Enums

Montag, 11. September 2023 12:46

Author: Damir Ljubic
e-mail: damirlj@yahoo.com

Intro

How would you add the logging facility (like with Decorator pattern) to the existing enum types
in a generic way? The compiler limitation is C++17 standard.

@Disclaimer Once again, I don't want to use the already existing libraries out there that provide the desired feature
out of box - but rather to find my own way to resolve this puzzle.

Implementation details

I've came up with two solutions, both somehow unsatisfactorily .
The first is the generic one, but not generic enough to stringify the enum names - from variadic pack of enumerators

We want to ensure, especially in embedded environment with C-style enums, as well with (C++) scoped enum classes - that the code
behaves as expected.
That is why there are some helper - utility methods to perform these kind of checks: preferably at compile time

```
namespace details
{
    template <typename Enum>
    constexpr auto underlying_type(Enum e) noexcept
    {
        return static_cast<std::underlying_type_t<Enum>>(e);
    }


    template <typename T, typename E>
    constexpr bool is_same(const T val, const E e) noexcept
    {
        if constexpr(std::is_enum_v<E>) // E as enum class (scoped enums)
        {
            if constexpr (std::is_convertible_v<T, std::underlying_type_t<E>>)// val is underlying type
            {
                return val == underlying_type(e);
            }
            else if constexpr (std::is_same_v<T, E>) // val itself is enum
            {
                return val == e;
            }
         }
         else if constexpr (std::is_convertible_v<T, E>) // c-style enums (unscoped enums)
         {
             return val == e;

         }

         return false;
     }
}// namespace details
```

We either have the underlying value, or the enum instance itself, for which we want to find corresponding string representation

```
namespace details
{
    static constexpr std::size_t INVALID_INDEX = -1;

    // Find the enum instance that matches the given value
    // @see details::is_same() : the given value can be underlying enum value, or the
    // the enum instance itself (unscoped/scoped)
    template <typename T, typename E, std::size_t N>
    [[nodiscard]] constexpr std::size_t find(const T val, const std::array<E, N>& enums) noexcept
    {
        std::size_t index = INVALID_INDEX;

        for(std::size_t i = 0; i < N; ++i) {
           if (is_same(val, enums[i])) { index = i; break; }
        }

        return index;
    }
```

```
    // Retrieve the enum instance from the underlying value, or default in case
    // that there is no match
    template <typename T, typename E, std::size_t N >
    [[nodiscard]] constexpr decltype(auto) from_underlying_value(const T val,
                const std::array<E, N>& enums,
                const E defaultValue) noexcept
    {
        const auto index = find(val, enums);
        return (index == INVALID_INDEX) ? defaultValue :enums[index];
    }

    // Enum instance (name) to the string representation, the same as Enum::toString() in Java
    template<typename T, typename E, std::size_t N>
    [[nodiscard]] constexpr decltype(auto) enum_to_string(const T val,
                const std::array<E, N>& enums,
                const std::array<std::string_view, N>& strings) noexcept
    {
        const auto index = find(val, enums);
        return (index == INVALID_INDEX) ? "<n/a>": strings[index];
    }
}// namespace details
```

I couldn't figure out better way of providing the stringify representation of enums name (like in Java Enum.toString()) than the following code

```
#define STRINGIFY(x) std::string_view(#x)

enum class AudioStream :std::uint8_t {main, alt, aux}; // existing enum type

// required: starting with C++23 local static constexpr variable are allowed
static const auto enums = createArray<AudioStream>(AudioStream::main, AudioStream::alt, AudioStream::aux),
static const auto names = createArray<std::string_view> (
                                    STRINGIFY(AudioStream::main),
                                    STRINGIFY(AudioStream::alt),
                                    STRINGIFY(AudioStream::aux))

template <typename T>
[[nodiscard]] constexpr decltype(auto) audioStreamToString(T audioStream) noexcept
{
    using namespace details;

    return enum_to_string(
                audioStream, // this can be underlying value, enum itself (unscoped and scoped as well)
                 enums,
                 names
               );
}
```

This use the helper method details::*createArray*, for creating the std::array from variadic argument pack

```
template <typename T1, typename...Ts>
constexpr bool are_same_args = (std::is_same_v<T1, Ts> && ...); //fold expression

template <typename E, typename...Ts>
// requires is_same_args<E, Ts...> // C++20
constexpr auto createArray(Ts&&...args) noexcept
{
    static_assert(are_same_args<E,Ts...>,"The arguments type mismatch");
    // in C++23 the local static constexpr std::array can be created and return by the reference
    constexpr auto N = sizeof...(Ts);
    return std::array<E, N> {std::forward<Ts>(args)...};
}
```

The second approach is customized to the given enum type - it's not generic at all, it doesn't work with underlying types - but it can be convenient

```
#define ENUM_CHECK(X) case (X) : return STRINGIFY(X)

constexpr std::string_view printAudioStream(AudioStream audioStream) noexcept
{
   switch (audioStream)
   {
        ENUM_CHECK(AudioStream::main);
        ENUM_CHECK(AudioStream::alt);
        ENUM_CHECK(AudioStream::aux);
```

```
        default: break;
    }
    return "<n/a>";
}
```

Links

Compiler Explorer: https://godbolt.org/z/ahEe36sbn

https://en.cppreference.com/w/cpp/language/enum