IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

COMPUTER SCIENCE
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PAPER 2

Wednesday 3 May 2006 (morning)

2 hours 15 minutes

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all the questions.

*Answer **all** the questions.*

1. Consider the following code which sorts an array.

```
private static void proc(int[] data, int lo, int hi)
{if (lo < hi)
  { if (data [lo] < data[lo + 1])
   { int t = data[lo + 1];
     data[lo + 1] = data[lo];
     data[lo] = t;
   }
   proc (data, lo + 1, hi);
   if (lo == 0)
     proc (data, 0, hi-1);
  }
}
```

(a) Copy and complete the trace table for the following. *[5 marks]*

`proc({37,11,52,7},0,3)`

data	hi	lo
37, 11, 52, 7	3	0
...	...	...
...	...	...
...	...	...

(b) Write a method that will accept 2 unordered arrays and combine them into a single, large unordered array and then order it using `proc`. Call the method `arrayjoin`. *[6 marks]*

Remember that `a.length` will return the length of an array.

(c) Write a method that will accept an ordered array and delete duplicates. Call it `arraydups`. *[6 marks]*

(d) Write a method that will accept two unsorted arrays and combine them into a single sorted array with no duplicates. Call it `msort`. *[3 marks]*

2. A large file containing private data is going to be sent over the Internet as 6 packets, using a secure, packet switched protocol.

(a) Outline how it will be assembled for transmission. *[4 marks]*

(b) Describe how the same large data file would travel over the Internet. *[4 marks]*

At the receiving end the packets will be stored in a binary tree as they arrive.

(c) Outline how the same large data file would be handled at the receiving end if the packets arrive in the order 5, 3, 6, 1, 2, 4. Include a drawing of the binary tree. *[6 marks]*

(d) Suggest a method of communication which would minimise the risk of the file being corrupted during transmission and explain your choice. *[3 marks]*

(e) State the need for data security measures when sending the file, and outline one method that could be used to ensure data security. *[3 marks]*

3. (a) State **four** file structures. *[4 marks]*

(b) Select which file structure is suitable to store a single MIDI file and explain why. *[4 marks]*

A very large database of large MIDI files is being created. Fast access is required.

(c) Suggest suitable organisation for the database and explain your choice. *[6 marks]*

The database will be compressed and archived on a weekly basis in case the database is corrupted or the storage device is damaged.

(d) State what is meant by *file compression*. *[1 mark]*

(e) Suggest a suitable storage medium for the archive and explain your choice. *[5 marks]*

This question requires the use of the Case Study.

4. Music can be recorded on a computer by *sampling* or by recording MIDI events.

(a) Describe the process of recording music by *sampling*. *[5 marks]*

(b) Describe the process of recording music using MIDI. *[8 marks]*

Two pieces of music are being recorded. One is a short simple tune to be edited and replayed on various cell phones. The other is of pupils singing and playing in a school band.

(c) State which recording method you would choose for each situation and explain your choice. *[6 marks]*

A program is being written to input, manipulate and output MIDI data.

(d) Describe a suitable ADT (abstract data type) for storing the MIDI data in RAM for use by the program. Give details of the *data types* included and explain your choice. *[6 marks]*

(e) Suggest how computers can be used to allow non-musical people to create music. *[5 marks]*

(f) Explain **two** features of MIDI sound modules that allow musicians to produce fuller, more varied sounds. *[4 marks]*

(This question continues on the following page)

(Question 4 continued)

(g) The most common MIDI channel voice instruction is **NOTE ON,** which consists of 1 status byte followed by 2 data bytes.

The general format of a **NOTE ON** instruction is as follows:

Status Byte	Data Byte #1 (pitch/note)	Data Byte #2 (volume)
1001nnnn	0xxxxxxx	0xxxxxxx

where, (**nnnn + 1**) represents the channel number, and **xxxxxxx** represents a decimal value between 0 and 127.

For example: 10011010 00111100 00000001
represents NOTE ON on channel 11 of note #60 (MIDDLE C) at a volume of 1 (the lowest possible volume).

(i) State which channel number is selected by the status byte 10010011. *[1 mark]*

(ii) Describe how the receiving device (e.g. a sound module) distinguishes between a status byte and a data byte. *[2 marks]*

(iii) State the number of different notes that can be played using this format. *[1 mark]*

(iv) Identify the bytes that would correspond to the following instruction: **NOTE ON** using Channel 12, playing Middle C at maximum volume. *[2 marks]*