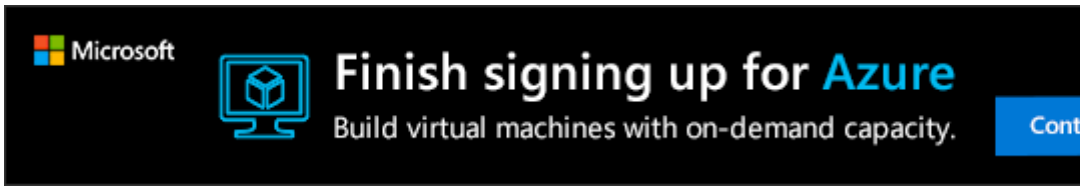

What is the difference between atan and atan2 in C++?

Ask Question

What is the difference between `atan` and `atan2` in C++?

c++ math.h

edited Apr 2 at 23:13

nbro
5,238 8 42 87

asked Nov 12 '08 at 9:20

yesraaj
19.5k 53 170 237

11 Answers

`std::atan2` allows calculating the arctangent of all four quadrants. `std::atan` only allows calculating from quadrants 1 and 4.

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swered Nov 12 '08 at 9:22

Chris Jester-Young

175k 33 328 390

From school mathematics we know that the tangent has the definition

```
tan(α) = sin
```

and we differentiate between four quadrants based on the angle that we supply to the functions. The sign of the `sin`, `cos` and `tan` have the following relationship (where we neglect the exact multiples of `π/2`):

```
  Quadrant
------------
  I
  II
  III
  IV
```

Given that the value of `tan(α)` is

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or third quadrant and if it is negative, it could come from the second or fourth quadrant. So by convention, `atan()` returns an angle from the first or fourth quadrant (i.e. `-π/2 <= atan() <= π/2`), regardless of the original input to the tangent.

In order to get back the full information, we must not use the result of the division `sin(α) / cos(α)` but we have to look at the values of the sine and cosine separately. And this is what `atan2()` does. It takes both, the `sin(α)` and `cos(α)` and resolves all four

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cosine is negative.

Remark: The `atan2(y, x)` function actually takes a `y` and a `x` argument, which is the projection of a vector with length `v` and angle `α` on the y- and x-axis, i.e.

```
y = v * sin(
x = v * cos(
```

which gives the relation

```
y/x = tan(α)
```

Conclusion: `atan(y/x)` is held back some information and can only assume that the input came from quadrants I or IV. In contrast, `atan2(y,x)` gets all the data and thus can resolve the correct angle.

lited Aug 14 '17 at 1:33

Community♦
1 1

swered Aug 17 '12 at 19:07

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the range `-π/2 <= atan() <= π/2` actually includes one point (`pi/2`) from quadrant II. – Z boson Jul 2 '15 at 11:30

Another thing to mention is that `atan2` is more stable when computing tangents using an expression like `atan(y / x)` and `x` is 0 or close to 0.

lited Apr 2 at 23:16

nbro
5,238 8 42 87

swered Nov 12 '08 at 17:03

Laserallan
7,598 8 33 60

Interesting, do you have a source

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C++? – Gerard Jan 30 '14 at 23:38

3 Check en.wikipedia.org/wiki/Atan2 See the history and motivation part. – Laserall Jun 4 '14 at 5:47

The actual values are in radians but to interpret them in degrees it will be:

- `atan` = gives angle value between -90 and 90
- `atan2` = gives angle value between -180 and 180

For my work which involves computation of various

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most cases does the job.

lited Feb 9 '15 at 10:06

iswered May 14 '14 at 23:32

Keugyeol
1,853 1 21 30

---

atan(x) Returns the principal value of the arc tangent of x, expressed in radians.

atan2(y,x) Returns the principal value of the arc tangent of y/x, expressed in radians.

Notice that because of the sign ambiguity, a function cannot determine with certainty in which quadrant the angle falls only by its tangent value (atan alone). You can use atan2 if you need to determine the quadrant.

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Roman M
1,907 7 25 38

2 atan2(x,y) -> atan2(y,x) – yesraaj Nov 12 '08 at 9:34

The range of principle values is `(-pi,pi]` but atan2 has the range `[-pi,pi]` so it includes one extra value `-pi` from another branch due to `atan2(-0.0,x)` for `x<0`. – Z boson Jul 2 '15 at 11:27

I guess the main question tries to figure out:

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I using the right one"?

I guess the important point is atan only was intended to feed positive values in a right-upwards direction curve like for time-distance vectors. Cero is always at the bottom left, and thigs can only go up and right, just slower or faster. atan doesn't return negative numbers, so you can't trace things in the 4 directions on a screen just by adding/subtracting its result.

atan2 is intended for the origin to be in the middle, and things can go backwards or down. That's what you'd use in a screen representation, because it DOES matter

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numbers, because its cero is in the center, and its result is something you can use to trace things in 4 directions.

lited Feb 9 '14 at 0:54

ıswered Feb 9 '14 at 0:48

sergio
606 6 14

With atan2 you can determine the quadrant as stated here.

> You can use atan2 if you need to determine the quadrant.

ıswered Nov 12 '08 at 9:22

Burkhard
11.5k 21 73 96

Consider a right angled triangle. We label the hypotenuse r, the horizontal side y and

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between x and r.

c++ atan2(y, x) will give us the value of angle @ in radians. atan is used if we only know or are interested in y/x not y and x individually. So if p = y/x then to get @ we'd use atan(p).

You cannot use atan2 to determine the quadrant, you can use atan2 only if you *already know* which quadrant your in! In particular positive x and y imply the first quadrant, positive y and negative x, the second and so on. atan or atan2 themselves simply return a positive or a negative number, nothing more.

ıswered Mar 9 '12 at 20:49

bheks

215 2 2

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still use `atan2(p,1)`. – Mark Ra Mar 9 '12 at 21:03

Mehrwolf below is correct, but here is a heuristic which may help:

If you are working in a 2-dimensional coordinate system, which is often the case for programming the inverse tangent, you should use definitely use atan2. It will give the full 2 pi range of angles and take care of zeros in the x coordinate for you.

Another way of saying this is that atan(y/x) is virtually always wrong. Only use atan if

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ıswered Jul 11 '16 at 1:46

Nick Mulgan
1 2

`atan2(y,x)` is generally used if you want to convert cartesian coordinates to polar coordinates. It will give you the angle, while `sqrt(x*x+y*y)` or, if available, `hypot(y,x)` will give you the size.

`atan(x)` is simply the inverse of tan. In the annoying case you have to use `atan(y/x)` because your system doesn't provide `atan2`, you would have to do additional checks for the signs of `x` and `y`, and for `x=0`, in order to get the correct angle.

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both arguments are zero.

lited Mar 5 '17 at 15:48

p0k8_
3,372 3 16 31

ıswered Mar 5 '17 at 15:14

user3303328
1

In atan2, the output is: `-pi < atan2(y,x) < pi` and in atan, the output is: `-pi/2 < atan(y/x) < pi/2` //it dose NOT consider the quarter.
If you want to get the orientation between `0` and `2*pi` (like the high-school math), we need to use the atan2 and for negative values add the `2*pi` to get the final result between `0` and `2*pi` .
Here is the Java source code to explain it

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```
System.out.p
System.out.p

System.out.p
System.out.p
```

lited Jun 22 at 19:36

swered Jun 21 at 21:04

user497884

1 1

protected by eyllanesc Jun 21 at 21:30

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