream << '\n';
16775     }
16776     void ConsoleReporter::printSummaryDivider() {
16777         stream << getLineOfChars<'-'>() << '\n';
16778     }
16779
16780     void ConsoleReporter::printTestFilters() {
16781         if (m_config->testSpec().hasFilters()) {
16782             Colour guard(Colour::BrightYellow);
16783             stream << "Filters: " << serializeFilters(m_config->getTestsOrTags()) << '\n';
16784         }
16785     }
16786
16787     CATCH_REGISTER_REPORTER("console", ConsoleReporter)
16788
16789 } // end namespace Catch
16790
16791 #if defined(_MSC_VER)
16792 #pragma warning(pop)
16793 #endif
16794
16795 #if defined(__clang__)
16796 #  pragma clang diagnostic pop
16797 #endif
16798 // end catch_reporter_console.cpp
16799 // start catch_reporter_junit.cpp
16800
16801 #include <cassert>
16802 #include <sstream>
16803 #include <ctime>
16804 #include <algorithm>
16805 #include <iomanip>
16806
16807 namespace Catch {
16808
16809     namespace {
16810         std::string getCurrentTimestamp() {
16811             // Beware, this is not reentrant because of backward compatibility issues
16812             // Also, UTC only, again because of backward compatibility (%z is C++11)
16813             time_t rawtime;
16814             std::time(&rawtime);
16815             auto const timeStampSize = sizeof("2017-01-16T17:06:45Z");
16816
16817 #ifdef _MSC_VER
16818             std::tm timeInfo = {};
16819             gmtime_s(&timeInfo, &rawtime);
16820 #else
16821             std::tm* timeInfo;
16822             timeInfo = std::gmtime(&rawtime);
16823 #endif
16824
16825             char timeStamp[timeStampSize];
16826             const char * const fmt = "%Y-%m-%dT%H:%M:%SZ";
16827
16828 #ifdef _MSC_VER
16829             std::strftime(timeStamp, timeStampSize, fmt, &timeInfo);
16830 #else
16831             std::strftime(timeStamp, timeStampSize, fmt, timeInfo);
16832 #endif
16833             return std::string(timeStamp, timeStampSize-1);
16834         }
16835
16836         std::string fileNameTag(const std::vector<std::string> &tags) {
16837             auto it = std::find_if(begin(tags),
16838                                    end(tags),
16839                                    [] (std::string const& tag) {return tag.front() == '#'; });
16840             if (it != tags.end())
16841                 return it->substr(1);
16842             return std::string();
16843         }
16844
16845         // Formats the duration in seconds to 3 decimal places.
16846         // This is done because some genius defined Maven Surefire schema
16847         // in a way that only accepts 3 decimal places, and tools like
```

```
16848         // Jenkins use that schema for validation JUnit reporter output.
16849         std::string formatDuration( double seconds ) {
16850             ReusableStringStream rss;
16851             rss « std::fixed « std::setprecision( 3 ) « seconds;
16852             return rss.str();
16853         }
16854
16855     } // anonymous namespace
16856
16857     JunitReporter::JunitReporter( ReporterConfig const& _config )
16858             :   CumulativeReporterBase( _config ),
16859                 xml( _config.stream() )
16860     {
16861         m_reporterPrefs.shouldRedirectStdOut = true;
16862         m_reporterPrefs.shouldReportAllAssertions = true;
16863     }
16864
16865     JunitReporter::~JunitReporter() {}
16866
16867     std::string JunitReporter::getDescription() {
16868         return "Reports test results in an XML format that looks like Ant's junitreport target";
16869     }
16870
16871     void JunitReporter::noMatchingTestCases( std::string const& /*spec*/ ) {}
16872
16873     void JunitReporter::testRunStarting( TestRunInfo const& runInfo )  {
16874         CumulativeReporterBase::testRunStarting( runInfo );
16875         xml.startElement( "testsuites" );
16876     }
16877
16878     void JunitReporter::testGroupStarting( GroupInfo const& groupInfo ) {
16879         suiteTimer.start();
16880         stdOutForSuite.clear();
16881         stdErrForSuite.clear();
16882         unexpectedExceptions = 0;
16883         CumulativeReporterBase::testGroupStarting( groupInfo );
16884     }
16885
16886     void JunitReporter::testCaseStarting( TestCaseInfo const& testCaseInfo ) {
16887         m_okToFail = testCaseInfo.okToFail();
16888     }
16889
16890     bool JunitReporter::assertionEnded( AssertionStats const& assertionStats ) {
16891         if( assertionStats.assertionResult.getResultType() == ResultWas::ThrewException && !m_okToFail
      )
16892             unexpectedExceptions++;
16893         return CumulativeReporterBase::assertionEnded( assertionStats );
16894     }
16895
16896     void JunitReporter::testCaseEnded( TestCaseStats const& testCaseStats ) {
16897         stdOutForSuite += testCaseStats.stdOut;
16898         stdErrForSuite += testCaseStats.stdErr;
16899         CumulativeReporterBase::testCaseEnded( testCaseStats );
16900     }
16901
16902     void JunitReporter::testGroupEnded( TestGroupStats const& testGroupStats ) {
16903         double suiteTime = suiteTimer.getElapsedSeconds();
16904         CumulativeReporterBase::testGroupEnded( testGroupStats );
16905         writeGroup( *m_testGroups.back(), suiteTime );
16906     }
16907
16908     void JunitReporter::testRunEndedCumulative() {
16909         xml.endElement();
16910     }
16911
16912     void JunitReporter::writeGroup( TestGroupNode const& groupNode, double suiteTime ) {
16913         XmlWriter::ScopedElement e = xml.scopedElement( "testsuite" );
16914
16915         TestGroupStats const& stats = groupNode.value;
16916         xml.writeAttribute( "name", stats.groupInfo.name );
16917         xml.writeAttribute( "errors", unexpectedExceptions );
16918         xml.writeAttribute( "failures", stats.totals.assertions.failed-unexpectedExceptions );
16919         xml.writeAttribute( "tests", stats.totals.assertions.total() );
16920         xml.writeAttribute( "hostname", "tbd" ); // !TBD
16921         if( m_config->showDurations() == ShowDurations::Never )
16922             xml.writeAttribute( "time", "" );
16923         else
16924             xml.writeAttribute( "time", formatDuration( suiteTime ) );
16925         xml.writeAttribute( "timestamp", getCurrentTimestamp() );
16926
16927         // Write properties if there are any
16928         if (m_config->hasTestFilters() || m_config->rngSeed() != 0) {
16929             auto properties = xml.scopedElement("properties");
16930             if (m_config->hasTestFilters()) {
16931                 xml.scopedElement("property")
16932                         .writeAttribute("name", "filters")
16933                         .writeAttribute("value", serializeFilters(m_config->getTestsOrTags()));
```

```
16934             }
16935             if (m_config->rngSeed() != 0) {
16936                 xml.scopedElement("property")
16937                         .writeAttribute("name", "random-seed")
16938                         .writeAttribute("value", m_config->rngSeed());
16939             }
16940         }
16941
16942         // Write test cases
16943         for( auto const& child : groupNode.children )
16944             writeTestCase( *child );
16945
16946         xml.scopedElement( "system-out" ).writeText( trim( stdOutForSuite ), XmlFormatting::Newline );
16947         xml.scopedElement( "system-err" ).writeText( trim( stdErrForSuite ), XmlFormatting::Newline );
16948     }
16949
16950     void JunitReporter::writeTestCase( TestCaseNode const& testCaseNode ) {
16951         TestCaseStats const& stats = testCaseNode.value;
16952
16953         // All test cases have exactly one section - which represents the
16954         // test case itself. That section may have 0-n nested sections
16955         assert( testCaseNode.children.size() == 1 );
16956         SectionNode const& rootSection = *testCaseNode.children.front();
16957
16958         std::string className = stats.testInfo.className;
16959
16960         if( className.empty() ) {
16961             className = fileNameTag(stats.testInfo.tags);
16962             if ( className.empty() )
16963                 className = "global";
16964         }
16965
16966         if ( !m_config->name().empty() )
16967             className = m_config->name() + "." + className;
16968
16969         writeSection( className, "", rootSection, stats.testInfo.okToFail() );
16970     }
16971
16972     void JunitReporter::writeSection( std::string const& className,
16973                                       std::string const& rootName,
16974                                       SectionNode const& sectionNode,
16975                                       bool testOkToFail) {
16976         std::string name = trim( sectionNode.stats.sectionInfo.name );
16977         if( !rootName.empty() )
16978             name = rootName + '/' + name;
16979
16980         if( !sectionNode.assertions.empty() ||
16981             !sectionNode.stdOut.empty() ||
16982             !sectionNode.stdErr.empty() ) {
16983             XmlWriter::ScopedElement e = xml.scopedElement( "testcase" );
16984             if( className.empty() ) {
16985                 xml.writeAttribute( "classname", name );
16986                 xml.writeAttribute( "name", "root" );
16987             }
16988             else {
16989                 xml.writeAttribute( "classname", className );
16990                 xml.writeAttribute( "name", name );
16991             }
16992             xml.writeAttribute( "time", formatDuration( sectionNode.stats.durationInSeconds ) );
16993             // This is not ideal, but it should be enough to mimic gtest's
16994             // junit output.
16995             // Ideally the JUnit reporter would also handle `skipTest`
16996             // events and write those out appropriately.
16997             xml.writeAttribute( "status", "run" );
16998
16999             if (sectionNode.stats.assertions.failedButOk) {
17000                 xml.scopedElement("skipped")
17001                         .writeAttribute("message", "TEST_CASE tagged with !mayfail");
17002             }
17003
17004             writeAssertions( sectionNode );
17005
17006             if( !sectionNode.stdOut.empty() )
17007                 xml.scopedElement( "system-out" ).writeText( trim( sectionNode.stdOut ),
      XmlFormatting::Newline );
17008             if( !sectionNode.stdErr.empty() )
17009                 xml.scopedElement( "system-err" ).writeText( trim( sectionNode.stdErr ),
      XmlFormatting::Newline );
17010         }
17011         for( auto const& childNode : sectionNode.childSections )
17012             if( className.empty() )
17013                 writeSection( name, "", *childNode, testOkToFail );
17014             else
17015                 writeSection( className, name, *childNode, testOkToFail );
17016     }
17017
17018     void JunitReporter::writeAssertions( SectionNode const& sectionNode ) {
```

```
17019         for( auto const& assertion : sectionNode.assertions )
17020             writeAssertion( assertion );
17021     }
17022
17023     void JunitReporter::writeAssertion( AssertionStats const& stats ) {
17024         AssertionResult const& result = stats.assertionResult;
17025         if( !result.isOk() ) {
17026             std::string elementName;
17027             switch( result.getResultType() ) {
17028                 case ResultWas::ThrewException:
17029                 case ResultWas::FatalErrorCondition:
17030                     elementName = "error";
17031                     break;
17032                 case ResultWas::ExplicitFailure:
17033                 case ResultWas::ExpressionFailed:
17034                 case ResultWas::DidntThrowException:
17035                     elementName = "failure";
17036                     break;
17037
17038                     // We should never see these here:
17039                 case ResultWas::Info:
17040                 case ResultWas::Warning:
17041                 case ResultWas::Ok:
17042                 case ResultWas::Unknown:
17043                 case ResultWas::FailureBit:
17044                 case ResultWas::Exception:
17045                     elementName = "internalError";
17046                     break;
17047             }
17048
17049             XmlWriter::ScopedElement e = xml.scopedElement( elementName );
17050
17051             xml.writeAttribute( "message", result.getExpression() );
17052             xml.writeAttribute( "type", result.getTestMacroName() );
17053
17054             ReusableStringStream rss;
17055             if (stats.totals.assertions.total() > 0) {
17056                 rss << "FAILED" << ":\n";
17057                 if (result.hasExpression()) {
17058                     rss << "  ";
17059                     rss << result.getExpressionInMacro();
17060                     rss << '\n';
17061                 }
17062                 if (result.hasExpandedExpression()) {
17063                     rss << "with expansion:\n";
17064                     rss << Column(result.getExpandedExpression()).indent(2) << '\n';
17065                 }
17066             } else {
17067                 rss << '\n';
17068             }
17069
17070             if( !result.getMessage().empty() )
17071                 rss << result.getMessage() << '\n';
17072             for( auto const& msg : stats.infoMessages )
17073                 if( msg.type == ResultWas::Info )
17074                     rss << msg.message << '\n';
17075
17076             rss << "at " << result.getSourceInfo();
17077             xml.writeText( rss.str(), XmlFormatting::Newline );
17078         }
17079     }
17080
17081     CATCH_REGISTER_REPORTER( "junit", JunitReporter )
17082
17083 } // end namespace Catch
17084 // end catch_reporter_junit.cpp
17085 // start catch_reporter_listening.cpp
17086
17087 #include <cassert>
17088
17089 namespace Catch {
17090
17091     ListeningReporter::ListeningReporter() {
17092         // We will assume that listeners will always want all assertions
17093         m_preferences.shouldReportAllAssertions = true;
17094     }
17095
17096     void ListeningReporter::addListener( IStreamingReporterPtr&& listener ) {
17097         m_listeners.push_back( std::move( listener ) );
17098     }
17099
17100     void ListeningReporter::addReporter(IStreamingReporterPtr&& reporter) {
17101         assert(!m_reporter && "Listening reporter can wrap only 1 real reporter");
17102         m_reporter = std::move( reporter );
17103         m_preferences.shouldRedirectStdOut = m_reporter->getPreferences().shouldRedirectStdOut;
17104     }
17105
```

```
17106     ReporterPreferences ListeningReporter::getPreferences() const {
17107         return m_preferences;
17108     }
17109
17110     std::set<Verbosity> ListeningReporter::getSupportedVerbosities() {
17111         return std::set<Verbosity>{ };
17112     }
17113
17114     void ListeningReporter::noMatchingTestCases( std::string const& spec ) {
17115         for ( auto const& listener : m_listeners ) {
17116             listener->noMatchingTestCases( spec );
17117         }
17118         m_reporter->noMatchingTestCases( spec );
17119     }
17120
17121     void ListeningReporter::reportInvalidArguments(std::string const&arg){
17122         for ( auto const& listener : m_listeners ) {
17123             listener->reportInvalidArguments( arg );
17124         }
17125         m_reporter->reportInvalidArguments( arg );
17126     }
17127
17128 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
17129     void ListeningReporter::benchmarkPreparing( std::string const& name ) {
17130         for (auto const& listener : m_listeners) {
17131             listener->benchmarkPreparing(name);
17132         }
17133         m_reporter->benchmarkPreparing(name);
17134     }
17135     void ListeningReporter::benchmarkStarting( BenchmarkInfo const& benchmarkInfo ) {
17136         for ( auto const& listener : m_listeners ) {
17137             listener->benchmarkStarting( benchmarkInfo );
17138         }
17139         m_reporter->benchmarkStarting( benchmarkInfo );
17140     }
17141     void ListeningReporter::benchmarkEnded( BenchmarkStats<> const& benchmarkStats ) {
17142         for ( auto const& listener : m_listeners ) {
17143             listener->benchmarkEnded( benchmarkStats );
17144         }
17145         m_reporter->benchmarkEnded( benchmarkStats );
17146     }
17147
17148     void ListeningReporter::benchmarkFailed( std::string const& error ) {
17149         for (auto const& listener : m_listeners) {
17150             listener->benchmarkFailed(error);
17151         }
17152         m_reporter->benchmarkFailed(error);
17153     }
17154 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
17155
17156     void ListeningReporter::testRunStarting( TestRunInfo const& testRunInfo ) {
17157         for ( auto const& listener : m_listeners ) {
17158             listener->testRunStarting( testRunInfo );
17159         }
17160         m_reporter->testRunStarting( testRunInfo );
17161     }
17162
17163     void ListeningReporter::testGroupStarting( GroupInfo const& groupInfo ) {
17164         for ( auto const& listener : m_listeners ) {
17165             listener->testGroupStarting( groupInfo );
17166         }
17167         m_reporter->testGroupStarting( groupInfo );
17168     }
17169
17170     void ListeningReporter::testCaseStarting( TestCaseInfo const& testInfo ) {
17171         for ( auto const& listener : m_listeners ) {
17172             listener->testCaseStarting( testInfo );
17173         }
17174         m_reporter->testCaseStarting( testInfo );
17175     }
17176
17177     void ListeningReporter::sectionStarting( SectionInfo const& sectionInfo ) {
17178         for ( auto const& listener : m_listeners ) {
17179             listener->sectionStarting( sectionInfo );
17180         }
17181         m_reporter->sectionStarting( sectionInfo );
17182     }
17183
17184     void ListeningReporter::assertionStarting( AssertionInfo const& assertionInfo ) {
17185         for ( auto const& listener : m_listeners ) {
17186             listener->assertionStarting( assertionInfo );
17187         }
17188         m_reporter->assertionStarting( assertionInfo );
17189     }
17190
17191     // The return value indicates if the messages buffer should be cleared:
17192     bool ListeningReporter::assertionEnded( AssertionStats const& assertionStats ) {
```

```
17193         for( auto const& listener : m_listeners ) {
17194             static_cast<void>( listener->assertionEnded( assertionStats ) );
17195         }
17196         return m_reporter->assertionEnded( assertionStats );
17197     }
17198
17199     void ListeningReporter::sectionEnded( SectionStats const& sectionStats ) {
17200         for ( auto const& listener : m_listeners ) {
17201             listener->sectionEnded( sectionStats );
17202         }
17203         m_reporter->sectionEnded( sectionStats );
17204     }
17205
17206     void ListeningReporter::testCaseEnded( TestCaseStats const& testCaseStats ) {
17207         for ( auto const& listener : m_listeners ) {
17208             listener->testCaseEnded( testCaseStats );
17209         }
17210         m_reporter->testCaseEnded( testCaseStats );
17211     }
17212
17213     void ListeningReporter::testGroupEnded( TestGroupStats const& testGroupStats ) {
17214         for ( auto const& listener : m_listeners ) {
17215             listener->testGroupEnded( testGroupStats );
17216         }
17217         m_reporter->testGroupEnded( testGroupStats );
17218     }
17219
17220     void ListeningReporter::testRunEnded( TestRunStats const& testRunStats ) {
17221         for ( auto const& listener : m_listeners ) {
17222             listener->testRunEnded( testRunStats );
17223         }
17224         m_reporter->testRunEnded( testRunStats );
17225     }
17226
17227     void ListeningReporter::skipTest( TestCaseInfo const& testInfo ) {
17228         for ( auto const& listener : m_listeners ) {
17229             listener->skipTest( testInfo );
17230         }
17231         m_reporter->skipTest( testInfo );
17232     }
17233
17234     bool ListeningReporter::isMulti() const {
17235         return true;
17236     }
17237
17238 } // end namespace Catch
17239 // end catch_reporter_listening.cpp
17240 // start catch_reporter_xml.cpp
17241
17242 #if defined(_MSC_VER)
17243 #pragma warning(push)
17244 #pragma warning(disable:4061) // Not all labels are EXPLICITLY handled in switch
17245                               // Note that 4062 (not all labels are handled
17246                               // and default is missing) is enabled
17247 #endif
17248
17249 namespace Catch {
17250     XmlReporter::XmlReporter( ReporterConfig const& _config )
17251             :   StreamingReporterBase( _config ),
17252                 m_xml(_config.stream())
17253     {
17254         m_reporterPrefs.shouldRedirectStdOut = true;
17255         m_reporterPrefs.shouldReportAllAssertions = true;
17256     }
17257
17258     XmlReporter::~XmlReporter() = default;
17259
17260     std::string XmlReporter::getDescription() {
17261         return "Reports test results as an XML document";
17262     }
17263
17264     std::string XmlReporter::getStylesheetRef() const {
17265         return std::string();
17266     }
17267
17268     void XmlReporter::writeSourceInfo( SourceLineInfo const& sourceInfo ) {
17269         m_xml
17270                 .writeAttribute( "filename", sourceInfo.file )
17271                 .writeAttribute( "line", sourceInfo.line );
17272     }
17273
17274     void XmlReporter::noMatchingTestCases( std::string const& s ) {
17275         StreamingReporterBase::noMatchingTestCases( s );
17276     }
17277
17278     void XmlReporter::testRunStarting( TestRunInfo const& testInfo ) {
17279         StreamingReporterBase::testRunStarting( testInfo );
```

```
17280         std::string stylesheetRef = getStylesheetRef();
17281         if( !stylesheetRef.empty() )
17282             m_xml.writeStylesheetRef( stylesheetRef );
17283         m_xml.startElement( "Catch" );
17284         if( !m_config->name().empty() )
17285             m_xml.writeAttribute( "name", m_config->name() );
17286         if (m_config->testSpec().hasFilters())
17287             m_xml.writeAttribute( "filters", serializeFilters( m_config->getTestsOrTags() ) );
17288         if( m_config->rngSeed() != 0 )
17289             m_xml.scopedElement( "Randomness" )
17290                     .writeAttribute( "seed", m_config->rngSeed() );
17291     }
17292
17293     void XmlReporter::testGroupStarting( GroupInfo const& groupInfo ) {
17294         StreamingReporterBase::testGroupStarting( groupInfo );
17295         m_xml.startElement( "Group" )
17296                 .writeAttribute( "name", groupInfo.name );
17297     }
17298
17299     void XmlReporter::testCaseStarting( TestCaseInfo const& testInfo ) {
17300         StreamingReporterBase::testCaseStarting(testInfo);
17301         m_xml.startElement( "TestCase" )
17302                 .writeAttribute( "name", trim( testInfo.name ) )
17303                 .writeAttribute( "description", testInfo.description )
17304                 .writeAttribute( "tags", testInfo.tagsAsString() );
17305
17306         writeSourceInfo( testInfo.lineInfo );
17307
17308         if ( m_config->showDurations() == ShowDurations::Always )
17309             m_testCaseTimer.start();
17310         m_xml.ensureTagClosed();
17311     }
17312
17313     void XmlReporter::sectionStarting( SectionInfo const& sectionInfo ) {
17314         StreamingReporterBase::sectionStarting( sectionInfo );
17315         if( m_sectionDepth++ > 0 ) {
17316             m_xml.startElement( "Section" )
17317                     .writeAttribute( "name", trim( sectionInfo.name ) );
17318             writeSourceInfo( sectionInfo.lineInfo );
17319             m_xml.ensureTagClosed();
17320         }
17321     }
17322
17323     void XmlReporter::assertionStarting( AssertionInfo const& ) { }
17324
17325     bool XmlReporter::assertionEnded( AssertionStats const& assertionStats ) {
17326
17327         AssertionResult const& result = assertionStats.assertionResult;
17328
17329         bool includeResults = m_config->includeSuccessfulResults() || !result.isOk();
17330
17331         if( includeResults || result.getResultType() == ResultWas::Warning ) {
17332             // Print any info messages in <Info> tags.
17333             for( auto const& msg : assertionStats.infoMessages ) {
17334                 if( msg.type == ResultWas::Info && includeResults ) {
17335                     m_xml.scopedElement( "Info" )
17336                             .writeText( msg.message );
17337                 } else if ( msg.type == ResultWas::Warning ) {
17338                     m_xml.scopedElement( "Warning" )
17339                             .writeText( msg.message );
17340                 }
17341             }
17342         }
17343
17344         // Drop out if result was successful but we're not printing them.
17345         if( !includeResults && result.getResultType() != ResultWas::Warning )
17346             return true;
17347
17348         // Print the expression if there is one.
17349         if( result.hasExpression() ) {
17350             m_xml.startElement( "Expression" )
17351                     .writeAttribute( "success", result.succeeded() )
17352                     .writeAttribute( "type", result.getTestMacroName() );
17353
17354             writeSourceInfo( result.getSourceInfo() );
17355
17356             m_xml.scopedElement( "Original" )
17357                     .writeText( result.getExpression() );
17358             m_xml.scopedElement( "Expanded" )
17359                     .writeText( result.getExpandedExpression() );
17360         }
17361
17362         // And... Print a result applicable to each result type.
17363         switch( result.getResultType() ) {
17364             case ResultWas::ThrewException:
17365                 m_xml.startElement( "Exception" );
17366                 writeSourceInfo( result.getSourceInfo() );
```

```
17367                 m_xml.writeText( result.getMessage() );
17368                 m_xml.endElement();
17369                 break;
17370             case ResultWas::FatalErrorCondition:
17371                 m_xml.startElement( "FatalErrorCondition" );
17372                 writeSourceInfo( result.getSourceInfo() );
17373                 m_xml.writeText( result.getMessage() );
17374                 m_xml.endElement();
17375                 break;
17376             case ResultWas::Info:
17377                 m_xml.scopedElement( "Info" )
17378                         .writeText( result.getMessage() );
17379                 break;
17380             case ResultWas::Warning:
17381                 // Warning will already have been written
17382                 break;
17383             case ResultWas::ExplicitFailure:
17384                 m_xml.startElement( "Failure" );
17385                 writeSourceInfo( result.getSourceInfo() );
17386                 m_xml.writeText( result.getMessage() );
17387                 m_xml.endElement();
17388                 break;
17389             default:
17390                 break;
17391         }
17392
17393         if( result.hasExpression() )
17394             m_xml.endElement();
17395
17396         return true;
17397     }
17398
17399     void XmlReporter::sectionEnded( SectionStats const& sectionStats ) {
17400         StreamingReporterBase::sectionEnded( sectionStats );
17401         if( --m_sectionDepth > 0 ) {
17402             XmlWriter::ScopedElement e = m_xml.scopedElement( "OverallResults" );
17403             e.writeAttribute( "successes", sectionStats.assertions.passed );
17404             e.writeAttribute( "failures", sectionStats.assertions.failed );
17405             e.writeAttribute( "expectedFailures", sectionStats.assertions.failedButOk );
17406
17407             if ( m_config->showDurations() == ShowDurations::Always )
17408                 e.writeAttribute( "durationInSeconds", sectionStats.durationInSeconds );
17409
17410             m_xml.endElement();
17411         }
17412     }
17413
17414     void XmlReporter::testCaseEnded( TestCaseStats const& testCaseStats ) {
17415         StreamingReporterBase::testCaseEnded( testCaseStats );
17416         XmlWriter::ScopedElement e = m_xml.scopedElement( "OverallResult" );
17417         e.writeAttribute( "success", testCaseStats.totals.assertions.allOk() );
17418
17419         if ( m_config->showDurations() == ShowDurations::Always )
17420             e.writeAttribute( "durationInSeconds", m_testCaseTimer.getElapsedSeconds() );
17421
17422         if( !testCaseStats.stdOut.empty() )
17423             m_xml.scopedElement( "StdOut" ).writeText( trim( testCaseStats.stdOut ),
      XmlFormatting::Newline );
17424         if( !testCaseStats.stdErr.empty() )
17425             m_xml.scopedElement( "StdErr" ).writeText( trim( testCaseStats.stdErr ),
      XmlFormatting::Newline );
17426
17427         m_xml.endElement();
17428     }
17429
17430     void XmlReporter::testGroupEnded( TestGroupStats const& testGroupStats ) {
17431         StreamingReporterBase::testGroupEnded( testGroupStats );
17432         // TODO: Check testGroupStats.aborting and act accordingly.
17433         m_xml.scopedElement( "OverallResults" )
17434                 .writeAttribute( "successes", testGroupStats.totals.assertions.passed )
17435                 .writeAttribute( "failures", testGroupStats.totals.assertions.failed )
17436                 .writeAttribute( "expectedFailures", testGroupStats.totals.assertions.failedButOk );
17437         m_xml.scopedElement( "OverallResultsCases")
17438                 .writeAttribute( "successes", testGroupStats.totals.testCases.passed )
17439                 .writeAttribute( "failures", testGroupStats.totals.testCases.failed )
17440                 .writeAttribute( "expectedFailures", testGroupStats.totals.testCases.failedButOk );
17441         m_xml.endElement();
17442     }
17443
17444     void XmlReporter::testRunEnded( TestRunStats const& testRunStats ) {
17445         StreamingReporterBase::testRunEnded( testRunStats );
17446         m_xml.scopedElement( "OverallResults" )
17447                 .writeAttribute( "successes", testRunStats.totals.assertions.passed )
17448                 .writeAttribute( "failures", testRunStats.totals.assertions.failed )
17449                 .writeAttribute( "expectedFailures", testRunStats.totals.assertions.failedButOk );
17450         m_xml.scopedElement( "OverallResultsCases")
17451                 .writeAttribute( "successes", testRunStats.totals.testCases.passed )
```

```
17452                 .writeAttribute( "failures", testRunStats.totals.testCases.failed )
17453                 .writeAttribute( "expectedFailures", testRunStats.totals.testCases.failedButOk );
17454         m_xml.endElement();
17455     }
17456
17457 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
17458     void XmlReporter::benchmarkPreparing(std::string const& name) {
17459         m_xml.startElement("BenchmarkResults")
17460             .writeAttribute("name", name);
17461     }
17462
17463     void XmlReporter::benchmarkStarting(BenchmarkInfo const &info) {
17464         m_xml.writeAttribute("samples", info.samples)
17465             .writeAttribute("resamples", info.resamples)
17466             .writeAttribute("iterations", info.iterations)
17467             .writeAttribute("clockResolution", info.clockResolution)
17468             .writeAttribute("estimatedDuration", info.estimatedDuration)
17469             .writeComment("All values in nano seconds");
17470     }
17471
17472     void XmlReporter::benchmarkEnded(BenchmarkStats<> const& benchmarkStats) {
17473         m_xml.startElement("mean")
17474             .writeAttribute("value", benchmarkStats.mean.point.count())
17475             .writeAttribute("lowerBound", benchmarkStats.mean.lower_bound.count())
17476             .writeAttribute("upperBound", benchmarkStats.mean.upper_bound.count())
17477             .writeAttribute("ci", benchmarkStats.mean.confidence_interval);
17478         m_xml.endElement();
17479         m_xml.startElement("standardDeviation")
17480             .writeAttribute("value", benchmarkStats.standardDeviation.point.count())
17481             .writeAttribute("lowerBound", benchmarkStats.standardDeviation.lower_bound.count())
17482             .writeAttribute("upperBound", benchmarkStats.standardDeviation.upper_bound.count())
17483             .writeAttribute("ci", benchmarkStats.standardDeviation.confidence_interval);
17484         m_xml.endElement();
17485         m_xml.startElement("outliers")
17486             .writeAttribute("variance", benchmarkStats.outlierVariance)
17487             .writeAttribute("lowMild", benchmarkStats.outliers.low_mild)
17488             .writeAttribute("lowSevere", benchmarkStats.outliers.low_severe)
17489             .writeAttribute("highMild", benchmarkStats.outliers.high_mild)
17490             .writeAttribute("highSevere", benchmarkStats.outliers.high_severe);
17491         m_xml.endElement();
17492         m_xml.endElement();
17493     }
17494
17495     void XmlReporter::benchmarkFailed(std::string const &error) {
17496         m_xml.scopedElement("failed").
17497             writeAttribute("message", error);
17498         m_xml.endElement();
17499     }
17500 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
17501
17502     CATCH_REGISTER_REPORTER( "xml", XmlReporter )
17503
17504 } // end namespace Catch
17505
17506 #if defined(_MSC_VER)
17507 #pragma warning(pop)
17508 #endif
17509 // end catch_reporter_xml.cpp
17510
17511 namespace Catch {
17512     LeakDetector leakDetector;
17513 }
17514
17515 #ifdef __clang__
17516 #pragma clang diagnostic pop
17517 #endif
17518
17519 // end catch_impl.hpp
17520 #endif
17521
17522 #ifdef CATCH_CONFIG_MAIN
17523 // start catch_default_main.hpp
17524
17525 #ifndef __OBJC__
17526
17527 #ifndef CATCH_INTERNAL_CDECL
17528 #ifdef _MSC_VER
17529 #define CATCH_INTERNAL_CDECL __cdecl
17530 #else
17531 #define CATCH_INTERNAL_CDECL
17532 #endif
17533 #endif
17534
17535 #if defined(CATCH_CONFIG_WCHAR) && defined(CATCH_PLATFORM_WINDOWS) && defined(_UNICODE) &&
      !defined(DO_NOT_USE_WMAIN)
17536 // Standard C/C++ Win32 Unicode wmain entry point
17537 extern "C" int CATCH_INTERNAL_CDECL wmain (int argc, wchar_t * argv[], wchar_t * []) {
```

```
17538 #else
17539 // Standard C/C++ main entry point
17540 int CATCH_INTERNAL_CDECL main (int argc, char * argv[]) {
17541 #endif
17542
17543     return Catch::Session().run( argc, argv );
17544 }
17545
17546 #else // __OBJC__
17547
17548 // Objective-C entry point
17549 int main (int argc, char * const argv[]) {
17550 #if !CATCH_ARC_ENABLED
17551     NSAutoreleasePool * pool = [[NSAutoreleasePool alloc] init];
17552 #endif
17553
17554     Catch::registerTestMethods();
17555     int result = Catch::Session().run( argc, (char**)argv );
17556
17557 #if !CATCH_ARC_ENABLED
17558     [pool drain];
17559 #endif
17560
17561     return result;
17562 }
17563
17564 #endif // __OBJC__
17565
17566 // end catch_default_main.hpp
17567 #endif
17568
17569 #if !defined(CATCH_CONFIG_IMPL_ONLY)
17570
17571 #ifdef CLARA_CONFIG_MAIN_NOT_DEFINED
17572 #  undef CLARA_CONFIG_MAIN
17573 #endif
17574
17575 #if !defined(CATCH_CONFIG_DISABLE)
17577 // If this config identifier is defined then all CATCH macros are prefixed with CATCH_
17578 #ifdef CATCH_CONFIG_PREFIX_ALL
17579
17580 #define CATCH_REQUIRE( ... ) INTERNAL_CATCH_TEST( "CATCH_REQUIRE", Catch::ResultDisposition::Normal,
      __VA_ARGS__ )
17581 #define CATCH_REQUIRE_FALSE( ... ) INTERNAL_CATCH_TEST( "CATCH_REQUIRE_FALSE",
      Catch::ResultDisposition::Normal | Catch::ResultDisposition::FalseTest, __VA_ARGS__ )
17582
17583 #define CATCH_REQUIRE_THROWS( ... ) INTERNAL_CATCH_THROWS( "CATCH_REQUIRE_THROWS",
      Catch::ResultDisposition::Normal, __VA_ARGS__ )
17584 #define CATCH_REQUIRE_THROWS_AS( expr, exceptionType ) INTERNAL_CATCH_THROWS_AS(
      "CATCH_REQUIRE_THROWS_AS", exceptionType, Catch::ResultDisposition::Normal, expr )
17585 #define CATCH_REQUIRE_THROWS_WITH( expr, matcher ) INTERNAL_CATCH_THROWS_STR_MATCHES(
      "CATCH_REQUIRE_THROWS_WITH", Catch::ResultDisposition::Normal, matcher, expr )
17586 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
17587 #define CATCH_REQUIRE_THROWS_MATCHES( expr, exceptionType, matcher ) INTERNAL_CATCH_THROWS_MATCHES(
      "CATCH_REQUIRE_THROWS_MATCHES", exceptionType, Catch::ResultDisposition::Normal, matcher, expr )
17588 #endif// CATCH_CONFIG_DISABLE_MATCHERS
17589 #define CATCH_REQUIRE_NOTHROW( ... ) INTERNAL_CATCH_NO_THROW( "CATCH_REQUIRE_NOTHROW",
      Catch::ResultDisposition::Normal, __VA_ARGS__ )
17590
17591 #define CATCH_CHECK( ... ) INTERNAL_CATCH_TEST( "CATCH_CHECK",
      Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
17592 #define CATCH_CHECK_FALSE( ... ) INTERNAL_CATCH_TEST( "CATCH_CHECK_FALSE",
      Catch::ResultDisposition::ContinueOnFailure | Catch::ResultDisposition::FalseTest, __VA_ARGS__ )
17593 #define CATCH_CHECKED_IF( ... ) INTERNAL_CATCH_IF( "CATCH_CHECKED_IF",
      Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
17594 #define CATCH_CHECKED_ELSE( ... ) INTERNAL_CATCH_ELSE( "CATCH_CHECKED_ELSE",
      Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
17595 #define CATCH_CHECK_NOFAIL( ... ) INTERNAL_CATCH_TEST( "CATCH_CHECK_NOFAIL",
      Catch::ResultDisposition::ContinueOnFailure | Catch::ResultDisposition::SuppressFail, __VA_ARGS__ )
17596
17597 #define CATCH_CHECK_THROWS( ... )  INTERNAL_CATCH_THROWS( "CATCH_CHECK_THROWS",
      Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
17598 #define CATCH_CHECK_THROWS_AS( expr, exceptionType ) INTERNAL_CATCH_THROWS_AS(
      "CATCH_CHECK_THROWS_AS", exceptionType, Catch::ResultDisposition::ContinueOnFailure, expr )
17599 #define CATCH_CHECK_THROWS_WITH( expr, matcher ) INTERNAL_CATCH_THROWS_STR_MATCHES(
      "CATCH_CHECK_THROWS_WITH", Catch::ResultDisposition::ContinueOnFailure, matcher, expr )
17600 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
17601 #define CATCH_CHECK_THROWS_MATCHES( expr, exceptionType, matcher ) INTERNAL_CATCH_THROWS_MATCHES(
      "CATCH_CHECK_THROWS_MATCHES", exceptionType, Catch::ResultDisposition::ContinueOnFailure, matcher,
      expr )
17602 #endif // CATCH_CONFIG_DISABLE_MATCHERS
17603 #define CATCH_CHECK_NOTHROW( ... ) INTERNAL_CATCH_NO_THROW( "CATCH_CHECK_NOTHROW",
      Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
17604
17605 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
17606 #define CATCH_CHECK_THAT( arg, matcher ) INTERNAL_CHECK_THAT( "CATCH_CHECK_THAT", matcher,
      Catch::ResultDisposition::ContinueOnFailure, arg )
```

```
17607
17608 #define CATCH_REQUIRE_THAT( arg, matcher ) INTERNAL_CHECK_THAT( "CATCH_REQUIRE_THAT", matcher,
      Catch::ResultDisposition::Normal, arg )
17609 #endif // CATCH_CONFIG_DISABLE_MATCHERS
17610
17611 #define CATCH_INFO( msg ) INTERNAL_CATCH_INFO( "CATCH_INFO", msg )
17612 #define CATCH_UNSCOPED_INFO( msg ) INTERNAL_CATCH_UNSCOPED_INFO( "CATCH_UNSCOPED_INFO", msg )
17613 #define CATCH_WARN( msg ) INTERNAL_CATCH_MSG( "CATCH_WARN", Catch::ResultWas::Warning,
      Catch::ResultDisposition::ContinueOnFailure, msg )
17614 #define CATCH_CAPTURE( ... ) INTERNAL_CATCH_CAPTURE( INTERNAL_CATCH_UNIQUE_NAME(capturer),
      "CATCH_CAPTURE",__VA_ARGS__ )
17615
17616 #define CATCH_TEST_CASE( ... ) INTERNAL_CATCH_TESTCASE( __VA_ARGS__ )
17617 #define CATCH_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_TEST_CASE_METHOD( className,
      __VA_ARGS__ )
17618 #define CATCH_METHOD_AS_TEST_CASE( method, ... ) INTERNAL_CATCH_METHOD_AS_TEST_CASE( method,
      __VA_ARGS__ )
17619 #define CATCH_REGISTER_TEST_CASE( Function, ... ) INTERNAL_CATCH_REGISTER_TESTCASE( Function,
      __VA_ARGS__ )
17620 #define CATCH_SECTION( ... ) INTERNAL_CATCH_SECTION( __VA_ARGS__ )
17621 #define CATCH_DYNAMIC_SECTION( ... ) INTERNAL_CATCH_DYNAMIC_SECTION( __VA_ARGS__ )
17622 #define CATCH_FAIL( ... ) INTERNAL_CATCH_MSG( "CATCH_FAIL", Catch::ResultWas::ExplicitFailure,
      Catch::ResultDisposition::Normal, __VA_ARGS__ )
17623 #define CATCH_FAIL_CHECK( ... ) INTERNAL_CATCH_MSG( "CATCH_FAIL_CHECK",
      Catch::ResultWas::ExplicitFailure, Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
17624 #define CATCH_SUCCEED( ... ) INTERNAL_CATCH_MSG( "CATCH_SUCCEED", Catch::ResultWas::Ok,
      Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
17625
17626 #define CATCH_ANON_TEST_CASE() INTERNAL_CATCH_TESTCASE()
17627
17628 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
17629 #define CATCH_TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ )
17630 #define CATCH_TEMPLATE_TEST_CASE_SIG( ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG( __VA_ARGS__ )
17631 #define CATCH_TEMPLATE_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD(
      className, __VA_ARGS__ )
17632 #define CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, ... )
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ )
17633 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE( ... ) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE( __VA_ARGS__
      )
17634 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG(
      __VA_ARGS__ )
17635 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... )
      INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, __VA_ARGS__ )
17636 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... )
      INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ )
17637 #else
17638 #define CATCH_TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ ) )
17639 #define CATCH_TEMPLATE_TEST_CASE_SIG( ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG( __VA_ARGS__ ) )
17640 #define CATCH_TEMPLATE_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD( className, __VA_ARGS__ ) )
17641 #define CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ ) )
17642 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE( ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE( __VA_ARGS__ ) )
17643 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG( __VA_ARGS__ ) )
17644 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, __VA_ARGS__ ) )
17645 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ ) )
17646 #endif
17647
17648 #if !defined(CATCH_CONFIG_RUNTIME_STATIC_REQUIRE)
17649 #define CATCH_STATIC_REQUIRE( ... )       static_assert(   __VA_ARGS__ ,      #__VA_ARGS__ );
      CATCH_SUCCEED( #__VA_ARGS__ )
17650 #define CATCH_STATIC_REQUIRE_FALSE( ... ) static_assert( !(__VA_ARGS__), "!(" #__VA_ARGS__ ")" );
      CATCH_SUCCEED( #__VA_ARGS__ )
17651 #else
17652 #define CATCH_STATIC_REQUIRE( ... )       CATCH_REQUIRE( __VA_ARGS__ )
17653 #define CATCH_STATIC_REQUIRE_FALSE( ... ) CATCH_REQUIRE_FALSE( __VA_ARGS__ )
17654 #endif
17655
17656 // "BDD-style" convenience wrappers
17657 #define CATCH_SCENARIO( ... ) CATCH_TEST_CASE( "Scenario: " __VA_ARGS__ )
17658 #define CATCH_SCENARIO_METHOD( className, ... ) INTERNAL_CATCH_TEST_CASE_METHOD( className, "Scenario:
      " __VA_ARGS__ )
17659 #define CATCH_GIVEN( desc )     INTERNAL_CATCH_DYNAMIC_SECTION( "    Given: " << desc )
17660 #define CATCH_AND_GIVEN( desc ) INTERNAL_CATCH_DYNAMIC_SECTION( "And given: " << desc )
17661 #define CATCH_WHEN( desc )      INTERNAL_CATCH_DYNAMIC_SECTION( "     When: " << desc )
17662 #define CATCH_AND_WHEN( desc )  INTERNAL_CATCH_DYNAMIC_SECTION( " And when: " << desc )
17663 #define CATCH_THEN( desc )      INTERNAL_CATCH_DYNAMIC_SECTION( "     Then: " << desc )
17664 #define CATCH_AND_THEN( desc )  INTERNAL_CATCH_DYNAMIC_SECTION( "      And: " << desc )
17665
17666 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
17667 #define CATCH_BENCHMARK(...) \
```

```
17668     INTERNAL_CATCH_BENCHMARK(INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_B_E_N_C_H_),
      INTERNAL_CATCH_GET_1_ARG(__VA_ARGS__„), INTERNAL_CATCH_GET_2_ARG(__VA_ARGS__„))
17669 #define CATCH_BENCHMARK_ADVANCED(name) \
17670     INTERNAL_CATCH_BENCHMARK_ADVANCED(INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_B_E_N_C_H_), name)
17671 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
17672
17673 // If CATCH_CONFIG_PREFIX_ALL is not defined then the CATCH_ prefix is not required
17674 #else
17675
17676 #define REQUIRE( ... ) INTERNAL_CATCH_TEST( "REQUIRE", Catch::ResultDisposition::Normal, __VA_ARGS__
      )
17677 #define REQUIRE_FALSE( ... ) INTERNAL_CATCH_TEST( "REQUIRE_FALSE", Catch::ResultDisposition::Normal |
      Catch::ResultDisposition::FalseTest, __VA_ARGS__ )
17678
17679 #define REQUIRE_THROWS( ... ) INTERNAL_CATCH_THROWS( "REQUIRE_THROWS",
      Catch::ResultDisposition::Normal, __VA_ARGS__ )
17680 #define REQUIRE_THROWS_AS( expr, exceptionType ) INTERNAL_CATCH_THROWS_AS( "REQUIRE_THROWS_AS",
      exceptionType, Catch::ResultDisposition::Normal, expr )
17681 #define REQUIRE_THROWS_WITH( expr, matcher ) INTERNAL_CATCH_THROWS_STR_MATCHES( "REQUIRE_THROWS_WITH",
      Catch::ResultDisposition::Normal, matcher, expr )
17682 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
17683 #define REQUIRE_THROWS_MATCHES( expr, exceptionType, matcher ) INTERNAL_CATCH_THROWS_MATCHES(
      "REQUIRE_THROWS_MATCHES", exceptionType, Catch::ResultDisposition::Normal, matcher, expr )
17684 #endif // CATCH_CONFIG_DISABLE_MATCHERS
17685 #define REQUIRE_NOTHROW( ... ) INTERNAL_CATCH_NO_THROW( "REQUIRE_NOTHROW",
      Catch::ResultDisposition::Normal, __VA_ARGS__ )
17686
17687 #define CHECK( ... ) INTERNAL_CATCH_TEST( "CHECK", Catch::ResultDisposition::ContinueOnFailure,
      __VA_ARGS__ )
17688 #define CHECK_FALSE( ... ) INTERNAL_CATCH_TEST( "CHECK_FALSE",
      Catch::ResultDisposition::ContinueOnFailure | Catch::ResultDisposition::FalseTest, __VA_ARGS__ )
17689 #define CHECKED_IF( ... ) INTERNAL_CATCH_IF( "CHECKED_IF",
      Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
17690 #define CHECKED_ELSE( ... ) INTERNAL_CATCH_ELSE( "CHECKED_ELSE",
      Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
17691 #define CHECK_NOFAIL( ... ) INTERNAL_CATCH_TEST( "CHECK_NOFAIL",
      Catch::ResultDisposition::ContinueOnFailure | Catch::ResultDisposition::SuppressFail, __VA_ARGS__ )
17692
17693 #define CHECK_THROWS( ... )  INTERNAL_CATCH_THROWS( "CHECK_THROWS",
      Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
17694 #define CHECK_THROWS_AS( expr, exceptionType ) INTERNAL_CATCH_THROWS_AS( "CHECK_THROWS_AS",
      exceptionType, Catch::ResultDisposition::ContinueOnFailure, expr )
17695 #define CHECK_THROWS_WITH( expr, matcher ) INTERNAL_CATCH_THROWS_STR_MATCHES( "CHECK_THROWS_WITH",
      Catch::ResultDisposition::ContinueOnFailure, matcher, expr )
17696 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
17697 #define CHECK_THROWS_MATCHES( expr, exceptionType, matcher ) INTERNAL_CATCH_THROWS_MATCHES(
      "CHECK_THROWS_MATCHES", exceptionType, Catch::ResultDisposition::ContinueOnFailure, matcher, expr )
17698 #endif // CATCH_CONFIG_DISABLE_MATCHERS
17699 #define CHECK_NOTHROW( ... ) INTERNAL_CATCH_NO_THROW( "CHECK_NOTHROW",
      Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
17700
17701 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
17702 #define CHECK_THAT( arg, matcher ) INTERNAL_CHECK_THAT( "CHECK_THAT", matcher,
      Catch::ResultDisposition::ContinueOnFailure, arg )
17703
17704 #define REQUIRE_THAT( arg, matcher ) INTERNAL_CHECK_THAT( "REQUIRE_THAT", matcher,
      Catch::ResultDisposition::Normal, arg )
17705 #endif // CATCH_CONFIG_DISABLE_MATCHERS
17706
17707 #define INFO( msg ) INTERNAL_CATCH_INFO( "INFO", msg )
17708 #define UNSCOPED_INFO( msg ) INTERNAL_CATCH_UNSCOPED_INFO( "UNSCOPED_INFO", msg )
17709 #define WARN( msg ) INTERNAL_CATCH_MSG( "WARN", Catch::ResultWas::Warning,
      Catch::ResultDisposition::ContinueOnFailure, msg )
17710 #define CAPTURE( ... ) INTERNAL_CATCH_CAPTURE( INTERNAL_CATCH_UNIQUE_NAME(capturer),
      "CAPTURE",__VA_ARGS__ )
17711
17712 #define TEST_CASE( ... ) INTERNAL_CATCH_TESTCASE( __VA_ARGS__ )
17713 #define TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_TEST_CASE_METHOD( className, __VA_ARGS__ )
17714 #define METHOD_AS_TEST_CASE( method, ... ) INTERNAL_CATCH_METHOD_AS_TEST_CASE( method, __VA_ARGS__ )
17715 #define REGISTER_TEST_CASE( Function, ... ) INTERNAL_CATCH_REGISTER_TESTCASE( Function, __VA_ARGS__ )
17716 #define SECTION( ... ) INTERNAL_CATCH_SECTION( __VA_ARGS__ )
17717 #define DYNAMIC_SECTION( ... ) INTERNAL_CATCH_DYNAMIC_SECTION( __VA_ARGS__ )
17718 #define FAIL( ... ) INTERNAL_CATCH_MSG( "FAIL", Catch::ResultWas::ExplicitFailure,
      Catch::ResultDisposition::Normal, __VA_ARGS__ )
17719 #define FAIL_CHECK( ... ) INTERNAL_CATCH_MSG( "FAIL_CHECK", Catch::ResultWas::ExplicitFailure,
      Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
17720 #define SUCCEED( ... ) INTERNAL_CATCH_MSG( "SUCCEED", Catch::ResultWas::Ok,
      Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
17721 #define ANON_TEST_CASE() INTERNAL_CATCH_TESTCASE()
17722
17723 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
17724 #define TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ )
17725 #define TEMPLATE_TEST_CASE_SIG( ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG( __VA_ARGS__ )
17726 #define TEMPLATE_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD(
      className, __VA_ARGS__ )
17727 #define TEMPLATE_TEST_CASE_METHOD_SIG( className, ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG(
      className, __VA_ARGS__ )
```

```
17728 #define TEMPLATE_PRODUCT_TEST_CASE( ... ) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE( __VA_ARGS__ )
17729 #define TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG(
      __VA_ARGS__ )
17730 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... )
      INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, __VA_ARGS__ )
17731 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... )
      INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ )
17732 #define TEMPLATE_LIST_TEST_CASE( ... ) INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE(__VA_ARGS__)
17733 #define TEMPLATE_LIST_TEST_CASE_METHOD( className, ... )
      INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD( className, __VA_ARGS__ )
17734 #else
17735 #define TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE(
      __VA_ARGS__ ) )
17736 #define TEMPLATE_TEST_CASE_SIG( ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG( __VA_ARGS__ ) )
17737 #define TEMPLATE_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD( className, __VA_ARGS__ ) )
17738 #define TEMPLATE_TEST_CASE_METHOD_SIG( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ ) )
17739 #define TEMPLATE_PRODUCT_TEST_CASE( ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE( __VA_ARGS__ ) )
17740 #define TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG( __VA_ARGS__ ) )
17741 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, __VA_ARGS__ ) )
17742 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ ) )
17743 #define TEMPLATE_LIST_TEST_CASE( ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE( __VA_ARGS__ ) )
17744 #define TEMPLATE_LIST_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD( className, __VA_ARGS__ ) )
17745 #endif
17746
17747 #if !defined(CATCH_CONFIG_RUNTIME_STATIC_REQUIRE)
17748 #define STATIC_REQUIRE( ... )       static_assert(   __VA_ARGS__,  #__VA_ARGS__ ); SUCCEED(
      #__VA_ARGS__ )
17749 #define STATIC_REQUIRE_FALSE( ... ) static_assert( !(__VA_ARGS__), "!(" #__VA_ARGS__ ")" ); SUCCEED(
      "!(" #__VA_ARGS__ ")" )
17750 #else
17751 #define STATIC_REQUIRE( ... )       REQUIRE( __VA_ARGS__ )
17752 #define STATIC_REQUIRE_FALSE( ... ) REQUIRE_FALSE( __VA_ARGS__ )
17753 #endif
17754
17755 #endif
17756
17757 #define CATCH_TRANSLATE_EXCEPTION( signature ) INTERNAL_CATCH_TRANSLATE_EXCEPTION( signature )
17758
17759 // "BDD-style" convenience wrappers
17760 #define SCENARIO( ... ) TEST_CASE( "Scenario: " __VA_ARGS__ )
17761 #define SCENARIO_METHOD( className, ... ) INTERNAL_CATCH_TEST_CASE_METHOD( className, "Scenario: "
      __VA_ARGS__ )
17762
17763 #define GIVEN( desc )     INTERNAL_CATCH_DYNAMIC_SECTION( "    Given: " << desc )
17764 #define AND_GIVEN( desc ) INTERNAL_CATCH_DYNAMIC_SECTION( "And given: " << desc )
17765 #define WHEN( desc )      INTERNAL_CATCH_DYNAMIC_SECTION( "     When: " << desc )
17766 #define AND_WHEN( desc )  INTERNAL_CATCH_DYNAMIC_SECTION( " And when: " << desc )
17767 #define THEN( desc )      INTERNAL_CATCH_DYNAMIC_SECTION( "     Then: " << desc )
17768 #define AND_THEN( desc )  INTERNAL_CATCH_DYNAMIC_SECTION( "      And: " << desc )
17769
17770 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
17771 #define BENCHMARK(...) \
17772     INTERNAL_CATCH_BENCHMARK(INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_B_E_N_C_H_), 
      INTERNAL_CATCH_GET_1_ARG(__VA_ARGS__,), INTERNAL_CATCH_GET_2_ARG(__VA_ARGS__,))
17773 #define BENCHMARK_ADVANCED(name) \
17774     INTERNAL_CATCH_BENCHMARK_ADVANCED(INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_B_E_N_C_H_), name)
17775 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
17776
17777 using Catch::Detail::Approx;
17778
17779 #else // CATCH_CONFIG_DISABLE
17780
17782 // If this config identifier is defined then all CATCH macros are prefixed with CATCH_
17783 #ifdef CATCH_CONFIG_PREFIX_ALL
17784
17785 #define CATCH_REQUIRE( ... )        (void)(0)
17786 #define CATCH_REQUIRE_FALSE( ... )  (void)(0)
17787
17788 #define CATCH_REQUIRE_THROWS( ... ) (void)(0)
17789 #define CATCH_REQUIRE_THROWS_AS( expr, exceptionType ) (void)(0)
17790 #define CATCH_REQUIRE_THROWS_WITH( expr, matcher )     (void)(0)
17791 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
17792 #define CATCH_REQUIRE_THROWS_MATCHES( expr, exceptionType, matcher ) (void)(0)
17793 #endif// CATCH_CONFIG_DISABLE_MATCHERS
17794 #define CATCH_REQUIRE_NOTHROW( ... ) (void)(0)
17795
17796 #define CATCH_CHECK( ... )          (void)(0)
17797 #define CATCH_CHECK_FALSE( ... )    (void)(0)
```

```
17798 #define CATCH_CHECKED_IF( ... )    if (__VA_ARGS__)
17799 #define CATCH_CHECKED_ELSE( ... )  if (!(__VA_ARGS__))
17800 #define CATCH_CHECK_NOFAIL( ... )  (void)(0)
17801
17802 #define CATCH_CHECK_THROWS( ... )  (void)(0)
17803 #define CATCH_CHECK_THROWS_AS( expr, exceptionType ) (void)(0)
17804 #define CATCH_CHECK_THROWS_WITH( expr, matcher )     (void)(0)
17805 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
17806 #define CATCH_CHECK_THROWS_MATCHES( expr, exceptionType, matcher ) (void)(0)
17807 #endif // CATCH_CONFIG_DISABLE_MATCHERS
17808 #define CATCH_CHECK_NOTHROW( ... ) (void)(0)
17809
17810 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
17811 #define CATCH_CHECK_THAT( arg, matcher )   (void)(0)
17812
17813 #define CATCH_REQUIRE_THAT( arg, matcher ) (void)(0)
17814 #endif // CATCH_CONFIG_DISABLE_MATCHERS
17815
17816 #define CATCH_INFO( msg )          (void)(0)
17817 #define CATCH_UNSCOPED_INFO( msg ) (void)(0)
17818 #define CATCH_WARN( msg )          (void)(0)
17819 #define CATCH_CAPTURE( msg )       (void)(0)
17820
17821 #define CATCH_TEST_CASE( ... ) INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_S_T_ ))
17822 #define CATCH_TEST_CASE_METHOD( className, ... )
      INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_S_T_ ))
17823 #define CATCH_METHOD_AS_TEST_CASE( method, ... )
17824 #define CATCH_REGISTER_TEST_CASE( Function, ... ) (void)(0)
17825 #define CATCH_SECTION( ... )
17826 #define CATCH_DYNAMIC_SECTION( ... )
17827 #define CATCH_FAIL( ... ) (void)(0)
17828 #define CATCH_FAIL_CHECK( ... ) (void)(0)
17829 #define CATCH_SUCCEED( ... ) (void)(0)
17830
17831 #define CATCH_ANON_TEST_CASE() INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_S_T_ ))
17832
17833 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
17834 #define CATCH_TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION(__VA_ARGS__)
17835 #define CATCH_TEMPLATE_TEST_CASE_SIG( ... )
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG_NO_REGISTRATION(__VA_ARGS__)
17836 #define CATCH_TEMPLATE_TEST_CASE_METHOD( className, ... )
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION(className, __VA_ARGS__)
17837 #define CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, ... )
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG_NO_REGISTRATION(className, __VA_ARGS__ )
17838 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE( ... ) CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ )
17839 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ )
17840 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... ) CATCH_TEMPLATE_TEST_CASE_METHOD(
      className, __VA_ARGS__ )
17841 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... ) CATCH_TEMPLATE_TEST_CASE_METHOD(
      className, __VA_ARGS__ )
17842 #else
17843 #define CATCH_TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION(__VA_ARGS__) )
17844 #define CATCH_TEMPLATE_TEST_CASE_SIG( ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG_NO_REGISTRATION(__VA_ARGS__) )
17845 #define CATCH_TEMPLATE_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION(className, __VA_ARGS__ ) )
17846 #define CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG_NO_REGISTRATION(className, __VA_ARGS__ ) )
17847 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE( ... ) CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ )
17848 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ )
17849 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... ) CATCH_TEMPLATE_TEST_CASE_METHOD(
      className, __VA_ARGS__ )
17850 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... ) CATCH_TEMPLATE_TEST_CASE_METHOD(
      className, __VA_ARGS__ )
17851 #endif
17852
17853 // "BDD-style" convenience wrappers
17854 #define CATCH_SCENARIO( ... ) INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_S_T_ ))
17855 #define CATCH_SCENARIO_METHOD( className, ... )
      INTERNAL_CATCH_TESTCASE_METHOD_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_S_T_ ),
      className )
17856 #define CATCH_GIVEN( desc )
17857 #define CATCH_AND_GIVEN( desc )
17858 #define CATCH_WHEN( desc )
17859 #define CATCH_AND_WHEN( desc )
17860 #define CATCH_THEN( desc )
17861 #define CATCH_AND_THEN( desc )
17862
17863 #define CATCH_STATIC_REQUIRE( ... )       (void)(0)
17864 #define CATCH_STATIC_REQUIRE_FALSE( ... ) (void)(0)
17865
17866 // If CATCH_CONFIG_PREFIX_ALL is not defined then the CATCH_ prefix is not required
17867 #else
```

```
17868
17869 #define REQUIRE( ... )        (void)(0)
17870 #define REQUIRE_FALSE( ... ) (void)(0)
17871
17872 #define REQUIRE_THROWS( ... ) (void)(0)
17873 #define REQUIRE_THROWS_AS( expr, exceptionType ) (void)(0)
17874 #define REQUIRE_THROWS_WITH( expr, matcher ) (void)(0)
17875 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
17876 #define REQUIRE_THROWS_MATCHES( expr, exceptionType, matcher ) (void)(0)
17877 #endif // CATCH_CONFIG_DISABLE_MATCHERS
17878 #define REQUIRE_NOTHROW( ... ) (void)(0)
17879
17880 #define CHECK( ... ) (void)(0)
17881 #define CHECK_FALSE( ... ) (void)(0)
17882 #define CHECKED_IF( ... ) if (__VA_ARGS__)
17883 #define CHECKED_ELSE( ... ) if (!(__VA_ARGS__))
17884 #define CHECK_NOFAIL( ... ) (void)(0)
17885
17886 #define CHECK_THROWS( ... )  (void)(0)
17887 #define CHECK_THROWS_AS( expr, exceptionType ) (void)(0)
17888 #define CHECK_THROWS_WITH( expr, matcher ) (void)(0)
17889 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
17890 #define CHECK_THROWS_MATCHES( expr, exceptionType, matcher ) (void)(0)
17891 #endif // CATCH_CONFIG_DISABLE_MATCHERS
17892 #define CHECK_NOTHROW( ... ) (void)(0)
17893
17894 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
17895 #define CHECK_THAT( arg, matcher ) (void)(0)
17896
17897 #define REQUIRE_THAT( arg, matcher ) (void)(0)
17898 #endif // CATCH_CONFIG_DISABLE_MATCHERS
17899
17900 #define INFO( msg ) (void)(0)
17901 #define UNSCOPED_INFO( msg ) (void)(0)
17902 #define WARN( msg ) (void)(0)
17903 #define CAPTURE( ... ) (void)(0)
17904
17905 #define TEST_CASE( ... )  INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_S_T_ ))
17906 #define TEST_CASE_METHOD( className, ... )
      INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_S_T_ ))
17907 #define METHOD_AS_TEST_CASE( method, ... )
17908 #define REGISTER_TEST_CASE( Function, ... ) (void)(0)
17909 #define SECTION( ... )
17910 #define DYNAMIC_SECTION( ... )
17911 #define FAIL( ... ) (void)(0)
17912 #define FAIL_CHECK( ... ) (void)(0)
17913 #define SUCCEED( ... ) (void)(0)
17914 #define ANON_TEST_CASE() INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_S_T_ ))
17915
17916 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
17917 #define TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION(__VA_ARGS__)
17918 #define TEMPLATE_TEST_CASE_SIG( ... )
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG_NO_REGISTRATION(__VA_ARGS__)
17919 #define TEMPLATE_TEST_CASE_METHOD( className, ... )
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION(className, __VA_ARGS__)
17920 #define TEMPLATE_TEST_CASE_METHOD_SIG( className, ... )
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG_NO_REGISTRATION(className, __VA_ARGS__ )
17921 #define TEMPLATE_PRODUCT_TEST_CASE( ... ) TEMPLATE_TEST_CASE( __VA_ARGS__ )
17922 #define TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) TEMPLATE_TEST_CASE( __VA_ARGS__ )
17923 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... ) TEMPLATE_TEST_CASE_METHOD( className,
      __VA_ARGS__ )
17924 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... ) TEMPLATE_TEST_CASE_METHOD( className,
      __VA_ARGS__ )
17925 #else
17926 #define TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION(__VA_ARGS__) )
17927 #define TEMPLATE_TEST_CASE_SIG( ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG_NO_REGISTRATION(__VA_ARGS__) )
17928 #define TEMPLATE_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION(className, __VA_ARGS__ ) )
17929 #define TEMPLATE_TEST_CASE_METHOD_SIG( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG_NO_REGISTRATION(className, __VA_ARGS__ ) )
17930 #define TEMPLATE_PRODUCT_TEST_CASE( ... ) TEMPLATE_TEST_CASE( __VA_ARGS__ )
17931 #define TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) TEMPLATE_TEST_CASE( __VA_ARGS__ )
17932 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... ) TEMPLATE_TEST_CASE_METHOD( className,
      __VA_ARGS__ )
17933 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... ) TEMPLATE_TEST_CASE_METHOD( className,
      __VA_ARGS__ )
17934 #endif
17935
17936 #define STATIC_REQUIRE( ... )        (void)(0)
17937 #define STATIC_REQUIRE_FALSE( ... ) (void)(0)
17938
17939 #endif
17940
```

```
17941 #define CATCH_TRANSLATE_EXCEPTION( signature ) INTERNAL_CATCH_TRANSLATE_EXCEPTION_NO_REG(
      INTERNAL_CATCH_UNIQUE_NAME( catch_internal_ExceptionTranslator ), signature )
17942
17943 // "BDD-style" convenience wrappers
17944 #define SCENARIO( ... ) INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_S_T_ ) )
17945 #define SCENARIO_METHOD( className, ... )
      INTERNAL_CATCH_TESTCASE_METHOD_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_S_T_ ),
      className )
17946
17947 #define GIVEN( desc )
17948 #define AND_GIVEN( desc )
17949 #define WHEN( desc )
17950 #define AND_WHEN( desc )
17951 #define THEN( desc )
17952 #define AND_THEN( desc )
17953
17954 using Catch::Detail::Approx;
17955
17956 #endif
17957
17958 #endif // ! CATCH_CONFIG_IMPL_ONLY
17959
17960 // start catch_reenable_warnings.h
17961
17962
17963 #ifdef __clang__
17964 #    ifdef __ICC // icpc defines the __clang__ macro
17965 #        pragma warning(pop)
17966 #    else
17967 #        pragma clang diagnostic pop
17968 #    endif
17969 #elif defined __GNUC__
17970 #    pragma GCC diagnostic pop
17971 #endif
17972
17973 // end catch_reenable_warnings.h
17974 // end catch.hpp
17975 #endif // TWOBLUECUBES_SINGLE_INCLUDE_CATCH_HPP_INCLUDED
17976 /*
17977  *  Catch v2.13.10
17978  *  Generated: 2022-10-16 11:01:23.452308
17979  *  ----------------------------------------------------------
17980  *  This file has been merged from multiple headers. Please don't edit it directly
17981  *  Copyright (c) 2022 Two Blue Cubes Ltd. All rights reserved.
17982  *
17983  *  Distributed under the Boost Software License, Version 1.0. (See accompanying
17984  *  file LICENSE_1_0.txt or copy at http://www.boost.org/LICENSE_1_0.txt)
17985  */
17986 #ifndef TWOBLUECUBES_SINGLE_INCLUDE_CATCH_HPP_INCLUDED
17987 #define TWOBLUECUBES_SINGLE_INCLUDE_CATCH_HPP_INCLUDED
17988 // start catch.hpp
17989
17990
17991 #define CATCH_VERSION_MAJOR 2
17992 #define CATCH_VERSION_MINOR 13
17993 #define CATCH_VERSION_PATCH 10
17994
17995 #ifdef __clang__
17996 #    pragma clang system_header
17997 #elif defined __GNUC__
17998 #    pragma GCC system_header
17999 #endif
18000
18001 // start catch_suppress_warnings.h
18002
18003 #ifdef __clang__
18004 #   ifdef __ICC // icpc defines the __clang__ macro
18005 #       pragma warning(push)
18006 #       pragma warning(disable: 161 1682)
18007 #   else // __ICC
18008 #       pragma clang diagnostic push
18009 #       pragma clang diagnostic ignored "-Wpadded"
18010 #       pragma clang diagnostic ignored "-Wswitch-enum"
18011 #       pragma clang diagnostic ignored "-Wcovered-switch-default"
18012 #    endif
18013 #elif defined __GNUC__
18014      // Because REQUIREs trigger GCC's -Wparentheses, and because still
18015      // supported version of g++ have only buggy support for _Pragmas,
18016      // Wparentheses have to be suppressed globally.
18017 #    pragma GCC diagnostic ignored "-Wparentheses" // See #674 for details
18018
18019 #    pragma GCC diagnostic push
18020 #    pragma GCC diagnostic ignored "-Wunused-variable"
18021 #    pragma GCC diagnostic ignored "-Wpadded"
18022 #endif
18023 // end catch_suppress_warnings.h
```

```
18024 #if defined(CATCH_CONFIG_MAIN) || defined(CATCH_CONFIG_RUNNER)
18025 #  define CATCH_IMPL
18026 #  define CATCH_CONFIG_ALL_PARTS
18027 #endif
18028
18029 // In the impl file, we want to have access to all parts of the headers
18030 // Can also be used to sanely support PCHs
18031 #if defined(CATCH_CONFIG_ALL_PARTS)
18032 #  define CATCH_CONFIG_EXTERNAL_INTERFACES
18033 #  if defined(CATCH_CONFIG_DISABLE_MATCHERS)
18034 #    undef CATCH_CONFIG_DISABLE_MATCHERS
18035 #  endif
18036 #  if !defined(CATCH_CONFIG_ENABLE_CHRONO_STRINGMAKER)
18037 #    define CATCH_CONFIG_ENABLE_CHRONO_STRINGMAKER
18038 #  endif
18039 #endif
18040
18041 #if !defined(CATCH_CONFIG_IMPL_ONLY)
18042 // start catch_platform.h
18043
18044 // See e.g.:
18045 // https://opensource.apple.com/source/CarbonHeaders/CarbonHeaders-18.1/TargetConditionals.h.auto.html
18046 #ifdef __APPLE__
18047 #  include <TargetConditionals.h>
18048 #  if (defined(TARGET_OS_OSX) && TARGET_OS_OSX == 1) || \
18049       (defined(TARGET_OS_MAC) && TARGET_OS_MAC == 1)
18050 #    define CATCH_PLATFORM_MAC
18051 #  elif (defined(TARGET_OS_IPHONE) && TARGET_OS_IPHONE == 1)
18052 #    define CATCH_PLATFORM_IPHONE
18053 #  endif
18054
18055 #elif defined(linux) || defined(__linux) || defined(__linux__)
18056 #  define CATCH_PLATFORM_LINUX
18057
18058 #elif defined(WIN32) || defined(__WIN32__) || defined(_WIN32) || defined(_MSC_VER) ||
     defined(__MINGW32__)
18059 #  define CATCH_PLATFORM_WINDOWS
18060 #endif
18061
18062 // end catch_platform.h
18063
18064 #ifdef CATCH_IMPL
18065 #  ifndef CLARA_CONFIG_MAIN
18066 #    define CLARA_CONFIG_MAIN_NOT_DEFINED
18067 #    define CLARA_CONFIG_MAIN
18068 #  endif
18069 #endif
18070
18071 // start catch_user_interfaces.h
18072
18073 namespace Catch {
18074     unsigned int rngSeed();
18075 }
18076
18077 // end catch_user_interfaces.h
18078 // start catch_tag_alias_autoregistrar.h
18079
18080 // start catch_common.h
18081
18082 // start catch_compiler_capabilities.h
18083
18084 // Detect a number of compiler features - by compiler
18085 // The following features are defined:
18086 //
18087 // CATCH_CONFIG_COUNTER : is the __COUNTER__ macro supported?
18088 // CATCH_CONFIG_WINDOWS_SEH : is Windows SEH supported?
18089 // CATCH_CONFIG_POSIX_SIGNALS : are POSIX signals supported?
18090 // CATCH_CONFIG_DISABLE_EXCEPTIONS : Are exceptions enabled?
18091 // ****************
18092 // Note to maintainers: if new toggles are added please document them
18093 // in configuration.md, too
18094 // ****************
18095
18096 // In general each macro has a _NO_<feature name> form
18097 // (e.g. CATCH_CONFIG_NO_POSIX_SIGNALS) which disables the feature.
18098 // Many features, at point of detection, define an _INTERNAL_ macro, so they
18099 // can be combined, en-mass, with the _NO_ forms later.
18100
18101 #ifdef __cplusplus
18102
18103 #  if (__cplusplus >= 201402L) || (defined(_MSVC_LANG) && _MSVC_LANG >= 201402L)
18104 #    define CATCH_CPP14_OR_GREATER
18105 #  endif
18106
18107 #  if (__cplusplus >= 201703L) || (defined(_MSVC_LANG) && _MSVC_LANG >= 201703L)
18108 #    define CATCH_CPP17_OR_GREATER
18109 #  endif
```

```
18110
18111 #endif
18112
18113 // Only GCC compiler should be used in this block, so other compilers trying to
18114 // mask themselves as GCC should be ignored.
18115 #if defined(__GNUC__) && !defined(__clang__) && !defined(__ICC) && !defined(__CUDACC__) &&
      !defined(__LCC__)
18116 #    define CATCH_INTERNAL_START_WARNINGS_SUPPRESSION _Pragma( "GCC diagnostic push" )
18117 #    define CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION  _Pragma( "GCC diagnostic pop" )
18118
18119 #    define CATCH_INTERNAL_IGNORE_BUT_WARN(...) (void)__builtin_constant_p(__VA_ARGS__)
18120
18121 #endif
18122
18123 #if defined(__clang__)
18124
18125 #    define CATCH_INTERNAL_START_WARNINGS_SUPPRESSION _Pragma( "clang diagnostic push" )
18126 #    define CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION  _Pragma( "clang diagnostic pop" )
18127
18128 // As of this writing, IBM XL's implementation of __builtin_constant_p has a bug
18129 // which results in calls to destructors being emitted for each temporary,
18130 // without a matching initialization. In practice, this can result in something
18131 // like `std::string::~string` being called on an uninitialized value.
18132 //
18133 // For example, this code will likely segfault under IBM XL:
18134 // ```
18135 // REQUIRE(std::string("12") + "34" == "1234")
18136 // ```
18137 //
18138 // Therefore, `CATCH_INTERNAL_IGNORE_BUT_WARN` is not implemented.
18139 #  if !defined(__ibmxl__) && !defined(__CUDACC__)
18140 #    define CATCH_INTERNAL_IGNORE_BUT_WARN(...) (void)__builtin_constant_p(__VA_ARGS__) /*
      NOLINT(cppcoreguidelines-pro-type-vararg, hicpp-vararg) */
18141 #  endif
18142
18143 #    define CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
18144         _Pragma( "clang diagnostic ignored \"-Wexit-time-destructors\"" ) \
18145         _Pragma( "clang diagnostic ignored \"-Wglobal-constructors\"")
18146
18147 #    define CATCH_INTERNAL_SUPPRESS_PARENTHESES_WARNINGS \
18148         _Pragma( "clang diagnostic ignored \"-Wparentheses\"" )
18149
18150 #    define CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS \
18151         _Pragma( "clang diagnostic ignored \"-Wunused-variable\"" )
18152
18153 #    define CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS \
18154         _Pragma( "clang diagnostic ignored \"-Wgnu-zero-variadic-macro-arguments\"" )
18155
18156 #    define CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
18157         _Pragma( "clang diagnostic ignored \"-Wunused-template\"" )
18158
18159 #endif // __clang__
18160
18162 // Assume that non-Windows platforms support posix signals by default
18163 #if !defined(CATCH_PLATFORM_WINDOWS)
18164     #define CATCH_INTERNAL_CONFIG_POSIX_SIGNALS
18165 #endif
18166
18168 // We know some environments not to support full POSIX signals
18169 #if defined(__CYGWIN__) || defined(__QNX__) || defined(__EMSCRIPTEN__) || defined(__DJGPP__)
18170     #define CATCH_INTERNAL_CONFIG_NO_POSIX_SIGNALS
18171 #endif
18172
18173 #ifdef __OS400__
18174 #       define CATCH_INTERNAL_CONFIG_NO_POSIX_SIGNALS
18175 #       define CATCH_CONFIG_COLOUR_NONE
18176 #endif
18177
18179 // Android somehow still does not support std::to_string
18180 #if defined(__ANDROID__)
18181 #    define CATCH_INTERNAL_CONFIG_NO_CPP11_TO_STRING
18182 #    define CATCH_INTERNAL_CONFIG_ANDROID_LOGWRITE
18183 #endif
18184
18186 // Not all Windows environments support SEH properly
18187 #if defined(__MINGW32__)
18188 #    define CATCH_INTERNAL_CONFIG_NO_WINDOWS_SEH
18189 #endif
18190
18192 // PS4
18193 #if defined(__ORBIS__)
18194 #    define CATCH_INTERNAL_CONFIG_NO_NEW_CAPTURE
18195 #endif
18196
18198 // Cygwin
18199 #ifdef __CYGWIN__
18200
```

```
18201 // Required for some versions of Cygwin to declare gettimeofday
18202 // see: http://stackoverflow.com/questions/36901803/gettimeofday-not-declared-in-this-scope-cygwin
18203 #   define _BSD_SOURCE
18204 // some versions of cygwin (most) do not support std::to_string. Use the libstd check.
18205 // https://gcc.gnu.org/onlinedocs/gcc-4.8.2/libstdc++/api/a01053_source.html line 2812-2813
18206 # if !((__cplusplus >= 201103L) && defined(_GLIBCXX_USE_C99) \
18207            && !defined(_GLIBCXX_HAVE_BROKEN_VSWPRINTF))
18208
18209 #    define CATCH_INTERNAL_CONFIG_NO_CPP11_TO_STRING
18210
18211 # endif
18212 #endif // __CYGWIN__
18213
18215 // Visual C++
18216 #if defined(_MSC_VER)
18217
18218 // Universal Windows platform does not support SEH
18219 // Or console colours (or console at all...)
18220 #  if defined(WINAPI_FAMILY) && (WINAPI_FAMILY == WINAPI_FAMILY_APP)
18221 #    define CATCH_CONFIG_COLOUR_NONE
18222 #  else
18223 #    define CATCH_INTERNAL_CONFIG_WINDOWS_SEH
18224 #  endif
18225
18226 #  if !defined(__clang__) // Handle Clang masquerading for msvc
18227
18228 // MSVC traditional preprocessor needs some workaround for __VA_ARGS__
18229 // _MSVC_TRADITIONAL == 0 means new conformant preprocessor
18230 // _MSVC_TRADITIONAL == 1 means old traditional non-conformant preprocessor
18231 #    if !defined(_MSVC_TRADITIONAL) || (defined(_MSVC_TRADITIONAL) && _MSVC_TRADITIONAL)
18232 #      define CATCH_INTERNAL_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
18233 #    endif // MSVC_TRADITIONAL
18234
18235 // Only do this if we're not using clang on Windows, which uses `diagnostic push` & `diagnostic pop`
18236 #    define CATCH_INTERNAL_START_WARNINGS_SUPPRESSION __pragma( warning(push) )
18237 #    define CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION  __pragma( warning(pop) )
18238 #  endif // __clang__
18239
18240 #endif // _MSC_VER
18241
18242 #if defined(_REENTRANT) || defined(_MSC_VER)
18243 // Enable async processing, as -pthread is specified or no additional linking is required
18244 # define CATCH_INTERNAL_CONFIG_USE_ASYNC
18245 #endif // _MSC_VER
18246
18248 // Check if we are compiled with -fno-exceptions or equivalent
18249 #if defined(__EXCEPTIONS) || defined(__cpp_exceptions) || defined(_CPPUNWIND)
18250 #  define CATCH_INTERNAL_CONFIG_EXCEPTIONS_ENABLED
18251 #endif
18252
18254 // DJGPP
18255 #ifdef __DJGPP__
18256 #  define CATCH_INTERNAL_CONFIG_NO_WCHAR
18257 #endif // __DJGPP__
18258
18260 // Embarcadero C++Build
18261 #if defined(__BORLANDC__)
18262     #define CATCH_INTERNAL_CONFIG_POLYFILL_ISNAN
18263 #endif
18264
18266
18267 // Use of __COUNTER__ is suppressed during code analysis in
18268 // CLion/AppCode 2017.2.x and former, because __COUNTER__ is not properly
18269 // handled by it.
18270 // Otherwise all supported compilers support COUNTER macro,
18271 // but user still might want to turn it off
18272 #if ( !defined(__JETBRAINS_IDE__) || __JETBRAINS_IDE__ >= 20170300L )
18273     #define CATCH_INTERNAL_CONFIG_COUNTER
18274 #endif
18275
18277
18278 // RTX is a special version of Windows that is real time.
18279 // This means that it is detected as Windows, but does not provide
18280 // the same set of capabilities as real Windows does.
18281 #if defined(UNDER_RTSS) || defined(RTX64_BUILD)
18282     #define CATCH_INTERNAL_CONFIG_NO_WINDOWS_SEH
18283     #define CATCH_INTERNAL_CONFIG_NO_ASYNC
18284     #define CATCH_CONFIG_COLOUR_NONE
18285 #endif
18286
18287 #if !defined(_GLIBCXX_USE_C99_MATH_TR1)
18288 #define CATCH_INTERNAL_CONFIG_GLOBAL_NEXTAFTER
18289 #endif
18290
18291 // Various stdlib support checks that require __has_include
18292 #if defined(__has_include)
18293   // Check if string_view is available and usable
```

```
18294   #if __has_include(<string_view>) && defined(CATCH_CPP17_OR_GREATER)
18295   #    define CATCH_INTERNAL_CONFIG_CPP17_STRING_VIEW
18296   #endif
18297
18298   // Check if optional is available and usable
18299   #  if __has_include(<optional>) && defined(CATCH_CPP17_OR_GREATER)
18300   #    define CATCH_INTERNAL_CONFIG_CPP17_OPTIONAL
18301   #  endif // __has_include(<optional>) && defined(CATCH_CPP17_OR_GREATER)
18302
18303   // Check if byte is available and usable
18304   #  if __has_include(<cstddef>) && defined(CATCH_CPP17_OR_GREATER)
18305   #    include <cstddef>
18306   #    if defined(__cpp_lib_byte) && (__cpp_lib_byte > 0)
18307   #      define CATCH_INTERNAL_CONFIG_CPP17_BYTE
18308   #    endif
18309   #  endif // __has_include(<cstddef>) && defined(CATCH_CPP17_OR_GREATER)
18310
18311   // Check if variant is available and usable
18312   #  if __has_include(<variant>) && defined(CATCH_CPP17_OR_GREATER)
18313   #    if defined(__clang__) && (__clang_major__ < 8)
18314           // work around clang bug with libstdc++ https://bugs.llvm.org/show_bug.cgi?id=31852
18315           // fix should be in clang 8, workaround in libstdc++ 8.2
18316   #      include <ciso646>
18317   #      if defined(__GLIBCXX__) && defined(_GLIBCXX_RELEASE) && (_GLIBCXX_RELEASE < 9)
18318   #        define CATCH_CONFIG_NO_CPP17_VARIANT
18319   #      else
18320   #        define CATCH_INTERNAL_CONFIG_CPP17_VARIANT
18321   #      endif // defined(__GLIBCXX__) && defined(_GLIBCXX_RELEASE) && (_GLIBCXX_RELEASE < 9)
18322   #    else
18323   #      define CATCH_INTERNAL_CONFIG_CPP17_VARIANT
18324   #    endif // defined(__clang__) && (__clang_major__ < 8)
18325   #  endif // __has_include(<variant>) && defined(CATCH_CPP17_OR_GREATER)
18326 #endif // defined(__has_include)
18327
18328 #if defined(CATCH_INTERNAL_CONFIG_COUNTER) && !defined(CATCH_CONFIG_NO_COUNTER) &&
      !defined(CATCH_CONFIG_COUNTER)
18329 #   define CATCH_CONFIG_COUNTER
18330 #endif
18331 #if defined(CATCH_INTERNAL_CONFIG_WINDOWS_SEH) && !defined(CATCH_CONFIG_NO_WINDOWS_SEH) &&
      !defined(CATCH_CONFIG_WINDOWS_SEH) && !defined(CATCH_INTERNAL_CONFIG_NO_WINDOWS_SEH)
18332 #   define CATCH_CONFIG_WINDOWS_SEH
18333 #endif
18334 // This is set by default, because we assume that unix compilers are posix-signal-compatible by
      default.
18335 #if defined(CATCH_INTERNAL_CONFIG_POSIX_SIGNALS) && !defined(CATCH_INTERNAL_CONFIG_NO_POSIX_SIGNALS)
      && !defined(CATCH_CONFIG_NO_POSIX_SIGNALS) && !defined(CATCH_CONFIG_POSIX_SIGNALS)
18336 #   define CATCH_CONFIG_POSIX_SIGNALS
18337 #endif
18338 // This is set by default, because we assume that compilers with no wchar_t support are just rare
      exceptions.
18339 #if !defined(CATCH_INTERNAL_CONFIG_NO_WCHAR) && !defined(CATCH_CONFIG_NO_WCHAR) &&
      !defined(CATCH_CONFIG_WCHAR)
18340 #   define CATCH_CONFIG_WCHAR
18341 #endif
18342
18343 #if !defined(CATCH_INTERNAL_CONFIG_NO_CPP11_TO_STRING) && !defined(CATCH_CONFIG_NO_CPP11_TO_STRING) &&
      !defined(CATCH_CONFIG_CPP11_TO_STRING)
18344 #    define CATCH_CONFIG_CPP11_TO_STRING
18345 #endif
18346
18347 #if defined(CATCH_INTERNAL_CONFIG_CPP17_OPTIONAL) && !defined(CATCH_CONFIG_NO_CPP17_OPTIONAL) &&
      !defined(CATCH_CONFIG_CPP17_OPTIONAL)
18348 #  define CATCH_CONFIG_CPP17_OPTIONAL
18349 #endif
18350
18351 #if defined(CATCH_INTERNAL_CONFIG_CPP17_STRING_VIEW) && !defined(CATCH_CONFIG_NO_CPP17_STRING_VIEW) &&
      !defined(CATCH_CONFIG_CPP17_STRING_VIEW)
18352 #  define CATCH_CONFIG_CPP17_STRING_VIEW
18353 #endif
18354
18355 #if defined(CATCH_INTERNAL_CONFIG_CPP17_VARIANT) && !defined(CATCH_CONFIG_NO_CPP17_VARIANT) &&
      !defined(CATCH_CONFIG_CPP17_VARIANT)
18356 #  define CATCH_CONFIG_CPP17_VARIANT
18357 #endif
18358
18359 #if defined(CATCH_INTERNAL_CONFIG_CPP17_BYTE) && !defined(CATCH_CONFIG_NO_CPP17_BYTE) &&
      !defined(CATCH_CONFIG_CPP17_BYTE)
18360 #  define CATCH_CONFIG_CPP17_BYTE
18361 #endif
18362
18363 #if defined(CATCH_CONFIG_EXPERIMENTAL_REDIRECT)
18364 #  define CATCH_INTERNAL_CONFIG_NEW_CAPTURE
18365 #endif
18366
18367 #if defined(CATCH_INTERNAL_CONFIG_NEW_CAPTURE) && !defined(CATCH_INTERNAL_CONFIG_NO_NEW_CAPTURE) &&
      !defined(CATCH_CONFIG_NO_NEW_CAPTURE) && !defined(CATCH_CONFIG_NEW_CAPTURE)
18368 #  define CATCH_CONFIG_NEW_CAPTURE
```

```
18369 #endif
18370
18371 #if !defined(CATCH_INTERNAL_CONFIG_EXCEPTIONS_ENABLED) && !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
18372 #  define CATCH_CONFIG_DISABLE_EXCEPTIONS
18373 #endif
18374
18375 #if defined(CATCH_INTERNAL_CONFIG_POLYFILL_ISNAN) && !defined(CATCH_CONFIG_NO_POLYFILL_ISNAN) &&
      !defined(CATCH_CONFIG_POLYFILL_ISNAN)
18376 #  define CATCH_CONFIG_POLYFILL_ISNAN
18377 #endif
18378
18379 #if defined(CATCH_INTERNAL_CONFIG_USE_ASYNC)  && !defined(CATCH_INTERNAL_CONFIG_NO_ASYNC) &&
      !defined(CATCH_CONFIG_NO_USE_ASYNC) && !defined(CATCH_CONFIG_USE_ASYNC)
18380 #  define CATCH_CONFIG_USE_ASYNC
18381 #endif
18382
18383 #if defined(CATCH_INTERNAL_CONFIG_ANDROID_LOGWRITE) && !defined(CATCH_CONFIG_NO_ANDROID_LOGWRITE) &&
      !defined(CATCH_CONFIG_ANDROID_LOGWRITE)
18384 #  define CATCH_CONFIG_ANDROID_LOGWRITE
18385 #endif
18386
18387 #if defined(CATCH_INTERNAL_CONFIG_GLOBAL_NEXTAFTER) && !defined(CATCH_CONFIG_NO_GLOBAL_NEXTAFTER) &&
      !defined(CATCH_CONFIG_GLOBAL_NEXTAFTER)
18388 #  define CATCH_CONFIG_GLOBAL_NEXTAFTER
18389 #endif
18390
18391 // Even if we do not think the compiler has that warning, we still have
18392 // to provide a macro that can be used by the code.
18393 #if !defined(CATCH_INTERNAL_START_WARNINGS_SUPPRESSION)
18394 #   define CATCH_INTERNAL_START_WARNINGS_SUPPRESSION
18395 #endif
18396 #if !defined(CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION)
18397 #   define CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
18398 #endif
18399 #if !defined(CATCH_INTERNAL_SUPPRESS_PARENTHESES_WARNINGS)
18400 #   define CATCH_INTERNAL_SUPPRESS_PARENTHESES_WARNINGS
18401 #endif
18402 #if !defined(CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS)
18403 #   define CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS
18404 #endif
18405 #if !defined(CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS)
18406 #   define CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS
18407 #endif
18408 #if !defined(CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS)
18409 #   define CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS
18410 #endif
18411
18412 // The goal of this macro is to avoid evaluation of the arguments, but
18413 // still have the compiler warn on problems inside...
18414 #if !defined(CATCH_INTERNAL_IGNORE_BUT_WARN)
18415 #   define CATCH_INTERNAL_IGNORE_BUT_WARN(...)
18416 #endif
18417
18418 #if defined(__APPLE__) && defined(__apple_build_version__) && (__clang_major__ < 10)
18419 #   undef CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS
18420 #elif defined(__clang__) && (__clang_major__ < 5)
18421 #   undef CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS
18422 #endif
18423
18424 #if !defined(CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS)
18425 #   define CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS
18426 #endif
18427
18428 #if defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
18429 #define CATCH_TRY if ((true))
18430 #define CATCH_CATCH_ALL if ((false))
18431 #define CATCH_CATCH_ANON(type) if ((false))
18432 #else
18433 #define CATCH_TRY try
18434 #define CATCH_CATCH_ALL catch (...)
18435 #define CATCH_CATCH_ANON(type) catch (type)
18436 #endif
18437
18438 #if defined(CATCH_INTERNAL_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR) &&
      !defined(CATCH_CONFIG_NO_TRADITIONAL_MSVC_PREPROCESSOR) &&
      !defined(CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR)
18439 #define CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
18440 #endif
18441
18442 // end catch_compiler_capabilities.h
18443 #define INTERNAL_CATCH_UNIQUE_NAME_LINE2( name, line ) name##line
18444 #define INTERNAL_CATCH_UNIQUE_NAME_LINE( name, line ) INTERNAL_CATCH_UNIQUE_NAME_LINE2( name, line )
18445 #ifdef CATCH_CONFIG_COUNTER
18446 #  define INTERNAL_CATCH_UNIQUE_NAME( name ) INTERNAL_CATCH_UNIQUE_NAME_LINE( name, __COUNTER__ )
18447 #else
18448 #  define INTERNAL_CATCH_UNIQUE_NAME( name ) INTERNAL_CATCH_UNIQUE_NAME_LINE( name, __LINE__ )
18449 #endif
```

```
18450
18451 #include <iosfwd>
18452 #include <string>
18453 #include <cstdint>
18454
18455 // We need a dummy global operator« so we can bring it into Catch namespace later
18456 struct Catch_global_namespace_dummy {};
18457 std::ostream& operator«(std::ostream&, Catch_global_namespace_dummy);
18458
18459 namespace Catch {
18460
18461     struct CaseSensitive { enum Choice {
18462         Yes,
18463         No
18464     }; };
18465
18466     class NonCopyable {
18467         NonCopyable( NonCopyable const& )              = delete;
18468         NonCopyable( NonCopyable && )                  = delete;
18469         NonCopyable& operator = ( NonCopyable const& ) = delete;
18470         NonCopyable& operator = ( NonCopyable && )     = delete;
18471
18472     protected:
18473         NonCopyable();
18474         virtual ~NonCopyable();
18475     };
18476
18477     struct SourceLineInfo {
18478
18479         SourceLineInfo() = delete;
18480         SourceLineInfo( char const* _file, std::size_t _line ) noexcept
18481         :   file( _file ),
18482             line( _line )
18483         {}
18484
18485         SourceLineInfo( SourceLineInfo const& other )            = default;
18486         SourceLineInfo& operator = ( SourceLineInfo const& )     = default;
18487         SourceLineInfo( SourceLineInfo&& )              noexcept = default;
18488         SourceLineInfo& operator = ( SourceLineInfo&& ) noexcept = default;
18489
18490         bool empty() const noexcept { return file[0] == '\0'; }
18491         bool operator == ( SourceLineInfo const& other ) const noexcept;
18492         bool operator < ( SourceLineInfo const& other ) const noexcept;
18493
18494         char const* file;
18495         std::size_t line;
18496     };
18497
18498     std::ostream& operator « ( std::ostream& os, SourceLineInfo const& info );
18499
18500     // Bring in operator« from global namespace into Catch namespace
18501     // This is necessary because the overload of operator« above makes
18502     // lookup stop at namespace Catch
18503     using ::operator«;
18504
18505     // Use this in variadic streaming macros to allow
18506     //    » +StreamEndStop
18507     // as well as
18508     //    » stuff +StreamEndStop
18509     struct StreamEndStop {
18510         std::string operator+() const;
18511     };
18512     template<typename T>
18513     T const& operator + ( T const& value, StreamEndStop ) {
18514         return value;
18515     }
18516 }
18517
18518 #define CATCH_INTERNAL_LINEINFO \
18519     ::Catch::SourceLineInfo( __FILE__, static_cast<std::size_t>( __LINE__ ) )
18520
18521 // end catch_common.h
18522 namespace Catch {
18523
18524     struct RegistrarForTagAliases {
18525         RegistrarForTagAliases( char const* alias, char const* tag, SourceLineInfo const& lineInfo );
18526     };
18527
18528 } // end namespace Catch
18529
18530 #define CATCH_REGISTER_TAG_ALIAS( alias, spec ) \
18531     CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
18532     CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
18533     namespace{ Catch::RegistrarForTagAliases INTERNAL_CATCH_UNIQUE_NAME( AutoRegisterTagAlias )(
      alias, spec, CATCH_INTERNAL_LINEINFO ); } \
18534     CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
18535
```

```
18536 // end catch_tag_alias_autoregistrar.h
18537 // start catch_test_registry.h
18538
18539 // start catch_interfaces_testcase.h
18540
18541 #include <vector>
18542
18543 namespace Catch {
18544
18545     class TestSpec;
18546
18547     struct ITestInvoker {
18548         virtual void invoke () const = 0;
18549         virtual ~ITestInvoker();
18550     };
18551
18552     class TestCase;
18553     struct IConfig;
18554
18555     struct ITestCaseRegistry {
18556         virtual ~ITestCaseRegistry();
18557         virtual std::vector<TestCase> const& getAllTests() const = 0;
18558         virtual std::vector<TestCase> const& getAllTestsSorted( IConfig const& config ) const = 0;
18559     };
18560
18561     bool isThrowSafe( TestCase const& testCase, IConfig const& config );
18562     bool matchTest( TestCase const& testCase, TestSpec const& testSpec, IConfig const& config );
18563     std::vector<TestCase> filterTests( std::vector<TestCase> const& testCases, TestSpec const&
      testSpec, IConfig const& config );
18564     std::vector<TestCase> const& getAllTestCasesSorted( IConfig const& config );
18565
18566 }
18567
18568 // end catch_interfaces_testcase.h
18569 // start catch_stringref.h
18570
18571 #include <cstddef>
18572 #include <string>
18573 #include <iosfwd>
18574 #include <cassert>
18575
18576 namespace Catch {
18577
18581     class StringRef {
18582     public:
18583         using size_type = std::size_t;
18584         using const_iterator = const char*;
18585
18586     private:
18587         static constexpr char const* const s_empty = "";
18588
18589         char const* m_start = s_empty;
18590         size_type m_size = 0;
18591
18592     public: // construction
18593         constexpr StringRef() noexcept = default;
18594
18595         StringRef( char const* rawChars ) noexcept;
18596
18597         constexpr StringRef( char const* rawChars, size_type size ) noexcept
18598         :   m_start( rawChars ),
18599             m_size( size )
18600         {}
18601
18602         StringRef( std::string const& stdString ) noexcept
18603         :   m_start( stdString.c_str() ),
18604             m_size( stdString.size() )
18605         {}
18606
18607         explicit operator std::string() const {
18608             return std::string(m_start, m_size);
18609         }
18610
18611     public: // operators
18612         auto operator == ( StringRef const& other ) const noexcept -> bool;
18613         auto operator != (StringRef const& other) const noexcept -> bool {
18614             return !(*this == other);
18615         }
18616
18617         auto operator[] ( size_type index ) const noexcept -> char {
18618             assert(index < m_size);
18619             return m_start[index];
18620         }
18621
18622     public: // named queries
18623         constexpr auto empty() const noexcept -> bool {
18624             return m_size == 0;
```

```
18625         }
18626         constexpr auto size() const noexcept -> size_type {
18627             return m_size;
18628         }
18629
18630         // Returns the current start pointer. If the StringRef is not
18631         // null-terminated, throws std::domain_exception
18632         auto c_str() const -> char const*;
18633
18634     public: // substrings and searches
18635         // Returns a substring of [start, start + length).
18636         // If start + length > size(), then the substring is [start, size()).
18637         // If start > size(), then the substring is empty.
18638         auto substr( size_type start, size_type length ) const noexcept -> StringRef;
18639
18640         // Returns the current start pointer. May not be null-terminated.
18641         auto data() const noexcept -> char const*;
18642
18643         constexpr auto isNullTerminated() const noexcept -> bool {
18644             return m_start[m_size] == '\0';
18645         }
18646
18647     public: // iterators
18648         constexpr const_iterator begin() const { return m_start; }
18649         constexpr const_iterator end() const { return m_start + m_size; }
18650     };
18651
18652     auto operator += ( std::string& lhs, StringRef const& sr ) -> std::string&;
18653     auto operator << ( std::ostream& os, StringRef const& sr ) -> std::ostream&;
18654
18655     constexpr auto operator "" _sr( char const* rawChars, std::size_t size ) noexcept -> StringRef {
18656         return StringRef( rawChars, size );
18657     }
18658 } // namespace Catch
18659
18660 constexpr auto operator "" _catch_sr( char const* rawChars, std::size_t size ) noexcept ->
      Catch::StringRef {
18661     return Catch::StringRef( rawChars, size );
18662 }
18663
18664 // end catch_stringref.h
18665 // start catch_preprocessor.hpp
18666
18667
18668 #define CATCH_RECURSION_LEVEL0(...) __VA_ARGS__
18669 #define CATCH_RECURSION_LEVEL1(...)
      CATCH_RECURSION_LEVEL0(CATCH_RECURSION_LEVEL0(CATCH_RECURSION_LEVEL0(__VA_ARGS__)))
18670 #define CATCH_RECURSION_LEVEL2(...)
      CATCH_RECURSION_LEVEL1(CATCH_RECURSION_LEVEL1(CATCH_RECURSION_LEVEL1(__VA_ARGS__)))
18671 #define CATCH_RECURSION_LEVEL3(...)
      CATCH_RECURSION_LEVEL2(CATCH_RECURSION_LEVEL2(CATCH_RECURSION_LEVEL2(__VA_ARGS__)))
18672 #define CATCH_RECURSION_LEVEL4(...)
      CATCH_RECURSION_LEVEL3(CATCH_RECURSION_LEVEL3(CATCH_RECURSION_LEVEL3(__VA_ARGS__)))
18673 #define CATCH_RECURSION_LEVEL5(...)
      CATCH_RECURSION_LEVEL4(CATCH_RECURSION_LEVEL4(CATCH_RECURSION_LEVEL4(__VA_ARGS__)))
18674
18675 #ifdef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
18676 #define INTERNAL_CATCH_EXPAND_VARGS(...) __VA_ARGS__
18677 // MSVC needs more evaluations
18678 #define CATCH_RECURSION_LEVEL6(...)
      CATCH_RECURSION_LEVEL5(CATCH_RECURSION_LEVEL5(CATCH_RECURSION_LEVEL5(__VA_ARGS__)))
18679 #define CATCH_RECURSE(...)  CATCH_RECURSION_LEVEL6(CATCH_RECURSION_LEVEL6(__VA_ARGS__))
18680 #else
18681 #define CATCH_RECURSE(...)  CATCH_RECURSION_LEVEL5(__VA_ARGS__)
18682 #endif
18683
18684 #define CATCH_REC_END(...)
18685 #define CATCH_REC_OUT
18686
18687 #define CATCH_EMPTY()
18688 #define CATCH_DEFER(id) id CATCH_EMPTY()
18689
18690 #define CATCH_REC_GET_END2() 0, CATCH_REC_END
18691 #define CATCH_REC_GET_END1(...) CATCH_REC_GET_END2
18692 #define CATCH_REC_GET_END(...) CATCH_REC_GET_END1
18693 #define CATCH_REC_NEXT0(test, next, ...) next CATCH_REC_OUT
18694 #define CATCH_REC_NEXT1(test, next) CATCH_DEFER ( CATCH_REC_NEXT0 ) ( test, next, 0)
18695 #define CATCH_REC_NEXT(test, next)  CATCH_REC_NEXT1(CATCH_REC_GET_END test, next)
18696
18697 #define CATCH_REC_LIST0(f, x, peek, ...) , f(x) CATCH_DEFER ( CATCH_REC_NEXT(peek, CATCH_REC_LIST1) )
      ( f, peek, __VA_ARGS__ )
18698 #define CATCH_REC_LIST1(f, x, peek, ...) , f(x) CATCH_DEFER ( CATCH_REC_NEXT(peek, CATCH_REC_LIST0) )
      ( f, peek, __VA_ARGS__ )
18699 #define CATCH_REC_LIST2(f, x, peek, ...)   f(x) CATCH_DEFER ( CATCH_REC_NEXT(peek, CATCH_REC_LIST1) )
      ( f, peek, __VA_ARGS__ )
18700
18701 #define CATCH_REC_LIST0_UD(f, userdata, x, peek, ...) , f(userdata, x) CATCH_DEFER (
```

```
    CATCH_REC_NEXT(peek, CATCH_REC_LIST1_UD) ) ( f, userdata, peek, __VA_ARGS__ )
18702 #define CATCH_REC_LIST1_UD(f, userdata, x, peek, ...) , f(userdata, x) CATCH_DEFER (
    CATCH_REC_NEXT(peek, CATCH_REC_LIST0_UD) ) ( f, userdata, peek, __VA_ARGS__ )
18703 #define CATCH_REC_LIST2_UD(f, userdata, x, peek, ...)   f(userdata, x) CATCH_DEFER (
    CATCH_REC_NEXT(peek, CATCH_REC_LIST1_UD) ) ( f, userdata, peek, __VA_ARGS__ )
18704
18705 // Applies the function macro `f` to each of the remaining parameters, inserts commas between the
    results,
18706 // and passes userdata as the first parameter to each invocation,
18707 // e.g. CATCH_REC_LIST_UD(f, x, a, b, c) evaluates to f(x, a), f(x, b), f(x, c)
18708 #define CATCH_REC_LIST_UD(f, userdata, ...) CATCH_RECURSE(CATCH_REC_LIST2_UD(f, userdata, __VA_ARGS__,
    ()()(), ()()(), ()()(), 0))
18709
18710 #define CATCH_REC_LIST(f, ...) CATCH_RECURSE(CATCH_REC_LIST2(f, __VA_ARGS__, ()()(), ()()(), ()()(),
    0))
18711
18712 #define INTERNAL_CATCH_EXPAND1(param) INTERNAL_CATCH_EXPAND2(param)
18713 #define INTERNAL_CATCH_EXPAND2(...) INTERNAL_CATCH_NO## __VA_ARGS__
18714 #define INTERNAL_CATCH_DEF(...) INTERNAL_CATCH_DEF __VA_ARGS__
18715 #define INTERNAL_CATCH_NOINTERNAL_CATCH_DEF
18716 #define INTERNAL_CATCH_STRINGIZE(...) INTERNAL_CATCH_STRINGIZE2(__VA_ARGS__)
18717 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
18718 #define INTERNAL_CATCH_STRINGIZE2(...) #__VA_ARGS__
18719 #define INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS(param)
    INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_REMOVE_PARENS(param))
18720 #else
18721 // MSVC is adding extra space and needs another indirection to expand
    INTERNAL_CATCH_NOINTERNAL_CATCH_DEF
18722 #define INTERNAL_CATCH_STRINGIZE2(...) INTERNAL_CATCH_STRINGIZE3(__VA_ARGS__)
18723 #define INTERNAL_CATCH_STRINGIZE3(...) #__VA_ARGS__
18724 #define INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS(param)
    (INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_REMOVE_PARENS(param)) + 1)
18725 #endif
18726
18727 #define INTERNAL_CATCH_MAKE_NAMESPACE2(...) ns_##__VA_ARGS__
18728 #define INTERNAL_CATCH_MAKE_NAMESPACE(name) INTERNAL_CATCH_MAKE_NAMESPACE2(name)
18729
18730 #define INTERNAL_CATCH_REMOVE_PARENS(...) INTERNAL_CATCH_EXPAND1(INTERNAL_CATCH_DEF __VA_ARGS__)
18731
18732 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
18733 #define INTERNAL_CATCH_MAKE_TYPE_LIST2(...)
    decltype(get_wrapper<INTERNAL_CATCH_REMOVE_PARENS_GEN(__VA_ARGS__)>())
18734 #define INTERNAL_CATCH_MAKE_TYPE_LIST(...)
    INTERNAL_CATCH_MAKE_TYPE_LIST2(INTERNAL_CATCH_REMOVE_PARENS(__VA_ARGS__))
18735 #else
18736 #define INTERNAL_CATCH_MAKE_TYPE_LIST2(...)
    INTERNAL_CATCH_EXPAND_VARGS(decltype(get_wrapper<INTERNAL_CATCH_REMOVE_PARENS_GEN(__VA_ARGS__)>()))
18737 #define INTERNAL_CATCH_MAKE_TYPE_LIST(...)
    INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_MAKE_TYPE_LIST2(INTERNAL_CATCH_REMOVE_PARENS(__VA_ARGS__)))
18738 #endif
18739
18740 #define INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES(...)\
18741     CATCH_REC_LIST(INTERNAL_CATCH_MAKE_TYPE_LIST,__VA_ARGS__)
18742
18743 #define INTERNAL_CATCH_REMOVE_PARENS_1_ARG(_0) INTERNAL_CATCH_REMOVE_PARENS(_0)
18744 #define INTERNAL_CATCH_REMOVE_PARENS_2_ARG(_0, _1) INTERNAL_CATCH_REMOVE_PARENS(_0),
    INTERNAL_CATCH_REMOVE_PARENS_1_ARG(_1)
18745 #define INTERNAL_CATCH_REMOVE_PARENS_3_ARG(_0, _1, _2) INTERNAL_CATCH_REMOVE_PARENS(_0),
    INTERNAL_CATCH_REMOVE_PARENS_2_ARG(_1, _2)
18746 #define INTERNAL_CATCH_REMOVE_PARENS_4_ARG(_0, _1, _2, _3) INTERNAL_CATCH_REMOVE_PARENS(_0),
    INTERNAL_CATCH_REMOVE_PARENS_3_ARG(_1, _2, _3)
18747 #define INTERNAL_CATCH_REMOVE_PARENS_5_ARG(_0, _1, _2, _3, _4) INTERNAL_CATCH_REMOVE_PARENS(_0),
    INTERNAL_CATCH_REMOVE_PARENS_4_ARG(_1, _2, _3, _4)
18748 #define INTERNAL_CATCH_REMOVE_PARENS_6_ARG(_0, _1, _2, _3, _4, _5) INTERNAL_CATCH_REMOVE_PARENS(_0),
    INTERNAL_CATCH_REMOVE_PARENS_5_ARG(_1, _2, _3, _4, _5)
18749 #define INTERNAL_CATCH_REMOVE_PARENS_7_ARG(_0, _1, _2, _3, _4, _5, _6)
    INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_6_ARG(_1, _2, _3, _4, _5, _6)
18750 #define INTERNAL_CATCH_REMOVE_PARENS_8_ARG(_0, _1, _2, _3, _4, _5, _6, _7)
    INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_7_ARG(_1, _2, _3, _4, _5, _6, _7)
18751 #define INTERNAL_CATCH_REMOVE_PARENS_9_ARG(_0, _1, _2, _3, _4, _5, _6, _7, _8)
    INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_8_ARG(_1, _2, _3, _4, _5, _6, _7, _8)
18752 #define INTERNAL_CATCH_REMOVE_PARENS_10_ARG(_0, _1, _2, _3, _4, _5, _6, _7, _8, _9)
    INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_9_ARG(_1, _2, _3, _4, _5, _6, _7, _8,
    _9)
18753 #define INTERNAL_CATCH_REMOVE_PARENS_11_ARG(_0, _1, _2, _3, _4, _5, _6, _7, _8, _9, _10)
    INTERNAL_CATCH_REMOVE_PARENS(_0), INTERNAL_CATCH_REMOVE_PARENS_10_ARG(_1, _2, _3, _4, _5, _6, _7, _8,
    _9, _10)
18754
18755 #define INTERNAL_CATCH_VA_NARGS_IMPL(_0, _1, _2, _3, _4, _5, _6, _7, _8, _9, _10, N, ...) N
18756
18757 #define INTERNAL_CATCH_TYPE_GEN\
18758     template<typename...> struct TypeList {};\
18759     template<typename...Ts>\
18760     constexpr auto get_wrapper() noexcept -> TypeList<Ts...> { return {}; }\
18761     template<template<typename...> class...> struct TemplateTypeList{};\
18762     template<template<typename...> class...Cs>\
18763     constexpr auto get_wrapper() noexcept -> TemplateTypeList<Cs...> { return {}; }\
```

```
18764     template<typename...>\
18765     struct append;\
18766     template<typename...>\
18767     struct rewrap;\
18768     template<template<typename...> class, typename...>\
18769     struct create;\
18770     template<template<typename...> class, typename>\
18771     struct convert;\
18772     \
18773     template<typename T> \
18774     struct append<T> { using type = T; };\
18775     template< template<typename...> class L1, typename...E1, template<typename...> class L2,
      typename...E2, typename...Rest>\
18776     struct append<L1<E1...>, L2<E2...>, Rest...> { using type = typename append<L1<E1...,E2...>,
      Rest...>::type; };\
18777     template< template<typename...> class L1, typename...E1, typename...Rest>\
18778     struct append<L1<E1...>, TypeList<mpl_::na>, Rest...> { using type = L1<E1...>; };\
18779     \
18780     template< template<typename...> class Container, template<typename...> class List,
      typename...elems>\
18781     struct rewrap<TemplateTypeList<Container>, List<elems...>> { using type =
      TypeList<Container<elems...>>; };\
18782     template< template<typename...> class Container, template<typename...> class List, class...Elems,
      typename...Elements>\
18783     struct rewrap<TemplateTypeList<Container>, List<Elems...>, Elements...> { using type = typename
      append<TypeList<Container<Elems...>>, typename rewrap<TemplateTypeList<Container>,
      Elements...>::type>::type; };\
18784     \
18785     template<template <typename...> class Final, template< typename...> class...Containers,
      typename...Types>\
18786     struct create<Final, TemplateTypeList<Containers...>, TypeList<Types...>> { using type = typename
      append<Final<>, typename rewrap<TemplateTypeList<Containers>, Types...>::type...>::type; };\
18787     template<template <typename...> class Final, template <typename...> class List, typename...Ts>\
18788     struct convert<Final, List<Ts...>> { using type = typename append<Final<>,TypeList<Ts>...>::type;
      };
18789
18790 #define INTERNAL_CATCH_NTTP_1(signature, ...)\
18791     template<INTERNAL_CATCH_REMOVE_PARENS(signature)> struct Nttp{};\
18792     template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
18793     constexpr auto get_wrapper() noexcept -> Nttp<__VA_ARGS__> { return {}; } \
18794     template<template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class...> struct
      NttpTemplateTypeList{};\
18795     template<template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class...Cs>\
18796     constexpr auto get_wrapper() noexcept -> NttpTemplateTypeList<Cs...> { return {}; } \
18797     \
18798     template< template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class Container,
      template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class List,
      INTERNAL_CATCH_REMOVE_PARENS(signature)>\
18799     struct rewrap<NttpTemplateTypeList<Container>, List<__VA_ARGS__>> { using type =
      TypeList<Container<__VA_ARGS__>>; };\
18800     template< template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class Container,
      template<INTERNAL_CATCH_REMOVE_PARENS(signature)> class List, INTERNAL_CATCH_REMOVE_PARENS(signature),
      typename...Elements>\
18801     struct rewrap<NttpTemplateTypeList<Container>, List<__VA_ARGS__>, Elements...> { using type =
      typename append<TypeList<Container<__VA_ARGS__>>, typename rewrap<NttpTemplateTypeList<Container>,
      Elements...>::type>::type; };\
18802     template<template <typename...> class Final, template<INTERNAL_CATCH_REMOVE_PARENS(signature)>
      class...Containers, typename...Types>\
18803     struct create<Final, NttpTemplateTypeList<Containers...>, TypeList<Types...>> { using type =
      typename append<Final<>, typename rewrap<NttpTemplateTypeList<Containers>, Types...>::type...>::type;
      };
18804
18805 #define INTERNAL_CATCH_DECLARE_SIG_TEST0(TestName)
18806 #define INTERNAL_CATCH_DECLARE_SIG_TEST1(TestName, signature)\
18807     template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
18808     static void TestName()
18809 #define INTERNAL_CATCH_DECLARE_SIG_TEST_X(TestName, signature, ...)\
18810     template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
18811     static void TestName()
18812
18813 #define INTERNAL_CATCH_DEFINE_SIG_TEST0(TestName)
18814 #define INTERNAL_CATCH_DEFINE_SIG_TEST1(TestName, signature)\
18815     template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
18816     static void TestName()
18817 #define INTERNAL_CATCH_DEFINE_SIG_TEST_X(TestName, signature,...)\
18818     template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
18819     static void TestName()
18820
18821 #define INTERNAL_CATCH_NTTP_REGISTER0(TestFunc, signature)\
18822     template<typename Type>\
18823     void reg_test(TypeList<Type>, Catch::NameAndTags nameAndTags)\
18824     {\
18825         Catch::AutoReg( Catch::makeTestInvoker(&TestFunc<Type>), CATCH_INTERNAL_LINEINFO,
      Catch::StringRef(), nameAndTags);\
18826     }
18827
18828 #define INTERNAL_CATCH_NTTP_REGISTER(TestFunc, signature, ...)\
```

```
18829     template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
18830     void reg_test(Nttp<__VA_ARGS__>, Catch::NameAndTags nameAndTags)\
18831     {\
18832         Catch::AutoReg( Catch::makeTestInvoker(&TestFunc<__VA_ARGS__>), CATCH_INTERNAL_LINEINFO,
      Catch::StringRef(), nameAndTags);\
18833     }
18834
18835 #define INTERNAL_CATCH_NTTP_REGISTER_METHOD0(TestName, signature, ...)\
18836     template<typename Type>\
18837     void reg_test(TypeList<Type>, Catch::StringRef className, Catch::NameAndTags nameAndTags)\
18838     {\
18839         Catch::AutoReg( Catch::makeTestInvoker(&TestName<Type>::test), CATCH_INTERNAL_LINEINFO,
      className, nameAndTags);\
18840     }
18841
18842 #define INTERNAL_CATCH_NTTP_REGISTER_METHOD(TestName, signature, ...)\
18843     template<INTERNAL_CATCH_REMOVE_PARENS(signature)>\
18844     void reg_test(Nttp<__VA_ARGS__>, Catch::StringRef className, Catch::NameAndTags nameAndTags)\
18845     {\
18846         Catch::AutoReg( Catch::makeTestInvoker(&TestName<__VA_ARGS__>::test), CATCH_INTERNAL_LINEINFO,
      className, nameAndTags);\
18847     }
18848
18849 #define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD0(TestName, ClassName)
18850 #define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD1(TestName, ClassName, signature)\
18851     template<typename TestType> \
18852     struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName)<TestType> { \
18853         void test();\
18854     }
18855
18856 #define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X(TestName, ClassName, signature, ...)\
18857     template<INTERNAL_CATCH_REMOVE_PARENS(signature)> \
18858     struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName)<__VA_ARGS__> { \
18859         void test();\
18860     }
18861
18862 #define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD0(TestName)
18863 #define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD1(TestName, signature)\
18864     template<typename TestType> \
18865     void INTERNAL_CATCH_MAKE_NAMESPACE(TestName)::TestName<TestType>::test()
18866 #define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X(TestName, signature, ...)\
18867     template<INTERNAL_CATCH_REMOVE_PARENS(signature)> \
18868     void INTERNAL_CATCH_MAKE_NAMESPACE(TestName)::TestName<__VA_ARGS__>::test()
18869
18870 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
18871 #define INTERNAL_CATCH_NTTP_0
18872 #define INTERNAL_CATCH_NTTP_GEN(...) INTERNAL_CATCH_VA_NARGS_IMPL(__VA_ARGS__,
      INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1(__VA_ARGS__),
      INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1(__VA_ARGS__),
      INTERNAL_CATCH_NTTP_1(__VA_ARGS__), INTERNAL_CATCH_NTTP_1( __VA_ARGS__), INTERNAL_CATCH_NTTP_1(
      __VA_ARGS__), INTERNAL_CATCH_NTTP_1( __VA_ARGS__), INTERNAL_CATCH_NTTP_1(
      __VA_ARGS__),INTERNAL_CATCH_NTTP_1( __VA_ARGS__), INTERNAL_CATCH_NTTP_0)
18873 #define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD(TestName, ...) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy",
      __VA_ARGS__, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD1, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD0)(TestName, __VA_ARGS__)
18874 #define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD(TestName, ClassName, ...) INTERNAL_CATCH_VA_NARGS_IMPL(
      "dummy", __VA_ARGS__,
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD
      INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD1, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD0)(TestName, ClassName,
      __VA_ARGS__)
18875 #define INTERNAL_CATCH_NTTP_REG_METHOD_GEN(TestName, ...) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy",
      __VA_ARGS__, INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD0,
      INTERNAL_CATCH_NTTP_REGISTER_METHOD0)(TestName, __VA_ARGS__)
18876 #define INTERNAL_CATCH_NTTP_REG_GEN(TestFunc, ...) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__,
      INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER,
      INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER,
      INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER,
      INTERNAL_CATCH_NTTP_REGISTER0, INTERNAL_CATCH_NTTP_REGISTER0)(TestFunc, __VA_ARGS__)
18877 #define INTERNAL_CATCH_DEFINE_SIG_TEST(TestName, ...) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy",
      __VA_ARGS__, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X,
      INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DEFINE_SIG_TEST1,
      INTERNAL_CATCH_DEFINE_SIG_TEST0)(TestName, __VA_ARGS__)
18878 #define INTERNAL_CATCH_DECLARE_SIG_TEST(TestName, ...) INTERNAL_CATCH_VA_NARGS_IMPL( "dummy",
      __VA_ARGS__, INTERNAL_CATCH_DECLARE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_SIG_TEST_X,
      INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DECLARE_SIG_TEST_X,
```

```
    INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DECLARE_SIG_TEST_X,
    INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_SIG_TEST_X,
    INTERNAL_CATCH_DECLARE_SIG_TEST1, INTERNAL_CATCH_DECLARE_SIG_TEST0)(TestName, __VA_ARGS__)
18879 #define INTERNAL_CATCH_REMOVE_PARENS_GEN(...) INTERNAL_CATCH_VA_NARGS_IMPL(__VA_ARGS__,
    INTERNAL_CATCH_REMOVE_PARENS_11_ARG,INTERNAL_CATCH_REMOVE_PARENS_10_ARG,INTERNAL_CATCH_REMOVE_PARENS_9_ARG,INTERNAL_CATC
18880 #else
18881 #define INTERNAL_CATCH_NTTP_0(signature)
18882 #define INTERNAL_CATCH_NTTP_GEN(...)
    INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL(__VA_ARGS__, INTERNAL_CATCH_NTTP_1,
    INTERNAL_CATCH_NTTP_1, INTERNAL_CATCH_NTTP_1, INTERNAL_CATCH_NTTP_1, INTERNAL_CATCH_NTTP_1,
    INTERNAL_CATCH_NTTP_1, INTERNAL_CATCH_NTTP_1, INTERNAL_CATCH_NTTP_1,
    INTERNAL_CATCH_NTTP_1,INTERNAL_CATCH_NTTP_1, INTERNAL_CATCH_NTTP_0)( __VA_ARGS__))
18883 #define INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD(TestName, ...)
    INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__,
    INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
    INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
    INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
    INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD_X,
    INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD1, INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD0)(TestName,
    __VA_ARGS__))
18884 #define INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD(TestName, ClassName, ...)
    INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__,
    INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,
    INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,
    INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,
    INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD_X,INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD
    INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD1, INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD0)(TestName, ClassName,
    __VA_ARGS__))
18885 #define INTERNAL_CATCH_NTTP_REG_METHOD_GEN(TestName, ...)
    INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__,
    INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
    INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
    INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
    INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD,
    INTERNAL_CATCH_NTTP_REGISTER_METHOD, INTERNAL_CATCH_NTTP_REGISTER_METHOD0,
    INTERNAL_CATCH_NTTP_REGISTER_METHOD0)(TestName, __VA_ARGS__))
18886 #define INTERNAL_CATCH_NTTP_REG_GEN(TestFunc, ...)
    INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__,
    INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER,
    INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER,
    INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER, INTERNAL_CATCH_NTTP_REGISTER,
    INTERNAL_CATCH_NTTP_REGISTER0, INTERNAL_CATCH_NTTP_REGISTER0)(TestFunc, __VA_ARGS__))
18887 #define INTERNAL_CATCH_DEFINE_SIG_TEST(TestName, ...)
    INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__,
    INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X,
    INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X, INTERNAL_CATCH_DEFINE_SIG_TEST_X,
    INTERNAL_CATCH_DEFINE_SIG_TEST_X,
    INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DEFINE_SIG_TEST1,
    INTERNAL_CATCH_DEFINE_SIG_TEST0)(TestName, __VA_ARGS__))
18888 #define INTERNAL_CATCH_DECLARE_SIG_TEST(TestName, ...)
    INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL( "dummy", __VA_ARGS__,
    INTERNAL_CATCH_DECLARE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_SIG_TEST_X,
    INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DECLARE_SIG_TEST_X,
    INTERNAL_CATCH_DECLARE_SIG_TEST_X, INTERNAL_CATCH_DECLARE_SIG_TEST_X,
    INTERNAL_CATCH_DEFINE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_SIG_TEST_X,INTERNAL_CATCH_DECLARE_SIG_TEST_X,
    INTERNAL_CATCH_DECLARE_SIG_TEST1, INTERNAL_CATCH_DECLARE_SIG_TEST0)(TestName, __VA_ARGS__))
18889 #define INTERNAL_CATCH_REMOVE_PARENS_GEN(...)
    INTERNAL_CATCH_EXPAND_VARGS(INTERNAL_CATCH_VA_NARGS_IMPL(__VA_ARGS__,
    INTERNAL_CATCH_REMOVE_PARENS_11_ARG,INTERNAL_CATCH_REMOVE_PARENS_10_ARG,INTERNAL_CATCH_REMOVE_PARENS_9_ARG,INTERNAL_CATC
18890 #endif
18891
18892 // end catch_preprocessor.hpp
18893 // start catch_meta.hpp
18894
18895
18896 #include <type_traits>
18897
18898 namespace Catch {
18899     template<typename T>
18900     struct always_false : std::false_type {};
18901
18902     template <typename> struct true_given : std::true_type {};
18903     struct is_callable_tester {
18904         template <typename Fun, typename... Args>
18905         true_given<decltype(std::declval<Fun>()(std::declval<Args>()...))> static test(int);
18906         template <typename...>
18907         std::false_type static test(...);
18908     };
18909
18910     template <typename T>
18911     struct is_callable;
18912
18913     template <typename Fun, typename... Args>
18914     struct is_callable<Fun(Args...)> : decltype(is_callable_tester::test<Fun, Args...>(0)) {};
18915
18916 #if defined(__cpp_lib_is_invocable) && __cpp_lib_is_invocable >= 201703
18917     // std::result_of is deprecated in C++17 and removed in C++20. Hence, it is
```

```
18918     // replaced with std::invoke_result here.
18919     template <typename Func, typename... U>
18920     using FunctionReturnType = std::remove_reference_t<std::remove_cv_t<std::invoke_result_t<Func,
      U...>>>;
18921 #else
18922     // Keep ::type here because we still support C++11
18923     template <typename Func, typename... U>
18924     using FunctionReturnType = typename std::remove_reference<typename std::remove_cv<typename
      std::result_of<Func(U...)>::type>::type>::type;
18925 #endif
18926
18927 } // namespace Catch
18928
18929 namespace mpl_{
18930     struct na;
18931 }
18932
18933 // end catch_meta.hpp
18934 namespace Catch {
18935
18936 template<typename C>
18937 class TestInvokerAsMethod : public ITestInvoker {
18938     void (C::*m_testAsMethod)();
18939 public:
18940     TestInvokerAsMethod( void (C::*testAsMethod)() ) noexcept : m_testAsMethod( testAsMethod ) {}
18941
18942     void invoke() const override {
18943         C obj;
18944         (obj.*m_testAsMethod)();
18945     }
18946 };
18947
18948 auto makeTestInvoker( void(*testAsFunction)() ) noexcept -> ITestInvoker*;
18949
18950 template<typename C>
18951 auto makeTestInvoker( void (C::*testAsMethod)() ) noexcept -> ITestInvoker* {
18952     return new(std::nothrow) TestInvokerAsMethod<C>( testAsMethod );
18953 }
18954
18955 struct NameAndTags {
18956     NameAndTags( StringRef const& name_ = StringRef(), StringRef const& tags_ = StringRef() )
      noexcept;
18957     StringRef name;
18958     StringRef tags;
18959 };
18960
18961 struct AutoReg : NonCopyable {
18962     AutoReg( ITestInvoker* invoker, SourceLineInfo const& lineInfo, StringRef const& classOrMethod,
      NameAndTags const& nameAndTags ) noexcept;
18963     ~AutoReg();
18964 };
18965
18966 } // end namespace Catch
18967
18968 #if defined(CATCH_CONFIG_DISABLE)
18969     #define INTERNAL_CATCH_TESTCASE_NO_REGISTRATION( TestName, ... ) \
18970         static void TestName()
18971     #define INTERNAL_CATCH_TESTCASE_METHOD_NO_REGISTRATION( TestName, ClassName, ... ) \
18972         namespace{                                      \
18973             struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName) { \
18974                 void test();                            \
18975             };                                          \
18976         }                                               \
18977         void TestName::test()
18978     #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION_2( TestName, TestFunc, Name, Tags,
      Signature, ... )  \
18979         INTERNAL_CATCH_DEFINE_SIG_TEST(TestFunc, INTERNAL_CATCH_REMOVE_PARENS(Signature))
18980     #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION_2( TestNameClass, TestName,
      ClassName, Name, Tags, Signature, ... )    \
18981         namespace{                                                                                 \
18982             namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName) {                                    \
18983             INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD(TestName, ClassName,
      INTERNAL_CATCH_REMOVE_PARENS(Signature));\
18984         }                                                                                          \
18985         }                                                                                          \
18986         INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD(TestName, INTERNAL_CATCH_REMOVE_PARENS(Signature))
18987
18988     #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
18989         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION(Name, Tags, ...) \
18990             INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, typename TestType, __VA_ARGS__ )
18991     #else
18992         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION(Name, Tags, ...) \
18993             INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION_2(
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, typename TestType, __VA_ARGS__ ) )
```

```
18994     #endif
18995
18996     #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
18997         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG_NO_REGISTRATION(Name, Tags, Signature, ...) \
18998             INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, Signature, __VA_ARGS__ )
18999     #else
19000         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG_NO_REGISTRATION(Name, Tags, Signature, ...) \
19001             INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION_2(
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, Signature, __VA_ARGS__ ) )
19002     #endif
19003
19004     #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
19005         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION( ClassName, Name, Tags,... )
      \
19006             INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, typename T, __VA_ARGS__ )
19007     #else
19008         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION( ClassName, Name, Tags,... )
      \
19009             INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION_2(
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ),
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, typename T,
      __VA_ARGS__ ) )
19010     #endif
19011
19012     #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
19013         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG_NO_REGISTRATION( ClassName, Name, Tags,
      Signature, ... ) \
19014             INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, Signature, __VA_ARGS__ )
19015     #else
19016         #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG_NO_REGISTRATION( ClassName, Name, Tags,
      Signature, ... ) \
19017             INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION_2(
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ),
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, Signature,
      __VA_ARGS__ ) )
19018     #endif
19019 #endif
19020
19022     #define INTERNAL_CATCH_TESTCASE2( TestName, ... ) \
19023         static void TestName(); \
19024         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
19025         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
19026         namespace{ Catch::AutoReg INTERNAL_CATCH_UNIQUE_NAME( autoRegistrar )( Catch::makeTestInvoker(
      &TestName ), CATCH_INTERNAL_LINEINFO, Catch::StringRef(), Catch::NameAndTags{ __VA_ARGS__ } ); } /*
      NOLINT */ \
19027         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
19028         static void TestName()
19029     #define INTERNAL_CATCH_TESTCASE( ... ) \
19030         INTERNAL_CATCH_TESTCASE2( INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_S_T_ ), __VA_ARGS__ )
19031
19033     #define INTERNAL_CATCH_METHOD_AS_TEST_CASE( QualifiedMethod, ... ) \
19034         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
19035         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
19036         namespace{ Catch::AutoReg INTERNAL_CATCH_UNIQUE_NAME( autoRegistrar )( Catch::makeTestInvoker(
      &QualifiedMethod ), CATCH_INTERNAL_LINEINFO, "&" #QualifiedMethod, Catch::NameAndTags{ __VA_ARGS__ }
      ); } /* NOLINT */ \
19037         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
19038
19040     #define INTERNAL_CATCH_TEST_CASE_METHOD2( TestName, ClassName, ... )\
19041         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
19042         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
19043         namespace{ \
19044             struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName) { \
19045                 void test(); \
19046             }; \
19047             Catch::AutoReg INTERNAL_CATCH_UNIQUE_NAME( autoRegistrar ) ( Catch::makeTestInvoker(
      &TestName::test ), CATCH_INTERNAL_LINEINFO, #ClassName, Catch::NameAndTags{ __VA_ARGS__ } ); /* NOLINT
      */ \
19048         } \
19049         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
19050         void TestName::test()
19051     #define INTERNAL_CATCH_TEST_CASE_METHOD( ClassName, ... ) \
19052         INTERNAL_CATCH_TEST_CASE_METHOD2( INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_S_T_ ), ClassName,
      __VA_ARGS__ )
19053
19055     #define INTERNAL_CATCH_REGISTER_TESTCASE( Function, ... ) \
19056         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
19057         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
19058         Catch::AutoReg INTERNAL_CATCH_UNIQUE_NAME( autoRegistrar )( Catch::makeTestInvoker( Function
      ), CATCH_INTERNAL_LINEINFO, Catch::StringRef(), Catch::NameAndTags{ __VA_ARGS__ } ); /* NOLINT */ \
```

```
19059         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
19060
19062     #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_2(TestName, TestFunc, Name, Tags, Signature, ... )\
19063         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
19064         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
19065         CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS \
19066         CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
19067         INTERNAL_CATCH_DECLARE_SIG_TEST(TestFunc, INTERNAL_CATCH_REMOVE_PARENS(Signature));\
19068         namespace {\
19069         namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName){\
19070             INTERNAL_CATCH_TYPE_GEN\
19071             INTERNAL_CATCH_NTTP_GEN(INTERNAL_CATCH_REMOVE_PARENS(Signature))\
19072             INTERNAL_CATCH_NTTP_REG_GEN(TestFunc,INTERNAL_CATCH_REMOVE_PARENS(Signature))\
19073             template<typename...Types> \
19074             struct TestName{\
19075                 TestName(){\
19076                     int index = 0;                                  \
19077                     constexpr char const* tmpl_types[] =
      {CATCH_REC_LIST(INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS, __VA_ARGS__)};\
19078                     using expander = int[];\
19079                     (void)expander{(reg_test(Types{}, Catch::NameAndTags{ Name " - " +
      std::string(tmpl_types[index]), Tags } ), index++)... };/* NOLINT */ \
19080                 }\
19081             };\
19082             static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){\
19083             TestName<INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES(__VA_ARGS__)>();\
19084             return 0;\
19085         }();\
19086         }\
19087         }\
19088         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
19089         INTERNAL_CATCH_DEFINE_SIG_TEST(TestFunc,INTERNAL_CATCH_REMOVE_PARENS(Signature))
19090
19091 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
19092     #define INTERNAL_CATCH_TEMPLATE_TEST_CASE(Name, Tags, ...) \
19093         INTERNAL_CATCH_TEMPLATE_TEST_CASE_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, typename TestType, __VA_ARGS__ )
19094 #else
19095     #define INTERNAL_CATCH_TEMPLATE_TEST_CASE(Name, Tags, ...) \
19096         INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, typename TestType, __VA_ARGS__ ) )
19097 #endif
19098
19099 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
19100     #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG(Name, Tags, Signature, ...) \
19101         INTERNAL_CATCH_TEMPLATE_TEST_CASE_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, Signature, __VA_ARGS__ )
19102 #else
19103     #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG(Name, Tags, Signature, ...) \
19104         INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, Signature, __VA_ARGS__ ) )
19105 #endif
19106
19107     #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2(TestName, TestFuncName, Name, Tags, Signature,
      TmplTypes, TypesList) \
19108         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION                    \
19109         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS                     \
19110         CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS               \
19111         CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS             \
19112         template<typename TestType> static void TestFuncName();      \
19113         namespace {\
19114         namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName) {                                  \
19115             INTERNAL_CATCH_TYPE_GEN                                                  \
19116             INTERNAL_CATCH_NTTP_GEN(INTERNAL_CATCH_REMOVE_PARENS(Signature))         \
19117             template<typename... Types>                              \
19118             struct TestName {                                        \
19119                 void reg_tests() {                                        \
19120                     int index = 0;                                   \
19121                     using expander = int[];                          \
19122                     constexpr char const* tmpl_types[] =
      {CATCH_REC_LIST(INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS, INTERNAL_CATCH_REMOVE_PARENS(TmplTypes))};\
19123                     constexpr char const* types_list[] =
      {CATCH_REC_LIST(INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS, INTERNAL_CATCH_REMOVE_PARENS(TypesList))};\
19124                     constexpr auto num_types = sizeof(types_list) / sizeof(types_list[0]);\
19125                     (void)expander{(Catch::AutoReg( Catch::makeTestInvoker( &TestFuncName<Types> ),
      CATCH_INTERNAL_LINEINFO, Catch::StringRef(), Catch::NameAndTags{ Name " - " +
      std::string(tmpl_types[index / num_types]) + "<" + std::string(types_list[index % num_types]) + ">",
      Tags } ), index++)... };/* NOLINT */\
19126                 }                                                    \
19127             };                                                       \
19128             static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){ \
19129                 using TestInit = typename create<TestName,
      decltype(get_wrapper<INTERNAL_CATCH_REMOVE_PARENS(TmplTypes)>()),
```

```
    TypeList<INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES(INTERNAL_CATCH_REMOVE_PARENS(TypesList))>::type; \
19130                 TestInit t;                                                 \
19131                 t.reg_tests();                                              \
19132                 return 0;                                                   \
19133             }();                                                            \
19134         }                                                                   \
19135         }                                                                   \
19136         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION                             \
19137         template<typename TestType>                                         \
19138         static void TestFuncName()
19139
19140 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
19141     #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE(Name, Tags, ...)\
19142         INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2(INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, typename T,__VA_ARGS__)
19143 #else
19144     #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE(Name, Tags, ...)\
19145         INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2(
    INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, typename T, __VA_ARGS__ ) )
19146 #endif
19147
19148 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
19149     #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG(Name, Tags, Signature, ...)\
19150         INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2(INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, Signature, __VA_ARGS__)
19151 #else
19152     #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG(Name, Tags, Signature, ...)\
19153         INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE2(
    INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, Signature, __VA_ARGS__ ) )
19154 #endif
19155
19156     #define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_2(TestName, TestFunc, Name, Tags, TmplList)\
19157         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
19158         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
19159         CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
19160         template<typename TestType> static void TestFunc();       \
19161         namespace {\
19162         namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName){\
19163         INTERNAL_CATCH_TYPE_GEN\
19164         template<typename... Types>                                 \
19165         struct TestName {                                           \
19166             void reg_tests() {                                          \
19167                 int index = 0;                                      \
19168                 using expander = int[];                             \
19169                 (void)expander{(Catch::AutoReg( Catch::makeTestInvoker( &TestFunc<Types> ),
    CATCH_INTERNAL_LINEINFO, Catch::StringRef(), Catch::NameAndTags{ Name " - " +
    std::string(INTERNAL_CATCH_STRINGIZE(TmplList)) + " - " + std::to_string(index), Tags } ), index++)...
    };/* NOLINT */\
19170             }                                                       \
19171         };\
19172         static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){ \
19173                 using TestInit = typename convert<TestName, TmplList>::type; \
19174                 TestInit t;                                         \
19175                 t.reg_tests();                                      \
19176                 return 0;                                           \
19177             }();                                                    \
19178         }}\
19179         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION                     \
19180         template<typename TestType>                                 \
19181         static void TestFunc()
19182
19183     #define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE(Name, Tags, TmplList) \
19184         INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_2( INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), Name, Tags, TmplList )
19185
19186     #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2( TestNameClass, TestName, ClassName, Name,
    Tags, Signature, ... ) \
19187         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
19188         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
19189         CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS \
19190         CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
19191         namespace {\
19192         namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName){ \
19193             INTERNAL_CATCH_TYPE_GEN\
19194             INTERNAL_CATCH_NTTP_GEN(INTERNAL_CATCH_REMOVE_PARENS(Signature))\
19195             INTERNAL_CATCH_DECLARE_SIG_TEST_METHOD(TestName, ClassName,
    INTERNAL_CATCH_REMOVE_PARENS(Signature));\
19196             INTERNAL_CATCH_NTTP_REG_METHOD_GEN(TestName, INTERNAL_CATCH_REMOVE_PARENS(Signature))\
19197             template<typename...Types> \
19198             struct TestNameClass{\
19199                 TestNameClass(){\
19200                     int index = 0;                                  \
```

```
19201                   constexpr char const* tmpl_types[] =
{CATCH_REC_LIST(INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS, __VA_ARGS__)};\
19202                   using expander = int[];\
19203                   (void)expander{(reg_test(Types{}, #ClassName, Catch::NameAndTags{ Name " - " +
std::string(tmpl_types[index]), Tags } ), index++)... };/* NOLINT */ \
19204               }\
19205           };\
19206           static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){\
19207               TestNameClass<INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES(__VA_ARGS__)>();\
19208               return 0;\
19209       }();\
19210       }\
19211       }\
19212       CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
19213       INTERNAL_CATCH_DEFINE_SIG_TEST_METHOD(TestName, INTERNAL_CATCH_REMOVE_PARENS(Signature))
19214
19215 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
19216     #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD( ClassName, Name, Tags,... ) \
19217         INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ), INTERNAL_CATCH_UNIQUE_NAME(
C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, typename T, __VA_ARGS__ )
19218 #else
19219     #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD( ClassName, Name, Tags,... ) \
19220         INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2(
INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ),
INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, typename T,
__VA_ARGS__ ) )
19221 #endif
19222
19223 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
19224     #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( ClassName, Name, Tags, Signature, ... ) \
19225         INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ), INTERNAL_CATCH_UNIQUE_NAME(
C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, Signature, __VA_ARGS__ )
19226 #else
19227     #define INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( ClassName, Name, Tags, Signature, ... ) \
19228         INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_2(
INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_C_L_A_S_S_ ),
INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ) , ClassName, Name, Tags, Signature,
__VA_ARGS__ ) )
19229 #endif
19230
19231     #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2(TestNameClass, TestName, ClassName,
Name, Tags, Signature, TmplTypes, TypesList)\
19232         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
19233         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
19234         CATCH_INTERNAL_SUPPRESS_ZERO_VARIADIC_WARNINGS \
19235         CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
19236         template<typename TestType> \
19237             struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName <TestType>) { \
19238                 void test();\
19239             };\
19240         namespace {\
19241         namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestNameClass) {\
19242             INTERNAL_CATCH_TYPE_GEN                     \
19243             INTERNAL_CATCH_NTTP_GEN(INTERNAL_CATCH_REMOVE_PARENS(Signature))\
19244             template<typename...Types>\
19245             struct TestNameClass{\
19246                 void reg_tests(){\
19247                     int index = 0;\
19248                     using expander = int[];\
19249                     constexpr char const* tmpl_types[] =
{CATCH_REC_LIST(INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS, INTERNAL_CATCH_REMOVE_PARENS(TmplTypes))};\
19250                     constexpr char const* types_list[] =
{CATCH_REC_LIST(INTERNAL_CATCH_STRINGIZE_WITHOUT_PARENS, INTERNAL_CATCH_REMOVE_PARENS(TypesList))};\
19251                     constexpr auto num_types = sizeof(types_list) / sizeof(types_list[0]);\
19252                     (void)expander{(Catch::AutoReg( Catch::makeTestInvoker( &TestName<Types>::test ),
CATCH_INTERNAL_LINEINFO, #ClassName, Catch::NameAndTags{ Name " - " + std::string(tmpl_types[index /
num_types]) + "<" + std::string(types_list[index % num_types]) + ">", Tags } ), index++)... };/*
NOLINT */ \
19253                 }\
19254             };\
19255             static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){\
19256                 using TestInit = typename create<TestNameClass,
decltype(get_wrapper<INTERNAL_CATCH_REMOVE_PARENS(TmplTypes)>()),
TypeList<INTERNAL_CATCH_MAKE_TYPE_LISTS_FROM_TYPES(INTERNAL_CATCH_REMOVE_PARENS(TypesList))>::type;\
19257                 TestInit t;\
19258                 t.reg_tests();\
19259                 return 0;\
19260             }(); \
19261         }\
19262         }\
19263         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
19264         template<typename TestType> \
19265         void TestName<TestType>::test()
19266
19267 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
```

```
19268     #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( ClassName, Name, Tags, ... )\
19269         INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), ClassName, Name, Tags, typename T, __VA_ARGS__ )
19270 #else
19271     #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( ClassName, Name, Tags, ... )\
19272         INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2(
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), ClassName, Name, Tags, typename T,__VA_ARGS__ ) )
19273 #endif
19274
19275 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
19276     #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( ClassName, Name, Tags, Signature,
      ... )\
19277         INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), ClassName, Name, Tags, Signature, __VA_ARGS__ )
19278 #else
19279     #define INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( ClassName, Name, Tags, Signature,
      ... )\
19280         INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_2(
      INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), ClassName, Name, Tags, Signature,__VA_ARGS__ ) )
19281 #endif
19282
19283     #define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD_2( TestNameClass, TestName, ClassName, Name,
      Tags, TmplList) \
19284         CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
19285         CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
19286         CATCH_INTERNAL_SUPPRESS_UNUSED_TEMPLATE_WARNINGS \
19287         template<typename TestType> \
19288         struct TestName : INTERNAL_CATCH_REMOVE_PARENS(ClassName <TestType>) { \
19289             void test();\
19290         };\
19291         namespace {\
19292         namespace INTERNAL_CATCH_MAKE_NAMESPACE(TestName){ \
19293             INTERNAL_CATCH_TYPE_GEN\
19294             template<typename...Types>\
19295             struct TestNameClass{\
19296                 void reg_tests(){\
19297                     int index = 0;\
19298                     using expander = int[];\
19299                     (void)expander{(Catch::AutoReg( Catch::makeTestInvoker( &TestName<Types>::test ),
      CATCH_INTERNAL_LINEINFO, #ClassName, Catch::NameAndTags{ Name " - " +
      std::string(INTERNAL_CATCH_STRINGIZE(TmplList)) + " - " + std::to_string(index), Tags } ), index++)...
      };/* NOLINT */ \
19300                 }\
19301             };\
19302             static int INTERNAL_CATCH_UNIQUE_NAME( globalRegistrar ) = [](){\
19303                 using TestInit = typename convert<TestNameClass, TmplList>::type;\
19304                 TestInit t;\
19305                 t.reg_tests();\
19306                 return 0;\
19307             }(); \
19308         }}\
19309         CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
19310         template<typename TestType> \
19311         void TestName<TestType>::test()
19312
19313 #define INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD(ClassName, Name, Tags, TmplList) \
19314         INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD_2( INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_ ), INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_M_P_L_A_T_E_T_E_S_T_F_U_N_C_ ), ClassName, Name, Tags, TmplList )
19315
19316 // end catch_test_registry.h
19317 // start catch_capture.hpp
19318
19319 // start catch_assertionhandler.h
19320
19321 // start catch_assertioninfo.h
19322
19323 // start catch_result_type.h
19324
19325 namespace Catch {
19326
19327     // ResultWas::OfType enum
19328     struct ResultWas { enum OfType {
19329         Unknown = -1,
19330         Ok = 0,
19331         Info = 1,
19332         Warning = 2,
19333
19334         FailureBit = 0x10,
19335
19336         ExpressionFailed = FailureBit | 1,
19337         ExplicitFailure = FailureBit | 2,
19338
```

```
19339         Exception = 0x100 | FailureBit,
19340
19341         ThrewException = Exception | 1,
19342         DidntThrowException = Exception | 2,
19343
19344         FatalErrorCondition = 0x200 | FailureBit
19345
19346     }; };
19347
19348     bool isOk( ResultWas::OfType resultType );
19349     bool isJustInfo( int flags );
19350
19351     // ResultDisposition::Flags enum
19352     struct ResultDisposition { enum Flags {
19353         Normal = 0x01,
19354
19355         ContinueOnFailure = 0x02,   // Failures fail test, but execution continues
19356         FalseTest = 0x04,           // Prefix expression with !
19357         SuppressFail = 0x08         // Failures are reported but do not fail the test
19358     }; };
19359
19360     ResultDisposition::Flags operator | ( ResultDisposition::Flags lhs, ResultDisposition::Flags rhs
      );
19361
19362     bool shouldContinueOnFailure( int flags );
19363     inline bool isFalseTest( int flags ) { return ( flags & ResultDisposition::FalseTest ) != 0; }
19364     bool shouldSuppressFailure( int flags );
19365
19366 } // end namespace Catch
19367
19368 // end catch_result_type.h
19369 namespace Catch {
19370
19371     struct AssertionInfo
19372     {
19373         StringRef macroName;
19374         SourceLineInfo lineInfo;
19375         StringRef capturedExpression;
19376         ResultDisposition::Flags resultDisposition;
19377
19378         // We want to delete this constructor but a compiler bug in 4.8 means
19379         // the struct is then treated as non-aggregate
19380         //AssertionInfo() = delete;
19381     };
19382
19383 } // end namespace Catch
19384
19385 // end catch_assertioninfo.h
19386 // start catch_decomposer.h
19387
19388 // start catch_tostring.h
19389
19390 #include <vector>
19391 #include <cstddef>
19392 #include <type_traits>
19393 #include <string>
19394 // start catch_stream.h
19395
19396 #include <iosfwd>
19397 #include <cstddef>
19398 #include <ostream>
19399
19400 namespace Catch {
19401
19402     std::ostream& cout();
19403     std::ostream& cerr();
19404     std::ostream& clog();
19405
19406     class StringRef;
19407
19408     struct IStream {
19409         virtual ~IStream();
19410         virtual std::ostream& stream() const = 0;
19411     };
19412
19413     auto makeStream( StringRef const &filename ) -> IStream const*;
19414
19415     class ReusableStringStream : NonCopyable {
19416         std::size_t m_index;
19417         std::ostream* m_oss;
19418     public:
19419         ReusableStringStream();
19420         ~ReusableStringStream();
19421
19422         auto str() const -> std::string;
19423
19424         template<typename T>
```

```
19425         auto operator « ( T const& value ) -> ReusableStringStream& {
19426             *m_oss « value;
19427             return *this;
19428         }
19429         auto get() -> std::ostream& { return *m_oss; }
19430     };
19431 }
19432
19433 // end catch_stream.h
19434 // start catch_interfaces_enum_values_registry.h
19435
19436 #include <vector>
19437
19438 namespace Catch {
19439
19440     namespace Detail {
19441         struct EnumInfo {
19442             StringRef m_name;
19443             std::vector<std::pair<int, StringRef» m_values;
19444
19445             ~EnumInfo();
19446
19447             StringRef lookup( int value ) const;
19448         };
19449     } // namespace Detail
19450
19451     struct IMutableEnumValuesRegistry {
19452         virtual ~IMutableEnumValuesRegistry();
19453
19454         virtual Detail::EnumInfo const& registerEnum( StringRef enumName, StringRef allEnums,
      std::vector<int> const& values ) = 0;
19455
19456         template<typename E>
19457         Detail::EnumInfo const& registerEnum( StringRef enumName, StringRef allEnums,
      std::initializer_list<E> values ) {
19458             static_assert(sizeof(int) >= sizeof(E), "Cannot serialize enum to int");
19459             std::vector<int> intValues;
19460             intValues.reserve( values.size() );
19461             for( auto enumValue : values )
19462                 intValues.push_back( static_cast<int>( enumValue ) );
19463             return registerEnum( enumName, allEnums, intValues );
19464         }
19465     };
19466
19467 } // Catch
19468
19469 // end catch_interfaces_enum_values_registry.h
19470
19471 #ifdef CATCH_CONFIG_CPP17_STRING_VIEW
19472 #include <string_view>
19473 #endif
19474
19475 #ifdef __OBJC__
19476 // start catch_objc_arc.hpp
19477
19478 #import <Foundation/Foundation.h>
19479
19480 #ifdef __has_feature
19481 #define CATCH_ARC_ENABLED __has_feature(objc_arc)
19482 #else
19483 #define CATCH_ARC_ENABLED 0
19484 #endif
19485
19486 void arcSafeRelease( NSObject* obj );
19487 id performOptionalSelector( id obj, SEL sel );
19488
19489 #if !CATCH_ARC_ENABLED
19490 inline void arcSafeRelease( NSObject* obj ) {
19491     [obj release];
19492 }
19493 inline id performOptionalSelector( id obj, SEL sel ) {
19494     if( [obj respondsToSelector: sel] )
19495         return [obj performSelector: sel];
19496     return nil;
19497 }
19498 #define CATCH_UNSAFE_UNRETAINED
19499 #define CATCH_ARC_STRONG
19500 #else
19501 inline void arcSafeRelease( NSObject* ){}
19502 inline id performOptionalSelector( id obj, SEL sel ) {
19503 #ifdef __clang__
19504 #pragma clang diagnostic push
19505 #pragma clang diagnostic ignored "-Warc-performSelector-leaks"
19506 #endif
19507     if( [obj respondsToSelector: sel] )
19508         return [obj performSelector: sel];
19509 #ifdef __clang__
```

```
19510 #pragma clang diagnostic pop
19511 #endif
19512     return nil;
19513 }
19514 #define CATCH_UNSAFE_UNRETAINED __unsafe_unretained
19515 #define CATCH_ARC_STRONG __strong
19516 #endif
19517
19518 // end catch_objc_arc.hpp
19519 #endif
19520
19521 #ifdef _MSC_VER
19522 #pragma warning(push)
19523 #pragma warning(disable:4180) // We attempt to stream a function (address) by const&, which MSVC
      complains about but is harmless
19524 #endif
19525
19526 namespace Catch {
19527     namespace Detail {
19528
19529         extern const std::string unprintableString;
19530
19531         std::string rawMemoryToString( const void *object, std::size_t size );
19532
19533         template<typename T>
19534         std::string rawMemoryToString( const T& object ) {
19535           return rawMemoryToString( &object, sizeof(object) );
19536         }
19537
19538         template<typename T>
19539         class IsStreamInsertable {
19540             template<typename Stream, typename U>
19541             static auto test(int)
19542                 -> decltype(std::declval<Stream&>() << std::declval<U>(), std::true_type());
19543
19544             template<typename, typename>
19545             static auto test(...)->std::false_type;
19546
19547         public:
19548             static const bool value = decltype(test<std::ostream, const T&>(0))::value;
19549         };
19550
19551         template<typename E>
19552         std::string convertUnknownEnumToString( E e );
19553
19554         template<typename T>
19555         typename std::enable_if<
19556             !std::is_enum<T>::value && !std::is_base_of<std::exception, T>::value,
19557         std::string>::type convertUnstreamable( T const& ) {
19558             return Detail::unprintableString;
19559         }
19560         template<typename T>
19561         typename std::enable_if<
19562             !std::is_enum<T>::value && std::is_base_of<std::exception, T>::value,
19563          std::string>::type convertUnstreamable(T const& ex) {
19564             return ex.what();
19565         }
19566
19567         template<typename T>
19568         typename std::enable_if<
19569             std::is_enum<T>::value
19570         , std::string>::type convertUnstreamable( T const& value ) {
19571             return convertUnknownEnumToString( value );
19572         }
19573
19574 #if defined(_MANAGED)
19576         template<typename T>
19577         std::string clrReferenceToString( T^ ref ) {
19578             if (ref == nullptr)
19579                 return std::string("null");
19580             auto bytes = System::Text::Encoding::UTF8->GetBytes(ref->ToString());
19581             cli::pin_ptr<System::Byte> p = &bytes[0];
19582             return std::string(reinterpret_cast<char const *>(p), bytes->Length);
19583         }
19584 #endif
19585
19586     } // namespace Detail
19587
19588     // If we decide for C++14, change these to enable_if_ts
19589     template <typename T, typename = void>
19590     struct StringMaker {
19591         template <typename Fake = T>
19592         static
19593         typename std::enable_if<::Catch::Detail::IsStreamInsertable<Fake>::value, std::string>::type
19594             convert(const Fake& value) {
19595                 ReusableStringStream rss;
19596                 // NB: call using the function-like syntax to avoid ambiguity with
```

```
19597                 // user-defined templated operator« under clang.
19598                 rss.operator«(value);
19599                 return rss.str();
19600         }
19601
19602         template <typename Fake = T>
19603         static
19604         typename std::enable_if<!::Catch::Detail::IsStreamInsertable<Fake>::value, std::string>::type
19605             convert( const Fake& value ) {
19606 #if !defined(CATCH_CONFIG_FALLBACK_STRINGIFIER)
19607             return Detail::convertUnstreamable(value);
19608 #else
19609             return CATCH_CONFIG_FALLBACK_STRINGIFIER(value);
19610 #endif
19611         }
19612     };
19613
19614     namespace Detail {
19615
19616         // This function dispatches all stringification requests inside of Catch.
19617         // Should be preferably called fully qualified, like ::Catch::Detail::stringify
19618         template <typename T>
19619         std::string stringify(const T& e) {
19620             return ::Catch::StringMaker<typename std::remove_cv<typename
      std::remove_reference<T>::type>::type>::convert(e);
19621         }
19622
19623         template<typename E>
19624         std::string convertUnknownEnumToString( E e ) {
19625             return ::Catch::Detail::stringify(static_cast<typename std::underlying_type<E>::type>(e));
19626         }
19627
19628 #if defined(_MANAGED)
19629         template <typename T>
19630         std::string stringify( T^ e ) {
19631             return ::Catch::StringMaker<T^>::convert(e);
19632         }
19633 #endif
19634
19635     } // namespace Detail
19636
19637     // Some predefined specializations
19638
19639     template<>
19640     struct StringMaker<std::string> {
19641         static std::string convert(const std::string& str);
19642     };
19643
19644 #ifdef CATCH_CONFIG_CPP17_STRING_VIEW
19645     template<>
19646     struct StringMaker<std::string_view> {
19647         static std::string convert(std::string_view str);
19648     };
19649 #endif
19650
19651     template<>
19652     struct StringMaker<char const *> {
19653         static std::string convert(char const * str);
19654     };
19655     template<>
19656     struct StringMaker<char *> {
19657         static std::string convert(char * str);
19658     };
19659
19660 #ifdef CATCH_CONFIG_WCHAR
19661     template<>
19662     struct StringMaker<std::wstring> {
19663         static std::string convert(const std::wstring& wstr);
19664     };
19665
19666 # ifdef CATCH_CONFIG_CPP17_STRING_VIEW
19667     template<>
19668     struct StringMaker<std::wstring_view> {
19669         static std::string convert(std::wstring_view str);
19670     };
19671 # endif
19672
19673     template<>
19674     struct StringMaker<wchar_t const *> {
19675         static std::string convert(wchar_t const * str);
19676     };
19677     template<>
19678     struct StringMaker<wchar_t *> {
19679         static std::string convert(wchar_t * str);
19680     };
19681 #endif
19682
```

```
19683     // TBD: Should we use `strnlen` to ensure that we don't go out of the buffer,
19684     //      while keeping string semantics?
19685     template<int SZ>
19686     struct StringMaker<char[SZ]> {
19687         static std::string convert(char const* str) {
19688             return ::Catch::Detail::stringify(std::string{ str });
19689         }
19690     };
19691     template<int SZ>
19692     struct StringMaker<signed char[SZ]> {
19693         static std::string convert(signed char const* str) {
19694             return ::Catch::Detail::stringify(std::string{ reinterpret_cast<char const *>(str) });
19695         }
19696     };
19697     template<int SZ>
19698     struct StringMaker<unsigned char[SZ]> {
19699         static std::string convert(unsigned char const* str) {
19700             return ::Catch::Detail::stringify(std::string{ reinterpret_cast<char const *>(str) });
19701         }
19702     };
19703
19704 #if defined(CATCH_CONFIG_CPP17_BYTE)
19705     template<>
19706     struct StringMaker<std::byte> {
19707         static std::string convert(std::byte value);
19708     };
19709 #endif // defined(CATCH_CONFIG_CPP17_BYTE)
19710     template<>
19711     struct StringMaker<int> {
19712         static std::string convert(int value);
19713     };
19714     template<>
19715     struct StringMaker<long> {
19716         static std::string convert(long value);
19717     };
19718     template<>
19719     struct StringMaker<long long> {
19720         static std::string convert(long long value);
19721     };
19722     template<>
19723     struct StringMaker<unsigned int> {
19724         static std::string convert(unsigned int value);
19725     };
19726     template<>
19727     struct StringMaker<unsigned long> {
19728         static std::string convert(unsigned long value);
19729     };
19730     template<>
19731     struct StringMaker<unsigned long long> {
19732         static std::string convert(unsigned long long value);
19733     };
19734
19735     template<>
19736     struct StringMaker<bool> {
19737         static std::string convert(bool b);
19738     };
19739
19740     template<>
19741     struct StringMaker<char> {
19742         static std::string convert(char c);
19743     };
19744     template<>
19745     struct StringMaker<signed char> {
19746         static std::string convert(signed char c);
19747     };
19748     template<>
19749     struct StringMaker<unsigned char> {
19750         static std::string convert(unsigned char c);
19751     };
19752
19753     template<>
19754     struct StringMaker<std::nullptr_t> {
19755         static std::string convert(std::nullptr_t);
19756     };
19757
19758     template<>
19759     struct StringMaker<float> {
19760         static std::string convert(float value);
19761         static int precision;
19762     };
19763
19764     template<>
19765     struct StringMaker<double> {
19766         static std::string convert(double value);
19767         static int precision;
19768     };
19769
```

```
19770     template <typename T>
19771     struct StringMaker<T*> {
19772         template <typename U>
19773         static std::string convert(U* p) {
19774             if (p) {
19775                 return ::Catch::Detail::rawMemoryToString(p);
19776             } else {
19777                 return "nullptr";
19778             }
19779         }
19780     };
19781
19782     template <typename R, typename C>
19783     struct StringMaker<R C::*> {
19784         static std::string convert(R C::* p) {
19785             if (p) {
19786                 return ::Catch::Detail::rawMemoryToString(p);
19787             } else {
19788                 return "nullptr";
19789             }
19790         }
19791     };
19792
19793 #if defined(_MANAGED)
19794     template <typename T>
19795     struct StringMaker<T^> {
19796         static std::string convert( T^ ref ) {
19797             return ::Catch::Detail::clrReferenceToString(ref);
19798         }
19799     };
19800 #endif
19801
19802     namespace Detail {
19803         template<typename InputIterator, typename Sentinel = InputIterator>
19804         std::string rangeToString(InputIterator first, Sentinel last) {
19805             ReusableStringStream rss;
19806             rss << "{ ";
19807             if (first != last) {
19808                 rss << ::Catch::Detail::stringify(*first);
19809                 for (++first; first != last; ++first)
19810                     rss << ", " << ::Catch::Detail::stringify(*first);
19811             }
19812             rss << " }";
19813             return rss.str();
19814         }
19815     }
19816
19817 #ifdef __OBJC__
19818     template<>
19819     struct StringMaker<NSString*> {
19820         static std::string convert(NSString * nsstring) {
19821             if (!nsstring)
19822                 return "nil";
19823             return std::string("@") + [nsstring UTF8String];
19824         }
19825     };
19826     template<>
19827     struct StringMaker<NSObject*> {
19828         static std::string convert(NSObject* nsObject) {
19829             return ::Catch::Detail::stringify([nsObject description]);
19830         }
19831
19832     };
19833     namespace Detail {
19834         inline std::string stringify( NSString* nsstring ) {
19835             return StringMaker<NSString*>::convert( nsstring );
19836         }
19837
19838     } // namespace Detail
19839 #endif // __OBJC__
19840
19841 } // namespace Catch
19842
19844 // Separate std-lib types stringification, so it can be selectively enabled
19845 // This means that we do not bring in
19846
19847 #if defined(CATCH_CONFIG_ENABLE_ALL_STRINGMAKERS)
19848 #  define CATCH_CONFIG_ENABLE_PAIR_STRINGMAKER
19849 #  define CATCH_CONFIG_ENABLE_TUPLE_STRINGMAKER
19850 #  define CATCH_CONFIG_ENABLE_VARIANT_STRINGMAKER
19851 #  define CATCH_CONFIG_ENABLE_CHRONO_STRINGMAKER
19852 #  define CATCH_CONFIG_ENABLE_OPTIONAL_STRINGMAKER
19853 #endif
19854
19855 // Separate std::pair specialization
19856 #if defined(CATCH_CONFIG_ENABLE_PAIR_STRINGMAKER)
19857 #include <utility>
```

```
19858 namespace Catch {
19859     template<typename T1, typename T2>
19860     struct StringMaker<std::pair<T1, T2> > {
19861         static std::string convert(const std::pair<T1, T2>& pair) {
19862             ReusableStringStream rss;
19863             rss << "{ "
19864                 << ::Catch::Detail::stringify(pair.first)
19865                 << ", "
19866                 << ::Catch::Detail::stringify(pair.second)
19867                 << " }";
19868             return rss.str();
19869         }
19870     };
19871 }
19872 #endif // CATCH_CONFIG_ENABLE_PAIR_STRINGMAKER
19873
19874 #if defined(CATCH_CONFIG_ENABLE_OPTIONAL_STRINGMAKER) && defined(CATCH_CONFIG_CPP17_OPTIONAL)
19875 #include <optional>
19876 namespace Catch {
19877     template<typename T>
19878     struct StringMaker<std::optional<T> > {
19879         static std::string convert(const std::optional<T>& optional) {
19880             ReusableStringStream rss;
19881             if (optional.has_value()) {
19882                 rss << ::Catch::Detail::stringify(*optional);
19883             } else {
19884                 rss << "{ }";
19885             }
19886             return rss.str();
19887         }
19888     };
19889 }
19890 #endif // CATCH_CONFIG_ENABLE_OPTIONAL_STRINGMAKER
19891
19892 // Separate std::tuple specialization
19893 #if defined(CATCH_CONFIG_ENABLE_TUPLE_STRINGMAKER)
19894 #include <tuple>
19895 namespace Catch {
19896     namespace Detail {
19897         template<
19898             typename Tuple,
19899             std::size_t N = 0,
19900             bool = (N < std::tuple_size<Tuple>::value)
19901             >
19902             struct TupleElementPrinter {
19903             static void print(const Tuple& tuple, std::ostream& os) {
19904                 os << (N ? ", " : " ")
19905                     << ::Catch::Detail::stringify(std::get<N>(tuple));
19906                 TupleElementPrinter<Tuple, N + 1>::print(tuple, os);
19907             }
19908         };
19909
19910         template<
19911             typename Tuple,
19912             std::size_t N
19913         >
19914             struct TupleElementPrinter<Tuple, N, false> {
19915             static void print(const Tuple&, std::ostream&) {}
19916         };
19917
19918     }
19919
19920     template<typename ...Types>
19921     struct StringMaker<std::tuple<Types...>> {
19922         static std::string convert(const std::tuple<Types...>& tuple) {
19923             ReusableStringStream rss;
19924             rss << '{';
19925             Detail::TupleElementPrinter<std::tuple<Types...>>::print(tuple, rss.get());
19926             rss << " }";
19927             return rss.str();
19928         }
19929     };
19930 }
19931 #endif // CATCH_CONFIG_ENABLE_TUPLE_STRINGMAKER
19932
19933 #if defined(CATCH_CONFIG_ENABLE_VARIANT_STRINGMAKER) && defined(CATCH_CONFIG_CPP17_VARIANT)
19934 #include <variant>
19935 namespace Catch {
19936     template<>
19937     struct StringMaker<std::monostate> {
19938         static std::string convert(const std::monostate&) {
19939             return "{ }";
19940         }
19941     };
19942
19943     template<typename... Elements>
19944     struct StringMaker<std::variant<Elements...>> {
```

```
19945         static std::string convert(const std::variant<Elements...>& variant) {
19946             if (variant.valueless_by_exception()) {
19947                 return "{valueless variant}";
19948             } else {
19949                 return std::visit(
19950                     [](const auto& value) {
19951                         return ::Catch::Detail::stringify(value);
19952                     },
19953                     variant
19954                 );
19955             }
19956         }
19957     };
19958 }
19959 #endif // CATCH_CONFIG_ENABLE_VARIANT_STRINGMAKER
19960
19961 namespace Catch {
19962     // Import begin/ end from std here
19963     using std::begin;
19964     using std::end;
19965
19966     namespace detail {
19967         template <typename...>
19968         struct void_type {
19969             using type = void;
19970         };
19971
19972         template <typename T, typename = void>
19973         struct is_range_impl : std::false_type {
19974         };
19975
19976         template <typename T>
19977         struct is_range_impl<T, typename void_type<decltype(begin(std::declval<T>()))>::type> :
      std::true_type {
19978         };
19979     } // namespace detail
19980
19981     template <typename T>
19982     struct is_range : detail::is_range_impl<T> {
19983     };
19984
19985 #if defined(_MANAGED) // Managed types are never ranges
19986     template <typename T>
19987     struct is_range<T^> {
19988         static const bool value = false;
19989     };
19990 #endif
19991
19992     template<typename Range>
19993     std::string rangeToString( Range const& range ) {
19994         return ::Catch::Detail::rangeToString( begin( range ), end( range ) );
19995     }
19996
19997     // Handle vector<bool> specially
19998     template<typename Allocator>
19999     std::string rangeToString( std::vector<bool, Allocator> const& v ) {
20000         ReusableStringStream rss;
20001         rss << "{ ";
20002         bool first = true;
20003         for( bool b : v ) {
20004             if( first )
20005                 first = false;
20006             else
20007                 rss << ", ";
20008             rss << ::Catch::Detail::stringify( b );
20009         }
20010         rss << " }";
20011         return rss.str();
20012     }
20013
20014     template<typename R>
20015     struct StringMaker<R, typename std::enable_if<is_range<R>::value &&
      !::Catch::Detail::IsStreamInsertable<R>::value>::type> {
20016         static std::string convert( R const& range ) {
20017             return rangeToString( range );
20018         }
20019     };
20020
20021     template <typename T, int SZ>
20022     struct StringMaker<T[SZ]> {
20023         static std::string convert(T const(&arr)[SZ]) {
20024             return rangeToString(arr);
20025         }
20026     };
20027
20028 } // namespace Catch
20029
```

```
20030 // Separate std::chrono::duration specialization
20031 #if defined(CATCH_CONFIG_ENABLE_CHRONO_STRINGMAKER)
20032 #include <ctime>
20033 #include <ratio>
20034 #include <chrono>
20035
20036 namespace Catch {
20037
20038 template <class Ratio>
20039 struct ratio_string {
20040     static std::string symbol();
20041 };
20042
20043 template <class Ratio>
20044 std::string ratio_string<Ratio>::symbol() {
20045     Catch::ReusableStringStream rss;
20046     rss « '[' « Ratio::num « '/'
20047         « Ratio::den « ']';
20048     return rss.str();
20049 }
20050 template <>
20051 struct ratio_string<std::atto> {
20052     static std::string symbol();
20053 };
20054 template <>
20055 struct ratio_string<std::femto> {
20056     static std::string symbol();
20057 };
20058 template <>
20059 struct ratio_string<std::pico> {
20060     static std::string symbol();
20061 };
20062 template <>
20063 struct ratio_string<std::nano> {
20064     static std::string symbol();
20065 };
20066 template <>
20067 struct ratio_string<std::micro> {
20068     static std::string symbol();
20069 };
20070 template <>
20071 struct ratio_string<std::milli> {
20072     static std::string symbol();
20073 };
20074
20076     // std::chrono::duration specializations
20077     template<typename Value, typename Ratio>
20078     struct StringMaker<std::chrono::duration<Value, Ratio» {
20079         static std::string convert(std::chrono::duration<Value, Ratio> const& duration) {
20080             ReusableStringStream rss;
20081             rss « duration.count() « ' ' « ratio_string<Ratio>::symbol() « 's';
20082             return rss.str();
20083         }
20084     };
20085     template<typename Value>
20086     struct StringMaker<std::chrono::duration<Value, std::ratio<1»> {
20087         static std::string convert(std::chrono::duration<Value, std::ratio<1» const& duration) {
20088             ReusableStringStream rss;
20089             rss « duration.count() « " s";
20090             return rss.str();
20091         }
20092     };
20093     template<typename Value>
20094     struct StringMaker<std::chrono::duration<Value, std::ratio<60»> {
20095         static std::string convert(std::chrono::duration<Value, std::ratio<60» const& duration) {
20096             ReusableStringStream rss;
20097             rss « duration.count() « " m";
20098             return rss.str();
20099         }
20100     };
20101     template<typename Value>
20102     struct StringMaker<std::chrono::duration<Value, std::ratio<3600»> {
20103         static std::string convert(std::chrono::duration<Value, std::ratio<3600» const& duration) {
20104             ReusableStringStream rss;
20105             rss « duration.count() « " h";
20106             return rss.str();
20107         }
20108     };
20109
20111     // std::chrono::time_point specialization
20112     // Generic time_point cannot be specialized, only std::chrono::time_point<system_clock>
20113     template<typename Clock, typename Duration>
20114     struct StringMaker<std::chrono::time_point<Clock, Duration» {
20115         static std::string convert(std::chrono::time_point<Clock, Duration> const& time_point) {
20116             return ::Catch::Detail::stringify(time_point.time_since_epoch()) + " since epoch";
20117         }
20118     };
```

```
20119     // std::chrono::time_point<system_clock> specialization
20120     template<typename Duration>
20121     struct StringMaker<std::chrono::time_point<std::chrono::system_clock, Duration>> {
20122         static std::string convert(std::chrono::time_point<std::chrono::system_clock, Duration> const&
      time_point) {
20123             auto converted = std::chrono::system_clock::to_time_t(time_point);
20124
20125 #ifdef _MSC_VER
20126             std::tm timeInfo = {};
20127             gmtime_s(&timeInfo, &converted);
20128 #else
20129             std::tm* timeInfo = std::gmtime(&converted);
20130 #endif
20131
20132             auto const timeStampSize = sizeof("2017-01-16T17:06:45Z");
20133             char timeStamp[timeStampSize];
20134             const char * const fmt = "%Y-%m-%dT%H:%M:%SZ";
20135
20136 #ifdef _MSC_VER
20137             std::strftime(timeStamp, timeStampSize, fmt, &timeInfo);
20138 #else
20139             std::strftime(timeStamp, timeStampSize, fmt, timeInfo);
20140 #endif
20141             return std::string(timeStamp);
20142         }
20143     };
20144 }
20145 #endif // CATCH_CONFIG_ENABLE_CHRONO_STRINGMAKER
20146
20147 #define INTERNAL_CATCH_REGISTER_ENUM( enumName, ... ) \
20148 namespace Catch { \
20149     template<> struct StringMaker<enumName> { \
20150         static std::string convert( enumName value ) { \
20151             static const auto& enumInfo =
      ::Catch::getMutableRegistryHub().getMutableEnumValuesRegistry().registerEnum( #enumName, #__VA_ARGS__,
      { __VA_ARGS__ } ); \
20152             return static_cast<std::string>(enumInfo.lookup( static_cast<int>( value ) )); \
20153         } \
20154     }; \
20155 }
20156
20157 #define CATCH_REGISTER_ENUM( enumName, ... ) INTERNAL_CATCH_REGISTER_ENUM( enumName, __VA_ARGS__ )
20158
20159 #ifdef _MSC_VER
20160 #pragma warning(pop)
20161 #endif
20162
20163 // end catch_tostring.h
20164 #include <iosfwd>
20165
20166 #ifdef _MSC_VER
20167 #pragma warning(push)
20168 #pragma warning(disable:4389) // '==' : signed/unsigned mismatch
20169 #pragma warning(disable:4018) // more "signed/unsigned mismatch"
20170 #pragma warning(disable:4312) // Converting int to T* using reinterpret_cast (issue on x64 platform)
20171 #pragma warning(disable:4180) // qualifier applied to function type has no meaning
20172 #pragma warning(disable:4800) // Forcing result to true or false
20173 #endif
20174
20175 namespace Catch {
20176
20177     struct ITransientExpression {
20178         auto isBinaryExpression() const -> bool { return m_isBinaryExpression; }
20179         auto getResult() const -> bool { return m_result; }
20180         virtual void streamReconstructedExpression( std::ostream &os ) const = 0;
20181
20182         ITransientExpression( bool isBinaryExpression, bool result )
20183         :   m_isBinaryExpression( isBinaryExpression ),
20184             m_result( result )
20185         {}
20186
20187         // We don't actually need a virtual destructor, but many static analysers
20188         // complain if it's not here :-(
20189         virtual ~ITransientExpression();
20190
20191         bool m_isBinaryExpression;
20192         bool m_result;
20193
20194     };
20195
20196     void formatReconstructedExpression( std::ostream &os, std::string const& lhs, StringRef op,
      std::string const& rhs );
20197
20198     template<typename LhsT, typename RhsT>
20199     class BinaryExpr  : public ITransientExpression {
20200         LhsT m_lhs;
20201         StringRef m_op;
```

```
20202         RhsT m_rhs;
20203
20204         void streamReconstructedExpression( std::ostream &os ) const override {
20205             formatReconstructedExpression
20206                     ( os, Catch::Detail::stringify( m_lhs ), m_op, Catch::Detail::stringify( m_rhs )
      );
20207         }
20208
20209     public:
20210         BinaryExpr( bool comparisonResult, LhsT lhs, StringRef op, RhsT rhs )
20211         :   ITransientExpression{ true, comparisonResult },
20212             m_lhs( lhs ),
20213             m_op( op ),
20214             m_rhs( rhs )
20215         {}
20216
20217         template<typename T>
20218         auto operator && ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
20219             static_assert(always_false<T>::value,
20220             "chained comparisons are not supported inside assertions, "
20221             "wrap the expression inside parentheses, or decompose it");
20222         }
20223
20224         template<typename T>
20225         auto operator || ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
20226             static_assert(always_false<T>::value,
20227             "chained comparisons are not supported inside assertions, "
20228             "wrap the expression inside parentheses, or decompose it");
20229         }
20230
20231         template<typename T>
20232         auto operator == ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
20233             static_assert(always_false<T>::value,
20234             "chained comparisons are not supported inside assertions, "
20235             "wrap the expression inside parentheses, or decompose it");
20236         }
20237
20238         template<typename T>
20239         auto operator != ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
20240             static_assert(always_false<T>::value,
20241             "chained comparisons are not supported inside assertions, "
20242             "wrap the expression inside parentheses, or decompose it");
20243         }
20244
20245         template<typename T>
20246         auto operator > ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
20247             static_assert(always_false<T>::value,
20248             "chained comparisons are not supported inside assertions, "
20249             "wrap the expression inside parentheses, or decompose it");
20250         }
20251
20252         template<typename T>
20253         auto operator < ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
20254             static_assert(always_false<T>::value,
20255             "chained comparisons are not supported inside assertions, "
20256             "wrap the expression inside parentheses, or decompose it");
20257         }
20258
20259         template<typename T>
20260         auto operator >= ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
20261             static_assert(always_false<T>::value,
20262             "chained comparisons are not supported inside assertions, "
20263             "wrap the expression inside parentheses, or decompose it");
20264         }
20265
20266         template<typename T>
20267         auto operator <= ( T ) const -> BinaryExpr<LhsT, RhsT const&> const {
20268             static_assert(always_false<T>::value,
20269             "chained comparisons are not supported inside assertions, "
20270             "wrap the expression inside parentheses, or decompose it");
20271         }
20272     };
20273
20274     template<typename LhsT>
20275     class UnaryExpr : public ITransientExpression {
20276         LhsT m_lhs;
20277
20278         void streamReconstructedExpression( std::ostream &os ) const override {
20279             os « Catch::Detail::stringify( m_lhs );
20280         }
20281
20282     public:
20283         explicit UnaryExpr( LhsT lhs )
20284         :   ITransientExpression{ false, static_cast<bool>(lhs) },
20285             m_lhs( lhs )
20286         {}
20287     };
```

```
20288
20289     // Specialised comparison functions to handle equality comparisons between ints and pointers (NULL
      deduces as an int)
20290     template<typename LhsT, typename RhsT>
20291     auto compareEqual( LhsT const& lhs, RhsT const& rhs ) -> bool { return static_cast<bool>(lhs ==
      rhs); }
20292     template<typename T>
20293     auto compareEqual( T* const& lhs, int rhs ) -> bool { return lhs == reinterpret_cast<void const*>(
      rhs ); }
20294     template<typename T>
20295     auto compareEqual( T* const& lhs, long rhs ) -> bool { return lhs == reinterpret_cast<void
      const*>( rhs ); }
20296     template<typename T>
20297     auto compareEqual( int lhs, T* const& rhs ) -> bool { return reinterpret_cast<void const*>( lhs )
      == rhs; }
20298     template<typename T>
20299     auto compareEqual( long lhs, T* const& rhs ) -> bool { return reinterpret_cast<void const*>( lhs )
      == rhs; }
20300
20301     template<typename LhsT, typename RhsT>
20302     auto compareNotEqual( LhsT const& lhs, RhsT&& rhs ) -> bool { return static_cast<bool>(lhs !=
      rhs); }
20303     template<typename T>
20304     auto compareNotEqual( T* const& lhs, int rhs ) -> bool { return lhs != reinterpret_cast<void
      const*>( rhs ); }
20305     template<typename T>
20306     auto compareNotEqual( T* const& lhs, long rhs ) -> bool { return lhs != reinterpret_cast<void
      const*>( rhs ); }
20307     template<typename T>
20308     auto compareNotEqual( int lhs, T* const& rhs ) -> bool { return reinterpret_cast<void const*>( lhs
      ) != rhs; }
20309     template<typename T>
20310     auto compareNotEqual( long lhs, T* const& rhs ) -> bool { return reinterpret_cast<void const*>(
      lhs ) != rhs; }
20311
20312     template<typename LhsT>
20313     class ExprLhs {
20314         LhsT m_lhs;
20315     public:
20316         explicit ExprLhs( LhsT lhs ) : m_lhs( lhs ) {}
20317
20318         template<typename RhsT>
20319         auto operator == ( RhsT const& rhs ) -> BinaryExpr<LhsT, RhsT const&> const {
20320             return { compareEqual( m_lhs, rhs ), m_lhs, "==", rhs };
20321         }
20322         auto operator == ( bool rhs ) -> BinaryExpr<LhsT, bool> const {
20323             return { m_lhs == rhs, m_lhs, "==", rhs };
20324         }
20325
20326         template<typename RhsT>
20327         auto operator != ( RhsT const& rhs ) -> BinaryExpr<LhsT, RhsT const&> const {
20328             return { compareNotEqual( m_lhs, rhs ), m_lhs, "!=", rhs };
20329         }
20330         auto operator != ( bool rhs ) -> BinaryExpr<LhsT, bool> const {
20331             return { m_lhs != rhs, m_lhs, "!=", rhs };
20332         }
20333
20334         template<typename RhsT>
20335         auto operator > ( RhsT const& rhs ) -> BinaryExpr<LhsT, RhsT const&> const {
20336             return { static_cast<bool>(m_lhs > rhs), m_lhs, ">", rhs };
20337         }
20338         template<typename RhsT>
20339         auto operator < ( RhsT const& rhs ) -> BinaryExpr<LhsT, RhsT const&> const {
20340             return { static_cast<bool>(m_lhs < rhs), m_lhs, "<", rhs };
20341         }
20342         template<typename RhsT>
20343         auto operator >= ( RhsT const& rhs ) -> BinaryExpr<LhsT, RhsT const&> const {
20344             return { static_cast<bool>(m_lhs >= rhs), m_lhs, ">=", rhs };
20345         }
20346         template<typename RhsT>
20347         auto operator <= ( RhsT const& rhs ) -> BinaryExpr<LhsT, RhsT const&> const {
20348             return { static_cast<bool>(m_lhs <= rhs), m_lhs, "<=", rhs };
20349         }
20350         template <typename RhsT>
20351         auto operator | (RhsT const& rhs) -> BinaryExpr<LhsT, RhsT const&> const {
20352             return { static_cast<bool>(m_lhs | rhs), m_lhs, "|", rhs };
20353         }
20354         template <typename RhsT>
20355         auto operator & (RhsT const& rhs) -> BinaryExpr<LhsT, RhsT const&> const {
20356             return { static_cast<bool>(m_lhs & rhs), m_lhs, "&", rhs };
20357         }
20358         template <typename RhsT>
20359         auto operator ^ (RhsT const& rhs) -> BinaryExpr<LhsT, RhsT const&> const {
20360             return { static_cast<bool>(m_lhs ^ rhs), m_lhs, "^", rhs };
20361         }
20362
20363         template<typename RhsT>
```

```
20364         auto operator && ( RhsT const& ) -> BinaryExpr<LhsT, RhsT const&> const {
20365             static_assert(always_false<RhsT>::value,
20366             "operator&& is not supported inside assertions, "
20367             "wrap the expression inside parentheses, or decompose it");
20368         }
20369
20370         template<typename RhsT>
20371         auto operator || ( RhsT const& ) -> BinaryExpr<LhsT, RhsT const&> const {
20372             static_assert(always_false<RhsT>::value,
20373             "operator|| is not supported inside assertions, "
20374             "wrap the expression inside parentheses, or decompose it");
20375         }
20376
20377         auto makeUnaryExpr() const -> UnaryExpr<LhsT> {
20378             return UnaryExpr<LhsT>{ m_lhs };
20379         }
20380     };
20381
20382     void handleExpression( ITransientExpression const& expr );
20383
20384     template<typename T>
20385     void handleExpression( ExprLhs<T> const& expr ) {
20386         handleExpression( expr.makeUnaryExpr() );
20387     }
20388
20389     struct Decomposer {
20390         template<typename T>
20391         auto operator <= ( T const& lhs ) -> ExprLhs<T const&> {
20392             return ExprLhs<T const&>{ lhs };
20393         }
20394
20395         auto operator <=( bool value ) -> ExprLhs<bool> {
20396             return ExprLhs<bool>{ value };
20397         }
20398     };
20399
20400 } // end namespace Catch
20401
20402 #ifdef _MSC_VER
20403 #pragma warning(pop)
20404 #endif
20405
20406 // end catch_decomposer.h
20407 // start catch_interfaces_capture.h
20408
20409 #include <string>
20410 #include <chrono>
20411
20412 namespace Catch {
20413
20414     class AssertionResult;
20415     struct AssertionInfo;
20416     struct SectionInfo;
20417     struct SectionEndInfo;
20418     struct MessageInfo;
20419     struct MessageBuilder;
20420     struct Counts;
20421     struct AssertionReaction;
20422     struct SourceLineInfo;
20423
20424     struct ITransientExpression;
20425     struct IGeneratorTracker;
20426
20427 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
20428     struct BenchmarkInfo;
20429     template <typename Duration = std::chrono::duration<double, std::nano»
20430     struct BenchmarkStats;
20431 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
20432
20433     struct IResultCapture {
20434
20435         virtual ~IResultCapture();
20436
20437         virtual bool sectionStarted(    SectionInfo const& sectionInfo,
20438                                         Counts& assertions ) = 0;
20439         virtual void sectionEnded( SectionEndInfo const& endInfo ) = 0;
20440         virtual void sectionEndedEarly( SectionEndInfo const& endInfo ) = 0;
20441
20442         virtual auto acquireGeneratorTracker( StringRef generatorName, SourceLineInfo const& lineInfo
    ) -> IGeneratorTracker& = 0;
20443
20444 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
20445         virtual void benchmarkPreparing( std::string const& name ) = 0;
20446         virtual void benchmarkStarting( BenchmarkInfo const& info ) = 0;
20447         virtual void benchmarkEnded( BenchmarkStats<> const& stats ) = 0;
20448         virtual void benchmarkFailed( std::string const& error ) = 0;
20449 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
```

```
20450
20451         virtual void pushScopedMessage( MessageInfo const& message ) = 0;
20452         virtual void popScopedMessage( MessageInfo const& message ) = 0;
20453
20454         virtual void emplaceUnscopedMessage( MessageBuilder const& builder ) = 0;
20455
20456         virtual void handleFatalErrorCondition( StringRef message ) = 0;
20457
20458         virtual void handleExpr
20459                 (   AssertionInfo const& info,
20460                     ITransientExpression const& expr,
20461                     AssertionReaction& reaction ) = 0;
20462         virtual void handleMessage
20463                 (   AssertionInfo const& info,
20464                     ResultWas::OfType resultType,
20465                     StringRef const& message,
20466                     AssertionReaction& reaction ) = 0;
20467         virtual void handleUnexpectedExceptionNotThrown
20468                 (   AssertionInfo const& info,
20469                     AssertionReaction& reaction ) = 0;
20470         virtual void handleUnexpectedInflightException
20471                 (   AssertionInfo const& info,
20472                     std::string const& message,
20473                     AssertionReaction& reaction ) = 0;
20474         virtual void handleIncomplete
20475                 (   AssertionInfo const& info ) = 0;
20476         virtual void handleNonExpr
20477                 (   AssertionInfo const &info,
20478                     ResultWas::OfType resultType,
20479                     AssertionReaction &reaction ) = 0;
20480
20481         virtual bool lastAssertionPassed() = 0;
20482         virtual void assertionPassed() = 0;
20483
20484         // Deprecated, do not use:
20485         virtual std::string getCurrentTestName() const = 0;
20486         virtual const AssertionResult* getLastResult() const = 0;
20487         virtual void exceptionEarlyReported() = 0;
20488     };
20489
20490     IResultCapture& getResultCapture();
20491 }
20492
20493 // end catch_interfaces_capture.h
20494 namespace Catch {
20495
20496     struct TestFailureException{};
20497     struct AssertionResultData;
20498     struct IResultCapture;
20499     class RunContext;
20500
20501     class LazyExpression {
20502         friend class AssertionHandler;
20503         friend struct AssertionStats;
20504         friend class RunContext;
20505
20506         ITransientExpression const* m_transientExpression = nullptr;
20507         bool m_isNegated;
20508     public:
20509         LazyExpression( bool isNegated );
20510         LazyExpression( LazyExpression const& other );
20511         LazyExpression& operator = ( LazyExpression const& ) = delete;
20512
20513         explicit operator bool() const;
20514
20515         friend auto operator << ( std::ostream& os, LazyExpression const& lazyExpr ) -> std::ostream&;
20516     };
20517
20518     struct AssertionReaction {
20519         bool shouldDebugBreak = false;
20520         bool shouldThrow = false;
20521     };
20522
20523     class AssertionHandler {
20524         AssertionInfo m_assertionInfo;
20525         AssertionReaction m_reaction;
20526         bool m_completed = false;
20527         IResultCapture& m_resultCapture;
20528
20529     public:
20530         AssertionHandler
20531             (   StringRef const& macroName,
20532                 SourceLineInfo const& lineInfo,
20533                 StringRef capturedExpression,
20534                 ResultDisposition::Flags resultDisposition );
20535         ~AssertionHandler() {
20536             if ( !m_completed ) {
```

```
20537                 m_resultCapture.handleIncomplete( m_assertionInfo );
20538             }
20539         }
20540
20541         template<typename T>
20542         void handleExpr( ExprLhs<T> const& expr ) {
20543             handleExpr( expr.makeUnaryExpr() );
20544         }
20545         void handleExpr( ITransientExpression const& expr );
20546
20547         void handleMessage(ResultWas::OfType resultType, StringRef const& message);
20548
20549         void handleExceptionThrownAsExpected();
20550         void handleUnexpectedExceptionNotThrown();
20551         void handleExceptionNotThrownAsExpected();
20552         void handleThrowingCallSkipped();
20553         void handleUnexpectedInflightException();
20554
20555         void complete();
20556         void setCompleted();
20557
20558         // query
20559         auto allowThrows() const -> bool;
20560     };
20561
20562     void handleExceptionMatchExpr( AssertionHandler& handler, std::string const& str, StringRef const&
      matcherString );
20563
20564 } // namespace Catch
20565
20566 // end catch_assertionhandler.h
20567 // start catch_message.h
20568
20569 #include <string>
20570 #include <vector>
20571
20572 namespace Catch {
20573
20574     struct MessageInfo {
20575         MessageInfo(    StringRef const& _macroName,
20576                         SourceLineInfo const& _lineInfo,
20577                         ResultWas::OfType _type );
20578
20579         StringRef macroName;
20580         std::string message;
20581         SourceLineInfo lineInfo;
20582         ResultWas::OfType type;
20583         unsigned int sequence;
20584
20585         bool operator == ( MessageInfo const& other ) const;
20586         bool operator < ( MessageInfo const& other ) const;
20587     private:
20588         static unsigned int globalCount;
20589     };
20590
20591     struct MessageStream {
20592
20593         template<typename T>
20594         MessageStream& operator << ( T const& value ) {
20595             m_stream << value;
20596             return *this;
20597         }
20598
20599         ReusableStringStream m_stream;
20600     };
20601
20602     struct MessageBuilder : MessageStream {
20603         MessageBuilder( StringRef const& macroName,
20604                         SourceLineInfo const& lineInfo,
20605                         ResultWas::OfType type );
20606
20607         template<typename T>
20608         MessageBuilder& operator << ( T const& value ) {
20609             m_stream << value;
20610             return *this;
20611         }
20612
20613         MessageInfo m_info;
20614     };
20615
20616     class ScopedMessage {
20617     public:
20618         explicit ScopedMessage( MessageBuilder const& builder );
20619         ScopedMessage( ScopedMessage& duplicate ) = delete;
20620         ScopedMessage( ScopedMessage&& old );
20621         ~ScopedMessage();
20622
```

```
20623         MessageInfo m_info;
20624         bool m_moved;
20625     };
20626
20627     class Capturer {
20628         std::vector<MessageInfo> m_messages;
20629         IResultCapture& m_resultCapture = getResultCapture();
20630         size_t m_captured = 0;
20631     public:
20632         Capturer( StringRef macroName, SourceLineInfo const& lineInfo, ResultWas::OfType resultType,
      StringRef names );
20633         ~Capturer();
20634
20635         void captureValue( size_t index, std::string const& value );
20636
20637         template<typename T>
20638         void captureValues( size_t index, T const& value ) {
20639             captureValue( index, Catch::Detail::stringify( value ) );
20640         }
20641
20642         template<typename T, typename... Ts>
20643         void captureValues( size_t index, T const& value, Ts const&... values ) {
20644             captureValue( index, Catch::Detail::stringify(value) );
20645             captureValues( index+1, values... );
20646         }
20647     };
20648
20649 } // end namespace Catch
20650
20651 // end catch_message.h
20652 #if !defined(CATCH_CONFIG_DISABLE)
20653
20654 #if !defined(CATCH_CONFIG_DISABLE_STRINGIFICATION)
20655   #define CATCH_INTERNAL_STRINGIFY(...) #__VA_ARGS__
20656 #else
20657   #define CATCH_INTERNAL_STRINGIFY(...) "Disabled by CATCH_CONFIG_DISABLE_STRINGIFICATION"
20658 #endif
20659
20660 #if defined(CATCH_CONFIG_FAST_COMPILE) || defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
20661
20663 // Another way to speed-up compilation is to omit local try-catch for REQUIRE*
20664 // macros.
20665 #define INTERNAL_CATCH_TRY
20666 #define INTERNAL_CATCH_CATCH( capturer )
20667
20668 #else // CATCH_CONFIG_FAST_COMPILE
20669
20670 #define INTERNAL_CATCH_TRY try
20671 #define INTERNAL_CATCH_CATCH( handler ) catch(...) { handler.handleUnexpectedInflightException(); }
20672
20673 #endif
20674
20675 #define INTERNAL_CATCH_REACT( handler ) handler.complete();
20676
20678 #define INTERNAL_CATCH_TEST( macroName, resultDisposition, ... ) \
20679     do { \
20680         CATCH_INTERNAL_IGNORE_BUT_WARN(__VA_ARGS__); \
20681         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(__VA_ARGS__), resultDisposition ); \
20682         INTERNAL_CATCH_TRY { \
20683             CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
20684             CATCH_INTERNAL_SUPPRESS_PARENTHESES_WARNINGS \
20685             catchAssertionHandler.handleExpr( Catch::Decomposer() <= __VA_ARGS__ ); \
20686             CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
20687         } INTERNAL_CATCH_CATCH( catchAssertionHandler ) \
20688         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
20689     } while( (void)0, (false) && static_cast<bool>( !!(__VA_ARGS__) ) )
20690
20692 #define INTERNAL_CATCH_IF( macroName, resultDisposition, ... ) \
20693     INTERNAL_CATCH_TEST( macroName, resultDisposition, __VA_ARGS__ ); \
20694     if( Catch::getResultCapture().lastAssertionPassed() )
20695
20697 #define INTERNAL_CATCH_ELSE( macroName, resultDisposition, ... ) \
20698     INTERNAL_CATCH_TEST( macroName, resultDisposition, __VA_ARGS__ ); \
20699     if( !Catch::getResultCapture().lastAssertionPassed() )
20700
20702 #define INTERNAL_CATCH_NO_THROW( macroName, resultDisposition, ... ) \
20703     do { \
20704         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(__VA_ARGS__), resultDisposition ); \
20705         try { \
20706             static_cast<void>(__VA_ARGS__); \
20707             catchAssertionHandler.handleExceptionNotThrownAsExpected(); \
20708         } \
20709         catch( ... ) { \
20710             catchAssertionHandler.handleUnexpectedInflightException(); \
20711         } \
```

```
20712         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
20713     } while( false )
20714
20716 #define INTERNAL_CATCH_THROWS( macroName, resultDisposition, ... ) \
20717     do { \
20718         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(__VA_ARGS__), resultDisposition); \
20719         if( catchAssertionHandler.allowThrows() ) \
20720             try { \
20721                 static_cast<void>(__VA_ARGS__); \
20722                 catchAssertionHandler.handleUnexpectedExceptionNotThrown(); \
20723             } \
20724             catch( ... ) { \
20725                 catchAssertionHandler.handleExceptionThrownAsExpected(); \
20726             } \
20727         else \
20728             catchAssertionHandler.handleThrowingCallSkipped(); \
20729         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
20730     } while( false )
20731
20733 #define INTERNAL_CATCH_THROWS_AS( macroName, exceptionType, resultDisposition, expr ) \
20734     do { \
20735         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(expr) ", " CATCH_INTERNAL_STRINGIFY(exceptionType), resultDisposition ); \
20736         if( catchAssertionHandler.allowThrows() ) \
20737             try { \
20738                 static_cast<void>(expr); \
20739                 catchAssertionHandler.handleUnexpectedExceptionNotThrown(); \
20740             } \
20741             catch( exceptionType const& ) { \
20742                 catchAssertionHandler.handleExceptionThrownAsExpected(); \
20743             } \
20744             catch( ... ) { \
20745                 catchAssertionHandler.handleUnexpectedInflightException(); \
20746             } \
20747         else \
20748             catchAssertionHandler.handleThrowingCallSkipped(); \
20749         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
20750     } while( false )
20751
20753 #define INTERNAL_CATCH_MSG( macroName, messageType, resultDisposition, ... ) \
20754     do { \
20755         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      Catch::StringRef(), resultDisposition ); \
20756         catchAssertionHandler.handleMessage( messageType, ( Catch::MessageStream() << __VA_ARGS__ +
      ::Catch::StreamEndStop() ).m_stream.str() ); \
20757         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
20758     } while( false )
20759
20761 #define INTERNAL_CATCH_CAPTURE( varName, macroName, ... ) \
20762     auto varName = Catch::Capturer( macroName, CATCH_INTERNAL_LINEINFO, Catch::ResultWas::Info,
      #__VA_ARGS__ ); \
20763     varName.captureValues( 0, __VA_ARGS__ )
20764
20766 #define INTERNAL_CATCH_INFO( macroName, log ) \
20767     Catch::ScopedMessage INTERNAL_CATCH_UNIQUE_NAME( scopedMessage )( Catch::MessageBuilder(
      macroName##_catch_sr, CATCH_INTERNAL_LINEINFO, Catch::ResultWas::Info ) << log );
20768
20770 #define INTERNAL_CATCH_UNSCOPED_INFO( macroName, log ) \
20771     Catch::getResultCapture().emplaceUnscopedMessage( Catch::MessageBuilder( macroName##_catch_sr,
      CATCH_INTERNAL_LINEINFO, Catch::ResultWas::Info ) << log )
20772
20774 // Although this is matcher-based, it can be used with just a string
20775 #define INTERNAL_CATCH_THROWS_STR_MATCHES( macroName, resultDisposition, matcher, ... ) \
20776     do { \
20777         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(__VA_ARGS__) ", " CATCH_INTERNAL_STRINGIFY(matcher), resultDisposition ); \
20778         if( catchAssertionHandler.allowThrows() ) \
20779             try { \
20780                 static_cast<void>(__VA_ARGS__); \
20781                 catchAssertionHandler.handleUnexpectedExceptionNotThrown(); \
20782             } \
20783             catch( ... ) { \
20784                 Catch::handleExceptionMatchExpr( catchAssertionHandler, matcher, #matcher##_catch_sr
      ); \
20785             } \
20786         else \
20787             catchAssertionHandler.handleThrowingCallSkipped(); \
20788         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
20789     } while( false )
20790
20791 #endif // CATCH_CONFIG_DISABLE
20792
20793 // end catch_capture.hpp
20794 // start catch_section.h
20795
20796 // start catch_section_info.h
```

```
20797
20798 // start catch_totals.h
20799
20800 #include <cstddef>
20801
20802 namespace Catch {
20803
20804     struct Counts {
20805         Counts operator - ( Counts const& other ) const;
20806         Counts& operator += ( Counts const& other );
20807
20808         std::size_t total() const;
20809         bool allPassed() const;
20810         bool allOk() const;
20811
20812         std::size_t passed = 0;
20813         std::size_t failed = 0;
20814         std::size_t failedButOk = 0;
20815     };
20816
20817     struct Totals {
20818
20819         Totals operator - ( Totals const& other ) const;
20820         Totals& operator += ( Totals const& other );
20821
20822         Totals delta( Totals const& prevTotals ) const;
20823
20824         int error = 0;
20825         Counts assertions;
20826         Counts testCases;
20827     };
20828 }
20829
20830 // end catch_totals.h
20831 #include <string>
20832
20833 namespace Catch {
20834
20835     struct SectionInfo {
20836         SectionInfo
20837             (   SourceLineInfo const& _lineInfo,
20838                 std::string const& _name );
20839
20840         // Deprecated
20841         SectionInfo
20842             (   SourceLineInfo const& _lineInfo,
20843                 std::string const& _name,
20844                 std::string const& ) : SectionInfo( _lineInfo, _name ) {}
20845
20846         std::string name;
20847         std::string description; // !Deprecated: this will always be empty
20848         SourceLineInfo lineInfo;
20849     };
20850
20851     struct SectionEndInfo {
20852         SectionInfo sectionInfo;
20853         Counts prevAssertions;
20854         double durationInSeconds;
20855     };
20856
20857 } // end namespace Catch
20858
20859 // end catch_section_info.h
20860 // start catch_timer.h
20861
20862 #include <cstdint>
20863
20864 namespace Catch {
20865
20866     auto getCurrentNanosecondsSinceEpoch() -> uint64_t;
20867     auto getEstimatedClockResolution() -> uint64_t;
20868
20869     class Timer {
20870         uint64_t m_nanoseconds = 0;
20871     public:
20872         void start();
20873         auto getElapsedNanoseconds() const -> uint64_t;
20874         auto getElapsedMicroseconds() const -> uint64_t;
20875         auto getElapsedMilliseconds() const -> unsigned int;
20876         auto getElapsedSeconds() const -> double;
20877     };
20878
20879 } // namespace Catch
20880
20881 // end catch_timer.h
20882 #include <string>
20883
```

```
20884 namespace Catch {
20885
20886     class Section : NonCopyable {
20887     public:
20888         Section( SectionInfo const& info );
20889         ~Section();
20890
20891         // This indicates whether the section should be executed or not
20892         explicit operator bool() const;
20893
20894     private:
20895         SectionInfo m_info;
20896
20897         std::string m_name;
20898         Counts m_assertions;
20899         bool m_sectionIncluded;
20900         Timer m_timer;
20901     };
20902
20903 } // end namespace Catch
20904
20905 #define INTERNAL_CATCH_SECTION( ... ) \
20906     CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
20907     CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS \
20908     if( Catch::Section const& INTERNAL_CATCH_UNIQUE_NAME( catch_internal_Section ) =
    Catch::SectionInfo( CATCH_INTERNAL_LINEINFO, __VA_ARGS__ ) ) \
20909     CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
20910
20911 #define INTERNAL_CATCH_DYNAMIC_SECTION( ... ) \
20912     CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
20913     CATCH_INTERNAL_SUPPRESS_UNUSED_WARNINGS \
20914     if( Catch::Section const& INTERNAL_CATCH_UNIQUE_NAME( catch_internal_Section ) =
    Catch::SectionInfo( CATCH_INTERNAL_LINEINFO, (Catch::ReusableStringStream() << __VA_ARGS__).str() ) ) \
20915     CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
20916
20917 // end catch_section.h
20918 // start catch_interfaces_exception.h
20919
20920 // start catch_interfaces_registry_hub.h
20921
20922 #include <string>
20923 #include <memory>
20924
20925 namespace Catch {
20926
20927     class TestCase;
20928     struct ITestCaseRegistry;
20929     struct IExceptionTranslatorRegistry;
20930     struct IExceptionTranslator;
20931     struct IReporterRegistry;
20932     struct IReporterFactory;
20933     struct ITagAliasRegistry;
20934     struct IMutableEnumValuesRegistry;
20935
20936     class StartupExceptionRegistry;
20937
20938     using IReporterFactoryPtr = std::shared_ptr<IReporterFactory>;
20939
20940     struct IRegistryHub {
20941         virtual ~IRegistryHub();
20942
20943         virtual IReporterRegistry const& getReporterRegistry() const = 0;
20944         virtual ITestCaseRegistry const& getTestCaseRegistry() const = 0;
20945         virtual ITagAliasRegistry const& getTagAliasRegistry() const = 0;
20946         virtual IExceptionTranslatorRegistry const& getExceptionTranslatorRegistry() const = 0;
20947
20948         virtual StartupExceptionRegistry const& getStartupExceptionRegistry() const = 0;
20949     };
20950
20951     struct IMutableRegistryHub {
20952         virtual ~IMutableRegistryHub();
20953         virtual void registerReporter( std::string const& name, IReporterFactoryPtr const& factory ) =
    0;
20954         virtual void registerListener( IReporterFactoryPtr const& factory ) = 0;
20955         virtual void registerTest( TestCase const& testInfo ) = 0;
20956         virtual void registerTranslator( const IExceptionTranslator* translator ) = 0;
20957         virtual void registerTagAlias( std::string const& alias, std::string const& tag,
    SourceLineInfo const& lineInfo ) = 0;
20958         virtual void registerStartupException() noexcept = 0;
20959         virtual IMutableEnumValuesRegistry& getMutableEnumValuesRegistry() = 0;
20960     };
20961
20962     IRegistryHub const& getRegistryHub();
20963     IMutableRegistryHub& getMutableRegistryHub();
20964     void cleanUp();
20965     std::string translateActiveException();
20966
```

```
20967 }
20968
20969 // end catch_interfaces_registry_hub.h
20970 #if defined(CATCH_CONFIG_DISABLE)
20971     #define INTERNAL_CATCH_TRANSLATE_EXCEPTION_NO_REG( translatorName, signature) \
20972         static std::string translatorName( signature )
20973 #endif
20974
20975 #include <exception>
20976 #include <string>
20977 #include <vector>
20978
20979 namespace Catch {
20980     using exceptionTranslateFunction = std::string(*)();
20981
20982     struct IExceptionTranslator;
20983     using ExceptionTranslators = std::vector<std::unique_ptr<IExceptionTranslator const»;
20984
20985     struct IExceptionTranslator {
20986         virtual ~IExceptionTranslator();
20987         virtual std::string translate( ExceptionTranslators::const_iterator it,
      ExceptionTranslators::const_iterator itEnd ) const = 0;
20988     };
20989
20990     struct IExceptionTranslatorRegistry {
20991         virtual ~IExceptionTranslatorRegistry();
20992
20993         virtual std::string translateActiveException() const = 0;
20994     };
20995
20996     class ExceptionTranslatorRegistrar {
20997         template<typename T>
20998         class ExceptionTranslator : public IExceptionTranslator {
20999         public:
21000
21001             ExceptionTranslator( std::string(*translateFunction)( T& ) )
21002             : m_translateFunction( translateFunction )
21003             {}
21004
21005             std::string translate( ExceptionTranslators::const_iterator it,
      ExceptionTranslators::const_iterator itEnd ) const override {
21006 #if defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
21007                 return "";
21008 #else
21009                 try {
21010                     if( it == itEnd )
21011                         std::rethrow_exception(std::current_exception());
21012                     else
21013                         return (*it)->translate( it+1, itEnd );
21014                 }
21015                 catch( T& ex ) {
21016                     return m_translateFunction( ex );
21017                 }
21018 #endif
21019             }
21020
21021         protected:
21022             std::string(*m_translateFunction)( T& );
21023         };
21024
21025     public:
21026         template<typename T>
21027         ExceptionTranslatorRegistrar( std::string(*translateFunction)( T& ) ) {
21028             getMutableRegistryHub().registerTranslator
21029                 ( new ExceptionTranslator<T>( translateFunction ) );
21030         }
21031     };
21032 }
21033
21035 #define INTERNAL_CATCH_TRANSLATE_EXCEPTION2( translatorName, signature ) \
21036     static std::string translatorName( signature ); \
21037     CATCH_INTERNAL_START_WARNINGS_SUPPRESSION \
21038     CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS \
21039     namespace{ Catch::ExceptionTranslatorRegistrar INTERNAL_CATCH_UNIQUE_NAME(
      catch_internal_ExceptionRegistrar )( &translatorName ); } \
21040     CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION \
21041     static std::string translatorName( signature )
21042
21043 #define INTERNAL_CATCH_TRANSLATE_EXCEPTION( signature ) INTERNAL_CATCH_TRANSLATE_EXCEPTION2(
      INTERNAL_CATCH_UNIQUE_NAME( catch_internal_ExceptionTranslator ), signature )
21044
21045 // end catch_interfaces_exception.h
21046 // start catch_approx.h
21047
21048 #include <type_traits>
21049
21050 namespace Catch {
```

```
21051 namespace Detail {
21052
21053     class Approx {
21054     private:
21055         bool equalityComparisonImpl(double other) const;
21056         // Validates the new margin (margin >= 0)
21057         // out-of-line to avoid including stdexcept in the header
21058         void setMargin(double margin);
21059         // Validates the new epsilon (0 < epsilon < 1)
21060         // out-of-line to avoid including stdexcept in the header
21061         void setEpsilon(double epsilon);
21062
21063     public:
21064         explicit Approx ( double value );
21065
21066         static Approx custom();
21067
21068         Approx operator-() const;
21069
21070         template <typename T, typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21071         Approx operator()( T const& value ) const {
21072             Approx approx( static_cast<double>(value) );
21073             approx.m_epsilon = m_epsilon;
21074             approx.m_margin = m_margin;
21075             approx.m_scale = m_scale;
21076             return approx;
21077         }
21078
21079         template <typename T, typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21080         explicit Approx( T const& value ): Approx(static_cast<double>(value))
21081         {}
21082
21083         template <typename T, typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21084         friend bool operator == ( const T& lhs, Approx const& rhs ) {
21085             auto lhs_v = static_cast<double>(lhs);
21086             return rhs.equalityComparisonImpl(lhs_v);
21087         }
21088
21089         template <typename T, typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21090         friend bool operator == ( Approx const& lhs, const T& rhs ) {
21091             return operator==( rhs, lhs );
21092         }
21093
21094         template <typename T, typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21095         friend bool operator != ( T const& lhs, Approx const& rhs ) {
21096             return !operator==( lhs, rhs );
21097         }
21098
21099         template <typename T, typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21100         friend bool operator != ( Approx const& lhs, T const& rhs ) {
21101             return !operator==( rhs, lhs );
21102         }
21103
21104         template <typename T, typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21105         friend bool operator <= ( T const& lhs, Approx const& rhs ) {
21106             return static_cast<double>(lhs) < rhs.m_value || lhs == rhs;
21107         }
21108
21109         template <typename T, typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21110         friend bool operator <= ( Approx const& lhs, T const& rhs ) {
21111             return lhs.m_value < static_cast<double>(rhs) || lhs == rhs;
21112         }
21113
21114         template <typename T, typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21115         friend bool operator >= ( T const& lhs, Approx const& rhs ) {
21116             return static_cast<double>(lhs) > rhs.m_value || lhs == rhs;
21117         }
21118
21119         template <typename T, typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21120         friend bool operator >= ( Approx const& lhs, T const& rhs ) {
21121             return lhs.m_value > static_cast<double>(rhs) || lhs == rhs;
21122         }
21123
21124         template <typename T, typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21125         Approx& epsilon( T const& newEpsilon ) {
21126             double epsilonAsDouble = static_cast<double>(newEpsilon);
```

```
21127             setEpsilon(epsilonAsDouble);
21128             return *this;
21129         }
21130
21131         template <typename T, typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21132         Approx& margin( T const& newMargin ) {
21133             double marginAsDouble = static_cast<double>(newMargin);
21134             setMargin(marginAsDouble);
21135             return *this;
21136         }
21137
21138         template <typename T, typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21139         Approx& scale( T const& newScale ) {
21140             m_scale = static_cast<double>(newScale);
21141             return *this;
21142         }
21143
21144         std::string toString() const;
21145
21146     private:
21147         double m_epsilon;
21148         double m_margin;
21149         double m_scale;
21150         double m_value;
21151     };
21152 } // end namespace Detail
21153
21154 namespace literals {
21155     Detail::Approx operator "" _a(long double val);
21156     Detail::Approx operator "" _a(unsigned long long val);
21157 } // end namespace literals
21158
21159 template<>
21160 struct StringMaker<Catch::Detail::Approx> {
21161     static std::string convert(Catch::Detail::Approx const& value);
21162 };
21163
21164 } // end namespace Catch
21165
21166 // end catch_approx.h
21167 // start catch_string_manip.h
21168
21169 #include <string>
21170 #include <iosfwd>
21171 #include <vector>
21172
21173 namespace Catch {
21174
21175     bool startsWith( std::string const& s, std::string const& prefix );
21176     bool startsWith( std::string const& s, char prefix );
21177     bool endsWith( std::string const& s, std::string const& suffix );
21178     bool endsWith( std::string const& s, char suffix );
21179     bool contains( std::string const& s, std::string const& infix );
21180     void toLowerInPlace( std::string& s );
21181     std::string toLower( std::string const& s );
21183     std::string trim( std::string const& str );
21185     StringRef trim(StringRef ref);
21186
21187     // !!! Be aware, returns refs into original string - make sure original string outlives them
21188     std::vector<StringRef> splitStringRef( StringRef str, char delimiter );
21189     bool replaceInPlace( std::string& str, std::string const& replaceThis, std::string const& withThis
      );
21190
21191     struct pluralise {
21192         pluralise( std::size_t count, std::string const& label );
21193
21194         friend std::ostream& operator << ( std::ostream& os, pluralise const& pluraliser );
21195
21196         std::size_t m_count;
21197         std::string m_label;
21198     };
21199 }
21200
21201 // end catch_string_manip.h
21202 #ifndef CATCH_CONFIG_DISABLE_MATCHERS
21203 // start catch_capture_matchers.h
21204
21205 // start catch_matchers.h
21206
21207 #include <string>
21208 #include <vector>
21209
21210 namespace Catch {
21211 namespace Matchers {
21212     namespace Impl {
```

```
21213
21214         template<typename ArgT> struct MatchAllOf;
21215         template<typename ArgT> struct MatchAnyOf;
21216         template<typename ArgT> struct MatchNotOf;
21217
21218         class MatcherUntypedBase {
21219         public:
21220             MatcherUntypedBase() = default;
21221             MatcherUntypedBase ( MatcherUntypedBase const& ) = default;
21222             MatcherUntypedBase& operator = ( MatcherUntypedBase const& ) = delete;
21223             std::string toString() const;
21224
21225         protected:
21226             virtual ~MatcherUntypedBase();
21227             virtual std::string describe() const = 0;
21228             mutable std::string m_cachedToString;
21229         };
21230
21231 #ifdef __clang__
21232 #    pragma clang diagnostic push
21233 #    pragma clang diagnostic ignored "-Wnon-virtual-dtor"
21234 #endif
21235
21236         template<typename ObjectT>
21237         struct MatcherMethod {
21238             virtual bool match( ObjectT const& arg ) const = 0;
21239         };
21240
21241 #if defined(__OBJC__)
21242         // Hack to fix Catch GH issue #1661. Could use id for generic Object support.
21243         // use of const for Object pointers is very uncommon and under ARC it causes some kind of
     signature mismatch that breaks compilation
21244         template<>
21245         struct MatcherMethod<NSString*> {
21246             virtual bool match( NSString* arg ) const = 0;
21247         };
21248 #endif
21249
21250 #ifdef __clang__
21251 #    pragma clang diagnostic pop
21252 #endif
21253
21254         template<typename T>
21255         struct MatcherBase : MatcherUntypedBase, MatcherMethod<T> {
21256
21257             MatchAllOf<T> operator && ( MatcherBase const& other ) const;
21258             MatchAnyOf<T> operator || ( MatcherBase const& other ) const;
21259             MatchNotOf<T> operator ! () const;
21260         };
21261
21262         template<typename ArgT>
21263         struct MatchAllOf : MatcherBase<ArgT> {
21264             bool match( ArgT const& arg ) const override {
21265                 for( auto matcher : m_matchers ) {
21266                     if (!matcher->match(arg))
21267                         return false;
21268                 }
21269                 return true;
21270             }
21271             std::string describe() const override {
21272                 std::string description;
21273                 description.reserve( 4 + m_matchers.size()*32 );
21274                 description += "( ";
21275                 bool first = true;
21276                 for( auto matcher : m_matchers ) {
21277                     if( first )
21278                         first = false;
21279                     else
21280                         description += " and ";
21281                     description += matcher->toString();
21282                 }
21283                 description += " )";
21284                 return description;
21285             }
21286
21287             MatchAllOf<ArgT> operator && ( MatcherBase<ArgT> const& other ) {
21288                 auto copy(*this);
21289                 copy.m_matchers.push_back( &other );
21290                 return copy;
21291             }
21292
21293             std::vector<MatcherBase<ArgT> const*> m_matchers;
21294         };
21295         template<typename ArgT>
21296         struct MatchAnyOf : MatcherBase<ArgT> {
21297
21298             bool match( ArgT const& arg ) const override {
```

```
21299                 for( auto matcher : m_matchers ) {
21300                     if (matcher->match(arg))
21301                         return true;
21302                 }
21303                 return false;
21304             }
21305             std::string describe() const override {
21306                 std::string description;
21307                 description.reserve( 4 + m_matchers.size()*32 );
21308                 description += "( ";
21309                 bool first = true;
21310                 for( auto matcher : m_matchers ) {
21311                     if( first )
21312                         first = false;
21313                     else
21314                         description += " or ";
21315                     description += matcher->toString();
21316                 }
21317                 description += " )";
21318                 return description;
21319             }
21320
21321             MatchAnyOf<ArgT> operator || ( MatcherBase<ArgT> const& other ) {
21322                 auto copy(*this);
21323                 copy.m_matchers.push_back( &other );
21324                 return copy;
21325             }
21326
21327             std::vector<MatcherBase<ArgT> const*> m_matchers;
21328         };
21329
21330         template<typename ArgT>
21331         struct MatchNotOf : MatcherBase<ArgT> {
21332
21333             MatchNotOf( MatcherBase<ArgT> const& underlyingMatcher ) : m_underlyingMatcher(
      underlyingMatcher ) {}
21334
21335             bool match( ArgT const& arg ) const override {
21336                 return !m_underlyingMatcher.match( arg );
21337             }
21338
21339             std::string describe() const override {
21340                 return "not " + m_underlyingMatcher.toString();
21341             }
21342             MatcherBase<ArgT> const& m_underlyingMatcher;
21343         };
21344
21345         template<typename T>
21346         MatchAllOf<T> MatcherBase<T>::operator && ( MatcherBase const& other ) const {
21347             return MatchAllOf<T>() && *this && other;
21348         }
21349         template<typename T>
21350         MatchAnyOf<T> MatcherBase<T>::operator || ( MatcherBase const& other ) const {
21351             return MatchAnyOf<T>() || *this || other;
21352         }
21353         template<typename T>
21354         MatchNotOf<T> MatcherBase<T>::operator ! () const {
21355             return MatchNotOf<T>( *this );
21356         }
21357
21358     } // namespace Impl
21359
21360 } // namespace Matchers
21361
21362 using namespace Matchers;
21363 using Matchers::Impl::MatcherBase;
21364
21365 } // namespace Catch
21366
21367 // end catch_matchers.h
21368 // start catch_matchers_exception.hpp
21369
21370 namespace Catch {
21371 namespace Matchers {
21372 namespace Exception {
21373
21374 class ExceptionMessageMatcher : public MatcherBase<std::exception> {
21375     std::string m_message;
21376 public:
21377
21378     ExceptionMessageMatcher(std::string const& message):
21379         m_message(message)
21380     {}
21381
21382     bool match(std::exception const& ex) const override;
21383
21384     std::string describe() const override;
```

```
21385 };
21386
21387 } // namespace Exception
21388
21389 Exception::ExceptionMessageMatcher Message(std::string const& message);
21390
21391 } // namespace Matchers
21392 } // namespace Catch
21393
21394 // end catch_matchers_exception.hpp
21395 // start catch_matchers_floating.h
21396
21397 namespace Catch {
21398 namespace Matchers {
21399
21400     namespace Floating {
21401
21402         enum class FloatingPointKind : uint8_t;
21403
21404         struct WithinAbsMatcher : MatcherBase<double> {
21405             WithinAbsMatcher(double target, double margin);
21406             bool match(double const& matchee) const override;
21407             std::string describe() const override;
21408         private:
21409             double m_target;
21410             double m_margin;
21411         };
21412
21413         struct WithinUlpsMatcher : MatcherBase<double> {
21414             WithinUlpsMatcher(double target, uint64_t ulps, FloatingPointKind baseType);
21415             bool match(double const& matchee) const override;
21416             std::string describe() const override;
21417         private:
21418             double m_target;
21419             uint64_t m_ulps;
21420             FloatingPointKind m_type;
21421         };
21422
21423         // Given IEEE-754 format for floats and doubles, we can assume
21424         // that float -> double promotion is lossless. Given this, we can
21425         // assume that if we do the standard relative comparison of
21426         // |lhs - rhs| <= epsilon * max(fabs(lhs), fabs(rhs)), then we get
21427         // the same result if we do this for floats, as if we do this for
21428         // doubles that were promoted from floats.
21429         struct WithinRelMatcher : MatcherBase<double> {
21430             WithinRelMatcher(double target, double epsilon);
21431             bool match(double const& matchee) const override;
21432             std::string describe() const override;
21433         private:
21434             double m_target;
21435             double m_epsilon;
21436         };
21437
21438     } // namespace Floating
21439
21440     // The following functions create the actual matcher objects.
21441     // This allows the types to be inferred
21442     Floating::WithinUlpsMatcher WithinULP(double target, uint64_t maxUlpDiff);
21443     Floating::WithinUlpsMatcher WithinULP(float target, uint64_t maxUlpDiff);
21444     Floating::WithinAbsMatcher WithinAbs(double target, double margin);
21445     Floating::WithinRelMatcher WithinRel(double target, double eps);
21446     // defaults epsilon to 100*numeric_limits<double>::epsilon()
21447     Floating::WithinRelMatcher WithinRel(double target);
21448     Floating::WithinRelMatcher WithinRel(float target, float eps);
21449     // defaults epsilon to 100*numeric_limits<float>::epsilon()
21450     Floating::WithinRelMatcher WithinRel(float target);
21451
21452 } // namespace Matchers
21453 } // namespace Catch
21454
21455 // end catch_matchers_floating.h
21456 // start catch_matchers_generic.hpp
21457
21458 #include <functional>
21459 #include <string>
21460
21461 namespace Catch {
21462 namespace Matchers {
21463 namespace Generic {
21464
21465 namespace Detail {
21466     std::string finalizeDescription(const std::string& desc);
21467 }
21468
21469 template <typename T>
21470 class PredicateMatcher : public MatcherBase<T> {
21471     std::function<bool(T const&)> m_predicate;
```

```
21472     std::string m_description;
21473 public:
21474
21475     PredicateMatcher(std::function<bool(T const&)> const& elem, std::string const& descr)
21476         :m_predicate(std::move(elem)),
21477         m_description(Detail::finalizeDescription(descr))
21478     {}
21479
21480     bool match( T const& item ) const override {
21481         return m_predicate(item);
21482     }
21483
21484     std::string describe() const override {
21485         return m_description;
21486     }
21487 };
21488
21489 } // namespace Generic
21490
21491     // The following functions create the actual matcher objects.
21492     // The user has to explicitly specify type to the function, because
21493     // inferring std::function<bool(T const&)> is hard (but possible) and
21494     // requires a lot of TMP.
21495     template<typename T>
21496     Generic::PredicateMatcher<T> Predicate(std::function<bool(T const&)> const& predicate, std::string
    const& description = "") {
21497         return Generic::PredicateMatcher<T>(predicate, description);
21498     }
21499
21500 } // namespace Matchers
21501 } // namespace Catch
21502
21503 // end catch_matchers_generic.hpp
21504 // start catch_matchers_string.h
21505
21506 #include <string>
21507
21508 namespace Catch {
21509 namespace Matchers {
21510
21511     namespace StdString {
21512
21513         struct CasedString
21514         {
21515             CasedString( std::string const& str, CaseSensitive::Choice caseSensitivity );
21516             std::string adjustString( std::string const& str ) const;
21517             std::string caseSensitivitySuffix() const;
21518
21519             CaseSensitive::Choice m_caseSensitivity;
21520             std::string m_str;
21521         };
21522
21523         struct StringMatcherBase : MatcherBase<std::string> {
21524             StringMatcherBase( std::string const& operation, CasedString const& comparator );
21525             std::string describe() const override;
21526
21527             CasedString m_comparator;
21528             std::string m_operation;
21529         };
21530
21531         struct EqualsMatcher : StringMatcherBase {
21532             EqualsMatcher( CasedString const& comparator );
21533             bool match( std::string const& source ) const override;
21534         };
21535         struct ContainsMatcher : StringMatcherBase {
21536             ContainsMatcher( CasedString const& comparator );
21537             bool match( std::string const& source ) const override;
21538         };
21539         struct StartsWithMatcher : StringMatcherBase {
21540             StartsWithMatcher( CasedString const& comparator );
21541             bool match( std::string const& source ) const override;
21542         };
21543         struct EndsWithMatcher : StringMatcherBase {
21544             EndsWithMatcher( CasedString const& comparator );
21545             bool match( std::string const& source ) const override;
21546         };
21547
21548         struct RegexMatcher : MatcherBase<std::string> {
21549             RegexMatcher( std::string regex, CaseSensitive::Choice caseSensitivity );
21550             bool match( std::string const& matchee ) const override;
21551             std::string describe() const override;
21552
21553         private:
21554             std::string m_regex;
21555             CaseSensitive::Choice m_caseSensitivity;
21556         };
21557
```

```
21558     } // namespace StdString
21559
21560     // The following functions create the actual matcher objects.
21561     // This allows the types to be inferred
21562
21563     StdString::EqualsMatcher Equals( std::string const& str, CaseSensitive::Choice caseSensitivity =
      CaseSensitive::Yes );
21564     StdString::ContainsMatcher Contains( std::string const& str, CaseSensitive::Choice caseSensitivity
      = CaseSensitive::Yes );
21565     StdString::EndsWithMatcher EndsWith( std::string const& str, CaseSensitive::Choice caseSensitivity
      = CaseSensitive::Yes );
21566     StdString::StartsWithMatcher StartsWith( std::string const& str, CaseSensitive::Choice
      caseSensitivity = CaseSensitive::Yes );
21567     StdString::RegexMatcher Matches( std::string const& regex, CaseSensitive::Choice caseSensitivity =
      CaseSensitive::Yes );
21568
21569 } // namespace Matchers
21570 } // namespace Catch
21571
21572 // end catch_matchers_string.h
21573 // start catch_matchers_vector.h
21574
21575 #include <algorithm>
21576
21577 namespace Catch {
21578 namespace Matchers {
21579
21580     namespace Vector {
21581         template<typename T, typename Alloc>
21582         struct ContainsElementMatcher : MatcherBase<std::vector<T, Alloc>> {
21583
21584             ContainsElementMatcher(T const &comparator) : m_comparator( comparator) {}
21585
21586             bool match(std::vector<T, Alloc> const &v) const override {
21587                 for (auto const& el : v) {
21588                     if (el == m_comparator) {
21589                         return true;
21590                     }
21591                 }
21592                 return false;
21593             }
21594
21595             std::string describe() const override {
21596                 return "Contains: " + ::Catch::Detail::stringify( m_comparator );
21597             }
21598
21599             T const& m_comparator;
21600         };
21601
21602         template<typename T, typename AllocComp, typename AllocMatch>
21603         struct ContainsMatcher : MatcherBase<std::vector<T, AllocMatch>> {
21604
21605             ContainsMatcher(std::vector<T, AllocComp> const &comparator) : m_comparator( comparator )
      {}
21606
21607             bool match(std::vector<T, AllocMatch> const &v) const override {
21608                 // !TBD: see note in EqualsMatcher
21609                 if (m_comparator.size() > v.size())
21610                     return false;
21611                 for (auto const& comparator : m_comparator) {
21612                     auto present = false;
21613                     for (const auto& el : v) {
21614                         if (el == comparator) {
21615                             present = true;
21616                             break;
21617                         }
21618                     }
21619                     if (!present) {
21620                         return false;
21621                     }
21622                 }
21623                 return true;
21624             }
21625             std::string describe() const override {
21626                 return "Contains: " + ::Catch::Detail::stringify( m_comparator );
21627             }
21628
21629             std::vector<T, AllocComp> const& m_comparator;
21630         };
21631
21632         template<typename T, typename AllocComp, typename AllocMatch>
21633         struct EqualsMatcher : MatcherBase<std::vector<T, AllocMatch>> {
21634
21635             EqualsMatcher(std::vector<T, AllocComp> const &comparator) : m_comparator( comparator ) {}
21636
21637             bool match(std::vector<T, AllocMatch> const &v) const override {
21638                 // !TBD: This currently works if all elements can be compared using !=
```

```
21639                 // - a more general approach would be via a compare template that defaults
21640                 // to using !=. but could be specialised for, e.g. std::vector<T, Alloc> etc
21641                 // - then just call that directly
21642                 if (m_comparator.size() != v.size())
21643                     return false;
21644                 for (std::size_t i = 0; i < v.size(); ++i)
21645                     if (m_comparator[i] != v[i])
21646                         return false;
21647                 return true;
21648             }
21649             std::string describe() const override {
21650                 return "Equals: " + ::Catch::Detail::stringify( m_comparator );
21651             }
21652             std::vector<T, AllocComp> const& m_comparator;
21653         };
21654
21655         template<typename T, typename AllocComp, typename AllocMatch>
21656         struct ApproxMatcher : MatcherBase<std::vector<T, AllocMatch>> {
21657
21658             ApproxMatcher(std::vector<T, AllocComp> const& comparator) : m_comparator( comparator ) {}
21659
21660             bool match(std::vector<T, AllocMatch> const &v) const override {
21661                 if (m_comparator.size() != v.size())
21662                     return false;
21663                 for (std::size_t i = 0; i < v.size(); ++i)
21664                     if (m_comparator[i] != approx(v[i]))
21665                         return false;
21666                 return true;
21667             }
21668             std::string describe() const override {
21669                 return "is approx: " + ::Catch::Detail::stringify( m_comparator );
21670             }
21671             template <typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21672             ApproxMatcher& epsilon( T const& newEpsilon ) {
21673                 approx.epsilon(newEpsilon);
21674                 return *this;
21675             }
21676             template <typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21677             ApproxMatcher& margin( T const& newMargin ) {
21678                 approx.margin(newMargin);
21679                 return *this;
21680             }
21681             template <typename = typename std::enable_if<std::is_constructible<double,
      T>::value>::type>
21682             ApproxMatcher& scale( T const& newScale ) {
21683                 approx.scale(newScale);
21684                 return *this;
21685             }
21686
21687             std::vector<T, AllocComp> const& m_comparator;
21688             mutable Catch::Detail::Approx approx = Catch::Detail::Approx::custom();
21689         };
21690
21691         template<typename T, typename AllocComp, typename AllocMatch>
21692         struct UnorderedEqualsMatcher : MatcherBase<std::vector<T, AllocMatch>> {
21693             UnorderedEqualsMatcher(std::vector<T, AllocComp> const& target) : m_target(target) {}
21694             bool match(std::vector<T, AllocMatch> const& vec) const override {
21695                 if (m_target.size() != vec.size()) {
21696                     return false;
21697                 }
21698                 return std::is_permutation(m_target.begin(), m_target.end(), vec.begin());
21699             }
21700
21701             std::string describe() const override {
21702                 return "UnorderedEquals: " + ::Catch::Detail::stringify(m_target);
21703             }
21704         private:
21705             std::vector<T, AllocComp> const& m_target;
21706         };
21707
21708     } // namespace Vector
21709
21710     // The following functions create the actual matcher objects.
21711     // This allows the types to be inferred
21712
21713     template<typename T, typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
21714     Vector::ContainsMatcher<T, AllocComp, AllocMatch> Contains( std::vector<T, AllocComp> const&
      comparator ) {
21715         return Vector::ContainsMatcher<T, AllocComp, AllocMatch>( comparator );
21716     }
21717
21718     template<typename T, typename Alloc = std::allocator<T>>
21719     Vector::ContainsElementMatcher<T, Alloc> VectorContains( T const& comparator ) {
21720         return Vector::ContainsElementMatcher<T, Alloc>( comparator );
21721     }
```

```
21722
21723     template<typename T, typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
21724     Vector::EqualsMatcher<T, AllocComp, AllocMatch> Equals( std::vector<T, AllocComp> const&
      comparator ) {
21725         return Vector::EqualsMatcher<T, AllocComp, AllocMatch>( comparator );
21726     }
21727
21728     template<typename T, typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
21729     Vector::ApproxMatcher<T, AllocComp, AllocMatch> Approx( std::vector<T, AllocComp> const&
      comparator ) {
21730         return Vector::ApproxMatcher<T, AllocComp, AllocMatch>( comparator );
21731     }
21732
21733     template<typename T, typename AllocComp = std::allocator<T>, typename AllocMatch = AllocComp>
21734     Vector::UnorderedEqualsMatcher<T, AllocComp, AllocMatch> UnorderedEquals(std::vector<T, AllocComp>
      const& target) {
21735         return Vector::UnorderedEqualsMatcher<T, AllocComp, AllocMatch>( target );
21736     }
21737
21738 } // namespace Matchers
21739 } // namespace Catch
21740
21741 // end catch_matchers_vector.h
21742 namespace Catch {
21743
21744     template<typename ArgT, typename MatcherT>
21745     class MatchExpr : public ITransientExpression {
21746         ArgT const& m_arg;
21747         MatcherT m_matcher;
21748         StringRef m_matcherString;
21749     public:
21750         MatchExpr( ArgT const& arg, MatcherT const& matcher, StringRef const& matcherString )
21751         :   ITransientExpression{ true, matcher.match( arg ) },
21752             m_arg( arg ),
21753             m_matcher( matcher ),
21754             m_matcherString( matcherString )
21755         {}
21756
21757         void streamReconstructedExpression( std::ostream &os ) const override {
21758             auto matcherAsString = m_matcher.toString();
21759             os « Catch::Detail::stringify( m_arg ) « ' ';
21760             if( matcherAsString == Detail::unprintableString )
21761                 os « m_matcherString;
21762             else
21763                 os « matcherAsString;
21764         }
21765     };
21766
21767     using StringMatcher = Matchers::Impl::MatcherBase<std::string>;
21768
21769     void handleExceptionMatchExpr( AssertionHandler& handler, StringMatcher const& matcher, StringRef
      const& matcherString  );
21770
21771     template<typename ArgT, typename MatcherT>
21772     auto makeMatchExpr( ArgT const& arg, MatcherT const& matcher, StringRef const& matcherString  ) ->
      MatchExpr<ArgT, MatcherT> {
21773         return MatchExpr<ArgT, MatcherT>( arg, matcher, matcherString );
21774     }
21775
21776 } // namespace Catch
21777
21779 #define INTERNAL_CHECK_THAT( macroName, matcher, resultDisposition, arg ) \
21780     do { \
21781         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(arg) ", " CATCH_INTERNAL_STRINGIFY(matcher), resultDisposition ); \
21782         INTERNAL_CATCH_TRY { \
21783             catchAssertionHandler.handleExpr( Catch::makeMatchExpr( arg, matcher, #matcher##_catch_sr
      ) ); \
21784         } INTERNAL_CATCH_CATCH( catchAssertionHandler ) \
21785         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
21786     } while( false )
21787
21789 #define INTERNAL_CATCH_THROWS_MATCHES( macroName, exceptionType, resultDisposition, matcher, ... ) \
21790     do { \
21791         Catch::AssertionHandler catchAssertionHandler( macroName##_catch_sr, CATCH_INTERNAL_LINEINFO,
      CATCH_INTERNAL_STRINGIFY(__VA_ARGS__) ", " CATCH_INTERNAL_STRINGIFY(exceptionType) ", "
      CATCH_INTERNAL_STRINGIFY(matcher), resultDisposition ); \
21792         if( catchAssertionHandler.allowThrows() ) \
21793             try { \
21794                 static_cast<void>(__VA_ARGS__ ); \
21795                 catchAssertionHandler.handleUnexpectedExceptionNotThrown(); \
21796             } \
21797             catch( exceptionType const& ex ) { \
21798                 catchAssertionHandler.handleExpr( Catch::makeMatchExpr( ex, matcher,
      #matcher##_catch_sr ) ); \
21799             } \
21800             catch( ... ) { \
```

```
21801                 catchAssertionHandler.handleUnexpectedInflightException(); \
21802             } \
21803         else \
21804             catchAssertionHandler.handleThrowingCallSkipped(); \
21805         INTERNAL_CATCH_REACT( catchAssertionHandler ) \
21806     } while( false )
21807
21808 // end catch_capture_matchers.h
21809 #endif
21810 // start catch_generators.hpp
21811
21812 // start catch_interfaces_generatortracker.h
21813
21814
21815 #include <memory>
21816
21817 namespace Catch {
21818
21819     namespace Generators {
21820         class GeneratorUntypedBase {
21821         public:
21822             GeneratorUntypedBase() = default;
21823             virtual ~GeneratorUntypedBase();
21824             // Attempts to move the generator to the next element
21825              //
21826              // Returns true iff the move succeeded (and a valid element
21827              // can be retrieved).
21828             virtual bool next() = 0;
21829         };
21830         using GeneratorBasePtr = std::unique_ptr<GeneratorUntypedBase>;
21831
21832     } // namespace Generators
21833
21834     struct IGeneratorTracker {
21835         virtual ~IGeneratorTracker();
21836         virtual auto hasGenerator() const -> bool = 0;
21837         virtual auto getGenerator() const -> Generators::GeneratorBasePtr const& = 0;
21838         virtual void setGenerator( Generators::GeneratorBasePtr&& generator ) = 0;
21839     };
21840
21841 } // namespace Catch
21842
21843 // end catch_interfaces_generatortracker.h
21844 // start catch_enforce.h
21845
21846 #include <exception>
21847
21848 namespace Catch {
21849 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
21850     template <typename Ex>
21851     [[noreturn]]
21852     void throw_exception(Ex const& e) {
21853         throw e;
21854     }
21855 #else // ^^ Exceptions are enabled //  Exceptions are disabled vv
21856     [[noreturn]]
21857     void throw_exception(std::exception const& e);
21858 #endif
21859
21860     [[noreturn]]
21861     void throw_logic_error(std::string const& msg);
21862     [[noreturn]]
21863     void throw_domain_error(std::string const& msg);
21864     [[noreturn]]
21865     void throw_runtime_error(std::string const& msg);
21866
21867 } // namespace Catch;
21868
21869 #define CATCH_MAKE_MSG(...) \
21870     (Catch::ReusableStringStream() << __VA_ARGS__).str()
21871
21872 #define CATCH_INTERNAL_ERROR(...) \
21873     Catch::throw_logic_error(CATCH_MAKE_MSG( CATCH_INTERNAL_LINEINFO << ": Internal Catch2 error: " <<
    __VA_ARGS__))
21874
21875 #define CATCH_ERROR(...) \
21876     Catch::throw_domain_error(CATCH_MAKE_MSG( __VA_ARGS__ ))
21877
21878 #define CATCH_RUNTIME_ERROR(...) \
21879     Catch::throw_runtime_error(CATCH_MAKE_MSG( __VA_ARGS__ ))
21880
21881 #define CATCH_ENFORCE( condition, ... ) \
21882     do{ if( !(condition) ) CATCH_ERROR( __VA_ARGS__ ); } while(false)
21883
21884 // end catch_enforce.h
21885 #include <memory>
21886 #include <vector>
```

```
21887 #include <cassert>
21888
21889 #include <utility>
21890 #include <exception>
21891
21892 namespace Catch {
21893
21894 class GeneratorException : public std::exception {
21895     const char* const m_msg = "";
21896
21897 public:
21898     GeneratorException(const char* msg):
21899         m_msg(msg)
21900     {}
21901
21902     const char* what() const noexcept override final;
21903 };
21904
21905 namespace Generators {
21906
21907     // !TBD move this into its own location?
21908     namespace pf{
21909         template<typename T, typename... Args>
21910         std::unique_ptr<T> make_unique( Args&&... args ) {
21911             return std::unique_ptr<T>(new T(std::forward<Args>(args)...));
21912         }
21913     }
21914
21915     template<typename T>
21916     struct IGenerator : GeneratorUntypedBase {
21917         virtual ~IGenerator() = default;
21918
21919         // Returns the current element of the generator
21920         //
21921         // \Precondition The generator is either freshly constructed,
21922         // or the last call to `next()` returned true
21923         virtual T const& get() const = 0;
21924         using type = T;
21925     };
21926
21927     template<typename T>
21928     class SingleValueGenerator final : public IGenerator<T> {
21929         T m_value;
21930     public:
21931         SingleValueGenerator(T&& value) : m_value(std::move(value)) {}
21932
21933         T const& get() const override {
21934             return m_value;
21935         }
21936         bool next() override {
21937             return false;
21938         }
21939     };
21940
21941     template<typename T>
21942     class FixedValuesGenerator final : public IGenerator<T> {
21943         static_assert(!std::is_same<T, bool>::value,
21944             "FixedValuesGenerator does not support bools because of std::vector<bool>"
21945             "specialization, use SingleValue Generator instead.");
21946         std::vector<T> m_values;
21947         size_t m_idx = 0;
21948     public:
21949         FixedValuesGenerator( std::initializer_list<T> values ) : m_values( values ) {}
21950
21951         T const& get() const override {
21952             return m_values[m_idx];
21953         }
21954         bool next() override {
21955             ++m_idx;
21956             return m_idx < m_values.size();
21957         }
21958     };
21959
21960     template <typename T>
21961     class GeneratorWrapper final {
21962         std::unique_ptr<IGenerator<T>> m_generator;
21963     public:
21964         GeneratorWrapper(std::unique_ptr<IGenerator<T>> generator):
21965             m_generator(std::move(generator))
21966         {}
21967         T const& get() const {
21968             return m_generator->get();
21969         }
21970         bool next() {
21971             return m_generator->next();
21972         }
21973     };
```

```
21974
21975     template <typename T>
21976     GeneratorWrapper<T> value(T&& value) {
21977         return GeneratorWrapper<T>(pf::make_unique<SingleValueGenerator<T»(std::forward<T>(value)));
21978     }
21979     template <typename T>
21980     GeneratorWrapper<T> values(std::initializer_list<T> values) {
21981         return GeneratorWrapper<T>(pf::make_unique<FixedValuesGenerator<T»(values));
21982     }
21983
21984     template<typename T>
21985     class Generators : public IGenerator<T> {
21986         std::vector<GeneratorWrapper<T» m_generators;
21987         size_t m_current = 0;
21988
21989         void populate(GeneratorWrapper<T>&& generator) {
21990             m_generators.emplace_back(std::move(generator));
21991         }
21992         void populate(T&& val) {
21993             m_generators.emplace_back(value(std::forward<T>(val)));
21994         }
21995         template<typename U>
21996         void populate(U&& val) {
21997             populate(T(std::forward<U>(val)));
21998         }
21999         template<typename U, typename... Gs>
22000         void populate(U&& valueOrGenerator, Gs &&... moreGenerators) {
22001             populate(std::forward<U>(valueOrGenerator));
22002             populate(std::forward<Gs>(moreGenerators)...);
22003         }
22004
22005     public:
22006         template <typename... Gs>
22007         Generators(Gs &&... moreGenerators) {
22008             m_generators.reserve(sizeof...(Gs));
22009             populate(std::forward<Gs>(moreGenerators)...);
22010         }
22011
22012         T const& get() const override {
22013             return m_generators[m_current].get();
22014         }
22015
22016         bool next() override {
22017             if (m_current >= m_generators.size()) {
22018                 return false;
22019             }
22020             const bool current_status = m_generators[m_current].next();
22021             if (!current_status) {
22022                 ++m_current;
22023             }
22024             return m_current < m_generators.size();
22025         }
22026     };
22027
22028     template<typename... Ts>
22029     GeneratorWrapper<std::tuple<Ts...» table( std::initializer_list<std::tuple<typename
     std::decay<Ts>::type...» tuples ) {
22030         return values<std::tuple<Ts...»( tuples );
22031     }
22032
22033     // Tag type to signal that a generator sequence should convert arguments to a specific type
22034     template <typename T>
22035     struct as {};
22036
22037     template<typename T, typename... Gs>
22038     auto makeGenerators( GeneratorWrapper<T>&& generator, Gs &&... moreGenerators ) -> Generators<T> {
22039         return Generators<T>(std::move(generator), std::forward<Gs>(moreGenerators)...);
22040     }
22041     template<typename T>
22042     auto makeGenerators( GeneratorWrapper<T>&& generator ) -> Generators<T> {
22043         return Generators<T>(std::move(generator));
22044     }
22045     template<typename T, typename... Gs>
22046     auto makeGenerators( T&& val, Gs &&... moreGenerators ) -> Generators<T> {
22047         return makeGenerators( value( std::forward<T>( val ) ), std::forward<Gs>( moreGenerators )...
     );
22048     }
22049     template<typename T, typename U, typename... Gs>
22050     auto makeGenerators( as<T>, U&& val, Gs &&... moreGenerators ) -> Generators<T> {
22051         return makeGenerators( value( T( std::forward<U>( val ) ) ), std::forward<Gs>( moreGenerators
     )... );
22052     }
22053
22054     auto acquireGeneratorTracker( StringRef generatorName, SourceLineInfo const& lineInfo ) ->
     IGeneratorTracker&;
22055
22056     template<typename L>
```

```
22057     // Note: The type after -> is weird, because VS2015 cannot parse
22058     //       the expression used in the typedef inside, when it is in
22059     //       return type. Yeah.
22060     auto generate( StringRef generatorName, SourceLineInfo const& lineInfo, L const&
      generatorExpression ) -> decltype(std::declval<decltype(generatorExpression())>().get()) {
22061         using UnderlyingType = typename decltype(generatorExpression())::type;
22062
22063         IGeneratorTracker& tracker = acquireGeneratorTracker( generatorName, lineInfo );
22064         if (!tracker.hasGenerator()) {
22065             tracker.setGenerator(pf::make_unique<Generators<UnderlyingType»(generatorExpression()));
22066         }
22067
22068         auto const& generator = static_cast<IGenerator<UnderlyingType> const&>(
      *tracker.getGenerator() );
22069         return generator.get();
22070     }
22071
22072 } // namespace Generators
22073 } // namespace Catch
22074
22075 #define GENERATE( ... ) \
22076     Catch::Generators::generate( INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_UNIQUE_NAME(generator)), \
22077                                  CATCH_INTERNAL_LINEINFO, \
22078                                  [ ]{ using namespace Catch::Generators; return makeGenerators(
      __VA_ARGS__ ); } ) //NOLINT(google-build-using-namespace)
22079 #define GENERATE_COPY( ... ) \
22080     Catch::Generators::generate( INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_UNIQUE_NAME(generator)), \
22081                                  CATCH_INTERNAL_LINEINFO, \
22082                                  [=]{ using namespace Catch::Generators; return makeGenerators(
      __VA_ARGS__ ); } ) //NOLINT(google-build-using-namespace)
22083 #define GENERATE_REF( ... ) \
22084     Catch::Generators::generate( INTERNAL_CATCH_STRINGIZE(INTERNAL_CATCH_UNIQUE_NAME(generator)), \
22085                                  CATCH_INTERNAL_LINEINFO, \
22086                                  [&]{ using namespace Catch::Generators; return makeGenerators(
      __VA_ARGS__ ); } ) //NOLINT(google-build-using-namespace)
22087
22088 // end catch_generators.hpp
22089 // start catch_generators_generic.hpp
22090
22091 namespace Catch {
22092 namespace Generators {
22093
22094     template <typename T>
22095     class TakeGenerator : public IGenerator<T> {
22096         GeneratorWrapper<T> m_generator;
22097         size_t m_returned = 0;
22098         size_t m_target;
22099     public:
22100         TakeGenerator(size_t target, GeneratorWrapper<T>&& generator):
22101             m_generator(std::move(generator)),
22102             m_target(target)
22103         {
22104             assert(target != 0 && "Empty generators are not allowed");
22105         }
22106         T const& get() const override {
22107             return m_generator.get();
22108         }
22109         bool next() override {
22110             ++m_returned;
22111             if (m_returned >= m_target) {
22112                 return false;
22113             }
22114
22115             const auto success = m_generator.next();
22116             // If the underlying generator does not contain enough values
22117             // then we cut short as well
22118             if (!success) {
22119                 m_returned = m_target;
22120             }
22121             return success;
22122         }
22123     };
22124
22125     template <typename T>
22126     GeneratorWrapper<T> take(size_t target, GeneratorWrapper<T>&& generator) {
22127         return GeneratorWrapper<T>(pf::make_unique<TakeGenerator<T»(target, std::move(generator)));
22128     }
22129
22130     template <typename T, typename Predicate>
22131     class FilterGenerator : public IGenerator<T> {
22132         GeneratorWrapper<T> m_generator;
22133         Predicate m_predicate;
22134     public:
22135         template <typename P = Predicate>
22136         FilterGenerator(P&& pred, GeneratorWrapper<T>&& generator):
22137             m_generator(std::move(generator)),
22138             m_predicate(std::forward<P>(pred))
```

```
22139         {
22140             if (!m_predicate(m_generator.get())) {
22141                 // It might happen that there are no values that pass the
22142                 // filter. In that case we throw an exception.
22143                 auto has_initial_value = nextImpl();
22144                 if (!has_initial_value) {
22145                     Catch::throw_exception(GeneratorException("No valid value found in filtered
      generator"));
22146                 }
22147             }
22148         }
22149
22150         T const& get() const override {
22151             return m_generator.get();
22152         }
22153
22154         bool next() override {
22155             return nextImpl();
22156         }
22157
22158     private:
22159         bool nextImpl() {
22160             bool success = m_generator.next();
22161             if (!success) {
22162                 return false;
22163             }
22164             while (!m_predicate(m_generator.get()) && (success = m_generator.next()) == true);
22165             return success;
22166         }
22167     };
22168
22169     template <typename T, typename Predicate>
22170     GeneratorWrapper<T> filter(Predicate&& pred, GeneratorWrapper<T>&& generator) {
22171         return GeneratorWrapper<T>(std::unique_ptr<IGenerator<T>>(pf::make_unique<FilterGenerator<T,
      Predicate>>(std::forward<Predicate>(pred), std::move(generator))));
22172     }
22173
22174     template <typename T>
22175     class RepeatGenerator : public IGenerator<T> {
22176         static_assert(!std::is_same<T, bool>::value,
22177             "RepeatGenerator currently does not support bools"
22178             "because of std::vector<bool> specialization");
22179         GeneratorWrapper<T> m_generator;
22180         mutable std::vector<T> m_returned;
22181         size_t m_target_repeats;
22182         size_t m_current_repeat = 0;
22183         size_t m_repeat_index = 0;
22184     public:
22185         RepeatGenerator(size_t repeats, GeneratorWrapper<T>&& generator):
22186             m_generator(std::move(generator)),
22187             m_target_repeats(repeats)
22188         {
22189             assert(m_target_repeats > 0 && "Repeat generator must repeat at least once");
22190         }
22191
22192         T const& get() const override {
22193             if (m_current_repeat == 0) {
22194                 m_returned.push_back(m_generator.get());
22195                 return m_returned.back();
22196             }
22197             return m_returned[m_repeat_index];
22198         }
22199
22200         bool next() override {
22201             // There are 2 basic cases:
22202             // 1) We are still reading the generator
22203             // 2) We are reading our own cache
22204
22205             // In the first case, we need to poke the underlying generator.
22206             // If it happily moves, we are left in that state, otherwise it is time to start reading
      from our cache
22207             if (m_current_repeat == 0) {
22208                 const auto success = m_generator.next();
22209                 if (!success) {
22210                     ++m_current_repeat;
22211                 }
22212                 return m_current_repeat < m_target_repeats;
22213             }
22214
22215             // In the second case, we need to move indices forward and check that we haven't run up
      against the end
22216             ++m_repeat_index;
22217             if (m_repeat_index == m_returned.size()) {
22218                 m_repeat_index = 0;
22219                 ++m_current_repeat;
22220             }
22221             return m_current_repeat < m_target_repeats;
```

```
22222         }
22223     };
22224
22225     template <typename T>
22226     GeneratorWrapper<T> repeat(size_t repeats, GeneratorWrapper<T>&& generator) {
22227         return GeneratorWrapper<T>(pf::make_unique<RepeatGenerator<T>>(repeats, std::move(generator)));
22228     }
22229
22230     template <typename T, typename U, typename Func>
22231     class MapGenerator : public IGenerator<T> {
22232         // TBD: provide static assert for mapping function, for friendly error message
22233         GeneratorWrapper<U> m_generator;
22234         Func m_function;
22235         // To avoid returning dangling reference, we have to save the values
22236         T m_cache;
22237     public:
22238         template <typename F2 = Func>
22239         MapGenerator(F2&& function, GeneratorWrapper<U>&& generator) :
22240             m_generator(std::move(generator)),
22241             m_function(std::forward<F2>(function)),
22242             m_cache(m_function(m_generator.get()))
22243         {}
22244
22245         T const& get() const override {
22246             return m_cache;
22247         }
22248         bool next() override {
22249             const auto success = m_generator.next();
22250             if (success) {
22251                 m_cache = m_function(m_generator.get());
22252             }
22253             return success;
22254         }
22255     };
22256
22257     template <typename Func, typename U, typename T = FunctionReturnType<Func, U>>
22258     GeneratorWrapper<T> map(Func&& function, GeneratorWrapper<U>&& generator) {
22259         return GeneratorWrapper<T>(
22260             pf::make_unique<MapGenerator<T, U, Func>>(std::forward<Func>(function),
      std::move(generator))
22261         );
22262     }
22263
22264     template <typename T, typename U, typename Func>
22265     GeneratorWrapper<T> map(Func&& function, GeneratorWrapper<U>&& generator) {
22266         return GeneratorWrapper<T>(
22267             pf::make_unique<MapGenerator<T, U, Func>>(std::forward<Func>(function),
      std::move(generator))
22268         );
22269     }
22270
22271     template <typename T>
22272     class ChunkGenerator final : public IGenerator<std::vector<T>> {
22273         std::vector<T> m_chunk;
22274         size_t m_chunk_size;
22275         GeneratorWrapper<T> m_generator;
22276         bool m_used_up = false;
22277     public:
22278         ChunkGenerator(size_t size, GeneratorWrapper<T> generator) :
22279             m_chunk_size(size), m_generator(std::move(generator))
22280         {
22281             m_chunk.reserve(m_chunk_size);
22282             if (m_chunk_size != 0) {
22283                 m_chunk.push_back(m_generator.get());
22284                 for (size_t i = 1; i < m_chunk_size; ++i) {
22285                     if (!m_generator.next()) {
22286                         Catch::throw_exception(GeneratorException("Not enough values to initialize the
      first chunk"));
22287                     }
22288                     m_chunk.push_back(m_generator.get());
22289                 }
22290             }
22291         }
22292         std::vector<T> const& get() const override {
22293             return m_chunk;
22294         }
22295         bool next() override {
22296             m_chunk.clear();
22297             for (size_t idx = 0; idx < m_chunk_size; ++idx) {
22298                 if (!m_generator.next()) {
22299                     return false;
22300                 }
22301                 m_chunk.push_back(m_generator.get());
22302             }
22303             return true;
22304         }
22305     };
```

```
22306
22307     template <typename T>
22308     GeneratorWrapper<std::vector<T> chunk(size_t size, GeneratorWrapper<T>&& generator) {
22309         return GeneratorWrapper<std::vector<T>(
22310             pf::make_unique<ChunkGenerator<T>(size, std::move(generator))
22311         );
22312     }
22313
22314 } // namespace Generators
22315 } // namespace Catch
22316
22317 // end catch_generators_generic.hpp
22318 // start catch_generators_specific.hpp
22319
22320 // start catch_context.h
22321
22322 #include <memory>
22323
22324 namespace Catch {
22325
22326     struct IResultCapture;
22327     struct IRunner;
22328     struct IConfig;
22329     struct IMutableContext;
22330
22331     using IConfigPtr = std::shared_ptr<IConfig const>;
22332
22333     struct IContext
22334     {
22335         virtual ~IContext();
22336
22337         virtual IResultCapture* getResultCapture() = 0;
22338         virtual IRunner* getRunner() = 0;
22339         virtual IConfigPtr const& getConfig() const = 0;
22340     };
22341
22342     struct IMutableContext : IContext
22343     {
22344         virtual ~IMutableContext();
22345         virtual void setResultCapture( IResultCapture* resultCapture ) = 0;
22346         virtual void setRunner( IRunner* runner ) = 0;
22347         virtual void setConfig( IConfigPtr const& config ) = 0;
22348
22349     private:
22350         static IMutableContext *currentContext;
22351         friend IMutableContext& getCurrentMutableContext();
22352         friend void cleanUpContext();
22353         static void createContext();
22354     };
22355
22356     inline IMutableContext& getCurrentMutableContext()
22357     {
22358         if( !IMutableContext::currentContext )
22359             IMutableContext::createContext();
22360         // NOLINTNEXTLINE(clang-analyzer-core.uninitialized.UndefReturn)
22361         return *IMutableContext::currentContext;
22362     }
22363
22364     inline IContext& getCurrentContext()
22365     {
22366         return getCurrentMutableContext();
22367     }
22368
22369     void cleanUpContext();
22370
22371     class SimplePcg32;
22372     SimplePcg32& rng();
22373 }
22374
22375 // end catch_context.h
22376 // start catch_interfaces_config.h
22377
22378 // start catch_option.hpp
22379
22380 namespace Catch {
22381
22382     // An optional type
22383     template<typename T>
22384     class Option {
22385     public:
22386         Option() : nullableValue( nullptr ) {}
22387         Option( T const& _value )
22388         : nullableValue( new( storage ) T( _value ) )
22389         {}
22390         Option( Option const& _other )
22391         : nullableValue( _other ? new( storage ) T( *_other ) : nullptr )
22392         {}
```

```
22393
22394         ~Option() {
22395             reset();
22396         }
22397
22398         Option& operator= ( Option const& _other ) {
22399             if( &_other != this ) {
22400                 reset();
22401                 if( _other )
22402                     nullableValue = new( storage ) T( *_other );
22403             }
22404             return *this;
22405         }
22406         Option& operator = ( T const& _value ) {
22407             reset();
22408             nullableValue = new( storage ) T( _value );
22409             return *this;
22410         }
22411
22412         void reset() {
22413             if( nullableValue )
22414                 nullableValue->~T();
22415             nullableValue = nullptr;
22416         }
22417
22418         T& operator*() { return *nullableValue; }
22419         T const& operator*() const { return *nullableValue; }
22420         T* operator->() { return nullableValue; }
22421         const T* operator->() const { return nullableValue; }
22422
22423         T valueOr( T const& defaultValue ) const {
22424             return nullableValue ? *nullableValue : defaultValue;
22425         }
22426
22427         bool some() const { return nullableValue != nullptr; }
22428         bool none() const { return nullableValue == nullptr; }
22429
22430         bool operator !() const { return nullableValue == nullptr; }
22431         explicit operator bool() const {
22432             return some();
22433         }
22434
22435     private:
22436         T *nullableValue;
22437         alignas(alignof(T)) char storage[sizeof(T)];
22438     };
22439
22440 } // end namespace Catch
22441
22442 // end catch_option.hpp
22443 #include <chrono>
22444 #include <iosfwd>
22445 #include <string>
22446 #include <vector>
22447 #include <memory>
22448
22449 namespace Catch {
22450
22451     enum class Verbosity {
22452         Quiet = 0,
22453         Normal,
22454         High
22455     };
22456
22457     struct WarnAbout { enum What {
22458         Nothing = 0x00,
22459         NoAssertions = 0x01,
22460         NoTests = 0x02
22461     }; };
22462
22463     struct ShowDurations { enum OrNot {
22464         DefaultForReporter,
22465         Always,
22466         Never
22467     }; };
22468     struct RunTests { enum InWhatOrder {
22469         InDeclarationOrder,
22470         InLexicographicalOrder,
22471         InRandomOrder
22472     }; };
22473     struct UseColour { enum YesOrNo {
22474         Auto,
22475         Yes,
22476         No
22477     }; };
22478     struct WaitForKeypress { enum When {
22479         Never,
```

```
22480         BeforeStart = 1,
22481         BeforeExit = 2,
22482         BeforeStartAndExit = BeforeStart | BeforeExit
22483     }; };
22484
22485     class TestSpec;
22486
22487     struct IConfig : NonCopyable {
22488
22489         virtual ~IConfig();
22490
22491         virtual bool allowThrows() const = 0;
22492         virtual std::ostream& stream() const = 0;
22493         virtual std::string name() const = 0;
22494         virtual bool includeSuccessfulResults() const = 0;
22495         virtual bool shouldDebugBreak() const = 0;
22496         virtual bool warnAboutMissingAssertions() const = 0;
22497         virtual bool warnAboutNoTests() const = 0;
22498         virtual int abortAfter() const = 0;
22499         virtual bool showInvisibles() const = 0;
22500         virtual ShowDurations::OrNot showDurations() const = 0;
22501         virtual double minDuration() const = 0;
22502         virtual TestSpec const& testSpec() const = 0;
22503         virtual bool hasTestFilters() const = 0;
22504         virtual std::vector<std::string> const& getTestsOrTags() const = 0;
22505         virtual RunTests::InWhatOrder runOrder() const = 0;
22506         virtual unsigned int rngSeed() const = 0;
22507         virtual UseColour::YesOrNo useColour() const = 0;
22508         virtual std::vector<std::string> const& getSectionsToRun() const = 0;
22509         virtual Verbosity verbosity() const = 0;
22510
22511         virtual bool benchmarkNoAnalysis() const = 0;
22512         virtual int benchmarkSamples() const = 0;
22513         virtual double benchmarkConfidenceInterval() const = 0;
22514         virtual unsigned int benchmarkResamples() const = 0;
22515         virtual std::chrono::milliseconds benchmarkWarmupTime() const = 0;
22516     };
22517
22518     using IConfigPtr = std::shared_ptr<IConfig const>;
22519 }
22520
22521 // end catch_interfaces_config.h
22522 // start catch_random_number_generator.h
22523
22524 #include <cstdint>
22525
22526 namespace Catch {
22527
22528     // This is a simple implementation of C++11 Uniform Random Number
22529     // Generator. It does not provide all operators, because Catch2
22530     // does not use it, but it should behave as expected inside stdlib's
22531     // distributions.
22532     // The implementation is based on the PCG family (http://pcg-random.org)
22533     class SimplePcg32 {
22534         using state_type = std::uint64_t;
22535     public:
22536         using result_type = std::uint32_t;
22537         static constexpr result_type (min)() {
22538             return 0;
22539         }
22540         static constexpr result_type (max)() {
22541             return static_cast<result_type>(-1);
22542         }
22543
22544         // Provide some default initial state for the default constructor
22545         SimplePcg32():SimplePcg32(0xed743cc4U) {}
22546
22547         explicit SimplePcg32(result_type seed_);
22548
22549         void seed(result_type seed_);
22550         void discard(uint64_t skip);
22551
22552         result_type operator()();
22553
22554     private:
22555         friend bool operator==(SimplePcg32 const& lhs, SimplePcg32 const& rhs);
22556         friend bool operator!=(SimplePcg32 const& lhs, SimplePcg32 const& rhs);
22557
22558         // In theory we also need operator« and operator»
22559         // In practice we do not use them, so we will skip them for now
22560
22561         std::uint64_t m_state;
22562         // This part of the state determines which "stream" of the numbers
22563         // is chosen -- we take it as a constant for Catch2, so we only
22564         // need to deal with seeding the main state.
22565         // Picked by reading 8 bytes from `/dev/random` :-)
22566         static const std::uint64_t s_inc = (0x13ed0cc53f939476ULL « 1ULL) | 1ULL;
```

```
22567     };
22568
22569 } // end namespace Catch
22570
22571 // end catch_random_number_generator.h
22572 #include <random>
22573
22574 namespace Catch {
22575 namespace Generators {
22576
22577 template <typename Float>
22578 class RandomFloatingGenerator final : public IGenerator<Float> {
22579     Catch::SimplePcg32& m_rng;
22580     std::uniform_real_distribution<Float> m_dist;
22581     Float m_current_number;
22582 public:
22583
22584     RandomFloatingGenerator(Float a, Float b):
22585         m_rng(rng()),
22586         m_dist(a, b) {
22587         static_cast<void>(next());
22588     }
22589
22590     Float const& get() const override {
22591         return m_current_number;
22592     }
22593     bool next() override {
22594         m_current_number = m_dist(m_rng);
22595         return true;
22596     }
22597 };
22598
22599 template <typename Integer>
22600 class RandomIntegerGenerator final : public IGenerator<Integer> {
22601     Catch::SimplePcg32& m_rng;
22602     std::uniform_int_distribution<Integer> m_dist;
22603     Integer m_current_number;
22604 public:
22605
22606     RandomIntegerGenerator(Integer a, Integer b):
22607         m_rng(rng()),
22608         m_dist(a, b) {
22609         static_cast<void>(next());
22610     }
22611
22612     Integer const& get() const override {
22613         return m_current_number;
22614     }
22615     bool next() override {
22616         m_current_number = m_dist(m_rng);
22617         return true;
22618     }
22619 };
22620
22621 // TODO: Ideally this would be also constrained against the various char types,
22622 //       but I don't expect users to run into that in practice.
22623 template <typename T>
22624 typename std::enable_if<std::is_integral<T>::value && !std::is_same<T, bool>::value,
22625 GeneratorWrapper<T»::type
22626 random(T a, T b) {
22627     return GeneratorWrapper<T>(
22628         pf::make_unique<RandomIntegerGenerator<T»(a, b)
22629     );
22630 }
22631
22632 template <typename T>
22633 typename std::enable_if<std::is_floating_point<T>::value,
22634 GeneratorWrapper<T»::type
22635 random(T a, T b) {
22636     return GeneratorWrapper<T>(
22637         pf::make_unique<RandomFloatingGenerator<T»(a, b)
22638     );
22639 }
22640
22641 template <typename T>
22642 class RangeGenerator final : public IGenerator<T> {
22643     T m_current;
22644     T m_end;
22645     T m_step;
22646     bool m_positive;
22647
22648 public:
22649     RangeGenerator(T const& start, T const& end, T const& step):
22650         m_current(start),
22651         m_end(end),
22652         m_step(step),
22653         m_positive(m_step > T(0))
```

```
22654     {
22655         assert(m_current != m_end && "Range start and end cannot be equal");
22656         assert(m_step != T(0) && "Step size cannot be zero");
22657         assert(((m_positive && m_current <= m_end) || (!m_positive && m_current >= m_end)) && "Step
      moves away from end");
22658     }
22659
22660     RangeGenerator(T const& start, T const& end):
22661         RangeGenerator(start, end, (start < end) ? T(1) : T(-1))
22662     {}
22663
22664     T const& get() const override {
22665         return m_current;
22666     }
22667
22668     bool next() override {
22669         m_current += m_step;
22670         return (m_positive) ? (m_current < m_end) : (m_current > m_end);
22671     }
22672 };
22673
22674 template <typename T>
22675 GeneratorWrapper<T> range(T const& start, T const& end, T const& step) {
22676     static_assert(std::is_arithmetic<T>::value && !std::is_same<T, bool>::value, "Type must be
      numeric");
22677     return GeneratorWrapper<T>(pf::make_unique<RangeGenerator<T»(start, end, step));
22678 }
22679
22680 template <typename T>
22681 GeneratorWrapper<T> range(T const& start, T const& end) {
22682     static_assert(std::is_integral<T>::value && !std::is_same<T, bool>::value, "Type must be an
      integer");
22683     return GeneratorWrapper<T>(pf::make_unique<RangeGenerator<T»(start, end));
22684 }
22685
22686 template <typename T>
22687 class IteratorGenerator final : public IGenerator<T> {
22688     static_assert(!std::is_same<T, bool>::value,
22689         "IteratorGenerator currently does not support bools"
22690         "because of std::vector<bool> specialization");
22691
22692     std::vector<T> m_elems;
22693     size_t m_current = 0;
22694 public:
22695     template <typename InputIterator, typename InputSentinel>
22696     IteratorGenerator(InputIterator first, InputSentinel last):m_elems(first, last) {
22697         if (m_elems.empty()) {
22698             Catch::throw_exception(GeneratorException("IteratorGenerator received no valid values"));
22699         }
22700     }
22701
22702     T const& get() const override {
22703         return m_elems[m_current];
22704     }
22705
22706     bool next() override {
22707         ++m_current;
22708         return m_current != m_elems.size();
22709     }
22710 };
22711
22712 template <typename InputIterator,
22713           typename InputSentinel,
22714           typename ResultType = typename std::iterator_traits<InputIterator>::value_type>
22715 GeneratorWrapper<ResultType> from_range(InputIterator from, InputSentinel to) {
22716     return GeneratorWrapper<ResultType>(pf::make_unique<IteratorGenerator<ResultType»(from, to));
22717 }
22718
22719 template <typename Container,
22720           typename ResultType = typename Container::value_type>
22721 GeneratorWrapper<ResultType> from_range(Container const& cnt) {
22722     return GeneratorWrapper<ResultType>(pf::make_unique<IteratorGenerator<ResultType»(cnt.begin(),
      cnt.end()));
22723 }
22724
22725 } // namespace Generators
22726 } // namespace Catch
22727
22728 // end catch_generators_specific.hpp
22729
22730 // These files are included here so the single_include script doesn't put them
22731 // in the conditionally compiled sections
22732 // start catch_test_case_info.h
22733
22734 #include <string>
22735 #include <vector>
22736 #include <memory>
```

```
22737
22738 #ifdef __clang__
22739 #pragma clang diagnostic push
22740 #pragma clang diagnostic ignored "-Wpadded"
22741 #endif
22742
22743 namespace Catch {
22744
22745     struct ITestInvoker;
22746
22747     struct TestCaseInfo {
22748         enum SpecialProperties{
22749             None = 0,
22750             IsHidden = 1 << 1,
22751             ShouldFail = 1 << 2,
22752             MayFail = 1 << 3,
22753             Throws = 1 << 4,
22754             NonPortable = 1 << 5,
22755             Benchmark = 1 << 6
22756         };
22757
22758         TestCaseInfo(   std::string const& _name,
22759                         std::string const& _className,
22760                         std::string const& _description,
22761                         std::vector<std::string> const& _tags,
22762                         SourceLineInfo const& _lineInfo );
22763
22764         friend void setTags( TestCaseInfo& testCaseInfo, std::vector<std::string> tags );
22765
22766         bool isHidden() const;
22767         bool throws() const;
22768         bool okToFail() const;
22769         bool expectedToFail() const;
22770
22771         std::string tagsAsString() const;
22772
22773         std::string name;
22774         std::string className;
22775         std::string description;
22776         std::vector<std::string> tags;
22777         std::vector<std::string> lcaseTags;
22778         SourceLineInfo lineInfo;
22779         SpecialProperties properties;
22780     };
22781
22782     class TestCase : public TestCaseInfo {
22783     public:
22784
22785         TestCase( ITestInvoker* testCase, TestCaseInfo&& info );
22786
22787         TestCase withName( std::string const& _newName ) const;
22788
22789         void invoke() const;
22790
22791         TestCaseInfo const& getTestCaseInfo() const;
22792
22793         bool operator == ( TestCase const& other ) const;
22794         bool operator < ( TestCase const& other ) const;
22795
22796     private:
22797         std::shared_ptr<ITestInvoker> test;
22798     };
22799
22800     TestCase makeTestCase(  ITestInvoker* testCase,
22801                             std::string const& className,
22802                             NameAndTags const& nameAndTags,
22803                             SourceLineInfo const& lineInfo );
22804 }
22805
22806 #ifdef __clang__
22807 #pragma clang diagnostic pop
22808 #endif
22809
22810 // end catch_test_case_info.h
22811 // start catch_interfaces_runner.h
22812
22813 namespace Catch {
22814
22815     struct IRunner {
22816         virtual ~IRunner();
22817         virtual bool aborting() const = 0;
22818     };
22819 }
22820
22821 // end catch_interfaces_runner.h
22822
22823 #ifdef __OBJC__
```

```
22824 // start catch_objc.hpp
22825
22826 #import <objc/runtime.h>
22827
22828 #include <string>
22829
22830 // NB. Any general catch headers included here must be included
22831 // in catch.hpp first to make sure they are included by the single
22832 // header for non obj-usage
22833
22835 // This protocol is really only here for (self) documenting purposes, since
22836 // all its methods are optional.
22837 @protocol OcFixture
22838
22839 @optional
22840
22841 -(void) setUp;
22842 -(void) tearDown;
22843
22844 @end
22845
22846 namespace Catch {
22847
22848     class OcMethod : public ITestInvoker {
22849
22850     public:
22851         OcMethod( Class cls, SEL sel ) : m_cls( cls ), m_sel( sel ) {}
22852
22853         virtual void invoke() const {
22854             id obj = [[m_cls alloc] init];
22855
22856             performOptionalSelector( obj, @selector(setUp)  );
22857             performOptionalSelector( obj, m_sel );
22858             performOptionalSelector( obj, @selector(tearDown)  );
22859
22860             arcSafeRelease( obj );
22861         }
22862     private:
22863         virtual ~OcMethod() {}
22864
22865         Class m_cls;
22866         SEL m_sel;
22867     };
22868
22869     namespace Detail{
22870
22871         inline std::string getAnnotation(   Class cls,
22872                                             std::string const& annotationName,
22873                                             std::string const& testCaseName ) {
22874             NSString* selStr = [[NSString alloc] initWithFormat:@"Catch_%s_%s",
      annotationName.c_str(), testCaseName.c_str()];
22875             SEL sel = NSSelectorFromString( selStr );
22876             arcSafeRelease( selStr );
22877             id value = performOptionalSelector( cls, sel );
22878             if( value )
22879                 return [(NSString*)value UTF8String];
22880             return "";
22881         }
22882     }
22883
22884     inline std::size_t registerTestMethods() {
22885         std::size_t noTestMethods = 0;
22886         int noClasses = objc_getClassList( nullptr, 0 );
22887
22888         Class* classes = (CATCH_UNSAFE_UNRETAINED Class *)malloc( sizeof(Class) * noClasses);
22889         objc_getClassList( classes, noClasses );
22890
22891         for( int c = 0; c < noClasses; c++ ) {
22892             Class cls = classes[c];
22893             {
22894                 u_int count;
22895                 Method* methods = class_copyMethodList( cls, &count );
22896                 for( u_int m = 0; m < count ; m++ ) {
22897                     SEL selector = method_getName(methods[m]);
22898                     std::string methodName = sel_getName(selector);
22899                     if( startsWith( methodName, "Catch_TestCase_" ) ) {
22900                         std::string testCaseName = methodName.substr( 15 );
22901                         std::string name = Detail::getAnnotation( cls, "Name", testCaseName );
22902                         std::string desc = Detail::getAnnotation( cls, "Description", testCaseName );
22903                         const char* className = class_getName( cls );
22904
22905                         getMutableRegistryHub().registerTest( makeTestCase( new OcMethod( cls,
      selector ), className, NameAndTags( name.c_str(), desc.c_str() ), SourceLineInfo("",0) ) );
22906                         noTestMethods++;
22907                     }
22908                 }
22909                 free(methods);
```

```
22910             }
22911         }
22912         return noTestMethods;
22913     }
22914
22915 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
22916
22917     namespace Matchers {
22918         namespace Impl {
22919         namespace NSStringMatchers {
22920
22921             struct StringHolder : MatcherBase<NSString*>{
22922                 StringHolder( NSString* substr ) : m_substr( [substr copy] ){}
22923                 StringHolder( StringHolder const& other ) : m_substr( [other.m_substr copy] ){}
22924                 StringHolder() {
22925                     arcSafeRelease( m_substr );
22926                 }
22927
22928                 bool match( NSString* str ) const override {
22929                     return false;
22930                 }
22931
22932                 NSString* CATCH_ARC_STRONG m_substr;
22933             };
22934
22935             struct Equals : StringHolder {
22936                 Equals( NSString* substr ) : StringHolder( substr ){}
22937
22938                 bool match( NSString* str ) const override {
22939                     return  (str != nil || m_substr == nil ) &&
22940                             [str isEqualToString:m_substr];
22941                 }
22942
22943                 std::string describe() const override {
22944                     return "equals string: " + Catch::Detail::stringify( m_substr );
22945                 }
22946             };
22947
22948             struct Contains : StringHolder {
22949                 Contains( NSString* substr ) : StringHolder( substr ){}
22950
22951                 bool match( NSString* str ) const override {
22952                     return  (str != nil || m_substr == nil ) &&
22953                             [str rangeOfString:m_substr].location != NSNotFound;
22954                 }
22955
22956                 std::string describe() const override {
22957                     return "contains string: " + Catch::Detail::stringify( m_substr );
22958                 }
22959             };
22960
22961             struct StartsWith : StringHolder {
22962                 StartsWith( NSString* substr ) : StringHolder( substr ){}
22963
22964                 bool match( NSString* str ) const override {
22965                     return  (str != nil || m_substr == nil ) &&
22966                             [str rangeOfString:m_substr].location == 0;
22967                 }
22968
22969                 std::string describe() const override {
22970                     return "starts with: " + Catch::Detail::stringify( m_substr );
22971                 }
22972             };
22973             struct EndsWith : StringHolder {
22974                 EndsWith( NSString* substr ) : StringHolder( substr ){}
22975
22976                 bool match( NSString* str ) const override {
22977                     return  (str != nil || m_substr == nil ) &&
22978                             [str rangeOfString:m_substr].location == [str length] - [m_substr length];
22979                 }
22980
22981                 std::string describe() const override {
22982                     return "ends with: " + Catch::Detail::stringify( m_substr );
22983                 }
22984             };
22985
22986         } // namespace NSStringMatchers
22987         } // namespace Impl
22988
22989         inline Impl::NSStringMatchers::Equals
22990             Equals( NSString* substr ){ return Impl::NSStringMatchers::Equals( substr ); }
22991
22992         inline Impl::NSStringMatchers::Contains
22993             Contains( NSString* substr ){ return Impl::NSStringMatchers::Contains( substr ); }
22994
22995         inline Impl::NSStringMatchers::StartsWith
22996             StartsWith( NSString* substr ){ return Impl::NSStringMatchers::StartsWith( substr ); }
```

```
22997
22998         inline Impl::NSStringMatchers::EndsWith
22999             EndsWith( NSString* substr ){ return Impl::NSStringMatchers::EndsWith( substr ); }
23000
23001     } // namespace Matchers
23002
23003     using namespace Matchers;
23004
23005 #endif // CATCH_CONFIG_DISABLE_MATCHERS
23006
23007 } // namespace Catch
23008
23010 #define OC_MAKE_UNIQUE_NAME( root, uniqueSuffix ) root##uniqueSuffix
23011 #define OC_TEST_CASE2( name, desc, uniqueSuffix ) \
23012 +(NSString*) OC_MAKE_UNIQUE_NAME( Catch_Name_test_, uniqueSuffix ) \
23013 { \
23014 return @ name; \
23015 } \
23016 +(NSString*) OC_MAKE_UNIQUE_NAME( Catch_Description_test_, uniqueSuffix ) \
23017 { \
23018 return @ desc; \
23019 } \
23020 -(void) OC_MAKE_UNIQUE_NAME( Catch_TestCase_test_, uniqueSuffix )
23021
23022 #define OC_TEST_CASE( name, desc ) OC_TEST_CASE2( name, desc, __LINE__ )
23023
23024 // end catch_objc.hpp
23025 #endif
23026
23027 // Benchmarking needs the externally-facing parts of reporters to work
23028 #if defined(CATCH_CONFIG_EXTERNAL_INTERFACES) || defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
23029 // start catch_external_interfaces.h
23030
23031 // start catch_reporter_bases.hpp
23032
23033 // start catch_interfaces_reporter.h
23034
23035 // start catch_config.hpp
23036
23037 // start catch_test_spec_parser.h
23038
23039 #ifdef __clang__
23040 #pragma clang diagnostic push
23041 #pragma clang diagnostic ignored "-Wpadded"
23042 #endif
23043
23044 // start catch_test_spec.h
23045
23046 #ifdef __clang__
23047 #pragma clang diagnostic push
23048 #pragma clang diagnostic ignored "-Wpadded"
23049 #endif
23050
23051 // start catch_wildcard_pattern.h
23052
23053 namespace Catch
23054 {
23055     class WildcardPattern {
23056         enum WildcardPosition {
23057             NoWildcard = 0,
23058             WildcardAtStart = 1,
23059             WildcardAtEnd = 2,
23060             WildcardAtBothEnds = WildcardAtStart | WildcardAtEnd
23061         };
23062
23063     public:
23064
23065         WildcardPattern( std::string const& pattern, CaseSensitive::Choice caseSensitivity );
23066         virtual ~WildcardPattern() = default;
23067         virtual bool matches( std::string const& str ) const;
23068
23069     private:
23070         std::string normaliseString( std::string const& str ) const;
23071         CaseSensitive::Choice m_caseSensitivity;
23072         WildcardPosition m_wildcard = NoWildcard;
23073         std::string m_pattern;
23074     };
23075 }
23076
23077 // end catch_wildcard_pattern.h
23078 #include <string>
23079 #include <vector>
23080 #include <memory>
23081
23082 namespace Catch {
23083
23084     struct IConfig;
```

```
23085
23086     class TestSpec {
23087         class Pattern {
23088         public:
23089             explicit Pattern( std::string const& name );
23090             virtual ~Pattern();
23091             virtual bool matches( TestCaseInfo const& testCase ) const = 0;
23092             std::string const& name() const;
23093         private:
23094             std::string const m_name;
23095         };
23096         using PatternPtr = std::shared_ptr<Pattern>;
23097
23098         class NamePattern : public Pattern {
23099         public:
23100             explicit NamePattern( std::string const& name, std::string const& filterString );
23101             bool matches( TestCaseInfo const& testCase ) const override;
23102         private:
23103             WildcardPattern m_wildcardPattern;
23104         };
23105
23106         class TagPattern : public Pattern {
23107         public:
23108             explicit TagPattern( std::string const& tag, std::string const& filterString );
23109             bool matches( TestCaseInfo const& testCase ) const override;
23110         private:
23111             std::string m_tag;
23112         };
23113
23114         class ExcludedPattern : public Pattern {
23115         public:
23116             explicit ExcludedPattern( PatternPtr const& underlyingPattern );
23117             bool matches( TestCaseInfo const& testCase ) const override;
23118         private:
23119             PatternPtr m_underlyingPattern;
23120         };
23121
23122         struct Filter {
23123             std::vector<PatternPtr> m_patterns;
23124
23125             bool matches( TestCaseInfo const& testCase ) const;
23126             std::string name() const;
23127         };
23128
23129     public:
23130         struct FilterMatch {
23131             std::string name;
23132             std::vector<TestCase const*> tests;
23133         };
23134         using Matches = std::vector<FilterMatch>;
23135         using vectorStrings = std::vector<std::string>;
23136
23137         bool hasFilters() const;
23138         bool matches( TestCaseInfo const& testCase ) const;
23139         Matches matchesByFilter( std::vector<TestCase> const& testCases, IConfig const& config )
      const;
23140         const vectorStrings & getInvalidArgs() const;
23141
23142     private:
23143         std::vector<Filter> m_filters;
23144         std::vector<std::string> m_invalidArgs;
23145         friend class TestSpecParser;
23146     };
23147 }
23148
23149 #ifdef __clang__
23150 #pragma clang diagnostic pop
23151 #endif
23152
23153 // end catch_test_spec.h
23154 // start catch_interfaces_tag_alias_registry.h
23155
23156 #include <string>
23157
23158 namespace Catch {
23159
23160     struct TagAlias;
23161
23162     struct ITagAliasRegistry {
23163         virtual ~ITagAliasRegistry();
23164         // Nullptr if not present
23165         virtual TagAlias const* find( std::string const& alias ) const = 0;
23166         virtual std::string expandAliases( std::string const& unexpandedTestSpec ) const = 0;
23167
23168         static ITagAliasRegistry const& get();
23169     };
23170
```

```
23171 } // end namespace Catch
23172
23173 // end catch_interfaces_tag_alias_registry.h
23174 namespace Catch {
23175
23176     class TestSpecParser {
23177         enum Mode{ None, Name, QuotedName, Tag, EscapedName };
23178         Mode m_mode = None;
23179         Mode lastMode = None;
23180         bool m_exclusion = false;
23181         std::size_t m_pos = 0;
23182         std::size_t m_realPatternPos = 0;
23183         std::string m_arg;
23184         std::string m_substring;
23185         std::string m_patternName;
23186         std::vector<std::size_t> m_escapeChars;
23187         TestSpec::Filter m_currentFilter;
23188         TestSpec m_testSpec;
23189         ITagAliasRegistry const* m_tagAliases = nullptr;
23190
23191     public:
23192         TestSpecParser( ITagAliasRegistry const& tagAliases );
23193
23194         TestSpecParser& parse( std::string const& arg );
23195         TestSpec testSpec();
23196
23197     private:
23198         bool visitChar( char c );
23199         void startNewMode( Mode mode );
23200         bool processNoneChar( char c );
23201         void processNameChar( char c );
23202         bool processOtherChar( char c );
23203         void endMode();
23204         void escape();
23205         bool isControlChar( char c ) const;
23206         void saveLastMode();
23207         void revertBackToLastMode();
23208         void addFilter();
23209         bool separate();
23210
23211         // Handles common preprocessing of the pattern for name/tag patterns
23212         std::string preprocessPattern();
23213         // Adds the current pattern as a test name
23214         void addNamePattern();
23215         // Adds the current pattern as a tag
23216         void addTagPattern();
23217
23218         inline void addCharToPattern(char c) {
23219             m_substring += c;
23220             m_patternName += c;
23221             m_realPatternPos++;
23222         }
23223
23224     };
23225     TestSpec parseTestSpec( std::string const& arg );
23226
23227 } // namespace Catch
23228
23229 #ifdef __clang__
23230 #pragma clang diagnostic pop
23231 #endif
23232
23233 // end catch_test_spec_parser.h
23234 // Libstdc++ doesn't like incomplete classes for unique_ptr
23235
23236 #include <memory>
23237 #include <vector>
23238 #include <string>
23239
23240 #ifndef CATCH_CONFIG_CONSOLE_WIDTH
23241 #define CATCH_CONFIG_CONSOLE_WIDTH 80
23242 #endif
23243
23244 namespace Catch {
23245
23246     struct IStream;
23247
23248     struct ConfigData {
23249         bool listTests = false;
23250         bool listTags = false;
23251         bool listReporters = false;
23252         bool listTestNamesOnly = false;
23253
23254         bool showSuccessfulTests = false;
23255         bool shouldDebugBreak = false;
23256         bool noThrow = false;
23257         bool showHelp = false;
```

```
23258         bool showInvisibles = false;
23259         bool filenamesAsTags = false;
23260         bool libIdentify = false;
23261
23262         int abortAfter = -1;
23263         unsigned int rngSeed = 0;
23264
23265         bool benchmarkNoAnalysis = false;
23266         unsigned int benchmarkSamples = 100;
23267         double benchmarkConfidenceInterval = 0.95;
23268         unsigned int benchmarkResamples = 100000;
23269         std::chrono::milliseconds::rep benchmarkWarmupTime = 100;
23270
23271         Verbosity verbosity = Verbosity::Normal;
23272         WarnAbout::What warnings = WarnAbout::Nothing;
23273         ShowDurations::OrNot showDurations = ShowDurations::DefaultForReporter;
23274         double minDuration = -1;
23275         RunTests::InWhatOrder runOrder = RunTests::InDeclarationOrder;
23276         UseColour::YesOrNo useColour = UseColour::Auto;
23277         WaitForKeypress::When waitForKeypress = WaitForKeypress::Never;
23278
23279         std::string outputFilename;
23280         std::string name;
23281         std::string processName;
23282 #ifndef CATCH_CONFIG_DEFAULT_REPORTER
23283 #define CATCH_CONFIG_DEFAULT_REPORTER "console"
23284 #endif
23285         std::string reporterName = CATCH_CONFIG_DEFAULT_REPORTER;
23286 #undef CATCH_CONFIG_DEFAULT_REPORTER
23287
23288         std::vector<std::string> testsOrTags;
23289         std::vector<std::string> sectionsToRun;
23290     };
23291
23292     class Config : public IConfig {
23293     public:
23294
23295         Config() = default;
23296         Config( ConfigData const& data );
23297         virtual ~Config() = default;
23298
23299         std::string const& getFilename() const;
23300
23301         bool listTests() const;
23302         bool listTestNamesOnly() const;
23303         bool listTags() const;
23304         bool listReporters() const;
23305
23306         std::string getProcessName() const;
23307         std::string const& getReporterName() const;
23308
23309         std::vector<std::string> const& getTestsOrTags() const override;
23310         std::vector<std::string> const& getSectionsToRun() const override;
23311
23312         TestSpec const& testSpec() const override;
23313         bool hasTestFilters() const override;
23314
23315         bool showHelp() const;
23316
23317         // IConfig interface
23318         bool allowThrows() const override;
23319         std::ostream& stream() const override;
23320         std::string name() const override;
23321         bool includeSuccessfulResults() const override;
23322         bool warnAboutMissingAssertions() const override;
23323         bool warnAboutNoTests() const override;
23324         ShowDurations::OrNot showDurations() const override;
23325         double minDuration() const override;
23326         RunTests::InWhatOrder runOrder() const override;
23327         unsigned int rngSeed() const override;
23328         UseColour::YesOrNo useColour() const override;
23329         bool shouldDebugBreak() const override;
23330         int abortAfter() const override;
23331         bool showInvisibles() const override;
23332         Verbosity verbosity() const override;
23333         bool benchmarkNoAnalysis() const override;
23334         int benchmarkSamples() const override;
23335         double benchmarkConfidenceInterval() const override;
23336         unsigned int benchmarkResamples() const override;
23337         std::chrono::milliseconds benchmarkWarmupTime() const override;
23338
23339     private:
23340
23341         IStream const* openStream();
23342         ConfigData m_data;
23343
23344         std::unique_ptr<IStream const> m_stream;
```

```
23345         TestSpec m_testSpec;
23346         bool m_hasTestFilters = false;
23347     };
23348
23349 } // end namespace Catch
23350
23351 // end catch_config.hpp
23352 // start catch_assertionresult.h
23353
23354 #include <string>
23355
23356 namespace Catch {
23357
23358     struct AssertionResultData
23359     {
23360         AssertionResultData() = delete;
23361
23362         AssertionResultData( ResultWas::OfType _resultType, LazyExpression const& _lazyExpression );
23363
23364         std::string message;
23365         mutable std::string reconstructedExpression;
23366         LazyExpression lazyExpression;
23367         ResultWas::OfType resultType;
23368
23369         std::string reconstructExpression() const;
23370     };
23371
23372     class AssertionResult {
23373     public:
23374         AssertionResult() = delete;
23375         AssertionResult( AssertionInfo const& info, AssertionResultData const& data );
23376
23377         bool isOk() const;
23378         bool succeeded() const;
23379         ResultWas::OfType getResultType() const;
23380         bool hasExpression() const;
23381         bool hasMessage() const;
23382         std::string getExpression() const;
23383         std::string getExpressionInMacro() const;
23384         bool hasExpandedExpression() const;
23385         std::string getExpandedExpression() const;
23386         std::string getMessage() const;
23387         SourceLineInfo getSourceInfo() const;
23388         StringRef getTestMacroName() const;
23389
23390     //protected:
23391         AssertionInfo m_info;
23392         AssertionResultData m_resultData;
23393     };
23394
23395 } // end namespace Catch
23396
23397 // end catch_assertionresult.h
23398 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
23399 // start catch_estimate.hpp
23400
23401  // Statistics estimates
23402
23403
23404 namespace Catch {
23405     namespace Benchmark {
23406         template <typename Duration>
23407         struct Estimate {
23408             Duration point;
23409             Duration lower_bound;
23410             Duration upper_bound;
23411             double confidence_interval;
23412
23413             template <typename Duration2>
23414             operator Estimate<Duration2>() const {
23415                 return { point, lower_bound, upper_bound, confidence_interval };
23416             }
23417         };
23418     } // namespace Benchmark
23419 } // namespace Catch
23420
23421 // end catch_estimate.hpp
23422 // start catch_outlier_classification.hpp
23423
23424 // Outlier information
23425
23426 namespace Catch {
23427     namespace Benchmark {
23428         struct OutlierClassification {
23429             int samples_seen = 0;
23430             int low_severe = 0;     // more than 3 times IQR below Q1
23431             int low_mild = 0;       // 1.5 to 3 times IQR below Q1
```

```
23432             int high_mild = 0;      // 1.5 to 3 times IQR above Q3
23433             int high_severe = 0;    // more than 3 times IQR above Q3
23434
23435             int total() const {
23436                 return low_severe + low_mild + high_mild + high_severe;
23437             }
23438         };
23439     } // namespace Benchmark
23440 } // namespace Catch
23441
23442 // end catch_outlier_classification.hpp
23443
23444 #include <iterator>
23445 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
23446
23447 #include <string>
23448 #include <iosfwd>
23449 #include <map>
23450 #include <set>
23451 #include <memory>
23452 #include <algorithm>
23453
23454 namespace Catch {
23455
23456     struct ReporterConfig {
23457         explicit ReporterConfig( IConfigPtr const& _fullConfig );
23458
23459         ReporterConfig( IConfigPtr const& _fullConfig, std::ostream& _stream );
23460
23461         std::ostream& stream() const;
23462         IConfigPtr fullConfig() const;
23463
23464     private:
23465         std::ostream* m_stream;
23466         IConfigPtr m_fullConfig;
23467     };
23468
23469     struct ReporterPreferences {
23470         bool shouldRedirectStdOut = false;
23471         bool shouldReportAllAssertions = false;
23472     };
23473
23474     template<typename T>
23475     struct LazyStat : Option<T> {
23476         LazyStat& operator=( T const& _value ) {
23477             Option<T>::operator=( _value );
23478             used = false;
23479             return *this;
23480         }
23481         void reset() {
23482             Option<T>::reset();
23483             used = false;
23484         }
23485         bool used = false;
23486     };
23487
23488     struct TestRunInfo {
23489         TestRunInfo( std::string const& _name );
23490         std::string name;
23491     };
23492     struct GroupInfo {
23493         GroupInfo(  std::string const& _name,
23494                     std::size_t _groupIndex,
23495                     std::size_t _groupsCount );
23496
23497         std::string name;
23498         std::size_t groupIndex;
23499         std::size_t groupsCounts;
23500     };
23501
23502     struct AssertionStats {
23503         AssertionStats( AssertionResult const& _assertionResult,
23504                         std::vector<MessageInfo> const& _infoMessages,
23505                         Totals const& _totals );
23506
23507         AssertionStats( AssertionStats const& )              = default;
23508         AssertionStats( AssertionStats && )                  = default;
23509         AssertionStats& operator = ( AssertionStats const& ) = delete;
23510         AssertionStats& operator = ( AssertionStats && )     = delete;
23511         virtual ~AssertionStats();
23512
23513         AssertionResult assertionResult;
23514         std::vector<MessageInfo> infoMessages;
23515         Totals totals;
23516     };
23517
23518     struct SectionStats {
```

```
23519         SectionStats(   SectionInfo const& _sectionInfo,
23520                         Counts const& _assertions,
23521                         double _durationInSeconds,
23522                         bool _missingAssertions );
23523         SectionStats( SectionStats const& )              = default;
23524         SectionStats( SectionStats && )                  = default;
23525         SectionStats& operator = ( SectionStats const& ) = default;
23526         SectionStats& operator = ( SectionStats && )     = default;
23527         virtual ~SectionStats();
23528
23529         SectionInfo sectionInfo;
23530         Counts assertions;
23531         double durationInSeconds;
23532         bool missingAssertions;
23533     };
23534
23535     struct TestCaseStats {
23536         TestCaseStats(  TestCaseInfo const& _testInfo,
23537                         Totals const& _totals,
23538                         std::string const& _stdOut,
23539                         std::string const& _stdErr,
23540                         bool _aborting );
23541
23542         TestCaseStats( TestCaseStats const& )              = default;
23543         TestCaseStats( TestCaseStats && )                  = default;
23544         TestCaseStats& operator = ( TestCaseStats const& ) = default;
23545         TestCaseStats& operator = ( TestCaseStats && )     = default;
23546         virtual ~TestCaseStats();
23547
23548         TestCaseInfo testInfo;
23549         Totals totals;
23550         std::string stdOut;
23551         std::string stdErr;
23552         bool aborting;
23553     };
23554
23555     struct TestGroupStats {
23556         TestGroupStats( GroupInfo const& _groupInfo,
23557                         Totals const& _totals,
23558                         bool _aborting );
23559         TestGroupStats( GroupInfo const& _groupInfo );
23560
23561         TestGroupStats( TestGroupStats const& )              = default;
23562         TestGroupStats( TestGroupStats && )                  = default;
23563         TestGroupStats& operator = ( TestGroupStats const& ) = default;
23564         TestGroupStats& operator = ( TestGroupStats && )     = default;
23565         virtual ~TestGroupStats();
23566
23567         GroupInfo groupInfo;
23568         Totals totals;
23569         bool aborting;
23570     };
23571
23572     struct TestRunStats {
23573         TestRunStats(   TestRunInfo const& _runInfo,
23574                         Totals const& _totals,
23575                         bool _aborting );
23576
23577         TestRunStats( TestRunStats const& )              = default;
23578         TestRunStats( TestRunStats && )                  = default;
23579         TestRunStats& operator = ( TestRunStats const& ) = default;
23580         TestRunStats& operator = ( TestRunStats && )     = default;
23581         virtual ~TestRunStats();
23582
23583         TestRunInfo runInfo;
23584         Totals totals;
23585         bool aborting;
23586     };
23587
23588 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
23589     struct BenchmarkInfo {
23590         std::string name;
23591         double estimatedDuration;
23592         int iterations;
23593         int samples;
23594         unsigned int resamples;
23595         double clockResolution;
23596         double clockCost;
23597     };
23598
23599     template <class Duration>
23600     struct BenchmarkStats {
23601         BenchmarkInfo info;
23602
23603         std::vector<Duration> samples;
23604         Benchmark::Estimate<Duration> mean;
23605         Benchmark::Estimate<Duration> standardDeviation;
```

```
23606         Benchmark::OutlierClassification outliers;
23607         double outlierVariance;
23608
23609         template <typename Duration2>
23610         operator BenchmarkStats<Duration2>() const {
23611             std::vector<Duration2> samples2;
23612             samples2.reserve(samples.size());
23613             std::transform(samples.begin(), samples.end(), std::back_inserter(samples2), [](Duration
      d) { return Duration2(d); });
23614             return {
23615                 info,
23616                 std::move(samples2),
23617                 mean,
23618                 standardDeviation,
23619                 outliers,
23620                 outlierVariance,
23621             };
23622         }
23623     };
23624 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
23625
23626     struct IStreamingReporter {
23627         virtual ~IStreamingReporter() = default;
23628
23629         // Implementing class must also provide the following static methods:
23630         // static std::string getDescription();
23631         // static std::set<Verbosity> getSupportedVerbosities()
23632
23633         virtual ReporterPreferences getPreferences() const = 0;
23634
23635         virtual void noMatchingTestCases( std::string const& spec ) = 0;
23636
23637         virtual void reportInvalidArguments(std::string const&) {}
23638
23639         virtual void testRunStarting( TestRunInfo const& testRunInfo ) = 0;
23640         virtual void testGroupStarting( GroupInfo const& groupInfo ) = 0;
23641
23642         virtual void testCaseStarting( TestCaseInfo const& testInfo ) = 0;
23643         virtual void sectionStarting( SectionInfo const& sectionInfo ) = 0;
23644
23645 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
23646         virtual void benchmarkPreparing( std::string const& ) {}
23647         virtual void benchmarkStarting( BenchmarkInfo const& ) {}
23648         virtual void benchmarkEnded( BenchmarkStats<> const& ) {}
23649         virtual void benchmarkFailed( std::string const& ) {}
23650 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
23651
23652         virtual void assertionStarting( AssertionInfo const& assertionInfo ) = 0;
23653
23654         // The return value indicates if the messages buffer should be cleared:
23655         virtual bool assertionEnded( AssertionStats const& assertionStats ) = 0;
23656
23657         virtual void sectionEnded( SectionStats const& sectionStats ) = 0;
23658         virtual void testCaseEnded( TestCaseStats const& testCaseStats ) = 0;
23659         virtual void testGroupEnded( TestGroupStats const& testGroupStats ) = 0;
23660         virtual void testRunEnded( TestRunStats const& testRunStats ) = 0;
23661
23662         virtual void skipTest( TestCaseInfo const& testInfo ) = 0;
23663
23664         // Default empty implementation provided
23665         virtual void fatalErrorEncountered( StringRef name );
23666
23667         virtual bool isMulti() const;
23668     };
23669     using IStreamingReporterPtr = std::unique_ptr<IStreamingReporter>;
23670
23671     struct IReporterFactory {
23672         virtual ~IReporterFactory();
23673         virtual IStreamingReporterPtr create( ReporterConfig const& config ) const = 0;
23674         virtual std::string getDescription() const = 0;
23675     };
23676     using IReporterFactoryPtr = std::shared_ptr<IReporterFactory>;
23677
23678     struct IReporterRegistry {
23679         using FactoryMap = std::map<std::string, IReporterFactoryPtr>;
23680         using Listeners = std::vector<IReporterFactoryPtr>;
23681
23682         virtual ~IReporterRegistry();
23683         virtual IStreamingReporterPtr create( std::string const& name, IConfigPtr const& config )
      const = 0;
23684         virtual FactoryMap const& getFactories() const = 0;
23685         virtual Listeners const& getListeners() const = 0;
23686     };
23687
23688 } // end namespace Catch
23689
23690 // end catch_interfaces_reporter.h
```

```
23691 #include <algorithm>
23692 #include <cstring>
23693 #include <cfloat>
23694 #include <cstdio>
23695 #include <cassert>
23696 #include <memory>
23697 #include <ostream>
23698
23699 namespace Catch {
23700     void prepareExpandedExpression(AssertionResult& result);
23701
23702     // Returns double formatted as %.3f (format expected on output)
23703     std::string getFormattedDuration( double duration );
23704
23706     bool shouldShowDuration( IConfig const& config, double duration );
23707
23708     std::string serializeFilters( std::vector<std::string> const& container );
23709
23710     template<typename DerivedT>
23711     struct StreamingReporterBase : IStreamingReporter {
23712
23713         StreamingReporterBase( ReporterConfig const& _config )
23714         :   m_config( _config.fullConfig() ),
23715             stream( _config.stream() )
23716         {
23717             m_reporterPrefs.shouldRedirectStdOut = false;
23718             if( !DerivedT::getSupportedVerbosities().count( m_config->verbosity() ) )
23719                 CATCH_ERROR( "Verbosity level not supported by this reporter" );
23720         }
23721
23722         ReporterPreferences getPreferences() const override {
23723             return m_reporterPrefs;
23724         }
23725
23726         static std::set<Verbosity> getSupportedVerbosities() {
23727             return { Verbosity::Normal };
23728         }
23729
23730         ~StreamingReporterBase() override = default;
23731
23732         void noMatchingTestCases(std::string const&) override {}
23733
23734         void reportInvalidArguments(std::string const&) override {}
23735
23736         void testRunStarting(TestRunInfo const& _testRunInfo) override {
23737             currentTestRunInfo = _testRunInfo;
23738         }
23739
23740         void testGroupStarting(GroupInfo const& _groupInfo) override {
23741             currentGroupInfo = _groupInfo;
23742         }
23743
23744         void testCaseStarting(TestCaseInfo const& _testInfo) override  {
23745             currentTestCaseInfo = _testInfo;
23746         }
23747         void sectionStarting(SectionInfo const& _sectionInfo) override {
23748             m_sectionStack.push_back(_sectionInfo);
23749         }
23750
23751         void sectionEnded(SectionStats const& /* _sectionStats */) override {
23752             m_sectionStack.pop_back();
23753         }
23754         void testCaseEnded(TestCaseStats const& /* _testCaseStats */) override {
23755             currentTestCaseInfo.reset();
23756         }
23757         void testGroupEnded(TestGroupStats const& /* _testGroupStats */) override {
23758             currentGroupInfo.reset();
23759         }
23760         void testRunEnded(TestRunStats const& /* _testRunStats */) override {
23761             currentTestCaseInfo.reset();
23762             currentGroupInfo.reset();
23763             currentTestRunInfo.reset();
23764         }
23765
23766         void skipTest(TestCaseInfo const&) override {
23767             // Don't do anything with this by default.
23768             // It can optionally be overridden in the derived class.
23769         }
23770
23771         IConfigPtr m_config;
23772         std::ostream& stream;
23773
23774         LazyStat<TestRunInfo> currentTestRunInfo;
23775         LazyStat<GroupInfo> currentGroupInfo;
23776         LazyStat<TestCaseInfo> currentTestCaseInfo;
23777
23778         std::vector<SectionInfo> m_sectionStack;
```

```
23779         ReporterPreferences m_reporterPrefs;
23780     };
23781
23782     template<typename DerivedT>
23783     struct CumulativeReporterBase : IStreamingReporter {
23784         template<typename T, typename ChildNodeT>
23785         struct Node {
23786             explicit Node( T const& _value ) : value( _value ) {}
23787             virtual ~Node() {}
23788
23789             using ChildNodes = std::vector<std::shared_ptr<ChildNodeT>>;
23790             T value;
23791             ChildNodes children;
23792         };
23793         struct SectionNode {
23794             explicit SectionNode(SectionStats const& _stats) : stats(_stats) {}
23795             virtual ~SectionNode() = default;
23796
23797             bool operator == (SectionNode const& other) const {
23798                 return stats.sectionInfo.lineInfo == other.stats.sectionInfo.lineInfo;
23799             }
23800             bool operator == (std::shared_ptr<SectionNode> const& other) const {
23801                 return operator==(*other);
23802             }
23803
23804             SectionStats stats;
23805             using ChildSections = std::vector<std::shared_ptr<SectionNode>>;
23806             using Assertions = std::vector<AssertionStats>;
23807             ChildSections childSections;
23808             Assertions assertions;
23809             std::string stdOut;
23810             std::string stdErr;
23811         };
23812
23813         struct BySectionInfo {
23814             BySectionInfo( SectionInfo const& other ) : m_other( other ) {}
23815             BySectionInfo( BySectionInfo const& other ) : m_other( other.m_other ) {}
23816             bool operator() (std::shared_ptr<SectionNode> const& node) const {
23817                 return ((node->stats.sectionInfo.name == m_other.name) &&
23818                         (node->stats.sectionInfo.lineInfo == m_other.lineInfo));
23819             }
23820             void operator=(BySectionInfo const&) = delete;
23821
23822         private:
23823             SectionInfo const& m_other;
23824         };
23825
23826         using TestCaseNode = Node<TestCaseStats, SectionNode>;
23827         using TestGroupNode = Node<TestGroupStats, TestCaseNode>;
23828         using TestRunNode = Node<TestRunStats, TestGroupNode>;
23829
23830         CumulativeReporterBase( ReporterConfig const& _config )
23831         :   m_config( _config.fullConfig() ),
23832             stream( _config.stream() )
23833         {
23834             m_reporterPrefs.shouldRedirectStdOut = false;
23835             if( !DerivedT::getSupportedVerbosities().count( m_config->verbosity() ) )
23836                 CATCH_ERROR( "Verbosity level not supported by this reporter" );
23837         }
23838         ~CumulativeReporterBase() override = default;
23839
23840         ReporterPreferences getPreferences() const override {
23841             return m_reporterPrefs;
23842         }
23843
23844         static std::set<Verbosity> getSupportedVerbosities() {
23845             return { Verbosity::Normal };
23846         }
23847
23848         void testRunStarting( TestRunInfo const& ) override {}
23849         void testGroupStarting( GroupInfo const& ) override {}
23850
23851         void testCaseStarting( TestCaseInfo const& ) override {}
23852
23853         void sectionStarting( SectionInfo const& sectionInfo ) override {
23854             SectionStats incompleteStats( sectionInfo, Counts(), 0, false );
23855             std::shared_ptr<SectionNode> node;
23856             if( m_sectionStack.empty() ) {
23857                 if( !m_rootSection )
23858                     m_rootSection = std::make_shared<SectionNode>( incompleteStats );
23859                 node = m_rootSection;
23860             }
23861             else {
23862                 SectionNode& parentNode = *m_sectionStack.back();
23863                 auto it =
23864                     std::find_if(   parentNode.childSections.begin(),
23865                                     parentNode.childSections.end(),
```

```
23866                                   BySectionInfo( sectionInfo ) );
23867                 if( it == parentNode.childSections.end() ) {
23868                     node = std::make_shared<SectionNode>( incompleteStats );
23869                     parentNode.childSections.push_back( node );
23870                 }
23871                 else
23872                     node = *it;
23873             }
23874             m_sectionStack.push_back( node );
23875             m_deepestSection = std::move(node);
23876         }
23877
23878         void assertionStarting(AssertionInfo const&) override {}
23879
23880         bool assertionEnded(AssertionStats const& assertionStats) override {
23881             assert(!m_sectionStack.empty());
23882             // AssertionResult holds a pointer to a temporary DecomposedExpression,
23883             // which getExpandedExpression() calls to build the expression string.
23884             // Our section stack copy of the assertionResult will likely outlive the
23885             // temporary, so it must be expanded or discarded now to avoid calling
23886             // a destroyed object later.
23887             prepareExpandedExpression(const_cast<AssertionResult&>( assertionStats.assertionResult )
      );
23888             SectionNode& sectionNode = *m_sectionStack.back();
23889             sectionNode.assertions.push_back(assertionStats);
23890             return true;
23891         }
23892         void sectionEnded(SectionStats const& sectionStats) override {
23893             assert(!m_sectionStack.empty());
23894             SectionNode& node = *m_sectionStack.back();
23895             node.stats = sectionStats;
23896             m_sectionStack.pop_back();
23897         }
23898         void testCaseEnded(TestCaseStats const& testCaseStats) override {
23899             auto node = std::make_shared<TestCaseNode>(testCaseStats);
23900             assert(m_sectionStack.size() == 0);
23901             node->children.push_back(m_rootSection);
23902             m_testCases.push_back(node);
23903             m_rootSection.reset();
23904
23905             assert(m_deepestSection);
23906             m_deepestSection->stdOut = testCaseStats.stdOut;
23907             m_deepestSection->stdErr = testCaseStats.stdErr;
23908         }
23909         void testGroupEnded(TestGroupStats const& testGroupStats) override {
23910             auto node = std::make_shared<TestGroupNode>(testGroupStats);
23911             node->children.swap(m_testCases);
23912             m_testGroups.push_back(node);
23913         }
23914         void testRunEnded(TestRunStats const& testRunStats) override {
23915             auto node = std::make_shared<TestRunNode>(testRunStats);
23916             node->children.swap(m_testGroups);
23917             m_testRuns.push_back(node);
23918             testRunEndedCumulative();
23919         }
23920         virtual void testRunEndedCumulative() = 0;
23921
23922         void skipTest(TestCaseInfo const&) override {}
23923
23924         IConfigPtr m_config;
23925         std::ostream& stream;
23926         std::vector<AssertionStats> m_assertions;
23927         std::vector<std::vector<std::shared_ptr<SectionNode>>> m_sections;
23928         std::vector<std::shared_ptr<TestCaseNode>> m_testCases;
23929         std::vector<std::shared_ptr<TestGroupNode>> m_testGroups;
23930
23931         std::vector<std::shared_ptr<TestRunNode>> m_testRuns;
23932
23933         std::shared_ptr<SectionNode> m_rootSection;
23934         std::shared_ptr<SectionNode> m_deepestSection;
23935         std::vector<std::shared_ptr<SectionNode>> m_sectionStack;
23936         ReporterPreferences m_reporterPrefs;
23937     };
23938
23939     template<char C>
23940     char const* getLineOfChars() {
23941         static char line[CATCH_CONFIG_CONSOLE_WIDTH] = {0};
23942         if( !*line ) {
23943             std::memset( line, C, CATCH_CONFIG_CONSOLE_WIDTH-1 );
23944             line[CATCH_CONFIG_CONSOLE_WIDTH-1] = 0;
23945         }
23946         return line;
23947     }
23948
23949     struct TestEventListenerBase : StreamingReporterBase<TestEventListenerBase> {
23950         TestEventListenerBase( ReporterConfig const& _config );
23951
```

```
23952         static std::set<Verbosity> getSupportedVerbosities();
23953
23954         void assertionStarting(AssertionInfo const&) override;
23955         bool assertionEnded(AssertionStats const&) override;
23956     };
23957
23958 } // end namespace Catch
23959
23960 // end catch_reporter_bases.hpp
23961 // start catch_console_colour.h
23962
23963 namespace Catch {
23964
23965     struct Colour {
23966         enum Code {
23967             None = 0,
23968
23969             White,
23970             Red,
23971             Green,
23972             Blue,
23973             Cyan,
23974             Yellow,
23975             Grey,
23976
23977             Bright = 0x10,
23978
23979             BrightRed = Bright | Red,
23980             BrightGreen = Bright | Green,
23981             LightGrey = Bright | Grey,
23982             BrightWhite = Bright | White,
23983             BrightYellow = Bright | Yellow,
23984
23985             // By intention
23986             FileName = LightGrey,
23987             Warning = BrightYellow,
23988             ResultError = BrightRed,
23989             ResultSuccess = BrightGreen,
23990             ResultExpectedFailure = Warning,
23991
23992             Error = BrightRed,
23993             Success = Green,
23994
23995             OriginalExpression = Cyan,
23996             ReconstructedExpression = BrightYellow,
23997
23998             SecondaryText = LightGrey,
23999             Headers = White
24000         };
24001
24002         // Use constructed object for RAII guard
24003         Colour( Code _colourCode );
24004         Colour( Colour&& other ) noexcept;
24005         Colour& operator=( Colour&& other ) noexcept;
24006         ~Colour();
24007
24008         // Use static method for one-shot changes
24009         static void use( Code _colourCode );
24010
24011     private:
24012         bool m_moved = false;
24013     };
24014
24015     std::ostream& operator << ( std::ostream& os, Colour const& );
24016
24017 } // end namespace Catch
24018
24019 // end catch_console_colour.h
24020 // start catch_reporter_registrars.hpp
24021
24022
24023 namespace Catch {
24024
24025     template<typename T>
24026     class ReporterRegistrar {
24027
24028         class ReporterFactory : public IReporterFactory {
24029
24030             IStreamingReporterPtr create( ReporterConfig const& config ) const override {
24031                 return std::unique_ptr<T>( new T( config ) );
24032             }
24033
24034             std::string getDescription() const override {
24035                 return T::getDescription();
24036             }
24037         };
24038
```

```
24039     public:
24040
24041         explicit ReporterRegistrar( std::string const& name ) {
24042             getMutableRegistryHub().registerReporter( name, std::make_shared<ReporterFactory>() );
24043         }
24044     };
24045
24046     template<typename T>
24047     class ListenerRegistrar {
24048
24049         class ListenerFactory : public IReporterFactory {
24050
24051             IStreamingReporterPtr create( ReporterConfig const& config ) const override {
24052                 return std::unique_ptr<T>( new T( config ) );
24053             }
24054             std::string getDescription() const override {
24055                 return std::string();
24056             }
24057         };
24058
24059     public:
24060
24061         ListenerRegistrar() {
24062             getMutableRegistryHub().registerListener( std::make_shared<ListenerFactory>() );
24063         }
24064     };
24065 }
24066
24067 #if !defined(CATCH_CONFIG_DISABLE)
24068
24069 #define CATCH_REGISTER_REPORTER( name, reporterType ) \
24070     CATCH_INTERNAL_START_WARNINGS_SUPPRESSION         \
24071     CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS          \
24072     namespace{ Catch::ReporterRegistrar<reporterType> catch_internal_RegistrarFor##reporterType( name
      ); } \
24073     CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
24074
24075 #define CATCH_REGISTER_LISTENER( listenerType ) \
24076     CATCH_INTERNAL_START_WARNINGS_SUPPRESSION   \
24077     CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS    \
24078     namespace{ Catch::ListenerRegistrar<listenerType> catch_internal_RegistrarFor##listenerType; } \
24079     CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
24080 #else // CATCH_CONFIG_DISABLE
24081
24082 #define CATCH_REGISTER_REPORTER(name, reporterType)
24083 #define CATCH_REGISTER_LISTENER(listenerType)
24084
24085 #endif // CATCH_CONFIG_DISABLE
24086
24087 // end catch_reporter_registrars.hpp
24088 // Allow users to base their work off existing reporters
24089 // start catch_reporter_compact.h
24090
24091 namespace Catch {
24092
24093     struct CompactReporter : StreamingReporterBase<CompactReporter> {
24094
24095         using StreamingReporterBase::StreamingReporterBase;
24096
24097         ~CompactReporter() override;
24098
24099         static std::string getDescription();
24100
24101         void noMatchingTestCases(std::string const& spec) override;
24102
24103         void assertionStarting(AssertionInfo const&) override;
24104
24105         bool assertionEnded(AssertionStats const& _assertionStats) override;
24106
24107         void sectionEnded(SectionStats const& _sectionStats) override;
24108
24109         void testRunEnded(TestRunStats const& _testRunStats) override;
24110
24111     };
24112
24113 } // end namespace Catch
24114
24115 // end catch_reporter_compact.h
24116 // start catch_reporter_console.h
24117
24118 #if defined(_MSC_VER)
24119 #pragma warning(push)
24120 #pragma warning(disable:4061) // Not all labels are EXPLICITLY handled in switch
24121                               // Note that 4062 (not all labels are handled
24122                               // and default is missing) is enabled
24123 #endif
24124
```

```
24125 namespace Catch {
24126     // Fwd decls
24127     struct SummaryColumn;
24128     class TablePrinter;
24129
24130     struct ConsoleReporter : StreamingReporterBase<ConsoleReporter> {
24131         std::unique_ptr<TablePrinter> m_tablePrinter;
24132
24133         ConsoleReporter(ReporterConfig const& config);
24134         ~ConsoleReporter() override;
24135         static std::string getDescription();
24136
24137         void noMatchingTestCases(std::string const& spec) override;
24138
24139         void reportInvalidArguments(std::string const&arg) override;
24140
24141         void assertionStarting(AssertionInfo const&) override;
24142
24143         bool assertionEnded(AssertionStats const& _assertionStats) override;
24144
24145         void sectionStarting(SectionInfo const& _sectionInfo) override;
24146         void sectionEnded(SectionStats const& _sectionStats) override;
24147
24148 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
24149         void benchmarkPreparing(std::string const& name) override;
24150         void benchmarkStarting(BenchmarkInfo const& info) override;
24151         void benchmarkEnded(BenchmarkStats<> const& stats) override;
24152         void benchmarkFailed(std::string const& error) override;
24153 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
24154
24155         void testCaseEnded(TestCaseStats const& _testCaseStats) override;
24156         void testGroupEnded(TestGroupStats const& _testGroupStats) override;
24157         void testRunEnded(TestRunStats const& _testRunStats) override;
24158         void testRunStarting(TestRunInfo const& _testRunInfo) override;
24159     private:
24160
24161         void lazyPrint();
24162
24163         void lazyPrintWithoutClosingBenchmarkTable();
24164         void lazyPrintRunInfo();
24165         void lazyPrintGroupInfo();
24166         void printTestCaseAndSectionHeader();
24167
24168         void printClosedHeader(std::string const& _name);
24169         void printOpenHeader(std::string const& _name);
24170
24171         // if string has a : in first line will set indent to follow it on
24172         // subsequent lines
24173         void printHeaderString(std::string const& _string, std::size_t indent = 0);
24174
24175         void printTotals(Totals const& totals);
24176         void printSummaryRow(std::string const& label, std::vector<SummaryColumn> const& cols,
      std::size_t row);
24177
24178         void printTotalsDivider(Totals const& totals);
24179         void printSummaryDivider();
24180         void printTestFilters();
24181
24182     private:
24183         bool m_headerPrinted = false;
24184     };
24185
24186 } // end namespace Catch
24187
24188 #if defined(_MSC_VER)
24189 #pragma warning(pop)
24190 #endif
24191
24192 // end catch_reporter_console.h
24193 // start catch_reporter_junit.h
24194
24195 // start catch_xmlwriter.h
24196
24197 #include <vector>
24198
24199 namespace Catch {
24200     enum class XmlFormatting {
24201         None = 0x00,
24202         Indent = 0x01,
24203         Newline = 0x02,
24204     };
24205
24206     XmlFormatting operator | (XmlFormatting lhs, XmlFormatting rhs);
24207     XmlFormatting operator & (XmlFormatting lhs, XmlFormatting rhs);
24208
24209     class XmlEncode {
24210     public:
```

```
24211         enum ForWhat { ForTextNodes, ForAttributes };
24212
24213         XmlEncode( std::string const& str, ForWhat forWhat = ForTextNodes );
24214
24215         void encodeTo( std::ostream& os ) const;
24216
24217         friend std::ostream& operator << ( std::ostream& os, XmlEncode const& xmlEncode );
24218
24219     private:
24220         std::string m_str;
24221         ForWhat m_forWhat;
24222     };
24223
24224     class XmlWriter {
24225     public:
24226
24227         class ScopedElement {
24228         public:
24229             ScopedElement( XmlWriter* writer, XmlFormatting fmt );
24230
24231             ScopedElement( ScopedElement&& other ) noexcept;
24232             ScopedElement& operator=( ScopedElement&& other ) noexcept;
24233
24234             ~ScopedElement();
24235
24236             ScopedElement& writeText( std::string const& text, XmlFormatting fmt =
      XmlFormatting::Newline | XmlFormatting::Indent );
24237
24238             template<typename T>
24239             ScopedElement& writeAttribute( std::string const& name, T const& attribute ) {
24240                 m_writer->writeAttribute( name, attribute );
24241                 return *this;
24242             }
24243
24244         private:
24245             mutable XmlWriter* m_writer = nullptr;
24246             XmlFormatting m_fmt;
24247         };
24248
24249         XmlWriter( std::ostream& os = Catch::cout() );
24250         ~XmlWriter();
24251
24252         XmlWriter( XmlWriter const& ) = delete;
24253         XmlWriter& operator=( XmlWriter const& ) = delete;
24254
24255         XmlWriter& startElement( std::string const& name, XmlFormatting fmt = XmlFormatting::Newline |
      XmlFormatting::Indent);
24256
24257         ScopedElement scopedElement( std::string const& name, XmlFormatting fmt =
      XmlFormatting::Newline | XmlFormatting::Indent);
24258
24259         XmlWriter& endElement(XmlFormatting fmt = XmlFormatting::Newline | XmlFormatting::Indent);
24260
24261         XmlWriter& writeAttribute( std::string const& name, std::string const& attribute );
24262
24263         XmlWriter& writeAttribute( std::string const& name, bool attribute );
24264
24265         template<typename T>
24266         XmlWriter& writeAttribute( std::string const& name, T const& attribute ) {
24267             ReusableStringStream rss;
24268             rss << attribute;
24269             return writeAttribute( name, rss.str() );
24270         }
24271
24272         XmlWriter& writeText( std::string const& text, XmlFormatting fmt = XmlFormatting::Newline |
      XmlFormatting::Indent);
24273
24274         XmlWriter& writeComment(std::string const& text, XmlFormatting fmt = XmlFormatting::Newline |
      XmlFormatting::Indent);
24275
24276         void writeStylesheetRef( std::string const& url );
24277
24278         XmlWriter& writeBlankLine();
24279
24280         void ensureTagClosed();
24281
24282     private:
24283
24284         void applyFormatting(XmlFormatting fmt);
24285
24286         void writeDeclaration();
24287
24288         void newlineIfNecessary();
24289
24290         bool m_tagIsOpen = false;
24291         bool m_needsNewline = false;
24292         std::vector<std::string> m_tags;
```

```
24293         std::string m_indent;
24294         std::ostream& m_os;
24295     };
24296
24297 }
24298
24299 // end catch_xmlwriter.h
24300 namespace Catch {
24301
24302     class JunitReporter : public CumulativeReporterBase<JunitReporter> {
24303     public:
24304         JunitReporter(ReporterConfig const& _config);
24305
24306         ~JunitReporter() override;
24307
24308         static std::string getDescription();
24309
24310         void noMatchingTestCases(std::string const& /*spec*/) override;
24311
24312         void testRunStarting(TestRunInfo const& runInfo) override;
24313
24314         void testGroupStarting(GroupInfo const& groupInfo) override;
24315
24316         void testCaseStarting(TestCaseInfo const& testCaseInfo) override;
24317         bool assertionEnded(AssertionStats const& assertionStats) override;
24318
24319         void testCaseEnded(TestCaseStats const& testCaseStats) override;
24320
24321         void testGroupEnded(TestGroupStats const& testGroupStats) override;
24322
24323         void testRunEndedCumulative() override;
24324
24325         void writeGroup(TestGroupNode const& groupNode, double suiteTime);
24326
24327         void writeTestCase(TestCaseNode const& testCaseNode);
24328
24329         void writeSection( std::string const& className,
24330                            std::string const& rootName,
24331                            SectionNode const& sectionNode,
24332                            bool testOkToFail );
24333
24334         void writeAssertions(SectionNode const& sectionNode);
24335         void writeAssertion(AssertionStats const& stats);
24336
24337         XmlWriter xml;
24338         Timer suiteTimer;
24339         std::string stdOutForSuite;
24340         std::string stdErrForSuite;
24341         unsigned int unexpectedExceptions = 0;
24342         bool m_okToFail = false;
24343     };
24344
24345 } // end namespace Catch
24346
24347 // end catch_reporter_junit.h
24348 // start catch_reporter_xml.h
24349
24350 namespace Catch {
24351     class XmlReporter : public StreamingReporterBase<XmlReporter> {
24352     public:
24353         XmlReporter(ReporterConfig const& _config);
24354
24355         ~XmlReporter() override;
24356
24357         static std::string getDescription();
24358
24359         virtual std::string getStylesheetRef() const;
24360
24361         void writeSourceInfo(SourceLineInfo const& sourceInfo);
24362
24363     public: // StreamingReporterBase
24364
24365         void noMatchingTestCases(std::string const& s) override;
24366
24367         void testRunStarting(TestRunInfo const& testInfo) override;
24368
24369         void testGroupStarting(GroupInfo const& groupInfo) override;
24370
24371         void testCaseStarting(TestCaseInfo const& testInfo) override;
24372
24373         void sectionStarting(SectionInfo const& sectionInfo) override;
24374
24375         void assertionStarting(AssertionInfo const&) override;
24376
24377         bool assertionEnded(AssertionStats const& assertionStats) override;
24378
24379         void sectionEnded(SectionStats const& sectionStats) override;
```

```
24380
24381         void testCaseEnded(TestCaseStats const& testCaseStats) override;
24382
24383         void testGroupEnded(TestGroupStats const& testGroupStats) override;
24384
24385         void testRunEnded(TestRunStats const& testRunStats) override;
24386
24387 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
24388         void benchmarkPreparing(std::string const& name) override;
24389         void benchmarkStarting(BenchmarkInfo const&) override;
24390         void benchmarkEnded(BenchmarkStats<> const&) override;
24391         void benchmarkFailed(std::string const&) override;
24392 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
24393
24394     private:
24395         Timer m_testCaseTimer;
24396         XmlWriter m_xml;
24397         int m_sectionDepth = 0;
24398     };
24399
24400 } // end namespace Catch
24401
24402 // end catch_reporter_xml.h
24403
24404 // end catch_external_interfaces.h
24405 #endif
24406
24407 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
24408 // start catch_benchmarking_all.hpp
24409
24410 // A proxy header that includes all of the benchmarking headers to allow
24411 // concise include of the benchmarking features. You should prefer the
24412 // individual includes in standard use.
24413
24414 // start catch_benchmark.hpp
24415
24416  // Benchmark
24417
24418 // start catch_chronometer.hpp
24419
24420 // User-facing chronometer
24421
24422
24423 // start catch_clock.hpp
24424
24425 // Clocks
24426
24427
24428 #include <chrono>
24429 #include <ratio>
24430
24431 namespace Catch {
24432     namespace Benchmark {
24433         template <typename Clock>
24434         using ClockDuration = typename Clock::duration;
24435         template <typename Clock>
24436         using FloatDuration = std::chrono::duration<double, typename Clock::period>;
24437
24438         template <typename Clock>
24439         using TimePoint = typename Clock::time_point;
24440
24441         using default_clock = std::chrono::steady_clock;
24442
24443         template <typename Clock>
24444         struct now {
24445             TimePoint<Clock> operator()() const {
24446                 return Clock::now();
24447             }
24448         };
24449
24450         using fp_seconds = std::chrono::duration<double, std::ratio<1>>;
24451     } // namespace Benchmark
24452 } // namespace Catch
24453
24454 // end catch_clock.hpp
24455 // start catch_optimizer.hpp
24456
24457  // Hinting the optimizer
24458
24459
24460 #if defined(_MSC_VER)
24461 #   include <atomic> // atomic_thread_fence
24462 #endif
24463
24464 namespace Catch {
24465     namespace Benchmark {
24466 #if defined(__GNUC__) || defined(__clang__)
```

```
24467         template <typename T>
24468         inline void keep_memory(T* p) {
24469             asm volatile("" : : "g"(p) : "memory");
24470         }
24471         inline void keep_memory() {
24472             asm volatile("" : : : "memory");
24473         }
24474
24475         namespace Detail {
24476             inline void optimizer_barrier() { keep_memory(); }
24477         } // namespace Detail
24478 #elif defined(_MSC_VER)
24479
24480 #pragma optimize("", off)
24481         template <typename T>
24482         inline void keep_memory(T* p) {
24483             // thanks @milleniumbug
24484             *reinterpret_cast<char volatile*>(p) = *reinterpret_cast<char const volatile*>(p);
24485         }
24486         // TODO equivalent keep_memory()
24487 #pragma optimize("", on)
24488
24489         namespace Detail {
24490             inline void optimizer_barrier() {
24491                 std::atomic_thread_fence(std::memory_order_seq_cst);
24492             }
24493         } // namespace Detail
24494
24495 #endif
24496
24497         template <typename T>
24498         inline void deoptimize_value(T&& x) {
24499             keep_memory(&x);
24500         }
24501
24502         template <typename Fn, typename... Args>
24503         inline auto invoke_deoptimized(Fn&& fn, Args&&... args) -> typename
      std::enable_if<!std::is_same<void, decltype(fn(args...))>::value>::type {
24504             deoptimize_value(std::forward<Fn>(fn) (std::forward<Args...>(args...)));
24505         }
24506
24507         template <typename Fn, typename... Args>
24508         inline auto invoke_deoptimized(Fn&& fn, Args&&... args) -> typename
      std::enable_if<std::is_same<void, decltype(fn(args...))>::value>::type {
24509             std::forward<Fn>(fn) (std::forward<Args...>(args...));
24510         }
24511     } // namespace Benchmark
24512 } // namespace Catch
24513
24514 // end catch_optimizer.hpp
24515 // start catch_complete_invoke.hpp
24516
24517 // Invoke with a special case for void
24518
24519
24520 #include <type_traits>
24521 #include <utility>
24522
24523 namespace Catch {
24524     namespace Benchmark {
24525         namespace Detail {
24526             template <typename T>
24527             struct CompleteType { using type = T; };
24528             template <>
24529             struct CompleteType<void> { struct type {}; };
24530
24531             template <typename T>
24532             using CompleteType_t = typename CompleteType<T>::type;
24533
24534             template <typename Result>
24535             struct CompleteInvoker {
24536                 template <typename Fun, typename... Args>
24537                 static Result invoke(Fun&& fun, Args&&... args) {
24538                     return std::forward<Fun>(fun)(std::forward<Args>(args)...);
24539                 }
24540             };
24541             template <>
24542             struct CompleteInvoker<void> {
24543                 template <typename Fun, typename... Args>
24544                 static CompleteType_t<void> invoke(Fun&& fun, Args&&... args) {
24545                     std::forward<Fun>(fun)(std::forward<Args>(args)...);
24546                     return {};
24547                 }
24548             };
24549
24550             // invoke and not return void :(
24551             template <typename Fun, typename... Args>
```

```
24552             CompleteType_t<FunctionReturnType<Fun, Args...» complete_invoke(Fun&& fun, Args&&... args)
      {
24553                 return CompleteInvoker<FunctionReturnType<Fun,
      Args...»::invoke(std::forward<Fun>(fun), std::forward<Args>(args)...);
24554             }
24555
24556             const std::string benchmarkErrorMsg = "a benchmark failed to run successfully";
24557         } // namespace Detail
24558
24559         template <typename Fun>
24560         Detail::CompleteType_t<FunctionReturnType<Fun» user_code(Fun&& fun) {
24561             CATCH_TRY{
24562                 return Detail::complete_invoke(std::forward<Fun>(fun));
24563             } CATCH_CATCH_ALL{
24564                 getResultCapture().benchmarkFailed(translateActiveException());
24565                 CATCH_RUNTIME_ERROR(Detail::benchmarkErrorMsg);
24566             }
24567         }
24568     } // namespace Benchmark
24569 } // namespace Catch
24570
24571 // end catch_complete_invoke.hpp
24572 namespace Catch {
24573     namespace Benchmark {
24574         namespace Detail {
24575             struct ChronometerConcept {
24576                 virtual void start() = 0;
24577                 virtual void finish() = 0;
24578                 virtual ~ChronometerConcept() = default;
24579             };
24580             template <typename Clock>
24581             struct ChronometerModel final : public ChronometerConcept {
24582                 void start() override { started = Clock::now(); }
24583                 void finish() override { finished = Clock::now(); }
24584
24585                 ClockDuration<Clock> elapsed() const { return finished - started; }
24586
24587                 TimePoint<Clock> started;
24588                 TimePoint<Clock> finished;
24589             };
24590         } // namespace Detail
24591
24592         struct Chronometer {
24593         public:
24594             template <typename Fun>
24595             void measure(Fun&& fun) { measure(std::forward<Fun>(fun), is_callable<Fun(int)>()); }
24596
24597             int runs() const { return k; }
24598
24599             Chronometer(Detail::ChronometerConcept& meter, int k)
24600                 : impl(&meter)
24601                 , k(k) {}
24602
24603         private:
24604             template <typename Fun>
24605             void measure(Fun&& fun, std::false_type) {
24606                 measure([&fun](int) { return fun(); }, std::true_type());
24607             }
24608
24609             template <typename Fun>
24610             void measure(Fun&& fun, std::true_type) {
24611                 Detail::optimizer_barrier();
24612                 impl->start();
24613                 for (int i = 0; i < k; ++i) invoke_deoptimized(fun, i);
24614                 impl->finish();
24615                 Detail::optimizer_barrier();
24616             }
24617
24618             Detail::ChronometerConcept* impl;
24619             int k;
24620         };
24621     } // namespace Benchmark
24622 } // namespace Catch
24623
24624 // end catch_chronometer.hpp
24625 // start catch_environment.hpp
24626
24627 // Environment information
24628
24629
24630 namespace Catch {
24631     namespace Benchmark {
24632         template <typename Duration>
24633         struct EnvironmentEstimate {
24634             Duration mean;
24635             OutlierClassification outliers;
24636
```

```
24637             template <typename Duration2>
24638             operator EnvironmentEstimate<Duration2>() const {
24639                 return { mean, outliers };
24640             }
24641         };
24642         template <typename Clock>
24643         struct Environment {
24644             using clock_type = Clock;
24645             EnvironmentEstimate<FloatDuration<Clock>> clock_resolution;
24646             EnvironmentEstimate<FloatDuration<Clock>> clock_cost;
24647         };
24648     } // namespace Benchmark
24649 } // namespace Catch
24650
24651 // end catch_environment.hpp
24652 // start catch_execution_plan.hpp
24653
24654  // Execution plan
24655
24656
24657 // start catch_benchmark_function.hpp
24658
24659  // Dumb std::function implementation for consistent call overhead
24660
24661
24662 #include <cassert>
24663 #include <type_traits>
24664 #include <utility>
24665 #include <memory>
24666
24667 namespace Catch {
24668     namespace Benchmark {
24669         namespace Detail {
24670             template <typename T>
24671             using Decay = typename std::decay<T>::type;
24672             template <typename T, typename U>
24673             struct is_related
24674                 : std::is_same<Decay<T>, Decay<U>> {};
24675
24676             struct BenchmarkFunction {
24677             private:
24678                 struct callable {
24679                     virtual void call(Chronometer meter) const = 0;
24680                     virtual callable* clone() const = 0;
24681                     virtual ~callable() = default;
24682                 };
24683                 template <typename Fun>
24684                 struct model : public callable {
24685                     model(Fun&& fun) : fun(std::move(fun)) {}
24686                     model(Fun const& fun) : fun(fun) {}
24687
24688                     model<Fun>* clone() const override { return new model<Fun>(*this); }
24689
24690                     void call(Chronometer meter) const override {
24691                         call(meter, is_callable<Fun(Chronometer)>());
24692                     }
24693                     void call(Chronometer meter, std::true_type) const {
24694                         fun(meter);
24695                     }
24696                     void call(Chronometer meter, std::false_type) const {
24697                         meter.measure(fun);
24698                     }
24699
24700                     Fun fun;
24701                 };
24702
24703                 struct do_nothing { void operator()() const {} };
24704
24705                 template <typename T>
24706                 BenchmarkFunction(model<T>* c) : f(c) {}
24707
24708             public:
24709                 BenchmarkFunction()
24710                     : f(new model<do_nothing>{ {} }) {}
24711
24712                 template <typename Fun,
24713                     typename std::enable_if<!is_related<Fun, BenchmarkFunction>::value, int>::type =
    0>
24714                     BenchmarkFunction(Fun&& fun)
24715                     : f(new model<typename std::decay<Fun>::type>(std::forward<Fun>(fun))) {}
24716
24717                 BenchmarkFunction(BenchmarkFunction&& that)
24718                     : f(std::move(that.f)) {}
24719
24720                 BenchmarkFunction(BenchmarkFunction const& that)
24721                     : f(that.f->clone()) {}
24722
24723
24724
24725
24726
24727
24728
24729
```

```
24730                 BenchmarkFunction& operator=(BenchmarkFunction&& that) {
24731                     f = std::move(that.f);
24732                     return *this;
24733                 }
24734
24735                 BenchmarkFunction& operator=(BenchmarkFunction const& that) {
24736                     f.reset(that.f->clone());
24737                     return *this;
24738                 }
24739
24740                 void operator()(Chronometer meter) const { f->call(meter); }
24741
24742             private:
24743                 std::unique_ptr<callable> f;
24744             };
24745         } // namespace Detail
24746     } // namespace Benchmark
24747 } // namespace Catch
24748
24749 // end catch_benchmark_function.hpp
24750 // start catch_repeat.hpp
24751
24752 // repeat algorithm
24753
24754
24755 #include <type_traits>
24756 #include <utility>
24757
24758 namespace Catch {
24759     namespace Benchmark {
24760         namespace Detail {
24761             template <typename Fun>
24762             struct repeater {
24763                 void operator()(int k) const {
24764                     for (int i = 0; i < k; ++i) {
24765                         fun();
24766                     }
24767                 }
24768                 Fun fun;
24769             };
24770             template <typename Fun>
24771             repeater<typename std::decay<Fun>::type> repeat(Fun&& fun) {
24772                 return { std::forward<Fun>(fun) };
24773             }
24774         } // namespace Detail
24775     } // namespace Benchmark
24776 } // namespace Catch
24777
24778 // end catch_repeat.hpp
24779 // start catch_run_for_at_least.hpp
24780
24781 // Run a function for a minimum amount of time
24782
24783
24784 // start catch_measure.hpp
24785
24786 // Measure
24787
24788
24789 // start catch_timing.hpp
24790
24791 // Timing
24792
24793
24794 #include <tuple>
24795 #include <type_traits>
24796
24797 namespace Catch {
24798     namespace Benchmark {
24799         template <typename Duration, typename Result>
24800         struct Timing {
24801             Duration elapsed;
24802             Result result;
24803             int iterations;
24804         };
24805         template <typename Clock, typename Func, typename... Args>
24806         using TimingOf = Timing<ClockDuration<Clock>, Detail::CompleteType_t<FunctionReturnType<Func,
    Args...>>>;
24807     } // namespace Benchmark
24808 } // namespace Catch
24809
24810 // end catch_timing.hpp
24811 #include <utility>
24812
24813 namespace Catch {
24814     namespace Benchmark {
24815         namespace Detail {
```

```
24816             template <typename Clock, typename Fun, typename... Args>
24817             TimingOf<Clock, Fun, Args...> measure(Fun&& fun, Args&&... args) {
24818                 auto start = Clock::now();
24819                 auto&& r = Detail::complete_invoke(fun, std::forward<Args>(args)...);
24820                 auto end = Clock::now();
24821                 auto delta = end - start;
24822                 return { delta, std::forward<decltype(r)>(r), 1 };
24823             }
24824         } // namespace Detail
24825     } // namespace Benchmark
24826 } // namespace Catch
24827
24828 // end catch_measure.hpp
24829 #include <utility>
24830 #include <type_traits>
24831
24832 namespace Catch {
24833     namespace Benchmark {
24834         namespace Detail {
24835             template <typename Clock, typename Fun>
24836             TimingOf<Clock, Fun, int> measure_one(Fun&& fun, int iters, std::false_type) {
24837                 return Detail::measure<Clock>(fun, iters);
24838             }
24839             template <typename Clock, typename Fun>
24840             TimingOf<Clock, Fun, Chronometer> measure_one(Fun&& fun, int iters, std::true_type) {
24841                 Detail::ChronometerModel<Clock> meter;
24842                 auto&& result = Detail::complete_invoke(fun, Chronometer(meter, iters));
24843
24844                 return { meter.elapsed(), std::move(result), iters };
24845             }
24846
24847             template <typename Clock, typename Fun>
24848             using run_for_at_least_argument_t = typename
      std::conditional<is_callable<Fun(Chronometer)>::value, Chronometer, int>::type;
24849
24850             struct optimized_away_error : std::exception {
24851                 const char* what() const noexcept override {
24852                     return "could not measure benchmark, maybe it was optimized away";
24853                 }
24854             };
24855
24856             template <typename Clock, typename Fun>
24857             TimingOf<Clock, Fun, run_for_at_least_argument_t<Clock, Fun>»
      run_for_at_least(ClockDuration<Clock> how_long, int seed, Fun&& fun) {
24858                 auto iters = seed;
24859                 while (iters < (1 « 30)) {
24860                     auto&& Timing = measure_one<Clock>(fun, iters, is_callable<Fun(Chronometer)>());
24861
24862                     if (Timing.elapsed >= how_long) {
24863                         return { Timing.elapsed, std::move(Timing.result), iters };
24864                     }
24865                     iters *= 2;
24866                 }
24867                 Catch::throw_exception(optimized_away_error{});
24868             }
24869         } // namespace Detail
24870     } // namespace Benchmark
24871 } // namespace Catch
24872
24873 // end catch_run_for_at_least.hpp
24874 #include <algorithm>
24875 #include <iterator>
24876
24877 namespace Catch {
24878     namespace Benchmark {
24879         template <typename Duration>
24880         struct ExecutionPlan {
24881             int iterations_per_sample;
24882             Duration estimated_duration;
24883             Detail::BenchmarkFunction benchmark;
24884             Duration warmup_time;
24885             int warmup_iterations;
24886
24887             template <typename Duration2>
24888             operator ExecutionPlan<Duration2>() const {
24889                 return { iterations_per_sample, estimated_duration, benchmark, warmup_time,
      warmup_iterations };
24890             }
24891
24892             template <typename Clock>
24893             std::vector<FloatDuration<Clock» run(const IConfig &cfg, Environment<FloatDuration<Clock»
      env) const {
24894                 // warmup a bit
24895
      Detail::run_for_at_least<Clock>(std::chrono::duration_cast<ClockDuration<Clock»(warmup_time),
      warmup_iterations, Detail::repeat(now<Clock>{}));
24896
```

```
24897                 std::vector<FloatDuration<Clock>> times;
24898                 times.reserve(cfg.benchmarkSamples());
24899                 std::generate_n(std::back_inserter(times), cfg.benchmarkSamples(), [this, env] {
24900                     Detail::ChronometerModel<Clock> model;
24901                     this->benchmark(Chronometer(model, iterations_per_sample));
24902                     auto sample_time = model.elapsed() - env.clock_cost.mean;
24903                     if (sample_time < FloatDuration<Clock>::zero()) sample_time =
      FloatDuration<Clock>::zero();
24904                     return sample_time / iterations_per_sample;
24905                 });
24906                 return times;
24907             }
24908         };
24909     } // namespace Benchmark
24910 } // namespace Catch
24911
24912 // end catch_execution_plan.hpp
24913 // start catch_estimate_clock.hpp
24914
24915  // Environment measurement
24916
24917
24918 // start catch_stats.hpp
24919
24920 // Statistical analysis tools
24921
24922
24923 #include <algorithm>
24924 #include <functional>
24925 #include <vector>
24926 #include <iterator>
24927 #include <numeric>
24928 #include <tuple>
24929 #include <cmath>
24930 #include <utility>
24931 #include <cstddef>
24932 #include <random>
24933
24934 namespace Catch {
24935     namespace Benchmark {
24936         namespace Detail {
24937             using sample = std::vector<double>;
24938
24939             double weighted_average_quantile(int k, int q, std::vector<double>::iterator first,
      std::vector<double>::iterator last);
24940
24941             template <typename Iterator>
24942             OutlierClassification classify_outliers(Iterator first, Iterator last) {
24943                 std::vector<double> copy(first, last);
24944
24945                 auto q1 = weighted_average_quantile(1, 4, copy.begin(), copy.end());
24946                 auto q3 = weighted_average_quantile(3, 4, copy.begin(), copy.end());
24947                 auto iqr = q3 - q1;
24948                 auto los = q1 - (iqr * 3.);
24949                 auto lom = q1 - (iqr * 1.5);
24950                 auto him = q3 + (iqr * 1.5);
24951                 auto his = q3 + (iqr * 3.);
24952
24953                 OutlierClassification o;
24954                 for (; first != last; ++first) {
24955                     auto&& t = *first;
24956                     if (t < los) ++o.low_severe;
24957                     else if (t < lom) ++o.low_mild;
24958                     else if (t > his) ++o.high_severe;
24959                     else if (t > him) ++o.high_mild;
24960                     ++o.samples_seen;
24961                 }
24962                 return o;
24963             }
24964
24965             template <typename Iterator>
24966             double mean(Iterator first, Iterator last) {
24967                 auto count = last - first;
24968                 double sum = std::accumulate(first, last, 0.);
24969                 return sum / count;
24970             }
24971
24972             template <typename URng, typename Iterator, typename Estimator>
24973             sample resample(URng& rng, int resamples, Iterator first, Iterator last, Estimator&
      estimator) {
24974                 auto n = last - first;
24975                 std::uniform_int_distribution<decltype(n)> dist(0, n - 1);
24976
24977                 sample out;
24978                 out.reserve(resamples);
24979                 std::generate_n(std::back_inserter(out), resamples, [n, first, &estimator, &dist,
      &rng] {
```

```
24980                   std::vector<double> resampled;
24981                   resampled.reserve(n);
24982                   std::generate_n(std::back_inserter(resampled), n, [first, &dist, &rng] { return
      first[dist(rng)]; });
24983                   return estimator(resampled.begin(), resampled.end());
24984               });
24985               std::sort(out.begin(), out.end());
24986               return out;
24987           }
24988
24989           template <typename Estimator, typename Iterator>
24990           sample jackknife(Estimator&& estimator, Iterator first, Iterator last) {
24991               auto n = last - first;
24992               auto second = std::next(first);
24993               sample results;
24994               results.reserve(n);
24995
24996               for (auto it = first; it != last; ++it) {
24997                   std::iter_swap(it, first);
24998                   results.push_back(estimator(second, last));
24999               }
25000
25001               return results;
25002           }
25003
25004           inline double normal_cdf(double x) {
25005               return std::erfc(-x / std::sqrt(2.0)) / 2.0;
25006           }
25007
25008           double erfc_inv(double x);
25009
25010           double normal_quantile(double p);
25011
25012           template <typename Iterator, typename Estimator>
25013           Estimate<double> bootstrap(double confidence_level, Iterator first, Iterator last, sample
      const& resample, Estimator&& estimator) {
25014               auto n_samples = last - first;
25015
25016               double point = estimator(first, last);
25017               // Degenerate case with a single sample
25018               if (n_samples == 1) return { point, point, point, confidence_level };
25019
25020               sample jack = jackknife(estimator, first, last);
25021               double jack_mean = mean(jack.begin(), jack.end());
25022               double sum_squares, sum_cubes;
25023               std::tie(sum_squares, sum_cubes) = std::accumulate(jack.begin(), jack.end(),
      std::make_pair(0., 0.), [jack_mean](std::pair<double, double> sqcb, double x) -> std::pair<double,
      double> {
25024                   auto d = jack_mean - x;
25025                   auto d2 = d * d;
25026                   auto d3 = d2 * d;
25027                   return { sqcb.first + d2, sqcb.second + d3 };
25028               });
25029
25030               double accel = sum_cubes / (6 * std::pow(sum_squares, 1.5));
25031               int n = static_cast<int>(resample.size());
25032               double prob_n = std::count_if(resample.begin(), resample.end(), [point](double x) {
      return x < point; }) / (double)n;
25033               // degenerate case with uniform samples
25034               if (prob_n == 0) return { point, point, point, confidence_level };
25035
25036               double bias = normal_quantile(prob_n);
25037               double z1 = normal_quantile((1. - confidence_level) / 2.);
25038
25039               auto cumn = [n](double x) -> int {
25040                   return std::lround(normal_cdf(x) * n); };
25041               auto a = [bias, accel](double b) { return bias + b / (1. - accel * b); };
25042               double b1 = bias + z1;
25043               double b2 = bias - z1;
25044               double a1 = a(b1);
25045               double a2 = a(b2);
25046               auto lo = (std::max)(cumn(a1), 0);
25047               auto hi = (std::min)(cumn(a2), n - 1);
25048
25049               return { point, resample[lo], resample[hi], confidence_level };
25050           }
25051
25052           double outlier_variance(Estimate<double> mean, Estimate<double> stddev, int n);
25053
25054           struct bootstrap_analysis {
25055               Estimate<double> mean;
25056               Estimate<double> standard_deviation;
25057               double outlier_variance;
25058           };
25059
25060           bootstrap_analysis analyse_samples(double confidence_level, int n_resamples,
      std::vector<double>::iterator first, std::vector<double>::iterator last);
```

```
25061         } // namespace Detail
25062     } // namespace Benchmark
25063 } // namespace Catch
25064
25065 // end catch_stats.hpp
25066 #include <algorithm>
25067 #include <iterator>
25068 #include <tuple>
25069 #include <vector>
25070 #include <cmath>
25071
25072 namespace Catch {
25073     namespace Benchmark {
25074         namespace Detail {
25075             template <typename Clock>
25076             std::vector<double> resolution(int k) {
25077                 std::vector<TimePoint<Clock» times;
25078                 times.reserve(k + 1);
25079                 std::generate_n(std::back_inserter(times), k + 1, now<Clock>{});
25080
25081                 std::vector<double> deltas;
25082                 deltas.reserve(k);
25083                 std::transform(std::next(times.begin()), times.end(), times.begin(),
25084                     std::back_inserter(deltas),
25085                     [](TimePoint<Clock> a, TimePoint<Clock> b) { return static_cast<double>((a -
      b).count()); });
25086
25087                 return deltas;
25088             }
25089
25090             const auto warmup_iterations = 10000;
25091             const auto warmup_time = std::chrono::milliseconds(100);
25092             const auto minimum_ticks = 1000;
25093             const auto warmup_seed = 10000;
25094             const auto clock_resolution_estimation_time = std::chrono::milliseconds(500);
25095             const auto clock_cost_estimation_time_limit = std::chrono::seconds(1);
25096             const auto clock_cost_estimation_tick_limit = 100000;
25097             const auto clock_cost_estimation_time = std::chrono::milliseconds(10);
25098             const auto clock_cost_estimation_iterations = 10000;
25099
25100             template <typename Clock>
25101             int warmup() {
25102                 return
      run_for_at_least<Clock>(std::chrono::duration_cast<ClockDuration<Clock»(warmup_time), warmup_seed,
      &resolution<Clock>)
25103                     .iterations;
25104             }
25105             template <typename Clock>
25106             EnvironmentEstimate<FloatDuration<Clock» estimate_clock_resolution(int iterations) {
25107                 auto r =
      run_for_at_least<Clock>(std::chrono::duration_cast<ClockDuration<Clock»(clock_resolution_estimation_time),
      iterations, &resolution<Clock>)
25108                     .result;
25109                 return {
25110                     FloatDuration<Clock>(mean(r.begin(), r.end())),
25111                     classify_outliers(r.begin(), r.end()),
25112                 };
25113             }
25114             template <typename Clock>
25115             EnvironmentEstimate<FloatDuration<Clock» estimate_clock_cost(FloatDuration<Clock>
      resolution) {
25116                 auto time_limit = (std::min)(
25117                     resolution * clock_cost_estimation_tick_limit,
25118                     FloatDuration<Clock>(clock_cost_estimation_time_limit));
25119                 auto time_clock = [](int k) {
25120                     return Detail::measure<Clock>([k] {
25121                         for (int i = 0; i < k; ++i) {
25122                             volatile auto ignored = Clock::now();
25123                             (void)ignored;
25124                         }
25125                     }).elapsed;
25126                 };
25127                 time_clock(1);
25128                 int iters = clock_cost_estimation_iterations;
25129                 auto&& r =
      run_for_at_least<Clock>(std::chrono::duration_cast<ClockDuration<Clock»(clock_cost_estimation_time),
      iters, time_clock);
25130                 std::vector<double> times;
25131                 int nsamples = static_cast<int>(std::ceil(time_limit / r.elapsed));
25132                 times.reserve(nsamples);
25133                 std::generate_n(std::back_inserter(times), nsamples, [time_clock, &r] {
25134                     return static_cast<double>((time_clock(r.iterations) / r.iterations).count());
25135                 });
25136                 return {
25137                     FloatDuration<Clock>(mean(times.begin(), times.end())),
25138                     classify_outliers(times.begin(), times.end()),
25139                 };
```

```
25140             }
25141
25142             template <typename Clock>
25143             Environment<FloatDuration<Clock>> measure_environment() {
25144                 static Environment<FloatDuration<Clock>>* env = nullptr;
25145                 if (env) {
25146                     return *env;
25147                 }
25148
25149                 auto iters = Detail::warmup<Clock>();
25150                 auto resolution = Detail::estimate_clock_resolution<Clock>(iters);
25151                 auto cost = Detail::estimate_clock_cost<Clock>(resolution.mean);
25152
25153                 env = new Environment<FloatDuration<Clock>>{ resolution, cost };
25154                 return *env;
25155             }
25156         } // namespace Detail
25157     } // namespace Benchmark
25158 } // namespace Catch
25159
25160 // end catch_estimate_clock.hpp
25161 // start catch_analyse.hpp
25162
25163  // Run and analyse one benchmark
25164
25165
25166 // start catch_sample_analysis.hpp
25167
25168 // Benchmark results
25169
25170
25171 #include <algorithm>
25172 #include <vector>
25173 #include <string>
25174 #include <iterator>
25175
25176 namespace Catch {
25177     namespace Benchmark {
25178         template <typename Duration>
25179         struct SampleAnalysis {
25180             std::vector<Duration> samples;
25181             Estimate<Duration> mean;
25182             Estimate<Duration> standard_deviation;
25183             OutlierClassification outliers;
25184             double outlier_variance;
25185
25186             template <typename Duration2>
25187             operator SampleAnalysis<Duration2>() const {
25188                 std::vector<Duration2> samples2;
25189                 samples2.reserve(samples.size());
25190                 std::transform(samples.begin(), samples.end(), std::back_inserter(samples2),
      [](Duration d) { return Duration2(d); });
25191                 return {
25192                     std::move(samples2),
25193                     mean,
25194                     standard_deviation,
25195                     outliers,
25196                     outlier_variance,
25197                 };
25198             }
25199         };
25200     } // namespace Benchmark
25201 } // namespace Catch
25202
25203 // end catch_sample_analysis.hpp
25204 #include <algorithm>
25205 #include <iterator>
25206 #include <vector>
25207
25208 namespace Catch {
25209     namespace Benchmark {
25210         namespace Detail {
25211             template <typename Duration, typename Iterator>
25212             SampleAnalysis<Duration> analyse(const IConfig &cfg, Environment<Duration>, Iterator
      first, Iterator last) {
25213                 if (!cfg.benchmarkNoAnalysis()) {
25214                     std::vector<double> samples;
25215                     samples.reserve(last - first);
25216                     std::transform(first, last, std::back_inserter(samples), [](Duration d) { return
      d.count(); });
25217
25218                     auto analysis =
      Catch::Benchmark::Detail::analyse_samples(cfg.benchmarkConfidenceInterval(), cfg.benchmarkResamples(),
      samples.begin(), samples.end());
25219                     auto outliers = Catch::Benchmark::Detail::classify_outliers(samples.begin(),
      samples.end());
25220
```

```
25221                     auto wrap_estimate = [](Estimate<double> e) {
25222                         return Estimate<Duration> {
25223                             Duration(e.point),
25224                                 Duration(e.lower_bound),
25225                                 Duration(e.upper_bound),
25226                                 e.confidence_interval,
25227                         };
25228                     };
25229                     std::vector<Duration> samples2;
25230                     samples2.reserve(samples.size());
25231                     std::transform(samples.begin(), samples.end(), std::back_inserter(samples2),
      [](double d) { return Duration(d); });
25232                     return {
25233                         std::move(samples2),
25234                         wrap_estimate(analysis.mean),
25235                         wrap_estimate(analysis.standard_deviation),
25236                         outliers,
25237                         analysis.outlier_variance,
25238                     };
25239                 } else {
25240                     std::vector<Duration> samples;
25241                     samples.reserve(last - first);
25242
25243                     Duration mean = Duration(0);
25244                     int i = 0;
25245                     for (auto it = first; it < last; ++it, ++i) {
25246                         samples.push_back(Duration(*it));
25247                         mean += Duration(*it);
25248                     }
25249                     mean /= i;
25250
25251                     return {
25252                         std::move(samples),
25253                         Estimate<Duration>{mean, mean, mean, 0.0},
25254                         Estimate<Duration>{Duration(0), Duration(0), Duration(0), 0.0},
25255                         OutlierClassification{},
25256                         0.0
25257                     };
25258                 }
25259             }
25260         } // namespace Detail
25261     } // namespace Benchmark
25262 } // namespace Catch
25263
25264 // end catch_analyse.hpp
25265 #include <algorithm>
25266 #include <functional>
25267 #include <string>
25268 #include <vector>
25269 #include <cmath>
25270
25271 namespace Catch {
25272     namespace Benchmark {
25273         struct Benchmark {
25274             Benchmark(std::string &&name)
25275                 : name(std::move(name)) {}
25276
25277             template <class FUN>
25278             Benchmark(std::string &&name, FUN &&func)
25279                 : fun(std::move(func)), name(std::move(name)) {}
25280
25281             template <typename Clock>
25282             ExecutionPlan<FloatDuration<Clock>> prepare(const IConfig &cfg,
      Environment<FloatDuration<Clock>> env) const {
25283                 auto min_time = env.clock_resolution.mean * Detail::minimum_ticks;
25284                 auto run_time = std::max(min_time,
      std::chrono::duration_cast<decltype(min_time)>(cfg.benchmarkWarmupTime()));
25285                 auto&& test =
      Detail::run_for_at_least<Clock>(std::chrono::duration_cast<ClockDuration<Clock>>(run_time), 1, fun);
25286                 int new_iters = static_cast<int>(std::ceil(min_time * test.iterations /
      test.elapsed));
25287                 return { new_iters, test.elapsed / test.iterations * new_iters *
      cfg.benchmarkSamples(), fun,
      std::chrono::duration_cast<FloatDuration<Clock>>(cfg.benchmarkWarmupTime()), Detail::warmup_iterations
      };
25288             }
25289
25290             template <typename Clock = default_clock>
25291             void run() {
25292                 IConfigPtr cfg = getCurrentContext().getConfig();
25293
25294                 auto env = Detail::measure_environment<Clock>();
25295
25296                 getResultCapture().benchmarkPreparing(name);
25297                 CATCH_TRY{
25298                     auto plan = user_code([&] {
25299                         return prepare<Clock>(*cfg, env);
```

```
25300                     });
25301
25302                     BenchmarkInfo info {
25303                         name,
25304                         plan.estimated_duration.count(),
25305                         plan.iterations_per_sample,
25306                         cfg->benchmarkSamples(),
25307                         cfg->benchmarkResamples(),
25308                         env.clock_resolution.mean.count(),
25309                         env.clock_cost.mean.count()
25310                     };
25311
25312                     getResultCapture().benchmarkStarting(info);
25313
25314                     auto samples = user_code([&] {
25315                         return plan.template run<Clock>(*cfg, env);
25316                     });
25317
25318                     auto analysis = Detail::analyse(*cfg, env, samples.begin(), samples.end());
25319                     BenchmarkStats<FloatDuration<Clock>> stats{ info, analysis.samples, analysis.mean,
      analysis.standard_deviation, analysis.outliers, analysis.outlier_variance };
25320                     getResultCapture().benchmarkEnded(stats);
25321
25322                 } CATCH_CATCH_ALL{
25323                     if (translateActiveException() != Detail::benchmarkErrorMsg) // benchmark errors
      have been reported, otherwise rethrow.
25324                         std::rethrow_exception(std::current_exception());
25325                 }
25326             }
25327
25328             // sets lambda to be used in fun *and* executes benchmark!
25329             template <typename Fun,
25330                 typename std::enable_if<!Detail::is_related<Fun, Benchmark>::value, int>::type = 0>
25331                 Benchmark & operator=(Fun func) {
25332                 fun = Detail::BenchmarkFunction(func);
25333                 run();
25334                 return *this;
25335             }
25336
25337             explicit operator bool() {
25338                 return true;
25339             }
25340
25341         private:
25342             Detail::BenchmarkFunction fun;
25343             std::string name;
25344         };
25345     }
25346 } // namespace Catch
25347
25348 #define INTERNAL_CATCH_GET_1_ARG(arg1, arg2, ...) arg1
25349 #define INTERNAL_CATCH_GET_2_ARG(arg1, arg2, ...) arg2
25350
25351 #define INTERNAL_CATCH_BENCHMARK(BenchmarkName, name, benchmarkIndex)\
25352     if( Catch::Benchmark::Benchmark BenchmarkName{name} ) \
25353         BenchmarkName = [&](int benchmarkIndex)
25354
25355 #define INTERNAL_CATCH_BENCHMARK_ADVANCED(BenchmarkName, name)\
25356     if( Catch::Benchmark::Benchmark BenchmarkName{name} ) \
25357         BenchmarkName = [&]
25358
25359 // end catch_benchmark.hpp
25360 // start catch_constructor.hpp
25361
25362 // Constructor and destructor helpers
25363
25364
25365 #include <type_traits>
25366
25367 namespace Catch {
25368     namespace Benchmark {
25369         namespace Detail {
25370             template <typename T, bool Destruct>
25371             struct ObjectStorage
25372             {
25373                 ObjectStorage() : data() {}
25374
25375                 ObjectStorage(const ObjectStorage& other)
25376                 {
25377                     new(&data) T(other.stored_object());
25378                 }
25379
25380                 ObjectStorage(ObjectStorage&& other)
25381                 {
25382                     new(&data) T(std::move(other.stored_object()));
25383                 }
25384
```

```
25385                 ~ObjectStorage() { destruct_on_exit<T>(); }
25386
25387                 template <typename... Args>
25388                 void construct(Args&&... args)
25389                 {
25390                     new (&data) T(std::forward<Args>(args)...);
25391                 }
25392
25393                 template <bool AllowManualDestruction = !Destruct>
25394                 typename std::enable_if<AllowManualDestruction>::type destruct()
25395                 {
25396                     stored_object().~T();
25397                 }
25398
25399             private:
25400                 // If this is a constructor benchmark, destruct the underlying object
25401                 template <typename U>
25402                 void destruct_on_exit(typename std::enable_if<Destruct, U>::type* = 0) {
    destruct<true>(); }
25403                 // Otherwise, don't
25404                 template <typename U>
25405                 void destruct_on_exit(typename std::enable_if<!Destruct, U>::type* = 0) { }
25406
25407                 T& stored_object() {
25408                     return *static_cast<T*>(static_cast<void*>(&data));
25409                 }
25410
25411                 T const& stored_object() const {
25412                     return *static_cast<T*>(static_cast<void*>(&data));
25413                 }
25414
25415                 struct { alignas(T) unsigned char data[sizeof(T)]; }  data;
25416             };
25417         }
25418
25419         template <typename T>
25420         using storage_for = Detail::ObjectStorage<T, true>;
25421
25422         template <typename T>
25423         using destructable_object = Detail::ObjectStorage<T, false>;
25424     }
25425 }
25426
25427 // end catch_constructor.hpp
25428 // end catch_benchmarking_all.hpp
25429 #endif
25430
25431 #endif // ! CATCH_CONFIG_IMPL_ONLY
25432
25433 #ifdef CATCH_IMPL
25434 // start catch_impl.hpp
25435
25436 #ifdef __clang__
25437 #pragma clang diagnostic push
25438 #pragma clang diagnostic ignored "-Wweak-vtables"
25439 #endif
25440
25441 // Keep these here for external reporters
25442 // start catch_test_case_tracker.h
25443
25444 #include <string>
25445 #include <vector>
25446 #include <memory>
25447
25448 namespace Catch {
25449 namespace TestCaseTracking {
25450
25451     struct NameAndLocation {
25452         std::string name;
25453         SourceLineInfo location;
25454
25455         NameAndLocation( std::string const& _name, SourceLineInfo const& _location );
25456         friend bool operator==(NameAndLocation const& lhs, NameAndLocation const& rhs) {
25457             return lhs.name == rhs.name
25458                 && lhs.location == rhs.location;
25459         }
25460     };
25461
25462     class ITracker;
25463
25464     using ITrackerPtr = std::shared_ptr<ITracker>;
25465
25466     class  ITracker {
25467         NameAndLocation m_nameAndLocation;
25468
25469     public:
25470         ITracker(NameAndLocation const& nameAndLoc) :
```

```
25471             m_nameAndLocation(nameAndLoc)
25472         {}
25473
25474         // static queries
25475         NameAndLocation const& nameAndLocation() const {
25476             return m_nameAndLocation;
25477         }
25478
25479         virtual ~ITracker();
25480
25481         // dynamic queries
25482         virtual bool isComplete() const = 0; // Successfully completed or failed
25483         virtual bool isSuccessfullyCompleted() const = 0;
25484         virtual bool isOpen() const = 0; // Started but not complete
25485         virtual bool hasChildren() const = 0;
25486         virtual bool hasStarted() const = 0;
25487
25488         virtual ITracker& parent() = 0;
25489
25490         // actions
25491         virtual void close() = 0; // Successfully complete
25492         virtual void fail() = 0;
25493         virtual void markAsNeedingAnotherRun() = 0;
25494
25495         virtual void addChild( ITrackerPtr const& child ) = 0;
25496         virtual ITrackerPtr findChild( NameAndLocation const& nameAndLocation ) = 0;
25497         virtual void openChild() = 0;
25498
25499         // Debug/ checking
25500         virtual bool isSectionTracker() const = 0;
25501         virtual bool isGeneratorTracker() const = 0;
25502     };
25503
25504     class TrackerContext {
25505
25506         enum RunState {
25507             NotStarted,
25508             Executing,
25509             CompletedCycle
25510         };
25511
25512         ITrackerPtr m_rootTracker;
25513         ITracker* m_currentTracker = nullptr;
25514         RunState m_runState = NotStarted;
25515
25516     public:
25517
25518         ITracker& startRun();
25519         void endRun();
25520
25521         void startCycle();
25522         void completeCycle();
25523
25524         bool completedCycle() const;
25525         ITracker& currentTracker();
25526         void setCurrentTracker( ITracker* tracker );
25527     };
25528
25529     class TrackerBase : public ITracker {
25530     protected:
25531         enum CycleState {
25532             NotStarted,
25533             Executing,
25534             ExecutingChildren,
25535             NeedsAnotherRun,
25536             CompletedSuccessfully,
25537             Failed
25538         };
25539
25540         using Children = std::vector<ITrackerPtr>;
25541         TrackerContext& m_ctx;
25542         ITracker* m_parent;
25543         Children m_children;
25544         CycleState m_runState = NotStarted;
25545
25546     public:
25547         TrackerBase( NameAndLocation const& nameAndLocation, TrackerContext& ctx, ITracker* parent );
25548
25549         bool isComplete() const override;
25550         bool isSuccessfullyCompleted() const override;
25551         bool isOpen() const override;
25552         bool hasChildren() const override;
25553         bool hasStarted() const override {
25554             return m_runState != NotStarted;
25555         }
25556
25557         void addChild( ITrackerPtr const& child ) override;
```

```
25558
25559         ITrackerPtr findChild( NameAndLocation const& nameAndLocation ) override;
25560         ITracker& parent() override;
25561
25562         void openChild() override;
25563
25564         bool isSectionTracker() const override;
25565         bool isGeneratorTracker() const override;
25566
25567         void open();
25568
25569         void close() override;
25570         void fail() override;
25571         void markAsNeedingAnotherRun() override;
25572
25573     private:
25574         void moveToParent();
25575         void moveToThis();
25576     };
25577
25578     class SectionTracker : public TrackerBase {
25579         std::vector<std::string> m_filters;
25580         std::string m_trimmed_name;
25581     public:
25582         SectionTracker( NameAndLocation const& nameAndLocation, TrackerContext& ctx, ITracker* parent
    );
25583
25584         bool isSectionTracker() const override;
25585
25586         bool isComplete() const override;
25587
25588         static SectionTracker& acquire( TrackerContext& ctx, NameAndLocation const& nameAndLocation );
25589
25590         void tryOpen();
25591
25592         void addInitialFilters( std::vector<std::string> const& filters );
25593         void addNextFilters( std::vector<std::string> const& filters );
25595         std::vector<std::string> const& getFilters() const;
25597         std::string const& trimmedName() const;
25598     };
25599
25600 } // namespace TestCaseTracking
25601
25602 using TestCaseTracking::ITracker;
25603 using TestCaseTracking::TrackerContext;
25604 using TestCaseTracking::SectionTracker;
25605
25606 } // namespace Catch
25607
25608 // end catch_test_case_tracker.h
25609
25610 // start catch_leak_detector.h
25611
25612 namespace Catch {
25613
25614     struct LeakDetector {
25615         LeakDetector();
25616         ~LeakDetector();
25617     };
25618
25619 }
25620 // end catch_leak_detector.h
25621 // Cpp files will be included in the single-header file here
25622 // start catch_stats.cpp
25623
25624 // Statistical analysis tools
25625
25626 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
25627
25628 #include <cassert>
25629 #include <random>
25630
25631 #if defined(CATCH_CONFIG_USE_ASYNC)
25632 #include <future>
25633 #endif
25634
25635 namespace {
25636     double erf_inv(double x) {
25637         // Code accompanying the article "Approximating the erfinv function" in GPU Computing Gems,
    Volume 2
25638         double w, p;
25639
25640         w = -log((1.0 - x) * (1.0 + x));
25641
25642         if (w < 6.250000) {
25643             w = w - 3.125000;
25644             p = -3.6444120640178196996e-21;
```

```
25645             p = -1.685059138182016589e-19 + p * w;
25646             p = 1.285848071525640016 7e-18 + p * w;
25647             p = 1.115787767802518096e-17 + p * w;
25648             p = -1.333171662854620906e-16 + p * w;
25649             p = 2.097276787596856163 7e-17 + p * w;
25650             p = 6.637638134358323832 5e-15 + p * w;
25651             p = -4.054566272975206863 9e-14 + p * w;
25652             p = -8.151934197605472152 2e-14 + p * w;
25653             p = 2.633509315308232297 7e-12 + p * w;
25654             p = -1.297513325345353249 8e-11 + p * w;
25655             p = -5.415412054294627931 7e-11 + p * w;
25656             p = 1.051212273321532285e-09 + p * w;
25657             p = -4.112633980346983697 6e-09 + p * w;
25658             p = -2.907036995788200508 6e-08 + p * w;
25659             p = 4.234787782793240351 8e-07 + p * w;
25660             p = -1.365469200083467864 5e-06 + p * w;
25661             p = -1.388252336278646871 9e-05 + p * w;
25662             p = 0.000186734208034057135 2 + p * w;
25663             p = -0.000740702534166266975 12 + p * w;
25664             p = -0.006033670871430149053 3 + p * w;
25665             p = 0.240158182425589616 93 + p * w;
25666             p = 1.65365456268310273 56 + p * w;
25667         } else if (w < 16.000000) {
25668             w = sqrt(w) - 3.250000;
25669             p = 2.2137376921775787049e-09;
25670             p = 9.075656193888539097 9e-08 + p * w;
25671             p = -2.751740629706454542 8e-07 + p * w;
25672             p = 1.823962921438922775 5e-08 + p * w;
25673             p = 1.502740396890982762 7e-06 + p * w;
25674             p = -4.013867526981545969e-06 + p * w;
25675             p = 2.923444908995544604 4e-06 + p * w;
25676             p = 1.247530448167177872 3e-05 + p * w;
25677             p = -4.731822900905573398 1e-05 + p * w;
25678             p = 6.828485145957317544 8e-05 + p * w;
25679             p = 2.403111038709789399 9e-05 + p * w;
25680             p = -0.000355037520362847479 6 + p * w;
25681             p = 0.000953289379737380497 03 + p * w;
25682             p = -0.001688275556023504731 3 + p * w;
25683             p = 0.002491442096107850806 6 + p * w;
25684             p = -0.003751208507569241210 7 + p * w;
25685             p = 0.005370914553590063617 + p * w;
25686             p = 1.0052589676941592334 + p * w;
25687             p = 3.0838856104922207635 + p * w;
25688         } else {
25689             w = sqrt(w) - 5.000000;
25690             p = -2.7109920616438573243e-11;
25691             p = -2.555641816996525205 5e-10 + p * w;
25692             p = 1.507657269350054808 3e-09 + p * w;
25693             p = -3.789465440126736993 7e-09 + p * w;
25694             p = 7.615701208078339380 4e-09 + p * w;
25695             p = -1.496002662714924047 8e-08 + p * w;
25696             p = 2.914795345090108082 6e-08 + p * w;
25697             p = -6.771199775845233949 8e-08 + p * w;
25698             p = 2.290048222802665471 7e-07 + p * w;
25699             p = -9.929827294231700253 9e-07 + p * w;
25700             p = 4.526062597223153703 9e-06 + p * w;
25701             p = -1.968177810553167056 7e-05 + p * w;
25702             p = 7.599527703001776113 9e-05 + p * w;
25703             p = -0.000215030119300444773 47 + p * w;
25704             p = -0.000138719318336231220 26 + p * w;
25705             p = 1.0103004648645343977 + p * w;
25706             p = 4.8499064014085844221 + p * w;
25707         }
25708         return p * x;
25709     }
25710
25711     double standard_deviation(std::vector<double>::iterator first, std::vector<double>::iterator last)
      {
25712         auto m = Catch::Benchmark::Detail::mean(first, last);
25713         double variance = std::accumulate(first, last, 0., [m](double a, double b) {
25714             double diff = b - m;
25715             return a + diff * diff;
25716             }) / (last - first);
25717             return std::sqrt(variance);
25718     }
25719
25720 }
25721
25722 namespace Catch {
25723     namespace Benchmark {
25724         namespace Detail {
25725
25726             double weighted_average_quantile(int k, int q, std::vector<double>::iterator first,
      std::vector<double>::iterator last) {
25727                 auto count = last - first;
25728                 double idx = (count - 1) * k / static_cast<double>(q);
25729                 int j = static_cast<int>(idx);
```

```
25730                 double g = idx - j;
25731                 std::nth_element(first, first + j, last);
25732                 auto xj = first[j];
25733                 if (g == 0) return xj;
25734 
25735                 auto xj1 = *std::min_element(first + (j + 1), last);
25736                 return xj + g * (xj1 - xj);
25737             }
25738 
25739             double erfc_inv(double x) {
25740                 return erf_inv(1.0 - x);
25741             }
25742 
25743             double normal_quantile(double p) {
25744                 static const double ROOT_TWO = std::sqrt(2.0);
25745 
25746                 double result = 0.0;
25747                 assert(p >= 0 && p <= 1);
25748                 if (p < 0 || p > 1) {
25749                     return result;
25750                 }
25751 
25752                 result = -erfc_inv(2.0 * p);
25753                 // result *= normal distribution standard deviation (1.0) * sqrt(2)
25754                 result *= /*sd * */ ROOT_TWO;
25755                 // result += normal disttribution mean (0)
25756                 return result;
25757             }
25758 
25759             double outlier_variance(Estimate<double> mean, Estimate<double> stddev, int n) {
25760                 double sb = stddev.point;
25761                 double mn = mean.point / n;
25762                 double mg_min = mn / 2.;
25763                 double sg = (std::min)(mg_min / 4., sb / std::sqrt(n));
25764                 double sg2 = sg * sg;
25765                 double sb2 = sb * sb;
25766 
25767                 auto c_max = [n, mn, sb2, sg2](double x) -> double {
25768                     double k = mn - x;
25769                     double d = k * k;
25770                     double nd = n * d;
25771                     double k0 = -n * nd;
25772                     double k1 = sb2 - n * sg2 + nd;
25773                     double det = k1 * k1 - 4 * sg2 * k0;
25774                     return (int)(-2. * k0 / (k1 + std::sqrt(det)));
25775                 };
25776 
25777                 auto var_out = [n, sb2, sg2](double c) {
25778                     double nc = n - c;
25779                     return (nc / n) * (sb2 - nc * sg2);
25780                 };
25781 
25782                 return (std::min)(var_out(1), var_out((std::min)(c_max(0.), c_max(mg_min)))) / sb2;
25783             }
25784 
25785             bootstrap_analysis analyse_samples(double confidence_level, int n_resamples,
      std::vector<double>::iterator first, std::vector<double>::iterator last) {
25786                 CATCH_INTERNAL_START_WARNINGS_SUPPRESSION
25787                 CATCH_INTERNAL_SUPPRESS_GLOBALS_WARNINGS
25788                 static std::random_device entropy;
25789                 CATCH_INTERNAL_STOP_WARNINGS_SUPPRESSION
25790 
25791                 auto n = static_cast<int>(last - first); // seriously, one can't use integral types
      without hell in C++
25792 
25793                 auto mean = &Detail::mean<std::vector<double>::iterator>;
25794                 auto stddev = &standard_deviation;
25795 
25796 #if defined(CATCH_CONFIG_USE_ASYNC)
25797                 auto Estimate = [=](double(*f)(std::vector<double>::iterator,
      std::vector<double>::iterator)) {
25798                     auto seed = entropy();
25799                     return std::async(std::launch::async, [=] {
25800                         std::mt19937 rng(seed);
25801                         auto resampled = resample(rng, n_resamples, first, last, f);
25802                         return bootstrap(confidence_level, first, last, resampled, f);
25803                     });
25804                 };
25805 
25806                 auto mean_future = Estimate(mean);
25807                 auto stddev_future = Estimate(stddev);
25808 
25809                 auto mean_estimate = mean_future.get();
25810                 auto stddev_estimate = stddev_future.get();
25811 #else
25812                 auto Estimate = [=](double(*f)(std::vector<double>::iterator,
      std::vector<double>::iterator)) {
```

```
25813                     auto seed = entropy();
25814                     std::mt19937 rng(seed);
25815                     auto resampled = resample(rng, n_resamples, first, last, f);
25816                     return bootstrap(confidence_level, first, last, resampled, f);
25817                 };
25818 
25819                 auto mean_estimate = Estimate(mean);
25820                 auto stddev_estimate = Estimate(stddev);
25821 #endif // CATCH_USE_ASYNC
25822 
25823                 double outlier_variance = Detail::outlier_variance(mean_estimate, stddev_estimate, n);
25824 
25825                 return { mean_estimate, stddev_estimate, outlier_variance };
25826             }
25827         } // namespace Detail
25828     } // namespace Benchmark
25829 } // namespace Catch
25830 
25831 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
25832 // end catch_stats.cpp
25833 // start catch_approx.cpp
25834 
25835 #include <cmath>
25836 #include <limits>
25837 
25838 namespace {
25839 
25840 // Performs equivalent check of std::fabs(lhs - rhs) <= margin
25841 // But without the subtraction to allow for INFINITY in comparison
25842 bool marginComparison(double lhs, double rhs, double margin) {
25843     return (lhs + margin >= rhs) && (rhs + margin >= lhs);
25844 }
25845 
25846 }
25847 
25848 namespace Catch {
25849 namespace Detail {
25850 
25851     Approx::Approx ( double value )
25852     :   m_epsilon( std::numeric_limits<float>::epsilon()*100 ),
25853         m_margin( 0.0 ),
25854         m_scale( 0.0 ),
25855         m_value( value )
25856     {}
25857 
25858     Approx Approx::custom() {
25859         return Approx( 0 );
25860     }
25861 
25862     Approx Approx::operator-() const {
25863         auto temp(*this);
25864         temp.m_value = -temp.m_value;
25865         return temp;
25866     }
25867 
25868     std::string Approx::toString() const {
25869         ReusableStringStream rss;
25870         rss << "Approx( " << ::Catch::Detail::stringify( m_value ) << " )";
25871         return rss.str();
25872     }
25873 
25874     bool Approx::equalityComparisonImpl(const double other) const {
25875         // First try with fixed margin, then compute margin based on epsilon, scale and Approx's value
25876         // Thanks to Richard Harris for his help refining the scaled margin value
25877         return marginComparison(m_value, other, m_margin)
25878             || marginComparison(m_value, other, m_epsilon * (m_scale + std::fabs(std::isinf(m_value)?
      0 : m_value)));
25879     }
25880 
25881     void Approx::setMargin(double newMargin) {
25882         CATCH_ENFORCE(newMargin >= 0,
25883             "Invalid Approx::margin: " << newMargin << '.'
25884             << " Approx::Margin has to be non-negative.");
25885         m_margin = newMargin;
25886     }
25887 
25888     void Approx::setEpsilon(double newEpsilon) {
25889         CATCH_ENFORCE(newEpsilon >= 0 && newEpsilon <= 1.0,
25890             "Invalid Approx::epsilon: " << newEpsilon << '.'
25891             << " Approx::epsilon has to be in [0, 1]");
25892         m_epsilon = newEpsilon;
25893     }
25894 
25895 } // end namespace Detail
25896 
25897 namespace literals {
25898     Detail::Approx operator "" _a(long double val) {
```

```
25899         return Detail::Approx(val);
25900     }
25901     Detail::Approx operator "" _a(unsigned long long val) {
25902         return Detail::Approx(val);
25903     }
25904 } // end namespace literals
25905
25906 std::string StringMaker<Catch::Detail::Approx>::convert(Catch::Detail::Approx const& value) {
25907     return value.toString();
25908 }
25909
25910 } // end namespace Catch
25911 // end catch_approx.cpp
25912 // start catch_assertionhandler.cpp
25913
25914 // start catch_debugger.h
25915
25916 namespace Catch {
25917     bool isDebuggerActive();
25918 }
25919
25920 #ifdef CATCH_PLATFORM_MAC
25921
25922     #if defined(__i386__) || defined(__x86_64__)
25923         #define CATCH_TRAP() __asm__("int $3\n" : : ) /* NOLINT */
25924     #elif defined(__aarch64__)
25925         #define CATCH_TRAP()  __asm__(".inst 0xd43e0000")
25926     #endif
25927
25928 #elif defined(CATCH_PLATFORM_IPHONE)
25929
25930     // use inline assembler
25931     #if defined(__i386__) || defined(__x86_64__)
25932         #define CATCH_TRAP()  __asm__("int $3")
25933     #elif defined(__aarch64__)
25934         #define CATCH_TRAP()  __asm__(".inst 0xd4200000")
25935     #elif defined(__arm__) && !defined(__thumb__)
25936         #define CATCH_TRAP()  __asm__(".inst 0xe7f001f0")
25937     #elif defined(__arm__) &&  defined(__thumb__)
25938         #define CATCH_TRAP()  __asm__(".inst 0xde01")
25939     #endif
25940
25941 #elif defined(CATCH_PLATFORM_LINUX)
25942     // If we can use inline assembler, do it because this allows us to break
25943     // directly at the location of the failing check instead of breaking inside
25944     // raise() called from it, i.e. one stack frame below.
25945     #if defined(__GNUC__) && (defined(__i386) || defined(__x86_64))
25946         #define CATCH_TRAP() asm volatile ("int $3") /* NOLINT */
25947     #else // Fall back to the generic way.
25948         #include <signal.h>
25949
25950         #define CATCH_TRAP() raise(SIGTRAP)
25951     #endif
25952 #elif defined(_MSC_VER)
25953     #define CATCH_TRAP() __debugbreak()
25954 #elif defined(__MINGW32__)
25955     extern "C" __declspec(dllimport) void __stdcall DebugBreak();
25956     #define CATCH_TRAP() DebugBreak()
25957 #endif
25958
25959 #ifndef CATCH_BREAK_INTO_DEBUGGER
25960     #ifdef CATCH_TRAP
25961         #define CATCH_BREAK_INTO_DEBUGGER() []{ if( Catch::isDebuggerActive() ) { CATCH_TRAP(); } }()
25962     #else
25963         #define CATCH_BREAK_INTO_DEBUGGER() []{}()
25964     #endif
25965 #endif
25966
25967 // end catch_debugger.h
25968 // start catch_run_context.h
25969
25970 // start catch_fatal_condition.h
25971
25972 #include <cassert>
25973
25974 namespace Catch {
25975
25976     // Wrapper for platform-specific fatal error (signals/SEH) handlers
25977     //
25978     // Tries to be cooperative with other handlers, and not step over
25979     // other handlers. This means that unknown structured exceptions
25980     // are passed on, previous signal handlers are called, and so on.
25981     //
25982     // Can only be instantiated once, and assumes that once a signal
25983     // is caught, the binary will end up terminating. Thus, there
25984     class FatalConditionHandler {
25985         bool m_started = false;
```

```
25986
25987         // Install/disengage implementation for specific platform.
25988         // Should be if-defed to work on current platform, can assume
25989         // engage-disengage 1:1 pairing.
25990         void engage_platform();
25991         void disengage_platform();
25992     public:
25993         // Should also have platform-specific implementations as needed
25994         FatalConditionHandler();
25995         ~FatalConditionHandler();
25996
25997         void engage() {
25998             assert(!m_started && "Handler cannot be installed twice.");
25999             m_started = true;
26000             engage_platform();
26001         }
26002
26003         void disengage() {
26004             assert(m_started && "Handler cannot be uninstalled without being installed first");
26005             m_started = false;
26006             disengage_platform();
26007         }
26008     };
26009
26011     class FatalConditionHandlerGuard {
26012         FatalConditionHandler* m_handler;
26013     public:
26014         FatalConditionHandlerGuard(FatalConditionHandler* handler):
26015             m_handler(handler) {
26016             m_handler->engage();
26017         }
26018         ~FatalConditionHandlerGuard() {
26019             m_handler->disengage();
26020         }
26021     };
26022
26023 } // end namespace Catch
26024
26025 // end catch_fatal_condition.h
26026 #include <string>
26027
26028 namespace Catch {
26029
26030     struct IMutableContext;
26031
26033
26034     class RunContext : public IResultCapture, public IRunner {
26035
26036     public:
26037         RunContext( RunContext const& ) = delete;
26038         RunContext& operator =( RunContext const& ) = delete;
26039
26040         explicit RunContext( IConfigPtr const& _config, IStreamingReporterPtr&& reporter );
26041
26042         ~RunContext() override;
26043
26044         void testGroupStarting( std::string const& testSpec, std::size_t groupIndex, std::size_t
      groupsCount );
26045         void testGroupEnded( std::string const& testSpec, Totals const& totals, std::size_t
      groupIndex, std::size_t groupsCount );
26046
26047         Totals runTest(TestCase const& testCase);
26048
26049         IConfigPtr config() const;
26050         IStreamingReporter& reporter() const;
26051
26052     public: // IResultCapture
26053
26054         // Assertion handlers
26055         void handleExpr
26056                 (   AssertionInfo const& info,
26057                     ITransientExpression const& expr,
26058                     AssertionReaction& reaction ) override;
26059         void handleMessage
26060                 (   AssertionInfo const& info,
26061                     ResultWas::OfType resultType,
26062                     StringRef const& message,
26063                     AssertionReaction& reaction ) override;
26064         void handleUnexpectedExceptionNotThrown
26065                 (   AssertionInfo const& info,
26066                     AssertionReaction& reaction ) override;
26067         void handleUnexpectedInflightException
26068                 (   AssertionInfo const& info,
26069                     std::string const& message,
26070                     AssertionReaction& reaction ) override;
26071         void handleIncomplete
26072                 (   AssertionInfo const& info ) override;
```

```
26073         void handleNonExpr
26074                 (   AssertionInfo const &info,
26075                     ResultWas::OfType resultType,
26076                     AssertionReaction &reaction ) override;
26077
26078         bool sectionStarted( SectionInfo const& sectionInfo, Counts& assertions ) override;
26079
26080         void sectionEnded( SectionEndInfo const& endInfo ) override;
26081         void sectionEndedEarly( SectionEndInfo const& endInfo ) override;
26082
26083         auto acquireGeneratorTracker( StringRef generatorName, SourceLineInfo const& lineInfo ) ->
      IGeneratorTracker& override;
26084
26085 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
26086         void benchmarkPreparing( std::string const& name ) override;
26087         void benchmarkStarting( BenchmarkInfo const& info ) override;
26088         void benchmarkEnded( BenchmarkStats<> const& stats ) override;
26089         void benchmarkFailed( std::string const& error ) override;
26090 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
26091
26092         void pushScopedMessage( MessageInfo const& message ) override;
26093         void popScopedMessage( MessageInfo const& message ) override;
26094
26095         void emplaceUnscopedMessage( MessageBuilder const& builder ) override;
26096
26097         std::string getCurrentTestName() const override;
26098
26099         const AssertionResult* getLastResult() const override;
26100
26101         void exceptionEarlyReported() override;
26102
26103         void handleFatalErrorCondition( StringRef message ) override;
26104
26105         bool lastAssertionPassed() override;
26106
26107         void assertionPassed() override;
26108
26109     public:
26110         // !TBD We need to do this another way!
26111         bool aborting() const final;
26112
26113     private:
26114
26115         void runCurrentTest( std::string& redirectedCout, std::string& redirectedCerr );
26116         void invokeActiveTestCase();
26117
26118         void resetAssertionInfo();
26119         bool testForMissingAssertions( Counts& assertions );
26120
26121         void assertionEnded( AssertionResult const& result );
26122         void reportExpr
26123                 (   AssertionInfo const &info,
26124                     ResultWas::OfType resultType,
26125                     ITransientExpression const *expr,
26126                     bool negated );
26127
26128         void populateReaction( AssertionReaction& reaction );
26129
26130     private:
26131
26132         void handleUnfinishedSections();
26133
26134         TestRunInfo m_runInfo;
26135         IMutableContext& m_context;
26136         TestCase const* m_activeTestCase = nullptr;
26137         ITracker* m_testCaseTracker = nullptr;
26138         Option<AssertionResult> m_lastResult;
26139
26140         IConfigPtr m_config;
26141         Totals m_totals;
26142         IStreamingReporterPtr m_reporter;
26143         std::vector<MessageInfo> m_messages;
26144         std::vector<ScopedMessage> m_messageScopes; /* Keeps owners of so-called unscoped messages. */
26145         AssertionInfo m_lastAssertionInfo;
26146         std::vector<SectionEndInfo> m_unfinishedSections;
26147         std::vector<ITracker*> m_activeSections;
26148         TrackerContext m_trackerContext;
26149         FatalConditionHandler m_fatalConditionhandler;
26150         bool m_lastAssertionPassed = false;
26151         bool m_shouldReportUnexpected = true;
26152         bool m_includeSuccessfulResults;
26153     };
26154
26155     void seedRng(IConfig const& config);
26156     unsigned int rngSeed();
26157 } // end namespace Catch
26158
```

```
26159 // end catch_run_context.h
26160 namespace Catch {
26161
26162     namespace {
26163         auto operator «( std::ostream& os, ITransientExpression const& expr ) -> std::ostream& {
26164             expr.streamReconstructedExpression( os );
26165             return os;
26166         }
26167     }
26168
26169     LazyExpression::LazyExpression( bool isNegated )
26170     :   m_isNegated( isNegated )
26171     {}
26172
26173     LazyExpression::LazyExpression( LazyExpression const& other ) : m_isNegated( other.m_isNegated )
      {}
26174
26175     LazyExpression::operator bool() const {
26176         return m_transientExpression != nullptr;
26177     }
26178
26179     auto operator « ( std::ostream& os, LazyExpression const& lazyExpr ) -> std::ostream& {
26180         if( lazyExpr.m_isNegated )
26181             os « "!";
26182
26183         if( lazyExpr ) {
26184             if( lazyExpr.m_isNegated && lazyExpr.m_transientExpression->isBinaryExpression() )
26185                 os « "(" « *lazyExpr.m_transientExpression « ")";
26186             else
26187                 os « *lazyExpr.m_transientExpression;
26188         }
26189         else {
26190             os « "{** error - unchecked empty expression requested **}";
26191         }
26192         return os;
26193     }
26194
26195     AssertionHandler::AssertionHandler
26196         (   StringRef const& macroName,
26197             SourceLineInfo const& lineInfo,
26198             StringRef capturedExpression,
26199             ResultDisposition::Flags resultDisposition )
26200     :   m_assertionInfo{ macroName, lineInfo, capturedExpression, resultDisposition },
26201         m_resultCapture( getResultCapture() )
26202     {}
26203
26204     void AssertionHandler::handleExpr( ITransientExpression const& expr ) {
26205         m_resultCapture.handleExpr( m_assertionInfo, expr, m_reaction );
26206     }
26207     void AssertionHandler::handleMessage(ResultWas::OfType resultType, StringRef const& message) {
26208         m_resultCapture.handleMessage( m_assertionInfo, resultType, message, m_reaction );
26209     }
26210
26211     auto AssertionHandler::allowThrows() const -> bool {
26212         return getCurrentContext().getConfig()->allowThrows();
26213     }
26214
26215     void AssertionHandler::complete() {
26216         setCompleted();
26217         if( m_reaction.shouldDebugBreak ) {
26218
26219             // If you find your debugger stopping you here then go one level up on the
26220             // call-stack for the code that caused it (typically a failed assertion)
26221
26222             // (To go back to the test and change execution, jump over the throw, next)
26223             CATCH_BREAK_INTO_DEBUGGER();
26224         }
26225         if (m_reaction.shouldThrow) {
26226 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
26227             throw Catch::TestFailureException();
26228 #else
26229             CATCH_ERROR( "Test failure requires aborting test!" );
26230 #endif
26231         }
26232     }
26233     void AssertionHandler::setCompleted() {
26234         m_completed = true;
26235     }
26236
26237     void AssertionHandler::handleUnexpectedInflightException() {
26238         m_resultCapture.handleUnexpectedInflightException( m_assertionInfo,
      Catch::translateActiveException(), m_reaction );
26239     }
26240
26241     void AssertionHandler::handleExceptionThrownAsExpected() {
26242         m_resultCapture.handleNonExpr(m_assertionInfo, ResultWas::Ok, m_reaction);
26243     }
```

```
26244     void AssertionHandler::handleExceptionNotThrownAsExpected() {
26245         m_resultCapture.handleNonExpr(m_assertionInfo, ResultWas::Ok, m_reaction);
26246     }
26247
26248     void AssertionHandler::handleUnexpectedExceptionNotThrown() {
26249         m_resultCapture.handleUnexpectedExceptionNotThrown( m_assertionInfo, m_reaction );
26250     }
26251
26252     void AssertionHandler::handleThrowingCallSkipped() {
26253         m_resultCapture.handleNonExpr(m_assertionInfo, ResultWas::Ok, m_reaction);
26254     }
26255
26256     // This is the overload that takes a string and infers the Equals matcher from it
26257     // The more general overload, that takes any string matcher, is in catch_capture_matchers.cpp
26258     void handleExceptionMatchExpr( AssertionHandler& handler, std::string const& str, StringRef const&
      matcherString  ) {
26259         handleExceptionMatchExpr( handler, Matchers::Equals( str ), matcherString );
26260     }
26261
26262 } // namespace Catch
26263 // end catch_assertionhandler.cpp
26264 // start catch_assertionresult.cpp
26265
26266 namespace Catch {
26267     AssertionResultData::AssertionResultData(ResultWas::OfType _resultType, LazyExpression const &
      _lazyExpression):
26268         lazyExpression(_lazyExpression),
26269         resultType(_resultType) {}
26270
26271     std::string AssertionResultData::reconstructExpression() const {
26272
26273         if( reconstructedExpression.empty() ) {
26274             if( lazyExpression ) {
26275                 ReusableStringStream rss;
26276                 rss « lazyExpression;
26277                 reconstructedExpression = rss.str();
26278             }
26279         }
26280         return reconstructedExpression;
26281     }
26282
26283     AssertionResult::AssertionResult( AssertionInfo const& info, AssertionResultData const& data )
26284     :   m_info( info ),
26285         m_resultData( data )
26286     {}
26287
26288     // Result was a success
26289     bool AssertionResult::succeeded() const {
26290         return Catch::isOk( m_resultData.resultType );
26291     }
26292
26293     // Result was a success, or failure is suppressed
26294     bool AssertionResult::isOk() const {
26295         return Catch::isOk( m_resultData.resultType ) || shouldSuppressFailure(
      m_info.resultDisposition );
26296     }
26297
26298     ResultWas::OfType AssertionResult::getResultType() const {
26299         return m_resultData.resultType;
26300     }
26301
26302     bool AssertionResult::hasExpression() const {
26303         return !m_info.capturedExpression.empty();
26304     }
26305
26306     bool AssertionResult::hasMessage() const {
26307         return !m_resultData.message.empty();
26308     }
26309
26310     std::string AssertionResult::getExpression() const {
26311         // Possibly overallocating by 3 characters should be basically free
26312         std::string expr; expr.reserve(m_info.capturedExpression.size() + 3);
26313         if (isFalseTest(m_info.resultDisposition)) {
26314             expr += "!(";
26315         }
26316         expr += m_info.capturedExpression;
26317         if (isFalseTest(m_info.resultDisposition)) {
26318             expr += ')';
26319         }
26320         return expr;
26321     }
26322
26323     std::string AssertionResult::getExpressionInMacro() const {
26324         std::string expr;
26325         if( m_info.macroName.empty() )
26326             expr = static_cast<std::string>(m_info.capturedExpression);
26327         else {
```

```
26328             expr.reserve( m_info.macroName.size() + m_info.capturedExpression.size() + 4 );
26329             expr += m_info.macroName;
26330             expr += "( ";
26331             expr += m_info.capturedExpression;
26332             expr += " )";
26333         }
26334         return expr;
26335     }
26336
26337     bool AssertionResult::hasExpandedExpression() const {
26338         return hasExpression() && getExpandedExpression() != getExpression();
26339     }
26340
26341     std::string AssertionResult::getExpandedExpression() const {
26342         std::string expr = m_resultData.reconstructExpression();
26343         return expr.empty()
26344                 ? getExpression()
26345                 : expr;
26346     }
26347
26348     std::string AssertionResult::getMessage() const {
26349         return m_resultData.message;
26350     }
26351     SourceLineInfo AssertionResult::getSourceInfo() const {
26352         return m_info.lineInfo;
26353     }
26354
26355     StringRef AssertionResult::getTestMacroName() const {
26356         return m_info.macroName;
26357     }
26358
26359 } // end namespace Catch
26360 // end catch_assertionresult.cpp
26361 // start catch_capture_matchers.cpp
26362
26363 namespace Catch {
26364
26365     using StringMatcher = Matchers::Impl::MatcherBase<std::string>;
26366
26367     // This is the general overload that takes a any string matcher
26368     // There is another overload, in catch_assertionhandler.h/.cpp, that only takes a string and
      infers
26369     // the Equals matcher (so the header does not mention matchers)
26370     void handleExceptionMatchExpr( AssertionHandler& handler, StringMatcher const& matcher, StringRef
      const& matcherString  ) {
26371         std::string exceptionMessage = Catch::translateActiveException();
26372         MatchExpr<std::string, StringMatcher const&> expr( exceptionMessage, matcher, matcherString );
26373         handler.handleExpr( expr );
26374     }
26375
26376 } // namespace Catch
26377 // end catch_capture_matchers.cpp
26378 // start catch_commandline.cpp
26379
26380 // start catch_commandline.h
26381
26382 // start catch_clara.h
26383
26384 // Use Catch's value for console width (store Clara's off to the side, if present)
26385 #ifdef CLARA_CONFIG_CONSOLE_WIDTH
26386 #define CATCH_TEMP_CLARA_CONFIG_CONSOLE_WIDTH CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH
26387 #undef CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH
26388 #endif
26389 #define CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH CATCH_CONFIG_CONSOLE_WIDTH-1
26390
26391 #ifdef __clang__
26392 #pragma clang diagnostic push
26393 #pragma clang diagnostic ignored "-Wweak-vtables"
26394 #pragma clang diagnostic ignored "-Wexit-time-destructors"
26395 #pragma clang diagnostic ignored "-Wshadow"
26396 #endif
26397
26398 // start clara.hpp
26399 // Copyright 2017 Two Blue Cubes Ltd. All rights reserved.
26400 //
26401 // Distributed under the Boost Software License, Version 1.0. (See accompanying
26402 // file LICENSE_1_0.txt or copy at http://www.boost.org/LICENSE_1_0.txt)
26403 //
26404 // See https://github.com/philsquared/Clara for more details
26405
26406 // Clara v1.1.5
26407
26408
26409 #ifndef CATCH_CLARA_CONFIG_CONSOLE_WIDTH
26410 #define CATCH_CLARA_CONFIG_CONSOLE_WIDTH 80
26411 #endif
26412
```

```
26413 #ifndef CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH
26414 #define CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH CATCH_CLARA_CONFIG_CONSOLE_WIDTH
26415 #endif
26416
26417 #ifndef CLARA_CONFIG_OPTIONAL_TYPE
26418 #ifdef __has_include
26419 #if __has_include(<optional>) && __cplusplus >= 201703L
26420 #include <optional>
26421 #define CLARA_CONFIG_OPTIONAL_TYPE std::optional
26422 #endif
26423 #endif
26424 #endif
26425
26426 // ----------- #included from clara_textflow.hpp -----------
26427
26428 // TextFlowCpp
26429 //
26430 // A single-header library for wrapping and laying out basic text, by Phil Nash
26431 //
26432 // Distributed under the Boost Software License, Version 1.0. (See accompanying
26433 // file LICENSE.txt or copy at http://www.boost.org/LICENSE_1_0.txt)
26434 //
26435 // This project is hosted at https://github.com/philsquared/textflowcpp
26436
26437
26438 #include <cassert>
26439 #include <ostream>
26440 #include <sstream>
26441 #include <vector>
26442
26443 #ifndef CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH
26444 #define CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH 80
26445 #endif
26446
26447 namespace Catch {
26448 namespace clara {
26449 namespace TextFlow {
26450
26451 inline auto isWhitespace(char c) -> bool {
26452     static std::string chars = " \t\n\r";
26453     return chars.find(c) != std::string::npos;
26454 }
26455 inline auto isBreakableBefore(char c) -> bool {
26456     static std::string chars = "[({<|";
26457     return chars.find(c) != std::string::npos;
26458 }
26459 inline auto isBreakableAfter(char c) -> bool {
26460     static std::string chars = "])}>.,:;*+-=&/\\";
26461     return chars.find(c) != std::string::npos;
26462 }
26463
26464 class Columns;
26465
26466 class Column {
26467     std::vector<std::string> m_strings;
26468     size_t m_width = CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH;
26469     size_t m_indent = 0;
26470     size_t m_initialIndent = std::string::npos;
26471
26472 public:
26473     class iterator {
26474         friend Column;
26475
26476         Column const& m_column;
26477         size_t m_stringIndex = 0;
26478         size_t m_pos = 0;
26479
26480         size_t m_len = 0;
26481         size_t m_end = 0;
26482         bool m_suffix = false;
26483
26484         iterator(Column const& column, size_t stringIndex)
26485             : m_column(column),
26486             m_stringIndex(stringIndex) {}
26487
26488         auto line() const -> std::string const& { return m_column.m_strings[m_stringIndex]; }
26489
26490         auto isBoundary(size_t at) const -> bool {
26491             assert(at > 0);
26492             assert(at <= line().size());
26493
26494             return at == line().size() ||
26495                 (isWhitespace(line()[at]) && !isWhitespace(line()[at - 1])) ||
26496                 isBreakableBefore(line()[at]) ||
26497                 isBreakableAfter(line()[at - 1]);
26498         }
26499
```

```
26500         void calcLength() {
26501             assert(m_stringIndex < m_column.m_strings.size());
26502
26503             m_suffix = false;
26504             auto width = m_column.m_width - indent();
26505             m_end = m_pos;
26506             if (line()[m_pos] == '\n') {
26507                 ++m_end;
26508             }
26509             while (m_end < line().size() && line()[m_end] != '\n')
26510                 ++m_end;
26511
26512             if (m_end < m_pos + width) {
26513                 m_len = m_end - m_pos;
26514             } else {
26515                 size_t len = width;
26516                 while (len > 0 && !isBoundary(m_pos + len))
26517                     --len;
26518                 while (len > 0 && isWhitespace(line()[m_pos + len - 1]))
26519                     --len;
26520
26521                 if (len > 0) {
26522                     m_len = len;
26523                 } else {
26524                     m_suffix = true;
26525                     m_len = width - 1;
26526                 }
26527             }
26528         }
26529
26530         auto indent() const -> size_t {
26531             auto initial = m_pos == 0 && m_stringIndex == 0 ? m_column.m_initialIndent :
      std::string::npos;
26532             return initial == std::string::npos ? m_column.m_indent : initial;
26533         }
26534
26535         auto addIndentAndSuffix(std::string const &plain) const -> std::string {
26536             return std::string(indent(), ' ') + (m_suffix ? plain + "-" : plain);
26537         }
26538
26539     public:
26540         using difference_type = std::ptrdiff_t;
26541         using value_type = std::string;
26542         using pointer = value_type * ;
26543         using reference = value_type & ;
26544         using iterator_category = std::forward_iterator_tag;
26545
26546         explicit iterator(Column const& column) : m_column(column) {
26547             assert(m_column.m_width > m_column.m_indent);
26548             assert(m_column.m_initialIndent == std::string::npos || m_column.m_width >
      m_column.m_initialIndent);
26549             calcLength();
26550             if (m_len == 0)
26551                 m_stringIndex++; // Empty string
26552         }
26553
26554         auto operator *() const -> std::string {
26555             assert(m_stringIndex < m_column.m_strings.size());
26556             assert(m_pos <= m_end);
26557             return addIndentAndSuffix(line().substr(m_pos, m_len));
26558         }
26559
26560         auto operator ++() -> iterator& {
26561             m_pos += m_len;
26562             if (m_pos < line().size() && line()[m_pos] == '\n')
26563                 m_pos += 1;
26564             else
26565                 while (m_pos < line().size() && isWhitespace(line()[m_pos]))
26566                     ++m_pos;
26567
26568             if (m_pos == line().size()) {
26569                 m_pos = 0;
26570                 ++m_stringIndex;
26571             }
26572             if (m_stringIndex < m_column.m_strings.size())
26573                 calcLength();
26574             return *this;
26575         }
26576         auto operator ++(int) -> iterator {
26577             iterator prev(*this);
26578             operator++();
26579             return prev;
26580         }
26581
26582         auto operator ==(iterator const& other) const -> bool {
26583             return
26584                 m_pos == other.m_pos &&
```

```
26585                 m_stringIndex == other.m_stringIndex &&
26586                 &m_column == &other.m_column;
26587         }
26588         auto operator !=(iterator const& other) const -> bool {
26589             return !operator==(other);
26590         }
26591     };
26592     using const_iterator = iterator;
26593
26594     explicit Column(std::string const& text) { m_strings.push_back(text); }
26595
26596     auto width(size_t newWidth) -> Column& {
26597         assert(newWidth > 0);
26598         m_width = newWidth;
26599         return *this;
26600     }
26601     auto indent(size_t newIndent) -> Column& {
26602         m_indent = newIndent;
26603         return *this;
26604     }
26605     auto initialIndent(size_t newIndent) -> Column& {
26606         m_initialIndent = newIndent;
26607         return *this;
26608     }
26609
26610     auto width() const -> size_t { return m_width; }
26611     auto begin() const -> iterator { return iterator(*this); }
26612     auto end() const -> iterator { return { *this, m_strings.size() }; }
26613
26614     inline friend std::ostream& operator << (std::ostream& os, Column const& col) {
26615         bool first = true;
26616         for (auto line : col) {
26617             if (first)
26618                 first = false;
26619             else
26620                 os << "\n";
26621             os << line;
26622         }
26623         return os;
26624     }
26625
26626     auto operator + (Column const& other)->Columns;
26627
26628     auto toString() const -> std::string {
26629         std::ostringstream oss;
26630         oss << *this;
26631         return oss.str();
26632     }
26633 };
26634
26635 class Spacer : public Column {
26636
26637 public:
26638     explicit Spacer(size_t spaceWidth) : Column("") {
26639         width(spaceWidth);
26640     }
26641 };
26642
26643 class Columns {
26644     std::vector<Column> m_columns;
26645
26646 public:
26647
26648     class iterator {
26649         friend Columns;
26650         struct EndTag {};
26651
26652         std::vector<Column> const& m_columns;
26653         std::vector<Column::iterator> m_iterators;
26654         size_t m_activeIterators;
26655
26656         iterator(Columns const& columns, EndTag)
26657             : m_columns(columns.m_columns),
26658             m_activeIterators(0) {
26659             m_iterators.reserve(m_columns.size());
26660
26661             for (auto const& col : m_columns)
26662                 m_iterators.push_back(col.end());
26663         }
26664
26665     public:
26666         using difference_type = std::ptrdiff_t;
26667         using value_type = std::string;
26668         using pointer = value_type * ;
26669         using reference = value_type & ;
26670         using iterator_category = std::forward_iterator_tag;
26671
```

```
26672         explicit iterator(Columns const& columns)
26673             : m_columns(columns.m_columns),
26674               m_activeIterators(m_columns.size()) {
26675               m_iterators.reserve(m_columns.size());
26676
26677               for (auto const& col : m_columns)
26678                   m_iterators.push_back(col.begin());
26679         }
26680
26681         auto operator ==(iterator const& other) const -> bool {
26682             return m_iterators == other.m_iterators;
26683         }
26684         auto operator !=(iterator const& other) const -> bool {
26685             return m_iterators != other.m_iterators;
26686         }
26687         auto operator *() const -> std::string {
26688             std::string row, padding;
26689
26690             for (size_t i = 0; i < m_columns.size(); ++i) {
26691                 auto width = m_columns[i].width();
26692                 if (m_iterators[i] != m_columns[i].end()) {
26693                     std::string col = *m_iterators[i];
26694                     row += padding + col;
26695                     if (col.size() < width)
26696                         padding = std::string(width - col.size(), ' ');
26697                     else
26698                         padding = "";
26699                 } else {
26700                     padding += std::string(width, ' ');
26701                 }
26702             }
26703             return row;
26704         }
26705         auto operator ++() -> iterator& {
26706             for (size_t i = 0; i < m_columns.size(); ++i) {
26707                 if (m_iterators[i] != m_columns[i].end())
26708                     ++m_iterators[i];
26709             }
26710             return *this;
26711         }
26712         auto operator ++(int) -> iterator {
26713             iterator prev(*this);
26714             operator++();
26715             return prev;
26716         }
26717     };
26718     using const_iterator = iterator;
26719
26720     auto begin() const -> iterator { return iterator(*this); }
26721     auto end() const -> iterator { return { *this, iterator::EndTag() }; }
26722
26723     auto operator += (Column const& col) -> Columns& {
26724         m_columns.push_back(col);
26725         return *this;
26726     }
26727     auto operator + (Column const& col) -> Columns {
26728         Columns combined = *this;
26729         combined += col;
26730         return combined;
26731     }
26732
26733     inline friend std::ostream& operator « (std::ostream& os, Columns const& cols) {
26734
26735         bool first = true;
26736         for (auto line : cols) {
26737             if (first)
26738                 first = false;
26739             else
26740                 os « "\n";
26741             os « line;
26742         }
26743         return os;
26744     }
26745
26746     auto toString() const -> std::string {
26747         std::ostringstream oss;
26748         oss « *this;
26749         return oss.str();
26750     }
26751 };
26752
26753 inline auto Column::operator + (Column const& other) -> Columns {
26754     Columns cols;
26755     cols += *this;
26756     cols += other;
26757     return cols;
26758 }
```

```
26759 }
26760
26761 }
26762 }
26763
26764 // ----------- end of #include from clara_textflow.hpp -----------
26765 // ........... back in clara.hpp
26766
26767 #include <cctype>
26768 #include <string>
26769 #include <memory>
26770 #include <set>
26771 #include <algorithm>
26772
26773 #if !defined(CATCH_PLATFORM_WINDOWS) && ( defined(WIN32) || defined(__WIN32__) || defined(_WIN32) ||
      defined(_MSC_VER) )
26774 #define CATCH_PLATFORM_WINDOWS
26775 #endif
26776
26777 namespace Catch { namespace clara {
26778 namespace detail {
26779
26780     // Traits for extracting arg and return type of lambdas (for single argument lambdas)
26781     template<typename L>
26782     struct UnaryLambdaTraits : UnaryLambdaTraits<decltype( &L::operator() )> {};
26783
26784     template<typename ClassT, typename ReturnT, typename... Args>
26785     struct UnaryLambdaTraits<ReturnT( ClassT::* )( Args... ) const> {
26786         static const bool isValid = false;
26787     };
26788
26789     template<typename ClassT, typename ReturnT, typename ArgT>
26790     struct UnaryLambdaTraits<ReturnT( ClassT::* )( ArgT ) const> {
26791         static const bool isValid = true;
26792         using ArgType = typename std::remove_const<typename std::remove_reference<ArgT>::type>::type;
26793         using ReturnType = ReturnT;
26794     };
26795
26796     class TokenStream;
26797
26798     // Transport for raw args (copied from main args, or supplied via init list for testing)
26799     class Args {
26800         friend TokenStream;
26801         std::string m_exeName;
26802         std::vector<std::string> m_args;
26803
26804     public:
26805         Args( int argc, char const* const* argv )
26806             : m_exeName(argv[0]),
26807               m_args(argv + 1, argv + argc) {}
26808
26809         Args( std::initializer_list<std::string> args )
26810         :   m_exeName( *args.begin() ),
26811             m_args( args.begin()+1, args.end() )
26812         {}
26813
26814         auto exeName() const -> std::string {
26815             return m_exeName;
26816         }
26817     };
26818
26819     // Wraps a token coming from a token stream. These may not directly correspond to strings as a
      single string
26820     // may encode an option + its argument if the : or = form is used
26821     enum class TokenType {
26822         Option, Argument
26823     };
26824     struct Token {
26825         TokenType type;
26826         std::string token;
26827     };
26828
26829     inline auto isOptPrefix( char c ) -> bool {
26830         return c == '-'
26831 #ifdef CATCH_PLATFORM_WINDOWS
26832             || c == '/'
26833 #endif
26834         ;
26835     }
26836
26837     // Abstracts iterators into args as a stream of tokens, with option arguments uniformly handled
26838     class TokenStream {
26839         using Iterator = std::vector<std::string>::const_iterator;
26840         Iterator it;
26841         Iterator itEnd;
26842         std::vector<Token> m_tokenBuffer;
26843
```

```
26844         void loadBuffer() {
26845             m_tokenBuffer.resize( 0 );
26846 
26847             // Skip any empty strings
26848             while( it != itEnd && it->empty() )
26849                 ++it;
26850 
26851             if( it != itEnd ) {
26852                 auto const &next = *it;
26853                 if( isOptPrefix( next[0] ) ) {
26854                     auto delimiterPos = next.find_first_of( " :=" );
26855                     if( delimiterPos != std::string::npos ) {
26856                         m_tokenBuffer.push_back( { TokenType::Option, next.substr( 0, delimiterPos ) }
      );
26857                         m_tokenBuffer.push_back( { TokenType::Argument, next.substr( delimiterPos + 1
      ) } );
26858                     } else {
26859                         if( next[1] != '-' && next.size() > 2 ) {
26860                             std::string opt = "- ";
26861                             for( size_t i = 1; i < next.size(); ++i ) {
26862                                 opt[1] = next[i];
26863                                 m_tokenBuffer.push_back( { TokenType::Option, opt } );
26864                             }
26865                         } else {
26866                             m_tokenBuffer.push_back( { TokenType::Option, next } );
26867                         }
26868                     }
26869                 } else {
26870                     m_tokenBuffer.push_back( { TokenType::Argument, next } );
26871                 }
26872             }
26873         }
26874 
26875     public:
26876         explicit TokenStream( Args const &args ) : TokenStream( args.m_args.begin(), args.m_args.end()
      ) {}
26877 
26878         TokenStream( Iterator it, Iterator itEnd ) : it( it ), itEnd( itEnd ) {
26879             loadBuffer();
26880         }
26881 
26882         explicit operator bool() const {
26883             return !m_tokenBuffer.empty() || it != itEnd;
26884         }
26885 
26886         auto count() const -> size_t { return m_tokenBuffer.size() + (itEnd - it); }
26887 
26888         auto operator*() const -> Token {
26889             assert( !m_tokenBuffer.empty() );
26890             return m_tokenBuffer.front();
26891         }
26892 
26893         auto operator->() const -> Token const * {
26894             assert( !m_tokenBuffer.empty() );
26895             return &m_tokenBuffer.front();
26896         }
26897 
26898         auto operator++() -> TokenStream & {
26899             if( m_tokenBuffer.size() >= 2 ) {
26900                 m_tokenBuffer.erase( m_tokenBuffer.begin() );
26901             } else {
26902                 if( it != itEnd )
26903                     ++it;
26904                 loadBuffer();
26905             }
26906             return *this;
26907         }
26908     };
26909 
26910     class ResultBase {
26911     public:
26912         enum Type {
26913             Ok, LogicError, RuntimeError
26914         };
26915 
26916     protected:
26917         ResultBase( Type type ) : m_type( type ) {}
26918         virtual ~ResultBase() = default;
26919 
26920         virtual void enforceOk() const = 0;
26921 
26922         Type m_type;
26923     };
26924 
26925     template<typename T>
26926     class ResultValueBase : public ResultBase {
26927     public:
```

```
26928         auto value() const -> T const & {
26929             enforceOk();
26930             return m_value;
26931         }
26932
26933     protected:
26934         ResultValueBase( Type type ) : ResultBase( type ) {}
26935
26936         ResultValueBase( ResultValueBase const &other ) : ResultBase( other ) {
26937             if( m_type == ResultBase::Ok )
26938                 new( &m_value ) T( other.m_value );
26939         }
26940
26941         ResultValueBase( Type, T const &value ) : ResultBase( Ok ) {
26942             new( &m_value ) T( value );
26943         }
26944
26945         auto operator=( ResultValueBase const &other ) -> ResultValueBase & {
26946             if( m_type == ResultBase::Ok )
26947                 m_value.~T();
26948             ResultBase::operator=(other);
26949             if( m_type == ResultBase::Ok )
26950                 new( &m_value ) T( other.m_value );
26951             return *this;
26952         }
26953
26954         ~ResultValueBase() override {
26955             if( m_type == Ok )
26956                 m_value.~T();
26957         }
26958
26959         union {
26960             T m_value;
26961         };
26962     };
26963
26964     template<>
26965     class ResultValueBase<void> : public ResultBase {
26966     protected:
26967         using ResultBase::ResultBase;
26968     };
26969
26970     template<typename T = void>
26971     class BasicResult : public ResultValueBase<T> {
26972     public:
26973         template<typename U>
26974         explicit BasicResult( BasicResult<U> const &other )
26975         :   ResultValueBase<T>( other.type() ),
26976             m_errorMessage( other.errorMessage() )
26977         {
26978             assert( type() != ResultBase::Ok );
26979         }
26980
26981         template<typename U>
26982         static auto ok( U const &value ) -> BasicResult { return { ResultBase::Ok, value }; }
26983         static auto ok() -> BasicResult { return { ResultBase::Ok }; }
26984         static auto logicError( std::string const &message ) -> BasicResult { return {
      ResultBase::LogicError, message }; }
26985         static auto runtimeError( std::string const &message ) -> BasicResult { return {
      ResultBase::RuntimeError, message }; }
26986
26987         explicit operator bool() const { return m_type == ResultBase::Ok; }
26988         auto type() const -> ResultBase::Type { return m_type; }
26989         auto errorMessage() const -> std::string { return m_errorMessage; }
26990
26991     protected:
26992         void enforceOk() const override {
26993
26994             // Errors shouldn't reach this point, but if they do
26995             // the actual error message will be in m_errorMessage
26996             assert( m_type != ResultBase::LogicError );
26997             assert( m_type != ResultBase::RuntimeError );
26998             if( m_type != ResultBase::Ok )
26999                 std::abort();
27000         }
27001
27002         std::string m_errorMessage; // Only populated if resultType is an error
27003
27004         BasicResult( ResultBase::Type type, std::string const &message )
27005         :   ResultValueBase<T>(type),
27006             m_errorMessage(message)
27007         {
27008             assert( m_type != ResultBase::Ok );
27009         }
27010
27011         using ResultValueBase<T>::ResultValueBase;
27012         using ResultBase::m_type;
```

```
27013     };
27014
27015     enum class ParseResultType {
27016         Matched, NoMatch, ShortCircuitAll, ShortCircuitSame
27017     };
27018
27019     class ParseState {
27020     public:
27021
27022         ParseState( ParseResultType type, TokenStream const &remainingTokens )
27023         : m_type(type),
27024           m_remainingTokens( remainingTokens )
27025         {}
27026
27027         auto type() const -> ParseResultType { return m_type; }
27028         auto remainingTokens() const -> TokenStream { return m_remainingTokens; }
27029
27030     private:
27031         ParseResultType m_type;
27032         TokenStream m_remainingTokens;
27033     };
27034
27035     using Result = BasicResult<void>;
27036     using ParserResult = BasicResult<ParseResultType>;
27037     using InternalParseResult = BasicResult<ParseState>;
27038
27039     struct HelpColumns {
27040         std::string left;
27041         std::string right;
27042     };
27043
27044     template<typename T>
27045     inline auto convertInto( std::string const &source, T& target ) -> ParserResult {
27046         std::stringstream ss;
27047         ss « source;
27048         ss » target;
27049         if( ss.fail() )
27050             return ParserResult::runtimeError( "Unable to convert '" + source + "' to destination
      type" );
27051         else
27052             return ParserResult::ok( ParseResultType::Matched );
27053     }
27054     inline auto convertInto( std::string const &source, std::string& target ) -> ParserResult {
27055         target = source;
27056         return ParserResult::ok( ParseResultType::Matched );
27057     }
27058     inline auto convertInto( std::string const &source, bool &target ) -> ParserResult {
27059         std::string srcLC = source;
27060         std::transform( srcLC.begin(), srcLC.end(), srcLC.begin(), []( unsigned char c ) { return
      static_cast<char>( std::tolower(c) ); } );
27061         if (srcLC == "y" || srcLC == "1" || srcLC == "true" || srcLC == "yes" || srcLC == "on")
27062             target = true;
27063         else if (srcLC == "n" || srcLC == "0" || srcLC == "false" || srcLC == "no" || srcLC == "off")
27064             target = false;
27065         else
27066             return ParserResult::runtimeError( "Expected a boolean value but did not recognise: '" +
      source + "'" );
27067         return ParserResult::ok( ParseResultType::Matched );
27068     }
27069 #ifdef CLARA_CONFIG_OPTIONAL_TYPE
27070     template<typename T>
27071     inline auto convertInto( std::string const &source, CLARA_CONFIG_OPTIONAL_TYPE<T>& target ) ->
      ParserResult {
27072         T temp;
27073         auto result = convertInto( source, temp );
27074         if( result )
27075             target = std::move(temp);
27076         return result;
27077     }
27078 #endif // CLARA_CONFIG_OPTIONAL_TYPE
27079
27080     struct NonCopyable {
27081         NonCopyable() = default;
27082         NonCopyable( NonCopyable const & ) = delete;
27083         NonCopyable( NonCopyable && ) = delete;
27084         NonCopyable &operator=( NonCopyable const & ) = delete;
27085         NonCopyable &operator=( NonCopyable && ) = delete;
27086     };
27087
27088     struct BoundRef : NonCopyable {
27089         virtual ~BoundRef() = default;
27090         virtual auto isContainer() const -> bool { return false; }
27091         virtual auto isFlag() const -> bool { return false; }
27092     };
27093     struct BoundValueRefBase : BoundRef {
27094         virtual auto setValue( std::string const &arg ) -> ParserResult = 0;
27095     };
```

```
27096     struct BoundFlagRefBase : BoundRef {
27097         virtual auto setFlag( bool flag ) -> ParserResult = 0;
27098         virtual auto isFlag() const -> bool { return true; }
27099     };
27100
27101     template<typename T>
27102     struct BoundValueRef : BoundValueRefBase {
27103         T &m_ref;
27104
27105         explicit BoundValueRef( T &ref ) : m_ref( ref ) {}
27106
27107         auto setValue( std::string const &arg ) -> ParserResult override {
27108             return convertInto( arg, m_ref );
27109         }
27110     };
27111
27112     template<typename T>
27113     struct BoundValueRef<std::vector<T» : BoundValueRefBase {
27114         std::vector<T> &m_ref;
27115
27116         explicit BoundValueRef( std::vector<T> &ref ) : m_ref( ref ) {}
27117
27118         auto isContainer() const -> bool override { return true; }
27119
27120         auto setValue( std::string const &arg ) -> ParserResult override {
27121             T temp;
27122             auto result = convertInto( arg, temp );
27123             if( result )
27124                 m_ref.push_back( temp );
27125             return result;
27126         }
27127     };
27128
27129     struct BoundFlagRef : BoundFlagRefBase {
27130         bool &m_ref;
27131
27132         explicit BoundFlagRef( bool &ref ) : m_ref( ref ) {}
27133
27134         auto setFlag( bool flag ) -> ParserResult override {
27135             m_ref = flag;
27136             return ParserResult::ok( ParseResultType::Matched );
27137         }
27138     };
27139
27140     template<typename ReturnType>
27141     struct LambdaInvoker {
27142         static_assert( std::is_same<ReturnType, ParserResult>::value, "Lambda must return void or
      clara::ParserResult" );
27143
27144         template<typename L, typename ArgType>
27145         static auto invoke( L const &lambda, ArgType const &arg ) -> ParserResult {
27146             return lambda( arg );
27147         }
27148     };
27149
27150     template<>
27151     struct LambdaInvoker<void> {
27152         template<typename L, typename ArgType>
27153         static auto invoke( L const &lambda, ArgType const &arg ) -> ParserResult {
27154             lambda( arg );
27155             return ParserResult::ok( ParseResultType::Matched );
27156         }
27157     };
27158
27159     template<typename ArgType, typename L>
27160     inline auto invokeLambda( L const &lambda, std::string const &arg ) -> ParserResult {
27161         ArgType temp{};
27162         auto result = convertInto( arg, temp );
27163         return !result
27164            ? result
27165            : LambdaInvoker<typename UnaryLambdaTraits<L>::ReturnType>::invoke( lambda, temp );
27166     }
27167
27168     template<typename L>
27169     struct BoundLambda : BoundValueRefBase {
27170         L m_lambda;
27171
27172         static_assert( UnaryLambdaTraits<L>::isValid, "Supplied lambda must take exactly one argument"
      );
27173         explicit BoundLambda( L const &lambda ) : m_lambda( lambda ) {}
27174
27175         auto setValue( std::string const &arg ) -> ParserResult override {
27176             return invokeLambda<typename UnaryLambdaTraits<L>::ArgType>( m_lambda, arg );
27177         }
27178     };
27179
27180     template<typename L>
```

```
27181     struct BoundFlagLambda : BoundFlagRefBase {
27182         L m_lambda;
27183
27184         static_assert( UnaryLambdaTraits<L>::isValid, "Supplied lambda must take exactly one argument"
      );
27185         static_assert( std::is_same<typename UnaryLambdaTraits<L>::ArgType, bool>::value, "flags must
      be boolean" );
27186
27187         explicit BoundFlagLambda( L const &lambda ) : m_lambda( lambda ) {}
27188
27189         auto setFlag( bool flag ) -> ParserResult override {
27190             return LambdaInvoker<typename UnaryLambdaTraits<L>::ReturnType>::invoke( m_lambda, flag );
27191         }
27192     };
27193
27194     enum class Optionality { Optional, Required };
27195
27196     struct Parser;
27197
27198     class ParserBase {
27199     public:
27200         virtual ~ParserBase() = default;
27201         virtual auto validate() const -> Result { return Result::ok(); }
27202         virtual auto parse( std::string const& exeName, TokenStream const &tokens) const ->
      InternalParseResult  = 0;
27203         virtual auto cardinality() const -> size_t { return 1; }
27204
27205         auto parse( Args const &args ) const -> InternalParseResult {
27206             return parse( args.exeName(), TokenStream( args ) );
27207         }
27208     };
27209
27210     template<typename DerivedT>
27211     class ComposableParserImpl : public ParserBase {
27212     public:
27213         template<typename T>
27214         auto operator|( T const &other ) const -> Parser;
27215
27216         template<typename T>
27217         auto operator+( T const &other ) const -> Parser;
27218     };
27219
27220     // Common code and state for Args and Opts
27221     template<typename DerivedT>
27222     class ParserRefImpl : public ComposableParserImpl<DerivedT> {
27223     protected:
27224         Optionality m_optionality = Optionality::Optional;
27225         std::shared_ptr<BoundRef> m_ref;
27226         std::string m_hint;
27227         std::string m_description;
27228
27229         explicit ParserRefImpl( std::shared_ptr<BoundRef> const &ref ) : m_ref( ref ) {}
27230
27231     public:
27232         template<typename T>
27233         ParserRefImpl( T &ref, std::string const &hint )
27234         :   m_ref( std::make_shared<BoundValueRef<T»( ref ) ),
27235             m_hint( hint )
27236         {}
27237
27238         template<typename LambdaT>
27239         ParserRefImpl( LambdaT const &ref, std::string const &hint )
27240         :   m_ref( std::make_shared<BoundLambda<LambdaT»( ref ) ),
27241             m_hint(hint)
27242         {}
27243
27244         auto operator()( std::string const &description ) -> DerivedT & {
27245             m_description = description;
27246             return static_cast<DerivedT &>( *this );
27247         }
27248
27249         auto optional() -> DerivedT & {
27250             m_optionality = Optionality::Optional;
27251             return static_cast<DerivedT &>( *this );
27252         };
27253
27254         auto required() -> DerivedT & {
27255             m_optionality = Optionality::Required;
27256             return static_cast<DerivedT &>( *this );
27257         };
27258
27259         auto isOptional() const -> bool {
27260             return m_optionality == Optionality::Optional;
27261         }
27262
27263         auto cardinality() const -> size_t override {
27264             if( m_ref->isContainer() )
```

```
27265                 return 0;
27266             else
27267                 return 1;
27268         }
27269
27270         auto hint() const -> std::string { return m_hint; }
27271     };
27272
27273     class ExeName : public ComposableParserImpl<ExeName> {
27274         std::shared_ptr<std::string> m_name;
27275         std::shared_ptr<BoundValueRefBase> m_ref;
27276
27277         template<typename LambdaT>
27278         static auto makeRef(LambdaT const &lambda) -> std::shared_ptr<BoundValueRefBase> {
27279             return std::make_shared<BoundLambda<LambdaT»( lambda) ;
27280         }
27281
27282     public:
27283         ExeName() : m_name( std::make_shared<std::string>( "<executable>" ) ) {}
27284
27285         explicit ExeName( std::string &ref ) : ExeName() {
27286             m_ref = std::make_shared<BoundValueRef<std::string»( ref );
27287         }
27288
27289         template<typename LambdaT>
27290         explicit ExeName( LambdaT const& lambda ) : ExeName() {
27291             m_ref = std::make_shared<BoundLambda<LambdaT»( lambda );
27292         }
27293
27294         // The exe name is not parsed out of the normal tokens, but is handled specially
27295         auto parse( std::string const&, TokenStream const &tokens ) const -> InternalParseResult
    override {
27296             return InternalParseResult::ok( ParseState( ParseResultType::NoMatch, tokens ) );
27297         }
27298
27299         auto name() const -> std::string { return *m_name; }
27300         auto set( std::string const& newName ) -> ParserResult {
27301
27302             auto lastSlash = newName.find_last_of( "\\/" );
27303             auto filename = ( lastSlash == std::string::npos )
27304                     ? newName
27305                     : newName.substr( lastSlash+1 );
27306
27307             *m_name = filename;
27308             if( m_ref )
27309                 return m_ref->setValue( filename );
27310             else
27311                 return ParserResult::ok( ParseResultType::Matched );
27312         }
27313     };
27314
27315     class Arg : public ParserRefImpl<Arg> {
27316     public:
27317         using ParserRefImpl::ParserRefImpl;
27318
27319         auto parse( std::string const &, TokenStream const &tokens ) const -> InternalParseResult
    override {
27320             auto validationResult = validate();
27321             if( !validationResult )
27322                 return InternalParseResult( validationResult );
27323
27324             auto remainingTokens = tokens;
27325             auto const &token = *remainingTokens;
27326             if( token.type != TokenType::Argument )
27327                 return InternalParseResult::ok( ParseState( ParseResultType::NoMatch, remainingTokens
    ) );
27328
27329             assert( !m_ref->isFlag() );
27330             auto valueRef = static_cast<detail::BoundValueRefBase*>( m_ref.get() );
27331
27332             auto result = valueRef->setValue( remainingTokens->token );
27333             if( !result )
27334                 return InternalParseResult( result );
27335             else
27336                 return InternalParseResult::ok( ParseState( ParseResultType::Matched,
    ++remainingTokens ) );
27337         }
27338     };
27339
27340     inline auto normaliseOpt( std::string const &optName ) -> std::string {
27341 #ifdef CATCH_PLATFORM_WINDOWS
27342         if( optName[0] == '/' )
27343             return "-" + optName.substr( 1 );
27344         else
27345 #endif
27346             return optName;
27347     }
```

```
27348
27349     class Opt : public ParserRefImpl<Opt> {
27350     protected:
27351         std::vector<std::string> m_optNames;
27352
27353     public:
27354         template<typename LambdaT>
27355         explicit Opt( LambdaT const &ref ) : ParserRefImpl( std::make_shared<BoundFlagLambda<LambdaT»(
      ref ) ) {}
27356
27357         explicit Opt( bool &ref ) : ParserRefImpl( std::make_shared<BoundFlagRef>( ref ) ) {}
27358
27359         template<typename LambdaT>
27360         Opt( LambdaT const &ref, std::string const &hint ) : ParserRefImpl( ref, hint ) {}
27361
27362         template<typename T>
27363         Opt( T &ref, std::string const &hint ) : ParserRefImpl( ref, hint ) {}
27364
27365         auto operator[]( std::string const &optName ) -> Opt & {
27366             m_optNames.push_back( optName );
27367             return *this;
27368         }
27369
27370         auto getHelpColumns() const -> std::vector<HelpColumns> {
27371             std::ostringstream oss;
27372             bool first = true;
27373             for( auto const &opt : m_optNames ) {
27374                 if (first)
27375                     first = false;
27376                 else
27377                     oss « ", ";
27378                 oss « opt;
27379             }
27380             if( !m_hint.empty() )
27381                 oss « " <" « m_hint « ">";
27382             return { { oss.str(), m_description } };
27383         }
27384
27385         auto isMatch( std::string const &optToken ) const -> bool {
27386             auto normalisedToken = normaliseOpt( optToken );
27387             for( auto const &name : m_optNames ) {
27388                 if( normaliseOpt( name ) == normalisedToken )
27389                     return true;
27390             }
27391             return false;
27392         }
27393
27394         using ParserBase::parse;
27395
27396         auto parse( std::string const&, TokenStream const &tokens ) const -> InternalParseResult
      override {
27397             auto validationResult = validate();
27398             if( !validationResult )
27399                 return InternalParseResult( validationResult );
27400
27401             auto remainingTokens = tokens;
27402             if( remainingTokens && remainingTokens->type == TokenType::Option ) {
27403                 auto const &token = *remainingTokens;
27404                 if( isMatch(token.token ) ) {
27405                     if( m_ref->isFlag() ) {
27406                         auto flagRef = static_cast<detail::BoundFlagRefBase*>( m_ref.get() );
27407                         auto result = flagRef->setFlag( true );
27408                         if( !result )
27409                             return InternalParseResult( result );
27410                         if( result.value() == ParseResultType::ShortCircuitAll )
27411                             return InternalParseResult::ok( ParseState( result.value(),
      remainingTokens ) );
27412                     } else {
27413                         auto valueRef = static_cast<detail::BoundValueRefBase*>( m_ref.get() );
27414                         ++remainingTokens;
27415                         if( !remainingTokens )
27416                             return InternalParseResult::runtimeError( "Expected argument following " +
      token.token );
27417                         auto const &argToken = *remainingTokens;
27418                         if( argToken.type != TokenType::Argument )
27419                             return InternalParseResult::runtimeError( "Expected argument following " +
      token.token );
27420                         auto result = valueRef->setValue( argToken.token );
27421                         if( !result )
27422                             return InternalParseResult( result );
27423                         if( result.value() == ParseResultType::ShortCircuitAll )
27424                             return InternalParseResult::ok( ParseState( result.value(),
      remainingTokens ) );
27425                     }
27426                     return InternalParseResult::ok( ParseState( ParseResultType::Matched,
      ++remainingTokens ) );
27427                 }
```

```
27428             }
27429             return InternalParseResult::ok( ParseState( ParseResultType::NoMatch, remainingTokens ) );
27430         }
27431
27432         auto validate() const -> Result override {
27433             if( m_optNames.empty() )
27434                 return Result::logicError( "No options supplied to Opt" );
27435             for( auto const &name : m_optNames ) {
27436                 if( name.empty() )
27437                     return Result::logicError( "Option name cannot be empty" );
27438 #ifdef CATCH_PLATFORM_WINDOWS
27439                 if( name[0] != '-' && name[0] != '/' )
27440                     return Result::logicError( "Option name must begin with '-' or '/'" );
27441 #else
27442                 if( name[0] != '-' )
27443                     return Result::logicError( "Option name must begin with '-'" );
27444 #endif
27445             }
27446             return ParserRefImpl::validate();
27447         }
27448     };
27449
27450     struct Help : Opt {
27451         Help( bool &showHelpFlag )
27452         :   Opt([&]( bool flag ) {
27453                 showHelpFlag = flag;
27454                 return ParserResult::ok( ParseResultType::ShortCircuitAll );
27455             })
27456         {
27457             static_cast<Opt &>( *this )
27458                     ("display usage information")
27459                     ["-?"]["-h"]["--help"]
27460                     .optional();
27461         }
27462     };
27463
27464     struct Parser : ParserBase {
27465
27466         mutable ExeName m_exeName;
27467         std::vector<Opt> m_options;
27468         std::vector<Arg> m_args;
27469
27470         auto operator|=( ExeName const &exeName ) -> Parser & {
27471             m_exeName = exeName;
27472             return *this;
27473         }
27474
27475         auto operator|=( Arg const &arg ) -> Parser & {
27476             m_args.push_back(arg);
27477             return *this;
27478         }
27479
27480         auto operator|=( Opt const &opt ) -> Parser & {
27481             m_options.push_back(opt);
27482             return *this;
27483         }
27484
27485         auto operator|=( Parser const &other ) -> Parser & {
27486             m_options.insert(m_options.end(), other.m_options.begin(), other.m_options.end());
27487             m_args.insert(m_args.end(), other.m_args.begin(), other.m_args.end());
27488             return *this;
27489         }
27490
27491         template<typename T>
27492         auto operator|( T const &other ) const -> Parser {
27493             return Parser( *this ) |= other;
27494         }
27495
27496         // Forward deprecated interface with '+' instead of '|'
27497         template<typename T>
27498         auto operator+=( T const &other ) -> Parser & { return operator|=( other ); }
27499         template<typename T>
27500         auto operator+( T const &other ) const -> Parser { return operator|( other ); }
27501
27502         auto getHelpColumns() const -> std::vector<HelpColumns> {
27503             std::vector<HelpColumns> cols;
27504             for (auto const &o : m_options) {
27505                 auto childCols = o.getHelpColumns();
27506                 cols.insert( cols.end(), childCols.begin(), childCols.end() );
27507             }
27508             return cols;
27509         }
27510
27511         void writeToStream( std::ostream &os ) const {
27512             if (!m_exeName.name().empty()) {
27513                 os « "usage:\n" « "  " « m_exeName.name() « " ";
27514                 bool required = true, first = true;
```

```
27515                 for( auto const &arg : m_args ) {
27516                     if (first)
27517                         first = false;
27518                     else
27519                         os « " ";
27520                     if( arg.isOptional() && required ) {
27521                         os « "[";
27522                         required = false;
27523                     }
27524                     os « "<" « arg.hint() « ">";
27525                     if( arg.cardinality() == 0 )
27526                         os « " ... ";
27527                 }
27528                 if( !required )
27529                     os « "]";
27530                 if( !m_options.empty() )
27531                     os « " options";
27532                 os « "\n\nwhere options are:" « std::endl;
27533             }
27534 
27535             auto rows = getHelpColumns();
27536             size_t consoleWidth = CATCH_CLARA_CONFIG_CONSOLE_WIDTH;
27537             size_t optWidth = 0;
27538             for( auto const &cols : rows )
27539                 optWidth = (std::max)(optWidth, cols.left.size() + 2);
27540 
27541             optWidth = (std::min)(optWidth, consoleWidth/2);
27542 
27543             for( auto const &cols : rows ) {
27544                 auto row =
27545                         TextFlow::Column( cols.left ).width( optWidth ).indent( 2 ) +
27546                         TextFlow::Spacer(4) +
27547                         TextFlow::Column( cols.right ).width( consoleWidth - 7 - optWidth );
27548                 os « row « std::endl;
27549             }
27550         }
27551 
27552         friend auto operator«( std::ostream &os, Parser const &parser ) -> std::ostream& {
27553             parser.writeToStream( os );
27554             return os;
27555         }
27556 
27557         auto validate() const -> Result override {
27558             for( auto const &opt : m_options ) {
27559                 auto result = opt.validate();
27560                 if( !result )
27561                     return result;
27562             }
27563             for( auto const &arg : m_args ) {
27564                 auto result = arg.validate();
27565                 if( !result )
27566                     return result;
27567             }
27568             return Result::ok();
27569         }
27570 
27571         using ParserBase::parse;
27572 
27573         auto parse( std::string const& exeName, TokenStream const &tokens ) const ->
      InternalParseResult override {
27574 
27575             struct ParserInfo {
27576                 ParserBase const* parser = nullptr;
27577                 size_t count = 0;
27578             };
27579             const size_t totalParsers = m_options.size() + m_args.size();
27580             assert( totalParsers < 512 );
27581             // ParserInfo parseInfos[totalParsers]; // <-- this is what we really want to do
27582             ParserInfo parseInfos[512];
27583 
27584             {
27585                 size_t i = 0;
27586                 for (auto const &opt : m_options) parseInfos[i++].parser = &opt;
27587                 for (auto const &arg : m_args) parseInfos[i++].parser = &arg;
27588             }
27589 
27590             m_exeName.set( exeName );
27591 
27592             auto result = InternalParseResult::ok( ParseState( ParseResultType::NoMatch, tokens ) );
27593             while( result.value().remainingTokens() ) {
27594                 bool tokenParsed = false;
27595 
27596                 for( size_t i = 0; i < totalParsers; ++i ) {
27597                     auto&  parseInfo = parseInfos[i];
27598                     if( parseInfo.parser->cardinality() == 0 || parseInfo.count <
      parseInfo.parser->cardinality() ) {
27599                         result = parseInfo.parser->parse(exeName, result.value().remainingTokens());
```

```
27600                         if (!result)
27601                             return result;
27602                         if (result.value().type() != ParseResultType::NoMatch) {
27603                             tokenParsed = true;
27604                             ++parseInfo.count;
27605                             break;
27606                         }
27607                     }
27608                 }
27609
27610                 if( result.value().type() == ParseResultType::ShortCircuitAll )
27611                     return result;
27612                 if( !tokenParsed )
27613                     return InternalParseResult::runtimeError( "Unrecognised token: " +
      result.value().remainingTokens()->token );
27614             }
27615             // !TBD Check missing required options
27616             return result;
27617         }
27618     };
27619
27620     template<typename DerivedT>
27621     template<typename T>
27622     auto ComposableParserImpl<DerivedT>::operator|( T const &other ) const -> Parser {
27623         return Parser() | static_cast<DerivedT const &>( *this ) | other;
27624     }
27625 } // namespace detail
27626
27627 // A Combined parser
27628 using detail::Parser;
27629
27630 // A parser for options
27631 using detail::Opt;
27632
27633 // A parser for arguments
27634 using detail::Arg;
27635
27636 // Wrapper for argc, argv from main()
27637 using detail::Args;
27638
27639 // Specifies the name of the executable
27640 using detail::ExeName;
27641
27642 // Convenience wrapper for option parser that specifies the help option
27643 using detail::Help;
27644
27645 // enum of result types from a parse
27646 using detail::ParseResultType;
27647
27648 // Result type for parser operation
27649 using detail::ParserResult;
27650
27651 }} // namespace Catch::clara
27652
27653 // end clara.hpp
27654 #ifdef __clang__
27655 #pragma clang diagnostic pop
27656 #endif
27657
27658 // Restore Clara's value for console width, if present
27659 #ifdef CATCH_TEMP_CLARA_CONFIG_CONSOLE_WIDTH
27660 #define CATCH_CLARA_TEXTFLOW_CONFIG_CONSOLE_WIDTH CATCH_TEMP_CLARA_CONFIG_CONSOLE_WIDTH
27661 #undef CATCH_TEMP_CLARA_CONFIG_CONSOLE_WIDTH
27662 #endif
27663
27664 // end catch_clara.h
27665 namespace Catch {
27666
27667     clara::Parser makeCommandLineParser( ConfigData& config );
27668
27669 } // end namespace Catch
27670
27671 // end catch_commandline.h
27672 #include <fstream>
27673 #include <ctime>
27674
27675 namespace Catch {
27676
27677     clara::Parser makeCommandLineParser( ConfigData& config ) {
27678
27679         using namespace clara;
27680
27681         auto const setWarning = [&]( std::string const& warning ) {
27682                 auto warningSet = [&]() {
27683                     if( warning == "NoAssertions" )
27684                         return WarnAbout::NoAssertions;
27685
```

```
27686                   if ( warning == "NoTests" )
27687                       return WarnAbout::NoTests;
27688
27689                   return WarnAbout::Nothing;
27690               }();
27691
27692               if (warningSet == WarnAbout::Nothing)
27693                   return ParserResult::runtimeError( "Unrecognised warning: '" + warning + "'" );
27694               config.warnings = static_cast<WarnAbout::What>( config.warnings | warningSet );
27695               return ParserResult::ok( ParseResultType::Matched );
27696           };
27697       auto const loadTestNamesFromFile = [&]( std::string const& filename ) {
27698               std::ifstream f( filename.c_str() );
27699               if( !f.is_open() )
27700                   return ParserResult::runtimeError( "Unable to load input file: '" + filename + "'"
      );
27701
27702               std::string line;
27703               while( std::getline( f, line ) ) {
27704                   line = trim(line);
27705                   if( !line.empty() && !startsWith( line, '#' ) ) {
27706                       if( !startsWith( line, '"' ) )
27707                           line = '"' + line + '"';
27708                       config.testsOrTags.push_back( line );
27709                       config.testsOrTags.emplace_back( "," );
27710                   }
27711               }
27712               //Remove comma in the end
27713               if(!config.testsOrTags.empty())
27714                   config.testsOrTags.erase( config.testsOrTags.end()-1 );
27715
27716               return ParserResult::ok( ParseResultType::Matched );
27717           };
27718       auto const setTestOrder = [&]( std::string const& order ) {
27719               if( startsWith( "declared", order ) )
27720                   config.runOrder = RunTests::InDeclarationOrder;
27721               else if( startsWith( "lexical", order ) )
27722                   config.runOrder = RunTests::InLexicographicalOrder;
27723               else if( startsWith( "random", order ) )
27724                   config.runOrder = RunTests::InRandomOrder;
27725               else
27726                   return clara::ParserResult::runtimeError( "Unrecognised ordering: '" + order + "'"
      );
27727               return ParserResult::ok( ParseResultType::Matched );
27728           };
27729       auto const setRngSeed = [&]( std::string const& seed ) {
27730               if( seed != "time" )
27731                   return clara::detail::convertInto( seed, config.rngSeed );
27732               config.rngSeed = static_cast<unsigned int>( std::time(nullptr) );
27733               return ParserResult::ok( ParseResultType::Matched );
27734           };
27735       auto const setColourUsage = [&]( std::string const& useColour ) {
27736                   auto mode = toLower( useColour );
27737
27738                   if( mode == "yes" )
27739                       config.useColour = UseColour::Yes;
27740                   else if( mode == "no" )
27741                       config.useColour = UseColour::No;
27742                   else if( mode == "auto" )
27743                       config.useColour = UseColour::Auto;
27744                   else
27745                       return ParserResult::runtimeError( "colour mode must be one of: auto, yes or
      no. '" + useColour + "' not recognised" );
27746               return ParserResult::ok( ParseResultType::Matched );
27747           };
27748       auto const setWaitForKeypress = [&]( std::string const& keypress ) {
27749               auto keypressLc = toLower( keypress );
27750               if (keypressLc == "never")
27751                   config.waitForKeypress = WaitForKeypress::Never;
27752               else if( keypressLc == "start" )
27753                   config.waitForKeypress = WaitForKeypress::BeforeStart;
27754               else if( keypressLc == "exit" )
27755                   config.waitForKeypress = WaitForKeypress::BeforeExit;
27756               else if( keypressLc == "both" )
27757                   config.waitForKeypress = WaitForKeypress::BeforeStartAndExit;
27758               else
27759                   return ParserResult::runtimeError( "keypress argument must be one of: never,
      start, exit or both. '" + keypress + "' not recognised" );
27760               return ParserResult::ok( ParseResultType::Matched );
27761           };
27762       auto const setVerbosity = [&]( std::string const& verbosity ) {
27763           auto lcVerbosity = toLower( verbosity );
27764           if( lcVerbosity == "quiet" )
27765               config.verbosity = Verbosity::Quiet;
27766           else if( lcVerbosity == "normal" )
27767               config.verbosity = Verbosity::Normal;
27768           else if( lcVerbosity == "high" )
```

```
27769                config.verbosity = Verbosity::High;
27770            else
27771                return ParserResult::runtimeError( "Unrecognised verbosity, '" + verbosity + "'" );
27772            return ParserResult::ok( ParseResultType::Matched );
27773        };
27774        auto const setReporter = [&]( std::string const& reporter ) {
27775            IReporterRegistry::FactoryMap const& factories =
      getRegistryHub().getReporterRegistry().getFactories();
27776
27777            auto lcReporter = toLower( reporter );
27778            auto result = factories.find( lcReporter );
27779
27780            if( factories.end() != result )
27781                config.reporterName = lcReporter;
27782            else
27783                return ParserResult::runtimeError( "Unrecognized reporter, '" + reporter + "'. Check
      available with --list-reporters" );
27784            return ParserResult::ok( ParseResultType::Matched );
27785        };
27786
27787        auto cli
27788            = ExeName( config.processName )
27789            | Help( config.showHelp )
27790            | Opt( config.listTests )
27791                ["-l"]["--list-tests"]
27792                ( "list all/matching test cases" )
27793            | Opt( config.listTags )
27794                ["-t"]["--list-tags"]
27795                ( "list all/matching tags" )
27796            | Opt( config.showSuccessfulTests )
27797                ["-s"]["--success"]
27798                ( "include successful tests in output" )
27799            | Opt( config.shouldDebugBreak )
27800                ["-b"]["--break"]
27801                ( "break into debugger on failure" )
27802            | Opt( config.noThrow )
27803                ["-e"]["--nothrow"]
27804                ( "skip exception tests" )
27805            | Opt( config.showInvisibles )
27806                ["-i"]["--invisibles"]
27807                ( "show invisibles (tabs, newlines)" )
27808            | Opt( config.outputFilename, "filename" )
27809                ["-o"]["--out"]
27810                ( "output filename" )
27811            | Opt( setReporter, "name" )
27812                ["-r"]["--reporter"]
27813                ( "reporter to use (defaults to console)" )
27814            | Opt( config.name, "name" )
27815                ["-n"]["--name"]
27816                ( "suite name" )
27817            | Opt( [&]( bool ){ config.abortAfter = 1; } )
27818                ["-a"]["--abort"]
27819                ( "abort at first failure" )
27820            | Opt( [&]( int x ){ config.abortAfter = x; }, "no. failures" )
27821                ["-x"]["--abortx"]
27822                ( "abort after x failures" )
27823            | Opt( setWarning, "warning name" )
27824                ["-w"]["--warn"]
27825                ( "enable warnings" )
27826            | Opt( [&]( bool flag ) { config.showDurations = flag ? ShowDurations::Always :
      ShowDurations::Never; }, "yes|no" )
27827                ["-d"]["--durations"]
27828                ( "show test durations" )
27829            | Opt( config.minDuration, "seconds" )
27830                ["-D"]["--min-duration"]
27831                ( "show test durations for tests taking at least the given number of seconds" )
27832            | Opt( loadTestNamesFromFile, "filename" )
27833                ["-f"]["--input-file"]
27834                ( "load test names to run from a file" )
27835            | Opt( config.filenamesAsTags )
27836                ["-#"]["--filenames-as-tags"]
27837                ( "adds a tag for the filename" )
27838            | Opt( config.sectionsToRun, "section name" )
27839                ["-c"]["--section"]
27840                ( "specify section to run" )
27841            | Opt( setVerbosity, "quiet|normal|high" )
27842                ["-v"]["--verbosity"]
27843                ( "set output verbosity" )
27844            | Opt( config.listTestNamesOnly )
27845                ["--list-test-names-only"]
27846                ( "list all/matching test cases names only" )
27847            | Opt( config.listReporters )
27848                ["--list-reporters"]
27849                ( "list all reporters" )
27850            | Opt( setTestOrder, "decl|lex|rand" )
27851                ["--order"]
27852                ( "test case order (defaults to decl)" )
```

```
27853             | Opt( setRngSeed, "'time'|number" )
27854                 ["--rng-seed"]
27855                 ( "set a specific seed for random numbers" )
27856             | Opt( setColourUsage, "yes|no" )
27857                 ["--use-colour"]
27858                 ( "should output be colourised" )
27859             | Opt( config.libIdentify )
27860                 ["--libidentify"]
27861                 ( "report name and version according to libidentify standard" )
27862             | Opt( setWaitForKeypress, "never|start|exit|both" )
27863                 ["--wait-for-keypress"]
27864                 ( "waits for a keypress before exiting" )
27865             | Opt( config.benchmarkSamples, "samples" )
27866                 ["--benchmark-samples"]
27867                 ( "number of samples to collect (default: 100)" )
27868             | Opt( config.benchmarkResamples, "resamples" )
27869                 ["--benchmark-resamples"]
27870                 ( "number of resamples for the bootstrap (default: 100000)" )
27871             | Opt( config.benchmarkConfidenceInterval, "confidence interval" )
27872                 ["--benchmark-confidence-interval"]
27873                 ( "confidence interval for the bootstrap (between 0 and 1, default: 0.95)" )
27874             | Opt( config.benchmarkNoAnalysis )
27875                 ["--benchmark-no-analysis"]
27876                 ( "perform only measurements; do not perform any analysis" )
27877             | Opt( config.benchmarkWarmupTime, "benchmarkWarmupTime" )
27878                 ["--benchmark-warmup-time"]
27879                 ( "amount of time in milliseconds spent on warming up each test (default: 100)" )
27880             | Arg( config.testsOrTags, "test name|pattern|tags" )
27881                 ( "which test or tests to use" );
27882
27883         return cli;
27884     }
27885
27886 } // end namespace Catch
27887 // end catch_commandline.cpp
27888 // start catch_common.cpp
27889
27890 #include <cstring>
27891 #include <ostream>
27892
27893 namespace Catch {
27894
27895     bool SourceLineInfo::operator == ( SourceLineInfo const& other ) const noexcept {
27896         return line == other.line && (file == other.file || std::strcmp(file, other.file) == 0);
27897     }
27898     bool SourceLineInfo::operator < ( SourceLineInfo const& other ) const noexcept {
27899         // We can assume that the same file will usually have the same pointer.
27900         // Thus, if the pointers are the same, there is no point in calling the strcmp
27901         return line < other.line || ( line == other.line && file != other.file && (std::strcmp(file,
      other.file) < 0));
27902     }
27903
27904     std::ostream& operator « ( std::ostream& os, SourceLineInfo const& info ) {
27905 #ifndef __GNUG__
27906         os « info.file « '(' « info.line « ')';
27907 #else
27908         os « info.file « ':' « info.line;
27909 #endif
27910         return os;
27911     }
27912
27913     std::string StreamEndStop::operator+() const {
27914         return std::string();
27915     }
27916
27917     NonCopyable::NonCopyable() = default;
27918     NonCopyable::~NonCopyable() = default;
27919
27920 }
27921 // end catch_common.cpp
27922 // start catch_config.cpp
27923
27924 namespace Catch {
27925
27926     Config::Config( ConfigData const& data )
27927     :   m_data( data ),
27928         m_stream( openStream() )
27929     {
27930         // We need to trim filter specs to avoid trouble with superfluous
27931         // whitespace (esp. important for bdd macros, as those are manually
27932         // aligned with whitespace).
27933
27934         for (auto& elem : m_data.testsOrTags) {
27935             elem = trim(elem);
27936         }
27937         for (auto& elem : m_data.sectionsToRun) {
27938             elem = trim(elem);
```

```
27939         }
27940
27941         TestSpecParser parser(ITagAliasRegistry::get());
27942         if (!m_data.testsOrTags.empty()) {
27943             m_hasTestFilters = true;
27944             for (auto const& testOrTags : m_data.testsOrTags) {
27945                 parser.parse(testOrTags);
27946             }
27947         }
27948         m_testSpec = parser.testSpec();
27949     }
27950
27951     std::string const& Config::getFilename() const {
27952         return m_data.outputFilename ;
27953     }
27954
27955     bool Config::listTests() const          { return m_data.listTests; }
27956     bool Config::listTestNamesOnly() const  { return m_data.listTestNamesOnly; }
27957     bool Config::listTags() const           { return m_data.listTags; }
27958     bool Config::listReporters() const      { return m_data.listReporters; }
27959
27960     std::string Config::getProcessName() const { return m_data.processName; }
27961     std::string const& Config::getReporterName() const { return m_data.reporterName; }
27962
27963     std::vector<std::string> const& Config::getTestsOrTags() const { return m_data.testsOrTags; }
27964     std::vector<std::string> const& Config::getSectionsToRun() const { return m_data.sectionsToRun; }
27965
27966     TestSpec const& Config::testSpec() const { return m_testSpec; }
27967     bool Config::hasTestFilters() const { return m_hasTestFilters; }
27968
27969     bool Config::showHelp() const { return m_data.showHelp; }
27970
27971     // IConfig interface
27972     bool Config::allowThrows() const                   { return !m_data.noThrow; }
27973     std::ostream& Config::stream() const               { return m_stream->stream(); }
27974     std::string Config::name() const                   { return m_data.name.empty() ?
      m_data.processName : m_data.name; }
27975     bool Config::includeSuccessfulResults() const      { return m_data.showSuccessfulTests; }
27976     bool Config::warnAboutMissingAssertions() const    { return !!(m_data.warnings &
      WarnAbout::NoAssertions); }
27977     bool Config::warnAboutNoTests() const              { return !!(m_data.warnings &
      WarnAbout::NoTests); }
27978     ShowDurations::OrNot Config::showDurations() const { return m_data.showDurations; }
27979     double Config::minDuration() const                 { return m_data.minDuration; }
27980     RunTests::InWhatOrder Config::runOrder() const     { return m_data.runOrder; }
27981     unsigned int Config::rngSeed() const               { return m_data.rngSeed; }
27982     UseColour::YesOrNo Config::useColour() const       { return m_data.useColour; }
27983     bool Config::shouldDebugBreak() const              { return m_data.shouldDebugBreak; }
27984     int Config::abortAfter() const                     { return m_data.abortAfter; }
27985     bool Config::showInvisibles() const                { return m_data.showInvisibles; }
27986     Verbosity Config::verbosity() const                { return m_data.verbosity; }
27987
27988     bool Config::benchmarkNoAnalysis() const                       { return m_data.benchmarkNoAnalysis;
      }
27989     int Config::benchmarkSamples() const                           { return m_data.benchmarkSamples; }
27990     double Config::benchmarkConfidenceInterval() const             { return
      m_data.benchmarkConfidenceInterval; }
27991     unsigned int Config::benchmarkResamples() const                { return m_data.benchmarkResamples;
      }
27992     std::chrono::milliseconds Config::benchmarkWarmupTime() const { return
      std::chrono::milliseconds(m_data.benchmarkWarmupTime); }
27993
27994     IStream const* Config::openStream() {
27995         return Catch::makeStream(m_data.outputFilename);
27996     }
27997
27998 } // end namespace Catch
27999 // end catch_config.cpp
28000 // start catch_console_colour.cpp
28001
28002 #if defined(__clang__)
28003 #    pragma clang diagnostic push
28004 #    pragma clang diagnostic ignored "-Wexit-time-destructors"
28005 #endif
28006
28007 // start catch_errno_guard.h
28008
28009 namespace Catch {
28010
28011     class ErrnoGuard {
28012     public:
28013         ErrnoGuard();
28014         ~ErrnoGuard();
28015     private:
28016         int m_oldErrno;
28017     };
28018
```

```
28019 }
28020
28021 // end catch_errno_guard.h
28022 // start catch_windows_h_proxy.h
28023
28024
28025 #if defined(CATCH_PLATFORM_WINDOWS)
28026
28027 #if !defined(NOMINMAX) && !defined(CATCH_CONFIG_NO_NOMINMAX)
28028 #  define CATCH_DEFINED_NOMINMAX
28029 #  define NOMINMAX
28030 #endif
28031 #if !defined(WIN32_LEAN_AND_MEAN) && !defined(CATCH_CONFIG_NO_WIN32_LEAN_AND_MEAN)
28032 #  define CATCH_DEFINED_WIN32_LEAN_AND_MEAN
28033 #  define WIN32_LEAN_AND_MEAN
28034 #endif
28035
28036 #ifdef __AFXDLL
28037 #include <AfxWin.h>
28038 #else
28039 #include <windows.h>
28040 #endif
28041
28042 #ifdef CATCH_DEFINED_NOMINMAX
28043 #  undef NOMINMAX
28044 #endif
28045 #ifdef CATCH_DEFINED_WIN32_LEAN_AND_MEAN
28046 #  undef WIN32_LEAN_AND_MEAN
28047 #endif
28048
28049 #endif // defined(CATCH_PLATFORM_WINDOWS)
28050
28051 // end catch_windows_h_proxy.h
28052 #include <sstream>
28053
28054 namespace Catch {
28055     namespace {
28056
28057         struct IColourImpl {
28058             virtual ~IColourImpl() = default;
28059             virtual void use( Colour::Code _colourCode ) = 0;
28060         };
28061
28062         struct NoColourImpl : IColourImpl {
28063             void use( Colour::Code ) override {}
28064
28065             static IColourImpl* instance() {
28066                 static NoColourImpl s_instance;
28067                 return &s_instance;
28068             }
28069         };
28070
28071     } // anon namespace
28072 } // namespace Catch
28073
28074 #if !defined( CATCH_CONFIG_COLOUR_NONE ) && !defined( CATCH_CONFIG_COLOUR_WINDOWS ) && !defined(
      CATCH_CONFIG_COLOUR_ANSI )
28075 #   ifdef CATCH_PLATFORM_WINDOWS
28076 #       define CATCH_CONFIG_COLOUR_WINDOWS
28077 #   else
28078 #       define CATCH_CONFIG_COLOUR_ANSI
28079 #   endif
28080 #endif
28081
28082 #if defined ( CATCH_CONFIG_COLOUR_WINDOWS )
28083
28084 namespace Catch {
28085 namespace {
28086
28087     class Win32ColourImpl : public IColourImpl {
28088     public:
28089         Win32ColourImpl() : stdoutHandle( GetStdHandle(STD_OUTPUT_HANDLE) )
28090         {
28091             CONSOLE_SCREEN_BUFFER_INFO csbiInfo;
28092             GetConsoleScreenBufferInfo( stdoutHandle, &csbiInfo );
28093             originalForegroundAttributes = csbiInfo.wAttributes & ~( BACKGROUND_GREEN | BACKGROUND_RED
      | BACKGROUND_BLUE | BACKGROUND_INTENSITY );
28094             originalBackgroundAttributes = csbiInfo.wAttributes & ~( FOREGROUND_GREEN | FOREGROUND_RED
      | FOREGROUND_BLUE | FOREGROUND_INTENSITY );
28095         }
28096
28097         void use( Colour::Code _colourCode ) override {
28098             switch( _colourCode ) {
28099                 case Colour::None:      return setTextAttribute( originalForegroundAttributes );
28100                 case Colour::White:     return setTextAttribute( FOREGROUND_GREEN | FOREGROUND_RED |
      FOREGROUND_BLUE );
28101                 case Colour::Red:       return setTextAttribute( FOREGROUND_RED );
```

```
28102                 case Colour::Green:     return setTextAttribute( FOREGROUND_GREEN );
28103                 case Colour::Blue:      return setTextAttribute( FOREGROUND_BLUE );
28104                 case Colour::Cyan:      return setTextAttribute( FOREGROUND_BLUE | FOREGROUND_GREEN );
28105                 case Colour::Yellow:    return setTextAttribute( FOREGROUND_RED | FOREGROUND_GREEN );
28106                 case Colour::Grey:      return setTextAttribute( 0 );
28107
28108                 case Colour::LightGrey:     return setTextAttribute( FOREGROUND_INTENSITY );
28109                 case Colour::BrightRed:     return setTextAttribute( FOREGROUND_INTENSITY |
      FOREGROUND_RED );
28110                 case Colour::BrightGreen:   return setTextAttribute( FOREGROUND_INTENSITY |
      FOREGROUND_GREEN );
28111                 case Colour::BrightWhite:   return setTextAttribute( FOREGROUND_INTENSITY |
      FOREGROUND_GREEN | FOREGROUND_RED | FOREGROUND_BLUE );
28112                 case Colour::BrightYellow:  return setTextAttribute( FOREGROUND_INTENSITY |
      FOREGROUND_RED | FOREGROUND_GREEN );
28113
28114                 case Colour::Bright: CATCH_INTERNAL_ERROR( "not a colour" );
28115
28116                 default:
28117                     CATCH_ERROR( "Unknown colour requested" );
28118             }
28119         }
28120
28121     private:
28122         void setTextAttribute( WORD _textAttribute ) {
28123             SetConsoleTextAttribute( stdoutHandle, _textAttribute | originalBackgroundAttributes );
28124         }
28125         HANDLE stdoutHandle;
28126         WORD originalForegroundAttributes;
28127         WORD originalBackgroundAttributes;
28128     };
28129
28130     IColourImpl* platformColourInstance() {
28131         static Win32ColourImpl s_instance;
28132
28133         IConfigPtr config = getCurrentContext().getConfig();
28134         UseColour::YesOrNo colourMode = config
28135             ? config->useColour()
28136             : UseColour::Auto;
28137         if( colourMode == UseColour::Auto )
28138             colourMode = UseColour::Yes;
28139         return colourMode == UseColour::Yes
28140             ? &s_instance
28141             : NoColourImpl::instance();
28142     }
28143
28144 } // end anon namespace
28145 } // end namespace Catch
28146
28147 #elif defined( CATCH_CONFIG_COLOUR_ANSI )
28148
28149 #include <unistd.h>
28150
28151 namespace Catch {
28152 namespace {
28153
28154     // use POSIX/ ANSI console terminal codes
28155     // Thanks to Adam Strzelecki for original contribution
28156     // (http://github.com/nanoant)
28157     // https://github.com/philsquared/Catch/pull/131
28158     class PosixColourImpl : public IColourImpl {
28159     public:
28160         void use( Colour::Code _colourCode ) override {
28161             switch( _colourCode ) {
28162                 case Colour::None:
28163                 case Colour::White:     return setColour( "[0m" );
28164                 case Colour::Red:       return setColour( "[0;31m" );
28165                 case Colour::Green:     return setColour( "[0;32m" );
28166                 case Colour::Blue:      return setColour( "[0;34m" );
28167                 case Colour::Cyan:      return setColour( "[0;36m" );
28168                 case Colour::Yellow:    return setColour( "[0;33m" );
28169                 case Colour::Grey:      return setColour( "[1;30m" );
28170
28171                 case Colour::LightGrey:     return setColour( "[0;37m" );
28172                 case Colour::BrightRed:     return setColour( "[1;31m" );
28173                 case Colour::BrightGreen:   return setColour( "[1;32m" );
28174                 case Colour::BrightWhite:   return setColour( "[1;37m" );
28175                 case Colour::BrightYellow:  return setColour( "[1;33m" );
28176
28177                 case Colour::Bright: CATCH_INTERNAL_ERROR( "not a colour" );
28178                 default: CATCH_INTERNAL_ERROR( "Unknown colour requested" );
28179             }
28180         }
28181         static IColourImpl* instance() {
28182             static PosixColourImpl s_instance;
28183             return &s_instance;
28184         }
```

```
28185
28186     private:
28187         void setColour( const char* _escapeCode ) {
28188             getCurrentContext().getConfig()->stream()
28189                 << '\033' << _escapeCode;
28190         }
28191     };
28192
28193     bool useColourOnPlatform() {
28194         return
28195 #if defined(CATCH_PLATFORM_MAC) || defined(CATCH_PLATFORM_IPHONE)
28196             !isDebuggerActive() &&
28197 #endif
28198 #if !(defined(__DJGPP__) && defined(__STRICT_ANSI__))
28199             isatty(STDOUT_FILENO)
28200 #else
28201             false
28202 #endif
28203             ;
28204     }
28205     IColourImpl* platformColourInstance() {
28206         ErrnoGuard guard;
28207         IConfigPtr config = getCurrentContext().getConfig();
28208         UseColour::YesOrNo colourMode = config
28209             ? config->useColour()
28210             : UseColour::Auto;
28211         if( colourMode == UseColour::Auto )
28212             colourMode = useColourOnPlatform()
28213                 ? UseColour::Yes
28214                 : UseColour::No;
28215         return colourMode == UseColour::Yes
28216             ? PosixColourImpl::instance()
28217             : NoColourImpl::instance();
28218     }
28219
28220 } // end anon namespace
28221 } // end namespace Catch
28222
28223 #else  // not Windows or ANSI ///////////////////////////////////////////////
28224
28225 namespace Catch {
28226
28227     static IColourImpl* platformColourInstance() { return NoColourImpl::instance(); }
28228
28229 } // end namespace Catch
28230
28231 #endif // Windows/ ANSI/ None
28232
28233 namespace Catch {
28234
28235     Colour::Colour( Code _colourCode ) { use( _colourCode ); }
28236     Colour::Colour( Colour&& other ) noexcept {
28237         m_moved = other.m_moved;
28238         other.m_moved = true;
28239     }
28240     Colour& Colour::operator=( Colour&& other ) noexcept {
28241         m_moved = other.m_moved;
28242         other.m_moved  = true;
28243         return *this;
28244     }
28245
28246     Colour::~Colour(){ if( !m_moved ) use( None ); }
28247
28248     void Colour::use( Code _colourCode ) {
28249         static IColourImpl* impl = platformColourInstance();
28250         // Strictly speaking, this cannot possibly happen.
28251         // However, under some conditions it does happen (see #1626),
28252         // and this change is small enough that we can let practicality
28253         // triumph over purity in this case.
28254         if (impl != nullptr) {
28255             impl->use( _colourCode );
28256         }
28257     }
28258
28259     std::ostream& operator << ( std::ostream& os, Colour const& ) {
28260         return os;
28261     }
28262
28263 } // end namespace Catch
28264
28265 #if defined(__clang__)
28266 #    pragma clang diagnostic pop
28267 #endif
28268
28269 // end catch_console_colour.cpp
28270 // start catch_context.cpp
28271
```

```
28272 namespace Catch {
28273
28274     class Context : public IMutableContext, NonCopyable {
28275
28276     public: // IContext
28277         IResultCapture* getResultCapture() override {
28278             return m_resultCapture;
28279         }
28280         IRunner* getRunner() override {
28281             return m_runner;
28282         }
28283
28284         IConfigPtr const& getConfig() const override {
28285             return m_config;
28286         }
28287
28288         ~Context() override;
28289
28290     public: // IMutableContext
28291         void setResultCapture( IResultCapture* resultCapture ) override {
28292             m_resultCapture = resultCapture;
28293         }
28294         void setRunner( IRunner* runner ) override {
28295             m_runner = runner;
28296         }
28297         void setConfig( IConfigPtr const& config ) override {
28298             m_config = config;
28299         }
28300
28301         friend IMutableContext& getCurrentMutableContext();
28302
28303     private:
28304         IConfigPtr m_config;
28305         IRunner* m_runner = nullptr;
28306         IResultCapture* m_resultCapture = nullptr;
28307     };
28308
28309     IMutableContext *IMutableContext::currentContext = nullptr;
28310
28311     void IMutableContext::createContext()
28312     {
28313         currentContext = new Context();
28314     }
28315
28316     void cleanUpContext() {
28317         delete IMutableContext::currentContext;
28318         IMutableContext::currentContext = nullptr;
28319     }
28320     IContext::~IContext() = default;
28321     IMutableContext::~IMutableContext() = default;
28322     Context::~Context() = default;
28323
28324     SimplePcg32& rng() {
28325         static SimplePcg32 s_rng;
28326         return s_rng;
28327     }
28328
28329 }
28330 // end catch_context.cpp
28331 // start catch_debug_console.cpp
28332
28333 // start catch_debug_console.h
28334
28335 #include <string>
28336
28337 namespace Catch {
28338     void writeToDebugConsole( std::string const& text );
28339 }
28340
28341 // end catch_debug_console.h
28342 #if defined(CATCH_CONFIG_ANDROID_LOGWRITE)
28343 #include <android/log.h>
28344
28345     namespace Catch {
28346         void writeToDebugConsole( std::string const& text ) {
28347             __android_log_write( ANDROID_LOG_DEBUG, "Catch", text.c_str() );
28348         }
28349     }
28350
28351 #elif defined(CATCH_PLATFORM_WINDOWS)
28352
28353     namespace Catch {
28354         void writeToDebugConsole( std::string const& text ) {
28355             ::OutputDebugStringA( text.c_str() );
28356         }
28357     }
28358
```

```
28359 #else
28360
28361     namespace Catch {
28362         void writeToDebugConsole( std::string const& text ) {
28363             // !TBD: Need a version for Mac/ XCode and other IDEs
28364             Catch::cout() << text;
28365         }
28366     }
28367
28368 #endif // Platform
28369 // end catch_debug_console.cpp
28370 // start catch_debugger.cpp
28371
28372 #if defined(CATCH_PLATFORM_MAC) || defined(CATCH_PLATFORM_IPHONE)
28373
28374 #  include <cassert>
28375 #  include <sys/types.h>
28376 #  include <unistd.h>
28377 #  include <cstddef>
28378 #  include <ostream>
28379
28380 #ifdef __apple_build_version__
28381     // These headers will only compile with AppleClang (XCode)
28382     // For other compilers (Clang, GCC, ... ) we need to exclude them
28383 #  include <sys/sysctl.h>
28384 #endif
28385
28386     namespace Catch {
28387         #ifdef __apple_build_version__
28388         // The following function is taken directly from the following technical note:
28389         // https://developer.apple.com/library/archive/qa/qa1361/_index.html
28390
28391         // Returns true if the current process is being debugged (either
28392         // running under the debugger or has a debugger attached post facto).
28393         bool isDebuggerActive(){
28394             int                 mib[4];
28395             struct kinfo_proc   info;
28396             std::size_t         size;
28397
28398             // Initialize the flags so that, if sysctl fails for some bizarre
28399             // reason, we get a predictable result.
28400
28401             info.kp_proc.p_flag = 0;
28402
28403             // Initialize mib, which tells sysctl the info we want, in this case
28404             // we're looking for information about a specific process ID.
28405
28406             mib[0] = CTL_KERN;
28407             mib[1] = KERN_PROC;
28408             mib[2] = KERN_PROC_PID;
28409             mib[3] = getpid();
28410
28411             // Call sysctl.
28412
28413             size = sizeof(info);
28414             if( sysctl(mib, sizeof(mib) / sizeof(*mib), &info, &size, nullptr, 0) != 0 ) {
28415                 Catch::cerr() << "\n** Call to sysctl failed - unable to determine if debugger is
      active **\n" << std::endl;
28416                 return false;
28417             }
28418
28419             // We're being debugged if the P_TRACED flag is set.
28420
28421             return ( (info.kp_proc.p_flag & P_TRACED) != 0 );
28422         }
28423         #else
28424         bool isDebuggerActive() {
28425             // We need to find another way to determine this for non-appleclang compilers on macOS
28426             return false;
28427         }
28428         #endif
28429     } // namespace Catch
28430
28431 #elif defined(CATCH_PLATFORM_LINUX)
28432     #include <fstream>
28433     #include <string>
28434
28435     namespace Catch{
28436         // The standard POSIX way of detecting a debugger is to attempt to
28437         // ptrace() the process, but this needs to be done from a child and not
28438         // this process itself to still allow attaching to this process later
28439         // if wanted, so is rather heavy. Under Linux we have the PID of the
28440         // "debugger" (which doesn't need to be gdb, of course, it could also
28441         // be strace, for example) in /proc/$PID/status, so just get it from
28442         // there instead.
28443         bool isDebuggerActive(){
28444             // Libstdc++ has a bug, where std::ifstream sets errno to 0
```

```
28445             // This way our users can properly assert over errno values
28446             ErrnoGuard guard;
28447             std::ifstream in("/proc/self/status");
28448             for( std::string line; std::getline(in, line); ) {
28449                 static const int PREFIX_LEN = 11;
28450                 if( line.compare(0, PREFIX_LEN, "TracerPid:\t") == 0 ) {
28451                     // We're traced if the PID is not 0 and no other PID starts
28452                     // with 0 digit, so it's enough to check for just a single
28453                     // character.
28454                     return line.length() > PREFIX_LEN && line[PREFIX_LEN] != '0';
28455                 }
28456             }
28457
28458             return false;
28459         }
28460     } // namespace Catch
28461 #elif defined(_MSC_VER)
28462     extern "C" __declspec(dllimport) int __stdcall IsDebuggerPresent();
28463     namespace Catch {
28464         bool isDebuggerActive() {
28465             return IsDebuggerPresent() != 0;
28466         }
28467     }
28468 #elif defined(__MINGW32__)
28469     extern "C" __declspec(dllimport) int __stdcall IsDebuggerPresent();
28470     namespace Catch {
28471         bool isDebuggerActive() {
28472             return IsDebuggerPresent() != 0;
28473         }
28474     }
28475 #else
28476     namespace Catch {
28477        bool isDebuggerActive() { return false; }
28478     }
28479 #endif // Platform
28480 // end catch_debugger.cpp
28481 // start catch_decomposer.cpp
28482
28483 namespace Catch {
28484
28485     ITransientExpression::~ITransientExpression() = default;
28486
28487     void formatReconstructedExpression( std::ostream &os, std::string const& lhs, StringRef op,
      std::string const& rhs ) {
28488         if( lhs.size() + rhs.size() < 40 &&
28489                 lhs.find('\n') == std::string::npos &&
28490                 rhs.find('\n') == std::string::npos )
28491             os « lhs « " " « op « " " « rhs;
28492         else
28493             os « lhs « "\n" « op « "\n" « rhs;
28494     }
28495 }
28496 // end catch_decomposer.cpp
28497 // start catch_enforce.cpp
28498
28499 #include <stdexcept>
28500
28501 namespace Catch {
28502 #if defined(CATCH_CONFIG_DISABLE_EXCEPTIONS) &&
      !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS_CUSTOM_HANDLER)
28503     [[noreturn]]
28504     void throw_exception(std::exception const& e) {
28505         Catch::cerr() « "Catch will terminate because it needed to throw an exception.\n"
28506                       « "The message was: " « e.what() « '\n';
28507         std::terminate();
28508     }
28509 #endif
28510
28511     [[noreturn]]
28512     void throw_logic_error(std::string const& msg) {
28513         throw_exception(std::logic_error(msg));
28514     }
28515
28516     [[noreturn]]
28517     void throw_domain_error(std::string const& msg) {
28518         throw_exception(std::domain_error(msg));
28519     }
28520
28521     [[noreturn]]
28522     void throw_runtime_error(std::string const& msg) {
28523         throw_exception(std::runtime_error(msg));
28524     }
28525
28526 } // namespace Catch;
28527 // end catch_enforce.cpp
28528 // start catch_enum_values_registry.cpp
28529 // start catch_enum_values_registry.h
```

```
28530
28531 #include <vector>
28532 #include <memory>
28533
28534 namespace Catch {
28535
28536     namespace Detail {
28537
28538         std::unique_ptr<EnumInfo> makeEnumInfo( StringRef enumName, StringRef allValueNames,
      std::vector<int> const& values );
28539
28540         class EnumValuesRegistry : public IMutableEnumValuesRegistry {
28541
28542             std::vector<std::unique_ptr<EnumInfo» m_enumInfos;
28543
28544             EnumInfo const& registerEnum( StringRef enumName, StringRef allEnums, std::vector<int>
      const& values) override;
28545         };
28546
28547         std::vector<StringRef> parseEnums( StringRef enums );
28548
28549     } // Detail
28550
28551 } // Catch
28552
28553 // end catch_enum_values_registry.h
28554
28555 #include <map>
28556 #include <cassert>
28557
28558 namespace Catch {
28559
28560     IMutableEnumValuesRegistry::~IMutableEnumValuesRegistry() {}
28561
28562     namespace Detail {
28563
28564         namespace {
28565             // Extracts the actual name part of an enum instance
28566             // In other words, it returns the Blue part of Bikeshed::Colour::Blue
28567             StringRef extractInstanceName(StringRef enumInstance) {
28568                 // Find last occurrence of ":"
28569                 size_t name_start = enumInstance.size();
28570                 while (name_start > 0 && enumInstance[name_start - 1] != ':') {
28571                     --name_start;
28572                 }
28573                 return enumInstance.substr(name_start, enumInstance.size() - name_start);
28574             }
28575         }
28576
28577         std::vector<StringRef> parseEnums( StringRef enums ) {
28578             auto enumValues = splitStringRef( enums, ',' );
28579             std::vector<StringRef> parsed;
28580             parsed.reserve( enumValues.size() );
28581             for( auto const& enumValue : enumValues ) {
28582                 parsed.push_back(trim(extractInstanceName(enumValue)));
28583             }
28584             return parsed;
28585         }
28586
28587         EnumInfo::~EnumInfo() {}
28588
28589         StringRef EnumInfo::lookup( int value ) const {
28590             for( auto const& valueToName : m_values ) {
28591                 if( valueToName.first == value )
28592                     return valueToName.second;
28593             }
28594             return "{** unexpected enum value **}"_sr;
28595         }
28596
28597         std::unique_ptr<EnumInfo> makeEnumInfo( StringRef enumName, StringRef allValueNames,
      std::vector<int> const& values ) {
28598             std::unique_ptr<EnumInfo> enumInfo( new EnumInfo );
28599             enumInfo->m_name = enumName;
28600             enumInfo->m_values.reserve( values.size() );
28601
28602             const auto valueNames = Catch::Detail::parseEnums( allValueNames );
28603             assert( valueNames.size() == values.size() );
28604             std::size_t i = 0;
28605             for( auto value : values )
28606                 enumInfo->m_values.emplace_back(value, valueNames[i++]);
28607
28608             return enumInfo;
28609         }
28610
28611         EnumInfo const& EnumValuesRegistry::registerEnum( StringRef enumName, StringRef allValueNames,
      std::vector<int> const& values ) {
28612             m_enumInfos.push_back(makeEnumInfo(enumName, allValueNames, values));
```

```
28613             return *m_enumInfos.back();
28614         }
28615
28616     } // Detail
28617 } // Catch
28618
28619 // end catch_enum_values_registry.cpp
28620 // start catch_errno_guard.cpp
28621
28622 #include <cerrno>
28623
28624 namespace Catch {
28625         ErrnoGuard::ErrnoGuard():m_oldErrno(errno){}
28626         ErrnoGuard::~ErrnoGuard() { errno = m_oldErrno; }
28627 }
28628 // end catch_errno_guard.cpp
28629 // start catch_exception_translator_registry.cpp
28630
28631 // start catch_exception_translator_registry.h
28632
28633 #include <vector>
28634 #include <string>
28635 #include <memory>
28636
28637 namespace Catch {
28638
28639     class ExceptionTranslatorRegistry : public IExceptionTranslatorRegistry {
28640     public:
28641         ~ExceptionTranslatorRegistry();
28642         virtual void registerTranslator( const IExceptionTranslator* translator );
28643         std::string translateActiveException() const override;
28644         std::string tryTranslators() const;
28645
28646     private:
28647         std::vector<std::unique_ptr<IExceptionTranslator const» m_translators;
28648     };
28649 }
28650
28651 // end catch_exception_translator_registry.h
28652 #ifdef __OBJC__
28653 #import "Foundation/Foundation.h"
28654 #endif
28655
28656 namespace Catch {
28657
28658     ExceptionTranslatorRegistry::~ExceptionTranslatorRegistry() {
28659     }
28660
28661     void ExceptionTranslatorRegistry::registerTranslator( const IExceptionTranslator* translator ) {
28662         m_translators.push_back( std::unique_ptr<const IExceptionTranslator>( translator ) );
28663     }
28664
28665 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
28666     std::string ExceptionTranslatorRegistry::translateActiveException() const {
28667         try {
28668 #ifdef __OBJC__
28669             // In Objective-C try objective-c exceptions first
28670             @try {
28671                 return tryTranslators();
28672             }
28673             @catch (NSException *exception) {
28674                 return Catch::Detail::stringify( [exception description] );
28675             }
28676 #else
28677             // Compiling a mixed mode project with MSVC means that CLR
28678             // exceptions will be caught in (...) as well. However, these
28679             // do not fill-in std::current_exception and thus lead to crash
28680             // when attempting rethrow.
28681             // /EHa switch also causes structured exceptions to be caught
28682             // here, but they fill-in current_exception properly, so
28683             // at worst the output should be a little weird, instead of
28684             // causing a crash.
28685             if (std::current_exception() == nullptr) {
28686                 return "Non C++ exception. Possibly a CLR exception.";
28687             }
28688             return tryTranslators();
28689 #endif
28690         }
28691         catch( TestFailureException& ) {
28692             std::rethrow_exception(std::current_exception());
28693         }
28694         catch( std::exception& ex ) {
28695             return ex.what();
28696         }
28697         catch( std::string& msg ) {
28698             return msg;
28699         }
```

```
28700         catch( const char* msg ) {
28701             return msg;
28702         }
28703         catch(...) {
28704             return "Unknown exception";
28705         }
28706     }
28707
28708     std::string ExceptionTranslatorRegistry::tryTranslators() const {
28709         if (m_translators.empty()) {
28710             std::rethrow_exception(std::current_exception());
28711         } else {
28712             return m_translators[0]->translate(m_translators.begin() + 1, m_translators.end());
28713         }
28714     }
28715
28716 #else // ^^ Exceptions are enabled // Exceptions are disabled vv
28717     std::string ExceptionTranslatorRegistry::translateActiveException() const {
28718         CATCH_INTERNAL_ERROR("Attempted to translate active exception under
    CATCH_CONFIG_DISABLE_EXCEPTIONS!");
28719     }
28720
28721     std::string ExceptionTranslatorRegistry::tryTranslators() const {
28722         CATCH_INTERNAL_ERROR("Attempted to use exception translators under
    CATCH_CONFIG_DISABLE_EXCEPTIONS!");
28723     }
28724 #endif
28725
28726 }
28727 // end catch_exception_translator_registry.cpp
28728 // start catch_fatal_condition.cpp
28729
28730 #include <algorithm>
28731
28732 #if !defined( CATCH_CONFIG_WINDOWS_SEH ) && !defined( CATCH_CONFIG_POSIX_SIGNALS )
28733
28734 namespace Catch {
28735
28736     // If neither SEH nor signal handling is required, the handler impls
28737     // do not have to do anything, and can be empty.
28738     void FatalConditionHandler::engage_platform() {}
28739     void FatalConditionHandler::disengage_platform() {}
28740     FatalConditionHandler::FatalConditionHandler() = default;
28741     FatalConditionHandler::~FatalConditionHandler() = default;
28742
28743 } // end namespace Catch
28744
28745 #endif // !CATCH_CONFIG_WINDOWS_SEH && !CATCH_CONFIG_POSIX_SIGNALS
28746
28747 #if defined( CATCH_CONFIG_WINDOWS_SEH ) && defined( CATCH_CONFIG_POSIX_SIGNALS )
28748 #error "Inconsistent configuration: Windows' SEH handling and POSIX signals cannot be enabled at the
    same time"
28749 #endif // CATCH_CONFIG_WINDOWS_SEH && CATCH_CONFIG_POSIX_SIGNALS
28750
28751 #if defined( CATCH_CONFIG_WINDOWS_SEH ) || defined( CATCH_CONFIG_POSIX_SIGNALS )
28752
28753 namespace {
28755     void reportFatal( char const * const message ) {
28756         Catch::getCurrentContext().getResultCapture()->handleFatalErrorCondition( message );
28757     }
28758
28762     constexpr std::size_t minStackSizeForErrors = 32 * 1024;
28763 } // end unnamed namespace
28764
28765 #endif // CATCH_CONFIG_WINDOWS_SEH || CATCH_CONFIG_POSIX_SIGNALS
28766
28767 #if defined( CATCH_CONFIG_WINDOWS_SEH )
28768
28769 namespace Catch {
28770
28771     struct SignalDefs { DWORD id; const char* name; };
28772
28773     // There is no 1-1 mapping between signals and windows exceptions.
28774     // Windows can easily distinguish between SO and SigSegV,
28775     // but SigInt, SigTerm, etc are handled differently.
28776     static SignalDefs signalDefs[] = {
28777         { static_cast<DWORD>(EXCEPTION_ILLEGAL_INSTRUCTION),  "SIGILL - Illegal instruction signal" },
28778         { static_cast<DWORD>(EXCEPTION_STACK_OVERFLOW), "SIGSEGV - Stack overflow" },
28779         { static_cast<DWORD>(EXCEPTION_ACCESS_VIOLATION), "SIGSEGV - Segmentation violation signal" },
28780         { static_cast<DWORD>(EXCEPTION_INT_DIVIDE_BY_ZERO), "Divide by zero error" },
28781     };
28782
28783     static LONG CALLBACK handleVectoredException(PEXCEPTION_POINTERS ExceptionInfo) {
28784         for (auto const& def : signalDefs) {
28785             if (ExceptionInfo->ExceptionRecord->ExceptionCode == def.id) {
28786                 reportFatal(def.name);
28787             }
```

```
28788         }
28789         // If its not an exception we care about, pass it along.
28790         // This stops us from eating debugger breaks etc.
28791         return EXCEPTION_CONTINUE_SEARCH;
28792     }
28793
28794     // Since we do not support multiple instantiations, we put these
28795     // into global variables and rely on cleaning them up in outlined
28796     // constructors/destructors
28797     static PVOID exceptionHandlerHandle = nullptr;
28798
28799     // For MSVC, we reserve part of the stack memory for handling
28800     // memory overflow structured exception.
28801     FatalConditionHandler::FatalConditionHandler() {
28802         ULONG guaranteeSize = static_cast<ULONG>(minStackSizeForErrors);
28803         if (!SetThreadStackGuarantee(&guaranteeSize)) {
28804             // We do not want to fully error out, because needing
28805             // the stack reserve should be rare enough anyway.
28806             Catch::cerr()
28807                 << "Failed to reserve piece of stack."
28808                 << " Stack overflows will not be reported successfully.";
28809         }
28810     }
28811
28812     // We do not attempt to unset the stack guarantee, because
28813     // Windows does not support lowering the stack size guarantee.
28814     FatalConditionHandler::~FatalConditionHandler() = default;
28815
28816     void FatalConditionHandler::engage_platform() {
28817         // Register as first handler in current chain
28818         exceptionHandlerHandle = AddVectoredExceptionHandler(1, handleVectoredException);
28819         if (!exceptionHandlerHandle) {
28820             CATCH_RUNTIME_ERROR("Could not register vectored exception handler");
28821         }
28822     }
28823
28824     void FatalConditionHandler::disengage_platform() {
28825         if (!RemoveVectoredExceptionHandler(exceptionHandlerHandle)) {
28826             CATCH_RUNTIME_ERROR("Could not unregister vectored exception handler");
28827         }
28828         exceptionHandlerHandle = nullptr;
28829     }
28830
28831 } // end namespace Catch
28832
28833 #endif // CATCH_CONFIG_WINDOWS_SEH
28834
28835 #if defined( CATCH_CONFIG_POSIX_SIGNALS )
28836
28837 #include <signal.h>
28838
28839 namespace Catch {
28840
28841     struct SignalDefs {
28842         int id;
28843         const char* name;
28844     };
28845
28846     static SignalDefs signalDefs[] = {
28847         { SIGINT,  "SIGINT - Terminal interrupt signal" },
28848         { SIGILL,  "SIGILL - Illegal instruction signal" },
28849         { SIGFPE,  "SIGFPE - Floating point error signal" },
28850         { SIGSEGV, "SIGSEGV - Segmentation violation signal" },
28851         { SIGTERM, "SIGTERM - Termination request signal" },
28852         { SIGABRT, "SIGABRT - Abort (abnormal termination) signal" }
28853     };
28854
28855 // Older GCCs trigger -Wmissing-field-initializers for T foo = {}
28856 // which is zero initialization, but not explicit. We want to avoid
28857 // that.
28858 #if defined(__GNUC__)
28859 #    pragma GCC diagnostic push
28860 #    pragma GCC diagnostic ignored "-Wmissing-field-initializers"
28861 #endif
28862
28863     static char* altStackMem = nullptr;
28864     static std::size_t altStackSize = 0;
28865     static stack_t oldSigStack{};
28866     static struct sigaction oldSigActions[sizeof(signalDefs) / sizeof(SignalDefs)]{};
28867
28868     static void restorePreviousSignalHandlers() {
28869         // We set signal handlers back to the previous ones. Hopefully
28870         // nobody overwrote them in the meantime, and doesn't expect
28871         // their signal handlers to live past ours given that they
28872         // installed them after ours..
28873         for (std::size_t i = 0; i < sizeof(signalDefs) / sizeof(SignalDefs); ++i) {
28874             sigaction(signalDefs[i].id, &oldSigActions[i], nullptr);
```

```
28875         }
28876         // Return the old stack
28877         sigaltstack(&oldSigStack, nullptr);
28878     }
28879
28880     static void handleSignal( int sig ) {
28881         char const * name = "<unknown signal>";
28882         for (auto const& def : signalDefs) {
28883             if (sig == def.id) {
28884                 name = def.name;
28885                 break;
28886             }
28887         }
28888         // We need to restore previous signal handlers and let them do
28889         // their thing, so that the users can have the debugger break
28890         // when a signal is raised, and so on.
28891         restorePreviousSignalHandlers();
28892         reportFatal( name );
28893         raise( sig );
28894     }
28895
28896     FatalConditionHandler::FatalConditionHandler() {
28897         assert(!altStackMem && "Cannot initialize POSIX signal handler when one already exists");
28898         if (altStackSize == 0) {
28899             altStackSize = std::max(static_cast<size_t>(SIGSTKSZ), minStackSizeForErrors);
28900         }
28901         altStackMem = new char[altStackSize]();
28902     }
28903
28904     FatalConditionHandler::~FatalConditionHandler() {
28905         delete[] altStackMem;
28906         // We signal that another instance can be constructed by zeroing
28907         // out the pointer.
28908         altStackMem = nullptr;
28909     }
28910
28911     void FatalConditionHandler::engage_platform() {
28912         stack_t sigStack;
28913         sigStack.ss_sp = altStackMem;
28914         sigStack.ss_size = altStackSize;
28915         sigStack.ss_flags = 0;
28916         sigaltstack(&sigStack, &oldSigStack);
28917         struct sigaction sa = { };
28918
28919         sa.sa_handler = handleSignal;
28920         sa.sa_flags = SA_ONSTACK;
28921         for (std::size_t i = 0; i < sizeof(signalDefs)/sizeof(SignalDefs); ++i) {
28922             sigaction(signalDefs[i].id, &sa, &oldSigActions[i]);
28923         }
28924     }
28925
28926 #if defined(__GNUC__)
28927 #    pragma GCC diagnostic pop
28928 #endif
28929
28930     void FatalConditionHandler::disengage_platform() {
28931         restorePreviousSignalHandlers();
28932     }
28933
28934 } // end namespace Catch
28935
28936 #endif // CATCH_CONFIG_POSIX_SIGNALS
28937 // end catch_fatal_condition.cpp
28938 // start catch_generators.cpp
28939
28940 #include <limits>
28941 #include <set>
28942
28943 namespace Catch {
28944
28945 IGeneratorTracker::~IGeneratorTracker() {}
28946
28947 const char* GeneratorException::what() const noexcept {
28948     return m_msg;
28949 }
28950
28951 namespace Generators {
28952
28953     GeneratorUntypedBase::~GeneratorUntypedBase() {}
28954
28955     auto acquireGeneratorTracker( StringRef generatorName, SourceLineInfo const& lineInfo ) ->
    IGeneratorTracker& {
28956         return getResultCapture().acquireGeneratorTracker( generatorName, lineInfo );
28957     }
28958
28959 } // namespace Generators
28960 } // namespace Catch
```

```
28961 // end catch_generators.cpp
28962 // start catch_interfaces_capture.cpp
28963
28964 namespace Catch {
28965     IResultCapture::~IResultCapture() = default;
28966 }
28967 // end catch_interfaces_capture.cpp
28968 // start catch_interfaces_config.cpp
28969
28970 namespace Catch {
28971     IConfig::~IConfig() = default;
28972 }
28973 // end catch_interfaces_config.cpp
28974 // start catch_interfaces_exception.cpp
28975
28976 namespace Catch {
28977     IExceptionTranslator::~IExceptionTranslator() = default;
28978     IExceptionTranslatorRegistry::~IExceptionTranslatorRegistry() = default;
28979 }
28980 // end catch_interfaces_exception.cpp
28981 // start catch_interfaces_registry_hub.cpp
28982
28983 namespace Catch {
28984     IRegistryHub::~IRegistryHub() = default;
28985     IMutableRegistryHub::~IMutableRegistryHub() = default;
28986 }
28987 // end catch_interfaces_registry_hub.cpp
28988 // start catch_interfaces_reporter.cpp
28989
28990 // start catch_reporter_listening.h
28991
28992 namespace Catch {
28993
28994     class ListeningReporter : public IStreamingReporter {
28995         using Reporters = std::vector<IStreamingReporterPtr>;
28996         Reporters m_listeners;
28997         IStreamingReporterPtr m_reporter = nullptr;
28998         ReporterPreferences m_preferences;
28999
29000     public:
29001         ListeningReporter();
29002
29003         void addListener( IStreamingReporterPtr&& listener );
29004         void addReporter( IStreamingReporterPtr&& reporter );
29005
29006     public: // IStreamingReporter
29007
29008         ReporterPreferences getPreferences() const override;
29009
29010         void noMatchingTestCases( std::string const& spec ) override;
29011
29012         void reportInvalidArguments(std::string const&arg) override;
29013
29014         static std::set<Verbosity> getSupportedVerbosities();
29015
29016 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
29017         void benchmarkPreparing(std::string const& name) override;
29018         void benchmarkStarting( BenchmarkInfo const& benchmarkInfo ) override;
29019         void benchmarkEnded( BenchmarkStats<> const& benchmarkStats ) override;
29020         void benchmarkFailed(std::string const&) override;
29021 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
29022
29023         void testRunStarting( TestRunInfo const& testRunInfo ) override;
29024         void testGroupStarting( GroupInfo const& groupInfo ) override;
29025         void testCaseStarting( TestCaseInfo const& testInfo ) override;
29026         void sectionStarting( SectionInfo const& sectionInfo ) override;
29027         void assertionStarting( AssertionInfo const& assertionInfo ) override;
29028
29029         // The return value indicates if the messages buffer should be cleared:
29030         bool assertionEnded( AssertionStats const& assertionStats ) override;
29031         void sectionEnded( SectionStats const& sectionStats ) override;
29032         void testCaseEnded( TestCaseStats const& testCaseStats ) override;
29033         void testGroupEnded( TestGroupStats const& testGroupStats ) override;
29034         void testRunEnded( TestRunStats const& testRunStats ) override;
29035
29036         void skipTest( TestCaseInfo const& testInfo ) override;
29037         bool isMulti() const override;
29038
29039     };
29040
29041 } // end namespace Catch
29042
29043 // end catch_reporter_listening.h
29044 namespace Catch {
29045
29046     ReporterConfig::ReporterConfig( IConfigPtr const& _fullConfig )
29047     :   m_stream( &_fullConfig->stream() ), m_fullConfig( _fullConfig ) {}
```

```
29048
29049     ReporterConfig::ReporterConfig( IConfigPtr const& _fullConfig, std::ostream& _stream )
29050     :   m_stream( &_stream ), m_fullConfig( _fullConfig ) {}
29051
29052     std::ostream& ReporterConfig::stream() const { return *m_stream; }
29053     IConfigPtr ReporterConfig::fullConfig() const { return m_fullConfig; }
29054
29055     TestRunInfo::TestRunInfo( std::string const& _name ) : name( _name ) {}
29056
29057     GroupInfo::GroupInfo(  std::string const& _name,
29058                            std::size_t _groupIndex,
29059                            std::size_t _groupsCount )
29060     :   name( _name ),
29061         groupIndex( _groupIndex ),
29062         groupsCounts( _groupsCount )
29063     {}
29064
29065      AssertionStats::AssertionStats( AssertionResult const& _assertionResult,
29066                                      std::vector<MessageInfo> const& _infoMessages,
29067                                      Totals const& _totals )
29068     :   assertionResult( _assertionResult ),
29069         infoMessages( _infoMessages ),
29070         totals( _totals )
29071     {
29072         assertionResult.m_resultData.lazyExpression.m_transientExpression =
    _assertionResult.m_resultData.lazyExpression.m_transientExpression;
29073
29074         if( assertionResult.hasMessage() ) {
29075             // Copy message into messages list.
29076             // !TBD This should have been done earlier, somewhere
29077             MessageBuilder builder( assertionResult.getTestMacroName(),
    assertionResult.getSourceInfo(), assertionResult.getResultType() );
29078             builder << assertionResult.getMessage();
29079             builder.m_info.message = builder.m_stream.str();
29080
29081             infoMessages.push_back( builder.m_info );
29082         }
29083     }
29084
29085      AssertionStats::~AssertionStats() = default;
29086
29087     SectionStats::SectionStats(  SectionInfo const& _sectionInfo,
29088                                  Counts const& _assertions,
29089                                  double _durationInSeconds,
29090                                  bool _missingAssertions )
29091     :   sectionInfo( _sectionInfo ),
29092         assertions( _assertions ),
29093         durationInSeconds( _durationInSeconds ),
29094         missingAssertions( _missingAssertions )
29095     {}
29096
29097     SectionStats::~SectionStats() = default;
29098
29099     TestCaseStats::TestCaseStats(  TestCaseInfo const& _testInfo,
29100                                    Totals const& _totals,
29101                                    std::string const& _stdOut,
29102                                    std::string const& _stdErr,
29103                                    bool _aborting )
29104     : testInfo( _testInfo ),
29105         totals( _totals ),
29106         stdOut( _stdOut ),
29107         stdErr( _stdErr ),
29108         aborting( _aborting )
29109     {}
29110
29111     TestCaseStats::~TestCaseStats() = default;
29112
29113     TestGroupStats::TestGroupStats( GroupInfo const& _groupInfo,
29114                                     Totals const& _totals,
29115                                     bool _aborting )
29116     :   groupInfo( _groupInfo ),
29117         totals( _totals ),
29118         aborting( _aborting )
29119     {}
29120
29121     TestGroupStats::TestGroupStats( GroupInfo const& _groupInfo )
29122     :   groupInfo( _groupInfo ),
29123         aborting( false )
29124     {}
29125
29126     TestGroupStats::~TestGroupStats() = default;
29127
29128     TestRunStats::TestRunStats(   TestRunInfo const& _runInfo,
29129                     Totals const& _totals,
29130                     bool _aborting )
29131     :   runInfo( _runInfo ),
29132         totals( _totals ),
```

```
29133         aborting( _aborting )
29134     {}
29135
29136     TestRunStats::~TestRunStats() = default;
29137
29138     void IStreamingReporter::fatalErrorEncountered( StringRef ) {}
29139     bool IStreamingReporter::isMulti() const { return false; }
29140
29141     IReporterFactory::~IReporterFactory() = default;
29142     IReporterRegistry::~IReporterRegistry() = default;
29143
29144 } // end namespace Catch
29145 // end catch_interfaces_reporter.cpp
29146 // start catch_interfaces_runner.cpp
29147
29148 namespace Catch {
29149     IRunner::~IRunner() = default;
29150 }
29151 // end catch_interfaces_runner.cpp
29152 // start catch_interfaces_testcase.cpp
29153
29154 namespace Catch {
29155     ITestInvoker::~ITestInvoker() = default;
29156     ITestCaseRegistry::~ITestCaseRegistry() = default;
29157 }
29158 // end catch_interfaces_testcase.cpp
29159 // start catch_leak_detector.cpp
29160
29161 #ifdef CATCH_CONFIG_WINDOWS_CRTDBG
29162 #include <crtdbg.h>
29163
29164 namespace Catch {
29165
29166     LeakDetector::LeakDetector() {
29167         int flag = _CrtSetDbgFlag(_CRTDBG_REPORT_FLAG);
29168         flag |= _CRTDBG_LEAK_CHECK_DF;
29169         flag |= _CRTDBG_ALLOC_MEM_DF;
29170         _CrtSetDbgFlag(flag);
29171         _CrtSetReportMode(_CRT_WARN, _CRTDBG_MODE_FILE | _CRTDBG_MODE_DEBUG);
29172         _CrtSetReportFile(_CRT_WARN, _CRTDBG_FILE_STDERR);
29173         // Change this to leaking allocation's number to break there
29174         _CrtSetBreakAlloc(-1);
29175     }
29176 }
29177
29178 #else
29179
29180     Catch::LeakDetector::LeakDetector() {}
29181
29182 #endif
29183
29184 Catch::LeakDetector::~LeakDetector() {
29185     Catch::cleanUp();
29186 }
29187 // end catch_leak_detector.cpp
29188 // start catch_list.cpp
29189
29190 // start catch_list.h
29191
29192 #include <set>
29193
29194 namespace Catch {
29195
29196     std::size_t listTests( Config const& config );
29197
29198     std::size_t listTestsNamesOnly( Config const& config );
29199
29200     struct TagInfo {
29201         void add( std::string const& spelling );
29202         std::string all() const;
29203
29204         std::set<std::string> spellings;
29205         std::size_t count = 0;
29206     };
29207
29208     std::size_t listTags( Config const& config );
29209
29210     std::size_t listReporters();
29211
29212     Option<std::size_t> list( std::shared_ptr<Config> const& config );
29213
29214 } // end namespace Catch
29215
29216 // end catch_list.h
29217 // start catch_text.h
29218
29219 namespace Catch {
```

```
29220     using namespace clara::TextFlow;
29221 }
29222
29223 // end catch_text.h
29224 #include <limits>
29225 #include <algorithm>
29226 #include <iomanip>
29227
29228 namespace Catch {
29229
29230     std::size_t listTests( Config const& config ) {
29231         TestSpec const& testSpec = config.testSpec();
29232         if( config.hasTestFilters() )
29233             Catch::cout() << "Matching test cases:\n";
29234         else {
29235             Catch::cout() << "All available test cases:\n";
29236         }
29237
29238         auto matchedTestCases = filterTests( getAllTestCasesSorted( config ), testSpec, config );
29239         for( auto const& testCaseInfo : matchedTestCases ) {
29240             Colour::Code colour = testCaseInfo.isHidden()
29241                 ? Colour::SecondaryText
29242                 : Colour::None;
29243             Colour colourGuard( colour );
29244
29245             Catch::cout() << Column( testCaseInfo.name ).initialIndent( 2 ).indent( 4 ) << "\n";
29246             if( config.verbosity() >= Verbosity::High ) {
29247                 Catch::cout() << Column( Catch::Detail::stringify( testCaseInfo.lineInfo ) ).indent(4)
      << std::endl;
29248                 std::string description = testCaseInfo.description;
29249                 if( description.empty() )
29250                     description = "(NO DESCRIPTION)";
29251                 Catch::cout() << Column( description ).indent(4) << std::endl;
29252             }
29253             if( !testCaseInfo.tags.empty() )
29254                 Catch::cout() << Column( testCaseInfo.tagsAsString() ).indent( 6 ) << "\n";
29255         }
29256
29257         if( !config.hasTestFilters() )
29258             Catch::cout() << pluralise( matchedTestCases.size(), "test case" ) << '\n' << std::endl;
29259         else
29260             Catch::cout() << pluralise( matchedTestCases.size(), "matching test case" ) << '\n' <<
      std::endl;
29261         return matchedTestCases.size();
29262     }
29263
29264     std::size_t listTestsNamesOnly( Config const& config ) {
29265         TestSpec const& testSpec = config.testSpec();
29266         std::size_t matchedTests = 0;
29267         std::vector<TestCase> matchedTestCases = filterTests( getAllTestCasesSorted( config ),
      testSpec, config );
29268         for( auto const& testCaseInfo : matchedTestCases ) {
29269             matchedTests++;
29270             if( startsWith( testCaseInfo.name, '#' ) )
29271                Catch::cout() << '"' << testCaseInfo.name << '"';
29272             else
29273                Catch::cout() << testCaseInfo.name;
29274             if ( config.verbosity() >= Verbosity::High )
29275                 Catch::cout() << "\t@" << testCaseInfo.lineInfo;
29276             Catch::cout() << std::endl;
29277         }
29278         return matchedTests;
29279     }
29280
29281     void TagInfo::add( std::string const& spelling ) {
29282         ++count;
29283         spellings.insert( spelling );
29284     }
29285
29286     std::string TagInfo::all() const {
29287         size_t size = 0;
29288         for (auto const& spelling : spellings) {
29289             // Add 2 for the brackes
29290             size += spelling.size() + 2;
29291         }
29292
29293         std::string out; out.reserve(size);
29294         for (auto const& spelling : spellings) {
29295             out += '[';
29296             out += spelling;
29297             out += ']';
29298         }
29299         return out;
29300     }
29301
29302     std::size_t listTags( Config const& config ) {
29303         TestSpec const& testSpec = config.testSpec();
```

```
29304         if( config.hasTestFilters() )
29305             Catch::cout() << "Tags for matching test cases:\n";
29306         else {
29307             Catch::cout() << "All available tags:\n";
29308         }
29309
29310         std::map<std::string, TagInfo> tagCounts;
29311
29312         std::vector<TestCase> matchedTestCases = filterTests( getAllTestCasesSorted( config ),
      testSpec, config );
29313         for( auto const& testCase : matchedTestCases ) {
29314             for( auto const& tagName : testCase.getTestCaseInfo().tags ) {
29315                 std::string lcaseTagName = toLower( tagName );
29316                 auto countIt = tagCounts.find( lcaseTagName );
29317                 if( countIt == tagCounts.end() )
29318                     countIt = tagCounts.insert( std::make_pair( lcaseTagName, TagInfo() ) ).first;
29319                 countIt->second.add( tagName );
29320             }
29321         }
29322
29323         for( auto const& tagCount : tagCounts ) {
29324             ReusableStringStream rss;
29325             rss << "  " << std::setw(2) << tagCount.second.count << "  ";
29326             auto str = rss.str();
29327             auto wrapper = Column( tagCount.second.all() )
29328                                                     .initialIndent( 0 )
29329                                                     .indent( str.size() )
29330                                                     .width( CATCH_CONFIG_CONSOLE_WIDTH-10 );
29331             Catch::cout() << str << wrapper << '\n';
29332         }
29333         Catch::cout() << pluralise( tagCounts.size(), "tag" ) << '\n' << std::endl;
29334         return tagCounts.size();
29335     }
29336
29337     std::size_t listReporters() {
29338         Catch::cout() << "Available reporters:\n";
29339         IReporterRegistry::FactoryMap const& factories =
      getRegistryHub().getReporterRegistry().getFactories();
29340         std::size_t maxNameLen = 0;
29341         for( auto const& factoryKvp : factories )
29342             maxNameLen = (std::max)( maxNameLen, factoryKvp.first.size() );
29343
29344         for( auto const& factoryKvp : factories ) {
29345             Catch::cout()
29346                     << Column( factoryKvp.first + ":" )
29347                             .indent(2)
29348                             .width( 5+maxNameLen )
29349                     +  Column( factoryKvp.second->getDescription() )
29350                             .initialIndent(0)
29351                             .indent(2)
29352                             .width( CATCH_CONFIG_CONSOLE_WIDTH - maxNameLen-8 )
29353                     << "\n";
29354         }
29355         Catch::cout() << std::endl;
29356         return factories.size();
29357     }
29358
29359     Option<std::size_t> list( std::shared_ptr<Config> const& config ) {
29360         Option<std::size_t> listedCount;
29361         getCurrentMutableContext().setConfig( config );
29362         if( config->listTests() )
29363             listedCount = listedCount.valueOr(0) + listTests( *config );
29364         if( config->listTestNamesOnly() )
29365             listedCount = listedCount.valueOr(0) + listTestsNamesOnly( *config );
29366         if( config->listTags() )
29367             listedCount = listedCount.valueOr(0) + listTags( *config );
29368         if( config->listReporters() )
29369             listedCount = listedCount.valueOr(0) + listReporters();
29370         return listedCount;
29371     }
29372
29373 } // end namespace Catch
29374 // end catch_list.cpp
29375 // start catch_matchers.cpp
29376
29377 namespace Catch {
29378 namespace Matchers {
29379     namespace Impl {
29380
29381         std::string MatcherUntypedBase::toString() const {
29382             if( m_cachedToString.empty() )
29383                 m_cachedToString = describe();
29384             return m_cachedToString;
29385         }
29386
29387         MatcherUntypedBase::~MatcherUntypedBase() = default;
29388
```

```
29389     } // namespace Impl
29390 } // namespace Matchers
29391
29392 using namespace Matchers;
29393 using Matchers::Impl::MatcherBase;
29394
29395 } // namespace Catch
29396 // end catch_matchers.cpp
29397 // start catch_matchers_exception.cpp
29398
29399 namespace Catch {
29400 namespace Matchers {
29401 namespace Exception {
29402
29403 bool ExceptionMessageMatcher::match(std::exception const& ex) const {
29404     return ex.what() == m_message;
29405 }
29406
29407 std::string ExceptionMessageMatcher::describe() const {
29408     return "exception message matches \"" + m_message + "\"";
29409 }
29410
29411 }
29412 Exception::ExceptionMessageMatcher Message(std::string const& message) {
29413     return Exception::ExceptionMessageMatcher(message);
29414 }
29415
29416 // namespace Exception
29417 } // namespace Matchers
29418 } // namespace Catch
29419 // end catch_matchers_exception.cpp
29420 // start catch_matchers_floating.cpp
29421
29422 // start catch_polyfills.hpp
29423
29424 namespace Catch {
29425     bool isnan(float f);
29426     bool isnan(double d);
29427 }
29428
29429 // end catch_polyfills.hpp
29430 // start catch_to_string.hpp
29431
29432 #include <string>
29433
29434 namespace Catch {
29435     template <typename T>
29436     std::string to_string(T const& t) {
29437 #if defined(CATCH_CONFIG_CPP11_TO_STRING)
29438         return std::to_string(t);
29439 #else
29440         ReusableStringStream rss;
29441         rss << t;
29442         return rss.str();
29443 #endif
29444     }
29445 } // end namespace Catch
29446
29447 // end catch_to_string.hpp
29448 #include <algorithm>
29449 #include <cmath>
29450 #include <cstdlib>
29451 #include <cstdint>
29452 #include <cstring>
29453 #include <sstream>
29454 #include <type_traits>
29455 #include <iomanip>
29456 #include <limits>
29457
29458 namespace Catch {
29459 namespace {
29460
29461     int32_t convert(float f) {
29462         static_assert(sizeof(float) == sizeof(int32_t), "Important ULP matcher assumption violated");
29463         int32_t i;
29464         std::memcpy(&i, &f, sizeof(f));
29465         return i;
29466     }
29467
29468     int64_t convert(double d) {
29469         static_assert(sizeof(double) == sizeof(int64_t), "Important ULP matcher assumption violated");
29470         int64_t i;
29471         std::memcpy(&i, &d, sizeof(d));
29472         return i;
29473     }
29474
29475     template <typename FP>
```

```
29476     bool almostEqualUlps(FP lhs, FP rhs, uint64_t maxUlpDiff) {
29477         // Comparison with NaN should always be false.
29478         // This way we can rule it out before getting into the ugly details
29479         if (Catch::isnan(lhs) || Catch::isnan(rhs)) {
29480             return false;
29481         }
29482
29483         auto lc = convert(lhs);
29484         auto rc = convert(rhs);
29485
29486         if ((lc < 0) != (rc < 0)) {
29487             // Potentially we can have +0 and -0
29488             return lhs == rhs;
29489         }
29490
29491         // static cast as a workaround for IBM XLC
29492         auto ulpDiff = std::abs(static_cast<FP>(lc - rc));
29493         return static_cast<uint64_t>(ulpDiff) <= maxUlpDiff;
29494     }
29495
29496 #if defined(CATCH_CONFIG_GLOBAL_NEXTAFTER)
29497
29498     float nextafter(float x, float y) {
29499         return ::nextafterf(x, y);
29500     }
29501
29502     double nextafter(double x, double y) {
29503         return ::nextafter(x, y);
29504     }
29505
29506 #endif // ^^^ CATCH_CONFIG_GLOBAL_NEXTAFTER ^^^
29507
29508 template <typename FP>
29509 FP step(FP start, FP direction, uint64_t steps) {
29510     for (uint64_t i = 0; i < steps; ++i) {
29511 #if defined(CATCH_CONFIG_GLOBAL_NEXTAFTER)
29512         start = Catch::nextafter(start, direction);
29513 #else
29514         start = std::nextafter(start, direction);
29515 #endif
29516     }
29517     return start;
29518 }
29519
29520 // Performs equivalent check of std::fabs(lhs - rhs) <= margin
29521 // But without the subtraction to allow for INFINITY in comparison
29522 bool marginComparison(double lhs, double rhs, double margin) {
29523     return (lhs + margin >= rhs) && (rhs + margin >= lhs);
29524 }
29525
29526 template <typename FloatingPoint>
29527 void write(std::ostream& out, FloatingPoint num) {
29528     out << std::scientific
29529         << std::setprecision(std::numeric_limits<FloatingPoint>::max_digits10 - 1)
29530         << num;
29531 }
29532
29533 } // end anonymous namespace
29534
29535 namespace Matchers {
29536 namespace Floating {
29537
29538     enum class FloatingPointKind : uint8_t {
29539         Float,
29540         Double
29541     };
29542
29543     WithinAbsMatcher::WithinAbsMatcher(double target, double margin)
29544         :m_target{ target }, m_margin{ margin } {
29545         CATCH_ENFORCE(margin >= 0, "Invalid margin: " << margin << '.'
29546             << " Margin has to be non-negative.");
29547     }
29548
29549     // Performs equivalent check of std::fabs(lhs - rhs) <= margin
29550     // But without the subtraction to allow for INFINITY in comparison
29551     bool WithinAbsMatcher::match(double const& matchee) const {
29552         return (matchee + m_margin >= m_target) && (m_target + m_margin >= matchee);
29553     }
29554
29555     std::string WithinAbsMatcher::describe() const {
29556         return "is within " + ::Catch::Detail::stringify(m_margin) + " of " +
    ::Catch::Detail::stringify(m_target);
29557     }
29558
29559     WithinUlpsMatcher::WithinUlpsMatcher(double target, uint64_t ulps, FloatingPointKind baseType)
29560         :m_target{ target }, m_ulps{ ulps }, m_type{ baseType } {
29561         CATCH_ENFORCE(m_type == FloatingPointKind::Double
```

```
29562                   || m_ulps < (std::numeric_limits<uint32_t>::max)(),
29563             "Provided ULP is impossibly large for a float comparison.");
29564     }
29565
29566 #if defined(__clang__)
29567 #pragma clang diagnostic push
29568 // Clang <3.5 reports on the default branch in the switch below
29569 #pragma clang diagnostic ignored "-Wunreachable-code"
29570 #endif
29571
29572     bool WithinUlpsMatcher::match(double const& matchee) const {
29573         switch (m_type) {
29574         case FloatingPointKind::Float:
29575             return almostEqualUlps<float>(static_cast<float>(matchee), static_cast<float>(m_target),
      m_ulps);
29576         case FloatingPointKind::Double:
29577             return almostEqualUlps<double>(matchee, m_target, m_ulps);
29578         default:
29579             CATCH_INTERNAL_ERROR( "Unknown FloatingPointKind value" );
29580         }
29581     }
29582
29583 #if defined(__clang__)
29584 #pragma clang diagnostic pop
29585 #endif
29586
29587     std::string WithinUlpsMatcher::describe() const {
29588         std::stringstream ret;
29589
29590         ret « "is within " « m_ulps « " ULPs of ";
29591
29592         if (m_type == FloatingPointKind::Float) {
29593             write(ret, static_cast<float>(m_target));
29594             ret « 'f';
29595         } else {
29596             write(ret, m_target);
29597         }
29598
29599         ret « " ([";
29600         if (m_type == FloatingPointKind::Double) {
29601             write(ret, step(m_target, static_cast<double>(-INFINITY), m_ulps));
29602             ret « ", ";
29603             write(ret, step(m_target, static_cast<double>( INFINITY), m_ulps));
29604         } else {
29605             // We have to cast INFINITY to float because of MinGW, see #1782
29606             write(ret, step(static_cast<float>(m_target), static_cast<float>(-INFINITY), m_ulps));
29607             ret « ", ";
29608             write(ret, step(static_cast<float>(m_target), static_cast<float>( INFINITY), m_ulps));
29609         }
29610         ret « "])";
29611
29612         return ret.str();
29613     }
29614
29615     WithinRelMatcher::WithinRelMatcher(double target, double epsilon):
29616         m_target(target),
29617         m_epsilon(epsilon){
29618         CATCH_ENFORCE(m_epsilon >= 0., "Relative comparison with epsilon <  0 does not make sense.");
29619         CATCH_ENFORCE(m_epsilon  < 1., "Relative comparison with epsilon >= 1 does not make sense.");
29620     }
29621
29622     bool WithinRelMatcher::match(double const& matchee) const {
29623         const auto relMargin = m_epsilon * (std::max)(std::fabs(matchee), std::fabs(m_target));
29624         return marginComparison(matchee, m_target,
29625                                 std::isinf(relMargin)? 0 : relMargin);
29626     }
29627
29628     std::string WithinRelMatcher::describe() const {
29629         Catch::ReusableStringStream sstr;
29630         sstr « "and " « m_target « " are within " « m_epsilon * 100. « "% of each other";
29631         return sstr.str();
29632     }
29633
29634 }// namespace Floating
29635
29636 Floating::WithinUlpsMatcher WithinULP(double target, uint64_t maxUlpDiff) {
29637     return Floating::WithinUlpsMatcher(target, maxUlpDiff, Floating::FloatingPointKind::Double);
29638 }
29639
29640 Floating::WithinUlpsMatcher WithinULP(float target, uint64_t maxUlpDiff) {
29641     return Floating::WithinUlpsMatcher(target, maxUlpDiff, Floating::FloatingPointKind::Float);
29642 }
29643
29644 Floating::WithinAbsMatcher WithinAbs(double target, double margin) {
29645     return Floating::WithinAbsMatcher(target, margin);
29646 }
29647
```

```
29648 Floating::WithinRelMatcher WithinRel(double target, double eps) {
29649     return Floating::WithinRelMatcher(target, eps);
29650 }
29651
29652 Floating::WithinRelMatcher WithinRel(double target) {
29653     return Floating::WithinRelMatcher(target, std::numeric_limits<double>::epsilon() * 100);
29654 }
29655
29656 Floating::WithinRelMatcher WithinRel(float target, float eps) {
29657     return Floating::WithinRelMatcher(target, eps);
29658 }
29659
29660 Floating::WithinRelMatcher WithinRel(float target) {
29661     return Floating::WithinRelMatcher(target, std::numeric_limits<float>::epsilon() * 100);
29662 }
29663
29664 } // namespace Matchers
29665 } // namespace Catch
29666 // end catch_matchers_floating.cpp
29667 // start catch_matchers_generic.cpp
29668
29669 std::string Catch::Matchers::Generic::Detail::finalizeDescription(const std::string& desc) {
29670     if (desc.empty()) {
29671         return "matches undescribed predicate";
29672     } else {
29673         return "matches predicate: \"" + desc + '"';
29674     }
29675 }
29676 // end catch_matchers_generic.cpp
29677 // start catch_matchers_string.cpp
29678
29679 #include <regex>
29680
29681 namespace Catch {
29682 namespace Matchers {
29683
29684     namespace StdString {
29685
29686         CasedString::CasedString( std::string const& str, CaseSensitive::Choice caseSensitivity )
29687         :   m_caseSensitivity( caseSensitivity ),
29688             m_str( adjustString( str ) )
29689         {}
29690         std::string CasedString::adjustString( std::string const& str ) const {
29691             return m_caseSensitivity == CaseSensitive::No
29692                    ? toLower( str )
29693                    : str;
29694         }
29695         std::string CasedString::caseSensitivitySuffix() const {
29696             return m_caseSensitivity == CaseSensitive::No
29697                    ? " (case insensitive)"
29698                    : std::string();
29699         }
29700
29701         StringMatcherBase::StringMatcherBase( std::string const& operation, CasedString const&
      comparator )
29702         : m_comparator( comparator ),
29703           m_operation( operation ) {
29704         }
29705
29706         std::string StringMatcherBase::describe() const {
29707             std::string description;
29708             description.reserve(5 + m_operation.size() + m_comparator.m_str.size() +
29709                                     m_comparator.caseSensitivitySuffix().size());
29710             description += m_operation;
29711             description += ": \"";
29712             description += m_comparator.m_str;
29713             description += "\"";
29714             description += m_comparator.caseSensitivitySuffix();
29715             return description;
29716         }
29717
29718         EqualsMatcher::EqualsMatcher( CasedString const& comparator ) : StringMatcherBase( "equals",
      comparator ) {}
29719
29720         bool EqualsMatcher::match( std::string const& source ) const {
29721             return m_comparator.adjustString( source ) == m_comparator.m_str;
29722         }
29723
29724         ContainsMatcher::ContainsMatcher( CasedString const& comparator ) : StringMatcherBase(
      "contains", comparator ) {}
29725
29726         bool ContainsMatcher::match( std::string const& source ) const {
29727             return contains( m_comparator.adjustString( source ), m_comparator.m_str );
29728         }
29729
29730         StartsWithMatcher::StartsWithMatcher( CasedString const& comparator ) : StringMatcherBase(
      "starts with", comparator ) {}
```

```
29731
29732         bool StartsWithMatcher::match( std::string const& source ) const {
29733             return startsWith( m_comparator.adjustString( source ), m_comparator.m_str );
29734         }
29735
29736         EndsWithMatcher::EndsWithMatcher( CasedString const& comparator ) : StringMatcherBase( "ends
      with", comparator ) {}
29737
29738         bool EndsWithMatcher::match( std::string const& source ) const {
29739             return endsWith( m_comparator.adjustString( source ), m_comparator.m_str );
29740         }
29741
29742         RegexMatcher::RegexMatcher(std::string regex, CaseSensitive::Choice caseSensitivity):
      m_regex(std::move(regex)), m_caseSensitivity(caseSensitivity) {}
29743
29744         bool RegexMatcher::match(std::string const& matchee) const {
29745             auto flags = std::regex::ECMAScript; // ECMAScript is the default syntax option anyway
29746             if (m_caseSensitivity == CaseSensitive::Choice::No) {
29747                 flags |= std::regex::icase;
29748             }
29749             auto reg = std::regex(m_regex, flags);
29750             return std::regex_match(matchee, reg);
29751         }
29752
29753         std::string RegexMatcher::describe() const {
29754             return "matches " + ::Catch::Detail::stringify(m_regex) + ((m_caseSensitivity ==
      CaseSensitive::Choice::Yes)? " case sensitively" : " case insensitively");
29755         }
29756
29757     } // namespace StdString
29758
29759     StdString::EqualsMatcher Equals( std::string const& str, CaseSensitive::Choice caseSensitivity ) {
29760         return StdString::EqualsMatcher( StdString::CasedString( str, caseSensitivity) );
29761     }
29762     StdString::ContainsMatcher Contains( std::string const& str, CaseSensitive::Choice caseSensitivity
      ) {
29763         return StdString::ContainsMatcher( StdString::CasedString( str, caseSensitivity) );
29764     }
29765     StdString::EndsWithMatcher EndsWith( std::string const& str, CaseSensitive::Choice caseSensitivity
      ) {
29766         return StdString::EndsWithMatcher( StdString::CasedString( str, caseSensitivity) );
29767     }
29768     StdString::StartsWithMatcher StartsWith( std::string const& str, CaseSensitive::Choice
      caseSensitivity ) {
29769         return StdString::StartsWithMatcher( StdString::CasedString( str, caseSensitivity) );
29770     }
29771
29772     StdString::RegexMatcher Matches(std::string const& regex, CaseSensitive::Choice caseSensitivity) {
29773         return StdString::RegexMatcher(regex, caseSensitivity);
29774     }
29775
29776 } // namespace Matchers
29777 } // namespace Catch
29778 // end catch_matchers_string.cpp
29779 // start catch_message.cpp
29780
29781 // start catch_uncaught_exceptions.h
29782
29783 namespace Catch {
29784     bool uncaught_exceptions();
29785 } // end namespace Catch
29786
29787 // end catch_uncaught_exceptions.h
29788 #include <cassert>
29789 #include <stack>
29790
29791 namespace Catch {
29792
29793     MessageInfo::MessageInfo(   StringRef const& _macroName,
29794                                 SourceLineInfo const& _lineInfo,
29795                                 ResultWas::OfType _type )
29796     :   macroName( _macroName ),
29797         lineInfo( _lineInfo ),
29798         type( _type ),
29799         sequence( ++globalCount )
29800     {}
29801
29802     bool MessageInfo::operator==( MessageInfo const& other ) const {
29803         return sequence == other.sequence;
29804     }
29805
29806     bool MessageInfo::operator<( MessageInfo const& other ) const {
29807         return sequence < other.sequence;
29808     }
29809
29810     // This may need protecting if threading support is added
29811     unsigned int MessageInfo::globalCount = 0;
```

```
29812
29814
29815     Catch::MessageBuilder::MessageBuilder( StringRef const& macroName,
29816                                            SourceLineInfo const& lineInfo,
29817                                            ResultWas::OfType type )
29818         :m_info(macroName, lineInfo, type) {}
29819
29821
29822     ScopedMessage::ScopedMessage( MessageBuilder const& builder )
29823     : m_info( builder.m_info ), m_moved()
29824     {
29825         m_info.message = builder.m_stream.str();
29826         getResultCapture().pushScopedMessage( m_info );
29827     }
29828
29829     ScopedMessage::ScopedMessage( ScopedMessage&& old )
29830     : m_info( old.m_info ), m_moved()
29831     {
29832         old.m_moved = true;
29833     }
29834
29835     ScopedMessage::~ScopedMessage() {
29836         if ( !uncaught_exceptions() && !m_moved ){
29837             getResultCapture().popScopedMessage(m_info);
29838         }
29839     }
29840
29841     Capturer::Capturer( StringRef macroName, SourceLineInfo const& lineInfo, ResultWas::OfType
      resultType, StringRef names ) {
29842         auto trimmed = [&] (size_t start, size_t end) {
29843             while (names[start] == ',' || isspace(static_cast<unsigned char>(names[start]))) {
29844                 ++start;
29845             }
29846             while (names[end] == ',' || isspace(static_cast<unsigned char>(names[end]))) {
29847                 --end;
29848             }
29849             return names.substr(start, end - start + 1);
29850         };
29851         auto skipq = [&] (size_t start, char quote) {
29852             for (auto i = start + 1; i < names.size() ; ++i) {
29853                 if (names[i] == quote)
29854                     return i;
29855                 if (names[i] == '\\')
29856                     ++i;
29857             }
29858             CATCH_INTERNAL_ERROR("CAPTURE parsing encountered unmatched quote");
29859         };
29860
29861         size_t start = 0;
29862         std::stack<char> openings;
29863         for (size_t pos = 0; pos < names.size(); ++pos) {
29864             char c = names[pos];
29865             switch (c) {
29866             case '[':
29867             case '{':
29868             case '(':
29869             // It is basically impossible to disambiguate between
29870             // comparison and start of template args in this context
29871 //            case '<':
29872                 openings.push(c);
29873                 break;
29874             case ']':
29875             case '}':
29876             case ')':
29877 //            case '>':
29878                 openings.pop();
29879                 break;
29880             case '"':
29881             case '\'':
29882                 pos = skipq(pos, c);
29883                 break;
29884             case ',':
29885                 if (start != pos && openings.empty()) {
29886                     m_messages.emplace_back(macroName, lineInfo, resultType);
29887                     m_messages.back().message = static_cast<std::string>(trimmed(start, pos));
29888                     m_messages.back().message += " := ";
29889                     start = pos;
29890                 }
29891             }
29892         }
29893         assert(openings.empty() && "Mismatched openings");
29894         m_messages.emplace_back(macroName, lineInfo, resultType);
29895         m_messages.back().message = static_cast<std::string>(trimmed(start, names.size() - 1));
29896         m_messages.back().message += " := ";
29897     }
29898     Capturer::~Capturer() {
29899         if ( !uncaught_exceptions() ){
```

```
29900             assert( m_captured == m_messages.size() );
29901             for( size_t i = 0; i < m_captured; ++i  )
29902                 m_resultCapture.popScopedMessage( m_messages[i] );
29903         }
29904     }
29905
29906     void Capturer::captureValue( size_t index, std::string const& value ) {
29907         assert( index < m_messages.size() );
29908         m_messages[index].message += value;
29909         m_resultCapture.pushScopedMessage( m_messages[index] );
29910         m_captured++;
29911     }
29912
29913 } // end namespace Catch
29914 // end catch_message.cpp
29915 // start catch_output_redirect.cpp
29916
29917 // start catch_output_redirect.h
29918 #ifndef TWOBLUECUBES_CATCH_OUTPUT_REDIRECT_H
29919 #define TWOBLUECUBES_CATCH_OUTPUT_REDIRECT_H
29920
29921 #include <cstdio>
29922 #include <iosfwd>
29923 #include <string>
29924
29925 namespace Catch {
29926
29927     class RedirectedStream {
29928         std::ostream& m_originalStream;
29929         std::ostream& m_redirectionStream;
29930         std::streambuf* m_prevBuf;
29931
29932     public:
29933         RedirectedStream( std::ostream& originalStream, std::ostream& redirectionStream );
29934         ~RedirectedStream();
29935     };
29936
29937     class RedirectedStdOut {
29938         ReusableStringStream m_rss;
29939         RedirectedStream m_cout;
29940     public:
29941         RedirectedStdOut();
29942         auto str() const -> std::string;
29943     };
29944
29945     // StdErr has two constituent streams in C++, std::cerr and std::clog
29946     // This means that we need to redirect 2 streams into 1 to keep proper
29947     // order of writes
29948     class RedirectedStdErr {
29949         ReusableStringStream m_rss;
29950         RedirectedStream m_cerr;
29951         RedirectedStream m_clog;
29952     public:
29953         RedirectedStdErr();
29954         auto str() const -> std::string;
29955     };
29956
29957     class RedirectedStreams {
29958     public:
29959         RedirectedStreams(RedirectedStreams const&) = delete;
29960         RedirectedStreams& operator=(RedirectedStreams const&) = delete;
29961         RedirectedStreams(RedirectedStreams&&) = delete;
29962         RedirectedStreams& operator=(RedirectedStreams&&) = delete;
29963
29964         RedirectedStreams(std::string& redirectedCout, std::string& redirectedCerr);
29965         ~RedirectedStreams();
29966     private:
29967         std::string& m_redirectedCout;
29968         std::string& m_redirectedCerr;
29969         RedirectedStdOut m_redirectedStdOut;
29970         RedirectedStdErr m_redirectedStdErr;
29971     };
29972
29973 #if defined(CATCH_CONFIG_NEW_CAPTURE)
29974
29975     // Windows's implementation of std::tmpfile is terrible (it tries
29976     // to create a file inside system folder, thus requiring elevated
29977     // privileges for the binary), so we have to use tmpnam(_s) and
29978     // create the file ourselves there.
29979     class TempFile {
29980     public:
29981         TempFile(TempFile const&) = delete;
29982         TempFile& operator=(TempFile const&) = delete;
29983         TempFile(TempFile&&) = delete;
29984         TempFile& operator=(TempFile&&) = delete;
29985
29986         TempFile();
```

```
29987         ~TempFile();
29988
29989         std::FILE* getFile();
29990         std::string getContents();
29991
29992     private:
29993         std::FILE* m_file = nullptr;
29994     #if defined(_MSC_VER)
29995         char m_buffer[L_tmpnam] = { 0 };
29996     #endif
29997     };
29998
29999     class OutputRedirect {
30000     public:
30001         OutputRedirect(OutputRedirect const&) = delete;
30002         OutputRedirect& operator=(OutputRedirect const&) = delete;
30003         OutputRedirect(OutputRedirect&&) = delete;
30004         OutputRedirect& operator=(OutputRedirect&&) = delete;
30005
30006         OutputRedirect(std::string& stdout_dest, std::string& stderr_dest);
30007         ~OutputRedirect();
30008
30009     private:
30010         int m_originalStdout = -1;
30011         int m_originalStderr = -1;
30012         TempFile m_stdoutFile;
30013         TempFile m_stderrFile;
30014         std::string& m_stdoutDest;
30015         std::string& m_stderrDest;
30016     };
30017
30018 #endif
30019
30020 } // end namespace Catch
30021
30022 #endif // TWOBLUECUBES_CATCH_OUTPUT_REDIRECT_H
30023 // end catch_output_redirect.h
30024 #include <cstdio>
30025 #include <cstring>
30026 #include <fstream>
30027 #include <sstream>
30028 #include <stdexcept>
30029
30030 #if defined(CATCH_CONFIG_NEW_CAPTURE)
30031     #if defined(_MSC_VER)
30032     #include <io.h>      //_dup and _dup2
30033     #define dup _dup
30034     #define dup2 _dup2
30035     #define fileno _fileno
30036     #else
30037     #include <unistd.h>  // dup and dup2
30038     #endif
30039 #endif
30040
30041 namespace Catch {
30042
30043     RedirectedStream::RedirectedStream( std::ostream& originalStream, std::ostream& redirectionStream
      )
30044     :   m_originalStream( originalStream ),
30045         m_redirectionStream( redirectionStream ),
30046         m_prevBuf( m_originalStream.rdbuf() )
30047     {
30048         m_originalStream.rdbuf( m_redirectionStream.rdbuf() );
30049     }
30050
30051     RedirectedStream::~RedirectedStream() {
30052         m_originalStream.rdbuf( m_prevBuf );
30053     }
30054
30055     RedirectedStdOut::RedirectedStdOut() : m_cout( Catch::cout(), m_rss.get() ) {}
30056     auto RedirectedStdOut::str() const -> std::string { return m_rss.str(); }
30057
30058     RedirectedStdErr::RedirectedStdErr()
30059     :   m_cerr( Catch::cerr(), m_rss.get() ),
30060         m_clog( Catch::clog(), m_rss.get() )
30061     {}
30062     auto RedirectedStdErr::str() const -> std::string { return m_rss.str(); }
30063
30064     RedirectedStreams::RedirectedStreams(std::string& redirectedCout, std::string& redirectedCerr)
30065     :   m_redirectedCout(redirectedCout),
30066         m_redirectedCerr(redirectedCerr)
30067     {}
30068
30069     RedirectedStreams::~RedirectedStreams() {
30070         m_redirectedCout += m_redirectedStdOut.str();
30071         m_redirectedCerr += m_redirectedStdErr.str();
30072     }
```

```
30073
30074 #if defined(CATCH_CONFIG_NEW_CAPTURE)
30075
30076 #if defined(_MSC_VER)
30077     TempFile::TempFile() {
30078         if (tmpnam_s(m_buffer)) {
30079             CATCH_RUNTIME_ERROR("Could not get a temp filename");
30080         }
30081         if (fopen_s(&m_file, m_buffer, "w+")) {
30082             char buffer[100];
30083             if (strerror_s(buffer, errno)) {
30084                 CATCH_RUNTIME_ERROR("Could not translate errno to a string");
30085             }
30086             CATCH_RUNTIME_ERROR("Could not open the temp file: '" « m_buffer « "' because: " «
      buffer);
30087         }
30088     }
30089 #else
30090     TempFile::TempFile() {
30091         m_file = std::tmpfile();
30092         if (!m_file) {
30093             CATCH_RUNTIME_ERROR("Could not create a temp file.");
30094         }
30095     }
30096
30097 #endif
30098
30099     TempFile::~TempFile() {
30100          // TBD: What to do about errors here?
30101          std::fclose(m_file);
30102          // We manually create the file on Windows only, on Linux
30103          // it will be autodeleted
30104 #if defined(_MSC_VER)
30105          std::remove(m_buffer);
30106 #endif
30107     }
30108
30109     FILE* TempFile::getFile() {
30110         return m_file;
30111     }
30112
30113     std::string TempFile::getContents() {
30114         std::stringstream sstr;
30115         char buffer[100] = {};
30116         std::rewind(m_file);
30117         while (std::fgets(buffer, sizeof(buffer), m_file)) {
30118             sstr « buffer;
30119         }
30120         return sstr.str();
30121     }
30122
30123     OutputRedirect::OutputRedirect(std::string& stdout_dest, std::string& stderr_dest) :
30124         m_originalStdout(dup(1)),
30125         m_originalStderr(dup(2)),
30126         m_stdoutDest(stdout_dest),
30127         m_stderrDest(stderr_dest) {
30128         dup2(fileno(m_stdoutFile.getFile()), 1);
30129         dup2(fileno(m_stderrFile.getFile()), 2);
30130     }
30131
30132     OutputRedirect::~OutputRedirect() {
30133         Catch::cout() « std::flush;
30134         fflush(stdout);
30135         // Since we support overriding these streams, we flush cerr
30136         // even though std::cerr is unbuffered
30137         Catch::cerr() « std::flush;
30138         Catch::clog() « std::flush;
30139         fflush(stderr);
30140
30141         dup2(m_originalStdout, 1);
30142         dup2(m_originalStderr, 2);
30143
30144         m_stdoutDest += m_stdoutFile.getContents();
30145         m_stderrDest += m_stderrFile.getContents();
30146     }
30147
30148 #endif // CATCH_CONFIG_NEW_CAPTURE
30149
30150 } // namespace Catch
30151
30152 #if defined(CATCH_CONFIG_NEW_CAPTURE)
30153     #if defined(_MSC_VER)
30154     #undef dup
30155     #undef dup2
30156     #undef fileno
30157     #endif
30158 #endif
```

```
30159 // end catch_output_redirect.cpp
30160 // start catch_polyfills.cpp
30161
30162 #include <cmath>
30163
30164 namespace Catch {
30165
30166 #if !defined(CATCH_CONFIG_POLYFILL_ISNAN)
30167     bool isnan(float f) {
30168         return std::isnan(f);
30169     }
30170     bool isnan(double d) {
30171         return std::isnan(d);
30172     }
30173 #else
30174     // For now we only use this for embarcadero
30175     bool isnan(float f) {
30176         return std::_isnan(f);
30177     }
30178     bool isnan(double d) {
30179         return std::_isnan(d);
30180     }
30181 #endif
30182
30183 } // end namespace Catch
30184 // end catch_polyfills.cpp
30185 // start catch_random_number_generator.cpp
30186
30187 namespace Catch {
30188
30189 namespace {
30190
30191 #if defined(_MSC_VER)
30192 #pragma warning(push)
30193 #pragma warning(disable:4146) // we negate uint32 during the rotate
30194 #endif
30195         // Safe rotr implementation thanks to John Regehr
30196         uint32_t rotate_right(uint32_t val, uint32_t count) {
30197             const uint32_t mask = 31;
30198             count &= mask;
30199             return (val » count) | (val « (-count & mask));
30200         }
30201
30202 #if defined(_MSC_VER)
30203 #pragma warning(pop)
30204 #endif
30205
30206 }
30207
30208     SimplePcg32::SimplePcg32(result_type seed_) {
30209         seed(seed_);
30210     }
30211
30212     void SimplePcg32::seed(result_type seed_) {
30213         m_state = 0;
30214         (*this)();
30215         m_state += seed_;
30216         (*this)();
30217     }
30218
30219     void SimplePcg32::discard(uint64_t skip) {
30220         // We could implement this to run in O(log n) steps, but this
30221         // should suffice for our use case.
30222         for (uint64_t s = 0; s < skip; ++s) {
30223             static_cast<void>((*this)());
30224         }
30225     }
30226
30227     SimplePcg32::result_type SimplePcg32::operator()() {
30228         // prepare the output value
30229         const uint32_t xorshifted = static_cast<uint32_t>(((m_state » 18u) ^ m_state) » 27u);
30230         const auto output = rotate_right(xorshifted, m_state » 59u);
30231
30232         // advance state
30233         m_state = m_state * 6364136223846793005ULL + s_inc;
30234
30235         return output;
30236     }
30237
30238     bool operator==(SimplePcg32 const& lhs, SimplePcg32 const& rhs) {
30239         return lhs.m_state == rhs.m_state;
30240     }
30241
30242     bool operator!=(SimplePcg32 const& lhs, SimplePcg32 const& rhs) {
30243         return lhs.m_state != rhs.m_state;
30244     }
30245 }
```

```
30246 // end catch_random_number_generator.cpp
30247 // start catch_registry_hub.cpp
30248
30249 // start catch_test_case_registry_impl.h
30250
30251 #include <vector>
30252 #include <set>
30253 #include <algorithm>
30254 #include <ios>
30255
30256 namespace Catch {
30257
30258     class TestCase;
30259     struct IConfig;
30260
30261     std::vector<TestCase> sortTests( IConfig const& config, std::vector<TestCase> const&
      unsortedTestCases );
30262
30263     bool isThrowSafe( TestCase const& testCase, IConfig const& config );
30264     bool matchTest( TestCase const& testCase, TestSpec const& testSpec, IConfig const& config );
30265
30266     void enforceNoDuplicateTestCases( std::vector<TestCase> const& functions );
30267
30268     std::vector<TestCase> filterTests( std::vector<TestCase> const& testCases, TestSpec const&
      testSpec, IConfig const& config );
30269     std::vector<TestCase> const& getAllTestCasesSorted( IConfig const& config );
30270
30271     class TestRegistry : public ITestCaseRegistry {
30272     public:
30273         virtual ~TestRegistry() = default;
30274
30275         virtual void registerTest( TestCase const& testCase );
30276
30277         std::vector<TestCase> const& getAllTests() const override;
30278         std::vector<TestCase> const& getAllTestsSorted( IConfig const& config ) const override;
30279
30280     private:
30281         std::vector<TestCase> m_functions;
30282         mutable RunTests::InWhatOrder m_currentSortOrder = RunTests::InDeclarationOrder;
30283         mutable std::vector<TestCase> m_sortedFunctions;
30284         std::size_t m_unnamedCount = 0;
30285         std::ios_base::Init m_ostreamInit; // Forces cout/ cerr to be initialised
30286     };
30287
30289
30290     class TestInvokerAsFunction : public ITestInvoker {
30291         void(*m_testAsFunction)();
30292     public:
30293         TestInvokerAsFunction( void(*testAsFunction)() ) noexcept;
30294
30295         void invoke() const override;
30296     };
30297
30298     std::string extractClassName( StringRef const& classOrQualifiedMethodName );
30299
30301 } // end namespace Catch
30303
30304 // end catch_test_case_registry_impl.h
30305 // start catch_reporter_registry.h
30306
30307 #include <map>
30308
30309 namespace Catch {
30310
30311     class ReporterRegistry : public IReporterRegistry {
30312
30313     public:
30314
30315         ~ReporterRegistry() override;
30316
30317         IStreamingReporterPtr create( std::string const& name, IConfigPtr const& config ) const
      override;
30318
30319         void registerReporter( std::string const& name, IReporterFactoryPtr const& factory );
30320         void registerListener( IReporterFactoryPtr const& factory );
30321
30322         FactoryMap const& getFactories() const override;
30323         Listeners const& getListeners() const override;
30324
30325     private:
30326         FactoryMap m_factories;
30327         Listeners m_listeners;
30328     };
30329 }
30330
30331 // end catch_reporter_registry.h
```

```
30332 // start catch_tag_alias_registry.h
30333
30334 // start catch_tag_alias.h
30335
30336 #include <string>
30337
30338 namespace Catch {
30339
30340     struct TagAlias {
30341         TagAlias(std::string const& _tag, SourceLineInfo _lineInfo);
30342
30343         std::string tag;
30344         SourceLineInfo lineInfo;
30345     };
30346
30347 } // end namespace Catch
30348
30349 // end catch_tag_alias.h
30350 #include <map>
30351
30352 namespace Catch {
30353
30354     class TagAliasRegistry : public ITagAliasRegistry {
30355     public:
30356         ~TagAliasRegistry() override;
30357         TagAlias const* find( std::string const& alias ) const override;
30358         std::string expandAliases( std::string const& unexpandedTestSpec ) const override;
30359         void add( std::string const& alias, std::string const& tag, SourceLineInfo const& lineInfo );
30360
30361     private:
30362         std::map<std::string, TagAlias> m_registry;
30363     };
30364
30365 } // end namespace Catch
30366
30367 // end catch_tag_alias_registry.h
30368 // start catch_startup_exception_registry.h
30369
30370 #include <vector>
30371 #include <exception>
30372
30373 namespace Catch {
30374
30375     class StartupExceptionRegistry {
30376 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
30377     public:
30378         void add(std::exception_ptr const& exception) noexcept;
30379         std::vector<std::exception_ptr> const& getExceptions() const noexcept;
30380     private:
30381         std::vector<std::exception_ptr> m_exceptions;
30382 #endif
30383     };
30384
30385 } // end namespace Catch
30386
30387 // end catch_startup_exception_registry.h
30388 // start catch_singletons.hpp
30389
30390 namespace Catch {
30391
30392     struct ISingleton {
30393         virtual ~ISingleton();
30394     };
30395
30396     void addSingleton( ISingleton* singleton );
30397     void cleanupSingletons();
30398
30399     template<typename SingletonImplT, typename InterfaceT = SingletonImplT, typename MutableInterfaceT
      = InterfaceT>
30400     class Singleton : SingletonImplT, public ISingleton {
30401
30402         static auto getInternal() -> Singleton* {
30403             static Singleton* s_instance = nullptr;
30404             if( !s_instance ) {
30405                 s_instance = new Singleton;
30406                 addSingleton( s_instance );
30407             }
30408             return s_instance;
30409         }
30410
30411     public:
30412         static auto get() -> InterfaceT const& {
30413             return *getInternal();
30414         }
30415         static auto getMutable() -> MutableInterfaceT& {
30416             return *getInternal();
30417         }
```

```
30418     };
30419
30420 } // namespace Catch
30421
30422 // end catch_singletons.hpp
30423 namespace Catch {
30424
30425     namespace {
30426
30427         class RegistryHub : public IRegistryHub, public IMutableRegistryHub,
30428                             private NonCopyable {
30429
30430         public: // IRegistryHub
30431             RegistryHub() = default;
30432             IReporterRegistry const& getReporterRegistry() const override {
30433                 return m_reporterRegistry;
30434             }
30435             ITestCaseRegistry const& getTestCaseRegistry() const override {
30436                 return m_testCaseRegistry;
30437             }
30438             IExceptionTranslatorRegistry const& getExceptionTranslatorRegistry() const override {
30439                 return m_exceptionTranslatorRegistry;
30440             }
30441             ITagAliasRegistry const& getTagAliasRegistry() const override {
30442                 return m_tagAliasRegistry;
30443             }
30444             StartupExceptionRegistry const& getStartupExceptionRegistry() const override {
30445                 return m_exceptionRegistry;
30446             }
30447
30448         public: // IMutableRegistryHub
30449             void registerReporter( std::string const& name, IReporterFactoryPtr const& factory )
      override {
30450                 m_reporterRegistry.registerReporter( name, factory );
30451             }
30452             void registerListener( IReporterFactoryPtr const& factory ) override {
30453                 m_reporterRegistry.registerListener( factory );
30454             }
30455             void registerTest( TestCase const& testInfo ) override {
30456                 m_testCaseRegistry.registerTest( testInfo );
30457             }
30458             void registerTranslator( const IExceptionTranslator* translator ) override {
30459                 m_exceptionTranslatorRegistry.registerTranslator( translator );
30460             }
30461             void registerTagAlias( std::string const& alias, std::string const& tag, SourceLineInfo
      const& lineInfo ) override {
30462                 m_tagAliasRegistry.add( alias, tag, lineInfo );
30463             }
30464             void registerStartupException() noexcept override {
30465 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
30466                 m_exceptionRegistry.add(std::current_exception());
30467 #else
30468                 CATCH_INTERNAL_ERROR("Attempted to register active exception under
      CATCH_CONFIG_DISABLE_EXCEPTIONS!");
30469 #endif
30470             }
30471             IMutableEnumValuesRegistry& getMutableEnumValuesRegistry() override {
30472                 return m_enumValuesRegistry;
30473             }
30474
30475         private:
30476             TestRegistry m_testCaseRegistry;
30477             ReporterRegistry m_reporterRegistry;
30478             ExceptionTranslatorRegistry m_exceptionTranslatorRegistry;
30479             TagAliasRegistry m_tagAliasRegistry;
30480             StartupExceptionRegistry m_exceptionRegistry;
30481             Detail::EnumValuesRegistry m_enumValuesRegistry;
30482         };
30483     }
30484
30485     using RegistryHubSingleton = Singleton<RegistryHub, IRegistryHub, IMutableRegistryHub>;
30486
30487     IRegistryHub const& getRegistryHub() {
30488         return RegistryHubSingleton::get();
30489     }
30490     IMutableRegistryHub& getMutableRegistryHub() {
30491         return RegistryHubSingleton::getMutable();
30492     }
30493     void cleanUp() {
30494         cleanupSingletons();
30495         cleanUpContext();
30496     }
30497     std::string translateActiveException() {
30498         return getRegistryHub().getExceptionTranslatorRegistry().translateActiveException();
30499     }
30500
30501 } // end namespace Catch
```

```
30502 // end catch_registry_hub.cpp
30503 // start catch_reporter_registry.cpp
30504
30505 namespace Catch {
30506
30507     ReporterRegistry::~ReporterRegistry() = default;
30508
30509     IStreamingReporterPtr ReporterRegistry::create( std::string const& name, IConfigPtr const& config
      ) const {
30510         auto it =  m_factories.find( name );
30511         if( it == m_factories.end() )
30512             return nullptr;
30513         return it->second->create( ReporterConfig( config ) );
30514     }
30515
30516     void ReporterRegistry::registerReporter( std::string const& name, IReporterFactoryPtr const&
      factory ) {
30517         m_factories.emplace(name, factory);
30518     }
30519     void ReporterRegistry::registerListener( IReporterFactoryPtr const& factory ) {
30520         m_listeners.push_back( factory );
30521     }
30522
30523     IReporterRegistry::FactoryMap const& ReporterRegistry::getFactories() const {
30524         return m_factories;
30525     }
30526     IReporterRegistry::Listeners const& ReporterRegistry::getListeners() const {
30527         return m_listeners;
30528     }
30529
30530 }
30531 // end catch_reporter_registry.cpp
30532 // start catch_result_type.cpp
30533
30534 namespace Catch {
30535
30536     bool isOk( ResultWas::OfType resultType ) {
30537         return ( resultType & ResultWas::FailureBit ) == 0;
30538     }
30539     bool isJustInfo( int flags ) {
30540         return flags == ResultWas::Info;
30541     }
30542
30543     ResultDisposition::Flags operator | ( ResultDisposition::Flags lhs, ResultDisposition::Flags rhs )
      {
30544         return static_cast<ResultDisposition::Flags>( static_cast<int>( lhs ) | static_cast<int>( rhs
      ) );
30545     }
30546
30547     bool shouldContinueOnFailure( int flags )    { return ( flags &
      ResultDisposition::ContinueOnFailure ) != 0; }
30548     bool shouldSuppressFailure( int flags )      { return ( flags & ResultDisposition::SuppressFail )
      != 0; }
30549
30550 } // end namespace Catch
30551 // end catch_result_type.cpp
30552 // start catch_run_context.cpp
30553
30554 #include <cassert>
30555 #include <algorithm>
30556 #include <sstream>
30557
30558 namespace Catch {
30559
30560     namespace Generators {
30561         struct GeneratorTracker : TestCaseTracking::TrackerBase, IGeneratorTracker {
30562             GeneratorBasePtr m_generator;
30563
30564             GeneratorTracker( TestCaseTracking::NameAndLocation const& nameAndLocation,
      TrackerContext& ctx, ITracker* parent )
30565             :   TrackerBase( nameAndLocation, ctx, parent )
30566             {}
30567             ~GeneratorTracker();
30568
30569             static GeneratorTracker& acquire( TrackerContext& ctx, TestCaseTracking::NameAndLocation
      const& nameAndLocation ) {
30570                 std::shared_ptr<GeneratorTracker> tracker;
30571
30572                 ITracker& currentTracker = ctx.currentTracker();
30573                 // Under specific circumstances, the generator we want
30574                 // to acquire is also the current tracker. If this is
30575                 // the case, we have to avoid looking through current
30576                 // tracker's children, and instead return the current
30577                 // tracker.
30578                 // A case where this check is important is e.g.
30579                 //     for (int i = 0; i < 5; ++i) {
30580                 //         int n = GENERATE(1, 2);
```

```
30581                 //     }
30582                 //
30583                 // without it, the code above creates 5 nested generators.
30584                 if (currentTracker.nameAndLocation() == nameAndLocation) {
30585                     auto thisTracker = currentTracker.parent().findChild(nameAndLocation);
30586                     assert(thisTracker);
30587                     assert(thisTracker->isGeneratorTracker());
30588                     tracker = std::static_pointer_cast<GeneratorTracker>(thisTracker);
30589                 } else if ( TestCaseTracking::ITrackerPtr childTracker = currentTracker.findChild(
      nameAndLocation ) ) {
30590                     assert( childTracker );
30591                     assert( childTracker->isGeneratorTracker() );
30592                     tracker = std::static_pointer_cast<GeneratorTracker>( childTracker );
30593                 } else {
30594                     tracker = std::make_shared<GeneratorTracker>( nameAndLocation, ctx,
      &currentTracker );
30595                     currentTracker.addChild( tracker );
30596                 }
30597
30598                 if( !tracker->isComplete() ) {
30599                     tracker->open();
30600                 }
30601
30602                 return *tracker;
30603             }
30604
30605             // TrackerBase interface
30606             bool isGeneratorTracker() const override { return true; }
30607             auto hasGenerator() const -> bool override {
30608                 return !!m_generator;
30609             }
30610             void close() override {
30611                 TrackerBase::close();
30612                 // If a generator has a child (it is followed by a section)
30613                 // and none of its children have started, then we must wait
30614                 // until later to start consuming its values.
30615                 // This catches cases where `GENERATE` is placed between two
30616                 // `SECTION`s.
30617                 // **The check for m_children.empty cannot be removed**.
30618                 // doing so would break `GENERATE` _not_ followed by `SECTION`s.
30619                 const bool should_wait_for_child = [&]() {
30620                     // No children -> nobody to wait for
30621                     if ( m_children.empty() ) {
30622                         return false;
30623                     }
30624                     // If at least one child started executing, don't wait
30625                     if ( std::find_if(
30626                              m_children.begin(),
30627                              m_children.end(),
30628                              []( TestCaseTracking::ITrackerPtr tracker ) {
30629                                  return tracker->hasStarted();
30630                              } ) != m_children.end() ) {
30631                         return false;
30632                     }
30633
30634                     // No children have started. We need to check if they _can_
30635                     // start, and thus we should wait for them, or they cannot
30636                     // start (due to filters), and we shouldn't wait for them
30637                     auto* parent = m_parent;
30638                     // This is safe: there is always at least one section
30639                     // tracker in a test case tracking tree
30640                     while ( !parent->isSectionTracker() ) {
30641                         parent = &( parent->parent() );
30642                     }
30643                     assert( parent &&
30644                             "Missing root (test case) level section" );
30645
30646                     auto const& parentSection =
30647                         static_cast<SectionTracker&>( *parent );
30648                     auto const& filters = parentSection.getFilters();
30649                     // No filters -> no restrictions on running sections
30650                     if ( filters.empty() ) {
30651                         return true;
30652                     }
30653
30654                     for ( auto const& child : m_children ) {
30655                         if ( child->isSectionTracker() &&
30656                              std::find( filters.begin(),
30657                                         filters.end(),
30658                                         static_cast<SectionTracker&>( *child )
30659                                             .trimmedName() ) !=
30660                                  filters.end() ) {
30661                             return true;
30662                         }
30663                     }
30664                     return false;
30665                 }();
```

```
30666
30667                 // This check is a bit tricky, because m_generator->next()
30668                 // has a side-effect, where it consumes generator's current
30669                 // value, but we do not want to invoke the side-effect if
30670                 // this generator is still waiting for any child to start.
30671                 if ( should_wait_for_child ||
30672                      ( m_runState == CompletedSuccessfully &&
30673                        m_generator->next() ) ) {
30674                     m_children.clear();
30675                     m_runState = Executing;
30676                 }
30677             }
30678
30679             // IGeneratorTracker interface
30680             auto getGenerator() const -> GeneratorBasePtr const& override {
30681                 return m_generator;
30682             }
30683             void setGenerator( GeneratorBasePtr&& generator ) override {
30684                 m_generator = std::move( generator );
30685             }
30686         };
30687         GeneratorTracker::~GeneratorTracker() {}
30688     }
30689
30690     RunContext::RunContext(IConfigPtr const& _config, IStreamingReporterPtr&& reporter)
30691     :   m_runInfo(_config->name()),
30692         m_context(getCurrentMutableContext()),
30693         m_config(_config),
30694         m_reporter(std::move(reporter)),
30695         m_lastAssertionInfo{ StringRef(), SourceLineInfo("",0), StringRef(), ResultDisposition::Normal
      },
30696         m_includeSuccessfulResults( m_config->includeSuccessfulResults() ||
      m_reporter->getPreferences().shouldReportAllAssertions )
30697     {
30698         m_context.setRunner(this);
30699         m_context.setConfig(m_config);
30700         m_context.setResultCapture(this);
30701         m_reporter->testRunStarting(m_runInfo);
30702     }
30703
30704     RunContext::~RunContext() {
30705         m_reporter->testRunEnded(TestRunStats(m_runInfo, m_totals, aborting()));
30706     }
30707
30708     void RunContext::testGroupStarting(std::string const& testSpec, std::size_t groupIndex,
      std::size_t groupsCount) {
30709         m_reporter->testGroupStarting(GroupInfo(testSpec, groupIndex, groupsCount));
30710     }
30711
30712     void RunContext::testGroupEnded(std::string const& testSpec, Totals const& totals, std::size_t
      groupIndex, std::size_t groupsCount) {
30713         m_reporter->testGroupEnded(TestGroupStats(GroupInfo(testSpec, groupIndex, groupsCount),
      totals, aborting()));
30714     }
30715
30716     Totals RunContext::runTest(TestCase const& testCase) {
30717         Totals prevTotals = m_totals;
30718
30719         std::string redirectedCout;
30720         std::string redirectedCerr;
30721
30722         auto const& testInfo = testCase.getTestCaseInfo();
30723
30724         m_reporter->testCaseStarting(testInfo);
30725
30726         m_activeTestCase = &testCase;
30727
30728         ITracker& rootTracker = m_trackerContext.startRun();
30729         assert(rootTracker.isSectionTracker());
30730         static_cast<SectionTracker&>(rootTracker).addInitialFilters(m_config->getSectionsToRun());
30731         do {
30732             m_trackerContext.startCycle();
30733             m_testCaseTracker = &SectionTracker::acquire(m_trackerContext,
      TestCaseTracking::NameAndLocation(testInfo.name, testInfo.lineInfo));
30734             runCurrentTest(redirectedCout, redirectedCerr);
30735         } while (!m_testCaseTracker->isSuccessfullyCompleted() && !aborting());
30736
30737         Totals deltaTotals = m_totals.delta(prevTotals);
30738         if (testInfo.expectedToFail() && deltaTotals.testCases.passed > 0) {
30739             deltaTotals.assertions.failed++;
30740             deltaTotals.testCases.passed--;
30741             deltaTotals.testCases.failed++;
30742         }
30743         m_totals.testCases += deltaTotals.testCases;
30744         m_reporter->testCaseEnded(TestCaseStats(testInfo,
30745                                   deltaTotals,
30746                                   redirectedCout,
```

```
30747                                   redirectedCerr,
30748                                   aborting()));
30749
30750         m_activeTestCase = nullptr;
30751         m_testCaseTracker = nullptr;
30752
30753         return deltaTotals;
30754     }
30755
30756     IConfigPtr RunContext::config() const {
30757         return m_config;
30758     }
30759
30760     IStreamingReporter& RunContext::reporter() const {
30761         return *m_reporter;
30762     }
30763
30764     void RunContext::assertionEnded(AssertionResult const & result) {
30765         if (result.getResultType() == ResultWas::Ok) {
30766             m_totals.assertions.passed++;
30767             m_lastAssertionPassed = true;
30768         } else if (!result.isOk()) {
30769             m_lastAssertionPassed = false;
30770             if( m_activeTestCase->getTestCaseInfo().okToFail() )
30771                 m_totals.assertions.failedButOk++;
30772             else
30773                 m_totals.assertions.failed++;
30774         }
30775         else {
30776             m_lastAssertionPassed = true;
30777         }
30778
30779         // We have no use for the return value (whether messages should be cleared), because messages
     were made scoped
30780         // and should be let to clear themselves out.
30781         static_cast<void>(m_reporter->assertionEnded(AssertionStats(result, m_messages, m_totals)));
30782
30783         if (result.getResultType() != ResultWas::Warning)
30784             m_messageScopes.clear();
30785
30786         // Reset working state
30787         resetAssertionInfo();
30788         m_lastResult = result;
30789     }
30790     void RunContext::resetAssertionInfo() {
30791         m_lastAssertionInfo.macroName = StringRef();
30792         m_lastAssertionInfo.capturedExpression = "{Unknown expression after the reported line}"_sr;
30793     }
30794
30795     bool RunContext::sectionStarted(SectionInfo const & sectionInfo, Counts & assertions) {
30796         ITracker& sectionTracker = SectionTracker::acquire(m_trackerContext,
     TestCaseTracking::NameAndLocation(sectionInfo.name, sectionInfo.lineInfo));
30797         if (!sectionTracker.isOpen())
30798             return false;
30799         m_activeSections.push_back(&sectionTracker);
30800
30801         m_lastAssertionInfo.lineInfo = sectionInfo.lineInfo;
30802
30803         m_reporter->sectionStarting(sectionInfo);
30804
30805         assertions = m_totals.assertions;
30806
30807         return true;
30808     }
30809     auto RunContext::acquireGeneratorTracker( StringRef generatorName, SourceLineInfo const& lineInfo
     ) -> IGeneratorTracker& {
30810         using namespace Generators;
30811         GeneratorTracker& tracker = GeneratorTracker::acquire(m_trackerContext,
30812                                                               TestCaseTracking::NameAndLocation(
     static_cast<std::string>(generatorName), lineInfo ) );
30813         m_lastAssertionInfo.lineInfo = lineInfo;
30814         return tracker;
30815     }
30816
30817     bool RunContext::testForMissingAssertions(Counts& assertions) {
30818         if (assertions.total() != 0)
30819             return false;
30820         if (!m_config->warnAboutMissingAssertions())
30821             return false;
30822         if (m_trackerContext.currentTracker().hasChildren())
30823             return false;
30824         m_totals.assertions.failed++;
30825         assertions.failed++;
30826         return true;
30827     }
30828
30829     void RunContext::sectionEnded(SectionEndInfo const & endInfo) {
```

```
30830         Counts assertions = m_totals.assertions - endInfo.prevAssertions;
30831         bool missingAssertions = testForMissingAssertions(assertions);
30832
30833         if (!m_activeSections.empty()) {
30834             m_activeSections.back()->close();
30835             m_activeSections.pop_back();
30836         }
30837
30838         m_reporter->sectionEnded(SectionStats(endInfo.sectionInfo, assertions,
      endInfo.durationInSeconds, missingAssertions));
30839         m_messages.clear();
30840         m_messageScopes.clear();
30841     }
30842
30843     void RunContext::sectionEndedEarly(SectionEndInfo const & endInfo) {
30844         if (m_unfinishedSections.empty())
30845             m_activeSections.back()->fail();
30846         else
30847             m_activeSections.back()->close();
30848         m_activeSections.pop_back();
30849
30850         m_unfinishedSections.push_back(endInfo);
30851     }
30852
30853 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
30854     void RunContext::benchmarkPreparing(std::string const& name) {
30855         m_reporter->benchmarkPreparing(name);
30856     }
30857     void RunContext::benchmarkStarting( BenchmarkInfo const& info ) {
30858         m_reporter->benchmarkStarting( info );
30859     }
30860     void RunContext::benchmarkEnded( BenchmarkStats<> const& stats ) {
30861         m_reporter->benchmarkEnded( stats );
30862     }
30863     void RunContext::benchmarkFailed(std::string const & error) {
30864         m_reporter->benchmarkFailed(error);
30865     }
30866 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
30867
30868     void RunContext::pushScopedMessage(MessageInfo const & message) {
30869         m_messages.push_back(message);
30870     }
30871
30872     void RunContext::popScopedMessage(MessageInfo const & message) {
30873         m_messages.erase(std::remove(m_messages.begin(), m_messages.end(), message),
      m_messages.end());
30874     }
30875
30876     void RunContext::emplaceUnscopedMessage( MessageBuilder const& builder ) {
30877         m_messageScopes.emplace_back( builder );
30878     }
30879
30880     std::string RunContext::getCurrentTestName() const {
30881         return m_activeTestCase
30882             ? m_activeTestCase->getTestCaseInfo().name
30883             : std::string();
30884     }
30885
30886     const AssertionResult * RunContext::getLastResult() const {
30887         return &(*m_lastResult);
30888     }
30889
30890     void RunContext::exceptionEarlyReported() {
30891         m_shouldReportUnexpected = false;
30892     }
30893
30894     void RunContext::handleFatalErrorCondition( StringRef message ) {
30895         // First notify reporter that bad things happened
30896         m_reporter->fatalErrorEncountered(message);
30897
30898         // Dont rebuild the result -- the stringification itself can cause more fatal errors
30899         // Instead, fake a result data.
30900         AssertionResultData tempResult( ResultWas::FatalErrorCondition, { false } );
30901         tempResult.message = static_cast<std::string>(message);
30902         AssertionResult result(m_lastAssertionInfo, tempResult);
30903
30904         assertionEnded(result);
30905
30906         handleUnfinishedSections();
30907
30908         // Recreate section for test case (as we will lose the one that was in scope)
30909         auto const& testCaseInfo = m_activeTestCase->getTestCaseInfo();
30910         SectionInfo testCaseSection(testCaseInfo.lineInfo, testCaseInfo.name);
30911
30912         Counts assertions;
30913         assertions.failed = 1;
30914         SectionStats testCaseSectionStats(testCaseSection, assertions, 0, false);
```

```
30915         m_reporter->sectionEnded(testCaseSectionStats);
30916
30917         auto const& testInfo = m_activeTestCase->getTestCaseInfo();
30918
30919         Totals deltaTotals;
30920         deltaTotals.testCases.failed = 1;
30921         deltaTotals.assertions.failed = 1;
30922         m_reporter->testCaseEnded(TestCaseStats(testInfo,
30923                                   deltaTotals,
30924                                   std::string(),
30925                                   std::string(),
30926                                   false));
30927         m_totals.testCases.failed++;
30928         testGroupEnded(std::string(), m_totals, 1, 1);
30929         m_reporter->testRunEnded(TestRunStats(m_runInfo, m_totals, false));
30930     }
30931
30932     bool RunContext::lastAssertionPassed() {
30933          return m_lastAssertionPassed;
30934     }
30935
30936     void RunContext::assertionPassed() {
30937         m_lastAssertionPassed = true;
30938         ++m_totals.assertions.passed;
30939         resetAssertionInfo();
30940         m_messageScopes.clear();
30941     }
30942
30943     bool RunContext::aborting() const {
30944         return m_totals.assertions.failed >= static_cast<std::size_t>(m_config->abortAfter());
30945     }
30946
30947     void RunContext::runCurrentTest(std::string & redirectedCout, std::string & redirectedCerr) {
30948         auto const& testCaseInfo = m_activeTestCase->getTestCaseInfo();
30949         SectionInfo testCaseSection(testCaseInfo.lineInfo, testCaseInfo.name);
30950         m_reporter->sectionStarting(testCaseSection);
30951         Counts prevAssertions = m_totals.assertions;
30952         double duration = 0;
30953         m_shouldReportUnexpected = true;
30954         m_lastAssertionInfo = { "TEST_CASE"_sr, testCaseInfo.lineInfo, StringRef(),
      ResultDisposition::Normal };
30955
30956         seedRng(*m_config);
30957
30958         Timer timer;
30959         CATCH_TRY {
30960             if (m_reporter->getPreferences().shouldRedirectStdOut) {
30961 #if !defined(CATCH_CONFIG_EXPERIMENTAL_REDIRECT)
30962                 RedirectedStreams redirectedStreams(redirectedCout, redirectedCerr);
30963
30964                 timer.start();
30965                 invokeActiveTestCase();
30966 #else
30967                 OutputRedirect r(redirectedCout, redirectedCerr);
30968                 timer.start();
30969                 invokeActiveTestCase();
30970 #endif
30971             } else {
30972                 timer.start();
30973                 invokeActiveTestCase();
30974             }
30975             duration = timer.getElapsedSeconds();
30976         } CATCH_CATCH_ANON (TestFailureException&) {
30977             // This just means the test was aborted due to failure
30978         } CATCH_CATCH_ALL {
30979             // Under CATCH_CONFIG_FAST_COMPILE, unexpected exceptions under REQUIRE assertions
30980             // are reported without translation at the point of origin.
30981             if( m_shouldReportUnexpected ) {
30982                 AssertionReaction dummyReaction;
30983                 handleUnexpectedInflightException( m_lastAssertionInfo, translateActiveException(),
      dummyReaction );
30984             }
30985         }
30986         Counts assertions = m_totals.assertions - prevAssertions;
30987         bool missingAssertions = testForMissingAssertions(assertions);
30988
30989         m_testCaseTracker->close();
30990         handleUnfinishedSections();
30991         m_messages.clear();
30992         m_messageScopes.clear();
30993
30994         SectionStats testCaseSectionStats(testCaseSection, assertions, duration, missingAssertions);
30995         m_reporter->sectionEnded(testCaseSectionStats);
30996     }
30997
30998     void RunContext::invokeActiveTestCase() {
30999         FatalConditionHandlerGuard _(&m_fatalConditionhandler);
```

```
31000         m_activeTestCase->invoke();
31001     }
31002
31003     void RunContext::handleUnfinishedSections() {
31004         // If sections ended prematurely due to an exception we stored their
31005         // infos here so we can tear them down outside the unwind process.
31006         for (auto it = m_unfinishedSections.rbegin(),
31007              itEnd = m_unfinishedSections.rend();
31008              it != itEnd;
31009              ++it)
31010             sectionEnded(*it);
31011         m_unfinishedSections.clear();
31012     }
31013
31014     void RunContext::handleExpr(
31015         AssertionInfo const& info,
31016         ITransientExpression const& expr,
31017         AssertionReaction& reaction
31018     ) {
31019         m_reporter->assertionStarting( info );
31020
31021         bool negated = isFalseTest( info.resultDisposition );
31022         bool result = expr.getResult() != negated;
31023
31024         if( result ) {
31025             if (!m_includeSuccessfulResults) {
31026                 assertionPassed();
31027             }
31028             else {
31029                 reportExpr(info, ResultWas::Ok, &expr, negated);
31030             }
31031         }
31032         else {
31033             reportExpr(info, ResultWas::ExpressionFailed, &expr, negated );
31034             populateReaction( reaction );
31035         }
31036     }
31037     void RunContext::reportExpr(
31038             AssertionInfo const &info,
31039             ResultWas::OfType resultType,
31040             ITransientExpression const *expr,
31041             bool negated ) {
31042
31043         m_lastAssertionInfo = info;
31044         AssertionResultData data( resultType, LazyExpression( negated ) );
31045
31046         AssertionResult assertionResult{ info, data };
31047         assertionResult.m_resultData.lazyExpression.m_transientExpression = expr;
31048
31049         assertionEnded( assertionResult );
31050     }
31051
31052     void RunContext::handleMessage(
31053             AssertionInfo const& info,
31054             ResultWas::OfType resultType,
31055             StringRef const& message,
31056             AssertionReaction& reaction
31057     ) {
31058         m_reporter->assertionStarting( info );
31059
31060         m_lastAssertionInfo = info;
31061
31062         AssertionResultData data( resultType, LazyExpression( false ) );
31063         data.message = static_cast<std::string>(message);
31064         AssertionResult assertionResult{ m_lastAssertionInfo, data };
31065         assertionEnded( assertionResult );
31066         if( !assertionResult.isOk() )
31067             populateReaction( reaction );
31068     }
31069     void RunContext::handleUnexpectedExceptionNotThrown(
31070             AssertionInfo const& info,
31071             AssertionReaction& reaction
31072     ) {
31073         handleNonExpr(info, Catch::ResultWas::DidntThrowException, reaction);
31074     }
31075
31076     void RunContext::handleUnexpectedInflightException(
31077             AssertionInfo const& info,
31078             std::string const& message,
31079             AssertionReaction& reaction
31080     ) {
31081         m_lastAssertionInfo = info;
31082
31083         AssertionResultData data( ResultWas::ThrewException, LazyExpression( false ) );
31084         data.message = message;
31085         AssertionResult assertionResult{ info, data };
31086         assertionEnded( assertionResult );
```

```
31087         populateReaction( reaction );
31088     }
31089
31090     void RunContext::populateReaction( AssertionReaction& reaction ) {
31091         reaction.shouldDebugBreak = m_config->shouldDebugBreak();
31092         reaction.shouldThrow = aborting() || (m_lastAssertionInfo.resultDisposition &
    ResultDisposition::Normal);
31093     }
31094
31095     void RunContext::handleIncomplete(
31096             AssertionInfo const& info
31097     ) {
31098         m_lastAssertionInfo = info;
31099
31100         AssertionResultData data( ResultWas::ThrewException, LazyExpression( false ) );
31101         data.message = "Exception translation was disabled by CATCH_CONFIG_FAST_COMPILE";
31102         AssertionResult assertionResult{ info, data };
31103         assertionEnded( assertionResult );
31104     }
31105     void RunContext::handleNonExpr(
31106             AssertionInfo const &info,
31107             ResultWas::OfType resultType,
31108             AssertionReaction &reaction
31109     ) {
31110         m_lastAssertionInfo = info;
31111
31112         AssertionResultData data( resultType, LazyExpression( false ) );
31113         AssertionResult assertionResult{ info, data };
31114         assertionEnded( assertionResult );
31115
31116         if( !assertionResult.isOk() )
31117             populateReaction( reaction );
31118     }
31119
31120     IResultCapture& getResultCapture() {
31121         if (auto* capture = getCurrentContext().getResultCapture())
31122             return *capture;
31123         else
31124             CATCH_INTERNAL_ERROR("No result capture instance");
31125     }
31126
31127     void seedRng(IConfig const& config) {
31128         if (config.rngSeed() != 0) {
31129             std::srand(config.rngSeed());
31130             rng().seed(config.rngSeed());
31131         }
31132     }
31133
31134     unsigned int rngSeed() {
31135         return getCurrentContext().getConfig()->rngSeed();
31136     }
31137
31138 }
31139 // end catch_run_context.cpp
31140 // start catch_section.cpp
31141
31142 namespace Catch {
31143
31144     Section::Section( SectionInfo const& info )
31145     :   m_info( info ),
31146         m_sectionIncluded( getResultCapture().sectionStarted( m_info, m_assertions ) )
31147     {
31148         m_timer.start();
31149     }
31150
31151     Section::~Section() {
31152         if( m_sectionIncluded ) {
31153             SectionEndInfo endInfo{ m_info, m_assertions, m_timer.getElapsedSeconds() };
31154             if( uncaught_exceptions() )
31155                 getResultCapture().sectionEndedEarly( endInfo );
31156             else
31157                 getResultCapture().sectionEnded( endInfo );
31158         }
31159     }
31160
31161     // This indicates whether the section should be executed or not
31162     Section::operator bool() const {
31163         return m_sectionIncluded;
31164     }
31165
31166 } // end namespace Catch
31167 // end catch_section.cpp
31168 // start catch_section_info.cpp
31169
31170 namespace Catch {
31171
31172     SectionInfo::SectionInfo
```

```
31173         (   SourceLineInfo const& _lineInfo,
31174             std::string const& _name )
31175     :   name( _name ),
31176         lineInfo( _lineInfo )
31177     {}
31178
31179 } // end namespace Catch
31180 // end catch_section_info.cpp
31181 // start catch_session.cpp
31182
31183 // start catch_session.h
31184
31185 #include <memory>
31186
31187 namespace Catch {
31188
31189     class Session : NonCopyable {
31190     public:
31191
31192         Session();
31193         ~Session() override;
31194
31195         void showHelp() const;
31196         void libIdentify();
31197
31198         int applyCommandLine( int argc, char const * const * argv );
31199     #if defined(CATCH_CONFIG_WCHAR) && defined(_WIN32) && defined(UNICODE)
31200         int applyCommandLine( int argc, wchar_t const * const * argv );
31201     #endif
31202
31203         void useConfigData( ConfigData const& configData );
31204
31205         template<typename CharT>
31206         int run(int argc, CharT const * const argv[]) {
31207             if (m_startupExceptions)
31208                 return 1;
31209             int returnCode = applyCommandLine(argc, argv);
31210             if (returnCode == 0)
31211                 returnCode = run();
31212             return returnCode;
31213         }
31214
31215         int run();
31216
31217         clara::Parser const& cli() const;
31218         void cli( clara::Parser const& newParser );
31219         ConfigData& configData();
31220         Config& config();
31221     private:
31222         int runInternal();
31223
31224         clara::Parser m_cli;
31225         ConfigData m_configData;
31226         std::shared_ptr<Config> m_config;
31227         bool m_startupExceptions = false;
31228     };
31229
31230 } // end namespace Catch
31231
31232 // end catch_session.h
31233 // start catch_version.h
31234
31235 #include <iosfwd>
31236
31237 namespace Catch {
31238
31239     // Versioning information
31240     struct Version {
31241         Version( Version const& ) = delete;
31242         Version& operator=( Version const& ) = delete;
31243         Version(    unsigned int _majorVersion,
31244                     unsigned int _minorVersion,
31245                     unsigned int _patchNumber,
31246                     char const * const _branchName,
31247                     unsigned int _buildNumber );
31248
31249         unsigned int const majorVersion;
31250         unsigned int const minorVersion;
31251         unsigned int const patchNumber;
31252
31253         // buildNumber is only used if branchName is not null
31254         char const * const branchName;
31255         unsigned int const buildNumber;
31256
31257         friend std::ostream& operator << ( std::ostream& os, Version const& version );
31258     };
31259
```

```
31260     Version const& libraryVersion();
31261 }
31262
31263 // end catch_version.h
31264 #include <cstdlib>
31265 #include <iomanip>
31266 #include <set>
31267 #include <iterator>
31268
31269 namespace Catch {
31270
31271     namespace {
31272         const int MaxExitCode = 255;
31273
31274         IStreamingReporterPtr createReporter(std::string const& reporterName, IConfigPtr const&
      config) {
31275             auto reporter = Catch::getRegistryHub().getReporterRegistry().create(reporterName,
      config);
31276             CATCH_ENFORCE(reporter, "No reporter registered with name: '" « reporterName « "'");
31277
31278             return reporter;
31279         }
31280
31281         IStreamingReporterPtr makeReporter(std::shared_ptr<Config> const& config) {
31282             if (Catch::getRegistryHub().getReporterRegistry().getListeners().empty()) {
31283                 return createReporter(config->getReporterName(), config);
31284             }
31285
31286             // On older platforms, returning std::unique_ptr<ListeningReporter>
31287             // when the return type is std::unique_ptr<IStreamingReporter>
31288             // doesn't compile without a std::move call. However, this causes
31289             // a warning on newer platforms. Thus, we have to work around
31290             // it a bit and downcast the pointer manually.
31291             auto ret = std::unique_ptr<IStreamingReporter>(new ListeningReporter);
31292             auto& multi = static_cast<ListeningReporter&>(*ret);
31293             auto const& listeners = Catch::getRegistryHub().getReporterRegistry().getListeners();
31294             for (auto const& listener : listeners) {
31295                 multi.addListener(listener->create(Catch::ReporterConfig(config)));
31296             }
31297             multi.addReporter(createReporter(config->getReporterName(), config));
31298             return ret;
31299         }
31300
31301         class TestGroup {
31302         public:
31303             explicit TestGroup(std::shared_ptr<Config> const& config)
31304             : m_config{config}
31305             , m_context{config, makeReporter(config)}
31306             {
31307                 auto const& allTestCases = getAllTestCasesSorted(*m_config);
31308                 m_matches = m_config->testSpec().matchesByFilter(allTestCases, *m_config);
31309                 auto const& invalidArgs = m_config->testSpec().getInvalidArgs();
31310
31311                 if (m_matches.empty() && invalidArgs.empty()) {
31312                     for (auto const& test : allTestCases)
31313                         if (!test.isHidden())
31314                             m_tests.emplace(&test);
31315                 } else {
31316                     for (auto const& match : m_matches)
31317                         m_tests.insert(match.tests.begin(), match.tests.end());
31318                 }
31319             }
31320
31321             Totals execute() {
31322                 auto const& invalidArgs = m_config->testSpec().getInvalidArgs();
31323                 Totals totals;
31324                 m_context.testGroupStarting(m_config->name(), 1, 1);
31325                 for (auto const& testCase : m_tests) {
31326                     if (!m_context.aborting())
31327                         totals += m_context.runTest(*testCase);
31328                     else
31329                         m_context.reporter().skipTest(*testCase);
31330                 }
31331
31332                 for (auto const& match : m_matches) {
31333                     if (match.tests.empty()) {
31334                         m_context.reporter().noMatchingTestCases(match.name);
31335                         totals.error = -1;
31336                     }
31337                 }
31338
31339                 if (!invalidArgs.empty()) {
31340                     for (auto const& invalidArg: invalidArgs)
31341                          m_context.reporter().reportInvalidArguments(invalidArg);
31342                 }
31343
31344                 m_context.testGroupEnded(m_config->name(), totals, 1, 1);
```

```
31345                 return totals;
31346             }
31347
31348         private:
31349             using Tests = std::set<TestCase const*>;
31350
31351             std::shared_ptr<Config> m_config;
31352             RunContext m_context;
31353             Tests m_tests;
31354             TestSpec::Matches m_matches;
31355         };
31356
31357         void applyFilenamesAsTags(Catch::IConfig const& config) {
31358             auto& tests = const_cast<std::vector<TestCase>&>(getAllTestCasesSorted(config));
31359             for (auto& testCase : tests) {
31360                 auto tags = testCase.tags;
31361
31362                 std::string filename = testCase.lineInfo.file;
31363                 auto lastSlash = filename.find_last_of("\\/");
31364                 if (lastSlash != std::string::npos) {
31365                     filename.erase(0, lastSlash);
31366                     filename[0] = '#';
31367                 }
31368                 else
31369                 {
31370                     filename.insert(0, "#");
31371                 }
31372
31373                 auto lastDot = filename.find_last_of('.');
31374                 if (lastDot != std::string::npos) {
31375                     filename.erase(lastDot);
31376                 }
31377
31378                 tags.push_back(std::move(filename));
31379                 setTags(testCase, tags);
31380             }
31381         }
31382
31383     } // anon namespace
31384
31385     Session::Session() {
31386         static bool alreadyInstantiated = false;
31387         if( alreadyInstantiated ) {
31388             CATCH_TRY { CATCH_INTERNAL_ERROR( "Only one instance of Catch::Session can ever be used"
      ); }
31389             CATCH_CATCH_ALL { getMutableRegistryHub().registerStartupException(); }
31390         }
31391
31392         // There cannot be exceptions at startup in no-exception mode.
31393 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
31394         const auto& exceptions = getRegistryHub().getStartupExceptionRegistry().getExceptions();
31395         if ( !exceptions.empty() ) {
31396             config();
31397             getCurrentMutableContext().setConfig(m_config);
31398
31399             m_startupExceptions = true;
31400             Colour colourGuard( Colour::Red );
31401             Catch::cerr() << "Errors occurred during startup!" << '\n';
31402             // iterate over all exceptions and notify user
31403             for ( const auto& ex_ptr : exceptions ) {
31404                 try {
31405                     std::rethrow_exception(ex_ptr);
31406                 } catch ( std::exception const& ex ) {
31407                     Catch::cerr() << Column( ex.what() ).indent(2) << '\n';
31408                 }
31409             }
31410         }
31411 #endif
31412
31413         alreadyInstantiated = true;
31414         m_cli = makeCommandLineParser( m_configData );
31415     }
31416     Session::~Session() {
31417         Catch::cleanUp();
31418     }
31419
31420     void Session::showHelp() const {
31421         Catch::cout()
31422                 << "\nCatch v" << libraryVersion() << "\n"
31423                 << m_cli << std::endl
31424                 << "For more detailed usage please see the project docs\n" << std::endl;
31425     }
31426     void Session::libIdentify() {
31427         Catch::cout()
31428                 << std::left << std::setw(16) << "description: " << "A Catch2 test executable\n"
31429                 << std::left << std::setw(16) << "category: " << "testframework\n"
31430                 << std::left << std::setw(16) << "framework: " << "Catch Test\n"
```

```
31431                 « std::left « std::setw(16) « "version: " « libraryVersion() « std::endl;
31432     }
31433
31434     int Session::applyCommandLine( int argc, char const * const * argv ) {
31435         if( m_startupExceptions )
31436             return 1;
31437
31438         auto result = m_cli.parse( clara::Args( argc, argv ) );
31439         if( !result ) {
31440             config();
31441             getCurrentMutableContext().setConfig(m_config);
31442             Catch::cerr()
31443                 « Colour( Colour::Red )
31444                 « "\nError(s) in input:\n"
31445                 « Column( result.errorMessage() ).indent( 2 )
31446                 « "\n\n";
31447             Catch::cerr() « "Run with -? for usage\n" « std::endl;
31448             return MaxExitCode;
31449         }
31450
31451         if( m_configData.showHelp )
31452             showHelp();
31453         if( m_configData.libIdentify )
31454             libIdentify();
31455         m_config.reset();
31456         return 0;
31457     }
31458
31459 #if defined(CATCH_CONFIG_WCHAR) && defined(_WIN32) && defined(UNICODE)
31460     int Session::applyCommandLine( int argc, wchar_t const * const * argv ) {
31461
31462         char **utf8Argv = new char *[ argc ];
31463
31464         for ( int i = 0; i < argc; ++i ) {
31465             int bufSize = WideCharToMultiByte( CP_UTF8, 0, argv[i], -1, nullptr, 0, nullptr, nullptr
      );
31466
31467             utf8Argv[ i ] = new char[ bufSize ];
31468
31469             WideCharToMultiByte( CP_UTF8, 0, argv[i], -1, utf8Argv[i], bufSize, nullptr, nullptr );
31470         }
31471
31472         int returnCode = applyCommandLine( argc, utf8Argv );
31473
31474         for ( int i = 0; i < argc; ++i )
31475             delete [] utf8Argv[ i ];
31476
31477         delete [] utf8Argv;
31478
31479         return returnCode;
31480     }
31481 #endif
31482
31483     void Session::useConfigData( ConfigData const& configData ) {
31484         m_configData = configData;
31485         m_config.reset();
31486     }
31487
31488     int Session::run() {
31489         if( ( m_configData.waitForKeypress & WaitForKeypress::BeforeStart ) != 0 ) {
31490             Catch::cout() « "...waiting for enter/ return before starting" « std::endl;
31491             static_cast<void>(std::getchar());
31492         }
31493         int exitCode = runInternal();
31494         if( ( m_configData.waitForKeypress & WaitForKeypress::BeforeExit ) != 0 ) {
31495             Catch::cout() « "...waiting for enter/ return before exiting, with code: " « exitCode «
      std::endl;
31496             static_cast<void>(std::getchar());
31497         }
31498         return exitCode;
31499     }
31500
31501     clara::Parser const& Session::cli() const {
31502         return m_cli;
31503     }
31504     void Session::cli( clara::Parser const& newParser ) {
31505         m_cli = newParser;
31506     }
31507     ConfigData& Session::configData() {
31508         return m_configData;
31509     }
31510     Config& Session::config() {
31511         if( !m_config )
31512             m_config = std::make_shared<Config>( m_configData );
31513         return *m_config;
31514     }
31515
```

```
31516     int Session::runInternal() {
31517         if( m_startupExceptions )
31518             return 1;
31519
31520         if (m_configData.showHelp || m_configData.libIdentify) {
31521             return 0;
31522         }
31523
31524         CATCH_TRY {
31525             config(); // Force config to be constructed
31526
31527             seedRng( *m_config );
31528
31529             if( m_configData.filenamesAsTags )
31530                 applyFilenamesAsTags( *m_config );
31531
31532             // Handle list request
31533             if( Option<std::size_t> listed = list( m_config ) )
31534                 return (std::min) (MaxExitCode, static_cast<int>(*listed));
31535
31536             TestGroup tests { m_config };
31537             auto const totals = tests.execute();
31538
31539             if( m_config->warnAboutNoTests() && totals.error == -1 )
31540                 return 2;
31541
31542             // Note that on unices only the lower 8 bits are usually used, clamping
31543             // the return value to 255 prevents false negative when some multiple
31544             // of 256 tests has failed
31545             return (std::min) (MaxExitCode, (std::max) (totals.error,
      static_cast<int>(totals.assertions.failed)));
31546         }
31547 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
31548         catch( std::exception& ex ) {
31549             Catch::cerr() << ex.what() << std::endl;
31550             return MaxExitCode;
31551         }
31552 #endif
31553     }
31554
31555 } // end namespace Catch
31556 // end catch_session.cpp
31557 // start catch_singletons.cpp
31558
31559 #include <vector>
31560
31561 namespace Catch {
31562
31563     namespace {
31564         static auto getSingletons() -> std::vector<ISingleton*>*& {
31565             static std::vector<ISingleton*>* g_singletons = nullptr;
31566             if( !g_singletons )
31567                 g_singletons = new std::vector<ISingleton*>();
31568             return g_singletons;
31569         }
31570     }
31571
31572     ISingleton::~ISingleton() {}
31573
31574     void addSingleton(ISingleton* singleton ) {
31575         getSingletons()->push_back( singleton );
31576     }
31577     void cleanupSingletons() {
31578         auto& singletons = getSingletons();
31579         for( auto singleton : *singletons )
31580             delete singleton;
31581         delete singletons;
31582         singletons = nullptr;
31583     }
31584
31585 } // namespace Catch
31586 // end catch_singletons.cpp
31587 // start catch_startup_exception_registry.cpp
31588
31589 #if !defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
31590 namespace Catch {
31591 void StartupExceptionRegistry::add( std::exception_ptr const& exception ) noexcept {
31592         CATCH_TRY {
31593             m_exceptions.push_back(exception);
31594         } CATCH_CATCH_ALL {
31595             // If we run out of memory during start-up there's really not a lot more we can do about
      it
31596             std::terminate();
31597         }
31598     }
31599
31600     std::vector<std::exception_ptr> const& StartupExceptionRegistry::getExceptions() const noexcept {
```

```
31601         return m_exceptions;
31602     }
31603
31604 } // end namespace Catch
31605 #endif
31606 // end catch_startup_exception_registry.cpp
31607 // start catch_stream.cpp
31608
31609 #include <cstdio>
31610 #include <iostream>
31611 #include <fstream>
31612 #include <sstream>
31613 #include <vector>
31614 #include <memory>
31615
31616 namespace Catch {
31617
31618     Catch::IStream::~IStream() = default;
31619
31620     namespace Detail { namespace {
31621         template<typename WriterF, std::size_t bufferSize=256>
31622         class StreamBufImpl : public std::streambuf {
31623             char data[bufferSize];
31624             WriterF m_writer;
31625
31626         public:
31627             StreamBufImpl() {
31628                 setp( data, data + sizeof(data) );
31629             }
31630
31631             ~StreamBufImpl() noexcept {
31632                 StreamBufImpl::sync();
31633             }
31634
31635         private:
31636             int overflow( int c ) override {
31637                 sync();
31638
31639                 if( c != EOF ) {
31640                     if( pbase() == epptr() )
31641                         m_writer( std::string( 1, static_cast<char>( c ) ) );
31642                     else
31643                         sputc( static_cast<char>( c ) );
31644                 }
31645                 return 0;
31646             }
31647
31648             int sync() override {
31649                 if( pbase() != pptr() ) {
31650                     m_writer( std::string( pbase(), static_cast<std::string::size_type>( pptr() -
     pbase() ) ) );
31651                     setp( pbase(), epptr() );
31652                 }
31653                 return 0;
31654             }
31655         };
31656
31658
31659         struct OutputDebugWriter {
31660
31661             void operator()( std::string const&str ) {
31662                 writeToDebugConsole( str );
31663             }
31664         };
31665
31667
31668         class FileStream : public IStream {
31669             mutable std::ofstream m_ofs;
31670         public:
31671             FileStream( StringRef filename ) {
31672                 m_ofs.open( filename.c_str() );
31673                 CATCH_ENFORCE( !m_ofs.fail(), "Unable to open file: '" « filename « "'" );
31674             }
31675             ~FileStream() override = default;
31676         public: // IStream
31677             std::ostream& stream() const override {
31678                 return m_ofs;
31679             }
31680         };
31681
31683
31684         class CoutStream : public IStream {
31685             mutable std::ostream m_os;
31686         public:
31687             // Store the streambuf from cout up-front because
31688             // cout may get redirected when running tests
31689             CoutStream() : m_os( Catch::cout().rdbuf() ) {}
```

```
31690             ~CoutStream() override = default;
31691
31692         public: // IStream
31693             std::ostream& stream() const override { return m_os; }
31694         };
31695
31697
31698         class DebugOutStream : public IStream {
31699             std::unique_ptr<StreamBufImpl<OutputDebugWriter» m_streamBuf;
31700             mutable std::ostream m_os;
31701         public:
31702             DebugOutStream()
31703             :   m_streamBuf( new StreamBufImpl<OutputDebugWriter>() ),
31704                 m_os( m_streamBuf.get() )
31705             {}
31706
31707             ~DebugOutStream() override = default;
31708
31709         public: // IStream
31710             std::ostream& stream() const override { return m_os; }
31711         };
31712
31713     }} // namespace anon::detail
31714
31716
31717     auto makeStream( StringRef const &filename ) -> IStream const* {
31718         if( filename.empty() )
31719             return new Detail::CoutStream();
31720         else if( filename[0] == '%' ) {
31721             if( filename == "%debug" )
31722                 return new Detail::DebugOutStream();
31723             else
31724                 CATCH_ERROR( "Unrecognised stream: '" « filename « "'" );
31725         }
31726         else
31727             return new Detail::FileStream( filename );
31728     }
31729
31730     // This class encapsulates the idea of a pool of ostringstreams that can be reused.
31731     struct StringStreams {
31732         std::vector<std::unique_ptr<std::ostringstream» m_streams;
31733         std::vector<std::size_t> m_unused;
31734         std::ostringstream m_referenceStream; // Used for copy state/ flags from
31735
31736         auto add() -> std::size_t {
31737             if( m_unused.empty() ) {
31738                 m_streams.push_back( std::unique_ptr<std::ostringstream>( new std::ostringstream ) );
31739                 return m_streams.size()-1;
31740             }
31741             else {
31742                 auto index = m_unused.back();
31743                 m_unused.pop_back();
31744                 return index;
31745             }
31746         }
31747
31748         void release( std::size_t index ) {
31749             m_streams[index]->copyfmt( m_referenceStream ); // Restore initial flags and other state
31750             m_unused.push_back(index);
31751         }
31752     };
31753
31754     ReusableStringStream::ReusableStringStream()
31755     :   m_index( Singleton<StringStreams>::getMutable().add() ),
31756         m_oss( Singleton<StringStreams>::getMutable().m_streams[m_index].get() )
31757     {}
31758
31759     ReusableStringStream::~ReusableStringStream() {
31760         static_cast<std::ostringstream*>( m_oss )->str("");
31761         m_oss->clear();
31762         Singleton<StringStreams>::getMutable().release( m_index );
31763     }
31764
31765     auto ReusableStringStream::str() const -> std::string {
31766         return static_cast<std::ostringstream*>( m_oss )->str();
31767     }
31768
31770
31771 #ifndef CATCH_CONFIG_NOSTDOUT // If you #define this you must implement these functions
31772     std::ostream& cout() { return std::cout; }
31773     std::ostream& cerr() { return std::cerr; }
31774     std::ostream& clog() { return std::clog; }
31775 #endif
31776 }
31777 // end catch_stream.cpp
31778 // start catch_string_manip.cpp
31779
```

```
31780 #include <algorithm>
31781 #include <ostream>
31782 #include <cstring>
31783 #include <cctype>
31784 #include <vector>
31785
31786 namespace Catch {
31787
31788     namespace {
31789         char toLowerCh(char c) {
31790             return static_cast<char>( std::tolower( static_cast<unsigned char>(c) ) );
31791         }
31792     }
31793
31794     bool startsWith( std::string const& s, std::string const& prefix ) {
31795         return s.size() >= prefix.size() && std::equal(prefix.begin(), prefix.end(), s.begin());
31796     }
31797     bool startsWith( std::string const& s, char prefix ) {
31798         return !s.empty() && s[0] == prefix;
31799     }
31800     bool endsWith( std::string const& s, std::string const& suffix ) {
31801         return s.size() >= suffix.size() && std::equal(suffix.rbegin(), suffix.rend(), s.rbegin());
31802     }
31803     bool endsWith( std::string const& s, char suffix ) {
31804         return !s.empty() && s[s.size()-1] == suffix;
31805     }
31806     bool contains( std::string const& s, std::string const& infix ) {
31807         return s.find( infix ) != std::string::npos;
31808     }
31809     void toLowerInPlace( std::string& s ) {
31810         std::transform( s.begin(), s.end(), s.begin(), toLowerCh );
31811     }
31812     std::string toLower( std::string const& s ) {
31813         std::string lc = s;
31814         toLowerInPlace( lc );
31815         return lc;
31816     }
31817     std::string trim( std::string const& str ) {
31818         static char const* whitespaceChars = "\n\r\t ";
31819         std::string::size_type start = str.find_first_not_of( whitespaceChars );
31820         std::string::size_type end = str.find_last_not_of( whitespaceChars );
31821
31822         return start != std::string::npos ? str.substr( start, 1+end-start ) : std::string();
31823     }
31824
31825     StringRef trim(StringRef ref) {
31826         const auto is_ws = [](char c) {
31827             return c == ' ' || c == '\t' || c == '\n' || c == '\r';
31828         };
31829         size_t real_begin = 0;
31830         while (real_begin < ref.size() && is_ws(ref[real_begin])) { ++real_begin; }
31831         size_t real_end = ref.size();
31832         while (real_end > real_begin && is_ws(ref[real_end - 1])) { --real_end; }
31833
31834         return ref.substr(real_begin, real_end - real_begin);
31835     }
31836
31837     bool replaceInPlace( std::string& str, std::string const& replaceThis, std::string const& withThis
      ) {
31838         bool replaced = false;
31839         std::size_t i = str.find( replaceThis );
31840         while( i != std::string::npos ) {
31841             replaced = true;
31842             str = str.substr( 0, i ) + withThis + str.substr( i+replaceThis.size() );
31843             if( i < str.size()-withThis.size() )
31844                 i = str.find( replaceThis, i+withThis.size() );
31845             else
31846                 i = std::string::npos;
31847         }
31848         return replaced;
31849     }
31850
31851     std::vector<StringRef> splitStringRef( StringRef str, char delimiter ) {
31852         std::vector<StringRef> subStrings;
31853         std::size_t start = 0;
31854         for(std::size_t pos = 0; pos < str.size(); ++pos ) {
31855             if( str[pos] == delimiter ) {
31856                 if( pos - start > 1 )
31857                     subStrings.push_back( str.substr( start, pos-start ) );
31858                 start = pos+1;
31859             }
31860         }
31861         if( start < str.size() )
31862             subStrings.push_back( str.substr( start, str.size()-start ) );
31863         return subStrings;
31864     }
31865
```

```
31866     pluralise::pluralise( std::size_t count, std::string const& label )
31867     :   m_count( count ),
31868         m_label( label )
31869     {}
31870
31871     std::ostream& operator « ( std::ostream& os, pluralise const& pluraliser ) {
31872         os « pluraliser.m_count « ' ' « pluraliser.m_label;
31873         if( pluraliser.m_count != 1 )
31874             os « 's';
31875         return os;
31876     }
31877
31878 }
31879 // end catch_string_manip.cpp
31880 // start catch_stringref.cpp
31881
31882 #include <algorithm>
31883 #include <ostream>
31884 #include <cstring>
31885 #include <cstdint>
31886
31887 namespace Catch {
31888     StringRef::StringRef( char const* rawChars ) noexcept
31889     : StringRef( rawChars, static_cast<StringRef::size_type>(std::strlen(rawChars) ) )
31890     {}
31891
31892     auto StringRef::c_str() const -> char const* {
31893         CATCH_ENFORCE(isNullTerminated(), "Called StringRef::c_str() on a non-null-terminated
      instance");
31894         return m_start;
31895     }
31896     auto StringRef::data() const noexcept -> char const* {
31897         return m_start;
31898     }
31899
31900     auto StringRef::substr( size_type start, size_type size ) const noexcept -> StringRef {
31901         if (start < m_size) {
31902             return StringRef(m_start + start, (std::min)(m_size - start, size));
31903         } else {
31904             return StringRef();
31905         }
31906     }
31907     auto StringRef::operator == ( StringRef const& other ) const noexcept -> bool {
31908         return m_size == other.m_size
31909             && (std::memcmp( m_start, other.m_start, m_size ) == 0);
31910     }
31911
31912     auto operator « ( std::ostream& os, StringRef const& str ) -> std::ostream& {
31913         return os.write(str.data(), str.size());
31914     }
31915
31916     auto operator+=( std::string& lhs, StringRef const& rhs ) -> std::string& {
31917         lhs.append(rhs.data(), rhs.size());
31918         return lhs;
31919     }
31920
31921 } // namespace Catch
31922 // end catch_stringref.cpp
31923 // start catch_tag_alias.cpp
31924
31925 namespace Catch {
31926     TagAlias::TagAlias(std::string const & _tag, SourceLineInfo _lineInfo): tag(_tag),
      lineInfo(_lineInfo) {}
31927 }
31928 // end catch_tag_alias.cpp
31929 // start catch_tag_alias_autoregistrar.cpp
31930
31931 namespace Catch {
31932
31933     RegistrarForTagAliases::RegistrarForTagAliases(char const* alias, char const* tag, SourceLineInfo
      const& lineInfo) {
31934         CATCH_TRY {
31935             getMutableRegistryHub().registerTagAlias(alias, tag, lineInfo);
31936         } CATCH_CATCH_ALL {
31937             // Do not throw when constructing global objects, instead register the exception to be
      processed later
31938             getMutableRegistryHub().registerStartupException();
31939         }
31940     }
31941
31942 }
31943 // end catch_tag_alias_autoregistrar.cpp
31944 // start catch_tag_alias_registry.cpp
31945
31946 #include <sstream>
31947
31948 namespace Catch {
```

```
31949
31950     TagAliasRegistry::~TagAliasRegistry() {}
31951
31952     TagAlias const* TagAliasRegistry::find( std::string const& alias ) const {
31953         auto it = m_registry.find( alias );
31954         if( it != m_registry.end() )
31955             return &(it->second);
31956         else
31957             return nullptr;
31958     }
31959
31960     std::string TagAliasRegistry::expandAliases( std::string const& unexpandedTestSpec ) const {
31961         std::string expandedTestSpec = unexpandedTestSpec;
31962         for( auto const& registryKvp : m_registry ) {
31963             std::size_t pos = expandedTestSpec.find( registryKvp.first );
31964             if( pos != std::string::npos ) {
31965                 expandedTestSpec =  expandedTestSpec.substr( 0, pos ) +
31966                                     registryKvp.second.tag +
31967                                     expandedTestSpec.substr( pos + registryKvp.first.size() );
31968             }
31969         }
31970         return expandedTestSpec;
31971     }
31972
31973     void TagAliasRegistry::add( std::string const& alias, std::string const& tag, SourceLineInfo
      const& lineInfo ) {
31974         CATCH_ENFORCE( startsWith(alias, "[@") && endsWith(alias, ']'),
31975                        "error: tag alias, '" « alias « "' is not of the form [@alias name].\n" «
      lineInfo );
31976
31977         CATCH_ENFORCE( m_registry.insert(std::make_pair(alias, TagAlias(tag, lineInfo))).second,
31978                        "error: tag alias, '" « alias « "' already registered.\n"
31979                        « "\tFirst seen at: " « find(alias)->lineInfo « "\n"
31980                        « "\tRedefined at: " « lineInfo );
31981     }
31982
31983     ITagAliasRegistry::~ITagAliasRegistry() {}
31984
31985     ITagAliasRegistry const& ITagAliasRegistry::get() {
31986         return getRegistryHub().getTagAliasRegistry();
31987     }
31988
31989 } // end namespace Catch
31990 // end catch_tag_alias_registry.cpp
31991 // start catch_test_case_info.cpp
31992
31993 #include <cctype>
31994 #include <exception>
31995 #include <algorithm>
31996 #include <sstream>
31997
31998 namespace Catch {
31999
32000     namespace {
32001         TestCaseInfo::SpecialProperties parseSpecialTag( std::string const& tag ) {
32002             if( startsWith( tag, '.' ) ||
32003                 tag == "!hide" )
32004                 return TestCaseInfo::IsHidden;
32005             else if( tag == "!throws" )
32006                 return TestCaseInfo::Throws;
32007             else if( tag == "!shouldfail" )
32008                 return TestCaseInfo::ShouldFail;
32009             else if( tag == "!mayfail" )
32010                 return TestCaseInfo::MayFail;
32011             else if( tag == "!nonportable" )
32012                 return TestCaseInfo::NonPortable;
32013             else if( tag == "!benchmark" )
32014                 return static_cast<TestCaseInfo::SpecialProperties>( TestCaseInfo::Benchmark |
      TestCaseInfo::IsHidden );
32015             else
32016                 return TestCaseInfo::None;
32017         }
32018         bool isReservedTag( std::string const& tag ) {
32019             return parseSpecialTag( tag ) == TestCaseInfo::None && tag.size() > 0 && !std::isalnum(
      static_cast<unsigned char>(tag[0]) );
32020         }
32021         void enforceNotReservedTag( std::string const& tag, SourceLineInfo const& _lineInfo ) {
32022             CATCH_ENFORCE( !isReservedTag(tag),
32023                            "Tag name: [" « tag « "] is not allowed.\n"
32024                            « "Tag names starting with non alphanumeric characters are reserved\n"
32025                            « _lineInfo );
32026         }
32027     }
32028
32029     TestCase makeTestCase(  ITestInvoker* _testCase,
32030                             std::string const& _className,
32031                             NameAndTags const& nameAndTags,
```

```
32032                           SourceLineInfo const& _lineInfo )
32033     {
32034         bool isHidden = false;
32035
32036         // Parse out tags
32037         std::vector<std::string> tags;
32038         std::string desc, tag;
32039         bool inTag = false;
32040         for (char c : nameAndTags.tags) {
32041             if( !inTag ) {
32042                 if( c == '[' )
32043                     inTag = true;
32044                 else
32045                     desc += c;
32046             }
32047             else {
32048                 if( c == ']' ) {
32049                     TestCaseInfo::SpecialProperties prop = parseSpecialTag( tag );
32050                     if( ( prop & TestCaseInfo::IsHidden ) != 0 )
32051                         isHidden = true;
32052                     else if( prop == TestCaseInfo::None )
32053                         enforceNotReservedTag( tag, _lineInfo );
32054
32055                     // Merged hide tags like `[.approvals]` should be added as
32056                     // `[.][approvals]`. The `[.]` is added at later point, so
32057                     // we only strip the prefix
32058                     if (startsWith(tag, '.') && tag.size() > 1) {
32059                         tag.erase(0, 1);
32060                     }
32061                     tags.push_back( tag );
32062                     tag.clear();
32063                     inTag = false;
32064                 }
32065                 else
32066                     tag += c;
32067             }
32068         }
32069         if( isHidden ) {
32070             // Add all "hidden" tags to make them behave identically
32071             tags.insert( tags.end(), { ".", "!hide" } );
32072         }
32073
32074         TestCaseInfo info( static_cast<std::string>(nameAndTags.name), _className, desc, tags,
      _lineInfo );
32075         return TestCase( _testCase, std::move(info) );
32076     }
32077
32078     void setTags( TestCaseInfo& testCaseInfo, std::vector<std::string> tags ) {
32079         std::sort(begin(tags), end(tags));
32080         tags.erase(std::unique(begin(tags), end(tags)), end(tags));
32081         testCaseInfo.lcaseTags.clear();
32082
32083         for( auto const& tag : tags ) {
32084             std::string lcaseTag = toLower( tag );
32085             testCaseInfo.properties = static_cast<TestCaseInfo::SpecialProperties>(
      testCaseInfo.properties | parseSpecialTag( lcaseTag ) );
32086             testCaseInfo.lcaseTags.push_back( lcaseTag );
32087         }
32088         testCaseInfo.tags = std::move(tags);
32089     }
32090
32091     TestCaseInfo::TestCaseInfo( std::string const& _name,
32092                                 std::string const& _className,
32093                                 std::string const& _description,
32094                                 std::vector<std::string> const& _tags,
32095                                 SourceLineInfo const& _lineInfo )
32096     :   name( _name ),
32097         className( _className ),
32098         description( _description ),
32099         lineInfo( _lineInfo ),
32100         properties( None )
32101     {
32102         setTags( *this, _tags );
32103     }
32104
32105     bool TestCaseInfo::isHidden() const {
32106         return ( properties & IsHidden ) != 0;
32107     }
32108     bool TestCaseInfo::throws() const {
32109         return ( properties & Throws ) != 0;
32110     }
32111     bool TestCaseInfo::okToFail() const {
32112         return ( properties & (ShouldFail | MayFail ) ) != 0;
32113     }
32114     bool TestCaseInfo::expectedToFail() const {
32115         return ( properties & (ShouldFail ) ) != 0;
32116     }
```

```
32117
32118     std::string TestCaseInfo::tagsAsString() const {
32119         std::string ret;
32120         // '[' and ']' per tag
32121         std::size_t full_size = 2 * tags.size();
32122         for (const auto& tag : tags) {
32123             full_size += tag.size();
32124         }
32125         ret.reserve(full_size);
32126         for (const auto& tag : tags) {
32127             ret.push_back('[');
32128             ret.append(tag);
32129             ret.push_back(']');
32130         }
32131
32132         return ret;
32133     }
32134
32135     TestCase::TestCase( ITestInvoker* testCase, TestCaseInfo&& info ) : TestCaseInfo( std::move(info)
      ), test( testCase ) {}
32136
32137     TestCase TestCase::withName( std::string const& _newName ) const {
32138         TestCase other( *this );
32139         other.name = _newName;
32140         return other;
32141     }
32142
32143     void TestCase::invoke() const {
32144         test->invoke();
32145     }
32146
32147     bool TestCase::operator == ( TestCase const& other ) const {
32148         return  test.get() == other.test.get() &&
32149                 name == other.name &&
32150                 className == other.className;
32151     }
32152
32153     bool TestCase::operator < ( TestCase const& other ) const {
32154         return name < other.name;
32155     }
32156
32157     TestCaseInfo const& TestCase::getTestCaseInfo() const
32158     {
32159         return *this;
32160     }
32161
32162 } // end namespace Catch
32163 // end catch_test_case_info.cpp
32164 // start catch_test_case_registry_impl.cpp
32165
32166 #include <algorithm>
32167 #include <sstream>
32168
32169 namespace Catch {
32170
32171     namespace {
32172         struct TestHasher {
32173             using hash_t = uint64_t;
32174
32175             explicit TestHasher( hash_t hashSuffix ):
32176                 m_hashSuffix{ hashSuffix } {}
32177
32178             uint32_t operator()( TestCase const& t ) const {
32179                 // FNV-1a hash with multiplication fold.
32180                 const hash_t prime = 1099511628211u;
32181                 hash_t hash = 14695981039346656037u;
32182                 for ( const char c : t.name ) {
32183                     hash ^= c;
32184                     hash *= prime;
32185                 }
32186                 hash ^= m_hashSuffix;
32187                 hash *= prime;
32188                 const uint32_t low{ static_cast<uint32_t>( hash ) };
32189                 const uint32_t high{ static_cast<uint32_t>( hash >> 32 ) };
32190                 return low * high;
32191             }
32192
32193         private:
32194             hash_t m_hashSuffix;
32195         };
32196     } // end unnamed namespace
32197
32198     std::vector<TestCase> sortTests( IConfig const& config, std::vector<TestCase> const&
      unsortedTestCases ) {
32199         switch( config.runOrder() ) {
32200             case RunTests::InDeclarationOrder:
32201                 // already in declaration order
```

```
32202                 break;
32203
32204             case RunTests::InLexicographicalOrder: {
32205                 std::vector<TestCase> sorted = unsortedTestCases;
32206                 std::sort( sorted.begin(), sorted.end() );
32207                 return sorted;
32208             }
32209
32210             case RunTests::InRandomOrder: {
32211                 seedRng( config );
32212                 TestHasher h{ config.rngSeed() };
32213
32214                 using hashedTest = std::pair<TestHasher::hash_t, TestCase const*>;
32215                 std::vector<hashedTest> indexed_tests;
32216                 indexed_tests.reserve( unsortedTestCases.size() );
32217
32218                 for (auto const& testCase : unsortedTestCases) {
32219                     indexed_tests.emplace_back(h(testCase), &testCase);
32220                 }
32221
32222                 std::sort(indexed_tests.begin(), indexed_tests.end(),
32223                           [](hashedTest const& lhs, hashedTest const& rhs) {
32224                           if (lhs.first == rhs.first) {
32225                               return lhs.second->name < rhs.second->name;
32226                           }
32227                           return lhs.first < rhs.first;
32228                 });
32229
32230                 std::vector<TestCase> sorted;
32231                 sorted.reserve( indexed_tests.size() );
32232
32233                 for (auto const& hashed : indexed_tests) {
32234                     sorted.emplace_back(*hashed.second);
32235                 }
32236
32237                 return sorted;
32238             }
32239         }
32240         return unsortedTestCases;
32241     }
32242
32243     bool isThrowSafe( TestCase const& testCase, IConfig const& config ) {
32244         return !testCase.throws() || config.allowThrows();
32245     }
32246
32247     bool matchTest( TestCase const& testCase, TestSpec const& testSpec, IConfig const& config ) {
32248         return testSpec.matches( testCase ) && isThrowSafe( testCase, config );
32249     }
32250
32251     void enforceNoDuplicateTestCases( std::vector<TestCase> const& functions ) {
32252         std::set<TestCase> seenFunctions;
32253         for( auto const& function : functions ) {
32254             auto prev = seenFunctions.insert( function );
32255             CATCH_ENFORCE( prev.second,
32256                     "error: TEST_CASE( \"" « function.name « "\" ) already defined.\n"
32257                     « "\tFirst seen at " « prev.first->getTestCaseInfo().lineInfo « "\n"
32258                     « "\tRedefined at " « function.getTestCaseInfo().lineInfo );
32259         }
32260     }
32261
32262     std::vector<TestCase> filterTests( std::vector<TestCase> const& testCases, TestSpec const&
    testSpec, IConfig const& config ) {
32263         std::vector<TestCase> filtered;
32264         filtered.reserve( testCases.size() );
32265         for (auto const& testCase : testCases) {
32266             if ((!testSpec.hasFilters() && !testCase.isHidden()) ||
32267                 (testSpec.hasFilters() && matchTest(testCase, testSpec, config))) {
32268                 filtered.push_back(testCase);
32269             }
32270         }
32271         return filtered;
32272     }
32273     std::vector<TestCase> const& getAllTestCasesSorted( IConfig const& config ) {
32274         return getRegistryHub().getTestCaseRegistry().getAllTestsSorted( config );
32275     }
32276
32277     void TestRegistry::registerTest( TestCase const& testCase ) {
32278         std::string name = testCase.getTestCaseInfo().name;
32279         if( name.empty() ) {
32280             ReusableStringStream rss;
32281             rss « "Anonymous test case " « ++m_unnamedCount;
32282             return registerTest( testCase.withName( rss.str() ) );
32283         }
32284         m_functions.push_back( testCase );
32285     }
32286
32287     std::vector<TestCase> const& TestRegistry::getAllTests() const {
```

```
32288         return m_functions;
32289     }
32290     std::vector<TestCase> const& TestRegistry::getAllTestsSorted( IConfig const& config ) const {
32291         if( m_sortedFunctions.empty() )
32292             enforceNoDuplicateTestCases( m_functions );
32293
32294         if(  m_currentSortOrder != config.runOrder() || m_sortedFunctions.empty() ) {
32295             m_sortedFunctions = sortTests( config, m_functions );
32296             m_currentSortOrder = config.runOrder();
32297         }
32298         return m_sortedFunctions;
32299     }
32300
32302     TestInvokerAsFunction::TestInvokerAsFunction( void(*testAsFunction)() ) noexcept :
      m_testAsFunction( testAsFunction ) {}
32303
32304     void TestInvokerAsFunction::invoke() const {
32305         m_testAsFunction();
32306     }
32307
32308     std::string extractClassName( StringRef const& classOrQualifiedMethodName ) {
32309         std::string className(classOrQualifiedMethodName);
32310         if( startsWith( className, '&' ) )
32311         {
32312             std::size_t lastColons = className.rfind( "::" );
32313             std::size_t penultimateColons = className.rfind( "::", lastColons-1 );
32314             if( penultimateColons == std::string::npos )
32315                 penultimateColons = 1;
32316             className = className.substr( penultimateColons, lastColons-penultimateColons );
32317         }
32318         return className;
32319     }
32320
32321 } // end namespace Catch
32322 // end catch_test_case_registry_impl.cpp
32323 // start catch_test_case_tracker.cpp
32324
32325 #include <algorithm>
32326 #include <cassert>
32327 #include <stdexcept>
32328 #include <memory>
32329 #include <sstream>
32330
32331 #if defined(__clang__)
32332 #    pragma clang diagnostic push
32333 #    pragma clang diagnostic ignored "-Wexit-time-destructors"
32334 #endif
32335
32336 namespace Catch {
32337 namespace TestCaseTracking {
32338
32339     NameAndLocation::NameAndLocation( std::string const& _name, SourceLineInfo const& _location )
32340     :   name( _name ),
32341         location( _location )
32342     {}
32343
32344     ITracker::~ITracker() = default;
32345
32346     ITracker& TrackerContext::startRun() {
32347         m_rootTracker = std::make_shared<SectionTracker>( NameAndLocation( "{root}",
      CATCH_INTERNAL_LINEINFO ), *this, nullptr );
32348         m_currentTracker = nullptr;
32349         m_runState = Executing;
32350         return *m_rootTracker;
32351     }
32352
32353     void TrackerContext::endRun() {
32354         m_rootTracker.reset();
32355         m_currentTracker = nullptr;
32356         m_runState = NotStarted;
32357     }
32358
32359     void TrackerContext::startCycle() {
32360         m_currentTracker = m_rootTracker.get();
32361         m_runState = Executing;
32362     }
32363     void TrackerContext::completeCycle() {
32364         m_runState = CompletedCycle;
32365     }
32366
32367     bool TrackerContext::completedCycle() const {
32368         return m_runState == CompletedCycle;
32369     }
32370     ITracker& TrackerContext::currentTracker() {
32371         return *m_currentTracker;
32372     }
32373     void TrackerContext::setCurrentTracker( ITracker* tracker ) {
```

```
32374         m_currentTracker = tracker;
32375     }
32376
32377     TrackerBase::TrackerBase( NameAndLocation const& nameAndLocation, TrackerContext& ctx, ITracker*
      parent ):
32378         ITracker(nameAndLocation),
32379         m_ctx( ctx ),
32380         m_parent( parent )
32381     {}
32382
32383     bool TrackerBase::isComplete() const {
32384         return m_runState == CompletedSuccessfully || m_runState == Failed;
32385     }
32386     bool TrackerBase::isSuccessfullyCompleted() const {
32387         return m_runState == CompletedSuccessfully;
32388     }
32389     bool TrackerBase::isOpen() const {
32390         return m_runState != NotStarted && !isComplete();
32391     }
32392     bool TrackerBase::hasChildren() const {
32393         return !m_children.empty();
32394     }
32395
32396     void TrackerBase::addChild( ITrackerPtr const& child ) {
32397         m_children.push_back( child );
32398     }
32399
32400     ITrackerPtr TrackerBase::findChild( NameAndLocation const& nameAndLocation ) {
32401         auto it = std::find_if( m_children.begin(), m_children.end(),
32402             [&nameAndLocation]( ITrackerPtr const& tracker ){
32403                 return
32404                     tracker->nameAndLocation().location == nameAndLocation.location &&
32405                     tracker->nameAndLocation().name == nameAndLocation.name;
32406             } );
32407         return( it != m_children.end() )
32408             ? *it
32409             : nullptr;
32410     }
32411     ITracker& TrackerBase::parent() {
32412         assert( m_parent ); // Should always be non-null except for root
32413         return *m_parent;
32414     }
32415
32416     void TrackerBase::openChild() {
32417         if( m_runState != ExecutingChildren ) {
32418             m_runState = ExecutingChildren;
32419             if( m_parent )
32420                 m_parent->openChild();
32421         }
32422     }
32423
32424     bool TrackerBase::isSectionTracker() const { return false; }
32425     bool TrackerBase::isGeneratorTracker() const { return false; }
32426
32427     void TrackerBase::open() {
32428         m_runState = Executing;
32429         moveToThis();
32430         if( m_parent )
32431             m_parent->openChild();
32432     }
32433
32434     void TrackerBase::close() {
32435
32436         // Close any still open children (e.g. generators)
32437         while( &m_ctx.currentTracker() != this )
32438             m_ctx.currentTracker().close();
32439
32440         switch( m_runState ) {
32441             case NeedsAnotherRun:
32442                 break;
32443
32444             case Executing:
32445                 m_runState = CompletedSuccessfully;
32446                 break;
32447             case ExecutingChildren:
32448                 if( std::all_of(m_children.begin(), m_children.end(), [](ITrackerPtr const& t){ return
      t->isComplete(); }) )
32449                     m_runState = CompletedSuccessfully;
32450                 break;
32451
32452             case NotStarted:
32453             case CompletedSuccessfully:
32454             case Failed:
32455                 CATCH_INTERNAL_ERROR( "Illogical state: " « m_runState );
32456
32457             default:
32458                 CATCH_INTERNAL_ERROR( "Unknown state: " « m_runState );
```

```
32459         }
32460         moveToParent();
32461         m_ctx.completeCycle();
32462     }
32463     void TrackerBase::fail() {
32464         m_runState = Failed;
32465         if( m_parent )
32466             m_parent->markAsNeedingAnotherRun();
32467         moveToParent();
32468         m_ctx.completeCycle();
32469     }
32470     void TrackerBase::markAsNeedingAnotherRun() {
32471         m_runState = NeedsAnotherRun;
32472     }
32473
32474     void TrackerBase::moveToParent() {
32475         assert( m_parent );
32476         m_ctx.setCurrentTracker( m_parent );
32477     }
32478     void TrackerBase::moveToThis() {
32479         m_ctx.setCurrentTracker( this );
32480     }
32481
32482     SectionTracker::SectionTracker( NameAndLocation const& nameAndLocation, TrackerContext& ctx,
      ITracker* parent )
32483     :   TrackerBase( nameAndLocation, ctx, parent ),
32484         m_trimmed_name(trim(nameAndLocation.name))
32485     {
32486         if( parent ) {
32487             while( !parent->isSectionTracker() )
32488                 parent = &parent->parent();
32489
32490             SectionTracker& parentSection = static_cast<SectionTracker&>( *parent );
32491             addNextFilters( parentSection.m_filters );
32492         }
32493     }
32494
32495     bool SectionTracker::isComplete() const {
32496         bool complete = true;
32497
32498         if (m_filters.empty()
32499             || m_filters[0] == ""
32500             || std::find(m_filters.begin(), m_filters.end(), m_trimmed_name) != m_filters.end()) {
32501             complete = TrackerBase::isComplete();
32502         }
32503         return complete;
32504     }
32505
32506     bool SectionTracker::isSectionTracker() const { return true; }
32507
32508     SectionTracker& SectionTracker::acquire( TrackerContext& ctx, NameAndLocation const&
      nameAndLocation ) {
32509         std::shared_ptr<SectionTracker> section;
32510
32511         ITracker& currentTracker = ctx.currentTracker();
32512         if( ITrackerPtr childTracker = currentTracker.findChild( nameAndLocation ) ) {
32513             assert( childTracker );
32514             assert( childTracker->isSectionTracker() );
32515             section = std::static_pointer_cast<SectionTracker>( childTracker );
32516         }
32517         else {
32518             section = std::make_shared<SectionTracker>( nameAndLocation, ctx, &currentTracker );
32519             currentTracker.addChild( section );
32520         }
32521         if( !ctx.completedCycle() )
32522             section->tryOpen();
32523         return *section;
32524     }
32525
32526     void SectionTracker::tryOpen() {
32527         if( !isComplete() )
32528             open();
32529     }
32530
32531     void SectionTracker::addInitialFilters( std::vector<std::string> const& filters ) {
32532         if( !filters.empty() ) {
32533             m_filters.reserve( m_filters.size() + filters.size() + 2 );
32534             m_filters.emplace_back(""); // Root - should never be consulted
32535             m_filters.emplace_back(""); // Test Case - not a section filter
32536             m_filters.insert( m_filters.end(), filters.begin(), filters.end() );
32537         }
32538     }
32539     void SectionTracker::addNextFilters( std::vector<std::string> const& filters ) {
32540         if( filters.size() > 1 )
32541             m_filters.insert( m_filters.end(), filters.begin()+1, filters.end() );
32542     }
32543
```

```
32544     std::vector<std::string> const& SectionTracker::getFilters() const {
32545         return m_filters;
32546     }
32547
32548     std::string const& SectionTracker::trimmedName() const {
32549         return m_trimmed_name;
32550     }
32551
32552 } // namespace TestCaseTracking
32553
32554 using TestCaseTracking::ITracker;
32555 using TestCaseTracking::TrackerContext;
32556 using TestCaseTracking::SectionTracker;
32557
32558 } // namespace Catch
32559
32560 #if defined(__clang__)
32561 #    pragma clang diagnostic pop
32562 #endif
32563 // end catch_test_case_tracker.cpp
32564 // start catch_test_registry.cpp
32565
32566 namespace Catch {
32567
32568     auto makeTestInvoker( void(*testAsFunction)() ) noexcept -> ITestInvoker* {
32569         return new(std::nothrow) TestInvokerAsFunction( testAsFunction );
32570     }
32571
32572     NameAndTags::NameAndTags( StringRef const& name_ , StringRef const& tags_ ) noexcept : name( name_
      ), tags( tags_ ) {}
32573
32574     AutoReg::AutoReg( ITestInvoker* invoker, SourceLineInfo const& lineInfo, StringRef const&
      classOrMethod, NameAndTags const& nameAndTags ) noexcept {
32575         CATCH_TRY {
32576             getMutableRegistryHub()
32577                     .registerTest(
32578                         makeTestCase(
32579                             invoker,
32580                             extractClassName( classOrMethod ),
32581                             nameAndTags,
32582                             lineInfo));
32583         } CATCH_CATCH_ALL {
32584             // Do not throw when constructing global objects, instead register the exception to be
      processed later
32585             getMutableRegistryHub().registerStartupException();
32586         }
32587     }
32588
32589     AutoReg::~AutoReg() = default;
32590 }
32591 // end catch_test_registry.cpp
32592 // start catch_test_spec.cpp
32593
32594 #include <algorithm>
32595 #include <string>
32596 #include <vector>
32597 #include <memory>
32598
32599 namespace Catch {
32600
32601     TestSpec::Pattern::Pattern( std::string const& name )
32602     : m_name( name )
32603     {}
32604
32605     TestSpec::Pattern::~Pattern() = default;
32606
32607     std::string const& TestSpec::Pattern::name() const {
32608         return m_name;
32609     }
32610
32611     TestSpec::NamePattern::NamePattern( std::string const& name, std::string const& filterString )
32612     : Pattern( filterString )
32613     , m_wildcardPattern( toLower( name ), CaseSensitive::No )
32614     {}
32615
32616     bool TestSpec::NamePattern::matches( TestCaseInfo const& testCase ) const {
32617         return m_wildcardPattern.matches( testCase.name );
32618     }
32619
32620     TestSpec::TagPattern::TagPattern( std::string const& tag, std::string const& filterString )
32621     : Pattern( filterString )
32622     , m_tag( toLower( tag ) )
32623     {}
32624
32625     bool TestSpec::TagPattern::matches( TestCaseInfo const& testCase ) const {
32626         return std::find(begin(testCase.lcaseTags),
32627                          end(testCase.lcaseTags),
```

```
32628                           m_tag) != end(testCase.lcaseTags);
32629     }
32630
32631     TestSpec::ExcludedPattern::ExcludedPattern( PatternPtr const& underlyingPattern )
32632     : Pattern( underlyingPattern->name() )
32633     , m_underlyingPattern( underlyingPattern )
32634     {}
32635
32636     bool TestSpec::ExcludedPattern::matches( TestCaseInfo const& testCase ) const {
32637         return !m_underlyingPattern->matches( testCase );
32638     }
32639
32640     bool TestSpec::Filter::matches( TestCaseInfo const& testCase ) const {
32641         return std::all_of( m_patterns.begin(), m_patterns.end(), [&]( PatternPtr const& p ){ return
      p->matches( testCase ); } );
32642     }
32643
32644     std::string TestSpec::Filter::name() const {
32645         std::string name;
32646         for( auto const& p : m_patterns )
32647             name += p->name();
32648         return name;
32649     }
32650
32651     bool TestSpec::hasFilters() const {
32652         return !m_filters.empty();
32653     }
32654
32655     bool TestSpec::matches( TestCaseInfo const& testCase ) const {
32656         return std::any_of( m_filters.begin(), m_filters.end(), [&]( Filter const& f ){ return
      f.matches( testCase ); } );
32657     }
32658
32659     TestSpec::Matches TestSpec::matchesByFilter( std::vector<TestCase> const& testCases, IConfig
      const& config ) const
32660     {
32661         Matches matches( m_filters.size() );
32662         std::transform( m_filters.begin(), m_filters.end(), matches.begin(), [&]( Filter const& filter
      ){
32663             std::vector<TestCase const*> currentMatches;
32664             for( auto const& test : testCases )
32665                 if( isThrowSafe( test, config ) && filter.matches( test ) )
32666                     currentMatches.emplace_back( &test );
32667             return FilterMatch{ filter.name(), currentMatches };
32668         } );
32669         return matches;
32670     }
32671
32672     const TestSpec::vectorStrings& TestSpec::getInvalidArgs() const{
32673         return  (m_invalidArgs);
32674     }
32675
32676 }
32677 // end catch_test_spec.cpp
32678 // start catch_test_spec_parser.cpp
32679
32680 namespace Catch {
32681
32682     TestSpecParser::TestSpecParser( ITagAliasRegistry const& tagAliases ) : m_tagAliases( &tagAliases
      ) {}
32683
32684     TestSpecParser& TestSpecParser::parse( std::string const& arg ) {
32685         m_mode = None;
32686         m_exclusion = false;
32687         m_arg = m_tagAliases->expandAliases( arg );
32688         m_escapeChars.clear();
32689         m_substring.reserve(m_arg.size());
32690         m_patternName.reserve(m_arg.size());
32691         m_realPatternPos = 0;
32692
32693         for( m_pos = 0; m_pos < m_arg.size(); ++m_pos )
32694           //if visitChar fails
32695            if( !visitChar( m_arg[m_pos] ) ){
32696                m_testSpec.m_invalidArgs.push_back(arg);
32697                break;
32698            }
32699         endMode();
32700         return *this;
32701     }
32702     TestSpec TestSpecParser::testSpec() {
32703         addFilter();
32704         return m_testSpec;
32705     }
32706     bool TestSpecParser::visitChar( char c ) {
32707         if( (m_mode != EscapedName) && (c == '\\') ) {
32708             escape();
32709             addCharToPattern(c);
```

```
32710             return true;
32711         }else if((m_mode != EscapedName) && (c == ',') )  {
32712             return separate();
32713         }
32714 
32715         switch( m_mode ) {
32716         case None:
32717             if( processNoneChar( c ) )
32718                 return true;
32719             break;
32720         case Name:
32721             processNameChar( c );
32722             break;
32723         case EscapedName:
32724             endMode();
32725             addCharToPattern(c);
32726             return true;
32727         default:
32728         case Tag:
32729         case QuotedName:
32730             if( processOtherChar( c ) )
32731                 return true;
32732             break;
32733         }
32734 
32735         m_substring += c;
32736         if( !isControlChar( c ) ) {
32737             m_patternName += c;
32738             m_realPatternPos++;
32739         }
32740         return true;
32741     }
32742     // Two of the processing methods return true to signal the caller to return
32743     // without adding the given character to the current pattern strings
32744     bool TestSpecParser::processNoneChar( char c ) {
32745         switch( c ) {
32746         case ' ':
32747             return true;
32748         case '~':
32749             m_exclusion = true;
32750             return false;
32751         case '[':
32752             startNewMode( Tag );
32753             return false;
32754         case '"':
32755             startNewMode( QuotedName );
32756             return false;
32757         default:
32758             startNewMode( Name );
32759             return false;
32760         }
32761     }
32762     void TestSpecParser::processNameChar( char c ) {
32763         if( c == '[' ) {
32764             if( m_substring == "exclude:" )
32765                 m_exclusion = true;
32766             else
32767                 endMode();
32768             startNewMode( Tag );
32769         }
32770     }
32771     bool TestSpecParser::processOtherChar( char c ) {
32772         if( !isControlChar( c ) )
32773             return false;
32774         m_substring += c;
32775         endMode();
32776         return true;
32777     }
32778     void TestSpecParser::startNewMode( Mode mode ) {
32779         m_mode = mode;
32780     }
32781     void TestSpecParser::endMode() {
32782         switch( m_mode ) {
32783         case Name:
32784         case QuotedName:
32785             return addNamePattern();
32786         case Tag:
32787             return addTagPattern();
32788         case EscapedName:
32789             revertBackToLastMode();
32790             return;
32791         case None:
32792         default:
32793             return startNewMode( None );
32794         }
32795     }
32796     void TestSpecParser::escape() {
```

```
32797         saveLastMode();
32798         m_mode = EscapedName;
32799         m_escapeChars.push_back(m_realPatternPos);
32800     }
32801     bool TestSpecParser::isControlChar( char c ) const {
32802         switch( m_mode ) {
32803             default:
32804                 return false;
32805             case None:
32806                 return c == '~';
32807             case Name:
32808                 return c == '[';
32809             case EscapedName:
32810                 return true;
32811             case QuotedName:
32812                 return c == '"';
32813             case Tag:
32814                 return c == '[' || c == ']';
32815         }
32816     }
32817
32818     void TestSpecParser::addFilter() {
32819         if( !m_currentFilter.m_patterns.empty() ) {
32820             m_testSpec.m_filters.push_back( m_currentFilter );
32821             m_currentFilter = TestSpec::Filter();
32822         }
32823     }
32824
32825     void TestSpecParser::saveLastMode() {
32826       lastMode = m_mode;
32827     }
32828
32829     void TestSpecParser::revertBackToLastMode() {
32830       m_mode = lastMode;
32831     }
32832
32833     bool TestSpecParser::separate() {
32834       if( (m_mode==QuotedName) || (m_mode==Tag) ){
32835          //invalid argument, signal failure to previous scope.
32836          m_mode = None;
32837          m_pos = m_arg.size();
32838          m_substring.clear();
32839          m_patternName.clear();
32840          m_realPatternPos = 0;
32841          return false;
32842       }
32843       endMode();
32844       addFilter();
32845       return true; //success
32846     }
32847
32848     std::string TestSpecParser::preprocessPattern() {
32849         std::string token = m_patternName;
32850         for (std::size_t i = 0; i < m_escapeChars.size(); ++i)
32851             token = token.substr(0, m_escapeChars[i] - i) + token.substr(m_escapeChars[i] - i + 1);
32852         m_escapeChars.clear();
32853         if (startsWith(token, "exclude:")) {
32854             m_exclusion = true;
32855             token = token.substr(8);
32856         }
32857
32858         m_patternName.clear();
32859         m_realPatternPos = 0;
32860
32861         return token;
32862     }
32863
32864     void TestSpecParser::addNamePattern() {
32865         auto token = preprocessPattern();
32866
32867         if (!token.empty()) {
32868             TestSpec::PatternPtr pattern = std::make_shared<TestSpec::NamePattern>(token,
      m_substring);
32869             if (m_exclusion)
32870                 pattern = std::make_shared<TestSpec::ExcludedPattern>(pattern);
32871             m_currentFilter.m_patterns.push_back(pattern);
32872         }
32873         m_substring.clear();
32874         m_exclusion = false;
32875         m_mode = None;
32876     }
32877
32878     void TestSpecParser::addTagPattern() {
32879         auto token = preprocessPattern();
32880
32881         if (!token.empty()) {
32882             // If the tag pattern is the "hide and tag" shorthand (e.g. [.foo])
```

```
32883             // we have to create a separate hide tag and shorten the real one
32884             if (token.size() > 1 && token[0] == '.') {
32885                 token.erase(token.begin());
32886                 TestSpec::PatternPtr pattern = std::make_shared<TestSpec::TagPattern>(".",
    m_substring);
32887                 if (m_exclusion) {
32888                     pattern = std::make_shared<TestSpec::ExcludedPattern>(pattern);
32889                 }
32890                 m_currentFilter.m_patterns.push_back(pattern);
32891             }
32892
32893             TestSpec::PatternPtr pattern = std::make_shared<TestSpec::TagPattern>(token, m_substring);
32894
32895             if (m_exclusion) {
32896                 pattern = std::make_shared<TestSpec::ExcludedPattern>(pattern);
32897             }
32898             m_currentFilter.m_patterns.push_back(pattern);
32899         }
32900         m_substring.clear();
32901         m_exclusion = false;
32902         m_mode = None;
32903     }
32904
32905     TestSpec parseTestSpec( std::string const& arg ) {
32906         return TestSpecParser( ITagAliasRegistry::get() ).parse( arg ).testSpec();
32907     }
32908
32909 } // namespace Catch
32910 // end catch_test_spec_parser.cpp
32911 // start catch_timer.cpp
32912
32913 #include <chrono>
32914
32915 static const uint64_t nanosecondsInSecond = 1000000000;
32916
32917 namespace Catch {
32918
32919     auto getCurrentNanosecondsSinceEpoch() -> uint64_t {
32920         return std::chrono::duration_cast<std::chrono::nanoseconds>(
    std::chrono::high_resolution_clock::now().time_since_epoch() ).count();
32921     }
32922
32923     namespace {
32924         auto estimateClockResolution() -> uint64_t {
32925             uint64_t sum = 0;
32926             static const uint64_t iterations = 1000000;
32927
32928             auto startTime = getCurrentNanosecondsSinceEpoch();
32929
32930             for( std::size_t i = 0; i < iterations; ++i ) {
32931
32932                 uint64_t ticks;
32933                 uint64_t baseTicks = getCurrentNanosecondsSinceEpoch();
32934                 do {
32935                     ticks = getCurrentNanosecondsSinceEpoch();
32936                 } while( ticks == baseTicks );
32937
32938                 auto delta = ticks - baseTicks;
32939                 sum += delta;
32940
32941                 // If we have been calibrating for over 3 seconds -- the clock
32942                 // is terrible and we should move on.
32943                 // TBD: How to signal that the measured resolution is probably wrong?
32944                 if (ticks > startTime + 3 * nanosecondsInSecond) {
32945                     return sum / ( i + 1u );
32946                 }
32947             }
32948
32949             // We're just taking the mean, here. To do better we could take the std. dev and exclude
    outliers
32950             // - and potentially do more iterations if there's a high variance.
32951             return sum/iterations;
32952         }
32953     }
32954     auto getEstimatedClockResolution() -> uint64_t {
32955         static auto s_resolution = estimateClockResolution();
32956         return s_resolution;
32957     }
32958
32959     void Timer::start() {
32960        m_nanoseconds = getCurrentNanosecondsSinceEpoch();
32961     }
32962     auto Timer::getElapsedNanoseconds() const -> uint64_t {
32963         return getCurrentNanosecondsSinceEpoch() - m_nanoseconds;
32964     }
32965     auto Timer::getElapsedMicroseconds() const -> uint64_t {
32966         return getElapsedNanoseconds()/1000;
```

```
32967     }
32968     auto Timer::getElapsedMilliseconds() const -> unsigned int {
32969         return static_cast<unsigned int>(getElapsedMicroseconds()/1000);
32970     }
32971     auto Timer::getElapsedSeconds() const -> double {
32972         return getElapsedMicroseconds()/1000000.0;
32973     }
32974
32975 } // namespace Catch
32976 // end catch_timer.cpp
32977 // start catch_tostring.cpp
32978
32979 #if defined(__clang__)
32980 #    pragma clang diagnostic push
32981 #    pragma clang diagnostic ignored "-Wexit-time-destructors"
32982 #    pragma clang diagnostic ignored "-Wglobal-constructors"
32983 #endif
32984
32985 // Enable specific decls locally
32986 #if !defined(CATCH_CONFIG_ENABLE_CHRONO_STRINGMAKER)
32987 #define CATCH_CONFIG_ENABLE_CHRONO_STRINGMAKER
32988 #endif
32989
32990 #include <cmath>
32991 #include <iomanip>
32992
32993 namespace Catch {
32994
32995 namespace Detail {
32996
32997     const std::string unprintableString = "{?}";
32998
32999     namespace {
33000         const int hexThreshold = 255;
33001
33002         struct Endianness {
33003             enum Arch { Big, Little };
33004
33005             static Arch which() {
33006                 int one = 1;
33007                 // If the lowest byte we read is non-zero, we can assume
33008                 // that little endian format is used.
33009                 auto value = *reinterpret_cast<char*>(&one);
33010                 return value ? Little : Big;
33011             }
33012         };
33013     }
33014
33015     std::string rawMemoryToString( const void *object, std::size_t size ) {
33016         // Reverse order for little endian architectures
33017         int i = 0, end = static_cast<int>( size ), inc = 1;
33018         if( Endianness::which() == Endianness::Little ) {
33019             i = end-1;
33020             end = inc = -1;
33021         }
33022
33023         unsigned char const *bytes = static_cast<unsigned char const *>(object);
33024         ReusableStringStream rss;
33025         rss << "0x" << std::setfill('0') << std::hex;
33026         for( ; i != end; i += inc )
33027              rss << std::setw(2) << static_cast<unsigned>(bytes[i]);
33028        return rss.str();
33029     }
33030 }
33031
33032 template<typename T>
33033 std::string fpToString( T value, int precision ) {
33034     if (Catch::isnan(value)) {
33035         return "nan";
33036     }
33037
33038     ReusableStringStream rss;
33039     rss << std::setprecision( precision )
33040         << std::fixed
33041         << value;
33042     std::string d = rss.str();
33043     std::size_t i = d.find_last_not_of( '0' );
33044     if( i != std::string::npos && i != d.size()-1 ) {
33045         if( d[i] == '.' )
33046             i++;
33047         d = d.substr( 0, i+1 );
33048     }
33049     return d;
33050 }
33051
33053 //
33054 //   Out-of-line defs for full specialization of StringMaker
```

```
33055 //
33057
33058 std::string StringMaker<std::string>::convert(const std::string& str) {
33059     if (!getCurrentContext().getConfig()->showInvisibles()) {
33060         return '"' + str + '"';
33061     }
33062
33063     std::string s("\"");
33064     for (char c : str) {
33065         switch (c) {
33066         case '\n':
33067             s.append("\\n");
33068             break;
33069         case '\t':
33070             s.append("\\t");
33071             break;
33072         default:
33073             s.push_back(c);
33074             break;
33075         }
33076     }
33077     s.append("\"");
33078     return s;
33079 }
33080
33081 #ifdef CATCH_CONFIG_CPP17_STRING_VIEW
33082 std::string StringMaker<std::string_view>::convert(std::string_view str) {
33083     return ::Catch::Detail::stringify(std::string{ str });
33084 }
33085 #endif
33086
33087 std::string StringMaker<char const*>::convert(char const* str) {
33088     if (str) {
33089         return ::Catch::Detail::stringify(std::string{ str });
33090     } else {
33091         return{ "{null string}" };
33092     }
33093 }
33094 std::string StringMaker<char*>::convert(char* str) {
33095     if (str) {
33096         return ::Catch::Detail::stringify(std::string{ str });
33097     } else {
33098         return{ "{null string}" };
33099     }
33100 }
33101
33102 #ifdef CATCH_CONFIG_WCHAR
33103 std::string StringMaker<std::wstring>::convert(const std::wstring& wstr) {
33104     std::string s;
33105     s.reserve(wstr.size());
33106     for (auto c : wstr) {
33107         s += (c <= 0xff) ? static_cast<char>(c) : '?';
33108     }
33109     return ::Catch::Detail::stringify(s);
33110 }
33111
33112 # ifdef CATCH_CONFIG_CPP17_STRING_VIEW
33113 std::string StringMaker<std::wstring_view>::convert(std::wstring_view str) {
33114     return StringMaker<std::wstring>::convert(std::wstring(str));
33115 }
33116 # endif
33117
33118 std::string StringMaker<wchar_t const*>::convert(wchar_t const * str) {
33119     if (str) {
33120         return ::Catch::Detail::stringify(std::wstring{ str });
33121     } else {
33122         return{ "{null string}" };
33123     }
33124 }
33125 std::string StringMaker<wchar_t *>::convert(wchar_t * str) {
33126     if (str) {
33127         return ::Catch::Detail::stringify(std::wstring{ str });
33128     } else {
33129         return{ "{null string}" };
33130     }
33131 }
33132 #endif
33133
33134 #if defined(CATCH_CONFIG_CPP17_BYTE)
33135 #include <cstddef>
33136 std::string StringMaker<std::byte>::convert(std::byte value) {
33137     return ::Catch::Detail::stringify(std::to_integer<unsigned long long>(value));
33138 }
33139 #endif // defined(CATCH_CONFIG_CPP17_BYTE)
33140
33141 std::string StringMaker<int>::convert(int value) {
33142     return ::Catch::Detail::stringify(static_cast<long long>(value));
```

```
33143 }
33144 std::string StringMaker<long>::convert(long value) {
33145     return ::Catch::Detail::stringify(static_cast<long long>(value));
33146 }
33147 std::string StringMaker<long long>::convert(long long value) {
33148     ReusableStringStream rss;
33149     rss « value;
33150     if (value > Detail::hexThreshold) {
33151         rss « " (0x" « std::hex « value « ')';
33152     }
33153     return rss.str();
33154 }
33155
33156 std::string StringMaker<unsigned int>::convert(unsigned int value) {
33157     return ::Catch::Detail::stringify(static_cast<unsigned long long>(value));
33158 }
33159 std::string StringMaker<unsigned long>::convert(unsigned long value) {
33160     return ::Catch::Detail::stringify(static_cast<unsigned long long>(value));
33161 }
33162 std::string StringMaker<unsigned long long>::convert(unsigned long long value) {
33163     ReusableStringStream rss;
33164     rss « value;
33165     if (value > Detail::hexThreshold) {
33166         rss « " (0x" « std::hex « value « ')';
33167     }
33168     return rss.str();
33169 }
33170
33171 std::string StringMaker<bool>::convert(bool b) {
33172     return b ? "true" : "false";
33173 }
33174
33175 std::string StringMaker<signed char>::convert(signed char value) {
33176     if (value == '\r') {
33177         return "'\\r'";
33178     } else if (value == '\f') {
33179         return "'\\f'";
33180     } else if (value == '\n') {
33181         return "'\\n'";
33182     } else if (value == '\t') {
33183         return "'\\t'";
33184     } else if ('\0' <= value && value < ' ') {
33185         return ::Catch::Detail::stringify(static_cast<unsigned int>(value));
33186     } else {
33187         char chstr[] = "' '";
33188         chstr[1] = value;
33189         return chstr;
33190     }
33191 }
33192 std::string StringMaker<char>::convert(char c) {
33193     return ::Catch::Detail::stringify(static_cast<signed char>(c));
33194 }
33195 std::string StringMaker<unsigned char>::convert(unsigned char c) {
33196     return ::Catch::Detail::stringify(static_cast<char>(c));
33197 }
33198
33199 std::string StringMaker<std::nullptr_t>::convert(std::nullptr_t) {
33200     return "nullptr";
33201 }
33202
33203 int StringMaker<float>::precision = 5;
33204
33205 std::string StringMaker<float>::convert(float value) {
33206     return fpToString(value, precision) + 'f';
33207 }
33208
33209 int StringMaker<double>::precision = 10;
33210
33211 std::string StringMaker<double>::convert(double value) {
33212     return fpToString(value, precision);
33213 }
33214
33215 std::string ratio_string<std::atto>::symbol() { return "a"; }
33216 std::string ratio_string<std::femto>::symbol() { return "f"; }
33217 std::string ratio_string<std::pico>::symbol() { return "p"; }
33218 std::string ratio_string<std::nano>::symbol() { return "n"; }
33219 std::string ratio_string<std::micro>::symbol() { return "u"; }
33220 std::string ratio_string<std::milli>::symbol() { return "m"; }
33221
33222 } // end namespace Catch
33223
33224 #if defined(__clang__)
33225 #    pragma clang diagnostic pop
33226 #endif
33227
33228 // end catch_tostring.cpp
33229 // start catch_totals.cpp
```

```
33230
33231 namespace Catch {
33232
33233     Counts Counts::operator - ( Counts const& other ) const {
33234         Counts diff;
33235         diff.passed = passed - other.passed;
33236         diff.failed = failed - other.failed;
33237         diff.failedButOk = failedButOk - other.failedButOk;
33238         return diff;
33239     }
33240
33241     Counts& Counts::operator += ( Counts const& other ) {
33242         passed += other.passed;
33243         failed += other.failed;
33244         failedButOk += other.failedButOk;
33245         return *this;
33246     }
33247
33248     std::size_t Counts::total() const {
33249         return passed + failed + failedButOk;
33250     }
33251     bool Counts::allPassed() const {
33252         return failed == 0 && failedButOk == 0;
33253     }
33254     bool Counts::allOk() const {
33255         return failed == 0;
33256     }
33257
33258     Totals Totals::operator - ( Totals const& other ) const {
33259         Totals diff;
33260         diff.assertions = assertions - other.assertions;
33261         diff.testCases = testCases - other.testCases;
33262         return diff;
33263     }
33264
33265     Totals& Totals::operator += ( Totals const& other ) {
33266         assertions += other.assertions;
33267         testCases += other.testCases;
33268         return *this;
33269     }
33270
33271     Totals Totals::delta( Totals const& prevTotals ) const {
33272         Totals diff = *this - prevTotals;
33273         if( diff.assertions.failed > 0 )
33274             ++diff.testCases.failed;
33275         else if( diff.assertions.failedButOk > 0 )
33276             ++diff.testCases.failedButOk;
33277         else
33278             ++diff.testCases.passed;
33279         return diff;
33280     }
33281
33282 }
33283 // end catch_totals.cpp
33284 // start catch_uncaught_exceptions.cpp
33285
33286 // start catch_config_uncaught_exceptions.hpp
33287
33288 //              Copyright Catch2 Authors
33289 // Distributed under the Boost Software License, Version 1.0.
33290 //   (See accompanying file LICENSE_1_0.txt or copy at
33291 //        https://www.boost.org/LICENSE_1_0.txt)
33292
33293 // SPDX-License-Identifier: BSL-1.0
33294
33295 #ifndef CATCH_CONFIG_UNCAUGHT_EXCEPTIONS_HPP
33296 #define CATCH_CONFIG_UNCAUGHT_EXCEPTIONS_HPP
33297
33298 #if defined(_MSC_VER)
33299 #  if _MSC_VER >= 1900 // Visual Studio 2015 or newer
33300 #    define CATCH_INTERNAL_CONFIG_CPP17_UNCAUGHT_EXCEPTIONS
33301 #  endif
33302 #endif
33303
33304 #include <exception>
33305
33306 #if defined(__cpp_lib_uncaught_exceptions) \
33307     && !defined(CATCH_INTERNAL_CONFIG_CPP17_UNCAUGHT_EXCEPTIONS)
33308
33309 #  define CATCH_INTERNAL_CONFIG_CPP17_UNCAUGHT_EXCEPTIONS
33310 #endif // __cpp_lib_uncaught_exceptions
33311
33312 #if defined(CATCH_INTERNAL_CONFIG_CPP17_UNCAUGHT_EXCEPTIONS) \
33313     && !defined(CATCH_CONFIG_NO_CPP17_UNCAUGHT_EXCEPTIONS) \
33314     && !defined(CATCH_CONFIG_CPP17_UNCAUGHT_EXCEPTIONS)
33315
33316 #  define CATCH_CONFIG_CPP17_UNCAUGHT_EXCEPTIONS
```

```
33317 #endif
33318
33319 #endif // CATCH_CONFIG_UNCAUGHT_EXCEPTIONS_HPP
33320 // end catch_config_uncaught_exceptions.hpp
33321 #include <exception>
33322
33323 namespace Catch {
33324     bool uncaught_exceptions() {
33325 #if defined(CATCH_CONFIG_DISABLE_EXCEPTIONS)
33326         return false;
33327 #elif defined(CATCH_CONFIG_CPP17_UNCAUGHT_EXCEPTIONS)
33328         return std::uncaught_exceptions() > 0;
33329 #else
33330         return std::uncaught_exception();
33331 #endif
33332   }
33333 } // end namespace Catch
33334 // end catch_uncaught_exceptions.cpp
33335 // start catch_version.cpp
33336
33337 #include <ostream>
33338
33339 namespace Catch {
33340
33341     Version::Version
33342         (   unsigned int _majorVersion,
33343             unsigned int _minorVersion,
33344             unsigned int _patchNumber,
33345             char const * const _branchName,
33346             unsigned int _buildNumber )
33347     :   majorVersion( _majorVersion ),
33348         minorVersion( _minorVersion ),
33349         patchNumber( _patchNumber ),
33350         branchName( _branchName ),
33351         buildNumber( _buildNumber )
33352     {}
33353
33354     std::ostream& operator « ( std::ostream& os, Version const& version ) {
33355         os  « version.majorVersion « '.'
33356             « version.minorVersion « '.'
33357             « version.patchNumber;
33358         // branchName is never null -> 0th char is \0 if it is empty
33359         if (version.branchName[0]) {
33360             os « '-' « version.branchName
33361                « '.' « version.buildNumber;
33362         }
33363         return os;
33364     }
33365
33366     Version const& libraryVersion() {
33367         static Version version( 2, 13, 10, "", 0 );
33368         return version;
33369     }
33370
33371 }
33372 // end catch_version.cpp
33373 // start catch_wildcard_pattern.cpp
33374
33375 namespace Catch {
33376
33377     WildcardPattern::WildcardPattern( std::string const& pattern,
33378                                       CaseSensitive::Choice caseSensitivity )
33379     :   m_caseSensitivity( caseSensitivity ),
33380         m_pattern( normaliseString( pattern ) )
33381     {
33382         if( startsWith( m_pattern, '*' ) ) {
33383             m_pattern = m_pattern.substr( 1 );
33384             m_wildcard = WildcardAtStart;
33385         }
33386         if( endsWith( m_pattern, '*' ) ) {
33387             m_pattern = m_pattern.substr( 0, m_pattern.size()-1 );
33388             m_wildcard = static_cast<WildcardPosition>( m_wildcard | WildcardAtEnd );
33389         }
33390     }
33391
33392     bool WildcardPattern::matches( std::string const& str ) const {
33393         switch( m_wildcard ) {
33394             case NoWildcard:
33395                 return m_pattern == normaliseString( str );
33396             case WildcardAtStart:
33397                 return endsWith( normaliseString( str ), m_pattern );
33398             case WildcardAtEnd:
33399                 return startsWith( normaliseString( str ), m_pattern );
33400             case WildcardAtBothEnds:
33401                 return contains( normaliseString( str ), m_pattern );
33402             default:
33403                 CATCH_INTERNAL_ERROR( "Unknown enum" );
```

```
33404         }
33405     }
33406
33407     std::string WildcardPattern::normaliseString( std::string const& str ) const {
33408         return trim( m_caseSensitivity == CaseSensitive::No ? toLower( str ) : str );
33409     }
33410 }
33411 // end catch_wildcard_pattern.cpp
33412 // start catch_xmlwriter.cpp
33413
33414 #include <iomanip>
33415 #include <type_traits>
33416
33417 namespace Catch {
33418
33419 namespace {
33420
33421     size_t trailingBytes(unsigned char c) {
33422         if ((c & 0xE0) == 0xC0) {
33423             return 2;
33424         }
33425         if ((c & 0xF0) == 0xE0) {
33426             return 3;
33427         }
33428         if ((c & 0xF8) == 0xF0) {
33429             return 4;
33430         }
33431         CATCH_INTERNAL_ERROR("Invalid multibyte utf-8 start byte encountered");
33432     }
33433
33434     uint32_t headerValue(unsigned char c) {
33435         if ((c & 0xE0) == 0xC0) {
33436             return c & 0x1F;
33437         }
33438         if ((c & 0xF0) == 0xE0) {
33439             return c & 0x0F;
33440         }
33441         if ((c & 0xF8) == 0xF0) {
33442             return c & 0x07;
33443         }
33444         CATCH_INTERNAL_ERROR("Invalid multibyte utf-8 start byte encountered");
33445     }
33446
33447     void hexEscapeChar(std::ostream& os, unsigned char c) {
33448         std::ios_base::fmtflags f(os.flags());
33449         os << "\\x"
33450             << std::uppercase << std::hex << std::setfill('0') << std::setw(2)
33451             << static_cast<int>(c);
33452         os.flags(f);
33453     }
33454
33455     bool shouldNewline(XmlFormatting fmt) {
33456         return !!(static_cast<std::underlying_type<XmlFormatting>::type>(fmt &
    XmlFormatting::Newline));
33457     }
33458
33459     bool shouldIndent(XmlFormatting fmt) {
33460         return !!(static_cast<std::underlying_type<XmlFormatting>::type>(fmt &
    XmlFormatting::Indent));
33461     }
33462
33463 } // anonymous namespace
33464
33465     XmlFormatting operator | (XmlFormatting lhs, XmlFormatting rhs) {
33466         return static_cast<XmlFormatting>(
33467             static_cast<std::underlying_type<XmlFormatting>::type>(lhs) |
33468             static_cast<std::underlying_type<XmlFormatting>::type>(rhs)
33469         );
33470     }
33471
33472     XmlFormatting operator & (XmlFormatting lhs, XmlFormatting rhs) {
33473         return static_cast<XmlFormatting>(
33474             static_cast<std::underlying_type<XmlFormatting>::type>(lhs) &
33475             static_cast<std::underlying_type<XmlFormatting>::type>(rhs)
33476         );
33477     }
33478
33479     XmlEncode::XmlEncode( std::string const& str, ForWhat forWhat )
33480     :   m_str( str ),
33481         m_forWhat( forWhat )
33482     {}
33483
33484     void XmlEncode::encodeTo( std::ostream& os ) const {
33485         // Apostrophe escaping not necessary if we always use " to write attributes
33486         // (see: http://www.w3.org/TR/xml/#syntax)
33487
33488         for( std::size_t idx = 0; idx < m_str.size(); ++ idx ) {
```

```
33489             unsigned char c = m_str[idx];
33490             switch (c) {
33491             case '<':   os « "&lt;"; break;
33492             case '&':   os « "&amp;"; break;
33493
33494             case '>':
33495                 // See: http://www.w3.org/TR/xml/#syntax
33496                 if (idx > 2 && m_str[idx - 1] == ']' && m_str[idx - 2] == ']')
33497                     os « "&gt;";
33498                 else
33499                     os « c;
33500                 break;
33501
33502             case '\"':
33503                 if (m_forWhat == ForAttributes)
33504                     os « "&quot;";
33505                 else
33506                     os « c;
33507                 break;
33508
33509             default:
33510                 // Check for control characters and invalid utf-8
33511
33512                 // Escape control characters in standard ascii
33513                 // see
    http://stackoverflow.com/questions/404107/why-are-control-characters-illegal-in-xml-1-0
33514                 if (c < 0x09 || (c > 0x0D && c < 0x20) || c == 0x7F) {
33515                     hexEscapeChar(os, c);
33516                     break;
33517                 }
33518
33519                 // Plain ASCII: Write it to stream
33520                 if (c < 0x7F) {
33521                     os « c;
33522                     break;
33523                 }
33524
33525                 // UTF-8 territory
33526                 // Check if the encoding is valid and if it is not, hex escape bytes.
33527                 // Important: We do not check the exact decoded values for validity, only the encoding
    format
33528                 // First check that this bytes is a valid lead byte:
33529                 // This means that it is not encoded as 1111 1XXX
33530                 // Or as 10XX XXXX
33531                 if (c <  0xC0 ||
33532                     c >= 0xF8) {
33533                     hexEscapeChar(os, c);
33534                     break;
33535                 }
33536
33537                 auto encBytes = trailingBytes(c);
33538                 // Are there enough bytes left to avoid accessing out-of-bounds memory?
33539                 if (idx + encBytes - 1 >= m_str.size()) {
33540                     hexEscapeChar(os, c);
33541                     break;
33542                 }
33543                 // The header is valid, check data
33544                 // The next encBytes bytes must together be a valid utf-8
33545                 // This means: bitpattern 10XX XXXX and the extracted value is sane (ish)
33546                 bool valid = true;
33547                 uint32_t value = headerValue(c);
33548                 for (std::size_t n = 1; n < encBytes; ++n) {
33549                     unsigned char nc = m_str[idx + n];
33550                     valid &= ((nc & 0xC0) == 0x80);
33551                     value = (value « 6) | (nc & 0x3F);
33552                 }
33553
33554                 if (
33555                     // Wrong bit pattern of following bytes
33556                     (!valid) ||
33557                     // Overlong encodings
33558                     (value < 0x80) ||
33559                     (0x80 <= value && value < 0x800   && encBytes > 2) ||
33560                     (0x800 < value && value < 0x10000 && encBytes > 3) ||
33561                     // Encoded value out of range
33562                     (value >= 0x110000)
33563                     ) {
33564                     hexEscapeChar(os, c);
33565                     break;
33566                 }
33567
33568                 // If we got here, this is in fact a valid(ish) utf-8 sequence
33569                 for (std::size_t n = 0; n < encBytes; ++n) {
33570                     os « m_str[idx + n];
33571                 }
33572                 idx += encBytes - 1;
33573                 break;
```

```
33574             }
33575         }
33576     }
33577
33578     std::ostream& operator « ( std::ostream& os, XmlEncode const& xmlEncode ) {
33579         xmlEncode.encodeTo( os );
33580         return os;
33581     }
33582
33583     XmlWriter::ScopedElement::ScopedElement( XmlWriter* writer, XmlFormatting fmt )
33584     :   m_writer( writer ),
33585         m_fmt(fmt)
33586     {}
33587
33588     XmlWriter::ScopedElement::ScopedElement( ScopedElement&& other ) noexcept
33589     :   m_writer( other.m_writer ),
33590         m_fmt(other.m_fmt)
33591     {
33592         other.m_writer = nullptr;
33593         other.m_fmt = XmlFormatting::None;
33594     }
33595     XmlWriter::ScopedElement& XmlWriter::ScopedElement::operator=( ScopedElement&& other ) noexcept {
33596         if ( m_writer ) {
33597             m_writer->endElement();
33598         }
33599         m_writer = other.m_writer;
33600         other.m_writer = nullptr;
33601         m_fmt = other.m_fmt;
33602         other.m_fmt = XmlFormatting::None;
33603         return *this;
33604     }
33605
33606     XmlWriter::ScopedElement::~ScopedElement() {
33607         if (m_writer) {
33608             m_writer->endElement(m_fmt);
33609         }
33610     }
33611
33612     XmlWriter::ScopedElement& XmlWriter::ScopedElement::writeText( std::string const& text,
      XmlFormatting fmt ) {
33613         m_writer->writeText( text, fmt );
33614         return *this;
33615     }
33616
33617     XmlWriter::XmlWriter( std::ostream& os ) : m_os( os )
33618     {
33619         writeDeclaration();
33620     }
33621
33622     XmlWriter::~XmlWriter() {
33623         while (!m_tags.empty()) {
33624             endElement();
33625         }
33626         newlineIfNecessary();
33627     }
33628
33629     XmlWriter& XmlWriter::startElement( std::string const& name, XmlFormatting fmt ) {
33630         ensureTagClosed();
33631         newlineIfNecessary();
33632         if (shouldIndent(fmt)) {
33633             m_os « m_indent;
33634             m_indent += "  ";
33635         }
33636         m_os « '<' « name;
33637         m_tags.push_back( name );
33638         m_tagIsOpen = true;
33639         applyFormatting(fmt);
33640         return *this;
33641     }
33642
33643     XmlWriter::ScopedElement XmlWriter::scopedElement( std::string const& name, XmlFormatting fmt ) {
33644         ScopedElement scoped( this, fmt );
33645         startElement( name, fmt );
33646         return scoped;
33647     }
33648
33649     XmlWriter& XmlWriter::endElement(XmlFormatting fmt) {
33650         m_indent = m_indent.substr(0, m_indent.size() - 2);
33651
33652         if( m_tagIsOpen ) {
33653             m_os « "/>";
33654             m_tagIsOpen = false;
33655         } else {
33656             newlineIfNecessary();
33657             if (shouldIndent(fmt)) {
33658                 m_os « m_indent;
33659             }
```

```
33660             m_os « "</" « m_tags.back() « ">";
33661         }
33662         m_os « std::flush;
33663         applyFormatting(fmt);
33664         m_tags.pop_back();
33665         return *this;
33666     }
33667
33668     XmlWriter& XmlWriter::writeAttribute( std::string const& name, std::string const& attribute ) {
33669         if( !name.empty() && !attribute.empty() )
33670             m_os « ' ' « name « "=\"" « XmlEncode( attribute, XmlEncode::ForAttributes ) « '"';
33671         return *this;
33672     }
33673
33674     XmlWriter& XmlWriter::writeAttribute( std::string const& name, bool attribute ) {
33675         m_os « ' ' « name « "=\"" « ( attribute ? "true" : "false" ) « '"';
33676         return *this;
33677     }
33678
33679     XmlWriter& XmlWriter::writeText( std::string const& text, XmlFormatting fmt) {
33680         if( !text.empty() ){
33681             bool tagWasOpen = m_tagIsOpen;
33682             ensureTagClosed();
33683             if (tagWasOpen && shouldIndent(fmt)) {
33684                 m_os « m_indent;
33685             }
33686             m_os « XmlEncode( text );
33687             applyFormatting(fmt);
33688         }
33689         return *this;
33690     }
33691
33692     XmlWriter& XmlWriter::writeComment( std::string const& text, XmlFormatting fmt) {
33693         ensureTagClosed();
33694         if (shouldIndent(fmt)) {
33695             m_os « m_indent;
33696         }
33697         m_os « "<!--" « text « "-->";
33698         applyFormatting(fmt);
33699         return *this;
33700     }
33701
33702     void XmlWriter::writeStylesheetRef( std::string const& url ) {
33703         m_os « "<?xml-stylesheet type=\"text/xsl\" href=\"" « url « "\"?>\n";
33704     }
33705
33706     XmlWriter& XmlWriter::writeBlankLine() {
33707         ensureTagClosed();
33708         m_os « '\n';
33709         return *this;
33710     }
33711
33712     void XmlWriter::ensureTagClosed() {
33713         if( m_tagIsOpen ) {
33714             m_os « '>' « std::flush;
33715             newlineIfNecessary();
33716             m_tagIsOpen = false;
33717         }
33718     }
33719
33720     void XmlWriter::applyFormatting(XmlFormatting fmt) {
33721         m_needsNewline = shouldNewline(fmt);
33722     }
33723
33724     void XmlWriter::writeDeclaration() {
33725         m_os « "<?xml version=\"1.0\" encoding=\"UTF-8\"?>\n";
33726     }
33727
33728     void XmlWriter::newlineIfNecessary() {
33729         if( m_needsNewline ) {
33730             m_os « std::endl;
33731             m_needsNewline = false;
33732         }
33733     }
33734 }
33735 // end catch_xmlwriter.cpp
33736 // start catch_reporter_bases.cpp
33737
33738 #include <cstring>
33739 #include <cfloat>
33740 #include <cstdio>
33741 #include <cassert>
33742 #include <memory>
33743
33744 namespace Catch {
33745     void prepareExpandedExpression(AssertionResult& result) {
33746         result.getExpandedExpression();
```

```
33747     }
33748
33749     // Because formatting using c++ streams is stateful, drop down to C is required
33750     // Alternatively we could use stringstream, but its performance is... not good.
33751     std::string getFormattedDuration( double duration ) {
33752         // Max exponent + 1 is required to represent the whole part
33753         // + 1 for decimal point
33754         // + 3 for the 3 decimal places
33755         // + 1 for null terminator
33756         const std::size_t maxDoubleSize = DBL_MAX_10_EXP + 1 + 1 + 3 + 1;
33757         char buffer[maxDoubleSize];
33758
33759         // Save previous errno, to prevent sprintf from overwriting it
33760         ErrnoGuard guard;
33761 #ifdef _MSC_VER
33762         sprintf_s(buffer, "%.3f", duration);
33763 #else
33764         std::sprintf(buffer, "%.3f", duration);
33765 #endif
33766         return std::string(buffer);
33767     }
33768
33769     bool shouldShowDuration( IConfig const& config, double duration ) {
33770         if ( config.showDurations() == ShowDurations::Always ) {
33771             return true;
33772         }
33773         if ( config.showDurations() == ShowDurations::Never ) {
33774             return false;
33775         }
33776         const double min = config.minDuration();
33777         return min >= 0 && duration >= min;
33778     }
33779
33780     std::string serializeFilters( std::vector<std::string> const& container ) {
33781         ReusableStringStream oss;
33782         bool first = true;
33783         for (auto&& filter : container)
33784         {
33785             if (!first)
33786                 oss « ' ';
33787             else
33788                 first = false;
33789
33790             oss « filter;
33791         }
33792         return oss.str();
33793     }
33794
33795     TestEventListenerBase::TestEventListenerBase(ReporterConfig const & _config)
33796         :StreamingReporterBase(_config) {}
33797
33798     std::set<Verbosity> TestEventListenerBase::getSupportedVerbosities() {
33799         return { Verbosity::Quiet, Verbosity::Normal, Verbosity::High };
33800     }
33801
33802     void TestEventListenerBase::assertionStarting(AssertionInfo const &) {}
33803
33804     bool TestEventListenerBase::assertionEnded(AssertionStats const &) {
33805         return false;
33806     }
33807
33808 } // end namespace Catch
33809 // end catch_reporter_bases.cpp
33810 // start catch_reporter_compact.cpp
33811
33812 namespace {
33813
33814 #ifdef CATCH_PLATFORM_MAC
33815     const char* failedString() { return "FAILED"; }
33816     const char* passedString() { return "PASSED"; }
33817 #else
33818     const char* failedString() { return "failed"; }
33819     const char* passedString() { return "passed"; }
33820 #endif
33821
33822     // Colour::LightGrey
33823     Catch::Colour::Code dimColour() { return Catch::Colour::FileName; }
33824
33825     std::string bothOrAll( std::size_t count ) {
33826         return count == 1 ? std::string() :
33827                count == 2 ? "both " : "all " ;
33828     }
33829
33830 } // anon namespace
33831
33832 namespace Catch {
33833 namespace {
```

```
33834 // Colour, message variants:
33835 // - white: No tests ran.
33836 // -   red: Failed [both/all] N test cases, failed [both/all] M assertions.
33837 // - white: Passed [both/all] N test cases (no assertions).
33838 // -   red: Failed N tests cases, failed M assertions.
33839 // - green: Passed [both/all] N tests cases with M assertions.
33840 void printTotals(std::ostream& out, const Totals& totals) {
33841     if (totals.testCases.total() == 0) {
33842         out « "No tests ran.";
33843     } else if (totals.testCases.failed == totals.testCases.total()) {
33844         Colour colour(Colour::ResultError);
33845         const std::string qualify_assertions_failed =
33846             totals.assertions.failed == totals.assertions.total() ?
33847             bothOrAll(totals.assertions.failed) : std::string();
33848         out «
33849             "Failed " « bothOrAll(totals.testCases.failed)
33850             « pluralise(totals.testCases.failed, "test case") « ", "
33851             "failed " « qualify_assertions_failed «
33852             pluralise(totals.assertions.failed, "assertion") « '.';
33853     } else if (totals.assertions.total() == 0) {
33854         out «
33855             "Passed " « bothOrAll(totals.testCases.total())
33856             « pluralise(totals.testCases.total(), "test case")
33857             « " (no assertions).";
33858     } else if (totals.assertions.failed) {
33859         Colour colour(Colour::ResultError);
33860         out «
33861             "Failed " « pluralise(totals.testCases.failed, "test case") « ", "
33862             "failed " « pluralise(totals.assertions.failed, "assertion") « '.';
33863     } else {
33864         Colour colour(Colour::ResultSuccess);
33865         out «
33866             "Passed " « bothOrAll(totals.testCases.passed)
33867             « pluralise(totals.testCases.passed, "test case") «
33868             " with " « pluralise(totals.assertions.passed, "assertion") « '.';
33869     }
33870 }
33871
33872 // Implementation of CompactReporter formatting
33873 class AssertionPrinter {
33874 public:
33875     AssertionPrinter& operator= (AssertionPrinter const&) = delete;
33876     AssertionPrinter(AssertionPrinter const&) = delete;
33877     AssertionPrinter(std::ostream& _stream, AssertionStats const& _stats, bool _printInfoMessages)
33878         : stream(_stream)
33879         , result(_stats.assertionResult)
33880         , messages(_stats.infoMessages)
33881         , itMessage(_stats.infoMessages.begin())
33882         , printInfoMessages(_printInfoMessages) {}
33883
33884     void print() {
33885         printSourceInfo();
33886
33887         itMessage = messages.begin();
33888
33889         switch (result.getResultType()) {
33890         case ResultWas::Ok:
33891             printResultType(Colour::ResultSuccess, passedString());
33892             printOriginalExpression();
33893             printReconstructedExpression();
33894             if (!result.hasExpression())
33895                 printRemainingMessages(Colour::None);
33896             else
33897                 printRemainingMessages();
33898             break;
33899         case ResultWas::ExpressionFailed:
33900             if (result.isOk())
33901                 printResultType(Colour::ResultSuccess, failedString() + std::string(" - but was ok"));
33902             else
33903                 printResultType(Colour::Error, failedString());
33904             printOriginalExpression();
33905             printReconstructedExpression();
33906             printRemainingMessages();
33907             break;
33908         case ResultWas::ThrewException:
33909             printResultType(Colour::Error, failedString());
33910             printIssue("unexpected exception with message:");
33911             printMessage();
33912             printExpressionWas();
33913             printRemainingMessages();
33914             break;
33915         case ResultWas::FatalErrorCondition:
33916             printResultType(Colour::Error, failedString());
33917             printIssue("fatal error condition with message:");
33918             printMessage();
33919             printExpressionWas();
33920             printRemainingMessages();
```

```
33921             break;
33922         case ResultWas::DidntThrowException:
33923             printResultType(Colour::Error, failedString());
33924             printIssue("expected exception, got none");
33925             printExpressionWas();
33926             printRemainingMessages();
33927             break;
33928         case ResultWas::Info:
33929             printResultType(Colour::None, "info");
33930             printMessage();
33931             printRemainingMessages();
33932             break;
33933         case ResultWas::Warning:
33934             printResultType(Colour::None, "warning");
33935             printMessage();
33936             printRemainingMessages();
33937             break;
33938         case ResultWas::ExplicitFailure:
33939             printResultType(Colour::Error, failedString());
33940             printIssue("explicitly");
33941             printRemainingMessages(Colour::None);
33942             break;
33943             // These cases are here to prevent compiler warnings
33944         case ResultWas::Unknown:
33945         case ResultWas::FailureBit:
33946         case ResultWas::Exception:
33947             printResultType(Colour::Error, "** internal error **");
33948             break;
33949         }
33950     }
33951
33952 private:
33953     void printSourceInfo() const {
33954         Colour colourGuard(Colour::FileName);
33955         stream « result.getSourceInfo() « ':';
33956     }
33957
33958     void printResultType(Colour::Code colour, std::string const& passOrFail) const {
33959         if (!passOrFail.empty()) {
33960             {
33961                 Colour colourGuard(colour);
33962                 stream « ' ' « passOrFail;
33963             }
33964             stream « ':';
33965         }
33966     }
33967
33968     void printIssue(std::string const& issue) const {
33969         stream « ' ' « issue;
33970     }
33971
33972     void printExpressionWas() {
33973         if (result.hasExpression()) {
33974             stream « ';';
33975             {
33976                 Colour colour(dimColour());
33977                 stream « " expression was:";
33978             }
33979             printOriginalExpression();
33980         }
33981     }
33982
33983     void printOriginalExpression() const {
33984         if (result.hasExpression()) {
33985             stream « ' ' « result.getExpression();
33986         }
33987     }
33988
33989     void printReconstructedExpression() const {
33990         if (result.hasExpandedExpression()) {
33991             {
33992                 Colour colour(dimColour());
33993                 stream « " for: ";
33994             }
33995             stream « result.getExpandedExpression();
33996         }
33997     }
33998
33999     void printMessage() {
34000         if (itMessage != messages.end()) {
34001             stream « " '" « itMessage->message « '\";
34002             ++itMessage;
34003         }
34004     }
34005
34006     void printRemainingMessages(Colour::Code colour = dimColour()) {
34007         if (itMessage == messages.end())
```

```
34008             return;
34009
34010         const auto itEnd = messages.cend();
34011         const auto N = static_cast<std::size_t>(std::distance(itMessage, itEnd));
34012
34013         {
34014             Colour colourGuard(colour);
34015             stream « " with " « pluralise(N, "message") « ':';
34016         }
34017
34018         while (itMessage != itEnd) {
34019             // If this assertion is a warning ignore any INFO messages
34020             if (printInfoMessages || itMessage->type != ResultWas::Info) {
34021                 printMessage();
34022                 if (itMessage != itEnd) {
34023                     Colour colourGuard(dimColour());
34024                     stream « " and";
34025                 }
34026                 continue;
34027             }
34028             ++itMessage;
34029         }
34030     }
34031
34032 private:
34033     std::ostream& stream;
34034     AssertionResult const& result;
34035     std::vector<MessageInfo> messages;
34036     std::vector<MessageInfo>::const_iterator itMessage;
34037     bool printInfoMessages;
34038 };
34039
34040 } // anon namespace
34041
34042         std::string CompactReporter::getDescription() {
34043             return "Reports test results on a single line, suitable for IDEs";
34044         }
34045
34046         void CompactReporter::noMatchingTestCases( std::string const& spec ) {
34047             stream « "No test cases matched '" « spec « '\'' « std::endl;
34048         }
34049
34050         void CompactReporter::assertionStarting( AssertionInfo const& ) {}
34051
34052         bool CompactReporter::assertionEnded( AssertionStats const& _assertionStats ) {
34053             AssertionResult const& result = _assertionStats.assertionResult;
34054
34055             bool printInfoMessages = true;
34056
34057             // Drop out if result was successful and we're not printing those
34058             if( !m_config->includeSuccessfulResults() && result.isOk() ) {
34059                 if( result.getResultType() != ResultWas::Warning )
34060                     return false;
34061                 printInfoMessages = false;
34062             }
34063
34064             AssertionPrinter printer( stream, _assertionStats, printInfoMessages );
34065             printer.print();
34066
34067             stream « std::endl;
34068             return true;
34069         }
34070
34071         void CompactReporter::sectionEnded(SectionStats const& _sectionStats) {
34072             double dur = _sectionStats.durationInSeconds;
34073             if ( shouldShowDuration( *m_config, dur ) ) {
34074                 stream « getFormattedDuration( dur ) « " s: " « _sectionStats.sectionInfo.name «
      std::endl;
34075             }
34076         }
34077
34078         void CompactReporter::testRunEnded( TestRunStats const& _testRunStats ) {
34079             printTotals( stream, _testRunStats.totals );
34080             stream « '\n' « std::endl;
34081             StreamingReporterBase::testRunEnded( _testRunStats );
34082         }
34083
34084         CompactReporter::~CompactReporter() {}
34085
34086     CATCH_REGISTER_REPORTER( "compact", CompactReporter )
34087
34088 } // end namespace Catch
34089 // end catch_reporter_compact.cpp
34090 // start catch_reporter_console.cpp
34091
34092 #include <cfloat>
34093 #include <cstdio>
```

```
34094
34095 #if defined(_MSC_VER)
34096 #pragma warning(push)
34097 #pragma warning(disable:4061) // Not all labels are EXPLICITLY handled in switch
34098  // Note that 4062 (not all labels are handled and default is missing) is enabled
34099 #endif
34100
34101 #if defined(__clang__)
34102 #  pragma clang diagnostic push
34103 // For simplicity, benchmarking-only helpers are always enabled
34104 #  pragma clang diagnostic ignored "-Wunused-function"
34105 #endif
34106
34107 namespace Catch {
34108
34109 namespace {
34110
34111 // Formatter impl for ConsoleReporter
34112 class ConsoleAssertionPrinter {
34113 public:
34114     ConsoleAssertionPrinter& operator= (ConsoleAssertionPrinter const&) = delete;
34115     ConsoleAssertionPrinter(ConsoleAssertionPrinter const&) = delete;
34116     ConsoleAssertionPrinter(std::ostream& _stream, AssertionStats const& _stats, bool
    _printInfoMessages)
34117         : stream(_stream),
34118         stats(_stats),
34119         result(_stats.assertionResult),
34120         colour(Colour::None),
34121         message(result.getMessage()),
34122         messages(_stats.infoMessages),
34123         printInfoMessages(_printInfoMessages) {
34124         switch (result.getResultType()) {
34125         case ResultWas::Ok:
34126             colour = Colour::Success;
34127             passOrFail = "PASSED";
34128             //if( result.hasMessage() )
34129             if (_stats.infoMessages.size() == 1)
34130                 messageLabel = "with message";
34131             if (_stats.infoMessages.size() > 1)
34132                 messageLabel = "with messages";
34133             break;
34134         case ResultWas::ExpressionFailed:
34135             if (result.isOk()) {
34136                 colour = Colour::Success;
34137                 passOrFail = "FAILED - but was ok";
34138             } else {
34139                 colour = Colour::Error;
34140                 passOrFail = "FAILED";
34141             }
34142             if (_stats.infoMessages.size() == 1)
34143                 messageLabel = "with message";
34144             if (_stats.infoMessages.size() > 1)
34145                 messageLabel = "with messages";
34146             break;
34147         case ResultWas::ThrewException:
34148             colour = Colour::Error;
34149             passOrFail = "FAILED";
34150             messageLabel = "due to unexpected exception with ";
34151             if (_stats.infoMessages.size() == 1)
34152                 messageLabel += "message";
34153             if (_stats.infoMessages.size() > 1)
34154                 messageLabel += "messages";
34155             break;
34156         case ResultWas::FatalErrorCondition:
34157             colour = Colour::Error;
34158             passOrFail = "FAILED";
34159             messageLabel = "due to a fatal error condition";
34160             break;
34161         case ResultWas::DidntThrowException:
34162             colour = Colour::Error;
34163             passOrFail = "FAILED";
34164             messageLabel = "because no exception was thrown where one was expected";
34165             break;
34166         case ResultWas::Info:
34167             messageLabel = "info";
34168             break;
34169         case ResultWas::Warning:
34170             messageLabel = "warning";
34171             break;
34172         case ResultWas::ExplicitFailure:
34173             passOrFail = "FAILED";
34174             colour = Colour::Error;
34175             if (_stats.infoMessages.size() == 1)
34176                 messageLabel = "explicitly with message";
34177             if (_stats.infoMessages.size() > 1)
34178                 messageLabel = "explicitly with messages";
34179             break;
```

```
34180             // These cases are here to prevent compiler warnings
34181         case ResultWas::Unknown:
34182         case ResultWas::FailureBit:
34183         case ResultWas::Exception:
34184             passOrFail = "** internal error **";
34185             colour = Colour::Error;
34186             break;
34187         }
34188     }
34189
34190     void print() const {
34191         printSourceInfo();
34192         if (stats.totals.assertions.total() > 0) {
34193             printResultType();
34194             printOriginalExpression();
34195             printReconstructedExpression();
34196         } else {
34197             stream << '\n';
34198         }
34199         printMessage();
34200     }
34201
34202 private:
34203     void printResultType() const {
34204         if (!passOrFail.empty()) {
34205             Colour colourGuard(colour);
34206             stream << passOrFail << ":\n";
34207         }
34208     }
34209     void printOriginalExpression() const {
34210         if (result.hasExpression()) {
34211             Colour colourGuard(Colour::OriginalExpression);
34212             stream << "  ";
34213             stream << result.getExpressionInMacro();
34214             stream << '\n';
34215         }
34216     }
34217     void printReconstructedExpression() const {
34218         if (result.hasExpandedExpression()) {
34219             stream << "with expansion:\n";
34220             Colour colourGuard(Colour::ReconstructedExpression);
34221             stream << Column(result.getExpandedExpression()).indent(2) << '\n';
34222         }
34223     }
34224     void printMessage() const {
34225         if (!messageLabel.empty())
34226             stream << messageLabel << ':' << '\n';
34227         for (auto const& msg : messages) {
34228             // If this assertion is a warning ignore any INFO messages
34229             if (printInfoMessages || msg.type != ResultWas::Info)
34230                 stream << Column(msg.message).indent(2) << '\n';
34231         }
34232     }
34233     void printSourceInfo() const {
34234         Colour colourGuard(Colour::FileName);
34235         stream << result.getSourceInfo() << ": ";
34236     }
34237
34238     std::ostream& stream;
34239     AssertionStats const& stats;
34240     AssertionResult const& result;
34241     Colour::Code colour;
34242     std::string passOrFail;
34243     std::string messageLabel;
34244     std::string message;
34245     std::vector<MessageInfo> messages;
34246     bool printInfoMessages;
34247 };
34248
34249 std::size_t makeRatio(std::size_t number, std::size_t total) {
34250     std::size_t ratio = total > 0 ? CATCH_CONFIG_CONSOLE_WIDTH * number / total : 0;
34251     return (ratio == 0 && number > 0) ? 1 : ratio;
34252 }
34253
34254 std::size_t& findMax(std::size_t& i, std::size_t& j, std::size_t& k) {
34255     if (i > j && i > k)
34256         return i;
34257     else if (j > k)
34258         return j;
34259     else
34260         return k;
34261 }
34262
34263 struct ColumnInfo {
34264     enum Justification { Left, Right };
34265     std::string name;
34266     int width;
```

```
34267     Justification justification;
34268 };
34269 struct ColumnBreak {};
34270 struct RowBreak {};
34271
34272 class Duration {
34273     enum class Unit {
34274         Auto,
34275         Nanoseconds,
34276         Microseconds,
34277         Milliseconds,
34278         Seconds,
34279         Minutes
34280     };
34281     static const uint64_t s_nanosecondsInAMicrosecond = 1000;
34282     static const uint64_t s_nanosecondsInAMillisecond = 1000 * s_nanosecondsInAMicrosecond;
34283     static const uint64_t s_nanosecondsInASecond = 1000 * s_nanosecondsInAMillisecond;
34284     static const uint64_t s_nanosecondsInAMinute = 60 * s_nanosecondsInASecond;
34285
34286     double m_inNanoseconds;
34287     Unit m_units;
34288
34289 public:
34290     explicit Duration(double inNanoseconds, Unit units = Unit::Auto)
34291         : m_inNanoseconds(inNanoseconds),
34292         m_units(units) {
34293         if (m_units == Unit::Auto) {
34294             if (m_inNanoseconds < s_nanosecondsInAMicrosecond)
34295                 m_units = Unit::Nanoseconds;
34296             else if (m_inNanoseconds < s_nanosecondsInAMillisecond)
34297                 m_units = Unit::Microseconds;
34298             else if (m_inNanoseconds < s_nanosecondsInASecond)
34299                 m_units = Unit::Milliseconds;
34300             else if (m_inNanoseconds < s_nanosecondsInAMinute)
34301                 m_units = Unit::Seconds;
34302             else
34303                 m_units = Unit::Minutes;
34304         }
34305
34306     }
34307
34308     auto value() const -> double {
34309         switch (m_units) {
34310         case Unit::Microseconds:
34311             return m_inNanoseconds / static_cast<double>(s_nanosecondsInAMicrosecond);
34312         case Unit::Milliseconds:
34313             return m_inNanoseconds / static_cast<double>(s_nanosecondsInAMillisecond);
34314         case Unit::Seconds:
34315             return m_inNanoseconds / static_cast<double>(s_nanosecondsInASecond);
34316         case Unit::Minutes:
34317             return m_inNanoseconds / static_cast<double>(s_nanosecondsInAMinute);
34318         default:
34319             return m_inNanoseconds;
34320         }
34321     }
34322     auto unitsAsString() const -> std::string {
34323         switch (m_units) {
34324         case Unit::Nanoseconds:
34325             return "ns";
34326         case Unit::Microseconds:
34327             return "us";
34328         case Unit::Milliseconds:
34329             return "ms";
34330         case Unit::Seconds:
34331             return "s";
34332         case Unit::Minutes:
34333             return "m";
34334         default:
34335             return "** internal error **";
34336         }
34337
34338     }
34339     friend auto operator << (std::ostream& os, Duration const& duration) -> std::ostream& {
34340         return os << duration.value() << ' ' << duration.unitsAsString();
34341     }
34342 };
34343 } // end anon namespace
34344
34345 class TablePrinter {
34346     std::ostream& m_os;
34347     std::vector<ColumnInfo> m_columnInfos;
34348     std::ostringstream m_oss;
34349     int m_currentColumn = -1;
34350     bool m_isOpen = false;
34351
34352 public:
34353     TablePrinter( std::ostream& os, std::vector<ColumnInfo> columnInfos )
```

```
34354     :   m_os( os ),
34355         m_columnInfos( std::move( columnInfos ) ) {}
34356
34357     auto columnInfos() const -> std::vector<ColumnInfo> const& {
34358         return m_columnInfos;
34359     }
34360
34361     void open() {
34362         if (!m_isOpen) {
34363             m_isOpen = true;
34364             *this << RowBreak();
34365
34366             Columns headerCols;
34367             Spacer spacer(2);
34368             for (auto const& info : m_columnInfos) {
34369                 headerCols += Column(info.name).width(static_cast<std::size_t>(info.width - 2));
34370                 headerCols += spacer;
34371             }
34372             m_os << headerCols << '\n';
34373
34374             m_os << Catch::getLineOfChars<'-'>() << '\n';
34375         }
34376     }
34377     void close() {
34378         if (m_isOpen) {
34379             *this << RowBreak();
34380             m_os << std::endl;
34381             m_isOpen = false;
34382         }
34383     }
34384
34385     template<typename T>
34386     friend TablePrinter& operator << (TablePrinter& tp, T const& value) {
34387         tp.m_oss << value;
34388         return tp;
34389     }
34390
34391     friend TablePrinter& operator << (TablePrinter& tp, ColumnBreak) {
34392         auto colStr = tp.m_oss.str();
34393         const auto strSize = colStr.size();
34394         tp.m_oss.str("");
34395         tp.open();
34396         if (tp.m_currentColumn == static_cast<int>(tp.m_columnInfos.size() - 1)) {
34397             tp.m_currentColumn = -1;
34398             tp.m_os << '\n';
34399         }
34400         tp.m_currentColumn++;
34401
34402         auto colInfo = tp.m_columnInfos[tp.m_currentColumn];
34403         auto padding = (strSize + 1 < static_cast<std::size_t>(colInfo.width))
34404             ? std::string(colInfo.width - (strSize + 1), ' ')
34405             : std::string();
34406         if (colInfo.justification == ColumnInfo::Left)
34407             tp.m_os << colStr << padding << ' ';
34408         else
34409             tp.m_os << padding << colStr << ' ';
34410         return tp;
34411     }
34412
34413     friend TablePrinter& operator << (TablePrinter& tp, RowBreak) {
34414         if (tp.m_currentColumn > 0) {
34415             tp.m_os << '\n';
34416             tp.m_currentColumn = -1;
34417         }
34418         return tp;
34419     }
34420 };
34421
34422 ConsoleReporter::ConsoleReporter(ReporterConfig const& config)
34423     : StreamingReporterBase(config),
34424     m_tablePrinter(new TablePrinter(config.stream(),
34425         [&config]() -> std::vector<ColumnInfo> {
34426         if (config.fullConfig()->benchmarkNoAnalysis())
34427         {
34428             return{
34429                 { "benchmark name", CATCH_CONFIG_CONSOLE_WIDTH - 43, ColumnInfo::Left },
34430                 { "     samples", 14, ColumnInfo::Right },
34431                 { "  iterations", 14, ColumnInfo::Right },
34432                 { "        mean", 14, ColumnInfo::Right }
34433             };
34434         }
34435         else
34436         {
34437             return{
34438                 { "benchmark name", CATCH_CONFIG_CONSOLE_WIDTH - 43, ColumnInfo::Left },
34439                 { "samples      mean       std dev", 14, ColumnInfo::Right },
34440                 { "iterations   low mean   low std dev", 14, ColumnInfo::Right },
```

```
34441                 { "estimated    high mean  high std dev", 14, ColumnInfo::Right }
34442             };
34443         }
34444     }())) {}
34445 ConsoleReporter::~ConsoleReporter() = default;
34446
34447 std::string ConsoleReporter::getDescription() {
34448     return "Reports test results as plain lines of text";
34449 }
34450
34451 void ConsoleReporter::noMatchingTestCases(std::string const& spec) {
34452     stream « "No test cases matched '" « spec « '\'' « std::endl;
34453 }
34454
34455 void ConsoleReporter::reportInvalidArguments(std::string const&arg){
34456     stream « "Invalid Filter: " « arg « std::endl;
34457 }
34458
34459 void ConsoleReporter::assertionStarting(AssertionInfo const&) {}
34460
34461 bool ConsoleReporter::assertionEnded(AssertionStats const& _assertionStats) {
34462     AssertionResult const& result = _assertionStats.assertionResult;
34463
34464     bool includeResults = m_config->includeSuccessfulResults() || !result.isOk();
34465
34466     // Drop out if result was successful but we're not printing them.
34467     if (!includeResults && result.getResultType() != ResultWas::Warning)
34468         return false;
34469
34470     lazyPrint();
34471
34472     ConsoleAssertionPrinter printer(stream, _assertionStats, includeResults);
34473     printer.print();
34474     stream « std::endl;
34475     return true;
34476 }
34477
34478 void ConsoleReporter::sectionStarting(SectionInfo const& _sectionInfo) {
34479     m_tablePrinter->close();
34480     m_headerPrinted = false;
34481     StreamingReporterBase::sectionStarting(_sectionInfo);
34482 }
34483 void ConsoleReporter::sectionEnded(SectionStats const& _sectionStats) {
34484     m_tablePrinter->close();
34485     if (_sectionStats.missingAssertions) {
34486         lazyPrint();
34487         Colour colour(Colour::ResultError);
34488         if (m_sectionStack.size() > 1)
34489             stream « "\nNo assertions in section";
34490         else
34491             stream « "\nNo assertions in test case";
34492         stream « " '" « _sectionStats.sectionInfo.name « "'\n" « std::endl;
34493     }
34494     double dur = _sectionStats.durationInSeconds;
34495     if (shouldShowDuration(*m_config, dur)) {
34496         stream « getFormattedDuration(dur) « " s: " « _sectionStats.sectionInfo.name « std::endl;
34497     }
34498     if (m_headerPrinted) {
34499         m_headerPrinted = false;
34500     }
34501     StreamingReporterBase::sectionEnded(_sectionStats);
34502 }
34503
34504 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
34505 void ConsoleReporter::benchmarkPreparing(std::string const& name) {
34506     lazyPrintWithoutClosingBenchmarkTable();
34507
34508     auto nameCol = Column(name).width(static_cast<std::size_t>(m_tablePrinter->columnInfos()[0].width
      - 2));
34509
34510     bool firstLine = true;
34511     for (auto line : nameCol) {
34512         if (!firstLine)
34513             (*m_tablePrinter) « ColumnBreak() « ColumnBreak() « ColumnBreak();
34514         else
34515             firstLine = false;
34516
34517         (*m_tablePrinter) « line « ColumnBreak();
34518     }
34519 }
34520
34521 void ConsoleReporter::benchmarkStarting(BenchmarkInfo const& info) {
34522     (*m_tablePrinter) « info.samples « ColumnBreak()
34523         « info.iterations « ColumnBreak();
34524     if (!m_config->benchmarkNoAnalysis())
34525         (*m_tablePrinter) « Duration(info.estimatedDuration) « ColumnBreak();
34526 }
```

```
34527 void ConsoleReporter::benchmarkEnded(BenchmarkStats<> const& stats) {
34528     if (m_config->benchmarkNoAnalysis())
34529     {
34530         (*m_tablePrinter) « Duration(stats.mean.point.count()) « ColumnBreak();
34531     }
34532     else
34533     {
34534         (*m_tablePrinter) « ColumnBreak()
34535             « Duration(stats.mean.point.count()) « ColumnBreak()
34536             « Duration(stats.mean.lower_bound.count()) « ColumnBreak()
34537             « Duration(stats.mean.upper_bound.count()) « ColumnBreak() « ColumnBreak()
34538             « Duration(stats.standardDeviation.point.count()) « ColumnBreak()
34539             « Duration(stats.standardDeviation.lower_bound.count()) « ColumnBreak()
34540             « Duration(stats.standardDeviation.upper_bound.count()) « ColumnBreak() « ColumnBreak() «
      ColumnBreak() « ColumnBreak() « ColumnBreak();
34541     }
34542 }
34543
34544 void ConsoleReporter::benchmarkFailed(std::string const& error) {
34545     Colour colour(Colour::Red);
34546     (*m_tablePrinter)
34547         « "Benchmark failed (" « error « ')'
34548         « ColumnBreak() « RowBreak();
34549 }
34550 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
34551
34552 void ConsoleReporter::testCaseEnded(TestCaseStats const& _testCaseStats) {
34553     m_tablePrinter->close();
34554     StreamingReporterBase::testCaseEnded(_testCaseStats);
34555     m_headerPrinted = false;
34556 }
34557 void ConsoleReporter::testGroupEnded(TestGroupStats const& _testGroupStats) {
34558     if (currentGroupInfo.used) {
34559         printSummaryDivider();
34560         stream « "Summary for group '" « _testGroupStats.groupInfo.name « "':\n";
34561         printTotals(_testGroupStats.totals);
34562         stream « '\n' « std::endl;
34563     }
34564     StreamingReporterBase::testGroupEnded(_testGroupStats);
34565 }
34566 void ConsoleReporter::testRunEnded(TestRunStats const& _testRunStats) {
34567     printTotalsDivider(_testRunStats.totals);
34568     printTotals(_testRunStats.totals);
34569     stream « std::endl;
34570     StreamingReporterBase::testRunEnded(_testRunStats);
34571 }
34572 void ConsoleReporter::testRunStarting(TestRunInfo const& _testInfo) {
34573     StreamingReporterBase::testRunStarting(_testInfo);
34574     printTestFilters();
34575 }
34576
34577 void ConsoleReporter::lazyPrint() {
34578
34579     m_tablePrinter->close();
34580     lazyPrintWithoutClosingBenchmarkTable();
34581 }
34582
34583 void ConsoleReporter::lazyPrintWithoutClosingBenchmarkTable() {
34584
34585     if (!currentTestRunInfo.used)
34586         lazyPrintRunInfo();
34587     if (!currentGroupInfo.used)
34588         lazyPrintGroupInfo();
34589
34590     if (!m_headerPrinted) {
34591         printTestCaseAndSectionHeader();
34592         m_headerPrinted = true;
34593     }
34594 }
34595 void ConsoleReporter::lazyPrintRunInfo() {
34596     stream « '\n' « getLineOfChars<'~'>() « '\n';
34597     Colour colour(Colour::SecondaryText);
34598     stream « currentTestRunInfo->name
34599         « " is a Catch v" « libraryVersion() « " host application.\n"
34600         « "Run with -? for options\n\n";
34601
34602     if (m_config->rngSeed() != 0)
34603         stream « "Randomness seeded to: " « m_config->rngSeed() « "\n\n";
34604
34605     currentTestRunInfo.used = true;
34606 }
34607 void ConsoleReporter::lazyPrintGroupInfo() {
34608     if (!currentGroupInfo->name.empty() && currentGroupInfo->groupsCounts > 1) {
34609         printClosedHeader("Group: " + currentGroupInfo->name);
34610         currentGroupInfo.used = true;
34611     }
34612 }
```

```
34613 void ConsoleReporter::printTestCaseAndSectionHeader() {
34614     assert(!m_sectionStack.empty());
34615     printOpenHeader(currentTestCaseInfo->name);
34616
34617     if (m_sectionStack.size() > 1) {
34618         Colour colourGuard(Colour::Headers);
34619
34620         auto
34621             it = m_sectionStack.begin() + 1, // Skip first section (test case)
34622             itEnd = m_sectionStack.end();
34623         for (; it != itEnd; ++it)
34624             printHeaderString(it->name, 2);
34625     }
34626
34627     SourceLineInfo lineInfo = m_sectionStack.back().lineInfo;
34628
34629     stream « getLineOfChars<'-'>() « '\n';
34630     Colour colourGuard(Colour::FileName);
34631     stream « lineInfo « '\n';
34632     stream « getLineOfChars<'.'>() « '\n' « std::endl;
34633 }
34634
34635 void ConsoleReporter::printClosedHeader(std::string const& _name) {
34636     printOpenHeader(_name);
34637     stream « getLineOfChars<'.'>() « '\n';
34638 }
34639 void ConsoleReporter::printOpenHeader(std::string const& _name) {
34640     stream « getLineOfChars<'-'>() « '\n';
34641     {
34642         Colour colourGuard(Colour::Headers);
34643         printHeaderString(_name);
34644     }
34645 }
34646
34647 // if string has a : in first line will set indent to follow it on
34648 // subsequent lines
34649 void ConsoleReporter::printHeaderString(std::string const& _string, std::size_t indent) {
34650     std::size_t i = _string.find(": ");
34651     if (i != std::string::npos)
34652         i += 2;
34653     else
34654         i = 0;
34655     stream « Column(_string).indent(indent + i).initialIndent(indent) « '\n';
34656 }
34657
34658 struct SummaryColumn {
34659
34660     SummaryColumn( std::string _label, Colour::Code _colour )
34661     :   label( std::move( _label ) ),
34662         colour( _colour ) {}
34663     SummaryColumn addRow( std::size_t count ) {
34664         ReusableStringStream rss;
34665         rss « count;
34666         std::string row = rss.str();
34667         for (auto& oldRow : rows) {
34668             while (oldRow.size() < row.size())
34669                 oldRow = ' ' + oldRow;
34670             while (oldRow.size() > row.size())
34671                 row = ' ' + row;
34672         }
34673         rows.push_back(row);
34674         return *this;
34675     }
34676
34677     std::string label;
34678     Colour::Code colour;
34679     std::vector<std::string> rows;
34680
34681 };
34682
34683 void ConsoleReporter::printTotals( Totals const& totals ) {
34684     if (totals.testCases.total() == 0) {
34685         stream « Colour(Colour::Warning) « "No tests ran\n";
34686     } else if (totals.assertions.total() > 0 && totals.testCases.allPassed()) {
34687         stream « Colour(Colour::ResultSuccess) « "All tests passed";
34688         stream « " ("
34689             « pluralise(totals.assertions.passed, "assertion") « " in "
34690             « pluralise(totals.testCases.passed, "test case") « ')'
34691             « '\n';
34692     } else {
34693
34694         std::vector<SummaryColumn> columns;
34695         columns.push_back(SummaryColumn("", Colour::None)
34696                           .addRow(totals.testCases.total())
34697                           .addRow(totals.assertions.total()));
34698         columns.push_back(SummaryColumn("passed", Colour::Success)
34699                           .addRow(totals.testCases.passed)
```

```
34700                           .addRow(totals.assertions.passed));
34701         columns.push_back(SummaryColumn("failed", Colour::ResultError)
34702                           .addRow(totals.testCases.failed)
34703                           .addRow(totals.assertions.failed));
34704         columns.push_back(SummaryColumn("failed as expected", Colour::ResultExpectedFailure)
34705                           .addRow(totals.testCases.failedButOk)
34706                           .addRow(totals.assertions.failedButOk));
34707
34708         printSummaryRow("test cases", columns, 0);
34709         printSummaryRow("assertions", columns, 1);
34710     }
34711 }
34712 void ConsoleReporter::printSummaryRow(std::string const& label, std::vector<SummaryColumn> const&
      cols, std::size_t row) {
34713     for (auto col : cols) {
34714         std::string value = col.rows[row];
34715         if (col.label.empty()) {
34716             stream « label « ": ";
34717             if (value != "0")
34718                 stream « value;
34719             else
34720                 stream « Colour(Colour::Warning) « "- none -";
34721         } else if (value != "0") {
34722             stream « Colour(Colour::LightGrey) « " | ";
34723             stream « Colour(col.colour)
34724                 « value « ' ' « col.label;
34725         }
34726     }
34727     stream « '\n';
34728 }
34729
34730 void ConsoleReporter::printTotalsDivider(Totals const& totals) {
34731     if (totals.testCases.total() > 0) {
34732         std::size_t failedRatio = makeRatio(totals.testCases.failed, totals.testCases.total());
34733         std::size_t failedButOkRatio = makeRatio(totals.testCases.failedButOk,
      totals.testCases.total());
34734         std::size_t passedRatio = makeRatio(totals.testCases.passed, totals.testCases.total());
34735         while (failedRatio + failedButOkRatio + passedRatio < CATCH_CONFIG_CONSOLE_WIDTH - 1)
34736             findMax(failedRatio, failedButOkRatio, passedRatio)++;
34737         while (failedRatio + failedButOkRatio + passedRatio > CATCH_CONFIG_CONSOLE_WIDTH - 1)
34738             findMax(failedRatio, failedButOkRatio, passedRatio)--;
34739
34740         stream « Colour(Colour::Error) « std::string(failedRatio, '=');
34741         stream « Colour(Colour::ResultExpectedFailure) « std::string(failedButOkRatio, '=');
34742         if (totals.testCases.allPassed())
34743             stream « Colour(Colour::ResultSuccess) « std::string(passedRatio, '=');
34744         else
34745             stream « Colour(Colour::Success) « std::string(passedRatio, '=');
34746     } else {
34747         stream « Colour(Colour::Warning) « std::string(CATCH_CONFIG_CONSOLE_WIDTH - 1, '=');
34748     }
34749     stream « '\n';
34750 }
34751 void ConsoleReporter::printSummaryDivider() {
34752     stream « getLineOfChars<'-'>() « '\n';
34753 }
34754
34755 void ConsoleReporter::printTestFilters() {
34756     if (m_config->testSpec().hasFilters()) {
34757         Colour guard(Colour::BrightYellow);
34758         stream « "Filters: " « serializeFilters(m_config->getTestsOrTags()) « '\n';
34759     }
34760 }
34761
34762 CATCH_REGISTER_REPORTER("console", ConsoleReporter)
34763
34764 } // end namespace Catch
34765
34766 #if defined(_MSC_VER)
34767 #pragma warning(pop)
34768 #endif
34769
34770 #if defined(__clang__)
34771 #  pragma clang diagnostic pop
34772 #endif
34773 // end catch_reporter_console.cpp
34774 // start catch_reporter_junit.cpp
34775
34776 #include <cassert>
34777 #include <sstream>
34778 #include <ctime>
34779 #include <algorithm>
34780 #include <iomanip>
34781
34782 namespace Catch {
34783
34784     namespace {
```

```
34785         std::string getCurrentTimestamp() {
34786             // Beware, this is not reentrant because of backward compatibility issues
34787             // Also, UTC only, again because of backward compatibility (%z is C++11)
34788             time_t rawtime;
34789             std::time(&rawtime);
34790             auto const timeStampSize = sizeof("2017-01-16T17:06:45Z");
34791
34792 #ifdef _MSC_VER
34793             std::tm timeInfo = {};
34794             gmtime_s(&timeInfo, &rawtime);
34795 #else
34796             std::tm* timeInfo;
34797             timeInfo = std::gmtime(&rawtime);
34798 #endif
34799
34800             char timeStamp[timeStampSize];
34801             const char * const fmt = "%Y-%m-%dT%H:%M:%SZ";
34802
34803 #ifdef _MSC_VER
34804             std::strftime(timeStamp, timeStampSize, fmt, &timeInfo);
34805 #else
34806             std::strftime(timeStamp, timeStampSize, fmt, timeInfo);
34807 #endif
34808             return std::string(timeStamp, timeStampSize-1);
34809         }
34810
34811         std::string fileNameTag(const std::vector<std::string> &tags) {
34812             auto it = std::find_if(begin(tags),
34813                                    end(tags),
34814                                    [] (std::string const& tag) {return tag.front() == '#'; });
34815             if (it != tags.end())
34816                 return it->substr(1);
34817             return std::string();
34818         }
34819
34820         // Formats the duration in seconds to 3 decimal places.
34821         // This is done because some genius defined Maven Surefire schema
34822         // in a way that only accepts 3 decimal places, and tools like
34823         // Jenkins use that schema for validation JUnit reporter output.
34824         std::string formatDuration( double seconds ) {
34825             ReusableStringStream rss;
34826             rss << std::fixed << std::setprecision( 3 ) << seconds;
34827             return rss.str();
34828         }
34829
34830     } // anonymous namespace
34831
34832     JunitReporter::JunitReporter( ReporterConfig const& _config )
34833         :   CumulativeReporterBase( _config ),
34834             xml( _config.stream() )
34835         {
34836             m_reporterPrefs.shouldRedirectStdOut = true;
34837             m_reporterPrefs.shouldReportAllAssertions = true;
34838         }
34839
34840     JunitReporter::~JunitReporter() {}
34841
34842     std::string JunitReporter::getDescription() {
34843         return "Reports test results in an XML format that looks like Ant's junitreport target";
34844     }
34845
34846     void JunitReporter::noMatchingTestCases( std::string const& /*spec*/ ) {}
34847
34848     void JunitReporter::testRunStarting( TestRunInfo const& runInfo )  {
34849         CumulativeReporterBase::testRunStarting( runInfo );
34850         xml.startElement( "testsuites" );
34851     }
34852
34853     void JunitReporter::testGroupStarting( GroupInfo const& groupInfo ) {
34854         suiteTimer.start();
34855         stdOutForSuite.clear();
34856         stdErrForSuite.clear();
34857         unexpectedExceptions = 0;
34858         CumulativeReporterBase::testGroupStarting( groupInfo );
34859     }
34860
34861     void JunitReporter::testCaseStarting( TestCaseInfo const& testCaseInfo ) {
34862         m_okToFail = testCaseInfo.okToFail();
34863     }
34864
34865     bool JunitReporter::assertionEnded( AssertionStats const& assertionStats ) {
34866         if( assertionStats.assertionResult.getResultType() == ResultWas::ThrewException && !m_okToFail
      )
34867             unexpectedExceptions++;
34868         return CumulativeReporterBase::assertionEnded( assertionStats );
34869     }
34870
```

```
34871     void JunitReporter::testCaseEnded( TestCaseStats const& testCaseStats ) {
34872         stdOutForSuite += testCaseStats.stdOut;
34873         stdErrForSuite += testCaseStats.stdErr;
34874         CumulativeReporterBase::testCaseEnded( testCaseStats );
34875     }
34876
34877     void JunitReporter::testGroupEnded( TestGroupStats const& testGroupStats ) {
34878         double suiteTime = suiteTimer.getElapsedSeconds();
34879         CumulativeReporterBase::testGroupEnded( testGroupStats );
34880         writeGroup( *m_testGroups.back(), suiteTime );
34881     }
34882
34883     void JunitReporter::testRunEndedCumulative() {
34884         xml.endElement();
34885     }
34886
34887     void JunitReporter::writeGroup( TestGroupNode const& groupNode, double suiteTime ) {
34888         XmlWriter::ScopedElement e = xml.scopedElement( "testsuite" );
34889
34890         TestGroupStats const& stats = groupNode.value;
34891         xml.writeAttribute( "name", stats.groupInfo.name );
34892         xml.writeAttribute( "errors", unexpectedExceptions );
34893         xml.writeAttribute( "failures", stats.totals.assertions.failed-unexpectedExceptions );
34894         xml.writeAttribute( "tests", stats.totals.assertions.total() );
34895         xml.writeAttribute( "hostname", "tbd" ); // !TBD
34896         if( m_config->showDurations() == ShowDurations::Never )
34897             xml.writeAttribute( "time", "" );
34898         else
34899             xml.writeAttribute( "time", formatDuration( suiteTime ) );
34900         xml.writeAttribute( "timestamp", getCurrentTimestamp() );
34901
34902         // Write properties if there are any
34903         if (m_config->hasTestFilters() || m_config->rngSeed() != 0) {
34904             auto properties = xml.scopedElement("properties");
34905             if (m_config->hasTestFilters()) {
34906                 xml.scopedElement("property")
34907                     .writeAttribute("name", "filters")
34908                     .writeAttribute("value", serializeFilters(m_config->getTestsOrTags()));
34909             }
34910             if (m_config->rngSeed() != 0) {
34911                 xml.scopedElement("property")
34912                     .writeAttribute("name", "random-seed")
34913                     .writeAttribute("value", m_config->rngSeed());
34914             }
34915         }
34916
34917         // Write test cases
34918         for( auto const& child : groupNode.children )
34919             writeTestCase( *child );
34920
34921         xml.scopedElement( "system-out" ).writeText( trim( stdOutForSuite ), XmlFormatting::Newline );
34922         xml.scopedElement( "system-err" ).writeText( trim( stdErrForSuite ), XmlFormatting::Newline );
34923     }
34924
34925     void JunitReporter::writeTestCase( TestCaseNode const& testCaseNode ) {
34926         TestCaseStats const& stats = testCaseNode.value;
34927
34928         // All test cases have exactly one section - which represents the
34929         // test case itself. That section may have 0-n nested sections
34930         assert( testCaseNode.children.size() == 1 );
34931         SectionNode const& rootSection = *testCaseNode.children.front();
34932
34933         std::string className = stats.testInfo.className;
34934
34935         if( className.empty() ) {
34936             className = fileNameTag(stats.testInfo.tags);
34937             if ( className.empty() )
34938                 className = "global";
34939         }
34940
34941         if ( !m_config->name().empty() )
34942             className = m_config->name() + "." + className;
34943
34944         writeSection( className, "", rootSection, stats.testInfo.okToFail() );
34945     }
34946
34947     void JunitReporter::writeSection( std::string const& className,
34948                                       std::string const& rootName,
34949                                       SectionNode const& sectionNode,
34950                                       bool testOkToFail) {
34951         std::string name = trim( sectionNode.stats.sectionInfo.name );
34952         if( !rootName.empty() )
34953             name = rootName + '/' + name;
34954
34955         if( !sectionNode.assertions.empty() ||
34956             !sectionNode.stdOut.empty() ||
34957             !sectionNode.stdErr.empty() ) {
```

```
34958             XmlWriter::ScopedElement e = xml.scopedElement( "testcase" );
34959             if( className.empty() ) {
34960                 xml.writeAttribute( "classname", name );
34961                 xml.writeAttribute( "name", "root" );
34962             }
34963             else {
34964                 xml.writeAttribute( "classname", className );
34965                 xml.writeAttribute( "name", name );
34966             }
34967             xml.writeAttribute( "time", formatDuration( sectionNode.stats.durationInSeconds ) );
34968             // This is not ideal, but it should be enough to mimic gtest's
34969             // junit output.
34970             // Ideally the JUnit reporter would also handle `skipTest`
34971             // events and write those out appropriately.
34972             xml.writeAttribute( "status", "run" );
34973
34974             if (sectionNode.stats.assertions.failedButOk) {
34975                 xml.scopedElement("skipped")
34976                     .writeAttribute("message", "TEST_CASE tagged with !mayfail");
34977             }
34978
34979             writeAssertions( sectionNode );
34980
34981             if( !sectionNode.stdOut.empty() )
34982                 xml.scopedElement( "system-out" ).writeText( trim( sectionNode.stdOut ),
    XmlFormatting::Newline );
34983             if( !sectionNode.stdErr.empty() )
34984                 xml.scopedElement( "system-err" ).writeText( trim( sectionNode.stdErr ),
    XmlFormatting::Newline );
34985         }
34986         for( auto const& childNode : sectionNode.childSections )
34987             if( className.empty() )
34988                 writeSection( name, "", *childNode, testOkToFail );
34989             else
34990                 writeSection( className, name, *childNode, testOkToFail );
34991     }
34992
34993     void JunitReporter::writeAssertions( SectionNode const& sectionNode ) {
34994         for( auto const& assertion : sectionNode.assertions )
34995             writeAssertion( assertion );
34996     }
34997
34998     void JunitReporter::writeAssertion( AssertionStats const& stats ) {
34999         AssertionResult const& result = stats.assertionResult;
35000         if( !result.isOk() ) {
35001             std::string elementName;
35002             switch( result.getResultType() ) {
35003                 case ResultWas::ThrewException:
35004                 case ResultWas::FatalErrorCondition:
35005                     elementName = "error";
35006                     break;
35007                 case ResultWas::ExplicitFailure:
35008                 case ResultWas::ExpressionFailed:
35009                 case ResultWas::DidntThrowException:
35010                     elementName = "failure";
35011                     break;
35012
35013                 // We should never see these here:
35014                 case ResultWas::Info:
35015                 case ResultWas::Warning:
35016                 case ResultWas::Ok:
35017                 case ResultWas::Unknown:
35018                 case ResultWas::FailureBit:
35019                 case ResultWas::Exception:
35020                     elementName = "internalError";
35021                     break;
35022             }
35023
35024             XmlWriter::ScopedElement e = xml.scopedElement( elementName );
35025
35026             xml.writeAttribute( "message", result.getExpression() );
35027             xml.writeAttribute( "type", result.getTestMacroName() );
35028
35029             ReusableStringStream rss;
35030             if (stats.totals.assertions.total() > 0) {
35031                 rss << "FAILED" << ":\n";
35032                 if (result.hasExpression()) {
35033                     rss << "  ";
35034                     rss << result.getExpressionInMacro();
35035                     rss << '\n';
35036                 }
35037                 if (result.hasExpandedExpression()) {
35038                     rss << "with expansion:\n";
35039                     rss << Column(result.getExpandedExpression()).indent(2) << '\n';
35040                 }
35041             } else {
35042                 rss << '\n';
```

```
35043             }
35044
35045             if( !result.getMessage().empty() )
35046                 rss « result.getMessage() « '\n';
35047             for( auto const& msg : stats.infoMessages )
35048                 if( msg.type == ResultWas::Info )
35049                     rss « msg.message « '\n';
35050
35051             rss « "at " « result.getSourceInfo();
35052             xml.writeText( rss.str(), XmlFormatting::Newline );
35053         }
35054     }
35055
35056     CATCH_REGISTER_REPORTER( "junit", JunitReporter )
35057
35058 } // end namespace Catch
35059 // end catch_reporter_junit.cpp
35060 // start catch_reporter_listening.cpp
35061
35062 #include <cassert>
35063
35064 namespace Catch {
35065
35066     ListeningReporter::ListeningReporter() {
35067         // We will assume that listeners will always want all assertions
35068         m_preferences.shouldReportAllAssertions = true;
35069     }
35070
35071     void ListeningReporter::addListener( IStreamingReporterPtr&& listener ) {
35072         m_listeners.push_back( std::move( listener ) );
35073     }
35074
35075     void ListeningReporter::addReporter(IStreamingReporterPtr&& reporter) {
35076         assert(!m_reporter && "Listening reporter can wrap only 1 real reporter");
35077         m_reporter = std::move( reporter );
35078         m_preferences.shouldRedirectStdOut = m_reporter->getPreferences().shouldRedirectStdOut;
35079     }
35080
35081     ReporterPreferences ListeningReporter::getPreferences() const {
35082         return m_preferences;
35083     }
35084
35085     std::set<Verbosity> ListeningReporter::getSupportedVerbosities() {
35086         return std::set<Verbosity>{ };
35087     }
35088
35089     void ListeningReporter::noMatchingTestCases( std::string const& spec ) {
35090         for ( auto const& listener : m_listeners ) {
35091             listener->noMatchingTestCases( spec );
35092         }
35093         m_reporter->noMatchingTestCases( spec );
35094     }
35095
35096     void ListeningReporter::reportInvalidArguments(std::string const&arg){
35097         for ( auto const& listener : m_listeners ) {
35098             listener->reportInvalidArguments( arg );
35099         }
35100         m_reporter->reportInvalidArguments( arg );
35101     }
35102
35103 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
35104     void ListeningReporter::benchmarkPreparing( std::string const& name ) {
35105         for (auto const& listener : m_listeners) {
35106             listener->benchmarkPreparing(name);
35107         }
35108         m_reporter->benchmarkPreparing(name);
35109     }
35110     void ListeningReporter::benchmarkStarting( BenchmarkInfo const& benchmarkInfo ) {
35111         for ( auto const& listener : m_listeners ) {
35112             listener->benchmarkStarting( benchmarkInfo );
35113         }
35114         m_reporter->benchmarkStarting( benchmarkInfo );
35115     }
35116     void ListeningReporter::benchmarkEnded( BenchmarkStats<> const& benchmarkStats ) {
35117         for ( auto const& listener : m_listeners ) {
35118             listener->benchmarkEnded( benchmarkStats );
35119         }
35120         m_reporter->benchmarkEnded( benchmarkStats );
35121     }
35122
35123     void ListeningReporter::benchmarkFailed( std::string const& error ) {
35124         for (auto const& listener : m_listeners) {
35125             listener->benchmarkFailed(error);
35126         }
35127         m_reporter->benchmarkFailed(error);
35128     }
35129 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
```

```
35130
35131     void ListeningReporter::testRunStarting( TestRunInfo const& testRunInfo ) {
35132         for ( auto const& listener : m_listeners ) {
35133             listener->testRunStarting( testRunInfo );
35134         }
35135         m_reporter->testRunStarting( testRunInfo );
35136     }
35137
35138     void ListeningReporter::testGroupStarting( GroupInfo const& groupInfo ) {
35139         for ( auto const& listener : m_listeners ) {
35140             listener->testGroupStarting( groupInfo );
35141         }
35142         m_reporter->testGroupStarting( groupInfo );
35143     }
35144
35145     void ListeningReporter::testCaseStarting( TestCaseInfo const& testInfo ) {
35146         for ( auto const& listener : m_listeners ) {
35147             listener->testCaseStarting( testInfo );
35148         }
35149         m_reporter->testCaseStarting( testInfo );
35150     }
35151
35152     void ListeningReporter::sectionStarting( SectionInfo const& sectionInfo ) {
35153         for ( auto const& listener : m_listeners ) {
35154             listener->sectionStarting( sectionInfo );
35155         }
35156         m_reporter->sectionStarting( sectionInfo );
35157     }
35158
35159     void ListeningReporter::assertionStarting( AssertionInfo const& assertionInfo ) {
35160         for ( auto const& listener : m_listeners ) {
35161             listener->assertionStarting( assertionInfo );
35162         }
35163         m_reporter->assertionStarting( assertionInfo );
35164     }
35165
35166     // The return value indicates if the messages buffer should be cleared:
35167     bool ListeningReporter::assertionEnded( AssertionStats const& assertionStats ) {
35168         for( auto const& listener : m_listeners ) {
35169             static_cast<void>( listener->assertionEnded( assertionStats ) );
35170         }
35171         return m_reporter->assertionEnded( assertionStats );
35172     }
35173
35174     void ListeningReporter::sectionEnded( SectionStats const& sectionStats ) {
35175         for ( auto const& listener : m_listeners ) {
35176             listener->sectionEnded( sectionStats );
35177         }
35178         m_reporter->sectionEnded( sectionStats );
35179     }
35180
35181     void ListeningReporter::testCaseEnded( TestCaseStats const& testCaseStats ) {
35182         for ( auto const& listener : m_listeners ) {
35183             listener->testCaseEnded( testCaseStats );
35184         }
35185         m_reporter->testCaseEnded( testCaseStats );
35186     }
35187
35188     void ListeningReporter::testGroupEnded( TestGroupStats const& testGroupStats ) {
35189         for ( auto const& listener : m_listeners ) {
35190             listener->testGroupEnded( testGroupStats );
35191         }
35192         m_reporter->testGroupEnded( testGroupStats );
35193     }
35194
35195     void ListeningReporter::testRunEnded( TestRunStats const& testRunStats ) {
35196         for ( auto const& listener : m_listeners ) {
35197             listener->testRunEnded( testRunStats );
35198         }
35199         m_reporter->testRunEnded( testRunStats );
35200     }
35201
35202     void ListeningReporter::skipTest( TestCaseInfo const& testInfo ) {
35203         for ( auto const& listener : m_listeners ) {
35204             listener->skipTest( testInfo );
35205         }
35206         m_reporter->skipTest( testInfo );
35207     }
35208
35209     bool ListeningReporter::isMulti() const {
35210         return true;
35211     }
35212
35213 } // end namespace Catch
35214 // end catch_reporter_listening.cpp
35215 // start catch_reporter_xml.cpp
35216
```

```
35217 #if defined(_MSC_VER)
35218 #pragma warning(push)
35219 #pragma warning(disable:4061) // Not all labels are EXPLICITLY handled in switch
35220                               // Note that 4062 (not all labels are handled
35221                               // and default is missing) is enabled
35222 #endif
35223
35224 namespace Catch {
35225     XmlReporter::XmlReporter( ReporterConfig const& _config )
35226     :   StreamingReporterBase( _config ),
35227         m_xml(_config.stream())
35228     {
35229         m_reporterPrefs.shouldRedirectStdOut = true;
35230         m_reporterPrefs.shouldReportAllAssertions = true;
35231     }
35232
35233     XmlReporter::~XmlReporter() = default;
35234
35235     std::string XmlReporter::getDescription() {
35236         return "Reports test results as an XML document";
35237     }
35238
35239     std::string XmlReporter::getStylesheetRef() const {
35240         return std::string();
35241     }
35242
35243     void XmlReporter::writeSourceInfo( SourceLineInfo const& sourceInfo ) {
35244         m_xml
35245             .writeAttribute( "filename", sourceInfo.file )
35246             .writeAttribute( "line", sourceInfo.line );
35247     }
35248
35249     void XmlReporter::noMatchingTestCases( std::string const& s ) {
35250         StreamingReporterBase::noMatchingTestCases( s );
35251     }
35252
35253     void XmlReporter::testRunStarting( TestRunInfo const& testInfo ) {
35254         StreamingReporterBase::testRunStarting( testInfo );
35255         std::string stylesheetRef = getStylesheetRef();
35256         if( !stylesheetRef.empty() )
35257             m_xml.writeStylesheetRef( stylesheetRef );
35258         m_xml.startElement( "Catch" );
35259         if( !m_config->name().empty() )
35260             m_xml.writeAttribute( "name", m_config->name() );
35261         if (m_config->testSpec().hasFilters())
35262             m_xml.writeAttribute( "filters", serializeFilters( m_config->getTestsOrTags() ) );
35263         if( m_config->rngSeed() != 0 )
35264             m_xml.scopedElement( "Randomness" )
35265                 .writeAttribute( "seed", m_config->rngSeed() );
35266     }
35267
35268     void XmlReporter::testGroupStarting( GroupInfo const& groupInfo ) {
35269         StreamingReporterBase::testGroupStarting( groupInfo );
35270         m_xml.startElement( "Group" )
35271             .writeAttribute( "name", groupInfo.name );
35272     }
35273
35274     void XmlReporter::testCaseStarting( TestCaseInfo const& testInfo ) {
35275         StreamingReporterBase::testCaseStarting(testInfo);
35276         m_xml.startElement( "TestCase" )
35277             .writeAttribute( "name", trim( testInfo.name ) )
35278             .writeAttribute( "description", testInfo.description )
35279             .writeAttribute( "tags", testInfo.tagsAsString() );
35280
35281         writeSourceInfo( testInfo.lineInfo );
35282
35283         if ( m_config->showDurations() == ShowDurations::Always )
35284             m_testCaseTimer.start();
35285         m_xml.ensureTagClosed();
35286     }
35287
35288     void XmlReporter::sectionStarting( SectionInfo const& sectionInfo ) {
35289         StreamingReporterBase::sectionStarting( sectionInfo );
35290         if( m_sectionDepth++ > 0 ) {
35291             m_xml.startElement( "Section" )
35292                 .writeAttribute( "name", trim( sectionInfo.name ) );
35293             writeSourceInfo( sectionInfo.lineInfo );
35294             m_xml.ensureTagClosed();
35295         }
35296     }
35297
35298     void XmlReporter::assertionStarting( AssertionInfo const& ) { }
35299
35300     bool XmlReporter::assertionEnded( AssertionStats const& assertionStats ) {
35301
35302         AssertionResult const& result = assertionStats.assertionResult;
35303
```

```
35304         bool includeResults = m_config->includeSuccessfulResults() || !result.isOk();
35305
35306         if( includeResults || result.getResultType() == ResultWas::Warning ) {
35307             // Print any info messages in <Info> tags.
35308             for( auto const& msg : assertionStats.infoMessages ) {
35309                 if( msg.type == ResultWas::Info && includeResults ) {
35310                     m_xml.scopedElement( "Info" )
35311                             .writeText( msg.message );
35312                 } else if ( msg.type == ResultWas::Warning ) {
35313                     m_xml.scopedElement( "Warning" )
35314                             .writeText( msg.message );
35315                 }
35316             }
35317         }
35318
35319         // Drop out if result was successful but we're not printing them.
35320         if( !includeResults && result.getResultType() != ResultWas::Warning )
35321             return true;
35322
35323         // Print the expression if there is one.
35324         if( result.hasExpression() ) {
35325             m_xml.startElement( "Expression" )
35326                 .writeAttribute( "success", result.succeeded() )
35327                 .writeAttribute( "type", result.getTestMacroName() );
35328
35329             writeSourceInfo( result.getSourceInfo() );
35330
35331             m_xml.scopedElement( "Original" )
35332                 .writeText( result.getExpression() );
35333             m_xml.scopedElement( "Expanded" )
35334                 .writeText( result.getExpandedExpression() );
35335         }
35336
35337         // And... Print a result applicable to each result type.
35338         switch( result.getResultType() ) {
35339             case ResultWas::ThrewException:
35340                 m_xml.startElement( "Exception" );
35341                 writeSourceInfo( result.getSourceInfo() );
35342                 m_xml.writeText( result.getMessage() );
35343                 m_xml.endElement();
35344                 break;
35345             case ResultWas::FatalErrorCondition:
35346                 m_xml.startElement( "FatalErrorCondition" );
35347                 writeSourceInfo( result.getSourceInfo() );
35348                 m_xml.writeText( result.getMessage() );
35349                 m_xml.endElement();
35350                 break;
35351             case ResultWas::Info:
35352                 m_xml.scopedElement( "Info" )
35353                     .writeText( result.getMessage() );
35354                 break;
35355             case ResultWas::Warning:
35356                 // Warning will already have been written
35357                 break;
35358             case ResultWas::ExplicitFailure:
35359                 m_xml.startElement( "Failure" );
35360                 writeSourceInfo( result.getSourceInfo() );
35361                 m_xml.writeText( result.getMessage() );
35362                 m_xml.endElement();
35363                 break;
35364             default:
35365                 break;
35366         }
35367
35368         if( result.hasExpression() )
35369             m_xml.endElement();
35370
35371         return true;
35372     }
35373
35374     void XmlReporter::sectionEnded( SectionStats const& sectionStats ) {
35375         StreamingReporterBase::sectionEnded( sectionStats );
35376         if( --m_sectionDepth > 0 ) {
35377             XmlWriter::ScopedElement e = m_xml.scopedElement( "OverallResults" );
35378             e.writeAttribute( "successes", sectionStats.assertions.passed );
35379             e.writeAttribute( "failures", sectionStats.assertions.failed );
35380             e.writeAttribute( "expectedFailures", sectionStats.assertions.failedButOk );
35381
35382             if ( m_config->showDurations() == ShowDurations::Always )
35383                 e.writeAttribute( "durationInSeconds", sectionStats.durationInSeconds );
35384
35385             m_xml.endElement();
35386         }
35387     }
35388
35389     void XmlReporter::testCaseEnded( TestCaseStats const& testCaseStats ) {
35390         StreamingReporterBase::testCaseEnded( testCaseStats );
```

```
35391         XmlWriter::ScopedElement e = m_xml.scopedElement( "OverallResult" );
35392         e.writeAttribute( "success", testCaseStats.totals.assertions.allOk() );
35393
35394         if ( m_config->showDurations() == ShowDurations::Always )
35395             e.writeAttribute( "durationInSeconds", m_testCaseTimer.getElapsedSeconds() );
35396
35397         if( !testCaseStats.stdOut.empty() )
35398             m_xml.scopedElement( "StdOut" ).writeText( trim( testCaseStats.stdOut ),
      XmlFormatting::Newline );
35399         if( !testCaseStats.stdErr.empty() )
35400             m_xml.scopedElement( "StdErr" ).writeText( trim( testCaseStats.stdErr ),
      XmlFormatting::Newline );
35401
35402         m_xml.endElement();
35403     }
35404
35405     void XmlReporter::testGroupEnded( TestGroupStats const& testGroupStats ) {
35406         StreamingReporterBase::testGroupEnded( testGroupStats );
35407         // TODO: Check testGroupStats.aborting and act accordingly.
35408         m_xml.scopedElement( "OverallResults" )
35409             .writeAttribute( "successes", testGroupStats.totals.assertions.passed )
35410             .writeAttribute( "failures", testGroupStats.totals.assertions.failed )
35411             .writeAttribute( "expectedFailures", testGroupStats.totals.assertions.failedButOk );
35412         m_xml.scopedElement( "OverallResultsCases")
35413             .writeAttribute( "successes", testGroupStats.totals.testCases.passed )
35414             .writeAttribute( "failures", testGroupStats.totals.testCases.failed )
35415             .writeAttribute( "expectedFailures", testGroupStats.totals.testCases.failedButOk );
35416         m_xml.endElement();
35417     }
35418
35419     void XmlReporter::testRunEnded( TestRunStats const& testRunStats ) {
35420         StreamingReporterBase::testRunEnded( testRunStats );
35421         m_xml.scopedElement( "OverallResults" )
35422             .writeAttribute( "successes", testRunStats.totals.assertions.passed )
35423             .writeAttribute( "failures", testRunStats.totals.assertions.failed )
35424             .writeAttribute( "expectedFailures", testRunStats.totals.assertions.failedButOk );
35425         m_xml.scopedElement( "OverallResultsCases")
35426             .writeAttribute( "successes", testRunStats.totals.testCases.passed )
35427             .writeAttribute( "failures", testRunStats.totals.testCases.failed )
35428             .writeAttribute( "expectedFailures", testRunStats.totals.testCases.failedButOk );
35429         m_xml.endElement();
35430     }
35431
35432 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
35433     void XmlReporter::benchmarkPreparing(std::string const& name) {
35434         m_xml.startElement("BenchmarkResults")
35435             .writeAttribute("name", name);
35436     }
35437
35438     void XmlReporter::benchmarkStarting(BenchmarkInfo const &info) {
35439         m_xml.writeAttribute("samples", info.samples)
35440             .writeAttribute("resamples", info.resamples)
35441             .writeAttribute("iterations", info.iterations)
35442             .writeAttribute("clockResolution", info.clockResolution)
35443             .writeAttribute("estimatedDuration", info.estimatedDuration)
35444             .writeComment("All values in nano seconds");
35445     }
35446
35447     void XmlReporter::benchmarkEnded(BenchmarkStats<> const& benchmarkStats) {
35448         m_xml.startElement("mean")
35449             .writeAttribute("value", benchmarkStats.mean.point.count())
35450             .writeAttribute("lowerBound", benchmarkStats.mean.lower_bound.count())
35451             .writeAttribute("upperBound", benchmarkStats.mean.upper_bound.count())
35452             .writeAttribute("ci", benchmarkStats.mean.confidence_interval);
35453         m_xml.endElement();
35454         m_xml.startElement("standardDeviation")
35455             .writeAttribute("value", benchmarkStats.standardDeviation.point.count())
35456             .writeAttribute("lowerBound", benchmarkStats.standardDeviation.lower_bound.count())
35457             .writeAttribute("upperBound", benchmarkStats.standardDeviation.upper_bound.count())
35458             .writeAttribute("ci", benchmarkStats.standardDeviation.confidence_interval);
35459         m_xml.endElement();
35460         m_xml.startElement("outliers")
35461             .writeAttribute("variance", benchmarkStats.outlierVariance)
35462             .writeAttribute("lowMild", benchmarkStats.outliers.low_mild)
35463             .writeAttribute("lowSevere", benchmarkStats.outliers.low_severe)
35464             .writeAttribute("highMild", benchmarkStats.outliers.high_mild)
35465             .writeAttribute("highSevere", benchmarkStats.outliers.high_severe);
35466         m_xml.endElement();
35467         m_xml.endElement();
35468     }
35469
35470     void XmlReporter::benchmarkFailed(std::string const &error) {
35471         m_xml.scopedElement("failed").
35472             writeAttribute("message", error);
35473         m_xml.endElement();
35474     }
35475 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
```

```
35476
35477     CATCH_REGISTER_REPORTER( "xml", XmlReporter )
35478
35479 } // end namespace Catch
35480
35481 #if defined(_MSC_VER)
35482 #pragma warning(pop)
35483 #endif
35484 // end catch_reporter_xml.cpp
35485
35486 namespace Catch {
35487     LeakDetector leakDetector;
35488 }
35489
35490 #ifdef __clang__
35491 #pragma clang diagnostic pop
35492 #endif
35493
35494 // end catch_impl.hpp
35495 #endif
35496
35497 #ifdef CATCH_CONFIG_MAIN
35498 // start catch_default_main.hpp
35499
35500 #ifndef __OBJC__
35501
35502 #ifndef CATCH_INTERNAL_CDECL
35503 #ifdef _MSC_VER
35504 #define CATCH_INTERNAL_CDECL __cdecl
35505 #else
35506 #define CATCH_INTERNAL_CDECL
35507 #endif
35508 #endif
35509
35510 #if defined(CATCH_CONFIG_WCHAR) && defined(CATCH_PLATFORM_WINDOWS) && defined(_UNICODE) &&
      !defined(DO_NOT_USE_WMAIN)
35511 // Standard C/C++ Win32 Unicode wmain entry point
35512 extern "C" int CATCH_INTERNAL_CDECL wmain (int argc, wchar_t * argv[], wchar_t * []) {
35513 #else
35514 // Standard C/C++ main entry point
35515 int CATCH_INTERNAL_CDECL main (int argc, char * argv[]) {
35516 #endif
35517
35518     return Catch::Session().run( argc, argv );
35519 }
35520
35521 #else // __OBJC__
35522
35523 // Objective-C entry point
35524 int main (int argc, char * const argv[]) {
35525 #if !CATCH_ARC_ENABLED
35526     NSAutoreleasePool * pool = [[NSAutoreleasePool alloc] init];
35527 #endif
35528
35529     Catch::registerTestMethods();
35530     int result = Catch::Session().run( argc, (char**)argv );
35531
35532 #if !CATCH_ARC_ENABLED
35533     [pool drain];
35534 #endif
35535
35536     return result;
35537 }
35538
35539 #endif // __OBJC__
35540
35541 // end catch_default_main.hpp
35542 #endif
35543
35544 #if !defined(CATCH_CONFIG_IMPL_ONLY)
35545
35546 #ifdef CLARA_CONFIG_MAIN_NOT_DEFINED
35547 #  undef CLARA_CONFIG_MAIN
35548 #endif
35549
35550 #if !defined(CATCH_CONFIG_DISABLE)
35552 // If this config identifier is defined then all CATCH macros are prefixed with CATCH_
35553 #ifdef CATCH_CONFIG_PREFIX_ALL
35554
35555 #define CATCH_REQUIRE( ... ) INTERNAL_CATCH_TEST( "CATCH_REQUIRE", Catch::ResultDisposition::Normal,
      __VA_ARGS__ )
35556 #define CATCH_REQUIRE_FALSE( ... ) INTERNAL_CATCH_TEST( "CATCH_REQUIRE_FALSE",
      Catch::ResultDisposition::Normal | Catch::ResultDisposition::FalseTest, __VA_ARGS__ )
35557
35558 #define CATCH_REQUIRE_THROWS( ... ) INTERNAL_CATCH_THROWS( "CATCH_REQUIRE_THROWS",
      Catch::ResultDisposition::Normal, __VA_ARGS__ )
35559 #define CATCH_REQUIRE_THROWS_AS( expr, exceptionType ) INTERNAL_CATCH_THROWS_AS(
```

```
    "CATCH_REQUIRE_THROWS_AS", exceptionType, Catch::ResultDisposition::Normal, expr )
35560 #define CATCH_REQUIRE_THROWS_WITH( expr, matcher ) INTERNAL_CATCH_THROWS_STR_MATCHES(
    "CATCH_REQUIRE_THROWS_WITH", Catch::ResultDisposition::Normal, matcher, expr )
35561 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
35562 #define CATCH_REQUIRE_THROWS_MATCHES( expr, exceptionType, matcher ) INTERNAL_CATCH_THROWS_MATCHES(
    "CATCH_REQUIRE_THROWS_MATCHES", exceptionType, Catch::ResultDisposition::Normal, matcher, expr )
35563 #endif// CATCH_CONFIG_DISABLE_MATCHERS
35564 #define CATCH_REQUIRE_NOTHROW( ... ) INTERNAL_CATCH_NO_THROW( "CATCH_REQUIRE_NOTHROW",
    Catch::ResultDisposition::Normal, __VA_ARGS__ )
35565
35566 #define CATCH_CHECK( ... ) INTERNAL_CATCH_TEST( "CATCH_CHECK",
    Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
35567 #define CATCH_CHECK_FALSE( ... ) INTERNAL_CATCH_TEST( "CATCH_CHECK_FALSE",
    Catch::ResultDisposition::ContinueOnFailure | Catch::ResultDisposition::FalseTest, __VA_ARGS__ )
35568 #define CATCH_CHECKED_IF( ... ) INTERNAL_CATCH_IF( "CATCH_CHECKED_IF",
    Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
35569 #define CATCH_CHECKED_ELSE( ... ) INTERNAL_CATCH_ELSE( "CATCH_CHECKED_ELSE",
    Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
35570 #define CATCH_CHECK_NOFAIL( ... ) INTERNAL_CATCH_TEST( "CATCH_CHECK_NOFAIL",
    Catch::ResultDisposition::ContinueOnFailure | Catch::ResultDisposition::SuppressFail, __VA_ARGS__ )
35571
35572 #define CATCH_CHECK_THROWS( ... )  INTERNAL_CATCH_THROWS( "CATCH_CHECK_THROWS",
    Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
35573 #define CATCH_CHECK_THROWS_AS( expr, exceptionType ) INTERNAL_CATCH_THROWS_AS(
    "CATCH_CHECK_THROWS_AS", exceptionType, Catch::ResultDisposition::ContinueOnFailure, expr )
35574 #define CATCH_CHECK_THROWS_WITH( expr, matcher ) INTERNAL_CATCH_THROWS_STR_MATCHES(
    "CATCH_CHECK_THROWS_WITH", Catch::ResultDisposition::ContinueOnFailure, matcher, expr )
35575 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
35576 #define CATCH_CHECK_THROWS_MATCHES( expr, exceptionType, matcher ) INTERNAL_CATCH_THROWS_MATCHES(
    "CATCH_CHECK_THROWS_MATCHES", exceptionType, Catch::ResultDisposition::ContinueOnFailure, matcher,
    expr )
35577 #endif // CATCH_CONFIG_DISABLE_MATCHERS
35578 #define CATCH_CHECK_NOTHROW( ... ) INTERNAL_CATCH_NO_THROW( "CATCH_CHECK_NOTHROW",
    Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
35579
35580 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
35581 #define CATCH_CHECK_THAT( arg, matcher ) INTERNAL_CHECK_THAT( "CATCH_CHECK_THAT", matcher,
    Catch::ResultDisposition::ContinueOnFailure, arg )
35582
35583 #define CATCH_REQUIRE_THAT( arg, matcher ) INTERNAL_CHECK_THAT( "CATCH_REQUIRE_THAT", matcher,
    Catch::ResultDisposition::Normal, arg )
35584 #endif // CATCH_CONFIG_DISABLE_MATCHERS
35585
35586 #define CATCH_INFO( msg ) INTERNAL_CATCH_INFO( "CATCH_INFO", msg )
35587 #define CATCH_UNSCOPED_INFO( msg ) INTERNAL_CATCH_UNSCOPED_INFO( "CATCH_UNSCOPED_INFO", msg )
35588 #define CATCH_WARN( msg ) INTERNAL_CATCH_MSG( "CATCH_WARN", Catch::ResultWas::Warning,
    Catch::ResultDisposition::ContinueOnFailure, msg )
35589 #define CATCH_CAPTURE( ... ) INTERNAL_CATCH_CAPTURE( INTERNAL_CATCH_UNIQUE_NAME(capturer),
    "CATCH_CAPTURE",__VA_ARGS__ )
35590
35591 #define CATCH_TEST_CASE( ... ) INTERNAL_CATCH_TESTCASE( __VA_ARGS__ )
35592 #define CATCH_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_TEST_CASE_METHOD( className,
    __VA_ARGS__ )
35593 #define CATCH_METHOD_AS_TEST_CASE( method, ... ) INTERNAL_CATCH_METHOD_AS_TEST_CASE( method,
    __VA_ARGS__ )
35594 #define CATCH_REGISTER_TEST_CASE( Function, ... ) INTERNAL_CATCH_REGISTER_TESTCASE( Function,
    __VA_ARGS__ )
35595 #define CATCH_SECTION( ... ) INTERNAL_CATCH_SECTION( __VA_ARGS__ )
35596 #define CATCH_DYNAMIC_SECTION( ... ) INTERNAL_CATCH_DYNAMIC_SECTION( __VA_ARGS__ )
35597 #define CATCH_FAIL( ... ) INTERNAL_CATCH_MSG( "CATCH_FAIL", Catch::ResultWas::ExplicitFailure,
    Catch::ResultDisposition::Normal, __VA_ARGS__ )
35598 #define CATCH_FAIL_CHECK( ... ) INTERNAL_CATCH_MSG( "CATCH_FAIL_CHECK",
    Catch::ResultWas::ExplicitFailure, Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
35599 #define CATCH_SUCCEED( ... ) INTERNAL_CATCH_MSG( "CATCH_SUCCEED", Catch::ResultWas::Ok,
    Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
35600
35601 #define CATCH_ANON_TEST_CASE() INTERNAL_CATCH_TESTCASE()
35602
35603 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
35604 #define CATCH_TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ )
35605 #define CATCH_TEMPLATE_TEST_CASE_SIG( ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG( __VA_ARGS__ )
35606 #define CATCH_TEMPLATE_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD(
    className, __VA_ARGS__ )
35607 #define CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, ... )
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ )
35608 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE( ... ) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE( __VA_ARGS__
    )
35609 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG(
    __VA_ARGS__ )
35610 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... )
    INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, __VA_ARGS__ )
35611 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... )
    INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ )
35612 #else
35613 #define CATCH_TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ ) )
35614 #define CATCH_TEMPLATE_TEST_CASE_SIG( ... ) INTERNAL_CATCH_EXPAND_VARGS(
```

```
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG( __VA_ARGS__ ) )
35615 #define CATCH_TEMPLATE_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD( className, __VA_ARGS__ ) )
35616 #define CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ ) )
35617 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE( ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE( __VA_ARGS__ ) )
35618 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG( __VA_ARGS__ ) )
35619 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, __VA_ARGS__ ) )
35620 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ ) )
35621 #endif
35622
35623 #if !defined(CATCH_CONFIG_RUNTIME_STATIC_REQUIRE)
35624 #define CATCH_STATIC_REQUIRE( ... )       static_assert(   __VA_ARGS__ ,      #__VA_ARGS__ );
    CATCH_SUCCEED( #__VA_ARGS__ )
35625 #define CATCH_STATIC_REQUIRE_FALSE( ... ) static_assert( !(__VA_ARGS__), "!(" #__VA_ARGS__ ")" );
    CATCH_SUCCEED( #__VA_ARGS__ )
35626 #else
35627 #define CATCH_STATIC_REQUIRE( ... )       CATCH_REQUIRE( __VA_ARGS__ )
35628 #define CATCH_STATIC_REQUIRE_FALSE( ... ) CATCH_REQUIRE_FALSE( __VA_ARGS__ )
35629 #endif
35630
35631 // "BDD-style" convenience wrappers
35632 #define CATCH_SCENARIO( ... ) CATCH_TEST_CASE( "Scenario: " __VA_ARGS__ )
35633 #define CATCH_SCENARIO_METHOD( className, ... ) INTERNAL_CATCH_TEST_CASE_METHOD( className, "Scenario:
    " __VA_ARGS__ )
35634 #define CATCH_GIVEN( desc )     INTERNAL_CATCH_DYNAMIC_SECTION( "    Given: " << desc )
35635 #define CATCH_AND_GIVEN( desc ) INTERNAL_CATCH_DYNAMIC_SECTION( "And given: " << desc )
35636 #define CATCH_WHEN( desc )      INTERNAL_CATCH_DYNAMIC_SECTION( "     When: " << desc )
35637 #define CATCH_AND_WHEN( desc )  INTERNAL_CATCH_DYNAMIC_SECTION( " And when: " << desc )
35638 #define CATCH_THEN( desc )      INTERNAL_CATCH_DYNAMIC_SECTION( "     Then: " << desc )
35639 #define CATCH_AND_THEN( desc )  INTERNAL_CATCH_DYNAMIC_SECTION( "      And: " << desc )
35640
35641 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
35642 #define CATCH_BENCHMARK(...) \
35643     INTERNAL_CATCH_BENCHMARK(INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_B_E_N_C_H_),
    INTERNAL_CATCH_GET_1_ARG(__VA_ARGS__,), INTERNAL_CATCH_GET_2_ARG(__VA_ARGS__,))
35644 #define CATCH_BENCHMARK_ADVANCED(name) \
35645     INTERNAL_CATCH_BENCHMARK_ADVANCED(INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_B_E_N_C_H_), name)
35646 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
35647
35648 // If CATCH_CONFIG_PREFIX_ALL is not defined then the CATCH_ prefix is not required
35649 #else
35650
35651 #define REQUIRE( ... ) INTERNAL_CATCH_TEST( "REQUIRE", Catch::ResultDisposition::Normal, __VA_ARGS__
    )
35652 #define REQUIRE_FALSE( ... ) INTERNAL_CATCH_TEST( "REQUIRE_FALSE", Catch::ResultDisposition::Normal |
    Catch::ResultDisposition::FalseTest, __VA_ARGS__ )
35653
35654 #define REQUIRE_THROWS( ... ) INTERNAL_CATCH_THROWS( "REQUIRE_THROWS",
    Catch::ResultDisposition::Normal, __VA_ARGS__ )
35655 #define REQUIRE_THROWS_AS( expr, exceptionType ) INTERNAL_CATCH_THROWS_AS( "REQUIRE_THROWS_AS",
    exceptionType, Catch::ResultDisposition::Normal, expr )
35656 #define REQUIRE_THROWS_WITH( expr, matcher ) INTERNAL_CATCH_THROWS_STR_MATCHES( "REQUIRE_THROWS_WITH",
    Catch::ResultDisposition::Normal, matcher, expr )
35657 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
35658 #define REQUIRE_THROWS_MATCHES( expr, exceptionType, matcher ) INTERNAL_CATCH_THROWS_MATCHES(
    "REQUIRE_THROWS_MATCHES", exceptionType, Catch::ResultDisposition::Normal, matcher, expr )
35659 #endif // CATCH_CONFIG_DISABLE_MATCHERS
35660 #define REQUIRE_NOTHROW( ... ) INTERNAL_CATCH_NO_THROW( "REQUIRE_NOTHROW",
    Catch::ResultDisposition::Normal, __VA_ARGS__ )
35661
35662 #define CHECK( ... ) INTERNAL_CATCH_TEST( "CHECK", Catch::ResultDisposition::ContinueOnFailure,
    __VA_ARGS__ )
35663 #define CHECK_FALSE( ... ) INTERNAL_CATCH_TEST( "CHECK_FALSE",
    Catch::ResultDisposition::ContinueOnFailure | Catch::ResultDisposition::FalseTest, __VA_ARGS__ )
35664 #define CHECKED_IF( ... ) INTERNAL_CATCH_IF( "CHECKED_IF",
    Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
35665 #define CHECKED_ELSE( ... ) INTERNAL_CATCH_ELSE( "CHECKED_ELSE",
    Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
35666 #define CHECK_NOFAIL( ... ) INTERNAL_CATCH_TEST( "CHECK_NOFAIL",
    Catch::ResultDisposition::ContinueOnFailure | Catch::ResultDisposition::SuppressFail, __VA_ARGS__ )
35667
35668 #define CHECK_THROWS( ... )  INTERNAL_CATCH_THROWS( "CHECK_THROWS",
    Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
35669 #define CHECK_THROWS_AS( expr, exceptionType ) INTERNAL_CATCH_THROWS_AS( "CHECK_THROWS_AS",
    exceptionType, Catch::ResultDisposition::ContinueOnFailure, expr )
35670 #define CHECK_THROWS_WITH( expr, matcher ) INTERNAL_CATCH_THROWS_STR_MATCHES( "CHECK_THROWS_WITH",
    Catch::ResultDisposition::ContinueOnFailure, matcher, expr )
35671 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
35672 #define CHECK_THROWS_MATCHES( expr, exceptionType, matcher ) INTERNAL_CATCH_THROWS_MATCHES(
    "CHECK_THROWS_MATCHES", exceptionType, Catch::ResultDisposition::ContinueOnFailure, matcher, expr )
35673 #endif // CATCH_CONFIG_DISABLE_MATCHERS
35674 #define CHECK_NOTHROW( ... ) INTERNAL_CATCH_NO_THROW( "CHECK_NOTHROW",
```

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    Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
35675
35676 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
35677 #define CHECK_THAT( arg, matcher ) INTERNAL_CHECK_THAT( "CHECK_THAT", matcher,
    Catch::ResultDisposition::ContinueOnFailure, arg )
35678
35679 #define REQUIRE_THAT( arg, matcher ) INTERNAL_CHECK_THAT( "REQUIRE_THAT", matcher,
    Catch::ResultDisposition::Normal, arg )
35680 #endif // CATCH_CONFIG_DISABLE_MATCHERS
35681
35682 #define INFO( msg ) INTERNAL_CATCH_INFO( "INFO", msg )
35683 #define UNSCOPED_INFO( msg ) INTERNAL_CATCH_UNSCOPED_INFO( "UNSCOPED_INFO", msg )
35684 #define WARN( msg ) INTERNAL_CATCH_MSG( "WARN", Catch::ResultWas::Warning,
    Catch::ResultDisposition::ContinueOnFailure, msg )
35685 #define CAPTURE( ... ) INTERNAL_CATCH_CAPTURE( INTERNAL_CATCH_UNIQUE_NAME(capturer),
    "CAPTURE",__VA_ARGS__ )
35686
35687 #define TEST_CASE( ... ) INTERNAL_CATCH_TESTCASE( __VA_ARGS__ )
35688 #define TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_TEST_CASE_METHOD( className, __VA_ARGS__ )
35689 #define METHOD_AS_TEST_CASE( method, ... ) INTERNAL_CATCH_METHOD_AS_TEST_CASE( method, __VA_ARGS__ )
35690 #define REGISTER_TEST_CASE( Function, ... ) INTERNAL_CATCH_REGISTER_TESTCASE( Function, __VA_ARGS__ )
35691 #define SECTION( ... ) INTERNAL_CATCH_SECTION( __VA_ARGS__ )
35692 #define DYNAMIC_SECTION( ... ) INTERNAL_CATCH_DYNAMIC_SECTION( __VA_ARGS__ )
35693 #define FAIL( ... ) INTERNAL_CATCH_MSG( "FAIL", Catch::ResultWas::ExplicitFailure,
    Catch::ResultDisposition::Normal, __VA_ARGS__ )
35694 #define FAIL_CHECK( ... ) INTERNAL_CATCH_MSG( "FAIL_CHECK", Catch::ResultWas::ExplicitFailure,
    Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
35695 #define SUCCEED( ... ) INTERNAL_CATCH_MSG( "SUCCEED", Catch::ResultWas::Ok,
    Catch::ResultDisposition::ContinueOnFailure, __VA_ARGS__ )
35696 #define ANON_TEST_CASE() INTERNAL_CATCH_TESTCASE()
35697
35698 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
35699 #define TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ )
35700 #define TEMPLATE_TEST_CASE_SIG( ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG( __VA_ARGS__ )
35701 #define TEMPLATE_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD(
    className, __VA_ARGS__ )
35702 #define TEMPLATE_TEST_CASE_METHOD_SIG( className, ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG(
    className, __VA_ARGS__ )
35703 #define TEMPLATE_PRODUCT_TEST_CASE( ... ) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE( __VA_ARGS__ )
35704 #define TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG(
    __VA_ARGS__ )
35705 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... )
    INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, __VA_ARGS__ )
35706 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... )
    INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ )
35707 #define TEMPLATE_LIST_TEST_CASE( ... ) INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE(__VA_ARGS__)
35708 #define TEMPLATE_LIST_TEST_CASE_METHOD( className, ... )
    INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD( className, __VA_ARGS__ )
35709 #else
35710 #define TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_EXPAND_VARGS( INTERNAL_CATCH_TEMPLATE_TEST_CASE(
    __VA_ARGS__ ) )
35711 #define TEMPLATE_TEST_CASE_SIG( ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG( __VA_ARGS__ ) )
35712 #define TEMPLATE_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD( className, __VA_ARGS__ ) )
35713 #define TEMPLATE_TEST_CASE_METHOD_SIG( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ ) )
35714 #define TEMPLATE_PRODUCT_TEST_CASE( ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE( __VA_ARGS__ ) )
35715 #define TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG( __VA_ARGS__ ) )
35716 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, __VA_ARGS__ ) )
35717 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, __VA_ARGS__ ) )
35718 #define TEMPLATE_LIST_TEST_CASE( ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE( __VA_ARGS__ ) )
35719 #define TEMPLATE_LIST_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_LIST_TEST_CASE_METHOD( className, __VA_ARGS__ ) )
35720 #endif
35721
35722 #if !defined(CATCH_CONFIG_RUNTIME_STATIC_REQUIRE)
35723 #define STATIC_REQUIRE( ... )       static_assert(   __VA_ARGS__,  #__VA_ARGS__ ); SUCCEED(
    #__VA_ARGS__ )
35724 #define STATIC_REQUIRE_FALSE( ... ) static_assert( !(__VA_ARGS__), "!(" #__VA_ARGS__ ")" ); SUCCEED(
    "!(" #__VA_ARGS__ ")" )
35725 #else
35726 #define STATIC_REQUIRE( ... )       REQUIRE( __VA_ARGS__ )
35727 #define STATIC_REQUIRE_FALSE( ... ) REQUIRE_FALSE( __VA_ARGS__ )
35728 #endif
35729
35730 #endif
35731
35732 #define CATCH_TRANSLATE_EXCEPTION( signature ) INTERNAL_CATCH_TRANSLATE_EXCEPTION( signature )
35733
35734 // "BDD-style" convenience wrappers
35735 #define SCENARIO( ... ) TEST_CASE( "Scenario: " __VA_ARGS__ )
```

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35736 #define SCENARIO_METHOD( className, ... ) INTERNAL_CATCH_TEST_CASE_METHOD( className, "Scenario: "
      __VA_ARGS__ )
35737
35738 #define GIVEN( desc )     INTERNAL_CATCH_DYNAMIC_SECTION( "    Given: " << desc )
35739 #define AND_GIVEN( desc ) INTERNAL_CATCH_DYNAMIC_SECTION( "And given: " << desc )
35740 #define WHEN( desc )      INTERNAL_CATCH_DYNAMIC_SECTION( "     When: " << desc )
35741 #define AND_WHEN( desc )  INTERNAL_CATCH_DYNAMIC_SECTION( " And when: " << desc )
35742 #define THEN( desc )      INTERNAL_CATCH_DYNAMIC_SECTION( "     Then: " << desc )
35743 #define AND_THEN( desc )  INTERNAL_CATCH_DYNAMIC_SECTION( "      And: " << desc )
35744
35745 #if defined(CATCH_CONFIG_ENABLE_BENCHMARKING)
35746 #define BENCHMARK(...) \
35747     INTERNAL_CATCH_BENCHMARK(INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_B_E_N_C_H_), INTERNAL_CATCH_GET_1_ARG(__VA_ARGS__,), INTERNAL_CATCH_GET_2_ARG(__VA_ARGS__,))
35748 #define BENCHMARK_ADVANCED(name) \
35749     INTERNAL_CATCH_BENCHMARK_ADVANCED(INTERNAL_CATCH_UNIQUE_NAME(C_A_T_C_H_B_E_N_C_H_), name)
35750 #endif // CATCH_CONFIG_ENABLE_BENCHMARKING
35751
35752 using Catch::Detail::Approx;
35753
35754 #else // CATCH_CONFIG_DISABLE
35755
35757 // If this config identifier is defined then all CATCH macros are prefixed with CATCH_
35758 #ifdef CATCH_CONFIG_PREFIX_ALL
35759
35760 #define CATCH_REQUIRE( ... )         (void)(0)
35761 #define CATCH_REQUIRE_FALSE( ... )   (void)(0)
35762
35763 #define CATCH_REQUIRE_THROWS( ... ) (void)(0)
35764 #define CATCH_REQUIRE_THROWS_AS( expr, exceptionType ) (void)(0)
35765 #define CATCH_REQUIRE_THROWS_WITH( expr, matcher )     (void)(0)
35766 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
35767 #define CATCH_REQUIRE_THROWS_MATCHES( expr, exceptionType, matcher ) (void)(0)
35768 #endif// CATCH_CONFIG_DISABLE_MATCHERS
35769 #define CATCH_REQUIRE_NOTHROW( ... ) (void)(0)
35770
35771 #define CATCH_CHECK( ... )          (void)(0)
35772 #define CATCH_CHECK_FALSE( ... )    (void)(0)
35773 #define CATCH_CHECKED_IF( ... )     if (__VA_ARGS__)
35774 #define CATCH_CHECKED_ELSE( ... )   if (!(__VA_ARGS__))
35775 #define CATCH_CHECK_NOFAIL( ... )   (void)(0)
35776
35777 #define CATCH_CHECK_THROWS( ... )   (void)(0)
35778 #define CATCH_CHECK_THROWS_AS( expr, exceptionType ) (void)(0)
35779 #define CATCH_CHECK_THROWS_WITH( expr, matcher )     (void)(0)
35780 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
35781 #define CATCH_CHECK_THROWS_MATCHES( expr, exceptionType, matcher ) (void)(0)
35782 #endif // CATCH_CONFIG_DISABLE_MATCHERS
35783 #define CATCH_CHECK_NOTHROW( ... ) (void)(0)
35784
35785 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
35786 #define CATCH_CHECK_THAT( arg, matcher )    (void)(0)
35787
35788 #define CATCH_REQUIRE_THAT( arg, matcher ) (void)(0)
35789 #endif // CATCH_CONFIG_DISABLE_MATCHERS
35790
35791 #define CATCH_INFO( msg )           (void)(0)
35792 #define CATCH_UNSCOPED_INFO( msg ) (void)(0)
35793 #define CATCH_WARN( msg )           (void)(0)
35794 #define CATCH_CAPTURE( msg )        (void)(0)
35795
35796 #define CATCH_TEST_CASE( ... ) INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_S_T_ ))
35797 #define CATCH_TEST_CASE_METHOD( className, ... )
      INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_S_T_ ))
35798 #define CATCH_METHOD_AS_TEST_CASE( method, ... )
35799 #define CATCH_REGISTER_TEST_CASE( Function, ... ) (void)(0)
35800 #define CATCH_SECTION( ... )
35801 #define CATCH_DYNAMIC_SECTION( ... )
35802 #define CATCH_FAIL( ... ) (void)(0)
35803 #define CATCH_FAIL_CHECK( ... ) (void)(0)
35804 #define CATCH_SUCCEED( ... ) (void)(0)
35805
35806 #define CATCH_ANON_TEST_CASE() INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME(
      C_A_T_C_H_T_E_S_T_ ))
35807
35808 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
35809 #define CATCH_TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION(__VA_ARGS__)
35810 #define CATCH_TEMPLATE_TEST_CASE_SIG( ... )
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG_NO_REGISTRATION(__VA_ARGS__)
35811 #define CATCH_TEMPLATE_TEST_CASE_METHOD( className, ... )
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION(className, __VA_ARGS__)
35812 #define CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, ... )
      INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG_NO_REGISTRATION(className, __VA_ARGS__ )
35813 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE( ... ) CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ )
35814 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ )
35815 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... ) CATCH_TEMPLATE_TEST_CASE_METHOD(
```

```
    className, __VA_ARGS__ )
35816 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... ) CATCH_TEMPLATE_TEST_CASE_METHOD(
    className, __VA_ARGS__ )
35817 #else
35818 #define CATCH_TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION(__VA_ARGS__) )
35819 #define CATCH_TEMPLATE_TEST_CASE_SIG( ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG_NO_REGISTRATION(__VA_ARGS__) )
35820 #define CATCH_TEMPLATE_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION(className, __VA_ARGS__ ) )
35821 #define CATCH_TEMPLATE_TEST_CASE_METHOD_SIG( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG_NO_REGISTRATION(className, __VA_ARGS__ ) )
35822 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE( ... ) CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ )
35823 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) CATCH_TEMPLATE_TEST_CASE( __VA_ARGS__ )
35824 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... ) CATCH_TEMPLATE_TEST_CASE_METHOD(
    className, __VA_ARGS__ )
35825 #define CATCH_TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... ) CATCH_TEMPLATE_TEST_CASE_METHOD(
    className, __VA_ARGS__ )
35826 #endif
35827
35828 // "BDD-style" convenience wrappers
35829 #define CATCH_SCENARIO( ... ) INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_S_T_ ))
35830 #define CATCH_SCENARIO_METHOD( className, ... )
    INTERNAL_CATCH_TESTCASE_METHOD_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_S_T_ ),
    className )
35831 #define CATCH_GIVEN( desc )
35832 #define CATCH_AND_GIVEN( desc )
35833 #define CATCH_WHEN( desc )
35834 #define CATCH_AND_WHEN( desc )
35835 #define CATCH_THEN( desc )
35836 #define CATCH_AND_THEN( desc )
35837
35838 #define CATCH_STATIC_REQUIRE( ... )       (void)(0)
35839 #define CATCH_STATIC_REQUIRE_FALSE( ... ) (void)(0)
35840
35841 // If CATCH_CONFIG_PREFIX_ALL is not defined then the CATCH_ prefix is not required
35842 #else
35843
35844 #define REQUIRE( ... )       (void)(0)
35845 #define REQUIRE_FALSE( ... ) (void)(0)
35846
35847 #define REQUIRE_THROWS( ... ) (void)(0)
35848 #define REQUIRE_THROWS_AS( expr, exceptionType ) (void)(0)
35849 #define REQUIRE_THROWS_WITH( expr, matcher ) (void)(0)
35850 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
35851 #define REQUIRE_THROWS_MATCHES( expr, exceptionType, matcher ) (void)(0)
35852 #endif // CATCH_CONFIG_DISABLE_MATCHERS
35853 #define REQUIRE_NOTHROW( ... ) (void)(0)
35854
35855 #define CHECK( ... ) (void)(0)
35856 #define CHECK_FALSE( ... ) (void)(0)
35857 #define CHECKED_IF( ... ) if (__VA_ARGS__)
35858 #define CHECKED_ELSE( ... ) if (!(__VA_ARGS__))
35859 #define CHECK_NOFAIL( ... ) (void)(0)
35860
35861 #define CHECK_THROWS( ... )  (void)(0)
35862 #define CHECK_THROWS_AS( expr, exceptionType ) (void)(0)
35863 #define CHECK_THROWS_WITH( expr, matcher ) (void)(0)
35864 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
35865 #define CHECK_THROWS_MATCHES( expr, exceptionType, matcher ) (void)(0)
35866 #endif // CATCH_CONFIG_DISABLE_MATCHERS
35867 #define CHECK_NOTHROW( ... ) (void)(0)
35868
35869 #if !defined(CATCH_CONFIG_DISABLE_MATCHERS)
35870 #define CHECK_THAT( arg, matcher ) (void)(0)
35871
35872 #define REQUIRE_THAT( arg, matcher ) (void)(0)
35873 #endif // CATCH_CONFIG_DISABLE_MATCHERS
35874
35875 #define INFO( msg ) (void)(0)
35876 #define UNSCOPED_INFO( msg ) (void)(0)
35877 #define WARN( msg ) (void)(0)
35878 #define CAPTURE( ... ) (void)(0)
35879
35880 #define TEST_CASE( ... )  INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_S_T_ ))
35881 #define TEST_CASE_METHOD( className, ... )
    INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_S_T_ ))
35882 #define METHOD_AS_TEST_CASE( method, ... )
35883 #define REGISTER_TEST_CASE( Function, ... ) (void)(0)
35884 #define SECTION( ... )
35885 #define DYNAMIC_SECTION( ... )
35886 #define FAIL( ... ) (void)(0)
35887 #define FAIL_CHECK( ... ) (void)(0)
35888 #define SUCCEED( ... ) (void)(0)
35889 #define ANON_TEST_CASE() INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME(
```

```
    C_A_T_C_H_T_E_S_T_ ))
35890
35891 #ifndef CATCH_CONFIG_TRADITIONAL_MSVC_PREPROCESSOR
35892 #define TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION(__VA_ARGS__)
35893 #define TEMPLATE_TEST_CASE_SIG( ... )
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG_NO_REGISTRATION(__VA_ARGS__)
35894 #define TEMPLATE_TEST_CASE_METHOD( className, ... )
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION(className, __VA_ARGS__)
35895 #define TEMPLATE_TEST_CASE_METHOD_SIG( className, ... )
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG_NO_REGISTRATION(className, __VA_ARGS__ )
35896 #define TEMPLATE_PRODUCT_TEST_CASE( ... ) TEMPLATE_TEST_CASE( __VA_ARGS__ )
35897 #define TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) TEMPLATE_TEST_CASE( __VA_ARGS__ )
35898 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... ) TEMPLATE_TEST_CASE_METHOD( className,
    __VA_ARGS__ )
35899 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... ) TEMPLATE_TEST_CASE_METHOD( className,
    __VA_ARGS__ )
35900 #else
35901 #define TEMPLATE_TEST_CASE( ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_NO_REGISTRATION(__VA_ARGS__) )
35902 #define TEMPLATE_TEST_CASE_SIG( ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_SIG_NO_REGISTRATION(__VA_ARGS__) )
35903 #define TEMPLATE_TEST_CASE_METHOD( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_NO_REGISTRATION(className, __VA_ARGS__ ) )
35904 #define TEMPLATE_TEST_CASE_METHOD_SIG( className, ... ) INTERNAL_CATCH_EXPAND_VARGS(
    INTERNAL_CATCH_TEMPLATE_TEST_CASE_METHOD_SIG_NO_REGISTRATION(className, __VA_ARGS__ ) )
35905 #define TEMPLATE_PRODUCT_TEST_CASE( ... ) TEMPLATE_TEST_CASE( __VA_ARGS__ )
35906 #define TEMPLATE_PRODUCT_TEST_CASE_SIG( ... ) TEMPLATE_TEST_CASE( __VA_ARGS__ )
35907 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD( className, ... ) TEMPLATE_TEST_CASE_METHOD( className,
    __VA_ARGS__ )
35908 #define TEMPLATE_PRODUCT_TEST_CASE_METHOD_SIG( className, ... ) TEMPLATE_TEST_CASE_METHOD( className,
    __VA_ARGS__ )
35909 #endif
35910
35911 #define STATIC_REQUIRE( ... )       (void)(0)
35912 #define STATIC_REQUIRE_FALSE( ... ) (void)(0)
35913
35914 #endif
35915
35916 #define CATCH_TRANSLATE_EXCEPTION( signature ) INTERNAL_CATCH_TRANSLATE_EXCEPTION_NO_REG(
    INTERNAL_CATCH_UNIQUE_NAME( catch_internal_ExceptionTranslator ), signature )
35917
35918 // "BDD-style" convenience wrappers
35919 #define SCENARIO( ... ) INTERNAL_CATCH_TESTCASE_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME(
    C_A_T_C_H_T_E_S_T_ ) )
35920 #define SCENARIO_METHOD( className, ... )
    INTERNAL_CATCH_TESTCASE_METHOD_NO_REGISTRATION(INTERNAL_CATCH_UNIQUE_NAME( C_A_T_C_H_T_E_S_T_ ),
    className )
35921
35922 #define GIVEN( desc )
35923 #define AND_GIVEN( desc )
35924 #define WHEN( desc )
35925 #define AND_WHEN( desc )
35926 #define THEN( desc )
35927 #define AND_THEN( desc )
35928
35929 using Catch::Detail::Approx;
35930
35931 #endif
35932
35933 #endif // ! CATCH_CONFIG_IMPL_ONLY
35934
35935 // start catch_reenable_warnings.h
35936
35937
35938 #ifdef __clang__
35939 #    ifdef __ICC // icpc defines the __clang__ macro
35940 #        pragma warning(pop)
35941 #    else
35942 #        pragma clang diagnostic pop
35943 #    endif
35944 #elif defined __GNUC__
35945 #    pragma GCC diagnostic pop
35946 #endif
35947
35948 // end catch_reenable_warnings.h
35949 // end catch.hpp
35950 #endif // TWOBLUECUBES_SINGLE_INCLUDE_CATCH_HPP_INCLUDED
```

7.3 /Users/samanthapope/msdscriptRepo/msdScript/cmake-build-debug/CMakeFiles/3.27.8/CompilerIdC/CMakeCCompilerId.c File Reference

Macros

- #define __has_include(x) 0
- #define COMPILER_ID ""
- #define STRINGIFY_HELPER(X) #X
- #define STRINGIFY(X) STRINGIFY_HELPER(X)
- #define PLATFORM_ID
- #define ARCHITECTURE_ID
- #define DEC(n)
- #define HEX(n)
- #define C_VERSION

Functions

- int main (int argc, char *argv[])

Variables

- char const * info_compiler = "INFO" ":" "compiler[" COMPILER_ID "]"
- char const * info_platform = "INFO" ":" "platform[" PLATFORM_ID "]"
- char const * info_arch = "INFO" ":" "arch[" ARCHITECTURE_ID "]"
- const char * info_language_standard_default
- const char * info_language_extensions_default

7.3.1 Macro Definition Documentation

7.3.1.1 __has_include

```
#define __has_include(
              x ) 0
```

Definition at line 17 of file CMakeCCompilerId.c.

7.3.1.2 ARCHITECTURE_ID

```
#define ARCHITECTURE_ID
```

Definition at line 716 of file CMakeCCompilerId.c.

7.3.1.3 C_VERSION

```
#define C_VERSION
```

Definition at line 805 of file CMakeCCompilerId.c.

7.3.1.4 COMPILER_ID

```
#define COMPILER_ID ""
```

Definition at line 427 of file CMakeCCompilerId.c.

7.3.1.5 DEC

```
#define DEC(
               n )
```

Value:

```
  ('0' + (((n) / 10000000)%10)), \
  ('0' + (((n) / 1000000)%10)),  \
  ('0' + (((n) / 100000)%10)),   \
  ('0' + (((n) / 10000)%10)),    \
  ('0' + (((n) / 1000)%10)),     \
  ('0' + (((n) / 100)%10)),      \
  ('0' + (((n) / 10)%10)),       \
  ('0' +  ((n) % 10))
```

Definition at line 720 of file CMakeCCompilerId.c.

7.3.1.6 HEX

```
#define HEX(
               n )
```

Value:

```
  ('0' + ((n)»28 & 0xF)), \
  ('0' + ((n)»24 & 0xF)), \
  ('0' + ((n)»20 & 0xF)), \
  ('0' + ((n)»16 & 0xF)), \
  ('0' + ((n)»12 & 0xF)), \
  ('0' + ((n)»8  & 0xF)), \
  ('0' + ((n)»4  & 0xF)), \
  ('0' + ((n)     & 0xF))
```

Definition at line 731 of file CMakeCCompilerId.c.

7.3.1.7 PLATFORM_ID

```
#define PLATFORM_ID
```

Definition at line 558 of file CMakeCCompilerId.c.

7.3.1.8 STRINGIFY

```
#define STRINGIFY(
               X ) STRINGIFY_HELPER(X)
```

Definition at line 448 of file CMakeCCompilerId.c.

7.3.1.9 STRINGIFY_HELPER

```
#define STRINGIFY_HELPER(
              X ) #X
```

Definition at line 447 of file CMakeCCompilerId.c.

7.3.2 Function Documentation

7.3.2.1 main()

```
int main (
             int argc,
             char * argv[] )
```

Definition at line 839 of file CMakeCCompilerId.c.

7.3.3 Variable Documentation

7.3.3.1 info_arch

```
char const* info_arch = "INFO" ":" "arch[" ARCHITECTURE_ID "]"
```

Definition at line 797 of file CMakeCCompilerId.c.

7.3.3.2 info_compiler

```
char const* info_compiler = "INFO" ":" "compiler[" COMPILER_ID "]"
```

Definition at line 434 of file CMakeCCompilerId.c.

7.3.3.3 info_language_extensions_default

```
const char* info_language_extensions_default
```

Initial value:

```
= "INFO" ":" "extensions_default["



  "OFF"

"]"
```

Definition at line 821 of file CMakeCCompilerId.c.

7.3.3.4 info_language_standard_default

```
const char* info_language_standard_default
```

Initial value:

```
=
  "INFO" ":" "standard_default[" C_VERSION "]"
```

Definition at line 818 of file CMakeCCompilerId.c.

7.3.3.5 info_platform

```
char const* info_platform = "INFO" ":" "platform[" PLATFORM_ID "]"
```

Definition at line 796 of file CMakeCCompilerId.c.

7.4 CMakeCCompilerId.c

Go to the documentation of this file.

```
00001 #ifdef __cplusplus
00002 # error "A C++ compiler has been selected for C."
00003 #endif
00004
00005 #if defined(__18CXX)
00006 # define ID_VOID_MAIN
00007 #endif
00008 #if defined(__CLASSIC_C__)
00009 /* cv-qualifiers did not exist in K&R C */
00010 # define const
00011 # define volatile
00012 #endif
00013
00014 #if !defined(__has_include)
00015 /* If the compiler does not have __has_include, pretend the answer is
00016    always no.  */
00017 #  define __has_include(x) 0
00018 #endif
00019
00020
00021 /* Version number components: V=Version, R=Revision, P=Patch
00022    Version date components:   YYYY=Year, MM=Month,   DD=Day  */
00023
00024 #if defined(__INTEL_COMPILER) || defined(__ICC)
00025 # define COMPILER_ID "Intel"
00026 # if defined(_MSC_VER)
00027 #  define SIMULATE_ID "MSVC"
00028 # endif
00029 # if defined(__GNUC__)
00030 #  define SIMULATE_ID "GNU"
00031 # endif
00032   /* __INTEL_COMPILER = VRP prior to 2021, and then VVVV for 2021 and later,
00033      except that a few beta releases use the old format with V=2021.  */
00034 # if __INTEL_COMPILER < 2021 || __INTEL_COMPILER == 202110 || __INTEL_COMPILER == 202111
00035 #  define COMPILER_VERSION_MAJOR DEC(__INTEL_COMPILER/100)
00036 #  define COMPILER_VERSION_MINOR DEC(__INTEL_COMPILER/10 % 10)
00037 #  if defined(__INTEL_COMPILER_UPDATE)
00038 #   define COMPILER_VERSION_PATCH DEC(__INTEL_COMPILER_UPDATE)
00039 #  else
00040 #   define COMPILER_VERSION_PATCH DEC(__INTEL_COMPILER   % 10)
00041 #  endif
00042 # else
00043 #  define COMPILER_VERSION_MAJOR DEC(__INTEL_COMPILER)
00044 #  define COMPILER_VERSION_MINOR DEC(__INTEL_COMPILER_UPDATE)
00045    /* The third version component from --version is an update index,
00046       but no macro is provided for it.  */
00047 #  define COMPILER_VERSION_PATCH DEC(0)
00048 # endif
00049 # if defined(__INTEL_COMPILER_BUILD_DATE)
00050    /* __INTEL_COMPILER_BUILD_DATE = YYYYMMDD */
00051 #  define COMPILER_VERSION_TWEAK DEC(__INTEL_COMPILER_BUILD_DATE)
00052 # endif
00053 # if defined(_MSC_VER)
```

```
00054    /* _MSC_VER = VVRR */
00055 #  define SIMULATE_VERSION_MAJOR DEC(_MSC_VER / 100)
00056 #  define SIMULATE_VERSION_MINOR DEC(_MSC_VER % 100)
00057 # endif
00058 # if defined(__GNUC__)
00059 #  define SIMULATE_VERSION_MAJOR DEC(__GNUC__)
00060 # elif defined(__GNUG__)
00061 #  define SIMULATE_VERSION_MAJOR DEC(__GNUG__)
00062 # endif
00063 # if defined(__GNUC_MINOR__)
00064 #  define SIMULATE_VERSION_MINOR DEC(__GNUC_MINOR__)
00065 # endif
00066 # if defined(__GNUC_PATCHLEVEL__)
00067 #  define SIMULATE_VERSION_PATCH DEC(__GNUC_PATCHLEVEL__)
00068 # endif
00069
00070 #elif (defined(__clang__) && defined(__INTEL_CLANG_COMPILER)) || defined(__INTEL_LLVM_COMPILER)
00071 # define COMPILER_ID "IntelLLVM"
00072 #if defined(_MSC_VER)
00073 # define SIMULATE_ID "MSVC"
00074 #endif
00075 #if defined(__GNUC__)
00076 # define SIMULATE_ID "GNU"
00077 #endif
00078 /* __INTEL_LLVM_COMPILER = VVVVRP prior to 2021.2.0, VVVVRRPP for 2021.2.0 and
00079  * later.  Look for 6 digit vs. 8 digit version number to decide encoding.
00080  * VVVV is no smaller than the current year when a version is released.
00081  */
00082 #if __INTEL_LLVM_COMPILER < 1000000L
00083 # define COMPILER_VERSION_MAJOR DEC(__INTEL_LLVM_COMPILER/100)
00084 # define COMPILER_VERSION_MINOR DEC(__INTEL_LLVM_COMPILER/10 % 10)
00085 # define COMPILER_VERSION_PATCH DEC(__INTEL_LLVM_COMPILER    % 10)
00086 #else
00087 # define COMPILER_VERSION_MAJOR DEC(__INTEL_LLVM_COMPILER/10000)
00088 # define COMPILER_VERSION_MINOR DEC(__INTEL_LLVM_COMPILER/100 % 100)
00089 # define COMPILER_VERSION_PATCH DEC(__INTEL_LLVM_COMPILER     % 100)
00090 #endif
00091 #if defined(_MSC_VER)
00092   /* _MSC_VER = VVRR */
00093 # define SIMULATE_VERSION_MAJOR DEC(_MSC_VER / 100)
00094 # define SIMULATE_VERSION_MINOR DEC(_MSC_VER % 100)
00095 #endif
00096 #if defined(__GNUC__)
00097 # define SIMULATE_VERSION_MAJOR DEC(__GNUC__)
00098 #elif defined(__GNUG__)
00099 # define SIMULATE_VERSION_MAJOR DEC(__GNUG__)
00100 #endif
00101 #if defined(__GNUC_MINOR__)
00102 # define SIMULATE_VERSION_MINOR DEC(__GNUC_MINOR__)
00103 #endif
00104 #if defined(__GNUC_PATCHLEVEL__)
00105 # define SIMULATE_VERSION_PATCH DEC(__GNUC_PATCHLEVEL__)
00106 #endif
00107
00108 #elif defined(__PATHCC__)
00109 # define COMPILER_ID "PathScale"
00110 # define COMPILER_VERSION_MAJOR DEC(__PATHCC__)
00111 # define COMPILER_VERSION_MINOR DEC(__PATHCC_MINOR__)
00112 # if defined(__PATHCC_PATCHLEVEL__)
00113 #  define COMPILER_VERSION_PATCH DEC(__PATHCC_PATCHLEVEL__)
00114 # endif
00115
00116 #elif defined(__BORLANDC__) && defined(__CODEGEARC_VERSION__)
00117 # define COMPILER_ID "Embarcadero"
00118 # define COMPILER_VERSION_MAJOR HEX(__CODEGEARC_VERSION__»24 & 0x00FF)
00119 # define COMPILER_VERSION_MINOR HEX(__CODEGEARC_VERSION__»16 & 0x00FF)
00120 # define COMPILER_VERSION_PATCH DEC(__CODEGEARC_VERSION__     & 0xFFFF)
00121
00122 #elif defined(__BORLANDC__)
00123 # define COMPILER_ID "Borland"
00124   /* __BORLANDC__ = 0xVRR */
00125 # define COMPILER_VERSION_MAJOR HEX(__BORLANDC__»8)
00126 # define COMPILER_VERSION_MINOR HEX(__BORLANDC__ & 0xFF)
00127
00128 #elif defined(__WATCOMC__) && __WATCOMC__ < 1200
00129 # define COMPILER_ID "Watcom"
00130    /* __WATCOMC__ = VVRR */
00131 # define COMPILER_VERSION_MAJOR DEC(__WATCOMC__ / 100)
00132 # define COMPILER_VERSION_MINOR DEC((__WATCOMC__ / 10) % 10)
00133 # if (__WATCOMC__ % 10) > 0
00134 #  define COMPILER_VERSION_PATCH DEC(__WATCOMC__ % 10)
00135 # endif
00136
00137 #elif defined(__WATCOMC__)
00138 # define COMPILER_ID "OpenWatcom"
00139    /* __WATCOMC__ = VVRP + 1100 */
00140 # define COMPILER_VERSION_MAJOR DEC((__WATCOMC__ - 1100) / 100)
```

```
00141 # define COMPILER_VERSION_MINOR DEC((__WATCOMC__ / 10) % 10)
00142 # if (__WATCOMC__ % 10) > 0
00143 #  define COMPILER_VERSION_PATCH DEC(__WATCOMC__ % 10)
00144 # endif
00145
00146 #elif defined(__SUNPRO_C)
00147 # define COMPILER_ID "SunPro"
00148 # if __SUNPRO_C >= 0x5100
00149    /* __SUNPRO_C = 0xVRRP */
00150 #  define COMPILER_VERSION_MAJOR HEX(__SUNPRO_C»12)
00151 #  define COMPILER_VERSION_MINOR HEX(__SUNPRO_C»4 & 0xFF)
00152 #  define COMPILER_VERSION_PATCH HEX(__SUNPRO_C    & 0xF)
00153 # else
00154    /* __SUNPRO_CC = 0xVRP */
00155 #  define COMPILER_VERSION_MAJOR HEX(__SUNPRO_C»8)
00156 #  define COMPILER_VERSION_MINOR HEX(__SUNPRO_C»4 & 0xF)
00157 #  define COMPILER_VERSION_PATCH HEX(__SUNPRO_C    & 0xF)
00158 # endif
00159
00160 #elif defined(__HP_cc)
00161 # define COMPILER_ID "HP"
00162   /* __HP_cc = VVRRPP */
00163 # define COMPILER_VERSION_MAJOR DEC(__HP_cc/10000)
00164 # define COMPILER_VERSION_MINOR DEC(__HP_cc/100 % 100)
00165 # define COMPILER_VERSION_PATCH DEC(__HP_cc     % 100)
00166
00167 #elif defined(__DECC)
00168 # define COMPILER_ID "Compaq"
00169   /* __DECC_VER = VVRRTPPPP */
00170 # define COMPILER_VERSION_MAJOR DEC(__DECC_VER/10000000)
00171 # define COMPILER_VERSION_MINOR DEC(__DECC_VER/100000  % 100)
00172 # define COMPILER_VERSION_PATCH DEC(__DECC_VER         % 10000)
00173
00174 #elif defined(__IBMC__) && defined(__COMPILER_VER__)
00175 # define COMPILER_ID "zOS"
00176   /* __IBMC__ = VRP */
00177 # define COMPILER_VERSION_MAJOR DEC(__IBMC__/100)
00178 # define COMPILER_VERSION_MINOR DEC(__IBMC__/10 % 10)
00179 # define COMPILER_VERSION_PATCH DEC(__IBMC__    % 10)
00180
00181 #elif defined(__open_xl__) && defined(__clang__)
00182 # define COMPILER_ID "IBMClang"
00183 # define COMPILER_VERSION_MAJOR DEC(__open_xl_version__)
00184 # define COMPILER_VERSION_MINOR DEC(__open_xl_release__)
00185 # define COMPILER_VERSION_PATCH DEC(__open_xl_modification__)
00186 # define COMPILER_VERSION_TWEAK DEC(__open_xl_ptf_fix_level__)
00187
00188
00189 #elif defined(__ibmxl__) && defined(__clang__)
00190 # define COMPILER_ID "XLClang"
00191 # define COMPILER_VERSION_MAJOR DEC(__ibmxl_version__)
00192 # define COMPILER_VERSION_MINOR DEC(__ibmxl_release__)
00193 # define COMPILER_VERSION_PATCH DEC(__ibmxl_modification__)
00194 # define COMPILER_VERSION_TWEAK DEC(__ibmxl_ptf_fix_level__)
00195
00196
00197 #elif defined(__IBMC__) && !defined(__COMPILER_VER__) && __IBMC__ >= 800
00198 # define COMPILER_ID "XL"
00199   /* __IBMC__ = VRP */
00200 # define COMPILER_VERSION_MAJOR DEC(__IBMC__/100)
00201 # define COMPILER_VERSION_MINOR DEC(__IBMC__/10 % 10)
00202 # define COMPILER_VERSION_PATCH DEC(__IBMC__    % 10)
00203
00204 #elif defined(__IBMC__) && !defined(__COMPILER_VER__) && __IBMC__ < 800
00205 # define COMPILER_ID "VisualAge"
00206   /* __IBMC__ = VRP */
00207 # define COMPILER_VERSION_MAJOR DEC(__IBMC__/100)
00208 # define COMPILER_VERSION_MINOR DEC(__IBMC__/10 % 10)
00209 # define COMPILER_VERSION_PATCH DEC(__IBMC__    % 10)
00210
00211 #elif defined(__NVCOMPILER)
00212 # define COMPILER_ID "NVHPC"
00213 # define COMPILER_VERSION_MAJOR DEC(__NVCOMPILER_MAJOR__)
00214 # define COMPILER_VERSION_MINOR DEC(__NVCOMPILER_MINOR__)
00215 # if defined(__NVCOMPILER_PATCHLEVEL__)
00216 #  define COMPILER_VERSION_PATCH DEC(__NVCOMPILER_PATCHLEVEL__)
00217 # endif
00218
00219 #elif defined(__PGI)
00220 # define COMPILER_ID "PGI"
00221 # define COMPILER_VERSION_MAJOR DEC(__PGIC__)
00222 # define COMPILER_VERSION_MINOR DEC(__PGIC_MINOR__)
00223 # if defined(__PGIC_PATCHLEVEL__)
00224 #  define COMPILER_VERSION_PATCH DEC(__PGIC_PATCHLEVEL__)
00225 # endif
00226
00227 #elif defined(_CRAYC)
```

```
00228 # define COMPILER_ID "Cray"
00229 # define COMPILER_VERSION_MAJOR DEC(_RELEASE_MAJOR)
00230 # define COMPILER_VERSION_MINOR DEC(_RELEASE_MINOR)
00231
00232 #elif defined(__TI_COMPILER_VERSION__)
00233 # define COMPILER_ID "TI"
00234   /* __TI_COMPILER_VERSION__ = VVVRRRPPP */
00235 # define COMPILER_VERSION_MAJOR DEC(__TI_COMPILER_VERSION__/1000000)
00236 # define COMPILER_VERSION_MINOR DEC(__TI_COMPILER_VERSION__/1000   % 1000)
00237 # define COMPILER_VERSION_PATCH DEC(__TI_COMPILER_VERSION__        % 1000)
00238
00239 #elif defined(__CLANG_FUJITSU)
00240 # define COMPILER_ID "FujitsuClang"
00241 # define COMPILER_VERSION_MAJOR DEC(__FCC_major__)
00242 # define COMPILER_VERSION_MINOR DEC(__FCC_minor__)
00243 # define COMPILER_VERSION_PATCH DEC(__FCC_patchlevel__)
00244 # define COMPILER_VERSION_INTERNAL_STR __clang_version__
00245
00246
00247 #elif defined(__FUJITSU)
00248 # define COMPILER_ID "Fujitsu"
00249 # if defined(__FCC_version__)
00250 #   define COMPILER_VERSION __FCC_version__
00251 # elif defined(__FCC_major__)
00252 #   define COMPILER_VERSION_MAJOR DEC(__FCC_major__)
00253 #   define COMPILER_VERSION_MINOR DEC(__FCC_minor__)
00254 #   define COMPILER_VERSION_PATCH DEC(__FCC_patchlevel__)
00255 # endif
00256 # if defined(__fcc_version)
00257 #   define COMPILER_VERSION_INTERNAL DEC(__fcc_version)
00258 # elif defined(__FCC_VERSION)
00259 #   define COMPILER_VERSION_INTERNAL DEC(__FCC_VERSION)
00260 # endif
00261
00262
00263 #elif defined(__ghs__)
00264 # define COMPILER_ID "GHS"
00265 /* __GHS_VERSION_NUMBER = VVVVRP */
00266 # ifdef __GHS_VERSION_NUMBER
00267 # define COMPILER_VERSION_MAJOR DEC(__GHS_VERSION_NUMBER / 100)
00268 # define COMPILER_VERSION_MINOR DEC(__GHS_VERSION_NUMBER / 10 % 10)
00269 # define COMPILER_VERSION_PATCH DEC(__GHS_VERSION_NUMBER      % 10)
00270 # endif
00271
00272 #elif defined(__TASKING__)
00273 # define COMPILER_ID "Tasking"
00274   # define COMPILER_VERSION_MAJOR DEC(__VERSION__/1000)
00275   # define COMPILER_VERSION_MINOR DEC(__VERSION__ % 100)
00276 # define COMPILER_VERSION_INTERNAL DEC(__VERSION__)
00277
00278 #elif defined(__TINYC__)
00279 # define COMPILER_ID "TinyCC"
00280
00281 #elif defined(__BCC__)
00282 # define COMPILER_ID "Bruce"
00283
00284 #elif defined(__SCO_VERSION__)
00285 # define COMPILER_ID "SCO"
00286
00287 #elif defined(__ARMCC_VERSION) && !defined(__clang__)
00288 # define COMPILER_ID "ARMCC"
00289 #if __ARMCC_VERSION >= 1000000
00290   /* __ARMCC_VERSION = VRRPPPP */
00291   # define COMPILER_VERSION_MAJOR DEC(__ARMCC_VERSION/1000000)
00292   # define COMPILER_VERSION_MINOR DEC(__ARMCC_VERSION/10000 % 100)
00293   # define COMPILER_VERSION_PATCH DEC(__ARMCC_VERSION     % 10000)
00294 #else
00295   /* __ARMCC_VERSION = VRPPPP */
00296   # define COMPILER_VERSION_MAJOR DEC(__ARMCC_VERSION/100000)
00297   # define COMPILER_VERSION_MINOR DEC(__ARMCC_VERSION/10000 % 10)
00298   # define COMPILER_VERSION_PATCH DEC(__ARMCC_VERSION    % 10000)
00299 #endif
00300
00301
00302 #elif defined(__clang__) && defined(__apple_build_version__)
00303 # define COMPILER_ID "AppleClang"
00304 # if defined(_MSC_VER)
00305 #  define SIMULATE_ID "MSVC"
00306 # endif
00307 # define COMPILER_VERSION_MAJOR DEC(__clang_major__)
00308 # define COMPILER_VERSION_MINOR DEC(__clang_minor__)
00309 # define COMPILER_VERSION_PATCH DEC(__clang_patchlevel__)
00310 # if defined(_MSC_VER)
00311   /* _MSC_VER = VVRR */
00312 #  define SIMULATE_VERSION_MAJOR DEC(_MSC_VER / 100)
00313 #  define SIMULATE_VERSION_MINOR DEC(_MSC_VER % 100)
00314 # endif
```

```
00315 # define COMPILER_VERSION_TWEAK DEC(__apple_build_version__)
00316
00317 #elif defined(__clang__) && defined(__ARMCOMPILER_VERSION)
00318 # define COMPILER_ID "ARMClang"
00319   # define COMPILER_VERSION_MAJOR DEC(__ARMCOMPILER_VERSION/1000000)
00320   # define COMPILER_VERSION_MINOR DEC(__ARMCOMPILER_VERSION/10000 % 100)
00321   # define COMPILER_VERSION_PATCH DEC(__ARMCOMPILER_VERSION/100   % 100)
00322 # define COMPILER_VERSION_INTERNAL DEC(__ARMCOMPILER_VERSION)
00323
00324 #elif defined(__clang__)
00325 # define COMPILER_ID "Clang"
00326 # if defined(_MSC_VER)
00327 #  define SIMULATE_ID "MSVC"
00328 # endif
00329 # define COMPILER_VERSION_MAJOR DEC(__clang_major__)
00330 # define COMPILER_VERSION_MINOR DEC(__clang_minor__)
00331 # define COMPILER_VERSION_PATCH DEC(__clang_patchlevel__)
00332 # if defined(_MSC_VER)
00333   /* _MSC_VER = VVRR */
00334 #  define SIMULATE_VERSION_MAJOR DEC(_MSC_VER / 100)
00335 #  define SIMULATE_VERSION_MINOR DEC(_MSC_VER % 100)
00336 # endif
00337
00338 #elif defined(__LCC__) && (defined(__GNUC__) || defined(__GNUG__) || defined(__MCST__))
00339 # define COMPILER_ID "LCC"
00340 # define COMPILER_VERSION_MAJOR DEC(__LCC__ / 100)
00341 # define COMPILER_VERSION_MINOR DEC(__LCC__ % 100)
00342 # if defined(__LCC_MINOR__)
00343 #  define COMPILER_VERSION_PATCH DEC(__LCC_MINOR__)
00344 # endif
00345 # if defined(__GNUC__) && defined(__GNUC_MINOR__)
00346 #  define SIMULATE_ID "GNU"
00347 #  define SIMULATE_VERSION_MAJOR DEC(__GNUC__)
00348 #  define SIMULATE_VERSION_MINOR DEC(__GNUC_MINOR__)
00349 #  if defined(__GNUC_PATCHLEVEL__)
00350 #   define SIMULATE_VERSION_PATCH DEC(__GNUC_PATCHLEVEL__)
00351 #  endif
00352 # endif
00353
00354 #elif defined(__GNUC__)
00355 # define COMPILER_ID "GNU"
00356 # define COMPILER_VERSION_MAJOR DEC(__GNUC__)
00357 # if defined(__GNUC_MINOR__)
00358 #  define COMPILER_VERSION_MINOR DEC(__GNUC_MINOR__)
00359 # endif
00360 # if defined(__GNUC_PATCHLEVEL__)
00361 #  define COMPILER_VERSION_PATCH DEC(__GNUC_PATCHLEVEL__)
00362 # endif
00363
00364 #elif defined(_MSC_VER)
00365 # define COMPILER_ID "MSVC"
00366   /* _MSC_VER = VVRR */
00367 # define COMPILER_VERSION_MAJOR DEC(_MSC_VER / 100)
00368 # define COMPILER_VERSION_MINOR DEC(_MSC_VER % 100)
00369 # if defined(_MSC_FULL_VER)
00370 #  if _MSC_VER >= 1400
00371     /* _MSC_FULL_VER = VVRRPPPPP */
00372 #   define COMPILER_VERSION_PATCH DEC(_MSC_FULL_VER % 100000)
00373 #  else
00374     /* _MSC_FULL_VER = VVRRPPPP */
00375 #   define COMPILER_VERSION_PATCH DEC(_MSC_FULL_VER % 10000)
00376 #  endif
00377 # endif
00378 # if defined(_MSC_BUILD)
00379 #  define COMPILER_VERSION_TWEAK DEC(_MSC_BUILD)
00380 # endif
00381
00382 #elif defined(_ADI_COMPILER)
00383 # define COMPILER_ID "ADSP"
00384 #if defined(__VERSIONNUM__)
00385   /* __VERSIONNUM__ = 0xVVRRPPTT */
00386 #  define COMPILER_VERSION_MAJOR DEC(__VERSIONNUM__ » 24 & 0xFF)
00387 #  define COMPILER_VERSION_MINOR DEC(__VERSIONNUM__ » 16 & 0xFF)
00388 #  define COMPILER_VERSION_PATCH DEC(__VERSIONNUM__ » 8 & 0xFF)
00389 #  define COMPILER_VERSION_TWEAK DEC(__VERSIONNUM__ & 0xFF)
00390 #endif
00391
00392 #elif defined(__IAR_SYSTEMS_ICC__) || defined(__IAR_SYSTEMS_ICC)
00393 # define COMPILER_ID "IAR"
00394 # if defined(__VER__) && defined(__ICCARM__)
00395 #  define COMPILER_VERSION_MAJOR DEC((__VER__) / 1000000)
00396 #  define COMPILER_VERSION_MINOR DEC(((__VER__) / 1000) % 1000)
00397 #  define COMPILER_VERSION_PATCH DEC((__VER__) % 1000)
00398 #  define COMPILER_VERSION_INTERNAL DEC(__IAR_SYSTEMS_ICC__)
00399 # elif defined(__VER__) && (defined(__ICCAVR__) || defined(__ICCRX__) || defined(__ICCRH850__) ||
      defined(__ICCRL78__) || defined(__ICC430__) || defined(__ICCRISCV__) || defined(__ICCV850__) ||
      defined(__ICC8051__) || defined(__ICCSTM8__))
```

```
00400 #  define COMPILER_VERSION_MAJOR DEC((__VER__) / 100)
00401 #  define COMPILER_VERSION_MINOR DEC((__VER__) - (((__VER__) / 100)*100))
00402 #  define COMPILER_VERSION_PATCH DEC(__SUBVERSION__)
00403 #  define COMPILER_VERSION_INTERNAL DEC(__IAR_SYSTEMS_ICC__)
00404 # endif
00405
00406 #elif defined(__SDCC_VERSION_MAJOR) || defined(SDCC)
00407 # define COMPILER_ID "SDCC"
00408 # if defined(__SDCC_VERSION_MAJOR)
00409 #  define COMPILER_VERSION_MAJOR DEC(__SDCC_VERSION_MAJOR)
00410 #  define COMPILER_VERSION_MINOR DEC(__SDCC_VERSION_MINOR)
00411 #  define COMPILER_VERSION_PATCH DEC(__SDCC_VERSION_PATCH)
00412 # else
00413   /* SDCC = VRP */
00414 #  define COMPILER_VERSION_MAJOR DEC(SDCC/100)
00415 #  define COMPILER_VERSION_MINOR DEC(SDCC/10 % 10)
00416 #  define COMPILER_VERSION_PATCH DEC(SDCC    % 10)
00417 # endif
00418
00419
00420 /* These compilers are either not known or too old to define an
00421   identification macro.  Try to identify the platform and guess that
00422   it is the native compiler.  */
00423 #elif defined(__hpux) || defined(__hpua)
00424 # define COMPILER_ID "HP"
00425
00426 #else /* unknown compiler */
00427 # define COMPILER_ID ""
00428 #endif
00429
00430 /* Construct the string literal in pieces to prevent the source from
00431    getting matched.  Store it in a pointer rather than an array
00432    because some compilers will just produce instructions to fill the
00433    array rather than assigning a pointer to a static array.  */
00434 char const* info_compiler = "INFO" ":" "compiler[" COMPILER_ID "]";
00435 #ifdef SIMULATE_ID
00436 char const* info_simulate = "INFO" ":" "simulate[" SIMULATE_ID "]";
00437 #endif
00438
00439 #ifdef __QNXNTO__
00440 char const* qnxnto = "INFO" ":" "qnxnto[]";
00441 #endif
00442
00443 #if defined(__CRAYXT_COMPUTE_LINUX_TARGET)
00444 char const *info_cray = "INFO" ":" "compiler_wrapper[CrayPrgEnv]";
00445 #endif
00446
00447 #define STRINGIFY_HELPER(X) #X
00448 #define STRINGIFY(X) STRINGIFY_HELPER(X)
00449
00450 /* Identify known platforms by name.  */
00451 #if defined(__linux) || defined(__linux__) || defined(linux)
00452 # define PLATFORM_ID "Linux"
00453
00454 #elif defined(__MSYS__)
00455 # define PLATFORM_ID "MSYS"
00456
00457 #elif defined(__CYGWIN__)
00458 # define PLATFORM_ID "Cygwin"
00459
00460 #elif defined(__MINGW32__)
00461 # define PLATFORM_ID "MinGW"
00462
00463 #elif defined(__APPLE__)
00464 # define PLATFORM_ID "Darwin"
00465
00466 #elif defined(_WIN32) || defined(__WIN32__) || defined(WIN32)
00467 # define PLATFORM_ID "Windows"
00468
00469 #elif defined(__FreeBSD__) || defined(__FreeBSD)
00470 # define PLATFORM_ID "FreeBSD"
00471
00472 #elif defined(__NetBSD__) || defined(__NetBSD)
00473 # define PLATFORM_ID "NetBSD"
00474
00475 #elif defined(__OpenBSD__) || defined(__OPENBSD)
00476 # define PLATFORM_ID "OpenBSD"
00477
00478 #elif defined(__sun) || defined(sun)
00479 # define PLATFORM_ID "SunOS"
00480
00481 #elif defined(_AIX) || defined(__AIX) || defined(__AIX__) || defined(__aix) || defined(__aix__)
00482 # define PLATFORM_ID "AIX"
00483
00484 #elif defined(__hpux) || defined(__hpux__)
00485 # define PLATFORM_ID "HP-UX"
00486
```

```
00487 #elif defined(__HAIKU__)
00488 # define PLATFORM_ID "Haiku"
00489
00490 #elif defined(__BeOS) || defined(__BEOS__) || defined(_BEOS)
00491 # define PLATFORM_ID "BeOS"
00492
00493 #elif defined(__QNX__) || defined(__QNXNTO__)
00494 # define PLATFORM_ID "QNX"
00495
00496 #elif defined(__tru64) || defined(_tru64) || defined(__TRU64__)
00497 # define PLATFORM_ID "Tru64"
00498
00499 #elif defined(__riscos) || defined(__riscos__)
00500 # define PLATFORM_ID "RISCos"
00501
00502 #elif defined(__sinix) || defined(__sinix__) || defined(__SINIX__)
00503 # define PLATFORM_ID "SINIX"
00504
00505 #elif defined(__UNIX_SV__)
00506 # define PLATFORM_ID "UNIX_SV"
00507
00508 #elif defined(__bsdos__)
00509 # define PLATFORM_ID "BSDOS"
00510
00511 #elif defined(_MPRAS) || defined(MPRAS)
00512 # define PLATFORM_ID "MP-RAS"
00513
00514 #elif defined(__osf) || defined(__osf__)
00515 # define PLATFORM_ID "OSF1"
00516
00517 #elif defined(_SCO_SV) || defined(SCO_SV) || defined(sco_sv)
00518 # define PLATFORM_ID "SCO_SV"
00519
00520 #elif defined(__ultrix) || defined(__ultrix__) || defined(_ULTRIX)
00521 # define PLATFORM_ID "ULTRIX"
00522
00523 #elif defined(__XENIX__) || defined(_XENIX) || defined(XENIX)
00524 # define PLATFORM_ID "Xenix"
00525
00526 #elif defined(__WATCOMC__)
00527 # if defined(__LINUX__)
00528 #  define PLATFORM_ID "Linux"
00529
00530 # elif defined(__DOS__)
00531 #  define PLATFORM_ID "DOS"
00532
00533 # elif defined(__OS2__)
00534 #  define PLATFORM_ID "OS2"
00535
00536 # elif defined(__WINDOWS__)
00537 #  define PLATFORM_ID "Windows3x"
00538
00539 # elif defined(__VXWORKS__)
00540 #  define PLATFORM_ID "VxWorks"
00541
00542 # else /* unknown platform */
00543 #  define PLATFORM_ID
00544 # endif
00545
00546 #elif defined(__INTEGRITY)
00547 # if defined(INT_178B)
00548 #  define PLATFORM_ID "Integrity178"
00549
00550 # else /* regular Integrity */
00551 #  define PLATFORM_ID "Integrity"
00552 # endif
00553
00554 # elif defined(_ADI_COMPILER)
00555 #  define PLATFORM_ID "ADSP"
00556
00557 #else /* unknown platform */
00558 # define PLATFORM_ID
00559
00560 #endif
00561
00562 /* For windows compilers MSVC and Intel we can determine
00563    the architecture of the compiler being used.  This is because
00564    the compilers do not have flags that can change the architecture,
00565    but rather depend on which compiler is being used
00566 */
00567 #if defined(_WIN32) && defined(_MSC_VER)
00568 # if defined(_M_IA64)
00569 #  define ARCHITECTURE_ID "IA64"
00570
00571 # elif defined(_M_ARM64EC)
00572 #  define ARCHITECTURE_ID "ARM64EC"
00573
```

```
00574 # elif defined(_M_X64) || defined(_M_AMD64)
00575 #  define ARCHITECTURE_ID "x64"
00576
00577 # elif defined(_M_IX86)
00578 #  define ARCHITECTURE_ID "X86"
00579
00580 # elif defined(_M_ARM64)
00581 #  define ARCHITECTURE_ID "ARM64"
00582
00583 # elif defined(_M_ARM)
00584 #  if _M_ARM == 4
00585 #   define ARCHITECTURE_ID "ARMV4I"
00586 #  elif _M_ARM == 5
00587 #   define ARCHITECTURE_ID "ARMV5I"
00588 #  else
00589 #   define ARCHITECTURE_ID "ARMV" STRINGIFY(_M_ARM)
00590 #  endif
00591
00592 # elif defined(_M_MIPS)
00593 #  define ARCHITECTURE_ID "MIPS"
00594
00595 # elif defined(_M_SH)
00596 #  define ARCHITECTURE_ID "SHx"
00597
00598 # else /* unknown architecture */
00599 #  define ARCHITECTURE_ID ""
00600 # endif
00601
00602 #elif defined(__WATCOMC__)
00603 # if defined(_M_I86)
00604 #  define ARCHITECTURE_ID "I86"
00605
00606 # elif defined(_M_IX86)
00607 #  define ARCHITECTURE_ID "X86"
00608
00609 # else /* unknown architecture */
00610 #  define ARCHITECTURE_ID ""
00611 # endif
00612
00613 #elif defined(__IAR_SYSTEMS_ICC__) || defined(__IAR_SYSTEMS_ICC)
00614 # if defined(__ICCARM__)
00615 #  define ARCHITECTURE_ID "ARM"
00616
00617 # elif defined(__ICCRX__)
00618 #  define ARCHITECTURE_ID "RX"
00619
00620 # elif defined(__ICCRH850__)
00621 #  define ARCHITECTURE_ID "RH850"
00622
00623 # elif defined(__ICCRL78__)
00624 #  define ARCHITECTURE_ID "RL78"
00625
00626 # elif defined(__ICCRISCV__)
00627 #  define ARCHITECTURE_ID "RISCV"
00628
00629 # elif defined(__ICCAVR__)
00630 #  define ARCHITECTURE_ID "AVR"
00631
00632 # elif defined(__ICC430__)
00633 #  define ARCHITECTURE_ID "MSP430"
00634
00635 # elif defined(__ICCV850__)
00636 #  define ARCHITECTURE_ID "V850"
00637
00638 # elif defined(__ICC8051__)
00639 #  define ARCHITECTURE_ID "8051"
00640
00641 # elif defined(__ICCSTM8__)
00642 #  define ARCHITECTURE_ID "STM8"
00643
00644 # else /* unknown architecture */
00645 #  define ARCHITECTURE_ID ""
00646 # endif
00647
00648 #elif defined(__ghs__)
00649 # if defined(__PPC64__)
00650 #  define ARCHITECTURE_ID "PPC64"
00651
00652 # elif defined(__ppc__)
00653 #  define ARCHITECTURE_ID "PPC"
00654
00655 # elif defined(__ARM__)
00656 #  define ARCHITECTURE_ID "ARM"
00657
00658 # elif defined(__x86_64__)
00659 #  define ARCHITECTURE_ID "x64"
00660
```

```
00661 # elif defined(__i386__)
00662 #  define ARCHITECTURE_ID "X86"
00663
00664 # else /* unknown architecture */
00665 #  define ARCHITECTURE_ID ""
00666 # endif
00667
00668 #elif defined(__TI_COMPILER_VERSION__)
00669 # if defined(__TI_ARM__)
00670 #  define ARCHITECTURE_ID "ARM"
00671
00672 # elif defined(__MSP430__)
00673 #  define ARCHITECTURE_ID "MSP430"
00674
00675 # elif defined(__TMS320C28XX__)
00676 #  define ARCHITECTURE_ID "TMS320C28x"
00677
00678 # elif defined(__TMS320C6X__) || defined(_TMS320C6X)
00679 #  define ARCHITECTURE_ID "TMS320C6x"
00680
00681 # else /* unknown architecture */
00682 #  define ARCHITECTURE_ID ""
00683 # endif
00684
00685 # elif defined(__ADSPSHARC__)
00686 #  define ARCHITECTURE_ID "SHARC"
00687
00688 # elif defined(__ADSPBLACKFIN__)
00689 #  define ARCHITECTURE_ID "Blackfin"
00690
00691 #elif defined(__TASKING__)
00692
00693 # if defined(__CTC__) || defined(__CPTC__)
00694 #  define ARCHITECTURE_ID "TriCore"
00695
00696 # elif defined(__CMCS__)
00697 #  define ARCHITECTURE_ID "MCS"
00698
00699 # elif defined(__CARM__)
00700 #  define ARCHITECTURE_ID "ARM"
00701
00702 # elif defined(__CARC__)
00703 #  define ARCHITECTURE_ID "ARC"
00704
00705 # elif defined(__C51__)
00706 #  define ARCHITECTURE_ID "8051"
00707
00708 # elif defined(__CPCP__)
00709 #  define ARCHITECTURE_ID "PCP"
00710
00711 # else
00712 #  define ARCHITECTURE_ID ""
00713 # endif
00714
00715 #else
00716 #  define ARCHITECTURE_ID
00717 #endif
00718
00719 /* Convert integer to decimal digit literals.  */
00720 #define DEC(n)                   \
00721   ('0' + (((n) / 10000000)%10)), \
00722   ('0' + (((n) / 1000000)%10)),  \
00723   ('0' + (((n) / 100000)%10)),   \
00724   ('0' + (((n) / 10000)%10)),    \
00725   ('0' + (((n) / 1000)%10)),     \
00726   ('0' + (((n) / 100)%10)),      \
00727   ('0' + (((n) / 10)%10)),       \
00728   ('0' +  ((n) % 10))
00729
00730 /* Convert integer to hex digit literals.  */
00731 #define HEX(n)             \
00732   ('0' + ((n)>>28 & 0xF)), \
00733   ('0' + ((n)>>24 & 0xF)), \
00734   ('0' + ((n)>>20 & 0xF)), \
00735   ('0' + ((n)>>16 & 0xF)), \
00736   ('0' + ((n)>>12 & 0xF)), \
00737   ('0' + ((n)>>8  & 0xF)), \
00738   ('0' + ((n)>>4  & 0xF)), \
00739   ('0' + ((n)     & 0xF))
00740
00741 /* Construct a string literal encoding the version number. */
00742 #ifdef COMPILER_VERSION
00743 char const* info_version = "INFO" ":" "compiler_version[" COMPILER_VERSION "]";
00744
00745 /* Construct a string literal encoding the version number components. */
00746 #elif defined(COMPILER_VERSION_MAJOR)
00747 char const info_version[] = {
```

```
00748   'I', 'N', 'F', 'O', ':',
00749   'c','o','m','p','i','l','e','r','_','v','e','r','s','i','o','n','[',
00750   COMPILER_VERSION_MAJOR,
00751 # ifdef COMPILER_VERSION_MINOR
00752   '.', COMPILER_VERSION_MINOR,
00753 #  ifdef COMPILER_VERSION_PATCH
00754    '.', COMPILER_VERSION_PATCH,
00755 #   ifdef COMPILER_VERSION_TWEAK
00756     '.', COMPILER_VERSION_TWEAK,
00757 #   endif
00758 #  endif
00759 # endif
00760   ']','\0'};
00761 #endif
00762
00763 /* Construct a string literal encoding the internal version number. */
00764 #ifdef COMPILER_VERSION_INTERNAL
00765 char const info_version_internal[] = {
00766   'I', 'N', 'F', 'O', ':',
00767   'c','o','m','p','i','l','e','r','_','v','e','r','s','i','o','n','_',
00768   'i','n','t','e','r','n','a','l','[',
00769   COMPILER_VERSION_INTERNAL,']','\0'};
00770 #elif defined(COMPILER_VERSION_INTERNAL_STR)
00771 char const* info_version_internal = "INFO" ":" "compiler_version_internal["
      COMPILER_VERSION_INTERNAL_STR "]";
00772 #endif
00773
00774 /* Construct a string literal encoding the version number components. */
00775 #ifdef SIMULATE_VERSION_MAJOR
00776 char const info_simulate_version[] = {
00777   'I', 'N', 'F', 'O', ':',
00778   's','i','m','u','l','a','t','e','_','v','e','r','s','i','o','n','[',
00779   SIMULATE_VERSION_MAJOR,
00780 # ifdef SIMULATE_VERSION_MINOR
00781   '.', SIMULATE_VERSION_MINOR,
00782 #  ifdef SIMULATE_VERSION_PATCH
00783    '.', SIMULATE_VERSION_PATCH,
00784 #   ifdef SIMULATE_VERSION_TWEAK
00785     '.', SIMULATE_VERSION_TWEAK,
00786 #   endif
00787 #  endif
00788 # endif
00789   ']','\0'};
00790 #endif
00791
00792 /* Construct the string literal in pieces to prevent the source from
00793    getting matched.  Store it in a pointer rather than an array
00794    because some compilers will just produce instructions to fill the
00795    array rather than assigning a pointer to a static array.  */
00796 char const* info_platform = "INFO" ":" "platform[" PLATFORM_ID "]";
00797 char const* info_arch = "INFO" ":" "arch[" ARCHITECTURE_ID "]";
00798
00799
00800
00801 #if !defined(__STDC__) && !defined(__clang__)
00802 # if defined(_MSC_VER) || defined(__ibmxl__) || defined(__IBMC__)
00803 #  define C_VERSION "90"
00804 # else
00805 #  define C_VERSION
00806 # endif
00807 #elif __STDC_VERSION__ > 201710L
00808 # define C_VERSION "23"
00809 #elif __STDC_VERSION__ >= 201710L
00810 # define C_VERSION "17"
00811 #elif __STDC_VERSION__ >= 201000L
00812 # define C_VERSION "11"
00813 #elif __STDC_VERSION__ >= 199901L
00814 # define C_VERSION "99"
00815 #else
00816 # define C_VERSION "90"
00817 #endif
00818 const char* info_language_standard_default =
00819   "INFO" ":" "standard_default[" C_VERSION "]";
00820
00821 const char* info_language_extensions_default = "INFO" ":" "extensions_default["
00822 #if (defined(__clang__) || defined(__GNUC__) || defined(__xlC__) ||           \
00823      defined(__TI_COMPILER_VERSION__)) &&                                     \
00824   !defined(__STRICT_ANSI__)
00825   "ON"
00826 #else
00827   "OFF"
00828 #endif
00829 "]";
00830
00831 /*--------------------------------------------------------------------------*/
00832
00833 #ifdef ID_VOID_MAIN
```

```
00834 void main() {}
00835 #else
00836 # if defined(__CLASSIC_C__)
00837 int main(argc, argv) int argc; char *argv[];
00838 # else
00839 int main(int argc, char* argv[])
00840 # endif
00841 {
00842   int require = 0;
00843   require += info_compiler[argc];
00844   require += info_platform[argc];
00845   require += info_arch[argc];
00846 #ifdef COMPILER_VERSION_MAJOR
00847   require += info_version[argc];
00848 #endif
00849 #ifdef COMPILER_VERSION_INTERNAL
00850   require += info_version_internal[argc];
00851 #endif
00852 #ifdef SIMULATE_ID
00853   require += info_simulate[argc];
00854 #endif
00855 #ifdef SIMULATE_VERSION_MAJOR
00856   require += info_simulate_version[argc];
00857 #endif
00858 #if defined(__CRAYXT_COMPUTE_LINUX_TARGET)
00859   require += info_cray[argc];
00860 #endif
00861   require += info_language_standard_default[argc];
00862   require += info_language_extensions_default[argc];
00863   (void)argv;
00864   return require;
00865 }
00866 #endif
```

7.5 /Users/samanthapope/msdscriptRepo/msdScript/cmake-build-debug/CMakeFiles/3.27.8/CompilerIdCXX/CMakeCXXCompilerId.cpp File Reference

Macros

- #define __has_include(x) 0
- #define COMPILER_ID ""
- #define STRINGIFY_HELPER(X) #X
- #define STRINGIFY(X) STRINGIFY_HELPER(X)
- #define PLATFORM_ID
- #define ARCHITECTURE_ID
- #define DEC(n)
- #define HEX(n)
- #define CXX_STD __cplusplus

Functions

- int main (int argc, char ∗argv[ ])

Variables

- char const ∗ info_compiler = "INFO" ":" "compiler[" COMPILER_ID "]"
- char const ∗ info_platform = "INFO" ":" "platform[" PLATFORM_ID "]"
- char const ∗ info_arch = "INFO" ":" "arch[" ARCHITECTURE_ID "]"
- const char ∗ info_language_standard_default
- const char ∗ info_language_extensions_default

7.5.1 Macro Definition Documentation

7.5.1.1 __has_include

```
#define __has_include(
              x ) 0
```

Definition at line 11 of file CMakeCXXCompilerId.cpp.

7.5.1.2 ARCHITECTURE_ID

```
#define ARCHITECTURE_ID
```

Definition at line 701 of file CMakeCXXCompilerId.cpp.

7.5.1.3 COMPILER_ID

```
#define COMPILER_ID ""
```

Definition at line 412 of file CMakeCXXCompilerId.cpp.

7.5.1.4 CXX_STD

```
#define CXX_STD __cplusplus
```

Definition at line 799 of file CMakeCXXCompilerId.cpp.

7.5.1.5 DEC

```
#define DEC(
              n )
```

Value:

```
  ('0' + (((n) / 10000000)%10)), \
  ('0' + (((n) / 1000000)%10)),  \
  ('0' + (((n) / 100000)%10)),   \
  ('0' + (((n) / 10000)%10)),    \
  ('0' + (((n) / 1000)%10)),     \
  ('0' + (((n) / 100)%10)),      \
  ('0' + (((n) / 10)%10)),       \
  ('0' +  ((n) % 10))
```

Definition at line 705 of file CMakeCXXCompilerId.cpp.

7.5.1.6 HEX

```
#define HEX(
              n )
```

Value:

```
  ('0' + ((n)>>28 & 0xF)), \
  ('0' + ((n)>>24 & 0xF)), \
  ('0' + ((n)>>20 & 0xF)), \
  ('0' + ((n)>>16 & 0xF)), \
  ('0' + ((n)>>12 & 0xF)), \
  ('0' + ((n)>>8  & 0xF)), \
  ('0' + ((n)>>4  & 0xF)), \
  ('0' + ((n)     & 0xF))
```

Definition at line 716 of file CMakeCXXCompilerId.cpp.

7.5.1.7 PLATFORM_ID

```
#define PLATFORM_ID
```

Definition at line 543 of file CMakeCXXCompilerId.cpp.

7.5.1.8 STRINGIFY

```
#define STRINGIFY(
              X ) STRINGIFY_HELPER(X)
```

Definition at line 433 of file CMakeCXXCompilerId.cpp.

7.5.1.9 STRINGIFY_HELPER

```
#define STRINGIFY_HELPER(
              X ) #X
```

Definition at line 432 of file CMakeCXXCompilerId.cpp.

7.5.2 Function Documentation

7.5.2.1 main()

```
int main (
             int argc,
             char * argv[] )
```

Definition at line 830 of file CMakeCXXCompilerId.cpp.

7.5.3 Variable Documentation

7.5.3.1 info_arch

```
char const* info_arch = "INFO" ":" "arch[" ARCHITECTURE_ID "]"
```

Definition at line 782 of file CMakeCXXCompilerId.cpp.

7.5.3.2 info_compiler

```
char const* info_compiler = "INFO" ":" "compiler[" COMPILER_ID "]"
```

Definition at line 419 of file CMakeCXXCompilerId.cpp.

7.5.3.3 info_language_extensions_default

```
const char* info_language_extensions_default
```

Initial value:

```
= "INFO" ":" "extensions_default["


  "OFF"

"]"
```

Definition at line 818 of file CMakeCXXCompilerId.cpp.

7.5.3.4 info_language_standard_default

```
const char* info_language_standard_default
```

Initial value:

```
= "INFO" ":" "standard_default["


  "98"

"]"
```

Definition at line 802 of file CMakeCXXCompilerId.cpp.

7.5.3.5 info_platform

```
char const* info_platform = "INFO" ":" "platform[" PLATFORM_ID "]"
```

Definition at line 781 of file CMakeCXXCompilerId.cpp.

7.6 CMakeCXXCompilerId.cpp

Go to the documentation of this file.

```
00001 /* This source file must have a .cpp extension so that all C++ compilers
00002    recognize the extension without flags.  Borland does not know .cxx for
00003    example.  */
00004 #ifndef __cplusplus
00005 # error "A C compiler has been selected for C++."
00006 #endif
00007
00008 #if !defined(__has_include)
00009 /* If the compiler does not have __has_include, pretend the answer is
00010    always no.  */
00011 #  define __has_include(x) 0
00012 #endif
00013
00014
00015 /* Version number components: V=Version, R=Revision, P=Patch
00016    Version date components:   YYYY=Year, MM=Month,   DD=Day  */
```

```
00017
00018 #if defined(__COMO__)
00019 # define COMPILER_ID "Comeau"
00020   /* __COMO_VERSION__ = VRR */
00021 # define COMPILER_VERSION_MAJOR DEC(__COMO_VERSION__ / 100)
00022 # define COMPILER_VERSION_MINOR DEC(__COMO_VERSION__ % 100)
00023
00024 #elif defined(__INTEL_COMPILER) || defined(__ICC)
00025 # define COMPILER_ID "Intel"
00026 # if defined(_MSC_VER)
00027 #  define SIMULATE_ID "MSVC"
00028 # endif
00029 # if defined(__GNUC__)
00030 #  define SIMULATE_ID "GNU"
00031 # endif
00032   /* __INTEL_COMPILER = VRP prior to 2021, and then VVVV for 2021 and later,
00033      except that a few beta releases use the old format with V=2021.  */
00034 # if __INTEL_COMPILER < 2021 || __INTEL_COMPILER == 202110 || __INTEL_COMPILER == 202111
00035 #  define COMPILER_VERSION_MAJOR DEC(__INTEL_COMPILER/100)
00036 #  define COMPILER_VERSION_MINOR DEC(__INTEL_COMPILER/10 % 10)
00037 #  if defined(__INTEL_COMPILER_UPDATE)
00038 #   define COMPILER_VERSION_PATCH DEC(__INTEL_COMPILER_UPDATE)
00039 #  else
00040 #   define COMPILER_VERSION_PATCH DEC(__INTEL_COMPILER   % 10)
00041 #  endif
00042 # else
00043 #  define COMPILER_VERSION_MAJOR DEC(__INTEL_COMPILER)
00044 #  define COMPILER_VERSION_MINOR DEC(__INTEL_COMPILER_UPDATE)
00045   /* The third version component from --version is an update index,
00046      but no macro is provided for it.  */
00047 #  define COMPILER_VERSION_PATCH DEC(0)
00048 # endif
00049 # if defined(__INTEL_COMPILER_BUILD_DATE)
00050   /* __INTEL_COMPILER_BUILD_DATE = YYYYMMDD */
00051 #  define COMPILER_VERSION_TWEAK DEC(__INTEL_COMPILER_BUILD_DATE)
00052 # endif
00053 # if defined(_MSC_VER)
00054   /* _MSC_VER = VVRR */
00055 #  define SIMULATE_VERSION_MAJOR DEC(_MSC_VER / 100)
00056 #  define SIMULATE_VERSION_MINOR DEC(_MSC_VER % 100)
00057 # endif
00058 # if defined(__GNUC__)
00059 #  define SIMULATE_VERSION_MAJOR DEC(__GNUC__)
00060 # elif defined(__GNUG__)
00061 #  define SIMULATE_VERSION_MAJOR DEC(__GNUG__)
00062 # endif
00063 # if defined(__GNUC_MINOR__)
00064 #  define SIMULATE_VERSION_MINOR DEC(__GNUC_MINOR__)
00065 # endif
00066 # if defined(__GNUC_PATCHLEVEL__)
00067 #  define SIMULATE_VERSION_PATCH DEC(__GNUC_PATCHLEVEL__)
00068 # endif
00069
00070 #elif (defined(__clang__) && defined(__INTEL_CLANG_COMPILER)) || defined(__INTEL_LLVM_COMPILER)
00071 # define COMPILER_ID "IntelLLVM"
00072 #if defined(_MSC_VER)
00073 # define SIMULATE_ID "MSVC"
00074 #endif
00075 #if defined(__GNUC__)
00076 # define SIMULATE_ID "GNU"
00077 #endif
00078 /* __INTEL_LLVM_COMPILER = VVVVRP prior to 2021.2.0, VVVVRRPP for 2021.2.0 and
00079  * later.  Look for 6 digit vs. 8 digit version number to decide encoding.
00080  * VVVV is no smaller than the current year when a version is released.
00081  */
00082 #if __INTEL_LLVM_COMPILER < 1000000L
00083 # define COMPILER_VERSION_MAJOR DEC(__INTEL_LLVM_COMPILER/100)
00084 # define COMPILER_VERSION_MINOR DEC(__INTEL_LLVM_COMPILER/10 % 10)
00085 # define COMPILER_VERSION_PATCH DEC(__INTEL_LLVM_COMPILER    % 10)
00086 #else
00087 # define COMPILER_VERSION_MAJOR DEC(__INTEL_LLVM_COMPILER/10000)
00088 # define COMPILER_VERSION_MINOR DEC(__INTEL_LLVM_COMPILER/100 % 100)
00089 # define COMPILER_VERSION_PATCH DEC(__INTEL_LLVM_COMPILER     % 100)
00090 #endif
00091 #if defined(_MSC_VER)
00092   /* _MSC_VER = VVRR */
00093 # define SIMULATE_VERSION_MAJOR DEC(_MSC_VER / 100)
00094 # define SIMULATE_VERSION_MINOR DEC(_MSC_VER % 100)
00095 #endif
00096 #if defined(__GNUC__)
00097 # define SIMULATE_VERSION_MAJOR DEC(__GNUC__)
00098 #elif defined(__GNUG__)
00099 # define SIMULATE_VERSION_MAJOR DEC(__GNUG__)
00100 #endif
00101 #if defined(__GNUC_MINOR__)
00102 # define SIMULATE_VERSION_MINOR DEC(__GNUC_MINOR__)
00103 #endif
```

```
00104 #if defined(__GNUC_PATCHLEVEL__)
00105 # define SIMULATE_VERSION_PATCH DEC(__GNUC_PATCHLEVEL__)
00106 #endif
00107
00108 #elif defined(__PATHCC__)
00109 # define COMPILER_ID "PathScale"
00110 # define COMPILER_VERSION_MAJOR DEC(__PATHCC__)
00111 # define COMPILER_VERSION_MINOR DEC(__PATHCC_MINOR__)
00112 # if defined(__PATHCC_PATCHLEVEL__)
00113 #  define COMPILER_VERSION_PATCH DEC(__PATHCC_PATCHLEVEL__)
00114 # endif
00115
00116 #elif defined(__BORLANDC__) && defined(__CODEGEARC_VERSION__)
00117 # define COMPILER_ID "Embarcadero"
00118 # define COMPILER_VERSION_MAJOR HEX(__CODEGEARC_VERSION__»24 & 0x00FF)
00119 # define COMPILER_VERSION_MINOR HEX(__CODEGEARC_VERSION__»16 & 0x00FF)
00120 # define COMPILER_VERSION_PATCH DEC(__CODEGEARC_VERSION__     & 0xFFFF)
00121
00122 #elif defined(__BORLANDC__)
00123 # define COMPILER_ID "Borland"
00124   /* __BORLANDC__ = 0xVRR */
00125 # define COMPILER_VERSION_MAJOR HEX(__BORLANDC__»8)
00126 # define COMPILER_VERSION_MINOR HEX(__BORLANDC__ & 0xFF)
00127
00128 #elif defined(__WATCOMC__) && __WATCOMC__ < 1200
00129 # define COMPILER_ID "Watcom"
00130    /* __WATCOMC__ = VVRR */
00131 # define COMPILER_VERSION_MAJOR DEC(__WATCOMC__ / 100)
00132 # define COMPILER_VERSION_MINOR DEC((__WATCOMC__ / 10) % 10)
00133 # if (__WATCOMC__ % 10) > 0
00134 #  define COMPILER_VERSION_PATCH DEC(__WATCOMC__ % 10)
00135 # endif
00136
00137 #elif defined(__WATCOMC__)
00138 # define COMPILER_ID "OpenWatcom"
00139    /* __WATCOMC__ = VVRP + 1100 */
00140 # define COMPILER_VERSION_MAJOR DEC((__WATCOMC__ - 1100) / 100)
00141 # define COMPILER_VERSION_MINOR DEC((__WATCOMC__ / 10) % 10)
00142 # if (__WATCOMC__ % 10) > 0
00143 #  define COMPILER_VERSION_PATCH DEC(__WATCOMC__ % 10)
00144 # endif
00145
00146 #elif defined(__SUNPRO_CC)
00147 # define COMPILER_ID "SunPro"
00148 # if __SUNPRO_CC >= 0x5100
00149    /* __SUNPRO_CC = 0xVRRP */
00150 #  define COMPILER_VERSION_MAJOR HEX(__SUNPRO_CC»12)
00151 #  define COMPILER_VERSION_MINOR HEX(__SUNPRO_CC»4 & 0xFF)
00152 #  define COMPILER_VERSION_PATCH HEX(__SUNPRO_CC    & 0xF)
00153 # else
00154    /* __SUNPRO_CC = 0xVRP */
00155 #  define COMPILER_VERSION_MAJOR HEX(__SUNPRO_CC»8)
00156 #  define COMPILER_VERSION_MINOR HEX(__SUNPRO_CC»4 & 0xF)
00157 #  define COMPILER_VERSION_PATCH HEX(__SUNPRO_CC    & 0xF)
00158 # endif
00159
00160 #elif defined(__HP_aCC)
00161 # define COMPILER_ID "HP"
00162   /* __HP_aCC = VVRRPP */
00163 # define COMPILER_VERSION_MAJOR DEC(__HP_aCC/10000)
00164 # define COMPILER_VERSION_MINOR DEC(__HP_aCC/100 % 100)
00165 # define COMPILER_VERSION_PATCH DEC(__HP_aCC     % 100)
00166
00167 #elif defined(__DECCXX)
00168 # define COMPILER_ID "Compaq"
00169   /* __DECCXX_VER = VVRRTPPPP */
00170 # define COMPILER_VERSION_MAJOR DEC(__DECCXX_VER/10000000)
00171 # define COMPILER_VERSION_MINOR DEC(__DECCXX_VER/100000  % 100)
00172 # define COMPILER_VERSION_PATCH DEC(__DECCXX_VER         % 10000)
00173
00174 #elif defined(__IBMCPP__) && defined(__COMPILER_VER__)
00175 # define COMPILER_ID "zOS"
00176   /* __IBMCPP__ = VRP */
00177 # define COMPILER_VERSION_MAJOR DEC(__IBMCPP__/100)
00178 # define COMPILER_VERSION_MINOR DEC(__IBMCPP__/10 % 10)
00179 # define COMPILER_VERSION_PATCH DEC(__IBMCPP__    % 10)
00180
00181 #elif defined(__open_xl__) && defined(__clang__)
00182 # define COMPILER_ID "IBMClang"
00183 # define COMPILER_VERSION_MAJOR DEC(__open_xl_version__)
00184 # define COMPILER_VERSION_MINOR DEC(__open_xl_release__)
00185 # define COMPILER_VERSION_PATCH DEC(__open_xl_modification__)
00186 # define COMPILER_VERSION_TWEAK DEC(__open_xl_ptf_fix_level__)
00187
00188
00189 #elif defined(__ibmxl__) && defined(__clang__)
00190 # define COMPILER_ID "XLClang"
```

```
00191 # define COMPILER_VERSION_MAJOR DEC(__ibmxl_version__)
00192 # define COMPILER_VERSION_MINOR DEC(__ibmxl_release__)
00193 # define COMPILER_VERSION_PATCH DEC(__ibmxl_modification__)
00194 # define COMPILER_VERSION_TWEAK DEC(__ibmxl_ptf_fix_level__)
00195
00196
00197 #elif defined(__IBMCPP__) && !defined(__COMPILER_VER__) && __IBMCPP__ >= 800
00198 # define COMPILER_ID "XL"
00199   /* __IBMCPP__ = VRP */
00200 # define COMPILER_VERSION_MAJOR DEC(__IBMCPP__/100)
00201 # define COMPILER_VERSION_MINOR DEC(__IBMCPP__/10 % 10)
00202 # define COMPILER_VERSION_PATCH DEC(__IBMCPP__    % 10)
00203
00204 #elif defined(__IBMCPP__) && !defined(__COMPILER_VER__) && __IBMCPP__ < 800
00205 # define COMPILER_ID "VisualAge"
00206   /* __IBMCPP__ = VRP */
00207 # define COMPILER_VERSION_MAJOR DEC(__IBMCPP__/100)
00208 # define COMPILER_VERSION_MINOR DEC(__IBMCPP__/10 % 10)
00209 # define COMPILER_VERSION_PATCH DEC(__IBMCPP__    % 10)
00210
00211 #elif defined(__NVCOMPILER)
00212 # define COMPILER_ID "NVHPC"
00213 # define COMPILER_VERSION_MAJOR DEC(__NVCOMPILER_MAJOR__)
00214 # define COMPILER_VERSION_MINOR DEC(__NVCOMPILER_MINOR__)
00215 # if defined(__NVCOMPILER_PATCHLEVEL__)
00216 #  define COMPILER_VERSION_PATCH DEC(__NVCOMPILER_PATCHLEVEL__)
00217 # endif
00218
00219 #elif defined(__PGI)
00220 # define COMPILER_ID "PGI"
00221 # define COMPILER_VERSION_MAJOR DEC(__PGIC__)
00222 # define COMPILER_VERSION_MINOR DEC(__PGIC_MINOR__)
00223 # if defined(__PGIC_PATCHLEVEL__)
00224 #  define COMPILER_VERSION_PATCH DEC(__PGIC_PATCHLEVEL__)
00225 # endif
00226
00227 #elif defined(_CRAYC)
00228 # define COMPILER_ID "Cray"
00229 # define COMPILER_VERSION_MAJOR DEC(_RELEASE_MAJOR)
00230 # define COMPILER_VERSION_MINOR DEC(_RELEASE_MINOR)
00231
00232 #elif defined(__TI_COMPILER_VERSION__)
00233 # define COMPILER_ID "TI"
00234   /* __TI_COMPILER_VERSION__ = VVVRRRPPP */
00235 # define COMPILER_VERSION_MAJOR DEC(__TI_COMPILER_VERSION__/1000000)
00236 # define COMPILER_VERSION_MINOR DEC(__TI_COMPILER_VERSION__/1000   % 1000)
00237 # define COMPILER_VERSION_PATCH DEC(__TI_COMPILER_VERSION__        % 1000)
00238
00239 #elif defined(__CLANG_FUJITSU)
00240 # define COMPILER_ID "FujitsuClang"
00241 # define COMPILER_VERSION_MAJOR DEC(__FCC_major__)
00242 # define COMPILER_VERSION_MINOR DEC(__FCC_minor__)
00243 # define COMPILER_VERSION_PATCH DEC(__FCC_patchlevel__)
00244 # define COMPILER_VERSION_INTERNAL_STR __clang_version__
00245
00246
00247 #elif defined(__FUJITSU)
00248 # define COMPILER_ID "Fujitsu"
00249 # if defined(__FCC_version__)
00250 #   define COMPILER_VERSION __FCC_version__
00251 # elif defined(__FCC_major__)
00252 #   define COMPILER_VERSION_MAJOR DEC(__FCC_major__)
00253 #   define COMPILER_VERSION_MINOR DEC(__FCC_minor__)
00254 #   define COMPILER_VERSION_PATCH DEC(__FCC_patchlevel__)
00255 # endif
00256 # if defined(__fcc_version)
00257 #   define COMPILER_VERSION_INTERNAL DEC(__fcc_version)
00258 # elif defined(__FCC_VERSION)
00259 #   define COMPILER_VERSION_INTERNAL DEC(__FCC_VERSION)
00260 # endif
00261
00262
00263 #elif defined(__ghs__)
00264 # define COMPILER_ID "GHS"
00265 /* __GHS_VERSION_NUMBER = VVVVRP */
00266 # ifdef __GHS_VERSION_NUMBER
00267 # define COMPILER_VERSION_MAJOR DEC(__GHS_VERSION_NUMBER / 100)
00268 # define COMPILER_VERSION_MINOR DEC(__GHS_VERSION_NUMBER / 10 % 10)
00269 # define COMPILER_VERSION_PATCH DEC(__GHS_VERSION_NUMBER      % 10)
00270 # endif
00271
00272 #elif defined(__TASKING__)
00273 # define COMPILER_ID "Tasking"
00274   # define COMPILER_VERSION_MAJOR DEC(__VERSION__/1000)
00275   # define COMPILER_VERSION_MINOR DEC(__VERSION__ % 100)
00276 # define COMPILER_VERSION_INTERNAL DEC(__VERSION__)
00277
```

```
00278 #elif defined(__SCO_VERSION__)
00279 # define COMPILER_ID "SCO"
00280
00281 #elif defined(__ARMCC_VERSION) && !defined(__clang__)
00282 # define COMPILER_ID "ARMCC"
00283 #if __ARMCC_VERSION >= 1000000
00284   /* __ARMCC_VERSION = VRRPPPP */
00285   # define COMPILER_VERSION_MAJOR DEC(__ARMCC_VERSION/1000000)
00286   # define COMPILER_VERSION_MINOR DEC(__ARMCC_VERSION/10000 % 100)
00287   # define COMPILER_VERSION_PATCH DEC(__ARMCC_VERSION     % 10000)
00288 #else
00289   /* __ARMCC_VERSION = VRPPPP */
00290   # define COMPILER_VERSION_MAJOR DEC(__ARMCC_VERSION/100000)
00291   # define COMPILER_VERSION_MINOR DEC(__ARMCC_VERSION/10000 % 10)
00292   # define COMPILER_VERSION_PATCH DEC(__ARMCC_VERSION    % 10000)
00293 #endif
00294
00295
00296 #elif defined(__clang__) && defined(__apple_build_version__)
00297 # define COMPILER_ID "AppleClang"
00298 # if defined(_MSC_VER)
00299 #  define SIMULATE_ID "MSVC"
00300 # endif
00301 # define COMPILER_VERSION_MAJOR DEC(__clang_major__)
00302 # define COMPILER_VERSION_MINOR DEC(__clang_minor__)
00303 # define COMPILER_VERSION_PATCH DEC(__clang_patchlevel__)
00304 # if defined(_MSC_VER)
00305   /* _MSC_VER = VVRR */
00306 #  define SIMULATE_VERSION_MAJOR DEC(_MSC_VER / 100)
00307 #  define SIMULATE_VERSION_MINOR DEC(_MSC_VER % 100)
00308 # endif
00309 # define COMPILER_VERSION_TWEAK DEC(__apple_build_version__)
00310
00311 #elif defined(__clang__) && defined(__ARMCOMPILER_VERSION)
00312 # define COMPILER_ID "ARMClang"
00313   # define COMPILER_VERSION_MAJOR DEC(__ARMCOMPILER_VERSION/1000000)
00314   # define COMPILER_VERSION_MINOR DEC(__ARMCOMPILER_VERSION/10000 % 100)
00315   # define COMPILER_VERSION_PATCH DEC(__ARMCOMPILER_VERSION/100   % 100)
00316 # define COMPILER_VERSION_INTERNAL DEC(__ARMCOMPILER_VERSION)
00317
00318 #elif defined(__clang__)
00319 # define COMPILER_ID "Clang"
00320 # if defined(_MSC_VER)
00321 #  define SIMULATE_ID "MSVC"
00322 # endif
00323 # define COMPILER_VERSION_MAJOR DEC(__clang_major__)
00324 # define COMPILER_VERSION_MINOR DEC(__clang_minor__)
00325 # define COMPILER_VERSION_PATCH DEC(__clang_patchlevel__)
00326 # if defined(_MSC_VER)
00327   /* _MSC_VER = VVRR */
00328 #  define SIMULATE_VERSION_MAJOR DEC(_MSC_VER / 100)
00329 #  define SIMULATE_VERSION_MINOR DEC(_MSC_VER % 100)
00330 # endif
00331
00332 #elif defined(__LCC__) && (defined(__GNUC__) || defined(__GNUG__) || defined(__MCST__))
00333 # define COMPILER_ID "LCC"
00334 # define COMPILER_VERSION_MAJOR DEC(__LCC__ / 100)
00335 # define COMPILER_VERSION_MINOR DEC(__LCC__ % 100)
00336 # if defined(__LCC_MINOR__)
00337 #  define COMPILER_VERSION_PATCH DEC(__LCC_MINOR__)
00338 # endif
00339 # if defined(__GNUC__) && defined(__GNUC_MINOR__)
00340 #  define SIMULATE_ID "GNU"
00341 #  define SIMULATE_VERSION_MAJOR DEC(__GNUC__)
00342 #  define SIMULATE_VERSION_MINOR DEC(__GNUC_MINOR__)
00343 #  if defined(__GNUC_PATCHLEVEL__)
00344 #   define SIMULATE_VERSION_PATCH DEC(__GNUC_PATCHLEVEL__)
00345 #  endif
00346 # endif
00347
00348 #elif defined(__GNUC__) || defined(__GNUG__)
00349 # define COMPILER_ID "GNU"
00350 # if defined(__GNUC__)
00351 #  define COMPILER_VERSION_MAJOR DEC(__GNUC__)
00352 # else
00353 #  define COMPILER_VERSION_MAJOR DEC(__GNUG__)
00354 # endif
00355 # if defined(__GNUC_MINOR__)
00356 #  define COMPILER_VERSION_MINOR DEC(__GNUC_MINOR__)
00357 # endif
00358 # if defined(__GNUC_PATCHLEVEL__)
00359 #  define COMPILER_VERSION_PATCH DEC(__GNUC_PATCHLEVEL__)
00360 # endif
00361
00362 #elif defined(_MSC_VER)
00363 # define COMPILER_ID "MSVC"
00364   /* _MSC_VER = VVRR */
```

```
00365 # define COMPILER_VERSION_MAJOR DEC(_MSC_VER / 100)
00366 # define COMPILER_VERSION_MINOR DEC(_MSC_VER % 100)
00367 # if defined(_MSC_FULL_VER)
00368 #  if _MSC_VER >= 1400
00369     /* _MSC_FULL_VER = VVRRPPPPP */
00370 #   define COMPILER_VERSION_PATCH DEC(_MSC_FULL_VER % 100000)
00371 #  else
00372     /* _MSC_FULL_VER = VVRRPPPP */
00373 #   define COMPILER_VERSION_PATCH DEC(_MSC_FULL_VER % 10000)
00374 #  endif
00375 # endif
00376 # if defined(_MSC_BUILD)
00377 #  define COMPILER_VERSION_TWEAK DEC(_MSC_BUILD)
00378 # endif
00379
00380 #elif defined(_ADI_COMPILER)
00381 # define COMPILER_ID "ADSP"
00382 #if defined(__VERSIONNUM__)
00383   /* __VERSIONNUM__ = 0xVVRRPPTT */
00384 #  define COMPILER_VERSION_MAJOR DEC(__VERSIONNUM__ » 24 & 0xFF)
00385 #  define COMPILER_VERSION_MINOR DEC(__VERSIONNUM__ » 16 & 0xFF)
00386 #  define COMPILER_VERSION_PATCH DEC(__VERSIONNUM__ » 8 & 0xFF)
00387 #  define COMPILER_VERSION_TWEAK DEC(__VERSIONNUM__ & 0xFF)
00388 #endif
00389
00390 #elif defined(__IAR_SYSTEMS_ICC__) || defined(__IAR_SYSTEMS_ICC)
00391 # define COMPILER_ID "IAR"
00392 # if defined(__VER__) && defined(__ICCARM__)
00393 #  define COMPILER_VERSION_MAJOR DEC((__VER__) / 1000000)
00394 #  define COMPILER_VERSION_MINOR DEC(((__VER__) / 1000) % 1000)
00395 #  define COMPILER_VERSION_PATCH DEC((__VER__) % 1000)
00396 #  define COMPILER_VERSION_INTERNAL DEC(__IAR_SYSTEMS_ICC__)
00397 # elif defined(__VER__) && (defined(__ICCAVR__) || defined(__ICCRX__) || defined(__ICCRH850__) ||
      defined(__ICCRL78__) || defined(__ICC430__) || defined(__ICCRISCV__) || defined(__ICCV850__) ||
      defined(__ICC8051__) || defined(__ICCSTM8__))
00398 #  define COMPILER_VERSION_MAJOR DEC((__VER__) / 100)
00399 #  define COMPILER_VERSION_MINOR DEC((__VER__) - (((__VER__) / 100)*100))
00400 #  define COMPILER_VERSION_PATCH DEC(__SUBVERSION__)
00401 #  define COMPILER_VERSION_INTERNAL DEC(__IAR_SYSTEMS_ICC__)
00402 # endif
00403
00404
00405 /* These compilers are either not known or too old to define an
00406   identification macro.  Try to identify the platform and guess that
00407   it is the native compiler.  */
00408 #elif defined(__hpux) || defined(__hpua)
00409 # define COMPILER_ID "HP"
00410
00411 #else /* unknown compiler */
00412 # define COMPILER_ID ""
00413 #endif
00414
00415 /* Construct the string literal in pieces to prevent the source from
00416    getting matched.  Store it in a pointer rather than an array
00417    because some compilers will just produce instructions to fill the
00418    array rather than assigning a pointer to a static array.  */
00419 char const* info_compiler = "INFO" ":" "compiler[" COMPILER_ID "]";
00420 #ifdef SIMULATE_ID
00421 char const* info_simulate = "INFO" ":" "simulate[" SIMULATE_ID "]";
00422 #endif
00423
00424 #ifdef __QNXNTO__
00425 char const* qnxnto = "INFO" ":" "qnxnto[]";
00426 #endif
00427
00428 #if defined(__CRAYXT_COMPUTE_LINUX_TARGET)
00429 char const *info_cray = "INFO" ":" "compiler_wrapper[CrayPrgEnv]";
00430 #endif
00431
00432 #define STRINGIFY_HELPER(X) #X
00433 #define STRINGIFY(X) STRINGIFY_HELPER(X)
00434
00435 /* Identify known platforms by name.  */
00436 #if defined(__linux) || defined(__linux__) || defined(linux)
00437 # define PLATFORM_ID "Linux"
00438
00439 #elif defined(__MSYS__)
00440 # define PLATFORM_ID "MSYS"
00441
00442 #elif defined(__CYGWIN__)
00443 # define PLATFORM_ID "Cygwin"
00444
00445 #elif defined(__MINGW32__)
00446 # define PLATFORM_ID "MinGW"
00447
00448 #elif defined(__APPLE__)
00449 # define PLATFORM_ID "Darwin"
```

```
00450
00451 #elif defined(_WIN32) || defined(__WIN32__) || defined(WIN32)
00452 # define PLATFORM_ID "Windows"
00453
00454 #elif defined(__FreeBSD__) || defined(__FreeBSD)
00455 # define PLATFORM_ID "FreeBSD"
00456
00457 #elif defined(__NetBSD__) || defined(__NetBSD)
00458 # define PLATFORM_ID "NetBSD"
00459
00460 #elif defined(__OpenBSD__) || defined(__OPENBSD)
00461 # define PLATFORM_ID "OpenBSD"
00462
00463 #elif defined(__sun) || defined(sun)
00464 # define PLATFORM_ID "SunOS"
00465
00466 #elif defined(_AIX) || defined(__AIX) || defined(__AIX__) || defined(__aix) || defined(__aix__)
00467 # define PLATFORM_ID "AIX"
00468
00469 #elif defined(__hpux) || defined(__hpux__)
00470 # define PLATFORM_ID "HP-UX"
00471
00472 #elif defined(__HAIKU__)
00473 # define PLATFORM_ID "Haiku"
00474
00475 #elif defined(__BeOS) || defined(__BEOS__) || defined(_BEOS)
00476 # define PLATFORM_ID "BeOS"
00477
00478 #elif defined(__QNX__) || defined(__QNXNTO__)
00479 # define PLATFORM_ID "QNX"
00480
00481 #elif defined(__tru64) || defined(_tru64) || defined(__TRU64__)
00482 # define PLATFORM_ID "Tru64"
00483
00484 #elif defined(__riscos) || defined(__riscos__)
00485 # define PLATFORM_ID "RISCos"
00486
00487 #elif defined(__sinix) || defined(__sinix__) || defined(__SINIX__)
00488 # define PLATFORM_ID "SINIX"
00489
00490 #elif defined(__UNIX_SV__)
00491 # define PLATFORM_ID "UNIX_SV"
00492
00493 #elif defined(__bsdos__)
00494 # define PLATFORM_ID "BSDOS"
00495
00496 #elif defined(_MPRAS) || defined(MPRAS)
00497 # define PLATFORM_ID "MP-RAS"
00498
00499 #elif defined(__osf) || defined(__osf__)
00500 # define PLATFORM_ID "OSF1"
00501
00502 #elif defined(_SCO_SV) || defined(SCO_SV) || defined(sco_sv)
00503 # define PLATFORM_ID "SCO_SV"
00504
00505 #elif defined(__ultrix) || defined(__ultrix__) || defined(_ULTRIX)
00506 # define PLATFORM_ID "ULTRIX"
00507
00508 #elif defined(__XENIX__) || defined(_XENIX) || defined(XENIX)
00509 # define PLATFORM_ID "Xenix"
00510
00511 #elif defined(__WATCOMC__)
00512 # if defined(__LINUX__)
00513 #  define PLATFORM_ID "Linux"
00514
00515 # elif defined(__DOS__)
00516 #  define PLATFORM_ID "DOS"
00517
00518 # elif defined(__OS2__)
00519 #  define PLATFORM_ID "OS2"
00520
00521 # elif defined(__WINDOWS__)
00522 #  define PLATFORM_ID "Windows3x"
00523
00524 # elif defined(__VXWORKS__)
00525 #  define PLATFORM_ID "VxWorks"
00526
00527 # else /* unknown platform */
00528 #  define PLATFORM_ID
00529 # endif
00530
00531 #elif defined(__INTEGRITY)
00532 # if defined(INT_178B)
00533 #  define PLATFORM_ID "Integrity178"
00534
00535 # else /* regular Integrity */
00536 #  define PLATFORM_ID "Integrity"
```

```
00537 # endif
00538
00539 # elif defined(_ADI_COMPILER)
00540 #  define PLATFORM_ID "ADSP"
00541
00542 #else /* unknown platform */
00543 # define PLATFORM_ID
00544
00545 #endif
00546
00547 /* For windows compilers MSVC and Intel we can determine
00548    the architecture of the compiler being used.  This is because
00549    the compilers do not have flags that can change the architecture,
00550    but rather depend on which compiler is being used
00551 */
00552 #if defined(_WIN32) && defined(_MSC_VER)
00553 # if defined(_M_IA64)
00554 #  define ARCHITECTURE_ID "IA64"
00555
00556 # elif defined(_M_ARM64EC)
00557 #  define ARCHITECTURE_ID "ARM64EC"
00558
00559 # elif defined(_M_X64) || defined(_M_AMD64)
00560 #  define ARCHITECTURE_ID "x64"
00561
00562 # elif defined(_M_IX86)
00563 #  define ARCHITECTURE_ID "X86"
00564
00565 # elif defined(_M_ARM64)
00566 #  define ARCHITECTURE_ID "ARM64"
00567
00568 # elif defined(_M_ARM)
00569 #  if _M_ARM == 4
00570 #   define ARCHITECTURE_ID "ARMV4I"
00571 #  elif _M_ARM == 5
00572 #   define ARCHITECTURE_ID "ARMV5I"
00573 #  else
00574 #   define ARCHITECTURE_ID "ARMV" STRINGIFY(_M_ARM)
00575 #  endif
00576
00577 # elif defined(_M_MIPS)
00578 #  define ARCHITECTURE_ID "MIPS"
00579
00580 # elif defined(_M_SH)
00581 #  define ARCHITECTURE_ID "SHx"
00582
00583 # else /* unknown architecture */
00584 #  define ARCHITECTURE_ID ""
00585 # endif
00586
00587 #elif defined(__WATCOMC__)
00588 # if defined(_M_I86)
00589 #  define ARCHITECTURE_ID "I86"
00590
00591 # elif defined(_M_IX86)
00592 #  define ARCHITECTURE_ID "X86"
00593
00594 # else /* unknown architecture */
00595 #  define ARCHITECTURE_ID ""
00596 # endif
00597
00598 #elif defined(__IAR_SYSTEMS_ICC__) || defined(__IAR_SYSTEMS_ICC)
00599 # if defined(__ICCARM__)
00600 #  define ARCHITECTURE_ID "ARM"
00601
00602 # elif defined(__ICCRX__)
00603 #  define ARCHITECTURE_ID "RX"
00604
00605 # elif defined(__ICCRH850__)
00606 #  define ARCHITECTURE_ID "RH850"
00607
00608 # elif defined(__ICCRL78__)
00609 #  define ARCHITECTURE_ID "RL78"
00610
00611 # elif defined(__ICCRISCV__)
00612 #  define ARCHITECTURE_ID "RISCV"
00613
00614 # elif defined(__ICCAVR__)
00615 #  define ARCHITECTURE_ID "AVR"
00616
00617 # elif defined(__ICC430__)
00618 #  define ARCHITECTURE_ID "MSP430"
00619
00620 # elif defined(__ICCV850__)
00621 #  define ARCHITECTURE_ID "V850"
00622
00623 # elif defined(__ICC8051__)
```

```
00624 #  define ARCHITECTURE_ID "8051"
00625
00626 # elif defined(__ICCSTM8__)
00627 #  define ARCHITECTURE_ID "STM8"
00628
00629 # else /* unknown architecture */
00630 #  define ARCHITECTURE_ID ""
00631 # endif
00632
00633 #elif defined(__ghs__)
00634 # if defined(__PPC64__)
00635 #  define ARCHITECTURE_ID "PPC64"
00636
00637 # elif defined(__ppc__)
00638 #  define ARCHITECTURE_ID "PPC"
00639
00640 # elif defined(__ARM__)
00641 #  define ARCHITECTURE_ID "ARM"
00642
00643 # elif defined(__x86_64__)
00644 #  define ARCHITECTURE_ID "x64"
00645
00646 # elif defined(__i386__)
00647 #  define ARCHITECTURE_ID "X86"
00648
00649 # else /* unknown architecture */
00650 #  define ARCHITECTURE_ID ""
00651 # endif
00652
00653 #elif defined(__TI_COMPILER_VERSION__)
00654 # if defined(__TI_ARM__)
00655 #  define ARCHITECTURE_ID "ARM"
00656
00657 # elif defined(__MSP430__)
00658 #  define ARCHITECTURE_ID "MSP430"
00659
00660 # elif defined(__TMS320C28XX__)
00661 #  define ARCHITECTURE_ID "TMS320C28x"
00662
00663 # elif defined(__TMS320C6X__) || defined(_TMS320C6X)
00664 #  define ARCHITECTURE_ID "TMS320C6x"
00665
00666 # else /* unknown architecture */
00667 #  define ARCHITECTURE_ID ""
00668 # endif
00669
00670 # elif defined(__ADSPSHARC__)
00671 #  define ARCHITECTURE_ID "SHARC"
00672
00673 # elif defined(__ADSPBLACKFIN__)
00674 #  define ARCHITECTURE_ID "Blackfin"
00675
00676 #elif defined(__TASKING__)
00677
00678 # if defined(__CTC__) || defined(__CPTC__)
00679 #  define ARCHITECTURE_ID "TriCore"
00680
00681 # elif defined(__CMCS__)
00682 #  define ARCHITECTURE_ID "MCS"
00683
00684 # elif defined(__CARM__)
00685 #  define ARCHITECTURE_ID "ARM"
00686
00687 # elif defined(__CARC__)
00688 #  define ARCHITECTURE_ID "ARC"
00689
00690 # elif defined(__C51__)
00691 #  define ARCHITECTURE_ID "8051"
00692
00693 # elif defined(__CPCP__)
00694 #  define ARCHITECTURE_ID "PCP"
00695
00696 # else
00697 #  define ARCHITECTURE_ID ""
00698 # endif
00699
00700 #else
00701 #  define ARCHITECTURE_ID
00702 #endif
00703
00704 /* Convert integer to decimal digit literals.  */
00705 #define DEC(n)                   \
00706   ('0' + (((n) / 10000000)%10)), \
00707   ('0' + (((n) / 1000000)%10)),  \
00708   ('0' + (((n) / 100000)%10)),   \
00709   ('0' + (((n) / 10000)%10)),    \
00710   ('0' + (((n) / 1000)%10)),     \
```

```
00711   ('0' + (((n) / 100)%10)),      \
00712   ('0' + (((n) / 10)%10)),       \
00713   ('0' +  ((n) % 10))
00714
00715 /* Convert integer to hex digit literals.  */
00716 #define HEX(n)             \
00717   ('0' + ((n)>>28 & 0xF)), \
00718   ('0' + ((n)>>24 & 0xF)), \
00719   ('0' + ((n)>>20 & 0xF)), \
00720   ('0' + ((n)>>16 & 0xF)), \
00721   ('0' + ((n)>>12 & 0xF)), \
00722   ('0' + ((n)>>8  & 0xF)), \
00723   ('0' + ((n)>>4  & 0xF)), \
00724   ('0' + ((n)     & 0xF))
00725
00726 /* Construct a string literal encoding the version number. */
00727 #ifdef COMPILER_VERSION
00728 char const* info_version = "INFO" ":" "compiler_version[" COMPILER_VERSION "]";
00729
00730 /* Construct a string literal encoding the version number components. */
00731 #elif defined(COMPILER_VERSION_MAJOR)
00732 char const info_version[] = {
00733   'I', 'N', 'F', 'O', ':',
00734   'c','o','m','p','i','l','e','r','_','v','e','r','s','i','o','n','[',
00735   COMPILER_VERSION_MAJOR,
00736 # ifdef COMPILER_VERSION_MINOR
00737   '.', COMPILER_VERSION_MINOR,
00738 #  ifdef COMPILER_VERSION_PATCH
00739   '.', COMPILER_VERSION_PATCH,
00740 #   ifdef COMPILER_VERSION_TWEAK
00741   '.', COMPILER_VERSION_TWEAK,
00742 #   endif
00743 #  endif
00744 # endif
00745   ']','\0'};
00746 #endif
00747
00748 /* Construct a string literal encoding the internal version number. */
00749 #ifdef COMPILER_VERSION_INTERNAL
00750 char const info_version_internal[] = {
00751   'I', 'N', 'F', 'O', ':',
00752   'c','o','m','p','i','l','e','r','_','v','e','r','s','i','o','n','_',
00753   'i','n','t','e','r','n','a','l','[',
00754   COMPILER_VERSION_INTERNAL,']','\0'};
00755 #elif defined(COMPILER_VERSION_INTERNAL_STR)
00756 char const* info_version_internal = "INFO" ":" "compiler_version_internal["
      COMPILER_VERSION_INTERNAL_STR "]";
00757 #endif
00758
00759 /* Construct a string literal encoding the version number components. */
00760 #ifdef SIMULATE_VERSION_MAJOR
00761 char const info_simulate_version[] = {
00762   'I', 'N', 'F', 'O', ':',
00763   's','i','m','u','l','a','t','e','_','v','e','r','s','i','o','n','[',
00764   SIMULATE_VERSION_MAJOR,
00765 # ifdef SIMULATE_VERSION_MINOR
00766   '.', SIMULATE_VERSION_MINOR,
00767 #  ifdef SIMULATE_VERSION_PATCH
00768   '.', SIMULATE_VERSION_PATCH,
00769 #   ifdef SIMULATE_VERSION_TWEAK
00770   '.', SIMULATE_VERSION_TWEAK,
00771 #   endif
00772 #  endif
00773 # endif
00774   ']','\0'};
00775 #endif
00776
00777 /* Construct the string literal in pieces to prevent the source from
00778    getting matched.  Store it in a pointer rather than an array
00779    because some compilers will just produce instructions to fill the
00780    array rather than assigning a pointer to a static array.  */
00781 char const* info_platform = "INFO" ":" "platform[" PLATFORM_ID "]";
00782 char const* info_arch = "INFO" ":" "arch[" ARCHITECTURE_ID "]";
00783
00784
00785
00786 #if defined(__INTEL_COMPILER) && defined(_MSVC_LANG) && _MSVC_LANG < 201403L
00787 #  if defined(__INTEL_CXX11_MODE__)
00788 #    if defined(__cpp_aggregate_nsdmi)
00789 #      define CXX_STD 201402L
00790 #    else
00791 #      define CXX_STD 201103L
00792 #    endif
00793 #  else
00794 #    define CXX_STD 199711L
00795 #  endif
00796 #elif defined(_MSC_VER) && defined(_MSVC_LANG)
```

```
00797 #  define CXX_STD _MSVC_LANG
00798 #else
00799 #  define CXX_STD __cplusplus
00800 #endif
00801
00802 const char* info_language_standard_default = "INFO" ":" "standard_default["
00803 #if CXX_STD > 202002L
00804   "23"
00805 #elif CXX_STD > 201703L
00806   "20"
00807 #elif CXX_STD >= 201703L
00808   "17"
00809 #elif CXX_STD >= 201402L
00810   "14"
00811 #elif CXX_STD >= 201103L
00812   "11"
00813 #else
00814   "98"
00815 #endif
00816 "]";
00817
00818 const char* info_language_extensions_default = "INFO" ":" "extensions_default["
00819 #if (defined(__clang__) || defined(__GNUC__) || defined(__xlC__) ||           \
00820      defined(__TI_COMPILER_VERSION__)) &&                                     \
00821   !defined(__STRICT_ANSI__)
00822   "ON"
00823 #else
00824   "OFF"
00825 #endif
00826 "]";
00827
00828 /*--------------------------------------------------------------------------*/
00829
00830 int main(int argc, char* argv[])
00831 {
00832   int require = 0;
00833   require += info_compiler[argc];
00834   require += info_platform[argc];
00835   require += info_arch[argc];
00836 #ifdef COMPILER_VERSION_MAJOR
00837   require += info_version[argc];
00838 #endif
00839 #ifdef COMPILER_VERSION_INTERNAL
00840   require += info_version_internal[argc];
00841 #endif
00842 #ifdef SIMULATE_ID
00843   require += info_simulate[argc];
00844 #endif
00845 #ifdef SIMULATE_VERSION_MAJOR
00846   require += info_simulate_version[argc];
00847 #endif
00848 #if defined(__CRAYXT_COMPUTE_LINUX_TARGET)
00849   require += info_cray[argc];
00850 #endif
00851   require += info_language_standard_default[argc];
00852   require += info_language_extensions_default[argc];
00853   (void)argv;
00854   return require;
00855 }
```

7.7 /Users/samanthapope/msdscriptRepo/msdScript/cmdline.cpp File Reference

```
#include <iostream>
#include <cstring>
#include "cmdline.h"
#include "catch.h"
```

Macros

- #define CATCH_CONFIG_RUNNER

Functions

- void useArgs (int argc, const char *argv[])

7.7.1 Macro Definition Documentation

7.7.1.1 CATCH_CONFIG_RUNNER

```
#define CATCH_CONFIG_RUNNER
```

Definition at line 7 of file cmdline.cpp.

7.7.2 Function Documentation

7.7.2.1 useArgs()

```
void useArgs (
            int argc,
            const char * argv[] )
```

Definition at line 11 of file cmdline.cpp.

7.8 cmdline.cpp

Go to the documentation of this file.

```
00001 //
00002 // Created by Samantha Pope on 1/19/24.
00003 //
00004
00005 #include <iostream>
00006 #include <cstring> // For strcmp
00007 #define CATCH_CONFIG_RUNNER
00008 #include "cmdline.h"
00009 #include "catch.h"
00010
00011  void useArgs(int argc, const char *argv[]) {
00012            static bool testAlreadyPressed = false;
00013
00014            for (int i = 1; i < argc; ++i) {
00015                //loop for all of it
00016                if (strcmp(argv[i], "--help") == 0) {
00017                    std::cout << "Usage: ./msdscript --[option]\n"
00018                              << "Options:\n"
00019                              << "  --help  Show this help message\n"
00020                              << "  --test  Run tests\n";
00021                    exit(0);
00022                }
00023
00024                    //have to control for if it is the first test that they wrote or not
00025                else if (strcmp(argv[i], "--test") == 0) {
00026                    if (!testAlreadyPressed) {
00027                        testAlreadyPressed = true;
00028                        if(Catch::Session().run(1,argv) !=0){
00029                            //if catch returns a non-zero value, then kill the program
00030                            exit(1);
00031                        }
00032
00033                        std::cout << "Tests passed\n";
00034                    }
00035                        //--test flag already seen
00036                    else {
00037                        std::cerr << "Error: --test argument already seen\n";
00038                        exit(1);
00039                    }
00040                } else {
00041                    std::cerr << "Error: Unknown argument:  " << argv[i] << "\n";
00042                    exit(1);
00043                }
00044
00045            }
00046        }
```

7.9 /Users/samanthapope/msdscriptRepo/msdScript/cmdline.h File Reference

Functions

- void useArgs (int argc, const char ∗argv[ ])

7.9.1 Function Documentation

7.9.1.1 useArgs()

```
void useArgs (
            int argc,
            const char * argv[] )
```

Definition at line 11 of file cmdline.cpp.

7.10 cmdline.h

Go to the documentation of this file.

```
00001 //
00002 // Created by Samantha Pope on 1/19/24.
00003 //
00004
00005 #ifndef CS6015PROJECT_CMDLINE_H
00006 #define CS6015PROJECT_CMDLINE_H
00007
00008
00009     void useArgs(int argc, const char * argv[]);
00010
00011
00012 #endif //CS6015PROJECT_CMDLINE_H
```

7.11 /Users/samanthapope/msdscriptRepo/msdScript/Expr.cpp File Reference

```
#include <sstream>
#include "Expr.h"
```

7.12 Expr.cpp

Go to the documentation of this file.

```
00001 #include <sstream>
00002 #include "Expr.h"
00003
00008 Num::Num(int val) {
00009     this->val = val;
00010 }
00011
00017 Add::Add(Expr *lhs, Expr *rhs) {
00018     this->lhs = lhs;
00019     this->rhs = rhs;
00020 }
```

```
00021
00027 Mult::Mult(Expr *lhs, Expr *rhs) {
00028     this->lhs = lhs;
00029     this->rhs = rhs;
00030 }
00031
00036 Var::Var(const std::string& varPassed) : var(std::move(varPassed)) {
00037 }
00038
00044 bool Num::equals(Expr *e) {
00045     Num* numPtr = dynamic_cast<Num*>(e);
00046     return numPtr && this->val == numPtr->val;
00047 }
00048
00054 bool Add::equals(Expr *e) {
00055     Add* addPtr = dynamic_cast<Add*>(e);
00056     return addPtr && ((this->lhs->equals(addPtr->lhs) && this->rhs->equals(addPtr->rhs)) ||
00057                       (this->lhs->equals(addPtr->rhs) && this->rhs->equals(addPtr->lhs)));
00058 }
00059
00065 bool Mult::equals(Expr *e) {
00066     Mult* multPtr = dynamic_cast<Mult*>(e);
00067     return multPtr && ((this->lhs->equals(multPtr->lhs) && this->rhs->equals(multPtr->rhs)) ||
00068                        (this->lhs->equals(multPtr->rhs) && this->rhs->equals(multPtr->lhs)));
00069 }
00070
00076 bool Var::equals(Expr *e) {
00077     Var* varPtr = dynamic_cast<Var*>(e);
00078     return varPtr && this->var == varPtr->var;
00079 }
00080
00085 int Num::interp() {
00086     return this->val;
00087 }
00088
00093 int Add::interp() {
00094     return this->lhs->interp() + this->rhs->interp();
00095 }
00096
00101 int Mult::interp() {
00102     return this->lhs->interp() * this->rhs->interp();
00103 }
00104
00109 int Var::interp() {
00110     throw std::runtime_error("no value for variable");
00111 }
00112
00117 bool Num::hasVariable() {
00118     return false;
00119 }
00120
00125 bool Add::hasVariable() {
00126     return this->lhs->hasVariable() || this->rhs->hasVariable();
00127 }
00128
00133 bool Mult::hasVariable() {
00134     return this->lhs->hasVariable() || this->rhs->hasVariable();
00135 }
00136
00141 bool Var::hasVariable() {
00142     return true;
00143 }
00144
00151 Expr* Num::subst(std::string stringInput, Expr* e) {
00152     return new Num(this->val);
00153 }
00154
00161 Expr* Add::subst(std::string stringInput, Expr* e) {
00162     Expr* newLHS = this->lhs->subst(stringInput,e);
00163     Expr* newRHS = this->rhs->subst(stringInput,e);
00164     return new Add(newLHS,newRHS);
00165 }
00166
00173 Expr* Mult::subst(std::string stringInput, Expr *e) {
00174     Expr* newLHS = this->lhs->subst(stringInput,e);
00175     Expr* newRHS = this->rhs->subst(stringInput,e);
00176     return new Mult(newLHS,newRHS);
00177 }
00178
00185 Expr* Var::subst(std::string stringInput, Expr *e) {
00186     if (this->var == stringInput) {
00187         return e;
00188     } else {
00189         return new Var(this->var);
00190     }
00191 }
00192
```

```
00197 void Num::print(std::ostream &stream) {
00198     stream « std::to_string(val);
00199 }
00200
00205 void Add::print(std::ostream &stream) {
00206     stream « "(";
00207     lhs->print(stream);
00208     stream « "+";
00209     rhs->print(stream);
00210     stream « ")";
00211 }
00212
00217 void Mult::print(std::ostream &stream) {
00218     stream « "(";
00219     lhs->print(stream);
00220     stream « "*";
00221     rhs->print(stream);
00222     stream « ")";
00223 }
00224
00229 void Var::print(std::ostream &stream) {
00230     stream « var;
00231 }
00232
00238 void Num::pretty_print(std::ostream &ot, precedence_t prec) {
00239     ot « val;
00240 }
00241
00247 void Add::pretty_print(std::ostream &ot, precedence_t prec) {
00248     bool needParens = prec > prec_add;
00249     if (needParens) ot « "(";
00250     lhs->pretty_print(ot, static_cast<precedence_t>(prec_add + 1));
00251     ot « " + ";
00252     rhs->pretty_print(ot, prec_add);
00253     if (needParens) ot « ")";
00254 }
00255
00261 void Mult::pretty_print(std::ostream &ot, precedence_t prec) {
00262     bool needParens = prec > prec_mult;
00263     if (needParens) ot « "(";
00264     lhs->pretty_print(ot, static_cast<precedence_t>(prec_mult + 1));
00265     ot « " * ";
00266     rhs->pretty_print(ot, prec_mult);
00267     if (needParens) ot « ")";
00268 }
00269
00275 void Var::pretty_print(std::ostream &ot, precedence_t prec) {
00276     ot « var;
00277 }
```

7.13 /Users/samanthapope/msdscriptRepo/msdScript/Expr.h File Reference

```
#include <string>
#include <stdexcept>
#include <sstream>
```

Classes

- class Expr
- class Num
- class Add
- class Mult
- class Var

Enumerations

- enum precedence_t { prec_none , prec_add , prec_mult }

7.13.1 Enumeration Type Documentation

7.13.1.1 precedence_t

```
enum precedence_t
```

Enumerator

prec_none	
prec_add	
prec_mult	

Definition at line 11 of file Expr.h.

7.14 Expr.h

Go to the documentation of this file.

```
00001 // Expr.h
00002
00003 #ifndef CS6015PROJECT_EXPR_H
00004 #define CS6015PROJECT_EXPR_H
00005 #include <string>
00006 #include <stdexcept>
00007 #include <sstream>
00008
00010
00011 typedef enum {
00012     prec_none,   // = 0
00013     prec_add,    // = 1
00014     prec_mult    // = 2
00015 } precedence_t;
00016
00017 class Expr {
00018 public:
00019     virtual ~Expr() = default; //virtual destructor - allows me to write tests using "delete" to test
      my deepCopy (prevents memory links)
00020     virtual bool equals(Expr *e) = 0;
00021     virtual int interp() =0;
00022     virtual bool hasVariable()=0;
00023     virtual Expr* subst(std::string stringInput, Expr* e)=0;
00024
00025     std::string to_string() {
00026         std::stringstream st("");
00027         this->print(st);
00028         return st.str();
00029     }
00030
00031     std::string to_pp_string(){
00032         std::stringstream st("");
00033         this->pretty_print_at(st);
00034         return st.str();
00035     }
00036
00037     virtual void print(std::ostream& stream)=0;
00038
00039     virtual void pretty_print(std::ostream& ot, precedence_t prec)=0;
00040
00041     void pretty_print_at(std::ostream &ot){
00042         this-> pretty_print(ot,prec_none);
00043     }
00044 };
00045
00046 class Num : public Expr {
00047 public:
00048     int val;
00049     Num(int val);
00050     bool equals(Expr *e) override;
00051     int interp() override;
00052     bool hasVariable() override;
00053     Expr* subst(std::string stringInput, Expr* e) override;
00054     void print(std::ostream& stream) override;
```

```
00055 protected:
00056     void pretty_print(std::ostream& ot, precedence_t prec) override;
00057 };
00058
00059 class Add : public Expr {
00060 public:
00061     Expr *lhs;
00062     Expr *rhs;
00063
00064     Add(Expr *lhs, Expr *rhs);
00065     bool equals(Expr *e) override;
00066     int interp() override;
00067     bool hasVariable() override;
00068     Expr* subst(std::string stringInput, Expr* e) override;
00069     void print(std::ostream& stream) override;
00070 protected:
00071     void pretty_print(std::ostream& ot, precedence_t prec) override;
00072
00073 };
00074
00075 class Mult : public Expr {
00076 public:
00077     Expr *lhs;
00078     Expr *rhs;
00079
00080     Mult(Expr *lhs, Expr *rhs);
00081     bool equals(Expr *e) override;
00082     int interp() override;
00083     bool hasVariable() override;
00084     Expr* subst(std::string stringInput, Expr* e) override;
00085     void print(std::ostream& stream) override;
00086 protected:
00087     void pretty_print(std::ostream& ot, precedence_t prec) override;
00088
00089 };
00090
00091 class Var : public Expr {
00092 public:
00093     std::string var;
00094     Var(const std::string& varPassed);
00095     bool equals(Expr *e) override;
00096     int interp() override;
00097     bool hasVariable() override;
00098     Expr* subst(std::string stringInput, Expr* e) override;
00099     void print(std::ostream& stream) override;
00100 protected:
00101     void pretty_print(std::ostream& ot, precedence_t prec) override;
00102
00103 };
00104
00105
00106 #endif //CS6015PROJECT_EXPR_H
```

7.15 /Users/samanthapope/msdscriptRepo/msdScript/ExprTest.cpp File Reference

```
#include "catch.h"
#include "Expr.h"
#include "cmdline.h"
#include <stdexcept>
#include <sstream>
```

Functions

- TEST_CASE ("Num equals tests", "[Num]")
- TEST_CASE ("Num Edge Cases")
- TEST_CASE ("Add equals tests", "Add")
- TEST_CASE ("Mult equals tests", "[Mult]")
- TEST_CASE ("Var equals tests", "[Var]")
- TEST_CASE ("interp tests", "All Expressions")

- TEST_CASE ("hasVariable tests", "All Expressions")
- TEST_CASE ("subst tests", "All Expressions")
- TEST_CASE ("to_string tests", "all expressions")
- TEST_CASE ("pretty_print_at Tests", "All expression classes")
- TEST_CASE ("Nabil's given tests")

7.15.1 Function Documentation

7.15.1.1 TEST_CASE() [1/11]

```
TEST_CASE (
            "Add equals tests" ,
            "Add"  )
```

Definition at line 43 of file ExprTest.cpp.

7.15.1.2 TEST_CASE() [2/11]

```
TEST_CASE (
            "hasVariable tests" ,
            "All Expressions"  )
```

Definition at line 173 of file ExprTest.cpp.

7.15.1.3 TEST_CASE() [3/11]

```
TEST_CASE (
            "interp tests" ,
            "All Expressions"  )
```

Definition at line 105 of file ExprTest.cpp.

7.15.1.4 TEST_CASE() [4/11]

```
TEST_CASE (
            "Mult equals tests" ,
            "" [Mult] )
```

Definition at line 65 of file ExprTest.cpp.

7.15.1.5 TEST_CASE() [5/11]

```
TEST_CASE (
            "Nabil's given tests"  )
```

Definition at line 352 of file ExprTest.cpp.

7.15.1.6 TEST_CASE() [6/11]

```
TEST_CASE (
             "Num Edge Cases"  )
```

Definition at line 30 of file ExprTest.cpp.

7.15.1.7 TEST_CASE() [7/11]

```
TEST_CASE (
             "Num equals tests" ,
             "" [Num] )
```

Definition at line 12 of file ExprTest.cpp.

7.15.1.8 TEST_CASE() [8/11]

```
TEST_CASE (
             "pretty_print_at Tests" ,
             "All expression classes"  )
```

Definition at line 315 of file ExprTest.cpp.

7.15.1.9 TEST_CASE() [9/11]

```
TEST_CASE (
             "subst tests" ,
             "All Expressions"  )
```

Definition at line 240 of file ExprTest.cpp.

7.15.1.10 TEST_CASE() [10/11]

```
TEST_CASE (
             "to_string tests" ,
             "all expressions"  )
```

Definition at line 298 of file ExprTest.cpp.

7.15.1.11 TEST_CASE() [11/11]

```
TEST_CASE (
             "Var equals tests" ,
             "" [Var] )
```

Definition at line 86 of file ExprTest.cpp.

7.16 ExprTest.cpp

Go to the documentation of this file.

```
00001 //
00002 // Created by Samantha Pope on 1/22/24.
00003 //
00004
00005
00006 #include "catch.h"
00007 #include "Expr.h"
00008 #include "cmdline.h"
00009 #include <stdexcept>
00010 #include <sstream>
00011
00012 TEST_CASE("Num equals tests", "[Num]") {
00013 Num num1(5);
00014 Num num2(5);
00015 Num num3(10);
00016
00017 SECTION("Equal numbers") {
00018 REQUIRE(num1.equals(&num2));
00019 }
00020
00021 SECTION("Not equal numbers") {
00022 REQUIRE_FALSE(num1.equals(&num3));
00023 }
00024
00025 SECTION("Comparison with null") {
00026 REQUIRE_FALSE(num1.equals(nullptr));
00027 }
00028 }
00029
00030 TEST_CASE("Num Edge Cases"){
00031     SECTION("Negative Numbers"){
00032         Num num1(-5);
00033         Num num2(-5);
00034         Num num3(-10);
00035         Num num4(5);
00036         REQUIRE(num1.equals(&num2));
00037         REQUIRE_FALSE(num1.equals(&num3));
00038         REQUIRE_FALSE(num1.equals(&num4));
00039         REQUIRE_FALSE(num1.equals(nullptr));
00040     }
00041 }
00042
00043 TEST_CASE("Add equals tests", "Add") {
00044 Num n1(3), n2(4), n3(3), n4(4);
00045 Add add1(&n1, &n2);
00046 Add add2(&n3, &n4);
00047 Add add3(&n2, &n1);  // Different order
00048 Num differentNum(7);
00049 Add differentAdd(&n1, &differentNum);
00050
00051 SECTION("Equal Adds") {
00052 REQUIRE(add1.equals(&add2));
00053 }
00054 SECTION("Equal Adds with different order") {
00055 REQUIRE(add1.equals(&add3));
00056 }
00057 SECTION("Not equal Adds") {
00058 REQUIRE_FALSE(add1.equals(&differentAdd));
00059 }
00060 SECTION("Comparison with null") {
00061 REQUIRE_FALSE(add1.equals(nullptr));
00062 }
00063 }
00064
00065 TEST_CASE("Mult equals tests", "[Mult]") {
00066 Num n1(2), n2(5), n3(2), n4(5);
00067 Mult mult1(&n1, &n2);
00068 Mult mult2(&n3, &n4);
00069 Mult mult3(&n2, &n1);  // Different order
00070 Num differentNum(9);
00071 Mult differentMult(&n1, &differentNum);
00072 SECTION("Equal Mults") {
00073 REQUIRE(mult1.equals(&mult2));
00074 }
00075 SECTION("Equal Mults with different order") {
00076 REQUIRE(mult1.equals(&mult3));
00077 }
00078 SECTION("Not equal Mults") {
00079 REQUIRE_FALSE(mult1.equals(&differentMult));
00080 }
00081 SECTION("Comparison with null") {
00082 REQUIRE_FALSE(mult1.equals(nullptr));
```

```
00083 }
00084 }
00085
00086 TEST_CASE("Var equals tests", "[Var]") {
00087     Var varExpr1("x");
00088     Var varExpr2("x");
00089     Var varExpr3("y");
00090     Num numExpr(5);
00091     SECTION("Equal VarExprs with same name") {
00092         REQUIRE(varExpr1.equals(&varExpr2));
00093     }
00094     SECTION("Not Equal VarExprs with different names") {
00095         REQUIRE_FALSE(varExpr1.equals(&varExpr3));
00096     }
00097     SECTION("Not Equal when compared with different type (Num)") {
00098         REQUIRE_FALSE(varExpr1.equals(&numExpr));
00099     }
00100     SECTION("Not Equal when compared with nullptr") {
00101         REQUIRE_FALSE(varExpr1.equals(nullptr));
00102     }
00103 }
00104
00105 TEST_CASE("interp tests", "All Expressions") {
00106     SECTION("Num interp") {
00107         Num num1(5);
00108         REQUIRE(num1.interp() == 5);
00109         Num num2(-3);
00110         REQUIRE(num2.interp() == -3);
00111         Num num3(0);
00112         REQUIRE(num3.interp() == 0);
00113         Num num4(100);
00114         REQUIRE(num4.interp() == 100);
00115         Num num5(-50);
00116         REQUIRE(num5.interp() == -50);
00117
00118     }
00119
00120     SECTION("Add interp") {
00121         Num num1(5);
00122         Num num2(10);
00123         Add add(&num1, &num2);
00124         REQUIRE(add.interp() == 15);
00125         Num num3(-5);
00126         Add addNegative(&num1, &num3);  // 5 + (-5)
00127         REQUIRE(addNegative.interp() == 0);
00128         Num num4(0);
00129         Add add3(&num2, &num4);  // 10 + 0
00130         REQUIRE(add3.interp() == 10);
00131         Num num5(-20);
00132         Add add4(&num5, &num5);  // -20 + (-20)
00133         REQUIRE(add4.interp() == -40);
00134         Num num6(100);
00135         Add add5(&num6, &num3);  // 100 + (-5)
00136         REQUIRE(add5.interp() == 95);
00137     }
00138
00139     SECTION("Mult interp") {
00140         Num num1(5);
00141         Num num2(3);
00142         Mult mult(&num1, &num2);
00143         REQUIRE(mult.interp() == 15);
00144         Num num3(-2);
00145         Mult multNegative(&num1, &num3);  // 5 * (-2)
00146         REQUIRE(multNegative.interp() == -10);
00147         Num num4(0);
00148         Mult mult3(&num2, &num4);  // 3 * 0
00149         REQUIRE(mult3.interp() == 0);
00150         Num num5(1);
00151         Mult mult4(&num5, &num2);  // 1 * 3
00152         REQUIRE(mult4.interp() == 3);
00153         Num num6(-1);
00154         Mult mult5(&num6, &num3);  // -1 * (-2)
00155         REQUIRE(mult5.interp() == 2);
00156     }
00157
00158     SECTION("Var interp throws exception") {
00159         Var varExpr("x");
00160         REQUIRE_THROWS_AS(varExpr.interp(), std::runtime_error);
00161         Var varExpr2("y");
00162         REQUIRE_THROWS_AS(varExpr2.interp(), std::runtime_error);
00163         Var varExpr3("var");
00164         REQUIRE_THROWS_AS(varExpr3.interp(), std::runtime_error);
00165         Var varExpr4("123");
00166         REQUIRE_THROWS_AS(varExpr4.interp(), std::runtime_error);
00167         Var varExpr5("testVar");
00168         REQUIRE_THROWS_AS(varExpr5.interp(), std::runtime_error);
00169     }
```

```
00170 }
00171
00172
00173 TEST_CASE("hasVariable tests", "All Expressions"){
00174     SECTION("Num hasVariable") {
00175         Num num1(5);
00176         REQUIRE_FALSE(num1.hasVariable());
00177         Num num2(-3);
00178         REQUIRE_FALSE(num2.hasVariable());
00179         Num num3(0);
00180         REQUIRE_FALSE(num3.hasVariable());
00181         Num num4(100);
00182         REQUIRE_FALSE(num4.hasVariable());
00183         Num num5(-50);
00184         REQUIRE_FALSE(num5.hasVariable());
00185     }
00186
00187     SECTION("Add hasVariable") {
00188         Num num1(5);
00189         Num num2(10);
00190         Var var1("x");
00191         Add add1(&num1, &num2);
00192         REQUIRE_FALSE(add1.hasVariable());
00193         Add add2(&num1, &var1);
00194         REQUIRE(add2.hasVariable());
00195         Add add3(&var1, &var1);
00196         REQUIRE(add3.hasVariable());
00197         Num num3(0);
00198         Add add4(&num2, &num3);
00199         REQUIRE_FALSE(add4.hasVariable());
00200         Var var2("y");
00201         Add add5(&var1, &var2);
00202         REQUIRE(add5.hasVariable());
00203     }
00204
00205     SECTION("Mult hasVariable") {
00206         Num num1(5);
00207         Num num2(3);
00208         Var var1("x");
00209         Mult mult1(&num1, &num2);
00210         REQUIRE_FALSE(mult1.hasVariable());
00211         Mult mult2(&num1, &var1);
00212         REQUIRE(mult2.hasVariable());
00213         Mult mult3(&var1, &var1);
00214         REQUIRE(mult3.hasVariable());
00215         Num num3(0);
00216         Mult mult4(&num2, &num3);
00217         REQUIRE_FALSE(mult4.hasVariable());
00218         Var var2("y");
00219         Mult mult5(&var1, &var2);
00220         REQUIRE(mult5.hasVariable());
00221     }
00222
00223     SECTION("Var hasVariable") {
00224         Var varExpr1("x");
00225         REQUIRE(varExpr1.hasVariable());
00226         Var varExpr2("y");
00227         REQUIRE(varExpr2.hasVariable());
00228         Var varExpr3("var");
00229         REQUIRE(varExpr3.hasVariable());
00230         Var varExpr4("123");
00231         REQUIRE(varExpr4.hasVariable());
00232         Var varExpr5("testVar");
00233         REQUIRE(varExpr5.hasVariable());
00234     }
00235
00236 }
00237
00238
00239
00240 TEST_CASE("subst tests", "All Expressions") {
00241     Num num5(5);
00242     Num num10(10);
00243     Var varX("x");
00244     Var varY("y");
00245
00246     SECTION("Num subst") {
00247         Expr* result1 = num5.subst("x", &num10);
00248         REQUIRE(result1->equals(&num5));
00249         delete result1;
00250         Expr* result2 = num10.subst("y", &num5);
00251         REQUIRE(result2->equals(&num10));
00252         delete result2;
00253     }
00254
00255     SECTION("Add subst") {
00256         Add add1(&num5, &varX);
```

```
00257         Expr* result1 = add1.subst("x", &num10);
00258         Add expected1(&num5, &num10);
00259         REQUIRE(result1->equals(&expected1));
00260         delete result1;
00261         Add add2(&varX, &varY);
00262         Expr* result2 = add2.subst("x", &num5);
00263         Add expected2(&num5, &varY);
00264         REQUIRE(result2->equals(&expected2));
00265         delete result2;
00266     }
00267 
00268     SECTION("Mult subst") {
00269         Mult mult1(&num5, &varX);
00270         Expr* result1 = mult1.subst("x", &num10);
00271         Mult expected1(&num5, &num10);
00272         REQUIRE(result1->equals(&expected1));
00273         delete result1;
00274         Mult mult2(&varX, &varY);
00275         Expr* result2 = mult2.subst("x", &num5);
00276         Mult expected2(&num5, &varY);
00277         REQUIRE(result2->equals(&expected2));
00278         delete result2;
00279     }
00280 
00281     SECTION("Var subst") {
00282         Expr* result1 = varX.subst("x", &num5);
00283         REQUIRE(result1 == &num5); // Check for same pointer, not just equality
00284         Var varAnotherX("x");
00285         Expr* result2 = varAnotherX.subst("x", &varY);
00286         REQUIRE(result2 == &varY); // Again, checking pointers
00287         Expr* result11 = varX.subst("y", &num5);
00288         REQUIRE(result11->equals(&varX));
00289         delete result11;
00290         Expr* result22 = varY.subst("x", &num5);
00291         REQUIRE(result22->equals(&varY));
00292         delete result22;
00293 
00294     }
00295 }
00296 
00297 
00298 TEST_CASE("to_string tests", "all expressions"){
00299     CHECK( (new Var("x"))->to_string() == "x" );
00300     CHECK( (new Add(new Num(1), new Num(2)))->to_string() == "(1+2)" );
00301     CHECK( (new Mult(new Num(3), new Num(4)))->to_string() == "(3*4)" );
00302     CHECK( (new Num(-5))->to_string() == "-5" );
00303     CHECK( (new Num(0))->to_string() == "0" );
00304     CHECK( (new Add(new Num(1), new Num(-2)))->to_string() == "(1+-2)" );
00305     CHECK( (new Mult(new Num(0), new Num(4)))->to_string() == "(0*4)" );
00306     CHECK( (new Mult(new Num(3), new Num(-4)))->to_string() == "(3*-4)" );
00307     CHECK( (new Add(new Num(-1), new Mult(new Num(2), new Num(-3))))->to_string() == "(-1+(2*-3))" );
00308     CHECK( (new Add(new Var("x"), new Mult(new Add(new Num(0), new Num(-5)), new
    Var("y"))))->to_string() == "(x+((0+-5)*y))" );
00309     CHECK( (new Mult(new Add(new Num(0), new Num(-2)), new Add(new Num(-3), new Num(4))))->to_string()
    == "((0+-2)*(-3+4))" );
00310     CHECK( (new Add(new Var("z"), new Num(-10)))->to_string() == "(z+-10)" );
00311     CHECK( (new Mult(new Add(new Var("a"), new Mult(new Num(-1), new Var("b"))), new Add(new Num(0),
    new Var("c"))))->to_string() == "((a+(-1*b))*(0+c))" );
00312 }
00313 
00314 
00315 TEST_CASE("pretty_print_at Tests", "All expression classes"){
00316 // Test for simple addition
00317     std::stringstream ss3;
00318     (new Add(new Num(4), new Num(5)))->pretty_print_at(ss3);
00319     CHECK(ss3.str() == "4 + 5");
00320 
00321 // Test for more complex expression with addition and multiplication
00322     std::stringstream ss4;
00323     (new Add(new Num(4), new Mult(new Num(5), new Num(6))))->pretty_print_at(ss4);
00324     CHECK(ss4.str() == "4 + 5 * 6");
00325 
00326 // Test for nested expressions with multiple parentheses
00327     std::stringstream ss5;
00328     (new Add(new Mult(new Num(1), new Num(2)), new Add(new Num(3), new Mult(new Num(4), new
    Num(5)))))->pretty_print_at(ss5);
00329     CHECK(ss5.str() == "1 * 2 + 3 + 4 * 5");
00330 
00331 // Test to_pp_string method for complex nested expression
00332     CHECK((new Add(new Mult(new Num(1), new Add(new Num(2), new Num(3))), new Num(4)))->to_pp_string()
    == "1 * (2 + 3) + 4");
00333 
00334 // Test for multiplication precedence over addition
00335     CHECK((new Mult(new Add(new Num(2), new Num(3)), new Num(4)))->to_pp_string() == "(2 + 3) * 4");
00336 
00337 // Test for deep nesting with multiple operations
00338     CHECK((new Add(new Num(2), new Mult(new Add(new Num(3), new Num(4)), new Num(5))))->to_pp_string()
```

```
    == "2 + (3 + 4) * 5");
00339
00340 // Test involving variables and operations
00341     CHECK((new Add(new Var("x"), new Mult(new Var("y"), new Num(2))))->to_pp_string() == "x + y * 2");
00342
00343 // Test for expression with multiple variables and numbers
00344     CHECK((new Mult(new Add(new Var("a"), new Var("b")), new Add(new Num(5), new
    Var("c"))))->to_pp_string() == "(a + b) * (5 + c)");
00345
00346 // Test for nested multiplications with a variable
00347     CHECK((new Mult(new Mult(new Var("z"), new Num(3)), new Add(new Num(4), new
    Num(5))))->to_pp_string() == "(z * 3) * (4 + 5)");
00348
00349 }
00350
00351
00352 TEST_CASE("Nabil's given tests") {
00353     SECTION("Given Tests Assignment 2") {
00354         CHECK((new Var("x"))->equals(new Var("x")) == true);
00355         CHECK((new Var("x"))->equals(new Var("y")) == false);
00356         CHECK((new Num(1))->equals(new Var("x")) == false);
00357         CHECK((new Add(new Num(2), new Num(3)))->equals(new Add(new Num(2), new Num(3))) == true);
00358         CHECK((new Add(new Num(2), new Num(3)))->equals(new Add(new Num(3), new Num(2))) == true);
00359     }
00360
00361     SECTION("Given Tests Assignment 3") {
00362         CHECK((new Mult(new Num(3), new Num(2)))
00363                     ->interp() == 6);
00364         CHECK((new Add(new Add(new Num(10), new Num(15)), new Add(new Num(20), new Num(20))))
00365                     ->interp() == 65);
00366         CHECK_THROWS_WITH((new Var("x"))->interp(), "no value for variable");
00367         CHECK((new Add(new Var("x"), new Num(1)))->hasVariable() == true);
00368         CHECK((new Mult(new Num(2), new Num(1)))->hasVariable() == false);
00369         CHECK((new Add(new Var("x"), new Num(7)))
00370                     ->subst("x", new Var("y"))
00371                     ->equals(new Add(new Var("y"), new Num(7))));
00372         CHECK((new Var("x"))
00373                     ->subst("x", new Add(new Var("y"), new Num(7)))
00374                     ->equals(new Add(new Var("y"), new Num(7))));
00375     }
00376
00377     SECTION("Given Tests for Assignment 4") {
00378         CHECK((new Num(10))->to_string() == "10");
00379
00380         // Create a stringstream to capture the output of pretty_print
00381         std::stringstream ss1;
00382         (new Add(new Num(1), new Mult(new Num(2), new Num(3))))->pretty_print_at(ss1);
00383         CHECK(ss1.str() == "1 + 2 * 3");
00384
00385         std::stringstream ss2;
00386         (new Mult(new Num(1), new Add(new Num(2), new Num(3))))->pretty_print_at(ss2);
00387         CHECK(ss2.str() == "1 * (2 + 3)");
00388
00389         CHECK ((new Mult(new Num(1), new Add(new Num(2), new Num(3))))->to_pp_string() == "1 * (2 +
    3)");
00390         CHECK ((new Mult(new Mult(new Num(8), new Num(1)), new Var("y")))->to_pp_string() == "(8 * 1)
    * y");
00391         CHECK ((new Mult(new Add(new Num(3), new Num(5)), new Mult(new Num(6), new
    Num(1))))->to_pp_string() ==
00392                 "(3 + 5) * 6 * 1");
00393         CHECK ((new Mult(new Mult(new Num(7), new Num(7)), new Add(new Num(9), new
    Num(2))))->to_pp_string() ==
00394                 "(7 * 7) * (9 + 2)");
00395
00396     }
00397 }
00398
00399
00400
```

7.17 /Users/samanthapope/msdscriptRepo/msdScript/main.cpp File Reference

```
#include <iostream>
#include "cmdline.h"
#include "Expr.h"
```

Functions

- int main (int argc, const char ∗argv[ ])

7.17.1 Function Documentation

7.17.1.1 main()

```
int main (
            int argc,
            const char * argv[] )
```

Definition at line 5 of file main.cpp.

7.18 main.cpp

Go to the documentation of this file.

```
00001 #include <iostream>
00002 #include "cmdline.h"
00003 #include "Expr.h"
00004
00005 int main(int argc, const char * argv[]) {
00006     useArgs(argc, argv);
00007     return 0;
00008 }
00009
00010
```