# CS 100: Simulation and Randomness

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Week 12-1

# Logistics

## HW6

- Due in 1 week
- Security Upgrades
- Term Paper Topics

## Reading

- Pattern: Ch 8 Machines that Learn
- Zyante: Ch 7 Privacy

# 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
- What can one learn by playing with the model

# Other Models

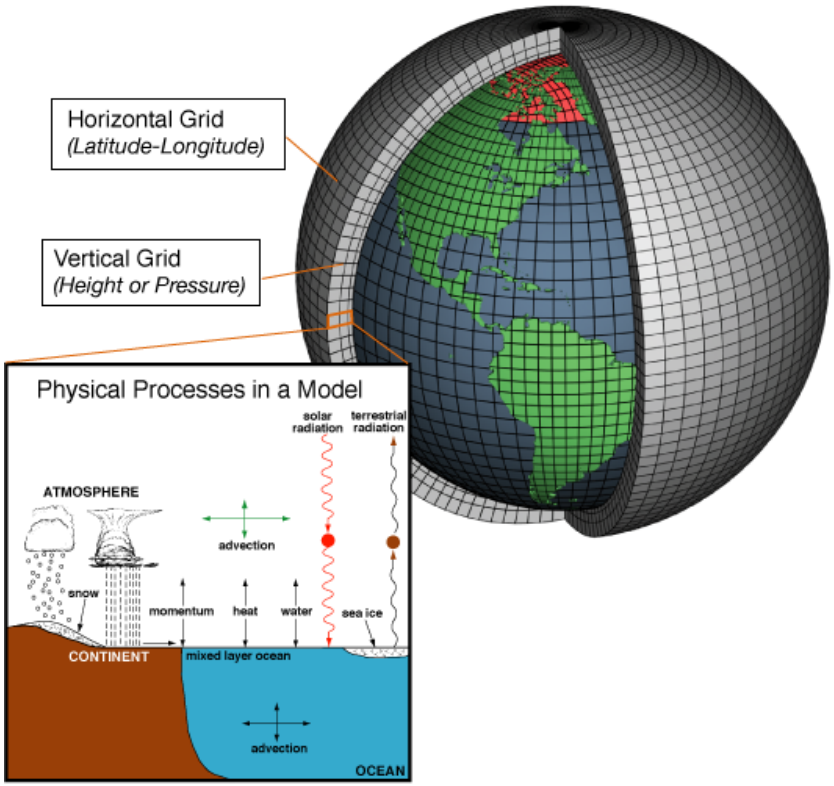
*All models are wrong, but some are useful.*
*– George Box, Statistician*

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

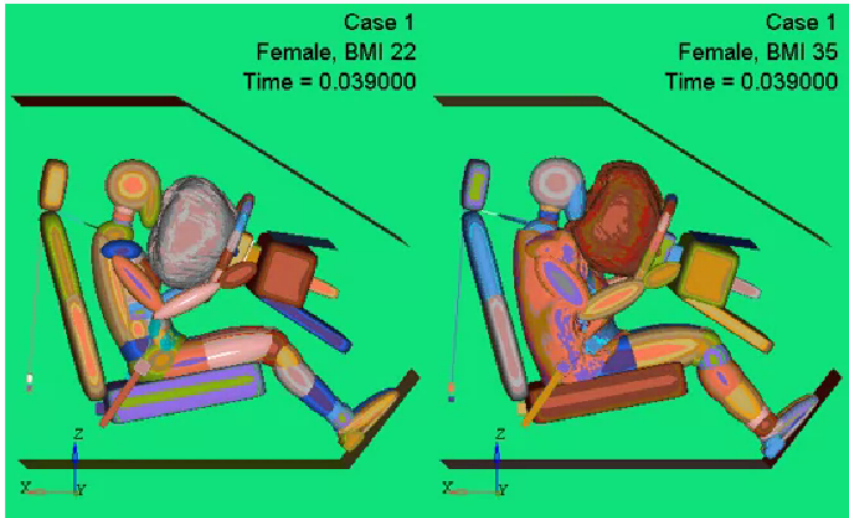
## Weather Prediction




Source: Wikip Numerical Weather Prediction

Siri: Will it rain this afternoon?

## Auto Safety During Crashes

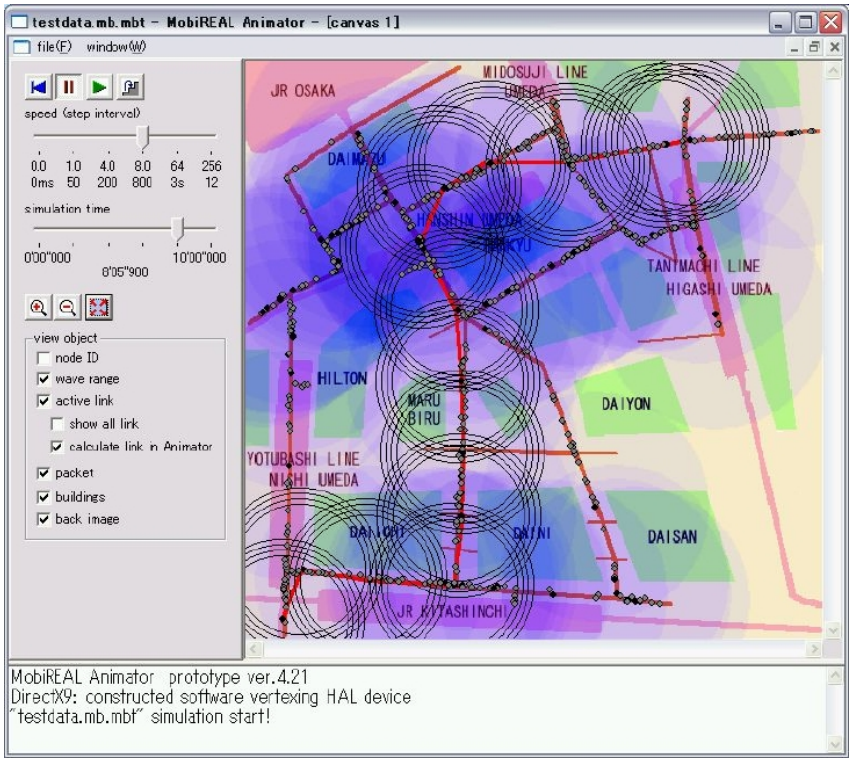



Source: Wikip Crash Simulation

Any volunteers to replace the simulated dummy?

# More Examples

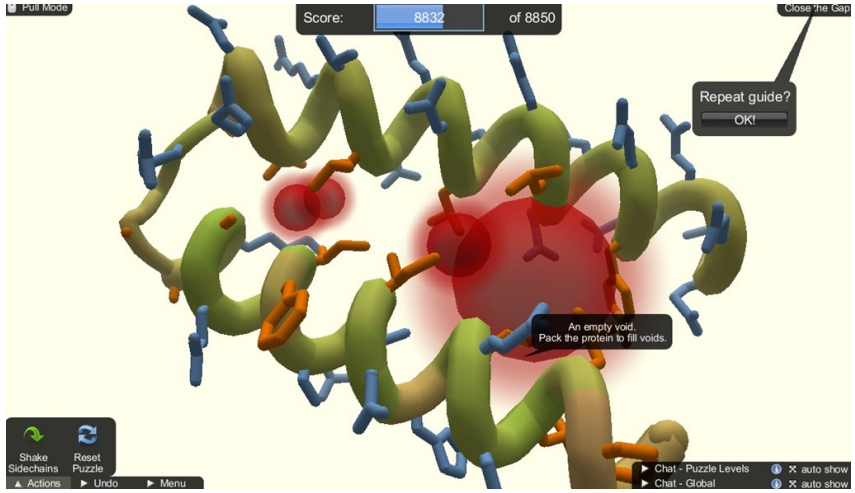
## Wireless Network Simulation




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

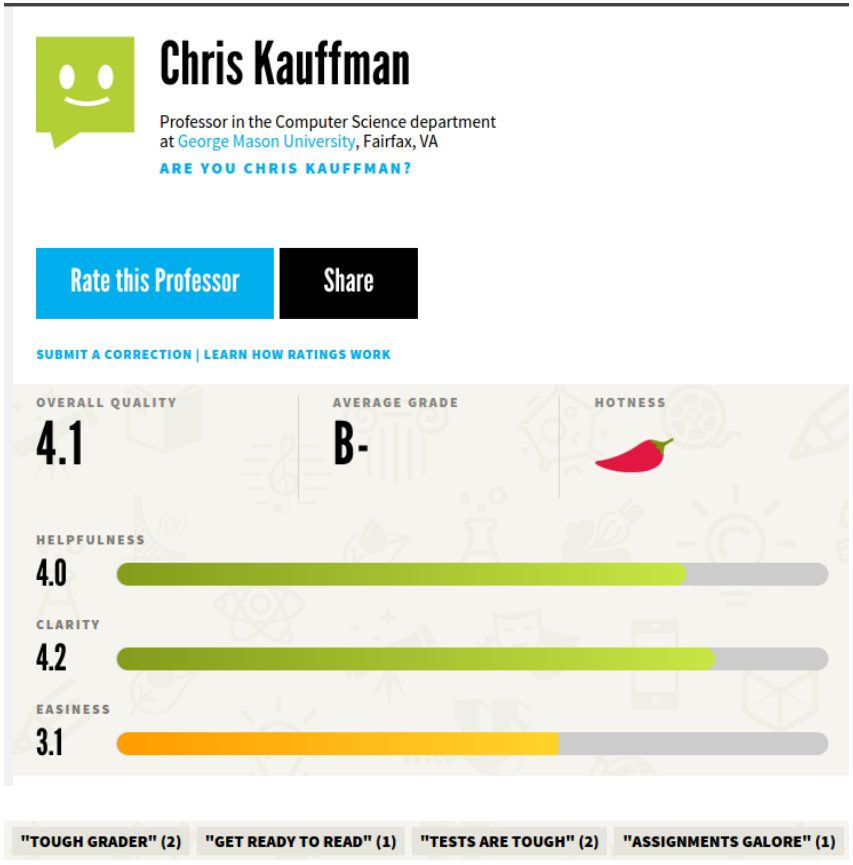
# Random Numbers

- 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

*Note: incorporating technical details of random number generation would be good in a term paper technical component, explore common number generation algorithms, give code and properties.*

# 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