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A General Study on Soft Computing and its Application

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ABSTRACT: *The discipline of computing is the systematic study ofalgorithmic processes thatdescribe andtransform information their theory, analysis, design, efficiency, implementation, and application.Nowa day'snew technique is available for computation known as soft computing. Soft computing is based on natural as well as artificialideas. Soft Computing techniques are Fuzzy Logic, Neural Network,SupprotVectorMachines, Evolutionary Computation and Machine Learning and Probabilistic Reasoning. Thispaper shows the techniques, applications and future of soft computing. Soft Computing refers to the science of reasoning, thinking and deduction that recognizes and uses the real world phenomena of grouping, memberships, and classification of various quantities under study. It differs from hard computing in that, unlike hard computing, it is tolerant of imprecision, uncertainty and partial truth. In effect, the role model for soft computing is the human mind. The guiding principle of soft computing is toexplorer the tolerance for imprecision, uncertainty and partial truth to achieve tractability, robustness and low solution cost. The main techniques in soft computing are evolutionary computing, artificial neural networks, fuzzy logic and Bayesian statistics. The applications of softcomputing have proved two main advantages. First, it made solving nonlinear problems, in which mathematical models are not available, Second, it introduced the human knowledge such as cognition, recognition, understanding, learning, and others into the fields of computing. This resulted in the possibility of constructing intelligent systems such as autonomous self-tuning systems, and automated designed systems. This paper highlights various areas of soft computing techniques.*

KEYWORDS:*Soft Computing, Neural Network, FL, GA*

I. INTRODUCTION

Soft Computing is anemergingfield that consists of complementary elements of fuzzy logic, neuralcomputing,evolutionarycomputation, machine learningand probabilistic reasoning. In real world, we have many problems which we have no way to solve logically, or problems which could be solved theoretically but actually impossible due to its requirement of huge resources and huge time required for computation. For these problems, methods motivated bynature sometimes work very efficiently and effectively. Although the solutions obtained by these methods do not always equal to the mathematically strict solutions, a near optimal solution is sometimes enough in most practical purposes. Soft Computing first coined by Professor "LotfiZadeh",who developed the concept of fuzzy logic. Soft computing is based on natural as well as artificial ideas. It differs from conventional computing that is hard computing. It is tolerance of imprecision, uncertainty, partial truth to achieve tractability, approximation, robustness, low solution cost, and better rapport with reality.

In fact the role model for soft computing is human mind. It refers to a collection of computational techniques in computer science, artificial intelligence, machine learning applied in engineering areas such as Aircraft, spacecraft, cooling and heating, communication network, mobile robot, inverters and converters, electric power system, power electronics and motion control etc. Traditionally soft computing has beencomprised by four technical disciplines. The first two, probabilistic reasoning (PR), and fuzzy logic (FL) reasoning systems, are based on knowledge-driven reasoning. The other two technical disciplines, Neuro Computing (NC) and Evolutionary Computing (EC), are data driven search and optimization approaches.The main characteristics of soft computingis its intrinsic capability to create hybrid systems that are based on the integration of constituent technologies. This integration provides complementary reasoning and searching methods that allow us to combine domain knowledge and empirical data to develop flexible computing tools and solve complex problems.

II. WHAT IS HARD COMPUTING?

Hardcomputing, i.e., conventionalcomputing requiresa precisely stated analytical model and often a lotof computation time. HardComputing Premises and guidingprinciples of Precision, Certainty, and rigor. Manycontemporary problems do notlendthemselves to precise solutionsuchasRecognitionproblems such as handwriting, speech, objects, images, Mobile robot coordination, forecasting and combinatorial problems etc.

III. TECHNIQUES IN SOFT COMPUTING

1.1 Neural Networks

An Artificial Neural Network (ANN) is an informationprocessing paradigmthatis inspiredbythe waybiologicalnervous systems, suchasthe brain, processinformation. The key element of this paradigms thenovelof the information system. It is composed of a largenumberof highly interconnectedprocessing elements (neurones) workingin unisontosolve specific problems. ANNs, like people, learn by example. An ANN isconfigured for a specific application, suchas patternrecognitionor classification, through a learningprocess.

1.2. Fuzzy Logic

FL is a problem-solving control system methodology that lendsitself toimplementinsystemsrangingfromsimple, small,embedded micro-controllers tolarge, networked, multi-channel PC orworkstationbaseddata acquisitionand control systems. It can beimplemented inhardware, software, or a combination ofboth. FL provides a simplewaytoarrive ata definiteconclusion basedupon vague, ambiguous, imprecise, noisy, ormissing inputinformation. FL'sapproach tocontrol problems mimics how a person would make decisions, only much faster.

1.3. Support VectorMachines

It is a setof related supervised learning methods usedfor classification and regression In simple words, given a set of training examples, each marked as belonging toone of two categories, an SVMtrainingalgorithmbuilds a model that predictswhether a new examplefalls into one category or the other. Intuitively,SVM model is a representation of the examples as points in space, mapped sothat theexamples of the separatecategories are divided by a clear gap that isas wide as possible. ASupport vector machine constructs a hyperplane set ofhyperplanes in a high or infinite dimensional space, which can be used for classification, regression or other tasks. Intuitively, a good separation is achieved bythe hyperplanethat has the largest distance to the nearest trainingdatapoints ofany class (so-calledfunctionalmargin), since ingeneral the larger the marginthe lower the generalization error of the classifier.

1.4. GeneticAlgorithms inEvolutionaryComputation

A geneticrevolutionaryalgorithmapplies the principles ofevolution found innaturetothe problem of findinganoptimal solution toa Solver problem. Ina "genetic algorithm," the problems encodedin a seriesof bitstrings thatare manipulated by the algorithm; in an "evolutionaryalgorithm," the decision variables and problem functionsare used directly. Most commercialSolverproducts are based on evolutionaryalgorithms. An evolutionary algorithmfor optimization is differentfrom “classical” optimization methods in several ways:

● RandomVersus DeterministicOperation

● Populationversus Single Best Solution

● Creating New SolutionsthroughMutation

● Combining SolutionsthroughCrossover

● SelectingSolutions via "Survival of the Fittest"

Randomness. First, itrelies inpatron randomsampling. This makes ita non-deterministic method, which mayyield somewhatdifferentsolutions ondifferentruns—evenifyouhaven'tchangedyourmodel. In contrast, the linear, nonlinear and integer Solvers also includedinthe Premium Solver are deterministic methods–theyalwaysyield thesamesolutionif you start withthe samevalues inthe decisionvariable cells. Population. Second, wheremost classical optimization methods maintaina single bestsolutionfound sofar, anevolutionary algorithmmaintains a population of candidatesolutions. Onlyone of these is "best," but the other members of the population are "sample points" inother regionsof the searchspace, where a better solutionmay later befound. The use ofa population of solutionshelps the evolutionaryalgorithmavoidbecoming "trapped" ata local optimum, when anevenbetter optimum may befound outside the vicinity ofthe current solution.Mutation. Third-- inspired by the role of mutationof an organism's DNA innatural evolution – anevolutionary algorithmperiodically makes randomchanges or mutations in one or more members of thecurrent population, yieldinga new candidate solution(which maybe better or worse than existingpopulation members).There are manypossiblewaystoperform a "mutation," and the EvolutionarySolver actuallyemploys threedifferentmutation strategies. The resultofa mutation may beinfeasible solution, andthe Evolutionary Solver attempts to "repair" sucha solution tomakeit feasible; this is sometimes, butnotalways, successful. Crossover. Fourth—inspiredbythe roleof sexualreproduction inthe evolutionof livingthings -- an evolutionary algorithmattempts tocombine elements ofexistingsolutionsinorder to create a new solution, withsomeof the features of each "parent." The elements(e.g. decision variable values) of existingsolutionsare combined in a "crossover" operation, inspired bythe crossover of DNA strands thatoccurs inreproduction ofbiologicalorganisms. As withmutation, there are manypossible ways toperforma crossover operation -- some much better thanothers -- and the Evolutionary Solver actuallyemploys multiple variations of twodifferentcrossover strategies. Selection.Fifth -- inspired bythe role ofnatural selection inevolution—anevolutionaryalgorithma selection processin which the "mostfit" members of the population survive andthe "least fit"members are eliminated. In aconstrained problem, the notion of "fitness" dependspartlyonwhether a solution isfeasible (i.e. whether it satisfies all of the constraints), and partlyon objective functionvalue. The selection processisthe step that guides the evolutionary algorithmtowards ever-better solution.

IV. IMPORTANCE OF SOFT COMPUTING

The complementarilyofFL, NC, GC, and PRhas animportantconsequence. Inmanycases a problemcan be solvedmosteffectivelyby using FL, NC, GCand PRincombination rather than exclusively. A striking example of a particularly effective combination is what has come to be known as "neuro fuzzy systems." Such systems are becoming increasinglyvisible as consumer products ranging fromair conditioners and washing machines to photocopiers and camcorders. Visible but perhaps more important are neuro fuzzy systems in industrial applications. What is particularly significant is that inbothconsumer productsandindustrialsystems, theemploymentofsoftcomputing techniques leads tosystems which have highMIQ (Machine Intelligence Quotient).Inlargemeasure, it is the high MIQ ofSC-based systems that accounts for the rapid growthin the number and varietyof applications of Soft computing.

V. APPLICATIONS OF SOFT COMPUTING

- HandwritingRecognition
- Image Processing and Data Compression
- Automotive Systems and Manufacturing
- SoftComputingto Architecture
- Decision-supportSystems
- SoftComputingto Power Systems
- Neuro Fuzzy systems
- Fuzzy Logic Control
- Machine Learning Applications
- Speech andVisionRecognitionSystems
- Process Control and So On.

VI.FUTURE OF SOFT COMPUTING

Soft computingis likely to play an especially important roleinscienceand engineering,buteventually its influence may extendmuch farther. Soft computing representsa significant paradigmshift inthe aims ofcomputing. A shift whichreflects the fact that the human mind, unlikepresent daycomputers, possesses a remarkable ability tostore and processinformationwhichis pervasively imprecise, uncertainandlackingin categoricity.

VII. CONCLUSIONAND SCOPE FOR FUTURE RESEARCH

In thispaper I have given aSoftComputingTechniques, applications and future ofSoft Computing. The present paper can provide the readers abetter understandingaboutSoftComputing and techniquesand the topics open to further research.

REFERENCES

[1] OnsenTOYGAR,AdnanACA,“FaceRecognition using PCA, LDAand ICAapproachesoncoloredimages”.

[2] Kailash J. Karande,SanjayN. Talbar, “Face recognition under Variation of Pose and llumination using IndependentComponent Analysis”.

[3] Shang-Hung Lin, “An Introduction to FaceRecogntion Technology”.

[4] Fromherz T., Stucki P., Bichsel M.,“A survey of FaceRecognition”.

[5] Calvo R., Partridge M., and Jabri M., “A Comparative Study ofPrincipal Components Analysis Techniques”.

[6] YamborW.S.,”Analysis of PCA-Based and FisherDiscriminant-Based Image Recognition”.

[7] RafaelC.Gonzalez,Richard E. Woods,StevenL.Eddins,”Digital Image Processing Using MATLAB”.

[8] S. Jayaraman et. al.,” Digital Image Processing”.

[9] G. Chakraborty and B. Chakraborty (1999), “A genetic algorithm approach to solve channel assignment problem in cellular radio networks,” in Proc. IEEE Midnight-Sun Workshop Soft Computing Methods inIndustrial Applications, Kuusamo, Finland, pp. 34–39.

[10] B. Dengiz, F. Altiparmak, and A. E. Smith (1997), “Local search genetic algorithm for optimal design of reliable networks,” IEEE Trans. Evol. Computer., vol.1, pp. 179–188.

[11] X. M. Gao, X. Z. Gao, J. M. A. Tanskanen, and S. J. Ovaska (1997), “Power prediction in mobile communication systems using an optimal neural-network structure,” IEEE Trans. Neural Networks, vol. 8,pp. 1446–1455.

[12] A. Kamiya, K. Kawai, I. Ono, and S. Kobayashi (1999), “Adaptive-edge search for power plant start-up scheduling,” IEEE Trans. Syst., Man, Cybern. C, vol. 29, pp. 518–530.

[13] J. Wen, S. Cheng, and O. P. Malik (1998), “A synchronous generator fuzzy excitation controller optimally designed with a genetic algorithm,” IEEE Trans. Power Syst., vol. 13, pp. 884–889.