

# Integer $\pi$ Ratio

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# What is $\pi$ ?

- $\pi$  is the ratio of a circle's circumference to diameter -  $C = \pi D$
- $\pi$  is an irrational number
- $\pi = 3.1415926535\ 8979323846\ 2643383279\ 5028841971$   
 $6939937510\ 5820974944\ 5923078164\ 0628620899\ 8628034825$   
 $3421170679\ \dots$

# $\pi$ in the Sky – 2012 over Stanford



# Calculating $\pi$

- Rather than calculating  $\pi$ , calculate two integers N & D such that N/D is the closest approximation to  $\pi$
- These numbers could be used with standard Forths using \*/
- $\pi$  can be approximated by 22/7, 355/113 is better
- But are there even better approximations?



Number = 3.1415926535

N = Integer(Number)

D = 1

Error = Abs(Float(N / D) – Number)

Begin

X = Float(N / D)

    X < Number

    if        N = N + 1        (increment numerator)

    else     D = D + 1        (increment denominator)

    then

Y = Abs(X – number)

    Y < Error

    if        print N, D

        Error = Y

    then

N > 2<sup>15</sup>

Until



# TCL Program circa 2005

```
# Find 2 integers N and D such that N/D is the closest
# approximation to an irrational number X

set x 3.14159265358979323846264338327950288419716939937510
set n [expr int ($x)]
set d 1
set dif [expr 1. + $n]

proc irr {} {
    global n
    global d
    global x
    global dif
    for {set try 0} {$n < 65535} {incr try} {
        incr try
        set temp [expr double ($n) / $d]
        set thisdif [expr abs($temp - $x)]
        if {$thisdif < $dif} {
            set dif $thisdif
            puts "$try $n $d $dif"
        }
        if {$temp < $x} {
            incr n
        } else {
            incr d
        }
    }
}
```



# Errors

- $22/7$  -  $\text{Pi} = 0.00126448926734961868021375957764$
- $355/113$  -  $\text{Pi} = 2.6676418906242231236893288649633e-7$
- $65298/20785$  -  $\text{Pi} = -1.5900235037101015360699853102949e-7$
  
- 10000 355 113 \*/ . 31415
- 10000 65298 20785 \*/ . 31415

# Results

	N	D
pi	65298	20785
e	49171	18089
sqrt 2	47321	33461
sqrt 3	51409	29681
sqrt 5	51841	23184
sqrt 6	47525	19402
sqrt 7	32257	12192
sqrt 8	55440	19601
sqrt 10	27379	8658