DUBLIN INSTITUTE OF TECHNOLOGY

BSc. (Honours) Degree in Computer Science

Year 1

SUMMER EXAMINATIONS 2014/2015

PROGRAMMING WITH PERSISTENT DATA [CMPU1028]

MR. PAUL LAIRD
DR. DEIRDRE LILLIS

MONDAY 11TH MAY   1.00 P.M. – 3.00 P.M.

TWO HOURS

ATTEMPT **QUESTION 1** AND **TWO** OTHER QUESTIONS

QUESTION 1 CARRIES 40 MARKS.

ALL OTHER QUESTIONS CARRY 30 MARKS EACH.

```c
#include<stdio.h>
struct accountdetails {
 char first[16];
 char last[16];
 char addr[48];
 int ac_no;
 int balance;
};
typedef struct accountdetails account;
account data;
int main(){
 FILE * fi, * fo;
 if((fi=fopen("accounts.bin","rb"))!=NULL){
  if((fo=fopen("overdrawn.bin","wb"))!=NULL){
   while(fread(&data,sizeof(account),1,fi)>0){
    if(data.balance<0){
     printf("Account %d of %s %s is overdrawn, with a balance of
%d. \n",
             data.ac_no, data.first, data.last, data.balance);
     fwrite(&data,sizeof(account),1,fo);
    }
   }
   fflush(fo);
   fclose(fo);
  }
  fclose(fi);
 }
}
```

Figure 1

1.   Examine the program code in the text box above, Figure 1.

   a) Explain each of the program statements which have been shaded (e.g. #include
      <stdio.h>), including syntax and any parameters/constants required.
                                                                    [20 marks]

   b) Describe the overall workings of the program, in terms of: the inputs received,
      any processing on data and outputs expected.   **[20 marks]**

2. The cost of retrieving information from a rotating hard disk can be characterised by three components: Seek time, rotational delay and data transfer time.
   (a) Give a brief explanation of each of these, and the factors which influence their values **[15 marks]**
   (b) A disk has 16 platters, 4800 tracks per platter, 2000 sectors per track, 4096 Bytes per sector, and a cluster size of 64 sectors. Its data transfer rate is 256MB/s, it spins at 7200rpm, and has a seek time approximated by 3ms + 0.01*(number of tracks traversed).
       a. How long, on average, would it take to read a 128 MB file stored in a single contiguous extent **[7 marks]**
       b. How long, on average, would it take to read an 8MB file stored in individual clusters randomly located on the disk. **[8 marks]**

3. A record can be defined as a set of fields that belong together when the file is viewed in terms of a higher level of organisation.

   The following are methods for organising a file into records, one or more of which is typically used for any given record file:

       a. Making records a predictable length.
       b. Beginning each record with a length indicator.
       c. Using a second file to keep track of addresses.
       d. Placing a delimiter at the end of each record.
   (a) Two of these allow records to be located by Relative Record Number.
       a. Which two are these? **[4 marks]**
       b. What are the advantages and disadvantages of these two methods? **[12 marks]**
   (b) One of the two methods selected in (a) requires the use of an additional method of record organisation
       a. Which is this and why? **[8 marks]**
       b. Compare the benefits of using each of the two additional organisation methods **[6 marks]**

4. For variable length record files, an avail list mechanism can be used to manage available space once records have been deleted. A placement strategy is the process of placing freed record space onto an avail list.

1) Briefly describe the placement strategies
   i.   First Fit
   ii. Best Fit
   iii. Worst fit
   noting their effect on efficiency of storage/fragmentation, and behaviour on insertion to and removal from the avail list.   **[12 Marks]**

2) For the purposes of illustrating avail lists, all tables below contain the following information:
   a. Byte offset (for information only – this information is not stored in the file)
   b. Record Length (in bytes)
   c. The contents of the first field of each record (This contains the name of the record, or an asterisk followed by the address (byte offset) of the next available slot if the record has been deleted)
   d. The contents of the head of the Avail List, implemented as a singly linked list with -1 as an end value sentinel.

a.	401	456	515	604	641	702	758	826
b.	55	59	89	37	61	56	68	
c.	R7	R8	R9	R10	R11	R12	R13	

d. Avail: -1 (There are no available slots)

After record R9 has been deleted, the following is stored, regardless of strategy employed:

a.	401	456	515	604	641	702	758	826
b.	55	59	89	37	61	56	68	
c.	R0	R8	*-1	R10	R11	R12	R13	

d. Avail: 515

Record R12 is subsequently deleted

    i. Assuming the placement strategy "First Fit" is being employed, reproduce the table and fill in the blanks for the state of the file following deletion of R12

a.	401	456	515	604	641	702	758	826
b.	55	59	89	37	61	56	68	
c.	R0	R8		R10	R11		R13	

d.   Avail: [_____]   **[4 marks]**

    ii. Assuming the placement strategy "Worst Fit" is being employed, reproduce the table and fill in the blanks for the state of the file following deletion of R9

a.	401	456	515	604	641	702	758	826
b.	55	59	89	37	61	56	68	
c.	R0	R8		R10	R11		R13	

d.   Avail: [_____]   **[4 marks]**

Records R14 and R15, of lengths 41 and 57 are added. There is no free space recovery being employed for underfilled slots

    iii. Assuming the placement strategy "First Fit" is being employed, reproduce the table and fill in the blanks for the state of the file following insertion of R14 and R15

a.	401	456	515	604	641	702	758	826
b.	55	59	89	37	61	56	68	
c.	R0	R8		R10	R11		R13	

d.   Avail: [_____]   **[5 marks]**

    iv. Assuming the placement strategy "Worst Fit" is being employed, reproduce the table and fill in the blanks for the state of the file following insertion of R14 and R15

a.	401	456	515	604	641	702	758	826
b.	55	59	89	37	61	56	68	
c.	R0	R8		R10	R11		R13	

d.   Avail: [_____]   **[5 marks]**