ficación estadística o del reconocimiento de patrones. LVQ es un método de aprendizaje adaptativo basado en los mapas auto-organizativos de Kohonen. Una descripción más detallada del mismo se puede consultar en [90].

La implementación utilizada en este trabajo corresponde a la versión 3.1. de LVQ PAK, y que se puede obtener en *ftp://cochlea.hut.fi/pub/lvq_pak*.

Hemos cogido los parámetros entre los rangos recomendados por los autores. El número de prototipos es aproximadamente un tercio del tamaño del conjunto de entrenamiento, el número de iteraciones es cien veces el número de prototipos y el parámetro α se ha tomado a 0.03.

- **Algoritmo CN2:** Este algoritmo aprende inductivamente un conjunto de reglas proposicionales a partir de un conjunto de ejemplos. El algoritmo fué diseñado por Niblett T. y Clark P. [19] y puede considerarse como un algoritmo que sigue la filosofía de los algoritmos AQ y que trata de mejorar el comportamiento de estos ante la presencia de ruido en el conjunto de entrenamiento.

  La implementación del software utilizada en esta memoria, fué realizada por Boswell R. en 1990 y puede obtenerse en *http://www.cs.utexas.edu/users/pclark/software.html*.

  Los parámetros utilizados para la obtención de los resultados presentados en este trabajo con este software, son los que dicha implementación asume por defecto.

- **Algoritmo WM:** Este software se ha utilizado para la clasificación de problemas con consecuente difuso. La implementación utilizada ha sido desarrollada por Cordón O. a partir de la descripción de la metodología de aprendizaje que se propone en [159].

Bibliografía

[1] Almuallim H., Dietterich T.G., *Learning with many irrelevant features.* Proceedings of Ninth National Conference on Artificial Intelligence. (1991), pp. 547-552.

[2] Almuallim H., Dietterich T.G., *Efficient algoritms for Identifying Relevant Features* (1993)

[3] Antonisse J., *A New Interpretation of Schema Notation that Overturns the Binary Encoding Constraint.* Proceeding of the Third Inter. Conf. on Genetic Algorithms, J. David Schaffer (Ed.) (Morgan Kaufmann Publishers, San Mateo, 1989), pp. 86-91.

[4] Bäck T., Hoffmeister F., *Genetic Algorithms and Evolution Strategies: Similarities and Differences.* Technical Report No. SYS-1/92. Dept. of Computer Science. Universidad de Dortmund, Alemania, Febrero, (1992).

[5] Bäck T., Schwefel H-P., *An Overview of Evolutionary Algorithms for Parameter Optimization.* Evolutionary Computation 1(1), (1993), pp. 1-23.

[6] Barone J.M., *Pruning Fuzzy Decision Trees.* Proceedings of the 2nd International Conference on Fuzzy Logic and Neural Networks, (1992), pp. 321-324.

[7] Bethke A.D., *Genetic Algorithms as Function Optimizers.* Ph. D. Dissertation, University microfilms No. 8106101, University of Michigan, Ann Arbor, MI (1981).

[8] Blumer A., Ehrenfeucht A., Haussler D., Warmuth M., *Learnability and the Vapnik-Chervonenkis Dimension.* Journal of ACM, 36 (4), (1990) pp. 929-965.

[9] Bongard N., *Pattern Recognition.* Spartan Books, New York, (1970).

[10] Bonelli P., Parodi A., Sen S., Wilson S. *NEWBOOLE: A Fast GBML System.* Proceedings of the Seventh International Conference on Machine Learning, (1990), pp. 153-159.

[11] Booker, L.B., *Intelligent Behavior as an Adaptation to the Task Enviroment.* Doctoral Dissertation. Department of Computer and Communication Science, University of Michigan, Ann Arbor, (1982).

[12] Booker, L.B., Goldber, D.E., Holland, J.H., *Classifier Systems and Genetic Algorithms* Artificial Intelligence 40 (1989) pp. 235-282.

[13] Breiman L., Friedman J.H., Olshen R.A., Stone C.J., *Classification and Regression Trees.* Wadsworth International Group, Belmont, California (1984).

[14] Buchanan B.G., Feigenbaum E.A., Lederberg J., *A Heuristic Programming Study of Theory Formation in Sciences.* Proceedings of the Second International Joint Conference on Artificial Intelligence, London (1971), pp. 40-48.

[15] Buchanan B.G., Michell T.M., *Model-Directed Learning of Production Rules.* Pattern-Directed Inference Systems, Academic Press, New York (1978)

[16] Carse, B., Fogarty, T.C., *A Fuzzy Classifier System Using the Pittsburgh Approach.* Parallel Problem Solving from Nature - PPSN III, Springer-Verlag, (1994), pp. 260-269.

[17] Cestnik B., Kononenko I., Bratko I., *ASSISTANT86: A Knowledge-Elicitation Tool for Sophisticated Users*. Progress in Machine Learning, (1987), pp. 31-45.

[18] Cheng J., Fayyad U.M., Irani K.B., Qian Z., *Improved decision trees: A generalized version of ID3*. Proceedings of the Fifth International Conference on Machine Learning, (1988), pp. 100-107.

[19] Clark P., Niblett T., *Learning If Then Rules in Noisy Domains*. TIRM 86-019, The Turing Institute, Glasgow (1986).

[20] Cohen B.L., *A Powerful and Efficient Structural Pattern Recognition System*. Artificial Intelligence, Vol. 9, No 3, (1977).

[21] Cordón O., del Jesús M.J., Herrera F., López E., *Selecting Fuzzy Rule-Based Classification Systems with Specific Reasoning Methods Using Genetic Algorithms*. Proceeding of IFSA'97, (1997).

[22] Cordón O., Herrera F., *A Three-Stage Process for Learning Descriptive and Approximative Fuzzy Logic Controller Knowledge Bases from Examples*. Por aparecer en Intl. Journal of Approximate Reasoning. (1997).

[23] Cordón O., Herrera F., *A Two-Stage evolucionary process for designing TSK fuzzy rule based system*. Technical Report #DECSAI-97115 (1997).

[24] Darwin C., *On the Origin of Species by Means of Natural Selection*, John Murray, 1859.

[25] Davies W.D.T., *System Identification for Self-Adaptative Control*. Wiley-Interscience, Wiley and Sons Ltd. (1970).

[26] Davis R., Lenat D.B., *Knowledge Based Systems in Artificial Intelligence*. McGraw-Hill, (1981).

[27] Davis L.D., *Applying Adaptive Algorithms to Epistatic Domains*, Proceedings IJCAI-85, Los Angeles, CA (1985), pp. 162-164.

[28] Davis L., *Handbook of Genetic Algorithms*, Van Nostrand Reinhold, New York, (1991).

[29] De Jong K.A., *An Analysis of the Behavior of a Class of Genetic Adaptative Systems*. Ph. D. Dissertation, University microfilms No. 76-9381, University of Michigan, Ann Arbor, MI (1975).

[30] De Jong K., *Learning with Genetic Algorithms: An overview*. Machine Learning 3, pp. 121-138 (1988).

[31] De Jong K.A., Spears W.M., Gordon D.F., *Using Genetic Algorithms for Concept Learning*. Machine Learning, 13, (1993) pp. 161-188.

[32] Dietterich T.G., *The Metodology of Knowledge Layers for Inducing Descriptions of Sequentially Ordered Events*. Master's thesis, University of Illinois, Urbana, (1979).

[33] Dorigo M., *New Perspectives about Default Hier Formation in Learning Classifier Systems*. Technical Report No. 91-002. Dipartamento di Elettronica, Politecnico di Milano Italy (1991).

[34] Driankov D., Hellendoorn H., Reinfrank M., *An Introduction to Fuzzy Control*. Springer-Verlag (1993).

[35] Eshelman L.J., Schaffer J.D., *Real-Coded Genetic Algorithms and Interval-Schemata*. Foundations of Genetic Algorithms 2, L.D. Whitley (Ed.) (Morgan Kaufmann Publishers, San Mateo, (1993), pp. 187-202.

[36] Feigenbaum E.A., *The Simulation of Verbal Learning Behavior*. Computers and Thought, McGraw-Hill, New York (1963), pp. 297-309.

[37] Fensel D., Wiese M., *Refinement of Rule Sets with JoJo.* Lectures Notes in Artificial Intelligence 667, (1993), pp. 378-383 .

[38] Fisher, R.A., *The use of multiple measurements in taxonomic problems.* Annual Eugenics. **7** (1936) Part II pp. 179–188.

[39] Firlej M., Hellens D., *Knowledge Elicitation : A Practical Handbook.* Prentice Hall, (1991).

[40] Fogel D.B., *System Identification Through Simulated Evolution: A Machine Learning Approach to Modeling*, Gin Press, Needham Heights, 1991.

[41] Fogel L.J., Owens A.J., Walsh M.J., *Artificial Intelligence Through Simulated Evolution*, John Wiley, New York, 1966.

[42] Friedberg R.M., *A Learning Machine: Part 1.* IBM Journal, Vol. 2 (1958). pp. 2-13.

[43] Friedberg R.M., Dunham B., North T., *A learning Machine: Part 2.* IBM Journal of Research and Develpment, Vol 3, No. 3 (1959), pp. 282-287.

[44] Fu K.S., *Pattern Recognition and Machine Learning.* Plenum Press, New York, (1971).

[45] Fu K.S., Tou J.T., *Learning Systems and Intelligent Robots.* Plenum Press, New York, (1974).

[46] Goldberg D.E., *Computer-aided gas pipeline operation using genetic algorithms and rule learning.* Doctoral Dissertation, Universidad de Michigan, Ann Arbor, MI (1983).

[47] Goldberg D.E., Richardson J. *Genetic Algorithms with sharing for Multimodal Function Optimization.* Proceedings of the Second International Conference on Genetic Algorithms. (1987).

[48] Goldberg, D.E., *Genetic Algorithms in Search, Optimization, and Machine Learning.* Addison-Wesley, New York, (1989).

[49] De Jong, K., Spears, W.M., Gordon, D.F., Using genetic algorithms for concept learning, Machine learning, 13, pp. 161-188, (1993).

[50] Goldberg D.E, *Real-Coded Genetic Algorithms, Virtual Alphabets, and Blocking.* Complex Systems 5, 1991, pp. 139-167.

[51] González A., Pérez R., Verdegay J.L., *Learning the Structure of a Fuzzy Rule: an Genetic Approach.* Proceedings del First European Congress on Fuzzy and Intelligent Technologies, Vol 2, (1993), pp. 814-819, también publicado en Fuzzy Systems and Artificial Intelligence, Vol 3, 1, (1994), pp. 57-70.

[52] González, A., Pérez, R., Valenzuela A., *Diagnosis of Myocardial Infarction through Fuzzy Learning Techniques.* Proceedings de IFSA'95 Vol 1, (1995), pp. 273-276.

[53] González, A., Pérez, R.: *Completeness and Consistency conditions for learning fuzzy rules.* Technical Report #DECSAI-95103 1995, también por aparecen en Fuzzy Sets and Systems (1998).

[54] González, A., *A learning methodology in uncertain and imprecise environments*, International Journal of Intelligent Systems, Vol 19, (1995), pp. 357-371.

[55] González, A., Pérez, R., *A Learning System of Fuzzy Control Rules.* In: F. Herrera, J.L. Verdegay (Eds.), Genetic Algorithms and Soft Computing, Physica-Verlag, (1996), pp. 202-225.

[56] González, A. Herrera, F., *Multi-stage Genetic Fuzzy Systems Based on the Iterative Rule Learning Approach*, Mathware and Soft Computing, Vol 4, n. 3, (1997), pp. 233-249.

[57] González, A., Pérez, R., *A Refinement Algorithm of Fuzzy Rules for Classification Problems*. Proceedings de la Sixth Int. Conference on Information Processing and Management of Uncertainty in Knowledge Based Systems, Granada, (1996), 533-538.

[58] González, A., Pérez, R., *Aplicación de un Sistema de Refinamiento de Reglas a Problemas de Clasificación*, Memoria del V Congreso Iberoamericano de Inteligencia Artificial, Editorial Limusa (1996), pp. 20-29.

[59] González, A. Pérez, R., *A two level genetic fuzzy learning algorithm for solving complex problems*. Proceedings de IFSA'97, Vol 2, (1997), pp. 192-197.

[60] González, A. Pérez, R., *Using information measures for determining the relevance of the predictive variables in learnings problemas*, proceedings del FUZZ-IEEE'97, Vol 3, (1997), pp. 1423-1428.

[61] González, A. Pérez, R., *A fuzzy theory refinement algorithm*, por aparecer en International Journal of Aproximate Reasoning, (1998).

[62] González, A. Pérez, R., *SLAVE: A genetic learning system based on an iterative approach*, Sometido al IEEE Transaction on Fuzzy System.

[63] Grefenstette J.J. *Credit Assignment in Rule Discovery Systems based on Genetic Algorithms*. Machine Learning 3 (1988), pp. 225-245.

[64] Grefenstette J.J., *Lamarckian learning in multi-agent enviroments*. Proceedings of the Fourth International Conference on Genetic Algoritms, (1991), pp. 303-310.

[65] Hàjek P., Havránek T., *Mechanizing Hypothesis Formation: Mathematical Foundations for a General Theory*. Springer-Verlag. (1978).

[66] Hayes-Roth F., *Schematic Classification Problem and their Solution*. Pattern Recognition, Vol 6, (1974), pp. 105-113.

[67] Hayes-Roth F., McDermott J., *An Interference Matching Technique for Inducing Abstractions*. Communications of the ACM, Vol. 21, No 6, (1978), pp. 401-410.

[68] Hellendoorn, H., Driankow, D., Reinfrank, M., *An introduction to Fuzzy Control*. Springer-Verlag (1993).

[69] Herrera F., Lozano M., Verdegay J.L., *Tuning Fuzzy Logic Controllers by Genetic Algorithms*. International Journal of Approximate Reasoning 12, (1995), pp. 299-315.

[70] Highleyman W.H., *Linear Decision Functions, with Applications to Pattern Recognition*. Proceedings of IRE, No. 50 (1967), pp. 1501-1504.

[71] Hilgard E.R., Bower G.H., *Theories of Learning* Third Edition, Appleton-Century-Grofts, New York, (1966).

[72] Holland J.H., *Adaptation in Natural and Artificial Systems*. Ann Arbor: The University of Michigan Press, (1975).

[73] Holland J.H., *Adaptation*. Progress in Theorical Biology, 4. New York: Plenum, (1976).

[74] Holland J.H., Reitman, J.S., *Cognitive Systems Based on Adaptative Algorithms*. Pattern-Directed Inference Systems. New York, Academic Press, (1978).

[75] Holland J.H., *Adaptive Algorithms for Discovering and Using General Patterns in Growing Knowledge Bases*. Policy Analysis and Information Systems, Vol. 4, No. 3, (1980).

[76] Holland J.H., *Properties of the Bucket Brigade Algorithm*. Proceedings of the First International Conference on Genetic Algorithms and Their Applications. Pittsburgh, PA, (1985), pp. 1-7.

[77] Holland J.H., *Escaping Brittleness.* Machine Learning: An artificial intelligence approach (Vol 2), San Mateo, CA: Morgan Kaufmann, (1986).

[78] Hougen H.P., Villanueva E., Valenzuela A., *Sudden Cardiac Death: a Comparative Study of Morphological, Histochemical and Biochemical Methods.* Forensic Science International 52, (1992), pp. 161-169

[79] Huang D., *The context-array Bucket Brigade Algorithm: An Enhanced Approach to Credit-Apportionment in Classifier Systems.* Proceedings of the Third International Conference on Genetic Algorithms. (1989), pp. 311-316.

[80] Hunt E.B., and Hovland C.I., *Programming a Model of Human Concept Formation*, Computers and Thought, McGraw-Hill, New York, (1963), pp. 310-325.

[81] Hunt E.B., Marin J., Stone P.T., *Experiments in Induction*, Academic Press,, New York, (1966).

[82] Ichikawa Y., Ishii Y., *Retainig Diversity of Genetic Algorithms for Multivariable Optimization and Neural Network Learning.* Proc. IEEE Int. Conf. on Neural Networks, San Francisco, California, (1993), pp. 1110-1114.

[83] Ishibuchi H., Morisawa T., Nakashima T., *Voting Schemes for Fuzzy-Rule-Based Classification Systems.* Proc. Fifth IEEE Intl. Conference on Fuzzy Systems,, pp. 614-620. (1996).

[84] Janikow C.Z., *Inductive Learning of decision rules from attribute-based examples.* A knowledge-intensive genetic algorithm approach. Technical Report No.91-030. The University of North Carolina at Chapel Hill. Departament of Computer Science, (1991).

[85] Janikow C.Z., *A Knowledge-intensive Genetic Algorithm for Supervised Learning.* Machine Learning, 13, (1993) pp. 189-228.

[86] Janikow C.Z., *Fuzzy Decision Tree with Missing Values: FIDMV 1.3.* User's manual. Universidad de Missouri-St.Louis.

[87] John G.H., Kohavi R., Pfleger K., *Irrelevant features and the selection problem.* Machine Learning: Proceedings of the 11th International Conference. Morgan Kaufmann. (1994), pp. 121-129

[88] Kaspinski J., Michalski R.S., *A System that Learns to Recognize Hand-written Alphanumeric Characters.* Technical Report 35, Proce Institute Automatyki, Polish Academy of Sciences, (1966)

[89] Koford T.S., Groner G.F., *The Use of an Adaptive Threshold Element to Design a Linear Optimal Pattern Classifier.* IEEE transactions-Information Theory, Vol. 1T-12, (1966) pp. 42-50.

[90] Kohonen *Self-Organizing Maps.* Springer Series in Information Sciences, Vol. 30, (1995).

[91] Koza J.R., *Evolving a Computer Program to Generate Random Numbers Using the Genetic Programming Paradigm.* Proc. of the Fourth Int. Conf. on Genetic Algorithms, R. Belew, L.B. Booker (Eds.) (Morgan Kaufmmann, San Mateo), (1991) pp. 37-44.

[92] Koza J.R., *Genetic Programing*, The MIT press, Cambridge, 1992.

[93] Kullback S., *Information Theory and Statistics*, Gloucester, Mass, (1978).

[94] Langley P.W., Neches R., Neves D., Anzai Y., *A domain-independent framework for procedure learning.* Journal of Policy Analysis and Information Systems, Vol 3. No. 2, (1980), pp. 163-197.

[95] Langley P.W., *Selection of relevant features in Machine Learning.* Proceedings of the AAAI Fall Symposium on Relevance. (1994).

[96] Langley P.W., Sage S., *Oblivious decision trees and abstract cases.* Proceedings of the Tenth Conference on Uncertainty in AI. (1994), pp. 399-406.

[97] Larson J., *Inductive inference in the variable-valued predicate logic system VL21: metodology and computer implementation.* Ph.D. dissertation, University of Illinois, (1977).

[98] Lenat D.B., *AM: An artificial intelligence approach to discovery in mathematics as heuristic search.* Ph.D.dissertation, Stardford University, (1976).

[99] Liepins G.E., Vose M.D., *Characterizing Crossover in Genetic Algorithms.* Annals of Mathematics and Artificial Intelligence 5(1), (1992), pp. 27-34.

[100] Lozano M., *Aplicación de técnicas basadas en la lógica difusa para la mejora del comportamiento de los algoritmos genéticos con codificación real.* Tesis Doctoral. Universidad de Granada (1996).

[101] Lucasius C.B., Kateman G., *Applications of Genetic Algorithms in Chemometrics.* Proc. of the Third Int. Conf. on Genetic Algorithms, J.D. Schaffer (Ed.) (Morgan Kaufmann Publishers, San Mateo, 1989), pp. 170-176.

[102] Magdalena L., Velasco J.R., *Fuzzy Rule-Based Controllers that Learn by Evolving their Knowledge Base.* In: F. Herrera, J.L. Verdegay (Eds.), Genetic Algorithms and Soft Computing, Physica-Verlag, 172-201, (1996).

[103] McCallum R.A., Spackman K.A., *Using Genetic Algorithms to Learn Disjuntive Rules from Examples.* Proceedings of the Seventh International Conference on Machine Learning, (1990), pp. 149-152.

[104] McCulloch W.S., Pitts W., *A Logical Calculus of Ideas Imminent in Nervous Activity.* Bull. Math. Biophysics, Vol. 5 (1943) pp. 115-133.

[105] Mendel T., Fu K.S., *Adaptive Learning and Pattern Recognition: Theory and Applications.* Spartan Books, New York (1970).

[106] Michalewicz Z., *Genetic Algorithms + Data Structures = Evolution Programs*, Springer-Verlag, New York, 1992.

[107] Michalski R.S., *A Variable-Valued Logic System as Applied to Picture Description and Recognition.* Graphic Languages, North-Holland (1972).

[108] Michalski R.S., *AQVAL/1- Computer implementation of a variable valued logic system VL1 and examples of its application to patter recognition.* Proceedings of the First International Joint Conference on Pattern Recognition, (1973), pp. 3-17.

[109] Michalski R.S., Larson J.B., *Selection of Most Representative Training Examples and Incremental Generation of VL1 Hypotheses: The Underlying Methodology and Despcription of Programs ESEL and AQ11.* Report 867, University of Illinois, (1978).

[110] Michalski R.S., *Pattern Recognition as rule-guided Inductive Inference.* IEEE Transactions on Pattern Analysis and Machine Learning, Vol. PAMI-2, 4, (1980), pp. 249-361.

[111] Michalski R.S., *Learning by being told and learning from examples: an experimental comparison of the two methodes of knowledge acquisition in the context of developing an expert system for soybean desease diagnoiss*, International Journal of Policy Analysis and Information Systems, (1980), 4(2), pp. 125-161.

[112] Michalski R.S., *Knowledge Acquisition Through Conceptual Clustering: A Theoretical Framework and an Algorithm for Partitioning Data into Conjuntiv Concepts.* Policy Analysis and Information Systems, Vol 4, 3, (1980), pp. 219-244.

[113] Michalski R.S., Stepp R., Diday E., *A Recent Advance in Data Analysis: Clustering Objects into Classes Characterized by Conjuntive concepts.* Progress in Pattern Recognition, North-Holland, (1981), pp. 33-56.

[114] Michalski R.S., *Theory and Methodology of inductive learning.* Machine Learning: An artificial intelligence approach (Vol I). San Mateo, CA: Morgan Kaufmann (1983).

[115] Michalski R.S., *Understanding the nature of learning*, Machine Learning: An artificial intelligence approach (Vol II). San Mateo, CA: Morgan Kaufmann (1986).

[116] Mitchell T.M., *Version Spaces: A Candidate Elimination Approach to Rule Learning.* Proceedings of the Fifth International Joint Conference on Artificial Intelligence. (1977).

[117] Mitchell T.M., *Version Spaces: An approach to concept learning.* Ph.D. Dissertation, Stanford University (1978).

[118] Nilsson N.J., *Learning Machines.* McGraw-Hill, New York (1965).

[119] Nozaki K., Ishibuchi H., Tanaka H., *A simple but powerful heuristic method for generating fuzzy rules from numerical data.* Fuzzy Sets and Systems, 86 (1997) pp.251-270.

[120] Ourston D., Mooney R.J., *Theory refinement combining analytical and empirical methods.* Artificial Intelligence 66 pp. 273-309 (1994).

[121] Parodi, A., Bonelli, P., *A New Approach to Fuzzy Classifier System.* Proceedings of the Fifth International Conference on Genetic Algorithms, San Mateo, (1993).

[122] Potter, M., De Jong K., *A cooperative coevolutionary approach to function optimization.* Proceedings of the Third Conference on Parallel Problem Solving from Nature. pp. 249-257. Springer-Verlag, (1994).

[123] Potter, M., De Jong K., Grefenstette *A coevolutionary approach to learning sequential decision rules.* Proceedings of the Sixth International (ICGA95). Morgan Kaufmann, (1995).

[124] Quinlan J.R., *Discovering rules from large collections of examples: a case study.* Expert Systems in the Micro Electronic Age. Edinburgh University Press, (1979).

[125] Quinlan J.R., *Induction of Decision Trees.* Machine Learning 1, (1986), pp. 81-106.

[126] Quinlan J.R., *Learning Decision Trees*, Technical Report 87.5, School of Computing Sciences, NSWIT, Sidney, Australia. (1987).

[127] Quinlan J.R., *Generating production rules from decision trees.* Proceedings of the Tenth International Joint Conference on Artificial Intelligence, (1987), pp. 304-307.

[128] Quinlan J.R., *C4.5: Programs for Machine Learning.* Morgan Kaufmann Publishers, San Francisco (1993).

[129] Radcliffe N.J., *Equivalence Class Analysis of Genetic Algorithms.* Complex Systems 5(2), (1991), pp. 183-205.

[130] Radcliffe N.J., *Non-Linear Genetic Representations.* Parallel Problem Solving from Nature 2, R. Männer, B. Manderick (Eds.) (Elsevier Science Publishers, Amsterdam, 1992), pp. 259-268.

[131] Rashevsky N., *Mathematical Biophysics.* University of Chicago Press, Chicago, IL, (1948).

[132] Rechemberg I., *Evolutionsstrategie: Optimierung Technischer Systeme nach Prinzipien der Biologischen Evolution*, Frommann-Holzboog, Stuttgart, 1973.

[133] Rissanen J., *Stochastic complexity and modeling.* Annals of Statistical, 14 (1986), pp. 1080-1100.

[134] Rosenblatt F., *El Perceptron: A Probabilistic Model for Information Storage and Organization in the Brain.* Psychological Review, Vol. 65, (1958) pp. 386-407.

[135] Samuel A.L., *Some Studies in Machine Learning Using the Game of Checkers.* IBM Journal of Research and Development, No. 3, (1959), pp. 211-229.

[136] Samuel A.L., *Some Studies in Machine Learning Using the Game of Checkers.* Computer and Thought, McGraw-Hill, New York, (1963), pp. 71-105.

[137] Schwefel H-P., *Numerical Optimization of Computer Models*, Wiley, Chichester, (1981).

[138] Schwefel H-P., *Evolution and Optimum Seeking. Sixth-Generation Computer Technology Series*, Wiley, New York, (1995).

[139] Selfridge O.G., *Pandemonium: A paradigm for Learning.* Proceedings of the Symposium on Mechanization of Thought Processes, Blake, D. and Uttley, A. (Eds), HMSO, London, (1959), pp. 511-529.

[140] Sestito S., Dillon T.S., *Automated Knowledge Adqusition.* Prentice Hall. (1994).

[141] Sigillito V.G., Wing S.P., Hutton L.V., Baker K.B., *Classification of Radar Returns from the Ionosphere using Neural Networks.* Johns Hopkins APL Technical Digest 10, (1989), pp. 262-266.

[142] Simon h.A., Kotovsky K., *Human acqusition of concepts for sequential patterns.* Psychological Review, Vol. 70, (1963), pp. 534-546.

[143] Simon H.A., Lea G., *Problem Solving and Rule Induction: A Unified View*, Knowledge and Cognition. Lawrence Erlbaum Associates, Potomac, Maryland (1974), pp. 105-127.

[144] Simon H.A., *Why Should Machine Learn?.* Machine Learning: An Artificial Intelligence Approach. Springer-Verlag (1983) pp. 25-38.

[145] Smith S.F., *A Learning System based on Genetic Algorithms.* Doctoral Dissertation, University of Pittsburgh, Departamente of Computer Science, (1980).

[146] Soloway E.M., Riseman E.M., *Levels of pattern description in learning.* Fifth International Joint Conference on Artificial Intelligence. (1977), pp. 801-811.

[147] Stepp R., *The investigation of the UNICLASS inductive program AQ7UNI and User's Guide.* Technical Report 949, Departament of Computer Science, University of Illinois (1978).

[148] Thrun S.B., Bala J., Bloedorn E., Bratko I., Cestnik B., Cheng J., De Jong K., Dzeroski S., Fahlman S.E., Fisher D., Hamann R., Kaufman K., Keller Sl, Reich Y., Vafaie H., Van de Welde W., Wenzel W., Wnek J., Zhang J., *The MONK's Problems: A Performance Comparison of Different Learning Algorithms.* CMU-CS-91-197, Carnegie Mellon University. (1991).

[149] Truxal T.G., *Automatic Feedback Control System Synthesis.* McGraw-Hill, New York (1955).

[150] Typskin Y.Z., *Self Learning - What is it?.* IEEE Transactions on Automatic Control, Vol. AC-18, No. 2, (1968), pp. 109-117.

[151] Typskin Y.Z., *Adaptation and Learning in Automatic Systems.* Academic Press, New York, (1971)

[152] Typskin Y.Z., *Foundations of the Theory of Learning Systems.* Academic Press, New York, (1973)

[153] Uhr L., *Pattern Recognition.* John Wiley and Sons, New York, (1966).

[154] Uthurusamy R., Fayyad U.M., Spangler S., *Learning useful rules from inconclusive data.* Knowledge Discovery in Databases, (1990).

[155] Valenzuela-Redón, M., *The Fuzzy Classifier System: Motivations and First Results.* Parallel Problem Solving from Nature II, Springer Verlag (1991), pp. 330-334.

[156] Velasco J.R., Magdalena L., *Genetic algorithms in Fuzzy Control Systems*, en: J. Periaux y G. Winter, Genetic Algorithms in Engineering and Computer Science, (1995).

[157] Venturini G., *SIA: a Supervised Inductive Algorithm with Genetic Search for Learning Attributes based Concepts.* Machine Learning: ECML-93, (1993) pp. 280-296.

[158] Vere S.A., *Induction of Concepts in the Predicate Calculus.* Proceedings of the Fourth International Joint Conference on Artificial Intelligence, IJCAI, (1975) pp. 281-287.

[159] Wang, L., Mendel, M., *Generating fuzzy rules by learning from examples.* IEEE Transactions on systems, man and cybernetics, vol.22 n.6, pp.1414-1427 (1992)

[160] Weber R., *Fuzzy-ID3: A Class of Methods for Automatic Knowledge Acquisition* Proceedings of the 2nd International Conference on Fuzzy Logic and Neural Network, (1992), pp. 265-268.

[161] Wehenkel, L., *On Uncertainty measures Used for Decision Tree Induction*, Proc. of IPMU'96, (1996), pp. 413-418.

[162] WeiB G., *Learning the Goal Relevance of Actions in Classifier Systems.* Proceedings of the Tenth European Conference on Artificial Intelligence, (1992), pp. 430-434.

[163] Widrow B., *Generalization and Information Storage in Networks of Adelaine (Neurons)*, Spartan Books, Washington D.C., (1962) pp. 435-461.

[164] Wilson, S.W., *Classifier Systems and the Animat Problem*, Machine Learning 2, (1987), pp. 199-228.

[165] Wilson, S.W., Goldberg D.E., *A Critical Review of Classifier Systems.* Proceedings of the Third International Conference on Genetic Algorithms, (1989), pp. 244-255.

[166] Wilson, S.W., *ZCS: A Zeroth Level Classifier System.* Evolutionary Computation Vol. 2, No. 1 (1994) pp. 1-18.

[167] Winston P.H., *Learning Structural Descriptions from Examples.* Ph. D. dissertation, MIT, (970).

[168] Winston P.H., *Learning structural descriptions from examples.* The Psychology of Computer Vision. McGraw-Hill, New York, ch. 5 (1975).

[169] Winston P.H., *Artificial Intelligence*, Addison-Wesley, (1977).

[170] Wright A., *Genetic Algorithms for Real Parameter Optimization.* Foundations of Genetic Algorithms 1, G.J.E. Rawlin(Ed.) (Morgan Kaufmann, San Mateo, 1991), pp. 205-218.

[171] Zadeh L.A., *Fuzzy Set.* Information and Control 8, pp. 338-353 (1965).

[172] Zadeh L.A., *The concept of a linguistic variable and its applications to approximate reasoning.* Part I Information Sciences vol.8, pp. 199-249, Part II Information Sciences vol. 8, pp. 301-357, Part III Information Sciences vol. 9, pp. 43-80. (1975).