

## Administrivia

- Labor day class - meet on Tuesday if possible?
- Last required homework. Replacement homeworks during project?
- Moving on from my class: concerns about future classes
- Project
- Reminder: office hours on Thursday now

## Mutation

- Effects of mutation

```
...
double pi = 3.14159;
...
double circleArea(int r) {
    return pi * r * r;
}
...
pi = 3;
...
circleArea(1) < 3.14
```

## Mutation

- Effects of mutation

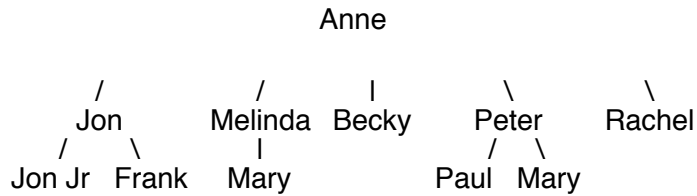
```
double totalGPA() {
    if ( queue.empty() )
        return 0;
    else
        return queue.pop().gpa() + totalGPA();
}
double length() {
    if (queue.empty())
        return 0;
    else {
        queue.pop();
        return 1 + length();
    }
}
double avgGPA() {
    return totalGPA()/length();
}
```

## Recursion with if

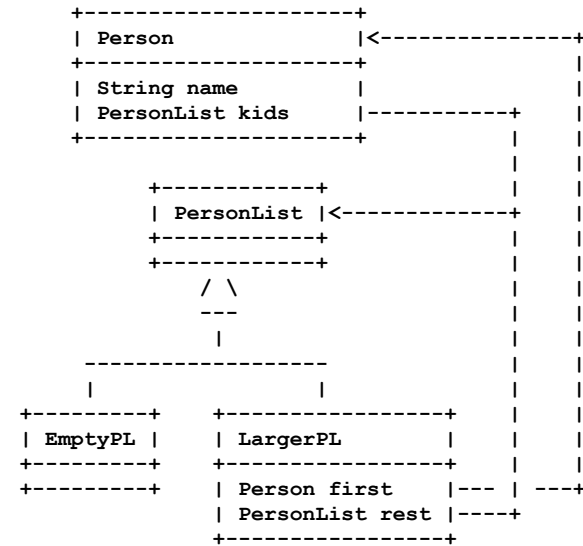
- Sometimes, we must manually separate the base case from the recursive case
  - Recursion on numbers
  - Recursive methods over finished data definitions

```
// factorial(0) == 1
// factorial(3) == 6
// To calculate n factorial
int factorial( int n ) {
    if (n == 0)
        return 1;
    else
        return n * factorial(n - 1);
}
```

## A family tree



## A family tree



## Graphs

Roads:

Ellis intersects E Hyde Park, 52nd, 53rd, 54th, 55th, 56th ...

E Hyde Park intersects Ellis, Greenwood, University, Woodlawn, ...

52nd intersects Ellis, Greenwood, University, Woodlawn, ...

## Graphs



• Possible next moves



- ...

hint... hint...

## More effects of mutation

- What happens when Jack and Jen get married?
- What happens when Jack and Jen's daughter Jill has her first daughter Marie?

To DrScheme

## How equality plays in to mutation circumstances:

- Do Jack and Jen have the same kids?

## I'm late... I'm late...

Our boss is always late for meetings, and has asked us to develop a program that will help him show up on time

- 7 days in a week... 52 weeks in a year

Let's focus on one week at a time

## A weekly scheduler

WeeklySchedule
String monday
String tuesday
String wednesday
String thursday
String friday
String saturday
String sunday

That's a lot of fields

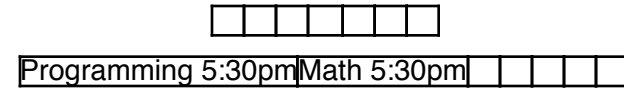
## Other options

- A list
  - Our schedule must have exactly 7 entries
- A binary tree
  - Strange
- A graph
  - Stranger and stanger
- Something new?
  -

probably...



## arrays



## ProfessorJ: Advanced



## Brief aside

- instanceof
  - Object o = new Empty();
  - o instanceof Empty
  - true
  - o instanceof Larger
  - false

and now back to the show

## arrays

- making an array in Java
  - `new int[4]`
  - `[0 0 0 0]`
- naming an array
  - `int[] fourSpot = new int[4];`

## Using arrays

- putting a value into an array
  - `fourSpot[0] = 5;`
  - `[5 0 0 0]`
  - `fourSpot[3] = 2;`
  - `[5 0 0 2]`
- Looking at a value in an array
  - `fourSpot[2]`
  - `0`
- Length of the array
  - `fourSpot.length`

## What can go in an array

- Anything, everything
- What's the default values for `new Object[10]`?
  - `null`

## null?

- An object place holder
  - Has no methods, no fields
    - Attempting to access one causes a runtime error
  - `null == null`
- Not** a replacement for `Empty`

## Setting all the values of an array

- Typically done with a 'for' loop

```
String[] schedule = new String[7];
for( int i = 0; i < schedule.length ; i=i+1 )
    schedule[i] = "Nothing to do";
```

## for loop vs recursion

```
String[] initSched( String[] schedule ) {
    for( int i = 0; i < schedule.length ; i=i+1 )
        schedule[i] = "Nothing to do";
    return schedule;
}

String[] initSched( String[] schedule ) {
    return scheduleHelp( schedule, 0 );
}

String[] scheduleHelp( String[] schedule, int i ) {
    if ( i >= schedule.length )
        return schedule;
    else {
        schedule[i] = "Nothing to do";
        return scheduleHelp( schedule, i + 1 );
    }
}
```

## A few problems

- Implementing the calendar for our boss
- Making sure our boss always remembers our daily lunch appointment
- Count the number of appointments in the calendar
- Sum the elements in int[10]

## Grid

- Anything can be placed in an array
  - Including arrays
- String[][] wholeYear = new String[52][7];

```
[ [null null null ... null null null]
  [null null null ... null null null]
  [null null null ... null null null]
  ...
  [null null null ... null null null]
  [null null null ... null null null]
  [null null null ... null null null]
]
```

- Setting a better default

```
for( int i = 0; i < wholeYear.length; i++)
    for( int j = 0; j < wholeYear[i].length; j++)
        wholeYear[i][j] = "Nothing to do";
```