CS 100: Simulation and Randomness

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Week 12-1

Logistics

HW6 Up Soon

- Last of the Semester
- Security Upgrades
- AI and Automation questions

Reading:

- Pattern on the Stone Ch 8 Machines that Learn
- Article: A Plan for Spam

End Game

Week 12	Tue 4/18	Simulation
	Thu 4/20	Machine Learning
Week 13	Tue 4/25	Machine Learning
	Thu 4/27	Automation
		Mini-Exam 4
Week 14	Tue 5/2	Intellectual Property
	Thu 5/4	Review
		HW 6 Due
Week 15	Thu 5/11	Final Exam
		10:30am-1:15pm

Quick Review of Parallel Computing

1. True or False: The number of transistors in modern computers is increasing. (If so, by how much)
2. True or False: Modern computers continue to increase in speed dramatically.
3. True or False: With 5 computers, one can always get a program to finish in 1/5th the time
4. If False: why? What is the slow down?
5. What is a histogram?

Simulations

- An important application of computation
- One of its earliest uses: artillery firing tables
- Lots of modern incarnations, many of which use parallel computation
- We will explore a few today

Schilling's Segregation Model

- Play with it here: http://www.avanderw.co.za/schellings-segregation-simulation/
- White is empty space
- City people are little red/blue squares, different "classes"
- People want to have neighbors w/ same class
- Tolerance threshold for like to not-like neighbors
- Too few like neighbors, move to a random empty location

Like	1
Unlike	5
Total	6
Ratio Like	1/6
Percentage	16.6%
Threshold	30%
Result	**Move**

Like	3
Unlike	4
Total	7
Ratio Like	3/7
Percentage	42.9%
Threshold	30%
Result	**Stay**

For Fun Disease Model

- Play with http://mattbierbaum.github.io/zombies-usa/
- Read about what is in the model here: http://arxiv.org/abs/1503.01104
- Consider what's good and bad about the model

Figure out

- What is the parameter α described as the "kill to bite ratio"
- What can one learn by playing with the model?

Other Models

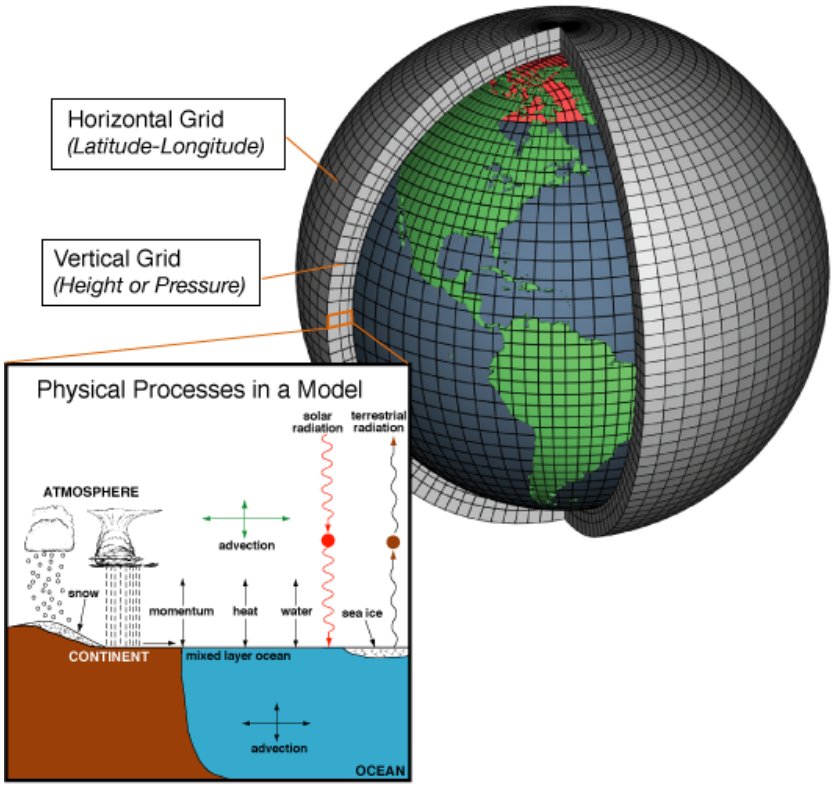
All models are wrong, but some are useful.
– George Box, Statistician

What other computer simulations affect your life?

- List at least 2
- What do you think is involved with the codes there?
- Could you run that code on your laptop?

Examples

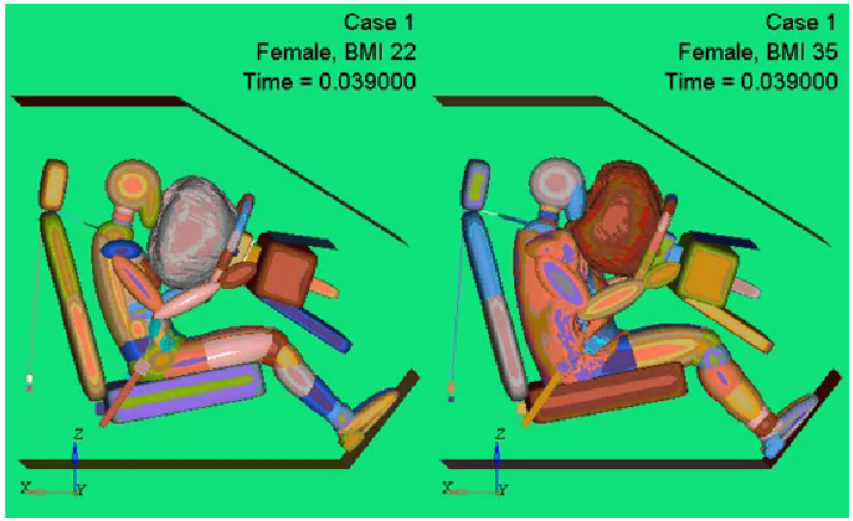
Weather Prediction



Source: Wikip Numerical Weather Prediction

Siri: Will it rain this afternoon?

Auto Safety During Crashes

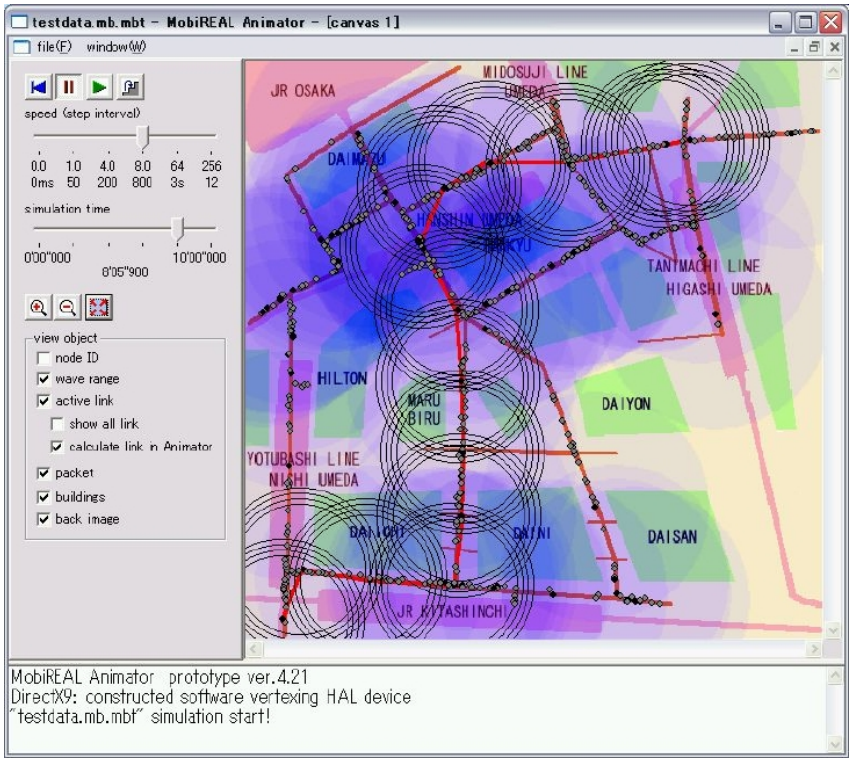


Source: Wikip Crash Simulation

Any volunteers to replace the simulated dummy?

More Examples

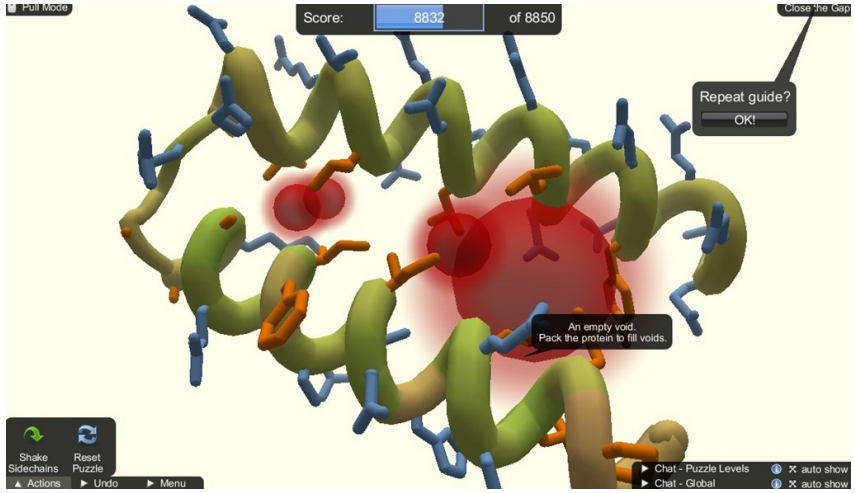
Wireless Network Simulation



Source: Higashino Lab

Can you hear me now?

Protein Structure Prediction



Source: Fold.it

Puzzle game that simulations biology, protein folding, disease and drug development research.

Randomness

Chance Events

- Segregation: location to move to is random
- Chance events are good for games too

Source: Alan's BlackJack Page

Google Me This

- Are computers random at all?
- How does a computer produce randomn numbers or random bits?
- Are they really random numbers?

Pseudo-Random

A classic random number generator from *The C Programming Language* by Kernighan and Ritchie

```
/* Tracks state of random number generator */
unsigned long int next = 1;

/* rand: return pseudo-random integer on 0..32767 */
int rand() {
  next = next * 1103515245 + 12345;
  return (unsigned int)(next/65536) % 32768;
}

/* srand: set seed for rand() */
void srand(unsigned int seed) {
  next = seed;
}
```

Is there anything random about it?

Example Program

Random Draws

```
/* Draw 10 cards from a deck of
   52 cards with replacement */
int main(){
  srand(12345);
  int i;
  for(i=0; i<20; i++){
    int myrand = rand() % 52;
    printf("%2d ",myrand);
  }
  printf("\n");
}
```

Always produces the sequence

```
44  4 17 14 27 29 33  6 38 41
12 43 34 27 31 24 25 28 33  8
```

Code Explained

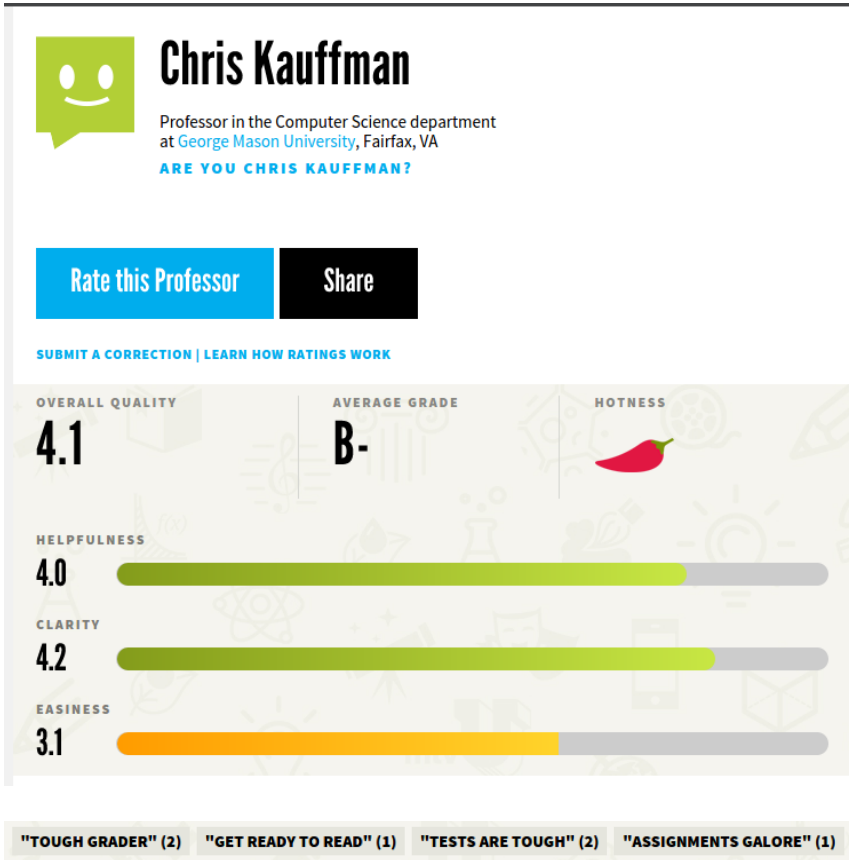
- `rand()` produces a positive number
- Range 0 to 32767
- Limit to 0 to 51 by dividing by 52 and taking remainder

Random Numbers

- Pseudo-random sequences are deterministic: always produce the same sequence if you start in the same spot
- If you want a different sequence, start somewhere different
- Most common trick: use the time of day to *seed* the random sequence
- Since time changes all the time (smirk) will get you different looking random sequences

Rate Anything!

- You're Running a Business Online
- Free web service
- RateAnything.com (currently available for purchase)
- Users can submit a person, place, or thing and start rating and feedback
- To make money: sell ads
- How do you choose what ads to sell?



Source: RateMyProfessor.com

Data Associations

Rating A Person

CS Professor Ads for programming books

Politician Political ads

Dentist Ads for Toothpaste, electric toothbrush

Rating a Place

Vacation Hotel Ads for local tour, restaurant

Restaurant Ads for other restaurants, coupon books

Rating a Thing

Frying Pan Ads for tongs, spatula, new oven

New Car Ads for insurance, car wash

Getting Paid

- You get paid by advertisers every time people click on your ads
- Want people to click as much as possible
- Try to make ads relevant to
  - Object being rated
  - User interests
- Any idea how do do this with a computer?

Machine Learning Can Help

- Algorithms that can learn patterns
  - This object relates to this ad
  - This user is interested in this stuff
- Requires information in a machine friendly form
  - List of words in rated object description
  - List of objects user has viewed
  - List of ads user has clicked on, which they have ignored
- Most machine learning requires training
  - Explicitly label "this object is like this object", "this ad should be served for this object", "the user clicked on this ad and ignored this ad"
  - Can learn the patterns so that a new ad can be associated to new rated objects
- Chapter 8 of The Pattern on the Stone discusses some machine learning, more next time