

## **Background Knowledge Requirement**

The concepts covered here are considered to constitute a minimal core body of knowledge that all PhD graduates of our department should be familiar with. These concepts are required prerequisites for many of our graduate classes; students must know these concepts to succeed at these classes.

### **Background concepts**

- **Machine Architecture and Organization.** Covers basic hardware/software components of a computer system, including data representation, machine-level programs, instruction set architecture, processor organization, memory hierarchy, virtual memory, compiling, and linking.
- **Theoretical Foundations.** Must cover *one of* the following two bodies of knowledge:
  - **Algorithms and Data Structures or Formal Languages and Automata Theory.**
    - **Algorithms and Data Structures.** Analysis, data structures, and algorithms, e.g.: basic algorithm analysis (recurrences, asymptotic notation), basic data structures (lists, stacks, queues, heaps, hash tables, (balanced) binary search trees), basic algorithms (sorting, searching, graph traversal, shortest paths, minimum spanning trees).
    - **Formal Languages and Automata Theory.** Logical/mathematical foundations of computer science. Specific topics include formal languages, their correspondence to machine models, lexical analysis, string matching, parsing, decidability, undecidability, limits of computability, and computational complexity.
- **Operating Systems.** Topics include processes/threads, process coordination, interprocess communication, asynchronous events, memory management/file systems.
- **Programming & Software Development.** Topics include: design and analysis of programs, software development tools and methods, debugging, I/O, state machines, exception handling, testing, coding standards, software lifecycle models, requirements analysis.

### **Satisfying the Background Knowledge Requirement**

The Background Knowledge Requirement may be satisfied in five different ways:

1. By passing the GRE Computer Science subject exam with a score in the 90th percentile or higher.
2. By passing an appropriate undergraduate course with a grade of B+ or higher. The appropriate courses at The University of Minnesota are noted below. However, a student may take such courses anywhere, and simply needs to point out on their transcript any qualifying courses. The Director of Graduate Studies is responsible for

approving the use of courses to satisfy the background requirement. The relevant UMN courses are:

- **Machine Architecture and Organization** - CSCI 2021
- **Theoretical Foundations:**
  - **Algorithms and Data Structures** - CSCI 4041
  - **Formal Languages and Automata Theory** - CSCI 4011
- **Operating Systems** - CSCI 4061
- **Programming & Software Development** - CSCI 3081

3. By passing the final exam for the appropriate UMN class with a grade of B+ or higher

4. By passing a graduate course with a grade of B+ or higher for which an appropriate undergraduate course is a clearly defined prerequisite. For example, at the University of Minnesota, CSCI 5421 "Advanced Algorithms and Data Structures" has CSCI 4041 "Algorithms and Data Structures" as a prerequisite. Thus, getting a B+ in 5421 is evidence that a student has adequate background in Algorithms and Data Structures. Students must check with the Director of Graduate Studies to verify that a specific graduate course demonstrates knowledge of a particular background area.

5. By petitioning the Director of Graduate Studies to accept some other experience as evidence of adequate background. For example, a student could have extensive industrial software development experience without having taken a course on software development.

**Students must satisfy the background requirement within their first year in the PhD program.** If they are not able to do so, they may – with the support of their advisor – petition the Director of Graduate Studies for an extension.

Prerequisite Table– Graduate courses for which background undergraduate courses are substantial prerequisites

<b>CSci 2021</b>	<b>CSci 4041</b>	<b>CSci 4011</b>	<b>CSci 4061</b>	<b>CSci 3081</b>
5204	5403	5106	5103	5106
	5421	5161	5105	5161
	5461		5211	5801
	5471			
	5481			
	5523			