SFU SIMON FRASER UNIVERSITY
BURNABY

Midterm
Solutions

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Question 1

1. Identify with check marks which of the following are valid C++ ***expressions***. Choose all that apply. Assume the variables are defined appropriately. 5 Marks

☒ `if (x < y) cout << "x is smaller";`

☑ `(x || y)`

☒ `++(a+b)`

☒ `while (a < 10) {cout << a++ << " ";}`

☑ `(a > b) ? a : b`

IF is a statement, not an expression.
(x || y) is a valid boolean expression: x or y
++ operator only works on variables, not expressions like (a+b)
WHILE is a statement too, not an expression.
Conditional expressions with ?: are valid expressions

Question 2

2. **Write a Boolean expression that evaluates to true if and only if one of A, B, or C are true and the others are false. 5 Marks**

`(A&&!B&&!C) || (!A&&B&&!C) || (!A&&!B&&C)`

Work out the logic one step at a time:

True if A is true and B and C false
=> **`A==true && B==false && C==false`**
=> **`A && !B && !C`**
also True if B is true and A and C false
=> **`B==true && A==false && C==false`**
=> **`B && !A && !C`**
and True if C is true and A and B false
=> **`C==true && A==false && B==false`**
=> **`C && !A && !B`**
No other cases
Put the three cases together using OR

Check precedence!

&& is higher precedence than ||

So no Need to add parenthesis

But they add clarity

Validate using a Truth Table:

A	B	C	`A&&!B&&!C`	`!A&&B&&!C`	`!A&&!B&&C`	`expr`
F	F	F	F	F	F	F
F	F	T	F	F	T	T
F	T	F	F	T	F	T
F	T	T	F	F	F	F
T	F	F	T	F	F	T
T	F	T	F	F	F	F
T	T	F	F	F	F	F
T	T	T	F	F	F	F

Question 3

3. **Briefly describe the difference between a Class and an Object. 5 Marks**

A Class is a blue print for an object. It defines a set of variables, methods, and interfaces but has no state and reserves no memory space for those variables.

An Object is an instantiation of a Class and is assigned a new copy of any instance data associated with that class. It has both state and methods that operate on that state.

Question 4

4. **Briefly describe the difference between a struct and class. 4 Marks**

A struct is an aggregation of data but defines no methods associated with that data.

A Class defines both data and methods associated with managing that data.

Class members are private by default. Struct members are public by default.

Question 5

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5. Match the different types of software testing activities with the descriptions by placing the correct letter A to F in front of the matching description. 6 Marks

Software Testing Types:

A. Unit Testing
B. Integration Testing
C. System Testing
D. Regression Testing
E. White-Box Testing
F. Black-Box Testing

F Tests observable functionality of one or more classes with no regard to internal implementation details

A Verifies that an individual Class and its methods function correctly given a set of sample inputs and expected outputs

E Tests both external and internal interfaces using implementation knowledge to verify correctness of all internal logic paths

D Test performed after software have been modified, that uses a small subset of existing testcases to verify that the software continues to function correctly.

C Tests that the product satisfies customer requirements and meets specific quality objectives and often includes regression testcases

B Verifies that several software components, packages, or classes produced by several teams work together as expected.

Question 6

6. What is the output from the following program fragment? 15 Marks

```
void helper (int x, int& y, int* z) {
     x    = 100;
     y    = 201;
     z[2] = 301;
}

int main(){
  int a    = 0;
  int b    = 1;
  int c[5] = {5, 6, 7};

  helper(a,b,c);

  cout << " a = " << a     << endl;
  cout << " b = " << b     << endl;
  cout << " c = ";
  for(int i=0; i<5; i++)
     cout << c[i] << " ";
  cout << endl;
}
```

(Write the output from executing the program here)

```
a = 0
b = 201
c = 5 6 301 0 0
```

Question 7

7. Find the Max **20 Marks**

Write a function `findMax` that takes two parameters: the first parameter is an int array that contains positive integers, and the second is the number of int elements in the array to search. The function should return the value of the largest element in the array.

For example, if `arr` is initialized to `{1,4}` and `arrLen` is 2, then the function should return the value 4. If there are no elements in the array, then return zero.

```
int findMax(int arr[], int arrLen) {
        (Write the function implementation here)

        int max = 0;

        for(int i=0; i<arrLen; i++)
            if (arr[i] > max)
                max = arr[i];

        return max;
}
```

Question 8

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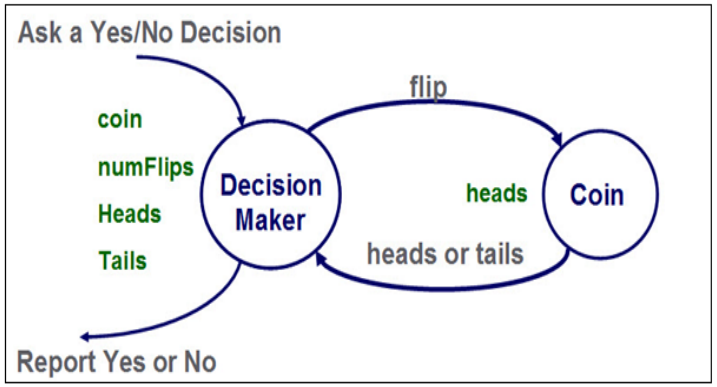
8. Data Flow Diagrams — 20 Marks

Implement the Coin class shown in the Data Flow Diagram below.



Complete the Coin class declaration, constructor, and flip method code below:

```
class Coin {
   public:  // Public  member declarations go here
     Coin();
     bool flip();
   private: // Private member declarations go here
     bool heads;

}

// Constructor definition goes here
     Coin::Coin() {
          srand(time(0)); // Seed rand()
          heads = ((rand()%2)==0);
     }
// Method definition goes here
     bool Coin::flip() {
          heads = ((rand()%2)==0);
          return heads;
     }
```

Question 9

9. Output a Bar Graph **20 Marks**

Write a procedure called `BarGraph` that takes three parameters: the output stream, an int array called `Production`, and the number of elements in the array.

void BarGraph(ostream& outStream, int Production[], int prodLen) {

(Write the code to implement BarGraph here)

```
for(int i=0; i<prodLen; i++) {
  outStream << i << ": ";
  // NumStars equals Production/10 rounded to nearest 10
  int numStars = (production[i]+5)/10;
  for(int j=0; j<numStars; j++)
      outStream << "*";
  outStream << endl;
}
```

Midterm Grade Distribution

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Summary Statistics

Mean Grade	73.28 / 100.00
Median Grade	75.00 / 100.00
Standard Deviation	14.19
Minimum Grade	41.00 / 100.00
Maximum Grade	95.00 / 100.00
Grades Received	47