Ph.D. Preliminary Examination
The Department of Computer Science
Kent State University

1. Goals and Definitions
The Ph.D. Preliminary Examination is in place to assess a student’s understanding of the basic prerequisite concepts for entrance into the Doctoral program in Computer Science. It is also in place to assure that all incoming Ph.D. students have the ability to effectively reason with and integrate the underlying knowledge and concepts in the broad field of Computer Science. This ability is necessary to continue the student’s studies in the degree program.

The goals of the Ph.D. Preliminary Exam:
• Assess a student’s general ability to enter the Doctoral program
• Give the student a positive learning experience that benefits their academic career (i.e., helps prepare them for study in the Doctoral program)
• Cover only required prerequisite breadth knowledge for the degree program
• The exam is NOT be tied to specific courses
• Support all Computer Science faculty/student research initiatives equally
• Be consistent, uniform, and fair for all students

Other constraints:
• The exam must be completed by the student within 20 months after entering the Ph.D. program
• The exam is completely separate from M.A. exit requirements

2. Exam Topics
Below is a set of topics, (and will be referred to as the Exam Topics) that are generally considered prerequisite (preliminary) knowledge for incoming students applying for entrance to the Ph.D. degree program in Computer Science. Any doctoral student conducting research in Computer Science must have a basic knowledge of the following six areas. These areas are aligned with the first six areas of the 2001 ACM/IEEE Computer Science Body of Knowledge namely, Discrete Structures (DS), Programming Fundamentals (PF), Algorithms and Complexity (AL), Programming Languages (PL), Architecture and Organization (AR), and Operating Systems (OS). These six areas represent the basic foundations of the fourteen areas in the CS Body of Knowledge. The 2001 ACM/IEEE Computer Science Body of Knowledge can be found at:
www.computer.org/education/cc2001/steelman/cc2001/

A complete and detailed list of the topics covered will be published with ample time (i.e., the six months prior to exam) for students to prepare for the exam. A suggested reading list will also be provided and it will be manageable and focused for the student’s benefit. The reading list will reference a text book(s) and associated chapters that reflect the topics covered on the exam. In certain cases a small number of classic papers may be part of the reading list. Textbooks must be those widely used in Computer Science curriculums and viewed as standard texts.

Below is the list of general exam topics. See the Preliminary Examination Reading List for a complete and detailed list of topics and suggested reading list. The reading list is the official description of the exam topics.

Discrete Structures
• Functions, relations, sets, basic logic
• Proof techniques: induction and recursion
• Counting, discrete probability, graphs and trees, Boolean algebra
• Modeling computation: basic languages and grammars, regular expressions

Design and Analysis of Algorithms
• Basic algorithm analysis and asymptotic notation
• Algorithm design strategies: greedy, divide and conquer, heuristic, dynamic programming
• Graph and string matching algorithms
• Basic computability, Complexity classes P and NP
Foundations of Programming Languages
- Describing syntax and semantics, names, bindings, type checking, and scope
- Lexical and syntactical analysis, data types, expressions, and statements
- Subprograms and parameter passing mechanisms
- Exception handling, object-oriented languages, functional and logic programming languages

Data Structures and Fundamentals of Programming
- Abstract data types, fundamental data structures
- Vectors, lists, stacks, queues, binary trees, graphs
- Object oriented programming, inheritance, polymorphism, and dynamic variable binding
- Containers and iterators, hashing, priority queues and heaps

Computer Operating Systems
- Processes, threads, CPU scheduling, process synchronization and Deadlock
- Memory Management, virtual Memory, file system and interfaces
- I/O systems, mass storage, file systems, protection, security, and distributed systems
- Linux and Windows XP

Computer Architecture and Organization
- Computer performance measure and analysis, computer arithmetic
- Processor design and control, instruction set design
- Memory organization, processor pipelining
- I/O subsystems, multiprocessors

3. Exam Format & Policies
The student must successfully complete the Preliminary Examination within 20 months after entering the Ph.D. program. The format will be a written examination. The exam topics will be arranged into the following groupings. These grouping will be referred to as the three Preliminary Exams:

- **Exam 1**
  - Discrete Structures
  - Design and Analysis of Algorithms

- **Exam 2**
  - Foundations of Programming Languages
  - Data Structures and Fundamentals of Programming

- **Exam 3**
  - Computer Operating Systems
  - Computer Architecture and Organization

The three exams will be administered one week before classes start in both the Fall (late August) and Spring (mid January) semesters. All three exams will be (typically) given during a one week period (MWF). The student may take one or more of the exams during this period.

Previous versions of the Preliminary Exams will NOT be made available to students. The text books and reading list offer ample example problems and represent potential candidates for exam questions.

Each of the three exams is passed individually. Each of the exams will be 3-4 hours and contain eight (8) questions, with four (4) questions from each topic. Out of these eight (8) questions the student must solve five (5) successfully. Additionally, at least two (2) questions must be solved from each area. A minimum average score 75% in each of the two topics is required for a passing grade.

A student will only have two (2) opportunities to pass each part the Preliminary Examinations. However, if the student fails the first attempt the second attempt must be done within the 20 month period. Extensions to this deadline can only be granted by the Graduate Studies Committee.
The student must register to take the exam at least two months prior to the examination date. The student should inform the Graduate Secretary and Graduate Coordinator by emailing to cs-gradinfo@cs.kent.edu.

4. Students Transferring into the New Ph.D. Program

Students who were admitted to the Ph.D. program and were enrolled in the Department prior to Fall 2004 will be given an extension to the 20 month deadline for completing the Preliminary Examination if they choose to transfer to the new program. For students that were admitted to the Ph.D. program prior to Fall 2004 the following rules apply:

- The student must take at least one part of the Preliminary Examination in January 2005 or before.
- The student must successfully complete the Preliminary Examination by August 2005 or before.

All other rules pertaining to the Preliminary Examination will apply. Students have only two opportunities to pass each part of the Preliminary Examination. If a student fails the first attempt, the second attempt must be done by August 2005 or before.

5. Management of Exam

A Preliminary Examination Committee (PEC) will be formed each year comprised of tenure track Graduate Faculty. These committee duties will rotate regularly among the Graduate Faculty. Because the exams are to be given the week before the term starts and the committee assignments are not approved until after the term starts, the committee’s duties will run from the Spring to the following Fall (as opposed to a Fall Spring schedule). The newly appointed committee will take up the coming Spring exam and the Fall exam will be the previous year committee’s duty. PEC should be composed of at least four Graduate Faculty members and membership should rotate regularly among the Faculty.

PEC will be in charge of:

- Administration of the exam
- Consistency and quality of the exam
- Publication of examination dates
- Publication of the Preliminary Examination Reading List in a timely manner (at least one full term before the exam date)
- Publication of additional study materials (previous exams, etc.)
- Creation of exam questions – PEC can (should) solicit questions/answers from entire faculty
- Grading of the exam
- Exam must be graded in a timely fashion, that is, four (4) weeks after the exam is administered. This is to ensure that exam results can be used by the GSC for GA (re)appointments.
- Changes to reading list will be recommended by PEC and given to GSC for approval
- Changes to exam format will be recommended by PEC and given to GSC for approval

Each question must be graded by at least two PEC members. If there is a large difference in the assigned grade, a third grader will be necessary. A Preliminary Examination Form/Spreadsheet will be used to record the student’s grades on each exam and dates they attempted the exam.

The exam will be developed in whole by the committee to ensure consistency. No one member can be completely in charge of developing questions and grading any one part of the exam.

PEC will give examination results and recommendations to GSC for final approval. The Graduate Coordinator, PEC, and the Graduate Secretary will maintain the Preliminary Examination Form/Spreadsheet for students.

It is the official responsibility of the Graduate Coordinator to inform a student of examination results. No other member of GSC or PEC may inform a student(s) of examination results or discuss the results with a student(s) prior to official notification by the Graduate Coordinator.