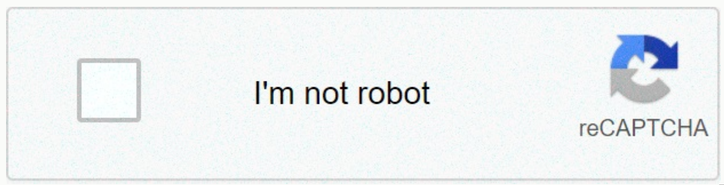

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C printf boolean format

Doc. no.: P1652R1 Date: 2019-07-17 Audience: LWG Reply-to: Zhihao Yuan Victor Zverovich rebase the wording on top of P0645R10 replace “applying” with “applied” replace “the ‘0’” with “the ‘0’ character” add an example demonstrating that the ‘0’ character is ignored when used together with alignment replace “. In such a case” with “, in which case” Printf heavily influences the formatting behavior design of std::format and Python str.format. However, in the process of development, the current specification of std::format misses a few beneficial outcomes comparing to printf and Python but inherits some unnecessary compromise from iostreams. This document is to show these corner cases and propose solutions in C++20.Problem 1: ‘#o’ specification should not print 0 as “00” variant behavior printf #o and #x print “0” for 0 Python #o, #x, and #b print “0o0”, “0x0”, “0b0”, respectively, for 0 format #o, #x, and #b print “00”, “0x0”, “0b0”, respectively, for 0 0odddd is not a pattern for octal literals in C++, so std::format replaces it with printf’s pattern dddd for #o. However, the # flag in printf is specified as follows: For o conversion, it increases the precision, if and only if necessary, to force the first digit of the result to be a zero (if the value and precision are both 0, a single 0 is printed). The output here matches C++ syntax where 0 is an octal literal. We propose to respecify std::format ‘#o’ to match printf output.Before:std::string s = std::format("{:#o}", 0); After:std::string s = std::format("{:#o}", 0); Problem 2: ‘c’ should be able to print 65 as “A” (ASCII) variant behavior printf ‘c’ prints “A” for 65, ‘lc’ prints “A” for (wint_t)65 Python ‘c’ prints “A” for 65 format throws an exception Not allowing ‘c’ to print integer generates a usability problem – the users won’t be able to print the return value of invoking cin.get() (also getc and fgetc) as characters. It is hostile to C++ learners if a cast is required to use stdio or iostreams with std::format for such a trivial task, while “{:c}” can be a way for them to express “show me a character here.”We propose to let integer presentation types support a new flag, ‘c’, which prints the argument x as-if static_cast(x), where charT is the character type of the format string defined in P0645. If the argument is not in the range representable by charT, format_error is thrown.Before:int c = 'A'; std::string s = std::format("{:c}", c); After:int c = 'A'; std::string s = std::format("{:c}", c); Problem 3: “-000nan” is not a floating point valueWhat printf("%07", -nan("")) prints is underspecified until C99 and POSIX 2008, where the effect of ‘0’ flag is described as: For d, i, o, u, x, X, a, A, e, E, f, F, g, and G conversions, leading zeros (following any indication of sign or base) are used to pad to the field width rather than performing space padding, except when converting an infinity or NaN. […] The last clause did not present in C89, C90, and POSIX 2003. The output “-000nan” cannot be correctly parsed by iostreams and strtod. As of 2016, FreeBSD libc, glibc, and Microsoft UCRT have all avoided it.However, iostreams mandates this pathological output with the internal iomanip. This output also presents in Python and fmt where the = alignment type is functionally equivalent to internal. Even worse, the dedicated ‘0’ std-format-spec is specified as “[…] equivalent to a fill character of ‘0’ with an alignment type of ‘=’”. So the output of ‘0’ flag in Python and fmt is incompatible with printf ‘0’ flag.The observations are: The internal iomanip only affects numeric output and does it poorly; The ‘=’ alignment type inherited all issues from internal and is verbose to write, hard to interpret, compared to ‘0’. Therefore, we propose to remove the ‘=’ alignment type and respecify ‘0’ to match C99 printf’s output. Note that Rust std::fmt, a newer Python-like formatting facility, also removed the ‘=’ align spec.Before:double nan = std::numeric_limits::quiet_NaN(); std::string s1 = std::format("{:0=6}", nan); std::string s2 = std::format("{:06}", nan); After:double nan = std::numeric_limits::quiet_NaN(); std::string s1 = std::format("{:0=6}", nan); std::string s2 = std::format("{:06}", nan); Problem 4: bool needs a type format specifier variant behavior printf does not print bool as “true” or “false” iostreams via boolalpha iomanip Python no type format specifier for bool but empty format specification invokes str() which returns “True” or “False” format no type format specifier for bool but empty format specification gives “true” or “false” So std::format can only print bool without a type format specifier, distinguishing it from all other fundamental types and string-like types. We consider ‘s’ flag to be a “Do What I Mean” (DWIM) improvement to this caveat. Note that the fmt library supports printing bool via %s in printf-compatible syntax, but did not propose the syntax for standardization.Before:std::string s = std::format("{:s}", true); After:std::string s = std::format("{:s}", true); Problem 5: double does not roundtrip float variant roundtrip double in shortest decimal representation float behavior printf No float is promoted to double iostreams No float is converted to double Python Yes does not support float32 format Yes float is converted to double Python prints shortest round-trip representations for floating point values by default; so does std::format – but not for float. Single-precision floating point values roundtrip in their realm and are already supported by std::to_chars. We should print a float as float rather than a long string used for disambiguating the value in double's realm.Before:std::string s = std::format("{}", 3.31f); After:std::string s = std::format("{}", 3.31f); WordingThe wording is relative to P0645R10.Modify 19.?.2 [format.string] as follows:format-spec ::= std-format-spec | custom-format-spec std-format-spec ::= [[fill] align] [sign] ['#'] ['0'] [width] ['.' precision] [type] fill ::= align ::= '' | '=' | '^' sign ::= '+' | '-' | ' ' width ::= nonzero-digit [integer] | '{' arg-id '}' precision ::= integer | '{' arg-id '}' type ::= 'a' | 'A' | 'b' | 'B' | 'c' | 'd' | 'e' | 'E' | 'f' | 'F' | 'g' | 'G' | 'n' | 'o' | 'p' | 's' | 'x' | 'X' […]The meaning of the various alignment options is as follows: Option Meaning '' Forces the field to be right-aligned within the available space. This is the default for arithmetic types other than charT and bool or when an integer presentation type is specified. '=' Forces the padding to be placed after the sign or prefix (if any) but before the digits. This is used for printing fields in the form +000000120. This alignment option is only valid for arithmetic types other than charT and bool or when an integer presentation type is specified. '^' Forces the field to be centered within the available space by inserting N/ 2 and N-N/ 2 fill characters before and after the value respectively, where N is the total number of fill characters to insert. [Example:char c = 120; string s0 = format("{:6}", 42); // s0 == " 42" string s1 = format("{:6}", 'x'); // s1 == "x " string s2 = format("{:*6}", 'x'); // s3 == "*****x" string s4 = format("{:*^6}", 'x'); // s4 == "**x***" string s5 = format("{:=6}", 'x'); // Error: '=' with charT and no integer presentation type string s65 = format("{:6d}", c); // s65 == " 120" string s7 = format("{:=+06d}", c); // s7 == "+00120" string s8 = format("{:0=#6x}", 0xa); // s8 == "0x000a" string s96 = format("{:6}", true); // s96 == "true " –end example]The '#' option causes the alternate form to be used for the conversion. This option is only valid for arithmetic types other than charT and bool or when an integer presentation type is specified. For integers, when binary , octal, or hexadecimal output is used, this option adds the respective prefix "0b" ("0B") , "0", or "0x" ("0X") to the output value. Whether the prefix is lower-case or upper-case is determined by the case of the type format specifier. The option prefixes the output value with "0" when octal output is used on nonzero integers. For floating-point numbers […]width is a decimal integer defining the minimum field width. If not specified, then the field width will be determined by the content.Preceding the width field by a zero ('0') character enables sign-aware zero-padding for arithmetic types. This is equivalent to a fill character of '0' with an alignment type of '='. pads leading zeros (following any indication of sign or base) to the field width, except when applied to an infinity or NaN. This option is only valid for arithmetic types other than charT and bool or when an integer presentation type is specified. If the ‘0’ character and an align option both appear, the ‘0’ character is ignored. [Example:char c = 120; string s1 = format("{:+06d}", c); // s1 == "+00120" string s2 = format("{:#06x}", 0xa); // s2 == "0x000a" string s3 = format("{:

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