

# Software Engineering

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## Program and Application Information

<b>Department Head:</b>	Dr. Kendall E. Nygard
<b>Graduate Coordinator:</b>	Dr. Gursimran Walia
<b>Department Location:</b>	258 QBB (formerly IACC)
<b>Department Phone:</b>	(701) 231-8562
<b>Department Email:</b>	gradinfo@cs.ndsu.edu
<b>Department Web Site:</b>	cs.ndsu.edu/
<b>Application Deadline:</b>	March 1 for fall admission; September 1 for spring admission* No summer admission for any Software Engineering Program
<b>Degrees Offered:</b>	Ph.D., M.S., M.S.E., Certificate
<b>Test Requirement:</b>	GRE (M.S. and Ph.D. only)
<b>English Proficiency Requirements:</b>	TOEFL ibT 79 IELTS 6.5

\*Spring admissions are given only occasionally, depending on funding and faculty interest. If there are no spring openings, spring applicants are automatically considered for the subsequent fall semester.

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## Program Description

Software Engineering is focused on the application of systematic, disciplined, and quantifiable approaches to the development, operation, and maintenance of software systems. Inclusive of computer programming but going well beyond, Software Engineering is concerned with methodologies, techniques, and tools to manage the entire software life cycle, including development of requirements, specifications, design, testing, maintenance, and project management. The advent of Software Engineering is a natural result of the continuous quest for software quality and reusability, and the maturing of the software development industry.

The Department of Computer Science offers a Graduate Certificate in Software Engineering, Master of Software Engineering, Master of Science in Software Engineering, and Ph.D. in Software Engineering. The programs are designed to appeal to both full-time students and software professionals who are employed and wish to pursue a program part time. The Master of Software Engineering is a course work only program while the Master of Science in Software Engineering is a course work, comprehensive examination and research program. For additional information, see [cs.ndsu.edu](http://cs.ndsu.edu) or contact the Computer Science Department at (701) 231-8562 or [gradinfo@cs.ndsu.edu](mailto:gradinfo@cs.ndsu.edu).

## Admissions Requirements

In addition to the Graduate School requirements (<http://bulletin.ndsu.edu/past-bulletin-archive/2017-18/graduate/admission-information>), applicants must fulfill the program requirements listed below:

### Certificate

1. B.S. or equivalent degree from an educational institution of recognized standing, including 12 semester hours or equivalent of Computer Science or Software Engineering courses from an educational institution of recognized standing, or at least one year full-time professional software engineering experience;
2. Programming skill in a modern higher level programming language, preferably C++, C#, or Java;
3. A 2.85 (on a 4.0 scale) GPA in previous course work.

### Master of Software Engineering

1. Bachelor's level (B.S., B.A., Sc.B., etc.) degree from an educational institution of recognized standing;
2. Ability to design and implement a program consisting of several interacting classes that might total approximately 100 executable statements;
3. International Students require a minimum TOEFL ibT of 79 or an IELTS of 6.5.
4. A 3.0 (on a 4.0 scale) GPA in previous coursework. Conditional admission may be given with a 2.7 or higher GPA and professional experience.

### Master of Science

1. Four year or longer B.S. or equivalent degree from an educational institution of recognized standing with at least a 3.0 grade point average on a 4.0 grade point scale. Eighteen semester hours or equivalent in Computer Science from an educational institution of recognized standing, or at least 2 years of full-time professional software engineering experience. Full time professional experience may offset the GPA requirement at the rate of 0.1 in GPA for each 18 months of such experience to a maximum of 0.3 in GPA;

2. Programming skill with one modern higher level programming language, preferably C++, C#, or Java.
3. A 3.0 (on a 4.0 scale) GPA in all previous coursework.

## Doctor of Philosophy

1. Four year or longer B.S. or equivalent degree from an educational institution of recognized standing with at least a 3.25 grade point average (GPA) on a 4.0 grade point scale. Eighteen semester hours or equivalent in Computer Science from an educational institution of recognized standing, or at least 3 years of full-time professional software engineering experience. Significant full-time professional software development experience may offset this GPA requirement at the rate of 0.1 in GPA for each 2 years of such experience to a maximum of 0.4 in GPA. If the applicant has an M.S. or equivalent degree from an educational institution of recognized standing, the GPA in that degree should be at least 3.35 on a 4.0 scale.
2. Programming skill in at least 1 higher level programming language, preferably C++, C#, or Java.

## Graduate Certificate

Requires 10 semester credit hours consisting of

Code	Title	Credits
CSCI 713	Software Development Processes	3
Select two of the following:		6
CSCI 714	Software Project Planning and Estimation	
CSCI 715	Software Requirements Definition and Analysis	
CSCI 716	Software Design	
CSCI 717	Software Construction	
CSCI 718	Software Testing and Debugging	
CSCI 790	Graduate Seminar (in appropriate area as approved by the student's adviser) Examples include: Database Systems, Extreme Programming, Formal Methods in Software Engineering, Intelligent Agents)	1
An extensive project of approximately one third of a semester incorporated into whichever of the above courses the student and her (his) adviser selected. The project may be job related. This project serves as the capstone experience for the student.		
Total Credits		10

## Sample Certificate Combinations:

### Software Design

Code	Title	Credits
CSCI 713	Software Development Processes	3
CSCI 715	Software Requirements Definition and Analysis	3
CSCI 716	Software Design (+ Seminar with project)	3

### Software Testing

Code	Title	Credits
CSCI 713	Software Development Processes	3
CSCI 714	Software Project Planning and Estimation	3
CSCI 718	Software Testing and Debugging (+ Seminar with project)	3

### Software Project Management

Code	Title	Credits
CSCI 713	Software Development Processes	3
CSCI 714	Software Project Planning and Estimation	3
CSCI 715	Software Requirements Definition and Analysis (+ Seminar with project)	3

## Software Construction

Code	Title	Credits
CSCI 713	Software Development Processes	3
CSCI 716	Software Design (+ Seminar with project)	3
CSCI 717	Software Construction (+ Seminar with project)	3

## Master of Software Engineering

Offered through on-campus classes or through Distance and Continuing Education classes. Please note that F-1 and J-1 non-immigrant international students are only allowed to take one online course per semester.

Completion of 12 courses listed below with grades of B or better and two-semester sequence of CSCI 771 and CSCI 772 Software Development Project. Any CSCI 700 or 800 level course can be substituted for a required course with departmental approval, except CSCI 771 and CSCI 772.

Code	Title	Credits
CSCI 713	Software Development Processes	3
CSCI 714	Software Project Planning and Estimation	3
CSCI 715	Software Requirements Definition and Analysis	3
CSCI 716	Software Design	3
CSCI 717	Software Construction	3
CSCI 718	Software Testing and Debugging	3
CSCI 724	Survey of Artificial Intelligence	3
CSCI 765	Introduction To Database Systems	3
CSCI 771	Software Development Project I	3
CSCI 772	Software Development Project II	3
CSCI 846	Development of Distributed Systems	3
CSCI 847	Software Complexity Metrics	3
Total Credits		36

- Successful completion of an Internet-based 16 hour module on Computer Ethics. This module will be required for students starting the program in fall, 2016 or later. Students are required to join a Blackboard group called MSE Ethics Module and complete the ethics module including answering all questions and the three case studies.
- Maximum of 4 courses may be attempted in any one semester. If a course is started in a particular semester, it must be dropped or completed within that semester.

## Master of Science in Software Engineering

The Software Engineering Comprehensive Examination. This examination shall include integrative questions on the 4 courses which make up the software engineering core. The exam must be passed within the first 5 semesters of the program. Each student is allowed a maximum of 2 attempts to pass this examination. Students are encouraged to complete the comprehensive examination early in their program.

Code	Title	Credits
Core Courses		12
Students must complete the core within five semesters of their entering the program.		
CSCI 713	Software Development Processes	
CSCI 715 or CSCI 718	Software Requirements Definition and Analysis Software Testing and Debugging	
CSCI 716	Software Design	
CSCI 765	Introduction To Database Systems	
<b>Six credits (not part of the core) from:</b>		6
CSCI 714	Software Project Planning and Estimation	
CSCI 715	Software Requirements Definition and Analysis	
CSCI 717	Software Construction	

CSCI 718	Software Testing and Debugging	
CSCI 845	Formal Methods for Software Development	
CSCI 846	Development of Distributed Systems	
CSCI 847	Software Complexity Metrics	
CSCI 848	Empirical Methods in Software Engineering	
Other Computer Science or Computer Engineering courses selected with and approved by the student's graduate advisory committee. (six - thesis students) or three (paper students)		3-6
CSCI 790	Graduate Seminar ( in software engineering areas (1 credit each), approved by adviser)	3
<b>Research Component*</b>		<b>3-6</b>
CSCI 797	Master's Paper	
or CSCI 798	Master's Thesis	
<b>Total Credits</b>		<b>33</b>

- \* Either a thesis option or comprehensive study paper based on a significant software development project undertaken by the student, perhaps as a member of a team, either at the University or as part of a job. This project will require design, implementation, and testing of a significant piece of computer software.
- Up to 9 previously earned credits from an educational institution of recognized standing with a grade of B or better may be used toward the 33 total credits required for the master degree, upon approval by the advisor, committee members and head of the department.
  - A Final Oral Examination on the paper and course work. This examination shall include questions on design choices, implementation methods, and testing choices for the student project.

## Ph.D. in Software Engineering

Program Requirements: 90 semester hours

All Master of Science in Software Engineering from NDSU requirements or their equivalent in transfer or examination credits.

Satisfactory completion of the Ph.D. Qualifying Examination. This examination will consist of integrative questions on the 4 core courses described under the Master of Science degree. Students must complete this requirement within their first 7 semesters of participation in the program.

Code	Title	Credits
Select 5 from the courses listed below and not duplicating any items used to satisfy requirements for the Master of Science degree:		15
CSCI 713	Software Development Processes	
CSCI 714	Software Project Planning and Estimation	
CSCI 715	Software Requirements Definition and Analysis	
CSCI 716	Software Design	
CSCI 717	Software Construction	
CSCI 718	Software Testing and Debugging	
CSCI 845	Formal Methods for Software Development	
CSCI 846	Development of Distributed Systems	
CSCI 847	Software Complexity Metrics	
CSCI 848	Empirical Methods in Software Engineering	
Courses in Computer Science or Electrical and Computer Engineering approved by the student's Supervisory Committee.		9
CSCI 899	Doctoral Dissertation	36-45

- Thirty-six to 45 semester credit hours for research, preparation, and defense of a dissertation in Software Engineering. These hours will be graded on a Satisfactory/Unsatisfactory basis.

### Additional course work requirements:

1. A student holding a Master of Science degree from an educational institution of recognized standing may use: 30 credits of previously completed coursework toward the 90 total credits required for the doctoral degree **OR** **Up to 9 credits previously earned from an educational institution of recognized standing with a grade of B or better may be used toward the 90 total credits required for the doctoral degree.**
2. The 90 credits may include a maximum of 15 credits of independent study and seminar hours. Seminars are limited to four of those credits.

3. The student's supervisory committee, the department chair, college dean, and the graduate dean all must approve the course work on the plan of study at least 4 semesters before graduation.

## Department Faculty

### **Anne Denton, Ph.D.**

University of Mainz, 1996

Research Interests: Data Mining, Bioinformatics, Scientific Informatics, Databases, Geospatial Data, Cloud Computing

### **Dean Knudson, Ph.D.**

Northwestern University, 1972

Research Interests: Software Engineering, International Capstone Programs, University/Industry Relationships

### **Jun Kong, Ph.D.**

University of Texas, Dallas, 2005

Research Interests: Human Computer Interaction, Mobile Computing, Software Engineering

### **Juan (Jen) Li, Ph.D.**

University of British Columbia, 2008

Research Interests: Large-scale Distributed System (P2P and Cloud Computing, Distributed Search, Routing Algorithms), Semantic Web Technologies, Social Networks, Information Retrieval, Knowledge Discovery

### **Simone Ludwig, Ph.D.**

Brunel University, 2004

Research Interests: Swarm Intelligence, Evolutionary Computation, Fuzzy Reasoning, Cloud Computing

### **Kenneth Magel, Ph.D.**

Brown University, 1977

Research Interests: Software Engineering, Human-Computer Interfaces, Software Complexity, and Software Design

### **Kendall Nygard, Ph.D.**

Virginia Polytechnic Institute and State University, 1978

Research Interests: Data Science, Optimization Modeling, Smart Grid, Sensor Networks, Agents, Artificial Intelligence, Security, Adaptive Systems, Swarm Intelligence

### **Saeed Salem, Ph.D.**

Rensselaer Polytechnic Institute, 2009

Research Interests: Bio-Informatics and Data Mining

### **Brian Slator, Ph.D.**

New Mexico State University, 1988

Research Interests: Artificial Intelligence, Educational Media

### **Jeremy Straub, Ph.D.**

University of North Dakota, 2015

Research Interests: Multi-tier Mission Architecture & Control, Autonomous Data Link Reduction, Autonomous Vehicle Control, Machine Vision, Super Resolution

### **Vasant Ubhaya, Ph.D.**

University of California-Berkeley, 1971

Research Interests: Algorithm Analysis, Approximation and Optimization

### **Gursimran Walia, Ph.D.**

Mississippi State University, 2009

Research Interests: Empirical Software Engineering, Software Errors and Software Quality Improvement, Requirements Engineering, Human Cognition in Software Engineering, Managing and Estimating Software Quality

### **Changhui Yan, Ph.D.**

Iowa State University, 2005

Research Interests: Bioinformatics, Computational Biology, Genomics, Machine Learning, Data Mining, Big Data, Cloud Computing

## Professors of Practice

### **Oksana Myronovych, Ph.D.**

North Dakota State University, 2009

**Mark Pavicic, Ph.D.**

Columbia University, 1985

## **Affiliate Faculty**

**Otto Borchert, Ph.D.**

North Dakota State University, 2015

Research Interests: Artificial Intelligence, Educational Games, STEM Learning

**Hyunsook Do, Ph.D.**

University of Nebraska, 2007

Research Interests: Software Engineering, Software Testing, Regression Testing, Software Maintenance, Requirements Verification, Software Empirical Methodologies

**Hassan Reza, Ph.D.**

North Dakota State University, 2002

Research Interests: Software Architecture, Cloud Computing, Architectural Analysis & Description

**Xiaodong Zhang, Ph.D.**

Dalhousie University, Canada, 2001

Research Interests: Satellite Sensing, Geographic Information Systems