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

<table>
<thead>
<tr>
<th>Like</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unlike</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
</tr>
<tr>
<td>Ratio Like</td>
<td>1/6</td>
</tr>
<tr>
<td>Percentage</td>
<td>16.6%</td>
</tr>
<tr>
<td>Threshold</td>
<td>30%</td>
</tr>
<tr>
<td>Result</td>
<td>Move</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Like</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unlike</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
</tr>
<tr>
<td>Ratio Like</td>
<td>3/7</td>
</tr>
<tr>
<td>Percentage</td>
<td>42.9%</td>
</tr>
<tr>
<td>Threshold</td>
<td>30%</td>
</tr>
<tr>
<td>Result</td>
<td>Stay</td>
</tr>
</tbody>
</table>
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

Auto Safety During Crashes

Any volunteers to replace the simulated dummy?

Siri: Will it rain this afternoon?
More Examples

Wireless Network Simulation

Protein Structure Prediction

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

Can you hear me now?
Randomness

Chance Events

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

Google Me This

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

Source: Alan’s BlackJack Page
Pseudo-Random

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

```c
/* 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