Homework 1

Problem Solving   Paul Cao

In this assignment, we will practice problem solving skills, which is the starting point of solving problems using computers. You will design algorithms to solve practical problems *on paper*. We will discuss the implementation of algorithms in C++ next week.

Warmup activity

1.Read the following paragraph about problem solving and C++ programming.

How does a computer solve a problem?
Here is how you can imagine this better. Suppose you are an architect who knows how to design a house and just got a job in Japan and wants to build a house there. You don't know the Japanese language, but you have access to a translator. So, you write, on a piece of paper, a set of instructions in English and will give that to the translator. The translator will bring you a copy of your instructions in Japanese the next day. This would happen if the translator would understand everything that you have said. If there is something that wouldn't make
sense to him/her (syntax error), the translator would halt his/her job and would let you know that there was something that must be fixed before he/she could give you a correct final translation. The possible errors could be caused by a set of syntactically incorrect instructions or could be due to missing syntax. If you have no error, then you would have a translation in your hand a bit later. When you look at the translated instructions set, you don't understand it, after all it is written in a different language. But don't be worried about this, there is someone who can read these instructions and complete the house for you. The next thing you need to do is to find a Japanese architect to build the house. The Japanese architect will bring all the resources together and will build the house for you. If all your measurements are correct and all the requests are valid, you will get a good house. Sometimes you may have made a request that is impossible to complete. An invalid request may not necessary be due to a wrong syntax. For example, you have asked the builder to build a dog house with height 0. Although that dimension is a valid dimension on the paper, it is not practical. So you may have asked the builder to build something that is not possible, in which case he/she will let you know at the time that is executing the instruction set (run-time error). A third type of error that may happen is due to a mistake that you have made when you designed your algorithm or when you were writing the set of instructions. For example, you may have written "keep the distance between each steps at 1 foot" but you meant to say "keep the distance between each steps at 1/2 foot". In that case, the builder will build have the steps placed based on what he/she sees on the instruction set. This kind of error is called logic error.

Match the characters and parts in the story with what we will see in this class.

1. You know how to design a house
2. The set of instructions you write
3. The Japanese translator
4. The translated version of your program
5. Resources
6. The house

a. You know how to write a C++ program - syntax
b. The C++ compiler
c. Linker, input data, ...
d. The output from your program
e. Your C++ program
f. The Executable file produced by the compiler

Homework

The most important part of a programmer's job is solving the problem first. It is much harder to solve a problem than to translate your ideas to a specific programming language. Thus, one should first think about a method and develop an algorithm to solve the problem. An algorithm is a sequence of <u>precise</u> instructions, which results in a solution. The keyword here is precision. If your algorithm has ambiguity in it, then you will not get the correct answer.

In the problem-solving phase, there are usually three steps.

> a. You will define the problem that you want to solve, clearly.
> b. You will design an algorithm that is precise and very well thought to solve the problem.
> c. You will test your algorithm on paper. Your algorithm should work correctly, before you can write a program for it. Usually, the testing process uses a set or sets of example values for the data described in the algorithm and see if the results are correct based on those "fake" values.

Q1

Suppose you are helping the school office with the registration process. You are to send students to six different rooms depending on the first letter of their last names and the age of the students. Here are the criteria you will use to separate them:

- Letters: A-E in Room 2, F-K in Room 3, L-O in Room 8, P-R in Room 10, and S-Z in Room 12.
- Students who are older than 21 years old will be sent to room 18.

Write (or draw a diagram) to show the steps that your algorithm will take to solve this problem.

Q2

Your niece brought home a math homework and needs your help. Your niece's math teacher gave her an integer and asked her to determine whether the integer is a multiple of 7 or not. Moreover, if the integer is a multiple of 7, your niece is required to determine whether the integer is even or odd. You thought about this and you decided that instead of answering the questions for that specific integer your niece brought home, you were going to design an algorithm that you can give to your niece to answer the same questions for any given integer.

Design the algorithm for this problem. Use the space below to draw a diagram or write in English the steps. Remember that your algorithm must be precise. Test your program and illustrate your testing procedures.