REU-CAAR:
You’re Here!
Origin of this talk
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- In 2010 a Univ of MD Cybersecurity REU produced a 20-page document:
  
  Cybersecurity Scholars Handbook.
Credit where Credit is Due

Origin of this talk
- Bill G modified this boring handbook into a fascinating ∼ 280-slide 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!

**Auguste:** Why are you telling them all that?
Origin of this talk

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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
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1. Who are the mentors?
Purpose of This Talk

1. Who are the mentors?
2. What are the projects?
Purpose of This Talk

1. Who are the mentors?
2. What are the projects?
3. What is expected of you?
Purpose of This Talk

1. Who are the mentors?
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4. What should you expect of us?
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.
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!
REU-CAAR

**REU:** Research Experience for Undergraduates.
REU-CAAR

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

Discuss a topic within CS that this title does not cover? Systems, HCI, Software Engineering, anything else?
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.
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Discuss Find a topic within CS that this title does not cover?

Systems, HCI, Software Engineering, anything else?
REU-CAAR: TEAM!
1. Classical and Quantum Error Correction: Victor A and Phillip F.
2. Improved Machine Translation for Wikipedia: Marine C and Eleftheria B.
3. Parallel Algorithms for High Dimensional Clustering: Laxman D.
4. Fair Decision Making: Furong H.
5. Exploring the Hilbert Geometry: Auguste G. and Dave M.
Mentors

1. **Classical and Quantum Error Correction:**
   Victor A and Phillip F.

2. **Improved Machine Translation for Wikipedia:**
   Marine C and Eleftheria B.

3. **Parallel Algorithms for High Dimensional Clustering:**
   Laxman D.

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Admin

- **REU-CAAR Director:** William Gasarch.

- **Housing:** Jennifer Bradley.

- **Your Salary:** Jodie Grey.

- **Lots of Stuff:** Sharron McElroy.

- **Arrange REU Lunches:** Deborah Jackson.

- **Lots of Stuff:** Auguste Gezalyan.

- **Airport, Amtrak Pickups:** Rob, Clyde, Auguste.

- **Help with Final Presentations:** Clyde.
Admin

- **REU-CAAR Director:** William Gasarch.  
  Wrote the grant,
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▶ **REU-CAAR Director:** William Gasarch.
   Wrote the grant, finds the mentors,
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Wrote the grant, finds the mentors, does admissions, manages the REU-CAAR website,
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▶ **REU-CAAR Director:** William Gasarch.
   Wrote the grant, finds the mentors, does admissions, manages the REU-CAAR website, makes decisions on housing,
Admin

- **REU-CAAR Director:** William Gasarch.
  Wrote the grant, finds the mentors, does admissions, manages the REU-CAAR website, makes decisions on housing, lunch activities,
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- **Help with Final Presentations:** Clyde.
REU-CAAR: Very Brief History
In 2013 Samir K. and Bill G. applied to the National Science Foundation (NSF) for an REU grant titled
The Original Grant

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**Combinatorics and Algorithms for Real Problems**
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From 2013-2016 we had projects in

- Crypto and Security
- Data Science
- Ramsey and Something more Applied (AI, ML, SAT-Solvers)
- Applied Algorithmic Graph Theory
- Algorithmic Game Theory
From 2013-2016 we had projects in
- Crypto and Security
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▶ Data Science
▶ Ramsey + Something more Applied (AI, ML, SAT-Solvers)
▶ Applied Algorithmic Graph Theory (e.g., Scheduling)
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- Crypto and Security
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- Algorithmic Game Theory
2017-2022

Big change. Projects in the fields above but also
2017-2022

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- Quantum Computing
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The AI projects all had a mathematical component.
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**Combinatorics, Algorithms, and AI for Real Problems.**
The REU-CAAR Grant


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

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

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

5. For 2022-23-24 we got additional money for a helper. In 2022 Auguste is that helper. He will (1) co-mentor a group, and (2) help Bill with a lot of stuff.
The REU-CAAR Grant

1. Grants are for 3 years. Original grant was 2013-14-15.

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Other REU Programs We Will Interact With

1. Mihai Pop got a grant for REU-BRIDGE (Bioinformatics Research in Data science for Economics) for 2022-23-24. This REU program is at Univ of MD at College Park.

2. Maria Cameron got a grant for REU-MATH (Modern Topics in Applied and Pure Math) for 2023-24-25. This REU program is at Univ of MD at College Park.


4. We will share some activities with these REU programs.
1. **Mihai Pop** got a grant for **REU-BRIDGE** *(Bioinformatics Research In Data science for GEnomics)* for 2022-23-24. This REU program is at Univ of MD at College Park.
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   (Modern Topics in Applied and Pure Math) for 2023-24-25.
   This REU program is at Univ of MD at College Park.

3. **Enyue ‘Annie’ Lu** got a grant for **REU-EXERCISE**
   (skipped 2020 because of pandemic).
   This REU program is at Salisbury University.
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Program Goals
and Expectations
Program Goals

1. **Research!** What is Research? Discuss!
Program Goals

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   Work on problems where the answers are **not** already known.
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!
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2. **Expose you to a variety of career paths.** Discuss!
   Grad School,
Program Goals

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   Work on problems where the answers are **not** already known.

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   Grad School, Industry,
1. **Research!** What is Research? Discuss!
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   Grad School, Industry, Government,
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1. **Research!** What is Research? Discuss!
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   Grad School, Industry, Government, Writer for the Simpsons,
Program Goals

1. **Research!** What is Research? Discuss!
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2. **Expose you to a variety of career paths.** Discuss!
   Grad School, Industry, Government, Writer for the Simpsons, Hobo,
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3. **Build skills**

---

**Note:** The text contains typographical errors such as "Team Work," "Communication," and "Project Management." These should be corrected to "Teamwork," "Communication," and "Project Management."
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!
3. **Build skills**
   Team Work,
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!

3. **Build skills**
   Team Work, Communication,
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!

3. **Build skills**
   Team Work, Communication, Project Management.
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4. **Build a network** with faculty and students.
Program Goals

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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.
What the Program Expects of You

1. Show up every weekday. On time and sober.
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   10:00AM-4:00PM
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This is the Wrong Way To Look at the program

I Invite you to talk about jobs you've had. I'll go first.

Upshot

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.
2. You are here because you care about Quantum or AI or Bias or Geometry or Mitigating Climate Change.
3. So you should want to keep working on your projects, perhaps on a lower level, after you go back to the dorms.
4. Talk to each other in the dorms about your projects!
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What the Program Expects of You: Restart

1. Show up every weekday.
What the Program Expects of You: Restart

1. Show up every weekday. On time AND sober.
What the Program Expects of You: Restart

1. **Show up** every weekday. On time AND sober. 10AM-4PM.

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.

5. **E**nthusiasm!

6. **A**ttend lunches, talks, and other activities. (Talks joint with REU-BRIDGE and REU-MATH.)

7. Give talks: Last week you will give a talk about your project. (Joint with REU-BRIDGE and REU-MATH.)

8. Enjoy yourselves!

First letters spell **S**PACE **A**GE. Better for an astronomy REU.
What the Program Expects of You: Restart

1. **Show up every weekday.** On time AND sober. 10AM-4PM. 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.**

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5. **Enthusiasm!**

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

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8. **Enjoy yourselves!**

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Your Mentor’s Role

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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.
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 your team changes that affect your participation.

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

First letters spell out **CAMERA**.
Better for a Vision REU.
Credit Auguste thought of making the first letters spell words.
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Issues that Probably Won’t Arise But Need to be Discussed
Sexual Harassment and Discrimination

1. If you feel uncomfortable, seek advice and guidance from others. Bill, Auguste, or Furong, (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.

2. While this slide is about Sexual Harassment and Discrimination, feel free to talk to Bill, Auguste, or Furong 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
- CAMERA
Do Your Part

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What is ‘your part’:
SPACE AGE and CAMERA
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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Key to a good relationship:

In any problem or dispute that arises the important thing is
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Key to a good relationship:

In any problem or dispute that arises the important thing is **not fixing it** and making things work out

its finding whose to **Blame :-)**
Schedule and Activities
First Week++ Talks

You should all know about each others projects:

In symbols \((\forall p)(\exists m, d)\) \(\text{MENTOR}(p, m) \land \text{TALK}(p, m, d)\).
First Week++ Talks

You should all know about each others projects:

For all projects $p$
First Week++ Talks

You should all know about each others projects:

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there exists a mentor $m$ for project $p$ and a day $d$ such that
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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 $(\forall p)(\exists m, d)[MENTOR(p, m) \land TALK(p, m, d)]$. 
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In symbols

$$(\forall p)(\exists m, d)[\text{MENTOR}(p, m) \land \text{TALK}(p, m, d)].$$
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. Every day of the first week, at 4:00, a talk by a mentor on their project.
3. Research—Every day.
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Most Weeks

1. Get here by 10:00AM go to 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 Thursday 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 Applying Quantum error correction, ML, and Geometry to Mitigate World Hunger
8. Weekends— Explore Washington DC! or College Park! (Check the metro website—lots of trains are not running at times.)
9. Some of these items may change (e.g., lunches, talks may be a diff day).
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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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   Howard U. undergrad Kamala Harris did an honors thesis on Improving Machine Translation for Wikipedia.
   Jill Biden is the first First Lady to have a PhD.
   U. of Del grad student Jill Biden did a PhD on Parallel Algorithms for High-Dimensional Clustering.
Explore Washington DC On Your Own AND

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   (Sergey Brin was a UMCP undergrad, so use Google maps.)
2. Weekends in June: visit Washington DC.
3. Go to the Whitehouse and say hello to President Biden. He increased the NSF funding!
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College Park Metro Station

There is a Metro Stop in College Park.
There is a Metro Stop in College Park. **YEAH!**
College Park Metro Station

There is a Metro Stop in College Park. YEAH!

It will stop running around July 2.
College Park Metro Station

There is a Metro Stop in College Park. **YEAH!**

It will stop running around July 2. **BOO!**
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When it does there are other ways to get to DC.
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**Upshot:** Visit **President Biden** and other DC sights in June.
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Those other ways are a pain. **BOO!**

**Upshot**: Visit President Biden and other DC sights in June.

**Upshot**: There are websites that have metro information- check them before any excursion.
Other Things We Will Do

1. Discussion of Ethics of Research.
2. Discussion of graduate school (with the other 3 REUs).
3. Game Nights with Pizza!
4. Final presentation the last week (with the other 2 local REUs).
5. Unexpected things will happen! Always expect the unexpected! (Is that a paradox? A project for Summer 2024 REU.)
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Summary of Projects and People
1. Classical and Quantum Error Correction

2. Elevator Pitch

Alice wants to send Bob a string $x \in \{0, 1\}^n$. But the channel is noisy! There are ways to send $x$ such that errors will be detected and corrected (if there aren't too many of them.) One way is to send $xxx$. There are better ways CLASSICALLY.

What if you had QUANTUM methods! Can you do better?

They will find out!

3. Students

Michael, Cella, Milan
1. Classical and Quantum Error Correction
Victor and Phillipe Quantum Project

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2. Elevator Pitch

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3. Students Michael, Cella, Milan
Marine-Eleftheria Translation Project

1. Improving Machine Translation for Wikipedia

2. Elevator Pitch

   Machine Translation uses deep learning. This sounds great :-). But it's not :-(. If only we had a large set of texts to experiment on and see what goes wrong.

   We do! Wikipedia.

   This project will use translations of Wikipedia pages to understand and evaluate different Machine Translation Services. The goal is to see when they do badly and find ways to make them better.

3. Students

   Linh, Grace, Angela
Marine-Eleftheria Translation Project

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3. **Students** Linh, Grace, Angela
Laxman Parallelism/Clustering Project

1. Parallel Algorithms for High-Dim Clustering

2. Elevator Pitch

Clustering is taking a set of data and grouping it in meaningful subset. EXAMPLE: take the set of students at UMCP and group them by major and by GPA and by GPA-in-the-major. For a very large dataset this is slow. What to do?

Use a PARALLEL algorithm on a PARALLEL machine. We will implement state-of-the-art parallel algorithms and see how they do!

3. Students

Papa, Mohammad, Andrew
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3. **Students** Papa, Mohammad, Andrew
Furong’s Fair Decision Making

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 decision making.

Students
Selena, Amy, David
1. Fair Division Making

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3. **Students** Selena, Amy, David
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

Zofia, Sally, Daniel, Carlos.
1. Exploring Hilbert Geometry
Auguste-Dave Geometry Project

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3. **Students** Zofia, Sally, Daniel, Carlos.
Aviva’s Markov Decision for Climate Risk

1. Using Markov Decision Processes to Mitigate Climate Risk

2. Elevator Pitch

Farmers in India need your help! Small changes in climate lead to big changes in when to plant crops. They need to predict the weather AND tie that into decision making for crop planting.

We will use MATH and AI to do this!

3. Students

Nick, Jasmine
Aviva’s Markov Decision for Climate Risk

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3. **Students** Nick, Jasmine
Who is Funding This?

1. National Science Foundation (NSF).

Great!

2. Google/An Zhu (An Zhu was an undergrad at UMCP who worked in Theory).

Great!


Great!

4. Other Schools mini-grants pay stipends.

Great!

5. KAUST: King Abdullah University of Science and Technology. They want to foster good relations between Saudi Arabia and America. They fund students from Saudi Arabia who are already at American Schools, to go to REU programs.

Great!

6. 3 unpaid local students

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7. The Winkler Foundation.

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7. The Winkler Foundation. Who?
Irwin Winkler

Bill Gasarch’s Mother is Pearl (Nee Winkler) Gasarch
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Pearl Gasarch’s Brother is Irwin Winkler
Bill Gasarch’s Mother is Pearl (Nee Winkler) Gasarch

Pearl Gasarch’s Brother is Irwin Winkler

Irwin Winkler is a producer in Hollywood.

Why am I telling you this?
Irwin Winkler

Bill Gasarch’s Mother is Pearl (Nee Winkler) Gasarch

Pearl Gasarch’s Brother is Irwin Winkler

Irwin Winkler is a producer in Hollywood.
  1. Produced over 50 movies
  2. Directed 7 movies
  3. David Selznick Lifetime achievement award for producing
  4. Produced Rocky1,..,6, Goodfellows, Creed 1,2,3

For more about him: https://www.imdb.com/name/nm0005563/?ref_=fn_al_nm_1

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Why am I telling you this?
Irwin Winkler has established a charitable foundation that gives money to
The Winkler Foundation

Irwin Winkler has established a charitable foundation that gives money to (a) many worth causes and
Irwin Winkler has established a charitable foundation that gives money to (a) many worth causes and (b) our REU!
Adam Winkler is Irwin’s son who administers the foundation.

Adam Winkler has written two books:

- Gunfight: The Battle over the Right to Bear Arms in America
- We the Corporations: How American Businesses won their civil rights

The last book got this review:

It is deeply shocking that We the Corporations is not boring.

Also, the last book was a nominee for the National Book Award.
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Show me the Money!

Where Does the Winkler Money Go?
Things the NSF won’t pay for:

- Money for housing for non-citizens.
- The REU Lunches.
- Misc.
Show me the Money!

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- Misc.
Does Where You Got Your Funding Matter? NO

1. Some of you are NSF funded.
2. Some of you are KAUST funded.
3. Some of you are Iribe funded.
4. Some of you are Google/Zhu funded.
5. Some of you are funded by your own school/Winkler/UMCP.
6. Some of you are not funded.
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None of this will matter except:

1. Google/Zhu & Iribe students will write letters of thanks.
2. KAUST may ask their students to fill out forms.
3. Unpaid students: no emails about travel or forms.
4. Non-citizens can’t get ID cards.
My Wife Says that if I Lie to You I Must Tell You
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Exploring the Hilbert Geometry.
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Joe Biden’s Senior Thesis was not on
Exploring the Hilbert Geometry.
It was on
Classical and Quantum Error Correction.
Questions from You?

I welcome questions now and anytime!