GETTING STARTED IN UNDERGRADUATE RESEARCH

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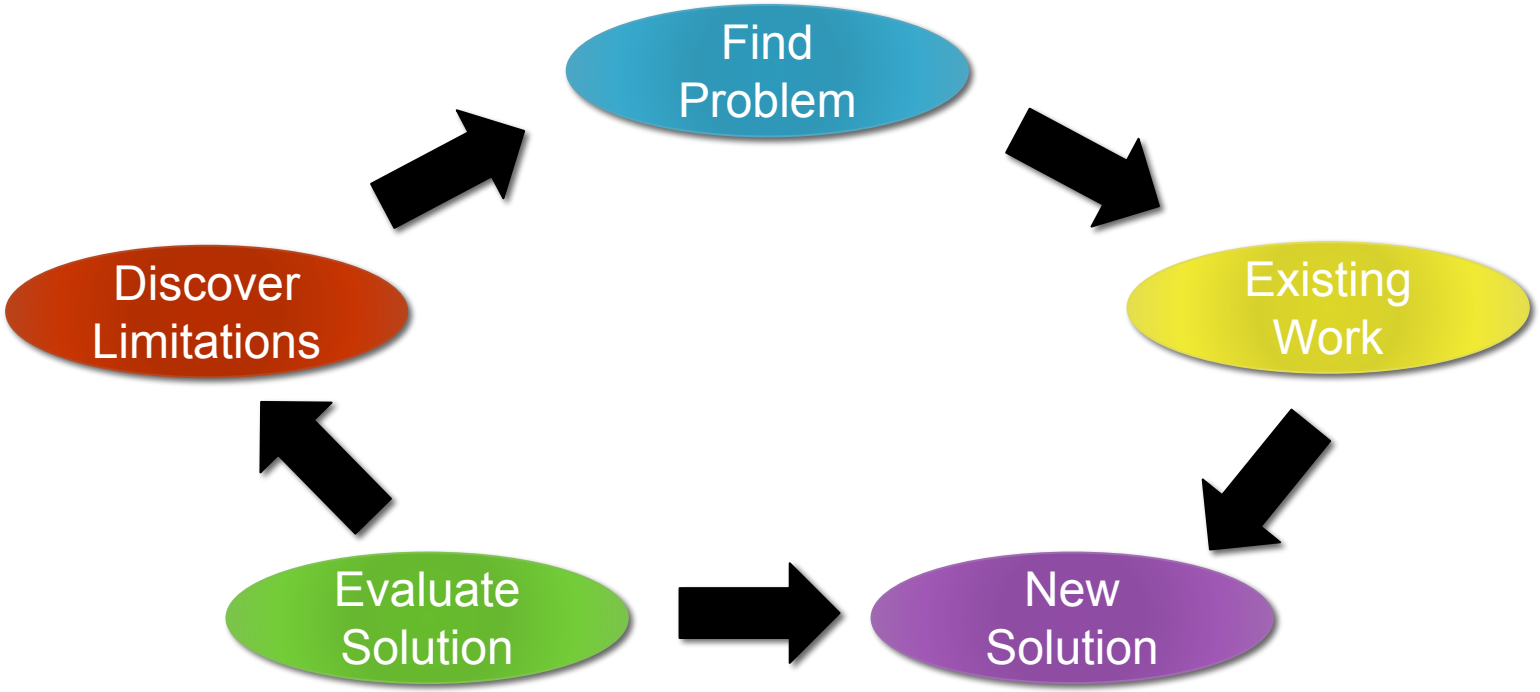
What is Research?



- 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

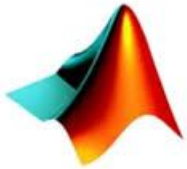
- Ask for a couple of related papers or textbooks
- Find additional papers
  - Look at papers cited in this paper
  - Find papers that cite this paper
  - Look at other work by paper's authors

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

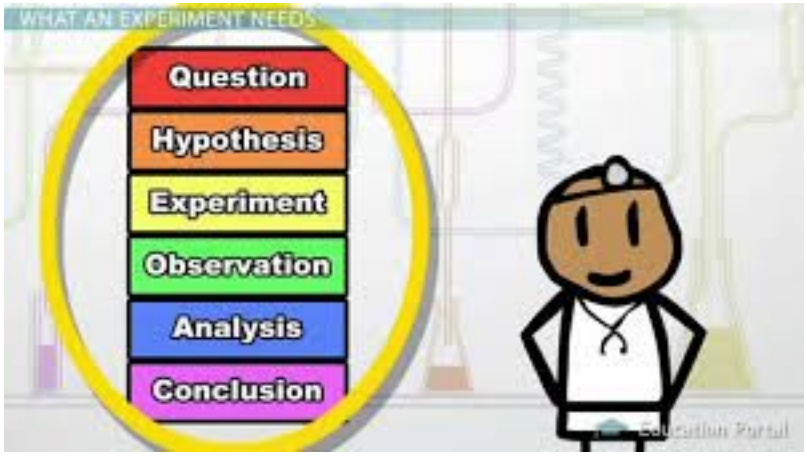
- Determine what tools you'll need to use
  - Data collection
  - Data analysis
  - Data visualization
- Find online resources
  - Web pages / Wikis
  - Online examples
  - O'Reilly electronic books
  - Discussion groups
- Familiarize yourself with tool top-down
  - Map out overall design structure of modules
  - Understand role of each module



MATLAB

O'REILLY

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!