REU-CAAR: You’re Here!
Credit where Credit is Due

Origin of this talk
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- In 2010 a Univ of MD Cybersecurity REU produced a 20-page document:
  - Cybersecurity Scholars Handbook.
- Bill G modified this "boring" handbook into a fascinating ~ 280-slide talk!
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Auguste: Why are you telling them all that?
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  *Cybersecurity Scholars Handbook.*

▶ Bill G modified this *boring* handbook into a *fascinating* ∼ 280-slide talk!

**Auguste:** Why are you telling them all that?  
**Bill:** In academia its very important to credit past work!
Purpose of This Talk

1. Who are the mentors?
2. What are the projects?
3. What is expected of you?
4. What should you expect of us?
5. Nuts and bolts of how the program works.
6. Advice on how to get the most out of this summer!
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REU-CAAR

REU: Research Experience for Undergraduates.
REU-CAAR

**REU:** Research Experience for Undergraduates.

**CAAR:** Combinatorics, Algorithms, and AI for Real Problems.
REU: Research Experience for Undergraduates.

CAAR: Combinatorics, Algorithms, and AI for Real Problems.

Discuss Find a topic within CS that this title does not cover?
REU: Research Experience for Undergraduates.
CAAR: Combinatorics, Algorithms, and AI for Real Problems.

Discuss Find a topic within CS that this title does not cover?

Systems, HCI, Software Engineering, anything else?
REU-CAAR: TEAM!
Mentors

1. Verif. of Quantum Simulation: Andrew C, Dhurv D, Alexy G.
2. Security Estimation for Post-Quantum Crypto: Dana DS.
3. Differential Economics: John D and Ian M.
4. Comparing AI to Human Int. with Regard to Bias: Tom G.
5. Ramsey Theory on Ordered Sets: Bill G.
6. Fair Decision, Resource Allocation, Bias: Furong H.
7. Exploring the Hilbert Geometry: Auguste G. and Dave M.
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- Housing: Jennifer Arseneault
- Your Salary: Jodie Grey
- Lots of Stuff: Sharron McElroy
- Lots of Stuff: Auguste Gezalyan
- Airport, Amtrak Pickups: Darling, Clyde and Alex Kruskal.
- Help with Final Presentations: Clyde Kruskal.
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REU-CAAR:
Very Brief History
The Original Grant

In 2013 Samir Khuller and Bill Gasarch applied to the NSF for an REU grant titled
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2013-2016

From 2013-2016 we had projects in

- Crypto and security (sometimes combined sometimes not)
- Data science
- Ramsey + Something more applied (AI, ML, SAT-Solvers)
- Applied algorithmic graph theory
- Algorithmic Game Theory
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2017-2022

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The AI projects all had a mathematical component.

We changed the name to Combinatorics, Algorithms, and AI for Real Problems.
2017-2022

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Bill G. has been the PI (Principle Investigator) 2013-2024.

2. Samir Khuller was co-PI (co-Principle Investigator) 2013-2019.

3. Samir left UMCP, became chair at NW in Spring 2020. John Dickerson has been co-PI 2020-2024.

4. For 2022-23-24 we got additional money for a helper. In 2022 Auguste is that helper. He will (1) co-mentoring a group, and (2) help Bill with some of the admin.


6. We will share some activities with them.
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5. Jacquelyn Michaelis and Mihai Pop got a grant for REU-BRIDGE, a comp-bio REU program 2022-23-24. We will share some activities with them.
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Program Goals and Expectations
Program Goals

1. **Research!** What is Research? Discuss!
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   Work on problems where the answers are *not* already known.
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1. **Research!** What is Research? Discuss!
   Work on problems where the answers are **not** already known.

2. **Expose you to a variety of career paths.** Discuss!
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   Grad School,
Program Goals

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   Grad School, Industry, Government, Writer for the Simpsons,
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Program Goals

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3. **Build skills**
   Team Work,
Program Goals

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   Work on problems where the answers are not already known.

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3. **Build skills**
   Team Work, Communication,
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   Work on problems where the answers are *not* already known.

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3. **Build skills**
   Team Work, Communication, Project Management.
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3. **Build skills**
   Team Work, Communication, Project Management.

4. **Build a network** with faculty and students.
Program Goals

1. **Research!** What is Research? Discuss! Work on problems where the answers are **not** already known.

2. **Expose you to a variety of career paths.** Discuss! Grad School, Industry, Government, Writer for the Simpsons, Hobo, Other.

3. **Build skills**
   Team Work, Communication, Project Management.

4. **Build a network** with faculty and students. Useful for the future!
What the Program Expects of You

1. Show up every weekday.
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1. Show up every weekday. On time and sober. 10A-4P
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This is the Wrong Way To Look at the program
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I Invite you to talk about jobs you’ve had. I’ll go first.
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1. This program should not be seen as a job where you put in your 8 hours a day and then you’re free to do what you want.
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1. This program should not be seen as a job where you put in your 8 hours a day and then you’re free to do whatever you want.
2. You are here because you care about Quantum or AI or ML or Bias or Ramsey Theory or Geometry or Security.
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3. So you should want to keep working on your projects, perhaps on a lower level, after you go back to the dorms.
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4. Talk to each other in the dorms about your projects!
What the Program Expects of You: Restart

1. **Show up** every weekday.

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**Acronym** SPACE AGE
What the Program Expects of You: Restart

1. **Show up every weekday. On time and sober. 10A-4P.**
What the Program Expects of You: Restart

1. **Show up** every weekday. On time and sober. 10A-4P. You should want to work longer, but prob back in the dorms.

2. **Participate** in assessments such as surveys.

3. **Actively contribute** to your research project and your team.

4. **Check e-mail**. Reminders, notices, requests will be emailed. (I hyphenated email? Why? The original handbook did this and I wanted you to see an interesting piece of history.)

5. **Enthusiasm!**

6. **Attend lunches, talks, and other activities.** (Talks and some activities joint with REU-BRIDGE.)

7. **Great talks:** Attend them and at the end of the semester you will give them. (Joint presentation with REU-BRIDGE.)

8. **Enjoy yourselves!**
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4. **C**heck e-mail. Reminders, notices, requests will be emailed. (I hyphenated **email**? Why? The original handbook did this and I wanted you to see an interesting piece of history. )
5. **E**nthusiasm!
6. **A**ttend lunches, talks, and other activities. (Talks and some activities joint with REU-BRIDGE.)
7. **G**reat talks: Attend them and at the end of the semester you will give them. (Joint presentation with REU-BRIDGE.)
8. **E**njoy yourselves!

Acronym: **SPACE AGE**
What the Program Expects of You: Restart

1. **S**how up every weekday. On time and sober. 10A-4P.
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Your Mentor’s Role

1. **Role modeling:** Their experiences offer clues for your own professional success story.
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1. **Role modeling:** Their experiences offer clues for your own professional success story.
2. **Communication:** Explain the project, answer questions, listen to your concerns and ideas, etc.
3. **Background:** Explain *why* the research is important! How it fits into other things!
4. **Connection:** Help connect you to their colleagues, graduate assistants, others. You will learn as much from them (or more!) as you do from your research tasks!
What Faculty Mentors Expect from You

1. **Communication:**
   - Be clear in verbal & written comm.
   - Seek clarification, ask questions, provide suggestions.

2. **Assertiveness:**
   - Think for yourself and support your own ideas.

3. **Maturity:**
   - Be reliable for what your mentor asks you do do.

4. **Enthusiasm:**
   - Be interested in the project, field, and topic.

5. **Responsible:**
   - Tell team changes that affect your participation.

6. **Adaptability:**
   - Be flexible and open minded.

Acronym: **CAMERA**
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Issues that Probably Won’t Arise But Need to be Discussed
Sexual Harassment and Discrimination

1. Speak directly to the individual in a respectful manner. This will let you immediately know if the different treatment is a misunderstanding or a major problem.

2. If you feel uncomfortable, seek advice and guidance from others. Bill Gasarch, John Dickerson, or Furong Huang (One of the REU-CAAR mentors) can offer assistance and direct you to campus resources for help. Note that in the United State there is Mandatory Reporting: if a mentor or director hears about a case of sexual harassment, they must report it.

3. While this slide is about Sexual Harassment and Discrimination, feel free to talk to Bill Gasarch, John Dickerson, or Furong Huang about any issue, even if it is uncomfortable.
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Do Your Part

Good News That You Know:
1. You get a stipend.
2. You get free room and some meal money.

If you do not do your part you could be asked to leave, which will mean you get less of your stipend. This is RARE! (once in 2014 and once in 2016).

What is 'your part':
SPACE AGE and CAMERA
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SPACE AGE and CAMERA
Complaints In the Past

Over the last year there was only THREE complaints:

- Being Virtual is a Real Downer
  
  This summer the program is in person!
  
  Talks should be at 4:00 instead of 3:00 so can get more done

- Non Citizens Could not get ID cards
  
  and hence had to pay Full Price at the Gym

- Mihai Pop of REU-BRIDGE was amazed this was true.

  I had to remind him that incredibly stupid university rules are not unusual.

- Not enough meat pizza on Game Nights

  I'll do what I can.
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I’ll do what I can.
Complain SOONER Rather than Later

Better to get a problem resolved EARLY, whatever they are.
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Key to a good relationship:
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its finding whose to Blame :-}
Schedule and Activities
You should all know about each others projects:
You should all know about each others projects:

For all projects $p$
First Week++ Talks

You should all know about each others projects:

For all projects $p$
there exists a mentor $m$ for project $p$ and a day $d$ such that
First Week++ Talks

You should all know about each others projects:

For all projects $p$
there exists a mentor $m$ for project $p$ and a day $d$ such that
mentor $m$ gives a talk on project $p$ on day $d$. 
You should all know about each other's projects:

For all projects $p$

there exists a mentor $m$ for project $p$ and a day $d$ such that mentor $m$ gives a talk on project $p$ on day $d$.

In symbols

$$(\forall p)(\exists m, d)[MENTOR(p, m) \land TALK(p, m, d)].$$
First Week - Lunch

1. Monday 12:00-1:00 lunch in IRB.
2. This lunch you will play telepictionary!
3. Tu, We, Th, Fr - Lunch in the union or IRB from your meal card.
4. Bill will join you for lunch some of the first week.
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First Week

1. Red Tape stuff (hopefully ends Tues).
2. Research-Every day.
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Most Weeks

1. Get here by 10:00AM goto your projects room.
2. Research 10:00-12:00 (approx)
3. Lunch 12:00-1:00 (approx). MONDAY lunch IRB
4. Research 1:30-4:00.
5. Talks on Wednesday afternoons at 4:00.
6. Every other Friday you get your paycheck! Don't blow it all on supercomputer time!
7. At night talk about Quantum ML for Security and Ramseyian Geometry
8. Weekends— Explore Washington DC! or College Park!
9. Some of these items may change (e.g., a talk on a Tuesday).
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Explore Washington DC On Your Own AND

1. Very few of you are locals. Use cell phones.
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Other Things We Will Do

1. Field Trip at Spy Museum (Prob a Monday in July).
2. Lunch where we discuss How to do Bad Science.
3. Lunch where we discuss graduate school (with guests).
4. Game Nights with Pizza!
5. Final presentation the last week.
6. Unexpected things will happen! Always expect the unexpected! (Is that a paradox?)
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Summary of Projects and People
Auguste-Dave Geometry Project

1. Exploring Hilbert Geometry

2. Elevator Pitch

Computational Geometry asks questions like Given a set of lines find all of the points of intersection. It is assumed they mean lines in the plane or perhaps $\mathbb{R}^n$. What if you are in another space? A curved space? What can you do? You can do this project!

3. Students

Madeline Bumpus, Caesar Dai, Samuel Monoz, Renita Santhoshkumar, Songyu Ye.
Auguste-Dave Geometry Project

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Auguste-Dave Geometry Project

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1. Exploring Hilbert Geometry

2. Elevator Pitch

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Auguste-Dave Geometry Project

1. **Exploring Hilbert Geometry**

2. **Elevator Pitch**
   Computational Geometry asks questions like *Given a set of lines find all of the points of intersection*. It is assumed they mean lines in the plane or perhaps $\mathbb{R}^n$. What if you are in another space? A curved space? What can you do? You can do **This project!**
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3. **Students** Madeline Bumpus, Caesar Dai, Samuel Monoz, Renita Santhoshkumar, Songyu Ye.
1. Verification of Quantum Simulation

2. Elevator Pitch

When we have quantum computers we will need to verify that their output is correct. One way to do this is to simulate a quantum computer on a classical device. This project will be about how to do that.

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Dana’s Security Project

1. Concrete Security Estimation for Post-Quantum Cryptosystems with Side Information

2. Elevator Pitch

Today’s crypto systems rely on factoring being a hard problem. Quantum computers can, theoretically, factor very quickly. Hence people are already building post-quantum cryptosystems which means those not based on factoring being hard.

What about non-math attacks like side-channel? Are the new systems secure against those? Let’s find out!

3. Students
Michael Gonzalez, Harikesh Kailad, Alexander Lindenbaum.
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1. Differentiable Economics

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How do we divide up goods (e.g., children to schools, organs to patients, muffins) in a fair way? What does fair mean? This project will apply AI/ML to these problems.

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3. **Students** Davidson Cheng, Yang Hong, Reem Al Marzoa, Abdulaziz Memesh.
Tom’s AI-HI Project

1. Comparing AI to Human Intelligence with Regard to Bias

2. Elevator Pitch

Humans are biased. AI systems are biased. We want to, of course, combat this for AI systems (for humans also, but that would be a Psychology REU).

In what ways are human bias and AI similar? different? Can we identify the source of AI bias? Correct it?

We can try!

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Maya Murry, Anneke Wernerfelt, Dalal Ahmidouch.
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3. **Students** Maya Murry, Anneke Wernerfelt, Dalal Ahmidouch.
Bill’s Ramsey Project

1. Ramsey Theory on Ordered Sets
2. Elevator Pitch
   If you color $\mathbb{N}$ (the natural numbers) **red** and **blue**, there will be an infinite $A \subseteq \mathbb{N}$ that is all the same color. As an ordered set, $A$ looks just like $\mathbb{N}$.
   What happens if you color $\mathbb{Z}$ (integers)? $\mathbb{Q}$ (rationals)? $\mathbb{R}$ (reals)? $\mathbb{N} \times \mathbb{N}$? Other sets?
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3. **Students** Joanne Boyland, Nathan Hurtig, Robert Rust.
Furong’s Fair Div and Bias

1. Fair Division, Resource Allocation, and Bias

At one point it was hoped that automating decisions would decrease human bias. But instead there are times when it inherits human bias.

Darn!

This project looks at how to deal with that (and reduce bias) in the context of ML/AI for resource allocation.

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Who is Funding This?

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Pearl Gasarch’s Brother is Irwin Winkler

Irwin Winkler is a producer in Hollywood.

1. Produced over 50 movies
2. Directed 7 movies
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4. Produced Rocky, ..., Goodfellows, Creed 1,2,3
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Irwin Winkler has established a Charitable foundation that gives money to

Where Does the Winkler Money Go?

Things the NSF won't pay for:

▶ Money for housing for non-citizens.
▶ The Monday Lunches.
Irwin Winkler has established a Charitable foundation that gives money to (a) many worth causes and

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Questions from You?

I welcome questions now and anytime!