- 1. Ackermann, W., Solvable Cases of the Decision Problem, Amsterdam, 1954.
- 2. Uttley, A. M., Conditional Probability Machines, Automata Studies, Princeton, 1956.
- 3. Aufenkamp, D. D., Analysis of sequential machines II, IRE Trans., EC-7, 1958, No. 4.
- 4. Aufenkamp, D. D. and F. S. Hohn, Analysis of sequential machines I, IRE Trans., EC-6, No. 4.
- Bauer, F. L., J. W. Backus et al., Report on the Algorithmic Language ALGOL-60, Comm. ACM 3 (1960), 299-314.
- Barsov, A. S., Chto takoye lineynoye programmirovaniye (What is Linear Programming?), Fizmatgiz, 1959.
- Bellman, R., Dynamic Programming, Princeton, 1957.
- Blake, A., Canonical Expression in Boolean Algebra, Chicago, 1938.
- Blokh, A. Sh., On problems solvable by sequential machines, Problemy kibernetiki, Vol. 3, 1960.
- O. Bottenbruch, H., Structure and use of ALGOL-60, Journ. Assoc. Comp. Mach., 1962, N 2.
- Braverman, E. M., Experiments in the machine learning of the recognition of visual images, Avtomatika i Telemakhanika, No. 3, 1962.
- Vaida, S., The Theory of Games and Linear Programming, Princeton, 1956.
- Veitch, E. W., A chart method for simplifying truth functions, Proc. Assoc. Comp. Mach., 1952, N 2-3.
- Gantmakher, F. R., Theory of Matrices, Chelsea.
- Gentzen, G., Untersuchungen uber das logische Schliessen, Math. Zeitschrift, 1934-1935, T. 39.
- Gödel, K., Die Vollstandigkeit der Axiome des logischen Funktionenkalkulus, Monatshefte Math. und Physik., 1930, T. 37.
- Gödel, K., On Undecidable Propositions of Formal Mathematical Systems, Princeton, 1934.

- 18. Gel'fand, I. M. and M. L. Tsetlin, On some methods of trolling complex systems, Uspekhi Matem. Nauk, 17, No. 1962.
- 19. Ginsburg, S., Synthesis of minimal state machines, IRE TransEC-8, 1959.
- 20. Hilbert, D. and W. Ackermann, Fundamentals of Mathematical Logic, Chelsea.
- 21. Glushkov, V. M., On an algorithm for the synthesis of about automata, U. M. Zh., 12, No. 2, 1960.
- 22. Glushkov, V. M., On a method of analysis of abstract automate Dokl. Akad. Nauk Ukr. SSR, No. 9, 1960.
- 23. Glushkov, V. M., Some problems in the synthesis of diameter automata, Zhurn. vychisl. matem. i matem. fiz., 1, 1961.
- 24. Glushkov, V. M., On a method of automatic programmed Problemy kibernetiki, Vol. 2, 1959.
- 25. Glushkov, V. M., Self-organizing systems and the about theory of automata, Zhurn. vychisl. matem i matem. No. 3, 1962.
- 26. Glushkov, V. M., Sintez tsifrovykh avtomatov (The Symbol of Digital Automata), Fitzmatgiz, Moscow, 1962.
- 27. Glushkov, V. M., The theory of learning in a class of disperceptrons, Zhurn. vychisl. matem. i matem. fiz., 2, 1962.
- 28. Glushkov, V. M., On the problem of self-education in the ceptron, Zhurn. vychisl. matem. i matem. fiz., 2, No. 6.
- 29. Glushkov, V. M., V. A. Kovalevskiy and V. I. Rybak, A land algorithm for the recognition of the simplest geometric in: Printsipy postroyeniya samoobuchayushchikhaya Gostekhizdat, Kiev, 1962.
- 30. Glushkov, V. M., N. M. Grishchenko and A. A. Stoppen algorithm for the recognition of meaningful sentences, 1962.
- 31. Gnedenko, B. V., V. S. Korolyuk and E. L. Yushan Elementy programmirovaniya, (The Elements of Programming), Fizmatgiz, Moscow, 1961.
- 32. Goldman, S., Information Theory, Prentice-Hall, 1963.
- 33. Detlovs, V. K., Normal algorithms and recursive fundamental Dokl. Akad. Nauk SSSR, 90, No. 5, 1953.
- 34. Joseph, A. D., On predicting perceptron performance. Intern. Conv. Rec., 1960, Vol. 8, No. 2.
- 35. Zhegalkin, N. I., On the technique of propositional calculations symbolic logic, Matem. sb., Vol. 34, 1927.
- 36. Zhuravlev, Yu. I., On the impossibility of constructing medical disjunctive normal forms of functions of logical algorithms, Dokl. Akad. Nauk SSSR. 132. No. 300 Medical algorithms.

37. Kaluzhnin, L. A., On the algorithmization of mathematical problems, Problemy kibernetiki, Vol. 2, 1959.

38. Kantorovich, V. L., Mathematicheskie metody organizatsii i planirovaniya proizvodstva (Mathematical Methods of Industrial Organization and Planning), Izd-vo LGU, Leningrad, 1939.

39. Kitov, A. I. and N. A. Krinitskiy, Elektronnye tsifrovyye mashiny i programmirovaniye (Electronic Digital Computers and Programming), Fizmatgiz, Moscow, 1959.

40. Kleene, S. C., Representation of events in nervenets and finite automata, Automata Studies, Princeton, 1956.

11. Kleene, S. C. Recursive predicates and quantifiers, Trans. Amer. Math. Soc., 1943, v. 53.

12. Kleene, S. C., Introduction to Metamathematics, Van Nostrand, 1952.

43. Kolmogorov, A. N. and V. A. Uspenskiy, On the definition of an algorithm, Uspekhi Matem. Nauk, 13, No. 4(82), 1958.

4. Korolyuk, V. S. and E. L. Yushchenko, Voprosy teorii i praktiki programmirovaniya (Problems of the Theory and Practice of Programming), Sbornik trudov po vychislitel'noy matematike i tekhnike, Isd-vo Akad. Nauk Ukr. SSR, Kiev, 1961.

6. Copi, I. M., C. Elgot and J. B. Wright, Realization of events by logical nets, Journ. Assoc. Comp. Mach., 1958, Vol. 5, No. 2.

- 6. Kotel'nikov, V. A., On the transmitting capacity of the ether and of wires in electrical communications, in: Materialy k 1-omu Vsesoyuznomy s'ezdu po voprosam tekhnicheskoy rekonstruktsii dela svyazi i razvitiya slabotochnoy promyshlennosti, Izd. Red. Upr. Svyazi RKKA, 1933.
- Kobrinskiy, N. Ye. and B. A. Trakhtenbrot, Vvedenie v teoriyu konechnykh avtomatov (Introduction to the Theory of Finite Automata), Fizmatgiz, Moscow, 1962.

18. Cramer, H., Mathematical Methods of Statistics, Princeton, 1946.

Of natural selection, Printsipy postroyeniya samoobuchayushchikhsya sistem, Gostekhizdat, Kiev, 1962.

O. Lyapunov, A. A., On logical program schemes, Problemy kibernetiki, Vol. 1, 1958.

Lupanov, O. B., On the possibility of synthesizing circuits from arbitrary elements, Trudy matematicheskogo Instituta im. V. A. Steklova, Izd-vo Akad. Nauk SSSR, Vol. 51, 1958.

Maltzew, A. I. Untersuchungen aus dem Gebiete der mathematischen Logik, Math. Coll., 1936, T. 1(43).

Markov, A. A., Theory of algorithms, Trudy matematicheskogo instituta im. V. A. Steklova, Izd-vo Akad. Nauk SSSR, Vol. 42, 1954

- 54. Medvedev, Yu. T., On the class of events representable finite automata, in: Avtomaty, IL, 1956.
- 55. Mealy, G. H., A method for synthesizing sequential circular Bell System Techn. J., 1955, vo. 34.
- 56. Mikhalevich, V. S. and N. Z. Shor, Numerical solution multivariate problems by the method of sequential and of variants, in: Nauchno-metodicheskiye materialy ekonomic matematicheskogo seminara, Vol. 1, Izd-vo Akad. Nauk Moscow. 1962.
- 57. Moore, E. F., Gedanken experiments on sequential machine in: Automata Studies, Princeton, 1956.
- 58. Nagornyy, N. M. An amplification of the reduction theory of the theory of normal algorithms, Dokl. Akad. Nauk 90, No. 3, 1953.
- 59. Novikov, P. S., On the consistency of certain logical calculation Matem. sb., 1943, Vol. 12(54).
- 60. Novikov, P. S., On the algorithmic unsolvability of the desired of words in group theory, Trudy matematicheskogo institute.

 V. A. Steklova, Izd-vo Akad. Nauk SSSR, Vol.
- 61. Novikov, P. S., Elements of Mathematical Logic, Firmatical 1962.
- 62. Post, E. L., Introduction to the general theory of elements propositions, Amer. J. Math., 1921, vo. 43.
- 63. Post, E. L., Finite combinatory processes, Formulation J. Symb. Logic, 1936, Vol. 1.
- 64. Post, E. L., Recursive unsolvability of a problem of J. Symb. Logic, 1945, v. 12.
- 65. Povarov, G. P., Mathematical theory of the synthesis n-terminal contact networks, Dokl. Akad. Nauk SSSIL No. 5, 1959.
- 66. Prawitz, D., H. Prawitz and N. Voghera, A mechanical procedure and its realization in an electronic composition. Ass. Comp. Mach., 1960, Vol. 7, No. 2.
- 67. Roberts, I. O., Pattern recognition with an adaptive notes IRE Intern. Conv. Rec., 1960, No. 2.
- 68. Romanovskiy, V. I., Diskretnye tsepi Markova (Markov Chains), GITTL, Moscow-Leningrad, 1949.
- 69. Rosenblatt, F., Two theorems of statistical separability Perceptron, Symp. Mechaniz. Thought Proc., Nat. Phys. Teddington, England, 1958.
- 70. Rosenblatt, F., Perceptron simulation experiments, IRE, 1960, Vol. 48, No. 3.
- 71. Rosser, B., Extension of some theorems of Gödel and Class Journ, Symb. Logic, 1936, Vol. 1.
- 72. Selfridge, O. G., Pandemonium: a paradigm for learning.
 Mechaniz. Thought Process, Nat. Phys. Lab., Teddington,
 land, 1958.

- 73. Turing, A. M., On computable numbers with an application to Entscheidungsproblem, Proc. London Math. Soc., 1936, Vol. 42(2); 1937, Vol. 43.
- 74. Whitehead, A. and B. Russell, Principia Mathematica, Cambridge, 1910, Vol. 1; 1912, Vol. 2; 1913, Vol. 3.
- 75. Wilkes, M. V. and J. B. Stringer, Microprogramming and the design of the control circuits in an electronic digital computer, Proc. Cambridge Phil. Soc., 1953, Vol. 49, No. 2.
- 76. Uspenskiy, V. A., Lektsii o vychislimykh funktsiyakh (Lectures on Computable Functions), Fizmatgiz, Moscow, 1960.
- 77. Hao-Wang, Towards mechanical mathematics, IBM Journ., 1960.
- 78. Hao-Wang, Proving theorems by pattern recognition I, Communic. Assoc. Comp. Mach., 1960, Vol. 3, No. 4.
- 79. Hao-Wang, Proving theorems by pattern recognition II, Bell System Techn. Journ., 1961, Vol. 40, No. 1.
- 80. Shannon, C., The synthesis of two-terminal switching circuits, Bell System Techn. Journ., 1949, Vol. 28, No. 1.
- 81. Feller, W., Introduction to Probability Theory and Its Applications, Wiley, 1957.
- 82. Tsetlin, M. L., Some problems in the behavior of finite automata, Dokl. Akad. Nauk SSSR, 139, No. 4, 1961.
- 83. Yablonskiy, S. V., Functional constructions in k-valued logic, Trudy matematicheskogo instituta im. V. A. Steklova, Izd-vo Akad. Nauk SSSR, 51, 1958.

Index

Abelian groups, theory of 309 Absorption rule 50 Abstract alphabet 1 Abstract automata 91 minimization of 116 Abstract pattern 170 Abstract representation 169 Abstract theory of algorithms Abstract transition table 129 Accumulators 237 Ackermann, W. 299 Address modification 233 registers 248 Addressing language 250 Algebraic addition 233 ALGOL-60 250, 254 ALGOL-60 programming, examples of 267 Algorithmic systems 11 Algorithmic unsolvability, concept of 31 Algorithms 9 abstract theory of 1 deterministic 10 equivalent 10 normal 11 self-modifying 10 stochastic 10 universal 19 a-perceptron 271 Alphabetic mapping 2 operators 1, 2 Alphabets, input 2 output 2 Array identifiers 257 Arrays 255 Boolean 256 integer 256 real 256 dimensionality of 256 Arithmetic functions 26 Arithmetic operations 230, 245 Arithmetic unit 235 Associativity rule 49 Asynchronous machines 237 Atomic formulas 304 Aufenkamp, D. D. 116 Aufenkamp-Hohn algorithm 118 Automata with random transitions 158

Automaton algorithms 99
Automaton mapping 97
Automaton operator 97
Axiom system 84
property of independence of 88

Bellman, R. 224 Bernoulli scheme 146 Bernoulli trials 147 Binary alphabet 122 Binary relations 279 Binomial distribution 145 law of 146 Blake, A. 57 Blake's algorithm 57 Boolean algebra 47 Boolean functions 125 linear 62 partial 41 Boolean expressions 257 Boolean variables 39, 255 Boundary elements 170 Boundary index 170 Bounding of variables 283 Braverman, E. M. 171 Brightness 169 Brightness levels 7

Canonical equations 122
Canonical minimization 117
Canonical polynomials 62
Cascade method 76
Characteristic tensor 180
Clock cycles 237
Clock pulses 237
Closed formula 290
Code mapping 3
Coding 124
Collision of variables 283
Commutativity rule 49
Complete automata 123
Complete sets of Boolean operations 59
Complex variational problems, methods of solving 214
Computers, electronic digital 227

Conditional jump 231
Conditional probability machines 202, 205
Conditional reflexes 208
Conditional reflex machine 212
Constrained order of execution 234
Control unit 235
Copi, I, M, 101
Cybernetics Institute, Ukr. SSR 252
Cycle, concepts of 134
Cyclic depth of a regular event 103
Cycling of information 134

Deduction theorem 87 Deductive equivalence, concept of 289 Deductive theories, construction of 300 Delay element 126 Delimiters 254 De Morgan rules 50 Designational expression 260 Digit by digit conjunction 230 Diode matrices 240 Directed graphs 93 Discrete a-perceptrons in a self-eduction regime 193 operation of 193 theory of learning in 180 Discrete automata, theory of 59 Discrete self-organizing systems, theory of 151 Disjunction of events 101 Disjunctive normal form 52 Disjunctive terms 45

Electromagnetic relays 228
Elements, coincidence 70
separator 70
Elgot, C. 101
Entropy, concept of 151
additivity property of 152
Equivalence transformations 102
Euclidean space 141, 223
Evaluation function 219
Events in automata 99
Excitation function 124
Excitatory input 175

Feller, W. 140
Finite automata 92
abstract synthesis of 109
analysis of 104
structural synthesis of 122
theory of 291
Formal arithmetic 291
FORTRAN 250
Four-address instruction system 230

Gate 75 Gated input 75 Gelfand, I. M. 220
General approximation algorithm 172
General purpose programmed automation 235
structure of 235
Gentzen, G. 299
Gentzen's elimination theory 304
Ginsberg, S. 120
Glushkov, V. M. 59, 101, 192, 212
Gödel, K. 29, 285
Gödel numbering 296
Gödel's theorem 291
Goldman, S. 152
Graph-schemes 11
nodes of 11
Grishchenko, N. M. 212

Hao-Wang 304
Hilbert system 301
Hunger counter 274
Hypothesis of compactness 171

IBM-704 computer 308
I-calculus 291
Idempotence rule 49
Identifiers 255
Images 168
Implication 45
Index registers 248
Information processors 8
Information theory 152
Inhibitory input 175
Initialization 248
Instruction counter 239
Instruction register 239
Iteration brackets 101
Iteration of events 101

Joseph, A. D. 176

Kaluzhnin, L. A. 11
Kantorovich, V. L. 223
Karnaugh maps 72, 130
Kleene, S. C. 28, 295
Kolmogorov-Uspenskiy algorithmic 18, 20
Kotel'nikov's principle 7
Kovalevskiy, V. A. 192

Lagrange multipliers, method of 216
Learning automaton 140
Learning sequence 153
Length of a chain 23
Length of a word 1
Letichevskiy, A. A. 273
Letter-to-letter mapping 3
Lexical information 5

Life counter 274
Limiting transitional probabilities 162
Linear programming, methods of 221
Logical elements 122
Logic operations 235
Logical classification systems 202
Logical-computation methods 124
Local theorems 286
Loop variable 261
Lovenheim's theorem 286
Lupanov, O. B. 77
Lyapunov, A. A. 252

Machine cycles 235 Maltzevv. A. I. 286 Mark-I computer 228 Marked transition table 94 Markov, A. A. 11 Markov chain, ergodic 163 homogeneous 159 Matrices, multiplication of 252 Mealy automata 93 Memory cells 228 unit 235 Method of ravines 220 Microoperation decoder 240 Microoperations 237 register of 239 Microprogram 237 Mikhalevich, V. S. 224 Miniscope form 305 Moivre-Laplace formula 147 Moore automata 93 shifted output function of 94 Movement of the automaton 274 Multiplicand register 238 Multiplication of events 101 Multiplier register 238

Nagornyy, N. M. 17
Natural laws 278
Natural order of execution 233
Nerve nets 111
Neurons 175
Newton's binomial formula 146
Normal forms, Skolem 287
prenex 287
Normalization principle 17
Novikov, P. S. 34, 299
n-place function 40
Numerical information 5

Objects 279
Octal number system 228
One-dimensional normal distribution law
146
Open formula 290
Operational unit 235

Operation of cycling 134
Operation of formal assignment of arguments 41
Operation of subcontrol 207
Operation of supercontrol 207
Operative automaton 140
Operators, arithmetic 252
address-modification 252
Optimalizing control 214

Parallel computers 236 Pattern recognition 168 problem of learning in 168 Patterns 168 auditory 168 visual 168 Perron formula 161 Physical transition table 129 Pierce function 46 Poisson distribution 151 law 151 Polynomial distribution law 148 Post, E. L. 29, 65, 295 Post algorithm 30, 228 Post's combinatorial problem 37 Predicate calculus 82, 279 basic concepts of 279 Prime implicants, concept of 56 Probability density function 141 Probability theory, concepts from 140 Procedure identifier 264 body 264 call statement 264 Procedures, Boolean 257 integer 257 real 257 Program-controlled digital automaton 232 Program-scheme description, operator method of 252 Programmed automata 227, 234 Programming concepts 244 Proofs, automatic construction of 300 Propositional calculus 39, 78, 279 Pseudofrequencies, conditional 209 unconditional 209 Pseudorandom numbers 269

Quantifiers, existential 280 universal 280

Random environments 164
Random quantity, concept of 141
continuous 141
discrete 141
multidimensional 141
Reaction probabilities 164
matrices of 164
Receptors 169

Receptors, continuous 169
discrete 169
Recursive functions 26
Region of definition 2
Register, defined 236
Reinforcement rule 176
Return address register 251
Roberts, I, O, 179
Roberts' adaptive network 179
Roberts' scheme 192
Romanovskiy, V. I, 162
Rosenblatt, F. 175, 193
Rosenblatt perceptron 174
Rosser, B. 299
Russell, B. 305
Russell's paradox 36
Rybak, V. I, 192

SAKO 250 Self-modification, concept of 133 Self-organization, concept of 133 Self-organization, quantitative measure of Self-organizing systems 133 Selfridge's pandemonium scheme 192 Sequent, defined 301 Series computers 236 Shannon, C. 76 Sheffer stroke 46 Shor, N. Z. 224 Simple arithmetic expressions 257 Simplex method 221 Single-address instruction system 234 Single-place function 257 Skolem's theorem 289 SMALGOL-61 266 Standard method of equalizing lengths of Standard subroutines, method of 253 Statements 259 Steepest-ascent method 215 Steepest-descent method 215 Stochastic algorithms 235 Stochastic matrices 159 Stogniy, A. A. 212 Storage elements 122 Stringer, J. B. 239 Strings 264, 265 Structural alphabet 122 Structural excitation function 125 Structural output function 125 Structural theory of automata 95 Subject domain 279 Subject variables 279 Subjects 279 Subordination, concept of 206

Subroutines 251
library of 251
Subset, concept of 207
Successive analysis of variants, method 224
Suppression function 47
Switch designator 260
Symbolic addresses 246

Table of correspondences 8 Test gradient 219 Theory of alphabetic operators 8 Theory of automata 91 Theory of matrices 161 Three-address instruction system 233 Three-place function 257 Threshold of neuron firing 175 Trajectories 223 Transfer of control operations 230 Transition probabilities 160 Translators 250 Translator libraries, method of 253 Translator programs, method of 253 Trials 141 Trigger counter 126 Triggers with separate inputs 126 Truncated paths 105 Tsetlin, M. L. 164, 220 Turing, A. M. 29, 287 Turing machine 30 Two-address system 234 Two-place function 257

Universality, concept of 229 Uttley, A. M. 203 Uttley's classification machine 203

Variational methods 220 Veitch diagrams 72 Verb rows 213

Whitehead, A. 305 Wilkes, M. V. 239 Working cells 245 Wright, J. B. 101

Yablonskiy, S. V. 66

Zero-order derivative 162 Zhegalkin's algebra 60 Zhuravlev, Yu. I. 57