Information and Computer Science Department

Summer Session 153

ICS 103 – Computer Programming in C

Midterm Exam

Wednesday, August 03rd, 2016

Duration: 120 minutes

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| Name: |  | Section # |  |

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| ID #: |  |  |  |  |  |  |  |  |  | Serial # |  |

Instructions:

1. Answer all questions. Make sure your answers are clear and readable.
2. Make sure there are 5 questions in 9 pages.
3. The exam is closed book and closed notes. No calculators or any helping aides are allowed. Make sure

 to turn off your mobile phone and keep it in your pocket.

1. If there is no space on the front of a question’s page, use the back of the page. Indicate this clearly.

|  |  |  |  |
| --- | --- | --- | --- |
| Question # | Maximum Grade | Obtained Grade | Remarks |
| 1 | 20 |  |  |
| 2 | 20 |  |  |
| 3 | 20 |  |  |
| 4 | 20 |  |  |
| 5 | 20 |  |  |
| Total | 100 |  |  |

**Question # 1 [20 Points] [4 + 4 + 6 + 6]**

1. Convert the given mathematical equation into an equivalent C statement:

|  |  |
| --- | --- |
| Mathematical Equation | C Statement |
| $$w= \frac{x^{\sqrt{y}}-z^{2}}{2x+y}$$ | **w = (pow(x, sqrt(y)) – z \* z) / (2\*x + y);** |

1. Show the correct order of evaluation for the C operators in the following expression:

 x != 3 || y < 3 + 2 && x \* 2 > 6



**Note:** It is not necessary to draw the expression tree.

1. Convert the following switch statement into an equivalent if-structure statement

|  |  |
| --- | --- |
| **switch** statement | Equivalent **if** structure |
| int x;scanf("%d", &x);switch(x){ case 4: case 6:  printf("even");break; case 5: case 7: printf ("prime");break; default:  printf("Wrong input"); } | int x;scanf("%d", &x);if(x == 4 || x == 6) printf("even");else if(x == 5 || x == 7) printf("even");else printf("Wrong input"); |

1. Write two **printf** statements to have the output shown below the program fragment. Each square represents one space.

**Note:** Do not use blank and tab characters in the format strings.

**double x = 742.167;**

**int k = 358;**

**printf("%7.1lf %6d \n", x, k);**

**printf("%4d %9.4lf", k, x);**

// or **printf("%7.1lf %6d \n %4d %9.4lf", x, k, k, x);**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 7 | 4 | 2 | . | 2 |  |  |  | 3 | 5 | 8 |
|  | 3 | 5 | 8 |  | 7 | 4 | 2 | . | 1 | 6 | 7 | 0 |

**Question** **#** **2** [20 Points] **[4 + 6 + 4+ 3 + 3]**

What is the output of each of the following C program fragments? If a fragment will cause an error, mention the error.

|  |  |  |
| --- | --- | --- |
|  | Program Fragment | Output |
| 1. | int k = 12;if(k > 9) printf("U");else if(k > 7) printf("P");if(k > 10) printf("K");if(k > 6) printf("F"); | **UKF** |
| 2. | int x;scanf("%d" , &x); switch(x) { case 4: case 2: x = x + 1; printf("%d ", x); case 5:  case 0: x = x + 2; case 3: case 1: x = x + 3; break; default: x = x + 4;} printf("%d", x); | input | output |
| 4 |  **5 10**  |
| 2 |  **3 8**  |
| 5 | **10** |
| 3. |  int x = 20; if (x > 15) x = 3; printf("%d", x + 2); else printf("%d", x + 4); | Compile-time error: else without if |
| 4. | double k = 2.0;switch(k){ case 3.0: printf("%f", k + 1); break; default: printf("%f", k + 3); break;} | **Error: switch expression is double** |
| 5. | printf("%f", 5 / 2 + 9.0 % 2); | **Error: % cannot be applied to an operand of type double.** |

Question # 3 [20 Points]

Write a complete interactive C program that prompts the user for the volume and height of the cylinder shown below, in cubic centimeters. Based on the user input, your will find and display the diameter of the cylinder, in centimeters, and the side of the square inscribed inside the circle, in centimeters.

Cylinder

Top View

Top View of Cylinder

height

Note: The diagonal of the square passes through the center of the circle.

$$diagonal of square=circle diameter$$

$$diagonal^{2}=side^{2}+side^{2}$$

$$area of square=side×side$$

$$circle area=π×radius^{2}$$

$$cylinder volume=π×height x radius^{2}$$

Notes:

1. Define π as a constant with a value of 3.14159
2. Your results must be displayed with 2 digits after the decimal point.

A sample program run is shown below:



**#include <stdio.h>**

**#include <math.h>**

**#define PI 3.14159**

**int main() {**

 **double cyl\_vol, height, side, diagonal, radius;**

 **printf("Please enter the volume of the cylinder [in cubic cm]: ");**

 **scanf("%lf", &cyl\_vol);**

 **printf("Please enter the height of the cylinder [in cm]: ");**

 **scanf("%lf", &height);**

 **radius = sqrt(cyl\_vol / (PI \* height));**

 **diagonal = 2 \* radius;**

 **side = sqrt(pow(diagonal, 2) / 2);**

 **printf("The circle diameter = %.2f cm\n", diagonal);**

 **printf("The side of the inner square = %.2f cm\n", side);**

 **return 0;**

**}**

**Question # 4 [20 Points]**

Write a *complete* interactive C program that prompts the user to enter three different integer numbers. If any two numbers or all the three numbers are not different the program displays an appropriate error message and terminates; otherwise the program prints on the screen the sum of the two larger numbers in the format shown in the sample run below. Your program must use a user-defined function **sumLargerNumbers** in determining the sum of the two larger numbers.

Notes:

* Your program must be general.
* The function **sumLargerNumbers** must have the three numbers as parameters. This function must not contain **scanf** and **printf** statements and it must be written after the **main** function.
* The logic of finding the sum of the two larger numbers must be in the function **sumLargerNumbers** and not in the **main** function.

Sample program runs:

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| --- | --- |
|  |  |

**#include <stdio.h>**

**int sumLargerNumbers(int x,int y, int z);**

**int main(void){**

 **int x, y, z, sum;**

 **printf("Enter three distinct integers: ");**

 **scanf("%d%d%d", &x, &y, &z);**

 **if(x == y || x == z || y == z){**

 **printf("Error: The values are not distinct");**

 **}else{**

 **sum = sumLargerNumbers(x, y, z);**

 **if(sum == x + y)**

 **printf("%d + %d = %d\n", x, y, sum);**

 **else if(sum == y + z)**

 **printf("%d + %d = %d\n", y, z, sum);**

 **else**

 **printf("%d + %d = %d\n", x, z, sum);**

 **}**

 **return 0;**

**}**

**int sumLargerNumbers(int x,int y, int z){**

 **int min = x;**

 **if(y < min)**

 **min = y;**

 **if(z < min)**

 **min = z;**

 **return x + y + z - min;**

}

**Question # 5 [20 Points]**

An internet shop charges 5.50 Saudi Riyals per hour or any fraction of an hour for the first 4 hours of service. The charge in excess of 4 hours is 3.50 Saudi Riyals per hour.

Write a complete C program that prompts for and reads the amount of service for a customer in **minutes** as an integer value. If the input is zero or negative, the program displays an error message and then terminates; otherwise, it calls a function **computeCharge** that computes and returns the charge for a customer in Saudi Riyals. The main function then displays the charge.

**Hint:** Use the **ceil()** standard function:

|  |  |  |  |
| --- | --- | --- | --- |
| C function | Mathematical Notation | Example | Comment |
| ceil(x) | ⎡ x ⎤ | ceil(45.1) = 46.0ceil(-7.9) = -7.0 | Returns the smallest integral value (of type double) greater or equal to x |

Notes:

* Your program must be general.
* The function **computeCharge** must not contain **scanf** and **printf** statements. It must also be written after the **main** function.
* Your program must use appropriate constants.

Sample Program Execution:

|  |  |
| --- | --- |
|  |  |

**#include <stdio.h>**

**#include <math.h>**

**#define CHARGE1 5.50**

**#define CHARGE2 3.50**

**double computeCharge(int minutes);**

**int main(void){**

 **int minutes;**

 **double hours, charge;**

 **printf("Enter service duration [minutes]: ");**

 **scanf("%d", &minutes);**

 **if(minutes <= 0)**

 **printf("Error: Invalid input");**

 **else{**

 **charge = computeCharge(minutes);**

 **printf("The charge for %d minutes is %.2f Saudi Riyals\n", minutes, charge);**

 **}**

 **return 0;**

**}**

**double computeCharge(int minutes){**

 **double hours, charge;**

 **hours = minutes / 60.0;**

 **if(hours <= 4)**

 **charge = ceil(hours) \* CHARGE1;**

 **else**

 **charge = 4 \* CHARGE1 + (hours - 4) \* CHARGE2;**

 **return charge;**

**}**