Index

adder
- binary, 215
- Compound adder, 222
- Conditional sum adder, 220
- Ripple carry adder, 217
- sequential, 296
- two’s complement adder, 238
- two’s complement subtractor, 239

addition, 215
- 3-bit carry, 14
- signed, 228

arbitration, 250
arc, 38
arithmetic logic unit (ALU), 326
arithmetic series, 19
arity, 68
assembler, 310
assembly language, 312
asymptotic behavior, 94

balanced partition, 174
balanced tree, 175
Big Endian, 104
binary operation, 15
idempotent, 116
binary representation, 52
binary string, 9, 53
bit, 9, 13, 53
carry bit, 216, 218
least significant (LSB), 54
most significant (MSB), 54
weight, 55
Boolean formula, 68, 69
atoms, 71, 92
contradiction, 93
logically equivalent, 73
normal forms, 109
satisfiable, 73
subformula, 70
bus, 184

byte, 57
Cartesian product, 4, 5
Central Processing Unit (CPU), 57
circuit, 153
behavior, 165
functionality, 165
synchronous, see synchronous circuits
clock, 247
closure, 71
combinational circuit, 154
delay, 164
delay analysis, 156
depth, 164
simulation, 156
combinational gate, 146
compiler, 310
conjunctive normal form (CNF), 113
connective
binary connectives, 68
complete set of connectives, 83
equivalence, 78, 134
implication, 77
unary connective, 68
constant, 68
contraposition, 7
counter, 299
critical segment, 249
D-latch, 258
DAG, 40
longest path, 44
De Morgan’s dual, 88
De Morgan’s laws, 9, 21, 88, 89
decoder, 186, 187, 202
design rules, 133, 166
digit, 53
digital abstraction, 133
digital circuit, 133
disjunctive normal form (DNF), 109
division, 52, 186
quotient, 52
electronic devices, 133
encoder, 192, 193
priority encoder, 213
factorial function, 23
fan-in, 149
fan-out, 150
Fibonacci sequence, 23, 94, 97, 102
finite state machine, see FSM
flip-flop
clock enabled, 260
delay triggered, 249
delay triggered with reset, 281
FSM, 272, 282
analysis, 289, 294
initialization, 298
synthesis, 269, 294
function, 9
associative, 15, 168
bijection, 24
Boolean function, 13
commutative, 15
composition, 9
cone, 176, 180
constant function, 12
domain, 9
identity function, 11, 14
injection, 24
majority, 14
one-to-one, 24
onto, 24
parity function, 14
range, 9
restriction, 10
surjection, 24
functional equivalence, 197
Galois field, 115
gate
AND, 154
inverter, 154
NAND, 154
NOR, 154
OR, 154
XOR, 154
Gauss elimination, 116
giga-bit, 57
giga-byte, 57
golden ratio, 23
graph
acyclic, 38
cycle, 39
directed acyclic graph, 40
directed edge, 38
directed graph, 38
reversed DAG, 41, 51
Gray code, 129, 131
Hamming distance, 193
heuristic, 120
hexadecimal representation, 63
immediate constant, 313
implicant, 121
essential prime, 123, 124
prime implicant, 122
induction
complete induction, 20
inductive basis, 20
induction hypothesis, 20
induction step, 20
instruction set architecture (ISA), 309
Karnaugh Maps, xix, 129, 131
kilo-byte, 57
leading zeros, 55
least significant bit first, 104
literal, 79, 109
Little Endian, 105
logical value, 136
LSB, see bit
maxterm, 113
mega-bit, 57
mega-byte, 57
memory, 312
dual port RAM, 271
controller, 323
effective address, 314
microprocessor, 311
RAM, 267, 302
ROM, 270
microprocessor control, 323, 331
datapath, 323
execution cycle, 330
minimum depth tree, 172
minterm, 110
mnemonic, 313
modulo, 52
remainder, 52
monomial, 118
most significant bit first, 104
MSB, see bit
multiplexer, 201
multiplication table, 11
negation, 68
negation normal form, 89
net, 150
netlist, 153
Index

node, 38
noise, 136, 138
additive noise, 140
bounded-noise model, 140

one’s complement, 228
order of growth rates, 94
ordered pair, 4
overflow, 236

Pólya, 21
parallel edges, 154
parse tree, 69
path, 39
closed, 39
critical, 165
interior vertex, 39
open, 39
self-loop, 39
simple, 39
permutation, 42
personal computer, 57
polynomial, 118
product of sums (POS), 113
product term, 110
simple, 110
product of sums, 114
proof by contradiction, 72, 87
propagation delay, 147
propositional logic, 68

rate of growth, 94
recurrence, 98
redundant representation, 225
register, 265
program counter (PC), 329
register file, 329
shift register, 266
architectural, 311
instruction register (IR), 328
instruction register (PC), 312
MAR, 312
MDR, 312
parallel load register, 266
program counter (PC), 312
shift register, 301
simplified DLX, 326

register transfer language (RTL), 335
relation
binary, 9
rooted trees, 47, 48
depth, 49, 172
height, 49
interior vertices, 49
leaves, 49
parent, 49
perfect, 173
subtree hanging, 49
segmentation fault, 314
self-loop, 39, 40, 153
semantics, 165
sequences, 29
arithmetic sequence, 30
finite sequence, 29
geometric sequence, 30
growth, 94
harmonic sequence, 30
series, 31
arithmetic, 31
geometric, 32
sets
axiomatic set theory, 5
cardinality, 7
complement, 4
difference, 4
disjoint, 6
element, 3
empty set, 4
intersection, 4
pairwise-disjoint, 6
power set, 4
Russell’s paradox, 5
strict containment, 10
subset, 4
union, 4
universal set, 3
shifter
arithmetic shifter, 211
barrel shifter, 205
cyclic, 205
environment, 327
logical shifter, 209
sign bit, 233
sign extension, 233
sign-magnitude representation, 228
signal
analog, 136
digital, 136
logical, 143
stable, 143
simulation
combinational circuit, 156
synchronous circuit, 288
static transfer function, 138
strings
concatenation, 53, 193
zero based, 54
substitution, 80
subtree, 48
sum of products (SOP), 109, 111
sum term, 113
symmetric difference, 126
synchronous circuit, 273
canonic form, 274
initialization, 279
min clock period, 285
synchronous circuit (cont.)
simulation, 288
timing, 255
timing analysis, 275, 283
zero delay, 264
syntax, 166

transistors, 133
truth assignment, 73
truth table, 13
two's complement, 228
negation, 231

variable, 68
Venn diagrams, 7
vertex, 38

walk, 39
word, 57