CSSE 220 Day 9

Two-dimensional arrays,
Copying arrays,
Software Engineering Techniques

Check out *TwoDArrays* from SVN

Questions?

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`

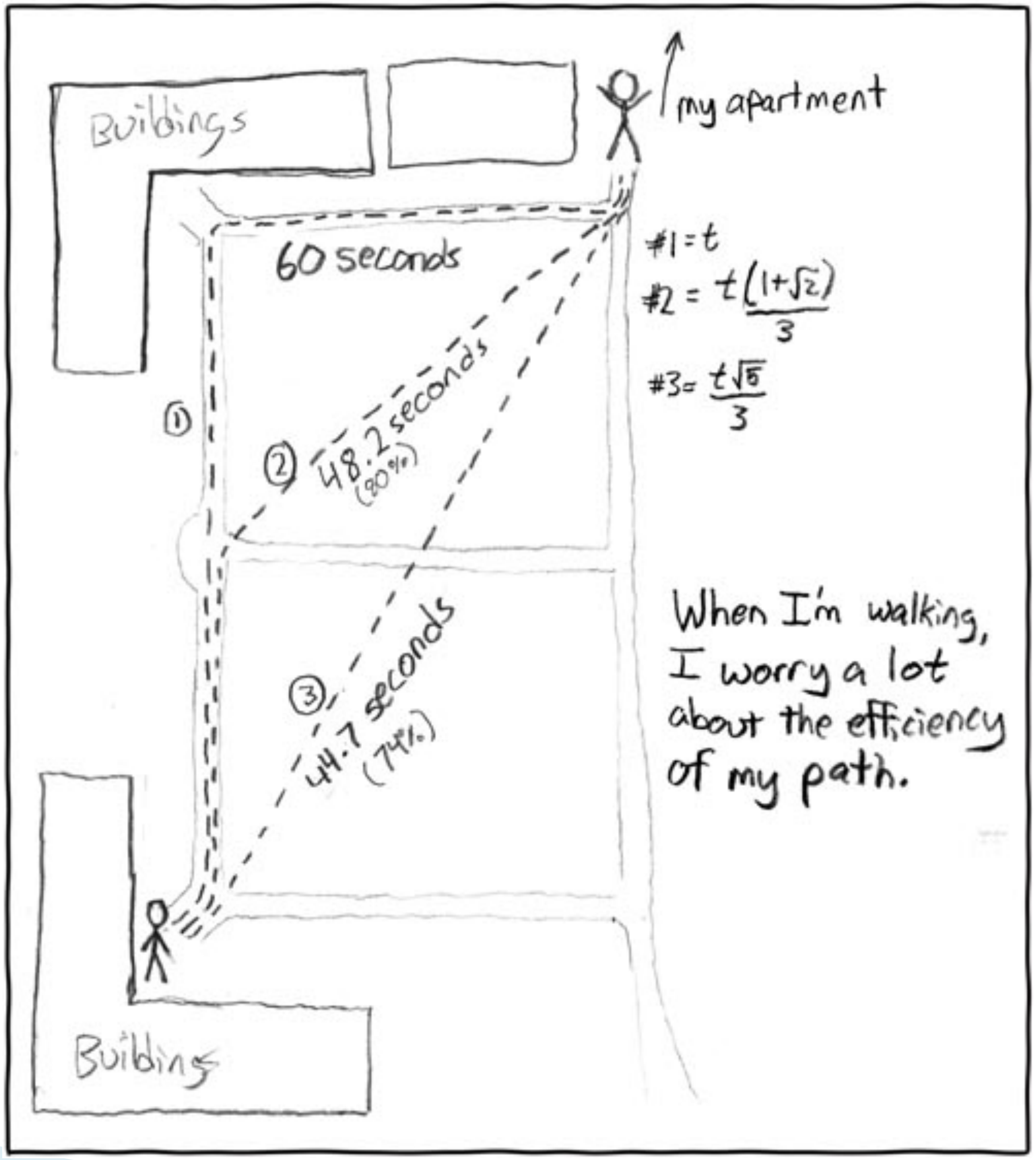
Note the (very common) pattern: loop-through-rows, for each row loop-through columns

Q1

Exercise

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

Interlude:



Buildings
my apartment
60 seconds
①
② 48.2 seconds (90%)
③ 44.7 seconds (74%)
#1 = t
#2 = $\frac{t(1+\sqrt{2})}{3}$
#3 = $\frac{t\sqrt{5}}{3}$
When I'm walking, I worry a lot about the efficiency of my path.
Buildings

http://xkcd.com/85/

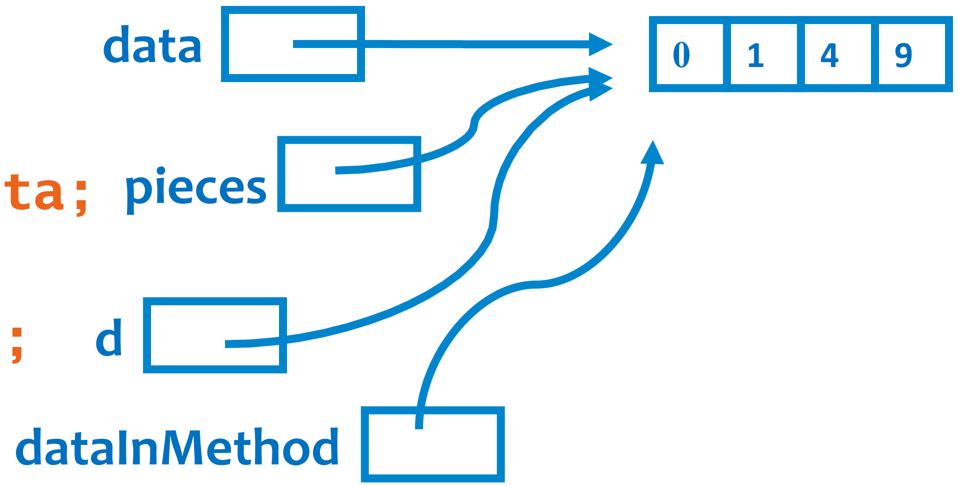
Copying Arrays – assignment

- 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;
     ...
}
```

Q2–4

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);
     ```

     Starting position in *oldArray*

     Starting position in *newArray*

     Number of elements to copy

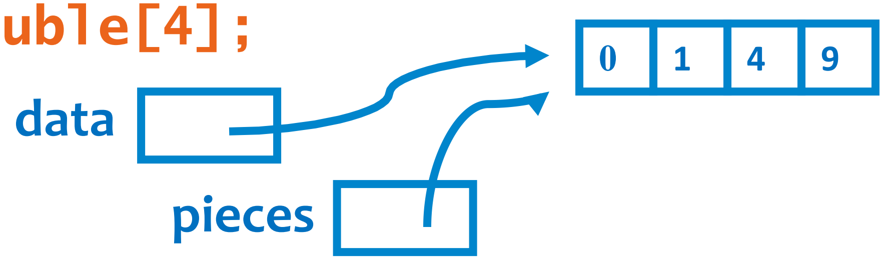
  4. Use the *Arrays.copyOf* method:

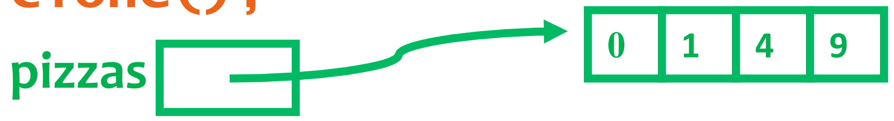
     ```
     newArray = Arrays.copyOf(
                      oldArray, oldArray.length);
     ```

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

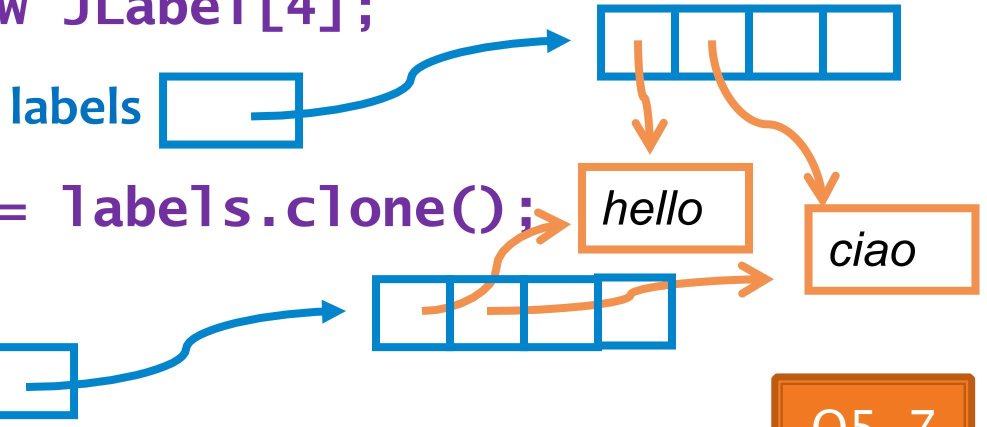
Copying Arrays – Shallow copies

- 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();
    ```


Q5-7

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?

Q8

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

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

Q9

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

Q10–11

Pair Programming Video

- Let's watch the video together

Pair Programming

Becoming a common interview technique!

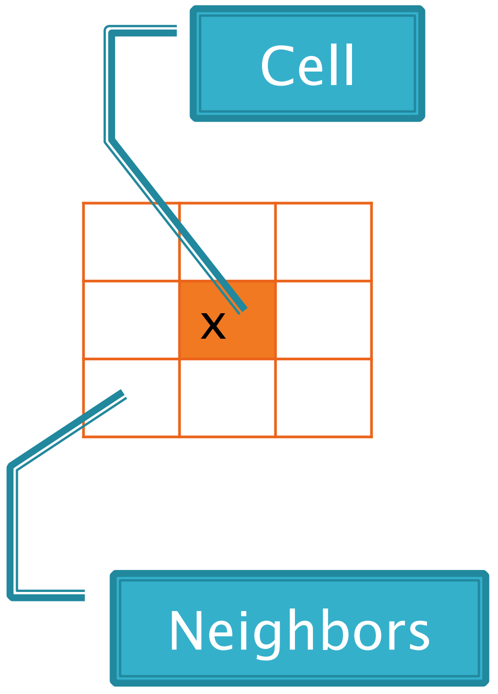
- Working in pairs on a single computer
  - One person, the *driver*, uses the keyboard
  - The other person, the *navigator*, watches, thinks, and takes notes
- For hard (or new) problems, this technique
  - Reduces number of errors
  - Saves time in the long run
- Works best when partners have similar 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



Developed by John Conway, 1970

Game of Life Teams Section 1

Format: repositoryName,firstStudent,secondStudent

csse220-201310-life-team01, boucheka, leversad
csse220-201310-life-team02, holzmajj, llewelsd
csse220-201310-life-team03, goldsbge, yinm
csse220-201310-life-team04, quj, huangf
csse220-201310-life-team05, crumpaa, heibelcj
csse220-201310-life-team06, hiancejk, earlda
csse220-201310-life-team07, winterc1, evansda
csse220-201310-life-team08, puhrjj, ametsid
csse220-201310-life-team09, sneedbj, zajacrc
csse220-201310-life-team10, hortoncb, fullerga
csse220-201310-life-team11, chenr, wangl2

Check out *GameOfLife* from SVN

Work Time

- Work with your partner on the GameOfLife project
  - Get help as needed
  - The TODOs are numbered – do them in the indicated order.
  - *Follow the practices of pair programming!*
- *Don’t do any of the work without your partner!*
- Due Tuesday, Sep 25, 2012 (1:35 pm).
- Note: *No late days for this assignment*
- Doing this assignment may be the best thing (but not the only thing) you can do to prepare for the exam.