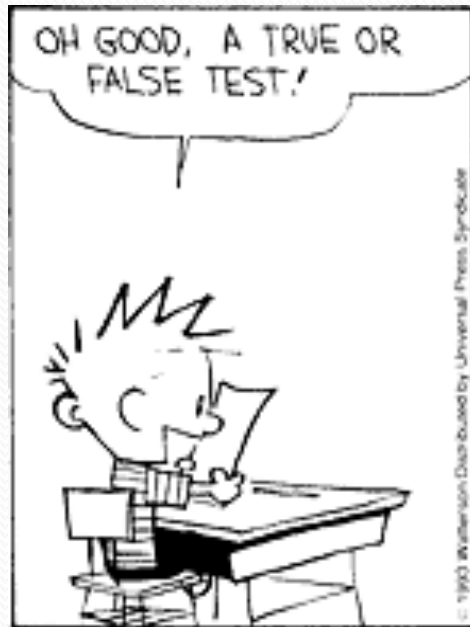




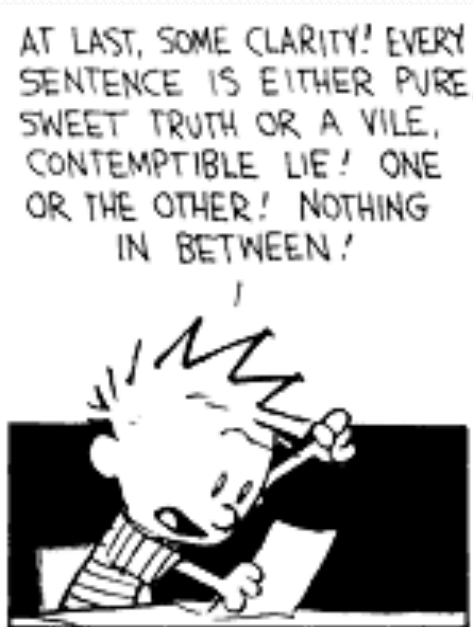
Building Java Programs

Chapter 5
Assertions

reading: 5.5



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Logical assertions

- **assertion:** A statement that is either true or false.

Examples:

- Java was created in 1995.
 - The sky is purple.
 - 23 is a prime number.
 - 10 is greater than 20.
 - x divided by 2 equals 7. (*depends on the value of x*)
-
- An assertion might be false ("The sky is purple" above), but it is still an assertion because it is a true/false statement.

Reasoning about assertions

- Suppose you have the following code:

```
if (x > 3) {  
    // Point A  
    x--;  
} else {  
    // Point B  
    x++;  
    // Point C  
}  
// Point D
```

- What do you know about x 's value at the three points?
 - Is $x > 3$? Always? Sometimes? Never?

Assertions in code

- We can make assertions about our code and ask whether they are true at various points in the code.
 - Valid answers are ALWAYS, NEVER, or SOMETIMES.

```
System.out.print("Type a nonnegative number: ");  
double number = console.nextDouble();  
// Point A: is number < 0.0 here? (SOMETIMES)
```

```
while (number < 0.0) {  
    // Point B: is number < 0.0 here? (ALWAYS)  
    System.out.print("Negative; try again: ");  
  
    number = console.nextDouble();  
    // Point C: is number < 0.0 here? (SOMETIMES)  
}
```

```
// Point D: is number < 0.0 here? (NEVER)
```

Reasoning about assertions

- Right after a variable is initialized, its value is known:

```
int x = 3;  
// is x > 0? ALWAYS
```

- In general you know nothing about parameters' values:

```
public static void mystery(int a, int b) {  
// is a == 10? SOMETIMES
```

- But inside an `if`, `while`, etc., you may know something:

```
public static void mystery(int a, int b) {  
    if (a < 0) {  
        // is a == 10? NEVER  
        ...  
    }  
}
```

Assertions and loops

- At the start of a loop's body, the loop's test must be true:

```
while (y < 10) {  
    // is y < 10?  ALWAYS  
    ...  
}
```

- After a loop, the loop's test must be false:

```
while (y < 10) {  
    ...  
}  
// is y < 10?  NEVER
```

- Inside a loop's body, the loop's test may become false:

```
while (y < 10) {  
    y++;  
    // is y < 10?  SOMETIMES  
}
```

"Sometimes"

- Things that cause a variable's value to be unknown (often leads to "sometimes" answers):
 - reading from a `Scanner`
 - reading a number from a `Random` object
 - a parameter's initial value to a method
- If you can reach a part of the program both with the answer being "yes" and the answer being "no", then the correct answer is "sometimes".
 - If you're unsure, "Sometimes" is a good guess.

Assertion example 1

```
public static void mystery(int x, int y) {  
    int z = 0;
```

```
    // Point A
```

```
    while (x >= y) {
```

```
        // Point B
```

```
        x = x - y;
```

```
        z++;
```

```
        if (x != y) {
```

```
            // Point C
```

```
            z = z * 2;
```

```
        }
```

```
        // Point D
```

```
    }
```

```
    // Point E
```

```
    System.out.println(z);
```

```
}
```

Which of the following assertions are true at which point(s) in the code?
Choose ALWAYS, NEVER, or SOMETIMES.

	$x < y$	$x == y$	$z == 0$
Point A	SOMETIMES	SOMETIMES	ALWAYS
Point B	NEVER	SOMETIMES	SOMETIMES
Point C	SOMETIMES	NEVER	NEVER
Point D	SOMETIMES	SOMETIMES	NEVER
Point E	ALWAYS	NEVER	SOMETIMES

Assertion example 2

```
public static int mystery(Scanner console) {  
    int prev = 0;  
    int count = 0;  
    int next = console.nextInt();
```

```
    // Point A
```

```
    while (next != 0) {
```

```
        // Point B
```

```
        if (next == prev) {
```

```
            // Point C
```

```
            count++;
```

```
        }
```

```
        prev = next;
```

```
        next = console.nextInt();
```

```
        // Point D
```

```
    }
```

```
    // Point E
```

```
    return count;
```

```
}
```

Which of the following assertions are true at which point(s) in the code?
Choose ALWAYS, NEVER, or SOMETIMES.

	<code>next == 0</code>	<code>prev == 0</code>	<code>next == prev</code>
Point A	SOMETIMES	ALWAYS	SOMETIMES
Point B	NEVER	SOMETIMES	SOMETIMES
Point C	NEVER	NEVER	ALWAYS
Point D	SOMETIMES	NEVER	SOMETIMES
Point E	ALWAYS	SOMETIMES	SOMETIMES

Assertion example 3

```
// Assumes y >= 0, and returns x^y
public static int pow(int x, int y) {
    int prod = 1;

    // Point A
    while (y > 0) {
        // Point B
        if (y % 2 == 0) {
            // Point C
            x = x * x;
            y = y / 2;
            // Point D
        } else {
            // Point E
            prod = prod * x;
            y--;
            // Point F
        }
    }
    // Point G
    return prod;
}
```

Which of the following assertions are true at which point(s) in the code?
Choose ALWAYS, NEVER, or SOMETIMES.

	$y > 0$	$y \% 2 == 0$
Point A	SOMETIMES	SOMETIMES
Point B	ALWAYS	SOMETIMES
Point C	ALWAYS	ALWAYS
Point D	ALWAYS	SOMETIMES
Point E	ALWAYS	NEVER
Point F	SOMETIMES	ALWAYS
Point G	NEVER	ALWAYS