CS 1110 Final Exam Recursion Review

May 11, 2011

What we'll do today

- Practice writing recursive specifications and functions
  - Given a recursive problem definition
    - Determine a proper specification (note preconditions)
  - Given a problem description and specification:
    - Write the recursive base case
    - Write the recursive call
    - Verify that it is correct

Questions?

Important Steps

1. Precise Specification
   - What does the method do?
   - What are the preconditions?
2. Write the base case
   - What is the most basic case?
   - What causes termination of the recursive method?
3. Write the recursive case
   - How do we make progress toward termination?
   - Is your computation correct?

Writing Specifications

- Write a specification for a Method that:

1. Computes the complement of a positive integer.
   ie. The complement of 12345 is 98765.
   /** = the complement of n, formed by replacing each decimal digit of n by 10-n. ie. the result for the integer 93723 is 17387.
   Precondition: n > 0 and no digit of n is 0 */
2. Reduce the positive input integer to a single digit.
   ie. 472 -> 47+2 = 49 -> 4+9 = 13 -> 1+3 = 4
   /** = n reduced to a single digit (by repeatedly summing its digits).
   Precondition: n > 0 */

Writing Specifications

- Write a specification for a Method that:

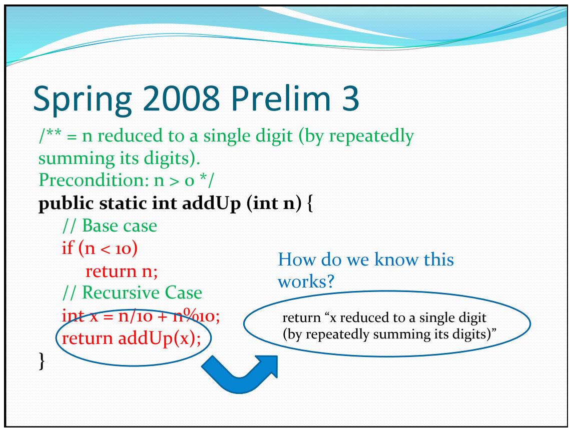
3. Compresses a String such that duplicate letters are replaced with counts.
   ie. aaabbbbbbccd -> a3b6c2d1
   /** = s compressed such that duplicates are replaced with the count of how many occurrences that character has in a row.*/
4. Converts an input integer to a string representation with commas. ie. 5923821 is converted to 5,923,821.
   /** = String representation of integer with commas added*/

Complement of an Integer

```
/** = the complement of n, formed by replacing
  each decimal digit of n by 10-n.
  ie. the result for the integer 93723 is 17387.
  Precondition: n > 0 and no digit of n is 0 */
  public static int complement(int n) {
      // Base Case

      if (n < 10)
         return 10 - n;
      // Recursive Case

      return complement(n/10) * 10 + (10 - n%10);
}
```



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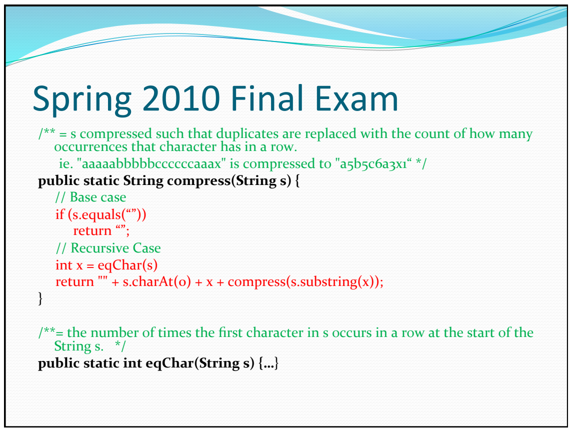
```
/** = n reduced to a single digit (by repeatedly
summing its digits).
Precondition: n > 0 */
public static int addUp (int n) {
    // Base case
    if (n < 10)
        return n;
    // Recursive Case
    int x = n/10 + n%10;
    return addUp(x);
}
```

How do we know this works?

return "x reduced to a single digit (by repeatedly summing its digits)"



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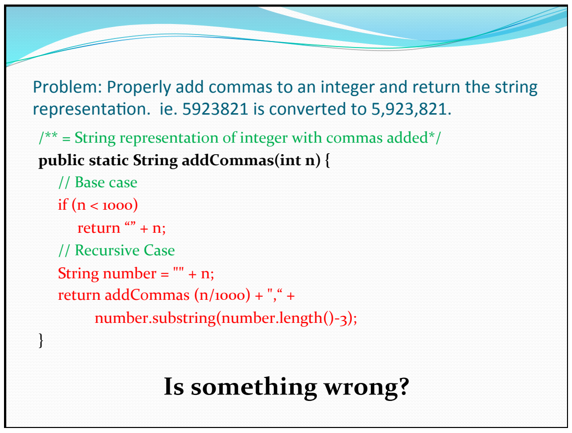
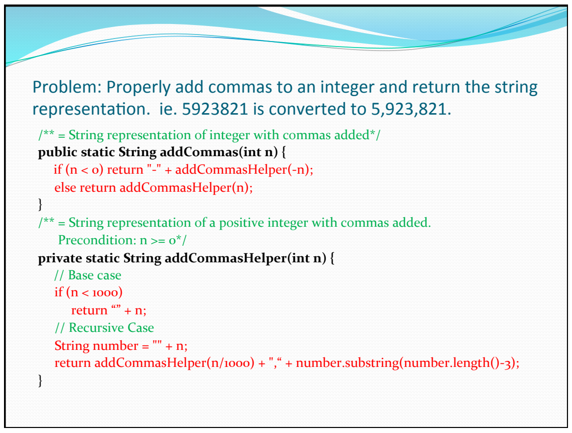
```
/** = s compressed such that duplicates are replaced with the count of how many
    occurrences that character has in a row.
     ie. "aaaaabbbbbccccccaaax" is compressed to "a5b5c6a3x1" */
public static String compress(String s) {
    // Base case
    if (s.equals(""))
        return "";
    // Recursive Case
    int x = eqChar(s)
    return "" + s.charAt(0) + x + compress(s.substring(x));
}

/**= the number of times the first character in s occurs in a row at the start of the
    String s.   */
public static int eqChar(String s) {…}
```



Problem: Properly add commas to an integer and return the string representation. ie. 5923821 is converted to 5,923,821.

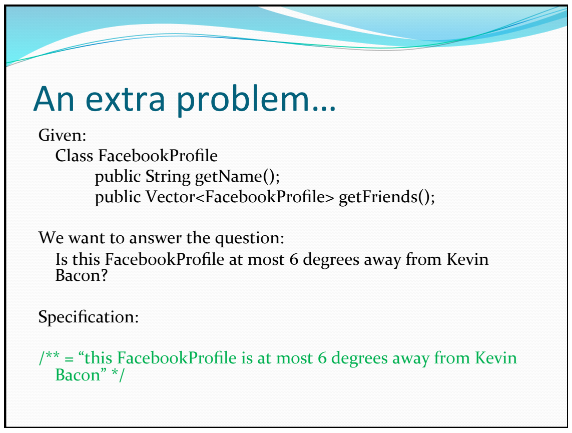
```
/** = String representation of integer with commas added*/
public static String addCommas(int n) {
    // Base case
    if (n < 1000)
        return "" + n;
    // Recursive Case
    String number = "" + n;
    return addCommas (n/1000) + "," +
            number.substring(number.length()-3);
}
```

Is something wrong?



Problem: Properly add commas to an integer and return the string representation. ie. 5923821 is converted to 5,923,821.

```
/** = String representation of integer with commas added*/
public static String addCommas(int n) {
    if (n < 0) return "-" + addCommasHelper(-n);
    else return addCommasHelper(n);
}
/** = String representation of a positive integer with commas added.
     Precondition: n >= 0*/
private static String addCommasHelper(int n) {
    // Base case
    if (n < 1000)
        return "" + n;
    // Recursive Case
    String number = "" + n;
    return addCommasHelper(n/1000) + "," + number.substring(number.length()-3);
}
```



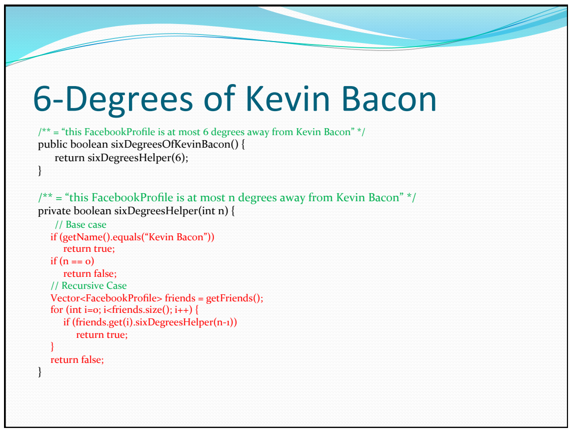
An extra problem…

Given:
    Class FacebookProfile
        public String getName();
        public Vector<FacebookProfile> getFriends();

We want to answer the question:
    Is this FacebookProfile at most 6 degrees away from Kevin Bacon?

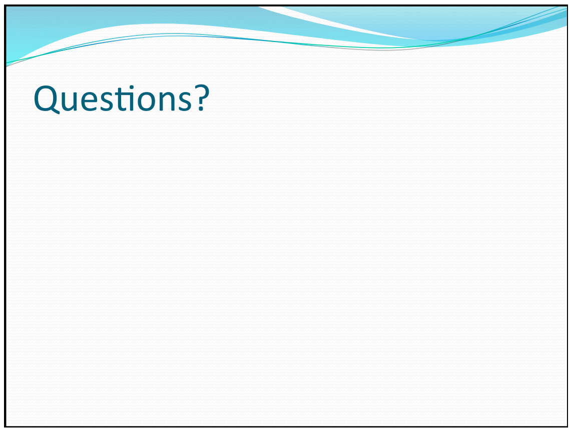
Specification:

/** = "this FacebookProfile is at most 6 degrees away from Kevin Bacon" */

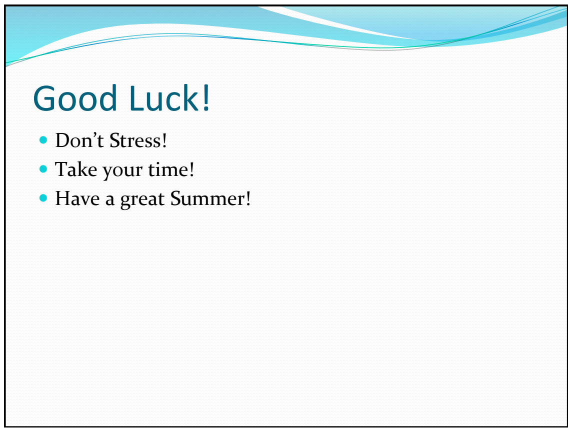


6-Degrees of Kevin Bacon

```
/** = "this FacebookProfile is at most 6 degrees away from Kevin Bacon" */
public boolean sixDegreesOfKevinBacon() {
    return sixDegreesHelper(6);
}

/** = "this FacebookProfile is at most n degrees away from Kevin Bacon" */
private boolean sixDegreesHelper(int n) {
    // Base case
    if (getName().equals("Kevin Bacon"))
        return true;
    if (n == 0)
        return false;
    // Recursive Case
    Vector<FacebookProfile> friends = getFriends();
    for (int i=0; i<friends.size(); i++) {
        if (friends.get(i).sixDegreesHelper(n-1))
            return true;
    }
    return false;
}
```



Questions?



Good Luck!

- Don't Stress!
- Take your time!
- Have a great Summer!