Remove `basic_string::reserve()` From C++26

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Contents

1 Abstract

The `basic_string::reserve()` function overload taking no arguments was deprecated for C++20 as a poor substitute for `basic_string::shrink_to_fit`. This paper proposes removing that overload from the C++ Standard Library.

2 Revision history

2.1 R1: 2023 August (mid-term mailing)

Updates following LEWG online review, before submitting to electronic poll.

— Fixed assorted typos and markdown issues
— Moved to LEWG from LEWGI
— Add a second paragraph to Analysis highlighting the risk of using the deprecated function across different versions of the standard.
— Added a subsection below Analysis for migrating old code.

— Corrected test results to show when MSVC started warning with the /W3 switch
— Strengthened recommendation to remove in C++26 to help correct old code that still expects the `shrink_to_fit` behavior.
— Confirmed that no changes are expected for 16.4.5.3.2 [zombie.names].
— Provided Annex C wording.
— Added acknowledgements for all the help!

2.2 R0: 2023 May (pre-Varna 2023)

Initial draft of this paper.

3 Introduction

At the start of the C++23 cycle, [P2139R2] tried to review each deprecated feature of C++ to see which we would benefit from actively removing and which might now be better undeprecated. Consolidating all this analysis into one place was intended to ease the (L)EWG review process but in return gave the author so much feedback that the next revision of the paper was not completed.

For the C++26 cycle, a much shorter paper, [P2863R0], will track the overall analysis, but for features that the author wants to actively progress, a distinct paper will decouple progress from the larger paper so that the delays on a single feature do not hold up progress on all.

This paper takes up the deprecated `basic_string::reserve()` function overload, D.25 [depr.string.capacity].

4 Analysis

The `basic_string::reserve()` function taking no arguments was deprecated for C++20 by the paper [P0966R1]. This deprecation was a consequence of cleaning up the behavior of the `reserve` function to no longer optionally reallocate on a request to shrink. The original C++98 specification for `basic_string` supplied a default argument of 0 for `reserve`, turning a call to `reserve()` into a non-binding `shrink_to_fit` request. Note that `shrink_to_fit` was added in C++11 to better support this use case. With the removal of the potentially reallocating behavior, `reserve()` is now a redundant function overload that is guaranteed to do nothing. Hence it was deprecated in C++20, with a view to removing it entirely in a later standard to eliminate one more legacy source of confusion from the standard.

Note that retaining this overload leads to a behavior change between code written against C++11 – C++17 vs. code written against C++20 or later. To maintain consistent behavior across all C++ dialects from C++11 onwards, the call should be changed to `shrink_to_fit()` instead.

4.1 Updating deprecated code

Code that is still using the deprecated function today can be updated in one of three ways.

1. Simply remove the function call, as it does nothing.
2. Call `reserve(0)` to retain the call if desired but it still does nothing
3. Call `shrink_to_fit()` instead, to preserve the pre-C++20 semantic

All three updates will compile with tool chains back to C++11, and all but option 3 will compile (with a different meaning) back to C++98.

4.2 Deprecation experience

The following program was tested on Godbolt Compiler Explorer to determine whether current library implementations report deprecation warnings in their C++20 build mode, and if so, from which release:

```
#include <string>

int main() {
    std::string s;
    s.reserve();    // Should be deprecated
}
```

— libc++ 12.0
— libstdc++ 11.1
— Microsoft 19.25 (requires /W3 in MSVC)

4.3 C++23 review

At the LEWG telecon on 2020/07/13, there was general agreement that this member is a holdover from another time, whose replacement has been in place for some time. There was consensus to remove this member from C++23, assuming the subsequent research does not reveal major concerns before the main LEWG review that is to follow.

5 Recommendation for C++26

Following up from the C++23 recommendation for removal, we note that the change of behavior between C++17 and C++20 was silent, so users may not be aware that the good style of switching to `shrink_to_fit` in C++11 is now essential to retain that behavior. Hence, we strongly encourage removing this deprecated feature from C++26.

6 Wording

All wording is relative to [N4950], the latest working draft at the time of writing.

6.1 Zombie names

The only function being removing is a single overload of a member function that remains. Hence, there is nothing to add to 16.4.5.3.2 [zombie.names].

6.2 Proposed changes

C.1.X Annex D: compatibility features [diff.cpp23.depr]

1 **Change:** Remove `basic_string::reserve()` with no arguments.

Rationale: An earlier standard changed this function from behaving like a call to `shrink_to_fit` to instead having no effect. It is misleading to use old code written to the old idiom across different implementation of this standard.

Effect on original feature: A valid C++ 2023 program that calls `reserve()` on a `basic_string` object may fail to compile. The old functionality can be achieved by calling `shrink_to_fit()` instead, or the function call can be safely eliminated with no side effects.

D.25 [depr.string.capacity] Deprecated basic_string capacity

1 The following member is declared in addition to those members specified in 23.4.3.5 [string.capacity]:

```
namespace std {
  template<class charT, class traits = char_traits<charT>,
           class Allocator = allocator<charT>>
    class basic_string {
```

```
    public:
      void reserve();
  };
}
```

```
void reserve();
```

2 *Effects:* After this call, `capacity()` has an unspecified value greater than or equal to `size()`.

[*Note 1:* This is a non-binding shrink to fit request. —*end note*]

7 Acknowledgements

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Thanks to Matt Godbolt for Compiler Explorer, still the best tool for testing code against a variety of compilers implementing multiple editions of the C++ Standard.

Thanks to Detlef Vollmann for highlighting the need to document a migration strategy.

Thanks to Tim Song for pointing out that MSVC actually does give a deprecation warning when the correct (default) warning flags are used.

8 References

[N4950] Thomas Köppe. 2023-05-10. Working Draft, Standard for Programming Language C++.
https://wg21.link/n4950

[P0966R1] Mark Zeren, Andrew Luo. 2018-02-08. string::reserve Should Not Shrink.
https://wg21.link/p0966r1

[P2139R2] Alisdair Meredith. 2020-07-15. Reviewing Deprecated Facilities of C++20 for C++23.
https://wg21.link/p2139r2