

I

80486DX cpu/fpu 66, 72
 80x87 chips
 See also 87stack
 80x87 co-processor family 66
 87stack 48, 67, 80
 >R
 See also R >

A

Abramowitz, M. and Stegun, I.A. 182
 absolute address 107
 action table 34 - 35
 See also execution array
 adaptive integration
 recursive version 165
 algebra
 See computer algebra
 ANSI FORTH 12, 24
 Argand
 — plot, — diagram, — plane 146
 arithmetic operators 24
 array notation 105
 arrays
 bounds checking 44
 FORTRAN notation 5
 assembler 52, 67
 < % ... % > 69
 CODE ... END-CODE 67
 DWORD-PTR 71
 FCOM. 74
 FCOMP. 74
 FCOMPP. 74 - 75
 FDECSTP. 80
 FIELD. 70 - 71
 FINCSTP 80
 FISTP. 70 - 71
 FLD. 71
 FSTP. 71, 75
 FTST. 74
 FWAIT. 68
 FXCH. 68
 QWORD-PTR 71
 TBYTE-PTR 71
 WORD-PTR 70

assembler ...

X* 150

avoiding decisions

97, 271

B

BEHEAD"

See beheading, headerless words

beheading

BEHEAD' and BEHEAD" 98

See also BEHEAD', BEHEAD" (words)

headerless words 41

binary search

See table look-up

BIOS

250

bit-reversal

See FFT

Brodie, L.

12

C

CALL

8, 16, 41, 43

Cauchy's theorem

calculus of residues 180

CFA

vectored execution

35

chi-squared/degree of freedom

200

CODE

See assembler

commenting

See (, \ (words)

fstack comment 43

stack comments 42

comparing numbers

See = (words)

relational operators 24

compile-time actions

See : (colon) (words)

compiler

compiled languages

2

See CREATE,], [(words)

compiling word

See defining word, CREATE ... DOES >

complex conjugate

See complex numbers, Hermitian matrix

complex functions

exponential 154

logarithm 155

trigonometric 154

- complex lexicon
 - 1/X 150
 - ARG 150
 - CMPLX 149
 - CONJG 149
 - DX@, DX! 148
 - F*X 149
 - FATAN2 150
 - FSINCOS 150, 155
 - IMAG 149
 - to POLAR 150
 - REAL 149
 - X* 149
 - X* (CODE version) 150
 - X*F 149
 - X*I 149
 - X+ 149
 - X/ 150
 - X/F 149
 - X2/ 155
 - X@, X! 148
 - X- 149
 - XABS 150
 - XCOS 155
 - XDROP 149
 - XDUP 53, 78, 149
 - XEXP 155
 - XLOG 155
 - XMODSQ 150
 - XOVER 149
 - XSIN 155
 - XSQRT 154
 - XSWAP 149
- complex numbers 144
 - 2×2 matrix representation 145
 - n roots of 151
 - algebraic rules 145
 - Cartesian representation 144, 147
 - complex conjugate 146
 - division 146
 - multiplication 145
 - multiplicative inverse 146
 - polar representation 147
 - real and imaginary parts 144
 - roots of polynomials 144
 - square roots 152 - 153
- computer algebra
 - \$stack 278
 - PERP 282
 - TR(277
 - Trg5(284
- contour integral
 - See adaptive numerical quadrature
- CPDUP
 - See XDUP
- Cramer's rule
 - See determinants
- D**
- danger
 - See rstack
- Data structures 91 - 114
- DEBUG 66, 69
 - logging output to file 257 - 258
- defining words 28
 - See CREATE, DOES
- definite integral 158
 - as limiting process 159
- DERIVE
 - See computer algebra
- determinants
 - Cramer's rule 218
- dictionary 13, 15, 28, 35, 39, 41
- differential equation
 - numerical quadrature as 160
- differential equations
 - See ordinary differential equations
- dimensioned data
 - intrinsic units 32
- division
 - See multiplicative inverse
- documenting code
 - See commenting; (, \ (words)
 - self-documenting style 269
- DOER ... MAKE
 - See also vectored execution
- DOS functions 255
- dummy words
 - See CREATE, vectored execution
- E**
- eigenvalue problems
 - solution of 217
- ESC (D8hex)
 - See escape
- "escape" instruction 66
- Euclid's algorithm
 - GCD 166 - 167

Euler's theorem	151, 154	F > , F = , F <	53, 75
execution array	97	F0 < , F0 = , F0 >	53, 75
F		F = 0	48
		F = 1	48
		F = 2	76
F\		F = L10(2) (0.3010300...)	48
See FR/		F = L2(10) (3.321928...)	48
Fast Fourier Transform (FFT)	184	F = L2(E) (1.442695...)	48
fetch		F = LN(2) (0.693147...)	48
See @, D@, R32@, @L, etc. (words)		F = PI (3.14159...)	48
FFT			
bit-reversal	187, 189	F@, FI	47
FFT algorithm	185	FDUP	47, 67, 70
Fibonacci sequence		FSWAP	47, 67, 70
See recursion		FDROP	47, 67, 70
FIG		FROT	47, 67-68
Forth Interest Group	12	F-ROT	70
file-oriented FORTHs	250	FOVER	47, 67, 70
finite state machine (FSM)		S->F	47, 71
FORTH version	269	D->F	47
See rule-based programs		F->S	47, 71
tabular representation	267	F->D	48
fitting functions		%	48
determining parameters	183	FUNDER	48
See "linear, nonlinear least-squares"		FPLUCK	48
representation of data	181	FnX	48
		FnR	48
floating point arithmetic	45		
floating point lexicon		FACOS	54, 80
DEG->RAD	54, 77	FASIN	54, 80
F*	72	FATAN	54, 80
F**	54, 77	FATAN2	150
F +	49, 72		
F -	49, 72	SINH	55
FR-	49, 72	COSH	55
F*	49	TANH	55
F/	49, 72	ARCSINH	55
FR/ (synonym F\)	49, 72	ARCCOSH	55
FNEGATE	49, 72		
FABS	49, 72	FICONSTANT	56
1/F (synonym FINV)	49	FINIT	57
F*NP	49		
F**2	52	FCOMPP	75
F2**	54, 77	FCONSTANT	77
		FCOS	79
F,	77	FEXP	54, 77
F2/	55	FLG	76
F32,	63	FLN	54, 77
		FLOG	54, 77
F2XM1	76	FMAX	53
F4x4 (IIT chip)	85		

floating point lexicon ...

FMIN	53
FPATAN	77, 79
FPOP	82
FPREM	78
FPTAN	77
FPUSH	82
FTRUNC	57
FRNDINT	57
FSQRT	54, 76

FSBP0, FSBP1, FSBP2
IIT chip instructions

85

FSCALE 77

FSIN	54, 79
FSGN	54, 72
FCOS	54
FTAN	54, 79

RAD- > DEG 54

FSTSW	74
FTST	75
FTSTP	75

FY*LG2X	76
FY*LG2XP1	76

I16@, I16!	70
I32@, I32!	71
I64@, I64!	71

R32@, R32!	71
R64@, R64!	71
R80@, R80!	71

floating point numbers

testing	53
FORmula TRANslator	296
< arglist >	297
< assignment >	298
< expression >	299
< factor >	299
< function >	297
< id >	298
< term >	299

FORTH words
See words

FORTRAN, rules of

See rule-based programs

fstack	46 - 47, 66
software 87stack extension	80
function library	6, 53
function protocol	
USE(162

fundamental theorem of calculus 159

G

gamma-5 (γ^5)	
special gamma matrix	276

Gaussian quadrature
See numerical integration

generic lexicon

)MONTE	162
1ARRAY	111
2ARRAY	113
?TYPE	113
}	113
}}	113
binary operators	104
G: ... ;	97
See also CASE: ... ;CASE (words)	
G@, G!	97
GB:	104
GU:	101
operators	100
unary operators	101

generic memory access
See G@, G!

GEnie network 12

globally optimizing compiler
See optimization

GOSUB 8, 16, 43

GOTO
computed, in FORTRAN etc. 267
See spaghetti code

Gram polynomials	184, 193
Gram-Schmidt orthogonalization	196

H

half-angle formulas	
See trigonometric functions	
Hammerley, J.M. and Handscomb, D.C.	
<i>Monte Carlo Methods</i>	165
hashing	
See table look-up	
Hermitian matrix	
See linear equations	
Hewlett-Packard calculator	17
Hilbert matrix	
See ill-conditioned matrix	
HMF	
See Abramowitz, M. and Stegun, I.A.	

I

FORTH I/O words	
\$"	251
\$->F	225, 251
<FILE	251
>FILE	253
CLOSE-INPUT	251
CLOSE-OUTPUT	253
CLOSEH	257
CRT	257
DUPH	256
file handle number	256
FILL <FILE	253
G#	251
G\$	251
GET-F#	225
IO-STAY	257
LOG-OFF	257
LOG-ON	257
MAKE-OUTPUT	253
MAT >FILE	253
MKFILE	256
NR	251
OPEN-INPUT	251
PCRT	257
SPICEH	256
splicing file handles	256
VEC >FILE	253 - 254
ifstack	93
typed data stack manager	99 - 100
ill-conditioned matrix	195

infinite series	116
divergent series	116
exponential	123
harmonic series	117
power series	116, 126
Weierstrass' theorem	121
Zeno's paradox	117

infix	17
See also postfix	
information hiding	40
and safety	41
integral of a function	158
Integrated Information Technology	
802c87 and 80c387 chips	85

Integration	
See also adaptive integration	
Monte-Carlo method	160
numerical	157
"Intelligent" fstack	
See ifstack	
Interpolation	
See fitting functions	
"interrupt"	
See DOS functions	
Inverse trigonometric functions	77

J

jump table	
See also execution array, action table	
in rule-based ...	270

K

Kelly, M. and Spies, N.	12
-------------------------	----

L

large arrays	106
linear equations	89
determinantal equation	216
determinants	214
eigenvalue problems	215
Hermitian matrices	216
linear algebraic equations	214

pivotal elimination	221
linear equations ...	
Strassen's algorithm	90
linear least-squares	
Gram polynomials	207
literal	3
local variables	
rstack used for	22
Loeliger, R.	
<i>Threaded Interpretive Languages</i>	1
logging screen output	254
logic trees	
"dead" code	267
loops	25
BEGIN ... UNTIL	25
BEGIN ... WHILE ... REPEAT	25
endless	26
indexed	26
Lukasewcleicz	
See RPN	17
M	
MACSYMA	
See computer algebra	
MATHEMATICA	
See computer algebra	
mathematics co-processor	65
Mathews, J. and Walker, R.L.	
<i>Mathematical Methods of Physics</i>	122
matrix, inverse	
See linear equations	
mean	59
minimization	
)MINIMIZE (simplex algorithm)	210
– functions of many variables	201
simplex algorithm	202
steepest descents	201
monomials	184
Monte-Carlo method	
)MONTE	162
convergence	162
See also numerical integration	
multidimensional integrals	162
stratified sampling	165
uncertainty in	161

N

naming conventions	
self-documenting code	43
nonlinear least-squares	201
numerical integration	
)INTEGRAL	165
Gaussian quadrature	204
See also integration, numerical	
Richardson extrapolation	206
trapezoidal rule	205

O

object oriented	64, 96
offset	
See absolute address	
optimization	51
peephole	53
ordinary differential equations	131
implicit Runge-Kutta method	136
Runge-Kutta method	132
orthogonal polynomials	196, 198
overloading	49
See "smart" operators	

P

parameter stack	47
pattern recognition	262
polynomial	
Legendre	7 - 8
Gram	184, 193
polynomial evaluation	50
fast algorithm (log(n) time)	186
postfix notation	17
Pountain, Dick	96
Press, W.H., et al.	
<i>Numerical Recipes ...</i>	160
PRN2FILE	258
PRNGs	
16-bit integer PRNG	62
random walk	60
Wichman and Hill	60
FORTH programs	
)MINIMIZE	210
}FFT	191

FORTH programs			
}FIT	207	reverse Polish notation (RPN)	17
}POLY	51	roots of polynomials	
		See also fundamental theorem of algebra	
(pseudo) random numbers	56	roundoff error	195
chi-squared (χ^2) test	58	rstack	
GGUBS (PRNG)	57	See return stack	
Monte-Carlo integration	162	rstack, caution in using	
random data structures	61	See also DO ... LOOP (words)	
Q		rule-based programs	
quadrature		\$stack	296
See integration		skip_exponent	271 - 272
QuickBasic® (Microsoft)	169	automatic translation tables	272
R		deterministic FSMs	265
RAD- > DEG		finite state machine	264
See DEG- > RAD (floating point ...)		formula evaluator	286
Ralston, A.	136	FORMula TRANslator	284
random numbers		FORTRAN rules	261
See (pseudo) random numbers		FSM:	270
testing PRNGs	58	function library	288
recursion		grammar	260
See also adaptive integration		hierarchy of operators	288
adaptive numerical integration	171	regular expressions	261
disadvantages	171	state transitions	270
elimination of	171	state variable	266, 271
estimating running time	168 - 169	run-time actions	
See also Euclid's algorithm		See DOES > (words)	
Fibonacci numbers	168	Runge-Kutta	
in rule-based programs	262	See ordinary differential equations	
potential problems	167	S	
RECURSE	170	say	14
recursive algorithms	165	SCHOONSCIP	
sorting using (mergesort)	169	See computer algebra	
speed of execution	167	segment descriptor	
when not to use	168	See absolute address	
recursive-descent optimizer	52	self-modifying code	28
redirection		Shaw, Gordon	114
- of MS-DOS output	254	signed integer	24
REDUCE		See also >, <, =, + LOOP (words)	
See computer algebra		simplex algorithm	184, 201
regular falsi		SMALLTALK	
See transcendental equations		See object oriented	
return stack	21	"smart operators"	
See also stack		FORTRAN	3
		smart operators	5
		smoothing	
		See fitting functions	
		solving equations	127
		sorting	

See recursion
 spaghetti code 39
 special constants
 math coprocessor chips 48
 stack 14, 17 - 18, 20
 See also 87stack
 See also fstack, lfstack, parameter stack,
 return stack
 state variable
 See rule-based programs
 store
 See !, D!, R32!, !L, etc. (words)
 Strassen's algorithm 87, 107
 strings 36
 See also FORTH I/O words
 structured programming 25, 38

 style
 FORTH conventions 38
 sub-programs 2
 subroutine
 word as 16, 44
 FORTH subroutines
 }POLY 51

T

table look-up 182
 threaded language 1
 TOS
 See stack
 trace
 gamma matrix products with γ^5 276
 of matrix 274
 product of gamma matrices 275
 transcendental equations 127
 binary search 127
 regula falsi 128
 trapezoidal rule
 See numerical integration
 trigonometric functions 77, 152, 184
 - identities 78
 typed data
 arrays 104
 COMPLEX (COMPLEX*8) 94
 DCOMPLEX (COMPLEX*16) 94
 multiple scalars 95
 REAL*4, REAL*8 94
 scalars 94
 variable 3

U

unsigned integers 24
 See also U <, /LOOP (words)

V

variables
 See also words (VARIABLE), local variables
 variance 59
 vectored execution 28
 analogy with EXTERNAL 9
 See also DOER ... MAKE,
 CA' x DEFINES y, USE(
 forward referencing 39, 300

 vocabulary 67

W

Williams, Al 109
 word
 subroutine 8, 13, 16
 FORTH words 49
 ! (store) 23, 29
 < 15 - 16
 * + 16
 : (colon) 15-16
 \$. (string-emit) 37
 \$" 37
 (42
 * 24
 */ 24, 32
 + 24
 + LOOP 26
 . (emit) 14
 / 24
 /LOOP 26
 /MOD 24
 0 <, 0 =, 0 > 24
 AS 33
 , (comma) 29
 <, =, > 24
 >R 21
 @ (fetch) 23, 29
 [(STATE = interpret) 34
 \ (comment) 38, 43
] (STATE = compile) 34
 - "minus" 24
 -ROT 20

ALLOT	28
BEGIN	25
BEHEAD	34
BEHEAD"	57
CI "byte-store"	23
C@ "byte-fetch"	23
CA' "code-address of"	27
CASE: ... ;CASE	268
CONSTANT	28, 30
COUNT	37
CREATE	26, 28, 30
CREATE ... DOES >	26
DI	23
D > R	21
D@	23
DDUP	22
DECIMAL	13
DEFINES	27
DO ... LOOP	21, 26
manipulating rstack within	23
DOER ... MAKE	44
DOES >	26, 30
DOS"	257
DR >	21
DROP	19
DUP	19 - 20
DUP > R	21
DVARIABLE	29
ELSE (compile only)	25
ENDIF (THEN)	25
EXECUTE	21
EXPECT	37

See also "floating point lexicon"

HEX	14
IF (compile only)	25
IMMEDIATE	270
KEY	37
MAX	53
MIN	53
MOD	24
NUMBER	14
ok	14
OVER	20
PAD	37
PICK	20
+	14
R >	21
R@	21

RDROP	23
RECURSE	166, 170, 299
REPEAT	25
ROLL	20
ROT	19 - 20
SWAP	19 - 20
THEN (compile only)	25
TRACE, SSTRACE	166
TYPE	37
U <	24
UNDER	20
UNITS	33
UNTIL	25
VARIABLE	22, 28
WHILE	25

Z

zero-based numbering	18
----------------------	----