

Writing Regexprs 2021-22 / Utils

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Chapter 1

Namespace Index

1.1 Namespace List

Here is a list of all namespaces with brief descriptions:

wr22	9
wr22::utils	9
wr22::utils::detail	11
wr22::utils::detail::adt	11

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

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

wr22::utils::Adt< Variants >	13
wr22::utils::Box< T >	16
std::exception	
wr22::utils::BoxIsEmpty	18
wr22::utils::detail::adt::Fs	
wr22::utils::detail::adt::MultiCallable< Fs >	19

Chapter 3

Class Index

3.1 Class List

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

wr22::utils::Adt< Variants >	
A helper class that simplifies creation of algebraic data types	13
wr22::utils::Box< T >	
A copyable and equality-comparable wrapper around <code>std::unique_ptr</code>	16
wr22::utils::BoxIsEmpty	18
wr22::utils::detail::adt::MultiCallable< Fs >	19

Chapter 4

File Index

4.1 File List

Here is a list of all files with brief descriptions:

include/wr22/utls/ adt.hpp	21
include/wr22/utls/ box.hpp	22
src/ box.cpp	24

Chapter 5

Namespace Documentation

5.1 wr22 Namespace Reference

Namespaces

- namespace [utils](#)

5.2 wr22::utils Namespace Reference

Namespaces

- namespace [detail](#)

Classes

- class [Adt](#)
A helper class that simplifies creation of algebraic data types.
- class [Box](#)
A copyable and equality-comparable wrapper around `std::unique_ptr`.
- struct [BoxIsEmpty](#)

Functions

- `template<typename... Variants>`
`bool operator== (const Adt< Variants... > &lhs, const Adt< Variants... > &rhs)`
Compare two compatible ADTs for equality.
- `template<typename... Variants>`
`bool operator!= (const Adt< Variants... > &lhs, const Adt< Variants... > &rhs)`
Compare two compatible ADTs for non-equality.
- `template<typename T>`
`Box (T &&value) -> Box< T >`
Type deduction guideline for [Box](#) (value initialization).
- `template<typename T>`
`Box (std::unique_ptr< T > ptr) -> Box< T >`
Type deduction guideline for [Box](#) (std::unique_ptr adoption).
- `template<typename T, typename U>`
`bool operator== (const Box< T > &lhs, const Box< U > &rhs)`
- `template<typename T, typename U>`
`bool operator!= (const Box< T > &lhs, const Box< U > &rhs)`

5.2.1 Function Documentation

5.2.1.1 `Box()` [1/2]

```
template<typename T >
wr22::utils::Box (
    std::unique_ptr< T > ptr ) -> Box< T >
```

Type deduction guideline for `Box` (`std::unique_ptr` adoption).

5.2.1.2 `Box()` [2/2]

```
template<typename T >
wr22::utils::Box (
    T && value ) -> Box< T >
```

Type deduction guideline for `Box` (value initialization).

5.2.1.3 `operator!=()` [1/2]

```
template<typename... Variants>
bool wr22::utils::operator!= (
    const Adt< Variants... > & lhs,
    const Adt< Variants... > & rhs )
```

Compare two compatible ADTs for non-equality.

5.2.1.4 `operator!=()` [2/2]

```
template<typename T , typename U >
bool wr22::utils::operator!= (
    const Box< T > & lhs,
    const Box< U > & rhs )
```

5.2.1.5 `operator==()` [1/2]

```
template<typename... Variants>
bool wr22::utils::operator== (
    const Adt< Variants... > & lhs,
    const Adt< Variants... > & rhs )
```

Compare two compatible ADTs for equality.

5.2.1.6 operator==([2/2]

```
template<typename T , typename U >
bool wr22::utils::operator==(
    const Box< T > & lhs,
    const Box< U > & rhs )
```

5.3 wr22::utils::detail Namespace Reference

Namespaces

- namespace [adt](#)

5.4 wr22::utils::detail::adt Namespace Reference

Classes

- struct [MultiCallable](#)

Chapter 6

Class Documentation

6.1 wr22::utils::Adt< Variants > Class Template Reference

A helper class that simplifies creation of algebraic data types.

```
#include <adt.hpp>
```

Public Types

- using [VariantType](#) = std::variant< Variants... >
A convenience type alias for the concrete `std::variant` type used.

Public Member Functions

- template<typename V >
[Adt](#) (V variant)
Constructor for each of the variants.
- template<typename... Fs>
decltype(auto) [visit](#) (Fs &&... visitors) const
Visit the ADT, applying the suitable function from the list of visitors on the variant held.
- template<typename... Fs>
decltype(auto) [visit](#) (Fs &&... visitors)
Visit the ADT, applying the suitable function from the list of visitors on the variant held.
- const [VariantType](#) & [as_variant](#) () const
Access the underlying `std::variant` type (constant version).
- [VariantType](#) & [as_variant](#) ()
Access the underlying `std::variant` type (non-constant version).

Protected Attributes

- [VariantType](#) m_variant

6.1.1 Detailed Description

```
template<typename... Variants>
class wr22::utils::Adt< Variants >
```

A helper class that simplifies creation of algebraic data types.

Algebraic data types are data types that can have one type of a predefined set of variants, but be stored and represented as values of one common type. In C++, `std::variant` serves exactly this purpose. It is, however, not very convenient to work with or build upon, so this class is designed to simplify building new algebraic data types. It still uses `std::variant` under the hood.

The template type parameters are the types that the variants may hold (must be distinct types).

6.1.2 Member Typedef Documentation

6.1.2.1 VariantType

```
template<typename... Variants>
using wr22::utils::Adt< Variants >::VariantType = std::variant<Variants...>
```

A convenience type alias for the concrete `std::variant` type used.

6.1.3 Constructor & Destructor Documentation

6.1.3.1 Adt()

```
template<typename... Variants>
template<typename V >
wr22::utils::Adt< Variants >::Adt (
    V variant ) [inline]
```

Constructor for each of the variants.

Construct an instance holding a specified variant. The type `V` of the variant provided must be one of the types from `Variants`. Note that this constructor is purposefully implicit, so that the variants as separate types are transparently converted to this common type when necessary.

The variant is taken by value and moved thereafter, so that, when constructing the common type, the variant may be either copied or moved, depending on the user's intentions.

6.1.4 Member Function Documentation

6.1.4.1 as_variant() [1/2]

```
template<typename... Variants>
VariantType & wr22::utils::Adt< Variants >::as_variant ( ) [inline]
```

Access the underlying `std::variant` type (non-constant version).

6.1.4.2 as_variant() [2/2]

```
template<typename... Variants>
const VariantType & wr22::utils::Adt< Variants >::as_variant ( ) const [inline]
```

Access the underlying `std::variant` type (constant version).

6.1.4.3 visit() [1/2]

```
template<typename... Variants>
template<typename... Fs>
decltype(auto) wr22::utils::Adt< Variants >::visit (
    Fs &&... visitors ) [inline]
```

Visit the ADT, applying the suitable function from the list of visitors on the variant held.

This is the non-constant version of the method. See the docs for the constant version for a detailed description and code examples. The only thing different in this version of the method is that the visitors get called with a non-const lvalue reference to the variants instead of a const reference.

6.1.4.4 visit() [2/2]

```
template<typename... Variants>
template<typename... Fs>
decltype(auto) wr22::utils::Adt< Variants >::visit (
    Fs &&... visitors ) const [inline]
```

Visit the ADT, applying the suitable function from the list of visitors on the variant held.

Using this method is essentially the same as using `std::visit` on the variant, except that, for convenience, multiple visitors are joined into one big visitor. That is, a typical `Adt` usage might look like this:

```
struct MyAdt : public Adt<int, double> {
    // Make the constructor available in the derived class.
    using Adt<int, double>::Adt;
};
// <...>
void func() {
    // Variant type: double.
    MyAdt my_adt = 3.14;
    // Prints "Double: 3.14".
    my_adt.visit(
        [] (int x) { std::cout << "Int: " << x << std::endl; },
        [] (double x) { std::cout << "Double: " << x << std::endl; }
    );
}
```

This is the constant version of the method. Visitors must be callable with the const reference to variant types.

6.1.5 Member Data Documentation

6.1.5.1 m_variant

```
template<typename... Variants>
VariantType wr22::utils::Adt< Variants >::m_variant [protected]
```

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

- include/wr22/utlis/[adt.hpp](#)

6.2 wr22::utils::Box< T > Class Template Reference

A copyable and equality-comparable wrapper around `std::unique_ptr`.

```
#include <box.hpp>
```

Public Member Functions

- [Box](#) (T &&value)
Constructor that places a value inside the wrapped `std::unique_ptr`.
- [Box](#) (std::unique_ptr< T > ptr)
Constructor that adopts an existing `std::unique_ptr`.
- template<typename Dummy = T>
[Box](#) (const [Box](#) &other)
Copy constructor.
- const T & [operator*](#) () const
Dereferencing operator: obtain a const reference to the stored value.
- T & [operator*](#) ()
Dereferencing operator: obtain a reference to the stored value.

Static Public Member Functions

- template<typename... Args>
static [Box](#)< T > [construct_in_place](#) (Args &&... args)
Construct a value on the heap in place.

6.2.1 Detailed Description

```
template<typename T>
class wr22::utils::Box< T >
```

A copyable and equality-comparable wrapper around `std::unique_ptr`.

The behavior of this wrapper regarding copying and equality comparison are akin to that of Rust's `std::boxed::Box`, and hence the class's name. Namely, when testing for (in)equality, the wrapped values are compared instead of raw pointers, and, when wrapped values are copyable, copying a [Box](#) creates another `std::unique_ptr` with a copy of the wrapped value.

A [Box](#) usually contains a value. However, it may become empty when it is moved from. To ensure safety, most operations on an empty box will throw a [BoxIsEmpty](#) exception instead of causing undefined behavior.

6.2.2 Constructor & Destructor Documentation

6.2.2.1 Box() [1/3]

```
template<typename T >
wr22::utils::Box< T >::Box (
    T && value ) [inline], [explicit]
```

Constructor that places a value inside the wrapped `std::unique_ptr`.

Takes the value by a universal reference and, due to perfect forwarding, both copy and move initialization is possible.

6.2.2.2 Box() [2/3]

```
template<typename T >
wr22::utils::Box< T >::Box (
    std::unique_ptr< T > ptr ) [inline], [explicit]
```

Constructor that adopts an existing `std::unique_ptr`.

Takes the `std::unique_ptr` by value, so the latter must be either passed directly as an rvalue or `std::move()` d into the argument. However, please note that if your code snippet looks like this:

```
Box(std::make_unique<T>(args...))
```

Then you should take a look at the `construct_in_place` method:

```
Box<T>::construct_in_place(args...)
```

6.2.2.3 Box() [3/3]

```
template<typename T >
template<typename Dummy = T>
wr22::utils::Box< T >::Box (
    const Box< T > & other ) [inline]
```

Copy constructor.

Creates another `std::unique_ptr` with a copy of the currently wrapped value.

Parameters

<code>`other`</code>	the <code>Box</code> from which to copy.
----------------------	--

Exceptions

<code>BoxIsEmpty</code>	if <code>other</code> is empty.
-------------------------	---------------------------------

6.2.3 Member Function Documentation

6.2.3.1 `construct_in_place()`

```
template<typename T >
template<typename... Args>
static Box< T > wr22::utils::Box< T >::construct_in_place (
    Args &&... args ) [inline], [static]
```

Construct a value on the heap in place.

Forwards the arguments to `std::make_unique` and wraps the resulting `std::unique_ptr`.

6.2.3.2 `operator*()` [1/2]

```
template<typename T >
T & wr22::utils::Box< T >::operator* ( ) [inline]
```

Dereferencing operator: obtain a reference to the stored value.

Exceptions

<i>BoxIsEmpty</i>	if this <code>Box</code> does not contain a value at the moment.
-----------------------------------	--

6.2.3.3 `operator*()` [2/2]

```
template<typename T >
const T & wr22::utils::Box< T >::operator* ( ) const [inline]
```

Dereferencing operator: obtain a const reference to the stored value.

Exceptions

<i>BoxIsEmpty</i>	if this <code>Box</code> does not contain a value at the moment.
-----------------------------------	--

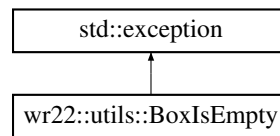
The documentation for this class was generated from the following file:

- `include/wr22/utlis/box.hpp`

6.3 `wr22::utils::BoxIsEmpty` Struct Reference

```
#include <box.hpp>
```

Inheritance diagram for wr22::utils::BoxIsEmpty:



Public Member Functions

- `const char * what () const` noexcept override

6.3.1 Member Function Documentation

6.3.1.1 what()

```
const char * wr22::utils::BoxIsEmpty::what ( ) const [override], [noexcept]
```

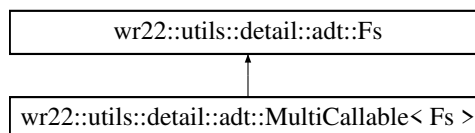
The documentation for this struct was generated from the following files:

- `include/wr22/utls/box.hpp`
- `src/box.cpp`

6.4 wr22::utils::detail::adt::MultiCallable< Fs > Struct Template Reference

```
#include <adt.hpp>
```

Inheritance diagram for wr22::utils::detail::adt::MultiCallable< Fs >:



Public Member Functions

- `MultiCallable (Fs &&... fs)`

6.4.1 Constructor & Destructor Documentation

6.4.1.1 MultiCallable()

```
template<typename... Fs>
wr22::utils::detail::adt::MultiCallable< Fs >::MultiCallable (
    Fs &&... fs ) [inline]
```

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

- `include/wr22/utls/adt.hpp`

Chapter 7

File Documentation

7.1 include/wr22/utils/adt.hpp File Reference

```
#include <utility>
#include <variant>
```

Classes

- struct [wr22::utils::detail::adt::MultiCallable< Fs >](#)
- class [wr22::utils::Adt< Variants >](#)

A helper class that simplifies creation of algebraic data types.

Namespaces

- namespace [wr22](#)
- namespace [wr22::utils](#)
- namespace [wr22::utils::detail](#)
- namespace [wr22::utils::detail::adt](#)

Functions

- template<typename... Variants>
bool [wr22::utils::operator==](#) (const Adt< Variants... > &lhs, const Adt< Variants... > &rhs)
Compare two compatible ADTs for equality.
- template<typename... Variants>
bool [wr22::utils::operator!=](#) (const Adt< Variants... > &lhs, const Adt< Variants... > &rhs)
Compare two compatible ADTs for non-equality.

7.2 adt.hpp

[Go to the documentation of this file.](#)

```

1 #pragma once
2
3 // stl
4 #include <utility>
5 #include <variant>
6
7 namespace wr22::utils {
8
9 namespace detail::adt {
10     // https://en.cppreference.com/w/cpp/utility/variant/visit#Example provides a very similar
11     // example of C++ template black magic.
12     template <typename... Fs>
13     struct MultiCallable : public Fs... {
14         MultiCallable(Fs&&... fs) : Fs(fs)... {}
15         using Fs::operator()...;
16     };
17 } // namespace detail::adt
18
19 template <typename... Variants>
20 class Adt {
21 public:
22     using VariantType = std::variant<Variants...>;
23
24     template <typename V>
25     Adt(V variant) : m_variant(std::move(variant)) {}
26
27     template <typename... Fs>
28     decltype(auto) visit(Fs&&... visitors) const {
29         return std::visit(
30             detail::adt::MultiCallable<Fs...>(std::forward<Fs>(visitors)...),
31             m_variant);
32     }
33
34     template <typename... Fs>
35     decltype(auto) visit(Fs&&... visitors) {
36         return std::visit(
37             detail::adt::MultiCallable<Fs...>(std::forward<Fs>(visitors)...),
38             m_variant);
39     }
40
41     const VariantType& as_variant() const {
42         return m_variant;
43     }
44
45     VariantType& as_variant() {
46         return m_variant;
47     }
48
49 protected:
50     VariantType m_variant;
51 };
52
53 template <typename... Variants>
54 bool operator==(const Adt<Variants...>& lhs, const Adt<Variants...>& rhs) {
55     return lhs.as_variant() == rhs.as_variant();
56 }
57
58 template <typename... Variants>
59 bool operator!=(const Adt<Variants...>& lhs, const Adt<Variants...>& rhs) {
60     return !(lhs == rhs);
61 }
62
63 } // namespace wr22::utils

```

7.3 include/wr22/utils/box.hpp File Reference

```

#include <exception>
#include <memory>
#include <utility>

```

Classes

- struct [wr22::utils::BoxIsEmpty](#)
- class [wr22::utils::Box< T >](#)

A copyable and equality-comparable wrapper around `std::unique_ptr`.

Namespaces

- namespace [wr22](#)
- namespace [wr22::utils](#)

Functions

- template<typename T >
[wr22::utils::Box](#) (T &&value) -> Box< T >
Type deduction guideline for [Box](#) (value initialization).
- template<typename T >
[wr22::utils::Box](#) (std::unique_ptr< T > ptr) -> Box< T >
Type deduction guideline for [Box](#) (std::unique_ptr adoption).
- template<typename T, typename U >
bool [wr22::utils::operator==](#) (const Box< T > &lhs, const Box< U > &rhs)
- template<typename T, typename U >
bool [wr22::utils::operator!=](#) (const Box< T > &lhs, const Box< U > &rhs)

7.4 box.hpp

[Go to the documentation of this file.](#)

```

1 #pragma once
2
3 // stl
4 #include <exception>
5 #include <memory>
6 #include <utility>
7
8 namespace wr22::utils {
9
10 struct BoxIsEmpty : public std::exception {
11     const char* what() const noexcept override;
12 };
13
14 template <typename T>
15 class Box {
16 public:
17     explicit Box(T&& value) : m_ptr(std::make_unique<T>(std::forward<T>(value))) {}
18
19     explicit Box(std::unique_ptr<T> ptr) : m_ptr(std::move(ptr)) {}
20
21     template <typename Dummy = T>
22     Box(const Box& other) : m_ptr(std::make_unique<T>(*other)) {}
23
24     template <typename... Args>
25     static Box<T> construct_in_place(Args&&... args) {
26         return Box(std::make_unique<T>(std::forward<Args>(args)...));
27     }
28
29     const T& operator*() const {
30         if (m_ptr == nullptr) {
31             throw BoxIsEmpty{};
32         }
33         return *m_ptr;
34     }
35
36     T& operator*() {
37         if (m_ptr == nullptr) {
38             throw BoxIsEmpty{};
39         }
40         return *m_ptr;
41     }
42
43     const T& operator*() const {
44         if (m_ptr == nullptr) {
45             throw BoxIsEmpty{};
46         }
47         return *m_ptr;
48     }
49
50     T& operator*() {
51         if (m_ptr == nullptr) {
52             throw BoxIsEmpty{};
53         }
54         return *m_ptr;
55     }
56
57     const T& operator*() const {
58         if (m_ptr == nullptr) {
59             throw BoxIsEmpty{};
60         }
61         return *m_ptr;
62     }
63
64     T& operator*() {
65         if (m_ptr == nullptr) {
66             throw BoxIsEmpty{};
67         }
68         return *m_ptr;
69     }
70
71     const T& operator*() const {
72         if (m_ptr == nullptr) {
73             throw BoxIsEmpty{};
74         }
75         return *m_ptr;
76     }
77
78     T& operator*() {
79         if (m_ptr == nullptr) {
80             throw BoxIsEmpty{};
81         }
82         return *m_ptr;
83     }
84
85     const T& operator*() const {
86         if (m_ptr == nullptr) {
87             throw BoxIsEmpty{};
88         }
89         return *m_ptr;
90     }
91
92     T& operator*() {
93         if (m_ptr == nullptr) {
94             throw BoxIsEmpty{};
95         }
96         return *m_ptr;
97     }
98
99     const T& operator*() const {
100         if (m_ptr == nullptr) {
101             throw BoxIsEmpty{};
102         }
103         return *m_ptr;
104     }
105
106     T& operator*() {
107         if (m_ptr == nullptr) {
108             throw BoxIsEmpty{};
109         }
110         return *m_ptr;
111     }
112
113     const T& operator*() const {
114         if (m_ptr == nullptr) {
115             throw BoxIsEmpty{};
116         }
117         return *m_ptr;
118     }
119
120     T& operator*() {
121         if (m_ptr == nullptr) {
122             throw BoxIsEmpty{};
123         }
124         return *m_ptr;
125     }
126
127     const T& operator*() const {
128         if (m_ptr == nullptr) {
129             throw BoxIsEmpty{};
130         }
131         return *m_ptr;
132     }
133
134     T& operator*() {
135         if (m_ptr == nullptr) {
136             throw BoxIsEmpty{};
137         }
138         return *m_ptr;
139     }
140
141     const T& operator*() const {
142         if (m_ptr == nullptr) {
143             throw BoxIsEmpty{};
144         }
145         return *m_ptr;
146     }
147
148     T& operator*() {
149         if (m_ptr == nullptr) {
150             throw BoxIsEmpty{};
151         }
152         return *m_ptr;
153     }
154
155     const T& operator*() const {
156         if (m_ptr == nullptr) {
157             throw BoxIsEmpty{};
158         }
159         return *m_ptr;
160     }
161
162     T& operator*() {
163         if (m_ptr == nullptr) {
164             throw BoxIsEmpty{};
165         }
166         return *m_ptr;
167     }
168
169     const T& operator*() const {
170         if (m_ptr == nullptr) {
171             throw BoxIsEmpty{};
172         }
173         return *m_ptr;
174     }
175
176     T& operator*() {
177         if (m_ptr == nullptr) {
178             throw BoxIsEmpty{};
179         }
180         return *m_ptr;
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```

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84         }
85         return *m_ptr;
86     }
87
88 private:
89     std::unique_ptr<T> m_ptr;
90 };
91
92 template <typename T>
93 Box(T&& value) -> Box<T>;
94
95 template <typename T>
96 Box(std::unique_ptr<T> ptr) -> Box<T>;
97
98 template <typename T, typename U>
99 bool operator==(const Box<T>& lhs, const Box<U>& rhs) {
100     return *lhs == *rhs;
101 }
102
103 template <typename T, typename U>
104 bool operator!=(const Box<T>& lhs, const Box<U>& rhs) {
105     return !(lhs == rhs);
106 }
107
108 // namespace wr22::utils
```

7.5 src/box.cpp File Reference

```
#include <wr22/utils/box.hpp>
```

Namespaces

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- namespace [wr22::utils](#)

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