Libdevice User's Guide

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Chapter 1. Introduction

1.1. What Is libdevice?

The libdevice library is a collection of NVVM bitcode functions that implement common functions for NVIDIA GPU devices, including math primitives and bit-manipulation functions. These functions are optimized for particular GPU architectures, and are intended to be linked with an NVVM IR module during compilation to PTX.

This guide documents both the functions available in libdevice and the basic usage of the library from a compiler writer's perspective.

Chapter 2. Basic Usage

2.1. Linking with libdevice

The libdevice library ships as an LLVM bitcode library and is meant to be linked with the target module early in the compilation process. The standard process for linking with libdevice is to first link it with the target module, then run the standard LLVM optimization and code generation passes. This allows the optimizers to inline and perform analyses on the used library functions, and eliminate any used functions as dead code.

Users of libnvvm can link with libdevice by adding the appropriate libdevice module to the `nvvmProgram` object being compiled. In addition, the following options for `nvvmCompileProgram` affect the behavior of libdevice functions:

Table 1. Supported Reflection Parameters

Parameter	Values	Description
`-ftz`	0 (default)	preserve denormal values, when performing single-precision floating-point operations
	1	flush denormal values to zero, when performing single-precision floating-point operations
`-prec-div`	0	use a faster approximation for single-precision floating-point division and reciprocals
	1 (default)	use IEEE round-to-nearest mode for single-precision floating-point division and reciprocals
`-prec-sqrt`	0	use a faster approximation for single-precision floating-point square root
	1 (default)	use IEEE round-to-nearest mode for single-precision floating-point square root

The following pseudo-code shows an example of linking an NVVM IR module with the libdevice library using libnvvm:

```
nvvmProgram prog;
size_t libdeviceModSize;

const char *libdeviceMod = loadFile('/path/to/libdevice.*.bc',
                                    &libdeviceModSize);
const char *myIr = /* NVVM IR in text or binary format */;
size_t myIrSize = /* size of myIr in bytes */;
```

```
// Create NVVM program object
nvvmCreateProgram(&prog);

// Add libdevice module to program
nvvmAddModuleToProgram(prog, libdeviceMod, libdeviceModSize);

// Add custom IR to program
nvvmAddModuleToProgram(prog, myIr, myIrSize);

// Declare compile options
const char *options[] = { "-ftz=1" };

// Compile the program
nvvmCompileProgram(prog, 1, options);
```

It is the responsibility of the client program to locate and read the libdevice library binary (represented by the `loadFile` function in the example).

Chapter 3. Function Reference

This chapter describes all functions available in libdevice.

3.1. __nv_abs

Prototype:

```
i32 @__nv_abs(i32 %x)
```

Description:

Determine the absolute value of the 32-bit signed integer x.

Returns:

Returns the absolute value of the 32-bit signed integer x.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.2. __nv_acos

Prototype:

```
double @__nv_acos(double %x)
```

Description:

Calculate the principal value of the arc cosine of the input argument x.

Returns:

Result will be in radians, in the interval [0, π] for x inside [-1, +1].

- __nv_acos(1) returns +0.

- __nv_acos(x) returns NaN for x outside [-1, +1].

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.3. __nv_acosf

Prototype:

```
float @__nv_acosf(float %x)
```

Description:

Calculate the principal value of the arc cosine of the input argument x.

Returns:

Result will be in radians, in the interval [0, π] for x inside [-1, +1].

- __nv_acosf(1) returns +0.
- __nv_acosf(x) returns NaN for x outside [-1, +1].

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.4. __nv_acosh

Prototype:

```
double @__nv_acosh(double %x)
```

Description:

Calculate the nonnegative arc hyperbolic cosine of the input argument x.

Returns:

Result will be in the interval $[0, +\infty]$.

- __nv_acosh(1) returns 0.
- __nv_acosh(x) returns NaN for x in the interval $[-\infty, 1)$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.5. __nv_acoshf

Prototype:

```
float @__nv_acoshf(float %x)
```

Description:

Calculate the nonnegative arc hyperbolic cosine of the input argument x.

Returns:

Result will be in the interval $[0, +\infty]$.

- __nv_acoshf(1) returns 0.
- __nv_acoshf(x) returns NaN for x in the interval $[-\infty, 1)$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.6. __nv_asin

Prototype:

```
double @__nv_asin(double %x)
```

Description:

Calculate the principal value of the arc sine of the input argument x.

Returns:

Result will be in radians, in the interval [- π /2, + π /2] for x inside [-1, +1].

- __nv_asin(0) returns +0.
- __nv_asin(x) returns NaN for x outside [-1, +1].

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.7. __nv_asinf

Prototype:

```
float @__nv_asinf(float %x)
```

Description:

Calculate the principal value of the arc sine of the input argument x.

Returns:

Result will be in radians, in the interval [- π /2, + π /2] for x inside [-1, +1].

- __nv_asinf(0) returns +0.
- __nv_asinf(x) returns NaN for x outside [-1, +1].

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.8. __nv_asinh

Prototype:

```
double @__nv_asinh(double %x)
```

Description:

Calculate the arc hyperbolic sine of the input argument `x`.

Returns:

- __nv_asinh(0) returns 1.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.9. __nv_asinhf

Prototype:

```
float @__nv_asinhf(float %x)
```

Description:

Calculate the arc hyperbolic sine of the input argument `x`.

Returns:

- __nv_asinh(0) returns 1.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.10. __nv_atan

Prototype:

```
double @__nv_atan(double %x)
```

Description:

Calculate the principal value of the arc tangent of the input argument x.

Returns:

Result will be in radians, in the interval [- π /2, + π /2].

- __nv_atan(0) returns +0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.11. __nv_atan2

Prototype:

```
double @__nv_atan2(double %x, double %y)
```

Description:

Calculate the principal value of the arc tangent of the ratio of first and second input arguments `x` / `y`. The quadrant of the result is determined by the signs of inputs `x` and `y`.

Returns:

Result will be in radians, in the interval [- π /, + π].

- __nv_atan2(0, 1) returns +0.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.12. __nv_atan2f

Prototype:

```
float @__nv_atan2f(float %x, float %y)
```

Description:

Calculate the principal value of the arc tangent of the ratio of first and second input arguments `x` / `y`. The quadrant of the result is determined by the signs of inputs `x` and `y`.

Returns:

Result will be in radians, in the interval [- π /, + π].

- __nv_atan2f(0, 1) returns +0.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.13. __nv_atanf

Prototype:

```
float @__nv_atanf(float %x)
```

Description:

Calculate the principal value of the arc tangent of the input argument x.

Returns:

Result will be in radians, in the interval [- π /2, + π /2].

- __nv_atan(0) returns +0.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.14. __nv_atanh

Prototype:

```
double @__nv_atanh(double %x)
```

Description:

Calculate the arc hyperbolic tangent of the input argument x.

Returns:

- __nv_atanh(± 0) returns ± 0.
- __nv_atanh(± 1) returns $\pm\infty$.
- __nv_atanh(x) returns NaN for x outside interval [-1, 1].

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.15. __nv_atanhf

Prototype:

```
float @__nv_atanhf(float %x)
```

Description:

Calculate the arc hyperbolic tangent of the input argument x.

Returns:

- __nv_atanhf(± 0) returns ± 0.
- __nv_atanhf(± 1) returns $\pm \infty$.
- __nv_atanhf(x) returns NaN for x outside interval [-1, 1].

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.16. __nv_brev

Prototype:

```
i32 @__nv_brev(i32 %x)
```

Description:

Reverses the bit order of the 32 bit unsigned integer x.

Returns:

Returns the bit-reversed value of x. i.e. bit N of the return value corresponds to bit 31-N of x.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.17. __nv_brevll

Prototype:

```
i64 @__nv_brevll(i64 %x)
```

Description:

Reverses the bit order of the 64 bit unsigned integer `x`.

Returns:

Returns the bit-reversed value of `x`. i.e. bit N of the return value corresponds to bit 63-N of `x`.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.18. __nv_byte_perm

Prototype:

```
i32 @__nv_byte_perm(i32 %x, i32 %y, i32 %z)
```

Description:

__nv_byte_perm(x,y,s) returns a 32-bit integer consisting of four bytes from eight input bytes provided in the two input integers `x` and `y`, as specified by a selector, `s`.

The input bytes are indexed as follows:

```
input[0] = x<7:0>   input[1] = x<15:8>
input[2] = x<23:16> input[3] = x<31:24>
input[4] = y<7:0>   input[5] = y<15:8>
input[6] = y<23:16> input[7] = y<31:24>
```

The selector indices are as follows (the upper 16-bits of the selector are not used):

```
selector[0] = s<2:0>  selector[1] = s<6:4>
selector[2] = s<10:8> selector[3] = s<14:12>
```

Returns:

The returned value r is computed to be: `result[n] := input[selector[n]]` where `result[n]` is the nth byte of r.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.19. __nv_cbrt

Prototype:

```
double @__nv_cbrt(double %x)
```

Description:

Calculate the cube root of x, $x^{1/3}$.

Returns:

Returns $x^{1/3}$.

- __nv_cbrt(± 0) returns ± 0.
- __nv_cbrt($\pm\infty$) returns $\pm\infty$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.20. __nv_cbrtf

Prototype:

```
float @__nv_cbrtf(float %x)
```

Description:

Calculate the cube root of x, $x^{1/3}$.

Returns:

Returns $x^{1/3}$.

- __nv_cbrtf(± 0) returns ± 0.
- __nv_cbrtf($\pm \infty$) returns $\pm \infty$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.21. __nv_ceil

Prototype:

```
double @__nv_ceil(double %x)
```

Description:

Compute the smallest integer value not less than x.

Returns:

Returns $\lceil x \rceil$ expressed as a floating-point number.

- __nv_ceil(± 0) returns ± 0.
- __nv_ceil($\pm \infty$) returns $\pm \infty$.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.22. __nv_ceilf

Prototype:

```
float @__nv_ceilf(float %x)
```

Description:

Compute the smallest integer value not less than x.

Returns:

Returns $\lceil x \rceil$ expressed as a floating-point number.

- __nv_ceilf(± 0) returns ± 0.
- __nv_ceilf($\pm \infty$) returns $\pm \infty$.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.23. __nv_clz

Prototype:

```
i32 @__nv_clz(i32 %x)
```

Description:

Count the number of consecutive leading zero bits, starting at the most significant bit (bit 31) of x.

Returns:

Returns a value between 0 and 32 inclusive representing the number of zero bits.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.24. __nv_clzll

Prototype:

```
i32 @__nv_clzll(i64 %x)
```

Description:

Count the number of consecutive leading zero bits, starting at the most significant bit (bit 63) of x.

Returns:

Returns a value between 0 and 64 inclusive representing the number of zero bits.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.25. __nv_copysign

Prototype:

```
double @__nv_copysign(double %x, double %y)
```

Description:

Create a floating-point value with the magnitude x and the sign of y.

Returns:

Returns a value with the magnitude of x and the sign of y.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.26. __nv_copysignf

Prototype:

```
float @__nv_copysignf(float %x, float %y)
```

Description:

Create a floating-point value with the magnitude x and the sign of y.

Returns:

Returns a value with the magnitude of x and the sign of y.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.27. __nv_cos

Prototype:

```
double @__nv_cos(double %x)
```

Description:

Calculate the cosine of the input argument x (measured in radians).

Returns:

- __nv_cos(± 0) returns 1.
- __nv_cos($\pm \infty$) returns NaN.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.28. __nv_cosf

Prototype:

```
float @__nv_cosf(float %x)
```

Description:

Calculate the cosine of the input argument x (measured in radians).

Returns:

- __nv_cosf(± 0) returns 1.
- __nv_cosf($\pm \infty$) returns NaN.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.29. __nv_cosh

Prototype:

```
double @__nv_cosh(double %x)
```

Description:

Calculate the hyperbolic cosine of the input argument x.

Returns:

- __nv_cosh(0) returns 1.
- __nv_cosh($\pm\infty$) returns $+\infty$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.30. __nv_coshf

Prototype:

```
float @__nv_coshf(float %x)
```

Description:

Calculate the hyperbolic cosine of the input argument x.

Returns:

- __nv_coshf(0) returns 1.

- __nv_coshf($\pm\infty$) returns $+\infty$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.31. __nv_cospi

Prototype:

```
double @__nv_cospi(double %x)
```

Description:

Calculate the cosine of $x \times \pi$ (measured in radians), where x is the input argument.

Returns:

- __nv_cospi(± 0) returns 1.
- __nv_cospi($\pm\infty$) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.32. __nv_cospif

Prototype:

```
float @__nv_cospif(float %x)
```

Description:

Calculate the cosine of $x \times \pi$ (measured in radians), where x is the input argument.

Returns:

- __nv_cospif(± 0) returns 1.
- __nv_cospif($\pm\infty$) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.33. __nv_dadd_rd

Prototype:

```
double @__nv_dadd_rd(double %x, double %y)
```

Description:

Adds two floating point values `x` and `y` in round-down (to negative infinity) mode.

Returns:

Returns `x + y`.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.34. __nv_dadd_rn

Prototype:

```
double @__nv_dadd_rn(double %x, double %y)
```

Description:

Adds two floating point values `x` and `y` in round-to-nearest-even mode.

Returns:

Returns `x + y`.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.
>
> This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.35. __nv_dadd_ru

Prototype:

```
double @__nv_dadd_ru(double %x, double %y)
```

Description:

Adds two floating point values `x` and `y` in round-up (to positive infinity) mode.

Returns:

Returns `x + y`.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.
>
> This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.36. __nv_dadd_rz

Prototype:

```
double @__nv_dadd_rz(double %x, double %y)
```

Description:

Adds two floating point values x and y in round-towards-zero mode.

Returns:

Returns x + y.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.
>
> This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.37. __nv_ddiv_rd

Prototype:

```
double @__nv_ddiv_rd(double %x, double %y)
```

Description:

Divides two floating point values x by y in round-down (to negative infinity) mode.

Returns:

Returns x / y.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.
>
> Requires compute capability >= 2.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.38. __nv_ddiv_rn

Prototype:

```
double @__nv_ddiv_rn(double %x, double %y)
```

Description:

Divides two floating point values `x` by `y` in round-to-nearest-even mode.

Returns:

Returns `x` / `y`.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.
>
> Requires compute capability >= 2.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.39. __nv_ddiv_ru

Prototype:

```
double @__nv_ddiv_ru(double %x, double %y)
```

Description:

Divides two floating point values `x` by `y` in round-up (to positive infinity) mode.

Returns:

Returns `x` / `y`.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Requires compute capability >= 2.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.40. __nv_ddiv_rz

Prototype:

```
double @__nv_ddiv_rz(double %x, double %y)
```

Description:

Divides two floating point values `x` by `y` in round-towards-zero mode.

Returns:

Returns `x` / `y`.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Requires compute capability >= 2.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.41. __nv_dmul_rd

Prototype:

```
double @__nv_dmul_rd(double %x, double %y)
```

Description:

Multiplies two floating point values `x` and `y` in round-down (to negative infinity) mode.

Returns:

Returns x * y.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.42. __nv_dmul_rn

Prototype:

```
double @__nv_dmul_rn(double %x, double %y)
```

Description:

Multiplies two floating point values x and y in round-to-nearest-even mode.

Returns:

Returns x * y.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.43. __nv_dmul_ru

Prototype:

```
double @__nv_dmul_ru(double %x, double %y)
```

Description:

Multiplies two floating point values `x` and `y` in round-up (to positive infinity) mode.

Returns:

Returns `x` * `y`.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.44. __nv_dmul_rz

Prototype:

```
double @__nv_dmul_rz(double %x, double %y)
```

Description:

Multiplies two floating point values `x` and `y` in round-towards-zero mode.

Returns:

Returns `x` * `y`.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.45. __nv_double2float_rd

Prototype:

```
float @__nv_double2float_rd(double %d)
```

Description:

Convert the double-precision floating point value x to a single-precision floating point value in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.46. __nv_double2float_rn

Prototype:

```
float @__nv_double2float_rn(double %d)
```

Description:

Convert the double-precision floating point value x to a single-precision floating point value in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.47. __nv_double2float_ru

Prototype:

```
float @__nv_double2float_ru(double %d)
```

Description:

Convert the double-precision floating point value x to a single-precision floating point value in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.48. __nv_double2float_rz

Prototype:

```
float @__nv_double2float_rz(double %d)
```

Description:

Convert the double-precision floating point value x to a single-precision floating point value in round-towards-zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.49. __nv_double2hiint

Prototype:

```
i32 @__nv_double2hiint(double %d)
```

Description:

Reinterpret the high 32 bits in the double-precision floating point value x as a signed integer.

Returns:

Returns reinterpreted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.50. __nv_double2int_rd

Prototype:

```
i32 @__nv_double2int_rd(double %d)
```

Description:

Convert the double-precision floating point value `x` to a signed integer value in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.51. __nv_double2int_rn

Prototype:

```
i32 @__nv_double2int_rn(double %d)
```

Description:

Convert the double-precision floating point value `x` to a signed integer value in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.52. __nv_double2int_ru

Prototype:

```
i32 @__nv_double2int_ru(double %d)
```

Description:

Convert the double-precision floating point value x to a signed integer value in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.53. __nv_double2int_rz

Prototype:

```
i32 @__nv_double2int_rz(double %d)
```

Description:

Convert the double-precision floating point value x to a signed integer value in round-towards-zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.54. __nv_double2ll_rd

Prototype:

```
i64 @__nv_double2ll_rd(double %f)
```

Description:

Convert the double-precision floating point value x to a signed 64-bit integer value in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.55. __nv_double2ll_rn

Prototype:

```
i64 @__nv_double2ll_rn(double %f)
```

Description:

Convert the double-precision floating point value x to a signed 64-bit integer value in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.56. __nv_double2ll_ru

Prototype:

```
i64 @__nv_double2ll_ru(double %f)
```

Description:

Convert the double-precision floating point value x to a signed 64-bit integer value in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.57. __nv_double2ll_rz

Prototype:

```
i64 @__nv_double2ll_rz(double %f)
```

Description:

Convert the double-precision floating point value x to a signed 64-bit integer value in round-towards-zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.58. __nv_double2loint

Prototype:

```
i32 @__nv_double2loint(double %d)
```

Description:

Reinterpret the low 32 bits in the double-precision floating point value x as a signed integer.

Returns:

Returns reinterpreted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.59. __nv_double2uint_rd

Prototype:

```
i32 @__nv_double2uint_rd(double %d)
```

Description:

Convert the double-precision floating point value `x` to an unsigned integer value in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.60. __nv_double2uint_rn

Prototype:

```
i32 @__nv_double2uint_rn(double %d)
```

Description:

Convert the double-precision floating point value `x` to an unsigned integer value in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.61. __nv_double2uint_ru

Prototype:

```
i32 @__nv_double2uint_ru(double %d)
```

Description:

Convert the double-precision floating point value `x` to an unsigned integer value in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.62. __nv_double2uint_rz

Prototype:

```
i32 @__nv_double2uint_rz(double %d)
```

Description:

Convert the double-precision floating point value `x` to an unsigned integer value in round-towards-zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.63. __nv_double2ull_rd

Prototype:

```
i64 @__nv_double2ull_rd(double %f)
```

Description:

Convert the double-precision floating point value `x` to an unsigned 64-bit integer value in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.64. __nv_double2ull_rn

Prototype:

```
i64 @__nv_double2ull_rn(double %f)
```

Description:

Convert the double-precision floating point value `x` to an unsigned 64-bit integer value in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.65. __nv_double2ull_ru

Prototype:

```
i64 @__nv_double2ull_ru(double %f)
```

Description:

Convert the double-precision floating point value `x` to an unsigned 64-bit integer value in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.66. __nv_double2ull_rz

Prototype:

```
i64 @__nv_double2ull_rz(double %f)
```

Description:

Convert the double-precision floating point value `x` to an unsigned 64-bit integer value in round-towards-zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.67. __nv_double_as_longlong

Prototype:

```
i64 @__nv_double_as_longlong(double %x)
```

Description:

Reinterpret the bits in the double-precision floating point value `x` as a signed 64-bit integer.

Returns:

Returns reinterpreted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.68. __nv_drcp_rd

Prototype:

```
double @__nv_drcp_rd(double %x)
```

Description:

Compute the reciprocal of `x` in round-down (to negative infinity) mode.

Returns:

Returns $\frac{1}{x}$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.
>
> Requires compute capability >= 2.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.69. __nv_drcp_rn

Prototype:

```
double @__nv_drcp_rn(double %x)
```

Description:

Compute the reciprocal of `x` in round-to-nearest-even mode.

Returns:

Returns $\frac{1}{x}$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.
>
> Requires compute capability >= 2.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.70. __nv_drcp_ru

Prototype:

```
double @__nv_drcp_ru(double %x)
```

Description:

Compute the reciprocal of `x` in round-up (to positive infinity) mode.

Returns:

Returns $\frac{1}{x}$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.
>
> Requires compute capability >= 2.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.71. __nv_drcp_rz

Prototype:

```
double @__nv_drcp_rz(double %x)
```

Description:

Compute the reciprocal of `x` in round-towards-zero mode.

Returns:

Returns $\frac{1}{x}$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.
>
> Requires compute capability >= 2.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.72. __nv_dsqrt_rd

Prototype:

```
double @__nv_dsqrt_rd(double %x)
```

Description:

Compute the square root of x in round-down (to negative infinity) mode.

Returns:

Returns $\sqrt{x}$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.
>
> Requires compute capability >= 2.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.73. __nv_dsqrt_rn

Prototype:

```
double @__nv_dsqrt_rn(double %x)
```

Description:

Compute the square root of x in round-to-nearest-even mode.

Returns:

Returns $\sqrt{x}$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.
>
> Requires compute capability >= 2.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.74. __nv_dsqrt_ru

Prototype:

```
double @__nv_dsqrt_ru(double %x)
```

Description:

Compute the square root of `x` in round-up (to positive infinity) mode.

Returns:

Returns $\sqrt{x}$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.
>
> Requires compute capability >= 2.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.75. __nv_dsqrt_rz

Prototype:

```
double @__nv_dsqrt_rz(double %x)
```

Description:

Compute the square root of `x` in round-towards-zero mode.

Returns:

Returns $\sqrt{x}$.

> **Note:**

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Requires compute capability >= 2.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.76. __nv_erf

Prototype:

```
double @__nv_erf(double %x)
```

Description:

Calculate the value of the error function for the input argument x, $\frac{2}{\sqrt{\pi}}\int_0^x e^{-t^2}dt$.

Returns:

- __nv_erf(± 0) returns ± 0.
- __nv_erf($\pm\infty$) returns ± 1.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.77. __nv_erfc

Prototype:

```
double @__nv_erfc(double %x)
```

Description:

Calculate the complementary error function of the input argument x, 1 - erf(x).

Returns:

- __nv_erfc($-\infty$) returns 2.
- __nv_erfc($+\infty$) returns +0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.78. __nv_erfcf

Prototype:

```
float @__nv_erfcf(float %x)
```

Description:

Calculate the complementary error function of the input argument x, 1 - erf(x).

Returns:

- __nv_erfcf($-\infty$) returns 2.
- __nv_erfcf($+\infty$) returns +0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.79. __nv_erfcinv

Prototype:

```
double @__nv_erfcinv(double %x)
```

Description:

Calculate the inverse complementary error function of the input argument y, for y in the interval [0, 2]. The inverse complementary error function find the value x that satisfies the equation y = erfc(x), for $0 \leq y \leq 2$, and $-\infty \leq x \leq \infty$.

Returns:

- __nv_erfcinv(0) returns $+\infty$.
- __nv_erfcinv(2) returns $-\infty$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.80. __nv_erfcinvf

Prototype:

```
float @__nv_erfcinvf(float %x)
```

Description:

Calculate the inverse complementary error function of the input argument y, for y in the interval [0, 2]. The inverse complementary error function find the value x that satisfies the equation y = erfc(x), for $0 \leq y \leq 2$, and $-\infty \leq x \leq \infty$.

Returns:

- __nv_erfcinvf(0) returns $+\infty$.
- __nv_erfcinvf(2) returns $-\infty$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.81. __nv_erfcx

Prototype:

```
double @__nv_erfcx(double %x)
```

Description:

Calculate the scaled complementary error function of the input argument x, $e^{x^2} \cdot \mathrm{erfc}(x)$.

Returns:

- __nv_erfcx($-\infty$) returns $+\infty$
- __nv_erfcx($+\infty$) returns +0
- __nv_erfcx(x) returns $+\infty$ if the correctly calculated value is outside the double floating point range.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.82. __nv_erfcxf

Prototype:

```
float @__nv_erfcxf(float %x)
```

Description:

Calculate the scaled complementary error function of the input argument x, $e^{x^2} \cdot \mathrm{erfc}(x)$.

Returns:

- __nv_erfcxf($-\infty$) returns $+\infty$
- __nv_erfcxf($+\infty$) returns +0

- __nv_erfcxf(x) returns $+\infty$ if the correctly calculated value is outside the double floating point range.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.83. __nv_erff

Prototype:

```
float @__nv_erff(float %x)
```

Description:

Calculate the value of the error function for the input argument x, $\frac{2}{\sqrt{\pi}}\int_0^x e^{-t^2}dt$.

Returns:

- __nv_erff(± 0) returns ± 0.
- __nv_erff($\pm\infty$) returns ± 1.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.84. __nv_erfinv

Prototype:

```
double @__nv_erfinv(double %x)
```

Description:

Calculate the inverse error function of the input argument `y`, for `y` in the interval [-1, 1]. The inverse error function finds the value `x` that satisfies the equation `y` = erf(`x`), for $-1 \leq y \leq 1$, and $-\infty \leq x \leq \infty$.

Returns:

- __nv_erfinv(1) returns $+\infty$.
- __nv_erfinv(-1) returns $-\infty$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.85. __nv_erfinvf

Prototype:

```
float @__nv_erfinvf(float %x)
```

Description:

Calculate the inverse error function of the input argument `y`, for `y` in the interval [-1, 1]. The inverse error function finds the value `x` that satisfies the equation `y` = erf(`x`), for $-1 \leq y \leq 1$, and $-\infty \leq x \leq \infty$.

Returns:

- __nv_erfinvf(1) returns $+\infty$.
- __nv_erfinvf(-1) returns $-\infty$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.86. __nv_exp

Prototype:

```
double @__nv_exp(double %x)
```

Description:

Calculate the base e exponential of the input argument x.

Returns:

Returns e^x.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.87. __nv_exp10

Prototype:

```
double @__nv_exp10(double %x)
```

Description:

Calculate the base 10 exponential of the input argument x.

Returns:

Returns 10^x.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.88. __nv_exp10f

Prototype:

```
float @__nv_exp10f(float %x)
```

Description:

Calculate the base 10 exponential of the input argument x.

Returns:

Returns 10^x.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.89. __nv_exp2

Prototype:

```
double @__nv_exp2(double %x)
```

Description:

Calculate the base 2 exponential of the input argument x.

Returns:

Returns 2^x.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.90. __nv_exp2f

Prototype:

```
float @__nv_exp2f(float %x)
```

Description:

Calculate the base 2 exponential of the input argument x.

Returns:

Returns 2^x.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.91. __nv_expf

Prototype:

```
float @__nv_expf(float %x)
```

Description:

Calculate the base e exponential of the input argument x.

Returns:

Returns e^x.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.92. __nv_expm1

Prototype:

```
double @__nv_expm1(double %x)
```

Description:

Calculate the base e exponential of the input argument x, minus 1.

Returns:

Returns $e^x - 1$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.93. __nv_expm1f

Prototype:

```
float @__nv_expm1f(float %x)
```

Description:

Calculate the base e exponential of the input argument x, minus 1.

Returns:

Returns $e^x - 1$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.94. __nv_fabs

Prototype:

```
double @__nv_fabs(double %f)
```

Description:

Calculate the absolute value of the input argument x.

Returns:

Returns the absolute value of the input argument.

- __nv_fabs($\pm\infty$) returns $+\infty$.
- __nv_fabs(± 0) returns 0.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.95. __nv_fabsf

Prototype:

```
float @__nv_fabsf(float %f)
```

Description:

Calculate the absolute value of the input argument x.

Returns:

Returns the absolute value of the input argument.

- __nv_fabsf($\pm\infty$) returns $+\infty$.

- __nv_fabsf(± 0) returns 0.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.96. __nv_fadd_rd

Prototype:

```
float @__nv_fadd_rd(float %x, float %y)
```

Description:

Compute the sum of `x` and `y` in round-down (to negative infinity) mode.

Returns:

Returns `x + y`.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.
>
> This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.97. __nv_fadd_rn

Prototype:

```
float @__nv_fadd_rn(float %x, float %y)
```

Description:

Compute the sum of `x` and `y` in round-to-nearest-even rounding mode.

Returns:

Returns x + y.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.98. __nv_fadd_ru

Prototype:

```
float @__nv_fadd_ru(float %x, float %y)
```

Description:

Compute the sum of x and y in round-up (to positive infinity) mode.

Returns:

Returns x + y.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.99. __nv_fadd_rz

Prototype:

```
float @__nv_fadd_rz(float %x, float %y)
```

Description:

Compute the sum of x and y in round-towards-zero mode.

Returns:

Returns x + y.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.
>
> This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.100. __nv_fast_cosf

Prototype:

```
float @__nv_fast_cosf(float %x)
```

Description:

Calculate the fast approximate cosine of the input argument x, measured in radians.

Returns:

Returns the approximate cosine of x.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.2, Table 9.
>
> Input and output in the denormal range is flushed to sign preserving 0.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.101. __nv_fast_exp10f

Prototype:

```
float @__nv_fast_exp10f(float %x)
```

Description:

Calculate the fast approximate base 10 exponential of the input argument x, 10^x.

Returns:

Returns an approximation to 10^x.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.2, Table 9.
>
> Most input and output values around denormal range are flushed to sign preserving 0.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.102. __nv_fast_expf

Prototype:

```
float @__nv_fast_expf(float %x)
```

Description:

Calculate the fast approximate base e exponential of the input argument x, e^x.

Returns:

Returns an approximation to e^x.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.2, Table 9.
>
> Most input and output values around denormal range are flushed to sign preserving 0.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.103. __nv_fast_fdividef

Prototype:

```
float @__nv_fast_fdividef(float %x, float %y)
```

Description:

Calculate the fast approximate division of x by y.

Returns:

Returns x / y.

- __nv_fast_fdividef(∞ , y) returns NaN for $2^{126} < y < 2^{128}$.
- __nv_fast_fdividef(x, y) returns 0 for $2^{126} < y < 2^{128}$ and $x \neq \infty$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.2, Table 9.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.104. __nv_fast_log10f

Prototype:

```
float @__nv_fast_log10f(float %x)
```

Description:

Calculate the fast approximate base 10 logarithm of the input argument x.

Returns:

Returns an approximation to $\log_{10}(x)$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.2, Table 9.
>
> Most input and output values around denormal range are flushed to sign preserving 0.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.105. __nv_fast_log2f

Prototype:

```
float @__nv_fast_log2f(float %x)
```

Description:

Calculate the fast approximate base 2 logarithm of the input argument `x`.

Returns:

Returns an approximation to $\log_2(x)$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.2, Table 9.
>
> Input and output in the denormal range is flushed to sign preserving 0.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.106. __nv_fast_logf

Prototype:

```
float @__nv_fast_logf(float %x)
```

Description:

Calculate the fast approximate base e logarithm of the input argument `x`.

Returns:

Returns an approximation to $\log_e(x)$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.2, Table 9.
>
> Most input and output values around denormal range are flushed to sign preserving 0.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.107. __nv_fast_powf

Prototype:

```
float @__nv_fast_powf(float %x, float %y)
```

Description:

Calculate the fast approximate of `x`, the first input argument, raised to the power of `y`, the second input argument, x^y.

Returns:

Returns an approximation to x^y.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.2, Table 9.
>
> Most input and output values around denormal range are flushed to sign preserving 0.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.108. __nv_fast_sincosf

Prototype:

```
void @__nv_fast_sincosf(float %x, float* %sptr, float* %cptr)
```

Description:

Calculate the fast approximate of sine and cosine of the first input argument `x` (measured in radians). The results for sine and cosine are written into the second argument, `sptr`, and, respectively, third argument, `zptr`.

Returns:

- none

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.2, Table 9.

Denorm input/output is flushed to sign preserving 0.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.109. __nv_fast_sinf

Prototype:

```
float @__nv_fast_sinf(float %x)
```

Description:

Calculate the fast approximate sine of the input argument `x`, measured in radians.

Returns:

Returns the approximate sine of `x`.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.2, Table 9.

Input and output in the denormal range is flushed to sign preserving 0.0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.110. __nv_fast_tanf

Prototype:

```
float @__nv_fast_tanf(float %x)
```

Description:

Calculate the fast approximate tangent of the input argument x, measured in radians.

Returns:

Returns the approximate tangent of x.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.2, Table 9.
>
> The result is computed as the fast divide of __nv_sinf() by __nv_cosf(). Denormal input and output are flushed to sign-preserving 0.0 at each step of the computation.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.111. __nv_fdim

Prototype:

```
double @__nv_fdim(double %x, double %y)
```

Description:

Compute the positive difference between x and y. The positive difference is x - y when x > y and +0 otherwise.

Returns:

Returns the positive difference between x and y.

- __nv_fdim(x, y) returns x - y if x > y.

- __nv_fdim(x, y) returns +0 if x ≤ y.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.112. __nv_fdimf

Prototype:

```
float @__nv_fdimf(float %x, float %y)
```

Description:

Compute the positive difference between x and y. The positive difference is x - y when x > y and +0 otherwise.

Returns:

Returns the positive difference between x and y.

- __nv_fdimf(x, y) returns x - y if x > y.
- __nv_fdimf(x, y) returns +0 if x ≤ y.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.113. __nv_fdiv_rd

Prototype:

```
float @__nv_fdiv_rd(float %x, float %y)
```

Description:

Divide two floating point values `x` by `y` in round-down (to negative infinity) mode.

Returns:

Returns `x` / `y`.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.114. __nv_fdiv_rn

Prototype:

```
float @__nv_fdiv_rn(float %x, float %y)
```

Description:

Divide two floating point values `x` by `y` in round-to-nearest-even mode.

Returns:

Returns `x` / `y`.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.115. __nv_fdiv_ru

Prototype:

```
float @__nv_fdiv_ru(float %x, float %y)
```

Description:

Divide two floating point values x by y in round-up (to positive infinity) mode.

Returns:

Returns x / y.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.116. __nv_fdiv_rz

Prototype:

```
float @__nv_fdiv_rz(float %x, float %y)
```

Description:

Divide two floating point values x by y in round-towards-zero mode.

Returns:

Returns x / y.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.117. __nv_ffs

Prototype:

```
i32 @__nv_ffs(i32 %x)
```

Description:

Find the position of the first (least significant) bit set to 1 in `x`, where the least significant bit position is 1.

Returns:

Returns a value between 0 and 32 inclusive representing the position of the first bit set.

- __nv_ffs(0) returns 0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.118. __nv_ffsll

Prototype:

```
i32 @__nv_ffsll(i64 %x)
```

Description:

Find the position of the first (least significant) bit set to 1 in `x`, where the least significant bit position is 1.

Returns:

Returns a value between 0 and 64 inclusive representing the position of the first bit set.

- __nv_ffsll(0) returns 0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.119. __nv_finitef

Prototype:

```
i32 @__nv_finitef(float %x)
```

Description:

Determine whether the floating-point value `x` is a finite value.

Returns:

Returns a non-zero value if and only if `x` is a finite value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.120. __nv_float2half_rn

Prototype:

```
i16 @__nv_float2half_rn(float %f)
```

Description:

Convert the single-precision float value `x` to a half-precision floating point value represented in `unsigned short` format, in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.121. __nv_float2int_rd

Prototype:

```
i32 @__nv_float2int_rd(float %in)
```

Description:

Convert the single-precision floating point value `x` to a signed integer in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.122. __nv_float2int_rn

Prototype:

```
i32 @__nv_float2int_rn(float %in)
```

Description:

Convert the single-precision floating point value `x` to a signed integer in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.123. __nv_float2int_ru

Prototype:

```
i32 @__nv_float2int_ru(float %in)
```

Description:

Convert the single-precision floating point value `x` to a signed integer in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.124. __nv_float2int_rz

Prototype:

```
i32 @__nv_float2int_rz(float %in)
```

Description:

Convert the single-precision floating point value x to a signed integer in round-towards-zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.125. __nv_float2ll_rd

Prototype:

```
i64 @__nv_float2ll_rd(float %f)
```

Description:

Convert the single-precision floating point value x to a signed 64-bit integer in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.126. __nv_float2ll_rn

Prototype:

```
i64 @__nv_float2ll_rn(float %f)
```

Description:

Convert the single-precision floating point value x to a signed 64-bit integer in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.127. __nv_float2ll_ru

Prototype:

```
i64 @__nv_float2ll_ru(float %f)
```

Description:

Convert the single-precision floating point value x to a signed 64-bit integer in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.128. __nv_float2ll_rz

Prototype:

```
i64 @__nv_float2ll_rz(float %f)
```

Description:

Convert the single-precision floating point value x to a signed 64-bit integer in round-towards-zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.129. __nv_float2uint_rd

Prototype:

```
i32 @__nv_float2uint_rd(float %in)
```

Description:

Convert the single-precision floating point value x to an unsigned integer in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.130. __nv_float2uint_rn

Prototype:

```
i32 @__nv_float2uint_rn(float %in)
```

Description:

Convert the single-precision floating point value x to an unsigned integer in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.131. __nv_float2uint_ru

Prototype:

```
i32 @__nv_float2uint_ru(float %in)
```

Description:

Convert the single-precision floating point value x to an unsigned integer in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.132. __nv_float2uint_rz

Prototype:

```
i32 @__nv_float2uint_rz(float %in)
```

Description:

Convert the single-precision floating point value x to an unsigned integer in round-towards-zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.133. __nv_float2ull_rd

Prototype:

```
i64 @__nv_float2ull_rd(float %f)
```

Description:

Convert the single-precision floating point value x to an unsigned 64-bit integer in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.134. __nv_float2ull_rn

Prototype:

```
i64 @__nv_float2ull_rn(float %f)
```

Description:

Convert the single-precision floating point value `x` to an unsigned 64-bit integer in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.135. __nv_float2ull_ru

Prototype:

```
i64 @__nv_float2ull_ru(float %f)
```

Description:

Convert the single-precision floating point value `x` to an unsigned 64-bit integer in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.136. __nv_float2ull_rz

Prototype:

```
i64 @__nv_float2ull_rz(float %f)
```

Description:

Convert the single-precision floating point value `x` to an unsigned 64-bit integer in round-towards_zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.137. __nv_float_as_int

Prototype:

```
i32 @__nv_float_as_int(float %x)
```

Description:

Reinterpret the bits in the single-precision floating point value `x` as a signed integer.

Returns:

Returns reinterpreted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.138. __nv_floor

Prototype:

```
double @__nv_floor(double %f)
```

Description:

Calculates the largest integer value which is less than or equal to x.

Returns:

Returns the largest integer value which is less than or equal to x expressed as a floating-point number.

- __nv_floor($\pm\infty$) returns $\pm\infty$.
- __nv_floor(± 0) returns ± 0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.139. __nv_floorf

Prototype:

```
float @__nv_floorf(float %f)
```

Description:

Calculates the largest integer value which is less than or equal to x.

Returns:

Returns the largest integer value which is less than or equal to x expressed as a floating-point number.

- __nv_floorf($\pm\infty$) returns $\pm\infty$.
- __nv_floorf(± 0) returns ± 0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.140. __nv_fma

Prototype:

```
double @__nv_fma(double %x, double %y, double %z)
```

Description:

Compute the value of $x \times y + z$ as a single ternary operation. After computing the value to infinite precision, the value is rounded once.

Returns:

Returns the rounded value of $x \times y + z$ as a single operation.

- __nv_fma($\pm \infty$, ± 0 , z) returns NaN.
- __nv_fma(± 0 , $\pm \infty$, z) returns NaN.
- __nv_fma(x, y, $-\infty$) returns NaN if $x \times y$ is an exact $+\infty$.
- __nv_fma(x, y, $+\infty$) returns NaN if $x \times y$ is an exact $-\infty$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.141. __nv_fma_rd

Prototype:

```
double @__nv_fma_rd(double %x, double %y, double %z)
```

Description:

Computes the value of $x \times y + z$ as a single ternary operation, rounding the result once in round-down (to negative infinity) mode.

Returns:

Returns the rounded value of $x \times y + z$ as a single operation.

- __nv_fma_rd($\pm\infty$, ± 0 , z) returns NaN.
- __nv_fma_rd(± 0 , $\pm\infty$, z) returns NaN.
- __nv_fma_rd(x, y, $-\infty$) returns NaN if $x \times y$ is an exact $+\infty$
- __nv_fma_rd(x, y, $+\infty$) returns NaN if $x \times y$ is an exact $-\infty$

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.142. __nv_fma_rn

Prototype:

```
double @__nv_fma_rn(double %x, double %y, double %z)
```

Description:

Computes the value of $x \times y + z$ as a single ternary operation, rounding the result once in round-to-nearest-even mode.

Returns:

Returns the rounded value of $x \times y + z$ as a single operation.

- __nv_fma_rn($\pm\infty$, ± 0 , z) returns NaN.
- __nv_fma_rn(± 0 , $\pm\infty$, z) returns NaN.
- __nv_fma_rn(x, y, $-\infty$) returns NaN if $x \times y$ is an exact $+\infty$
- __nv_fma_rn(x, y, $+\infty$) returns NaN if $x \times y$ is an exact $-\infty$

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.143. __nv_fma_ru

Prototype:

```
double @__nv_fma_ru(double %x, double %y, double %z)
```

Description:

Computes the value of $x \times y + z$ as a single ternary operation, rounding the result once in round-up (to positive infinity) mode.

Returns:

Returns the rounded value of $x \times y + z$ as a single operation.

- __nv_fma_ru($\pm\infty$, ± 0 , z) returns NaN.
- __nv_fma_ru(± 0 , $\pm\infty$, z) returns NaN.
- __nv_fma_ru(x, y, $-\infty$) returns NaN if $x \times y$ is an exact $+\infty$
- __nv_fma_ru(x, y, $+\infty$) returns NaN if $x \times y$ is an exact $-\infty$

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.144. __nv_fma_rz

Prototype:

```
double @__nv_fma_rz(double %x, double %y, double %z)
```

Description:

Computes the value of $x \times y + z$ as a single ternary operation, rounding the result once in round-towards-zero mode.

Returns:

Returns the rounded value of $x \times y + z$ as a single operation.

- __nv_fma_rz($\pm\infty$, ± 0 , z) returns NaN.

- __nv_fma_rz(± 0 , $\pm\infty$, z) returns NaN.
- __nv_fma_rz(x, y, $-\infty$) returns NaN if $x \times y$ is an exact $+\infty$
- __nv_fma_rz(x, y, $+\infty$) returns NaN if $x \times y$ is an exact $-\infty$

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.145. __nv_fmaf

Prototype:

```
float @__nv_fmaf(float %x, float %y, float %z)
```

Description:

Compute the value of $x \times y + z$ as a single ternary operation. After computing the value to infinite precision, the value is rounded once.

Returns:

Returns the rounded value of $x \times y + z$ as a single operation.

- __nv_fmaf($\pm\infty$, ± 0 , z) returns NaN.
- __nv_fmaf(± 0 , $\pm\infty$, z) returns NaN.
- __nv_fmaf(x, y, $-\infty$) returns NaN if $x \times y$ is an exact $+\infty$.
- __nv_fmaf(x, y, $+\infty$) returns NaN if $x \times y$ is an exact $-\infty$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.146. __nv_fmaf_rd

Prototype:

```
float @__nv_fmaf_rd(float %x, float %y, float %z)
```

Description:

Computes the value of $x \times y + z$ as a single ternary operation, rounding the result once in round-down (to negative infinity) mode.

Returns:

Returns the rounded value of $x \times y + z$ as a single operation.

- __nv_fmaf_rd($\pm\infty$, ± 0 , z) returns NaN.
- __nv_fmaf_rd(± 0 , $\pm\infty$, z) returns NaN.
- __nv_fmaf_rd(x, y, $-\infty$) returns NaN if $x \times y$ is an exact $+\infty$.
- __nv_fmaf_rd(x, y, $+\infty$) returns NaN if $x \times y$ is an exact $-\infty$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.147. __nv_fmaf_rn

Prototype:

```
float @__nv_fmaf_rn(float %x, float %y, float %z)
```

Description:

Computes the value of $x \times y + z$ as a single ternary operation, rounding the result once in round-to-nearest-even mode.

Returns:

Returns the rounded value of $x \times y + z$ as a single operation.

- __nv_fmaf_rn($\pm\infty$, ± 0 , z) returns NaN.

- __nv_fmaf_rn(± 0 , $\pm \infty$, z) returns NaN.
- __nv_fmaf_rn(x, y, $-\infty$) returns NaN if $x \times y$ is an exact $+\infty$.
- __nv_fmaf_rn(x, y, $+\infty$) returns NaN if $x \times y$ is an exact $-\infty$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.148. __nv_fmaf_ru

Prototype:

```
float @__nv_fmaf_ru(float %x, float %y, float %z)
```

Description:

Computes the value of $x \times y + z$ as a single ternary operation, rounding the result once in round-up (to positive infinity) mode.

Returns:

Returns the rounded value of $x \times y + z$ as a single operation.

- __nv_fmaf_ru($\pm \infty$, ± 0 , z) returns NaN.
- __nv_fmaf_ru(± 0 , $\pm \infty$, z) returns NaN.
- __nv_fmaf_ru(x, y, $-\infty$) returns NaN if $x \times y$ is an exact $+\infty$.
- __nv_fmaf_ru(x, y, $+\infty$) returns NaN if $x \times y$ is an exact $-\infty$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.149. __nv_fmaf_rz

Prototype:

```
float @__nv_fmaf_rz(float %x, float %y, float %z)
```

Description:

Computes the value of $x \times y + z$ as a single ternary operation, rounding the result once in round-towards-zero mode.

Returns:

Returns the rounded value of $x \times y + z$ as a single operation.

- __nv_fmaf_rz($\pm\infty$, ± 0 , z) returns NaN.
- __nv_fmaf_rz(± 0 , $\pm\infty$, z) returns NaN.
- __nv_fmaf_rz(x, y, $-\infty$) returns NaN if $x \times y$ is an exact $+\infty$.
- __nv_fmaf_rz(x, y, $+\infty$) returns NaN if $x \times y$ is an exact $-\infty$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.150. __nv_fmax

Prototype:

```
double @__nv_fmax(double %x, double %y)
```

Description:

Determines the maximum numeric value of the arguments x and y. Treats NaN arguments as missing data. If one argument is a NaN and the other is legitimate numeric value, the numeric value is chosen.

Returns:

Returns the maximum numeric values of the arguments x and y.

- If both arguments are NaN, returns NaN.
- If one argument is NaN, returns the numeric argument.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.151. __nv_fmaxf

Prototype:

```
float @__nv_fmaxf(float %x, float %y)
```

Description:

Determines the maximum numeric value of the arguments `x` and `y`. Treats NaN arguments as missing data. If one argument is a NaN and the other is legitimate numeric value, the numeric value is chosen.

Returns:

Returns the maximum numeric values of the arguments `x` and `y`.

- If both arguments are NaN, returns NaN.
- If one argument is NaN, returns the numeric argument.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.152. __nv_fmin

Prototype:

```
double @__nv_fmin(double %x, double %y)
```

Description:

Determines the minimum numeric value of the arguments `x` and `y`. Treats NaN arguments as missing data. If one argument is a NaN and the other is legitimate numeric value, the numeric value is chosen.

Returns:

Returns the minimum numeric values of the arguments `x` and `y`.

- If both arguments are NaN, returns NaN.
- If one argument is NaN, returns the numeric argument.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.153. __nv_fminf

Prototype:

```
float @__nv_fminf(float %x, float %y)
```

Description:

Determines the minimum numeric value of the arguments `x` and `y`. Treats NaN arguments as missing data. If one argument is a NaN and the other is legitimate numeric value, the numeric value is chosen.

Returns:

Returns the minimum numeric values of the arguments `x` and `y`.

- If both arguments are NaN, returns NaN.

- If one argument is NaN, returns the numeric argument.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.154. __nv_fmod

Prototype:

```
double @__nv_fmod(double %x, double %y)
```

Description:

Calculate the double-precision floating-point remainder of x / y. The floating-point remainder of the division operation x / y calculated by this function is exactly the value x - n*y, where n is x / y with its fractional part truncated. The computed value will have the same sign as x, and its magnitude will be less than the magnitude of y.

Returns:

- Returns the floating-point remainder of x / y.
- __nv_fmod(± 0 , y) returns ± 0 if y is not zero.
- __nv_fmod(x, $\pm\infty$) returns x if x is finite.
- __nv_fmod(x, y) returns NaN if x is $\pm\infty$ or y is zero.
- If either argument is NaN, NaN is returned.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.155. __nv_fmodf

Prototype:

```
float @__nv_fmodf(float %x, float %y)
```

Description:

Calculate the floating-point remainder of x / y. The floating-point remainder of the division operation x / y calculated by this function is exactly the value x - n*y, where n is x / y with its fractional part truncated. The computed value will have the same sign as x, and its magnitude will be less than the magnitude of y.

Returns:

- Returns the floating-point remainder of x / y.
- __nv_fmodf(± 0 , y) returns ± 0 if y is not zero.
- __nv_fmodf(x, $\pm \infty$) returns x if x is finite.
- __nv_fmodf(x, y) returns NaN if x is $\pm \infty$ or y is zero.
- If either argument is NaN, NaN is returned.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.156. __nv_fmul_rd

Prototype:

```
float @__nv_fmul_rd(float %x, float %y)
```

Description:

Compute the product of x and y in round-down (to negative infinity) mode.

Returns:

Returns x * y.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.157. __nv_fmul_rn

Prototype:

```
float @__nv_fmul_rn(float %x, float %y)
```

Description:

Compute the product of x and y in round-to-nearest-even mode.

Returns:

Returns x * y.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.158. __nv_fmul_ru

Prototype:

```
float @__nv_fmul_ru(float %x, float %y)
```

Description:

Compute the product of x and y in round-up (to positive infinity) mode.

Returns:

Returns x * y.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.159. __nv_fmul_rz

Prototype:

```
float @__nv_fmul_rz(float %x, float %y)
```

Description:

Compute the product of x and y in round-towards-zero mode.

Returns:

Returns x * y.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.160. __nv_frcp_rd

Prototype:

```
float @__nv_frcp_rd(float %x)
```

Description:

Compute the reciprocal of x in round-down (to negative infinity) mode.

Returns:

Returns $\frac{1}{x}$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.161. __nv_frcp_rn

Prototype:

```
float @__nv_frcp_rn(float %x)
```

Description:

Compute the reciprocal of x in round-to-nearest-even mode.

Returns:

Returns $\frac{1}{x}$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.162. __nv_frcp_ru

Prototype:

```
float @__nv_frcp_ru(float %x)
```

Description:

Compute the reciprocal of x in round-up (to positive infinity) mode.

Returns:

Returns $\frac{1}{x}$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.163. __nv_frcp_rz

Prototype:

```
float @__nv_frcp_rz(float %x)
```

Description:

Compute the reciprocal of x in round-towards-zero mode.

Returns:

Returns $\frac{1}{x}$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.164. __nv_frexp

Prototype:

```
double @__nv_frexp(double %x, i32* %b)
```

Description:

Decompose the floating-point value `x` into a component `m` for the normalized fraction element and another term `n` for the exponent. The absolute value of `m` will be greater than or equal to 0.5 and less than 1.0 or it will be equal to 0; $x = m \cdot 2^n$. The integer exponent `n` will be stored in the location to which `nptr` points.

Returns:

Returns the fractional component `m`.

- __nv_frexp(0, `nptr`) returns 0 for the fractional component and zero for the integer component.
- __nv_frexp(± 0 , `nptr`) returns ± 0 and stores zero in the location pointed to by `nptr`.
- __nv_frexp($\pm\infty$, `nptr`) returns $\pm\infty$ and stores an unspecified value in the location to which `nptr` points.
- __nv_frexp(NaN, `y`) returns a NaN and stores an unspecified value in the location to which `nptr` points.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.165. __nv_frexpf

Prototype:

```
float @__nv_frexpf(float %x, i32* %b)
```

Description:

Decompose the floating-point value `x` into a component `m` for the normalized fraction element and another term `n` for the exponent. The absolute value of `m` will be greater than or equal to

0.5 and less than 1.0 or it will be equal to 0; $x = m \cdot 2^n$. The integer exponent `n` will be stored in the location to which `nptr` points.

Returns:

Returns the fractional component `m`.

- __nv_frexpf(0, `nptr`) returns 0 for the fractional component and zero for the integer component.
- __nv_frexpf(± 0 , `nptr`) returns ± 0 and stores zero in the location pointed to by `nptr`.
- __nv_frexpf($\pm \infty$, `nptr`) returns $\pm \infty$ and stores an unspecified value in the location to which `nptr` points.
- __nv_frexpf(NaN, `y`) returns a NaN and stores an unspecified value in the location to which `nptr` points.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.166. __nv_frsqrt_rn

Prototype:

```
float @__nv_frsqrt_rn(float %x)
```

Description:

Compute the reciprocal square root of `x` in round-to-nearest-even mode.

Returns:

Returns $1/\sqrt{x}$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.167. __nv_fsqrt_rd

Prototype:

```
float @__nv_fsqrt_rd(float %x)
```

Description:

Compute the square root of x in round-down (to negative infinity) mode.

Returns:

Returns $\sqrt{x}$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.168. __nv_fsqrt_rn

Prototype:

```
float @__nv_fsqrt_rn(float %x)
```

Description:

Compute the square root of x in round-to-nearest-even mode.

Returns:

Returns $\sqrt{x}$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.169. __nv_fsqrt_ru

Prototype:

```
float @__nv_fsqrt_ru(float %x)
```

Description:

Compute the square root of `x` in round-up (to positive infinity) mode.

Returns:

Returns $\sqrt{x}$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.170. __nv_fsqrt_rz

Prototype:

```
float @__nv_fsqrt_rz(float %x)
```

Description:

Compute the square root of `x` in round-towards-zero mode.

Returns:

Returns $\sqrt{x}$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.171. __nv_fsub_rd

Prototype:

```
float @__nv_fsub_rd(float %x, float %y)
```

Description:

Compute the difference of `x` and `y` in round-down (to negative infinity) mode.

Returns:

Returns `x - y`.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.
>
> This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.172. __nv_fsub_rn

Prototype:

```
float @__nv_fsub_rn(float %x, float %y)
```

Description:

Compute the difference of `x` and `y` in round-to-nearest-even rounding mode.

Returns:

Returns `x - y`.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.173. __nv_fsub_ru

Prototype:

```
float @__nv_fsub_ru(float %x, float %y)
```

Description:

Compute the difference of `x` and `y` in round-up (to positive infinity) mode.

Returns:

Returns `x - y`.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.174. __nv_fsub_rz

Prototype:

```
float @__nv_fsub_rz(float %x, float %y)
```

Description:

Compute the difference of `x` and `y` in round-towards-zero mode.

Returns:

Returns x - y.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

This operation will never be merged into a single multiply-add instruction.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.175. __nv_hadd

Prototype:

```
i32 @__nv_hadd(i32 %x, i32 %y)
```

Description:

Compute average of signed input arguments x and y as (x + y) >> 1, avoiding overflow in the intermediate sum.

Returns:

Returns a signed integer value representing the signed average value of the two inputs.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.176. __nv_half2float

Prototype:

```
float @__nv_half2float(i16 %h)
```

Description:

Convert the half-precision floating point value x represented in `unsigned short` format to a single-precision floating point value.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.177. __nv_hiloint2double

Prototype:

```
double @__nv_hiloint2double(i32 %x, i32 %y)
```

Description:

Reinterpret the integer value of `hi` as the high 32 bits of a double-precision floating point value and the integer value of `lo` as the low 32 bits of the same double-precision floating point value.

Returns:

Returns reinterpreted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.178. __nv_hypot

Prototype:

```
double @__nv_hypot(double %x, double %y)
```

Description:

Calculate the length of the hypotenuse of a right triangle whose two sides have lengths `x` and `y` without undue overflow or underflow.

Returns:

Returns the length of the hypotenuse $\sqrt{x^2+y^2}$. If the correct value would overflow, returns $+\infty$. If the correct value would underflow, returns 0. If one of the input arguments is 0, returns the other argument

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.179. __nv_hypotf

Prototype:

```
float @__nv_hypotf(float %x, float %y)
```

Description:

Calculate the length of the hypotenuse of a right triangle whose two sides have lengths x and y without undue overflow or underflow.

Returns:

Returns the length of the hypotenuse $\sqrt{x^2+y^2}$. If the correct value would overflow, returns $+\infty$. If the correct value would underflow, returns 0. If one of the input arguments is 0, returns the other argument

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.180. __nv_ilogb

Prototype:

```
i32 @__nv_ilogb(double %x)
```

Description:

Calculates the unbiased integer exponent of the input argument x.

Returns:

- If successful, returns the unbiased exponent of the argument.
- __nv_ilogb(0) returns `INT_MIN`.
- __nv_ilogb(NaN) returns `INT_MIN`.
- __nv_ilogb(x) returns `INT_MAX` if `x` is ∞ or the correct value is greater than `INT_MAX`.
- __nv_ilogb(x) return `INT_MIN` if the correct value is less than `INT_MIN`.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.181. __nv_ilogbf

Prototype:

```
i32 @__nv_ilogbf(float %x)
```

Description:

Calculates the unbiased integer exponent of the input argument `x`.

Returns:

- If successful, returns the unbiased exponent of the argument.
- __nv_ilogbf(0) returns `INT_MIN`.
- __nv_ilogbf(NaN) returns `INT_MIN`.
- __nv_ilogbf(x) returns `INT_MAX` if `x` is ∞ or the correct value is greater than `INT_MAX`.
- __nv_ilogbf(x) return `INT_MIN` if the correct value is less than `INT_MIN`.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.182. __nv_int2double_rn

Prototype:

```
double @__nv_int2double_rn(i32 %i)
```

Description:

Convert the signed integer value x to a double-precision floating point value.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.183. __nv_int2float_rd

Prototype:

```
float @__nv_int2float_rd(i32 %in)
```

Description:

Convert the signed integer value x to a single-precision floating point value in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.184. __nv_int2float_rn

Prototype:

```
float @__nv_int2float_rn(i32 %in)
```

Description:

Convert the signed integer value x to a single-precision floating point value in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.185. __nv_int2float_ru

Prototype:

```
float @__nv_int2float_ru(i32 %in)
```

Description:

Convert the signed integer value x to a single-precision floating point value in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.186. __nv_int2float_rz

Prototype:

```
float @__nv_int2float_rz(i32 %in)
```

Description:

Convert the signed integer value x to a single-precision floating point value in round-towards-zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.187. __nv_int_as_float

Prototype:

```
float @__nv_int_as_float(i32 %x)
```

Description:

Reinterpret the bits in the signed integer value `x` as a single-precision floating point value.

Returns:

Returns reinterpreted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.188. __nv_isfinited

Prototype:

```
i32 @__nv_isfinited(double %x)
```

Description:

Determine whether the floating-point value `x` is a finite value (zero, subnormal, or normal and not infinity or NaN).

Returns:

Returns a nonzero value if and only if `x` is a finite value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.189. __nv_isinfd

Prototype:

```
i32 @__nv_isinfd(double %x)
```

Description:

Determine whether the floating-point value x is an infinite value (positive or negative).

Returns:

Returns a nonzero value if and only if x is a infinite value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.190. __nv_isinff

Prototype:

```
i32 @__nv_isinff(float %x)
```

Description:

Determine whether the floating-point value x is an infinite value (positive or negative).

Returns:

Returns a nonzero value if and only if x is a infinite value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.191. __nv_isnand

Prototype:

```
i32 @__nv_isnand(double %x)
```

Description:

Determine whether the floating-point value `x` is a NaN.

Returns:

Returns a nonzero value if and only if `x` is a NaN value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.192. __nv_isnanf

Prototype:

```
i32 @__nv_isnanf(float %x)
```

Description:

Determine whether the floating-point value `x` is a NaN.

Returns:

Returns a nonzero value if and only if `x` is a NaN value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.193. __nv_j0

Prototype:

```
double @__nv_j0(double %x)
```

Description:

Calculate the value of the Bessel function of the first kind of order 0 for the input argument `x`, $J_0(x)$.

Returns:

Returns the value of the Bessel function of the first kind of order 0.

- __nv_j0($\pm\infty$) returns +0.
- __nv_j0(NaN) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.194. __nv_j0f

Prototype:

```
float @__nv_j0f(float %x)
```

Description:

Calculate the value of the Bessel function of the first kind of order 0 for the input argument `x`, $J_0(x)$.

Returns:

Returns the value of the Bessel function of the first kind of order 0.

- __nv_j0f($\pm\infty$) returns +0.
- __nv_j0f(NaN) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.195. __nv_j1

Prototype:

```
double @__nv_j1(double %x)
```

Description:

Calculate the value of the Bessel function of the first kind of order 1 for the input argument x, $J_1(x)$.

Returns:

Returns the value of the Bessel function of the first kind of order 1.

- __nv_j1(± 0) returns ± 0.
- __nv_j1($\pm \infty$) returns ± 0.
- __nv_j1(NaN) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.196. __nv_j1f

Prototype:

```
float @__nv_j1f(float %x)
```

Description:

Calculate the value of the Bessel function of the first kind of order 1 for the input argument x, $J_1(x)$.

Returns:

Returns the value of the Bessel function of the first kind of order 1.

- __nv_j1f(± 0) returns ± 0.
- __nv_j1f($\pm \infty$) returns ± 0.
- __nv_j1f(NaN) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.197. __nv_jn

Prototype:

```
double @__nv_jn(i32 %n, double %x)
```

Description:

Calculate the value of the Bessel function of the first kind of order n for the input argument x, $J_n(x)$.

Returns:

Returns the value of the Bessel function of the first kind of order n.

- __nv_jn(n, NaN) returns NaN.
- __nv_jn(n, x) returns NaN for n < 0.
- __nv_jn(n, $+\infty$) returns +0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.198. __nv_jnf

Prototype:

```
float @__nv_jnf(i32 %n, float %x)
```

Description:

Calculate the value of the Bessel function of the first kind of order n for the input argument x, $J_n(x)$.

Returns:

Returns the value of the Bessel function of the first kind of order n.

- __nv_jnf(n, NaN) returns NaN.
- __nv_jnf(n, x) returns NaN for n < 0.
- __nv_jnf(n, $+\infty$) returns +0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.199. __nv_ldexp

Prototype:

```
double @__nv_ldexp(double %x, i32 %y)
```

Description:

Calculate the value of $x \cdot 2^{exp}$ of the input arguments x and exp.

Returns:

- __nv_ldexp(x) returns $\pm\infty$ if the correctly calculated value is outside the double floating point range.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.200. __nv_ldexpf

Prototype:

```
float @__nv_ldexpf(float %x, i32 %y)
```

Description:

Calculate the value of $x \cdot 2^{exp}$ of the input arguments x and exp.

Returns:

- __nv_ldexpf(x) returns $\pm\infty$ if the correctly calculated value is outside the double floating point range.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.201. __nv_lgamma

Prototype:

```
double @__nv_lgamma(double %x)
```

Description:

Calculate the natural logarithm of the absolute value of the gamma function of the input argument x, namely the value of $\log_e\left(\int_0^\infty e^{-t}t^{x-1}dt\right)$

Returns:

- __nv_lgamma(1) returns +0.
- __nv_lgamma(2) returns +0.
- __nv_lgamma(x) returns $\pm\infty$ if the correctly calculated value is outside the double floating point range.
- __nv_lgamma(x) returns $+\infty$ if x $\leq$ 0.
- __nv_lgamma($-\infty$) returns $-\infty$.

- __nv_lgamma($+\infty$) returns $+\infty$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.202. __nv_lgammaf

Prototype:

```
float @__nv_lgammaf(float %x)
```

Description:

Calculate the natural logarithm of the absolute value of the gamma function of the input argument x, namely the value of $\log_e\left(\int_0^\infty e^{-t}t^{x-1}dt\right)$

Returns:

- __nv_lgammaf(1) returns +0.
- __nv_lgammaf(2) returns +0.
- __nv_lgammaf(x) returns $\pm\infty$ if the correctly calculated value is outside the double floating point range.
- __nv_lgammaf(x) returns $+\infty$ if x $\leq$ 0.
- __nv_lgammaf($-\infty$) returns $-\infty$.
- __nv_lgammaf($+\infty$) returns $+\infty$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.203. __nv_ll2double_rd

Prototype:

```
double @__nv_ll2double_rd(i64 %l)
```

Description:

Convert the signed 64-bit integer value `x` to a double-precision floating point value in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.204. __nv_ll2double_rn

Prototype:

```
double @__nv_ll2double_rn(i64 %l)
```

Description:

Convert the signed 64-bit integer value `x` to a double-precision floating point value in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.205. __nv_ll2double_ru

Prototype:

```
double @__nv_ll2double_ru(i64 %l)
```

Description:

Convert the signed 64-bit integer value x to a double-precision floating point value in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.206. __nv_ll2double_rz

Prototype:

```
double @__nv_ll2double_rz(i64 %l)
```

Description:

Convert the signed 64-bit integer value x to a double-precision floating point value in round-towards-zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.207. __nv_ll2float_rd

Prototype:

```
float @__nv_ll2float_rd(i64 %l)
```

Description:

Convert the signed integer value x to a single-precision floating point value in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.208. __nv_ll2float_rn

Prototype:

```
float @__nv_ll2float_rn(i64 %l)
```

Description:

Convert the signed 64-bit integer value x to a single-precision floating point value in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.209. __nv_ll2float_ru

Prototype:

```
float @__nv_ll2float_ru(i64 %l)
```

Description:

Convert the signed integer value x to a single-precision floating point value in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.210. __nv_ll2float_rz

Prototype:

```
float @__nv_ll2float_rz(i64 %l)
```

Description:

Convert the signed integer value x to a single-precision floating point value in round-towards-zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.211. __nv_llabs

Prototype:

```
i64 @__nv_llabs(i64 %x)
```

Description:

Determine the absolute value of the 64-bit signed integer x.

Returns:

Returns the absolute value of the 64-bit signed integer x.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.212. __nv_llmax

Prototype:

```
i64 @__nv_llmax(i64 %x, i64 %y)
```

Description:

Determine the maximum value of the two 64-bit signed integers `x` and `y`.

Returns:

Returns the maximum value of the two 64-bit signed integers `x` and `y`.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.213. __nv_llmin

Prototype:

```
i64 @__nv_llmin(i64 %x, i64 %y)
```

Description:

Determine the minimum value of the two 64-bit signed integers `x` and `y`.

Returns:

Returns the minimum value of the two 64-bit signed integers `x` and `y`.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.214. __nv_llrint

Prototype:

```
i64 @__nv_llrint(double %x)
```

Description:

Round `x` to the nearest integer value, with halfway cases rounded towards zero. If the result is outside the range of the return type, the result is undefined.

Returns:

Returns rounded integer value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.215. __nv_llrintf

Prototype:

```
i64 @__nv_llrintf(float %x)
```

Description:

Round x to the nearest integer value, with halfway cases rounded towards zero. If the result is outside the range of the return type, the result is undefined.

Returns:

Returns rounded integer value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.216. __nv_llround

Prototype:

```
i64 @__nv_llround(double %x)
```

Description:

Round x to the nearest integer value, with halfway cases rounded away from zero. If the result is outside the range of the return type, the result is undefined.

Returns:

Returns rounded integer value.

Note:

This function may be slower than alternate rounding methods. See llrint().

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.217. __nv_llroundf

Prototype:

```
i64 @__nv_llroundf(float %x)
```

Description:

Round x to the nearest integer value, with halfway cases rounded away from zero. If the result is outside the range of the return type, the result is undefined.

Returns:

Returns rounded integer value.

> **Note:**
>
> This function may be slower than alternate rounding methods. See llrint().

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.218. __nv_log

Prototype:

```
double @__nv_log(double %x)
```

Description:

Calculate the base e logarithm of the input argument x.

Returns:

- __nv_log(± 0) returns $-\infty$.
- __nv_log(1) returns +0.
- __nv_log(x) returns NaN for x < 0.
- __nv_log($+\infty$) returns $+\infty$

> **Note:**

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.219. __nv_log10

Prototype:

```
double @__nv_log10(double %x)
```

Description:

Calculate the base 10 logarithm of the input argument x.

Returns:

- __nv_log10(± 0) returns $-\infty$.
- __nv_log10(1) returns +0.
- __nv_log10(x) returns NaN for x < 0.
- __nv_log10($+\infty$) returns $+\infty$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.220. __nv_log10f

Prototype:

```
float @__nv_log10f(float %x)
```

Description:

Calculate the base 10 logarithm of the input argument x.

Returns:

- __nv_log10f(± 0) returns $-\infty$.
- __nv_log10f(1) returns +0.
- __nv_log10f(x) returns NaN for x < 0.
- __nv_log10f($+\infty$) returns $+\infty$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.221. __nv_log1p

Prototype:

```
double @__nv_log1p(double %x)
```

Description:

Calculate the value of $log_e(1+x)$ of the input argument x.

Returns:

- __nv_log1p(± 0) returns $-\infty$.
- __nv_log1p(-1) returns +0.
- __nv_log1p(x) returns NaN for x < -1.
- __nv_log1p($+\infty$) returns $+\infty$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.222. __nv_log1pf

Prototype:

```
float @__nv_log1pf(float %x)
```

Description:

Calculate the value of $log_e(1+x)$ of the input argument x.

Returns:

- __nv_log1pf(± 0) returns $-\infty$.
- __nv_log1pf(-1) returns +0.
- __nv_log1pf(x) returns NaN for x < -1.
- __nv_log1pf($+\infty$) returns $+\infty$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.223. __nv_log2

Prototype:

```
double @__nv_log2(double %x)
```

Description:

Calculate the base 2 logarithm of the input argument x.

Returns:

- __nv_log2(± 0) returns $-\infty$.
- __nv_log2(1) returns +0.
- __nv_log2(x) returns NaN for x < 0.

- __nv_log2($+\infty$) returns $+\infty$.

> **Note:**
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.224. __nv_log2f

Prototype:

```
float @__nv_log2f(float %x)
```

Description:

Calculate the base 2 logarithm of the input argument x.

Returns:

- __nv_log2f(± 0) returns $-\infty$.
- __nv_log2f(1) returns +0.
- __nv_log2f(x) returns NaN for x < 0.
- __nv_log2f($+\infty$) returns $+\infty$.

> **Note:**
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.225. __nv_logb

Prototype:

```
double @__nv_logb(double %x)
```

Description:

Calculate the floating point representation of the exponent of the input argument x.

Returns:

- __nv_logb ± 0 returns $-\infty$
- __nv_logb $\pm\infty$ returns $+\infty$

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.226. __nv_logbf

Prototype:

```
float @__nv_logbf(float %x)
```

Description:

Calculate the floating point representation of the exponent of the input argument x.

Returns:

- __nv_logbf ± 0 returns $-\infty$
- __nv_logbf $\pm\infty$ returns $+\infty$

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.227. __nv_logf

Prototype:

```
float @__nv_logf(float %x)
```

Description:

Calculate the base e logarithm of the input argument x.

Returns:

- __nv_logf(± 0) returns $-\infty$.
- __nv_logf(1) returns +0.
- __nv_logf(x) returns NaN for x < 0.
- __nv_logf($+\infty$) returns $+\infty$

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.228. __nv_longlong_as_double

Prototype:

```
double @__nv_longlong_as_double(i64 %x)
```

Description:

Reinterpret the bits in the 64-bit signed integer value x as a double-precision floating point value.

Returns:

Returns reinterpreted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.229. __nv_max

Prototype:

```
i32 @__nv_max(i32 %x, i32 %y)
```

Description:

Determine the maximum value of the two 32-bit signed integers `x` and `y`.

Returns:

Returns the maximum value of the two 32-bit signed integers `x` and `y`.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.230. __nv_min

Prototype:

```
i32 @__nv_min(i32 %x, i32 %y)
```

Description:

Determine the minimum value of the two 32-bit signed integers `x` and `y`.

Returns:

Returns the minimum value of the two 32-bit signed integers `x` and `y`.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.231. __nv_modf

Prototype:

```
double @__nv_modf(double %x, double* %b)
```

Description:

Break down the argument x into fractional and integral parts. The integral part is stored in the argument iptr. Fractional and integral parts are given the same sign as the argument x.

Returns:

- __nv_modf($\pm x$, iptr) returns a result with the same sign as x.
- __nv_modf($\pm\infty$, iptr) returns ± 0 and stores $\pm\infty$ in the object pointed to by iptr.
- __nv_modf(NaN, iptr) stores a NaN in the object pointed to by iptr and returns a NaN.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.232. __nv_modff

Prototype:

```
float @__nv_modff(float %x, float* %b)
```

Description:

Break down the argument x into fractional and integral parts. The integral part is stored in the argument iptr. Fractional and integral parts are given the same sign as the argument x.

Returns:

- __nv_modff($\pm x$, iptr) returns a result with the same sign as x.
- __nv_modff($\pm\infty$, iptr) returns ± 0 and stores $\pm\infty$ in the object pointed to by iptr.
- __nv_modff(NaN, iptr) stores a NaN in the object pointed to by iptr and returns a NaN.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.233. __nv_mul24

Prototype:

```
i32 @__nv_mul24(i32 %x, i32 %y)
```

Description:

Calculate the least significant 32 bits of the product of the least significant 24 bits of x and y. The high order 8 bits of x and y are ignored.

Returns:

Returns the least significant 32 bits of the product x * y.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.234. __nv_mul64hi

Prototype:

```
i64 @__nv_mul64hi(i64 %x, i64 %y)
```

Description:

Calculate the most significant 64 bits of the 128-bit product x * y, where x and y are 64-bit integers.

Returns:

Returns the most significant 64 bits of the product x * y.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.235. __nv_mulhi

Prototype:

```
i32 @__nv_mulhi(i32 %x, i32 %y)
```

Description:

Calculate the most significant 32 bits of the 64-bit product `x` * `y`, where `x` and `y` are 32-bit integers.

Returns:

Returns the most significant 32 bits of the product `x` * `y`.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.236. __nv_nan

Prototype:

```
double @__nv_nan(i8* %tagp)
```

Description:

Return a representation of a quiet NaN. Argument `tagp` selects one of the possible representations.

Returns:

- __nv_nan(`tagp`) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.237. __nv_nanf

Prototype:

```
float @__nv_nanf(i8* %tagp)
```

Description:

Return a representation of a quiet NaN. Argument `tagp` selects one of the possible representations.

Returns:

- __nv_nanf(`tagp`) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.238. __nv_nearbyint

Prototype:

```
double @__nv_nearbyint(double %x)
```

Description:

Round argument `x` to an integer value in double precision floating-point format.

Returns:

- __nv_nearbyint(± 0) returns ± 0.
- __nv_nearbyint($\pm \infty$) returns $\pm \infty$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.239. __nv_nearbyintf

Prototype:

```
float @__nv_nearbyintf(float %x)
```

Description:

Round argument x to an integer value in double precision floating-point format.

Returns:

- __nv_nearbyintf(± 0) returns ± 0.
- __nv_nearbyintf($\pm \infty$) returns $\pm \infty$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.240. __nv_nextafter

Prototype:

```
double @__nv_nextafter(double %x, double %y)
```

Description:

Calculate the next representable double-precision floating-point value following x in the direction of y. For example, if y is greater than x, nextafter() returns the smallest representable number greater than x

Returns:

- __nv_nextafter($\pm\infty$, y) returns $\pm\infty$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.241. __nv_nextafterf

Prototype:

```
float @__nv_nextafterf(float %x, float %y)
```

Description:

Calculate the next representable double-precision floating-point value following `x` in the direction of `y`. For example, if `y` is greater than `x`, nextafter() returns the smallest representable number greater than `x`

Returns:

- __nv_nextafterf($\pm\infty$, y) returns $\pm\infty$.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.242. __nv_normcdf

Prototype:

```
double @__nv_normcdf(double %x)
```

Description:

Calculate the cumulative distribution function of the standard normal distribution for input argument y, $\Phi(y)$.

Returns:

- __nv_normcdf($+\infty$) returns 1
- __nv_normcdf($-\infty$) returns +0

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.243. __nv_normcdff

Prototype:

```
float @__nv_normcdff(float %x)
```

Description:

Calculate the cumulative distribution function of the standard normal distribution for input argument y, $\Phi(y)$.

Returns:

- __nv_normcdff($+\infty$) returns 1
- __nv_normcdff($-\infty$) returns +0

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.244. __nv_normcdfinv

Prototype:

```
double @__nv_normcdfinv(double %x)
```

Description:

Calculate the inverse of the standard normal cumulative distribution function for input argument y, $\Phi^{-1}(y)$. The function is defined for input values in the interval $(0, 1)$.

Returns:

- __nv_normcdfinv(0) returns $-\infty$.
- __nv_normcdfinv(1) returns $+\infty$.
- __nv_normcdfinv(x) returns NaN if x is not in the interval [0,1].

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.245. __nv_normcdfinvf

Prototype:

```
float @__nv_normcdfinvf(float %x)
```

Description:

Calculate the inverse of the standard normal cumulative distribution function for input argument y, $\Phi^{-1}(y)$. The function is defined for input values in the interval $(0, 1)$.

Returns:

- __nv_normcdfinvf(0) returns $-\infty$.
- __nv_normcdfinvf(1) returns $+\infty$.

- __nv_normcdfinvf(x) returns NaN if x is not in the interval [0,1].

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.246. __nv_popc

Prototype:

```
i32 @__nv_popc(i32 %x)
```

Description:

Count the number of bits that are set to 1 in x.

Returns:

Returns a value between 0 and 32 inclusive representing the number of set bits.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.247. __nv_popcll

Prototype:

```
i32 @__nv_popcll(i64 %x)
```

Description:

Count the number of bits that are set to 1 in x.

Returns:

Returns a value between 0 and 64 inclusive representing the number of set bits.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.248. __nv_pow

Prototype:

```
double @__nv_pow(double %x, double %y)
```

Description:

Calculate the value of x to the power of y

Returns:

- __nv_pow(± 0 , y) returns $\pm\infty$ for y an integer less than 0.
- __nv_pow(± 0 , y) returns ± 0 for y an odd integer greater than 0.
- __nv_pow(± 0 , y) returns +0 for y > 0 and not and odd integer.
- __nv_pow(-1, $\pm\infty$) returns 1.
- __nv_pow(+1, y) returns 1 for any y, even a NaN.
- __nv_pow(x, ± 0) returns 1 for any x, even a NaN.
- __nv_pow(x, y) returns a NaN for finite x < 0 and finite non-integer y.
- __nv_pow(x, $-\infty$) returns $+\infty$ for $|x| < 1$.
- __nv_pow(x, $-\infty$) returns +0 for $|x| > 1$.
- __nv_pow(x, $+\infty$) returns +0 for $|x| < 1$.
- __nv_pow(x, $+\infty$) returns $+\infty$ for $|x| > 1$.
- __nv_pow($-\infty$, y) returns -0 for y an odd integer less than 0.
- __nv_pow($-\infty$, y) returns +0 for y < 0 and not an odd integer.
- __nv_pow($-\infty$, y) returns $-\infty$ for y an odd integer greater than 0.
- __nv_pow($-\infty$, y) returns $+\infty$ for y > 0 and not an odd integer.
- __nv_pow($+\infty$, y) returns +0 for y < 0.
- __nv_pow($+\infty$, y) returns $+\infty$ for y > 0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.249. __nv_powf

Prototype:

```
float @__nv_powf(float %x, float %y)
```

Description:

Calculate the value of x to the power of y

Returns:

- __nv_powf(± 0 , y) returns $\pm\infty$ for y an integer less than 0.
- __nv_powf(± 0 , y) returns ± 0 for y an odd integer greater than 0.
- __nv_powf(± 0 , y) returns +0 for y > 0 and not and odd integer.
- __nv_powf(-1, $\pm\infty$) returns 1.
- __nv_powf(+1, y) returns 1 for any y, even a NaN.
- __nv_powf(x, ± 0) returns 1 for any x, even a NaN.
- __nv_powf(x, y) returns a NaN for finite x < 0 and finite non-integer y.
- __nv_powf(x, $-\infty$) returns $+\infty$ for $|x| < 1$.
- __nv_powf(x, $-\infty$) returns +0 for $|x| > 1$.
- __nv_powf(x, $+\infty$) returns +0 for $|x| < 1$.
- __nv_powf(x, $+\infty$) returns $+\infty$ for $|x| > 1$.
- __nv_powf($-\infty$, y) returns -0 for y an odd integer less than 0.
- __nv_powf($-\infty$, y) returns +0 for y < 0 and not an odd integer.
- __nv_powf($-\infty$, y) returns $-\infty$ for y an odd integer greater than 0.
- __nv_powf($-\infty$, y) returns $+\infty$ for y > 0 and not an odd integer.
- __nv_powf($+\infty$, y) returns +0 for y < 0.
- __nv_powf($+\infty$, y) returns $+\infty$ for y > 0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.250. __nv_powi

Prototype:

```
double @__nv_powi(double %x, i32 %y)
```

Description:

Calculate the value of x to the power of y

Returns:

- __nv_powi(± 0 , y) returns $\pm\infty$ for y an integer less than 0.
- __nv_powi(± 0 , y) returns ± 0 for y an odd integer greater than 0.
- __nv_powi(± 0 , y) returns +0 for y > 0 and not and odd integer.
- __nv_powi(-1, $\pm\infty$) returns 1.
- __nv_powi(+1, y) returns 1 for any y, even a NaN.
- __nv_powi(x, ± 0) returns 1 for any x, even a NaN.
- __nv_powi(x, y) returns a NaN for finite x < 0 and finite non-integer y.
- __nv_powi(x, $-\infty$) returns $+\infty$ for $|x| < 1$.
- __nv_powi(x, $-\infty$) returns +0 for $|x| > 1$.
- __nv_powi(x, $+\infty$) returns +0 for $|x| < 1$.
- __nv_powi(x, $+\infty$) returns $+\infty$ for $|x| > 1$.
- __nv_powi($-\infty$, y) returns -0 for y an odd integer less than 0.
- __nv_powi($-\infty$, y) returns +0 for y < 0 and not an odd integer.
- __nv_powi($-\infty$, y) returns $-\infty$ for y an odd integer greater than 0.
- __nv_powi($-\infty$, y) returns $+\infty$ for y > 0 and not an odd integer.
- __nv_powi($+\infty$, y) returns +0 for y < 0.
- __nv_powi($+\infty$, y) returns $+\infty$ for y > 0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.251. __nv_powif

Prototype:

```
float @__nv_powif(float %x, i32 %y)
```

Description:

Calculate the value of x to the power of y.

Returns:

- __nv_powif(± 0 , y) returns $\pm \infty$ for y an integer less than 0.
- __nv_powif(± 0 , y) returns ± 0 for y an odd integer greater than 0.
- __nv_powif(± 0 , y) returns +0 for y > 0 and not and odd integer.
- __nv_powif(-1, $\pm \infty$) returns 1.
- __nv_powif(+1, y) returns 1 for any y, even a NaN.
- __nv_powif(x, ± 0) returns 1 for any x, even a NaN.
- __nv_powif(x, y) returns a NaN for finite x < 0 and finite non-integer y.
- __nv_powif(x, $-\infty$) returns $+\infty$ for $|x| < 1$.
- __nv_powif(x, $-\infty$) returns +0 for $|x| > 1$.
- __nv_powif(x, $+\infty$) returns +0 for $|x| < 1$.
- __nv_powif(x, $+\infty$) returns $+\infty$ for $|x| > 1$.
- __nv_powif($-\infty$, y) returns -0 for y an odd integer less than 0.
- __nv_powif($-\infty$, y) returns +0 for y < 0 and not an odd integer.
- __nv_powif($-\infty$, y) returns $-\infty$ for y an odd integer greater than 0.
- __nv_powif($-\infty$, y) returns $+\infty$ for y > 0 and not an odd integer.
- __nv_powif($+\infty$, y) returns +0 for y < 0.
- __nv_powif($+\infty$, y) returns $+\infty$ for y > 0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.252. __nv_rcbrt

Prototype:

```
double @__nv_rcbrt(double %x)
```

Description:

Calculate reciprocal cube root function of x

Returns:

- __nv_rcbrt(± 0) returns $\pm \infty$.
- __nv_rcbrt($\pm \infty$) returns ± 0.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.253. __nv_rcbrtf

Prototype:

```
float @__nv_rcbrtf(float %x)
```

Description:

Calculate reciprocal cube root function of x

Returns:

- __nv_rcbrtf(± 0) returns $\pm \infty$.
- __nv_rcbrtf($\pm \infty$) returns ± 0.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.254. __nv_remainder

Prototype:

```
double @__nv_remainder(double %x, double %y)
```

Description:

Compute double-precision floating-point remainder r of dividing x by y for nonzero y. Thus $r = x - ny$. The value n is the integer value nearest $\frac{x}{y}$. In the case when $\left|n - \frac{x}{y}\right| = \frac{1}{2}$, the even n value is chosen.

Returns:

- __nv_remainder(x, 0) returns NaN.
- __nv_remainder($\pm\infty$, y) returns NaN.
- __nv_remainder(x, $\pm\infty$) returns x for finite x.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.255. __nv_remainderf

Prototype:

```
float @__nv_remainderf(float %x, float %y)
```

Description:

Compute double-precision floating-point remainder r of dividing x by y for nonzero y. Thus $r = x - ny$. The value n is the integer value nearest $\frac{x}{y}$. In the case when $\left|n - \frac{x}{y}\right| = \frac{1}{2}$, the even n value is chosen.

Returns:

- __nv_remainderf(x, 0) returns NaN.
- __nv_remainderf($\pm\infty$, y) returns NaN.
- __nv_remainderf(x, $\pm\infty$) returns x for finite x.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.256. __nv_remquo

Prototype:

```
double @__nv_remquo(double %x, double %y, i32* %c)
```

Description:

Compute a double-precision floating-point remainder in the same way as the remainder() function. Argument quo returns part of quotient upon division of x by y. Value quo has the same sign as $\frac{x}{y}$ and may not be the exact quotient but agrees with the exact quotient in the low order 3 bits.

Returns:

Returns the remainder.

- __nv_remquo(x, 0, quo) returns NaN.
- __nv_remquo($\pm\infty$, y, quo) returns NaN.
- __nv_remquo(x, $\pm\infty$, quo) returns x.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.257. __nv_remquof

Prototype:

```
float @__nv_remquof(float %x, float %y, i32* %quo)
```

Description:

Compute a double-precision floating-point remainder in the same way as the remainder() function. Argument quo returns part of quotient upon division of x by y. Value quo has the same sign as $\frac{x}{y}$ and may not be the exact quotient but agrees with the exact quotient in the low order 3 bits.

Returns:

Returns the remainder.

- __nv_remquof(x, 0, quo) returns NaN.
- __nv_remquof($\pm\infty$, y, quo) returns NaN.
- __nv_remquof(x, $\pm\infty$, quo) returns x.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.258. __nv_rhadd

Prototype:

```
i32 @__nv_rhadd(i32 %x, i32 %y)
```

Description:

Compute average of signed input arguments x and y as (x + y + 1) >> 1, avoiding overflow in the intermediate sum.

Returns:

Returns a signed integer value representing the signed rounded average value of the two inputs.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.259. __nv_rint

Prototype:

```
double @__nv_rint(double %x)
```

Description:

Round x to the nearest integer value in floating-point format, with halfway cases rounded to the nearest even integer value.

Returns:

Returns rounded integer value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.260. __nv_rintf

Prototype:

```
float @__nv_rintf(float %x)
```

Description:

Round x to the nearest integer value in floating-point format, with halfway cases rounded to the nearest even integer value.

Returns:

Returns rounded integer value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.261. __nv_round

Prototype:

```
double @__nv_round(double %x)
```

Description:

Round x to the nearest integer value in floating-point format, with halfway cases rounded away from zero.

Returns:

Returns rounded integer value.

> **Note:**
>
> This function may be slower than alternate rounding methods. See rint().

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.262. __nv_roundf

Prototype:

```
float @__nv_roundf(float %x)
```

Description:

Round x to the nearest integer value in floating-point format, with halfway cases rounded away from zero.

Returns:

Returns rounded integer value.

> **Note:**
>
> This function may be slower than alternate rounding methods. See rint().

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.263. __nv_rsqrt

Prototype:

```
double @__nv_rsqrt(double %x)
```

Description:

Calculate the reciprocal of the nonnegative square root of x, $1/\sqrt{x}$.

Returns:

Returns $1/\sqrt{x}$.

- __nv_rsqrt($+\infty$) returns +0.
- __nv_rsqrt(± 0) returns $\pm\infty$.
- __nv_rsqrt(x) returns NaN if x is less than 0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.264. __nv_rsqrtf

Prototype:

```
float @__nv_rsqrtf(float %x)
```

Description:

Calculate the reciprocal of the nonnegative square root of x, $1/\sqrt{x}$.

Returns:

Returns $1/\sqrt{x}$.

- __nv_rsqrtf($+\infty$) returns +0.
- __nv_rsqrtf(± 0) returns $\pm\infty$.

- __nv_rsqrtf(x) returns NaN if x is less than 0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.265. __nv_sad

Prototype:

```
i32 @__nv_sad(i32 %x, i32 %y, i32 %z)
```

Description:

Calculate $|x-y|+z$, the 32-bit sum of the third argument z plus and the absolute value of the difference between the first argument, x, and second argument, y.

Inputs x and y are signed 32-bit integers, input z is a 32-bit unsigned integer.

Returns:

Returns $|x-y|+z$.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.266. __nv_saturatef

Prototype:

```
float @__nv_saturatef(float %x)
```

Description:

Clamp the input argument x to be within the interval [+0.0, 1.0].

Returns:

- __nv_saturatef(x) returns 0 if x < 0.

- __nv_saturatef(x) returns 1 if x > 1.
- __nv_saturatef(x) returns x if $0 \leq x \leq 1$.
- __nv_saturatef(NaN) returns 0.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.267. __nv_scalbn

Prototype:

```
double @__nv_scalbn(double %x, i32 %y)
```

Description:

Scale x by 2^n by efficient manipulation of the floating-point exponent.

Returns:

Returns x * 2^n.

- __nv_scalbn(± 0 , n) returns ± 0.
- __nv_scalbn(x, 0) returns x.
- __nv_scalbn($\pm\infty$, n) returns $\pm\infty$.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.268. __nv_scalbnf

Prototype:

```
float @__nv_scalbnf(float %x, i32 %y)
```

Description:

Scale x by 2^n by efficient manipulation of the floating-point exponent.

Returns:

Returns x * 2^n.

- __nv_scalbnf(± 0 , n) returns ± 0.
- __nv_scalbnf(x, 0) returns x.
- __nv_scalbnf($\pm \infty$, n) returns $\pm \infty$.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.269. __nv_signbitd

Prototype:

```
i32 @__nv_signbitd(double %x)
```

Description:

Determine whether the floating-point value x is negative.

Returns:

Returns a nonzero value if and only if x is negative. Reports the sign bit of all values including infinities, zeros, and NaNs.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.270. __nv_signbitf

Prototype:

```
i32 @__nv_signbitf(float %x)
```

Description:

Determine whether the floating-point value x is negative.

Returns:

Returns a nonzero value if and only if x is negative. Reports the sign bit of all values including infinities, zeros, and NaNs.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.271. __nv_sin

Prototype:

```
double @__nv_sin(double %x)
```

Description:

Calculate the sine of the input argument x (measured in radians).

Returns:

- __nv_sin(± 0) returns ± 0.
- __nv_sin($\pm \infty$) returns NaN.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.272. __nv_sincos

Prototype:

```
void @__nv_sincos(double %x, double* %sptr, double* %cptr)
```

Description:

Calculate the sine and cosine of the first input argument x (measured in radians). The results for sine and cosine are written into the second argument, sptr, and, respectively, third argument, zptr.

Returns:

- none

See __nv_sin() and __nv_cos().

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.273. __nv_sincosf

Prototype:

```
void @__nv_sincosf(float %x, float* %sptr, float* %cptr)
```

Description:

Calculate the sine and cosine of the first input argument `x` (measured in radians). The results for sine and cosine are written into the second argument, `sptr`, and, respectively, third argument, `zptr`.

Returns:

- none

See __nv_sinf() and __nv_cosf().

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.274. __nv_sincospi

Prototype:

```
void @__nv_sincospi(double %x, double* %sptr, double* %cptr)
```

Description:

Calculate the sine and cosine of the first input argument, `x` (measured in radians), $\times \pi$. The results for sine and cosine are written into the second argument, `sptr`, and, respectively, third argument, `zptr`.

Returns:

- none

See __nv_sinpi() and __nv_cospi().

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.275. __nv_sincospif

Prototype:

```
void @__nv_sincospif(float %x, float* %sptr, float* %cptr)
```

Description:

Calculate the sine and cosine of the first input argument, `x` (measured in radians), $\times \pi$. The results for sine and cosine are written into the second argument, `sptr`, and, respectively, third argument, `zptr`.

Returns:

- none

See __nv_sinpif() and __nv_cospif().

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.276. __nv_sinf

Prototype:

```
float @__nv_sinf(float %x)
```

Description:

Calculate the sine of the input argument x (measured in radians).

Returns:

- __nv_sinf(± 0) returns ± 0.
- __nv_sinf($\pm \infty$) returns NaN.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.277. __nv_sinh

Prototype:

```
double @__nv_sinh(double %x)
```

Description:

Calculate the hyperbolic sine of the input argument x.

Returns:

- __nv_sinh(± 0) returns ± 0.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.278. __nv_sinhf

Prototype:

```
float @__nv_sinhf(float %x)
```

Description:

Calculate the hyperbolic sine of the input argument x.

Returns:

- __nv_sinhf(± 0) returns ± 0.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.279. __nv_sinpi

Prototype:

```
double @__nv_sinpi(double %x)
```

Description:

Calculate the sine of x $\times \pi$ (measured in radians), where x is the input argument.

Returns:

- __nv_sinpi(± 0) returns ± 0.
- __nv_sinpi($\pm \infty$) returns NaN.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.280. __nv_sinpif

Prototype:

```
float @__nv_sinpif(float %x)
```

Description:

Calculate the sine of x $\times \pi$ (measured in radians), where x is the input argument.

Returns:

- __nv_sinpif(± 0) returns ± 0.
- __nv_sinpif($\pm \infty$) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.281. __nv_sqrt

Prototype:

```
double @__nv_sqrt(double %x)
```

Description:

Calculate the nonnegative square root of x, $\sqrt{x}$.

Returns:

Returns $\sqrt{x}$.

- __nv_sqrt(± 0) returns ± 0.

- __nv_sqrt($+\infty$) returns $+\infty$.
- __nv_sqrt(x) returns NaN if x is less than 0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.282. __nv_sqrtf

Prototype:

```
float @__nv_sqrtf(float %x)
```

Description:

Calculate the nonnegative square root of x, $\sqrt{x}$.

Returns:

Returns $\sqrt{x}$.

- __nv_sqrtf(± 0) returns ± 0.
- __nv_sqrtf($+\infty$) returns $+\infty$.
- __nv_sqrtf(x) returns NaN if x is less than 0.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.283. __nv_tan

Prototype:

```
double @__nv_tan(double %x)
```

Description:

Calculate the tangent of the input argument x (measured in radians).

Returns:

- __nv_tan(± 0) returns ± 0.
- __nv_tan($\pm \infty$) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.284. __nv_tanf

Prototype:

```
float @__nv_tanf(float %x)
```

Description:

Calculate the tangent of the input argument x (measured in radians).

Returns:

- __nv_tanf(± 0) returns ± 0.
- __nv_tanf($\pm \infty$) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.285. __nv_tanh

Prototype:

```
double @__nv_tanh(double %x)
```

Description:

Calculate the hyperbolic tangent of the input argument x.

Returns:

- __nv_tanh(± 0) returns ± 0.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.286. __nv_tanhf

Prototype:

```
float @__nv_tanhf(float %x)
```

Description:

Calculate the hyperbolic tangent of the input argument x.

Returns:

- __nv_tanhf(± 0) returns ± 0.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.287. __nv_tgamma

Prototype:

```
double @__nv_tgamma(double %x)
```

Description:

Calculate the gamma function of the input argument x, namely the value of $\int_0^{\infty} e^{-t} t^{x-1} dt$.

Returns:

- __nv_tgamma(± 0) returns $\pm \infty$.
- __nv_tgamma(2) returns +0.
- __nv_tgamma(x) returns $\pm \infty$ if the correctly calculated value is outside the double floating point range.
- __nv_tgamma(x) returns NaN if x < 0.
- __nv_tgamma($-\infty$) returns NaN.
- __nv_tgamma($+\infty$) returns $+\infty$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.288. __nv_tgammaf

Prototype:

```
float @__nv_tgammaf(float %x)
```

Description:

Calculate the gamma function of the input argument x, namely the value of $\int_0^\infty e^{-t} t^{x-1} dt$.

Returns:

- __nv_tgammaf(± 0) returns $\pm\infty$.
- __nv_tgammaf(2) returns +0.
- __nv_tgammaf(x) returns $\pm\infty$ if the correctly calculated value is outside the double floating point range.
- __nv_tgammaf(x) returns NaN if x < 0.
- __nv_tgammaf($-\infty$) returns NaN.
- __nv_tgammaf($+\infty$) returns $+\infty$.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.289. __nv_trunc

Prototype:

```
double @__nv_trunc(double %x)
```

Description:

Round x to the nearest integer value that does not exceed x in magnitude.

Returns:

Returns truncated integer value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.290. __nv_truncf

Prototype:

```
float @__nv_truncf(float %x)
```

Description:

Round `x` to the nearest integer value that does not exceed `x` in magnitude.

Returns:

Returns truncated integer value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.291. __nv_uhadd

Prototype:

```
i32 @__nv_uhadd(i32 %x, i32 %y)
```

Description:

Compute average of unsigned input arguments `x` and `y` as (`x` + `y`) >> 1, avoiding overflow in the intermediate sum.

Returns:

Returns an unsigned integer value representing the unsigned average value of the two inputs.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.292. __nv_uint2double_rn

Prototype:

```
double @__nv_uint2double_rn(i32 %i)
```

Description:

Convert the unsigned integer value `x` to a double-precision floating point value.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.293. __nv_uint2float_rd

Prototype:

```
float @__nv_uint2float_rd(i32 %in)
```

Description:

Convert the unsigned integer value `x` to a single-precision floating point value in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.294. __nv_uint2float_rn

Prototype:

```
float @__nv_uint2float_rn(i32 %in)
```

Description:

Convert the unsigned integer value `x` to a single-precision floating point value in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.295. __nv_uint2float_ru

Prototype:

```
float @__nv_uint2float_ru(i32 %in)
```

Description:

Convert the unsigned integer value `x` to a single-precision floating point value in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.296. __nv_uint2float_rz

Prototype:

```
float @__nv_uint2float_rz(i32 %in)
```

Description:

Convert the unsigned integer value `x` to a single-precision floating point value in round-towards-zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.297. __nv_ull2double_rd

Prototype:

```
double @__nv_ull2double_rd(i64 %l)
```

Description:

Convert the unsigned 64-bit integer value `x` to a double-precision floating point value in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.298. __nv_ull2double_rn

Prototype:

```
double @__nv_ull2double_rn(i64 %l)
```

Description:

Convert the unsigned 64-bit integer value `x` to a double-precision floating point value in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.299. __nv_ull2double_ru

Prototype:

```
double @__nv_ull2double_ru(i64 %l)
```

Description:

Convert the unsigned 64-bit integer value x to a double-precision floating point value in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.300. __nv_ull2double_rz

Prototype:

```
double @__nv_ull2double_rz(i64 %l)
```

Description:

Convert the unsigned 64-bit integer value x to a double-precision floating point value in round-towards-zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.301. __nv_ull2float_rd

Prototype:

```
float @__nv_ull2float_rd(i64 %l)
```

Description:

Convert the unsigned integer value x to a single-precision floating point value in round-down (to negative infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.302. __nv_ull2float_rn

Prototype:

```
float @__nv_ull2float_rn(i64 %l)
```

Description:

Convert the unsigned integer value `x` to a single-precision floating point value in round-to-nearest-even mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.303. __nv_ull2float_ru

Prototype:

```
float @__nv_ull2float_ru(i64 %l)
```

Description:

Convert the unsigned integer value `x` to a single-precision floating point value in round-up (to positive infinity) mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.304. __nv_ull2float_rz

Prototype:

```
float @__nv_ull2float_rz(i64 %l)
```

Description:

Convert the unsigned integer value x to a single-precision floating point value in round-towards-zero mode.

Returns:

Returns converted value.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.305. __nv_ullmax

Prototype:

```
i64 @__nv_ullmax(i64 %x, i64 %y)
```

Description:

Determine the maximum value of the two 64-bit unsigned integers x and y.

Returns:

Returns the maximum value of the two 64-bit unsigned integers x and y.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.306. __nv_ullmin

Prototype:

```
i64 @__nv_ullmin(i64 %x, i64 %y)
```

Description:

Determine the minimum value of the two 64-bit unsigned integers `x` and `y`.

Returns:

Returns the minimum value of the two 64-bit unsigned integers `x` and `y`.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.307. __nv_umax

Prototype:

```
i32 @__nv_umax(i32 %x, i32 %y)
```

Description:

Determine the maximum value of the two 32-bit unsigned integers `x` and `y`.

Returns:

Returns the maximum value of the two 32-bit unsigned integers `x` and `y`.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.308. __nv_umin

Prototype:

```
i32 @__nv_umin(i32 %x, i32 %y)
```

Description:

Determine the minimum value of the two 32-bit unsigned integers `x` and `y`.

Returns:

Returns the minimum value of the two 32-bit unsigned integers `x` and `y`.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.309. __nv_umul24

Prototype:

```
i32 @__nv_umul24(i32 %x, i32 %y)
```

Description:

Calculate the least significant 32 bits of the product of the least significant 24 bits of x and y. The high order 8 bits of x and y are ignored.

Returns:

Returns the least significant 32 bits of the product x * y.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.310. __nv_umul64hi

Prototype:

```
i64 @__nv_umul64hi(i64 %x, i64 %y)
```

Description:

Calculate the most significant 64 bits of the 128-bit product x * y, where x and y are 64-bit unsigned integers.

Returns:

Returns the most significant 64 bits of the product x * y.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.311. __nv_umulhi

Prototype:

```
i32 @__nv_umulhi(i32 %x, i32 %y)
```

Description:

Calculate the most significant 32 bits of the 64-bit product x * y, where x and y are 32-bit unsigned integers.

Returns:

Returns the most significant 32 bits of the product x * y.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.312. __nv_urhadd

Prototype:

```
i32 @__nv_urhadd(i32 %x, i32 %y)
```

Description:

Compute average of unsigned input arguments x and y as (x + y + 1) >> 1, avoiding overflow in the intermediate sum.

Returns:

Returns an unsigned integer value representing the unsigned rounded average value of the two inputs.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.313. __nv_usad

Prototype:

```
i32 @__nv_usad(i32 %x, i32 %y, i32 %z)
```

Description:

Calculate $|x-y|+z$, the 32-bit sum of the third argument `z` plus and the absolute value of the difference between the first argument, `x`, and second argument, `y`.

Inputs `x`, `y`, and `z` are unsigned 32-bit integers.

Returns:

Returns $|x-y|+z$.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.314. __nv_y0

Prototype:

```
double @__nv_y0(double %x)
```

Description:

Calculate the value of the Bessel function of the second kind of order 0 for the input argument `x`, $Y_0(x)$.

Returns:

Returns the value of the Bessel function of the second kind of order 0.

- __nv_y0(0) returns $-\infty$.
- __nv_y0(`x`) returns NaN for `x` < 0.
- __nv_y0($+\infty$) returns +0.
- __nv_y0(NaN) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.315. __nv_y0f

Prototype:

```
float @__nv_y0f(float %x)
```

Description:

Calculate the value of the Bessel function of the second kind of order 0 for the input argument x, $Y_0(x)$.

Returns:

Returns the value of the Bessel function of the second kind of order 0.

- __nv_y0f(0) returns $-\infty$.
- __nv_y0f(x) returns NaN for x < 0.
- __nv_y0f($+\infty$) returns +0.
- __nv_y0f(NaN) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.316. __nv_y1

Prototype:

```
double @__nv_y1(double %x)
```

Description:

Calculate the value of the Bessel function of the second kind of order 1 for the input argument x, $Y_1(x)$.

Returns:

Returns the value of the Bessel function of the second kind of order 1.

- __nv_y1(0) returns $-\infty$.
- __nv_y1(x) returns NaN for x < 0.
- __nv_y1($+\infty$) returns +0.
- __nv_y1(NaN) returns NaN.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.317. __nv_y1f

Prototype:

```
float @__nv_y1f(float %x)
```

Description:

Calculate the value of the Bessel function of the second kind of order 1 for the input argument x, $Y_1(x)$.

Returns:

Returns the value of the Bessel function of the second kind of order 1.

- __nv_y1f(0) returns $-\infty$.
- __nv_y1f(x) returns NaN for x < 0.
- __nv_y1f($+\infty$) returns +0.
- __nv_y1f(NaN) returns NaN.

> **Note:**
>
> For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.318. __nv_yn

Prototype:

```
double @__nv_yn(i32 %n, double %x)
```

Description:

Calculate the value of the Bessel function of the second kind of order `n` for the input argument `x`, $Y_n(x)$.

Returns:

Returns the value of the Bessel function of the second kind of order `n`.

- __nv_yn(`n`, `x`) returns NaN for `n` < 0.
- __nv_yn(`n`, 0) returns $-\infty$.
- __nv_yn(`n`, `x`) returns NaN for `x` < 0.
- __nv_yn(`n`, $+\infty$) returns +0.
- __nv_yn(`n`, NaN) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 7.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

3.319. __nv_ynf

Prototype:

```
float @__nv_ynf(i32 %n, float %x)
```

Description:

Calculate the value of the Bessel function of the second kind of order n for the input argument x, $Y_n(x)$.

Returns:

Returns the value of the Bessel function of the second kind of order n.

- __nv_ynf(n, x) returns NaN for n < 0.
- __nv_ynf(n, 0) returns $-\infty$.
- __nv_ynf(n, x) returns NaN for x < 0.
- __nv_ynf(n, $+\infty$) returns +0.
- __nv_ynf(n, NaN) returns NaN.

Note:

For accuracy information for this function see the CUDA C++ Programming Guide, Appendix E.1, Table 6.

Library Availability:

Compute 2.0: Yes

Compute 3.0: Yes

Compute 3.5: Yes

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