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COMPUTER SCIENCE **9608/42**

Paper 4 Written Paper **May/June 2017**

MARK SCHEME

Maximum Mark: 75

Published

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Question	Answer	Marks
1(a)		9

Label	Op code	Operand	Comment	
START:	**IN**		// INPUT character	1
	STO	**CHAR1**	// store in CHAR1	
	IN		// INPUT character	1
	STO	**CHAR2**	// store in CHAR2	
	LDD	**CHAR1**	// initialise ACC to ASCII value of CHAR1	1
LOOP:	**OUT**		//output contents of ACC	1+1
	CMP	**CHAR2**	// compare ACC with CHAR2	1
	JPE	**ENDFOR**	// if equal jump to end of FOR loop	1
	INC	**ACC**	// increment ACC	1
	JMP	**LOOP**	// jump to LOOP	1
ENDFOR:	END			
CHAR1:				
CHAR2:				

Question	Marks
1(b)	6

Label	Op code	Operand	Comment	
START:	**LDD**	**NUMBER1**		1
	XOR	MASK	// convert to one's complement	1
	INC	**ACC**	// convert to two's complement	1
	STO	**NUMBER2**		1
	END			
MASK:	**B11111111**		// show value of mask in binary here	1
NUMBER1:	B00000101		// positive integer	
NUMBER2:	**B11111011**		// show value of negative equivalent	1

Question	Answer	Marks
2(a)	• A pointer that doesn't point to another node/other data/address // indicates the end of the branch	1
2(b)	one mark per bullet • node with 'Athens' linked to left pointer of Berlin (ignore null pointer) • null pointers in left and right pointers of Athens	2
2(c)(i)	RootPointer: 0 FreePointer: 7 1 mark [0] 2 Dublin 1 [1] -1/∅ London 3 [2] 6 Berlin 5 [3] 4 Paris -1/∅ [4] -1/∅ Madrid -1/∅ [5] -1/∅ Copenhagen -1/∅ [6] -1/∅ Athens -1/∅ [7] 8 -1/∅ [8] 9 -1/∅ [9] -1/∅ -1/∅	5
2(c)(ii)	• –1 • It is not the number for any node.	2

Question	Answer	Marks
2(d)(i)	TYPE Node LeftPointer : INTEGER RightPointer : INTEGER Data : STRING ENDTYPE	7 1
	DECLARE Tree : ARRAY[0 : 9] OF Node	1
	DECLARE FreePointer : INTEGER DECLARE RootPointer : INTEGER PROCEDURE CreateTree() DECLARE Index : INTEGER	
	RootPointer ← -1	1
	FreePointer ← 0	1
	FOR Index ← 0 TO 9 // link nodes	
	Tree[Index].LeftPointer ← Index + 1	1
	Tree[Index].RightPointer ← -1	1
	ENDFOR	
	Tree[9].LeftPointer ← -1	1
	ENDPROCEDURE	

Question	Answer	Marks

2(d)(ii)	PROCEDURE AddToTree(ByVal NewDataItem : STRING)
	// if no free node report an error
	IF FreePointer = **-1** 1
	THEN
	ERROR("No free space left")
	ELSE // add new data item to first node in the free list
	NewNodePointer ← FreePointer
	Tree[NewNodePointer].Data ← NewDataItem 1
	// adjust free pointer
	FreePointer ← **Tree[FreePointer].LeftPointer** 1
	// clear left pointer
	Tree[NewNodePointer].LeftPointer ← **-1** 1
	// is tree currently empty ?
	IF **RootPointer = -1** 1
	THEN // make new node the root node
	RootPointer ← NewNodePointer 1
	ELSE // find position where new node is to be added
	Index ← RootPointer
	CALL FindInsertionPoint(NewDataItem, Index, Direction)
		8

Question	Answer	Marks

	`IF Direction = "Left"`
	`THEN // add new node on left`
	`Tree[Index].LeftPointer ← NewNodePointer` 1
	`ELSE // add new node on right`
	`Tree[Index].RightPointer ← NewNodePointer` **1**
	`ENDIF`
	`ENDIF`
	`ENDIF`
	`ENDPROCEDURE`	

2(e)	**1 mark per bullet**
	• test for base case (null/-1)
	• recursive call for left pointer
	• output data
	• recursive call for right pointer
	• order, visit left, output, visit right
	`IF Pointer <> NULL` 1
	`THEN`
	`TraverseTree(Tree[Pointer].LeftPointer)` 1
	`OUTPUT Tree[Pointer].Data` 1 + 1
	`TraverseTree(Tree[Pointer].RightPointer)` 1
	`ENDIF`
	`ENDPROCEDURE`
		5

Question	Answer	Marks

3(a)	**1 mark per bullet**
	• Instantiation of island object and calling DisplayGrid
	• Loop 3 times and Island.HideTreasure
	• Call procedures StartDig and DisplayGrid
	
	Example Python
	`Island = IslandClass()`
	`DisplayGrid()` — 1
	`for Treasure in range(3):`
	`  Island.HideTreasure()` — 1
	`StartDig()`
	`DisplayGrid()` — 1
	
	Example Pascal
	`var Island : IslandClass;`
	`var Treasure : integer;`
	`begin`
	`  Island := IslandClass.Create();`
	`  DisplayGrid;` — 1
	`  for Treasure := 1 to 3 do`
	`  Island.HideTreasure();` — 1
	`  StartDig;`
	`  DisplayGrid;` — 1
	`end;`
		3

Question	Answer	Marks

	Example VB.NET
	`Dim Island As New IslandClass()`
	`DisplayGrid()` — 1
	`For Treasure = 1 To 3`
	`  Island.HideTreasure()`
	`Next` — 1
	`StartDig()`
	`DisplayGrid()` — 1	

Question	Answer	Marks
3(b)	**1 mark per bullet to max 5** • Class heading and ending (in appropriate place) • Constructor heading and ending (in appropriate place) • Declaring grid with correct dimensions (as private) • Declaring Sand as a constant • Nested loops covering dimensions (0 – 29 and 0 – 9) • Assigning Sand // '.' to each array element	**5**

Example Python

```
class IslandClass:                                          1
   def __init__(self):                                      1
      Sand = '.'                                            1
      self.__Grid = [[Sand for j in range(30)]              1 + 1
                             for i in range(10)]            1
```

Example Pascal

```
type
IslandClass = class                                         1
private
   Grid : array[0..9, 0..29] of char;                       1
public
   constructor Create();
   procedure HideTreasure();
   procedure DigHole(x, y : integer);
   function GetSquare(x, y : integer) : char;
end;
constructor IslandClass.Create();                           1
   const Sand = '.';                                        1
   var i, j : integer;
   begin
      for i := 0 to 9 do
         for j := 0 to 29 do                                1
            Grid[i, j] := Sand;                             1
   end;
```

Question	Answer	Marks

	Example VB.NET
	`Class IslandClass` 1
	`  Private Grid (9, 29) As Char` 1
	`  Public Sub New()` 1
	`  Const Sand = "."` 1
	`  For i = 0 To 9`
	`  For j = 0 To 29` 1
	`  Grid(i, j) = Sand` 1
	`  Next`
	`  Next`
	`  End Sub`
	`End Class`	

3(c)(i)	**1 mark per bullet**
	• Method (getter or property) heading, takes two parameters returns char, and ending
	• Method returns Grid value
	
	Example Python
	`def GetSquare(self, Row, Column) :` 1
	`  return self.__Grid[Row][Column]` 1
	
	Example Pascal
	`function IslandClass.GetSquare( Row, Column : integer) As Char;` 1
	`begin`
	`  Result := Grid[Row, Column];`
	`end;` 1
	
	Example VB.NET
	`Public Function GetSquare(Row As Integer, Column As Integer) As Char` 1
	`  Return Grid(Row, Column)` 1
	`end Function`
		2

Question	Answer	Marks
3(c)(ii)	1 mark per bullet • DisplayGrid header and ending, with two loops with correct limits • Calling **Island.**GetSquare with correct parameters inside iteration • Output an entire row in one line • Output a new line at the end of a row	**4**

Example Python

```
def DisplayGrid() :
   for i in range (10) :
      for j in range (30) :                          1
         print(island.GetSquare(i, j), end='')       1 + 1
      print()                                        1
```

Example Pascal

```
procedure DisplayGrid():
var i, j : integer;
begin
   for i := 0 to 9 do
      begin
         for j := 0 to 29 do                         1
            write(island.GetSquare(i, j)));          1 + 1
         writeLn;                                    1
      end;
 end;
```

Example VB.NET

```
 Sub DisplayGrid()
    For i = 0 to 9
       For j = 0 to 29                               1
          Console.Write(island.GetSquare(i, j))      1 + 1
       Next
       Console.WriteLine()                           1
    Next
 End Sub
```

Question	Answer	Marks
3(d)	**1 mark per bullet to max 5** • Method header and Declaring Treasure as a constant • Generating a random number for column • Generating a random number for row • Check whether treasure already at generated location • Repeatedly generate new coordinates in a loop • Assign Treasure to location	**Max 5**

Example Python

```
def HideTreasure(self):
   Treasure = 'T'
   x = randint(0,9)
   y = randint(0,29)
   while self.__Grid[y][x] == Treasure:
      x = randint(0,9)
      y = randint(0,29)
   self.__Grid[y][x] = Treasure
```

1 (def HideTreasure(self): + Treasure = 'T')
1 (x = randint(0,9))
1 (y = randint(0,29))
1+1 (while self.__Grid[y][x] == Treasure:)
1 (self.__Grid[y][x] = Treasure)

Example Pascal

```
procedure IslandClass.HideTreasure();
   const Treasure = 'T';
   var x, y : integer;
   begin
      repeat
         x := Random(10);
         y := random(30);
      until Grid[x, y] <> Treasure;
      Grid[x, y] := Treasure;
   end;
```

1 (procedure IslandClass.HideTreasure(); + const Treasure = 'T'; + var x, y : integer;)
1 (x := Random(10);)
1 (y := random(30);)
1+1 (until Grid[x, y] <> Treasure;)
1 (Grid[x, y] := Treasure;)

Question	Answer	Marks
	Example VB.NET	
	`Public Sub HideTreasure()`	
	`  Const Treasure = "T"`	1
	`  Dim RandomNumber As New Random`	
	`  Dim x, y As Integer`	
	`  Do`	
	`  x = RandomNumber.Next(0, 10)`	1
	`  y = RandomNumber.Next(0, 30)`	1
	`  Loop Until Grid(x, y) <> Treasure`	1+1
	`  Grid(x, y) = Treasure`	1
	`End Sub`	

Question	Answer	Marks

3(e)(i)	**1 mark per bullet**
	• Method heading, with two parameters & Declaring constants for Treasure, Hole and FoundTreasure
	• Check if treasure at parameter locations
	• Set to FoundTreasure (X) and Set to Hole (O)
	
	Example Python
	`def DigHole(self, x, y) :`
	`  Treasure = 'T'`
	`  Hole = 'O'` 1
	`  Foundtreasure = 'X'`
	`  if self.__Grid[x][y] == Treasure:` 1
	`  self.__Grid[x][y] = Foundtreasure`
	`  else :` 1
	`  self.__Grid[x][y] = Hole`
	`  return`
	
	Example Pascal
	`procedure IslandClass.DigHole(x, y : integer);`
	`  const Treasure = 'T';`
	`  const Hole = 'O';`
	`  const Foundtreasure = 'X';` 1
	`  begin`
	`  if Grid[x, y] = Treasure` 1
	`  then`
	`  Grid[x, y] := Foundtreasure`
	`  else`
	`  Grid[x, y] := Hole;` 1
	`  end;`
		3

Question	Answer	Marks

	Example VB.NET
	`Public Sub DigHole(x As Integer, y As Integer)`
	`  Const Treasure = "T"`
	`  Const Hole = "O"`
	`  Const Foundtreasure = "X"`
		1

	`  If Grid(x, y) = Treasure Then`	1

	`  Grid(x, y) = Foundtreasure`
	`  Else`
	`  Grid(x, y) = Hole`
	`  End If`
		1

	`End Sub`	

Question	Answer	Marks
3(e)(ii)	**1 mark per bullet to max 5** • Prompt to user for position down and across, read positions input as an IntegerValidation for position row – between 0 and 9 • Validation for position column- between 0 and 29 • Exception handling/pass for validation • Ask for repeated input until valid (for both row and column) • Call Island.DigHole method with the coordinates **Example Python**	**Max 5**

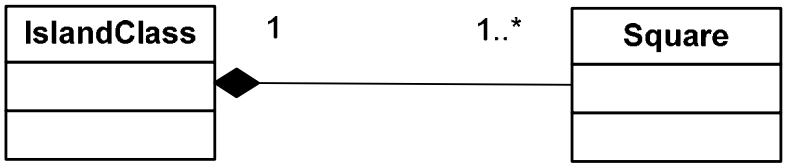
```
def StartDig() :
   Valid = False
   while not Valid :      # validate down position                    1
      try:
         x = int(input("position down <0 to 9> ? "))                  1
         if x >= 0 and x <= 9 :                                       1
            Valid = True
      except:
         Valid = False
   Valid = False
   while not Valid :      # validate across position
      try :
         y = int(input("position across <0 to 29> ? "))               1
         if y >= 0 and y <= 29 :                                      1
            Valid = True
      except :
         Valid = False
   island.DigHole(x, y)                                               1
    return
```

Question	Answer	Marks
	Example Pascal	
	`procedure StartDig;`	
	`var xString, yString : String;`	
	`  x, y : integer;`	
	`begin`	
	`  Valid := False;`	
	`  repeat`	
	`  Write('position down <0 to 9>? '); ReadLn(xString);`	1
	`  try`	
	`  x := StrToInt(xString);`	
	`  if (x >= 0) AND (x <= 9)`	1
	`  then`	
	`  Valid := True;`	
	`  except`	
	`  Valid := False;`	
	`  until Valid;`	
	`  Valid := False;`	
	`  repeat`	
	`  Write(position across <0 to 29> ? '); ReadLn(yString);`	1
	`  try`	
	`  y := StrToInt(yString);`	
	`  if (y >= 0) AND (y <= 29)`	1
	`  then`	
	`  Valid := True;`	
	`  except`	
	`  Valid := False;`	
	`  until Valid;`	1
	`  island.DigHole(x,y);`	1
	`end;`	

Question	Answer	Marks

	Example VB.NET
	`Sub StartDig()`
	`  Dim x, y As Integer`
	`  Dim Valid = False`
	`  Do`
	`  Console.Write("Position down <0 to 9>? ")`
	`  Try`
	`  x = CInt(Console.ReadLine())` 1
	`  If (x >= 0) AND (x <= 9) Then` 1
	`  Valid = True`
	`  End If`
	`  Catch`
	`  Valid = False 'accept different types of exceptions`
	`  End Try`
	`  Loop Until Valid`
	`Valid = False`
	`  Do`
	`  Console.Write("Position across <0 to 29> ? ")`
	`  Try`
	`  y = int(Console.ReadLine())` 1
	`  If (y >= 0) AND (y <= 29) Then` 1
	`  Valid = True`
	`  End IF`
	`  Catch`
	`  Valid = False`
	`  End Try`
	`  Loop until Valid` 1
	`  island.DigHole(x, y)` 1
	`End Sub`	

3(f)(i)	containment/aggregation	**1**

Question	Answer	Marks
3(f)(ii)	• IslandClass box and Square Box, with correct connection • One at IslandClass and one .. * at Square  	**Max 2**