

A SFINAE-friendly trait to determine the extent of statically sized containers

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1 Abstract

We propose `ranges::static_extent`, a SFINAE friendly replacement of `std::extent` compatible with all statically sized containers.

2 Tony tables

Here is a (simplified) wording for `span` without and with this proposal

Before	After
<pre>template<class ElementType, ptrdiff_t Extent = dynamic_extent> class span { template<size_t N> constexpr span(element_type (&arr)[N]); template<size_t N> constexpr span(array<value_type, N>& arr); template<size_t N> constexpr span(const array<value_type, N>& arr); template<ContiguousRange R> constexpr span(R&& cont); //... }</pre>	<pre>template<class ElementType, ptrdiff_t Extent = dynamic_extent> class span { template <ranges::ContiguousRange R> requires Extent == dynamic_extent ranges::static_extent_v<R> == dynamic_extent constexpr span(R&& r); //... };</pre>

3 Motivation

This paper is an offshoot of [P1394]. While writing the wording and the implementation of `span` constructors, it became clear that a trait to determine the extent of a type would simplify both the wording and the implementation of `std::span` and any code dealing with types with static extent.

`std::extent` suffers from a few shortcomings that make it ill suited for the task:

- It only supports raw arrays
- `extent<T>::value` is well-formed for non-array types which means it can't be used in SFINAE contexts
- Because it returns 0 for types with no static extent, types with a static extent of 0 and types with no static extent would not be valid.

4 Proposal

We propose a new type trait `std::ranges::static_extent` to supersede `std::extent` such that:

- `ranges::static_extent<T>::value` is well formed if and only if the type has a static extent.
- `ranges::static_extent` can be specialized for non array types such as `std::array`, `std::span`, `std::mdspan` and user defined types;

5 Proposed wording

```
namespace ranges {
    template<class T, unsigned I = 0>
        struct static_extent;
    template <class T, unsigned I>
        struct static_extent<T[], I> : std::extent<T[], I> {};
    template<class T, std::size_t N, unsigned I>
        struct static_extent<T[N], I> : std::extent<T[N], I> {}
    template <class T, std::size_t N>
        struct static_extent<std::array<T, N>> : std::integral_constant<size_t, N> {};
    template <class T, std::size_t N>
        struct static_extent<std::span<T, N>> : std::integral_constant<size_t, N> {};

    template<class T, unsigned I = 0>
        inline constexpr size_t static_extent_v = static_extent<T, I>::value;
};
```

```
template<class T, unsigned I = 0>
struct static_extent;
```

If `T` is an array, the member `value` shall be equal to `std::extent_v<T[], I>`. Otherwise, unless this trait is specialized there shall be no member `value`.

Pursuant to [namespace.std], a program may specialize `static_extent` for statically sized types satisfying the requirements of Ranges such that, given an instance `c` of type `T`:

- If `I` equals 0 then `range::size(c)` shall always be equal to `static_extent<T>::value`

- Otherwise, `range::size(c[I])` shall always be equal to `static_extent<T, I>::value`

[*Example:*

```
// the following assertions hold:
static_assert (static_extent_v<int[2]> == 2);
static_assert (static_extent_v<int[2][4], 1> == 4);
static_assert (static_extent_v<int[][4], 1> == 4);
static_assert (static_extent_v<std::span<int, 5>> == 5);
static_assert (static_extent_v<std::array<int, 1>> == 1);
// the following expression are ill formed
(static_extent_v<int>);
(static_extent_v<std::vector<int>>);
(static_extent_v<std::span<int>>);
(static_extent_v<std::array<int>, 1>);
```

— *end example*]

5.1 `std::dynamic_extent`

For consistency, we propose to move `std::dynamic_extent` from the header `` to `std::ranges::dynamic_extent` in the header `<ranges>`

6 Future work

`std::span` should be modified to benefits of the changes proposed here.

7 References

[P1394] Corentin Jabot, Casey Carter *Range constructor for `std::span`*
<https://wg21.link/P1394>