

P1406R1

Add more `std::hash` specializations

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Source:

https://github.com/ZaMaZaN4iK/ConfsANDProps/blob/master/Proposals/complex_hash.bs

Abstract

In Standard library we already have `std::hash` specializations for some classes like `std::string`. Unfortunately, we have no specializations for a lot of other classes from Standard Library like `std::vector`, `std::array`, etc. At the moment people who need hash calculations for such containers must use `Boost.Hash` functions or write `std::hash` specialization manually. This proposal adds `std::hash` specializations for different containers from Standard Library. Addresses an issue LWG #1025.

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§ 1. Design decisions

- Proposed hash specializations give the same hash value for different containers with the same content. This may be useful for users to compare different containers in a fast manner. This also allows users to have heterogeneous searches in unordered maps by keys of different type.
- We do not enable `hash` for `unordered_set`, `unordered_map`, `unordered_multiset`, `unordered_multimap` because of the hashing collisions and buckets count. Position of the element depends on those two factors, which leads to different hashes for containers with the same content.
- We do not enable hash for `stack` and `queue` adapters for now.

§ 2. Proposed wording

Add a new Section "19.4.6, Hash support [pair.hash]", with following content:

```
template<typename A, typename B>
    struct hash<pair<A, B>>;
```

Enabled if specializations `hash<remove_const_t<A>>` and `hash<remove_const_t>` are both enabled, and disabled otherwise.

Let `PAIR` denote a `pair` type, `x` denote a value of type `PAIR`. For enabled specialization `hash<PAIR>` the following holds: `hash<PAIR>{}(x) == hash<decltype(tuple{x})>{}(x)`.

Add a new Section "19.5.3.11, Hash support [tuple.hash]", with following content:

```
template<typename... T>
    struct hash<tuple<T...>>;
```

Enabled if specialization `hash<remove_const_t<U>>` is enabled for every template argument `U` in the parameter pack, and disabled otherwise.

Add a new Section "21.3.7.7, Hash support [array.hash]", with following content:

```
template<typename T, std::size_t N>
    struct hash<array<T, N>>;
```

Enabled if specialization `hash<remove_const_t<T>>` is enabled, and disabled otherwise.

Add a new Section "21.3.8.6, Hash support [deque.hash]", with following content:

```
template<typename T, typename Allocator>
    struct hash<deque<T, Allocator>>;
```

Enabled if specialization `hash<remove_const_t<T>>` is enabled, and disabled otherwise.

Add a new Section "21.3.9.8, Hash support [forward_list.hash]", with following content:

```
template<typename T, typename Allocator>
    struct hash<forward_list<T, Allocator>>;
```

Enabled if specialization `hash<remove_const_t<T>>` is enabled, and disabled otherwise.

Add a new Section "21.3.10.7, Hash support [list.hash]", with following content:

```
template<typename T, typename Allocator>
    struct hash<list<T, Allocator>>;
```

Enabled if specialization `hash<remove_const_t<T>>` is enabled, and disabled otherwise.

Add a new Section "21.3.11.7, Hash support [vector.hash]", with following content:

```
template<typename T, typename Allocator>
    struct hash<vector<T, Allocator>>;
```

Enabled if specialization `hash<remove_const_t<T>>` is enabled, and disabled otherwise.

Add a new Section "21.4.4.6, Hash support [map.hash]", with following content:

```
template<typename Key, typename T, typename Compare, typename Allocator>
    struct hash<map<Key, T, Compare, Allocator>>;
```

Enabled if specialization if specializations `hash<remove_const_t<Key>>` and `hash<remove_const_t<T>>` are both enabled, and disabled otherwise.

Add a new Section "21.4.5.5, Hash support [multimap.hash]", with following content:

```
template<typename Key, typename T, typename Compare, typename Allocator>
    struct hash<multimap<Key, T, Compare, Allocator>>;
```

Enabled if specialization if specializations `hash<remove_const_t<Key>>` and `hash<remove_const_t<T>>` are both enabled, and disabled otherwise.

Add a new Section "21.4.6.4, Hash support [set.hash]", with following content:

```
template<typename Key, typename Compare, typename Allocator>
    struct hash<set<Key, Compare, Allocator>>;
```

Enabled if specialization if specializations `hash<remove_const_t<Key>>` is enabled, and disabled otherwise.

Add a new Section "21.4.7.4, Hash support [multiset.hash]", with following content:

```
template<typename Key, typename Compare, typename Allocator>
    struct hash<multiset<Key, Compare, Allocator>>;
```

Enabled if specialization if specializations `hash<remove_const_t<Key>>` is enabled, and disabled otherwise.

Add a new Section "25.7.2.9, Hash support [valarray.hash]", with following content:

```
template<typename T>
    struct hash<valarray<T>>;
```

Enabled if specialization `hash<remove_const_t<T>>` is enabled, and disabled otherwise.

Remove a paragraph from Section "20.3.5, Hash support [basic.string.hash]", with following content:

```
template<> struct hash<string>;
template<> struct hash<u8string>;
template<> struct hash<u16string>;
template<> struct hash<u32string>;
template<> struct hash<wstring>;
template<> struct hash<pmr::string>;
template<> struct hash<pmr::u8string>;
template<> struct hash<pmr::u16string>;
template<> struct hash<pmr::u32string>;
template<> struct hash<pmr::wstring>;
```

Add a new paragraph to Section "20.3.5, Hash support [basic.string.hash]", with following content:

```
template<typename charT, typename Allocator>
    struct hash<basic_string<charT, char_traits<charT>, Allocator>>;
```

Enabled if specialization `hash<remove_const_t<charT>>` is enabled, and disabled otherwise.

Add a new paragraph to "21.2.1, General container requirements [container.requirements.general]", with following content:

Let `X` denote a container type, `x` denote a value of type `X`, `TUPLE` denote a tuple value of all the values of `x` from `begin()` to `end()` where `get<i>(TUPLE)` equals `*advance(x.begin(), i)` for any `i` in range `[0; x.size())`. For enabled specialization `hash<X>` the following holds: `hash<X>{}(x) == hash<decltype(TUPLE)>{}(TUPLE)`.

§ 3. Possible implementation

Some possible implementations can be found in [Boost.Hash](#) library.

§ 4. References

[Boost.Hash](#)