# Homework 3: Writing and interpreting algorithms Answers

1. The numbers 15, 73, 29, 66, 35, 11, 43, 21 held in array a[n] of length n are to be sorted using a bubble sort. The array index starts at 1.

The algorithm is given below.

n = length(a)

REPEAT

flag = FALSE

FOR count = 1 to n-1

IF a[count] > a[count + 1] THEN

temp = a[count]

a[count] = a[count + 1]

a[count + 1] = temp

flag = TRUE

ENDIF

ENDFOR

n = n-1

UNTIL n = 1 OR flag = FALSE

(a) Show the state of the array after each pass through the data. [3]

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| **15** | **73** | **29** | **66** | **35** | **11** | **43** | **21** |

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| **15** | **29** | **66** | **35** | **11** | **43** | **21** | **73** |

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| **15** | **29** | **35** | **11** | **43** | **21** | **66** | **73** |

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| **15** | **29** | **11** | **35** | **21** | **43** | **66** | **73** |

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| **15** | **11** | **29** | **21** | **35** | **43** | **66** | **73** |

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| **11** | **15** | **21** | **29** | **35** | **43** | **66** | **73** |

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| **11** | **15** | **21** | **29** | **35** | **43** | **66** | **73** |

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(b) What is the purpose of the variable **flag** in the algorithm? [1]

To indicate when there have been no swaps in a pass, therefore the list is sorted.

(c) How many times will the REPEAT loop be performed when sorting the following numbers? Explain your answer. [2]

32, 11, 15, 21, 29, 35, 43, 66, 73

Twice. Once to swap 32 and move into the correct position. Once to pass through cleanly without making any swaps.

(d) Name **two** circumstances in which a Bubble sort will execute in about the same time as a much more efficient sort algorithm such as the recursive Merge sort. [2]

For a very small data set, and if the list is virtually sorted already.

2. A factory uses barcodes which represent 6 digits, with the last digit being a check digit.

For example, 253217 is a valid barcode.

The check digit is calculated as follows:

* assign weights of 1, 3, 1, 3, 1 to the first five digits
* multiply each digit by its weight
* add the weighted numbers together
* divide the total by 10
* the remainder is the check digit

(a) One of the following barcodes is invalid. Which one is invalid, and what should the check digit be?

(i) 365125 invalid – should be 1

(ii) 212557 [2]

(b) Write a pseudocode algorithm which

* inputs 100 barcodes, each input as six individual random digits
* recalculates the check digit for each one and compares it with the one input
* outputs the number of barcodes which were input correctly [5]

(see program **check barcodes.py** – this is given below.)

subroutine to calculate barcode held as separate digits in array **code**

Assume array index starts at 0

SUB calculateCheckDigit (code):

x 🡨 code[0] + code[2] + code[4] + (code[1] + code[3])\*3

x 🡨 x mod 10

return x

ENDSUB

#main program

totalCorrect 🡨 0

FOR count = 0 to 99

barcode 🡨 [] #initialise array of barcode digits

FOR n = 0 to 5

digit 🡨 random(0,9)

barcode[n] 🡨 digit

END FOR

checkdigit 🡨 calculateCheckDigit(barcode)

IF checkdigit = barcode[5] THEN

totalCorrect 🡨 totalCorrect + 1

OUTPUT(barcode)

END IF

END FOR

OUTPUT ("Total correct barcodes ",totalCorrect)

[Total 15 marks]