University of Cape Town ~ Department of Computer Science

Computer Science 1015F ~ 2009

June Exam

Question	Max	Internal	External	Question	Max	Internal	External
1	10			7	8		
2	10			8	7		
3	10			9	15		
4	10			10	20		
5	5						
6	5						
				TOTAL	**100**		

Marks   : 100
Time   : 180 minutes
Instructions:

a) Answer all questions.

b) Write your answers in pen in the spaces provided.

c) Show all calculations where applicable.

Question 1 [10]

a) What is an algorithm? [1]

_____

_____

_____

_____

b) Are all algorithms also computer programs? Explain your answer. [1]

_____

_____

_____

_____

c) What is the purpose of a compiler? [1]

_____

_____

_____

_____

d) What is the purpose of a debugger? [1]

_____

_____

_____

_____

e) Briefly describe 1 advantage and 1 disadvantage of using Java bytecode as opposed to machine code. [2]

_____

_____

_____

_____

f) What is the difference between computer hardware and computer software? [2]

_____

_____

_____

_____

g) What is the purpose of the following hardware components: (i) memory (ii) hard drive?   [2]

_____

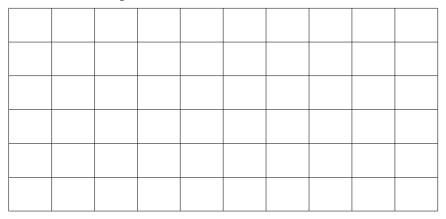_____

_____

_____

_____

_____

Question 2 [10]

Consider the following program and answer the questions that follow.

```
public boolean action ( int number )
{
   for ( int i=2; i<number; i++ )
      if (number % i == 0)
          return false;
   return true;
}
```

a) What does this method do?   [2]

_____

_____

_____

_____

b) What is the formal parameter in this method?   [1]

_____

_____

c) Is the dangling else a problem in this program? Explain why or why not.   [2]

_____

_____

_____

_____

d) What simple change can be made to the loop so it performs fewer iterations without changing the meaning of the method?   [2]

_____

_____

_____

e) Assume you want to use equivalence classes to test the method. Describe the equivalence classes and provide a test value corresponding to each.   [3]

_____

_____

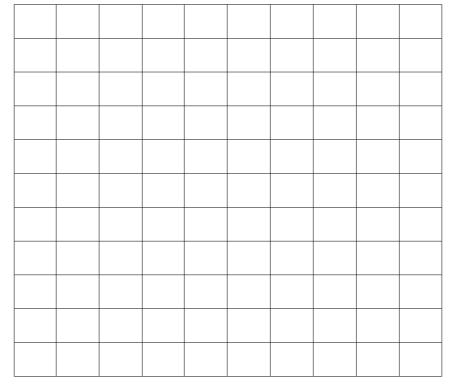_____

_____

_____

Question 3 [10]

Consider the following method and answer the questions that follow.

```java
public void drawShape ( int n )
{
   for ( int i=1; i<=n; i++ )
   {
      for ( int j=0; j<i; j++ )
         System.out.print ('*');
      System.out.println ();
   }
}
```

a) What is the output if n = 2? Write one character in each block and assume the top-left corner is where the output starts.   [2]

b) What is the output if n = 4? Write one character in each block and assume the top-left corner is where the output starts.   [2]

5

c) Rewrite the following 2 lines of the program in the form of a **while** loop. [2]

```
for ( int j=0; j<i; j++ )
    System.out.print ('*');
```

f) Write a method to draw the following square of single digit integers, for any given height from 1-9. In the example below, the height is 5. [4]

```
11111
22222
33333
44444
55555
```

Question 4 [10]

Examine the following incomplete class definition and answer the questions that follow.

```
public class Person
{
   private String name;
   private int age;

   public Person ( String aName, int anAge )
   {
      name = aName;
      age = anAge;
   }
   ...
}
```

a) Write accessors for the 2 instance variables. [2]

b) Write mutators for the 2 instance variables. [4]

c) What is the purpose of the constructor? [1]

d) Write the code to create an object with the initial values ["Kathy", 60] and assign this object to the variable theDean. [1]

e) If we wish to create another constructor in the same class, what condition must hold for this new constructor? [1]

f) What is information hiding? [1]

Question 5 [5]

Consider the code below which shows part of the Course class:

```
public class Course          // line 1
{  String name;              // line 2
   Student classrep;         // line 3
   Course corequisite;       // line 4
   Course prerequisite;      // line 5
   ...                       // other variables and methods...
   public Student someMethod( Course crs )
                                                    // line 6
   {
      System.out.println( corequisite.getName( ) ); // line 7
      System.out.println( Course.total );           // line 8
      corequisite = new Course ( );                  // line 9
      prerequisite = crs;                            // line 10
      ...
      return new Student( classrep );                // line 11
   }
}
```

a) In which line above is a static variable being used? (just give the line number)   [1]

_____

_____

_____

b) In which line above is a copy constructor being called? (just give the line number)   [1]

_____

_____

_____

c) In which line above is there a privacy leak? (just give the line number)   [1]

_____

_____

_____

d) Why is it a good idea to use a copy constructor rather than object assignment i.e. what is the reason for having a copy constructor?   [1]

_____

_____

_____

_____

_____

e) When would you use a static variable rather than an ordinary instance variable i.e. what is the advantage of having a static variable in a class? [1]

_____

_____

_____

_____

_____

Question 6 [5]

Write Java code to do each of the following tasks:

a) Define a 1-dimensional array that holds the following integer values: [1]

    1   3   -2 2   -7   -2   -10   -1

_____

_____

_____

_____

b) Add 1 to the 1st element, 2 to the second element and so on.   [2]

    1   3   -2 2   -7   -2   -10   -1

would become

    2   5   1   6   -2   4   -3   7

_____

_____

_____

_____

_____

_____

_____

_____

c) Add the 2 adjacent elements of the array together and set the 1st of these elements to the sum. The last element of the array remains the same.   [2]

    2   5   1   6   -2   4   -3   7

would become

    7   6   7   4   2   1   4   7

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Question 7 [8]

a) Write Java code to set the elements of a 2-dimensional array to the values indicated below. Two loops must be used and no value may be read in. Define all variables used. The code should work for any square array. [6]

-10	10	10	10	10
1	-10	20	20	20
1	2	-10	30	30
1	2	3	-10	40
1	2	3	4	-10

```
public static void main ( String [ ] args )
{
   int max = 5;
```

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

```
}
```

b) If the 2 for loops in your program were swopped around would this change the result of the program? [1]

_____

_____

_____

c) Explain why. [1]

_____

_____

_____

_____

_____

Question 8 [7]

You are given the class `equilateral` below where each side of the triangle is the same length.

```
public class equilateral
{
   protected int side1;

   public equilateral ( int s )
   { side1 = s; }

   public int perimeter ( )
   { return  3*side1; }

   public String toString ( )
   { return "Side 1 =" + side 1; }
}
```

Write a derived class called `triangle`. `triangle` is similar to `equilateral`, except that each side has a different length. Use the principles of inheritance in your solution and rewrite each of the methods.   [7]

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Question 9 [15]

a) Convert the decimal number 123 to binary, showing your working. [2]

_____

_____

_____

_____

_____

_____

_____

_____

_____

b) Convert the octal number 123 to decimal, showing your working. [1]

_____

_____

_____

_____

c) Convert the octal number 321 to hexadecimal, showing your working. [2]

_____

_____

_____

_____

d) Convert the decimal fraction 0.3 to binary, showing your working. [3]

_____

_____

_____

_____

_____

_____

_____

_____

_____

e) Calculate 3 - 12 using 8-bit 1's complement binary representation, showing all your working. (i.e. convert the numbers to 8-bit 1's complement before adding) [2]

_____

_____

_____

_____

_____

_____

_____

_____

_____

f) Find the value represented by the floating point number written below using IEEE754 representation (bias of 127 added to the exponent; first bit is the sign bit, next 8 bits are the biased exponent, rightmost 23 bits are the significand). Show all your working. [5]

    0 01111111 10000000000000000000000

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Question 10 [20]

Bridging the Generation Gap

Teenagers communicate electronically using a language that adults often do not understand. You have been asked to investigate a solution to translate a list of words in SMS language into regular English. For example, the word "l8r" would be translated into "later".

You are only required to translate the following 5 words (translations are in brackets) :

u (you), r (are), l8r (later), gr8 (great), c (see)

You need to produce a single string as output, with words separated by spaces. If a word does not appear in the list above, it must remain untranslated.

a) Describe (in English) the algorithm you will use to perform the translation.   [4]

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

b) Describe 2 classes you could use in your solution and what the purpose of each is.   [4]

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

c) Write the code for the **translate** method that performs the translation and returns the translated string. Assume the words to be translated are passed as a parameter that is an array of Strings and the return value is a String. A Driver class and code skeleton is provided for you.   [10]

```
class TranslationDriver
{
   public static void main ( String [] args )
   {
      String [] words = {"u","r","gr8","dude","c","u","l8r"};
      Translation babel = new Translation ();
      System.out.println (babel.translate (words));
   }
}

class Translation
{
   public String translate ( String [] words )
   {
```

```
   }
}
```

d) If the input to your method was provided as a single String instead of as separate words, explain how you could convert it into separate words. [2]

_____

_____

_____

_____

_____

_____