CMPE 523 Parallel and Distributed Programming (3 / 0) 3
Types of parallel systems and their peculiarities, approaches for programming supercomputers using various versions of FORTRAN language, OCCAM and ANSI C languages for transputer systems, C and Assembler languages for parallel neuroprocessor, using of parallel constructions in Win32 operating systems, using of parallel programming in the distributed environment on the base of CORBA, DCOM approaches for Win32 and PVM for Unix.

CMPE 528 Computational Principles of Robotics (3 / 0) 3
Types of parallel systems and their peculiarities, approaches for programming supercomputers using various versions of FORTRAN language, OCCAM and ANSI C languages for transputer systems, C and Assembler languages for parallel neuroprocessor, using of parallel constructions in Win32 operating systems, using of parallel programming in the distributed environment on the base of CORBA, DCOM approaches for Win32 and PVM for Unix.

CMPE 531 Logic Programming (3 / 0) 3
Declarative Prolog programming, unification and resolution, backtracking, cut and fail, non-determinism, representation of data structures, meta-programming, constraint-logic programming, parallel Prolog.

CMPE 532 Constraint Programming (3 / 0) 3
Constraint programming is a programming paradigm in which a set of constraints that a solution to a problem must satisfy are specified rather than set of steps to obtain such a solution. Techniques used in constraint programming come from diverse fields such as artificial intelligence, computational logic and operations research. The process of solving problems by only stating constraints which must be satisfied by a solution to a problem involves modeling the problem by means of a set of variables, each ranging over a specific domain, and constraints to restrict the variables’ domain values. Constraint problems can then be specified and solved by means of a constraint programming language. The aim of this course is to create an understanding of the fundamental concepts underlying constraint programming, develop skills in modeling and solving combinatorial optimization problems, and provide an opportunity for applying constraint solving techniques to real-life problems using a modern constraint programming environment. Topics covered will include constraints and valuations, modeling with constraints, constraint satisfaction, examples of constraint domains, constraint simplification, optimization, the Simplex algorithm, backtracking, node and arc consistency, constraint logic programming (CLP), modeling in CLP, using data structures, controlling search, advanced programming techniques and incremental constraint solving.

CMPE 534 Automated Deduction (3 / 0) 3
This course is about automatically (and mechanically) proving theorems in first order predicate calculus. Introduction to propositional logic, predicate calculus and proof methods. Herbrand’s theorem. The resolution principle (in its various forms) as the theoretical background for the programming language Prolog. Paramodulation, term rewriting systems and e-unification under equational logic. Applications of automated reasoning.

CMPE 535 Knowledge Engineering (3 / 0) 3
An overview of AI, Knowledge-based systems - a survey, Knowledge Engineering concepts; Human Problem Solving, Human Information Processing System, Cognition Models; Knowledge Acquisition; Knowledge Representation, Production Rules; Inference, Forward Chaining, Backward Chaining, Mixed Chaining; Uncertainty, Certainty Factors, Bayesian, Fuzzy set based and Dempster-Shafer methods; Automated Knowledge Acquisition, Machine Learning Approaches in Expert Systems, Rule and Decision-Tree Induction; Connectionist expert systems; Expert System Building Tools, Development languages, Shells, Environments; Expert system design using rule-based shells; Expert system development life-cycle; Blackboard architectures; Truth Maintenance Systems.
CMPE 536 Metaheuristics (3 / 0) 3
Heuristics and meta-heuristics, neighborhood search, local and global optimization, simulated annealing, greedy randomized adaptive search, tabu search, evolutionary algorithms, ant-colony optimization, Lagrangean relaxation, hybrid methods, performance evaluation of meta-heuristics.

CMPE 537 Evolutionary Neuro-Fuzzy Systems (3 / 0) 3

CMPE 538 Evolutionary Multi-Objective Optimization (3 / 0) 3
This graduate-level course introduces the basic concepts of evolutionary and other nature-inspired multi-objective optimization techniques. The course starts with an introduction to multi-objective optimization. Basic definitions, notations, quality assessment methods, and benchmarking principles are introduced. This lecture is followed with the introduction of fuzzy sets, fuzzy numbers, fuzzy functions, and formulation of fuzzy multiobjective optimization. In the third part of the lectures, basic evolutionary and nature-inspired metaheuristics are described together with principles of their practical implementations. In this respect, multiobjective implementation details are given a special emphasis. The fourth and the final phase of lectures cover the use of nature-inspired metaheuristics for fuzzy multiobjective implementation. Case studies on fuzzy versions of well-known multiobjective optimization problems are studied in detail. This is a unique course where students get an exposure to latest developments in soft computing, particularly nature-inspired methods and fuzzified formulation of well-known problems of practical importance. Strengths and weaknesses of the presented approaches are highlighted. The course also discusses a number of current research issues, besides discussing a number of interesting case studies. Active student participation is necessary in lectures. The students, by the end of this course, are expected to get a detailed understanding of nature-inspired methods in fuzzy multiobjective optimization.

CMPE 539 Multiagent Systems (3 / 0) 3
CMPE 541 Networks and Distributed Systems (3 / 0) 3
Evolution of computer networks, distributed systems and distributed information processing. Basic
c characteristics of distributed systems. Design goals of distributed systems. Networking for
distributed systems. Distributed systems and the Internet. TCP/IP protocols for distributed systems
in the Internet. The role of the remote interprocess communication for distributed systems.
Advanced Internet sockets and Remote Procedure Call (RPC). Group communication. Message
ordering in group communication. Time and synchronization in distributed systems. Mutual
exclusion and election in distributed systems. Distributed transaction processing. Concurrency
control of transactions. Handling with deadlocks. Survey of architectures and packages for the
organization of distributed data processing. Formal techniques for the description and investigation
of distributed systems.

CMPE 542 Advanced Networks (3 / 0) 3
Layered network systems, cross-layer design, design trade-offs; modeling network traffic, fluid models
of network traffic, models for data, voice, and video traffic; access control: leaky buckets; flow and
congestion control and models; broadband wireless, design challenges, recent trends and models;
embedded network systems: deployment, data dissemination, coverage, and connectivity.

CMPE 547 Queuing Networks for Computer Applications (3 / 0) 3
Basic probability and statistics overview, transforms, discrete and continuous time Markov chains,
steady-state solutions of Markov chains, queuing systems, queuing networks and their applications
in computer systems.

CMPE 548 Analysis of Computer Communication Networks (3 / 0) 3
Advanced topics in communication networks. Topics include Markov processes, renewal theory,
queues, stochastic networks, network calculus, routing and congestion control, utility functions,
max- min and proportional fairness.

CMPE 549 Wireless Personal Communications (3 / 0) 3
Wireless communication, mobile analog cellular telephony, GSM: channels, messages, mobility
management, handoff issues, data and multimedia communication over mobile systems,
recent advances in mobile systems, wireless ATM.

CMPE 551 Database Theory (3 / 0) 3
Predicate calculus, first-order logic, relational databases: representation, updating, querying,
completeness, model theory, proof theory, incomplete and deductive databases.

CMPE 552 Database and File Security (3 / 0) 3
Confidentiality, discretionary security, multilevel security, security levels, Trojan horse, covert
channel.

CMPE 553 Cryptography and Network Security (3 / 0) 3
This is a course on Cryptography and Network Security, objectives are: Classical encryption
techniques, Block ciphers and the Data Encryption Standard, Basics of finite fields, Advanced
Encryption Standard, Contemporary Symmetric Ciphers, Confidentiality Using Symmetric
Encryption, Basics of Number Theory, Key Management; Other Public Key Cryptosystems, Message
Authentication, Hash Functions and Algorithms, Digital Signatures and Authentication Protocols,
Malicious Software, Firewalls.
CMPE 554 Introduction to Natural Language Processing (3 / 0) 3
This course introduces the students to fundamental techniques used in Natural Language Processing. Topics covered include, morphological analysis, lexical acquisition, corpus based work, N-gram models, smoothing, Hidden Markov Models, Part-of-Speech tagging, Probabilistic context free grammars, probabilistic parsing, word-sense disambiguation, information extraction, text categorization, text mining, and machine translation.

CMPE 556 Information Retrieval (3 / 0) 3
Boolean retrieval, term vocabulary and postings lists, dictionaries and tolerant retrieval, index construction and compression, scoring, term weighting, vector space model, score computation in search systems, evaluation techniques in information retrieval systems, xml retrieval, probabilistic information retrieval, text classification using Naïve Bayes, vector space classification, use of support vector machines in information retrieval.

CMPE 558 Data Mining (3 / 0) 3
Data types, data preprocessing, measures of similarity, classification, classifier evaluation and comparison techniques, basic concepts in association, clustering analysis, cluster evaluation, anomaly detection, issues in multimedia mining and text mining.

CMPE 561 Neural Networks (3 / 0) 3
Human brain and biological neurons, artificial neuron models, the perceptron and the perceptron learning algorithm, the least-mean square algorithm, multilayer networks and the backpropagation algorithm, unsupervised and reinforcement learning, growth algorithms, Hopfield networks and other recurrent networks, simulated annealing, the Boltzmann machine, self-organizing systems.

CMPE 562 Pattern Recognition (3 / 0) 3
An introduction to probability and random variables, feature vectors, pattern classes, decision rule, discriminant function, Bayes decision rule, Bayes discriminant functions, minimum error classification, linear discriminant functions and their training, parametric classification, maximum likelihood estimation, Bayesian parameter estimation, clustering techniques, multiple classifier systems.

CMPE 564 Ensemble Learning (3 / 0) 3
Learning associations, classification, regression, unsupervised learning, supervised learning, linear discriminant classifier, quadratic discriminant classifier, decision trees, interpolation, k-means and fuzzy c-means clustering, abstract level fusion, voting, weighted voting, naive Bayesian fusion, Borda count method, diversity in ensembles, diversity generation methods, measures of diversity, measurement level fusion, linear and logarithmic opinion pools, decision templates, static and dynamic expert selection, bagging, random forests, boosting, Adaboost, random subspace method, cluster ensembles, majority vote clustering, evidence accumulation algorithm.

CMPE 573 Computer Vision (3 / 0) 3
Introduction to computer vision, the goal of computer vision, applications of computer vision, special effects such as shape capture, motion capture and camera tracking, difficulties of computer vision, image formation, filtering, edge detection, feature detection and matching, segmentation, feature-based alignment, structure from motion, image stitching, computational photography.

CMPE 574 Biometrics (3 / 0) 3
Introduction to biometrics, person recognition, modules of biometric systems, biometric functionalities: verification and identification, biometric system errors and performance measures, the design cycle of biometric systems, applications of biometric systems, face recognition, iris recognition, fingerprint recognition, additional biometric traits, introduction to multibiometrics.
CMPE 576 Advanced Systems Simulation (3 / 0) 3

CMPE 581 Modeling Multimedia Systems (3 / 0) 3
Digital representations of multimedia information, multimedia devices and system architectures, interactive and distributed multimedia systems, programming environments, timed-automata and petri-tcs, temporal synchronization models for multimedia systems, timed extensions of HTML, SMIL.

CMPE 583 Web Semantics (3 / 0) 3
Course will cover URI scheme; XML and processing; resource description framework (RDF); model, syntax, schema and languages; ontology concept, Web-based ontologies, integration and interoperability, semantics and abstract syntax of OWL, DAML; semantic grid concept and applications; Web services and agents; best practice case studies; W3 Consortium, current activities and future directions.

CMPE 586 Software Implementation of Fuzzy Systems (3 / 0) 3
Uncertainty, imprecision and vagueness, fuzzy sets and systems, membership function design, inference principles and techniques, approximate reasoning, possibility distributions, fuzzy systems as universal approximators, fuzzy software packages, research fields in fuzzy theory.

CMPE 598 Seminar Course (3 / 0) 3
This course will be given as seminars by teaching staff covering their specialties or research interest.

CMPE 599 Special Topics in Computer Engineering (3 / 0) 3
Recent advances in selected topics in computer engineering will be examined. The specific topic(s) and the contents of the course will be determined and announced by the department at the beginning of each semester.