Forth was developed by Chuck Moore in the 1960s (see *Forth - The Early Years* by C. Moore and *The Evolution of Forth* by E. Rather, et al).

Original use for Forth was to perform instrument control, data acquisition, and least-squares curve-fitting at NRAO and Kitt Peak.

Became a formal programming language in 1977 with Forth-77 standard. Subsequent standards were Forth-79 and *Forth-83* by the Forth Standards Team.

First commercial Forth system for IBM-PC introduced in 1982 by Laboratory Microsystems, Inc.

Became an ANSI standard language in 1994, resulting in *ANS-Forth*. 

History of Forth
Overview of Forth

- Forth is interactive
  - Perform computations directly at the Forth prompt.
  - Define and examine variables and constants
  - Define and execute new Forth words (individual subroutines).
  - Execute operating system commands.
Overview of Forth

- Forth syntax is derived from use of a data stack.
  - The basic method of passing arguments to, and obtaining results from, Forth words is through the data stack.

```
[ 1 cell ]
Top of Stack
```

```
Bottom of Stack
```
Overview of Forth

- Forth maintains a list of words, a dictionary.

```
words
WORD WORDS FIND ' [ ]
[ ] CREATE DOES> >BODY
FORGET COLD ALLOT ?ALLOT LITERAL
EVALUATE IMMEDIATE CONSTANT FCONSTANT VARIABLE
FVARIABLE CELLS CELL+ CHAR+ DFLOATS
DFLOAT+ SFLOATS SFLOAT+ ? @
! 2@ 2! A@ C@
C! W@ W! F@ F!
DF@ DF! SF@ SF! SP@
RP@ >R R> R@ 2>R
2R> 2R@ ?DUP DUP DROP
SWAP OVER ROT -ROT NIP
TUCK PICK ROLL 2DUP 2DROP
2SWAP 2OVER 2ROT DEPTH BASE
BINARY DECIMAL HEX 1+ 1-
2+ 2- 2* 2/ DO
?DO LOOP +LOOP LEAVE UNLOOP
I J BEGIN WHILE REPEAT
UNTIL AGAIN IF ELSE THEN
CASE ENDCASE OF ENDOF RECURSE
BYE EXIT QUIT ABORT ABORT"
```
Applications of Forth

- **Embedded Systems:**
  - smart cards, robotics, Fed-Ex package trackers, embedded web servers, space applications

- **Software Tools Development**
  - writing cross-assemblers and disassemblers
  - writing parsers and programming languages
  - scripting and software testing

- **Application Development**
  - editors, word processors, games, circuit modeling, VLSI design, ...

- **Laboratory Automation**
  - Hardware Interfacing
  - Data acquisition, data logging
  - Instrument control

- **Engineering and Scientific Computing**
  - Data analysis
  - Simulation and modeling
  - Visualization

- **Exploratory Computing**
  - algorithm development
  - artificial intelligence programming, cellular automata, evolutionary programming
Forth Language

Stack Operations:

DUP SWAP ROT DROP OVER
>R R> ?DUP NIP TUCK
PICK .S .  2DUP ...

Examples:

```
1 2 .S
2 2
1 1

2 1
1 2

3 1
2 3
1 2
```

```
1 2 3 ROT .S
```
Forth Language

Integer Arithmetic:

+   -    *   /   */
MOD /MOD 1+  1-
NEGATE  ABS

Examples:

3 8 * . 24 ok
56 5 MOD . 1 ok
Forth Language

Relational Operators:

\[ = < > <= >= \]
\[ 0= 0< \ldots \]

Examples:

1 3 < . -1 ok
4 0= . 0 ok
-5 -2 <= . -1 ok
Forth Language

Bitwise Operators: AND OR XOR INVERT LSHIFT RSHIFT 2* 2/

Example:

: byte-swap ( n – m )
  DUP 8 RSHIFT SWAP 255 AND 8 LSHIFT OR ;

4096 byte-swap . 16 ok
Forth Language

Branching:

IF ... THEN
IF ... ELSE ... THEN
CASE ... OF ... ENDOF ... ENDCASE

Example:

: even? ( n -- )
  2 MOD 0= IF ." YES" ELSE ." NO" THEN ;

5 even?  NO ok
8 even?  YES ok
Forth Language

Looping:

```
DO ... LOOP      ?DO ... LOOP
DO ... +LOOP     ?DO ... +LOOP
I  J
BEGIN ... AGAIN
BEGIN ... UNTIL
BEGIN ... WHILE ... REPEAT
```

Example:

```
: 2^ ( n – 2^n) 1 SWAP LSHIFT ;

: pow2-sum ( n – m | sum of terms 2^i, i=0,n-1) 0 SWAP 0 ?DO i 2^ + LOOP ;

10 pow2-sum . 1023 ok
```
Indefinite Loop Example:

: pad2 ( n – m | m is next power of 2, >= n) DUP 0 <= IF DROP 1 THEN 1 BEGIN 2DUP > WHILE 2* 2DUP > REPEAT NIP ;

348 pad2 . 512 ok
Recursion Example:

\ Find the greatest common divisor of two \ integers

: gcd ( n1 n2 -- gcd )
    ?DUP IF SWAP OVER MOD RECURSE THEN ;

1050 432 gcd . 6 ok

From A Beginner's Guide to Forth by J.V. Noble
Forth Resources

- Forth Programmers Handbook
- Forth Code Index
- comp.lang.forth

Forth in Python:
http://openbookproject.net/py4fun/forth/forth.html