A Chronology of Pi

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Note: This page uses R(n) to indicate the square root of n (this notation was commonly used before the modern day notation was adopted). This page also uses pi for the irrational number 3.14159..., phi for the golden mean (which is the irrational number 1.618...), and ^ to indicate exponents.

About 2000BC
The Babylonians use 3 1/8 for pi.

About 2000BC
The Egyptians use (16/9)^2 = 3.1605 for pi.

About 1200BC
The Chinese use 3 for pi.

About 550BC
The Bible implies that pi=3.

About 250BC
In *Measurement of the Circle*, Archimedes gives an approximation of the value of pi with a method which will allow improved approximations. He declares that 3 10/71 < pi < 3 1/7 and approximates pi as 211875/67441 = 3.14163. He needs to approximate R(3) to make these calculations, so he bounded R(3) by 1351/780 > R(3) > 265/153, which he probably finds by what will later be called Heron's Method.

About 225BC
Appolonius improves the Archimedean value of pi, but it is unknown to what extent.

About 20BC
Vitruvius estimates pi as 25/8 = 3.125.

About 130
Chung Hing uses pi=R(10) = 3.16....

About 150
Ptolemy uses pi=377/120 = 3.1416666....

About 200
Wang Fau uses pi=142/45 = 3.15555....

263
By using a regular polygon with 192 sides Liu Hui calculates the value of pi as 3.14159 which is correct to five decimal places.

About 480
Tsu Ch'ung Chi gives the approximation 355/113 to pi which is correct to 6 decimal places and establishes that 3.1415926 < pi < 3.1415927.

499
Aryabhata I calculates pi to be 3.1416. He produces his *Aryabhatiya*, a treatise on quadratic equations, the value of pi, and other scientific problems.

628
Brahmagupta writes *Brahmasphutasiddanta* (*The Opening of the Universe*), a work on astronomy and mathematics. He uses zero and negative numbers, gives methods to solve quadratic equations, sum series, and compute square roots. Brahmagupta uses pi=R(10) = 3.16....

About 800
Al-Khwarizmi estimates pi to be 3.1416.

1220
Fibonacci finds pi=3.141818.

1400
Madhava of Sangamagramma proves a number of results about infinite sums giving Taylor expansions of trigonometric functions. He uses these to find an approximation for pi correct to 11 decimal places.

1424
Al-Kashi writes *Treatise on the Circumference* giving a remarkably good approximation to pi in both sexagesimal and decimal forms. Al-Kashi calculates pi to 14 decimal places. Later, in 1429, he calculates pi to 16 decimal places.

1573
Otho finds pi = 355/133 = 3.1415929.

1583
Duchesne finds pi=(39/22)^2 = 3.14256...

1593
Van Roomen calculates pi to 16 decimal places. Romanus also calculates pi to 15 decimal places this year.

1593
Viete finds an infinite irrational product for pi.

1596
Ludolph van Ceulen calculates pi to 32 places, and later in 1610, he calculates it to 35 places. Some still call pi the Ludolphine Number.

1621
Snell refines the Archimedean Method for calculating digits of pi. Grienberger uses this refinement to calculate pi to 39 decimal places in 1630. Huygens, in 1654, proves the validity of this refinement.

1655
Brouncker gives a continued fraction expansion of 4/pi based on the infinite rational product for pi that Wallis has just discovered.

1663
Muramatsu Shigekiyo finds seven accurate digits for pi.

1665
Newton calculates pi to at least 16 decimal places using his own idea, but his results are not published until 1737, after his death. This same year, Newton also comes up with the MacLaurin series for e.

1671
James Gregory discovers Taylor's Theorem and writes to Collins telling him of his discovery. His series expansion for arctan(x) later gives a series for pi/4 (Leibniz is credited with this additional idea in 1674).

1672
Mengoli publishes *The Problem of Squaring the Circle* which studies infinite series and gives an infinite product expansion for pi/2.

1685
Kochanski gives an approximate method to find the length of the circumference of a circle.

1700
Seki Kowa calculates pi to 10 decimal places.

1705
Sharp calculates pi to 72 decimal places.

1706
Jones introduces the Greek letter, pi, to represent the ratio of the circumference of a circle to its diameter in his *Synopsis Palmariorum Matheseos* (*A New Introduction to Mathematics*).

1706
Machin calculates pi to 100 places using his modification of the Gregory-Leibniz arctan(x) series.

1713
Su-li Ching-yun is published, containing pi accurate to 19 digits.

1719
De Lagny calculates pi to 127 places, but only 112 are correct.

1722
Takebe Kenko finds 40 digits of pi.

1730
Kamata calculates 25 decimal places of pi.

1737
Euler is able to show that both e and e^2 are irrational and gives several continued fractions involving e. Euler popularizes the use of the symbol pi for the ratio of the circumference to the diameter of a circle. The year before, he had determined a simple series for (pi^2)/6.

1739

Matsunaga calculates 50 decimal places of pi.

1748
Euler publishes *Analysis Infinitorum* (*Analysis of the Infinite*) which is an introduction to mathematical analysis. The famous formula e^(i*pi) = -1 appears for the first time in this text, as well as many series for pi and pi^2. A series for e appears, as well as the fact that e is the limit as n approaches infinity of (1 + 1/n)^n. Euler also approximates e to 18 decimal places and gives several continued fractions involving e.

1755
Euler derives a very rapidly converging arctangent series.

1761
Lambert proves that pi is irrational. He publishes a more general result in 1768. He also shows that the functions e^x and tanx cannot assume rational values if x is a non-zero rational number.

1775
Euler suggests that pi is transcendental.

1777
Buffon carries out his probability experiment to calculate pi by throwing sticks over his shoulder onto a tiled floor and counting the number of times the sticks fall across the lines between the tiles.

1794
Legendre proves the irrationality of pi and pi^2.

1794
Vega calculates pi to 140 decimal places.

1824
Rutherford calculates 208 decimal places of pi, but only 152 are correct.

1844
Strassnitsky and Dase calculate pi to 200 places.

1847
Clausen calculates 248 digits of pi.

1853
Lehmann correctly calculates 261 decimal places of pi.

1855
Richter calculates pi to 500 decimal places.

1864
Benjamin Pierce has his picture taken in front of a blackboard with the formula i^-i=R(e^pi) inscribed on it. In 1859, he had tried to introduce new symbols for e and pi, but they did not become popularly accepted.

1873
Shanks gives pi to 707 places (in 1944 it was discovered, by Ferguson, that Shanks was wrong from the 528th place on).

1874
Tseng Chi-hung finds 100 digits of pi.

1882
Lindemann proves that pi is transcendental. This proves that it is impossible to construct a square with the same area as a given circle using only a ruler and compass. The classic mathematical problem of squaring the circle dates back to ancient Greece and had proved a driving force for mathematical ideas through many centuries.

1934
Gelfond and Schneider solve "Hilbert's Seventh problem" independently. They prove that a^q is transcendental when a is algebraic (and not equal 0 or 1) and q is an irrational algebraic number. Gelfond proves that e^pi is transcendental.

1946
Ferguson publishes 620 decimal places of pi. Later, in 1947, he extends this to 808 places using a desk calculator.

1949
ENIAC is programmed to compute 2037 decimals of pi. This same year, Smith & Wrench use a desk calculator to compute 1120 places of pi.

1954
NORC is programmed to compute 3089 decimals of pi.

1957
Pegasus computer computes 7480 places of pi. The next year it computes 10021 digits of pi.

1959
IBM 704 computes 16167 decimal places of pi.

1961
Shanks and Wrench improve the IBM 7090 computer program for pi, and compute 100,000 decimal places for pi.

1966
IBM 7030 computes 250,000 decimal places for pi.

1967
CDC 6600 computes 500,000 decimal places for pi.

1973
Guilloud and Bouyer compute 1 million decimal places of pi.

1976
Salamin and Brent find an arithmetic-geometric mean algorithm for pi.

1981
Miyoshi and Kanada compute over 2 million digits of pi. Kanada becomes a life-long "pi digit-hunter."

1983
Tamura and Kanada compute 16 million digits of pi.

1988
Kanada computes over 200 million digits of pi.

1989
The Chudnovsky brothers find 480 million digits of pi. In the same year, Kanada calculates 536 million digits of pi, and the Chudnovsky brothers reclaim the "most digits of pi" title by calculating 1 billion digits of pi.

1994
The Chudnovsky brothers put together a home-made parallel computer and use it to calculate over 4 million digits of pi.

1995
The Borwein brothers develop a method to find the nth hexadecimal digit of pi (without calculating the preceding digits). Also, in this year, Kanada computes 6 billion digits of pi.

1996
The Chudnovsky brothers compute over 8 billion digits of pi.

1997
Plouffe finds a method to calculate the nth digit of pi in any base. Also, Kanada and Takahashi calculate over 51 billion digits of pi.

1999
Kanada captures the current record for the number of digits of pi, over 206 billion.

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