CSci 1113
Midterm 1

Name: _____________________________________________

Student ID: ______________________________

Instructions: Please pick and answer any 7 of the 9 problems for a total of 70 points. If you answer more than 7 problems, only the first 7 will be graded. The time limit is 50 minutes. Please write your answers in the space provided. The exam is open book and notes. You may use electronic devices to ONLY look at either an e-book version or electronic notes. You may not use the internet, compiler or any other outside resources. (If you are typing on your keyboard/input device for anything other than ctrl-F to find words in the e-book or notes, this is probably not acceptable.)

Problem (1) [10 points] Write a single if-statement that is true for all the values of i shown. The "..." represents that the pattern of numbers continues in the direction indicated.

(Example) int i: ... -2, -1, 0

Answer: if(i <= 0)

(a) int i: 0, 1, 2, 3, 4, 5
(b) int i: ... -2, -1, 0, 5, 6 7, 8, ...
(c) int i: ... -2, 0, 2, 4, 6, 8, ...
(d) int i: 0, 2, 4, 6, 8
(e) int i: ... -4, -2, 2, 4, 6, 8, ...

Solution:
(a) if(0 <= i && i <= 5)
(b) if(i <= 0 || i <= 5)
(c) if(i%2==0)
(d) if(i%2==0 && 0 <= i && i < 10)
(e) if(i%2==0 && i!=0)
Problem (2) [10 points] Suppose you need to calculate \( d \) as follows:

\[
d = \max \left( \frac{6}{5} + \min(x, y) \right)
\]

Write C++ code that when finished finds \( d \) as desired, without using any functions, i.e. \texttt{max()} or \texttt{min()}. Assume all the variables involved have already been declared to be of type double. (Hint: think of the definition of the absolute value.)

Solution:
Oops, it should \( \max(6/5, \min(x,y)) \) with a comma not a +

```cpp
dmin = x;
if(y < x) {
    dmin = y;
}
d = 6.0/5;
if (dmin > d) {
    d = dmin;
}
```
Problem (3) [10 points] Assume x, y, and z are ints that have already been declared.
(a) The following C++ code fragment, which is complete except for the if-condition, should print out "a and b are both between y and z" if both a and b, are between the values of y and z.

```cpp
if ( // condition missing )
    cout << "a and b are both between y and z" << endl;
```

Write the C++ for the missing condition here:

Solution:

```cpp
if((a > z && b > z && a < y && b < y) || (a > y && b > y && a < z && b < z))
```

(b) Suppose you are given four declared variables d, e, f and g of type int. Write C++ code that finds the two median values and put them in a and b from part (a)). For example, if d=2, e=7, f=10 and g=5, then a=5 and b=7 (or a=7 and b=5)

Solution (easiest way might be to write part (a) 6 times. Another solution is:

```cpp
a=d;
if((d < e && d < f && d < g) || (d > e && d > f && d > g)) { //d is max or min
    a=e;
    if((e < d && e < f && e < g) || (e > d && e > f && e > g)) {
        a=f;
        b=g;
    }
    else {
        b=f;
        if((f < d && f < e && f < g) || (f > d && f > e && f > g)) {
            b=g;
        }
    }
} else {
    b=e;
    if((e < d && e < f && e < g) || (e > d && e > f && e > g)) {
        b=f;
        if((f < d && f < e && f < g) || (f > d && f > e && f > g)) {
            b=g;
        }
    }
}
```
Problem (4) [10 points] Suppose the user enters an int \( n \). Write a C++ code segment that displays a triangle of height \( n \) and base \( n \) using the character ‘x’. You may assume \( n \) already has a value entered before your code segment (you do not need to cin it). Declare any variables other than \( n \) that you use. For example, if \( n=5 \), then the code should display the following:

- x
- xx
- xxx
- xxxx
- xxxxx

Solution:

```cpp
for(int i=1; i <= n; i++)
{
    for(int j=1; j <= i; j++)
    {
        cout << "X";
    }
    cout << endl;
}
```

Problem (5) [10 points] Suppose a char \( c \) has been declared. Write a piece of C++ code that reads from the keyboard and counts the number of characters before a period (‘.’). Example (user input is underlined):

- Hi.

2 characters

Solution:

```cpp
int total=0;
do
{
    cin >> c;
    total++;
}while(c != '.');

cout << total-1 << endl;
```
Problem (6) [10 points] Suppose d and e are ints, and consider the following code:

```cpp
if ( (d+e)%2==0 && (!(e/10 == d/10 || e > d)) )
  cout << "Meets condition" << endl;
else
  cout << "Does not meet condition" << endl;
```

For each of the three cases below, circle whether the code would output "Meets condition" or "Does not meet condition".

(a) $d = 13$, $e = 19$

<table>
<thead>
<tr>
<th>Meets condition</th>
<th>Does not meet condition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T</strong></td>
<td><strong>F</strong></td>
</tr>
</tbody>
</table>

Solution:

$$(d+e)%2==0 \&\& !((e/10 == d/10 || e > d))$$

$$(32)%2==0 \&\& (!1 == 1 || F)$$

$$(T \&\& (!T || F))$$

$$(T \&\& F)$$

Does not meet condition

(b) $d = 4$, $e = 1$

<table>
<thead>
<tr>
<th>Meets condition</th>
<th>Does not meet condition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F</strong></td>
<td><strong>T</strong></td>
</tr>
</tbody>
</table>

Solution:

$$(d+e)%2==0 \&\& !((e/10 == d/10 || e > d))$$

$$(5)%2==0 \&\& !((0 == 0 || F))$$

$$(F \&\& (!T || F))$$ // can stop here due to short circuit evaluation

$$(F \&\& F)$$

Does not meet condition

(c) $d = 12$, $e = 2$

<table>
<thead>
<tr>
<th>Meets condition</th>
<th>Does not meet condition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T</strong></td>
<td><strong>F</strong></td>
</tr>
</tbody>
</table>

Solution:

$$(d+e)%2==0 \&\& !((e/10 == d/10 || e > d))$$

$$(5)%2==0 \&\& !((0 == 0 || F))$$

$$(F \&\& F)$$
Solution:
(d+e)%2==0 && (!(e/10 == d/10 || e > d))
(12+2)%2==0 && (!(2/10 == 12/10 || 2 > 12))
(14)%2==0 && (!(0 == 1 || F) )
T && (!(T || F) )
T && (!T)
T && F
T
Meets condition

(d) d = 2, e = 12

Meets condition               Does not meet condition

Solution:
(13+1)%2==0 && (!(1/10 == 13/10 || 1 > 13))
(14)%2==0 && (!(0 == 1 || F) )
T && (!F)
T && T
T
Meets condition
Problem (7) [10 points] Find 3 possible places for errors in the following code. Assume the user properly enters an integer. Explain specifically what causes the error and whether it is a syntax, runtime or logic error:

```cpp
int main()
{
    int start;
    cout << "Enter a number: ";
    cin >> start;
    cout << "Between 0 and " << start;

    for(start > 0)
    {
        if(start % 7 ==0)
        {
            divisible++;
        }
    }

    cout << ", there are " << divisible << " number divisible by 7 exactly.\n";
    return 0;
}
```

Solution:
1. divisible not declared, syntax.
2. divisible not initialized to zero, logic.
3. start not changing inside loop (need start--;), logic.
4. for loop looks like a while loop, syntax.
Problem (8) [10 points] For each of the following, write what is displayed after running the following pieces of code:

(a)  
for(int i=1; i < 30; i*=2)  
{  
i--;  
cout << i << "", ";
}  

Solution:  
0, -1, -3, -7, 15, ... (infinite loop)

(b)  
int i = 20;  
while(i > 0)  
{  
i++;  
cout << i << ", ";
   i = i/3;
}  

Solution:  
21, 8, 3, 2

(c)  
int x = 97, i = 10;  
while(x > 0)  
{  
cout << x%i << ", ";
     x-=x%i;
}  

Solution:  
7, 0, 0, 0, 0, ... (infinite loop)
Problem (9) [10 points] For each of the following loops, assume \( a \) is declared and has value 0 before the loop runs. What is the value of \( a \) after the loop? (i.e. how many times did the loop run?)

(a) 
\[
\begin{align*}
\text{for(int } & i = 30; \ i > 0; \ i=i/3) \\
& \{ \\
& \quad a++; \\
& \}
\end{align*}
\]

Solution:
4 (30, 10, 3, 1, 0)

(b) 
\[
\begin{align*}
\text{int } & i = 20; \\
\text{while(} & i > 0) \\
& \{ \\
& \quad i=-(i/2)+1; \\
& \quad a++; \\
& \}
\end{align*}
\]

Solution:
4 (20, 9, 4, 1, 0)

(c) 
\[
\begin{align*}
\text{for(int } & i = 0; \ i < 30; \ i++) \\
& \{ \\
& \quad \text{for(int } j = 0; \ j < 10; \ j++) \\
& \quad \quad \{ \\
& \quad \quad \quad a++; \\
& \quad \quad \} \\
& \quad \}
\end{align*}
\]

Solution:
300 (30 times 10)