# UCSD CSE 15L

# Java Debugging and the Scientific Method

Week 4
October 19, 2011

# Quiz today!

1. Keep your quiz sheet upside down.
2. At the announcement, turn it over and start.
3. Write on the front and, if necessary, on the back.
4. You have ***seven*** minutes.
5. Turn the quiz over again, at the announcement.

# Quiz question

The specification of `wc.java` for the October 12 lab says "If multiple files are specified, then the program prints counts for each file separately, and also prints aggregate counts." The code for `wc.java` includes the lines

```
if( fileMaxLineLength > totalMaxLineLength )
    fileMaxLineLength = totalMaxLineLength;
```

Describe precisely in English (i) a test case that would reveal the defect in the code above, and (ii) the symptom(s) that would be produced.

# Technical terms in English

What does “aggregate” mean?

What does “behavior is undefined” mean?

# Important reminders

Check carefully that you have found and fixed all bugs.

Don’t be hasty in deciding that you have finished.

Create your own test cases.

Be paranoid :-)

ANDREW S.

# GROVE

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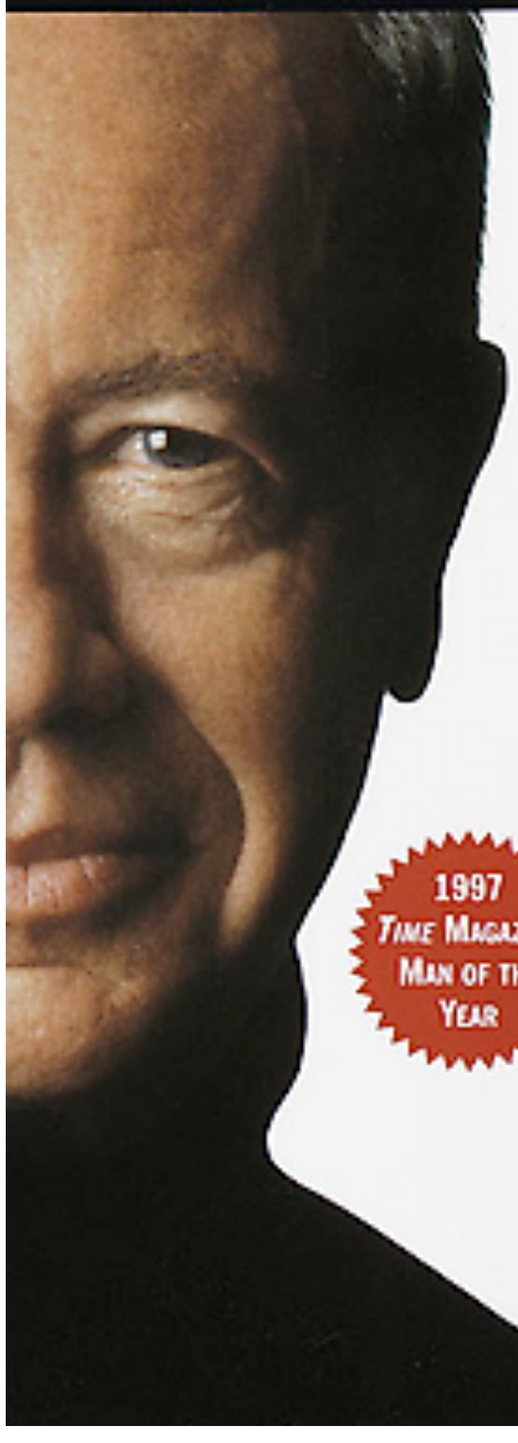

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# The scientific method in debugging

- A symptom: a ***discrepancy*** between desired and actual behavior.

- Hypothesis (a potential ***cause*** of the symptom)
- Experiment (a manipulation of the ***artifact***)
- Prediction (the expected outcome of the experiment)
- Observation (the actual outcome)

- Conclusion (the hypothesis is falsified, or ***supported***)

# What is a hypothesis?

A hypothesis $H$ is a Boolean (logical, true-or-false) statement.
A useful hypothesis logically implies the symptom $S$:

$$H \Rightarrow S$$

With the experiment, $H$ also implies the prediction $P$:

$$H \text{ and } E \Rightarrow P$$

If $P$ is false (the observation is $\neg P$), then $H$ must be false:

$$E \text{ and (not } P) \Rightarrow \text{(not } H)$$

Even if the prediction is true, you ***cannot*** deduce that

$$E \text{ and } P \Rightarrow H.$$

# Recursion

```
public class Factorial
{ // Evaluate n!
  public static long factorial( int n )
  {
      if (n <= 1) return 1;  // base case
      else
         return n * factorial( n - 1 );
  }
```

What to think about for a recursive method:

- Does the recursive case always decrease a counter?
- Is the base case correct?

# The scientific method in notes

What we need to see in the notes:

- Locate and fix every bug correctly.
- Copy and paste inputs, outputs, code changes, test data.
- Clearly state every ***hypothesis*** that you investigate.

"Every hypothesis" means both those that are falsified and those that are supported.

# Making the SM visible

We said show the full scientific method in the notes, but only write down hypotheses; cut-and-paste everything else.

But predictions cannot be cut and pasted.

Notes will get full points if they have ***written*** hypotheses, ***and*** both experiments and results are visible.

Writing down predictions explicitly is desirable but optional.

# The scientific method in reports

The ***entire*** scientific method must be explicit ***and*** explained.

The report describes your work for ***one*** bug.  For this bug, describe how you followed the scientific method.

Use full sentences and explain ***every*** step of the scientific method explicitly.

# Let's go!

The code for this week's lab is on the class website at

`http://cseweb.ucsd.edu/~elkan/15L`

Please move to the labs now: B230, B40, B250 and B260.

Pick a partner and get started.