What is undergraduate research?

What is involved in undergraduate research?

Varies a lot depending on the professor or lab!

- Work on a big project with several grad student(s).

- Assisting one grad student/postdoc on their project

- Individual research project supervised by faculty or lab member.

Lots of different activities

- Programming, running simulations

- Data analysis and visualization

- Fabricating devices, building circuits, robots, etc.

- Testing/characterizing devices

- Running subjects in an experiment

- Proving theorems (?)

- Attending lab meetings and reading groups

Why do research as an undergrad?

- Apply class material to real problems.

- Learn new material that's outside the curriculum.

- Develop professional skills / good for potential employers.

- Interested in pursuing a research career/grad school

- Publications! (Maybe)

What you get out of it

- Learning: get exposed to cutting-edge research and new ideas/topics.

- Money: some research positions come with hourly pay.

- Course credit: some research opportunities can give independent study credit.

What research opportunities are out there?

Research programs

Some research opportunities come through summer or semester/year programs:

- Well-defined research question or project

- Work with professor or grad student(s) or in a group project

- Funding (modest) available, so limited number of spots.

Organized research programs

- Semester @ Rutgers: *Aresty* Center

- Summer @ Rutgers: WINLAB internship program

- REU Programs: many universities have them, often sponsored by NSF.

Internships

Summer internships are often about *development* but some are more research-oriented:

- National labs (Sandia, Livermore, Los Alamos, etc.)

- Academic-affiliated labs (Lincoln Labs, Draper Labs, etc.)

- Companies that do R&D work for the government (SRI, Galois, etc.)

Individual research

The most common way to get involved in research is to work with a professor or their lab on one of their ongoing research projects:

- get exposure to the research process

- get a chance to learn things and try things outside of class

- challenging because it's on you to keep going

Research opportunities in Rutgers ECE

- Contact faculty members directly (more on that later).

- Look for posted announcement / advertisement.

- Ask around at this event.

We are trying to figure out the best way to make available opportunities more findable.

Example of a posting

Cyber-Physical Systems Laboratory, Electrical and Computer Engineering, Rutgers University directed by Dr. Dario Pompili is looking for highly motivated students for projects in the areas of accelerating speed of computer vision applications on mobile devices, drone navigation using computer vision techniques, and 3D reconstruction using structure from motion among others.

Any of the following qualifications

1. Experience with Raspberry-Pi

2. Knowledge of an object–oriented language

3. Experience with using OpenCV

4. Knowledge of computer-vision techniques for object detection and tracking

5. Experience with any deep learning framework

We encourage interested students with GPA > 3.5 to send us their resume along with any information about the projects they have done so far (e.g., via GitHub repository).

Parsing the posting

- Research is *more challenging than coursework* : if you have a weak performance in relevant courses, it will be hard to do research.

- Research often involves using *additional tools*: learning other languages (C/C++, Python, etc.) or experience with software packages (OpenCV, pandas) or experience with platforms (Raspberry Pi) are things you might want to learn outside of class.

- Research involves *communication*: having a GitHub repo or other (public) documentation is useful.

How to start doing research

Getting involved in a research project

1. Look around at faculty homepage and their research interests or recent publications (see also Google Scholar)

2. Try to read the abstract/intro of a paper:

   - What real-world issue this paper is trying to address?

   - What kind of work is involved? Programming? Designing circuits? Lots of experiments and comparisons? Proving theorems?

3. If it seems interesting, email the professor.

How *not* to email

Dear professor,

I hope you are doing well! My name is [REDACTED] and I am very interested in doing research in your exciting lab. Please let me know if you have time to meet with me.

Sincerely,

[REDACTED]

A checklist

👍 Send an email to that professor specifically

👍 Mention why you are generally interested
in research

👍 Mention a specific paper/work that you
tried to read. Explain what you understood
from it (and/or also questions)

👍 Make a suggestion for a research topic/area

👍 Provide some times where you are available

Example, part 1

Dear Professor Sarwate,

My name is [REDACTED] and I am a sophomore majoring in ECE. I am taking probability this semester and am enjoying it quite a lot. I wanted to get a chance to use what I learned in a non-course setting and I thought doing a research project would be a good way to do that. I was thinking that I might also want to go to grad school in the future.

- **specific address and reasons for research interest**

Example, part 2

I saw from your homepage that you work on applied probability. I tried to read your paper on "High Dimensional Inference with Random Maximum A-Posteriori Perturbations" (https://arxiv.org/abs/1602.03571) but it was a bit challenging for me. I googled "Gibbs distributions" and they seem to be about physics, but I wasn't sure what that had to do with image segmentation (in Figure 1). It sounded interesting though, and I was wondering if you had a project related to that where I could contribute.

- **specific work and indication of effort**

Example, part 3

If you have time to talk about this or other research opportunities, please let me know! I am generally on Busch campus Monday, Tuesday, and Friday, and am free before noon or after 4:40.

Sincerely,

[REDACTED]

- **suggestion of times**

Possible negative outcomes

- **No response:** you can try to email again, but give it a few days. Professors get a lot of emails.

- **I'm busy for the next N weeks, after that is ok:** this might be true, but it also might mean they are too busy to supervise a project. What kind of project are you looking for?

- **I don't have time for another student:** this happens, and don't take it personally.

- **I don't have an appropriate project:** see above.

Summary

If/when you do get an UG research position
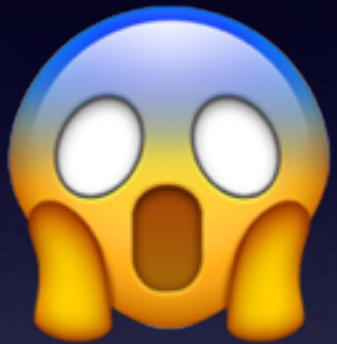
- Be prepared for surprises, good and bad. Some research is

- Stay in communication with your advisor/mentor. Don't ghost!

- Remember why you are doing research and think of how this fits into your goals.

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