How to Get Into Graduate School in the USA: A Lecture and Workshop

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Acknowledgments

- Phil Agre, UCLA
  Advice for Undergraduates Considering Graduate School
  http://polaris.gseis.ucla.edu/pagre/grad-school.html

- William B. Thompson, University of Utah
  Applying to Graduate School in Computer Science
  http://www.cs.utah.edu/~thompson/Graduate_School_in_CS.html
Autonomous Vehicle Navigation

• Continuous streams of data
  - Laser range finders, camera arrays, inertial measurement units, GPS, ...

• Demands real-time algorithms
  - Feature detection & tracking, depth inference, mission planning, ...

Air conditioner

40 Computers

Photo compliments of the MIT DARPA Grand Challenge Team, http://grandchallenge.mit.edu/
The Multicore Revolution

Hardware was responsible for improving performance
The Multicore Revolution

Now, performance burden falls on programmers
void->void pipeline FMRadio(int N, float lo, float hi) {

add AtoD();

add FMDemod();

add splitjoin {
    split duplicate;
    for (int i=0; i<N; i++) {
        add pipeline {
            add LowPassFilter(lo + i*(hi - lo)/N);
            add HighPassFilter(lo + i*(hi - lo)/N);
        }
    }
    join roundrobin();
}

add Adder();

add Speaker();
}
The StreamIt Language

- **Applications**
  - DES and Serpent [PLDI 05]
  - MPEG-2 [IPDPS 06]
  - SAR, DSP benchmarks, JPEG, ...

- **Programmability**
  - StreamIt Language (CC 02)
  - Teleport Messaging (PPOPP 05)
  - Programming Environment in Eclipse (P-PHEC 05)

- **Domain Specific Optimizations**
  - Linear Analysis and Optimization (PLDI 03)
  - Optimizations for bit streaming (PLDI 05)
  - Linear State Space Analysis (CASES 05)

- **Automatic Parallelization for Multicores**
  - Compiling for Communication-Exposed Architectures (ASPLOS 02 & 06, dasCMP 07)
  - Phased Scheduling (LCTES 03)
  - Cache Aware Optimization (LCTES 05)
  - Load-Balanced Rendering (Graphics Hardware 05)

- **Migrating Legacy Code to a Stream Representation**
  - Using a Dynamic Analysis (MICRO 07)
What is “Graduate School”?

• People use the term to refer to different things:
  – *Professional school*, such as law, medicine, education, etc.
  – *Master’s programs*, where the highest degree is an M.S.
  – *Doctoral programs*, where the highest degree is a Ph.D.

• In this talk, we focus on doctoral programs

• However, in almost all doctoral programs, one obtains a Master’s degree en route to the Ph.D.
  – Even if you think you might stop with a M.S., it is likely cheaper and higher quality to enroll in a Ph.D. program
Why Enter a Doctoral Program?

• **Because you want to do research**
  – The primary goal of doctoral programs is to train researchers
  – You want to pursue scholarly subjects in great depth
  – You want to make fundamental contributions to a field

• **Because you want to teach at the college level**
  – A Ph.D. is required to be a professor at most universities

• **Reasons NOT to go to graduate school:**
  – You enjoy taking courses
  – You are in a hurry to get a real job
  – You are trying to improve your salary

<table>
<thead>
<tr>
<th>Median salary amongst engineers (1999):</th>
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<tbody>
<tr>
<td>Ph.D. $93,000</td>
</tr>
<tr>
<td>M.S. $74,000</td>
</tr>
<tr>
<td>B.S. $67,000</td>
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*Note: A Master’s degree may be a good financial investment*
Graduate Student Lifestyle

• Graduate school provides a very attractive lifestyle

• You have a large amount of freedom while in school
  – Unlike classes, you can approach research at your own pace
  – You can usually work whatever hours are best for you
  – You can often work from home
  – Your vacation days are extremely flexible
  – You can work on projects not directly related to your degree

• There is an extremely supportive community of peers and mentors
  – Your fellow students share your background and interests
  – A good thesis advisor also serves as an all-around life coach

• There is built-in support for international students

• If you publish papers, there are travel opportunities
  – For me: India, Sri Lanka, South Korea, Hong Kong, France, Singapore, and >20 locations in the United States
Lifestyle Following Graduation

• A research career often maintains much of the freedom of graduate school

• Compared to engineers with a B.S., those with a Ph.D.:
  – Have more responsibility in group projects
  – Have more control over the direction of their work
  – Work on more open-ended problems
  – Are respected in the academic community

• Any job that is available to you with a B.S. is also available with a Ph.D.
  – There is nothing to lose (besides time, money) in grad. school

• Graduate school also provides a unique platform for launching startup companies
  – Companies like Google, Yahoo founded by grad. students
Paying for Graduate School

• Good doctoral programs are usually free for almost everyone who attends. How?
  1. Research assistanceship (RA)
  2. Teaching assistanceship (TA)
  3. Fellowship

• If you apply to a Master’s program rather than a Ph.D. program, it may be very expensive
  – This is one reason to apply to Ph.D. programs
What is Required in a Ph.D. Program?

- Class work
- Qualifying exams
- Master’s thesis
- Research, research, and more research…
- Teaching assistance
- Ph.D. thesis
What is Research?

• Research is the process of creating new knowledge

• As opposed to product development, you focus on:
  – Understanding the fundamentals
  – Developing the most general theory, framework, or approach
  – Exploring high-risk, high-reward ideas
  – Looking ahead 10 to 20 years, rather than 3-5 years
  – Publishing all results in open, peer-reviewed venues

• In academia, research is often associated with:
  – Working on whatever interests you most
  – Focusing on aesthetics, beauty, and learning for the sake of learning, rather than only focusing on immediate applications

“If we knew what we were doing, it wouldn’t be called research”

- Albert Einstein
Examples of Research

(third-party slides omitted from the online version of this presentation)
How to Apply to Graduate School

• Most schools require you to submit the following:
  – GRE scores
  – TOEFL scores
  – Statement of Purpose
  – Grades Transcript
  – 3-4 letters of recommendation
  – Application fee

• A Master’s degree is NOT required to apply to a doctoral program!
Application Timeline

• **Years in advance:**
  – Explore areas of interest
  – Develop relationships with professors who can write letters

• **By Nov 1, 2008:**
  – Take GRE and TOEFL
  – Identify schools of interest
  – Request recommendation letters from professors

• **By Dec 1, 2008:** Prepare drafts of applications

• **In Dec 2008 / Jan 2009:** Submit applications

• **In March 2009 / April 2009:** Receive notifications

• **In April 2009:** Possibly visit schools of interest

• **In September 2009:** Start graduate school!
Where to Apply

• Factors to consider
  – Ranking of program, versus strength of your application
  – Location
  – Size
  – Specific research groups and labs that interest you

• Identifying an advisor
  – Eventually, your relationship with your thesis advisor will likely be the most important aspect of graduate school
  – While difficult to assess from afar, you can identify people of interest by reading journals, conferences, and web sites

• Sources of information:
  – U.S. News ranking of graduate schools
  – CRA Foresythe List
  – National Research Council
Rankings I Will Share with You (U.S. News)

<table>
<thead>
<tr>
<th>Chemical Engineering</th>
<th>Industrial Engineering</th>
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<tr>
<td>Civil Engineering</td>
<td>Materials Engineering</td>
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<tr>
<td>Computer Science</td>
<td>Mathematics</td>
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<tr>
<td>Electrical Engineering</td>
<td>Mechanical Engineering</td>
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<tr>
<td>Engineering (Overall)</td>
<td>Nuclear Engineering</td>
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How to Get Accepted

• If possible, the *best thing you can do* is to perform research as an undergraduate and to publish it
  – Graduate schools are making a big investment when they accept you. If they know you are capable of research, and that you enjoy it, then they are much more likely to take you.
  – If you can publish your research, the venue provides a national or international measure of your quality as a candidate
    • Google “CS Conference Ranking” for best CS conferences

• How to perform research?
  – Ask faculty members if you can assist them with research
  – Continue class projects in new and interesting directions after the class has ended
  – Read journal and conference papers and look for open problems that you can pursue as an independent project
How to Get Accepted (II): Letters of Recommendation

• Letters of reference are extremely important

• It is important to start developing your relationship with your letter writers as soon as possible – possibly years in advance!
  – Try to get involved as a research assistant
  – Ask questions in class
  – Pursue projects outside of class
  – Take leadership in academic and extracurricular activities

• When requesting a letter, give as much information as possible
  – Provide the letter writer with your complete application
  – Possibly draft a few paragraphs describing your strengths and highlighting the outstanding parts of your application
How to Get Accepted (III): Statement of Purpose

- Graduate schools require a “statement of purpose”

- This statement is intended to ascertain:
  - Your interest in a research career
  - Your prior research experience
  - Your understanding of a viable research question

- The statement will be read by experts in your field
  - It is worthwhile to read some conference and journal papers to understand the terminology used
  - Upon entering graduate school, you will not be required to pursue the directions proposed in this statement. Write something that is as scholarly and interesting as possible.

- Ask professors for feedback, and revise several times

- I will send out several samples from MIT grad. students
How to Get Accepted (IV): Targeting Specific Schools

• Many applicants write form letters to professors at schools they are applying to
  – This does NOT help! It is likely to annoy professors.

• However, it can sometimes be helpful to contact professors with feedback on their research
  – Example: carefully read the latest paper from a professor’s research group, and send the author your thoughts and comments
    • Aim for creative and constructive feedback
    • Try to think of things the researchers might have missed
  – If the researcher replies, you can later mention that you are applying for graduate school and would be interested in discussing further
  – If you make an excellent impression, this could possibly influence admission (if the professor is on the committee)
Working Session

- The rest of this session will be in groups, and 1-on-1
- Goals:
  - Get all questions answered about graduate school
  - Construct initial list of schools interested in applying to
- We will move to the computer lab for Internet access

Any Questions?