EFFECTIVE TEACHING TACTICS

Helen Hu, Westminster College
Susan Rodger, Duke University

CRA-W.org
@CRAWomen

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Computing Research Association
Widening Participation

What is CRA-WP?
Individual & Group Research Mentoring

Undergrads: Undergraduate Research Experiences (CREU & DREU), Research-Focused Scholarship opportunities at GHC (GHC Research Scholars)

Grad Cohort: Group Mentoring of Graduate Students (Grad Cohort for URMD & Grad Cohort for Women)

Grad Students & Academics/PhD Researchers: Mentoring Tracks @ GHC, Returning Scholars @ GHC, Group Mentoring for Early & Mid Career @ CMW

Undergraduates → Graduate Students → Academic careers / Industry/government labs

2400+ students & PhDs a year

Stay in touch: cra.org/cra-wp, Twitter: @CRA_WP, Facebook: CRA-WP, Linked-in: CRA-Widening Participation

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Susan Rodger

Intro #1: The Technical Me…

- NCSU - BS Math & CS
- Purdue - PhD
- Rensselaer - Assist Professor
- Duke - Professor of the Practice
- Research: Visualization, algorithm animation, CS education

Intro #2: Non-Technical Me

- Married
- Kids: Two boys (grown)
- 3 cats, over 200 fish
- Other fun: swimming, running, write Wikipedia pages, baking
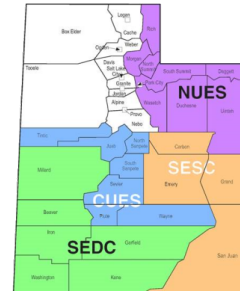
Helen Hu

Intro #1: The Technical Me…

- Princeton - BS in CS
- University of Utah – PhD
- Westminster College – Assistant, Associate, Full Professor, and currently Chair of the Department
- Research: K-12 CS Ed, POGIL in CS

Intro #2: Non-Technical Me

- Married, two children (one son, one daughter)
- Ice Hockey, Girl Scouts
- Love travel, hiking

SIMPLE IDEAS TO TRY

Here is a slide for the first day…

Classroom rule:

NO SITTING IN THE LAST FOUR ROWS!

Come join the rest of us!

Get students closer to you

Quick Poll: Who's in the room?

Current instructors?

       Average class size?

TAs?

Students who plan to teach someday?

High school teachers?

Ways to select students to answer questions

Problem – same students always eager

How do you get other students to participate?

- Randomly call on them (card for each student)
- Keep track of who has spoken already
- Work in groups – call on group
- Assigned groups – call on group numbers

Read the book

Read before coming to class
- Ready to work in class

Reality
- Run out of time to read, not prepared

Bring on – Reading quizzes
- Online (Sakai, Blackboard, etc)
- Turn off when class starts

What is the output of the following:

```
alist = [6, 3, 4, 9]

del alist[1]

print alist
```

A. [6]

B. [3, 4, 9]

C. [6, 3, 4]

D. [6, 4, 9]

Reset Selection

Have an engaging book….

Runescape (Brad Miller)

Here is the program in activecode. Note that the function definition is the same as it was before. All that has changed is the details of how the squaring is done. This is a great example of "black box" design. We can change out the details inside of the box and still use the function exactly as we did before.

Run | Save | Load | Show in Codelens

```
1  def square(x):
2      runningtotal = 0
3      for counter in range(x):
4          runningtotal = runningtotal + x
5
6      return runningtotal
7
8  toSquare = 10
9  squareResult = square(toSquare)
10 print("The result of", toSquare, "squared is", squareResult)
11
```

ActiveCode: 1 (sq_accum1)

Pair Programming

Students work on problem with one computer in pairs

- "Driver" and "navigator" - rotate often
- Shown to improve student learning outcomes and retention

Interactive Lecture Notes and Handouts

Create two versions of lecture notes

Slides with missing parts

Release complete slides later

Instant Feedback in Lecture

Clickers

Google forms

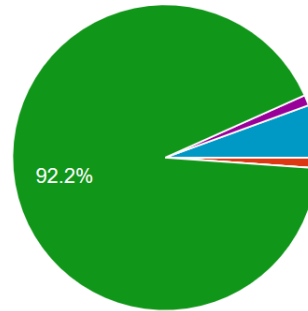What's printed from the first statement under main numbered # 1? *

○ "Go"

○ "Go3"

○ "Go*3"

○ "GoGoGo"

○ None

○ Nothing is printed

(180 responses)

92.2%

- ● "Go"
- ● "Go3"
- ● "Go*3"
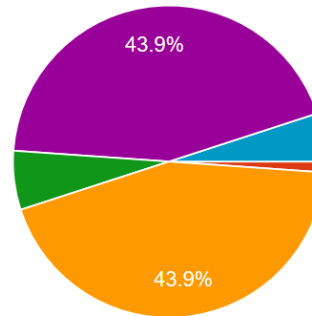- ● "GoGoGo"
- ● None
- ● Nothing is printed

Instant Feedback in Lecture

What's printed from the second statement under main numbered # 2? *

(180 responses)

- "Go"
- "Go5"
- "GoGoGoGoGo"
- None
- "GoGoGoGoGo" and None
- Nothing is printed

Legend:
- "Go"
- "Go5"
- "GoGoGoGoGo"
- None
- "GoGoGoGoGo" and None
- Nothing is printed

43.9%
43.9%

Setting up Google Forms

Make it easy for students to get the form

TECHNIQUES

Think - Pair - Share

Collaborative Learning Strategy

- First answer question individually
- Partner with peer to develop answer
- Share answer with class

Advantages:

- Increases classroom participation
- Higher confidence in reporting ideas to class
- More productive classroom discussions

Adding active learning to your classroom:
A spectrum from tiny tweaks to significant overhaul

Got workshop new idea fatigue?

Don't beat yourself up!

Choose the amount of change you're ready to make:

Minor tweaks   Significant overhaul

⟵——————————————————————————⟶

More traditional   Pervasive active learning

- Every little bit helps! The more active learning, the more students benefit.
  - Chi, Michelene T. H. & Ruth Wylie The ICAP Framework: Linking Cognitive Engagement to Active Learning Outcomes. Educational Psychologist Vol. 49 , Iss. 4,2014

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Classroom Assessment Techniques (CATs)

Simple, Non-graded, In-class Activities

- Exit Tickets
- Muddiest Point (what was most confusing topic today)
- One Minute Papers (what was most important topic learned today)
- Student Generated Test Questions

Pervasive Active Learning

Long List for Reference

- Peer Instruction (PI)
- POGIL (Process Oriented Guided Inquiry Learning)
- PLTL (Peer Led Team Learning)
- PBL (Problem Based Learning)
- Studio Based Learning

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What else have you tried in your classes?
What else *could* you do?

Think - Pair - Share

Every little bit helps! The research shows the more active learning, the more students benefit.

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Pushback

Faculty Colleague Resistance

- What pushback might you get if you tried to recruit a colleague to do active learning?

- How would you respond?

Student Resistance

- What pushback might you get from students for doing active learning?

- How would you respond?

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# POGIL - Process Oriented Guided Inquiry Learning

HOW students learn is as important as WHAT they learn

Process Oriented:
Designed with intent to teach process skills

Guided Inquiry:
Guide students to explore and discover concepts for themselves

Targeted Process Skills:
- Information Processing
- Critical Thinking
- Problem Solving
- Communication
- Teamwork
- Management
- Assessment

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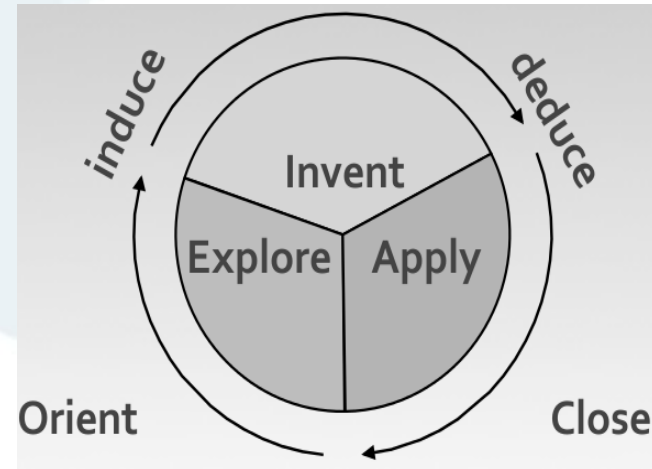
POGIL Resources

How To Learn More

http://www.pogil.org
- Educators: Implementation Guide

POGIL Workshops
- 3-day summer workshops
- 1-day workshop on request

POGIL Activities

CS 0 in AppInventor
- http://tinyurl.com/CSPpogil

CS 1 in Java and Python:
- http://introcsPOGIL.org

CS 2 in Java
Software Engineering
Cybersecurity
Discrete Math

http://www.CSpogil.org

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POGIL in Introductory CS

IntroCS-POGIL Project

http://www.introcspogil.org

- Looking for cohort teaching CS1 in Java or Python in 2020-2021
- Mentoring
- Stipend
- Travel Funds to attend POGIL workshops

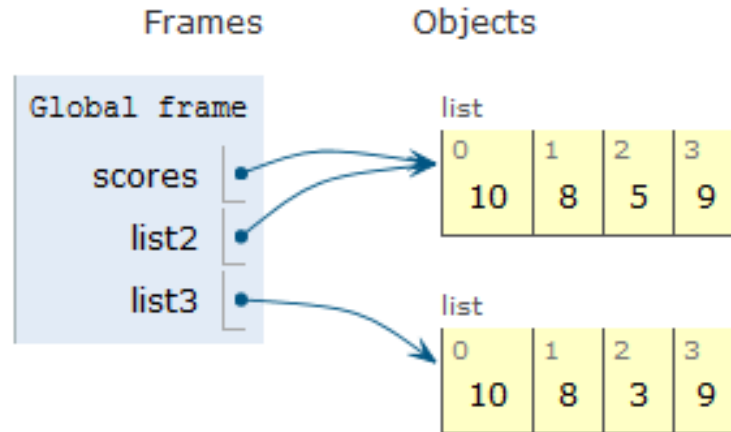# USING ANIMATIONS/SOFTWARE TOOLS AND PROPS IN CLASS

Use Engaging and Visual Tools
Example: Python Tutor
www.pythontutor.com

Active Learning

- CS Unplugged – csunplugged.org
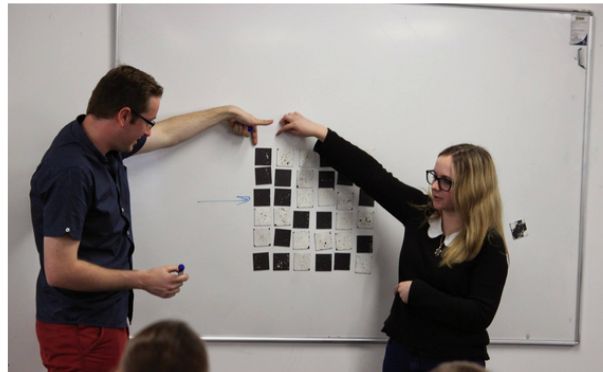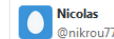
Parson's Problems
Example: Runestone Academy

Mixed-up code examples that students put in order

7-22-2: The following program segment should fill an array with elements that count up from 0 to 50 by 5 (0, 5, 10, 15, 20...). But the blocks have been mixed up. Drag the needed blocks from the left and put them in the correct order on the right. Click the *Check Me* button to check your solution.

Drag from here

Drop blocks here

```
System.out.println(arr[i]);
```

```
arr[i] = i * 5;
```

```
for (int i = 0; i < 11; i++) {
```
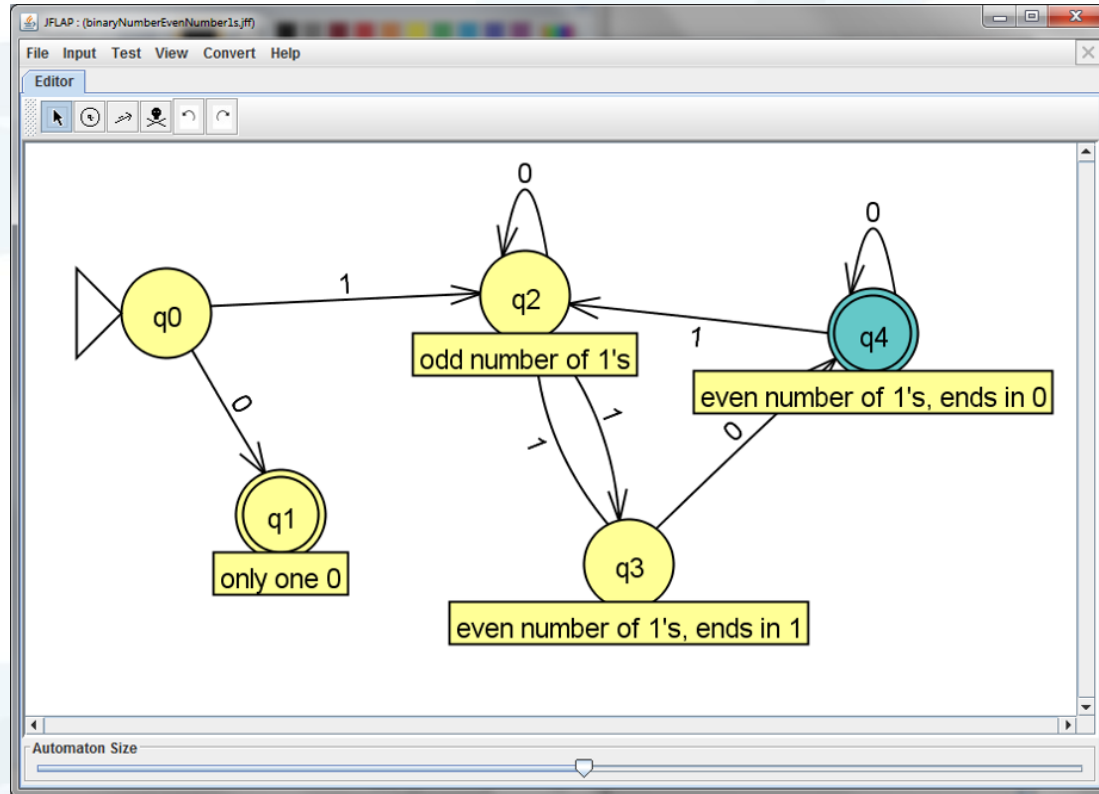
```
}
```

```
int[] arr = new int[11];
```

Check Me   Reset   Help Me

Teaching Automata with JFLAP

Passing Parameters in Class

Pass by reference – throw frisbee

Pass by value – throw copy of frisbee

Pass by const reference – throw "protected" frisbee

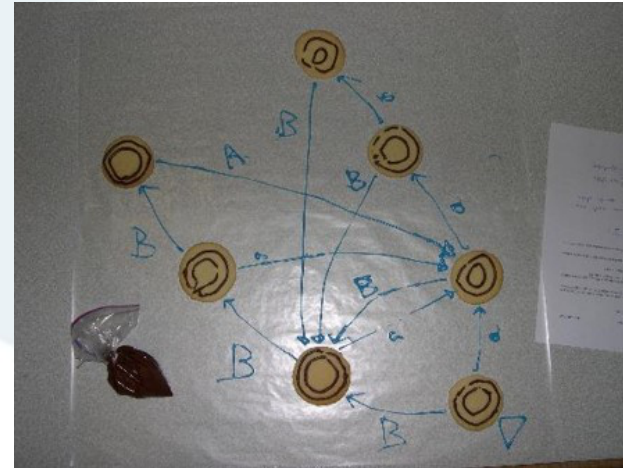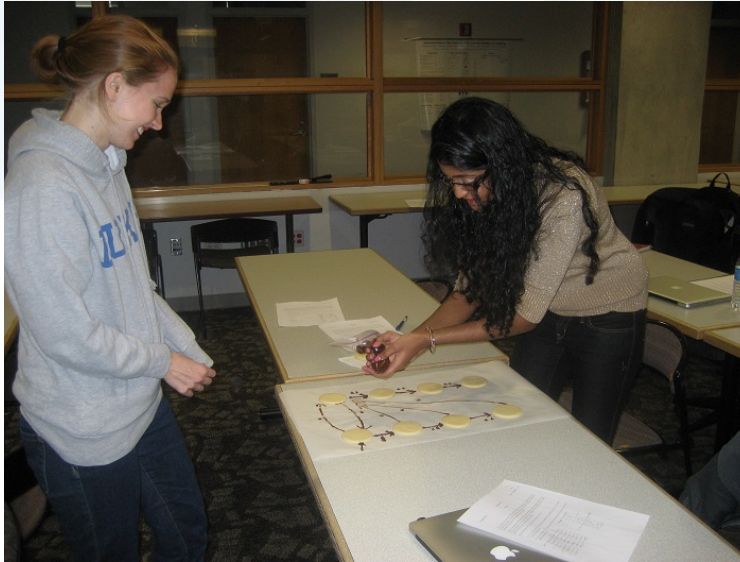# Ways to use playing cards: www.cs.duke.edu/csed/wikipedia

Insertion Sort

Card Class – shuffling, dealing hands

Poker hands – Full house, Flush, etc.

Edible Computer Science

SURVIVAL

How to Survive Large Courses

- Cut back on Email
- Use Bulletin Board – like Piazza
  - Students can post anonymously
  - Lots of people can be answer questions
  - You can endorse answers
- Manage with google forms
  - Form if you are sick and need extension
  - Form if you get test accommodations
  - Form to sign up for alternate exam time
  - Form to request a regrade
- Automate Grading of Assignments

Duke: large = 300-350

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Assessing Course/Teaching

- Course Evaluation – end of semester
    - These matter to your Dept/University
    - What do the majority say, ignore outliers
- Get feedback earlier – do your own
    - Have anonymous form for feedback and encourage
- Get Someone to sit in and provide feedback
- Determine what you need to improve on

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Teaching Assistants Undergraduate/Graduate

- Mandatory training session
    - Behavior - Don't date your students
    - How to help someone
    - What not to do
- Link to Duke site
  www.cs.duke.edu/courses/spring15/compsci101/training/
- Meet weekly with them
    - Make them do X before they help students with X

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Improving Teaching

- Is there a teaching and learning center?
- Video tape yourself and watch it
- Class boring? Voice monotone?
  - Practice tongue-twisters
  - Take theatre or public speaking course
  - Toastmasters
- Talk too fast? Note to remind to slow down
- Don't move? Start moving around
  - Get a wireless/laser presenter

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Improving Teaching Attend SIGCSE

- Conference focuses on CS Education
  - Papers, Panels, Workshops, BOFs
  - Attend every year, always get new ideas to try in your courses
  - Friendliest and Cheapest Conference
  - CRA-W Mentoring Workshops every other year
- If you can't attend, check out SIGCSE papers in ACM Digital Library

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Commit to Try Something New

Share ideas at your table

Enter something you want to try:
http://bit.ly/ghcTeach

We will email you a reminder next week (and only one reminder).

Slides available: bit.ly/cra-teaching-2019

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THANKS

Please rate and review the session in the GHC 19 mobile app

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