What's the deal with this "Grad School" thing?

A guide to navigating options for
graduate school as an undergrad

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Northwestern University

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What's this talk about?

Introductions

Why Grad School?

Choosing the Correct Program

The Application Process

Q & A

Tech Talk

Introductions

Who Am I? Griffin @ Clemson

- B.S. in ECE, May 2021
- Co-op at Delta Air Lines, internship at Oak Ridge National Laboratory
- Research in Lossy Compression for HPC
  - Student Cluster Competition
  - Joined Creative Inquiry
- Applied to 5 Ph.D. programs
  - **Northwestern**, UChicago, Georgia Tech, **IIT**, Northeastern University

Who Am I? Griffin @ Northwestern

- Why Northwestern?
    - Collaborations, focus on system co-design
    - Connections to National Laboratories
- Ph.D. in Computer Science, Systems
    - Focused on programmability of extremely heterogeneous systems
- So Far…
    - **Year 1:** Take courses, get involved in research, internship @ Sandia
    - **Year 2:** Finish courses, begin leading projects

Who Am I? with David

- B.S. in CPE, December '22 Graduation
- Research in Lossy Compression for HPC at Argonne National Laboratory
  - ACM best poster SC'22 Award Winner
  - Presented at workshops and poster sessions
- Recently went through the application process for graduate school
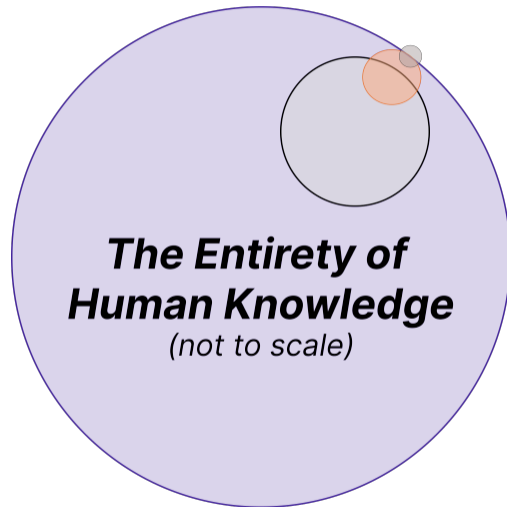- Starting at Northwestern in January '23
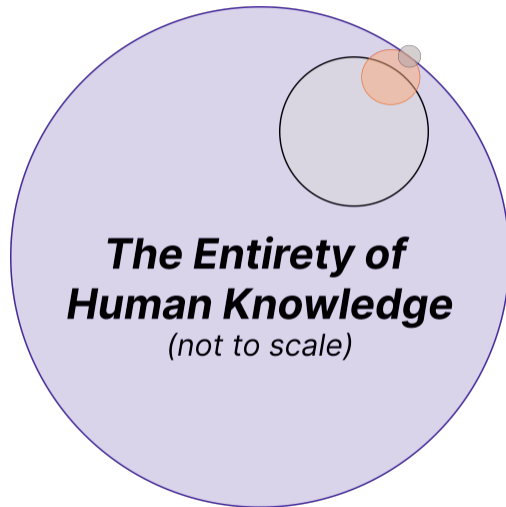
Why Grad School?

What is Grad School?

What is the point of Grad School?

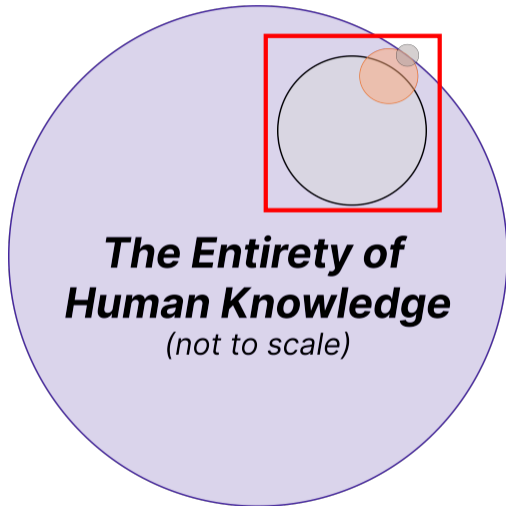***The Entirety of Human Knowledge***
(not to scale)

What is Grad School?

What's the point of education in general?

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What is Grad School?

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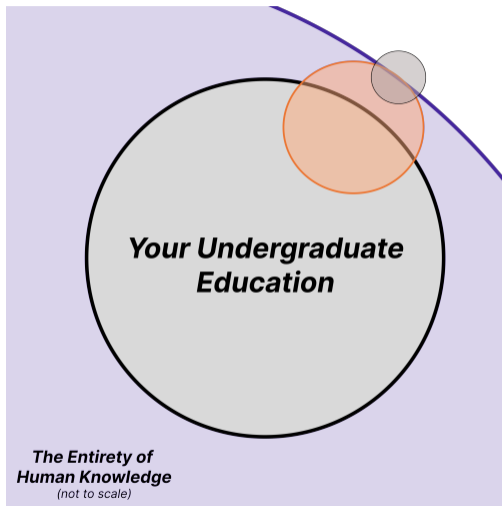

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What is Grad School?

Undergraduate Education fills some of the gaps:

- Very Broad
- Cover an entire field (ideally) in just a few years

Your Undergraduate Education

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What is Grad School?

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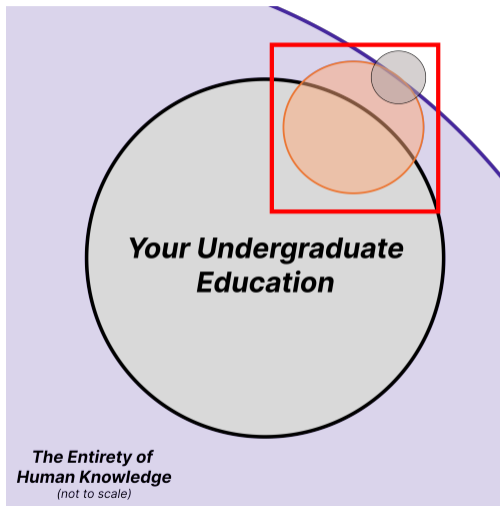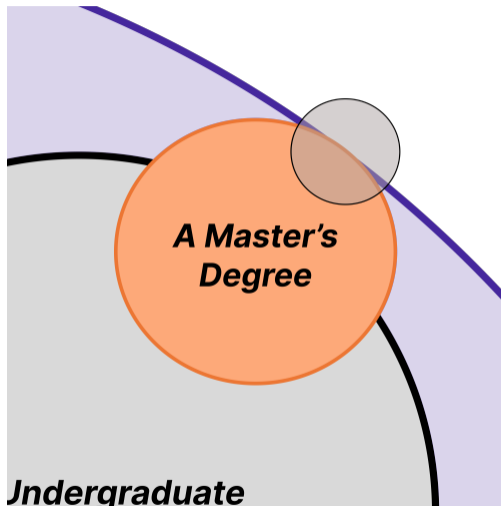- Cover an entire field (ideally) in just a few years

Your Undergraduate Education

The Entirety of Human Knowledge
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What is Grad School?

With a Master's, you can specialize further:

- Focus on a specific sub-field
- May conduct some guided research

A Master's Degree

Undergraduate

What is Grad School?

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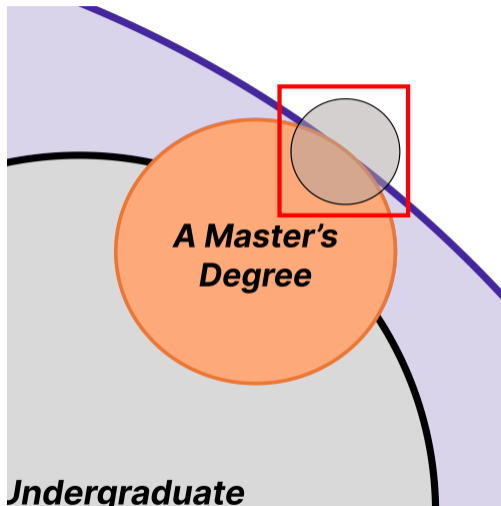- Focus on a specific sub-field
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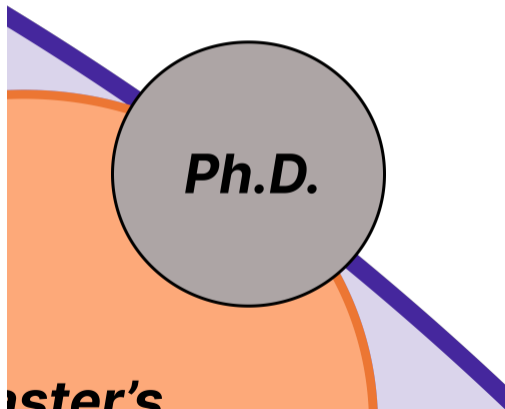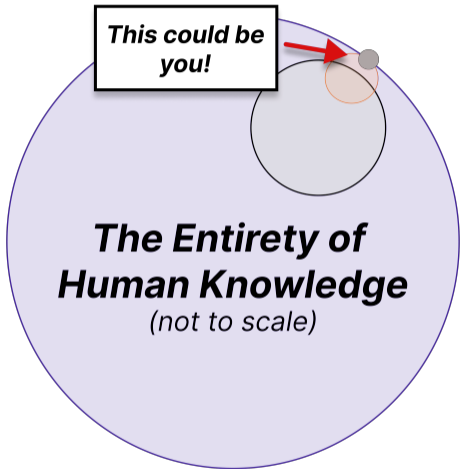

A Master's Degree

Undergraduate

What is Grad School?

In a Ph.D. program:

- Apprenticeship in how to conduct research
- Expand the boundaries of human knowledge

What is Grad School?

This could be you!

The Entirety of
Human Knowledge
(not to scale)

Choosing the Correct Program

Where should I go?

- Search for professors whose research interests align with your own
- Reach out to current grad students at the universities you're interested in
- Consider work-life balance, advisor expectations, and geographical location
- Don't take the decision lightly
  - You'll be spending the next 5+ years there, make sure it's a good fit

The Application Process

Once you found a school that's a fit…

- APPLY!
- What do you need to apply?
    - Personal Statement
    - Research Proposal
    - Resume
    - Recommendation letters

Personal Statement

- Tell me about you
- What have you done during your time at Clemson?
- Why are different than others?
- What is unique to you?
    - Interests
    - Hobbies / Lifestyle

Research Proposal

- What do you have interest in?
- Mention specific professors that you are interested in working with
- Why would this school be a good choice for your area of interest?

Resume

- Have internships + research experience highlighted
- Major plus if you already have publications
- Use Clemson's career center for resume development advice
- Have many people look over it

Recommendation Letters

- Think about three people that you have impressed during your time at Clemson
- How well do they know you?
- Quality is better than quantity
- Give time (minimum 2 weeks) to construct a quality letter

I finished writing all the proposals/letters

- Have other people read them!
  - Peers
  - Advisors
  - Career center
- Restructure your research statement for each school you are applying to
- Make an excel spreadsheet for all schools that you sent applications to share with your recommendation writers
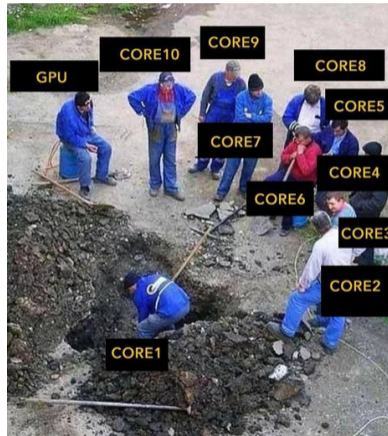
Q & A

Tech Talk

Towards Performance, Portability, & Productivity on Heterogeneous Systems
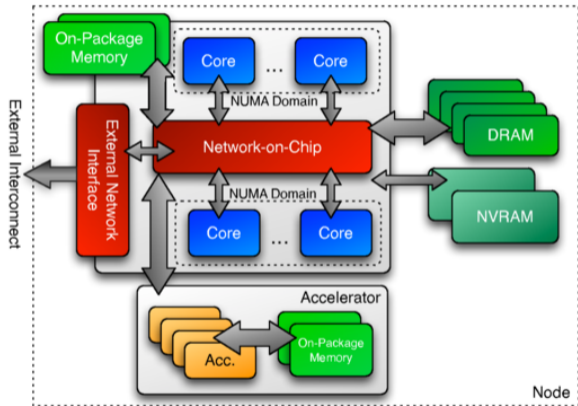
Programming is HARD.

Parallel Programming is HARDER.

- Manage concurrency, synchronization, etc.
- Handle communication of data across threads and processes

What happens when we add heterogeneity?

- The challenges are greatly increased
- We now also have to deal with conflicting programming models

What happens when we add heterogeneity?

- Various programming models attempt to address this
- Kokkos/RAJA, SYCL, OpenACC, Various DSLs
- Template Metaprogramming, Directives, Language Extensions

Co-design to handle heterogeneity

- Approaches bridging the HW/SW stack
  - (PL, Compiler, Runtime/OS, Architecture)
- Take advantage of parallelism in high-level languages (HLLs)
- Writing in HLLs abstracts hardware specific complexity

Proof of Concept: NESL and RISC-V Accelerators

- NESL is a HLL based on ML
- Inherent Parallelism, not reliant on underlying Architecture
- We can match parallel operations in NESL to custom HW Accelerators

```
1 function square(x) = { a * a : a in x };
2
3 % example input to the function %
4 square([1, 2, 3, 4]);
```

Benefits of High-Level Languages

- High level of abstraction promotes portability
- More productive programming (Reduction in LOC)
- Main challenges lie in achieving equivalent performance

Thank you for listening!

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Good Questions to Ask

- Masters vs. Ph.D.?
- I am a (Fr, So, Jr, Sr), what can I do now to prepare?
- How do I find the right university for me?
- How does admissions work from the other side?
- What do professors look for in an application?
- Differences between types of advisors?

Ph.D. vs. Masters

Ph.D.

- You get paid ($30,000-$40,000 per year)
- 5+ years if you're coming straight from undergrad
- Lead larger-scale, long-term research
    - Become subject expert in one particular area
- Masters in Passing Program
    - Earn M.S. degree automatically during first few years of Ph.D.
    - Can be a good alternative if you decide later that a Ph.D. is not for you
- Access to Ph.D. only / Research careers (Academia, National Labs, Industry Research)

Masters

- You *pay* ($30,000+ per year)
- 2-3 years, depending on Masters type (course-, project-, or thesis-based)
- More breadth + depth according to your interests (flexible course requirements)
- Can get involved with or potentially lead a small-scale research project
- Access to similar careers as with undergrad degree, but with higher pay

I am a Freshman/Sophomore, what can I do?

- Do well in courses, **get good grades**
- Talk to older students/professors about research opportunities
    - Get involved ASAP
- Apply for research-oriented internships
    - R&D internships at companies
    - **REU programs** at other universities

I am a Junior, what can I do?

- Take advanced tech electives to explore subject matters aligned to your interest
- Get involved in research
    - Do well in electives
    - Talk to professors
- Start exploring potential graduate programs
    - Find professors doing research you are interested in
    - Take the GRE

I am a Senior, what can I do?

- Reach out to potential advisors
  - One paragraph email expressing interest, asking if they are searching for new students
  - Ask a question about a specific research project/paper to spark a conversation
- Apply to programs
  - Spend time on Statement of Purpose
  - Have trusted mentors proofread
  - Ask for letters of recommendation well ahead of deadlines

The other side of graduate admissions (at Northwestern)

- Applications that meet minimum requirements are compiled into a repository and shared with all professors
    - Professors mentioned by name in the SOP are called out for each student
- Professors may/may not look at the list/details of each application
    - Shows the importance of reaching out before applying
- Professors must **advocate** for an individual's admission
    - May require further communication, an interview, etc.

What do professors look for in applications?

- They are trying to gauge your potential to perform independent research
- Academic rigor (GPA, GRE, performance in coursework, etc.) is a minimum bar to clear
- Experience (Internships, research, etc.)
- Character Traits
  - Motivations for grad school, recommendation letters, etc.
  - Wide range of important skills: work ethic, creativity, leadership
- Interest in their work (will this person want to work on projects I have funding for?)

Highlight these things in your SOP

Different Types of Advisors

- Non-tenured (i.e., Assistant) Professors
    - More helpful with completing projects/more hands-on
    - More opinionated about project direction/goals
    - Push for publications for their tenure portfolio
- Tenured (i.e., Associate/Full) Professors
    - Less involved in day-to-day of projects
    - Give students more freedom regarding what they work on and how they do it
    - Less motivated to publish quickly
- Every professor is different