UNIVERSITY OF THE DISTRICT OF COLUMBIA

PROPOSAL FOR A DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE AND ENGINEERING (CSE)

School of Engineering and Applied Sciences
UNIVERSITY OF THE DISTRICT OF COLUMBIA

UNIVERSITY SENATE

ACADEMIC PROGRAMS

TRANSMITTAL FORM

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Executive Summary

The School of Engineering and Applied Sciences (SEAS) proposes a new Doctor of Philosophy (Ph.D.) degree in Computer Science and Engineering (CSE). The CSE Ph.D. degree program being proposed is a 72 credit hour professional graduate degree designed to prepare students for academic and research careers. Through departmental collaboration in SEAS, students can choose their field of study from the three areas of specialization: (1) computer science, (2) electrical and computer engineering, and (3) computational science in Engineering.

We propose the Ph.D. degree program to begin on August 16, 2013. It is anticipated that between 10 and 20 students will be entering the program each year. The existing SEAS faculty is sufficient in advising these students and for implementing the program.

The implementation of the program is consistent with the vision and mission of the University of the District of Columbia to “offer exceptional, research-driven graduate and professional programs of importance to the District and the nation”. The goal of the CSE Ph.D. degree program is to prepare graduate and professional degree recipients capable of meeting the needs for the Washington, DC metro area and the nation.

In summary, UDC will benefit from a CSE Ph.D. program in three ways: the program will support and expand UDC’s current research profile; the university will contribute more to the community and receive more recognition in return by creating greater synergy among its departments through contributing research; the enrollment will increase and more students will be attracted as we provide the Ph.D. opportunity.

1. Demonstration of Need

The University of the District of Columbia's vision is to be a “diverse, selective, teaching, research, and service university”. To accomplish this vision, UDC's public goal is to “offer exceptional, research-driven graduate and professional programs of importance to the District and the nation”. In support of UDC’s vision and mission, the following information was gathered to demonstrate the need for a Ph.D. program in computer science and engineering:

- **Students demand the Ph.D. degree program** A recent survey was given to our computer science graduate students in the Fall of 2012. Out of 18 students who responded to the survey, 11 indicated they are planning on pursuing a Ph.D. within the next 1-2 years, and 7 indicated 3-5 years.

- **Graduate students are the main work force in research activities.** The graduate students admitted to the program will help enhance the quality of the research conducted by the faculty. This is essential for applying to research grants from sources such as the National Science Foundation (NSF), The Department of Education (DOE), and the Department of Defense (DoD), to list a few.
• **Offering both master's and Ph.D. shall increase the number of graduate applications.** The results of the [2012 Council of Graduate Schools International Graduate Admissions Survey, Phase I: Applications](http://www.cogere.org) indicate that applications of prospective international students to graduate schools increased 9% between 2011 and 2012 for the seventh consecutive year. In addition, survey results show that international students are much more likely to apply to institutions offering doctoral programs than master’s focused institutions.

• **Occupations needing a doctoral or professional degree are projected to grow.** In February 2012, the [U.S. Department of Labor](http://www.dol.gov) released its employment projections through 2020. The occupations needing a doctoral or professional degree are projected to grow by 19.9 percent.

• **Employment projections continue to show an increase in science, technology, and engineering fields; especially in Washington, D.C.** Employment projections in STEM fields appear promising. The [U.S. Department of Labor](http://www.dol.gov) has predicted a 29 percent increase in STEM jobs, adding about 2.1 million new jobs between 2010 and 2020. Washington, D.C. has more than two times the concentration of STEM jobs than the national average.

• **Interest in graduate studies of computer science and engineering continues to grow.** According to the [2012 Graduate Enrollment and Degrees](http://www.cogere.org) report by the Council of Graduate Schools, master's and doctoral enrollment for first-time students in many disciplines dropped by 1.7 percent between 2010 and 2011. However, first-time students enrollment increased for mathematics and computer science (3.8 percent) and engineering (2.2 percent) disciplines.

### 2. Mission Statement and Objectives

Congruent with the missions of the University of the District of Columbia (UDC), the mission of the CSE Ph.D. program is to “prepare students for immediate entry into the nation’s doctoral and professional workforce in computer science and engineering.” The proposed Ph.D. will help provide advanced quality graduate studies, in the areas of critical importance and great demands (such as cybersecurity, cloud computing, and high-performance computing in Computer Science, Computer and Electrical Engineering, and Computational Science in Engineering), to the citizens of the District of Columbia and to the nation.

The CSE Ph.D. program should be a high-quality degree program aimed at preparing graduates who can (a) show an ability to conduct independent and creative research that contributes to the advancement of knowledge; (b) demonstrate not only a sufficient breadth of understanding in computer science and engineering but also a significant depth of understanding in their chosen area of research specialization; (c) apply their knowledge and creativity to solve complex problems in the society. This requires each successful Ph.D. student to produce a significant piece of original research that is
presented in a written dissertation and is defended through an oral examination. The work must be of high quality such that several peer-reviewed journal and conference papers can be produced from it in premium computer science and engineering venues.

3. Rationale and Motivations

The Department of Computer Science and Information Technology (CSIT: http://csit.udc.edu) will manage the proposed Ph.D. program in the School of Engineering and Applied Sciences (SEAS) at the University of the District of Columbia. The school currently offers five undergraduate major programs and two Master’s degree programs (i.e. MSCS in Computer Science and MSEE in Electrical Engineering). In the past, the enrollment of the MSCS program has almost doubled. We expect the MSCS program to grow at a much higher pace in light of this new Ph.D. program over the coming years.

The major factors that motivate the need for a PhD degree program in Computer Science and Engineering (CSE) include:

1) A new Vision that includes targeted and research-based doctoral programs in the University as demonstrated in Section 1.
2) Retain our graduates in the DC metro area in our own PhD in Computer Science and Engineering degree program.
3) As the only public university in the nation’s capital, UDC ought to meet the Ph.D.-level demands as demonstrated in Section 1. This proposal opens up a Ph.D. degree opportunity in the most demanding areas of computer science and engineering for the residents who cannot afford the high cost of tuition at the private universities.
4) UDC is in an ideal position to increase minority PhD graduates. This will ultimately produce a great impact on (a) UDC visibility nationally and internationally and on (b) supporting various government agencies and federal research laboratories located in and around the Washington DC area with increasingly required Ph.D. scientists (see Section 1). UDC will produce future computer science and engineering professors.
5) With a strong PhD program in Computer Science and Engineering, we will be in a better position to compete for larger external funding for serious research and deeper education from NSF, DoD, NIH, DOE, etc, where many programs are open only to PhD granting institutions.
6) We also foresee that our PhD program will be a strong vehicle to fuel future multi-disciplinary research synergies with other departments and centers in the fields of humanities and natural sciences, beyond the engineering school at the university.
7) Over fifteen (15) doctoral faculty members have joined the SEAS over the last several years with nationally and internationally competitive research expertise in computer science and engineering through highly competitive and selective national searches. Competitive research needs Ph.D. disciples for growth.
4. Current Faculty Research Strengths and Projected Research Areas

The Ph.D. faculty members of the SEAS have produced numerous research publications in reputable and specialized research venues. They have experience in producing MSs and PhDs in the area of computer science and engineering. To support and sustain a full-fledged Ph.D. program in CSE, the existing faculty members have their proved records in the following targeted research areas:

- Cloud Computing (national initiatives)
- Big Data (national initiatives)
- Cyber-Security and Information Assurance (national initiatives)
- Robotics
- Visual Analytics
- Machine Learning, AI, Data Mining
- Advanced Networking
- Spatio-Temporal Databases
- Computer Architecture and Embedded System design
- Detection and Estimation in digital communication systems
- VLSI Architecture & Electronic Materials and Devices
- High-performance Computing and Scientific Applications in Computing
- Computational Science in Environmental, Nano, Energy, and Water Resource Engineering and Sciences (national initiatives)

5. Institutional Support

5.1. Faculty Lines

The faculty for the proposed CSE Ph.D. degree program will be drawn from the existing faculty in SEAS. The faculty members of SEAS have the highest qualifications needed for their profession and have many years of teaching and research experiences with, collectively, hundreds of research publications in reputable forums and venues (Appendix B details faculty qualifications). No additional faculty hires are required.

5.1. Research Space and Adequacy of Supplies and Equipment

The faculty members of the SEAS have research laboratories, which have been utilized in several federal and industry funded competitive research projects with graduate students. The initial establishment of Ph.D.-level research laboratories and teams will be organized within the existing research laboratories in the SEAS.
5.2. Student Support

Student support is important in terms of increasing the number of students in the new CSE Ph.D. degree program. At the university level, the currently existing RA/GA/TA system will be utilized to support new Ph.D. degree students. Currently, several SEAS faculty members have active research grants from federal agencies including NSF and DoD to initiate larger and deeper research activities with Ph.D. students, which will enable larger Ph.D.-level funding soon after the launch of the proposed Ph.D. program.

New and enhanced funding opportunities enabled by the Ph.D. program include the following to list a few:

- NSF, Centers of Research Excellence in Science and Technology (CREST), typically 5-year, $5M.
- NSF, HBCU Research Infrastructure for Science and Engineering (HBCU-RISE), $2M.
- Better CAREER and Young Investigator funding opportunities for junior faculty members.
- DARPA and most deep research funding programs requiring Ph.D. program.
- Federal funding programs supporting CAEIA/R NSA National Center of Academic Excellence in Information Assurance / Research.

6. Marketing and Growth Projection

As we mentioned above, UDC students show interest in pursuing a Ph.D. degree. A recent survey (performed in Fall 2012) shows that all 18 MSCS graduates and students (M.S. students) positively and immediately responded to the survey indicating that they are planning to pursue a Ph.D. in Computer Science. The CSE Ph.D. program will start with about 5-10 students in Fall 2013. We expect to see reaching 5-10 new students per year over the first two years, and 10-20/year soon thereafter. Considering 5-year degree period, over the first five years, the program will grow to 50- to 100-student Ph.D. program producing 10-15 new Ph.D.s annually.

To recruit future Ph.D. students, we will chase several avenues including:

1) recruitment in our existing undergraduate and graduate programs (see Section 10),
2) government agencies and national laboratories,
3) our advisory boards,
4) the consortium universities,
5) partnership and collaboration with other universities,
6) marketing flyers advertising the program locally, nationally, and internationally, extensively utilizing the Internet and search engines, such as Google,

7. Avoidance of Duplication and Faculty Workloads

The proposed PhD program is not a duplicate of any existing program at the University of the District of Columbia. To manage the proposed PhD program, faculty workload should be adjusted. To this effort, the Department of Computer Science and Information Technology’s 6 undergraduate electives in the Information Technology (BSIT) program will be removed, and the Information Technology (BSIT) program will be integrated into the Computer Science (BSCS) program as a concentration area, offering US National Security Agency’s CNSS 4011 & 4012 Certifications to the graduates (the department CSIT has already acquired this certification as a preparation as shown in http://informatics.udc.edu/arctic and http://csit.udc.edu).

The department has worked on this preparation over the past three years in collaboration with the US National Security Agency, National Science Foundation, the University of Denver, and other partners. In year 2011, the National Security Agency has recognized the University of the District of Columbia for its information assurance curriculum offered by CSIT (http://csit.udc.edu) and ARCTIC (http://informatics.udc.edu/arctic), which includes specialties within the information technology and computer science degree programs. The CSIT/ARCTIC faculty team was supported in significant part by a grant from the National Science Foundation along with collaboration by the University of Denver. As a part of the concentration area in the BSCS program, UDC graduates who meet the CSIT/ARCTIC’s requirements will receive institutional certificates as Information Systems Security (INFOSEC) Professionals NSTISSI No. 4011 or Senior Systems Managers CNSSI No. 4012 as approved by the Committee on National Security Systems National Training Standards.

With the Information Assurance concentration and the minimum standards for the duties and responsibilities of Information Systems Security (INFORSEC) professionals (NSTISSI 4011) and Senior Systems Managers (CNSSI 4012), the department is planning to receive NSA designation as a National Center of Academic Excellence in Information Assurance Education (CAE/IAE). With this effort, graduate students (including MS and Ph.D. students) will be engaged in Information Assurance research activities. These accomplishments and the new Ph.D. program will position us in a category of universities that are allowed to apply for the next level national designation: CAE/IAR National Center of Academic Excellence in Information Assurance Research, which requires a Ph.D. program in Computer Science.

8. Relationship with other programs/departments/schools/colleges/ with written response from those concerned.
The proposed PhD program will complement and help strengthen other graduate programs in the university such as the SEAS Master of Science programs and enable competitive research in multidisciplinary areas. Through the proposed three specialization areas, the Ph.D. students will have a deep learning opportunity in focused research application areas by being co-advised by the application domain experts (non-CS faculty participating in this Ph.D. program); other participating faculty will more competitively sustain and grow their research by having an opportunity to have Ph.D. students working in the specialization areas. In future, the specialization areas can be augmented through other areas, such as bioscience (computational biology), humanities (social networking and human interfaces), physics (data science for high-energy particle accelerator), etc., facilitating the university-wide development to meet the community’s demand for increasingly higher levels of research-oriented education as presented in Section 1.

9. Effect on student development, employment, or program effectiveness, if relevant.

The PhD program will produce graduates with the state-of-the-art knowledge and competitive research capabilities in the Computer Science and Engineering professions. Such program is in great demand across the nation. Many industries encourage their employ to pursue graduate studies through tuition assistance and flexible work programs. The establishment PhD degree program will have extremely positive impact on the quality of teaching, course offering, and research in SEAS departments’ undergraduate and graduate programs. Sections 1 and 3 cover relevant factors with evidence.

10. Requirements

10.1. Program Requirements

The proposed Ph.D. program is a 72 semester-hour program comprising 45 credit hours of coursework (up to 30 credits can be transferred from other previous graduate programs), 24 credit hours of research, and 3 hours for attending research colloquiums.

10.2. Admission Requirements

The standards for admission are as follows:

1. B.S. or M.S. in related field (computer science, engineering, information technology, etc.). Applicants with other degrees may be admitted conditionally, subject to receiving B or better on all of the following background courses (not counted towards the 45-cr coursework requirement):
   (1) Discrete Mathematics
(2) Object-oriented programming (or CS I and II)
(3) Data Structure
(4) Fundamentals or Principles of Operating Systems
(5) Fundamentals or Principles of Databases
(6) Fundamentals or Principles of Software Engineering or UML
(7) Fundamentals or Principles of Computer Networking

2. There is no specific cut-off GRE score. However, all applicants need to submit an official GRE score.
3. A TOEFL score of 550 (paper-based) or 213 (computer-based), for applicants with degrees from schools where the primary language of instruction is not US English.
5. A Personal Statement of research and career goals.
6. Other requirements as specified by the Office responsible for Graduate Admissions.

10.3. Requirements for the Degree:
The requirements for the Ph.D. degree will be:

1. Completion of 45 semester-hours of graduate coursework
2. Completion of 24 research semester-hours
3. Attendance of 3 hours of colloquiums (1 credit per semester)
4. A passing grade on the qualifying examination (written and oral)
5. An approval of proposal defense (written and oral)
6. Completion of dissertation (written)
7. Passing of dissertation defense (oral)

10.4. Course Requirements
Students need to complete at least 45 credits of required graduate coursework with a minimum GPA of 3.0 and must always obtain at least a “B” grade in every course applicable toward the degree. Any course that is nearly equivalent to the one taken during the master’s program will not be counted towards the Ph.D. credits. After passing the Ph.D. qualifying exam, a student must remain registered in the program each semester for at least 3 credits of research or dissertation. To complete the Ph.D. program, a student needs to finish minimum 24 research/dissertation credit hours.

After the completion of the M.S., students can fulfill the Ph.D. course requirements by completing at least 9 hours of coursework in the student’s specialized field (see Appendix A) and 6 hours in computer science specialization field (see Appendix A). In addition, students are required to take colloquia to satisfy the minimum 3 colloquium credits.

11. Examination and Dissertation
Before candidates can register for research or dissertation credits, they must have earned at least 30 credits and passed the PhD Qualifying Exam.
11.1. Qualifying Examination Committee

If a student did not choose an academic advisor(s), a temporary academic advisor(s) is assigned when admitted to the Program. Before the end of their fourth semester in the program, students should select a Doctoral Advisor and, in consultation with their Doctoral Advisor, form a Qualifying Exam Committee. The Qualifying Exam Committee should include at least three Doctoral Faculty members, including the Doctoral Advisor who chairs the Committee.

11.2. Qualifying Examination

Students must take the PhD Qualifying exam within two semesters after completing 30 hours of coursework (out of the 45 hours coursework requirement). Each student must select a primary area of focus and then pass a qualifying exam in that area, given and evaluated by the student’s Qualifying Exam Committee. The purpose of the qualifying exam is to allow the student to demonstrate that they are capable of doing Ph.D. level research leading to a dissertation.

The Qualifying Examination consists of two mandatory components: an original written research report and an oral presentation of the report on the student’s primary area of focus. The student must file Qualifying Examination Application at least one month before the examination takes place. Copies of the original written research report must be submitted at the time of filing the Qualifying Examination Application. To satisfy this requirement, the student is required to write a technical research paper that shows his/her ability to follow a research methodology. The paper (6-8 pages in IEEE/ACM two-column format incorporating typical sections such as introduction, problem statement, proposed method, evaluation and discussion of results, and relevant references) should be in a format that can be publishable in a refereed venue. The Qualifying Examination Committee will evaluate the research report based on the corresponding rubric and grade it on a pass/fail basis.

The oral part of the Qualifying Examination is the student’s presentation of the written research report. Upon completion of the presentation of the report, exam committee will make its final decision within one month.

A second failure of the exam will result in the termination of the student's enrollment in the Ph.D. program.

After passing the Qualifying Exam, the student will be allowed to register for research and dissertation credits.

11.3. Dissertation Committee

After passing the qualifying exam, set up a Dissertation Committee of at least four graduate faculty members, which are all Ph.D. faculty members. This Committee may, but is not required to consist of the same faculty members as the Qualifying Exam Committee. Ordinarily, the chair of this committee will be the student's advisor(s), who must be a Ph.D. faculty member and will insure that the composition of the committee is
appropriate. The Dissertation Committee must be approved by the Ph.D. program coordinator. After identifying and obtaining the signatures of the faculty who will be serving on the Committee, the Dissertation Committee Form must be submitted to the Graduate School.

11.4. Proposal Defense

Each student must present and successfully defend a Ph.D. dissertation proposal after passing the qualifying exam and within ten (10) semesters since entering the Ph.D. program. The proposal defense will be conducted by the student's Dissertation Committee and will be open to the Ph.D. faculty and students. The student shall provide copies of the written proposal to the Committee members at least two weeks before the scheduled defense. At the discretion of the Dissertation Committee, the defense may include questions that cover the student's program of study and background knowledge in the area of the proposal. The proposal defense will be graded as pass/fail according to the corresponding rubrics by the Committee. A pass must be unanimous decision by the committee members; otherwise the proposal defense fails. A student can re-take the proposal defense if he/she cannot pass it the first time and should consult the Ph.D. program coordinator before the second attempt. The second failed defense of a dissertation proposal will result in the termination of the student's enrollment in the Ph.D. program.

11.5. Ph.D. Candidacy

A doctoral student advances to Ph.D. candidacy after the dissertation proposal has been successfully defended.

11.6. Dissertation Defense

Each student must complete a research program approved by the student's Dissertation Advisor(s) that yields a high quality, original and substantial piece of research. The Ph.D. dissertation describes this research and its results. The dissertation defense is a public presentation. A written copy of the dissertation must be made available to each member of the student Ph.D. Dissertation Committee at least two weeks before the public defense. The date of the defense must be publicly announced at least two weeks prior to the defense. The student must present the dissertation and defend it in a manner accepted by the Dissertation Committee. The dissertation will be graded as pass/fail based on the corresponding rubrics by the Dissertation Committee. A pass decision must be unanimous and must be approved by the Dean of the Graduate School. A student who fails the defense of a dissertation twice will be terminated from the Ph.D. program.

11.7. Program of study

The proposed program covers fields of Computer Science, Electrical and Computer Engineering, and Computational Sciences with a minimum of 72 hours.
1. After the M.S. course completion requirements, students can fulfill the Ph.D. course requirements by completing at least 9 hours of coursework in the student's specialized field and 6 hours in elective courses.
2. Course selection requires the approval of the student’s thesis advisor.
3. To remain in good standing students must maintain a grade point average of 3.0.
4. Course Requirements (see Appendix A for pending catalog descriptions of courses).
5. Qualifying examination: The student is required to take the qualifying exam during the first 2 semesters after 30 hours of coursework (out of the 45 semester-hours coursework requirement) has been completed.
6. Dissertation Credits: Before candidates can register for research or dissertation credits, they must have passed the PhD qualifying Exam.
7. Proposal Defense: Students are expected to form a doctoral committee by discussing with his/her advisor in the 4 semester of his PhD program. The committee shall include at least three CSIT faculty members and one specialization field faculty member. Students will write a thesis proposal in a format agreed upon by their doctoral committee. The proposal should include some background information about the research topic and a timeline for completion of the thesis. The student will submit this proposal to the doctoral committee at least 14 days prior to an oral defense. Students are advanced to candidacy upon successful completion of the qualifying examinations.
8. Dissertation: The doctoral degree program requires the completion of an approved dissertation that demonstrates the student's ability to perform original, independent research and constitutes a distinct contribution to knowledge in the principal field of study.
9. Dissertation Defense: Students will defend their dissertation in an oral examination attended by the doctoral committee. The student will submit their dissertation to the doctoral committee at least two weeks prior to the defense, and the defense will be advertised at least 2 weeks prior to the defense.
APPENDIX A: COURSE DESCRIPTIONS

UDC CSE PhD Courses (Oct 11, 2012)

Computer Science (can also be a Specialization Field): 60X, 61X, 62X, 67X, 68X, 69X

CSE 601 - Advanced Algorithm Analysis (3-cr)
This course is an advanced course in algorithms design and analysis. This is the advanced version of the 500-level counterpart. It covers many new topics and also revisit some the topics covered in 500-level counterpart in more detail. It will begin by reviewing sorting and graph algorithms as well as studying approximation algorithms, NP-completeness, heuristic algorithms, randomized algorithms, linear programming, pseudorandom generators, cryptography, etc.

CSE 602 - Theory of Computational Complexity (3-cr)
This is a theoretical computer science course to identify the limitations of the computers through formalizing computation (by introducing several models including Turing Machines) and applying mathematical techniques to the formal models obtained.

CSE 603 - Pattern Recognition (3-cr)
Pattern recognition systems, statistical methods, clustering analysis, unsupervised learning, feature extraction and feature processing.

CSE 671 - Autonomous Mobile Robots (3-cr)
Fundamental constraints, technologies, and algorithms related to autonomous mobile robots. Topics include motion, kinematics, simulation testing, sensor incorporation and unmodeled factors. Develop an autonomous robot in simulation or on a physical robot.

CSE 672 - Visual Analytics (3-cr)
Science of analytical reasoning facilitated by interactive visual interfaces. Topics include visual analytics tools and techniques to synthesize information and derive insight from massive, dynamic, ambiguous, and often conflicting data, provide timely, defensible, and understandable assessments.

CSE 673 - Virtual Reality (3-cr)
Concepts and techniques including a systematic introduction to the underpinnings of Virtual Environments (VE), Virtual Worlds, advanced displays, and immersive technologies.

CSE 674 - Advanced Topics in Networking (3-cr)

Cloud computing, Mobile Ad Hoc networks, Future Internet, Internet of Things (IoT), Energy-Efficient Networks and Protocols, Mobile Multimedia, Broadband Wireless Networks (WiMAX, LTE, LTE-Advanced), Cognitive radio, Vehicular Ad Hoc Networks (VANETs) and Sensor Networking.

CSE 675 - Spatio-Temporal Databases (3-cr)

Spatial and Temporal Databases: history, applications, practices, theory, design, implementation, indexing, and querying.

CSE 676 - Big Data Science (3-cr)

Definition and applications of Big Data, Big Data in Cloud Computing, data-intensive parallel processing and column-oriented distributed data management.

CSE 689 – Special Topics in Computer Science (3-cr)

Specialization Field: Electrical and Computer Engineering: 63X, 64X

CSE 631 - Advanced Computational Intelligence (3-cr): Topics covered in this course include pattern classification, supervised learning, unsupervised learning, data clustering, time series prediction, feature selection and extraction, decision tree learning, neural networks, support vector machine, and others. Implement computational intelligence algorithms.

CSE 632 - Advanced Computer Architecture (3-cr): High performance computer architectures: instruction set principles, pipelining, multiprocessing systems, parallel processing, instruction level parallelism, fine-grain and coarse grain parallelism, SIMD, MIMD, multiple instruction issue, data coherency, memory hierarchy design, interconnection networks, vector processors.

CSE 633 - Advanced Embedded System design (3-cr): Advanced embedded system design principles and practices. Emphasizes formal design methodologies such as hardware-software co-design and co-verification, performance optimization, distributed embedded systems. Soft core and hard core embedded microprocessors. (Esther has a different description.)

CSE 634 - Detection and Estimation (3-cr): Estimation of unknown parameters, Cramer-Rao lower bound; optimum (map) demodulation; filtering, amplitude and angle modulation, comparison with conventional systems;
statistical decision theory Bayes, minimax, Neyman/Pearson, Criteria-68 simple and composite hypotheses; application to coherent and incoherent signal detection; M-ary hypotheses; application to uncoded and coded digital communication systems.

**CSE 635 - VLSI Architecture (3-cr):** MOS transistors: fabrication, layout, characterization; CMOS circuit and logic design: circuit and logic simulation, fully complementary CMOS logic, pseudo-nMOS logic, dynamic CMOS logic, pass-transistor logic, clocking strategies; sub system design: ALUs, multipliers, memories, PLAs; architecture design: datapath, floorplanning, iterative cellular arrays, systolic arrays; VLSI algorithms; chip design and test: full custom design of chips, possible chip fabrication by MOSIS and subsequent chip testing.

**CSE 636 - Advanced Electronic Materials and Devices (3-cr):** Operating principles, fabrication, characteristics and applications of advanced electronic devices will be covered. Core topics are as follows: ideal properties of electron gas; electronic states in bulk GaAs and at the heterojunctions; doping properties in heterostructures; electron transport properties at 2D interfaces (including resonant tunneling); electronic and optical properties at 2D interfaces; device applications (HEMT, HBT, QW Laser, QD Laser), low-dimensional and nanometer-scale device physics, magnetic & ferroelectric devices, single-electron transistors, quantum devices, and RTD's.

**CSE 637 - Advanced Communication Systems (3-cr):** Basis functions, orthogonalization of signals, vector representation of signals, optimal detection in noise, matched filters, pulse shaping, intersymbol interference, maximum likelihood detection, channel cutoff rates, error probabilities, bandwidth, and power-limited signaling.

**CSE 649 – Special Topics in Computer Engineering (3-cr)**

**Concentration Area: Computational Science in Engineering: 65X, 66X**

**CSE 651 - Computational engineering and scientific modeling (3-cr):** Use cloud, super computer, and even normal desktop computer (GPU or CPU based). An engineer or scientist with little to no expertise to understand the limits and capabilities of different computational systems. This may be a unique course. I can assist/co-teach such course at opportune time.

**CSE 652 - Systems Engineering Approach (3-cr):** Engineering of complex hardware, software systems encompasses quantitative methods to understand vague problem statements, determine what a proposed product/system must do (functionality), generate measurable requirements, decide how to select the most appropriate solution design, integrate the hardware and software subsystems and test the finished product to verify it satisfies the documented requirements.
Additional topics that span the entire product life cycle include interface management and control, risk management, tailing of process to meet organizational and project environments, configuration management, test strategies and trade-off studies.

CSE 653 - Engineering Systems: Modeling & Simulation (3-cr): This course will present principles of computational modeling and simulation of systems. General topics covered include: parametric and non-parametric modeling; system simulation; parameter estimation, linear regression and least squares; model structure and model validation through simulation; and, numerical issues in systems theory. Techniques covered include methods from numerical linear algebra, nonlinear programming and Monte Carlo simulation, with applications to general engineering systems. Modeling and simulation software is utilized in this course.

CSE 654 - Water Resources System Analysis (3-cr): This course covers planning, design and management of multi-component water resources systems. After a review of the use and nature of water resources systems, topics studied in detail are: water resource economics; methodology of design; systems analysis; systems design and decision making; applied mathematical programming; probabilistic models and water quality modeling.

CSE 655 - Water Resources System Modeling (3-cr): Water resources systems are physically complex and the solution of appropriate mathematical models is computationally demanding. This course considers physical processes in water resource systems, their mathematical representation and numerical solutions. This course covers meteorologic data analysis, deterministic and stochastic modeling techniques; Flood control: structural and nonstructural alternatives and Urban drainage and runoff control, risk analysis, economics and decision making.

CSE 669 – Special Topics in Computational Science in Eng (3-cr)
APPENDIX B: FACULTY QUALIFICATIONS

Over the recent years, research-oriented faculty members of SEAS (10-15 faculty members) have been managing over 2 million funded research and education projects. These faculty members have many hundred peer-reviewed research papers published in reputable and premium science, engineering, and technology venues and forums. These faculty members are nationally competitive in research and have been trying hard to sustain and grow their competitive research activities by actively building their research groups with existing undergraduate and master’s students in collaboration with external partners and collaborators. A sample of a number of such new research groups is found on the web at http://informatics.udc.edu and http://informatics.udc.edu/arctic. As a departmental sample, the professional web pages of CSIT faculty are found at http://csit.udc.edu/ “People” “Faculty”. In addition, other departments, including Electrical Engineering and Civil and Mechanical Engineering, add their funded and well-published research capability to this qualification justification.
APPENDIX C: COURSE SYLLABI

In here, course syllabus for each course is enclosed.

______________________________
Advanced Algorithm Analysis
Class location: TBA
Class Meeting time(s): TBA
Course level and # of credit hours: CSE 601 (3 credits)

Coordinator: Dr. Li Chen
Instructor: TBA
Office Hours: TBA

I. Course Description
This course is an advanced course in algorithms design and analysis. It will cover the topics of approximation algorithms, NP-completeness, heuristic algorithms, randomized algorithms, linear programming, pseudorandom generators, cryptography, etc.

II. Course Goals, Objectives, Prerequisites, and Co-requisites
Goals:
Students learn a body of knowledge and a practical set of well known, tested, and necessary skills related to Algorithm Analysis.

Prerequisite: None
Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: (1) understanding approximation algorithms and linear programming; (2) identifying NP-completeness and pseudorandom generators; (3) applying heuristic, randomized algorithms to practical algorithmic problems; (4) identification of important algorithms used in information assurance.

Student Learning Outcomes:
By the end of the course, students will be able to:
1) Understand various advanced algorithms
   Assessment: Assignments, Exams, Class project, and Paper presentation.
2) Understand how to apply approximation algorithms and linear programming approach
   Assessment: Assignments, Exams, Class project, and Paper presentation.
3) Identify advanced algorithms used in information assurance (cryptograph, RAS, DES, etc.)
   Assessment: Assignments, Exams, Class project, and Paper presentation.
4) Know how to cope with NP-completeness
   Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements
A. Course content
   • Required texts: Algorithms by Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani
     Publisher: McGraw-Hill Science; 1 edition (Sept. 13, 2006)
     ISBN-10: 0073523402

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
Students are encouraged to check following resources to become successful on this course.

- **Academic Support Center.** “Here you may have a trained English major or English professional proofread your work. Visit Building 32, B-level.”
- **Blackboard.** “From [http://udc.blackboard.com](http://udc.blackboard.com), you can review and complete assignments, view your grades, send messages to your professor or your classmates, access course content, print another syllabus, or read sample essays.”
- **UDC Email.** All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

**VI. Assessment Procedures**
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.

**VII. Grades**
Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
1) Project: 20 (%)  
2) Mid-term exam: 20 (%)  
3) Final exam: 20 (%)  
4) Assignments: 20 (%)  
5) Attendance: 10 (%)  
6) Paper presentation: 10 (%)  

**VIII. Expectations**
From this course, students are expected to knowing the necessary concepts in Advanced Algorithm Analysis.

**IX. Academic Integrity**
UDC standards on academic integrity (see UDC Academic Policies and Procedures Manual). As they apply, include industry or specialized accreditiation standards.

**X. Statement on ADA (Americans with Disabilities Act) Procedures**
The University is committed to providing an educational environment that is accessible to all students. If any student requires assistance, support services, or verification of a disability, then he or she should please visit the Office of Services to Students with Disabilities.

**XI. Course Schedule (Tentative)**

<table>
<thead>
<tr>
<th>Topics</th>
<th>Readings/other Assignments</th>
<th>Assessments</th>
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</thead>
<tbody>
<tr>
<td><strong>Week 1</strong></td>
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<tr>
<td>Chapter 1: Algorithms with numbers</td>
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<tr>
<td><strong>Week 2</strong></td>
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<tr>
<td>Chapter 2: Divide-and-conquer algorithms</td>
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<tr>
<td><strong>Week 3 &amp; 4</strong></td>
<td>Assignment</td>
<td>Due: Assignment</td>
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<tr>
<td>Chapter 3: Decompositions of graphs</td>
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<tr>
<td><strong>Week 5</strong></td>
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<tr>
<td>Chapter 4: Paths in graphs</td>
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<tr>
<td><strong>Week 6 &amp; 7</strong></td>
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<tr>
<td>Chapter 5: Greedy algorithms</td>
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<tr>
<td><strong>Week 8</strong></td>
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<tr>
<td>Chapter 6: Dynamic programming</td>
<td>Mid-term Exam</td>
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<tr>
<td><strong>Week 9</strong></td>
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<tr>
<td>Chapter 7: Linear programming</td>
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<tr>
<td><strong>Week 10</strong></td>
<td>Assignment</td>
<td>Paper Presentation</td>
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<tr>
<td>Paper Presentation</td>
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<tr>
<td><strong>Week 11</strong></td>
<td></td>
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<tr>
<td>Chapter 8: NP-complete problems</td>
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</tbody>
</table>
Theory of Computational Complexity
Class location: TBA
Class Meeting time(s): TBA
Course level and # of credit hours: CSE 602 (3 credits)

Coordinator: Dr. Li Chen
Instructor: TBA
Office Hours: TBA

I. Course Description
This is a theoretical computer science course to identify the limitations of the computers through formalizing computation (by introducing several models including Turing Machines) and applying mathematical techniques to the formal models obtained.

II. Course Goals, Objectives, Prerequisites, and Co-requisites

**Goals:**
Students gain a clear understanding of even the most complex, highly theoretical computational theory topics.

**Prerequisite:** None
**Course Credits:** 3 credits

**Learning Objectives:**
Student learning objectives are as follows: (1) understanding today's computational theory; (2) identifying theoretical treatment of deterministic context-free languages is ideal for a better understanding of parsing and LR(k) grammars; (3) gaining a solid understanding of the fundamental mathematical properties of computer hardware, software, and applications with a blend of practical and philosophical coverage and mathematical treatments, including advanced theorems and proofs.

**Student Learning Outcomes:**
By the end of the course, students will be able to:
1) Understand computational theory
   - Assessment: Assignments, Exams, Class project, and Paper presentation.
2) Understand deterministic context-free languages and LR(k) grammars
   - Assessment: Assignments, Exams, Class project, and Paper presentation.
3) Identify complexity theory including time complexity and space complexity
   - Assessment: Assignments, Exams, Class project, and Paper presentation.
4) Know computability theory (The Church-Turing Thesis)
   - Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements

**A. Course content**
- Required texts: *Introduction to the Theory of Computation* by Michael Sipser
  Publisher: PWS Pub. Co.; 1 edition (December 13, 1996)
  ISBN-10: 053494728X

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
Students are encouraged to check following resources to become successful on this course.

- **Academic Support Center.** “Here you may have a trained English major or English professional proofread your work. Visit Building 32, B-level.”
- **Blackboard.** “From http://udc.blackboard.com, you can review and complete assignments, view your grades, send messages to your professor or your classmates, access course content, print another syllabus, or read sample essays.”
- **UDC Email.** All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

VI. Assessment Procedures
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.

VII. Grades

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<th>Grade</th>
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<tr>
<td>A</td>
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<td>D</td>
<td>60-70</td>
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<td>F</td>
<td>Below 60</td>
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The grading system is as follows:

1) Project: 20 (%)
2) Mid-term exam: 20 (%)
3) Final exam: 20 (%)
4) Assignments: 20 (%)
5) Attendance: 10 (%)
6) Paper presentation: 10 (%)

VIII. Expectations
From this course, students are expected to knowing the necessary concepts in the theory of computation.

IX. Academic Integrity
UDC standards on academic integrity (see UDC Academic Policies and Procedures Manual). As they apply, include industry or specialized accreditation standards.

X. Statement on ADA (Americans with Disabilities Act) Procedures
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XI. Course Schedule (Tentative)

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<tr>
<th>Topics</th>
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<th>Assessments</th>
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<tbody>
<tr>
<td>Week 1 Introduction &amp; Automata and Languages</td>
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<tr>
<td>Week 2 Regular Languages</td>
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<tr>
<td>Week 3 Context-Free Languages</td>
<td>Assignment</td>
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<tr>
<td>Week 4 Computability Theory</td>
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<tr>
<td>Week 5 The Church-Turing Thesis</td>
<td>Due: Assignment</td>
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<tr>
<td>Week 6 Decidability</td>
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<tr>
<td>Week 7 Reducibility</td>
<td>Mid-term Exam</td>
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</tbody>
</table>
Pattern Recognition
Class location: TBA
Class Meeting time(s): TBA
Course level and # of credit hours: CSE 603 (3 credits)

Coordinator: Dr. Li Chen and Dr. Lily Liang
Instructor: TBA
Office Hours: TBA

I. Course Description
This course covers Pattern recognition systems, statistical methods, clustering analysis, unsupervised learning, feature extraction and feature processing.

II. Course Goals, Objectives, Prerequisites, and Co-requisites
Goals:
The student should also have some exposure to the theoretical issues involved in pattern recognition system design such as the curse of dimensionality.

Prerequisite: It is assumed the students have a working knowledge of calculus, linear algebra, and probability theory. It is also assumed the students have some experience programming in a scientific computing environment.

Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: a clear understanding of 1) the design and construction and a pattern recognition system and 2) the major approaches in statistical and syntactic pattern recognition.

Student Learning Outcomes:
By the end of the course, students will be able to:
1) Understand pattern classification algorithms
   Assessment: Assignments, Exams, Class project, and Paper presentation.
2) Develop pattern recognition applications
   Assessment: Assignments, Exams, Class project, and Paper presentation.
3) Identify parametric techniques and unsupervised methods
   Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements

A. Course content

- Required texts: Pattern Classification by Richard O. Duda, Peter E. Hart, David G. Stork
  Publisher: Wiley-Interscience; 2 edition (October 2000)
IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
Students are encouraged to check following resources to become successful on this course.

- **Academic Support Center.** “Here you may have a trained English major or English professional proofread your work. Visit Building 32, B-level.”
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- **UDC Email.** All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

VI. Assessment Procedures
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.

VII. Grades
Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
1) Project: 20 (%)
2) Mid-term exam: 20 (%)
3) Final exam: 20 (%)
4) Assignments: 20 (%)
5) Attendance: 10 (%)
6) Paper presentation: 10 (%)

VIII. Expectations
From this course, students are expected to knowing the necessary concepts in pattern recognition.

IX. Academic Integrity
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X. Statement on ADA (Americans with Disabilities Act) Procedures
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XI. Course Schedule (Tentative)

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<tr>
<th>Topics</th>
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<tbody>
<tr>
<td>Week 1 Introduction to Pattern Recognition</td>
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<tr>
<td>Week 2 Tree Classifiers Getting our feet wet with real classifiers (a) Decision Trees: CART, C4.5, ID3. (b) Random Forests</td>
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<tr>
<td>Week 3 Bayesian Decision Theory Grounding our inquiry</td>
<td>Assignment</td>
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</tbody>
</table>
## Linear Discriminants Discriminative Classifiers: the Decision Boundary
(a) Separability
(b) Perceptrons
(c) Support Vector Machines

## Week 5
Parametric Techniques Generative Methods grounded in Bayesian Decision Theory
(a) Maximum Likelihood Estimation
(b) Bayesian Parameter Estimation
(c) Sufficient Statistics

## Week 6 & 7
Non-Parametric Techniques
(a) Kernel Density Estimators
(b) Parzen Window
(c) Nearest Neighbor Methods

## Week 8 & 9
Unsupervised Methods Exploring the Data for Latent Structure
(a) Component Analysis and Dimension Reduction
(b) Clustering

## Week 10
Classifier Ensembles
(a) Bagging
(b) Boosting / AdaBoost

## Week 11 & 12
Graphical Models The Modern Language of Pattern Recognition and Machine Learning
(a) Introductory ideas and relation back to earlier topics
(b) Bayesian Networks
(c) Sequential Models

## Week 13
Algorithm Independent Topics Theoretical Treatments in the Context of Learned Tools
(a) No Free Lunch Theorem
(b) Ugly Duckling Theorem
(c) Bias-Variance Dilemma
(d) Jackknife and Bootstrap Methods

## Autonomous Mobile Robots
Class location: TBA
Class Meeting time(s): TBA
Course level and # of credit hours: CSE 671 (3 credits)

Coordinator: Dr. Briana Wellman
Instructor: TBA

December 5, 12
Office Hours: TBA

I. Course Description
This course covers fundamental constraints, technologies, and algorithms related to autonomous mobile robots. Topics include motion, kinematics, simulation testing, sensor incorporation and unmodeled factors. Develop an autonomous robot in simulation or on a physical robot.

II. Course Goals, Objectives, Prerequisites, and Co-requisites

Goals:
Students understand theoretical concepts in autonomous robots and gain a practical knowledge on developing an autonomous robot.

Prerequisite: None
Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: (1) understanding fundamentals of mobile robotics; (2) examining the basic principles of locomotion, kinematics, sensing, perception, and cognition that are key to the development of autonomous mobile robots; (3) gaining the mechanisms that allow a mobile robot to move through a real world environment to perform its tasks.

Student Learning Outcomes:
By the end of the course, students will be able to:
1) Understand fundamentals of mobile robotics
   Assessment: Assignments, Exams, Class project, and Paper presentation.
2) Understand the basic principles of locomotion, kinematics, sensing, perception, and cognition
   Assessment: Assignments, Exams, Class project, and Paper presentation.
3) Identify different aspect of mobility (from low-level to high-level)
   Assessment: Assignments, Exams, Class project, and Paper presentation.
4) Discuss and understand higher-level challenges of localization and cognition
   Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements

A. Course content
   - Required texts: *Introduction to Autonomous Mobile Robots (Intelligent Robotics and Autonomous Agents series)* by Roland Siegwart, Illah R. Nourbakhsh
     Publisher: The MIT Press (March 5, 2004)
     ISBN-10: 026219502X

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
Students are encouraged to check following resources to become successful on this course.
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- **UDC Email.** All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

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All students need to finish all given assignments in a timely manner. In order to get feedbacks from the instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.
VII. Grades
Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
1) Project: 20 (%)
2) Mid-term exam: 20 (%)
3) Final exam: 20 (%)
4) Assignments: 20 (%)
5) Attendance: 10 (%)
6) Paper presentation: 10 (%)

VIII. Expectations
From this course, students are expected to knowing the necessary concepts in autonomous robots.

IX. Academic Integrity
UDC standards on academic integrity (see UDC Academic Policies and Procedures Manual). As they apply, include industry or specialized accreditation standards.

X. Statement on ADA (Americans with Disabilities Act) Procedures
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XI. Course Schedule (Tentative)

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<tbody>
<tr>
<td>Week 1 Locomotion</td>
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<tr>
<td>Week 2 Kinematic Models and Constraint</td>
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<tr>
<td>Week 3 Mobile Robot Maneuverability</td>
<td>Assignment</td>
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<tr>
<td>Week 4 Mobile Robot Workspace</td>
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<tr>
<td>Week 5 Sensors for Mobile Robots</td>
<td>Due: Assignment</td>
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<tr>
<td>Week 6 Representing Uncertainty &amp; Feature Extraction</td>
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<td>Mid-term Exam</td>
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<tr>
<td>Week 7 The Challenge of Localization: Noise and Aliasing &amp; Belief Representation</td>
<td>Assignment</td>
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<tr>
<td>Week 8 &amp; 9 Probabilistic Map-Based Localization</td>
<td>Assignment</td>
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<tr>
<td>Week 11 Autonomous Map Building</td>
<td>Paper Presentation</td>
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<tr>
<td>Week 12 &amp; 13 Competences for Navigation: Planning and Reacting</td>
<td>Due: Assignment</td>
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<tr>
<td>Week 14 &amp; 15 Navigation Architectures</td>
<td>Project Presentation / Final Exam</td>
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</tbody>
</table>

Visual Analytics
Class location: TBA
Class Meeting time(s): TBA
Course level and # of credit hours: CSE 672 (3 credits)
Coordinator: Dr. Dong H. Jeong
Instructor: TBA
Office Hours: TBA

I. Course Description
This course covers the topics include visual analytics tools and techniques to synthesize information and derive insight from massive, dynamic, ambiguous, and often conflicting data, provide timely, defensible, and understandable assessments.

II. Course Goals, Objectives, Prerequisites, and Co-requisites
Goals:
Students gain a clear understanding of topics in visual analytics.

Prerequisite: None
Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: (1) understanding Visual Analytics; (2) identifying Visualization Concepts and Design; (3) gaining knowledge on Data Sciences/Processing for visualization; (4) Understand the context of Use, Sensemaking and Human Factors.

Student Learning Outcomes:
By the end of the course, students will be able to:
1) Understand techniques in visual analytics
   Assessment: Assignments, Exams, Class project, and Paper presentation.
2) Understand how to create visual analytics systems
   Assessment: Assignments, Exams, Class project, and Paper presentation.
3) Identify the importance of visual analytics
   Assessment: Assignments, Exams, Class project, and Paper presentation.
4) Understand human factors in visual analytics
   Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements
   A. Course content
      • Required texts: *Illuminating the Path: The Research and Development Agenda for Visual Analytics* by James J. Thomas and Kristin A. Cook
        Publisher: National Visualization and Analytics Ctr (2005)
        ISBN-10: 0769523234

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
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VII. Grades
Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
7) Project: 20 (%)
8) Mid-term exam: 20 (%)
9) Final exam: 20 (%)
10) Assignments: 20 (%)
11) Attendance: 10 (%)
12) Paper presentation: 10 (%)

VIII. Expectations
From this course, students are expected to knowing the necessary concepts in visual analytics.

IX. Academic Integrity
UDC standards on academic integrity (see UDC Academic Policies and Procedures Manual). As they apply, include industry or specialized accreditation standards.

X. Statement on ADA (Americans with Disabilities Act) Procedures
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XI. Course Schedule (Tentative)

<table>
<thead>
<tr>
<th>Topics</th>
<th>Readings/other Assignments</th>
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<td>Week 1 Introduction</td>
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<td>Week 2 &amp; 3 Mental and visualization models</td>
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<td>Week 4 Data Foundations &amp; Storage</td>
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<tr>
<td>Week 5 Data Retrieval &amp; Transform</td>
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<td>Week 6 &amp; 7 Visualization survey</td>
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<td>Week 8 &amp; 9 Interaction and analysis</td>
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<tr>
<td>Week 10 &amp; 11 VAST Challenges</td>
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<tr>
<td>Week 12 &amp; 13 Disseminating approaches</td>
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<tr>
<td>Week 14 &amp; 15 Evaluation methods</td>
<td>Project Presentation / Final Exam</td>
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</tr>
</tbody>
</table>

Virtual Reality
Class location: TBA
Class Meeting time(s): TBA
Course level and # of credit hours: CSE 673 (3 credits)

Coordinator: Dr. Dong H Jeong
Instructor: TBA
Office Hours: TBA

December 5, 12
I. Course Description
This course covers concepts and techniques including a systematic introduction to the underpinnings of Virtual Environments (VE), Virtual Worlds, advanced displays, and immersive technologies.

II. Course Goals, Objectives, Prerequisites, and Co-requisites
Goals:
Students understand theoretical concepts in visual environments (VE).

Prerequisite: None
Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: (1) understanding fundamentals of immersive technologies; (2) examining the basic principles in visual worlds including locomotion, sensing, perception, and cognition; (3) identifying mechanisms that are used for designing virtual worlds.

Student Learning Outcomes:
By the end of the course, students will be able to:

1) Understand fundamentals in VEs
   Assessment: Assignments, Exams, Class project, and Paper presentation.

2) Understand the basic locomotion and interaction techniques in VEs
   Assessment: Assignments, Exams, Class project, and Paper presentation.

3) Identify different aspect of immersive technologies
   Assessment: Assignments, Exams, Class project, and Paper presentation.

4) Discuss and understand higher-level challenges in VEs
   Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements
A. Course content
   • Required texts: *3D User Interfaces: Theory and Practice* by Doug A. Bowman, Ernst Kruijff, Joseph J. LaViola Jr., Ivan Poupyrev
     Publisher: Addison-Wesley Professional; 1 edition (August 5, 2004)
     ISBN-10: 0201758679

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
Students are encouraged to check following resources to become successful on this course.

   • Academic Support Center. “Here you may have a trained English major or English professional proofread your work. Visit Building 32, B-level.”

   • Blackboard. “From *http://udc.blackboard.com*, you can review and complete assignments, view your grades, send messages to your professor or your classmates, access course content, print another syllabus, or read sample essays.”

   • UDC Email. All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

VI. Assessment Procedures
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.

VII. Grades
Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
1) Project: 20 (%)
2) Mid-term exam: 20 (%)
3) Final exam: 20 (%)
4) Assignments: 20 (%)
5) Attendance: 10 (%)
6) Paper presentation: 10 (%)

VIII. Expectations
Students are expected to knowing the necessary concepts in VEs

IX. Academic Integrity
UDC standards on academic integrity (see UDC Academic Policies and Procedures Manual). As they apply, include industry or specialized accreditation standards.

X. Statement on ADA (Americans with Disabilities Act) Procedures
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XI. Course Schedule (Tentative)

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<thead>
<tr>
<th>Topics</th>
<th>Readings/other Assignments</th>
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<tbody>
<tr>
<td>Week 1</td>
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<tr>
<td>Chapter 1: Introduction to 3D User Interfaces</td>
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<tr>
<td>Week 2</td>
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<tr>
<td>Chapter 2: 3D User Interfaces: History and Roadmap</td>
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<tr>
<td>Week 3</td>
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<td>Assignment</td>
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<tr>
<td>Chapter 3: 3D User Interface Output Hardware</td>
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<td>Week 4</td>
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<td>Chapter 4: 3D User Interface Input Hardware</td>
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<td>Week 5</td>
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<td>Due: Assignment</td>
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<td>Chapter 5: Selection and Manipulation</td>
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<td>Week 6 &amp; 7</td>
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<td>Mid-term Exam</td>
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<td>Chapter 6: Travel</td>
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<td>Week 8</td>
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<td>Assignment</td>
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<td>Chapter 7: Wayfinding</td>
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<td>Week 9</td>
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<td>Chapter 8: System Control</td>
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<tr>
<td>Week 10</td>
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<td>Paper Presentation</td>
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<td>Chapter 9: Symbolic Input</td>
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<td>Week 11</td>
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<tr>
<td>Chapter 10: Strategies for Designing and Developing 3D User Interfaces</td>
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<tr>
<td>Week 12</td>
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<td>Chapter 11: Evaluation of 3D User Interfaces</td>
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<tr>
<td>Week 13</td>
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<td>Due: Assignment</td>
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<tr>
<td>Chapter 12: Beyond Virtual: 3D User Interfaces for the Real World</td>
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<tr>
<td>Week 14 &amp; 15</td>
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<tr>
<td>Chapter 13: The Future of 3D User Interfaces</td>
<td></td>
<td>Project Presentation / Final Exam</td>
</tr>
</tbody>
</table>
Advanced Topics in Networking
Class location: TBA
Class Meeting time(s): TBA
Course level and # of credit hours: CSE 674 (3 credits)

Coordinator: Dr. Sherali Zeadally
Instructor: TBA
Office Hours: TBA

I. Course Description
This course covers Cloud computing, Mobile Ad Hoc networks, Future Internet, Internet of Things (IoT), Energy-Efficient Networks and Protocols, Mobile Multimedia, Broadband Wireless Networks (WiMAX, LTE, LTE-Advanced), Cognitive radio, Vehicular Ad Hoc Networks (VANETs) and Sensor Networking.

II. Course Goals, Objectives, Prerequisites, and Co-requisites

Goals:
Students understand theoretical advanced concepts in networking.

Prerequisite: None
Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: (1) understanding advanced topics in networking; (2) examining principles of various advanced networking technologies; (3) identifying broadband wireless networks.

Student Learning Outcomes:
By the end of the course, students will be able to:
1) Understand concepts in networking
   Assessment: Assignments, Exams, Class project, and Paper presentation.
2) Understand advanced networking technologies
   Assessment: Assignments, Exams, Class project, and Paper presentation.
3) Identify wireless and wired networking
   Assessment: Assignments, Exams, Class project, and Paper presentation.
4) Understand mobile networking environments
   Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements

A. Course content
   - Required texts: Network Systems Design Using Network Processors by Douglas E. Comer
     Publisher: Prentice Hall (February 9, 2003)
     ISBN-10: 0131417924

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
Students are encouraged to check following resources to become successful on this course.

- Academic Support Center, “Here you may have a trained English major or English professional proofread your work. Visit Building 32, B-level.”
- Blackboard, “From http://udc.blackboard.com, you can review and complete assignments, view your grades, send messages to your professor or your classmates, access course content, print another syllabus, or read sample essays.”
UDC Email. All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

VI. Assessment Procedures
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.

VII. Grades
Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
1) Project: 20 (%)
2) Mid-term exam: 20 (%)
3) Final exam: 20 (%)
4) Assignments: 20 (%)
5) Attendance: 10 (%)
6) Paper presentation: 10 (%)

VIII. Expectations
Students are expected to knowing the necessary concepts in advanced networking.

IX. Academic Integrity
UDC standards on academic integrity (see UDC Academic Policies and Procedures Manual). As they apply, include industry or specialized accreditation standards.

X. Statement on ADA (Americans with Disabilities Act) Procedures
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XI. Course Schedule (Tentative)

| Topics                          | Readings/other Assignments | Assessments
|--------------------------------|-----------------------------|-------------
| Week 1: Large-Scale Dynamics of the Internet |                             |             |
| Week 2: Network Protocols and Security       | Assignment                  |             |
| Week 3: Network Interface Design             | Assignment                  |             |
| Week 4: Switching Networks                  |                             |             |
| Week 5 & 6: Wireless Ad Hoc Networks         | Due: Assignment             |             |
| Week 7: Game theory in Networks             |                             | Mid-term Exam|
| Week 8: Network Economics                   | Assignment                  |             |
| Week 9 & 10: Worms & Web Security and Privacy | Paper Presentation       |             |
| Week 11: Cloud computing                    |                             |             |
| Week 12: Mobile Ad Hoc networks             |                             |             |
| Week 13: Broadband wireless networks        | Due: Assignment             |             |
| Week 14 & 15: Sensor networking             | Project Presentation/Final Exam |         |
Spatio-Temporal Databases
Class location: TBA
Class Meeting time(s): TBA
Course level and # of credit hours: CSE 675 (3 credits)

Coordinator: Dr. Byunggu Yu
Instructor: TBA
Office Hours: TBA

I. Course Description
This course covers Spatial and Temporal Databases: history, applications, practices, theory, design, implementation, indexing, and querying.

II. Course Goals, Objectives, Prerequisites, and Co-requisites

Goals:
Students understand theoretical concepts in spatial and temporal databases.

Prerequisite: None

Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: (1) understanding fundamentals of spatial and temporal databases; (2) understanding how to design and implement spatial and temporal databases; (3) identifying mechanisms to perform querying.

Student Learning Outcomes:
By the end of the course, students will be able to:
1) Understand fundamentals in spatial and temporal databases
   Assessment: Assignments, Exams, Class project, and Paper presentation.
2) Understand theoretical considerations in designing spatial and temporal databases
   Assessment: Assignments, Exams, Class project, and Paper presentation.
3) Identify to perform indexing and querying
   Assessment: Assignments, Exams, Class project, and Paper presentation.
4) Understand how to design and implement spatial and temporal databases
   Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements

A. Course content
   • Required texts: None
   • Reading materials and lecture notes will be provided

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

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UDC Email. All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

VI. Assessment Procedures
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.

VII. Grades
Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
1) Project: 20 (%)
2) Mid-term exam: 20 (%)
3) Final exam: 20 (%)
4) Assignments: 20 (%)
5) Attendance: 10 (%)
6) Paper presentation: 10 (%)

VIII. Expectations
Students are expected to knowing the necessary concepts in spatial and temporal databases.

IX. Academic Integrity
UDC standards on academic integrity (see UDC Academic Policies and Procedures Manual). As they apply, include industry or specialized accreditation standards.

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<tbody>
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<tr>
<td>Introduction to Spatial and temporal databases</td>
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<td>Week 3 &amp; 4</td>
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<td>Due: Assignment</td>
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<tr>
<td>Data structure and query processing</td>
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<td>Week 5 &amp; 6</td>
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<td>Spatial database and system design</td>
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<td>Week 7 &amp; 8</td>
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<td>Moving object query processing</td>
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<td>Week 8 &amp; 9</td>
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<tr>
<td>Temporal indexing &amp; data mining</td>
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<td>Week 10 &amp; 11</td>
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<tr>
<td>Data warehousing and mining</td>
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<td>Week 12 &amp; 13</td>
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<tr>
<td>Temporal indexing</td>
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<tr>
<td>Week 14 &amp; 15</td>
<td>Project Presentation / Final Exam</td>
<td>Due: Assignment</td>
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<tr>
<td>Spatial indexing</td>
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Big Data Science
Coordinator: Dr. Byunggu Yu
Instructor: TBA
Office Hours: TBA

I. Course Description
This course covers definitions and applications of Big Data, Big Data in Cloud Computing, data-intensive parallel processing and column-oriented distributed data management.

II. Course Goals, Objectives, Prerequisites, and Co-requisites

Goals:
Students understand theoretical concepts in Cloud Computing.

Prerequisite: None
Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: (1) understanding fundamentals of cloud computing; (2) examining the basic principles of big data problems; (3) identifying mechanisms to perform parallel processing; (4) understanding the concepts of column-oriented distributed data management.

Student Learning Outcomes:
By the end of the course, students will be able to:
1) Understand fundamentals in Cloud Computing
   Assessment: Assignments, Exams, Class project, and Paper presentation.
2) Understand the basic principles of Big Data problems
   Assessment: Assignments, Exams, Class project, and Paper presentation.
3) Identify different aspect of cloud computing technologies
   Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements

A. Course content
- Required texts: Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg and Andrzej M. Goscinski
  Publisher: Wiley, 2011
  ISBN-10: 0470887990

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

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- UDC Email. All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

VI. Assessment Procedures
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the
instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.

VII. Grades
Grade will be assigned on the scale: 90-100=A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
1) Project: 20 (%)
2) Mid-term exam: 20 (%)
3) Final exam: 20 (%)
4) Assignments: 20 (%)
5) Attendance: 10 (%)
6) Paper presentation: 10 (%)

VIII. Expectations
Students are expected to knowing the necessary concepts of Cloud Computing

IX. Academic Integrity
UDC standards on academic integrity (see UDC Academic Policies and Procedures Manual). As they apply, include industry or specialized accreditation standards.

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<tr>
<td>Introduction to cloud computing</td>
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<tr>
<td>Week 2 &amp; 3</td>
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<tr>
<td>Introduction to data centers: servers, data storage, networking and virtualization</td>
<td>Assignment</td>
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<tr>
<td>Week 4 &amp; 5</td>
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<td>Due: Assignment</td>
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<tr>
<td>Introduction to the Green Data Center</td>
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<tr>
<td>Week 6 &amp; 7</td>
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<td>Mid-term Exam</td>
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<tr>
<td>Introduction to server virtualization software: VMware VSphere</td>
<td>Assignment</td>
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<tr>
<td>Week 8 &amp; 9</td>
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<tr>
<td>Virtual machine management: provisioning, placement, resource allocation, fault tolerance, etc.</td>
<td>Assignment</td>
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<tr>
<td>Week 10 &amp; 11</td>
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<td>Paper Presentation</td>
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<tr>
<td>Data center networking: Ethernet, network topologies, routing, addressing, transport layer protocols, etc.</td>
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<tr>
<td>Week 12</td>
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<td>Due: Assignment</td>
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<tr>
<td>Platform-as-a-Service</td>
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<tr>
<td>Week 13 &amp; 14</td>
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<td>The MapReduce model and Hadoop</td>
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<tr>
<td>Week 14 &amp; 15</td>
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<td>Project Presentation / Final Exam</td>
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I. Course Description
Topics covered in this course include pattern classification, supervised learning, unsupervised learning, data clustering, time series prediction, feature selection and extraction, decision tree learning, neural networks, support vector machine, and others. Implement computational intelligence algorithms.

II. Course Goals, Objectives, Prerequisites, and Co-requisites
Goals:
Students understand theoretical concepts in computational intelligence.

Prerequisite: None
Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: (1) understanding fundamentals of computational approaches; (2) identify mechanisms of classification, supervised and unsupervised learning techniques; (3) knowing how to implement computation intelligence algorithms.

Student Learning Outcomes:
By the end of the course, students will be able to:
1) Understand fundamentals in computational intelligence
   Assessment: Assignments, Exams, Class project, and Paper presentation.
2) Understand supervised and unsupervised learning techniques
   Assessment: Assignments, Exams, Class project, and Paper presentation.
3) Identify different aspect of computational intelligence technologies
   Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements
   A. Course content
      • Required texts: TBA

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

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   ❖ UDC Email, All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

VI. Assessment Procedures
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VII. Grades
Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
1) Project: 20 (%)
2) Mid-term exam: 20 (%)
3) Final exam: 20 (%)
4) Assignments: 20 (%)
5) Attendance: 10 (%)
6) Paper presentation: 10 (%)

VIII. Expectations
Students are expected to knowing the necessary concepts in Computational Intelligence.

IX. Academic Integrity
UDC standards on academic integrity (see UDC Academic Policies and Procedures Manual). As they apply, include industry or specialized accreditation standards.

X. Statement on ADA (Americans with Disabilities Act) Procedures
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<td>Week 1</td>
<td>Mimicking Nature for Problem Solving: The Basic Concepts</td>
<td>Assignment</td>
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<td>Week 2</td>
<td>Single-Layer and Multi-Layer Feedforward Neural Networks</td>
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<td>Week 3</td>
<td>Feedback Neural Networks</td>
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<td>Week 4</td>
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<td>Week 5</td>
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<td>Week 7</td>
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<td>Week 9</td>
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<td>Week 10</td>
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<td>Week 11</td>
<td>Fuzzy Sets and Fuzzy Logic</td>
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<td>Week 12</td>
<td>Fuzzy Neural Networks</td>
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<td>Week 13</td>
<td>Fuzzy ARTMAP</td>
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<td>Week 13</td>
<td>Swarm Intelligence and Ant Colony Optimization</td>
<td>Due: Assignment</td>
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<tr>
<td>Week 15</td>
<td>The Power and Computational Complexity of Computational Intelligence Models</td>
<td>Project Presentation / Final Exam</td>
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</tbody>
</table>
Advanced Computer Architecture
Class location: TBA
Class Meeting time(s): TBA
Course level and # of credit hours: CSE 632 (3 credits)

Coordinator: Dr. Dong H Jeong
Instructor: TBA
Office Hours: TBA

I. Course Description
This course covers concepts in high performance computer architectures: instruction set principles, pipelining, multiprocessing systems, parallel processing, instruction level parallelism, fine-grain and coarse grain parallelism, SIMD, MIMD, multiple instruction issue, data coherency, memory hierarchy design, interconnection networks, vector processors.

II. Course Goals, Objectives, Prerequisites, and Co-requisites
Goals:
Students understand theoretical concepts in advanced computer architecture.

Prerequisite: None
Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: (1) understanding fundamentals of computer architecture concepts; (2) understand the basic principles of high performance computer architectures; (3) identifying systematic architectural mechanisms.

Student Learning Outcomes:
By the end of the course, students will be able to:
1) Understand fundamentals in high performance computer architectures
2) Discuss and understand higher-level concepts in high performance computer architectures

III. Course Requirements
A. Course content
     ISBN-10: 0070570647

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
Students are encouraged to check following resources to become successful on this course.
- Academic Support Center, “Here you may have a trained English major or English professional proofread your work. Visit Building 32, B-level.”
- Blackboard, “From http://udc.blackboard.com, you can review and complete assignments, view your grades, send messages to your professor or your classmates, access course content, print another syllabus, or read sample essays.”
- UDC Email, All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.
VI. Assessment Procedures
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.

VII. Grades
Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
1) Mid-term exam: 30 (%)
2) Final exam: 30 (%)
3) Assignments: 20 (%)
4) Attendance: 10 (%)
5) Paper presentation: 10 (%)

VIII. Expectations
Students are expected to knowing the necessary concepts in high performance computer architectures

IX. Academic Integrity
UDC standards on academic integrity (see UDC Academic Policies and Procedures Manual). As they apply, include industry or specialized accreditation standards.

X. Statement on ADA (Americans with Disabilities Act) Procedures
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XI. Course Schedule (Tentative)

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<th>Topics</th>
<th>Readings/other Assignments</th>
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<td>Week 1</td>
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<tr>
<td>Processor Design</td>
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<td>Week 2</td>
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<tr>
<td>Pipelined Processors</td>
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<tr>
<td>Week 3</td>
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<td>Assignment</td>
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<tr>
<td>Memory and I/O Systems</td>
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<td>Week 4</td>
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<tr>
<td>Superscalar Organization</td>
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<tr>
<td>Week 5</td>
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<tr>
<td>Superscalar Techniques</td>
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<td>Due: Assignment</td>
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<tr>
<td>Week 6 &amp; 7</td>
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<td>Mid-term Exam</td>
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<tr>
<td>The PowerPC 620</td>
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<td>Week 8</td>
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<td>Assignment</td>
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<td>Intel’s P6 Microarchitecture</td>
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<tr>
<td>Week 9</td>
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<td>Paper Presentation</td>
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<tr>
<td>Survey of Superscalar Processors</td>
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<td>Due: Assignment</td>
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<tr>
<td>Week 10</td>
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<tr>
<td>Advanced Instruction Flow Techniques</td>
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<tr>
<td>Week 11</td>
<td></td>
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<tr>
<td>Advanced Register Data Flow Techniques</td>
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<tr>
<td>Week 12</td>
<td></td>
<td>Final Exam</td>
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</tbody>
</table>
Advanced Embedded System Design
Class location: TBA
Class Meeting time(s): TBA
Course level and # of credit hours: CSE 633 (3 credits)

Coordinator: Dr. Wagdy Mahmoud or Dr. Esther Ososanya
Instructor: TBA
Office Hours: TBA

I. Course Description
This course covers concepts in advanced embedded system design principles and practices based on
emphasizing formal design methodologies such as hardware-software co-design and co-verification,
performance optimization, distributed embedded systems. Soft core and hard core embedded
microprocessors. (Esther has a different description.)

II. Course Goals, Objectives, Prerequisites, and Co-requisites

Goals:
Expose students to the state-of-the-art design and analysis techniques for embedded systems.

Prerequisite: None
Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: (1) understanding fundamental concepts in hardware/software
codeign of embedded systems; (2) exposing students to the cutting edge research works and the
emerging trends in the related topic areas; (3) providing students with research experience in embedded
system design and analysis.

Student Learning Outcomes:
By the end of the course, students will be able to:
1) Understand concepts in embedded systems
   Assessment: Assignments, Exams, Class project, and Paper presentation.
2) Understand cutting edge research works
   Assessment: Assignments, Exams, Class project, and Paper presentation.
3) Discuss and understand how to design embedded systems
   Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements
A. Course content
   • Required texts: none
   • Referenced texts:
     b. J. Straustrup and W. Wolf (Eds.), Hardware/Software Co-Design Principles and

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are
strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge
traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving,
and reasoning over simple memorization.

V. Student Resources
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UDC Email. All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

VI. Assessment Procedures
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.

VII. Grades
Grade will be assigned on the scale: 90-100 = A, 80-90 = B, 70-80 = C; 60-70 = D; Below 60 = F
The grading system is as follows:
1) Project: 20 (%)
2) Mid-term exam: 20 (%)
3) Final exam: 20 (%)
4) Assignments: 20 (%)
5) Attendance: 10 (%)
6) Paper presentation: 10 (%)

VIII. Expectations
Students are expected to knowing the necessary concepts in embedded systems.

IX. Academic Integrity
UDC standards on academic integrity (see UDC Academic Policies and Procedures Manual). As they apply, include industry or specialized accreditation standards.

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<tr>
<td>- Introduction and Overview</td>
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<td>Mid-term Exam</td>
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<tr>
<td>• What is an embedded system?</td>
<td>Assignment</td>
<td>Due: Assignment</td>
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<td>• Design challenges</td>
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<tr>
<td>• Current design methodologies</td>
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<td>Week 3 &amp; 4</td>
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<tr>
<td>- Modeling and Specication</td>
<td>Assignment</td>
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<tr>
<td>• Basic concepts</td>
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<td>• Common models of computation</td>
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<td>• Specification languages</td>
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<td>• Internal representations</td>
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<td>Week 5 ~ 7</td>
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<tr>
<td>- Analysis and Estimation</td>
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<tr>
<td>• Software performance estimation</td>
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<td>• System performance analysis</td>
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<td>• Real-time system analysis</td>
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<td>• Power estimation</td>
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<tr>
<td>- Partitioning, Synthesis and Interfacing</td>
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<td>- Basic partitioning issues</td>
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<td>- Two earlier cosynthesis frameworks</td>
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<td>- System-level partitioning</td>
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<td>- Interface generation</td>
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<td>- A design environment</td>
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<td>- Memory issues</td>
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<td>Week 12 ~ 15</td>
<td>Project Presentation / Final Exam</td>
<td>Due: Assignment</td>
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<tr>
<td>- Other Codesign Issues</td>
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<td>- Hw/sw co-verification</td>
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<td>- Prototyping and emulation</td>
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<td>- Reconfigurable platforms</td>
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Detection and Estimation

Class location: TBA
Class Meeting time(s): TBA
Course level and # of credit hours: CSE 634 (3 credits)

Coordinator: Dr. Sasan Haghani
Instructor: TBA
Office Hours: TBA

I. Course Description
This course covers concepts including Estimation of unknown parameters, Cramer-Rao lower bound; optimum (map) demodulation; filtering, amplitude and angle modulation, comparison with conventional systems; statistical decision theory Bayes, minimax, Neyman/Pearson, Criteria-68 simple and composite hypotheses; application to coherent and incoherent signal detection; M-ary hypotheses; application to uncoded and coded digital communication systems.

II. Course Goals, Objectives, Prerequisites, and Co-requisites

Goals:
Students understand theoretical concepts in conventional systems and digital communication.

Prerequisite: None
Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: (1) understanding fundamentals of digital communication systems; (2) identifying various mechanisms and theoretical models in conventional systems.

Student Learning Outcomes:
By the end of the course, students will be able to:

1) Understand fundamentals in digital communication

2) Understand concepts in theoretical conventional systems including statistical signal processing and estimation theory.

III. Course Requirements

A. Course content
   Required texts: Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory (v. 1) by Steven Kay
   Publisher: Prentice Hall; 1 edition (April 5, 1993)
   ISBN-10: 0133457117

December 5, 12 44
IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
Students are encouraged to check following resources to become successful on this course.
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- **Blackboard.** “From [http://udc.blackboard.com](http://udc.blackboard.com), you can review and complete assignments, view your grades, send messages to your professor or your classmates, access course content, print another syllabus, or read sample essays.”
- **UDC Email.** All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

VI. Assessment Procedures
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.

VII. Grades
Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
1) Mid-term exam: 30 (%)
2) Final exam: 30 (%)
3) Assignments: 20 (%)
4) Attendance: 10 (%)
5) Paper presentation: 10 (%)

VIII. Expectations
Students are expected to knowing the necessary concepts in VEs

IX. Academic Integrity
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X. Statement on ADA (Americans with Disabilities Act) Procedures
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XI. Course Schedule (Tentative)

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<td>Introduction</td>
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<td>Week 2</td>
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<tr>
<td>Review of Linear and Matrix Algebra</td>
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<td>Week 3</td>
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<tr>
<td>Review of Probability, Statistics, and Random Processes</td>
<td>Assignment</td>
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<tr>
<td>Week 4</td>
<td>Classical Spectral Estimation</td>
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<tr>
<td>Week 5</td>
<td>Parametric Modeling</td>
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</tbody>
</table>
### I. Course Description
This course covers MOS transistors: fabrication, layout, characterization; CMOS circuit and logic design: circuit and logic simulation, fully complementary CMOS logic, pseudo-nMOS logic, dynamic CMOS logic, pass-transistor logic, clocking strategies; sub system design: ALUs, multipliers, memories, PLAs; architecture design: datapath, floorplanning, iterative cellular arrays, systolic arrays; VLSI algorithms; chip design and test: full custom design of chips, possible chip fabrication by MOSIS and subsequent chip testing.

### II. Course Goals, Objectives, Prerequisites, and Co-requisites

**Goals:**
Students understand theoretical concepts in VLSI Architecture

**Prerequisite:** None

**Course Credits:** 3 credits

**Learning Objectives:**
Student learning objectives are as follows: (1) understanding the basic approaches and methodologies for VLSI design of signal processing and communication systems; (2) having hands-on VLSI system design experience using hardware description language (HDL) and commercial EDA tools (Synopsys); (3) identifying real-life case studies of communication system integrated circuit (IC) design and implementation.
Student Learning Outcomes:
By the end of the course, students will be able to:
1) Understand fundamentals in VLSI Architecture
   Assessment: Assignments, Exams, Class project, and Paper presentation.
2) Understand integrated circuit (IC) design and implementation
   Assessment: Assignments, Exams, Class project, and Paper presentation.
3) Understand hardware description language (HDL) and commercial EDA tools
   Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements

A. Course content

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
Students are encouraged to check following resources to become successful on this course.
- Academic Support Center.  “Here you may have a trained English major or English professional proofread your work.  Visit Building 32, B-level.”
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- UDC Email. All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

VI. Assessment Procedures
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.

VII. Grades
Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
1) Project: 20 (%)  
2) Mid-term exam: 20 (%)  
3) Final exam: 20 (%)  
4) Assignments: 20 (%)  
5) Attendance: 10 (%)  
6) Paper presentation: 10 (%)  

VIII. Expectations
Students are expected to knowing the necessary concepts in VLSI architecture.

IX. Academic Integrity
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XI. Course Schedule (Tentative)
### Advanced Electronic Materials and Devices

Class location: TBA  
Class Meeting time(s): TBA  
Course level and # of credit hours: CSE 636 (3 credits)

Coordinator: Dr. Samuel Lakeou  
Instructor: TBA  
Office Hours: TBA

**I. Course Description**  
Operating principles, fabrication, characteristics and applications of advanced electronic devices will be covered. Core topics are as follows: ideal properties of electron gas; electronic states in bulk GaAs and at the heterojunctions; doping properties in heterostructures; electron transport properties at 2D interfaces (including resonant tunneling); electronic and optical properties at 2D interfaces; device applications (HEMT, HBT, QWLaser, QDLaser), low-dimensional and nanometer-scale device physics, magnetic & ferroelectric devices, single-electron transistors, quantum devices, and RTD's.

**II. Course Goals, Objectives, Prerequisites, and Co-requisites**
PROPOSAL FOR A DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE AND ENGINEERING (CSE)

**Goals:**
Students understand theoretical concepts in electronic materials and devices.

**Prerequisite:** None

**Course Credits:** 3 credits

**Learning Objectives:**
Student learning objectives are as follows: (1) understanding fundamentals of immersive technologies; (2) examining the basic principles in visual worlds including locomotion, sensing, perception, and cognition; (3) identifying mechanisms that are used for designing virtual worlds.

**Student Learning Outcomes:**
By the end of the course, students will be able to:
1) Understand fundamentals in electronic materials
2) Understand operating principles, fabrication, characteristics and applications of advanced electronic devices

**III. Course Requirements**

A. **Course content**
   - Required texts: TBA

**IV. Format and Procedures**
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

**V. Student Resources**
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The grading system is as follows:
1) Mid-term exam: 30 (%)
2) Final exam: 30 (%)
3) Assignments: 20 (%)
4) Attendance: 10 (%)
5) Paper presentation: 10 (%)

**VIII. Expectations**
Students are expected to knowing the necessary concepts in Electronic materials

**IX. Academic Integrity**
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<td>Week 2 Operating principles, fabrication, characteristics and applications of advanced electronic devices</td>
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<tr>
<td>Week 3 Ideal properties of electron gas</td>
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<td>Week 4 &amp; 5 Electronic states in bulk GaAs and at the heterojunctions</td>
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<td>Week 6 &amp; 7 Doping properties in heterostructures</td>
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<tr>
<td>Week 8 &amp; 9 Electron transport properties at 2D interfaces (including resonant tunneling)</td>
<td>Assignment</td>
<td>Mid-term Exam</td>
</tr>
<tr>
<td>Week 10 ~ 12 Electronic and optical properties at 2D interfaces</td>
<td>Paper Presentation</td>
<td>Due: Assignment</td>
</tr>
<tr>
<td>Week 13 ~ 15 Device applications (HEMT, HBT, QWLaser, QDLaser), low-dimensional and nanometer-scale device physics, magnetic &amp; ferroelectric devices, single-electron transistors, quantum devices, and RTD's</td>
<td>Final Exam</td>
<td></td>
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</tbody>
</table>

Advanced Communication Systems
Class location: TBA
Class Meeting time(s): TBA
Course level and # of credit hours: CSE 637 (3 credits)

Coordinator: Dr. Paul Cotae
Instructor: TBA
Office Hours: TBA

I. Course Description
This course covers basis functions, orthogonalization of signals, vector representation of signals, optimal detection in noise, matched filters, pulse shaping, intersymbol interference, maximum likelihood detection, channel cutoff rates, error probabilities, bandwidth, and power-limited signaling.

II. Course Goals, Objectives, Prerequisites, and Co-requisites

Goals:
Students understand theoretical concepts in communication systems.

Prerequisite: None
Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: (1) understanding fundamentals of communication systems; (2) identifying techniques used in communication.

Student Learning Outcomes:
By the end of the course, students will be able to:
1) Understand fundamentals in communication systems
2) Understand communication techniques

III. Course Requirements
   A. Course content
      • Required texts: TBA

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
Students are encouraged to check following resources to become successful on this course.
   ❖ Academic Support Center. “Here you may have a trained English major or English professional proofread your work. Visit Building 32, B-level.”
   ❖ Blackboard. “From http://udc.blackboard.com, you can review and complete assignments, view your grades, send messages to your professor or your classmates, access course content, print another syllabus, or read sample essays.”
   ❖ UDC Email. All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

VI. Assessment Procedures
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.

VII. Grades
Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
1) Mid-term exam: 30 (%) 
2) Final exam: 30 (%) 
3) Assignments: 20 (%) 
4) Attendance: 10 (%) 
5) Paper presentation: 10 (%) 

VIII. Expectations
Students are expected to knowing the necessary concepts in communication systems

IX. Academic Integrity
UDC standards on academic integrity (see UDC Academic Policies and Procedures Manual). As they apply, include industry or specialized accreditation standards.

X. Statement on ADA (Americans with Disabilities Act) Procedures
The University is committed to providing an educational environment that is accessible to all students. If any student requires assistance, support services, or verification of a disability, then he or she should please visit the Office of Services to Students with Disabilities.
### XI. Course Schedule (Tentative)

<table>
<thead>
<tr>
<th>Topics</th>
<th>Readings/other</th>
<th>Assessments</th>
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<tr>
<td>Week 1  Introduction</td>
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<tr>
<td>Week 2  Basis functions</td>
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<tr>
<td>Week 3  Orthogonalization of signals</td>
<td>Assignment</td>
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<tr>
<td>Week 4  Vector representation of signals</td>
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<tr>
<td>Week 5  Optimal detection in noise</td>
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<tr>
<td>Week 6 &amp; 7  Matched filters</td>
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<td>Mid-term Exam</td>
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<tr>
<td>Week 8  Pulse shaping</td>
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<td>Week 9  Intersymbol interference</td>
<td>Assignment</td>
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<tr>
<td>Week 10 Maximum likelihood detection</td>
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<td>Paper Presentation</td>
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<td>Week 11 Channel cutoff rates</td>
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<td>Week 12 &amp; 13 Error probabilities</td>
<td></td>
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<tr>
<td>Week 14 &amp; 15 Bandwidth &amp; power-limited signaling</td>
<td>Assignment</td>
<td></td>
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</tbody>
</table>

**Computational Engineering and Scientific Modeling**

Class location: TBA  
Class Meeting time(s): TBA  
Course level and # of credit hours: CSE 651 (3 credits)

Coordinator: Dr. Pawan Tyagi  
Instructor: TBA  
Office Hours: TBA

**I. Course Description**

This course covers computational modeling techniques including how to examine the features, types, uses, construction and simulation of models in management of decision making processes.

**II. Course Goals, Objectives, Prerequisites, and Co-requisites**

**Goals:**  
Students understand theoretical concepts in computational modeling.

**Prerequisite:** None  
**Course Credits:** 3 credits

**Learning Objectives:**  
Student learning objectives are as follows: (1) understanding computational modeling; (2) examining the basic principles in simulation and validation.

**Student Learning Outcomes:**  
By the end of the course, students will be able to:  
1) Understand fundamentals in computational modeling  
   Assessment: Assignments, Exams, Class project, and Paper presentation.
2) Identify different aspect of modeling techniques
   Assessment: Assignments, Exams, Class project, and Paper presentation.
3) Understand simulation and validation methods
   Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements

   A. Course content
      • Required texts: *Discrete-Event System Simulation, 5/E* by Jerry Banks, John S. Carson, II, Barry L. Nelson, David M. Nicol
        Publisher: Prentice Hall, 2010
        ISBN-10: 0136062121

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
Students are encouraged to check following resources to become successful on this course.
   - Academic Support Center, “Here you may have a trained English major or English professional proofread your work. Visit Building 32, B-level.”
   - Blackboard, “From [http://udc.blackboard.com](http://udc.blackboard.com), you can review and complete assignments, view your grades, send messages to your professor or your classmates, access course content, print another syllabus, or read sample essays.”
   - UDC Email. All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

VI. Assessment Procedures
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.

VII. Grades
   Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
   The grading system is as follows:
   1) Project: 20 (%)
   2) Mid-term exam: 20 (%)
   3) Final exam: 20 (%)
   4) Assignments: 20 (%)
   5) Attendance: 10 (%)
   6) Paper presentation: 10 (%)

VIII. Expectations
Students are expected to knowing the necessary concepts in computational modeling.

IX. Academic Integrity
UDC standards on academic integrity (see UDC Academic Policies and Procedures Manual). As they apply, include industry or specialized accreditation standards.

X. Statement on ADA (Americans with Disabilities Act) Procedures
   The University is committed to providing an educational environment that is accessible to all students. If any student requires assistance, support services, or verification of a disability, then he or she should please visit the Office of Services to Students with Disabilities.

XI. Course Schedule (Tentative)
### Systems Engineering Approach

- **Class location:** TBA  
- **Class Meeting time(s):** TBA  
- **Course level and # of credit hours:** CSE 652 (3 credits)

Coordinator: Dr. Stephen Arhin  
Instructor: TBA  
Office Hours: TBA

#### I. Course Description
This course covers engineering of complex hardware, software systems encompasses quantitative methods to understand vague problem statements, determine what a proposed product/system must do (functionality), generate measurable requirements, decide how to select the most appropriate solution design, integrate the hardware and software subsystems and test the finished product to verify it satisfies the documented requirements.

#### II. Course Goals, Objectives, Prerequisites, and Co-requisites

**Goals:**  
Students understand theoretical concepts in systems engineering.

**Prerequisite:** None  
**Course Credits:** 3 credits  

**Learning Objectives:**  
Student learning objectives are as follows: (1) understanding fundamentals of engineering systems; (2) identifying measurable requirements; (3) understanding how to integrate the hardware and software subsystems and test the finished product to verify it satisfies the documented requirements.
Student Learning Outcomes:
By the end of the course, students will be able to:
1) Understand fundamentals in engineering systems
   Assessment: Assignments, Exams, Class project, and Paper presentation.
2) Understand the integration of the hardware and software subsystems
   Assessment: Assignments, Exams, Class project, and Paper presentation

III. Course Requirements

   A. Course content
      • Required texts: Systems Engineering Guidebook: A Process for Developing Systems and Products

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
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   ❖ Blackboard. “From http://udc.blackboard.com, you can review and complete assignments, view your grades, send messages to your professor or your classmates, access course content, print another syllabus, or read sample essays.”
   ❖ UDC Email. All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic use and will be the address that instructors use to communicate with students from inside Blackboard.

VI. Assessment Procedures
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam will take place to measure their gained knowledge on the covered topics.

VII. Grades
Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
1) Mid-term exam: 30 (%)  
2) Final exam: 30 (%)  
3) Assignments: 20 (%)  
4) Attendance: 10 (%)  
5) Paper presentation: 10 (%)

VIII. Expectations
Students are expected to knowing the necessary concepts in System Engineering Approach

IX. Academic Integrity
UDC standards on academic integrity (see UDC Academic Policies and Procedures Manual). As they apply, include industry or specialized accreditation standards.

X. Statement on ADA (Americans with Disabilities Act) Procedures
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XI. Course Schedule (Tentative)


<table>
<thead>
<tr>
<th>Week 1</th>
<th>Introduction to Systems Engineering</th>
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</thead>
<tbody>
<tr>
<td>Week 2</td>
<td>Systems Concepts</td>
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<tr>
<td>Week 3</td>
<td>Process Concepts</td>
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<tr>
<td>Week 4</td>
<td>Systems Engineering Process Overview I</td>
</tr>
<tr>
<td>Week 5 &amp; 6</td>
<td>Systems Engineering Process Overview II</td>
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<tr>
<td>Week 7 &amp; 8</td>
<td>SE Process Tailoring</td>
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<tr>
<td>Week 9</td>
<td>SE Management Subprocess</td>
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<tr>
<td>Week 10 ~ 12</td>
<td>SE Requirements and Arch. Definition Subprocess</td>
</tr>
<tr>
<td>Week 13 ~ 15</td>
<td>SE System Integration and Verification Subprocess</td>
</tr>
</tbody>
</table>

### Engineering Systems: Modeling & Simulation

**Class location:** TBA  
**Class Meeting time(s):** TBA  
**Course level and # of credit hours:** CSE 653 (3 credits)

Coordinator: Dr. Stephen Arhin  
Instructor: TBA  
Office Hours: TBA

**I. Course Description**

This course will present principles of computational modeling and simulation of systems. General topics covered include: parametric and non-parametric modeling; system simulation; parameter estimation, linear regression and least squares; model structure and model validation through simulation; and, numerical issues in systems theory. Techniques covered include methods from numerical linear algebra, nonlinear programming and Monte Carlo simulation, with applications to general engineering systems. Modeling and simulation software is utilized in this course.

**II. Course Goals, Objectives, Prerequisites, and Co-requisites**

**Goals:**  
Students understand theoretical concepts in computational modeling and simulation of systems.

**Prerequisite:** None  
**Course Credits:** 3 credits

**Learning Objectives:**  
Student learning objectives are as follows: (1) understanding fundamentals of computational modeling and simulation of systems; (2) identifying modeling and simulation techniques; (3) Exploring systems engineering processes.

**Student Learning Outcomes:**  
By the end of the course, students will be able to:  
1) Understand fundamentals in computational modeling  
2) Understand simulation techniques  
3) Examine foundational technologies and simulation design issues

III. Course Requirements

   A. Course content
   • Required texts: TBA

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are
strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge
traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving,
and reasoning over simple memorization.

V. Student Resources
Students are encouraged to check following resources to become successful on this course.
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     proofread your work. Visit Building 32, B-level.”
    Blackboard. “From http://udc.blackboard.com, you can review and complete assignments, view your
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    UDC Email. All students must use a UDC e-mail account. UDC e-mail is the only e-mail for academic
     use and will be the address that instructors use to communicate with students from inside
     Blackboard.

VI. Assessment Procedures
All students need to finish all given assignments in a timely manner. In order to get feedbacks from the
instructor, all students are encouraged to ask questions in the classroom. Mid-term exam, and Final exam
will take place to measure their gained knowledge on the covered topics.

VII. Grades
Grade will be assigned on the scale: 90-100= A, 80-90=B, 70-80=C; 60-70=D; Below 60=F
The grading system is as follows:
   1) Project: 20 (%)
   2) Mid-term exam: 20 (%)
   3) Final exam: 20 (%)
   4) Assignments: 20 (%)
   5) Attendance: 10 (%)
   6) Paper presentation: 10 (%)

VIII. Expectations
Students are expected to knowing the necessary concepts in modeling and simulation

IX. Academic Integrity
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include industry or specialized accreditation standards.

X. Statement on ADA (Americans with Disabilities Act) Procedures
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XI. Course Schedule (Tentative)

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<thead>
<tr>
<th>Topics</th>
<th>Readings/other Assignments</th>
<th>Assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modeling &amp; Simulation Development Process</td>
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</tbody>
</table>
I. Course Description
This course covers planning, design and management of multi-component water resources systems. After a review of the use and nature of water resources systems, topics studied in detail are: water resource economics; methodology of design; systems analysis; systems design and decision making; applied mathematical programming; probabilistic models and water quality.

II. Course Goals, Objectives, Prerequisites, and Co-requisites

Goals:
Students understand water resources systems and analytical techniques.

Prerequisite: None
Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: (1) understanding systematic approaches to the mathematical modeling of various water resources issues; (2) understanding of simulation, optimization, multi-criterion-decision-making, as well as engineering economics and time series analysis.

Student Learning Outcomes:
By the end of the course, students will be able to:

1) Understand fundamentals in water resources systems
   Assessment: Assignments, Exams, Class project, and Paper presentation.
2) Understand for prioritizing and addressing critical issues such as flood control, power generation, and water quality management
   Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements

   A. Course content
      • Required texts: Water Resources Systems Analysis by Mohammad Karamouz, Ferenc Szidarovszky, Banafsheh Zahraie
        Publisher: CRC Press; 1 edition (June 27, 2003)
        ISBN-10: 1566706424

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
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3) Final exam: 20 (%)
4) Assignments: 20 (%)
5) Attendance: 10 (%)
6) Paper presentation: 10 (%)

VIII. Expectations
Students are expected to knowing the necessary concepts in water resources systems

IX. Academic Integrity
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X. Statement on ADA (Americans with Disabilities Act) Procedures
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XI. Course Schedule (Tentative)
Water Resources System Modeling

Class location: TBA
Class Meeting time(s): TBA
Course level and # of credit hours: CSE 655 (3 credits)

Coordinator: Dr. Pradeep Behera
Instructor: TBA
Office Hours: TBA

I. Course Description
Water resources systems are physically complex and the solution of appropriate mathematical models is computationally demanding. This course considers physical processes in water resource systems, their mathematical representation and numerical solutions. This course covers meteorologic data analysis, deterministic and stochastic modeling techniques; Flood control: structural and nonstructural alternatives and Urban drainage and runoff control, risk analysis, economics and decision making.

II. Course Goals, Objectives, Prerequisites, and Co-requisites

Goals:
Students understand theoretical concepts in visual environments (VE).

Prerequisite: None
Course Credits: 3 credits

Learning Objectives:
Student learning objectives are as follows: (1) understanding the current status of water resources utilization; (2) examining advantages and disadvantages of systems techniques in water resources; (3) identifying statistical tools for data analysis.
Student Learning Outcomes:
By the end of the course, students will be able to:

1) Understand fundamentals in water resources systems
   Assessment: Assignments, Exams, Class project, and Paper presentation.

2) Understand approaches of analysis water resources
   Assessment: Assignments, Exams, Class project, and Paper presentation.

3) Identify emerging techniques such as Remote Sensing, GIS, Artificial Neural Networks, and Expert Systems
   Assessment: Assignments, Exams, Class project, and Paper presentation.

III. Course Requirements

   A. Course content
      • Required texts: Water Resources Systems Planning and Management (Developments in Water Science) by Sharad K. Jain, V.P. Singh
        Publisher: Elsevier Science; 1 edition (September 26, 2003)
        ISBN-10: 0444514295

IV. Format and Procedures
This course will employ lectures, discussions, projects, assignments, and examinations. Students are strongly encouraged to participate extensively, ask questions, express ideas and opinions, and challenge traditional ideas and concepts. Instructional methodologies will emphasize critical thinking, problem solving, and reasoning over simple memorization.

V. Student Resources
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VII. Grades
Grade will be assigned on the scale: 90-100= A, 80-90= B, 70-80= C; 60-70= D; Below 60= F
The grading system is as follows:
1) Project: 20 (%)
2) Mid-term exam: 20 (%)
3) Final exam: 20 (%)
4) Assignments: 20 (%)
5) Attendance: 10 (%)
6) Paper presentation: 10 (%)

VIII. Expectations
Students are expected to knowing the necessary concepts in water resources systems

IX. Academic Integrity
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X. Statement on ADA (Americans with Disabilities Act) Procedures
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**XI. Course Schedule (Tentative)**

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<td>Water Resources Planning and Management: An Overview</td>
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<td>Water Resource Systems Modeling: Its Role in Planning and Management</td>
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<td>Week 3</td>
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<td>Modeling Methods for Evaluating Alternatives</td>
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<td>Week 4</td>
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<td>Optimization Methods</td>
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<td>Week 6 &amp; 7</td>
<td>Mid-term Exam</td>
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<td>Data-Based Models</td>
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<td>Week 8</td>
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<td>Concepts in Probability, Statistics and Stochastic Modeling</td>
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<td>Week 9</td>
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<td>Modeling Uncertainty</td>
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<td>Model Sensitivity and Uncertainty Analysis</td>
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<td>Week 11</td>
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<td>River Basin Planning Models</td>
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<td>Week 13</td>
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<td>Water Quality Modeling and Prediction</td>
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<td>Week 14 &amp; 15</td>
<td>Project Presentation / Final Exam</td>
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<tr>
<td>Urban Water Systems</td>
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