بسم الله الرحمن الرحيم

Information and Computer Science Department
Spring Semester 132
ICS 103 – Computer Programming in C
Midterm Exam key
Thursday, April 03, 2014
Duration: 120 minutes

Name:

ID#:

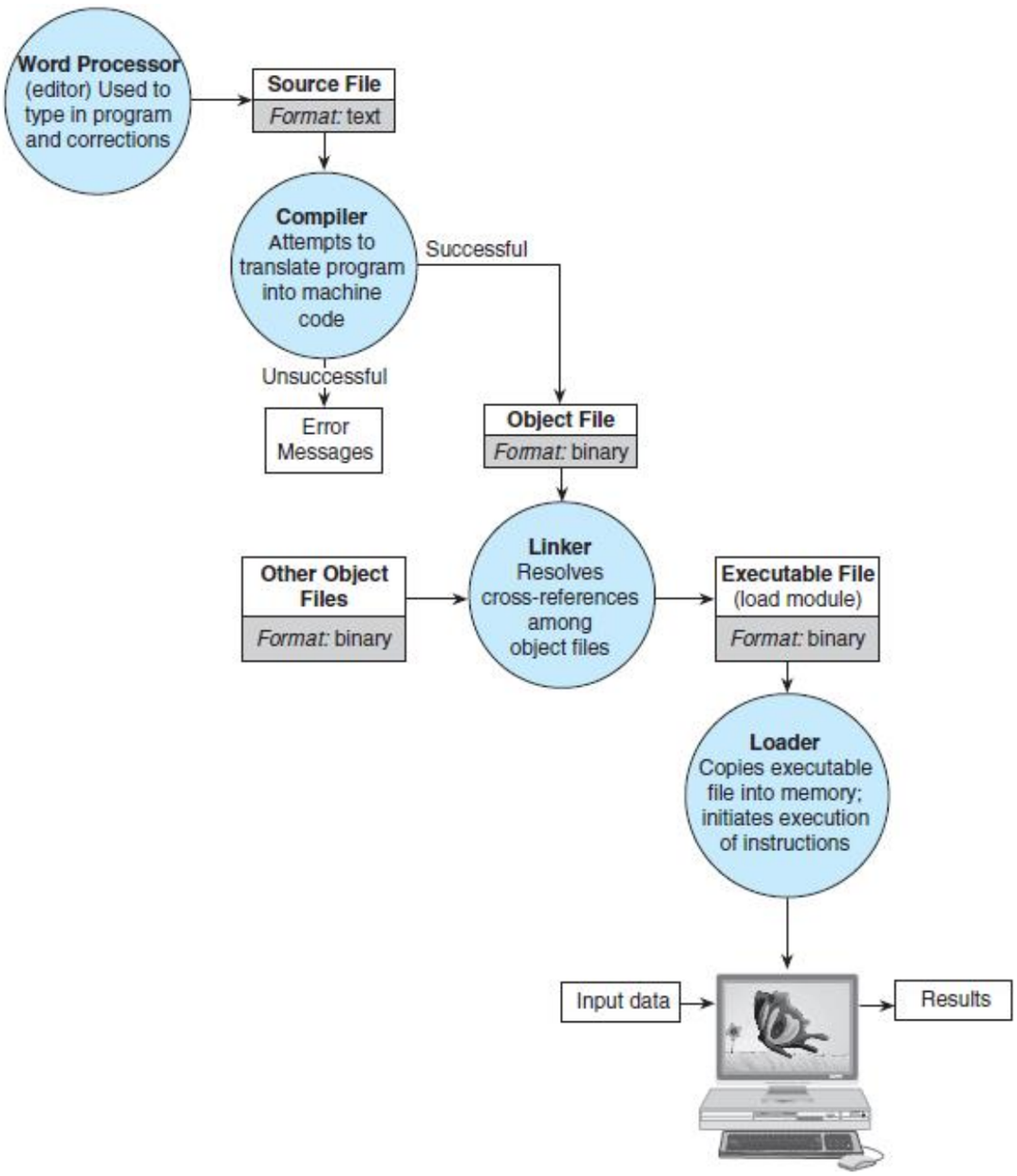
Section#:

Instructor:

Question #	Maximum Grade	Obtained Grade
1	4	
2	12	
3	36	
4	15	
5	10	
6	8	
7	15	
Total	100	

Question # 1 [4 points]

Fill in the circles with the software used in developing a high-level language program:



Question # 2 [12 points]

Apply the software development method to find the volume and surface area of a sphere given its radius.

$volume = \frac{4}{3}\pi r^3$ $surface\ area = 4\pi r^2$, where r is the radius and π=3.14159

Note: Apply the first four steps ending with a complete C program.

Problem:

Find the volume and surface area of a sphere given its radius.

Analysis:

Problem Constant
PI 3.14159

Problem Input
double radius

Problem Output
double volume, surface_area

Relevant Formula

$volume = \frac{4}{3}\pi r^3$ $surface\ area = 4\pi r^2$, where r is the radius and π=3.14159

Design:

Algorithm

1. Get the radius
2. Compute the volume
    a. Assign 4/3 * PI * radius ^ 3 to the volume
3. Compute the surface area
    a. Assign 4 * PI * radius ^ 2 to the surface area
4. Display the volume and the surface area

Implementation:

```
/* Calculating the Volume and the Surface Area of a Sphere */

#include <stdio.h>
#define PI 3.14159

int main(void)
{
	double radius; /* input - radius of a sphere */
	double volume; /* output - volume */
	double surface_area; /* output - surface area */

	/* Get the radius */
	printf("Enter radius> ");
	scanf("%lf", &radius);

	/* Calculate the volume */
	volume = 4.0 / 3.0 * PI * radius * radius * radius;

	/* Calculate the surface area */
	surface_area = 4 * PI * radius * radius;

	/* Display the volume and surface area */
	printf("The volume is %.2f\n", volume);
	printf("The surface_area is %.2f\n", surface_area);

	return (0);
}
```

Question # 3 [36 points]

Identify the error(s), if any, in each of the following code fragments. If a fragment has no errors, write its output. [Note: No explanation of error(s) is required].

Code Fragment	Output

`int x = 3;`
`x = x * x – x / x;`
`printf("%d", x);`
	1 mark
	8

`int a, b, c, x;`
`x = 1;`
`a = 77;`
`b = 10;`
`c = 11;`
`x = a % b;`
`printf("%d ", x);`
`x = a / b;`
`printf("%d ", x);`
`x = b % a;`
`printf("%d ", x);`
`x = b / a;`
`printf("%d ", x);`
	4 marks
	7 7 10 0

`double x=1234.5678;`
`int y=77;`
`printf("%.1f%d\n", x, y);`
`printf("%1.1f%2d\n", x, y);`
`printf("%4.2f%3d\n", x, y);`
`printf("%7.3f%4d\n", x, y);`
`printf("%9.3f%4d\n", x, y);`
	5 marks
	1 2 3 4 . 6 7 7
	1 2 3 4 . 6 7 7
	1 2 3 4 . 5 7 7 7
	1 2 3 4 . 5 6 8 7 7
	1 2 3 4 . 5 6 8 7 7

`double x = 10.4, y;`
`int m = 2 , n = 7 ;`
`y = x / m;`
`printf("%.1f\n", y);`
`y = n / m;`
`printf("%.1f\n", y);`
	2 marks
	5.2
	3.0

`int x = 12;`
`if(x > 5)`
`  printf("A");`
`if(x > 6)`
`  printf("B");`
`if(x > 12)`
`  printf("C");`
`else if(x > 8)`
`  printf("D");`
`else if(x > 4)`
`  printf("E");`
`else`
`  printf("F");`
	3 marks
	ABD

`int x = 10;`
`if (x > 15)`
`  x = 0;`
`  printf("%d", x);`
`else`
`  printf("%d", x + 5);`
	2 marks
	Else without if

`int x;`
`scanf("%d", &x);`
`switch(x){`
`case 1:  x = x + 1;`
`  break;`
`case 3:  x = x + 2;`
`case 5:  if(x == 4)`
`  x = x + 6;`
`case 6:  x = x + 3;`
`  break;`
`default:  x = x – 1;`
`}`
`printf("%d", x);`
	3 marks
	When x is 1
	2
	
	When x is 2
	1
	
	When x is 3
	8

Code Fragment	Output

`int i, j;`
`i = 3;`
`while (i < 7){`
`  for(j = 5; j >= i; j = j-2) {`
`  printf("%d ", i + j);`
`  }`
`  printf("\n");`
`  i = i + 3;`
`}`
`printf("%d %d\n", i, j);`
	4 marks
	8 6
	
	9 5

`int i,j,count = 0;`
`for(i = 3; i != 5; i +=2)`
`  for(j = 3; j > i; j = j-2)`
`  count++;`
`printf("%d %d %d\n", i, j,count);`
	3 marks
	5 3 0

`int i, j;`
`for (i = 1; i <= 5; i++){`
`  for (j = 1; j <= i; j++)`
`  printf("%d",j);`
`  for (j = i; j <= 5; j++)`
`  printf("%d",j);`
`  printf("\n");`
`}`
	5 marks
	112345
	122345
	123345
	123445
	123455

`#include <stdio.h>`
`int f1(int x);`
`int main()`
`{`
`  int k = 1,m = 6;`
`  printf("%d %d \n",f1(k),f1(m));`
`  return 0;`
`}`
`int f1(int x)`
`{`
`  if (x <= 2)`
`  return 2;`
`  else`
`  return 2*(x-1);`
`}`
	4 marks
	2 10

Question # 4 [15 points]

In each semester, a private University charges 2000 Saudi Riyals per course for each of the first four courses a student takes. For each course in excess of 4, the charge is 1500 per course. Write a C program that prompts for and reads the number of courses a student takes in a semester; it then displays the total charge to be paid. Your program must display an appropriate error message if the entered number of courses is zero or negative.

Sample program runs:

```
Enter number of courses: 3
Total charge = 6000 Saudi Riyals
```

```
Enter number of courses: 5
Total charge = 9500 Saudi Riyals
```

Note: Your program must be general and not specific to the given sample runs.

```
#include <stdio.h>
#define CHARGE1 2000
#define CHARGE2 1500

int main(void){
	int numCourses, charge;
	printf("Enter number of courses: ");
	scanf("%d", &numCourses);
	if(numCourses <= 0)
		printf("Error: Invalid number of courses\n");
	else{
		if(numCourses <= 4)
			charge = numCourses * CHARGE1;
		else
			charge = 4 * CHARGE1 + (numCourses - 4)*CHARGE2;

		printf("Total charge = %d Saudi Riyals\n", charge) ;
	}

	return 0;
}
```

Question # 5 [10 points]

Write a C program that asks the user to enter an integer number n and displays the multiplication table for numbers 1 to n. Display each number in 3 places. The output of your program should be as follows for n = 5:

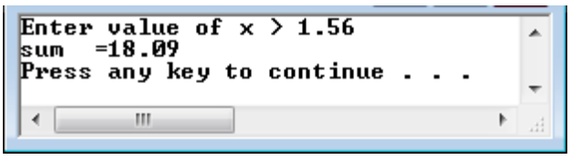
```
Enter a number: 5
     1  2  3  4  5
  1  1  2  3  4  5
  2  2  4  6  8 10
  3  3  6  9 12 15
  4  4  8 12 16 20
  5  5 10 15 20 25
```

```
#include <stdio.h>
int main ()
{
	int n, i, j;
	printf("Enter a number: ");
	scanf("%d", &n);
	printf("   ");
	for (i = 1; i <= n; i++)
		printf("%3d",i);
	printf("\n");
	for (i = 1; i <= n; i++){
		printf("%3d", i);
		for (j = 1; j <= n; j++)
			printf("%3d", i*j);
		printf("\n");
	}
	return 0;
}
```

Question # 6 [8 points]

Write a C program that computes the following sum based on the value of x input by the user.

$$sum = \sum_{1=1}^{i=10} \frac{x^i}{2i-1}$$




```
#include <stdio.h>
#include <math.h>
int main(){
	double x, sum, i;
	sum = 0;
	printf("Enter value of x >");
	scanf("%lf", &x);
	for(i = 1; i <= 10; i = i + 1)
		sum = sum + pow(x, i) / (2 * i - 1);
	printf("sum  =%.2f\n", sum);
	return 0;
}
```

Question # 7 [15 points]

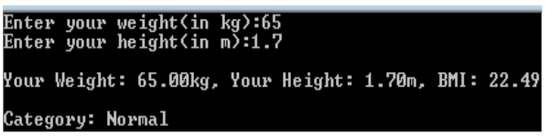
The body mass index **(BMI)** is a measure for human body shape based on an individual's weight and height. It is a simple method to assess how much an individual's body weight departs from what is normal. It can be measure by the formula:

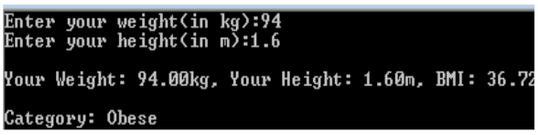
$$\textbf{BMI} = \textbf{(weight in kg) / (height in m)}^2$$

Depending on the value of BMI, a person can be categorized in different weight ranges as given in the table below.

BMI (kg/m^2)	Weight Range
Less than 18.5	Underweight
From 18.5 to 24.9	Normal
From 25 to 29.9	Overweight
30 and more	Obese

Write a complete C language program using a function **bmi_calc** to calculate BMI. Ask the user about height and weight in the main function. Print a message to the user showing him weight in kg, height in m, BMI and the weight range category as shown in the image.






```
#include <stdio.h>

double bmi_calc (double weight, double height);

int main(){
	double w, h, bmi;

	/* get the input weight from the user */
	printf("Enter your weight(in kg):");
	scanf("%lf", &w);

	/* get the input height from the user */
	printf("Enter your height(in m):");
	scanf("%lf", &h);
	bmi = bmi_calc (w, h);

	/* print the result */
	printf("\nYour Weight: %.2fkg, Your Height: %.2fm, BMI: %.2f\n\n", w, h, bmi);
	if (bmi < 18.5)
		printf("Category: Underweight\n\n");
	else if (bmi < 25)
		printf("Category: Normal\n\n");
	else if (bmi < 30)
		printf("Category: Overweight\n\n");
	else
		printf("Category: Obese\n\n");
	return 0;
	}

double bmi_calc (double weight, double height){
	/* bmi calculation */
	return (weight)/(height * height);
}
```