COS 126 Exam Review

• Written exam logistics
• Example written exam questions
Written Exam Logistics

The first written exam is on Thursday March 5.

You don't all fit in this room.
  • Pay attention and know where to go.
  • Arrive early.

See yesterday's "Written Exam 1 Info" email.
  • Read carefully!
  • Policies spelled out there are our "contract"

Advice.
  • Review lectures/reading.
  • Try an old exam (untimed).
  • Try another one (timed).
  • Browse a few others.

Quick summary
  • Closed book/notes.
  • No computer/tablet/phone/calculator.
  • 1 page (front and back) cheatsheet.

See Exams tab (warning: some old exams have different coverage)
Things to remember about inclass exams

We know that you don't have much time.
- Exams are 50 minutes.
- Therefore, questions are 5 minutes.

We have to grade the exams.
- 400+ exams.
- No open-ended questions.
- Fully prepared rubrics.

Old exams are not completely reliable.
- Course offerings differ slightly.
- We have made mistakes in the past.

Each exam is only part of the story.
Example question: Basics

Q. Do you understand types and Java's type conversion and precedence rules?

Ex. (Fall 2014 Question 1) Give the type and value of each of the following Java expressions, supposing that it is used as the argument of a println() call.

```
(3 < 2) && (1 > 0)   boolean  FALSE
"800" + 99           String   80099
800 + 99 + "A"       String   899A
3 + (int) Math.random()  int     3
(double)(3 / 2)      double   1.0
3 / 2.0 + 2 / 5      double   1.5
(8 <= 2) || (2e88 <= 88e2) boolean  FALSE
Integer.parseInt("8.5*2")  ILLEGAL
8 / 2 * (2 + 2)      int     16
```

```bash
% jshell
| Welcome to JShell -- Version 11.0.2
| For an introduction type: /help intro

jshell> (3 < 2) && (1 > 0)
$1 ==> false

jshell> "800" + 99
$2 ==> "80099"

jshell> 800 + 99 + "A"
$3 ==> "899A"

jshell> 3 + (int) Math.random()
$4 ==> 3

jshell> (double)(3 / 2)
$5 ==> 1.0

jshell> 3 / 2.0 + 2 / 5
$6 ==> 1.5
```
Precedence matters

8 ÷ 2(2 + 2) = ?

The New York Times

The Math Equation That Tried to Stump the Internet

Many respondents were certain the answer was 16. Others … insisted the right answer was 1. That’s when the trash talking began. “Some of y’all failed math and it shows,” said one. Another posted a photo showing that even two different electronic calculators disagreed. The normally reassuring world of math, where right and wrong exist, and logic must prevail, started to seem troublingly, perhaps tantalizingly, fluid.

“When arithmetic operators have the same precedence, the order is determined by left associativity, so that a - b - c and (a - b) - c represent the same sequence of operations.”

– Sedgewick and Wayne, p. 17
Example question: Binary operations

Q. Why is \( \sim 0 \) equal to \(-1\) and not \(1\)? (Fall 2014 Q1B)

A (wrong).
\( \sim \) is "not"
0 is "false"
"not false" is "true"
"true" is 1

you might find this on an old exam, BUT probably not on your exam

Reason 1: Timing of lectures differ.
Reason 2: We try to avoid trick questions nowadays.

A (correct).
\( \sim \) is **BITWISE "not"
0 is 00000000000000000000000000000000
\( \sim 0 \) is 11111111111111111111111111111111
11111111111111111111111111111111 is \(-1\) (2s complement)

you'll learn about this next week
Example question: Arrays

Q. Do you understand basic properties and rules about Java arrays?

Ex. (Fall 2016 Question 2) Which of the following statements are true for Java arrays? Mark each statement as either TRUE or FALSE.

- An array can't simultaneously store both an element of type double and an element of type boolean. **TRUE**

- Once you create an array, you cannot change its type. **TRUE**

- You must access the elements in an array in sequential order, e.g., you cannot access a[5] until you have accessed a[0], a[1], through a[4]. **FALSE**

- If a[] is a boolean array of length 126, then the expression a[i] will evaluate arbitrarily to either true or false if the index i is equal to 126. **FALSE**

- If a[] and b[] are two arrays of length 2, then a == b is true if and only if both a[0] == b[0] and a[1] == b[1] are true. **FALSE**
Example question: Loops and conditionals

Q. Can you figure out the effect of a simple Java program that uses `while` and `if` statements?

Ex. (Fall 2014 Question 2) Fill in the trace for just after each iteration of the outer `for` loop in this program:

```java
int[] a = new int[N];
a[0] = 1;
for (int i = 1; i < N; i++)
{
    int sum = 0;
    for (int j = 0; j < i; j++)
        sum = sum + a[j];
    a[i] = 1 + (2 * sum) / i;
}
```

<table>
<thead>
<tr>
<th>i</th>
<th>sum</th>
<th>a[i]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
<td>11</td>
</tr>
<tr>
<td>6</td>
<td>36</td>
<td>13</td>
</tr>
</tbody>
</table>

Write one line of code that could replace the body of the outer loop.

```java
a[i] = 2*i + 1;
```
Q. Do you understand basic ways of communicating with your programs?

Ex. (S2011 Q4) Give the results of invoking this program with the given commands.

```java
public class Q4 {
    public static void main(String[] args) {
        int curr = StdIn.readInt();
        StdOut.print(curr + " ");
        int prev = curr;
        while (!StdIn.isEmpty()) {
            curr = StdIn.readInt();
            StdOut.print((prev + curr) / 2 + " ");
            prev = curr;
        }
        StdOut.println();
    }
}
```

*Hint: Start by READING THE PROGRAM*

```
% more input.txt
2 4 6 8 10 12 8 2
% java Q4 < input.txt
2 3 5 7 9 11 10 5
% java Q4 < input.txt | java Q4
2 2 4 6 8 10 10 7
```

*Note: It prints the first number, then the average of each number and its predecessor.*
Q. Do you understand basic mechanisms for invoking functions?

**Ex.** (S2018 Q7) Give the contents of the array a[] after executing the given code.

```java
public static int halve1(int x)
{
    x = x / 2;
    return x;
}

public static void halve2(int[] a)
{
    for (int i = 0; i < a.length; i++)
    {
        halve1(a[i]); // No effect on a[]!
        a[i] = halve1(a[i]);
    }
}
```

```java
int[] a = { 16, 32, 48, 64 };
halve2(a);

8 16 24 32 NOT 4 8 12 16
```

```java
int[] a = { 16, 32, 48, 64 };;
halve2(a);

4 8 12 16
```
Example question: Functions II

**Ex. (S2018 Q7)** Give the contents of the array `a[]` after executing the given code.

```java
public static void halve3(int[] a)
{
    int n = a.length;
    int[] b = new int[n/2];
    for (int i = 0; i < n/2; i++)
        b[i] = a[i];
    a = b;
}
```

```java
int[] a = { 16, 32, 48, 64 };
halve3(a);
halve3(a);
```

16 32 48 64
Ex. Give the contents of the array a[] after executing the given code.

```java
public static int[] halve4(int[] a) {
    int n = a.length;
    int[] b = new int[n];
    for (int i = 0; i < n; i++)
        b[i] = a[i]/2;
    return b;
}

int[] a = { 16, 32, 48, 64 };
a = halve4(a);

// Output
8 16 24 32
Example question: Recursion

Q. Can you figure out the effect of a simple recursive program (or two)?

Ex. (Fall 2017 Q5) What is the value of mystery2(5)?

```
public static int mystery1(int n) {
    if (n == 0) return 0;
    else return mystery2(n - 1);
}

public static int mystery2(int n) {
    if (n == 0) return 1;
    else return mystery1(n - 1);
}
```

<table>
<thead>
<tr>
<th>n</th>
<th>mystery1(n)</th>
<th>mystery2(n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Write one line of code that could replace the body of mystery(1).

```
return n % 2;
```
Good luck!