

Unit 1: Introduction to Problem Solving and Programming

Unit 1 is designed to introduce the student to problem solving skills and basic programming concepts required for the rest of the book. These concepts include the steps used in problem solving and numerical concepts such as constants and variables, data types, operators, hierarchy of operations, expressions, and equations. Chapter 3 introduces the problem solving tools used in the book, which include

1. The Problem Analysis Chart (PAC)
2. The Interactivity Chart (Structure Chart)
3. The IPO Chart
4. The Algorithms
5. The Flowcharts

When the students have completed these three chapters, they are ready to learn about the four logic structures presented in Unit 2.

Some Teaching Suggestions

Beginning problem solving students learn problems solving skills faster and with less frustration when working with one or two other people. The old adage “two heads are better than one” really is true for these students. Working in groups about once a week helps to cement the concepts presented in class. A problem presented to the class and solved in a group allows the students to go through the thinking process with the help of other students. Students working in study groups outside of class also helps. Students who work together are, for the most part, the most successful in learning problem solving skills.

The “jigsaw” method of group learning also works very well with beginning problem solving students. This can be fun for the students, along with a change in the regular methods of learning. This method allows a student “expert” to teach a concept to a peer group. The steps to complete this exercise are:

1. Divide the lesson to be learned into categories or concepts—one category for each “Expert Group”.
2. Divide the class into as many groups as the are expert categories.
3. Give each group a category. These groups become the Expert Groups. The students learn their category as thoroughly as possible.
4. Peer groups are then formed by taking one person from each of the Expert Groups to form a Peer Group.
5. Each person in the Peer Group teaches the rest of the group about their category.
6. Each person then takes a test over the categories, and the Peer Group which has the highest average score wins.

Students differ in the way they look at designing a solution to a problem. Some have to look at the whole problem and then break the solution into parts or modules. Other students need to look at the individual types of modules before putting them together for the total solution. It is important to present a solution in both ways. One way to do this is to present the whole solution, break the whole into modules, discuss the modules, and then put the modules back together again.

Chapter 1: General Problem Solving Concepts

Students need to realize that problem solving skills are used in everyday life as well as with a computer. Since the students are familiar with everyday problems, the course should start by identifying and developing solutions to these problems using the six problem solving steps. These everyday problems deal with people since they have a broad and expandable knowledge base. Problem Two at the end of the chapter presents some problems which the student can develop a solution and then check with another student. Though the use of Otto the Robot in Appendix A, the students can relate these same problem solving steps using a limited knowledge base. Associated with the instructor's Manual you will find a simulator for OTTO the Robot. The solutions to these problems can be developed and tested in groups. This should lead to the fact that all work on a computer deals with a limited knowledge base.

Lecture Outline

- I. Introduction to class
- II. Six steps in problems solving:
 - A. Identify the problem
 - B. Understand the problem
 - C. Identify alternative ways to solve the problem
 - D. Select the best way to solve the problem
 - E. List instructions that enable you to solve the problems using the selected solution
 - F. Evaluate the solution
- III. Types of problems:
 - A. Algorithmic
 - B. Heuristic
- IV. Problem solving with other humans vs problem solving with computers
 - A. Terminology
 1. solution
 2. results
 3. program
 - B. Why do we as humans have problems with problem solving?
 - C. Use one of the tasks in problem one to illustrate problem solving with another English speaking human. The students should write the set of instructions and then test the instructions in a group situation.
 - D. Use Appendix A with Otto the Robot to narrow the vocabulary and move into problem solving with computers. Associated with the Instructor's Manual you will find a simulator for OTTO the Robot. You may want to use it to demonstrate how Otto works and/or you may want to have the students test some of the instructions and try out their solutions to see if they work. You will need to install the program on your computer and/or the student's computers.

Solutions to Questions and Problems

Questions:

1. See page 3-4 in text.
2. An Algorithmic solution is a series of direct actions taken to solve a problem.
3. Each student will have different answers. Some typical answers are:
 - a. balancing a checkbook
 - b. putting a bicycle together
 - c. baking a cake
4. A HEURISTIC solution to a problem requires knowledge, experience, trial and error.
5. Each student will have different answers. Some typical answers are:
 - a. raising a child
 - b. making money on the stock market
 - c. creating a compromise
6. Each student will have different answers. Some typical answers are:
 - a. Financial planning
 - b. Address book
 - c. Writing reports
7. See section on Problem Solving Steps.

Problems:

1. Each student's answer will be different according to the problem they selected. Correct the problem according to what should be contained in each step.
2. Each student's answer may be a modification of these solutions. The main thing to look for is the correlation between the knowledge base and the instructions. There are certain assumptions the student may make, such as the language spoken. These are excellent problems for students to develop in a group.
 - a. Make a cup of cocoa:
Knowledge Base: cup, milk, cocoa mix, spoon, microwave, how to pour liquid into a cup
Instructions:
 - 1.) open cocoa mix
 - 2.) pour cocoa mix into a cup
 - 3.) fill cup with milk to 1 inch of top
 - 4.) stir with spoon until dissolved
 - 5.) heat in microwave for 2 minutes
 - b. Sharpen a pencil.
Knowledge base: pencil, pencil sharpener, sharp point, turn a handle
Instructions:
 - 1.) go to a pencil sharpener
 - 2.) put unsharpened end of the pencil in the hole in the side or top of pencil sharpener
 - 3.) turn handle
 - 4.) check to see if the pencil has a sharp point every 5 turns
 - 5.) remove pencil and use
 - c. Walk from the classroom to the student lounge, your dorm, or the cafeteria.
This problem will have a different solution, depending upon the campus where the student attends classes.