COMPUTER SCIENCE

The discipline of computer science pertains to the study and design of computer systems, hardware and software, computing techniques, and underlying theory. Our program provides a student with a broad technical background in computer science. It is a flexible program providing breadth and permitting a student to develop strengths in selected areas within computer science, as well as in related areas such as electrical engineering, mathematics, or business, depending on a student's interests. Technical electives available in the Computer Science major span courses in a broad spectrum of areas such as Networks, Computer Security, Artificial Intelligence, and Database Systems.

Mission Statement

The Department of Electrical Engineering and Computer Science is committed to outstanding undergraduate and graduate education, distinguished research programs, and strong service to our students, professional and technical societies, and the community.

Programs

- Applied Computing, BS (http://catalog.uwm.edu/engineering-applied-science/computer-science/applied-computing-bs)
- Applied Math and Computer Science, BS (College of Engineering and Applied Science, Department of Computer Science) (http://catalog.uwm.edu/engineering-applied-science/computer-science/applied-math-computer-science-bs)
- Computer Science, BS (http://catalog.uwm.edu/engineering-applied-science/computer-science-computer-science-bs)
- Computer Science, Minor (http://catalog.uwm.edu/engineering-applied-science/computer-science/computer-science-minor)
- Computer Science, MS (http://catalog.uwm.edu/engineering-applied-science/computer-science/computer-science-ms)
- Web Development, Undergraduate Certificate (http://catalog.uwm.edu/engineering-applied-science/computer-science/web-development-undergraduate-certificate)

Applied Computing Courses

APC 300 Programming 1
3 cr. Undergraduate.
Introduction to history of computing, fundamental computer concepts and structured programming techniques.
Prerequisites: none.
Last Taught: Spring 2018, Fall 2017.
Current Offerings: http://uwm.edu/schedule

APC 310 Math for Computer Science
3 cr. Undergraduate.
Important foundational topics in computer science.
Prerequisites: none.
Last Taught: Spring 2018.
Current Offerings: http://uwm.edu/schedule

APC 320 Introduction to Business
3 cr. Undergraduate.
Introduction to the major functional areas of business including the roles of accounting, finance, human resources, marketing, information systems, and operations in the organization.
Prerequisites: none.
Last Taught: Spring 2018, Fall 2017.
Current Offerings: http://uwm.edu/schedule

APC 330 Technical and Professional Communication
3 cr. Undergraduate.
Technical and professional communication skills and techniques. Practice in creating effective memos and reports, developing technical material, delivering presentations, and developing communication within teams.
Prerequisites: none.
Last Taught: Spring 2018, Fall 2017.
Current Offerings: http://uwm.edu/schedule

APC 340 Legal and Ethical Responsibilities of the IT Professional
3 cr. Undergraduate.
Legal, regulatory, ethical and compliance issues associated with developing software and using information systems in an organization.
Prerequisites: admis to BS-APC prog; APC 320(P).
Last Taught: Spring 2018.
Current Offerings: http://uwm.edu/schedule

APC 350 Programming 2
3 cr. Undergraduate.
Continuation of fundamental computer concepts and Programming.
Prerequisites: APC 300(P); 310(P).
Current Offerings: http://uwm.edu/schedule

APC 360 Database Management 1
3 cr. Undergraduate.
Design and implementation of relational database management systems to support computer-based information systems.
Prerequisites: admis to BS-APC prog; APC 300(P); 310(P).
Current Offerings: http://uwm.edu/schedule

APC 370 System Analysis and Design
3 cr. Undergraduate.
The five phases of Systems Development Life Cycle: scope definition, problem analysis, requirements analysis, logical design and decision analysis.
Prerequisites: admis to BS-APC prog; APC 300(P); 320(P); 330(P).
Current Offerings: http://uwm.edu/schedule

APC 380 Project Management Techniques
3 cr. Undergraduate.
An introduction to project management techniques including project selection and life cycle, stakeholder/scopequality/procurement management, budget control, scheduling, risk identification.
Prerequisites: admis to BS-APC prog; APC 370(P).
Current Offerings: http://uwm.edu/schedule

APC 390 Object Oriented Programming
3 cr. Undergraduate.
An introduction to Object-Oriented Programming techniques using the Java programming language.
Prerequisites: APC 350(P)
Current Offerings: http://uwm.edu/schedule
APC 400 Applied Communication Networks
3 cr. Undergraduate.
Fundamental concepts in the design, configuration, and problem solving of computer networks.
Prerequisites: admis to BS-APC prog; APC 350(P).
Current Offerings: http://uwm.edu/schedule

APC 410 Database Management 2
3 cr. Undergraduate.
Architecture and use-cases of non-relational (NoSQL) based on four types of databases including document, Graph, Key-value, and wide column store.
Prerequisites: admis to BS-APC prog; APC 360(P).
Current Offerings: http://uwm.edu/schedule

APC 420 Computer Security 1
3 cr. Undergraduate.
Security and risk management, security engineering, identity and access management, and security operations.
Prerequisites: APC 350(P).
Current Offerings: http://uwm.edu/schedule

APC 430 Applied Data Structures and Algorithms
3 cr. Undergraduate.
Concepts and the application of data structures and algorithms.
Prerequisites: APC 390(P).
Current Offerings: http://uwm.edu/schedule

APC 440 Web Development
3 cr. Undergraduate.
Creating advanced and interactive websites web sites using technologies like HTML 5, CSS, JavaScript, Bootstrap, XML, web services, and database integration within the ASP.Net platform.
Prerequisites: APC 360(P); 400(P).
Current Offerings: http://uwm.edu/schedule

APC 450 Operating Systems Theory and Practice
3 cr. Undergraduate.
An introduction to important operating systems concepts such as processes, threads, scheduling, concurrency control and memory management.
Prerequisites: admis to BS-APC prog; APC 430(C).
Current Offerings: http://uwm.edu/schedule

APC 460 Software Engineering
3 cr. Undergraduate.
Basic software development methodologies and tools, including the waterfall, iterative, and agile approaches.
Prerequisites: APC 370(P); 390(P).
Current Offerings: http://uwm.edu/schedule

APC 470 IS Strategy and Management
3 cr. Undergraduate.
Organizational/IS strategy using a capability maturity model for topics such as budgeting, acquisition, service/change/personnel management.
Prerequisites: admis to BS-APC prog; APC 380(P); 460(C).
Current Offerings: http://uwm.edu/schedule

APC 480 Computer Security 2
3 cr. Undergraduate.
Communication and network security, security assessment and testing, software development security, and asset security.
Prerequisites: APC 360(P); 400(P); 420(P); 450(P).
Current Offerings: http://uwm.edu/schedule

APC 490 Capstone Project Preparation
1 cr. Undergraduate.
Student capstone project and creation of initial plan with specific deliverables identified.
Prerequisites: admis to BS-APC prog; APC 460(C).
Current Offerings: http://uwm.edu/schedule

APC 495 Capstone Project
3 cr. Undergraduate.
Development, management and delivery of an applied computer science project for a client, including communication of project requirements and status to a non-technical audience.
Prerequisites: admis to BS-APC prog; APC 490(P).
Current Offerings: http://uwm.edu/schedule

COMPSCI 101 Introduction to PC Application Software
3 cr. Undergraduate.
Introduction to software applications of the personal computer, including word processing, desktop publishing, spreadsheets, and databases.
Prerequisites: none.
Course Rules: Not open to CompSci students for cr.
Last Taught: Fall 2017, Fall 2016, Fall 2015, Fall 2014.
Current Offerings: http://uwm.edu/schedule

COMPSCI 111 Introduction to Unix
1 cr. Undergraduate.
Introduction to basic user skills for Unix operating systems. File system structure and access control. Basic user commands. Text editing. Internet utilities.
Prerequisites: none.
Last Taught: Fall 2010, Fall 2009, Spring 2009, Fall 2008.
Current Offerings: http://uwm.edu/schedule

COMPSCI 112 Introduction to the Internet and the World Wide Web
3 cr. Undergraduate.
Survey of the technologies that enable common Internet applications and their security/privacy issues. Topics include HTTP, TCP/IP, DNS, email protcols, search engines, encryption, digital signatures and malware.
Prerequisites: none.
Last Taught: Fall 2012, Fall 2011, Fall 2009, Spring 2009.
Current Offerings: http://uwm.edu/schedule

COMPSCI 113 Introduction to Web Document Production
3 cr. Undergraduate.
An introduction to the computer languages used in World Wide Web documents. Design principles; techniques for form processing and inclusion of multimedia content.
Prerequisites: none.
Last Taught: Spring 2018, Fall 2014, Fall 2013, Spring 2013.
Current Offerings: http://uwm.edu/schedule
COMPSCI 132 Introduction to Computers and Programming  
3 cr. Undergraduate.  
How computers work; communicating with computers; introductory programming in a high-level language; elementary problem solving.  
Prerequisites: Level 30 on Math Placement Test or Math 105(C).  
Current Offerings: http://uwm.edu/schedule

COMPSCI 140 Introduction to the Computer Science Laboratories  
1 cr. Undergraduate.  
Survey of the programming tools available in the Computer Science laboratory environment.  
Prerequisites: CompSci 201(C)  
Current Offerings: http://uwm.edu/schedule

COMPSCI 150 Survey of Computer Science  
3 cr. Undergraduate.  
A survey of computer science. Topics include data storage and manipulation, operating systems and networks, algorithms and data structures, programming languages, artificial intelligence, and computability.  
Prerequisites: none.  
Course Rules: Counts as repeat of CompSci 299 with similar topic.  
General Education Requirements: NS  
Current Offerings: http://uwm.edu/schedule

COMPSCI 151 Introduction to Scientific Programming in Fortran  
3 cr. Undergraduate.  
Design and implementation of computer programs in fortran; stress will be placed on applications to different fields of science and engineering.  
Prerequisites: Math 231(C) or 226(C).  
Current Offerings: http://uwm.edu/schedule

COMPSCI 160 Introduction to Computer Game Design and Programming  
3 cr. Undergraduate.  
An overview of computer game history; design concepts and considerations; implementation using a modern software development platform, such as GameMaker.  
Prerequisites: none.  
Current Offerings: http://uwm.edu/schedule

COMPSCI 202 Introductory Programming Using Python  
3 cr. Undergraduate.  
Programming in Python. Basic control structures including recursion. Basic and library data types. Problem solving with objects. Writing classes. Basic software development skills.  
Prerequisites: Counts as repeat of CompSci 290 with similar topic. Pre-req: Level 30 on Math Placement Test, or a grade of C or better in Math 105 or 108.  
Current Offerings: http://uwm.edu/schedule

COMPSCI 240 Introduction to Engineering Programming  
3 cr. Undergraduate.  
Problem solving with structured programming techniques using an engineering oriented programming language, such as MATLAB, including control structures, functions, arrays and matrices.  
Prerequisites: Math Placement Level 40 or Math 116(P).  
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.  
Current Offerings: http://uwm.edu/schedule

COMPSCI 241 C Programming for Embedded Systems  
3 cr. Undergraduate.  
Problem solving with structured programming techniques, using the C programming language; Topics include using Arrays & Pointers; Memory Management; Unions, Structures; Files & Low Level IO; Process’s & Inter-process Communication.  
Prerequisites: C or better in CompSci 240(P)  
Last Taught: Spring 2018.  
Current Offerings: http://uwm.edu/schedule

COMPSCI 250 Introductory Computer Programming  
3 cr. Undergraduate.  
Problem solving with structured programming techniques using an object-oriented programming language, including control structures, functions, arrays, vectors, and pre-defined objects.  
Prerequisites: Math Placement level 30.  
Current Offerings: http://uwm.edu/schedule

COMPSCI 251 Intermediate Computer Programming  
3 cr. Undergraduate.  
Problem solving with objects. Writing classes. Use of standard data structures. Basic software development skills including text analysis tools, debugging, and configuration management.  
Prerequisites: Math Placement Level 40 or Math 116(P) or Math 211(P); C or better in CompSci 250(201)(P).  
Current Offerings: http://uwm.edu/schedule

COMPSCI 290 Introductory Topics in Computer Science: Language Programming  
1-3 cr. Undergraduate.  
Lectures on new introductory material in computer science. Variable-content course.  
Prerequisites: specific courses dependent on topic.  
Course Rules: May be retaken to max of 6 cr w/chg in topic.  
Current Offerings: http://uwm.edu/schedule

COMPSCI 315 Introduction to Computer Organization and Assembly Language Programming  
3 cr. Undergraduate.  
Introduction to number systems, arithmetic and Boolean operations. Digital computer organization. A specific computer system, assembly and machine language programming.  
Prerequisites: Math Placement Level 40 or Math 116(P) or Math 211(P); CompSci 250(201)(P).  
Current Offerings: http://uwm.edu/schedule

COMPSCI 317 Discrete Information Structures  
3 cr. Undergraduate.  
Introductory discussion of logic, proof techniques, sets, functions, relations, combinatorics, probability, and graphs.  
Prerequisites: Math Placement Level 40; grade of C or better in CompSci 250(P).  
Current Offerings: http://uwm.edu/schedule
COMPSCI 318 Topics in Discrete Mathematics
3 cr. Undergraduate.
Number theory topics related to cryptography; discrete structures including graphs, partial orders, Latin squares and block designs; advanced counting techniques.
Prerequisites: a grade of C or better in CompSci 317(P) or Math 341(P).
Course Rules: Jointly offered with & count as repeat of Math 318.
Current Offerings: http://uwm.edu/schedule

COMPSCI 337 System Programming
3 cr. Undergraduate.
Introduction to the application programmer interface for a modern operating system. Overview of mechanisms for object oriented programming and memory management
Prerequisites: C or better in CompSci 251(P)
Current Offerings: http://uwm.edu/schedule

COMPSCI 351 Data Structures and Algorithms
3 cr. Undergraduate.
Programming in a structured, high-level, object-oriented language. Implementation of data structures and algorithms and their application.
Prerequisites: Math Placement Level 40 or Math 116(P) or 211(P); C or better in CompSci 251(P).
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.
Current Offerings: http://uwm.edu/schedule

COMPSCI 361 Introduction to Software Engineering
3 cr. Undergraduate.
Introduction to core topics of software engineering including requirements analysis, object-oriented design, testing, and project management. Overview of ethical and social issues in computing.
Prerequisites: C or better in CompSci 351(P), satisfaction of GER English Composition competency req.
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.
Current Offerings: http://uwm.edu/schedule

COMPSCI 395 Social, Professional, and Ethical Issues
3 cr. Undergraduate.
The social, professional and ethical issues that arise in the context of professional computing.
Prerequisites: soph st or cons instr.
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.
Current Offerings: http://uwm.edu/schedule

COMPSCI 417 Introduction to the Theory of Computation
3 cr. Undergraduate/Graduate.
Introduction to formal languages, grammars and automata. Finite state automata, pushdown automata, turing machines. Regular, context-free recursive and recursively enumerable languages. Decidability.
Prerequisites: jr st; grade of C or better in CompSci 317(P) or grade of C or better in Math 341(P).
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.
Current Offerings: http://uwm.edu/schedule

COMPSCI 422 Introduction to Artificial Intelligence
3 cr. Undergraduate/Graduate.
Introduction to core techniques and broad survey of AI. Topics include: Lisp, heuristic search, knowledge representation, planning, vision, learning.
Prerequisites: jr st; C or better in CompSci 317(217)(P); & CompSci351(252)(P).
Current Offerings: http://uwm.edu/schedule

COMPSCI 423 Introduction to Natural Language Processing
3 cr. Undergraduate/Graduate.
Introduction to natural language processing programs and an overview of the field. Topics include syntactic frameworks, parsing, semantics, interpretation, and applications.
Prerequisites: jr st; C or better in CompSci 351(P).
Last Taught: Fall 2017, Fall 2015, Fall 2013, Spring 2012.
Current Offerings: http://uwm.edu/schedule

COMPSCI 425 Introduction to Data Mining
3 cr. Undergraduate/Graduate.
Algorithms for uncovering useful information from data. Topics include data exploration, association rules, clustering, supervised learning, and mining structured data (e.g., sequences or graphs).
Prerequisites: jr st; CompSci 251(P), Math 221(P) or Math 232(P)
Course Rules: Counts as repeat of CompSci 657 with same topic.
Current Offerings: http://uwm.edu/schedule

COMPSCI 427 Introduction to Information Retrieval
3 cr. Undergraduate/Graduate.
Introduction to text retrieval, text classification and their biomedical applications; topics include: indexing, query processing, and document retrieval methods.
Prerequisites: jr st; CompSci 351(P) or HCA 442(P).
Course Rules: Jointly offered with & counts as repeat of HCA 444, CompSci 744, & HCA 744.
Last Taught: Spring 2015, Spring 2013, Fall 2010, Fall 2007.
Current Offerings: http://uwm.edu/schedule

COMPSCI 431 Programming Languages Concepts
3 cr. Undergraduate/Graduate.
Examination of abstract features of languages. Study of syntactic and semantic models; design and programming in procedural, object-oriented, functional and logical languages. Implementation methods.
Prerequisites: jr st; grade of C or better in CompSci 351(252)(P).
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.
Current Offerings: http://uwm.edu/schedule

COMPSCI 433 Introduction to Database Systems
3 cr. Undergraduate/Graduate.
Examination and analysis of state-of-the-art database systems and their applications. Introduction to core techniques and broad survey of DBMS. Topics include: design and implementation of database systems, transaction processing, query languages and optimizer, security and recovery, data warehousing.
Prerequisites: jr st; grade of C or better in CompSci 317(217)(P); & CompSci351(252)(P).
Current Offerings: http://uwm.edu/schedule

COMPSCI 444 Introduction to Data Mining
3 cr. Undergraduate/Graduate.
Algorithms for uncovering useful information from data. Topics include data exploration, association rules, clustering, supervised learning, and mining structured data (e.g., sequences or graphs).
Prerequisites: jr st; CompSci 251(P), Math 221(P) or Math 232(P)
Course Rules: Counts as repeat of CompSci 657 with same topic.
Current Offerings: http://uwm.edu/schedule

COMPSCI 445 Introduction to Text Retrieval and Its Applications in Biomedicine
3 cr. Undergraduate/Graduate.
Introduction to text retrieval, text classification and their biomedical applications; topics include: indexing, query processing, and document retrieval methods.
Prerequisites: jr st; CompSci 351(P) or HCA 442(P).
Course Rules: Jointly offered with & counts as repeat of HCA 444, CompSci 744, & HCA 744.
Last Taught: Spring 2015, Spring 2013, Fall 2010, Fall 2007.
Current Offerings: http://uwm.edu/schedule

COMPSCI 458 Computer Architecture
3 cr. Undergraduate/Graduate.
Processor organization and design; memory organization; microprogramming and control unit design; I-O organization; case studies of selected machine architectures.
Prerequisites: jr st; ElecEng 354(P), C or better in CompSci 315(P) or ElecEng 367(P).
Course Rules: Jointly offered with & counts as repeat of ElecEng 458.
Current Offerings: http://uwm.edu/schedule
COMPSCI 459 Fundamentals of Computer Graphics
3 cr. Undergraduate/Graduate.
Scan-line algorithms, object representation, homogeneous coordinates, geometric transformations, viewing curves, illumination models, interactive input methods, texture mapping.
Prerequisites: jr st; Math 232(P); CompSci 251(P).
Last Taught: Fall 2017, Fall 2016, Fall 2015, Fall 2014.
Current Offerings: http://uwm.edu/schedule

COMPSCI 469 Introduction to Computer Security
3 cr. Undergraduate/Graduate.
Privacy and authenticity of data and programs, communication, operating systems, network and database security, computer viruses, cryptography, private and public key cryptosystems, protocols.
Prerequisites: jr st; C or better in both CompSci 317(217)(P) & 251(P).
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.
Current Offerings: http://uwm.edu/schedule

COMPSCI 481 Server-side Internet Programming
3 cr. Undergraduate/Graduate.
Introduces students to the concept of server-side programming and web applications development. Topics include dynamic web site development, session management, security, and relational databases.
Prerequisites: jr st; one of CompSci 113 (P), InfoSt 320 (P), or Art 324 (P); C or better in CompSci 202(P) or CompSt 702(P)
Last Taught: Spring 2018, Fall 2016, Fall 2015, Fall 2014.
Current Offerings: http://uwm.edu/schedule

COMPSCI 482 Rich Internet Applications
3 cr. Undergraduate/Graduate.
Prerequisites: jr st; CompSci 361(P) or 481(P).
Current Offerings: http://uwm.edu/schedule

COMPSCI 511 Symbolic Logic
3 cr. Undergraduate/Graduate.
First-order predicate calculus; formal properties of theoretical systems; chief results of modern mathematical logic; advanced topics such as completeness and computability.
Prerequisites: jr st & either Philos 212(P) or 6 cr Math at the 300-level or above; or grad st.
Course Rules: CompSci 511, Math 511, & Philos 511 are jointly offered & count as repeat of each other.
Last Taught: Spring 2017, Fall 2015, Fall 1989, Fall 1988.
Current Offerings: http://uwm.edu/schedule

COMPSCI 520 Computer Networks
3 cr. Undergraduate/Graduate.
Layered network architecture, protocols, data transmission, local area networks, multiplexing and switching, routing flow and congestion control, internetworking, wireless networking, network reliability and security.
Prerequisites: jr st; CompSci 315(215)(P) or CompSci 458(P) or ElecEng 367(P).
Current Offerings: http://uwm.edu/schedule

COMPSCI 522 Computer Game Design
3 cr. Undergraduate/Graduate.
Design of rules, environments, rewards, and punishments, Game metrics, Including artificial intelligence in games, Puzzle generation, Automatic design, Humanness test, Influence maps, Diversity, Unpredictability.
Prerequisites: jr st; grade of C or better in CompSci 317(P).
Course Rules: Counts as repeat of CompSci 657 with similar topic.
Current Offerings: http://uwm.edu/schedule

COMPSCI 530 Computer Networks Laboratory
3 cr. Undergraduate/Graduate.
Prerequisites: jr st; CompSci 520(P).
Last Taught: Spring 2017, Spring 2016, Fall 2015, Spring 2015.
Current Offerings: http://uwm.edu/schedule

COMPSCI 535 Algorithm Design and Analysis
3 cr. Undergraduate/Graduate.
Introduction to abstract data structures, analysis of time and space requirements of numerical and non-numerical algorithms methods for data manipulation.
Prerequisites: jr st; Math 211(P), 213(P), 221(P) or 231(P); C or better in both CompSci 317(P) & 351(P).
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.
Current Offerings: http://uwm.edu/schedule

COMPSCI 536 Software Engineering
3 cr. Undergraduate/Graduate.
Software engineering, the software life cycle, qualities of software; design, specification and verification of software, programming environments and tools, object oriented programming.
Prerequisites: jr st; grade of C or better in CompSci 251(P).
Last Taught: Spring 2012, Fall 2011, Summer 2011, Spring 2011.
Current Offerings: http://uwm.edu/schedule

COMPSCI 537 Introduction to Operating Systems
3 cr. Undergraduate/Graduate.
Process management including process creation, switching, multithreading, scheduling, communication and concurrency control; memory management including paging, segmentation and virtual memory; systems programming.
Prerequisites: jr st; CompSci 458(C) or ElecEng 458(C); CompSci 337(P).
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.
Current Offerings: http://uwm.edu/schedule

COMPSCI 545 FPGA Embedded CPUs & Firmware Development
3 cr. Undergraduate/Graduate.
Use of modern embedded system central processor units (CPUs) with integrated field-programmable gate arrays (FPGAs). Design and implementation of firmware for these devices.
Prerequisites: jr st; ElecEng 367(P) & 457(P).
Course Rules: Jointly offered with & counts as repeat of ElecEng 545.
Last Taught: Fall 2014.
Current Offerings: http://uwm.edu/schedule
COMPSCI 547 User-Centered Interaction Design
3 cr. Undergraduate/Graduate.
Introduction of human-computer interaction theories and design processes. Emphasis is on applied user experience (UX) design.
Prerequisites: sr st.
Course Rules: Jointly offered with & counts as repeat of InfoSt 547.
Current Offerings: http://uwm.edu/schedule

COMPSCI 552 Advanced Object-Oriented Programming
3 cr. Undergraduate/Graduate.
An advanced course in object-oriented programming. Abstraction; single and multiple inheritance; dynamic binding of functions; polymorphic types and operators; survey of object-oriented techniques.
Prerequisites: jr st; CompSci 351(P) & 361(P).
Last Taught: Fall 2016, Fall 2014, Fall 2012, Fall 2009.
Current Offerings: http://uwm.edu/schedule

COMPSCI 555 Compiler Implementation Laboratory
3 cr. Undergraduate/Graduate.
Implementation of compiler phases: scanner, parser, semantic analysis; code generation and optimization.
Prerequisites: Prereq. jr st, CompSci 431(P); 654(C) or 754(C).
Current Offerings: http://uwm.edu/schedule

COMPSCI 557 Introduction to Database Systems
3 cr. Undergraduate/Graduate.
Prerequisites: jr st; CompSci 315(215)(P) & 251(P) or equiv.
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.
Current Offerings: http://uwm.edu/schedule

COMPSCI 565 Compiler Implementation Laboratory
3 cr. Undergraduate/Graduate.
Implementation of compiler phases: scanner, parser, semantic analysis; code generation and optimization.
Prerequisites: Prereq. jr st, CompSci 431(P); 654(C) or 754(C).
Current Offerings: http://uwm.edu/schedule

COMPSCI 577 Independent Study
1-3 cr. Undergraduate/Graduate.
Lectures on recent advances in computer science. Specific credits and any additional prerequisites will be announced in Schedule of Classes whenever course is offered.
Prerequisites: jr st.
Course Rules: May be retaken w/chg in topic to 9 cr max.
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.
Current Offerings: http://uwm.edu/schedule

COMPSCI 558 Topics in Applied Computing:
1-4 cr. Undergraduate.
Lectures on recent advances in applied computing. Specific credits and any additional prerequisites will be announced in Schedule of Classes whenever course is offered.
Prerequisites: jr st.
Course Rules: May be retaken w/chg in topic.
Current Offerings: http://uwm.edu/schedule

COMPSCI 595 Capstone Project
4 cr. Undergraduate.
Students will integrate their knowledge of the undergraduate computer science curriculum by implementing a significant computer science team project.
Prerequisites: sr st, CompSci 351 (P), CompSci 361 (P), and credit in at least 6 credits of 400 or higher CompSci courses.
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.
Current Offerings: http://uwm.edu/schedule

COMPSCI 599 Senior Thesis
3 cr. Undergraduate.
Independent scholarly research in Computer Science supervised by a faculty member.
Prerequisites: sr st & cons instr.
Last Taught: Spring 2018, Summer 2014.
Current Offerings: http://uwm.edu/schedule

COMPSCI 654 Introduction to Compilers
3 cr. Undergraduate.
Fundamentals of compiler construction for modern programming languages. Syntax analysis, table organization, storage administration, semantic routines and code generation
Prerequisites: jr st; CompSci 431(P), 655(C).
Current Offerings: http://uwm.edu/schedule

COMPSCI 655 Compiler Implementation Laboratory
3 cr. Undergraduate/Graduate.
Implementation of compiler phases: scanner, parser, semantic analysis; code generation and optimization.
Prerequisites: Prereq. jr st, CompSci 431(P); 654(C) or 754(C).
Current Offerings: http://uwm.edu/schedule

COMPSCI 657 Topics in Computer Science:
1-4 cr. Undergraduate/Graduate.
Lectures on recent advances in computer science. Specific credits and any additional prerequisites will be announced in Schedule of Classes whenever course is offered.
Prerequisites: jr st.
Course Rules: May be retaken w/chg in topic to 9 cr max.
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.
Current Offerings: http://uwm.edu/schedule

COMPSCI 658 Topics in Applied Computing:
1-4 cr. Undergraduate.
Lectures on recent advances in applied computing. Specific credits and any additional prerequisites will be announced in Schedule of Classes whenever course is offered.
Prerequisites: jr st.
Course Rules: May be retaken w/chg in topic.
Current Offerings: http://uwm.edu/schedule

COMPSCI 699 Independent Study
1-3 cr. Undergraduate/Graduate.
Prerequisites: jr st; cons instr.
Course Rules: May be retaken to max of 6 cr by undergraduates.
Current Offerings: http://uwm.edu/schedule

COMPSCI 700 CEAS Graduate Seminar
1-3 cr. Graduate.
Seminar in professional ethics, oral and written communication, contemporary social issues, career development, time management, and laboratory safety.
Prerequisites: grad st
Course Rules: Civ Eng 700, CompSci 700, ElecEng 700, Ind Eng 700, MatlEng 700 & MechEng 700 are jointly offered and count as repeats of one another
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.
Current Offerings: http://uwm.edu/schedule

COMPSCI 704 Analysis of Algorithms
3 cr. Graduate.
Introduction to concrete complexity theory and efficient algorithms. Fast data structure and graph algorithms, matrix multiplication, algebraic and numeric algorithms, reducibilities and np-completeness. Exponential and non-elementary lower bounds.
Prerequisites: grad st; CompSci 217(P) & 535(P).
Last Taught: Fall 2017, Fall 2016, Spring 2016, Fall 2015.
Current Offerings: http://uwm.edu/schedule
COMPSCI 708 Scientific Computing
3 cr. Graduate.
Fundamental algorithms and practical issues of scientific computing, including Monte Carlo simulations, data fitting, fast Fourier transform, optimization, numerical integration & differentiation, parallel computing, selected biomedical applications.
Prerequisites: grad st
Current Offerings: http://uwm.edu/schedule

COMPSCI 710 Artificial Intelligence
3 cr. Graduate.
AI programming, search techniques game playing, knowledge representation, knowledge acquisition, expert systems, selected topics from learning. Natural language understanding, vision and robotics.
Prerequisites: grad st, CompSci 252(P) & 535(P).
Course Rules: Not open to students who have cr in ElecEng 710, which is identical to CompSci 710.
Last Taught: Spring 2018, Spring 2016, Fall 2014, Fall 2012.
Current Offerings: http://uwm.edu/schedule

COMPSCI 711 Introduction to Machine Learning
3 cr. Graduate.
Introduction to machine learning techniques and applications, including optimal classification, regression, support vector machines, boosting, deep learning, and clustering.
Prerequisites: grad st
Course Rules: ElecEng 711 & CompSci 711 are jointly offered; they count as repeats of one another.
Last Taught: Fall 2017, Spring 2016, Fall 2013, Spring 2011.
Current Offerings: http://uwm.edu/schedule

COMPSCI 712 Image Processing
3 cr. Graduate.
This course covers the materials required to process and enhance photographic images, remote sensor multispatial scanner data and others. Topics include transform techniques, recorders, discriminate function, and associated hardware.
Prerequisites: grad st
Course Rules: ElecEng 410(P) or cons instr.
Last Taught: Fall 2017, Fall 2016, Fall 2015, Fall 2013.
Current Offerings: http://uwm.edu/schedule

COMPSCI 713 Computer Vision
3 cr. Graduate.
Fundamental issues and current research in computer vision. Topics in early or low-level vision, intermediate vision or perceptual organization, and high-level vision or object recognition.
Prerequisites: grad st; ElecEng 410(P) or cons instr.
Course Rules: Jointly offered w/ and counts as a repeat of ElecEng 713.
Last Taught: Fall 2005.
Current Offerings: http://uwm.edu/schedule

COMPSCI 714 Computational Geometry
3 cr. Graduate.
Special data structures and algorithmic techniques for representing and manipulating geometric objects, such as points, lines and polygons. Applications to vlsi design and robotics.
Prerequisites: grad st, CompSci 535(P).
Current Offerings: http://uwm.edu/schedule

COMPSCI 718 Advanced Computer Graphics: Modeling and Animation
3 cr. Graduate.
Advanced graphics topics on mesh processing, illumination models, ray-tracing, and volumetric data visualization; popular animation approaches such as keyframes, particles, fluids and rigid bodies.
Prerequisites: grad st
Current Offerings: http://uwm.edu/schedule

COMPSCI 720 Computational Models of Decision Making
3 cr. Graduate.
Theoretical foundations and practical problems of formulating and constructing computational models of decision making.
Prerequisites: basic course in Probability or Statistics.
Last Taught: Fall 2017, Fall 2016, Fall 2015, Fall 2014.
Current Offerings: http://uwm.edu/schedule

COMPSCI 722 Artificial Intelligence Planning Techniques
3 cr. Graduate.
Algorithms and representations for classical and more expressive planning, search control techniques, study and comparison of a variety of planners, applications of planning.
Prerequisites: grad st; Comp Sci 535(P).
Current Offerings: http://uwm.edu/schedule

COMPSCI 723 Natural Language Processing
3 cr. Graduate.
Principles and problems of natural language processing with emphasis on recent advances and open problems. Topics: lexicons, parsing, interpretation, discourse structure, generation, and collaborative interfaces.
Prerequisites: grad st; CompSci 422(P) or 710(P).
Course Rules: Not open to students with cr in CompSci 423.
Last Taught: Fall 2017, Fall 2015, Fall 2013, Spring 2012.
Current Offerings: http://uwm.edu/schedule

COMPSCI 724 Distributed Algorithms
3 cr. Graduate.
Identification of canonical problems in distributed computing, design and analysis of algorithms to solve these problems. Formal proof techniques and impossibility results.
Prerequisites: grad st; CompSci 517(P), 535(P), or 523(P).
Current Offerings: http://uwm.edu/schedule

COMPSCI 725 Robot Motion Planning
3 cr. Graduate.
Configuration space, C-obstacles, sampling-based algorithms, potential fields, coverage, hierarchical motion planning, human control, relaxation, moving or deformable obstacles, multirobot motion planning, metrics, outdoor planning.
Prerequisites: grad st
Current Offerings: http://uwm.edu/schedule

COMPSCI 729 Real-Time Operating Systems
3 cr. Graduate.
Fundamentals of real-time operating systems with emphasis on scheduling and resource management.
Prerequisites: grad st
Current Offerings: http://uwm.edu/schedule
COMPSCI 730 Advanced Computer Networks
3 cr. Graduate.
Network architecture, protocols, routing, congestion control, traffic management, ATM, optical networks, TCP/IP, LANs, WANs, QoS, wireless and mobile networks, mobility management, security, multimedia, network management.
Prerequisites: CompSci 520 (P).
Last Taught: Fall 2014, Fall 2010, Fall 2009, Fall 2008.
Current Offerings: http://uwm.edu/schedule

COMPSCI 732 Type Systems for Programming Languages
3 cr. Graduate.
Lambda calculus, simple types, record types, subtypes, polymorphic types, type reconstruction, universal types, bounded quantification, higher-order types.
Prerequisites: grad st; CompSci 431 (P) & 654 (P).
Last Taught: Fall 2016, Spring 2015, Spring 2014, Fall 2011.
Current Offerings: http://uwm.edu/schedule

COMPSCI 737 Software Project Management
3 cr. Graduate.
Concepts and techniques for management of large software projects. Life cycle models; team organization; cost estimation and budgeting; schedule and risk management; software metrics.
Prerequisites: grad st; CompSci 361 (P) or equivalent
Current Offerings: http://uwm.edu/schedule

COMPSCI 738 Program Analysis for Software Engineering
3 cr. Graduate.
Static techniques for determining run-time properties of a program: data-flow analysis, abstract interpretation.
Prerequisites: grad st.
Current Offerings: http://uwm.edu/schedule

COMPSCI 743 Intelligent User Interfaces
3 cr. Graduate.
Principles, methods, and current research in intelligent user interfaces including applications, architectures, knowledge representation, and evaluation.
Prerequisites: grad st.
Last Taught: Fall 2017, Fall 2015, Spring 2014, Fall 2012.
Current Offerings: http://uwm.edu/schedule

COMPSCI 744 Text Retrieval and Its Applications in Biomedicine
3 cr. Graduate.
Fundamental issues and current research in text retrieval, text classification and their biomedical applications; Programming and use of indexing, query processing, and document retrieval methods.
Prerequisites: grad st; COMPSCI 351 (P) or HCA 442 (P)
Course Rules: Not open to students who have cr in HCA 744, COMPSCI 444, or HCA 444.
Last Taught: Spring 2015, Spring 2013, Fall 2010, Fall 2007.
Current Offerings: http://uwm.edu/schedule

COMPSCI 747 Principles & Practices of User Interface Design
3 cr. Graduate.
Principles and practices of user interface design for desktop, web, and mobile applications: interaction principles; UI design elements; user-centered design process and practices.
Prerequisites: grad st.
Current Offerings: http://uwm.edu/schedule

COMPSCI 754 Compiler Construction and Theory
3 cr. Graduate.
Fundamentals of compiler construction for modern programming languages. Syntax analysis, table organization, storage administration, semantic routines and code generation.
Prerequisites: grad st.
Course Rules: Not open to those who have cr in CompSci 654.
Current Offerings: http://uwm.edu/schedule

COMPSCI 755 Information and Coding Theory
3 cr. Graduate.
Information measures, entropy, source coding, channel's theorems, channel capacity, error correcting codes, linear codes, convolutional codes, arithmetic codes, encoding and decoding algorithms.
Prerequisites: grad st.
Last Taught: Fall 2017, Fall 2016, Fall 2015, Fall 2014.
Current Offerings: http://uwm.edu/schedule

COMPSCI 757 Data Base Organization and File Structure
3 cr. Graduate.
Introduction to automatic information organization and retrieval. Dictionary construction and operation, statistical and syntactic operations, performance evaluation of retrieval systems, design of query languages, models of database systems, database security.
Prerequisites: grad st; CompSci 217 (P) & 535 (P).
Current Offerings: http://uwm.edu/schedule

COMPSCI 758 Advanced Computer Architecture
3 cr. Graduate.
Advanced topics in computer architecture including pipeline processing, multiple and parallel processing systems, performance enhancement issues and vlsi computing structures.
Prerequisites: grad st; CompSci 458 (NP) or ElecEng 458 (NP).
Course Rules: Not open to students who have cr in ElecEng 758, which is identical to CompSci 758.
Current Offerings: http://uwm.edu/schedule

COMPSCI 759 Data Security
3 cr. Graduate.
Protection of data in computer and communication systems, cryptography, classical one key and public key cryptosystems, database protection, operating system security.
Prerequisites: grad st; CompSci 217 (P) & 536 (P).
Current Offerings: http://uwm.edu/schedule
COMPSCI 760 Computer Systems Performance Evaluation
3 cr. Graduate.
Performance measurement and tools, workload characterization, markov models, queueing theory, simulation, benchmarks, data analysis, parallel systems performance analysis.
**Prerequisites:** grad st; CompSci 458(P) or ElecEng 458(P).
**Course Rules:** Not open to students who have cr in ElecEng 760, which is the same as CompSci 760.
**Last Taught:** Fall 2017, Fall 2016, Fall 2014, Spring 2013.
**Current Offerings:** http://uwm.edu/schedule

COMPSCI 761 Software Testing and Verification
3 cr. Graduate.
Software testing techniques: test case generation, test oracles, regression testing, structural testing, test coverage, mutation testing, and model-based testing. Testing for object-oriented and distributed software. Security testing.
**Prerequisites:** grad st; CompSci 361(P) or equivalent
**Current Offerings:** http://uwm.edu/schedule

COMPSCI 762 Fault-Tolerant Computing
3 cr. Graduate.
Faults in digital circuits, fault detection, fault location, system reconfiguration or repair, system recovery, design for testability, self-checking circuits, fault-tolerant interconnection networks, systems level fault-diagnosis, fault-tolerant software.
**Prerequisites:** grad st; ElecEng 354(P).
**Course Rules:** Not open to students with cr for ElecEng 762.
**Current Offerings:** http://uwm.edu/schedule

COMPSCI 780 Multimedia Systems
3 cr. Graduate.
Survey of principles and applications of multimedia computer systems. Media fundamentals. Networking, architecture, software engineering, and user interface issues.
**Prerequisites:** CompSci 537(P).
**Last Taught:** Spring 2015, Spring 2010, Spring 2005, Fall 2001.
**Current Offerings:** http://uwm.edu/schedule

COMPSCI 790 Advanced Topics in Computer Science:
3 cr. Graduate.
Discussion of special advanced topics in theoretical as well as applied areas in computer science.
**Prerequisites:** grad st; add'l prereqs depending on topic.
**Course Rules:** Retakable w/chg in topic to 9 cr max. Specific topics may be jointly-offered w/Philos.
**Last Taught:** Summer 2017, Spring 2017, Fall 2016, Summer 2016.
**Current Offerings:** http://uwm.edu/schedule

COMPSCI 805 Randomized Algorithms; Pseudorandom Numbers
3 cr. Graduate.
**Prerequisites:** CompSci 704(P) CompSci 523(R).
**Last Taught:** Fall 2013, Fall 2010, Spring 2007, Fall 2005.
**Current Offerings:** http://uwm.edu/schedule

COMPSCI 810 Knowledge Representation
3 cr. Graduate.
Study of the design and properties of formalisms for representing knowledge in computational systems. Topics include: first-order logic, nonmonotonic logic, uncertainty, time, space, beliefs, plans.
**Prerequisites:** grad st; CompSci 710(P).
**Last Taught:** Fall 2014, Spring 2011.
**Current Offerings:** http://uwm.edu/schedule

COMPSCI 854 Advanced Compiler Techniques
3 cr. Graduate.
Details of compiler construction: syntax theory, attribute grammars, implementing advanced language features, optimization
**Prerequisites:** grad st; CompSci 654(P) or 754(P)
**Last Taught:** Fall 2015, Fall 2010.
**Current Offerings:** http://uwm.edu/schedule

COMPSCI 859 Advanced Cryptography and Security Protocols
3 cr. Graduate.
Elliptic curve cryptography, AES, cryptanalysis, secret sharing, zero knowledge proofs, provable security.
**Prerequisites:** grad st; CompSci 469(P) & CompSci 535(P), or CompSci 759(P)
**Last Taught:** Spring 2012, Fall 2008.
**Current Offerings:** http://uwm.edu/schedule

COMPSCI 870 Medical Informatics Seminar
1 cr. Graduate.
Presentations by medical informatics affiliated faculty and invited speakers. Graduate students may present their work or published research from recent medical informatics journals or conferences.
**Prerequisites:** grad st.
**Course Rules:** Meets once every two weeks for 100 minutes.
**Last Taught:** Spring 2018, Fall 2017, Spring 2017, Fall 2016.
**Current Offerings:** http://uwm.edu/schedule

COMPSCI 880 Bioengineering Seminar
1 cr. Graduate.
Presentations by bioengineering affiliated faculty, invited speakers, and graduate students.
**Prerequisites:** grad st
**Course Rules:** MechEng 880, ElecEng 880, CompSci 880, MatlEng 880, IndEng 880 & Civ Eng 880 are jointly offered and count as repeats of one another. May be repeated to 3 cr. max.
**Last Taught:** Spring 2015, Fall 2012.
**Current Offerings:** http://uwm.edu/schedule

COMPSCI 888 Candidate for Degree
0 cr. Graduate.
Available for graduate students who must meet minimum credit load requirement.
**Prerequisites:** grad st.
**Course Rules:** Fee for 1 cr assessed.
**Last Taught:** Summer 2017, Summer 2016, Spring 2016, Fall 2015.
**Current Offerings:** http://uwm.edu/schedule

COMPSCI 990 Masters Thesis
1-9 cr. Graduate.
**Prerequisites:** grad st; cons instr.
**Last Taught:** Spring 2018, Fall 2017, Summer 2017, Spring 2017.
**Current Offerings:** http://uwm.edu/schedule
COMPSCI 995 Master’s Capstone Project
1-3 cr. Graduate.
Independent project supervised by student’s adviser
Prerequisites: grad st; cons instr & grad prog comm.
Last Taught: Spring 2018, Fall 2017, Spring 2017, Fall 2016.
Current Offerings: http://uwm.edu/schedule

COMPSCI 998 Doctoral Thesis
1-12 cr. Graduate.
Prerequisites: grad st; cons instr & grad prog committee.
Current Offerings: http://uwm.edu/schedule

COMPSCI 999 Advanced Independent Study
1-3 cr. Graduate.
Prerequisites: grad st; cons instr & grad prog comm.
Current Offerings: http://uwm.edu/schedule

Computer Studies Courses

COMPST 701 Mathematical & Computing Fundamentals for IT Professionals
3 cr. Graduate.
Introductory discussion of logic and reasoning techniques, discrete structures, combinatorics, probability, and their applications to IT.
Prerequisites: grad st.
Last Taught: Fall 2017.
Current Offerings: http://uwm.edu/schedule

COMPST 702 Software Development in Python
3 cr. Graduate.
Programming in Python. Basic control structures including recursion. Basic and library data types. Problem solving with objects. Writing classes. Basic software development skills.
Prerequisites: grad st.
Current Offerings: http://uwm.edu/schedule

COMPST 703 Software Engineering Principles
3 cr. Graduate.
Introduction to core topics of software engineering including requirements analysis, object-oriented design, testing, and project management. Overview of ethical and social issues in computing.
Prerequisites: CompSt 702 or equiv.
Last Taught: Summer 2017.
Current Offerings: http://uwm.edu/schedule

COMPST 750 Problem Solving with Object-Oriented Programming
3 cr. Graduate.
Problem solving with object-oriented programming language. Topics include arrays, strings, classes, standard data structures, graphical user interfaces, exceptions, files, debugging, and configuration management.
Prerequisites: Previous programming experience such as CompSt 702(P), CompSci 240(P), or CompSci 250(P).
Last Taught: Spring 2018.
Current Offerings: http://uwm.edu/schedule

COMPST 751 Data Structures and Algorithms
3 cr. Graduate.
Programming in a structured, high-level, object-oriented language. Implementation of data structures and algorithms and their application.
Prerequisites: CompSt 750(P) or CompSci 251(R).
Last Taught: Spring 2018.
Current Offerings: http://uwm.edu/schedule

COMPST 790 Advanced Topics in Computer Studies:
3-9 cr. Graduate.
Discussion of special advanced topics in the study of computing. Retakable with change in topic to 9 cr max.
Prerequisites: grad st; add'l prereqs depending on topic.
Current Offerings: http://uwm.edu/schedule

Faculty

<table>
<thead>
<tr>
<th>Name</th>
<th>Rank</th>
<th>Degree</th>
<th>School</th>
<th>Graduate Faculty</th>
<th>Emeritus Faculty</th>
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<tbody>
<tr>
<td>Brian Armstrong</td>
<td>Professor</td>
<td>PhD</td>
<td>Stanford University</td>
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<tr>
<td>John T. Boyland</td>
<td>Professor</td>
<td>PhD</td>
<td>University of California, Berkeley</td>
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<tr>
<td>Christine T. Cheng</td>
<td>Associate Professor</td>
<td>PhD</td>
<td>Johns Hopkins University</td>
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<tr>
<td>Robert Cuzner</td>
<td>Assistant Professor</td>
<td>PhD</td>
<td>University of Wisconsin-Madison</td>
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<td>George T. Davida</td>
<td>Professor</td>
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<tr>
<td>Adrian Dumitrescu</td>
<td>Professor</td>
<td>PhD</td>
<td>Rutgers, The State University of New Jersey</td>
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<td>Mukul Goyal</td>
<td>Associate Professor</td>
<td>PhD</td>
<td>Ohio State University</td>
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<tr>
<td>George W. Hanson</td>
<td>Professor, Chair</td>
<td>PhD</td>
<td>Michigan State University</td>
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<td>Seyed Hosseini</td>
<td>Professor</td>
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<td>University of Iowa</td>
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<tr>
<td>Yi Hu</td>
<td>Associate Professor</td>
<td>PhD</td>
<td>University of Texas at Dallas</td>
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<td>Charles E. Kahn Jr.</td>
<td>Adjunct Professor</td>
<td>MD</td>
<td>University of Illinois at Chicago</td>
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<td>Nikolai A. Kouklin</td>
<td>Associate Professor, Professor</td>
<td>PhD</td>
<td>University of Nebraska-Lincoln</td>
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<td>Robert J. Krueger</td>
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<td>Chiu T. Law</td>
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<td>Leonard P. Levine</td>
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<td>Amol D. Mali</td>
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<td>David McClanahan</td>
<td>Faculty Associate</td>
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<td>University of Wisconsin-Milwaukee</td>
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<td>Susan McRoy</td>
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<td>Devendra K. Misra</td>
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<td>Ethan V. Munson</td>
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<td>Adel Nasiri</td>
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<td>Illinois Institute of Technology</td>
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<td>Ramin Pashaie</td>
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<td>Mahsa Ranji</td>
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<td>Ali Reza</td>
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<td>Jayson Rock</td>
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<td>University of Wisconsin-Milwaukee</td>
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<td>Robert Sorenson</td>
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<td>Ichiro Suzuki</td>
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<td>Osaka University, Japan</td>
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<td>Weizong Wang</td>
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<td>Guangwu Xu</td>
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<td>Jun Zhang</td>
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