C H A P T E R   5

PROBLEM SPECIFICATIONS

The answers for the Problem Specifications section are located at the end of the section.

1. WM-Figure 5-1 shows a problem specification and algorithm involving a robot named Rob. Modify the algorithm to direct Rob to bring an umbrella if it's raining.

Rob is standing in front of a closed door in his living room. The door leads to the outside. Your task is to direct Rob to go outside and then close the door.

1. open the door
2. walk forward
3. close the door

WM-Figure 5-1   First problem specification and algorithm using Rob

2. WM-Figure 5-2 shows a problem specification and algorithm involving a robot named Rob. Modify the algorithm to direct Rob to buy two tickets if the tickets are on sale.

Rob wants to buy a ticket to a basketball game.

1. call the ticket broker
2. order the ticket
3. pay for the order
4. pick up the order

WM-Figure 5-2   Second problem specification and algorithm using Rob

3. WM-Figure 5-3 shows a solution for the Haperin Company. Modify the algorithm to calculate the 5% commission only when the sales are at least $25000.

Input	Processing	Output
sales	Processing items: none	commission
	Algorithm:	
	1. enter the sales	
	2. calculate the commission by multiplying the sales by .05	
	3. display the commission	

WM-Figure 5-3   Problem specification and solution for the Haperin Company

4. Modify the algorithm shown in WM-Figure 5-3 to calculate a 7% commission when the sales are over $75000; otherwise, calculate a 3% commission.

5. Analyze the problem specification shown in WM-Figure 5-4.

> Your friend, Jacob, wants a program that calculates and displays the balance in his checking account, given the beginning balance, the amount of money he deposited, and the amount of money he withdrew. The program also should display the "Overdrawn" message when the ending balance is less than 0.

WM-Figure 5-4   Problem specification for Jacob

6. Analyze the problem specification shown in WM-Figure 5-5.

> Professor Jerome wants a program that displays either the "Pass" message or the "Fail" message. The appropriate message depends on the average of three test scores entered by the professor. The "Pass" message should be displayed when the average is at least 70; otherwise, the "Fail" message should be displayed.

WM-Figure 5-5   Problem specification for Professor Jerome

7. Analyze the problem specification shown in WM-Figure 5-6.

> Yonger College wants a program that displays either the "Accepted" or "Not Accepted" message. The appropriate message depends on the student's SAT score, which is composed of three subscores for Critical Reading, Mathematics, and Writing. The user will enter the three subscores. The "Accepted" message should be displayed when the SAT score is at least 1500; otherwise, the "Not Accepted" message should be displayed.

WM-Figure 5-6   Problem specification for Yonger College

8. Analyze the problem specification shown in WM-Figure 5-7.

> South Carlton Bank wants a program that displays the bank's service fee for a checking account. The basic fee is $2 per month. The bank also charges $.02 per check for the first 6 checks written, and then $.10 for each additional check. The user will enter the number of checks written.

WM-Figure 5-7   Problem specification for South Carlton Bank

9. Analyze the problem specification shown in WM-Figure 5-8.

> Cartwright Grocery is located in a state that charges a 4% sales tax on all items except food. The store manager wants a program that allows a salesclerk to enter an item's price and its type (either food or non-food). The program should display the total amount the customer owes for the item.

WM-Figure 5-8   Problem specification for Cartwright Grocery

10. Analyze the problem specification shown in WM-Figure 5-9.

> Universal Surveys wants a program that displays the number of males and females responding to a survey. The user will enter the respondent's gender (M for Male or F for Female).

WM-Figure 5-9   Problem specification for Universal Surveys

ANSWERS FOR THE PROBLEM SPECIFICATIONS SECTION

1.   See WM-Figure 5-10.

```
1. open the door
2. if (it's raining)
       bring an umbrella
   end if
3. walk forward
4. close the door
```

WM-Figure 5-10   Modified algorithm for the first problem using Rob

2.   See WM-Figure 5-11.

```
1. call the ticket broker
2. if (the tickets are on sale)
       order two tickets
   else
       order one ticket
   end if
3. pay for the order
4. pick up the order
```

WM-Figure 5-11   Modified algorithm for the second problem using Rob

3.   See WM-Figure 5-12.

```
1. enter the sales
2. if (the sales are at least 25000)
       calculate the commission by multiplying the sales by .05
   else
       assign 0 as the commission
   end if
3. display the commission
```

WM-Figure 5-12   First modified algorithm for the Haperin Company

4.   See WM-Figure 5-13.

```
1. enter the sales
2. if (the sales are greater than 75000)
       calculate the commission by multiplying the sales by .07
   else
       calculate the commission by multiplying the sales by .03
   end if
3. display the commission
```

WM-Figure 5-13   Second modified algorithm for the Haperin Company

5.   See WM-Figure 5-14.

Input	Processing	Output
beginning balance amount deposited amount withdrawn	Processing items: none	ending balance "Overdrawn" message

	Algorithm:
	1. enter the beginning balance,
	   amount deposited, and amount withdrawn
	2. calculate the ending balance by adding
	   the amount deposited to the beginning
	   balance, and then subtracting the amount
	   withdrawn from the result
	3. display the ending balance
	4. if (the ending balance is less than 0)
	       display "Overdrawn"
	   end if	

WM-Figure 5-14 Solution for the Jacob problem

6.   See WM-Figure 5-15.

Input	Processing	Output
score 1 score 2 score 3	Processing items: average	message (either "Pass" or "Fail")

	Algorithm:
	1. enter score 1, score 2, and score 3
	2. calculate the average by adding
	   together score 1, score 2, and score 3,
	   and then dividing the sum by 3
	3. if (the average is at least 70)
	       display "Pass" message
	   else
	       display "Fail" message
	   end if	

WM-Figure 5-15 Solution for the Professor Jerome problem

7.   See WM-Figure 5-16.

Input	Processing	Output

reading score
math score
writing score
	Processing items:
	   SAT score
	
	Algorithm:
	1. enter reading score, math score,
	   and writing score
	2. calculate the SAT score by adding
	   together the reading score, math
	   score, and writing score
	3. if (the SAT score is greater than
	   or equal to 1500)
	     display "Accepted" message
	   else
	     display "Not Accepted" message
	   end if
		message (either "Accepted"
		  or "Not Accepted")

WM-Figure 5-16 Solution for the Yonger College problem

8.   See WM-Figure 5-17.

Input	Processing	Output

number of checks written	Processing items:
	   check charge
	
	Algorithm:
	1. enter the number of checks written
	2. if (the number of checks written is
	   less than or equal to 6)
	     calculate the check charge by
	     multiplying the number of checks
	     written by .02
	   else
	     calculate the check charge by
	     subtracting 6 from the number
	     of checks written, then
	     multiplying the result by .10,
	     and then adding .12 to the result
	   end if
	3. calculate the service fee by adding
	   2 to the check charge
	4. display the service fee
		service fee

WM-Figure 5-17 Solution for the South Carlton Bank problem

9.   See WM-Figure 5-18.

Input	Processing	Output

item price
item type
	Processing items: none
	
	Algorithm:
	1. enter the item price and item type
	2. if (item type is non-food)
	     calculate the total owed by
	     multiplying the item price by
	     .04 and then adding the result
	     to the total owed
	  end if
	3. display the total owed
		total owed

WM-Figure 5-18 Solution for the Cartwright Grocery problem

10.   See WM-Figure 5-19.

Input	Processing	Output

gender (M for male or F
or F for female)
	Processing items: none
	
	Algorithm:
	1. enter the gender
	2. if (the gender is M)
	    add 1 to the number of males
	  else
	    add 1 to the number of females
	  end if
	3. display the number of males
	  and number of females
		number of males
		 number of females

WM-Figure 5-19 Solution for the Universal Surveys problem

OPERATORS

The answers for the Operators section are located at the end of the section.

1. Complete the chart shown in WM-Figure 5-20 by recording the steps for evaluating each expression. Use the first example, as well as Figure 5-24 in the book, as a guide.

Original expression	Evaluation steps
`3 + 2 * 6` 2 * 6 is evaluated first 3 + 12 is evaluated last	3 + 12 15
`10 < 25 / 2`	
`7 – 2 * 3`	
`47 / 2 > 25 && 3 < 6`	
`4 * (3 – 1) <= 12 / 3`	
`8 * 2 + 5 * 3 – 1 > 20 || 7 * 2 < 12`	
`10 / 2 * 5 + 1 >= 26`	

   WM-Figure 5-20   Chart

2. Write an expression that subtracts the number 6 from the contents of a `double` variable named `sales`, and then multiplies the result by .05.

3. The `num` variable has the `int` data type. Write an expression that divides the variable's contents by 3 and then returns the result as a `double` number.

4. Complete the chart shown in WM-Figure 5-21.

Original expression (9 – 7) is performed first _____is performed second _____is performed third _____is performed fourth _____is performed last	6 * 3 * 3 + (9 – 7) * 5 6 * 3 * 3 + 2 * 5 _____ _____ _____

   WM-Figure 5-21   Evaluation of an expression

5. If the parentheses are removed from the original expression in WM-Figure 5-21, the expression evaluates to _____.

6. If additional parentheses are added around the 3 * 3 in the original expression in WM-Figure 5-21, the expression evaluates to_____.

7. Write an expression that adds together the contents of two `int` variables named the `num1` and `num2`, and then multiplies the result by 10.

8. The expression `8 – 5 <= 1 + 6 / 2` evaluates to_____.

9. Write an expression that subtracts the contents of the `expenses` variable from the contents of the `revenue` variable, and then divides the difference by 2. The variables have the `double` data type.

10. The expression `10 + 4 − 6 * 2 / 4 + (3 − 1) * 2` evaluates to_____.

ANSWERS TO OPERATORS SECTION

1.

Original expression	Evaluation steps
`3 + 2 * 6` 2 * 6 is evaluated first 3 + 12 is evaluated last	3 + 12 15
`10 < 25 / 2` 25 / 2 is evaluated first 10 < 12.5 is evaluated last	10 < 12.5 true
`7 − 2 * 3 <= 20` 2 * 3 is evaluated first 7 − 6 is evaluated second 1 <= 20 is evaluated last	7 − 6 <= 20 1 <= 2 true
`47 / 2 > 25 && 3 < 6` 47 / 2 is evaluated first 23.5 > 25 is evaluated second 3 < 6 is evaluated third false && true is evaluated last	23.5 > 25 && 3 < 6 false && 3 < 6 false && true false
`4 * (3 − 1) <= 12 / 3` (3 − 1) is evaluated first 4 * 2 is evaluated second 12 / 3 is evaluated third 8 <= 4 is evaluated last	4 * 2 <= 12 / 3 8 <= 12 / 3 8 <= 4 false
`8 * 2 + 5 * 3 − 1 > 20 || 7 * 2 < 12` 8 * 2 is evaluated first 5 * 3 is evaluated second 7 * 2 is evaluated third 16 + 15 is evaluated fourth 31 − 1 is evaluated fifth 30 > 20 is evaluated sixth 14 < 12 is evaluated seventh True || false is evaluated last	16 + 5 * 3 − 1 > 20 || 7 * 2 < 12 16 + 15 − 1 > 20 || 7 * 2 < 12 16 + 15 − 1 > 20 || 14 < 12 31 − 1 > 20 || 14 < 12 30 > 20 || 14 < 12 true || 14 < 12 true || false true
`10 / 2 * 5 + 1 >= 26` 10 / 2 is evaluated first 5 * 5 is evaluated second 25 + 1 is evaluated third 26 >= 26 is evaluated last	5 * 5 + 1 >= 26 25 + 1 >= 26 26 >= 26 true

WM-Figure 5-22 Completed chart from WM-Figure 5-20

2. `(sales − 6) * .05`
3. You can use any of the following:
```
num / 3.0
static_cast<double>num / 3.0
static_cast<double>num / 3
```

4.

Original expression	6 * 3 * 3 + (9 – 7) * 5
(9 – 7) is performed first	6 * 3 * 3 + 2 * 5
6 * 3 is performed second	18 * 3 + 2 * 5
18 * 3 is performed third	54 + 2 * 5
2 * 5 is performed fourth	54 + 10
54 + 10 is performed last	64

WM-Figure 5-23 Completed chart from WM-Figure 5-21

5. 28
6. 64
7. `(num1 + num2) * 10`
8. true
9. `(revenue – expenses) / 2`
10. 15