

Name \_\_\_\_\_ Section Number \_\_\_\_\_

CS210 Exam #1 \*\*\* TURN OFF ALL ELECTRONIC DEVICES \*\*\* Practice  
Sections 3 and 4 Bob Wilson

OPEN BOOK / OPEN NOTES:

Spend only about one minute per point on each question to complete the exam on time.

1. Java Syntax and Semantics (40 Points)

For each of the following snippets of Java code, indicate whether the syntax is correct or not.

If it is correct, explain the semantics (what it does).

If it is not correct, correct it, give reason, and explain the semantics of your corrected code.

a. `int myNumbers = new int[25];` // Correct syntax? Yes \_\_\_\_\_ No \_\_\_\_\_  
// Correct, give reason, and/or explain semantics

b. `int i = 35;` // Correct syntax? Yes \_\_\_\_\_ No \_\_\_\_\_  
`++i;` // Correct, give reason, and/or explain semantics

c. `double f = 3.45;` // Correct syntax? Yes \_\_\_\_\_ No \_\_\_\_\_  
`int j = int(f);` // Correct, give reason, and/or explain semantics

d. `String s = "Hello World";` // Correct syntax? Yes \_\_\_\_\_ No \_\_\_\_\_  
`int length = s.length();` // Correct, give reason, and/or explain semantics

e. `boolean protected = true;` // Correct syntax? Yes \_\_\_\_\_ No \_\_\_\_\_  
// Correct, give reason, and/or explain semantics

(continued on next page)

- f. `String [] animals` // Correct syntax? Yes\_\_\_\_\_ No \_\_\_\_\_  
`= {"dog", "cat", "rat"}; // Correct, give reason, and/or explain semantics`  
`animals.add("bat");`
- g. `int i, j;` // Correct syntax? Yes\_\_\_\_\_ No \_\_\_\_\_  
`. . . // code to initialize values of i and j`  
`if (j == 0) // Correct, give reason, and/or explain semantics`  
`raise ArithmeticException("j is zero");`  
`System.out.println(i/j);`
- h. `public class MainProgram` // Correct syntax? Yes\_\_\_\_\_ No \_\_\_\_\_  
`{ // Correct, give reason, and/or explain semantics`  
`public static main (String [] args)`  
`{`  
`System.out.println("Hello World");`  
`}`  
`}`
- i. `int result = function();` // Correct syntax? Yes\_\_\_\_\_ No \_\_\_\_\_  
`. . . // Correct, give reason, and/or explain semantics`
- `// elsewhere in the same class`  
`private double function()`  
`{`  
`return 42.0;`  
`}`
- j. `String myString =` // Correct syntax? Yes\_\_\_\_\_ No \_\_\_\_\_  
`new String("Hello World"); // Correct, give reason, and/or explain semantics`

## 2. Big-O Analysis (30 Points)

Show the big-O analysis for each of the following code segments based on the identified independent variable N. **Explain your answers.**

a. Based on the number (N) of lines in the file "input.txt":  $O(\text{_____})$

```
Scanner file = new Scanner(new File("input.txt"));
while (file.hasNextLine())
    some Java statement using file.nextLine();
```

b. Based on the independent variable N:  $O(\text{_____})$

```
for (int i = N; i > 0; i /= 2)
    some Java statement using variable i;
```

c. Based on the independent variable N:  $O(\text{_____})$

```
for (int i = 0; i < Math.pow(N, 2); i++)
    some Java statement using variable i;
```

d. Based on the independent variable N:  $O(\text{_____})$

```
for (int i = 0; i < N; i++)
    for (int j = 0; j < Math.log10(N); j++)
        some Java statement using variables i and j;
```

e. Based on the independent variable N:  $O(\text{_____})$

```
for (int i = 0; i < N; i++)
    some Java statement using variable i;
for (int j = 0; j < Math.log10(N); j++)
    some Java statement using variable j;
```

### 3. Linked Data Structures (30 Points)

Assume that you have a `DoubleNode<T>` class as defined in the lecture notes and text. (The `DoubleNode` code is attached for reference.) Class `DoubleList` implements a linked list using `DoubleNode` objects. You need to write code for the `DoubleList` class `addFirst` method. The `addFirst` method adds a new `DoubleNode` object with a reference to the element of type `T` as the first object in the linked list.

```
public class DoubleList<T>
{
    private DoubleNode<T> first;
    private DoubleNode<T> last;
    private int count;

    public DoubleList()
    {
        count = 0;
        first = last = null;
    }

    public void addFirst(T element) // write your code here
    {

    }
}
```

Draw a picture of the data storage strategy here to help write the code and be eligible for partial credit.

For reference in Problem 4:

```
public class DoubleNode<T>
{
    DoubleNode<T> next;
    DoubleNode<T> prev;
    T element;

    public DoubleNode(T element)
    {
        this.element = element;
        next = prev = null;
    }

    public void setNext(DoubleNode<T> next)
    {
        this.next = next;
    }

    public void setPrev(DoubleNode<T> prev)
    {
        this.prev = prev;
    }

    public DoubleNode<T> getNext()
    {
        return this.next;
    }

    public DoubleNode<T> getPrev()
    {
        return this.prev;
    }

    public T getElement()
    {
        return this.element;
    }
} // end class DoubleNode<T>
```

Answer Key:

1. Java Syntax and Semantics

a. `int [] myNumbers = new int[25];` // Correct syntax? Yes\_\_\_\_\_ No X\_\_\_\_  
// Correct, give reason, and/or explain semantics

**Need [ ] brackets in declaration data type. Instantiates a new array of 25 ints.**

b. `int i = 35;` // Correct syntax? Yes X No \_\_\_\_\_  
`++i;` // Correct, give reason, and/or explain semantics

**Initializes i to 35 and then pre increments value of i by one to 36.**

c. `double f = 3.45;` // Correct syntax? Yes\_\_\_\_\_ No X\_\_\_\_  
`int j = int(f); (int) f;` // Correct, give reason, and/or explain semantics

**Incorrect cast syntax. Initializes f to 3.45 and then initializes j to truncated integer value of 3.**

d. `String s = "Hello World";` // Correct syntax? Yes X No \_\_\_\_\_  
`int length = s.length();` // Correct, give reason, and/or explain semantics

**Initializes s to a String reference and gets the length of the String (= 11).**

e. `boolean protected = true;` // Correct syntax? Yes\_\_\_\_\_ No X\_\_\_\_  
// Correct, give reason, and/or explain semantics

**“protected” is a Java reserved word and can’t be used as a variable name. Change the name.**

f. `String [] animals` // Correct syntax? Yes\_\_\_\_\_ No X\_\_\_\_  
`= {"dog", "cat", "rat"};` // Correct, give reason, and/or explain semantics  
~~`animals.add("bat");`~~ `^, "bat"`

**Can’t add elements to a Java array after instantiation. Add “bat” to initializer list in first line.**

g. `int i, j;` // Correct syntax? Yes\_\_\_\_\_ No X\_\_\_\_  
`. . . // code to initialize values of i and j`  
`if (j == 0)` // Correct, give reason, and/or explain semantics  
~~`raise throw new`~~ `ArithmeticException("j is zero");`

`System.out.println(i/j);`  
**“raise” is not the correct Java reserved word. Use “throw new”.**

h. `public class MainProgram` // Correct syntax? Yes\_\_\_\_\_ No X\_\_\_\_  
`{` // Correct, give reason, and/or explain semantics  
`public static void main (String [] args)`  
`{`  
`System.out.println("Hello World");`  
`}`  
`}` **Return type was missing in “main” method header.**

i. `int result = function();` // Correct syntax? Yes\_\_\_\_ No X  
`. . .` // Correct, give reason, and/or explain semantics

// elsewhere in the same class  
private **double** function()  
{  
return **42.0**;  
}

**Mismatch between data type of result and function's return type. Change one or the other and adjust return statement if needed.**

j. `String myString =` // Correct syntax? YesX No \_\_\_\_\_  
`new String("Hello World");` // Correct, give reason, and/or explain semantics  
**Instantiates a new String object and stores reference in variable named "myString".**

## 2. Big-O Analysis

a. Based on the number (N) of lines in the file "input.txt":  $O(N)$   
Scanner file = new Scanner(new File("input.txt"));  
while (file.hasNextLine())  
some Java statement using file.nextLine();

**The Scanner file's hasNextLine method will return true N times – once for each line.**

b. Based on the independent variable N:  $O(\log N)$   
for (int i = N; i > 0; i /= 2)  
some Java statement using variable i;

**The value of i starts at N and is divided in half each pass through the loop. It will reach 1 and then 0 (due to integer truncation) to end the loop in  $(\log_2 N + 1)$  passes.**

c. Based on the independent variable N:  $O(N^2)$   
for (int i = 0; i < Math.pow(N, 2); i++)  
some Java statement using variable i;

**The variable i is incremented by one each pass until it reaches the value  $N^2$**

d. Based on the independent variable N:  $O(N \log N)$   
for (int i = 0; i < N; i++)  
for (int j = 0; j < Math.log10(N); j++)  
some Java statement using variables i and j;

**Two nested loops are multiplied. The product is the growth rate.**

e. Based on the independent variable N:  $O(N)$   
for (int i = 0; i < N; i++)  
some Java statement using variable i;  
for (int j = 0; j < Math.log10(N); j++)  
some Java statement using variable j;

**Two loops in series are added and only the fastest growing term is kept.**

### 3. Linked Data Structures:

```
public void addFirst(T element)
{
    DoubleNode<T> newNode = new DoubleNode<T>(element);
    if (count++ == 0) {
        first = last = newNode;
    }
    else {
        newNode.setNext(first);
        newNode.setPrev(first.getPrev()); // not really needed
        first.setPrev(newNode);
        first = newNode;
    }
}
```