

Analyze Recursive Methods

Monday, April 15, 2013
8:00 AM

1. Consider the following two static methods, where f_2 is intended to be the iterative version of f_1 .

```

public static int f1(int n) {
    if (n < 0) {
        return 0;
    }
    else {
        return (f1(n - 1) + n * 5);
    }
}

```

```

public static int f2(int n) {
    int answer = 0;

    while (n > 0) {
        answer = answer + n * 5;
        n--;
    }

    return answer;
}

```

$$\begin{aligned}
 f_1(4) &: f_1(3)^5 + 4 \times 5 = 50 \\
 f_1(3) &: f_1(2)^5 + 3 \times 5 = 30 \\
 f_1(2) &: f_1(1)^5 + 2 \times 5 = 15 \\
 f_1(1) &: f_1(0)^5 + 1 \times 5 = 5 \\
 f_1(0) &: f_1(-1)^5 + 0 \times 5 = 0 \\
 f_1(-1) &: 0
 \end{aligned}$$

$\frac{50}{5} = 10$
 $10 \times 5 = 50$

Answer

0
 20
 $20 + 15 = 35$
 $35 + 10 = 45$
 $45 + 5 = 50$

The method f_2 will always produce the same results as f_1 under which of the following conditions?

- I. $n < 0$ they are the same
 ✓ II. $n = 0$ they are the same
 ✓ III. $n > 0$ they were the same when n was 4.

- a) I only
 b) II only
 c) III only
 d) II and III only
 e) I, II, and III

✱ The recursive case must eventually move the method to the base case condition, or infinite recursion will occur and result in a runtime error.

2. Assume that methods f and g are defined as follows. *Indirect Recursion*

```
public static int f(int x) {
    if (x <= 0) {
        return 1;
    }
    else {
        return g(x - 1);
    }
}
```

```
public static int g(int x) {
    if (x <= 0) {
        return 0;
    }
    else {
        return f(x - 1) + x;
    }
}
```

$$f(1): \underline{g(0)} \boxed{10}$$

$$g(5): \underline{f(4)}^5 + 5 \rightarrow 10$$

$$f(4): \underline{g(3)}^5$$

$$g(3): \underline{f(2)}^2 + 3 \rightarrow 5$$

$$f(2): \underline{g(1)}^2$$

$$g(1): \underline{f(0)}^1 + 1 \rightarrow 2$$

$$f(0): 1$$

What value is returned as a result of the call $f(6)$?

- a) 0
- b) 6
- c) 9
- d) 10
- e) 12

3. Consider the following static method

```
public static void recur(int n) {
    if (n != 0) {
        recur(n - 2);
        System.out.print(n + " ");
    }
}
```

$$\text{recur}(7): \underline{\text{recur}(5)}$$

$$\text{recur}(5): \underline{\text{recur}(3)}$$

$$\text{recur}(3): \underline{\text{recur}(1)}$$

$$\text{recur}(1): \underline{\text{recur}(-1)}$$

What numbers will be printed as a result of the call $\text{recur}(7)$?

- a) -1 1 3 5 7
- b) 1 3 5 7
- c) 7 5 3 1
- d) Many numbers will be printed because of infinite recursion
- e) No numbers will be printed because of infinite recursion.

4. Consider the following code segment

```
public static void mystery(int n) {
    int a = n / 2;
    int b = n % 2;

    if (a > 0) {
        mystery(a);
    }
    System.out.print(b);
}
```

$m(8): a=4 \ b=0 \ m(4)$
 $m(4): a=2 \ b=0 \ m(2)$
 $m(2): a=1 \ b=0 \ m(1)$
 $m(1): a=0 \ b=1$

1000

81

What would be printed by the call `mystery(8)`?

5. Consider the following code segment

```
public static int mystery(int x, int y) {
    if (y == 1)
        return x;
    else
        return x * mystery(x, y - 1);
}
```

$m(3,4): 3 * m(3,3)^{27}$
 $m(3,3): 3 * m(3,2)^9$
 $m(3,2): 3 * m(3,1)^3$
 $m(3,1): 3$

What would be the return value from the call `mystery(3, 4)`?

6. Consider the following code segment (No Returns! Has Prints instead)

```
public static void mystery1() {
    int k;
    k = Keyboard.readInt();
    if (k != 0) {
        mystery1();
        System.out.print(k + " ");
    }
}
```

$mystery(): k=1 \ mystery(); \text{print } 1$
 $mystery(): k=2 \ mystery(); \text{print } 2$
 $mystery(): k=3 \ mystery(); \text{print } 3$
 $mystery(): k=4 \ mystery(); \text{print } 4$
 $mystery(): k=0$

Consider window

4321

What would be printed if the user typed in 1 2 3 4 0 at the keyboard?

7. Consider the following code segment

```
public static void mystery1() {
    int k;
    k = Keyboard.readInt();
    if (k != 0) {
        System.out.print(k + " ");
        mystery1();
    }
}
```

$m(): k=1 \ m()$
 $m(): k=2 \ m()$
 $m(): k=3 \ m()$
 $m(): k=4 \ m()$
 $m(): k=0$

Console

1234

What would be printed if the user typed in 1 2 3 4 0 at the keyboard?