LAB ASSIGNMENTS

Problem Solving and Program Design

Using C

(CSE 3942)

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3. Programming project on Selection Structures: if and switch statements

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3.1 Keith's Sheet Music needs a program to implement its music teacher's discount policy. The program is to prompt the user to enter the purchase total and to indicate whether the purchaser is a teacher. The store plans to give each customer a printed receipt, so your program is to create a nicely formatted file called receipt.txt. Music teachers receive a 10% discount on their sheet music purchases unless the purchase total is $100 or higher. In that case, the discount is 12%. The discount calculation occurs before addition of the 5% sales tax. Here are two sample output files—one for a teacher and one for a nonteacher.

Total purchases	$122.00
Teacher's discount(12%)	14.64
Discounted total	107.36
Sales tax (5%)	5.37
Total	$112.73

Total purchases	$24.90
Sales tax (5%)	1.25
Total	$26.15

Note: to display a % sign, place two % signs in the format string:
printf("%d%%", SALES_TAX);

3.2 Write a program that calculates the user's body mass index (BMI) and categorizes it as underweight, normal, overweight, or obese, based on the following table from the United States Centers for Disease Control:

BMI	Weight Status
Below 18.5	Underweight
$18.5 - 24.9$	Normal
$25.0 - 29.9$	Overweight
30.0 and above	Obese

To calculate BMI based on weight in pounds (wt_lb) and height in inches (ht_in), use this formula (rounded to tenths):

$$\frac{703 \times wt\_lb}{ht\_in^2}$$

Prompt the user to enter weight in pounds and height in inches.

3.3 While spending the summer as a surveyor's assistant, you decide to write a program that transforms compass headings in degrees (0 to 360) to compass bearings. A compass bearing consists of three items: the direction you face (north or south), an angle between 0 and 90 degrees, and the direction you turn before walking (east or west). For example, to get the bearing for a compass heading of 110.0 degrees, you would first face due south (180 degrees) and then turn 70.0 degrees east (180.0 - 70.0 = 110.0). Therefore, the bearing is South 70.0 degrees East. Be sure to check the input for invalid compass headings.

3.4 Write a program that reports the contents of a compressed-gas cylinder based on the first letter of the cylinder's color. The program input is a character representing the observed color of the

cylinder: 'Y' or 'y' for yellow, 'O' or 'o' for orange, and so on. Cylinder colors and associated contents are as follows:

orange   ammonia
brown   carbon monoxide
yellow   hydrogen
green   oxygen

Your program should respond to input of a letter other than the first letters of the given colors with the message, Contents unknown .

3.5 The National Earthquake Information Center has asked you to write a program implementing the following decision table to characterize an earthquake based on its Richter scale number.

Richter Scale Number (n)	Characterization
$n < 5.0$	Little or no damage
$5.0 \leq n < 5.5$	Some damage
$5.5 \leq n < 6.5$	Serious damage: walls may crack or fall
$6.5 \leq n < 7.5$	Disaster: houses and buildings may collapse
higher	Catastrophe: most buildings destroyed

Could you handle this problem with a switch statement? If so, use a switch statement; if not, explain why.

3.6 Write a program that takes the $x - y$ coordinates of a point in the Cartesian plane and prints a message telling either an axis on which the point lies or the quadrant in which it is found.
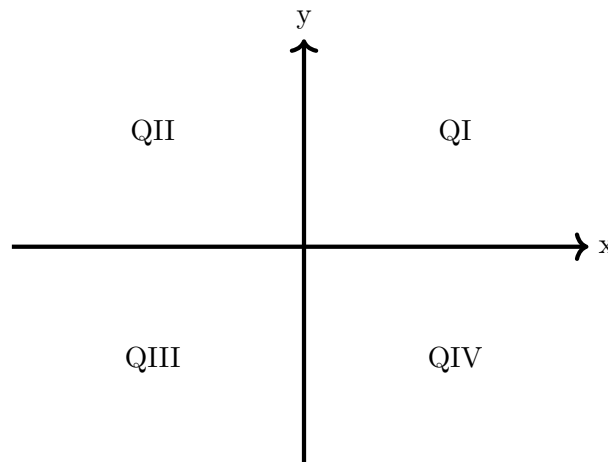
Sample lines of output:
(-1.0, -2.5) is in quadrant III
(0.0, 4.8) is on the y-axis.

3.7 Write a program that determines the day number (1 to 366) in a year for a date that is provided as input data. As an example, January 1, 1994, is day 1. December 31, 1993, is day 365. December 31, 1996, is day 366, since 1996 is a leap year. A year is a leap year if it is divisible by four, except that any year divisible by 100 is a leap year only if it is divisible by 400. Your program should accept the month, day, and year as integers. Include a function leap that returns 1 if called with a leap year, 0 otherwise.

3.8 Write a program that interacts with the user like this:
(1) Carbon monoxide

(2) Hydrocarbons
(3) Nitrogen oxides
(4) Nonmethane hydrocarbons

Enter pollutant number: 2
Enter number of grams emitted per mile: 0.35
Enter odometer reading: 40112
Emissions exceed permitted level of 0.31 grams/mile.

Use the table of emissions limits below to determine the appropriate message.

	First 50,000 Miles	Second 50,000 Miles
carbon monoxide	3.4 grams/mile	4.2 grams/mile
hydrocarbons	0.31 grams/mile	0.39 grams/mile
nitrogen oxides	0.4 grams/mile	0.5 grams/mile
nonmethane hydrocarbons	0.25 grams/mile	0.31 grams/mile

3.9 Chatflow Wireless offers customers 600 weekday minutes for a flat rate of 39.99. Night (8 P.M. to 7 A.M.) and weekend minutes are free, but additional weekday minutes cost 0.40 each. There are taxes of 5.25Write a program that prompts the user to enter the number of weekday minutes, night minutes, and weekend minutes used, and calculates the monthly bill and average cost of a minute before taxes. The program should display with labels all the input data, the pretax bill and average minute cost, the taxes, and the total bill. Store all monetary values as whole cents (rounding the taxes and average minute cost), and divide by 100 for display of results.

3.10 Write a program to control a bread machine. Allow the user to input the type of bread as W for White and S for Sweet. Ask the user if the loaf size is double and if the baking is manual. The following table details the time chart for the machine for each bread type. Display a statement for each step. If the loaf size is double, increase the baking time by 50 percent. If baking is manual, stop after the loaf-shaping cycle and instruct the user to remove the dough for manual baking. Use functions to display instructions to the user and to compute the baking time.

Operation	White Bread	Sweet Bread
Primary kneading	15 mins	20 mins
Primary rising	60 mins	60 mins
Secondary kneading	18 mins	33 mins
Secondary rising	20 mins	30 mins
Loaf shaping	2 seconds	2 seconds
Final rising	75 mins	75 mins
Baking	45 mins	35 mins
Cooling	30 mins	30 mins

3.11 The table below shows the normal boiling points of several substances. Write a program that prompts the user for the observed boiling point of a substance in °C and identifies the substance if the observed boiling point is within 5% of the expected boiling point. If the data input is more than 5% higher or lower than any of the boiling points in the table, the program should output the message Substance Unknown.

Substance	Normal boiling point (°C)
Water	100
Mercury	357
Copper	1187
Silver	2193
Gold	2660

Your program should define and call a function within_x_percent that takes as parameters a reference value ref , a data value data , and a percentage value x and returns 1 meaning true if data is within x % of ref —that is, (ref − x% * ref) ≤ data ≤ (ref + x % * ref) . Otherwise within_x_percent would return zero, meaning false. For example, the call within_x_percent(357, 323, 10) would return true, since 10% of 357 is 35.7, and 323 falls between 321.3 and 392.7.

3.12 Let's say you are an accountant setting up a payroll system based on Table given below, which shows five different ranges for salaries up to $150,000.00. Each table line shows the base tax amount (column 2) and tax percentage (column 3) for a particular salary range (column 1). For the given person's salary, write a C program which calculates the tax due by adding the base tax to the product of the percentage times the excess salary over the minimum salary for that range.

Salary Range ($)	Base Tax ($)	Percentage of Excess
0.00–14,999.99	0.00	15
15,000.00–29,999.99	2,250.00	18
30,000.00–49,999.99	5,400.00	22
50,000.00–79,999.99	11,000.00	27
80,000.00–150,000.00	21,600.00	33