Getting involved in research at Rutgers ECE (and beyond)

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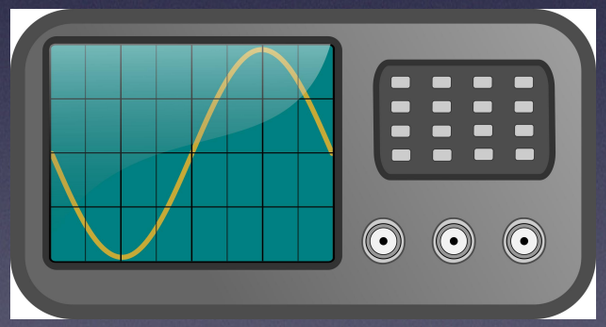
What is undergraduate research?

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?

- See how class topics apply to real problems.
- Learn new stuff not covered in class.
- Develop professional skills: hands-on lab experience, programming skills, *effective communication*
- Explore potential of 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
- Research Experiences for Undergraduates (REU) Programs

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

Work with a professor and research group here at Rutgers. Can take several different forms.

1. Work on a large established project with other students (undergraduate or graduate). Example: developing an underwater drone.

2. Individual research project with a professor. Example: building a GUI to demo machine learning algorithms.

3. Group research project with other undergraduates. Example: research-based capstone project.

How do you find research opportunities @ RU 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.

Example continued

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

- **Coursework/GPA:** need the right background knowledge to contribute. Research can be *more challenging* than classes.
- **Additional skills/tools:** you may need to pick up new languages (C/C++, Python, etc.), new software packages (OpenCV, pandas), or platforms (Raspberry Pi) *outside of class*.
- **GitHub repository:** shows that you have done some independent work and are comfortable sharing it publicly

Exploring potential research opportunities

Do some self-reflection

If you think you want to do research… you should do some some research yourself.

- What kind of technologies, applications, or course topics are interesting to me?
- What am I hoping to get out of a research?
- How can I show *through actions* that I am eager and committed to working on a project?

Pre-research research

Look around at professors' websites.

Check out Google Scholar.
http://scholar.google.com/

What kind of topics do they work on?

Are those topics interesting to you?

If so… dig a little deeper

Investigating projects

1. What projects have they been working on recently?
   Chances are that's what they are working on now.

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?

   This is part of your pre-research research – shows that you have done your leg work!

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

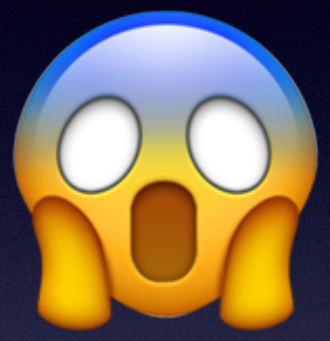
- **No response:** you can try to email again, but give it a few days. Professors get a lot of emails.
- **I'm busy for the next N weeks, after that is ok:** this might be true, but it also might mean they are too busy to supervise a project. What kind of project are you looking for?
- **I don't have time for another student:** this happens, and don't take it personally.
- **I don't have an appropriate project:** see above.

Possible positive outcomes

- you get to work (hard) on an exciting project!
- you learn a ton of stuff!
- you get a great recommendation/reference letter!
- you get your name on a publication!

Final thoughts

If/when you do get an UG research position



- Be prepared for surprises (good, bad, and ugly) Research has a lot of starts and stops.

- 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.