What is Undergraduate Research?

- Undergraduate research refers to independent original investigations conducted by undergraduates.
  - Assisting professors with their research.
  - Same skills as graduate research but with more supervision and less scale of contribution.

- Graduate Research
  - Produce original research
  - Defense
  - Broad research abilities
    - Communication – write, present, talk
    - Experimentation
  - Scholarship
    - highest standards of integrity, accountability, and responsibility
  - Funding
Funding cycle

1. Write a grant
2. Get funded
3. Pay tuition/fees/stipend for students
4. Produce research work
5. Publish research
6. Get well known/accepted by scientific community
A piece of the puzzle

- Student
- Team
- Professor
- Research Topic and Laboratory

Produce results
Typical scenario

Professor (ALMIGHTY)

PhD Student

Master Student

Undergraduate Student
CAHSI/ARG

- CAHSI
  - Computing Alliance for Hispanic Serving Institutions
  - Interventions
    - Undergraduate Research
    - ARG
      - Affinity Research Group model
        - Student is tough skills
# ARG vs Traditional

<table>
<thead>
<tr>
<th>Traditional</th>
<th>ARG</th>
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<tbody>
<tr>
<td>Only students with both technical and soft skills will participate.</td>
<td>Some technical background, may lack soft skills, skills deliberately taught and modeled.</td>
</tr>
<tr>
<td>Advanced students only</td>
<td>Students with ability to learn or interest</td>
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<tr>
<td>Expert student</td>
<td>Create an expert</td>
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<tr>
<td>No core purpose</td>
<td>Core purpose decides who joins group.</td>
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Core purpose?

- Thrive for excellence
- Passionate about work
- Integrity / ethics
- Pillars of character
  - Trustworthiness
  - Respect
  - Responsibility
  - Fairness
  - Caring
  - Citizenship
Johnson Institute Pillars of Character

- **Trustworthiness**
  - Be honest • Don’t deceive, cheat, or steal • Be reliable — do what you say you’ll do • Have the courage to do the right thing • Build a good reputation • Be loyal — stand by your family, friends, and country

- **Respect**
  - Treat others with respect; follow the Golden Rule • Be tolerant and accepting of differences • Use good manners, not bad language • Be considerate of the feelings of others • Don’t threaten, hit or hurt anyone • Deal peacefully with anger, insults, and disagreements

- **Responsibility**
  - Do what you are supposed to do • Plan ahead • Persevere: keep on trying! • Always do your best • Use self-control • Be self-disciplined • Think before you act — consider the consequences • Be accountable for your words, actions, and attitudes • Set a good example for others

- **Fairness**
  - Play by the rules • Take turns and share • Be open-minded; listen to others • Don’t take advantage of others • Don’t blame others carelessly • Treat all people fairly

- **Caring**
  - Be kind • Be compassionate and show you care • Express gratitude • Forgive others • Help people in need

- **Citizenship**
  - Do your share to make your school and community better • Cooperate • Get involved in community affairs • Stay informed; vote • Be a good neighbor • Obey laws and rules • Respect authority • Protect the environment • Volunteer
Study yourself

Do you share the same core purpose?
Advantage of working in UR

- Develop communication skills
  - Write
  - Present
- Teamwork
- Expert in a topic
- Contact with faculty (mentoring)
- Exposure
Topics
Research Topics

- Hyperspectral images on GPUs and CUDA for detection
  - BIAT
- Hyperspectral algorithms for FPGAs
- Cloud
Research topics

- CUDA/C/GPU
  - Hyperspectral Images
  - Detection algorithms
  - GPU
  - Cuda

- Skills
  - Program in C
    - Pointers
    - Malloc
    - API
    - Mem management
    - Using external libraries

- Plus
  - Linux
  - Repositories
  - Library / SW Eng
Hyperspectral Image
GPU and CUDA
Reed Xiaoli Detection
Learning

C → Detection Algorithm → GPU → CUDA → Parallel Programming → Optimize → Library Testing Repos.
Cloud Computing

- Virtual Machine

- Skills
  - Java
  - Web Technologies
FPGAs

- Field Programmable Gate Arrays
  - Continuation
  - Abundance Estimation algorithm
    - ISRA
    - Hyperspectral
    - FPGAs
      - Functional Units

- Electronics
  - VHDL/Verilog (HDL)
  - Architecture
  - Digital Design/ synthesis
FPGAs

- **Steps**
  - Create a design
  - Logic Components
  - Test / verify
  - Synthesize

- **Skills**
  - Electronics
  - Digital
  - Language (OO)
  - Architecture is +
Other

- Nature inspired optimization algorithms
  - Evolutionary algorithms
    - Genetic algorithms
    - Simulated annealing
  - Swarm intelligence
  - Ant colony optimization

- Optimize what?
  - Circuit Design
Logistics
The logistics of undergraduate research

- Initial meeting
  - Know each other, develop community of research

- ARG meetings
  - 5 skill development workshops
  - Hands on
  - Suggestion: one Saturday

- Weekly meetings
  - One hour
  - Progress

- Deliverables
  - Mid and final report
  - Happy Hours, Exam (this semester)
  - Posters
  - Paper
  - Presentation
  - Travel (not always)
Meetings

- Computing Research Laboratory
- CRL
  - Rules lab
    - Be nice
  - Access restricted
  - No one else is allowed
My compromise
Trainings

- Offer trainings
- Available for questions
- Facilities
Requirements

- Time!
  - If you do not have 10 hours a week for research, do not apply.
- Interest and dedication
- Willingness to work
- Respect for others
- Service attitude
- Basic Skills (more)
Basic Skills

- **GPU/CUDA**
  - Program in C
    - Pointers, Malloc, API, Mem management, Using external libraries
    - Plus
      - Linux, Repositories, Library / SW Eng

- **FPGAs**
  - Digital, logic circuits, programming
  - Plus: VHDL or Verilog, Architecture

- **Cloud**
  - Servers
  - Java
  - Web Technologies (HTML, CSS, Javascript)
  - Linux
Selection for research

- Resume
- Transcript
- Diagnostic Exam
  - January 10-12, 2011
  - Test skills related to your work
Questions

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