Problem Solving

Objectives

- Explain the problem-solving process used to create a computer program
- Analyze a problem
- Complete an IPO chart
- Plan an algorithm using pseudocode and flowcharts
- Desk-check an algorithm

Solving Everyday Problems

- First step in solving a problem: analyze it
  - E.g., problem of being hungry
- Next, you plan, review, implement, evaluate, and modify (if necessary) the solution
  - E.g., if you are still hungry

You Do It…

- You are hungry…
  - Develop a plan to solve the issue
  - Do not worry about money
  - Assume that you have any ingredients that you might need

Solving Everyday Problems (continued)

result of analysis step

Items used to accomplish the goal	Algorithm	Goal
lettuce tomato cucumber salad dressing	1. rinse the lettuce, tomato, and cucumber 2. cut up the lettuce, tomato, and cucumber 3. place the lettuce, tomato, and cucumber in a salad bowl 4. pour the salad dressing on the salad 5. eat the salad	stop the hunger pangs

result of planning step

Figure 2-1: Summary of the analysis and planning steps for the hunger problem

Solving Everyday Problems (continued)

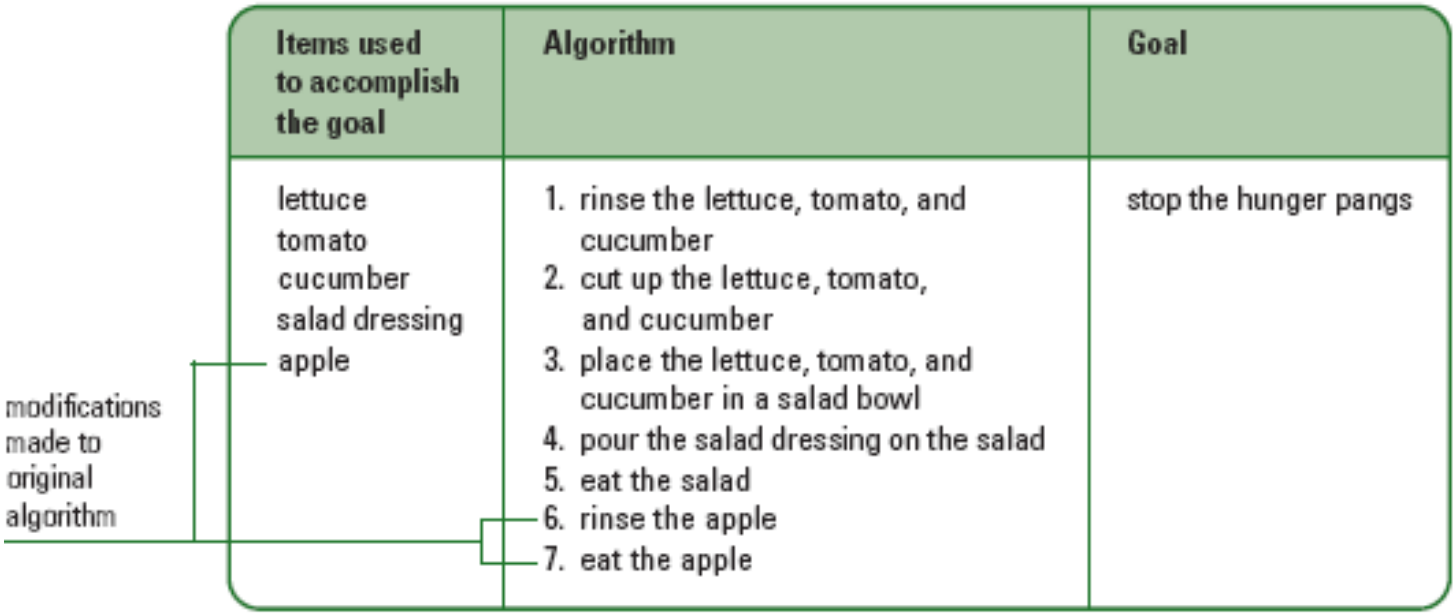

Figure 2-2: Modified algorithm for the hunger problem

Creating Computer Solutions to Problems

- Analysis tools: IPO charts, pseudocode, flowcharts
- To **desk-check** or **hand-trace**, use pencil, paper, and sample data to walk through algorithm
- A **coded** algorithm is called a **program**

Creating Computer Solutions to Problems (continued)

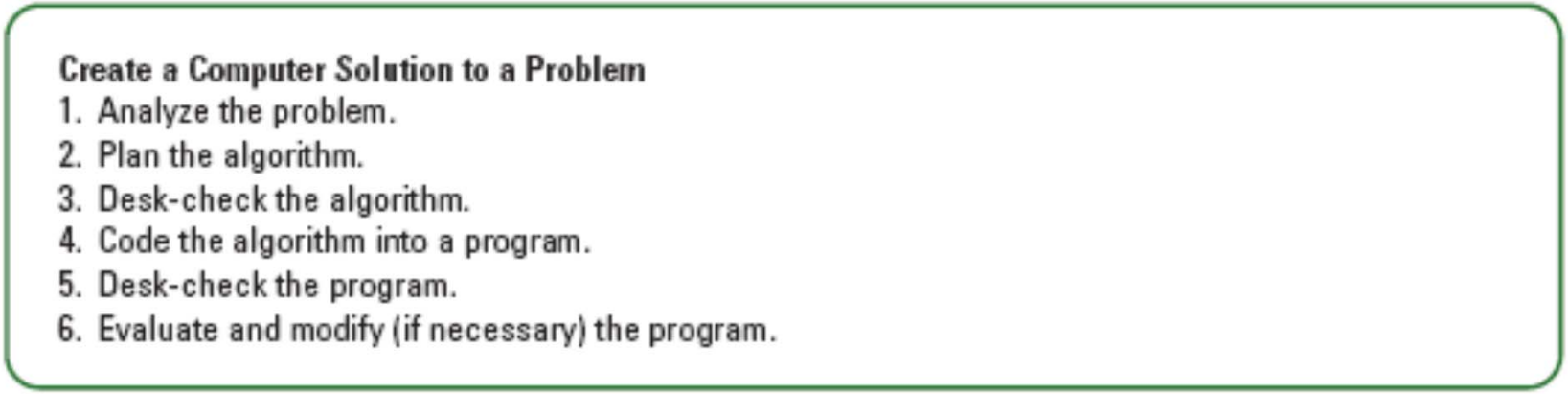

Figure 2-3: How to create a computer solution to a problem

Analyzing the Problem

- Analyze a problem to:
  - Determine the goal of solving it
    - **Output**
  - Determine the items needed to achieve that goal
    - **Input**
- Always search first for the output

Analyzing the Problem (continued)

Sarah Martin has been working for Quality Builders for four years. Last year, Sarah received a 4% raise, which brought her current weekly pay to $250. Sarah is scheduled to receive a 3% raise next week. She wants you to write a program that will display, on the computer screen, the amount of her new weekly pay.

Figure 2-4: Problem specification

IPO Charts

- Use an **IPO chart** to organize and summarize the results of a problem analysis
  - **IPO**: Input, Processing, and Output

IPO Charts (continued)

Input	Processing	Output
	Processing items: Algorithm:	new weekly pay

Figure 2-5: Partially completed IPO chart showing the output item

IPO Charts (continued)

Input	Processing	Output
current weekly pay raise rate	Processing items: Algorithm:	new weekly pay

Figure 2-6: Partially completed IPO chart showing the input and output items

Analyzing the Problem (continued)

- First, reduce the amount of information you need to consider in your analysis:

~~Sarah Martin has been working for Quality Builders for four years. Last year, Sarah received a 4% raise, which brought~~ her current weekly pay to $250. Sarah is scheduled to receive a 3% raise next week. ~~She wants you to~~ write a program that will display, on the computer screen, the amount of her new weekly pay.

Figure 2-7: Problem specification with unimportant information crossed out

Analyzing the Problem (continued)

- Worse than having too much information is not having enough information to solve problem:

Jack Osaki, one of the shipping clerks at Quality Builders, earns $7 per hour. Last week, Jack worked 40 hours. He wants you to write a program that will display his weekly net pay.

Figure 2-8: Problem specification that does not contain enough information

Analyzing the Problem (continued)

- Distinguish between information that is missing and information that is implied:

> Sharon Begay, who works for Quality Builders, needs a program that will display the area of any rectangle. The dimensions of the rectangle will be given in feet.

Figure 2-9: Problem specification in which the input is not explicitly stated

Planning the Algorithm

- Algorithm: set of instructions that will transform the problem's input into its output
  - Record it in the Processing column of the IPO chart
- **Processing item:** intermediate value used by algorithm when processing input into output
- **Pseudocode** is a tool programmers use to help them plan an algorithm
  - Short English statements

Planning the Algorithm (continued)

Input	Processing	Output
current weekly pay raise rate	Processing items: weekly raise Algorithm: 1. enter the current weekly pay and raise rate 2. calculate the weekly raise by multiplying the current weekly pay by the raise rate 3. calculate the new weekly pay by adding the weekly raise to the current weekly pay 4. display the new weekly pay	new weekly pay

Figure 2-10: Completed IPO chart

Planning the Algorithm (continued)

- A problem can have more than one solution:

Input	Processing	Output
current weekly pay raise rate	Processing items: none Algorithm: 1. enter the current weekly pay and raise rate 2. calculate the new weekly pay by multiplying the current weekly pay by the raise rate, and then adding the result to the current weekly pay 3. display the new weekly pay	new weekly pay

Figure 2-12: Another way to solve Sarah's problem

Hints for Writing Algorithms

Quality Builders is increasing by 3% the price of each item it sells. The owner of the company wants you to write a program that will display the amount of the increase and the new price.

Figure 2-13: Problem specification similar to one you worked with in this lesson

This problem specification is almost identical to the one shown earlier in Figure 2-4

Input	Processing	Output
current price increase rate	Processing items: none Algorithm: 1. enter the current price and increase rate 2. calculate the increase amount by multiplying the current price by the increase rate 3. calculate the new price by adding the increase amount to the current price 4. display the increase amount and new price	increase amount new price

Figure 2-14: IPO chart for the problem specification shown in Figure 2-13

Hints for Writing Algorithms (continued)

You may use a portion of a previous solution to solve current problem

At the end of every year, Quality Builders gives each of its employees a bonus. This year the bonus rate is 6% of the employee's current yearly salary. Mary Vasko wants you to write a program that will display her bonus.

Figure 2-15: Problem specification that contains a portion that is similar to one you worked with in this lesson

Input	Processing	Output
current yearly salary bonus rate	Processing items: none Algorithm: 1. enter the current yearly salary and bonus rate 2. calculate the bonus by multiplying the current yearly salary by the bonus rate 3. display the bonus	bonus

Figure 2-16: IPO chart for the problem specification shown in Figure 2-15

Desk-Checking the Algorithm

current weekly pay	raise rate	weekly raise	new weekly pay

Figure 2-18: Desk-check table showing columns for the input, processing, and output items from the IPO chart

current weekly pay	raise rate	weekly raise	new weekly pay
250	.03		

Figure 2-19: Desk-check table showing input values entered in the appropriate columns

current weekly pay	raise rate	weekly raise	new weekly pay
250	.03	7.50	

Figure 2-20: Weekly raise entry included in the desk-check table

Desk-Checking the Algorithm (continued)

current weekly pay	raise rate	weekly raise	new weekly pay
250	.03	7.50	257.50

Figure 2-21: New weekly pay entry included in the desk-check table

cross out the previous values

current weekly pay	raise rate	weekly raise	new weekly pay
~~250~~ 100	~~.03~~ .10	7.50	257.50

Figure 2-22: Desk-check table for the second set of input values

current weekly pay	raise rate	weekly raise	new weekly pay
~~250~~ 100	~~.03~~ .10	~~7.50~~ 10	~~257.50~~ 110

Figure 2-23: Desk-check table showing the results of the second desk-check

Desk-Checking the Algorithm (continued)

- **Valid data** is data that the programmer is expecting the user to enter
- **Invalid data** is data that he or she is not expecting the user to enter
- You should test an algorithm with invalid data
  - Users may make mistakes when entering data

The Gas Mileage Problem

When Jacob Steinberg began his trip from California to Vermont, he filled his car's tank with gas and reset its trip meter to zero. After traveling 324 miles, Jacob stopped at a gas station to refuel; the gas tank required 17 gallons. Create a program that Jacob can use to display his car's gas mileage—the number of miles his car can be driven per gallon of gas—at anytime during the trip.

Figure 2-24: Problem specification for the gas mileage problem

Input	Processing	Output
number of miles driven number of gallons used	Processing items: none Algorithm: 1. enter the number of miles driven and the number of gallons used 2. calculate the miles per gallon by dividing the number of miles driven by the number of gallons used 3. display the miles per gallon	miles per gallon

Figure 2-25: Completed IPO chart for the gas mileage problem

The Gas Mileage Problem (continued)

- After planning the algorithm, you desk-check it:

number of miles driven	number of gallons used	miles per gallon
~~324~~ 200	~~17~~ 12	~~19.06~~ 16.67

Figure 2-26: Completed desk-check table for the gas mileage problem

Summary

- Problem-solving typically involves analyzing the problem, and then planning, reviewing, implementing, evaluating, and modifying (if necessary) the solution
- Programmers use tools (IPO charts, pseudocode, flowcharts) to help them analyze problems and develop algorithms
  - During analysis, you determine the output and input
  - During planning, you write the steps that will transform the input into the output

Summary (continued)

- After the analysis and planning, you desk-check the algorithm
  - Follow each of the steps in algorithm by hand
- Coding refers to translating the algorithm into a language that the computer can understand
- Before writing an algorithm, consider whether you have already solved a similar problem

Application Lesson: Using the First Steps in the Problem-Solving Process

- Practice
  - Page 78
    - John Lee wants a program that allows him to enter the following three pieces of information: his checking account balance at the beginning of the month, the amount of money he deposited during the month, and the amount of money he withdrew during the month. He wasn't the program to display his balance at the end of the month.
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  - Type them in Word and turn in. You have 15 minutes