

# PhD Student Orientation

## Fall 2019

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# Goals

- Introduce the CS Department
- Describe the PhD Degree Requirements
- Provide suggestions and general tips

# Today's Agenda

- 10:30 PhD Orientation Presentation
- 12:00 Lunch & Reception (Room 4201)

# Computer Science @ GMU

## ■ People

- 41 faculty (from which to choose a dissertation director)
- Plus 9 instructional, 4 emeriti, and 3 affiliated faculty
- Five research centers and ten research labs

## ■ Programs

- **Undergraduate**: Computer Science and Applied Computer Science (1500+ students)
- **Masters** in Computer Science, Software Engineering, Information Systems, Information Security and Assurance (400+ students)
- **PhD** in Computer Science (~100 students)  
In addition, we participate in the school-wide PhD program in Information Technology (PhD IT)

# Areas of Research Expertise

- Algorithms and Theory of Computation
- Artificial Intelligence and Robotics
- Bioinformatics
- Computer Game Design
- Computer Vision
- Big Data / Databases
- Graphics and Image Processing
- Programming Languages
- Software Engineering
- Security
- Systems and Networks
- Parallel and Distributed Computing
- Data Mining
- Information Systems
- Computer Science Education

# Key People

- Chair of the Computer Science Department: Sanjeev Setia
- Director of the PhD program: Hakan Aydin
- Your **Academic Advisor**
  - Assigned based on your areas of interest
  - Advises you on all academic/procedural matters
- Your **Research Advisor**
  - Advises you on your doctoral research
  - When you have one, he/she will also serve as your academic advisor.
  - When your dissertation committee is formed, he/she becomes your **dissertation director**
- Office staff
  - Ryan Lucas (Office Manager, **graduate program specialist** e-mail: wlucas@gmu.edu)
  - Michèle Pieper (Department Operations Manager)

# What is PhD (in CS)?

- Highest academic degree awarded in Computer Science
- On top of multi-year graduate study, PhD degree requires producing **original research** in a sub-field of Computer Science, culminating in the **creation and defense of a research dissertation**
- The research must be worthy of publication in **peer-reviewed** academic journals and/or conference proceedings.

# Success Criteria in PhD

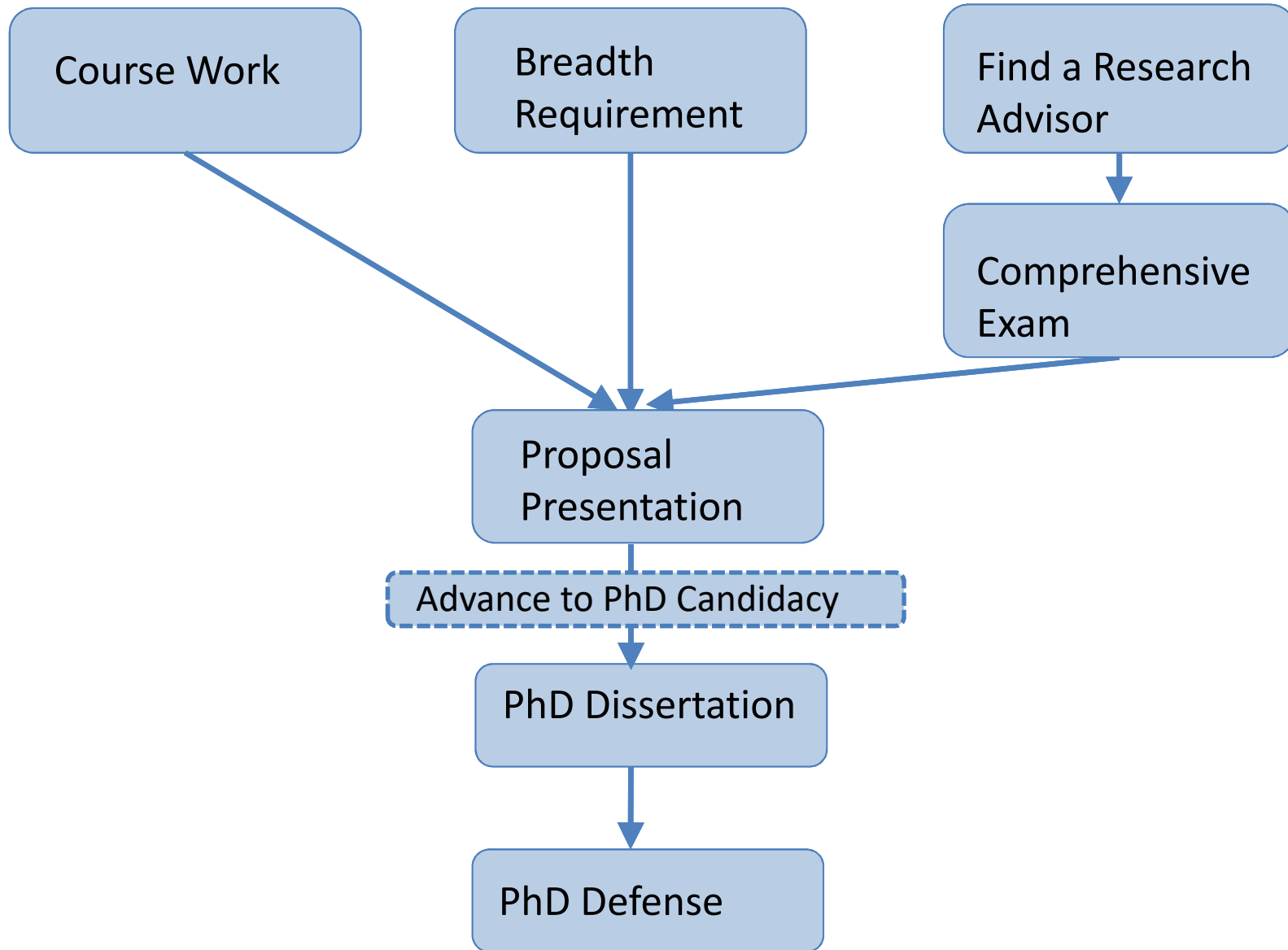
- Success in the graduate courses and exams is a necessary condition
  - But not sufficient!
- The culmination of the PhD study is the dissertation which requires
  - Becoming an active researcher in a specific area
  - Producing original research



# PhD Degree Requirements

- GMU Catalog is the official resource  
[catalog.gmu.edu](http://catalog.gmu.edu)
- Lots of information on the CS web site  
<http://cs.gmu.edu>
- Degree requirements have changed effective Fall'18
  1. Courses
  2. Breadth Requirement
  3. Comprehensive Exam
  4. Dissertation Proposal
  5. Dissertation

# Overall Picture



# 1. Course Work

- 72 credits post Bachelor's degree (GMU requirement)
- Up to 30 credits may be granted for MS degree
- 42 credits post-Masters
  - CS 600 (3 credits) - Theoretical Computer Science [requires B+ or better]
  - CS 700 (3 credits) - Research Methodology in Computer Science
  - CS 701 (3 credits) - Research Experience in Computer Science
  - 3 advanced graduate courses (9 credits)
    - Complete list of approved courses on the CS web site (almost 100).
  - CS 800 (2 x 0 credits) - CS Colloquium
  - CS 998 (proposal) and CS 999 (dissertation)
    - At least 24 credits (at least 12 in CS 999)
    - Not more than 24 will be counted towards the degree

# Credit for Previous Graduate Work

- If you did graduate work in computer science you may get credit (maximum 30).
  - Courses must be graduate level computer science (IT or business courses do not count).
  - Grade B or better
- An MS degree in computer science may get you a total of 30 credits.
- Must apply during your first academic year
- Case-by-case evaluation
- Transcripts are required.
  - Sometimes, additional course details could be required.

# CS 700 & CS 701

- Two mandatory courses
  - CS 700 (Research Methodology in CS) will be offered in Fall semester
  - CS 701 (Research Experience in CS) will be offered in Spring semester
- You must take CS 700 in Fall'19 and CS 701 in Spring'20
- Register in CS 700 for Fall'19 if you haven't done so already!

# CS 700 – Research Methodology in CS

- Has three components
  1. General research literacy knowledge
    - How to read, evaluate, write research papers
    - Research integrity and ethics
    - How to become a successful PhD student
    - Main steps of research
  2. Quantitative Models and Methods in Experimental CS
  3. Guest talks by CS faculty about their on-going research projects

# CS 701 – Research Experience in CS

- Main objective is to give the student a first “research experience”
- The student works closely with a CS faculty on a preliminary research task.
  - The student reports his/her findings in a professionally prepared document
  - All CS 701 students give brief (10-minute) presentations about their projects at the end of the semester during a public meeting.
  - A departmental form will be signed by the student and the faculty sponsor before the student can enroll in CS 701.

## Advice: Courses

- Consult your academic advisor on your course plan.
- Students who do not receive the full 30 credit reduction should choose additional graduate level computer science courses.
- Those additional courses must be selected from the list of graduate level courses in Computer Science or a field related to the intended doctoral research area of the student, in consultation with the academic advisor.
- Courses that will potentially help the student to satisfy the breadth requirement should be considered.
- With careful selection of courses, students may earn an MS in Computer Science degree as part of their PhD studies.
  - Consult the catalog for the requirements of the MS-CS.



## Advice: Courses

- Students who do not receive the full 30 credit reduction may also choose to take additional credits of **CS 896 – Directed Reading and Research** with the research advisor's approval
  - Must satisfy the breadth requirement before enrolling in CS 896
  - May be repeated up to 18 credits

## 2. Breadth Requirement

- The students should demonstrate the breadth of knowledge at the graduate level in multiple Computer Science areas
- Two ways to satisfy the breadth requirement
  - Show superior performance in graduate courses (The course-oriented criterion – default)
  - Take and pass written qualifying exams in different areas

# Course-Oriented Criterion for Breadth Requirement

- The student should demonstrate superior performance in **four** selected courses that span at least **three** different areas:
  - In at least **three out of four courses**, the student should receive at least a grade of **A- or better**.
  - In the **fourth course**, the student should receive a grade of **B or better**.
  - *CS 583 Analysis of Algorithms* (from the *Theoretical Computer Science* area) must be selected.
  - A course may be repeated at most once (otherwise the course cannot be used to satisfy the breadth requirement)
  - If a course is repeated, the grade in the second attempt is considered for the breadth requirement

# Breadth Requirement: Courses and Areas

Course	Area
Analysis of Algorithms (CS 583)	Theoretical Computer Science
Computer Networks (CS 555)	Systems and Networks
Operating Systems (CS 571)	Systems and Networks
Network Security (ISA 656)	Security
Database Systems (CS 550)	Databases
Artificial Intelligence (CS 580)	Artificial Intelligence
Data Mining (CS 584)	Artificial Intelligence
Compilers and Languages (CS 540)	Programming Languages
Software Construction (SWE 619)	Software Engineering
Software Testing (SWE 637)	Software Engineering
Computer Graphics (CS 551)	Visual Computing

## Course-Based Criterion for Breadth Requirement

- The student can use the grade (s)he received in the past if the course was taken at GMU.
  - No more than five years must have elapsed since the student took the course.
- Exceptions to this rule are rare and require filing a petition with supplementary documents to the Computer Science department.

# Written Qualifying Exams

- Qualifying exams are an alternative way to satisfy the breadth requirement.
- Must pass exams in **four** different areas:
  - *Foundations of CS* + any 3 from 8 areas (software construction, software testing, operating systems, networks, languages & compilers, databases, AI, information security)
- Each area has a recommended graduate course
  - If you have MS degree, you may have taken suitable courses.
- Exams offered in August and January
  - **Two** chances to pass four exams in **two consecutive semesters**.

# Satisfying the Breadth Requirement

- The breadth requirement must be satisfied within the **first 24 credits** in the program either through the course-oriented criterion **or** written qualifying exams
- The course-oriented criterion will apply by default
- **Mixing and matching** the written qualification exams and the course grades is not allowed
- *If the student takes a written qualifying exam, the course-oriented criterion can no longer apply.*

# Advice: Research Advisor

- Remember: The most important component of the PhD study is the PhD **research**
- Common mistake: Postponing research activity to the completion of the formal course work or breadth requirement
  - Finding a PhD research topic and research advisor does not happen in one day!
- Start exploring potential research topics and interacting with the faculty while taking courses!



# How to get involved in research?

- Identify the areas of Computer Science you are interested in
  - But be open-minded as well!
- Attend departmental research talks / symposia
- Take the courses in those areas to build a good background
  - Seminars, independent-study based courses.
- Check the web pages of the CS faculty, learn more about their research activities

# How to get involved in research?

- Make the best use of CS 700 and CS 701
  - In CS 700 (Fall), CS faculty will give research talks in a couple of class meetings
  - In CS 701 (Spring), you will have a chance to pair up with a CS faculty to work on a preliminary research topic.
- Interact with the faculty outside class hours
  - The faculty will be happy to provide more pointers/papers to get you trained in their areas
- Get involved in their research!

# Determining Research Advisor

- All full-time PhD CS students must determine their research advisor within the **first 24 credits**.
  
- This is also important because the **comprehensive exam** (with the deadline of 36 credits) assumes that:
  - you have determined your research area,
  - you have linked up with your research advisor, and,
  - you have gained the depth of knowledge in that specific area to start your original research.

## 3. Comprehensive Exam

- Checks the **depth** of the student's knowledge in the target PhD research area
  - Has both written and oral components.
  - Administered by a departmental comprehensive exam committee
- The student can form the dissertation committee only after passing the comprehensive exam
- Comprehensive exam must be taken within the **first 36 credits** in the PhD program.

# Comprehensive Exam

- Written Part: The student prepares a **critical review** of the research literature on a specific topic, and submits to the exam committee in advance
- Oral Part: The student makes a short presentation about his/her report, which is followed by the **question-answer phase**

## Comprehensive Exam (Written Part)

- The written report will summarize **the state of knowledge** in the target area with particular emphasis on **open problems**, and possible approaches to tackle those problems
- The report should be 8-10 pages long and should contain a minimum of 20 references

## Comprehensive Exam (Oral Part)

- About two hours, student presentation is limited to 20 minutes
- The committee asks questions about the presentation and material in the **reading list**
  - Key textbooks, important papers in the **broader research area** and determined by the examination committee
  - Papers selected by the student/advisor
- The oral exam is **public** (but only the examination committee can ask questions).

# Decision in the Comprehensive Exam

- The exam committee consists of 4 members
  - Research advisor
  - Another CS or School of Engineering faculty member determined by the advisor and the student
  - Two tenured CS faculty members appointed by the PhD CS Program Director (one of them chairs the committee)
- Majority vote is needed to pass the exam
  - At least 3 out of 4 members should give PASS in both written and oral components
- A student who fails in the exam must succeed in the next attempt (which must occur during the next semester).



## The role of the advisor in the comprehensive exam

- The written report must reflect the student's own writing and paper reading skills.
- The advisor may not work closely with the student on the comprehensive exam preparation
- *The student's reliance on the advisor for the exam should be at a minimum*

# Dissertation Committee

- Each student forms a dissertation committee.
  - Must first pass the comprehensive exam
- Four (or five) members:
  - **Three** members must be tenured or tenure-track faculty in CS Department.
  - **One** member must be from GMU but outside the CS Department.
  - The fifth member (if any) may be from outside the university.
  - Dissertation director chairs the committee.
  - Committee must be approved by the Chair of the Computer Science Department.

## 4. Dissertation Proposal

- Each student must prepare a written dissertation proposal.
- While preparing the proposal, student enrolls in CS 998.
- Proposal must be presented to and approved by the dissertation committee.
  - Two chances to pass
- Committee determines:
  - Whether the proposal has merit and can lead to significant research contributions, and
  - If the student has knowledge and skills to complete proposed work successfully, and in timely manner.
- Upon completing proposal successfully and finishing the course work, the student is **advanced to candidacy** for the PhD degree.

## 5. Dissertation

- While preparing the dissertation, the candidate enrolls in CS 999.
- When the work is complete, the dissertation is defended.
- Public defense is preceded by a **pre-defense** meeting:
  - Candidate meets with the dissertation committee and the Director of PhD program.
  - If the committee approves, the candidate may schedule the **public defense**.
- At least 1 month between pre-defense and public defense.

## 5. Dissertation (cont.)

- Dissertation
  - Must make significant contributions to its area
  - Must be publishable in quality journals or conferences.
- Dissertation Defense is oral and open to all
  - Two chances to pass

# Other Requirements

- CS 800 Computer Science Colloquium
  - Take 2 semesters (0 credit)
  - Each semester, attend about 12 seminars
  - Purpose:
    - Help to choose a research area.
    - Broaden knowledge of cutting-edge research.
    - See examples of “new research results”.
    - Learn presentation techniques.
  - Must be completed within the first 36 credits

## Summary of Milestone Deadlines (for full-time students)

- Complete CS 700 in Fall 2019
- Complete CS 701 in Spring 2020
- Complete the breadth requirement and determine the research advisor:  
Within the first 24 credits
- Take the comprehensive exam and complete both instances of CS 800:  
Within the first 36 credits

## Milestone Deadlines are Firm

- *Students who fail to meet the deadlines will be dismissed from the program unless there are extenuating circumstances approved by the department.*

(From the PhD CS program GMU catalog entry)



# Time Frame for Graduation

- GMU rules:
  - Maximum time from starting PhD program to advancement to candidacy – 6 years.
  - Maximum time for the entire PhD – 9 years.
- This does not distinguish between full-time and part-time students.
- Expectation from full-time students: Complete the program in 4-5 years.

# International Students

- Students with F-1 or J-1 visas must be full-time students
  - At least 9 credits per semester
  - 6 credits for GTAs and GRAs
  - May not switch to part-time status.

# How many credits per semester?

- Depends on your capabilities and available time.
- Remember that milestone deadlines for full-time students are expressed in terms of credits
  - Example: a GTA taking 9 credits per semester is required to satisfy the breadth requirement in 3 semesters and pass the comprehensive exam in 4 semesters.
  - But this translates to 4 and 6 semesters, respectively, for a GTA taking 6 credits per semester

# Course Selection for the first year (Suggestion)

- Fall:
  - CS 700 (required)
  - Consider one or two additional courses that can be used to satisfy the breadth requirement (or to prepare for the written qualifying exams)
- Spring:
  - CS 701 (required)
  - One additional course to satisfy the breadth requirement
  - An advanced PhD course (seminar) in your interest area [or another breadth course]

## About CS 530 & CS 531

- CS 530 (Mathematical Foundations of CS) and CS 531 (Fundamentals of System Programming) are for MS students and they can't be taken for credit by the PhD CS students
  - (Effective Fall 2019)

# Graduate Assistantships

- **Graduate Teaching Assistants (GTAs):** Participate directly in instructional activities, such as giving recitations, grading, holding office hours. Funded by the school /department.
- **Graduate Research Assistants (GRAs):** Participate in a research project administered by the GMU faculty. Funded by the sponsored research project.

# Graduate Assistantships

- We expect that the doctoral GTAs will
  - Become gradually research active
  - Transition to GRA positions funded by the specific CS faculty
  
- The department cannot guarantee funding as GTA after two years.
  - Three years is the maximum limit.

# Annual Progress Report

- Submit report every year in Fall semester (you will be contacted).
- Helps us monitor the progress of each individual, advise students about the upcoming “milestones”, etc.
- Students who fail to submit are blocked from enrolling in classes.



## Resources

- GMU email will be used for communicating with you.
- Computing
  - VS&E Computing Labs: <http://labs.vse.gmu.edu>
  - Follow online procedure for obtaining account.
- Workspace
  - All GRAs, GTAs, and departmental fellows are assigned space in research centers or labs, or in departmental rooms designated for supported students.

Thanks for your attention...

QUESTIONS?