CMATH Library

Math and Computer Science

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cmath Library

- c in cmath means it is from the C language.
- Contains many functions that preform common mathematical operations.
- To use the library:

```
#include <cmath>
```

Trigonometric Functions

- cos – compute the cosine of x radians, returns this value
- sin – compute the sine of x radians , returns this value
- tan – compute the tangent of x radians , returns this value

* Common mistake is to use degrees instead of radian.

radians = degrees * PI / 180

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Prototypes for Cosine

- float cos (float radians);
- double cos (double radians);
- long double cos (long double radians);
- *new double cos (T x); // T is any integral type

```
double radians = 2.14159;
double cosresult;
cosresult = cos( radians ); // -0.5403
```

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Prototypes for Sine functions

- float sin (float radians);
- double sin (double radians);
- long double sin (long double radians);
- *new double sin (T radians); // T is any integral type

```
double radians = 2.14159;
double sinresult;
sinresult = sin( radians ); // 0.81472
```

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Prototypes for Tangent Functions

- float tan (float radians);
- double tan (double radians);
- long double tan(long double radians);
- *new double tan(T radians); // T is any integral type

```
double radians = 2.14159;
double tanresult;
tanresult = tan( radians ); // -1.55742
```

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Arc Trigonometric Functions

- Has the arc trigonometric functions as well
  - acos – arc cosine
  - asin – arc sine
  - atan – arc tangent
  - atan2 – arc tangent with 2 arguments.
    - Arc tangent of y-coordinate / x-coordinate.
    - double atan2(double y, double x);
    - float atan2(float y, float x);
    - long double atan2 (long double y, long double x);
    - *new double atan2 (T y, T x); // T is any integer type.
- Same prototypes as the cos, sin, and tangent

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Hyperbolic Trigonometric Functions

- cosh – hyperbolic cosine
- sinh – hyperbolic sine
- tanh – hyperbolic tangent

```
float cosh( float radians );
double cosh ( double radians );
long double cosh( long double radians );
*new double cosh( T radians ); // T is any integer type
```

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Arc Hyperbolic Trigonometric Functions

- acosh – arc hyperbolic cosine
- asinh – arc hyperbolic sine
- Atanh – arc hyperbolic tangent

```
float asinh( float radians );
double asinh( double radians );
long double asinh(long double radians );
*new double asinh( T  radians ); // T is any integer types
```

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Exponential and Logarithmic

- exp – exponential function. Returns e^x
- log – natural logarithm. Returns the natural logarithm of X.
- log10 – Base 10 logarithm. Returns the common logarithm of X.

  same as other trig functions result = log10(8.0);

- modf – Splits X into an integer portion and a fractional portion.

  X = 3.14159;

  fractionalpart = modf(x, &intpart); // intpart is 3, fractional part is .14159

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Power Functions

- pow – power. Returns the base raised to an exponent. (X^Y)

  float pow (float base, float exponent);

  double pow (double base, double exponent);

  long double pow (long double base, long double exponent);

  *new double pow (T base, T exponent); // T is any integer

```
double base = 4.1, exponent = 3.2;
double result;
result = pow( base, exponent); // result is 91.392 ( 4.1 3.2 )
```

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Specialized Power Functions

- sqrt – Returns the square root of x
  - float sqrt(float x);
  - double sqrt(double x);
  - long double sqrt (long double x);
  - *new double sqrt (T x); // T is any integer type

```
double x = 16.0;
double result;
result = sqrt ( 16.0 ); // result is now 4.0
```

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Specialize Power Functions

- cbrt – cube root – Does not exist in Visual Studio, exist in g++

```
float cbrt ( float x );
double cbrt (double x );
long double cbrt (long double x );
*new long double cbrt ( T  x ); // T is any integer type

double x = 64.0;
double result;
result = cbrt ( x );  // result is 4.0
```

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Specialized Power Functions

- hypot – Returns the hypotenuse of a right triangle with x & y as legs.

  float hypot(float x, float y);

  double hypot(double x, double y);

  long double hypot(long double x, long double y);

  *new double hypot(T x, T y); // T is any integer type.

```
double side1 = 3.0, side2 = 4.0;
double hypotenuse;
hypotenuse = hypot( side1, side2 ); // hypotenuse is 5.0
```

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Rounding Functions

- Ceil – Rounds X upward returning the smallest integer value that is not less than x
  - float ceil (float x);
  - double ceil (double x);
  - long double ceil (long double x);
  - *new double ceil (T x); // T is any integral types

```
float x = -2.3;
float result;
result = ceil( x );  // result is -2.0
```

2.1 → 3.0, 4.9 → 5.0, -6.1 → -6.0, -6.9 → -6.0 *careful on negatives

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Rounding Functions

- floor – Rounds X downward returning the smallest integer value that is not greater than x
  - float floor(float x);
  - double floor(double x);
  - long double floor(long double x);
  - *new double floor(T x); // T is any integral types

- 3.2 → 3.0, 6.8 → 6.0, -4.2 → -5.0, -5.8 → -6.0

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Remainder Function

- fmod – Remainder of division
  - float fmod(float numerator, float denominator);
  - double fmod(double numerator, double denominator);
  - long double fmod(long double numerator, long double denominator);
  - *new double fmod(T numerator, T denominator); // T any type

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Miscellaneous

- fabs – Floating point absolute value
  - float fabs(float x);
  - double fabs(double x);
  - long double fabs (long double x);
- abs – integer absolute value
  - int abs(int x);
  - long int abs(long int x);
  - long long int abs (long long int x);
  - float abs(float x);
  - double abs(double x);
  - long double abs (long double x);

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Absolute examples

```
double x = -3.56;
int a = -98;

cout << "x = " << x << "  fabs = " << fabs(x) << endl;
cout << "a = " << a << "   abs = " << abs(a) << endl;
```

Output:

x = -3.56 fabs = 3.56

a = -98 abs = 98

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Notes

- Remember these functions

  pow, sqrt, sin, cos, tan, abs, fabs
- Be aware of what exists out in the cmath library.
- Do not rewrite the functions that exist without good reason.