Effective Teaching and Class Management

CRA-W Early CMW

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What is Professor "of the Practice"?

- Position exists in many departments at Duke
  - About 20% of Arts and Sciences Faculty
- PhD preferred, or appropriate professional experience
- Non-tenure track, permanent position, promotable
- Renewable contracts (4 –8 yrs)
- Focus on "education in the discipline"
- Focus on undergraduates
- Main tasks
  - Teaching (2 courses per semester)
  - Research (related to education) – grants/publish in CSED
  - Service, advising

Be Aware: Different Types of Learners

- Learning Styles
  - Visual Learners – visual displays
  - Auditory Learners – verbal lectures, discussions
  - Kinesthetic Learners – moving, doing, touching
- Some people are a mix
- How do you reach all learners?
  - Provide pictures, diagrams and text
  - Discuss what you are doing
  - Provide activities for trying it

Teaching a Course

- **Surviving** as a teacher…
  - Ask others for their course materials
  - Find course materials on line
  - Do the same thing every year
- **Thriving** as a teacher…
  - Create a class you'd like to attend
  - Entertaining, Relevant, Challenging, Clear
  - Experiment – try new ways to present
  - Active teaching, Active Learning
    - Flipped classroom, "Think, Pair, Share"

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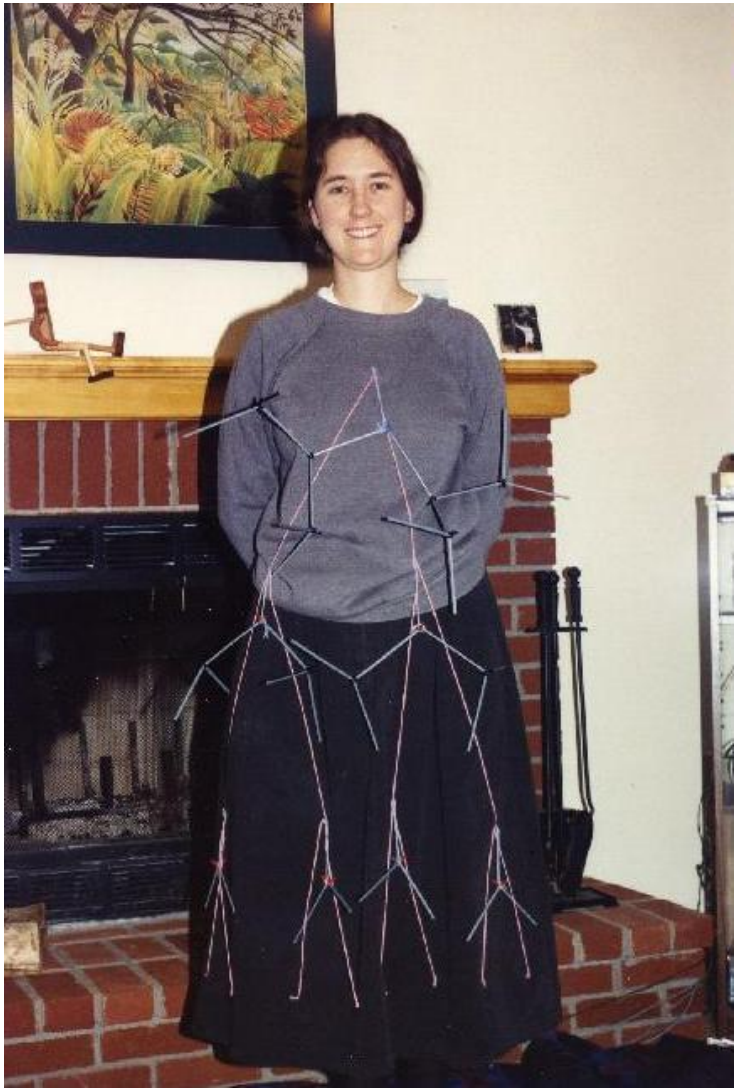
You could dress up as a data structure

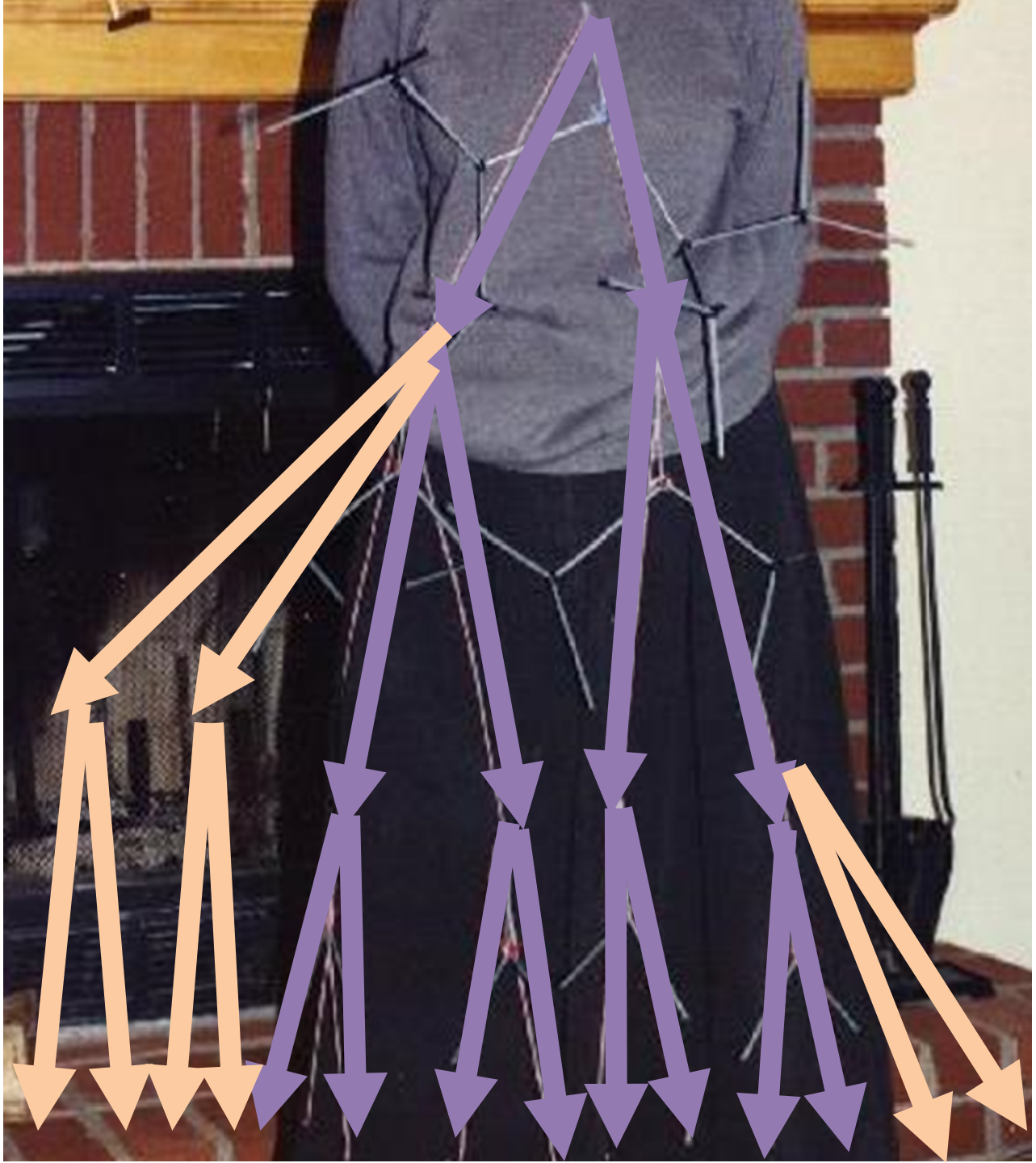
What data structure is this?



YARN,
in the
shape of a
binary tree

Subtrees
made
with
molecule
kit

What is it?



2D-range tree

Search in x-y plane

Main tree organized by x-values

Subtree organized by y values

Planning - Syllabus

- Book, papers, online materials
- Outline of topics and assigned readings
- Homework/assignments
- How many tests? Final exam?
- Grade based on?
- Course policies - explicit
  - collaboration? On which assignments?
  - Who can they get help from? Internet? People outside the course?
  - Check assignments with Moss

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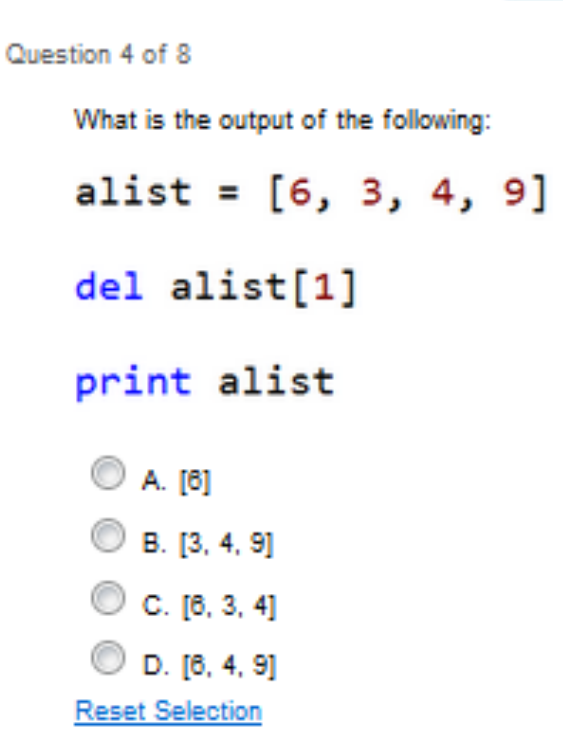
Read the book

- Read before coming to class
  - Ready to work in class
- Reality
  - Run out of time to read, not prepared
- Bring on – Reading quizzes
  - Online
  - Turn off when class starts



Have an engaging book….

Runescape (Brad Miller)

Electronic Textbooks (ebooks) engage students

OpenDSA (Shaffer, Virgina Tech)

Algorithm animations built in

runestoneinteractive.org (Brad Miller,

Several books (Python)

- Python - try and run code built in
- Quizzes

Zyante.com – interactive textbooks

Track student progress

Requirements and design strategies for open source interactive computer science eBooks

ITiCSE 2013 Working Group (Korhonen, Naps, et al)

Preparation for first day and first day…

What type of lecture?

What type of room?

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Classroom rule:

NO SITTING IN THE LAST FOUR ROWS!

Come forward

Yes YOU who is sitting in the last four rows.

Get to know your students!

- Get their picture
  - Pass around a camera the first day
  - Registrar photo lists

Ways to Select students to answer questions

Problem – same students always eager

How do you get other students to participate?

- Randomly call on them
- Work in groups – call on group
- Assigned groups – call on group numbers

Randomly Select a Student
Pick A Student Program

Collect pictures
of students

program that
cycles through
and randomly
picks one

Remove, then
start again

From Owen Astrachan

Lecture Format

Traditional way of teaching

- Professor Lectures
- Students hear only 13%
- Most of what they here is:

BLAH BLAH BLAH BLAH BLAH

Interactive or “Flipped” Lecture

- Students must prepare (read, video)
- Lecture/Introduce for 5-15 minutes
- Students solve a problem
  - Solve problem from scratch (longer)
  - Find what is wrong with a “solution” (shorter)
- Discuss solution
  - Ask how many did X? (gets students involved)
  - Go over your solution (intentionally make mistakes)
  - Go over student attempt/solution
  - Student present solution (longer)
- REPEAT

Pair Programming

Students work on problem with one computer in pairs

"Driver" and "navigator"

Alternative

Everyone has their own laptop

But work in pairs

Groups/Pairs

Assigned

```
CompSci 4 Section 1
Pairs as of October 22, 2009

   Front of room

          G1 G2  G3 G4
 G5  G6  G7   G8   G9
 G10 G11 G12 G13 G14 G15
 G16 G17 G18 G19 G20
 G21 G22 G23 G24 G25

Group 1
```

Interactive Lecture Notes and Handouts

Create 4 versions of my lecture

- Slides with holes
- Handouts with holes
- My notes – holes filled in
- Library notes (handouts with holes filled in)
  - Don’t give out any more

How to create Lecture notes

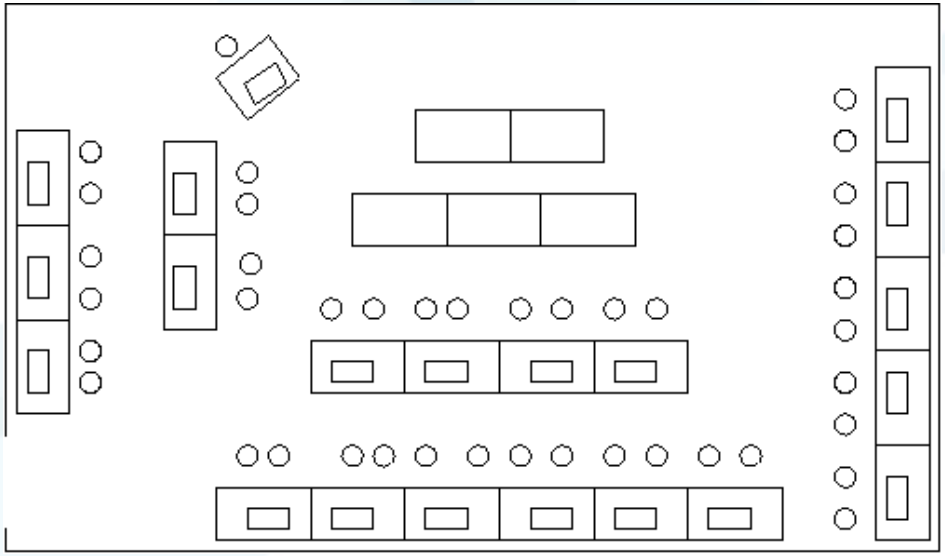
- Latex – 1 file with tags
  - %M – my notes only
  - %S – slides and handout
  - %SO – slides only
  - %LH – library notes, my notes and handout
  - Etc..
- Powerpoint
  - Use notes feature, print slides 4 per page
- Tablet PC
  - Different views

Does Your School have special rooms to teach in?
Example: Special Layout with Computers

20 computers, 40 students

Extra desks for group work

Advantage: see what students are doing



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

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

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Instant Feedback in Lecture

Clickers

Google forms

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Mystery While

* Required

NETID of person 1 *

Example: abc123

NETID of person 2

Example: abc123

NETID of person 3

Example: abc123

NETID of person 4

Example: abc123

Names of people filling out form *

(first and last name for each person, separate each name by a comman)

Google Forms (cont)

What does Mystery2 do (in words)?*

What does Mystery3 do?*
(in words)

Google Forms (responses)

H	I	J	K	L
What does Mystery3 do?				
It counts every character in a word except for lowercase "e"s				
It counts the number of characters in the word that aren't lowercase e's.				
It is counting the number of characters in the word that are not e's				
Count the number of characters that are not 'e' in the word				
Mystery 3 retums a given a given word without the lowercase e's.				
Counts the lower case es in the word.				
It retums the number of characters in a word that are not e.				
Counts all of the letters in word that aren't 'e'				
Counts the number of characters that are not e in the word.				
Counts all the characters that aren't e				
counts how many letters there are that are not "e"				
Mystery 3 counts the characters in a string that are not 'e', then retums the total count.				

Setting up Google Forms

Make it easy for students to get form

Use bit.ly links

Problem Solving with Feedback

APT – Algorithmic Problem Tester

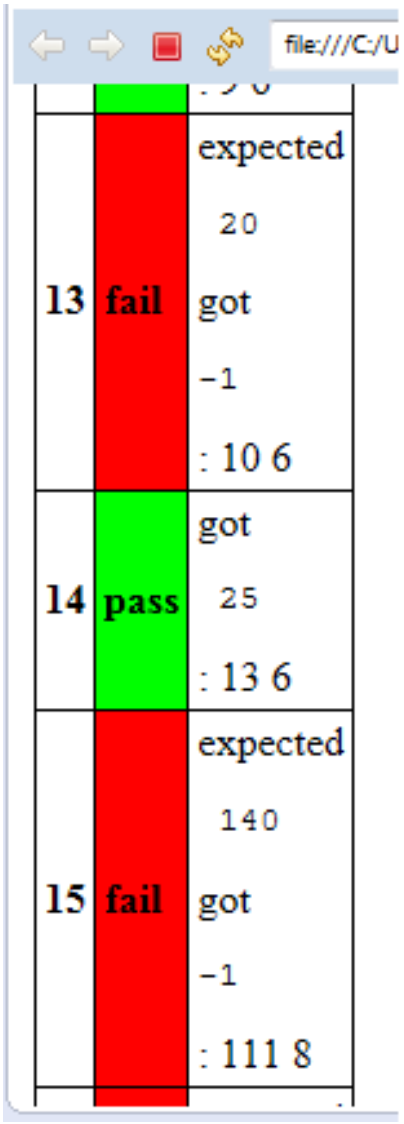
Test one function

Runs on multiple inputs

Autograde

# of correct: 14 out of 17

1	pass
2	pass
3	pass
4	pass
5	pass
6	pass
7	pass
8	pass
9	pass
10	pass
11	pass
12	pass
13	fail
14	pass



Engaging students in a group activities/large course

- Acting out stories, games
  - *Everything I needed to know about teaching*… - Pollard, Duvall (SIGCSE 2007)
- Acting out algorithms with the whole class
  - Make a binary tree with the whole class
  - Calculate the height of the tree
  - *Making Lemonade … large lecture classes* – Wolfman (SIGCSE 2002)
- Acting out algorithms with a subset of students
  - Sorting algorithms – selection sort, insertionsort, etc
  - CS Unplugged activities

Large Courses - UTAs

- Had 35 UTAs for CS 1!
- Get Head UTAs
  - One to run the lab training
  - One to organizing evening consulting hours
- Have separate Piazza site for Profs/TA/UTAs
- Fill out time card AND google form to account for what hours spent on
- Costly!

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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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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
  - Been attending over 20 years, always get new ideas to try in my courses
  - Friendliest and Cheapest Conference
- If you can't attend, check out SIGCSE papers in ACM Digital Library

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Online Teaching

- MOOC or Regular Course/Other Sites
- Videos – you make or work with professionals, short or full course length
- Prepare material way in advance
- May have to prepare many additional materials
  - Quizzes may randomly select questions

Using Animations/Software Tools in Class

Algorithm Animation Software/ Aps/Videos

AlgoViz.org – collection of algorithm visualizations

Samba, Jsamba - Stasko (Georgia Tech)

AnimalScript – Roessling (Darmstadt Univ of Tech, SIGCSE 2001)

JHAVE – Naps (U. Wisc. Oshkosh, SIGCSE 2000)

TRAKLA2 – Software Visualization Group – TKK Finland

JAWAA – Rodger et al (Duke, SIGCSE 2003)

Lots of animations and systems on the web!

Lots of videos of algorithm animations on the web!

Learner Engagement Taxonomy with visualization software

Different forms of Learner engagement

- No Viewing
- Viewing
- Responding
- Changing
- Constructing
- Presenting

ITiCSE Working Group Report 2002 (Naps et al.)

Example – Arrays
Shuffle, then Selection Sort

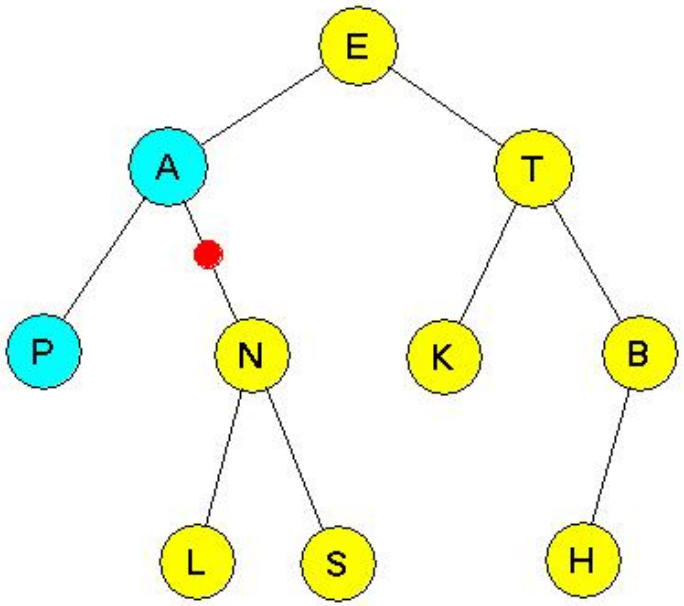
Use of Algorithm Animation in CS 1/2

Instructor

- Make/Use animations for lecture
- Stop/Pause – ask what will happen next
- must be interactive

Student

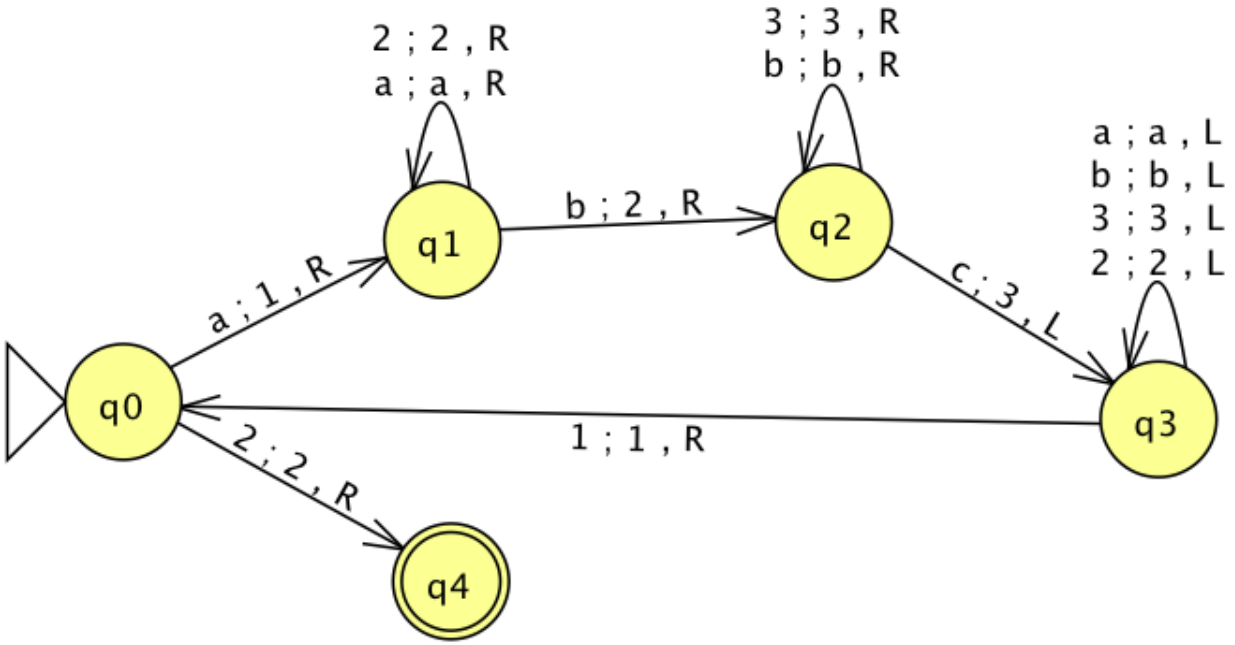
- Create animations
- Replay animations from lecture with same or new inputs



Use engaging and visual tools
Example: Python Tutor
www.pythontutor.com

Use of JFLAP by Instructor

Is this correct for $a^n b^n c^n$?



How do we fix it?

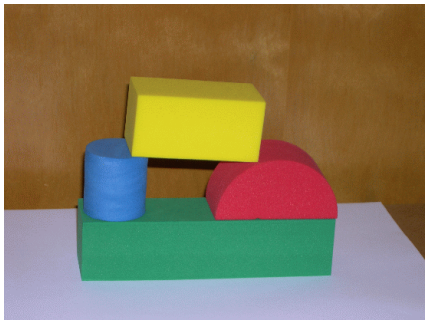
www.jflap.org www.cs.duke.edu/courses/spring14/compsci334

Active Learning

- CS Unplugged – csunplugged.org

Middle School students sorting themselves with Bubblesort

Example of Problem Solving: Be A Robot



Group of 4 – brain, eyes, 2 hands

Only brain knows what you are building

Only eyes can see

Must work together precisely like a robot

Teaching with Props

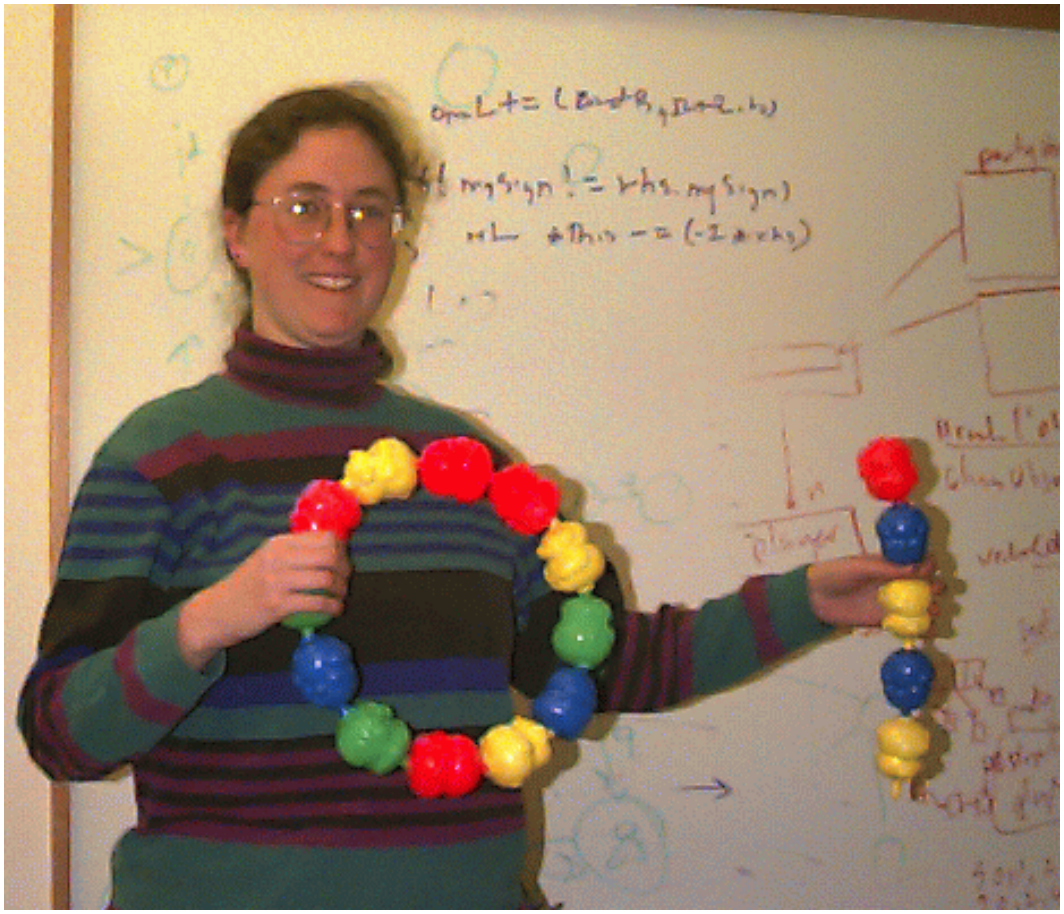
Interaction in Class – Props
Passing "Parameters" in Class

Pass by reference – throw frisbee

Pass by value – throw copy of frisbee

Pass by const reference – throw "protected" frisbee

Interaction in Class – Props Linked List and Memory Heaps



ITiCSE 98 – Astrachan – “Concrete Teaching: Hooks and Props as Instructional Technology”

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

Insertion Sort

Card Class – shuffling, dealing hands

Poker hands – Full house, Flush, etc.

Example of Computer Science concept

Children's book

The Cat in the Hat
Comes Back

By Dr. Seuss

Also a story about
recursion

Edible CS

- Make treats for students
- Use food to solve a problem
- Then eat the treats!

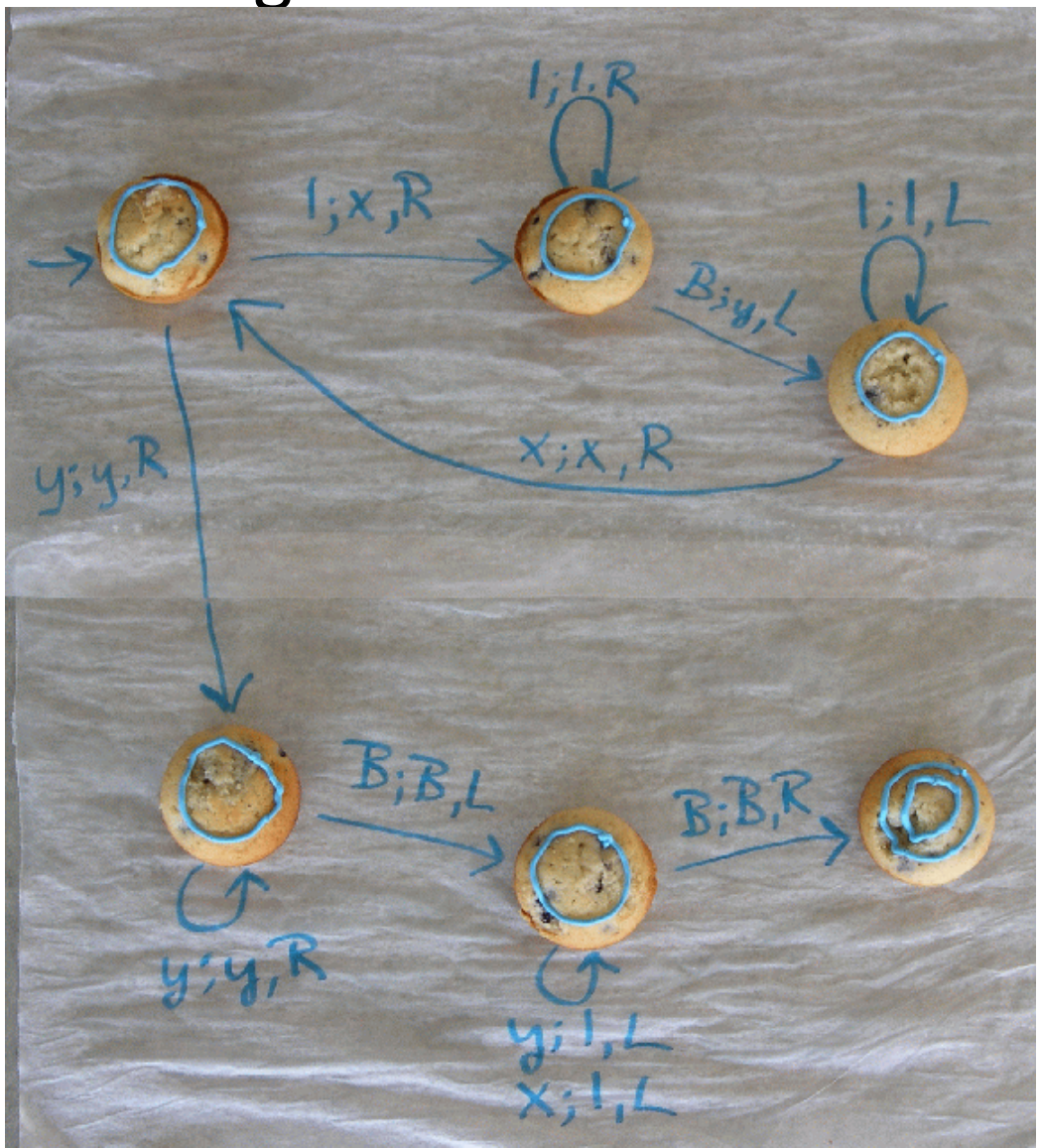
CS 1 Sorting Cookies

Automata Theory
Interaction in Class – Props
Edible Turing Machine

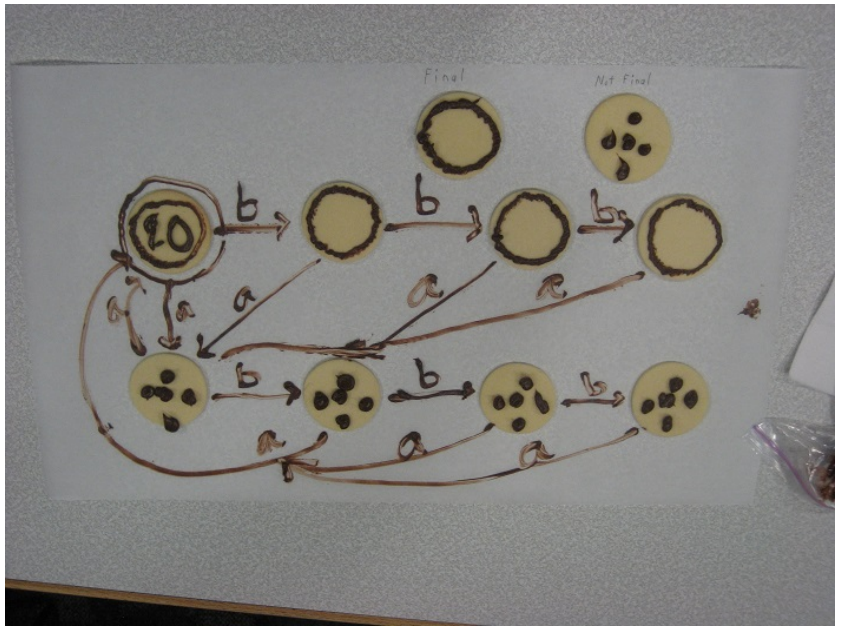
TM for f(x)=2x
where x is unary

TM is not correct,
can you fix it?
Then eat it!

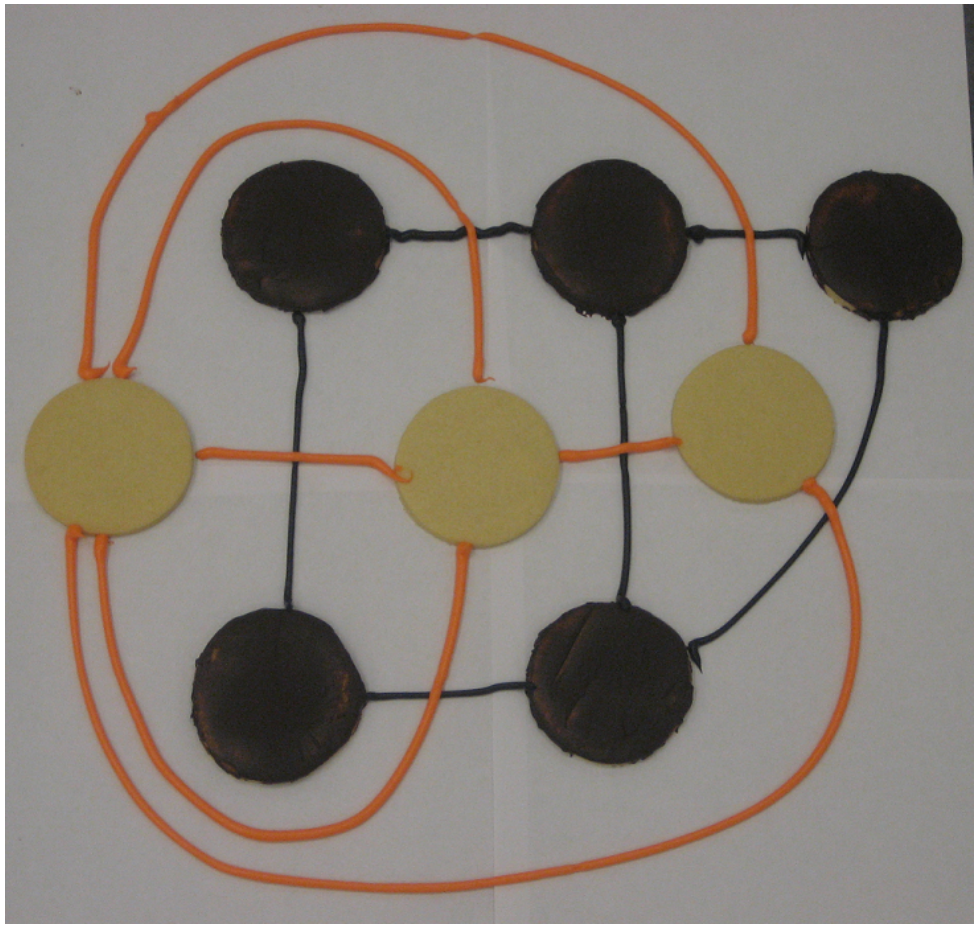
States are
blueberry
muffins



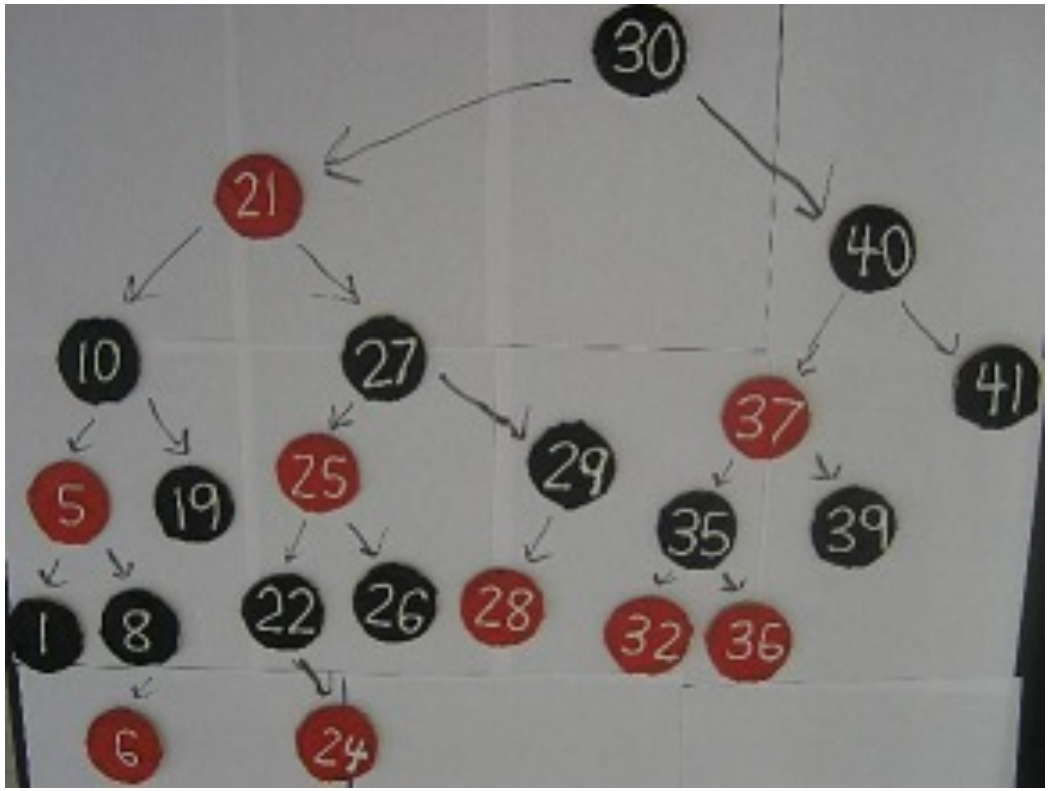
Students building DFA with cookies and icing



Discrete math
A graph and its Dual Graph



CS 2 – Data Structures
Red-Black Tree (cookies)



Alice Programming Language