GETTING STARTED IN UNDERGRADUATE RESEARCH

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What is Research?

- Collaborative and evolutionary process
  - Standing on the shoulders of giants
- All results advance scientific field
Benefits of Doing Research

• It’s fun!
• Develops skills
  • New programming languages
  • New tools
  • Data analysis
  • Experiment creation
  • Collaboration
• Conversation starter
  • Future employers
  • Grad school applications
• New relationships
Discovering Research Opportunities

• Look locally
  • Department presentations about research
  • Explore faculty member webpages
  • Talk to faculty members

• Think nationally
  • NSF Research Experiences for Undergraduates
  • CRA-W/CDC Distributed Research Experiences for Undergraduates
  • Research universities
    • MIT
    • Princeton
    • Caltech
  • Government agencies and national labs
Choosing a Project

• Does the topic interest you?
  • Read papers or presentations
  • Come up with a question or two
  • Talk to researcher

• Do you like the research advisor’s style?
  • Talk to other student researchers
  • Ask about interaction styles
  • Ask about expectation

• What time can you commit?
  • One unit course
  • 10 hour a week
  • Summer fellowship
Learning About the Problem

- Ask for a couple of related papers or textbooks
- Find additional papers
  - Look at papers cited in this paper
  - Find papers that cite this paper
  - Look at other work by paper’s authors
Reading Technical Papers

• Read introduction to see if interesting
• Decide if paper is worth reading
• Skim for unknown words and look up
• Read paper
• Ask yourself
  • What problem is being solved?
  • Who cares and why?
  • What is the pivotal insight?
  • What is the proposed solution?
  • How effective is the solution?
  • What limitations are there?
Learning the Tools

• Determine what tools you’ll need to use
  • Data collection
  • Data analysis
  • Data visualization

• Find online resources
  • Web pages / Wikis
  • Online examples
  • O’Reilly electronic books
  • Discussion groups

• Familiarize yourself with tool top-down
  • Map out overall design structure of modules
  • Understand role of each module
Designing Experiments

- What question am I trying to answer?
- What data do I need to collect to answer that question?
  - Global metrics vs. local metrics
- How do I collect that data?
  - What mechanism/tool will I use to collect data?
  - What inputs do I need to provide for each test?
  - How do I need to configure the mechanism for each test?
Analyzing Data

• Verify correctness of your tool
  • Create simple tests with known answer
• Verify reasonableness of results
  • Calculate best possible result
  • Calculate worst possible result
  • Is your result in that range?
• Visualize results to detect patterns
  • Try different graph types
  • Use different axes
Best Wishes!

A little step may be the beginning of a great journey.