MSD Script

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Chapter 1

MSDScript

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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

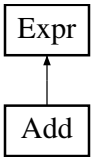
Here is a list of all documented files with brief descriptions:

Chapter 5

Class Documentation

5.1 Add Class Reference

Inheritance diagram for Add:



Public Member Functions

- Add (Expr *lhs, Expr *rhs)

  Constuctor of Add object.
- bool equals (Expr *e) override

  Compare whether two expression are equal.
- int interp () override

  Interpret the value.
- bool has_variable () override

  To check whether there are any variables in expressions.
- Expr * subst (std::string s, Expr *e) override

  If the first argument exists, it will be substitued with the second argument.
- void print (std::ostream &ot) override

  To print out the expression.
- void pretty_print_at (std::ostream &ot, precedence_t prec) override

  Helper funtion for pretty_print to decide where to add parentheses.

Public Member Functions inherited from Expr

- std::string to_string ()

  Print out the result of print() function.
- void **pretty_print** (std::ostream &ot)

  Make the format better.
- std::string to_pretty_string ()

  Print out the result of pretty_print() function.

Public Attributes

- Expr * **lhs**

  an Expr object on the left hand side
- Expr * **rhs**

  an Expr object on the right hand side

5.1.1 Constructor & Destructor Documentation

5.1.1.1 Add()

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

Constuctor of Add object.

Parameters

lhs	an Expr object on the right hand side
rhs	an Expr object on the left hand side

5.1.2 Member Function Documentation

5.1.2.1 equals()

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

Compare whether two expression are equal.

Parameters

e	an expressionto be compared

Returns

boolean

Implements Expr.

5.1.2.2 has_variable()

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

To check whether there are any variables in expressions.

Returns

boolean

Implements Expr.

5.1.2.3 interp()

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

Interpret the value.

Returns

int

Implements Expr.

5.1.2.4 pretty_print_at()

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

Helper funtion for pretty_print to decide where to add parentheses.

Parameters

ot	the outputstream to be written
prec	the order of importance

Implements Expr.

5.1.2.5 print()

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

To print out the expression.

Parameters

ot	the outputstream to be written

Implements Expr.

5.1.2.6 subst()

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

If the first argument exists, it will be substitued with the second argument.

Parameters

s	the value to be substitued
e	the replacement

Returns

Expression itself

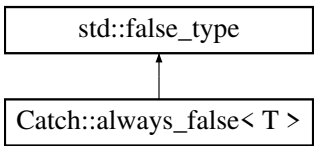
Implements Expr.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/expr.hpp
- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/expr.cpp

5.2 Catch::always_false< T > Struct Template Reference

Inheritance diagram for Catch::always_false< T >:



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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.3 Catch::Detail::Approx Class Reference

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

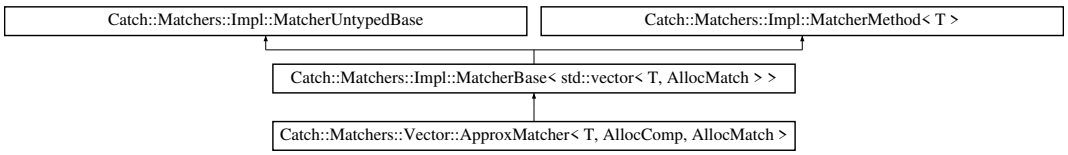
- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> bool **operator==** (const T &lhs, Approx const &rhs)
- template<typename T , typename = typename std::enable_if<std::is_constructible<double, T>::value>::type> bool **operator==** (Approx const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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

5.4.1 Member Function Documentation

5.4.1.1 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.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.6 Catch::AssertionHandler Class Reference

Public Member Functions

- **AssertionHandler** (StringRef const &macroName, SourceLineInfo const &lineInfo, StringRef capturedExpression, ResultDisposition::Flags resultDisposition)
- 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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.7 Catch::AssertionInfo Struct Reference

Public Attributes

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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.8 Catch::AssertionReaction Struct Reference

Public Attributes

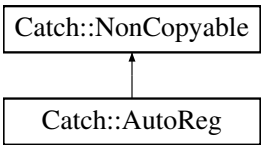
- bool **shouldDebugBreak** = false
- bool **shouldThrow** = false

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.9 Catch::AutoReg Struct Reference

Inheritance diagram for Catch::AutoReg:



Public Member Functions

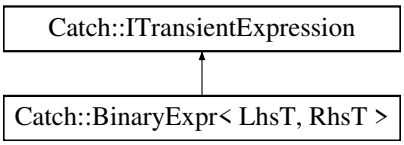
- **AutoReg** (ITestInvoker *invoker, SourceLineInfo const &lineInfo, StringRef const &classOrMethod, NameAndTags const &nameAndTags) noexcept

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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)

Additional Inherited Members

Public Attributes inherited from Catch::ITransientExpression

- bool **m_isBinaryExpression**
- bool **m_result**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.11 Catch::Capturer Class Reference

Public Member Functions

- **Capturer** (StringRef macroName, SourceLineInfo const &lineInfo, ResultWas::OfType resultType, StringRef names)
- 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)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.12 Catch::Matchers::StdString::CasedString Struct Reference

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**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.13 Catch::CaseSensitive Struct Reference

Public Types

- enum **Choice** { **Yes** , **No** }

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

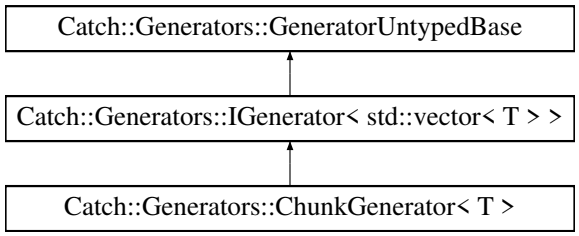
5.14 Catch_global_namespace_dummy Struct Reference

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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

Additional Inherited Members

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

- using **type**

5.15.1 Member Function Documentation

5.15.1.1 get()

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

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

5.15.1.2 next()

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

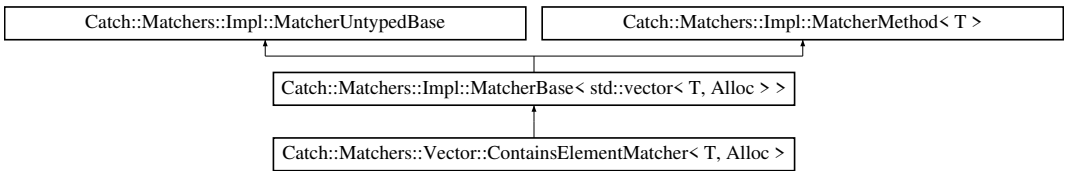
Implements Catch::Generators::GeneratorUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

5.16.1 Member Function Documentation

5.16.1.1 describe()

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

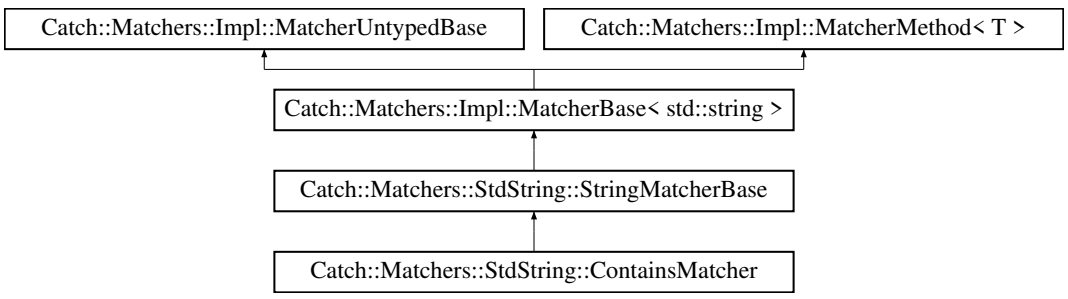
Implements Catch::Matchers::Impl::MatcherUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.17 Catch::Matchers::StdString::ContainsMatcher Struct Reference

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

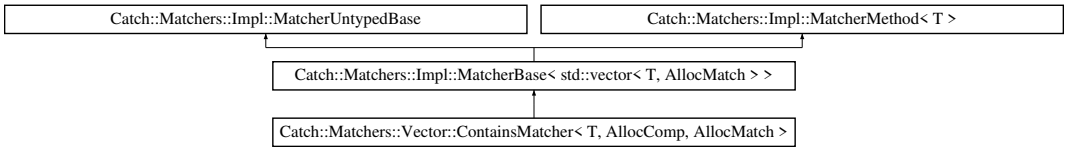
- std::string **m_cachedToString**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

5.18.1 Member Function Documentation

5.18.1.1 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.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.19 Catch::Counts Struct Reference

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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.20 Catch::Decomposer Struct Reference

Public Member Functions

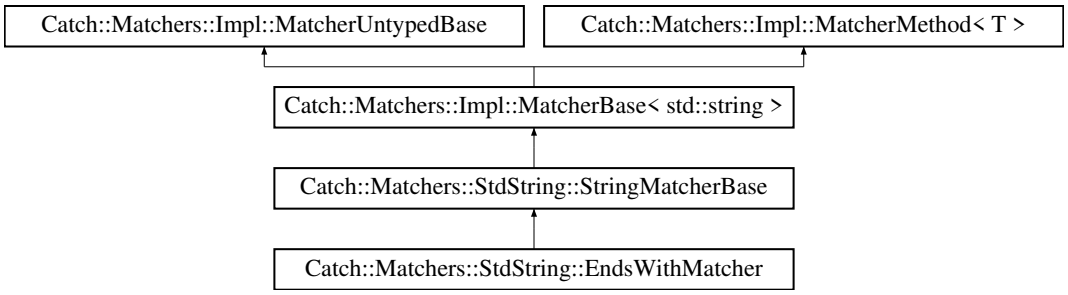
- template<typename T >
  auto **operator<=** (T const &lhs) -> ExprLhs< T const & >
- auto **operator<=** (bool value) -> ExprLhs< bool >

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.21 Catch::Matchers::StdString::EndsWithMatcher Struct Reference

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.22 Catch::Detail::EnumInfo Struct Reference

Public Member Functions

- StringRef **lookup** (int value) const

Public Attributes

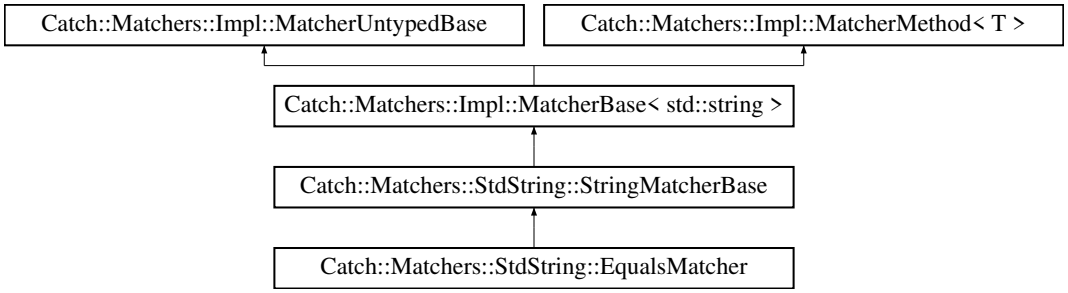
- StringRef **m_name**
- std::vector< std::pair< int, StringRef > > **m_values**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.23 Catch::Matchers::StdString::EqualsMatcher Struct Reference

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

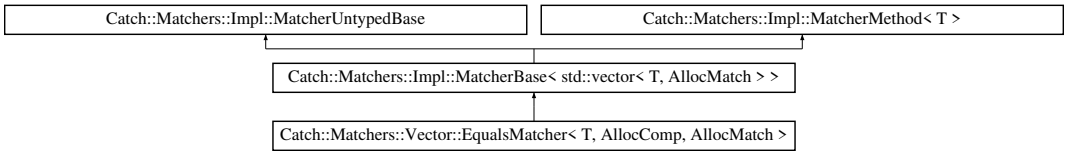
- std::string **m_cachedToString**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

5.24.1 Member Function Documentation

5.24.1.1 describe()

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

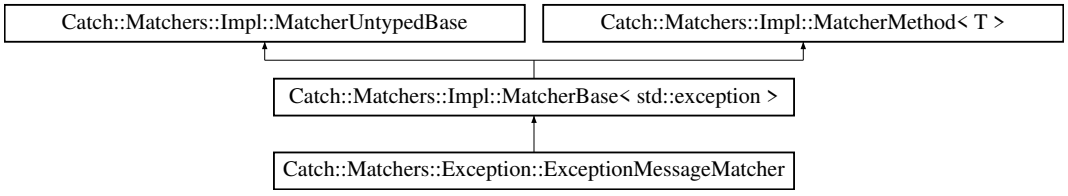
Implements Catch::Matchers::Impl::MatcherUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.25 Catch::Matchers::Exception::ExceptionMessageMatcher Class Reference

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

5.25.1 Member Function Documentation

5.25.1.1 describe()

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

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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.26 Catch::ExceptionTranslatorRegistrar Class Reference

Public Member Functions

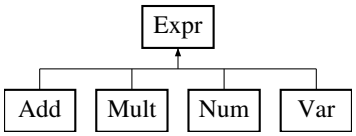
- template<typename T >
  ExceptionTranslatorRegistrar (std::string(*translateFunction)(T &))

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.27 Expr Class Reference

Inheritance diagram for Expr:



Public Member Functions

- virtual bool equals (Expr *e)=0
- virtual int interp ()=0
- virtual bool has_variable ()=0
- virtual Expr * subst (std::string s, Expr *e)=0
- virtual void print (std::ostream &ot)=0
- std::string to_string ()

  Print out the result of print() function.
- void **pretty_print** (std::ostream &ot)

  Make the format better.
- std::string to_pretty_string ()

  Print out the result of pretty_print() function.
- virtual void pretty_print_at (std::ostream &ot, precedence_t prec)=0

5.27.1 Member Function Documentation

5.27.1.1 equals()

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

Implemented in Num, Add, Mult, and Var.

5.27.1.2 has_variable()

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

Implemented in Num, Add, Mult, and Var.

5.27.1.3 interp()

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

Implemented in Num, Add, Mult, and Var.

5.27.1.4 pretty_print_at()

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

Implemented in Num, Add, Mult, and Var.

5.27.1.5 print()

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

Implemented in Num, Add, Mult, and Var.

5.27.1.6 subst()

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

Implemented in Num, Add, Mult, and Var.

5.27.1.7 to_pretty_string()

```
std::string Expr::to_pretty_string ( )
```

Print out the result of pretty_print() function.

Returns

string

5.27.1.8 to_string()

```
std::string Expr::to_string ( )
```

Print out the result of print() function.

Returns

string

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/expr.hpp
- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/expr.cpp

5.28 Catch::ExprLhs< LhsT > Class Template Reference

Public Member Functions

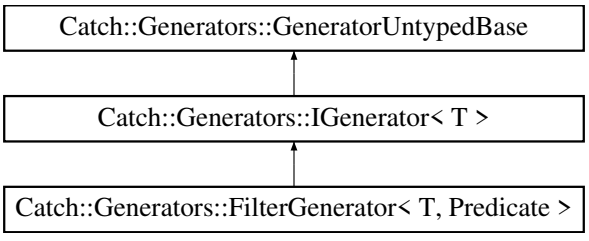
- **ExprLhs** (LhsT lhs)
- template<typename RhsT >
  auto **operator==** (RhsT const &rhs) -> BinaryExpr< LhsT, RhsT const & > const
- auto **operator==** (bool rhs) -> BinaryExpr< LhsT, bool > const
- template<typename RhsT >
  auto **operator!=** (RhsT const &rhs) -> BinaryExpr< LhsT, RhsT const &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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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

Additional Inherited Members

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

- using **type** = T

5.29.1 Member Function Documentation

5.29.1.1 get()

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

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

5.29.1.2 next()

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

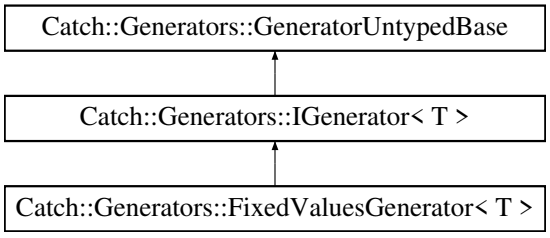
Implements Catch::Generators::GeneratorUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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



Public Member Functions

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

Additional Inherited Members

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

- using **type** = T

5.30.1 Member Function Documentation

5.30.1.1 get()

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

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

5.30.1.2 next()

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

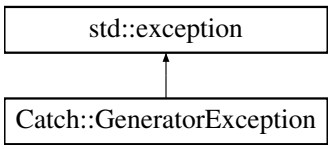
Implements Catch::Generators::GeneratorUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.31 Catch::GeneratorException Class Reference

Inheritance diagram for Catch::GeneratorException:



Public Member Functions

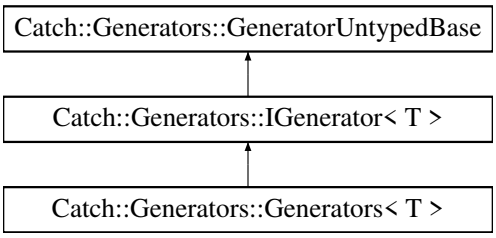
- **GeneratorException** (const char *msg)
- const char * **what** () const noexcept override final

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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



Public Member Functions

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

Additional Inherited Members

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

- using **type** = T

5.32.1 Member Function Documentation

5.32.1.1 get()

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

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

5.32.1.2 next()

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

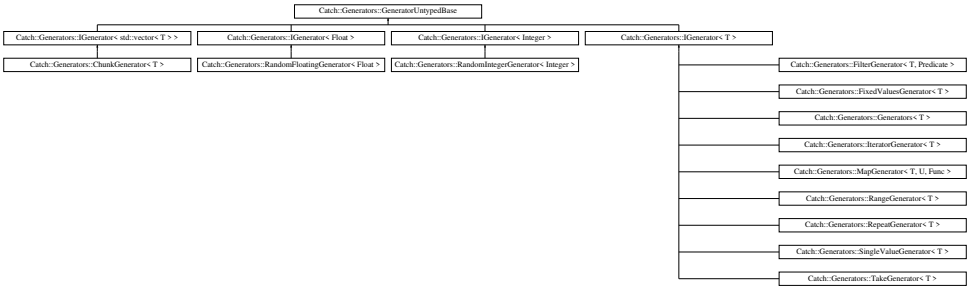
Implements Catch::Generators::GeneratorUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.33 Catch::Generators::GeneratorUntypedBase Class Reference

Inheritance diagram for Catch::Generators::GeneratorUntypedBase:



Public Member Functions

- virtual bool **next** ()=0

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

Public Member Functions

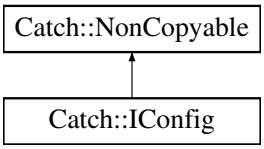
- **GeneratorWrapper** (std::unique_ptr< IGenerator< T > > generator)
- T const & **get** () const
- bool **next** ()

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.35 Catch::IConfig Struct Reference

Inheritance diagram for Catch::IConfig:



Public Member Functions

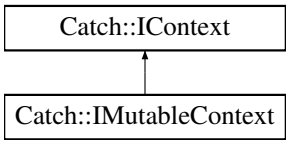
- virtual bool **allowThrows** () const =0
- virtual std::ostream & **stream** () const =0
- virtual std::string **name** () const =0
- virtual bool **includeSuccessfulResults** () const =0
- virtual bool **shouldDebugBreak** () const =0
- virtual bool **warnAboutMissingAssertions** () const =0
- virtual 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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.36 Catch::IContext Struct Reference

Inheritance diagram for Catch::IContext:



Public Member Functions

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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.37 Catch::IExceptionTranslator Struct Reference

Public Member Functions

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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.38 Catch::IExceptionTranslatorRegistry Struct Reference

Public Member Functions

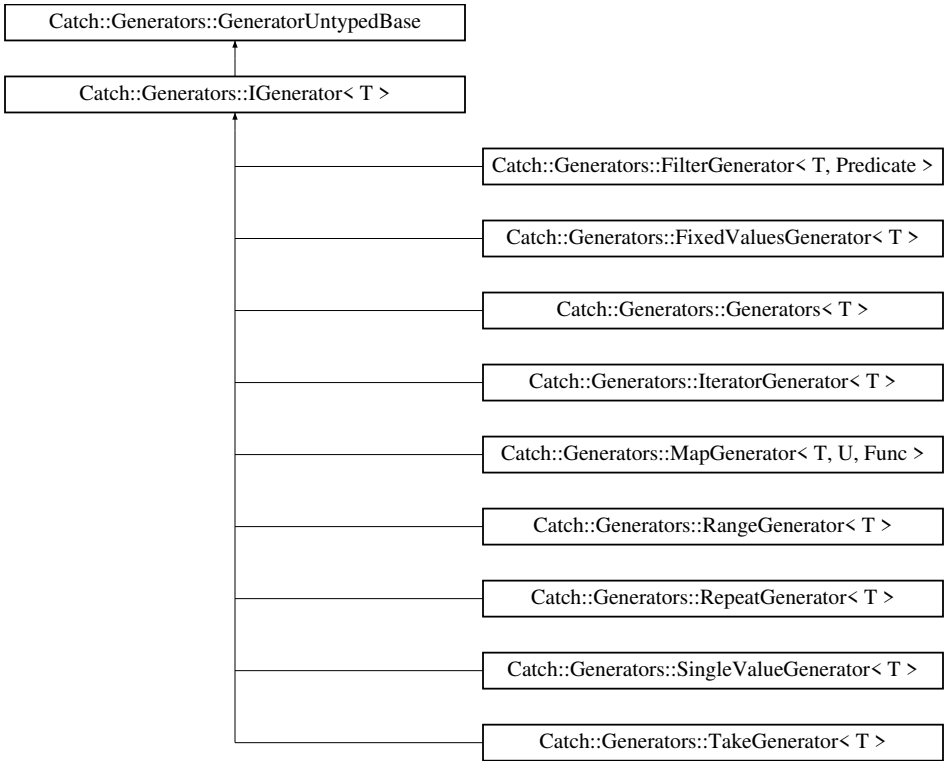
- virtual std::string **translateActiveException** () const =0

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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



Public Types

- using **type** = T

Public Member Functions

- virtual T const & **get** () const =0

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

- virtual bool **next** ()=0

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.40 Catch::IGeneratorTracker Struct Reference

Public Member Functions

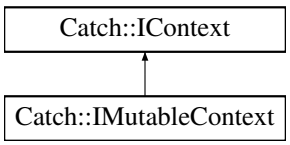
- virtual auto **hasGenerator** () const -> bool=0
- virtual auto **getGenerator** () const -> Generators::GeneratorBasePtr const &=0
- virtual void **setGenerator** (Generators::GeneratorBasePtr &&generator)=0

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.41 Catch::IMutableContext Struct Reference

Inheritance diagram for Catch::IMutableContext:



Public Member Functions

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

Friends

- IMutableContext & **getCurrentMutableContext** ()
- void **cleanUpContext** ()

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.42 Catch::IMutableEnumValuesRegistry Struct Reference

Public Member Functions

- 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)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.43 Catch::IMutableRegistryHub Struct Reference

Public Member Functions

- 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 &line↩ Info)=0
- virtual void **registerStartupException** () noexcept=0
- virtual IMutableEnumValuesRegistry & **getMutableEnumValuesRegistry** ()=0

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.44 Catch::IRegistryHub Struct Reference

Public Member Functions

- 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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.45 Catch::IResultCapture Struct Reference

Public Member Functions

- 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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.46 Catch::IRunner Struct Reference

Public Member Functions

- virtual bool **aborting** () const =0

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.47 Catch::is_callable< T > Struct Template Reference

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.49 Catch::is_callable_tester Struct Reference

Static Public Member Functions

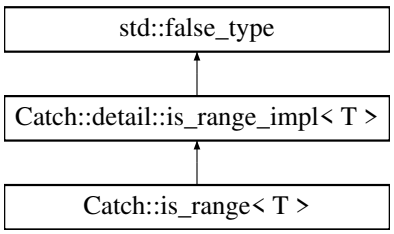
- template<typename Fun , typename... Args>
  static true_given< decltype(std::declval< Fun >()(std::declval< Args >()...))> **test** (int)
- template<typename... >
  static std::false_type **test** (...)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.50 Catch::is_range< T > Struct Template Reference

Inheritance diagram for Catch::is_range< T >:

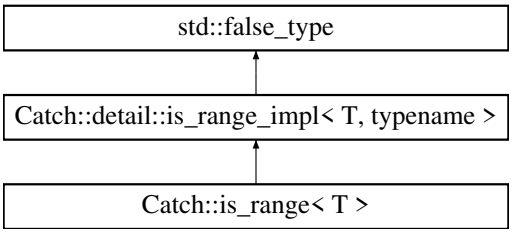


The documentation for this struct was generated from the following file:

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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

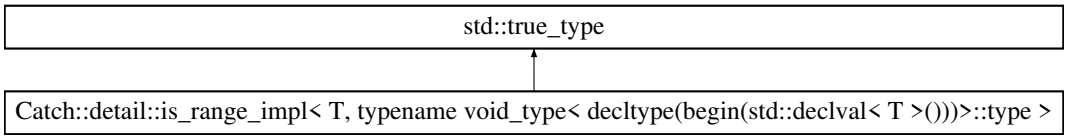


The documentation for this struct was generated from the following file:

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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



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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

Static Public Attributes

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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.54 Catch::IStream Struct Reference

Public Member Functions

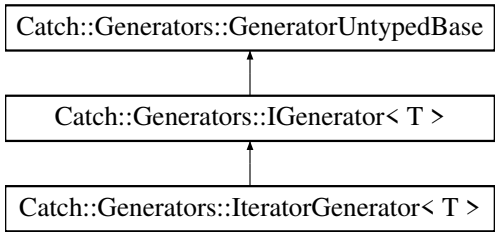
- virtual std::ostream & **stream** () const =0

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

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

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

Additional Inherited Members

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

- using **type** = T

5.55.1 Member Function Documentation

5.55.1.1 get()

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

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

5.55.1.2 next()

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

Implements Catch::Generators::GeneratorUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.56 Catch::ITestCaseRegistry Struct Reference

Public Member Functions

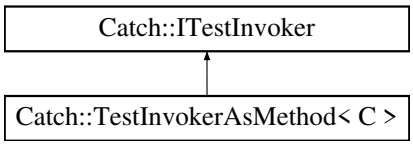
- virtual std::vector< TestCase > const & **getAllTests** () const =0
- virtual std::vector< TestCase > const & **getAllTestsSorted** (IConfig const &config) const =0

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.57 Catch::ITestInvoker Struct Reference

Inheritance diagram for Catch::ITestInvoker:



Public Member Functions

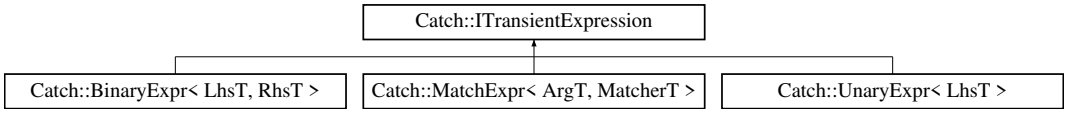
- virtual void **invoke** () const =0

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.58 Catch::ITransientExpression Struct Reference

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)

Public Attributes

- bool **m_isBinaryExpression**
- bool **m_result**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.59 Catch::LazyExpression Class Reference

Public Member Functions

- **LazyExpression** (bool isNegated)
- **LazyExpression** (LazyExpression const &other)
- LazyExpression & **operator=** (LazyExpression const &)=delete
- **operator bool** () const

Friends

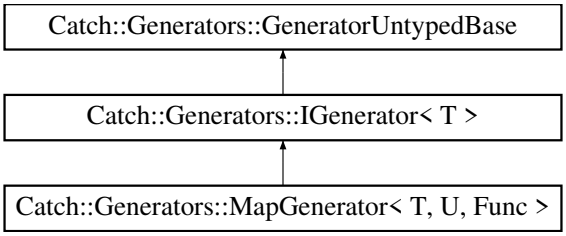
- class **AssertionHandler**
- struct **AssertionStats**
- class **RunContext**
- auto **operator**<< (std::ostream &os, LazyExpression const &lazyExpr) -> std::ostream &

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.60 Catch::Generators::MapGenerator< T, U, Func > Class Template Reference

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

Additional Inherited Members

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

- using **type** = T

5.60.1 Member Function Documentation

5.60.1.1 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 >.

5.60.1.2 next()

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

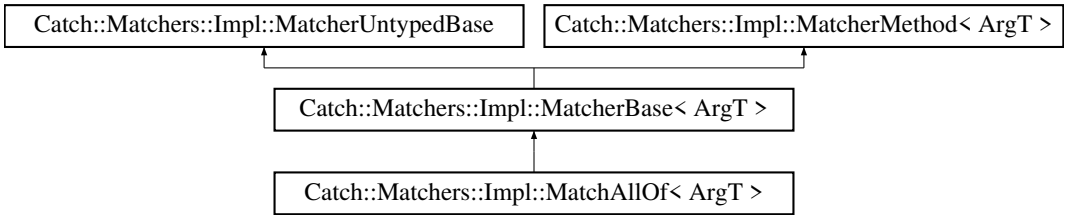
Implements Catch::Generators::GeneratorUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.61 Catch::Matchers::Impl::MatchAllOf< ArgT > Struct Template Reference

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

5.61.1 Member Function Documentation

5.61.1.1 describe()

```
template<typename ArgT >
std::string Catch::Matchers::Impl::MatchAllOf< ArgT >::describe ( ) const  [inline], [override],
[virtual]
```

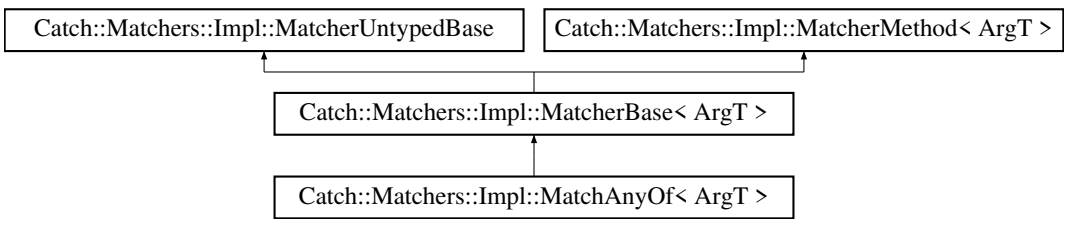
Implements Catch::Matchers::Impl::MatcherUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.62 Catch::Matchers::Impl::MatchAnyOf< ArgT > Struct Template Reference

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

5.62.1 Member Function Documentation

5.62.1.1 describe()

```
template<typename ArgT >
std::string Catch::Matchers::Impl::MatchAnyOf< ArgT >::describe ( ) const  [inline], [override],
[virtual]
```

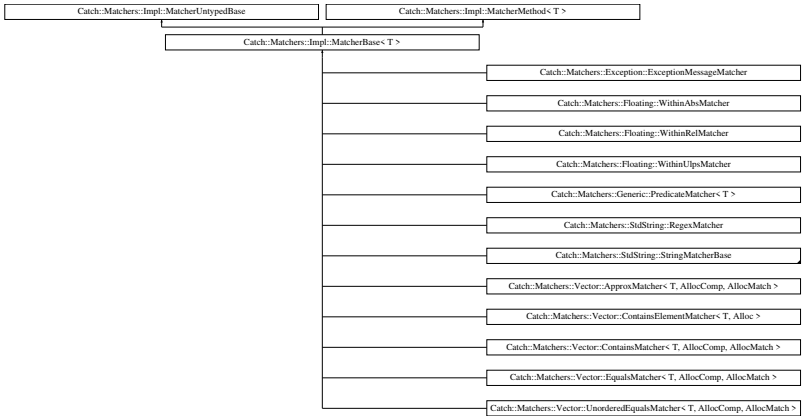
Implements Catch::Matchers::Impl::MatcherUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.63 Catch::Matchers::Impl::MatcherBase< T > Struct Template Reference

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** (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 std::string **describe** () const =0

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

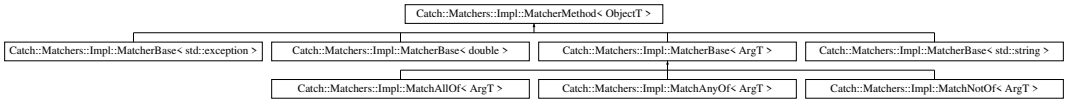
- std::string **m_cachedToString**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.64 Catch::Matchers::Impl::MatcherMethod< ObjectT > Struct Template Reference

Inheritance diagram for Catch::Matchers::Impl::MatcherMethod< ObjectT >:



Public Member Functions

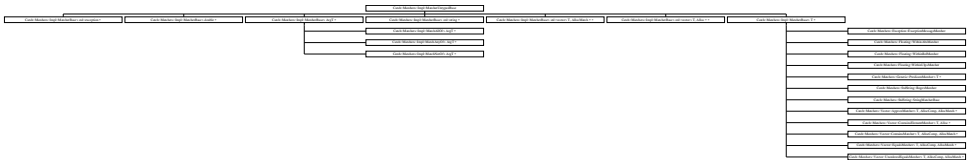
- virtual bool **match** (ObjectT const &arg) const =0

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.65 Catch::Matchers::Impl::MatcherUntypedBase Class Reference

Inheritance diagram for Catch::Matchers::Impl::MatcherUntypedBase:



Public Member Functions

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

Protected Member Functions

- virtual std::string **describe** () const =0

Protected Attributes

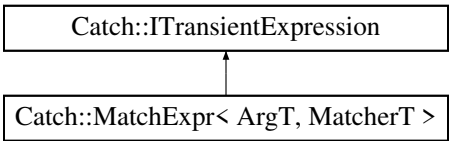
- std::string **m_cachedToString**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.66 Catch::MatchExpr< ArgT, MatcherT > Class Template Reference

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)

Additional Inherited Members

Public Attributes inherited from Catch::ITransientExpression

- bool **m_isBinaryExpression**
- bool **m_result**

5.66.1 Member Function Documentation

5.66.1.1 streamReconstructedExpression()

```
template<typename ArgT , typename MatcherT >
void Catch::MatchExpr< ArgT, MatcherT >::streamReconstructedExpression (
            std::ostream & os ) const  [inline], [override], [virtual]
```

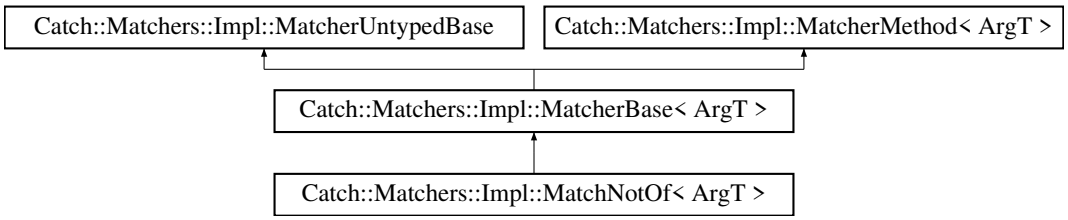
Implements Catch::ITransientExpression.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.67 Catch::Matchers::Impl::MatchNotOf< ArgT > Struct Template Reference

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

5.67.1 Member Function Documentation

5.67.1.1 describe()

```
template<typename ArgT >
std::string Catch::Matchers::Impl::MatchNotOf< ArgT >::describe ( ) const  [inline], [override],
[virtual]
```

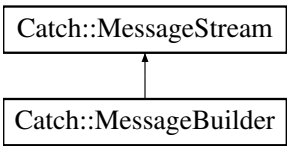
Implements Catch::Matchers::Impl::MatcherUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.68 Catch::MessageBuilder Struct Reference

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**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.69 Catch::MessageInfo Struct Reference

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

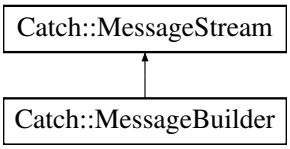
- StringRef **macroName**
- std::string **message**
- SourceLineInfo **lineInfo**
- ResultWas::OfType **type**
- unsigned int **sequence**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.70 Catch::MessageStream Struct Reference

Inheritance diagram for Catch::MessageStream:



Public Member Functions

- template<typename T >
  MessageStream & **operator<<** (T const &value)

Public Attributes

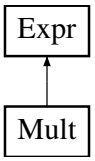
- ReusableStringStream **m_stream**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.71 Mult Class Reference

Inheritance diagram for Mult:



Public Member Functions

- Mult (Expr *lhs, Expr *rhs)
  Constuctor of Mult object.
- bool equals (Expr *e) override
  Compare whether two expression are equal.
- int interp () override
  Interpret the value.
- bool has_variable () override
  To check whether there are any variables in expressions.
- Expr * subst (std::string s, Expr *e) override
  If the first argument exists, it will be substitued with the second argument.
- void print (std::ostream &ot) override
  To print out the expression.
- void pretty_print_at (std::ostream &ot, precedence_t prec) override
  Helper funtion for pretty_print to decide where to add parentheses.

Public Member Functions inherited from Expr

- std::string to_string ()
  Print out the result of print() function.
- void **pretty_print** (std::ostream &ot)
  Make the format better.
- std::string to_pretty_string ()
  Print out the result of pretty_print() function.

Public Attributes

- Expr * **lhs**
  an Expr object on the left hand side
- Expr * **rhs**
  an Expr object on the right hand side

5.71.1 Constructor & Destructor Documentation

5.71.1.1 Mult()

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

Constuctor of Mult object.

Parameters

lhs	an Expr object on the right hand side
rhs	an Expr object on the left hand side

5.71.2 Member Function Documentation

5.71.2.1 equals()

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

Compare whether two expression are equal.

Parameters

e	an expressionto be compared

Returns

boolean

Implements Expr.

5.71.2.2 has_variable()

```
bool Mult::has_variable ( )  [override], [virtual]
```

To check whether there are any variables in expressions.

Returns

boolean

Implements Expr.

5.71.2.3 interp()

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

Interpret the value.

Returns

int

Implements Expr.

5.71.2.4 pretty_print_at()

```
void Mult::pretty_print_at (
            std::ostream & ot,
            precedence_t prec )  [override], [virtual]
```

Helper funtion for pretty_print to decide where to add parentheses.

Parameters

ot	the outputstream to be written
prec	the order of importance

Implements Expr.

5.71.2.5 print()

```
void Mult::print (
            std::ostream & ot )  [override], [virtual]
```

To print out the expression.

Parameters

ot	the outputstream to be written

Implements Expr.

5.71.2.6 subst()

```
Expr * Mult::subst (
            std::string s,
            Expr * e )  [override], [virtual]
```

If the first argument exists, it will be substitued with the second argument.

Parameters

s	the value to be substitued
e	the replacement

Returns

Expression itself

Implements Expr.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/expr.hpp
- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/expr.cpp

5.72 Catch::NameAndTags Struct Reference

Public Member Functions

- **NameAndTags** (StringRef const &name_=StringRef(), StringRef const &tags_=StringRef()) noexcept

Public Attributes

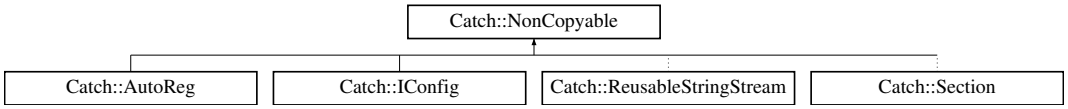
- StringRef **name**
- StringRef **tags**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.73 Catch::NonCopyable Class Reference

Inheritance diagram for Catch::NonCopyable:

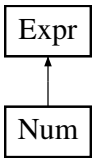


The documentation for this class was generated from the following file:

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.74 Num Class Reference

Inheritance diagram for Num:



Public Member Functions

- Num (int val)

  Constuctor of Num object.
- bool equals (Expr *e) override

  Compare whether two expression are equal.
- int interp () override

  Interpret the value.
- bool has_variable () override

  To check whether there are any variables in expressions.
- Expr * subst (std::string s, Expr *e) override

  If the first argument exists, it will be substitued with the second argument.
- void print (std::ostream &ot) override

  To print out the expression.
- void pretty_print_at (std::ostream &ot, precedence_t prec) override

  Helper funtion for pretty_print to decide where to add parentheses.

Public Member Functions inherited from Expr

- std::string to_string ()

  Print out the result of print() function.
- void **pretty_print** (std::ostream &ot)

  Make the format better.
- std::string to_pretty_string ()

  Print out the result of pretty_print() function.

Public Attributes

- int **val**

  the value of a Num object

5.74.1 Constructor & Destructor Documentation

5.74.1.1 Num()

```
Num::Num (
            int val )
```

Constuctor of Num object.

Parameters

val	the value of a Num object

5.74.2 Member Function Documentation

5.74.2.1 equals()

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

Compare whether two expression are equal.

Parameters

e	an expressionto be compared

Returns

boolean

Implements Expr.

5.74.2.2 has_variable()

```
bool Num::has_variable ( )  [override], [virtual]
```

To check whether there are any variables in expressions.

Returns

boolean

Implements Expr.

5.74.2.3 interp()

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

Interpret the value.

Returns

int

Implements Expr.

5.74.2.4 pretty_print_at()

```
void Num::pretty_print_at (
            std::ostream & ot,
            precedence_t prec )  [override], [virtual]
```

Helper funtion for pretty_print to decide where to add parentheses.

Parameters

ot	the outputstream to be written
prec	the order of importance

Implements Expr.

5.74.2.5 print()

```
void Num::print (
            std::ostream & ot )  [override], [virtual]
```

To print out the expression.

Parameters

ot	the outputstream to be written

Implements Expr.

5.74.2.6 subst()

```
Expr * Num::subst (
            std::string s,
            Expr * e )  [override], [virtual]
```

If the first argument exists, it will be substitued with the second argument.

Parameters

s	the value to be substitued
e	the replacement

Returns

Expression itself

Implements Expr.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/expr.hpp
- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/expr.cpp

5.75 Catch::Option< T > Class Template Reference

Public Member Functions

- **Option** (T const &_value)
- **Option** (Option const &_other)
- 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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.76 Catch::pluralise Struct Reference

Public Member Functions

- **pluralise** (std::size_t count, std::string const &label)

Public Attributes

- std::size_t **m_count**
- std::string **m_label**

Friends

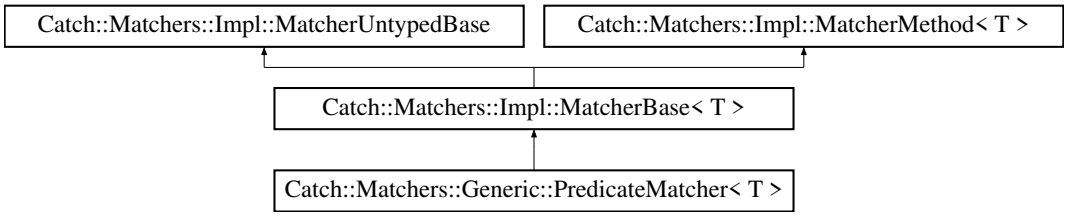
- std::ostream & **operator**<< (std::ostream &os, pluralise const &pluraliser)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.77 Catch::Matchers::Generic::PredicateMatcher< T > Class Template Reference

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

Additional Inherited Members

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

- std::string **m_cachedToString**

5.77.1 Member Function Documentation

5.77.1.1 describe()

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

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

5.77.1.2 match()

```
template<typename T >
bool Catch::Matchers::Generic::PredicateMatcher< T >::match (
            T const & item ) const  [inline], [override], [virtual]
```

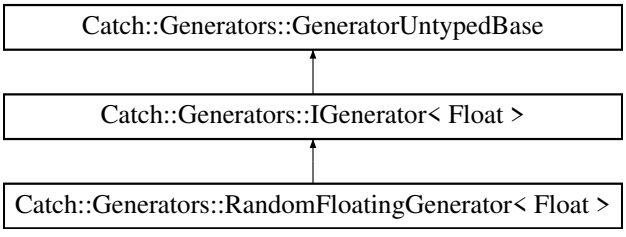
Implements Catch::Matchers::Impl::MatcherMethod< T >.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.78 Catch::Generators::RandomFloatingGenerator< Float > Class Template Reference

Inheritance diagram for Catch::Generators::RandomFloatingGenerator< Float >:



Public Member Functions

- **RandomFloatingGenerator** (Float a, Float b)
- Float const & get () const override
- bool next () override

Additional Inherited Members

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

- using **type**

5.78.1 Member Function Documentation

5.78.1.1 get()

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

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

5.78.1.2 next()

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

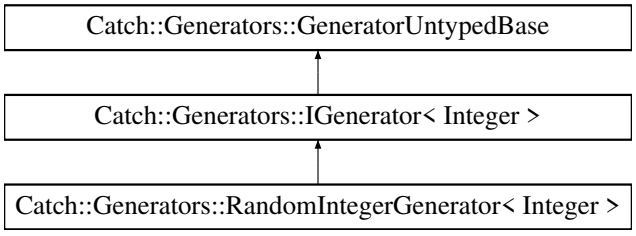
Implements Catch::Generators::GeneratorUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.79 Catch::Generators::RandomIntegerGenerator< Integer > Class Template Reference

Inheritance diagram for Catch::Generators::RandomIntegerGenerator< Integer >:



Public Member Functions

- **RandomIntegerGenerator** (Integer a, Integer b)
- Integer const & get () const override
- bool next () override

Additional Inherited Members

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

- using **type**

5.79.1 Member Function Documentation

5.79.1.1 get()

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

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

5.79.1.2 next()

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

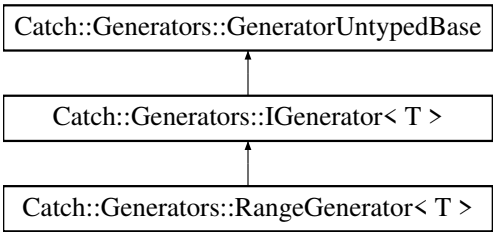
Implements Catch::Generators::GeneratorUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.80 Catch::Generators::RangeGenerator< T > Class Template Reference

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

Additional Inherited Members

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

- using **type** = T

5.80.1 Member Function Documentation

5.80.1.1 get()

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

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

5.80.1.2 next()

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

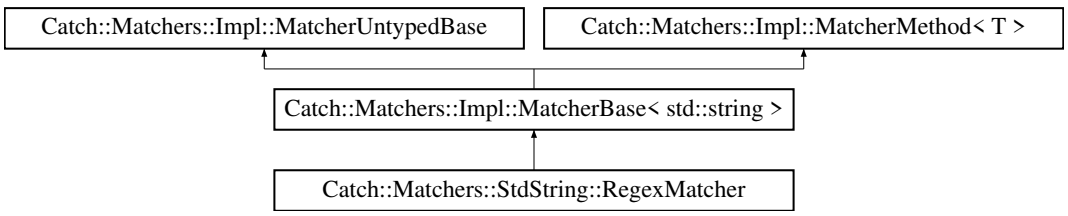
Implements Catch::Generators::GeneratorUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.81 Catch::Matchers::StdString::RegexMatcher Struct Reference

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

5.81.1 Member Function Documentation

5.81.1.1 describe()

```
std::string Catch::Matchers::StdString::RegexMatcher::describe ( ) const  [override], [virtual]
```

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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.82 Catch::RegistrarForTagAliases Struct Reference

Public Member Functions

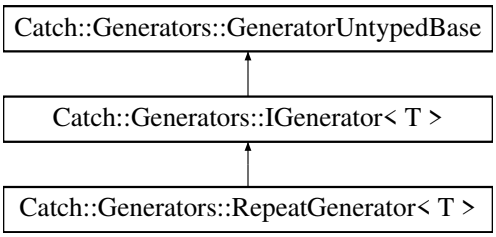
- **RegistrarForTagAliases** (char const *alias, char const *tag, SourceLineInfo const &lineInfo)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.83 Catch::Generators::RepeatGenerator< T > Class Template Reference

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

Additional Inherited Members

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

- using **type** = T

5.83.1 Member Function Documentation

5.83.1.1 get()

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

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

5.83.1.2 next()

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

Implements Catch::Generators::GeneratorUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.84 Catch::ResultDisposition Struct Reference

Public Types

- enum **Flags** { **Normal** = 0x01 , **ContinueOnFailure** = 0x02 , **FalseTest** = 0x04 , **SuppressFail** = 0x08 }

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.85 Catch::ResultWas Struct Reference

Public Types

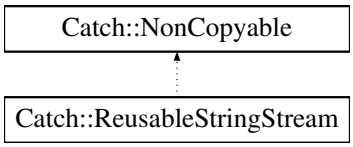
- enum **OfType** {
  Unknown = -1 , **Ok** = 0 , **Info** = 1 , **Warning** = 2 ,
  FailureBit = 0x10 , **ExpressionFailed** = FailureBit | 1 , **ExplicitFailure** = FailureBit | 2 , **Exception** = 0x100 | FailureBit ,
  ThrewException = Exception | 1 , **DidntThrowException** = Exception | 2 , **FatalErrorCondition** = 0x200 | FailureBit }

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.86 Catch::ReusableStringStream Class Reference

Inheritance diagram for Catch::ReusableStringStream:



Public Member Functions

- auto **str** () const -> std::string
- template<typename T >
  auto **operator**<< (T const &value) -> ReusableStringStream &
- auto **get** () -> std::ostream &

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.87 Catch::RunTests Struct Reference

Public Types

- enum **InWhatOrder** { **InDeclarationOrder** , **InLexicographicalOrder** , **InRandomOrder** }

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.88 Catch::ScopedMessage Class Reference

Public Member Functions

- **ScopedMessage** (MessageBuilder const &builder)
- **ScopedMessage** (ScopedMessage &duplicate)=delete
- **ScopedMessage** (ScopedMessage &&old)

Public Attributes

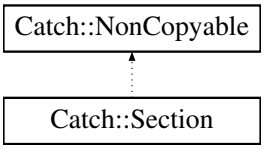
- MessageInfo **m_info**
- bool **m_moved**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.89 Catch::Section Class Reference

Inheritance diagram for Catch::Section:



Public Member Functions

- **Section** (SectionInfo const &info)
- **operator bool** () const

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.90 Catch::SectionEndInfo Struct Reference

Public Attributes

- SectionInfo **sectionInfo**
- Counts **prevAssertions**
- double **durationInSeconds**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.91 Catch::SectionInfo Struct Reference

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**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.92 Catch::ShowDurations Struct Reference

Public Types

- enum **OrNot** { **DefaultForReporter** , **Always** , **Never** }

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.93 Catch::SimplePcg32 Class Reference

Public Types

- using **result_type** = std::uint32_t

Public Member Functions

- **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

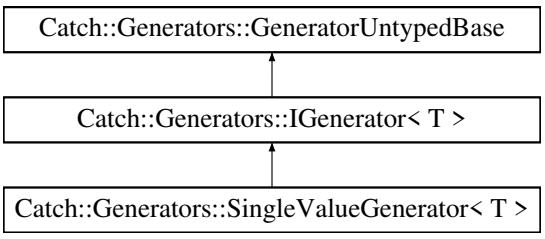
- bool **operator==** (SimplePcg32 const &lhs, SimplePcg32 const &rhs)
- bool **operator!=** (SimplePcg32 const &lhs, SimplePcg32 const &rhs)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.94 Catch::Generators::SingleValueGenerator< T > Class Template Reference

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



Public Member Functions

- **SingleValueGenerator** (T &&value)
- T const & get () const override
- bool next () override

Additional Inherited Members

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

- using **type** = T

5.94.1 Member Function Documentation

5.94.1.1 get()

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

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

5.94.1.2 next()

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

Implements Catch::Generators::GeneratorUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.95 Catch::SourceLineInfo Struct Reference

Public Member Functions

- **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

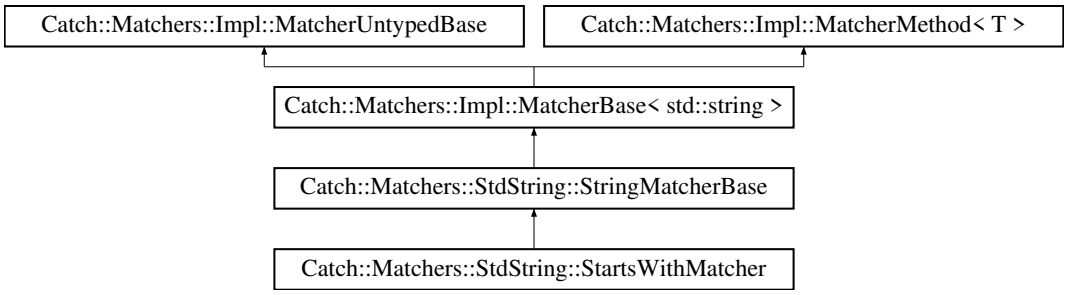
- char const * **file**
- std::size_t **line**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.96 Catch::Matchers::StdString::StartsWithMatcher Struct Reference

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.97 Catch::StreamEndStop Struct Reference

Public Member Functions

- std::string **operator+** () const

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.98 Catch::StringMaker< T, typename > Struct Template Reference

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)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.99 Catch::StringMaker< bool > Struct Reference

Static Public Member Functions

- static std::string **convert** (bool b)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.100 Catch::StringMaker< Catch::Detail::Approx > Struct Reference

Static Public Member Functions

- static std::string **convert** (Catch::Detail::Approx const &value)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.101 Catch::StringMaker< char * > Struct Reference

Static Public Member Functions

- static std::string **convert** (char *str)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.102 Catch::StringMaker< char > Struct Reference

Static Public Member Functions

- static std::string **convert** (char c)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.103 Catch::StringMaker< char const * > Struct Reference

Static Public Member Functions

- static std::string **convert** (char const *str)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.104 Catch::StringMaker< char[SZ]> Struct Template Reference

Static Public Member Functions

- static std::string **convert** (char const *str)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.105 Catch::StringMaker< double > Struct Reference

Static Public Member Functions

- static std::string **convert** (double value)

Static Public Attributes

- static int **precision**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.106 Catch::StringMaker< float > Struct Reference

Static Public Member Functions

- static std::string **convert** (float value)

Static Public Attributes

- static int **precision**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.107 Catch::StringMaker< int > Struct Reference

Static Public Member Functions

- static std::string **convert** (int value)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.108 Catch::StringMaker< long > Struct Reference

Static Public Member Functions

- static std::string **convert** (long value)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.109 Catch::StringMaker< long long > Struct Reference

Static Public Member Functions

- static std::string **convert** (long long value)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.110 Catch::StringMaker< R C::* > Struct Template Reference

Static Public Member Functions

- static std::string **convert** (R C::*p)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.111 Catch::StringMaker< R, typename std::enable_if< is_range< R >::value &&!::Catch::Detail::IsStreamInsertable< R >::value >::type > Struct Template Reference

Static Public Member Functions

- static std::string **convert** (R const &range)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.112 Catch::StringMaker< signed char > Struct Reference

Static Public Member Functions

- static std::string **convert** (signed char c)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.113 Catch::StringMaker< signed char[SZ]> Struct Template Reference

Static Public Member Functions

- static std::string **convert** (signed char const *str)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.114 Catch::StringMaker< std::nullptr_t > Struct Reference

Static Public Member Functions

- static std::string **convert** (std::nullptr_t)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.115 Catch::StringMaker< std::string > Struct Reference

Static Public Member Functions

- static std::string **convert** (const std::string &str)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.116 Catch::StringMaker< std::wstring > Struct Reference

Static Public Member Functions

- static std::string **convert** (const std::wstring &wstr)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.117 Catch::StringMaker< T * > Struct Template Reference

Static Public Member Functions

- template<typename U >
  static std::string **convert** (U *p)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.118 Catch::StringMaker< T[SZ]> Struct Template Reference

Static Public Member Functions

- static std::string **convert** (T const(&arr)[SZ])

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.119 Catch::StringMaker< unsigned char > Struct Reference

Static Public Member Functions

- static std::string **convert** (unsigned char c)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.120 Catch::StringMaker< unsigned char[SZ]> Struct Template Reference

Static Public Member Functions

- static std::string **convert** (unsigned char const *str)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.121 Catch::StringMaker< unsigned int > Struct Reference

Static Public Member Functions

- static std::string **convert** (unsigned int value)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.122 Catch::StringMaker< unsigned long > Struct Reference

Static Public Member Functions

- static std::string **convert** (unsigned long value)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.123 Catch::StringMaker< unsigned long long > Struct Reference

Static Public Member Functions

- static std::string **convert** (unsigned long long value)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.124 Catch::StringMaker< wchar_t * > Struct Reference

Static Public Member Functions

- static std::string **convert** (wchar_t *str)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.125 Catch::StringMaker< wchar_t const * > Struct Reference

Static Public Member Functions

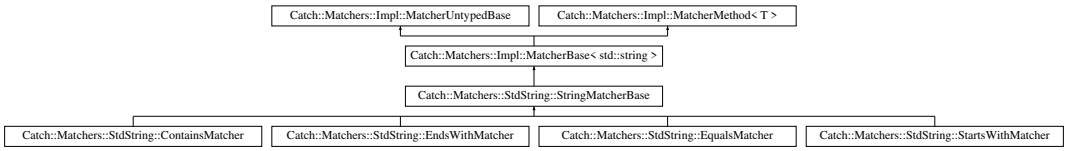
- static std::string **convert** (wchar_t const *str)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.126 Catch::Matchers::StdString::StringMatcherBase Struct Reference

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

5.126.1 Member Function Documentation

5.126.1.1 describe()

```
std::string Catch::Matchers::StdString::StringMatcherBase::describe ( ) const  [override],
[virtual]
```

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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.127 Catch::StringRef Class Reference

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

Public Types

- using **size_type** = std::size_t
- using **const_iterator** = const char*

Public Member Functions

- **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

5.127.1 Detailed Description

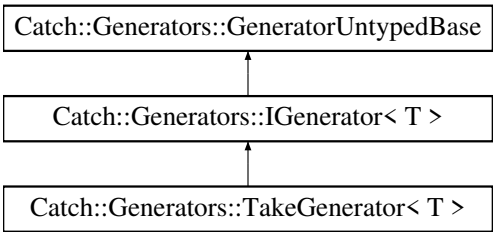
A non-owning string class (similar to the forthcoming std::string_view) Note that, because a StringRef may be a substring of another string, it may not be null terminated.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.128 Catch::Generators::TakeGenerator< T > Class Template Reference

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

Additional Inherited Members

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

- using **type** = T

5.128.1 Member Function Documentation

5.128.1.1 get()

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

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

5.128.1.2 next()

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

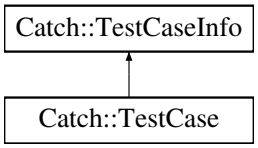
Implements Catch::Generators::GeneratorUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.129 Catch::TestCase Class Reference

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

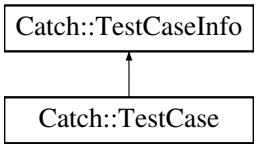
- std::string **name**
- std::string **className**
- std::string **description**
- std::vector< std::string > **tags**
- std::vector< std::string > **lcaseTags**
- SourceLineInfo **lineInfo**
- SpecialProperties **properties**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.130 Catch::TestCaseInfo Struct Reference

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)

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

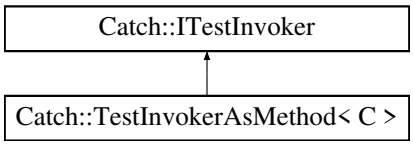
5.131 Catch::TestFailureException Struct Reference

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.132 Catch::TestInvokerAsMethod< C > Class Template Reference

Inheritance diagram for Catch::TestInvokerAsMethod< C >:



Public Member Functions

- **TestInvokerAsMethod** (void(C::*testAsMethod)()) noexcept
- void invoke () const override

5.132.1 Member Function Documentation

5.132.1.1 invoke()

```
template<typename C >
void Catch::TestInvokerAsMethod< C >::invoke ( ) const  [inline], [override], [virtual]
```

Implements Catch::ITestInvoker.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.133 Catch::Timer Class Reference

Public Member Functions

- void **start** ()
- auto **getElapsedNanoseconds** () const -> uint64_t
- auto **getElapsedMicroseconds** () const -> uint64_t
- auto **getElapsedMilliseconds** () const -> unsigned int
- auto **getElapsedSeconds** () const -> double

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.134 Catch::Totals Struct Reference

Public Member Functions

- Totals **operator-** (Totals const &other) const
- Totals & **operator+=** (Totals const &other)
- Totals **delta** (Totals const &prevTotals) const

Public Attributes

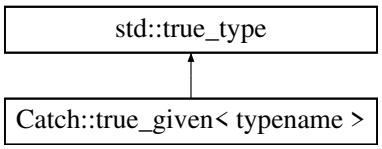
- int **error** = 0
- Counts **assertions**
- Counts **testCases**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.135 Catch::true_given< typename > Struct Template Reference

Inheritance diagram for Catch::true_given< typename >:

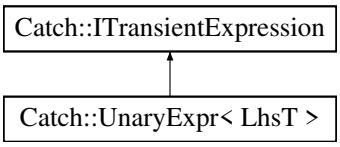


The documentation for this struct was generated from the following file:

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.136 Catch::UnaryExpr< LhsT > Class Template Reference

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)

Additional Inherited Members

Public Attributes inherited from Catch::ITransientExpression

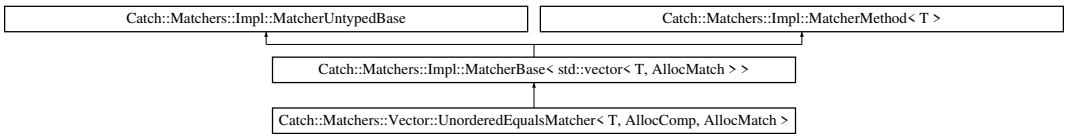
- bool **m_isBinaryExpression**
- bool **m_result**

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.137 Catch::Matchers::Vector::UnorderedEqualsMatcher< T, AllocComp, AllocMatch > Struct Template Reference

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

5.137.1 Member Function Documentation

5.137.1.1 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.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.138 Catch::UseColour Struct Reference

Public Types

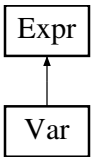
- enum **YesOrNo** { **Auto** , **Yes** , **No** }

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.139 Var Class Reference

Inheritance diagram for Var:



Public Member Functions

- Var (std::string name)

  Constuctor of Var object.
- bool equals (Expr ∗e) override

  Compare whether two expression are equal.
- int interp () override

  Interpret the value.
- bool has_variable () override

  To check whether there are any variables in expressions.
- Expr ∗ subst (std::string s, Expr ∗e) override

  If the first argument exists, it will be substitued with the second argument.
- void print (std::ostream &ot) override

  To print out the expression.
- void pretty_print_at (std::ostream &ot, precedence_t prec) override

  Helper funtion for pretty_print to decide where to add parentheses.

Public Member Functions inherited from Expr

- std::string to_string ()

  Print out the result of print() function.
- void **pretty_print** (std::ostream &ot)

  Make the format better.
- std::string to_pretty_string ()

  Print out the result of pretty_print() function.

Public Attributes

- std::string **name**

  the name of an Var object

5.139.1 Constructor & Destructor Documentation

5.139.1.1 Var()

```
Var::Var (
            std::string name )
```

Constuctor of Var object.

Parameters

name	the name of the Var object

5.139.2 Member Function Documentation

5.139.2.1 equals()

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

Compare whether two expression are equal.

Parameters

e	an expressionto be compared

Returns

boolean

Implements Expr.

5.139.2.2 has_variable()

```
bool Var::has_variable ( )  [override], [virtual]
```

To check whether there are any variables in expressions.

Returns

boolean

Implements Expr.

5.139.2.3 interp()

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

Interpret the value.

Returns

int

Implements Expr.

5.139.2.4 pretty_print_at()

```
void Var::pretty_print_at (
            std::ostream & ot,
            precedence_t prec )  [override], [virtual]
```

Helper funtion for pretty_print to decide where to add parentheses.

Parameters

ot	the outputstream to be written
prec	the order of importance

Implements Expr.

5.139.2.5 print()

```
void Var::print (
            std::ostream & ot )  [override], [virtual]
```

To print out the expression.

Parameters

ot	the outputstream to be written

Implements Expr.

5.139.2.6 subst()

```
Expr * Var::subst (
            std::string s,
            Expr * e )  [override], [virtual]
```

If the first argument exists, it will be substitued with the second argument.

Parameters

s	the value to be substitued
e	the replacement

Returns

Expression itself

Implements Expr.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/expr.hpp
- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/expr.cpp

5.140 Catch::detail::void_type<... > Struct Template Reference

Public Types

- using **type** = void

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.141 Catch::WaitForKeypress Struct Reference

Public Types

- enum **When** { **Never** , **BeforeStart** = 1 , **BeforeExit** = 2 , **BeforeStartAndExit** = BeforeStart | BeforeExit }

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.142 Catch::WarnAbout Struct Reference

Public Types

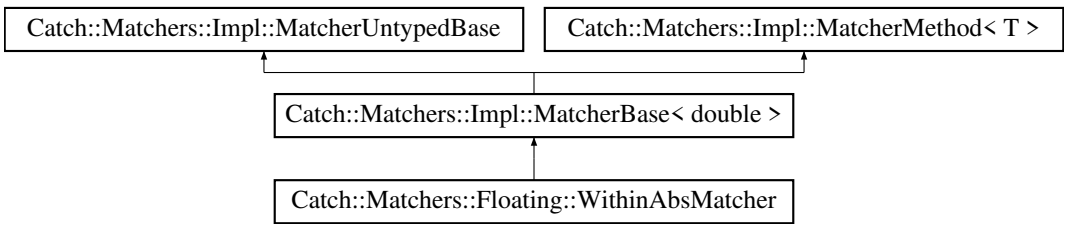
- enum **What** { **Nothing** = 0x00 , **NoAssertions** = 0x01 , **NoTests** = 0x02 }

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.143 Catch::Matchers::Floating::WithinAbsMatcher Struct Reference

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

5.143.1 Member Function Documentation

5.143.1.1 describe()

```
std::string Catch::Matchers::Floating::WithinAbsMatcher::describe ( ) const  [override], [virtual]
```

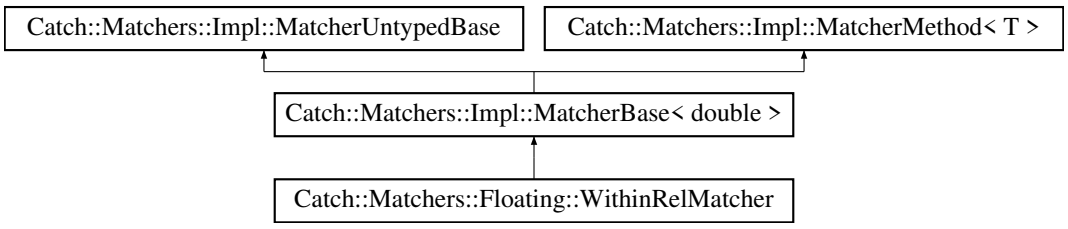
Implements Catch::Matchers::Impl::MatcherUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.144 Catch::Matchers::Floating::WithinRelMatcher Struct Reference

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

5.144.1 Member Function Documentation

5.144.1.1 describe()

```
std::string Catch::Matchers::Floating::WithinRelMatcher::describe ( ) const  [override], [virtual]
```

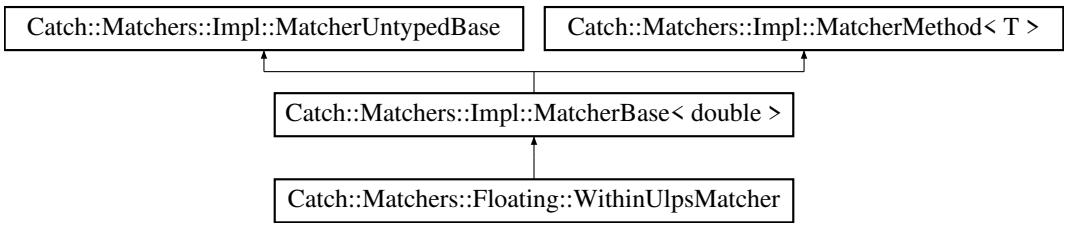
Implements Catch::Matchers::Impl::MatcherUntypedBase.

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

5.145 Catch::Matchers::Floating::WithinUlpsMatcher Struct Reference

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** (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 Attributes inherited from Catch::Matchers::Impl::MatcherUntypedBase

- std::string **m_cachedToString**

5.145.1 Member Function Documentation

5.145.1.1 describe()

```
std::string Catch::Matchers::Floating::WithinUlpsMatcher::describe ( ) const  [override],
[virtual]
```

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

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

- /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

Chapter 6

File Documentation

6.1 /Users/christina/Desktop/MSD/CS6015/MSDScript/MSDScript/catch.h

```
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_PATCH 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_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_CAT
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,
```

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      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_CAT
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(
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      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 = -4.054566272975206863e-14 + p * w;
07677             p = -8.151934197605472152e-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 = 2.2137676921775787049e-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 = -0.00035503752036284747960 + 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         // Dont 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
13683
13684         struct OutputDebugWriter {
13685
13686             void operator()( std::string const&str ) {
13687                 writeToDebugConsole( str );
13688             }
13689         };
13690
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
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
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(
```

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    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
```

6.2 /Users/christina/Desktop/MSD/CS6015/MSDScript/↩ MSDScript/cmdline.hpp

```
00001 //
00002 //  cmdline.hpp
00003 //  MSDscript
00004 //
00005 //  Created by  on 1/14/24.
00006 //
00007
00008 #ifndef cmdline_hpp
00009 #define cmdline_hpp
```

```
00010
00011
00012 #include <iostream>
00013 #include <string>
00014 #include <map>
00015 #include <stdio.h>
00016 #include <stdexcept>
00017 #include "catch.h"
00018
00019
00020
00021 void use_arguments(int argc,const char * argv[]);
00022
00023 #endif /* cmdline_hpp */
```

6.3 /Users/christina/Desktop/MSD/CS6015/MSDScript/↩ MSDScript/expr.hpp

```
00001
00005 #ifndef expr_hpp
00006 #define expr_hpp
00007
00008 #include "catch.h"
00009 #include <stdio.h>
00010 #include <stdexcept>
00011 #include <ios>
00012 #include <iostream>
00013 #include <cstring>
00014 #include <string>
00015 #include <sstream>
00016
00017 // Magic numbers
00018 typedef enum {
00019   prec_none, // = 0
00020   prec_add,  // = 1
00021   prec_mult, // = 2
00022 } precedence_t;
00023
00024 class Expr {
00025
00026 public:
00027     virtual bool equals(Expr *e) = 0;
00028     virtual int interp() = 0;
00029     virtual bool has_variable() =0;
00030     virtual Expr* subst(std::string s, Expr* e)=0;
00031     virtual void print(std::ostream& ot)=0;
00032     std::string to_string();
00033     void pretty_print(std::ostream& ot);
00034     std::string to_pretty_string();
00035     virtual void pretty_print_at(std::ostream& ot,precedence_t prec)=0;
00036 };
00037
00038 class Num : public Expr {
00039 public:
00040     int val;
00041     Num(int val);
00042     bool equals(Expr *e) override;
00043     int interp() override;
00044     bool has_variable()override;
00045     Expr* subst(std::string s, Expr* e)override;
00046     void print(std::ostream& ot)override;
00047     void pretty_print_at(std::ostream& ot,precedence_t prec )override;
00048
00049 };
00050
00051 class Add : public Expr {
00052 public:
00053     Expr *lhs;
00054     Expr *rhs;
00055     Add(Expr *lhs, Expr *rhs);
00056     bool equals(Expr* e) override;
00057     int interp()override;
00058     bool has_variable()override;
00059     Expr* subst(std::string s, Expr* e)override;
00060     void print(std::ostream& ot)override;
00061     void pretty_print_at(std::ostream& ot,precedence_t prec)override;
00062
00063 };
00064
00065 class Mult : public Expr{
00066 public:
00067     Expr *lhs;
```

```
00068     Expr *rhs;
00069     Mult(Expr *lhs, Expr *rhs);
00070     bool equals(Expr *e) override;
00071     int interp()override;
00072     bool has_variable()override;
00073     Expr* subst(std::string s, Expr* e)override;
00074     void print(std::ostream& ot)override;
00075     void pretty_print_at(std::ostream& ot,precedence_t prec )override;
00076 
00077 };
00078 
00079 class Var : public Expr {
00080 public:
00081     std::string name;
00082 
00083     Var(std::string name);
00084     bool equals(Expr *e) override;
00085     int interp() override;
00086     bool has_variable()override;
00087     Expr* subst(std::string s, Expr* e)override;
00088     void print(std::ostream& ot)override;
00089     void pretty_print_at(std::ostream& ot,precedence_t prec )override;
00090 };
00091 
00092 #endif /* expr_hpp */
```

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