Second Semester Examination
2016/2017 Academic Session

June 2017

CPT113/CPM213 – Programming Methodology & Data Structures
[Metodologi Pengaturcaraan & Struktur Data]

Duration : 2 hours
[Masa : 2 jam]

INSTRUCTIONS TO CANDIDATE:
[ARAHAN KEPADA CALON:]

• Please ensure that this examination paper contains **THREE** questions in **FOURTEEN** printed pages before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **TIGA** soalan di dalam **EMPAT BELAS** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

• Answer **ALL** questions.

*[Jawab **SEMUA** soalan.]*

• You may answer the questions either in English or in Bahasa Malaysia.

[Anda dibenarkan menjawab soalan sama ada dalam bahasa Inggeris atau bahasa Malaysia.]

• 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.]

1. (a) (i) What is the purpose of constructor and destructor in an object oriented program? State when constructor and destructor are executed in a program.

Apakah tujuan pembina dan pemusnah di dalam atur cara berorientasikan objek? Nyatakan bila pembina dan pemusnah dilaksanakan dalam atur cara.

(ii) Write a class definition named **XYZ** and write the related function/method implementation for the class **XYZ**. Variables should be defined as a `private` members and function/method should be defined as `public` members of the class **XYZ**. **Class XYZ** consists of the following class members:

*Tulis takrifan kelas yang bernama **XYZ** dan tulis implementasi fungsi/kaedah yang berkenaan untuk kelas **XYZ**. Pemboleh-pemboleh ubah perlu diisytiharkan sebagai ahli `private` dan fungsi/kaedah perlu diisytiharkan sebagai ahli `public` bagi kelas **XYZ**. Kelas **XYZ** mempunyai ahli-ahli seperti berikut:*

- Three (3) integer variables **W**, **D** and **L**.

   *Tiga (3) pemboleh ubah integer **W, D** dan **L**.*

- **setValue(..)** function/method which receives three (3) integer parameters and assign the received parameters to the `private` members of the class **XYZ**.

   *Fungsi/kaedah **setValue(..)** yang menerima tiga (3) parameter integer dan umpukan parameter yang diterima kepada ahli-ahli `private` kelas **XYZ**.*

- **result(..)** function/method which receives an integer parameter and increase the related variable value accordingly. If the received parameter is 1 then increase **W** by 1, if the received parameter is 0 then increase **D** by 1 and if the received parameter is -1 then increase **L** by 1.

   *Fungsi/kaedah **result(..)** yang menerima satu parameter integer dan menambah nilai pemboleh ubah yang berkenaan. Jika nilai parameter yang diterima adalah 1, maka tambah 1 kepada **W**, jika nilai parameter yang diterima adalah 0, maka tambah 1 kepada **D** dan jika nilai parameter yang diterima adalah -1, maka tambah 1 kepada **L**.*

- **Default constructor** which initializes all values to 0 and **alternate constructor**.

   Pembina lalai *yang mengawalkan semua nilai kepada 0 dan **pembina alternatif**.*

- `showVal()` function/method which will display the values of `W`, `D` and `L`.

   Fungsi/kaedah `showVal()` yang akan memaparkan nilai `W`, `D` dan `L`.

(iii)   Based on 1(a) (ii), for each the given `main()` function, state the output and explain how you get the output. If there is any error, state a reason which causes the error.

   Berdasarkan 1(a)(ii), untuk setiap fungsi `main()` yang diberi, nyatakan output dan jelaskan bagaimana anda mendapat output. Jika terdapat ralat, nyatakan sebab terjadi ralat tersebut.

`main()` function	Output and reason
```int main() { XYZ m1(3,2,1); cout <<"Win: " << m1.W << endl; cout <<"Draw: " << m1.D << endl; cout <<"Lose: " << m1.L << endl; system("pause"); }```	
```int main() { XYZ m1; m1.showVal(); m1.setValue(3,1,2); m1.result(-1); m1.showVal(); system("pause"); }```	

(40/100)

(b)　Given the following class definition and class implementation:

Diberi takrifan kelas dan implementasi kelas seperti berikut:

```cpp
#include <iostream>
using namespace std;
class ABC {
private:
  int x;
  int y;
public:
  void setVal(int j,int k){
     x=j;y=k;}
  ABC(){x=1;y=1;}
  ABC(int,int);
  void show();
};

ABC::ABC(int a,int b){
x=a;y=b;
}

void ABC::show(){
cout << x <<"  " << y << endl;
}
```

```cpp
class ICE:public ABC{
     int z;
     public:
       void incVal();
       void show();
       ICE(){z=0;}
       int sum();
       ~ICE(){ }
};

int ICE::sum(){
  return (x + y + z);
}

void ICE::show()
{
  ABC::show();
  cout << z << endl;
}
```

(i)　Is there any error in the class definition and the class implementation in 1(b)? If yes, states which statements cause the error and explain on how to correct the error.

Adakah terdapat ralat dalam takrifan kelas dan implementasi kelas dalam 1(b)? Jika ya, nyatakan penyataan-penyataan mana yang menyebabkan ralat dan berikan penjelasan untuk membetulkan ralat tersebut.

(ii)　Write an alternate constructor for the derived **class ICE** which will initiate the values of variables x, y and z.

*Tulis pembina alternatif untuk kelas pewarisan **ICE** yang akan mengawal nilai pemboleh ubah x, y dan z.*

(iii)   Give the output of the given `main()` function:

Beri output untuk fungsi `main()` berikut:

```
int main()
{
    ICE ice1;
    ICE ice2(2,3,6);
    ice1.show();
    cout <<"\n\n.................." <<endl;
    ice2.show();
    system("pause");
}
```

(iv)   Modify the class definition in 1(b) so that the class `ICE` has one (1) friend function named **frenDisplay(…)** and write **frenDisplay(…)** function definition to display the values of variables `x`, `y` and `z`.

*Ubahsuai takrifan kelas dalam 1(b) supaya kelas `ICE` mempunyai satu (1) fungsi kawan yang bernama **frenDisplay(…)** dan tulis definisi fungsi **frenDisplay(…)** untuk memaparkan nilai-nilai pemboleh ubah `x,y` dan `z`.*

(30/100)

(c)   Given the following class definition and the class implementation:

Diberi takrifan kelas dan implementasi kelas seperti berikut:

```
#include <iostream>
using namespace std;

class Infor {
   private:
      int no_Stu;
      int no_Prog;
   public:
      Infor(){
      no_Stu=0;
      no_Prog=0;}
      ~Infor() {}
      void setInfor(int,int);
      void printInfor();
   };


void Infor::printInfor(){
   cout <<"No. of Programme: " ;
   cout << no_Prog << endl;
   cout <<"No. of student: " ;
   cout << no_Stu << endl;
   }
```

```
void Infor::setInfor (int p,int s)
  {
      no_Prog=p;
      no_Stu=s;
  }


class School{
  private:
      string schCode;
      int acadStaff;
      ……………………………….
  public:
      School(){
          acadStaff=0;
          schCode="NULL";
      }
      ~School(){}
      void setData(string,int,int,int);
      ………………………………………
  };
```

(i) Modify the class definition in 1(c) so that the class **School** consists of the additional class members as follow:

Ubahsuai takrifan kelas dalam 1(c) supaya kelas **School** *mempunyai ahli-ahli kelas tambahan seperti berikut:*

• an object typed of the class `Infor`.

satu objek berjenis kelas `Infor`.

• `displayData()` function/method that display all related information.

Fungsi/kaedah `displayData()` *yang memaparkan semua maklumat berkenaan.*

(ii) Write `setData()` function/method implementation to set number of student, number of programme, school code and number of academic staff.

Tulis implementasi fungsi/kaedah `setData()` *untuk menetapkan bilangan pelajar, bilangan rancangan, kod pusat pengajian dan bilangan staf akademik.*

(iii) Write `displayData()` function/method implementation to display all related information.

Tulis implementasi fungsi/kaedah `displayData()` *untuk memaparkan semua maklumat berkenaan.*

(iv) Give the output of the following `main()` function:

Beri output fungsi `main()` *berikut:*

```
int main()
{
   School sch1;
   sch1.displayData();
   sch1.setData("CS",45,6,460);
   sch1.displayData();
   system("pause");
}
```

(30/100)

2. (a) (i) Explain what is dynamic array and how it is different with static array?

Jelaskan maksud tata susunan dinamik dan bagaimana ia berbeza dengan tata susunan statik?

(ii) Given the incomplete program below:

Diberi atur cara tidak lengkap di bawah:

```cpp
#include<iostream>

using namespace std;

int main(){
     int input;

   (i) . . . . // declare pointer type int named "ptr"
   cout<<"How many items you want to enter : "<<endl;
   cin>>input;

     (ii). . . // create dynamic array based on user input as above


     for (int counter=0; counter < input; counter++){

     (iii). . . //prompt user to fill array with numbers typed in  from
     user input
   }
   //display items entered
     cout<<"The items you have entered are : "<<endl;

     for (int counter=0; counter < input; counter++){
     cout<<counter+1<<"Item is : "<<*(ptr+counter)<<endl;

   }
   (iv) . . .; //destroy the dynamic array

   return 0;
}
```

Write the correct C++ statements for (i), (ii), (iii) and (iv).

Tulis kenyataan- kenyataan C++ yang betul untuk (i), (ii), (iii) dan (iv).

(25/100)

(b)   Given the following diagram:

Diberikan gambar rajah seperti berikut:

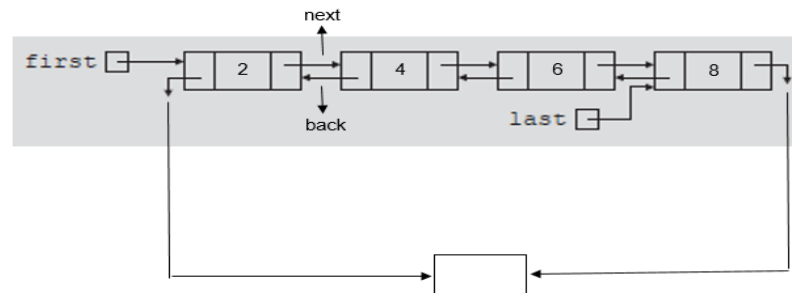
Figure 1/Rajah 1

(i)   What are the content of the two pointers above? Fill in the blank box.

Apakah maklumat bagi dua penunjuk di atas? Isi kotak kosong.

(ii)   What is the type of linked list?

Apakah jenis senarai berpaut di atas?

(iii)   Explain the function of the following pointers: `first`, `last`, `next` and `back`.

Terangkan fungsi bagi setiap penunjuk berikut: `first`, `last`, `next` and `back`.

(iv)   Declare the structure of the nodes.

Isytiharkan struktur nod-nod.

(v)   Write statement to print the value of the nodes in reverse order.

Tulis kenyataan untuk mencetak nilai bagi nod-nod dalam turutan terbalik.

(20 /100)

(c) You are to write a program to store data for the 14th Malaysian General Election (GE14). The information to store are: name, IC, gender, age and codeArea. The following is the definition of the struct nodeType and abstract class linkedListType as ADT:

Anda dikehendaki menulis atur cara untuk menyimpan data bagi Pilihan raya Umum Malaysia ke-14 (GE14). Maklumat untuk disimpan adalah: name, IC, gender, age dan codeArea. Berikut adalah definisi struct nodeType dan kelas abstrak linkedListType sebagai ADT:

```cpp
template <class Type>
struct nodeType
{
   Type info;
   nodeType<Type> *link;
};

template <class Type>
class linkedListType
{
public:
   const linkedListType<Type>& operator=
                     (const linkedListType<Type>&);
   void initializeList();
   bool isEmptyList() const;
   void print() const;
   void displayVotersIC(string IC);
   int length() const;
   void destroyList();
   Type front() const;
   Type back() const;
   bool search(const Type& searchItem);
   void insertInfo(const Type& newItem);
   deleteNode(const Type& deleteItem);
   linkedListType();
   ~linkedListType();

protected:
   int count;
   nodeType<Type> *first;
   nodeType<Type> *last;
};
```

Assume that the following structure is used to store the voter information:

Anggapkan struktur berikut digunakan untuk menyimpan maklumat pengundi:

```cpp
struct  VotersInfo {
   string name;
   string IC;
   string gender;
   int age;
   string codeArea;

};
```

(i) Write a `displayVotersIC()` function to display all voters info based on search criteria *IC.*

Tulis satu fungsi displayVotersIC() untuk memaparkan semua maklumat pengundi berpandukan kriteria pencarian IC.

(ii) Write a complete function `insertInfo()` to insert data in ascending order into the linked list based on voter's age.

Tulis fungsi lengkap insertInfo() untuk menyelit data dalam susunan menaik ke dalam senarai berpaut berdasarkan umur pengundi.

(15/100)

(d) Given is the main function of the program:

```
int main() {

// set structure typed VotersInfo to be stored in the node (info
// part of the nodeType) in the linkedlist
(iii)_____;

VotersInfo vote;

int choice;

bool flag=true;
do{
    system ("cls");
    cout <<"\n 1. Input Voters";
    cout <<"\n 2. Display the oldest voter: ";
    cout <<"\n 3. Exit";
    cout <<"\n Your choice: ";
    cin >> choice;

switch (choice){

case 1:
        //store name, IC, gender, age and codeArea to the struc
        // vote declared in main()
        (iv)_____;

        // call function to insert voters info and send vote as
        // actual parameter
        (v)_____;
        break;
case 2:
        //call function to display the oldest voter
        (vi)_____;
        cout <<"First data: \n";
        cout <<vote.name << " " << vote.name << endl;
        system("pause");
        break;
case 3: flag=false; break;

default:
        cout <<"Input not valid ....";
    }
}
```

...11/-

Write the correct statements for number (iii), (iv), (v) and (vi) above.

Tulis kenyataan yang betul untuk (iii), (iv), (v) and (vi) di atas.

(40/100)

3. You are given the abstract class as ADT for **Stack** and **Queue**.

*Anda diberi kelas abstrak sebagai ADT untuk **Tindanan** dan **Baris Gilir**.*

Stack	Queue

```template <class Type>```
```class linkedStackType: public```
```   stackADT<Type>```
```{```
```public:```
```   const linkedStackType<Type>&```
```   operator=(const linkedStackType```
```   <Type>&);```
```   void initializeStack();```
```   bool isEmptyStack() const;```
```   bool isFullStack() const;```
```   void push(const Type& newItem);```
```   Type top() const;```
```   void pop();```
```   linkedStackType();```
```   linkedStackType(const```
```   linkedStackType<Type>& otherStack);```
```   ~linkedStackType();```
```private:```
```   nodeType<Type> *stackTop;```
```   void copyStack(const```
```   linkedStackType<Type>& otherStack);```
```};```
	```template <class Type>```
	```class linkedQueueType: public```
	``` queueADT <Type>```
	```{```
	```public:```
	``` const linkedQueueType<Type> &```
	``` operator= (const```
	``` linkedQueueType <Type>&);```
	``` bool isEmptyQueue() const;```
	``` bool isFullQueue() const;```
	``` void initializeQueue();```
	``` void deleteQueue();```
	``` Type front()const;```
	``` Type back() const;```
	``` void addQueue(Type& newItem);```
	``` linkedQueueType();```
	``` linkedQueueType (const```
	``` linkedQueueType<Type>&otherQueue);```
	``` ~linkedQueueType();```
	```private:```
	``` nodeType<Type> *queueFront;```
	``` nodeType<Type> *queuRear;```
	``` };```

(a) (i) For each of the following situations, which of these ADTs (1 through 4) would be most appropriate: (1) queues; (2) stacks; (3) lists; (4) none of these?

Untuk setiap situasi berikut, yang mana satu ADTs ini (1 hingga 4) yang paling sesuai: (1) baris gilir; (2) tindanan; (3) senarai; (4) tiada yang sesuai?

- The customers at bank who take numbers to mark their arrival.

  Pelanggan di bank yang mengambil nombor untuk menandakan ketibaan mereka.

- Integers that need to be sorted.

  Integer yang perlu disusun.

- Arrangement of flowers in a vase.

  Susunan bunga dalam pasu.

- Airplanes that are waiting to land at a busy airport.

   Kapal terbang yang sedang menunggu untuk mendarat di lapangan terbang yang sibuk.

- An employer who fires the most recently hired person.

   Majikan yang memberhentikan pekerja yang paling baru diambil bekerja.

(ii)   Suppose you have a stack `aStack` and an empty auxiliary stack `auxStack.` Show how you can do each of the following tasks by using only the ADT stack operations:

   Anggapkan anda mempunyai tindanan `aStack` dan tindanan bantu kosong `auxStack`. Tunjukkan bagaimana anda boleh melakukan setiap tugas berikut dengan menggunakan hanya operasi ADT tindanan:

- Display the contents of `aStack` in reverse order; that is, display the top last.

   Papar kandungan `aStack` secara terbalik; iaitu, kandungan atas paling akhir.

- Delete every occurrence of a specified item from `aStack`, leaving the order of the remaining items unchanged.

   Hapuskan setiap kewujudan item yang dinyatakan dari `aStack`, tanpa mengubah susunan kandungan asal yang masih tinggal.

(30/100)

(b)   Consider the language **L** below:

L = {w\$w' : w is a string of characters other than \$, w' = reverse(w)}

The string `A$A`, `ABC$CBA`, and `$` are in **L**, but `AB$AB` is not. Assume **L** contains only one `$`.

Write the program segment that recognize whether a particular strings is in the language **L**.

*Pertimbangkan bahasa **L** di bawah:*

L = {w\$w' : w ialah rentetan aksara yang bukan \$, w' = terbalik(w)}

*Rentetan `A$A`, `ABC$CBA`, dan `$` adalah **L**, tetapi bukan `AB$AB`. Anggapkan **L** mengandungi hanya satu `$`.*

*Tulis segmen program yang mengiktiraf sama ada rentetan tertentu adalah dalam bahasa **L**.*

    (i)   Use both the ADT stack and queue operations.

           Guna kedua-dua operasi ADT tindanan dan baris gilir

    (ii)   Use only ADT stack operations.

           Guna hanya operasi ADT tindanan.

                                  (30/100)

(c)   (i)   What is the output of the following program and what argument values, if any could you pass to the function f to cause the program to run forever?

         Apakah output program berikut dan apakah nilai-nilai hujah jika ada, yang boleh di hantar kepada fungsi f yang menyebabkan larian program selama-lamanya?

```
#include <iostream.h>
int f(int n)

int main()
{
  cout <<"The value of f(8) is "<< f(8) <<endl;
  return 0;
}//end main

int f(int n)
//Precondition: n >= 0
{
  cout <<"Function entered with n = "<< n <<endl;
  switch (n)
  {
    case 0:case 1:case 2: return n + 1;
    default: return f(n-2) * f(n-4);
  }//end switch
}end f
```

    (ii)   Write a recursive function displayOctal() that receives a positive decimal number then converts the number to base 8 and display the result.

         Tulis fungsi rekursi displayOctal() yang menerima nombor perpuluhan positif, kemudian menukarkan kepada nombor asas 8 dan paparkan hasilnya.

                                  (20/100)

(d) (i) Given the nodes of a binary tree in the preorder sequence and the postorder sequence, show that it may not be possible to reconstruct a unique binary tree.

Diberi nod pepohon perduaan dalam jujukan tertib awalan dan jujukan tertib akhiran, tunjukkan bahawa tidak mungkin untuk membina semula pepohon perduaan yang unik.

(ii) Suppose you are given two sequences of elements of corresponding to the inorder sequence and the preorder sequence. Prove that it is possible to reconstruct a unique binary tree.

Anggapkan anda diberi dua jujukan unsur-unsur yang sepadan dengan jujukan tertib sisipan dan jujukan tertib awalan. Buktikan bahawa ada kemungkinan boleh membina semula pepohon perduaan yang unik.

(20/100)

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