Midterm Solutions

PROBLEM 1 :  *(Short ones (18 points))*

1. For each of the following, summarize the distinction between the two terms. Your answer should be *brief*.

   A.  [2pts] Internet vs. World Wide Web
       The Internet is a network of networks communicating using the Internet Protocol. The World Wide Web is the global interconnected set of hypertext documents on top of the Internet.

   B.  [2pts] Program vs. algorithm
       A program is a formal representation of an algorithm designed for computer application.

   C.  [2pts] In Java, = operator vs. == operator
       = is the assignment operator, while == is a boolean operator that tests whether its two arguments have the same value.

2.  [3pts] Draw a circle around the portion of the URL below that identifies the directory containing the file being addressed. Underline the portion that identifies the protocol that should be used when accessing the file. Draw a rectangle around the portion that identifies the file name itself.

   http://batcave.metropolis.com/heroes/superheroes/batpage.html

   /heroes/superheroes/: directory
   http: protocol batpage.html: file name

3.  [2pts] What does this Java code do (assuming a and b are ints)?

   ```java
   a = a + b;
   b = a - b;
   a = a - b;
   ```

   Swaps the values of a and b

4.  [3pts] Java supports two kinds of comments.

   - Single-line comments beginning with // and extending to the end of the line
   - Multiple-line comments beginning with /* and extending to */ on the same line or a later line

   What is the purpose of these comments? In other words, what and who are comments for? Comments help communicate the algorithm to a human, whether it is the original programmer or others. Comments usually address one of two questions about code: what does it do or how does it do it.
5. [2pts] The following method, floorRoot, was designed to compute the largest integer whose square is no greater than N, where N is assumed to be a positive number. (If N is 5, then the procedure should report the value 2.) Find and correct the error.

```java
/* returns the largest integer whose square is no greater than n */
public int floorRoot(int n)
{
    int x = 0;
    while (x * x <= n)
    {
        x = x + 1;
    }
    return x;
}
change last line to return x-1
```

PROBLEM 2:  (Eval Time (8 points))

Show the order of evaluation of the operators in each of the following Java statements, and show the value of the variable after the statement is performed.

You should use the following example as a model.

```
int x;
x = 2 + 3 - 6;
3 1 2 <- order of evaluation
x = -1 <- value of x
```

The numbers under the code indicate that the addition (+) is the first operation evaluated, followed by subtraction(-) and the last is the assignment (=).

a. Given the following declarations:

```java
int p = 2, q = 6, r = 1;
```

Evaluate

```java
p = -1 + p * (2 % q - r);
5 4 3 1 2
= -1 + 2 * (2 % 6 - 1);
= -1 + 2 * (1 - 1);
= -1 + 2
= 1
```

b. Given the following declaration:

```java
double a = 1.0;
double b = 0.5;
int c = 2;
int d = 3;
int e = 5;
```
Evaluate

\[
a = b + c \times d + e;
\]
\[
\begin{align*}
4 & \quad 2 & \quad 1 & \quad 3 \\
& = 0.5 + 2 \times 3 + 5; \\
& = 0.5 + 6 + 5; \\
& = 6.5 + 5; \\
& = 11.5
\end{align*}
\]

**PROBLEM 3 : (Parsing (8 points))**
For the following lines of code, state whether each line is a legal syntactical statement. If it is not a legal Java statement, explain why. If it is a legal Java statement, show how to parse it using the list of rules for Java at the end of Chapter 2 in *Great Ideas* (also reproduced at the end of the test).

a. \[p = 3p + q \% z;\]
   illegal syntax \(3p\) is not a name

b. \[tField = new Button("x + y");\]

\[
\begin{align*}
\text{<statement>} \\
\#3 & \quad <\text{name}> = \text{new} <\text{class}>(<\text{arguments}>); \\
\#5 & \quad <\text{name}> = \text{new} <\text{class}>(<\text{expression}>); \\
\#6 & \quad <\text{name}> = \text{new} <\text{class}>(<\text{string-expression}>); \\
\#8 & \quad <\text{name}> = \text{new} <\text{class}>(<\text{string}>); \\
\#1 \quad tField = \text{new} <\text{class}>(<\text{string}>); \\
\#18 \quad tField = \text{new} Button(<\text{string}>); \\
\#9 \quad tField = \text{new} Button("x + y");
\end{align*}
\]

**PROBLEM 4 : (Robots (6 points))**
Consider the following code excerpt from a Robots class

```java
import becker.robots.*;

public class PickUp
{
    public static void main(String[] args)
    {
        // Set up the initial situation
        City durham = new City();
        Thing warning1 = new Thing(durham, 0, 1);
        Thing warning2 = new Thing(durham, 1, 1);
        Thing warning3 = new Thing(durham, 2, 1);
        Thing warning4 = new Thing(durham, 3, 1);
        Robot karel = new Robot(durham, 0, 1, Direction.EAST);

        // If the following code is executed next,
        if (karel.isBesideThing())
        {
            karel.move();
        }
        karel.turnLeft();
    }
}
```

show the state of the world after the code executes. If the robot breaks, be sure to note that.

(1,1) facing north

B. Now consider the following code in place of the fragment from part A (i.e. karel starts at (0,1) again):

```
while (karel.isBesideThing())
{
    karel.pickThing();
    karel.move();
}
```

Where will the robot end up? What direction will it be facing? How many Things will it hold.

(4,1) facing east with 4 Things in backpack

PROBLEM 5: (Graphs (12 points))

In this question, we describe the launch of CS-Book, a hypothetical online social network much like the Facebook system discussed in class. We ask questions about what the network is like at different steps. In this system, people are nodes and the mutual relationship of “CS-friendship” is the only kind of link. Accepting an invitation to join CS-Book is one way to create a “CS-friendship” link between yourself and the person who invited you. Once on the system, you can offer CS-friendship to another person who is already on CS-Book. Accepting an offer of CS-friendship (when both parties are already on the system) is the only other way to add a link of CS-friendship. A person can unilaterally “un-CS-friend” any CS-friend, which removes the link that connects them.

1. Owen launches CS-Book and is the only CS-friend on the system.
2. Owen invites Jeff and Nick.
3. Nick accepts the invitation from Owen.
4. Jeff accepts the invitation from Owen.
5. Jeff invites Susan to join CS-Book.
7. Robert accepts the invitation from Nick.
8. Owen and Nick get into an argument and Nick un-CS-friends Owen.
9. Robert offers CS-Friendship to Jeff.
10. Jeff accepts the offer from Robert.
11. Owen invites Thomas.
12. Thomas accepts the invitation from Owen.
13. Susan accepts the offer from Jeff.

The following questions refer to CS-Book and the sequence of 14 events listed above.
A. [3pts] If the CS-Book graph is disconnected at any point, write the number of each step in which the graph becomes disconnected. If it is always connected, write “always connected.”

8, 14. If you assumed invitees are part of the graph, then 2, 5, 14

B. [3pts] Write Owen’s degree after each of the 14 steps above. Your answer will be a sequence of 14 numbers.

0 0 1 2 2 2 1 1 1 1 2 2 2

C. [6pts] After the last step, 14, consider all paths that do not include cycles. Pick the shortest path between each pair of nodes. What is the maximum shortest path (the maximum number of links that must be traversed to get between any pair of nodes)? Write all of the people who lie along the path in order (including the people on the ends of it).

Thomas-Owen-Jeff-Susan or the reverse