



MARKSCHEME

November 2009

COMPUTER SCIENCE

Higher Level

Paper 2

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General Marking Instructions

*After marking a sufficient number of scripts to become familiar with the markscheme and candidates' responses to all or the majority of questions, Assistant Examiners (AEs) will be contacted by their Team Leader (TL). The purpose of this contact is to discuss the standard of marking, the interpretation of the markscheme and any difficulties with particular questions. It may be necessary to review your initial marking after contacting your TL. **DO NOT BEGIN THE FINAL MARKING OF YOUR SCRIPTS IN RED INK UNTIL YOU RECEIVE NOTIFICATION THAT THE MARKSCHEME IS FINALIZED.** You will be informed by e-mail, fax or post of modifications to the markscheme and should receive these about one week after the date of the examination. If you have not received them within 10 days you should contact your TL and IB Cardiff. Make an allowance for any difference in time zone before calling. **AEs WHO DO NOT COMPLY WITH THESE INSTRUCTIONS MAY NOT BE INVITED TO MARK IN FUTURE SESSIONS.***

You should contact the TL whose name appears on your “Allocation of Schools listing” sheet.

Note:

Please use a personal courier service when sending sample materials to TLs unless postal services can be guaranteed. Record the costs on your examiner claim form.

General Marking Instructions

1. Once markscheme is received mark in pencil until final markscheme is received.
2. Follow the markscheme provided, do **not** use decimals or fractions and mark only in **RED**.
3. Where a mark is awarded, a tick (✓) should be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark.
4. Sometimes, careful consideration is required to decide whether or not to award a mark. Indeed, another examiner may have arrived at the opposite decision. In these cases write a brief annotation in the **left hand margin** to explain your decision. You are encouraged to write comments where it helps clarity, especially for moderation and re-marking.
5. Unexplained symbols or personal codes/notations on their own are unacceptable.
6. Record subtotals (where applicable) in the right-hand margin against the part of the answer to which they refer. Show a mark for each part question (a), (b), *etc.* Do **not** circle sub-totals. Circle the total mark for the question in the right-hand margin opposite the last line of the answer.
7. Where an answer to a part question is worth no marks, put a zero in the right-hand margin.
8. Record the mark awarded for each of the four questions answered in the Examiner Column on the cover sheet. Add up the marks awarded and enter this in the box marked TOTAL in the Examiner Column on the cover sheet.
9. After entering the marks on the cover sheet check your addition of all marks to ensure that you have not made an arithmetical error. Check also that you have transferred the marks correctly to the cover sheet. **We have script checking and a note of all clerical errors may be given in feedback to all examiners.**
10. Every page and every question must have an indication that you have marked it. Do this by **writing your initials** on each page where you have made no other mark.
11. A candidate can be penalized if he/she clearly contradicts him/herself within an answer. Once again make a comment to this effect in the left hand margin.

Subject Details: Computer Science HL Paper 2 Markscheme

Mark Allocation

Candidates are required to answer ALL questions [*20 marks*] for question 1, [*20 marks*] for question 2, [*20 marks*] for question 3 and [*40 marks*] for question 4. Maximum total = [*100 marks*].

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for that part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each statement worth one point has a separate line and the end is signified by means of a semi-colon (;).
- An alternative answer or wording is indicated in the markscheme by a “/”; either wording can be accepted.
- Words in (...) in the markscheme are not necessary to gain the mark.
- If the candidate’s answer has the same meaning or can be clearly interpreted as being the same as that in the markscheme then award the mark.
- Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalising them for what they have not achieved or what they have got wrong.
- Remember that many candidates are writing in a second language; be forgiving of minor linguistic slips. In this subject effective communication is more important than grammatical accuracy.
- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with “**FT**”.

1. (a) *Award up to [2 marks max].*
The algorithm sums elements from 0 to 3;
This should be 0 to 4;
Change 4 to 5;
(Or) change < to <=; **[2 marks]**
- (b) $O(n^2)$; **[1 mark]**
- (c) *Award marks as follows up to [4 marks max].*
Award [1 mark] for correct method header (signature).
Award [1 mark] for cycling through columns first.
Award [1 mark] for then cycling through rows.
*Award [1 mark] for correct limits to both **for** loops.*

Example:

```
public void sumCols(int[][] data, int[] s)
{
    for (int c = 0; c < 5; c++)
    {
        s[c] = 0;
        for (int r = 0; r < 5; r++)
        {
            s[c] = s[c] + data[r][c];
        }
    }
}
```

[4 marks]

continued...

Question 1 continued

- (d) *Award marks as follows up to [11 marks max].*
*Award [1 mark] for matrix or equivalent as a parameter **and** consistently used in method body.*
*Award [1 mark] for **all** local variables declared as required for candidate's solution.*
*Award [1 mark] for correct limits to both **for** loops.*
Award [1 mark] for initialising `sum` or equivalent in correct place.
Award [1 mark] for initialising `n` or equivalent in correct place.
*Award [1 mark] for **if** statement used in inner loop.*
*Award [1 mark] for correct Boolean condition in **if** statement.*
Award [1 mark] for correct `sum` calculated.
Award [1 mark] for correct value of `n` calculated.
Award [1 mark] for correct average calculated.
Award [1 mark] for use of a cast to double.
Award [1 mark] for output of row number.
(Text part not required. Accept output (`r + average`), for example.)
Award [1 mark] for output of average.

Example:

```
public void rowAverages(int[][] matrix)
{
    double average;
    int sum, n;
    for (int r = 0; r < 5; r++)
    {
        sum = 0;
        n = 0;
        for (int c = 0; c < 5; c++)
        {
            if (matrix[r][c] != 0)
            {
                sum = sum + matrix[r][c];
                n = n + 1;
            }
        }
        average = (double) sum / n;
        output("row: " + r + " " + average);
    }
}
```

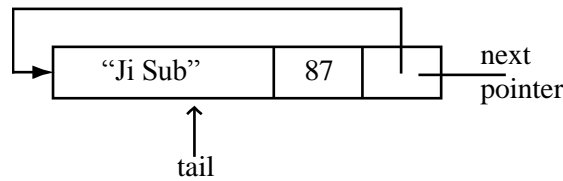
[11 marks]

- (e) *Award up to [2 marks max].*
 Any value(s) calculated in the method are passed back to the calling method/statement;
 (Whereas) for primitives this does not happen; **[2 marks]**

Total: [20 marks]

2. (a) The diagrams should appear as follows.

Diagram 1



Award up to [5 marks max] for diagram 1.

Award [1 mark] for node with three clearly defined fields.

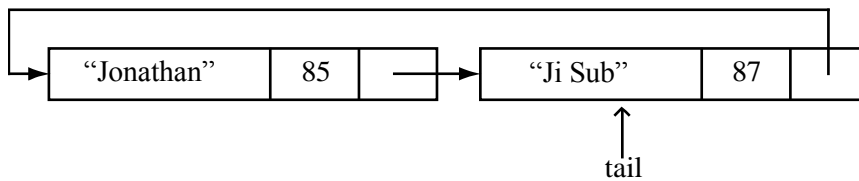
Award [1 mark] for correctly completed data fields.

Award [1 mark] for next pointer identified (by label or implied by arrow coming out).

Award [1 mark] for next pointer self-referential.

Award [1 mark] for tail pointing to the node (somewhere).

Diagram 2



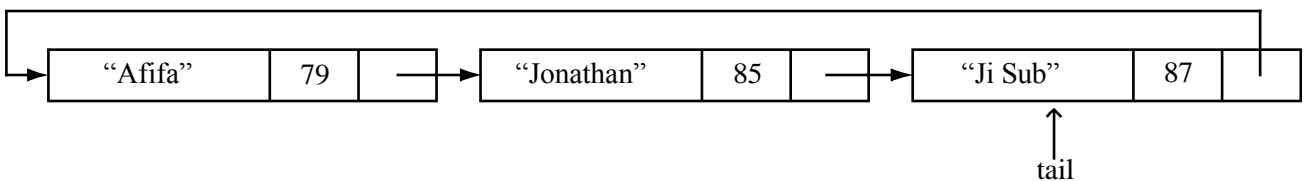
Award up to [3 marks max] for diagram 2.

Award [1 mark] for new node labelled clearly "Jonathan".

Award [1 mark] for correct pointer from "Ji Sub" to "Jonathan".

Award [1 mark] for tail pointing to "Ji Sub".

Diagram 3



Award up to [2 marks max] for diagram 3.

Award [1 mark] for correctly positioned "Afifa" node.

Award [1 mark] for correct pointer from "Ji Sub" to "Afifa".

[10 marks]

continued...

Question 2 continued

- (b) *Award marks as follows up to [8 marks].*
 - Award [1 mark] for correct check for empty list.*
 - Award [1 mark] for finding the list head.*
 - Award [1 mark] for (doing this by) looking at tail's next node.*
 - Award [1 mark] for using getNext () method (provided in Node).*
 - Award [1 mark] for loop through list.*
 - Award [1 mark] for output of name and data (supplementary text not needed).*
 - Award [1 mark] for (doing this by) using accessor methods.*
 - Award [1 mark] for moving to next node in list.*
 - Award [1 mark] for checking for an end to the list.*
 - Award [1 mark] for completely correct terminating condition.*

Example:

```
private void displayList()
{
    if (tail != null)
    {
        // Get the first Node(the head)
        Node temp = tail.getNext();
        do
        {
            System.out.println(temp.getName() + ": " + temp.getData());
            temp = temp.getNext();
        } while (temp != tail.getNext());
    }
}
```

[8 marks]

- (c) *Award up to [2 marks max].*
 - Start at the item next to the tail/the head;*
 - Loop/move through the list incrementing count;*
 - Until the tail node is reached;*
 - Test for an empty list / tail = null;*
 - Return 0 if it is;*

[2 marks]

Total: [20 marks]

3. (a) The start of each record cannot be calculated;
The fields have to be extracted by parsing/searching for the @ character; [2 marks]
- (b) Records in File 1;
As an index cannot be created / record positions cannot be calculated; [2 marks]
- (c) ID; [1 mark]
- (d) (i) *Award up to [3 marks max].*
Because each record is a fixed length;
It is possible to know where every record starts;
And move to that record directly;
The start position can be stored in a file/table/index; [3 marks]
- (ii) *Award up to [3 marks max].*
A full index would be created;
Using the locker number;
The index would contain the start position of every record;
And be ordered by locker number; [3 marks]
- (e) (i) O(n); [1 mark]
- (ii) O(1); [1 mark]
- (f) (i) 1; [1 mark]
- (ii) 1; [1 mark]
- (g) *Award up to [1 mark max].*
Allocate the next free space;
Use an overflow table; [1 mark]
- (h) *Award [1 mark] for a suitable reason and [1 mark] for an elaboration up to [2 marks max] × 2 = [4 marks].*

Room for expansion;

If more students join;
And require more lockers;

Efficiency;

If the table size is larger than the number of records;
Clashes are less likely to occur;

[4 marks]

Total: [20 marks]

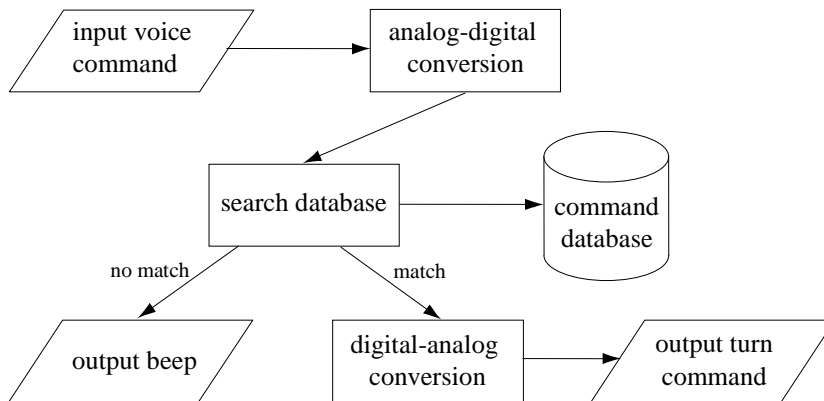
4. (a) (i) Graphical user interface/GUI;
Command line interface/CLI; *[2 marks]*
- (ii) *Award [1 mark] for a suitable modification and [1 mark] for an elaboration up to [2 marks max] × 2 = [4 marks].*
Examples:
The GUI could be modified to use an Electronic Braille display;
As the user will need to move around the screen;
- The CLI could be modified to make use of a speech output system;
Which can output lines (of text) in sequence;
- Accept any other reasonable modification.* *[4 marks]*
- (b) (i) A macro is a series of recorded commands/keystrokes;
Which can be played back using a single key; *[2 marks]*
- (ii) *Award up to [3 mark max].*
A number of keystrokes/common operations;
e.g. typing an address / printing the current page;
Can be combined under a single/function key;
Reducing the amount of typing required; *[3 marks]*
- (c) (i) *Award up to [2 mark max].*
The (heart rate) sensor would use polling;
As the system would need to check on a regular basis;
A heart-rate alarm could use an interrupt;
As polling would require waiting for interrogation; *[2 marks]*
- (ii) The push button would use interrupts;
As a service is only required when it is pushed; *[2 marks]*
- (d) (i) *Award [2 marks] for an advantage and [2 marks] for a disadvantage up to [4 marks max].*
Examples:
Disadvantage
Sophisticated software may be able to respond to other voices;
Not only that of the wheelchair owner;
Possibly causing unintended consequences;
- Advantage**
More sophisticated software could respond faster;
This could be an advantage in an emergency;
And might be able to make use of context;
Accept any other reasonable advantage/disadvantage *[4 marks]*

continued...

Question 4 (d) continued

- (ii) Award marks as follows up to **[4 marks]**.
 (Each box must be labelled appropriately.)
 Award **[1 mark]** for the input voice command box.
 Award **[1 mark]** for the conversion boxes (ADC and DAC).
 Award **[1 mark]** for database search process (including the database itself).
 Award **[1 mark]** for output turn left command on match.

Example:



[4 marks]

- (iii) Award up to **[3 marks max]**.
 Real time;
 As the wheelchair must respond quickly;
 When an input command is given;
 Otherwise “something bad” may happen;

[3 marks]

- (iv) Award up to **[3 marks max]**.
 Voice data is analog;
 But the wheelchair (control system) only understands digital data;
 Therefore the voice command must be converted to digital (data);
 The command list is in digital form;
 But the wheelchair (wheels/motors) only respond to analog outputs;
 Therefore the output command must be converted to analog (data);

[3 marks]

- (v) Award up to **[3 marks max]**.
 The user will not hear any warnings / will not hear the beep;
 Therefore another method of **output** is required;
 e.g. a light/LED;
 e.g. a vibrator/thumper;
 Accept any reasonable suggestion.

[3 marks]

continued...

Question 4 continued

- (e) *Award up to [4 marks max] for any reasonable points.*

Examples:

Housebound people are able to communicate more easily;
(They can) take a greater role in society (than before);
(For example) work, participate (*e.g.* education/politics), socialise;
But so may able-bodied people;
So in competition for work/participation/social activity;
The advantage may be nullified;
Today's internet is increasingly mobile;
Benefits include aids for hearing/sight impaired that can be carried;
Such as **online** translators, screen-readers, word processors;
However such compact devices;
May not suit all impairments;
For example small mobile screens are difficult to see;
etc.

[4 marks]

- (f) (i) *Award up to [2 marks max] for any reasonable points.*

Examples:

A Braille display could be added;
This may be read with the fingers;
Audible feedback may be given;
As fingers touch different parts of the screen;

[2 marks]

- (ii) *Award up to [2 marks max] for any reasonable points.*

Examples:

Buttons/keys could be made larger;
And therefore easier to discriminate/activate/touch accurately;
The keys could be made less sensitive to touch;
Causing less likelihood of incorrect presses (*e.g.* due to shaking);
Voice input could be added;
So that the person could speak the desired number;

[2 marks]

Total: [40 marks]
