UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2016/2017 Academic Session

June 2017

MAT181 – Programming For Scientific Applications
[Pengaturcaraan Untuk Penggunaan Sains]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of <u>EIGHT</u> pages of printed material before you begin the examination.

[*Sila pastikan bahawa kertas peperiksaan ini mengandungi <u>LAPAN</u> muka surat yang bercetak sebelum anda memulakan peperiksaan ini.*]

Instructions: Answer **all FOUR** (4) questions. All answers must be written on the answer script papers provided.

[**<u>Arahan:</u>** *Jawab* **<u>semua EMPAT</u>** *(4) soalan. Semua jawapan mestilah dituliskan pada kertas skrip jawapan yang disediakan.*]

In the event of any discrepancies, the English version shall be used.

[*Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.*]

Question 1

(a)   Write the following algebraic expressions as C++ assignment statements. Assume that all variables are declared correctly and necessary header files are already included.

(i) $A = \dfrac{a}{\left[a/(4.5+b)\right]+5.0}$

(ii) $w = \sqrt{\dfrac{4ac}{x+y} - \dfrac{z^5}{x-y}}$

(b)   Given the following declarations:

```
int a, b, c;
double d, e, f, g, x, y, z;
```

and the current values of each variable are as follows:

```
a = -10,b = 5,c = 23,d=5.5,e=3.75,f=14.8, g=1.0;
x = 2.3, y = 8.5, z = 21.6;
```

What is the output of each of the following statements in the ordering as shown?

```
cout << (a%(int)e - f );
cout << endl << (pow (d, c%abs(a++)));
cout << endl << (a/b + 1/c);
cout << endl << (g += 1.5 * 3 + ++g);
cout << endl << (z < y+x || z - 15 < x*y);
```

(c)   Combine the following four `if` statements to produce only ONE nested `if…else` statement without compound conditions (i.e. conditions without the `&&` operator)

```
if ((ch == 'F') && (pay > 1000))
      x + = 1;
if ((ch == 'F') && (pay <= 1000))
      x + = 2;
if ((ch == 'M') && (pay > 1000))
      x + = 3;
if ((ch == 'M') && (pay <= 1000))
      x + = 5;
```

(d)   Refer to the following program segment for parts (i), (ii) and (iii).

```
:
#define SIZE 100
void main()
{
    int V[SIZE];
    void Read_in(...);      // For question (1)(d)(i)
    void Sort(...);         // For question (1)(d)(ii)
    void Repeating(...);    // For question (1)(d)(iii)
```

```
        Read_in(...);
        Sort(...);
        Repeating(...);
}

// function definitions
 :
```

(i)   Write the function definition `Read_in` which reads in 100 values to the array `V[]` from a text file called `input.txt`. The file needs to be processed according to the complete file processing steps; declaration of file, opening of file, verification of file, closing of file, etc. must be within this function.

(ii) Write the function definition `Sort` which sorts `V[]` according to the bubble sort algorithm and prints the sorted values on the screen in descending order.

(iii) Write the function definition `Repeating` which determines whether there are repeated values in the array. If there are, the function should return the value 1. If not, the function should return the value 0. This value should be returned via reference parameter. The execution of this function should be terminated when the first repeated value is encountered.

Soalan 1

(a)   *Tulis ungkapan-ungkapan aljabar berikut sebagai pernyataan umpukan C++. Anggapkan semua pembolehubah telah diisytiharkan dengan betul dan semua fail pengepala yang diperlukan telahpun disertakan.*

i. $$A = \frac{a}{\left[a/(4.5+b) \right] + 5.0}$$

ii. $$w = \sqrt{\frac{4ac}{x+y} - \frac{z^5}{x-y}}$$

(b)   *Diberi pengisytiharan-pengisytiharan berikut:*

```
int a, b, c;
double d, e, f, g, x, y, z;
```

dan nilai-nilai terkini bagi setiap pembolehubah adalah seperti berikut:

```
a = -10,b = 5,c = 23,d=5.5,e=3.75,f=14.8, g=1.0;
x = 2.3, y = 8.5, z = 21.6;
```

Apakah output bagi setiap pernyataan berikut mengikut tertib yang ditunjukkan?

```
cout << (a%(int)e - f );
cout << endl << (pow (d, c%abs(a++)));
cout << endl << (a/b + 1/c);
cout << endl << (g += 1.5 * 3 + ++g);
cout << endl << (z < y+x || z - 15 < x*y);
```

(c) *Gabungkan empat pernyataan* `if` *berikut untuk menghasilkan hanya SATU pernyataan* `if…else` *tersarang tanpa syarat-syarat kompaun (i.e. syarat-syarat tanpa operator* `&&`*)*

```
if ((ch == 'F') && (pay > 1000))
     x + = 1;
if ((ch == 'F') && (pay <= 1000))
     x + = 2;
if ((ch == 'M') && (pay > 1000))
     x + = 3;
if ((ch == 'M') && (pay <= 1000))
     x + = 5;
```

(d) *Rujuk kepada segmen program berikut bagi bahagian (i), (ii) dan (iii).*

```
:
#define SIZE 100
void main()
{
    int V[SIZE];
    void Read_in(...);        // Bagi soalan (1)(d)(i)
    void Sort(...);           // Bagi soalan (1)(d)(ii)
    void Repeating(...);      // Bagi soalan (1)(d)(iii)

    Read_in(...);
    Sort(...);
    Repeating(...);
}

// definisi fungsi
:
```

(i) *Tulis definisi fungsi* `Read_in` *yang membaca 100 nilai kepada tatasusunan* `V[]` *dari satu fail teks bernama* `input.txt`*. Fail ini perlu diproses mengikut langkah-langkah pemprosesan fail lengkap; pengisytiharan fail, pembukaan fail, pengesahan fail, penutupan fail, dsb, perlu dibuat dalam fungsi ini.*

(ii) *Tulis definisi fungsi* `Sort` *yang mengisih* `V[]` *mengikut algoritma isih buih dan mencetak nilai-nilai diisih itu pada skrin dalam tertib menurun.*

(iii) *Tulis definisi fungsi* `Repeating` *yang menentukan sama ada terdapat nilai-nilai berulang dalam tatasusunan tersebut. Sekiranya ada, fungsi ini perlu mengembalikan nilai 1. Sekiranya tiada, fungsi ini perlu mengembalikan nilai 0. Nilai ini perlulah dikembalikan melalui parameter rujukan. Pelaksanaan fungsi ini perlu dihentikan apabila nilai berulang pertama ditemui.*

Question 2

Write a complete C++ program to compute the value

$$p = \sum_{i=1}^{m} i^2 + \prod_{j=2}^{n} j .$$

Note: $\sum_{i=1}^{3} i^2 = 1^2 + 2^2 + 3^2$, while $\prod_{j=2}^{6} j = 2\text{x}3\text{x}4\text{x}5\text{x}6$.

Let A $= \sum_{i=1}^{m} i^2$ and B $= \prod_{j=2}^{n} j$. Your program must consist of the following functions:

i) `void main()` − to input the values of `m` and `n` and send them to the respective functions.

ii) `int Add(int m)` − to receive the value of `m` from the `main()` function and compute the value of A. This value must be returned to `main()` via the function name.

iii) `void Multiply(int n, int *B)` − to receive the value of `n` from `main()` and compute the value of B. This value must be returned to `main()` via a pointer.

iv) `void Add_Print(…)` − to receive the values of A and B from `main()` and add these numbers and prints the sum `p` with appropriate messages

Soalan 2

Tulis satu program C++ yang mengira nilai

$$p = \sum_{i=1}^{m} i^2 + \prod_{j=2}^{n} j \ .$$

Nota: $\sum_{i=1}^{3} i^2 = 1^2 + 2^2 + 3^2$, *manakala* $\prod_{j=2}^{6} j = 2\text{x}3\text{x}4\text{x}5\text{x}6$.

Biarkan A $= \sum_{i=1}^{m} i^2$ *manakala B* $= \prod_{j=2}^{n} j$. *Program anda perlu mengandungi fungsi-fungsi berikut:*

i) *`void main()` − untuk menginput nilai-nilai `m` dan `n` serta menghantar mereka kepada fungsi-fungsi masing-masing.*

ii) *`int Add(int m)` − untuk menerima nilai `m` dari fungsi `main()` dan mengira nilai A. Nilai ini perlu dikembalikan kepada `main()` melalui nama fungsi.*

iii) *`void Multiply(int n, int *B)` − untuk menerima nilai `n` dari `main()` dan mengira nilai B. Nilai ini perlu dikembalikan kepada `main()` melalui penuding.*

iv) *`void Add_Print(…)` − untuk menerima nilai-nilai A dan B dari `main()` dan jumlahkan mereka serta mencetak hasiltambah `p` dengan mesej yang bersesuaian.*

Question 3

(a) Consider the following declarations and assignment statements:

```
int num=100, iarray[6]={10,15,30,-10,-15,-30};
int *ptr_num, *ptr_i;
ptr_i = iarray + 2;
ptr_num = &num;
```

Based on these statements, state whether the following expressions are TRUE, FALSE or ILLEGAL. Assume that the starting address of array `iarray[]` is 002AFE20, and the data of type `int` occupies 4 bytes of memory space.

```
(i)     num == *ptr_num
(ii)    num == &ptr_num
(iii)   ptr_num == *num
(iv)    ptr_i == &iarray[0]
(v)     iarray[4] == ptr_i + 2
(vi)    (ptr_i + 1)== 002AFE2C
(vii)   &*ptr_i == 002AFE28
(viii)  &ptr_num == &num
(ix)    *(iarray + 4) == *ptr_i + 2
(x)     *(ptr_i + 1)== -10
```

(b) A record of 50 students consists of the following information:

  – matric number (6 digits)
  – name (maximum 20 characters)
  – gender ('F' or 'M')
  – CGPA (e.g. 2.0, 3.5, etc.)
  – marks (e.g. 34.4, 78.6, etc.)

Write a C++ declaration of an array of structure for the above record.

In addition, write a C++ program segment which initializes all the students' marks to 0.0.

(c) Consider a two dimensional array which is declared as follows:

```
int Matrix[5][6];
```

Write a nested `for` loop that will assign the elements in the array `Matrix[][]` in the position as displayed in the following rows and columns:

0	5	10	15	20	25
1	6	11	16	21	26
2	7	12	17	22	27
3	8	13	18	23	28
4	9	14	19	24	29

(d) What will be printed by the following statement?

```
char char1[20] = "PRST";
char char2[10];
char char3[10] = "UVW";
double P = 765.88844;
double Q = 9.67457;
strcat_s(char1,char3);
strncpy_s(char2, char1, 6);
```

```
cout << setiosflags(ios::left) <<
setiosflags(ios::fixed)<< setw(10)<<
setprecision(4) << setfill('*') << P  <<  setw(10)
<< char2 << resetiosflags(ios::left) << setw(12) << Q;
```

Soalan 3

(a)   Pertimbangkan pernyataan-pernyataan pengisytiharan dan umpukan berikut:

```
int num=100, iarray[6]={10,15,30,-10,-15,-30};
int *ptr_num, *ptr_i;
ptr_i = iarray + 2;
ptr_num = &num;
```

Berdasarkan pernyataan-pernyataan ini, nyatakan sama ada ungkapan-ungkapan berikut adalah BENAR, SALAH atau TIDAK SAH. Anggapkan alamat mula bagi tatasusunan `iarray[]` adalah `002AFE20`, dan data berjenis `int` mengisi 4 bait ruang ingatan.

(i)   `num == *ptr_num`
(ii)   `num == &ptr_num`
(iii)   `ptr_num == *num`
(iv)   `ptr_i == &iarray[0]`
(v)   `iarray[4] == ptr_i + 2`
(vi)   `(ptr_i + 1)== 002AFE2C`
(vii)   `&*ptr_i == 002AFE28`
(viii)   `&ptr_num == &num`
(ix)   `*(iarray + 4) == *ptr_i + 2`
(x)   `*(ptr_i + 1)== -10`

(b)   Satu rekod 50 orang pelajar mengandungi maklumat berikut:

    - nombor matrik (6 digit)
    - nama (maksimum 20 aksara)
    - jantina ('F' atau 'M')
    - PNGK (e.g. 2.0, 3.5, dsb.)
    - markah (e.g. 34.4, 78.6, dsb.)

Tulis satu pengisytiharan C++ untuk satu tatasusunan struktur bagi rekod di atas.

Secara tambahan, tulis satu segmen program C++ yang menilai awalkan semua markah pelajar kepada 0.0.

(c)   Pertimbangkan tatasusunan dua dimensi yang diisytiharkan seperti berikut:

```
int Matrix[5][6];
```

Tulis satu gelung `for` *tersarang yang akan mengumpukkan elemen-elemen dalam tatasusunan* `Matrix[][]` *pada posisi seperti yang paparkan dalam baris dan lajur berikut:*

0	5	10	15	20	25
1	6	11	16	21	26
2	7	12	17	22	27
3	8	13	18	23	28
4	9	14	19	24	29

(d)   Apakah yang akan dicetak oleh segmen berikut?

```
char char1[20] = "PRST";
char char2[10];
char char3[10] = "UVW";
double P = 765.88844;
double Q = 9.67457;
strcat_s(char1,char3);
strncpy_s(char2, char1, 6);

cout << setiosflags(ios::left) <<
setiosflags(ios::fixed)<< setw(10)<<
setprecision(4) << setfill('*') << P  << setw(10)
<< char2 << resetiosflags(ios::left) << setw(12) << Q;
```

Question 4

Write a C++ program to enter any positive integer and check whether the number is a Strong number or not. A Strong number is a number whose sum of factorial of digits is equal to the original number. For example, 145 is a Strong number since

   $1! + 4! + 5! = 145$

Examples of Strong numbers: 1, 2, 145, 40585

Soalan 4

Tulis satu program C++ untuk memasukkan sebarang integer positif dan semak sama ada nombor tersebut satu nombor Strong atau tidak. Nombor Strong ialah nombor yang hasiltambah tertisi digitnya bersamaan dengan nombor yang asal. Contohnya,   145 ialah nombor Strong kerana

   $1! + 4! + 5! = 145$

Contoh nombor-nombor Strong: 1, 2, 145, 40585

(100 marks)
(100 markah)

- ooo 0 ooo -