The Sixth Form at George Abbot

'Academic excellence within a vibrant community.'

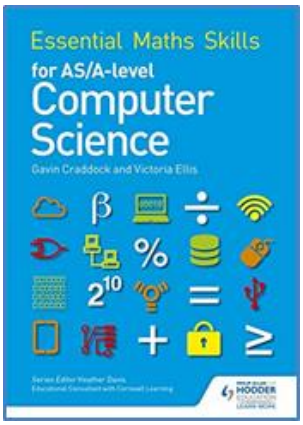
Subject: Computer Science
Head of Department: Mr Hunter jhunter@georgeabbot.surrey.sch.uk

Pre Sixth Form Tasks

Task	Detail	Demonstrated		
		Yes	Partially	No
Organisation	Prepare the following for storing lesson notes: • Large Ring-binder • Dividers • Plastic wallets • Multi-coloured pens • Highlighters • Ruler Complete the tasks below.			
Further Reading	**Books** *Trigger Happy: The inner life of videogames - Stephen Poole.* A witty, comprehensive and passionate discourse on the videogame explosion. Essential reading for anyone with an interest in this industry. *Accidental Empires – Robert X Cringely.* An insider's account of the origins and growth of the micro-computing industry from the earliest times to the present day; acerbic and funny in equal measure. **Magazines:** Wired New Scientist Websites: http://www.tnmoc.org/ http://pcpro.com http://www.theregister.co.uk/			
Additional task(s)	Complete the 'Computer Science – Skeleton Code Task' activity. Print out the questions below and answer them on the sheet. Bring the work to the first lesson.			

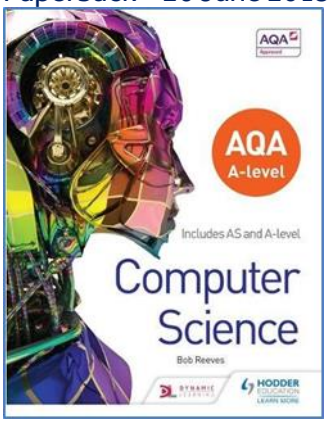
Suggested Reading List and Subject Resource

Essential Maths Skills for AS/A-Level Computer Science



Either of the following textbooks are beneficial to the course:

AQA A level Computer Science
Paperback – 26 June 2015



AQA AS and A Level Computer Science
Paperback – 24 Apr 2016

All tasks completed	Yes	No
Subject Teacher Signature		

INSTRUCTIONS:

Read the following preliminary material, which introduces the concept of the attached skeleton code.

Depending on your language preference at this stage, choose to use the either the Python Skeleton Code (Appendix A), or the VB.NET Skeleton Code (Appendix B).

Load the code into either Python/Thonny (Python), or Visual Studio Community (VB.NET). Run the code, which will run a basic version of the program.

Answer the attached questions 1-4, which will test your understanding of your ability to interpret the respective skeleton codes. Use the space provided to write your answers to each question.

THERE IS NO EXPECTATION TO WRITE ANY CODE IN THIS TASK.

PLANT GROWING SIMULATION – Pre-Liminary Material

The **Skeleton Programs (Appendix A - Python and Appendix B – VB.Net)** accompanying this **Preliminary Material** are the programs for the simulation of plants growing.

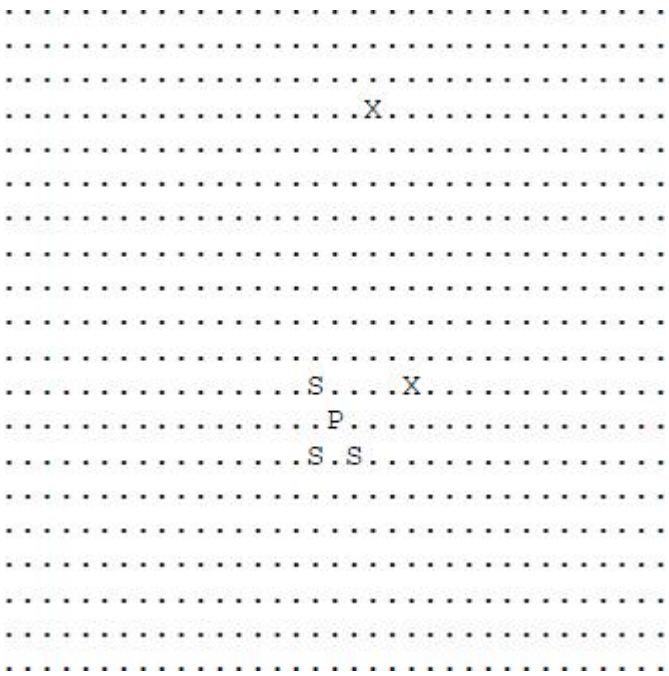
A plant scientist wants to use a computer to simulate how a specific plant will propagate over several years.

The field in which the plant is to grow and propagate is represented as a rectangular grid of cells. A cell can contain just soil, a plant, a seed or rock. It will always contain only one of these.

- If a cell contains just soil, then the cell is represented by '.'
- If a cell has a plant growing in it, the cell is represented by 'P'
- If a cell contains a seed, then the cell is represented by 'S'
- If a cell contains rock, then the cell is represented by 'X'

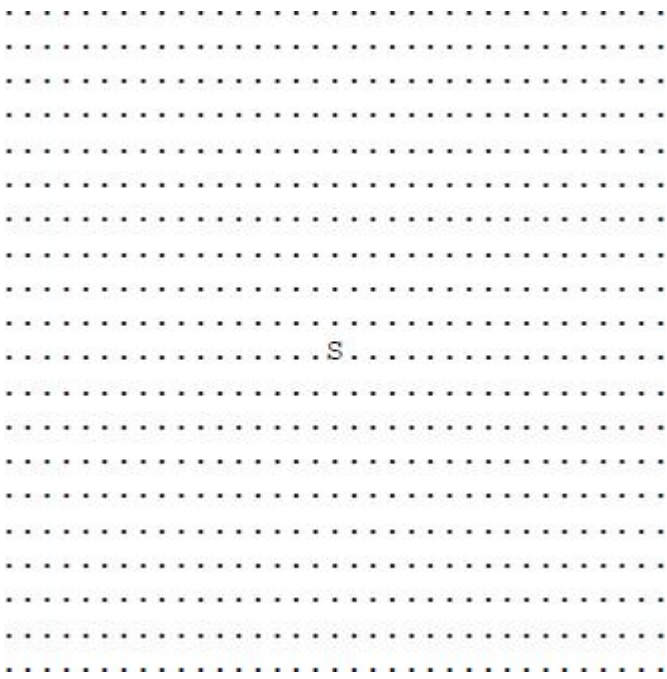
Figure 1 is an example of a field model.

Figure 1



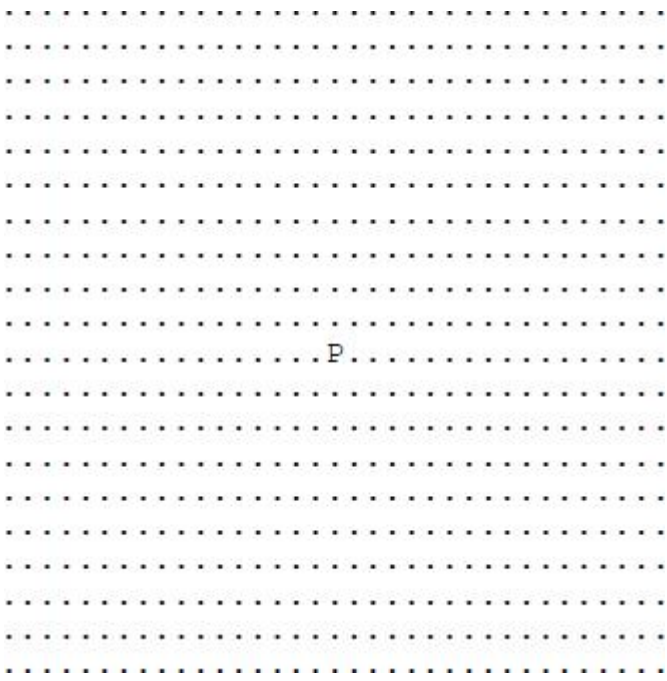
A new field starts with a seed in the middle of the field as shown in **Figure 2**.

Figure 2



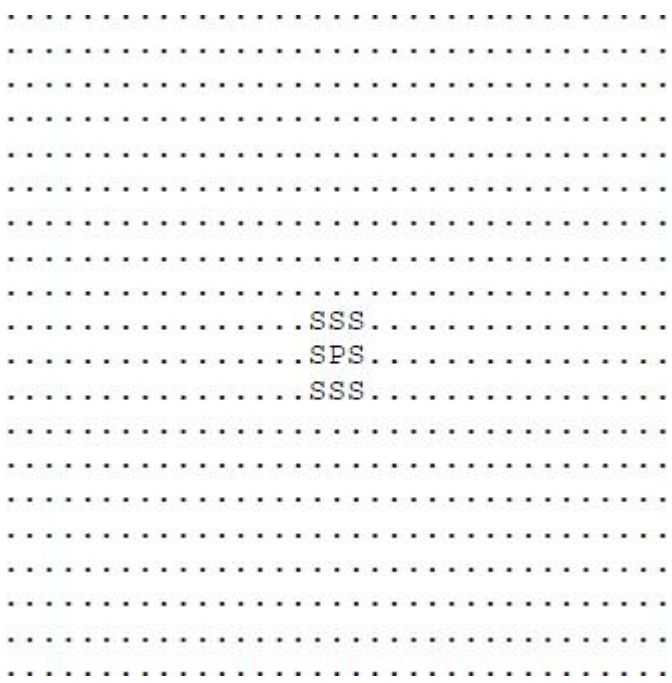
In the spring the seed germinates into a plant as shown in **Figure 3**.

Figure 3



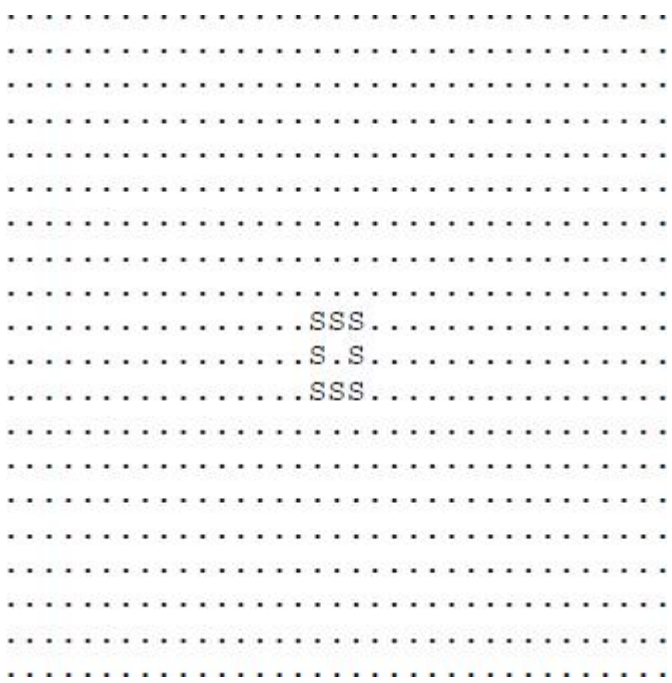
In the autumn the plant drops a seed in each cell immediately around the plant as shown in **Figure 4**.

Figure 4



In the winter the plant dies. This is represented by the cell content changing to a '.' as shown in **Figure 5**.

Figure 5

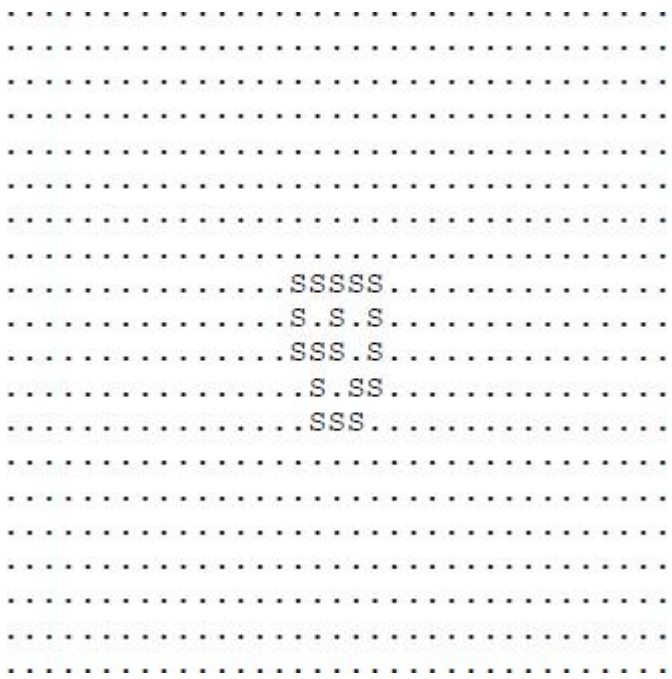


The seeds then lie dormant until spring when the cycle starts again and each seed germinates into a plant. In the spring a random frost may occur and kill off some of the plants. In the summer random rainfall patterns can result in a severe drought which also kills off some of the plants. In the autumn plants drop their seeds.

- If more than one seed lands in (drops into) a cell, only one seed survives.
- If there is a plant where a seed lands, the seed does not survive. The plant remains in the cell.
- If there is rock where a seed lands the seed does not survive. The rock remains in the cell.

At the end of year 2 the field contents may be as shown in **Figure 6**.

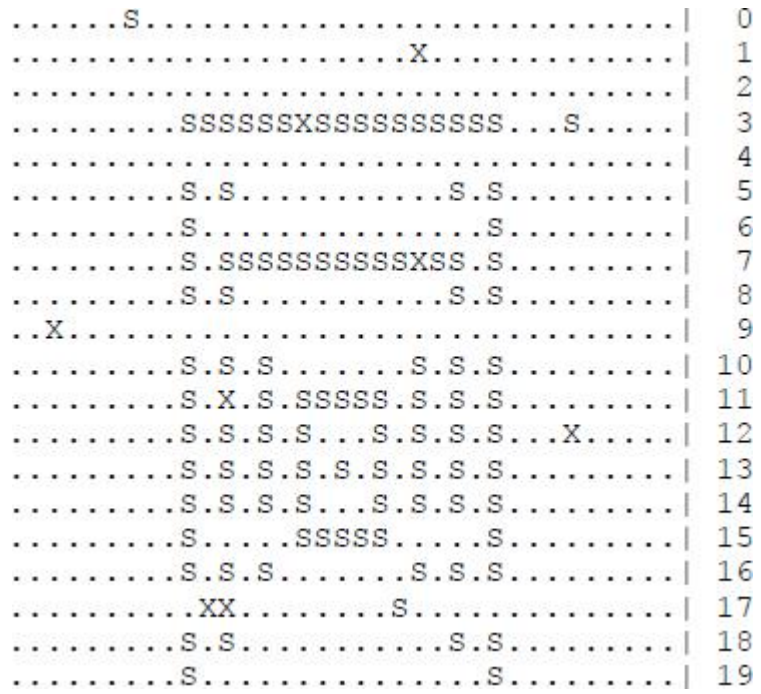
Figure 6



The **Skeleton Program** can use the **TestCase.txt Data File** to start the simulation with a different setup.

Figure 7 shows the contents of **TestCase.txt**.

Figure 7



The **Skeleton Program** allows the user to simulate plant growth and propagation for up to five years. There is also an option to step through the simulation a year at a time.

APPENDIX A

PYTHON SKELETON CODE

```
# Skeleton Program for the AQA A1 Summer 2017 examination
# this code should be used in conjunction with the Preliminary Material
# written by the AQA AS1 Programmer Team
# developed in a Python 3 environment

from random import *

SOIL = '.'
SEED = 'S'
PLANT = 'P'
ROCKS = 'X'

FIELDLENGTH = 20
FIELDWIDTH = 35

def GetHowLongToRun():
 print('Welcome to the Plant Growing Simulation')
 print()
 print('You can step through the simulation a year at a time')
 print('or run the simulation for 0 to 5 years')
 print('How many years do you want the simulation to run?')
 Years = int(input('Enter a number between 0 and 5, or -1 for stepping mode: '))
 return Years

def CreateNewField():
 Field = [[SOIL for Column in range(FIELDWIDTH)] for Row in range(FIELDLENGTH)]
 Row = FIELDLENGTH // 2
 Column = FIELDWIDTH // 2
 Field[Row][Column] = SEED
 return Field

def ReadFile():
 FileName = input('Enter file name: ')
 Field = [[SOIL for Column in range(FIELDWIDTH)] for Row in range(FIELDLENGTH)]
 try:
  FileHandle = open(FileName, 'r')
  for Row in range(FIELDLENGTH):
   FieldRow = FileHandle.readline()
   for Column in range(FIELDWIDTH):
    Field[Row][Column] = FieldRow[Column]
  FileHandle.close()
 except:
  Field = CreateNewField()
 return Field
```

```
def InitialiseField():
 Response = input('Do you want to load a file with seed positions? (Y/N): ')
 if Response == 'Y':
  Field = ReadFile()
 else:
  Field = CreateNewField()
 return Field

def Display(Field, Season, Year):
 print('Season: ', Season, '  Year number: ', Year)
 for Row in range(FIELDLENGTH):
  for Column in range(FIELDWIDTH):
   print(Field[Row][Column], end='')
  print('|{0:>3}'.format(Row))
 print()

def CountPlants(Field):
 NumberOfPlants = 0
 for Row in range(FIELDLENGTH):
  for Column in range(FIELDWIDTH):
   if Field[Row][Column] == PLANT:
    NumberOfPlants += 1
 if NumberOfPlants == 1:
  print('There is 1 plant growing')
 else:
  print('There are', NumberOfPlants, 'plants growing')

def SimulateSpring(Field):
 for Row in range(FIELDLENGTH):
  for Column in range(FIELDWIDTH):
   if Field[Row][Column] == SEED:
    Field[Row][Column] = PLANT
 CountPlants(Field)
 if randint(0, 1) == 1:
  Frost = True
 else:
  Frost = False
 if Frost:
  PlantCount = 0
  for Row in range(FIELDLENGTH):
   for Column in range(FIELDWIDTH):
    if Field[Row][Column] == PLANT:
     PlantCount += 1
     if PlantCount % 3 == 0:
      Field[Row][Column] = SOIL
  print('There has been a frost')
  CountPlants(Field)
```

```
 return Field

def SimulateSummer(Field):
 RainFall = randint(0, 2)
 if RainFall == 0:
  PlantCount = 0
  for Row in range(FIELDLENGTH):
   for Column in range(FIELDWIDTH):
    if Field[Row][Column] == PLANT:
     PlantCount += 1
     if PlantCount % 2 == 0:
      Field[Row][Column] = SOIL
  print('There has been a severe drought')
  CountPlants(Field)
 return Field

def SeedLands(Field, Row, Column):
 if Row >= 0 and Row < FIELDLENGTH and Column >= 0 and Column < FIELDWIDTH:
  if Field[Row][Column] == SOIL:
   Field[Row][Column] = SEED
 return Field

def SimulateAutumn(Field):
 for Row in range(FIELDLENGTH):
  for Column in range(FIELDWIDTH):
   if Field[Row][Column] == PLANT:
    Field = SeedLands(Field, Row - 1, Column - 1)
    Field = SeedLands(Field, Row - 1, Column)
    Field = SeedLands(Field, Row - 1, Column + 1)
    Field = SeedLands(Field, Row, Column - 1)
    Field = SeedLands(Field, Row, Column + 1)
    Field = SeedLands(Field, Row + 1, Column - 1)
    Field = SeedLands(Field, Row + 1, Column)
    Field = SeedLands(Field, Row + 1, Column + 1)
 return Field

def SimulateWinter(Field):
 for Row in range(FIELDLENGTH):
  for Column in range(FIELDWIDTH):
   if Field[Row][Column] == PLANT:
    Field[Row][Column] = SOIL
 return Field

def SimulateOneYear(Field, Year):
 Field = SimulateSpring(Field)
 Display(Field, 'spring', Year)
 Field = SimulateSummer(Field)
 Display(Field, 'summer', Year)
```

```
  Field = SimulateAutumn(Field)
  Display(Field, 'autumn', Year)
  Field = SimulateWinter(Field)
  Display(Field, 'winter', Year)

def Simulation():
  YearsToRun = GetHowLongToRun()
  if YearsToRun != 0:
    Field = InitialiseField()
    if YearsToRun >= 1:
      for Year in range(1, YearsToRun + 1):
        SimulateOneYear(Field, Year)
    else:
      Continuing = True
      Year = 0
      while Continuing:
        Year += 1
        SimulateOneYear(Field, Year)
        Response = input('Press Enter to run simulation for another Year, Input X to stop: ')
        if Response == 'x' or Response == 'X':
          Continuing = False
    print('End of Simulation')
  input()

if __name__ == "__main__":
  Simulation()
```

APPENDIX B

VB.Net SKELETON CODE

```
' Skeleton Program for the AQA A1 Summer 2017 examination
' this code should be used in conjunction with the Preliminary Material
' written by the AQA AS1 Programmer Team
' developed in the VB.Net 2008 environment


Imports System.IO

Module Module1
  Const SOIL As Char = "."
  Const SEED As Char = "S"
  Const PLANT As Char = "P"
  Const ROCKS As Char = "X"
  Const FIELDLENGTH As Integer = 20
  Const FIELDWIDTH As Integer = 35

  Function GetHowLongToRun() As Integer
    Dim Years As Integer
    Console.WriteLine("Welcome to the Plant Growing Simulation")
    Console.WriteLine()
    Console.WriteLine("You can step through the simulation a year at a time")
    Console.WriteLine("or run the simulation for 0 to 5 years")
    Console.WriteLine("How many years do you want the simulation to run?")
    Console.Write("Enter a number between 0 and 5, or -1 for stepping mode: ")
    Years = Console.ReadLine()
    Return Years
  End Function

  Function CreateNewField() As Char(,)
    Dim Row As Integer
    Dim Column As Integer
    Dim Field(FIELDLENGTH, FIELDWIDTH) As Char
    For Row = 0 To FIELDLENGTH - 1
      For Column = 0 To FIELDWIDTH - 1
        Field(Row, Column) = SOIL
      Next
    Next
    Row = FIELDLENGTH \ 2
    Column = FIELDWIDTH \ 2
    Field(Row, Column) = SEED
    Return Field
  End Function

  Function ReadFile() As Char(,)
```

```
    Dim Row As Integer
    Dim Column As Integer
    Dim Field(FIELDLENGTH, FIELDWIDTH) As Char
    Dim FileName As String
    Dim FieldRow As String
    Dim FileHandle As IO.StreamReader
    Console.Write("Enter file name: ")
    FileName = Console.ReadLine()
    Try
      FileHandle = New IO.StreamReader(FileName)
      For Row = 0 To FIELDLENGTH - 1
        FieldRow = FileHandle.ReadLine
        For Column = 0 To FIELDWIDTH - 1
          Field(Row, Column) = FieldRow(Column)
        Next
      Next
      FileHandle.Close()
    Catch
      Field = CreateNewField()
    End Try
    Return Field
End Function

Function InitialiseField() As Char(,)
    Dim Field(FIELDLENGTH, FIELDWIDTH) As Char
    Dim Response As String
    Console.Write("Do you want to load a file with seed positions? (Y/N): ")
    Response = Console.ReadLine()
    If Response = "Y" Then
      Field = ReadFile()
    Else
      Field = CreateNewField()
    End If
    Return Field
End Function

Sub Display(ByVal Field(,) As Char, ByVal Season As String, ByVal Year As Integer)
    Dim Row As Integer
    Dim Column As Integer
    Console.WriteLine("Season: " & Season & "  Year number: " & Year)
    For Row = 0 To FIELDLENGTH - 1
      For Column = 0 To FIELDWIDTH - 1
        Console.Write(Field(Row, Column))
      Next
      Console.WriteLine("|" & Str(Row).PadLeft(3))
    Next
    Console.WriteLine()
End Sub
```

```
Sub CountPlants(ByVal Field(,) As Char)
  Dim Row As Integer
  Dim Column As Integer
  Dim NumberOfPlants As Integer
  NumberOfPlants = 0
  For Row = 0 To FIELDLENGTH - 1
    For Column = 0 To FIELDWIDTH - 1
      If Field(Row, Column) = PLANT Then
        NumberOfPlants += 1
      End If
    Next
  Next
  If NumberOfPlants = 1 Then
    Console.WriteLine("There is 1 plant growing")
  Else
    Console.WriteLine("There are " & NumberOfPlants & " plants growing")
  End If
End Sub

Function SimulateSpring(ByVal Field As Char(,)) As Char(,)
  Dim Frost As Boolean
  Dim PlantCount As Integer
  For Row = 0 To FIELDLENGTH - 1
    For Column = 0 To FIELDWIDTH - 1
      If Field(Row, Column) = SEED Then
        Field(Row, Column) = PLANT
      End If
    Next
  Next
  CountPlants(Field)
  If Int(Rnd() * 2) = 1 Then
    Frost = True
  Else
    Frost = False
  End If
  If Frost Then
    PlantCount = 0
    For Row = 0 To FIELDLENGTH - 1
      For Column = 0 To FIELDWIDTH - 1
        If Field(Row, Column) = PLANT Then
          PlantCount += 1
          If PlantCount Mod 3 = 0 Then
            Field(Row, Column) = SOIL
          End If
        End If
      Next
    Next
```

```
    Console.WriteLine("There has been a frost")
    CountPlants(Field)
  End If
  Return Field
End Function

Function SimulateSummer(ByVal Field(,) As Char) As Char(,)
  Dim RainFall As Integer
  Dim PlantCount As Integer
  RainFall = Int(Rnd() * 3)
  If RainFall = 0 Then
    PlantCount = 0
    For Row = 0 To FIELDLENGTH - 1
      For Column = 0 To FIELDWIDTH - 1
        If Field(Row, Column) = PLANT Then
          PlantCount += 1
          If PlantCount Mod 2 = 0 Then
            Field(Row, Column) = SOIL
          End If
        End If
      Next
    Next
    Console.WriteLine("There has been a severe drought")
    CountPlants(Field)
  End If
  Return Field
End Function

Function SeedLands(ByVal Field(,) As Char, ByVal Row As Integer, ByVal Column As Integer) As Char(,)
  If Row >= 0 And Row < FIELDLENGTH And Column >= 0 And Column < FIELDWIDTH Then
    If Field(Row, Column) = SOIL Then
      Field(Row, Column) = SEED
    End If
  End If
  Return Field
End Function

Function SimulateAutumn(ByVal Field(,) As Char) As Char(,)
  For Row = 0 To FIELDLENGTH - 1
    For Column = 0 To FIELDWIDTH - 1
      If Field(Row, Column) = PLANT Then
        Field = SeedLands(Field, Row - 1, Column - 1)
        Field = SeedLands(Field, Row - 1, Column)
        Field = SeedLands(Field, Row - 1, Column + 1)
        Field = SeedLands(Field, Row, Column - 1)
        Field = SeedLands(Field, Row, Column + 1)
        Field = SeedLands(Field, Row + 1, Column - 1)
        Field = SeedLands(Field, Row + 1, Column)
```

```
          Field = SeedLands(Field, Row + 1, Column + 1)
        End If
      Next
    Next
    Return Field
End Function

Function SimulateWinter(ByVal Field As Char(,)) As Char(,)
    For Row = 0 To FIELDLENGTH - 1
      For Column = 0 To FIELDWIDTH - 1
        If Field(Row, Column) = PLANT Then
          Field(Row, Column) = SOIL
        End If
      Next
    Next
    Return Field
End Function

Sub SimulateOneYear(ByVal Field(,) As Char, ByVal Year As Integer)
    Field = SimulateSpring(Field)
    Display(Field, "spring", Year)
    Field = SimulateSummer(Field)
    Display(Field, "summer", Year)
    Field = SimulateAutumn(Field)
    Display(Field, "autumn", Year)
    Field = SimulateWinter(Field)
    Display(Field, "winter", Year)
End Sub

Sub Simulation()
    Dim YearsToRun As Integer
    Dim Continuing As Boolean
    Dim Response As String
    Dim Year As Integer
    Dim Field(FIELDWIDTH, FIELDLENGTH) As Char
    YearsToRun = GetHowLongToRun()
    If YearsToRun <> 0 Then
      Field = InitialiseField()
      If YearsToRun >= 1 Then
        For Year = 1 To YearsToRun
          SimulateOneYear(Field, Year)
        Next
      Else
        Continuing = True
        Year = 0
        While Continuing
          Year += 1
          SimulateOneYear(Field, Year)
```

```
            Console.Write("Press Enter to run simulation for another Year, Input X to stop: ")
            Response = Console.ReadLine()
            If Response = "x" Or Response = "X" Then
              Continuing = False
            End If
          End While
        End If
        Console.WriteLine("End of Simulation")
      End If
      Console.ReadLine()
    End Sub

    Sub Main()
      Randomize()
      Simulation()
    End Sub
End Module
```

Q1.

State the name of an identifier for:

(a) a variable that is used to store a Boolean value.

(1)

(b) a user-defined subroutine that returns an integer value.

(1)

(c) an array or list variable.

(1)

(d) a local variable used to store a string value.

(1)

(Total 4 marks)

Q2.

(a) Explain the benefits of defining FIELDLENGTH and FIELDWIDTH as named constants instead of using the actual values in the code.

(2)

(b) Explain the purpose of the first selection structure in the subroutine SeedLands.

(1)

(c) The simulation is to be refined to include another level of drought: a minor drought.

There is a 1 in 3 chance of a severe drought, and a 1 in 3 chance of a minor drought. If there is a minor drought, then one in four plants will die.

Describe the changes that need to be made to the subroutine SimulateSummer in order to simulate a minor drought.

You are **not** expected to make any changes to the **Skeleton Program**.

(3)

(d) State the type of arithmetic operation carried out in the subroutine CreateNewField when the variables Row and Column are assigned new values outside the FOR loops.

State the values calculated for Row and Column using the values of FIELDLENGTH and FIELDWIDTH that are specified in the **Skeleton Program**.

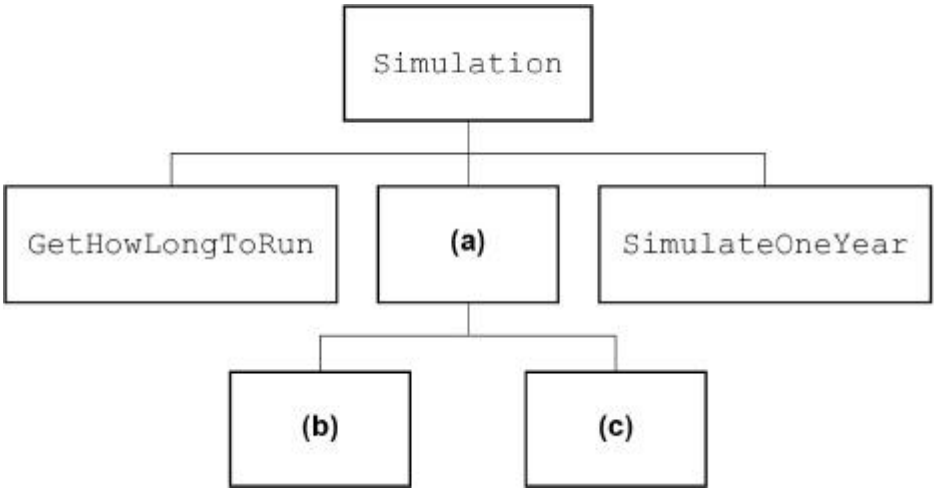
(2)

(Total 8 marks)

Q3.

Figure 1 shows an incomplete hierarchy chart for part of the **Skeleton Program**.

Figure 1



With reference to the **Skeleton Program** and **Figure 1**, answer the questions below.

(a) What should be written in box **(a)** in **Figure 1**?

(1)

_____

_____

(b) What should be written in box **(b)** in **Figure 1**?

(1)

_____

_____

(c) What should be written in box **(c)** in **Figure 1**?

(1)

_____

_____

(d) Explain how data is shared between the separate subroutines.

(2)

_____

_____

_____

_____**(Total 5 marks)**

Q4.

This question refers to the subroutine ReadFile.

(a) Explain what will happen if the number of rows and columns supplied in the data file is greater than the number of rows and columns of the field modelled in the **Skeleton Program**.

(2)

(b) Assume it is a perfect growing year and there is no frost in spring and no drought in summer.

A **Data File** is read in which has an S (seed) in every possible location.

Explain what happens to the contents of Field in each season for the **first year only**.

(4)

(Total 6 marks)