**News**

- Midterm 2: Thu Mar 16, 6:30pm
- Woodward 1&2
- hour-long exam, reserve 6:30-8 time slot
  - for buffer in case of fire alarms etc
- Assignment 2 was due Friday 5pm
- Internet crash at 4:45pm led to 24-hr extension to 5pm Sat
- hardcopy was due Mon noon
- no labs/tutorials this week
  - but one TA will be in lab during normal lab hours to answer questions

**Midterm 2**

- coverage: through arrays (Chap 8)
  - includes/builds on material covered in previous midterm
- reading
  - Chap 1, 2, 3, 4, 6, 7 (not 5)
  - Chap 8.1, 8.5-8.7
- study tips
  - write and test programs, not just read book
  - try programming exercises from book!

**Reading**

- This week: 9.3-9.4, 9.6-9.8

---

**Recap/Correct: Multidimensional Arrays**

- now that we know 2D, we can do nD!
- any number of dimensions: 3D, 4D...
  - up to 255D, actually
- example: student quiz scores over multiple terms
  - row: students
  - col: quiz scores
  - stack: term

**Recap: Sorting in \(N^2\) Time**

Let's assume that your computer could make 1 billion (1,000,000,000) comparisons per second. That's a lot of comparisons in a second. And let's say your computer was using selection sort to sort the names of the people in the following hypothetical telephone books. Here's some mathematical food for thought.

<table>
<thead>
<tr>
<th>phone book</th>
<th>number of people (N)</th>
<th>(N^2)</th>
<th>number of seconds to sort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancouver</td>
<td>544,320</td>
<td>296,284,262,400</td>
<td>296, or 5 minutes</td>
</tr>
<tr>
<td>Canada</td>
<td>30,000,000</td>
<td>900,000,000,000,000</td>
<td>900,000, or 10.4 days</td>
</tr>
<tr>
<td>People's Republic of China</td>
<td>1,000,000,000</td>
<td>1,000,000,000,000,000,000</td>
<td>1,000,000,000, or 31.7 years</td>
</tr>
<tr>
<td>World</td>
<td>6,000,000,000</td>
<td>36,000,000,000,000,000,000</td>
<td>36,000,000,000, or 1142 years</td>
</tr>
</tbody>
</table>
Bunny Class Warmup

Question 4: [15 marks]
Now let’s use Java to simulate bunnies! (Why? Because everybody likes bunnies!) In our simulation, each bunny is on a grid at some location defined by an X-coordinate and a Y-coordinate. Also, each bunny has some number of energy units measured in carrot sticks. (X-coordinates, Y-coordinates, and the number of carrot sticks are integer values.) Bunnies can hop north, south, east, or west. When a bunny hops to the north, the bunny’s Y-coordinate is increased by 1, and the X-coordinate remains unchanged. When a bunny hops to the west, the bunny’s X-coordinate is decreased by 1, and the Y-coordinate remains unchanged. Same idea for hops east (X-coordinate increased by 1, Y-coordinate unchanged) and south (Y-coordinate decreased by 1, X-coordinate unchanged). Note that making one hop requires a bunny to eat one carrot stick, and when a bunny has eaten all of his or her carrot sticks, that bunny can’t hop.

Use Java to create a Bunny class which can be used to generate Bunny objects that behave as described above. When a new Bunny object is created, the Bunny always starts at coordinates X = 10, Y = 10, and the Bunny has 5 carrot sticks. Your Bunny class definition must include a hop(int direction) method, and a displayInfo() method. The direction parameter is 12 for north, 3 for east, 6 for south, and 9 for west (like a clock face). The hop() method should test to make sure that the Bunny has not eaten all the carrot sticks — if the Bunny still has carrot sticks, the hop() method should update coordinates as explained above and print the message “hop”. If no carrot sticks remain, it should just print the message “This bunny can’t hop.”

The displayInfo() method should print the Bunny’s location and number of remaining carrot sticks. Below is a simple test program that could be used to test your Bunny class definition, followed by the output we’d expect to see when using this test program with your Bunny class definition.

```java
public class BunnyTest {  public static void main(String[] args)  {    System.out.println("Testing Peter");    Bunny peter = new Bunny();    peter.displayInfo();    peter.hop();    peter.hop();    peter.hop();    System.out.println("Testing Emily");    Bunny emily = new Bunny();    emily.displayInfo();    emily.hop();    System.out.println("Testing Emily’s favorite color!");    emily.displayInfo();    emily.hop();  }  
```

More Bunnies

How could we keep track of a herd of bunnies?

We could make an array of bunnies.

```
```

Even More Bunnies

Question 5: [16 marks]
The world desperately needs better bunny management software, so please help by writing a BunnyHerd class. A BunnyHerd object holds an array of Bunny objects. Your BunnyHerd class definition should include the following four methods:

- constructor Expects two parameters, an integer representing the maximum number of bunnies in the herd, and a String for the name of the herd.
- addBunny(int xPos, int yPos, int carrots, String name) Expects four parameters, the X- and Y-coordinates of the bunny, the number of carrots, and the name. This method creates a new Bunny object and stores the reference to the object in the next available location in the BunnyHerd object.
- deleteBunny(String name) Expects one parameter, the name of the bunny. This method removes from the BunnyHerd object all references to bunnies with the given name by overwriting those references with the null pointer. This method does not change the pointer to the next available location in the BunnyHerd object.
- printHerd() This method uses the toString() method of the Bunny object to print information about every Bunny in the herd.

```java
private int maxBunnies;  
private String herdName;  
private Bunny[] myBunnyHerd = new Bunny[maxBunnies];  
```

Favorite Colors (If Time...)

- record everybody’s favorite color
- how can we do "averages" per row?