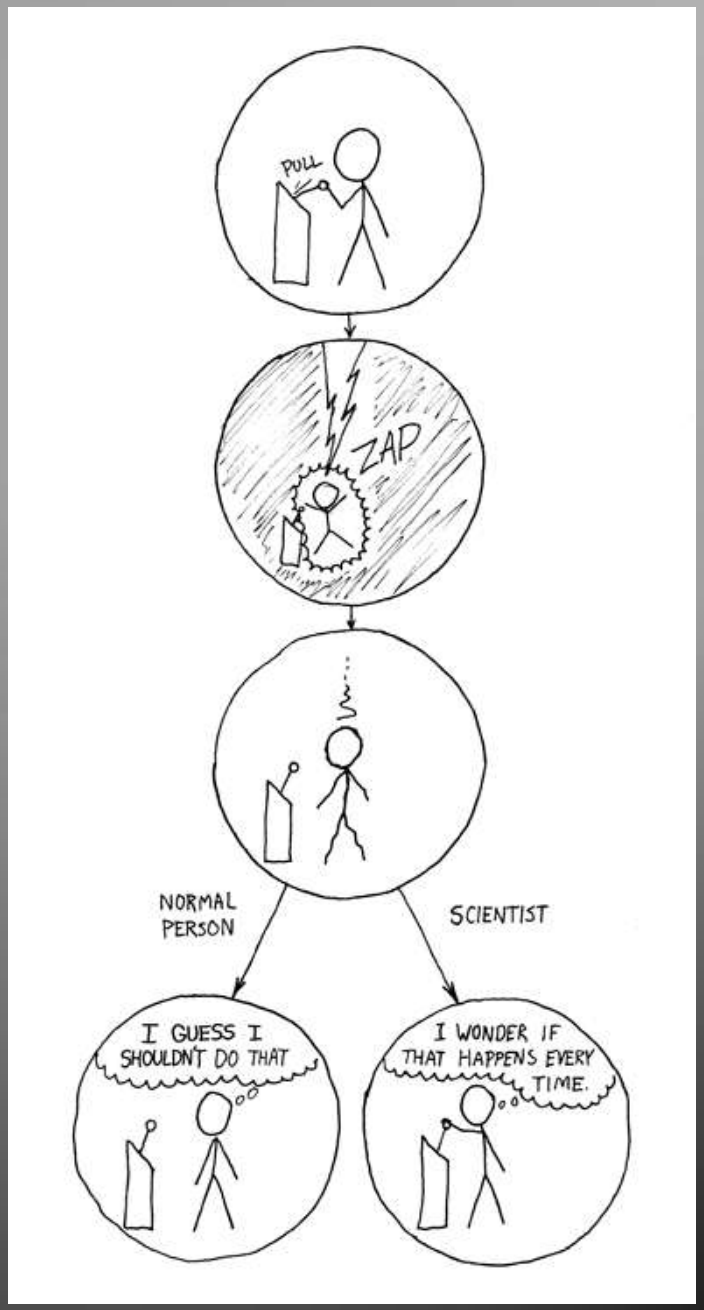
CSSE 220 Day 9

Two-dimensional arrays,
Copying arrays,
Software Engineering Techniques

Check out *TwoDArrays* from SVN

Questions?

Science!



http://xkcd.com/242/

Two-dimensional arrays

```
public class TicTacToe {
    private final int rows;
    private final int columns;
    private String[][] board;

    /**
     * Constructs a 3x3 TicTacToe board with all squares blank.
     */
    public TicTacToe() {
        this.rows = 3;
        this.columns = 3;

        this.board = new String[this.rows][this.columns];

        for (int r = 0; r < this.rows; r++) {
            for (int c = 0; c < this.columns; c++) {
                this.board[r][c] = " ";
            }
        }
    }
```

What is the value of `this.board[1][2]` immediately after this statement executes?

Could have used: `this.board.length`

Could have used: `this.board[r].length`

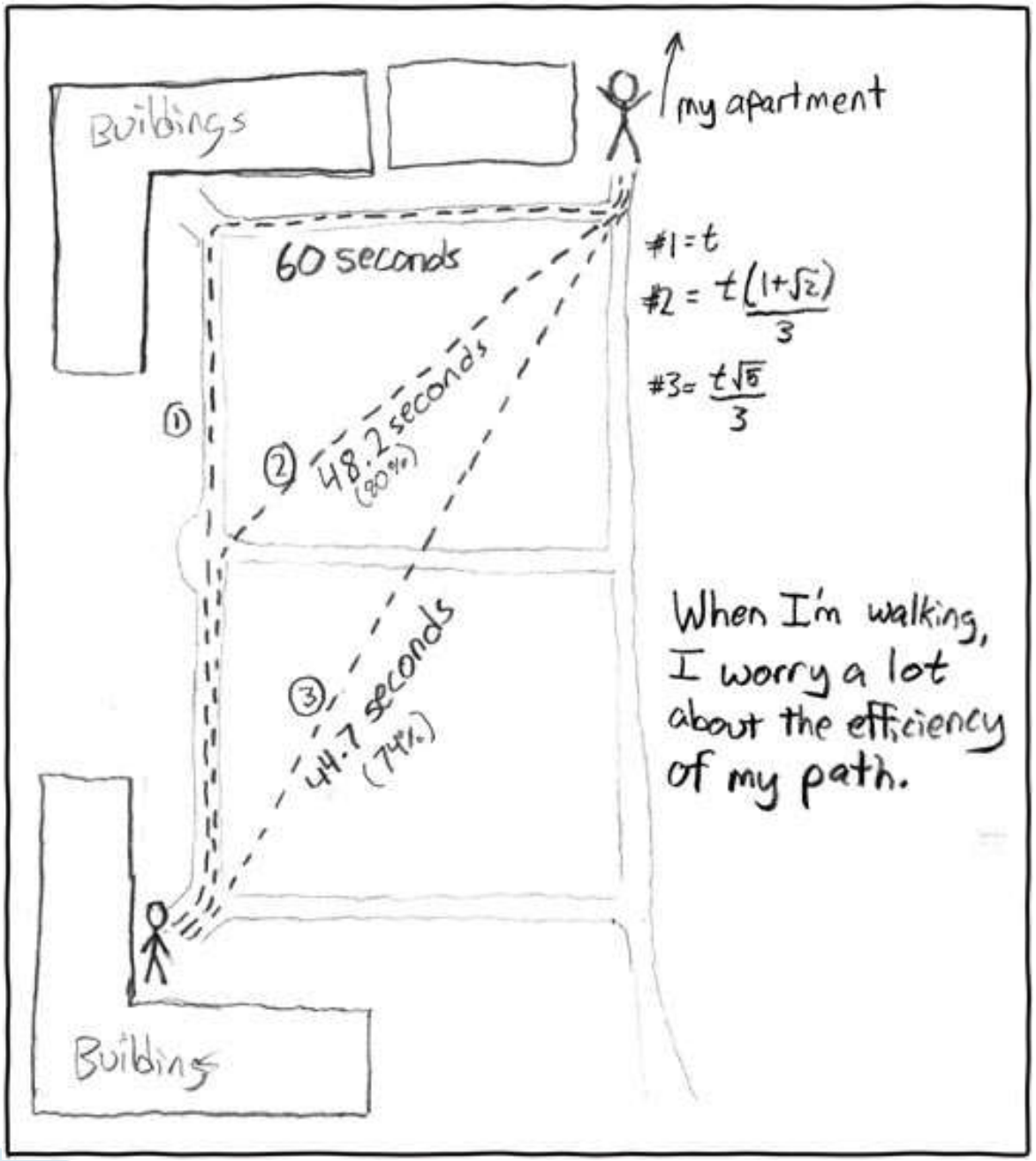
Note the (very common) pattern: loop-through-rows, for each row loop-through columns

Q1-2

Exercise

- Complete the TODO items in TicTacToe and TicTacToeTest
- They're numbered; do 'em in order.

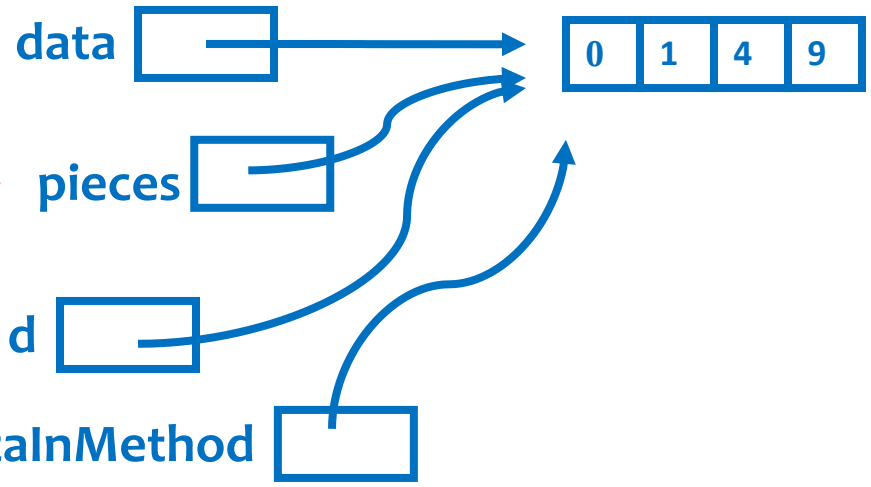
Interlude:



http://xkcd.com/85/

Copying Arrays – assignment

- Assignment uses *reference* values:
  - ```
    double[] data = new double[4];
    for (int i = 0; i < data.length; i++) {
        data[i] = i * i;
    }
    ```
  - ```
    double[] pieces = data;
    ```
  - ```
    foo.someMethod(data);
    ```



This makes the field a reference to (NOT a copy of) a list that exists elsewhere in the code. Think carefully about whether you want this or a clone (copy).

```
public void someMethod(double[] d) {
    this.dataInMethod = d;
    ...
}
```

Q3-5
```

Copying Arrays – many ways

- You can copy an array in any of several ways:
  1. Write an explicit loop, copying the elements one by one
  2. Use the *clone* method that all arrays have

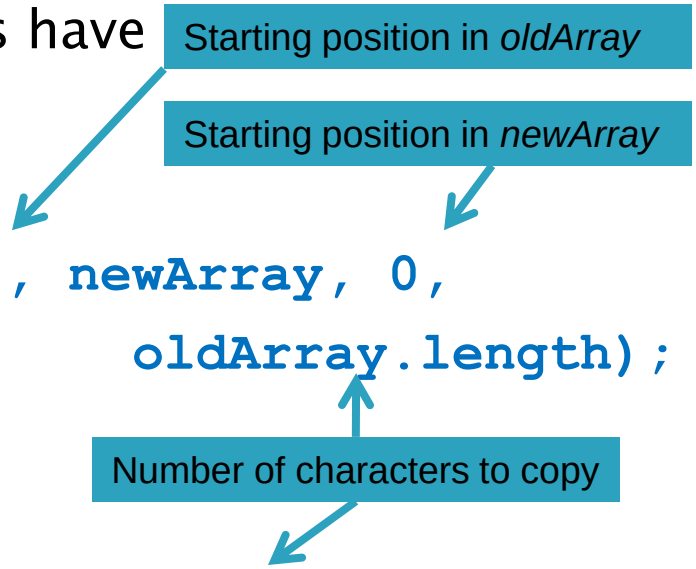
```
newArray = oldArray.clone();
```

  3. Use the *System.arraycopy* method:

```
System.arraycopy(oldArray, 0, newArray, 0,
                 oldArray.length);
```

  4. Use the *Arrays.copyOf* method:

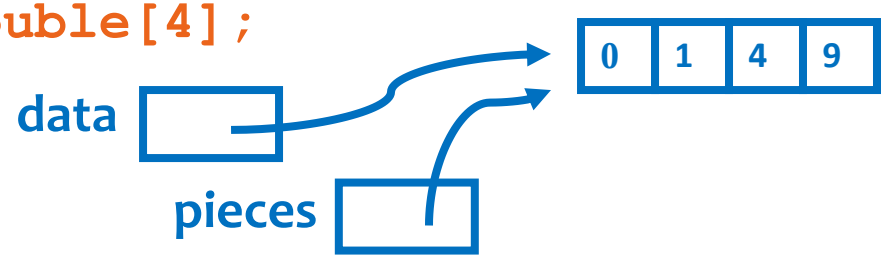
```
newArray = Arrays.copyOf(
                 oldArray, oldArray.length);
```



The key point is that all of these except possibly the first make *shallow copies* – see next slide

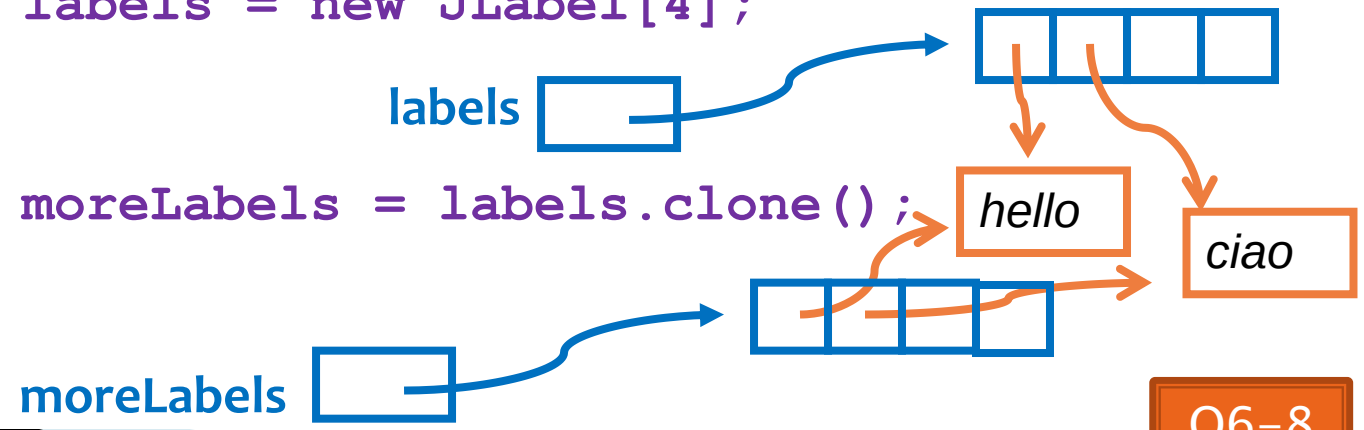
Copying Arrays – Shallow copies

- Can copy whole arrays in several ways:
  - `double[] data = new double[4];`
    `...`
    `pieces = data;`



  - `double[] pizzas = data.clone();`

  - `JLabel[] labels = new JLabel[4];`
    `...`
    `JLabel[] moreLabels = labels.clone();`



Q6-8

Quality Tip –"Avoid parallel arrays"

- Consider an ElectionSimulator:
  - Instead of storing:
    - ```
      ArrayList<String> stateNames;
      ArrayList<Integer> electoralVotes;
      ArrayList<Double> percentOfVotersWhoPlanToVoteForA;
      ArrayList<Double> percentOfVotersWhoPlanToVoteForB;
      ```
  - We used:
    - ```
      ArrayList<State> states;
      ```
      and put the 4 pieces of data inside a State object
- Why bother?

Pick the Right Data Structure

- Array or ArrayList, that is the question

- General rule: use ArrayList
  - Less error-prone because it grows as needed
  - More powerful because it has methods
  - More general because it can be extended

- Exceptions:
  - Lots of primitive data in time critical code
  - Two (or more) dimensional arrays

Q10

Software Engineering Techniques

- Regression testing
- Pair programming
- Team version control

Regression Testing

- Keep and run old test cases
- Create test cases for new bugs
  - Like antibodies, to keep a bug from coming back
- Remember:
  - You can right-click the project in Eclipse to run all the unit tests

Pair Programming

Becoming a common interview technique!

- Working in pairs on a single computer
  - One person, the *driver*, uses the keyboard
  - The other person, the *navigator*, watches, thinks, and takes notes
- For hard (or new) problems, this technique
  - Reduces number of errors
  - Saves time in the long run
- Works best when partners have similar skill level
  - If not, then student with most experience should navigate, while the other student drives.

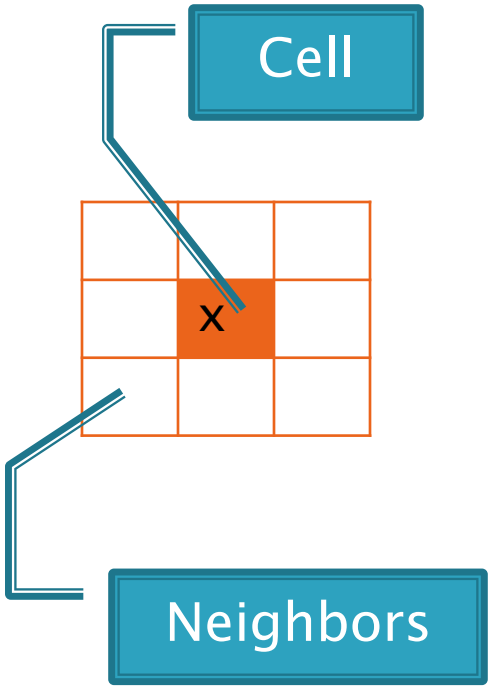
Team Version Control

- **Always**:
  - **Update before** working
  - **Update again** before committing
  - **Commit often** and with good messages

- **Communicate** with teammates so you don't edit the same code simultaneously
  - Pair programming eliminates this issue

Game of Life

1. A new cell is born on an empty square if it has exactly 3 neighbor cells
2. A cell dies of overcrowding if it is surrounded by 4 or more neighbor cells
3. A cells dies of loneliness if it has just 0 or 1 neighbor cells



Game of Life Teams – Clifton

11,filhobc,hirtjd
12,taos,luok
13,addantnb,caijy
14,hopwoocp,lyonska
15,eckertzs,shanx
16,wilsonam,cornetcl
17,nelsonca,chena1
18,spurrme,elswicwj

Team number used in repository name:
http://svn.csse.rose-hulman.edu/repos/csse220-201130-life-teamXX

Check out *GameOfLife* from SVN

Game of Life Teams – Defoe

21,amesen,solorzaa,mehrinla
22,lawrener,tilleraj
23,fengk,cooperdl
24,vassardm,rybickcb
25,zhenw,whitemrj
26,myersem,hazelrtj
27,senatwj,oliverr
28,haydr,finnelhn

Team number used in repository name:
http://svn.csse.rose-hulman.edu/repos/csse220-201130-life-teamXX

Check out *GameOfLife* from SVN

Work Time

- Work with your partner on the Game of Life project
  - Get help as needed
  - The TODOs are numbered – do them in the indicated order.
  - Follow the practices of pair programming!
- Don’t work without your partner!
- Due Thursday of next week