Research For Undergraduates and REU Programs

William Gasarch
PART I

UNDERGRADUATE RESEARCH
What is Research?

Definition Research is working on problems where the answers are not already known.

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1. Extend work someone else did. Example: Redo an experiment but with better design.
2. Simplify work someone else did. Example: Find easier proof of a known theorem.
3. Proof an old theorem a new way. Example: \[|\text{PRIMES}| = \infty\].
4. An improvement on a known technique. Example: Speed up alg by using a different data structure.
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3. Prove an old theorem a new way.

   Example: There are \( \geq 100 \) proofs that \( |\text{PRIMES}| = \infty \).

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   Example: Speed up the algorithm by using a different data structure.
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How to Find a Problem to Work on

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Key You have to work on problems you are interested in.
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Make the problem well defined.
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1. For Math this could be a clean mathematical statement.

Example: Find \( k \) such that every number can be written as the sum of \( \leq k \) 9th powers.

2. For Computer Science this could be a better way to do something.

Example: You want to do a searchable database for comic books. Do a user study, build a prototype.

3. For Science this could be to set up an experiment.

Example: Theory says the Higgs-Boson exists. Let's set up an experiment to find it!

(They found it under Peter Higgs' couch :-).)
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2. **Build skills**
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3. **Build a network** with faculty and students. Useful for the future!
How to Get Involved in Research

1. If you are taking a course you like and the course has a project you can ask the professor if you can keep working on it the following semester.

2. If you are taking a course you like you can ask the professor if they are taking students for research projects. Knock on doors!

3. If your school has some sort of Honors Program, the Honors Chair may help you find someone to do research with.

4. REU programs - this is next part of this talk.
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5. The program has a theme. Examples on next slide.
Examples

The NSF website of REU programs is here: https://www.nsf.gov/crssprgm/reu/reu_search.jsp

Here are topics of a few in Computer Science:

2. Image Processing.
3. Cloud computing.
4. Crypto OR Security OR Blockchain (that's 3 different REUs).
5. AI OR ML OR Data Science3 (that's 3 different REUs).
8. Computational biology. That's another one at UMCP.
9. Biometrics, Cybersecurity, ML (That's 1 REU.)
10. There are many others.
Should you Apply to an REU (for Summer 2024)?

IF some combination of the following hold then you should apply to MANY REU programs.

1. You are thinking of going to Grad School and want to see what research is like.
2. You are definitely going to apply to grad school and want to have a letter from someone you have done research for. (A paper would be good also.)
3. You have an interest in one of the topics on the REU website and want to explore it more.
4. The notion of spending your summer with other people who are serious about computer science appeals to you (as opposed to your partying hallmates).
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1. Apply to about 10 and apply Early. They are very competitive!
2. You need good grades in your Comp Sci and Math classes (and other relevant classes).
3. READ the REU’s website so you know what they want in your statement of purpose.
4. Your statement should have a little on why you like CS and a lot on why you are qualified and interested in their REU.
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