

ECONOMICAL DEVELOPMENT OF ALGORITHMS FOR CLARIFICATION

Erdonov Mukhammadamin Erdon o'g'li

Assistant, Samarkand Institute of Economics and service

Khakimov Damir Ulugbekovich

Samarkand economy and service

Student of the Institute

ANNOTATION

PROGRAMMING IS DIFFICULT (like many activities that are useful and worthwhile—and like most of those activities, it can also be rewarding and a lot of fun). When you write a program, you have to tell the computer every small detail of what to do. And you have to get everything exactly right, since the computer will blindly follow your program exactly as written. How, then, do people write any but the most simple programs? It's not a big mystery, actually. It's a matter of learning to think in the right way.

A program is an expression of an idea. A programmer starts with a general idea of a task for the computer to perform. Presumably, the programmer has some idea of how to perform the task by hand, at least in general outline. The problem is to flesh out that outline into a complete, unambiguous, step-by-step procedure for carrying out the task. Such a procedure is called an "algorithm." (Technically, an algorithm is an unambiguous, step-by-step procedure that always terminates after a finite number of steps. We don't want to count procedures that might go on forever.) An algorithm is not the same as a program. A program is written in some particular programming language. An algorithm is more like the idea behind the program, but it's the idea of the steps the program will take to perform its task, not just the idea of what the task needs to accomplish in the end. When describing an algorithm, the steps don't necessarily have to be specified in complete detail, as long as the steps are unambiguous and it's clear that carrying out the steps will accomplish the assigned task. An algorithm can be expressed in any language,

including English. Of course, an algorithm can only be expressed as an actual program if all the details have been filled in. So, where do algorithms come from? Usually, they have to be developed, often with a lot of thought and hard work. Skill at algorithm development is something that comes with practice, but there are techniques and guidelines that can help. I'll talk here about some techniques and guidelines that are relevant to "programming in the small," and I will return to the subject several times in later chapters.

When programming in the small, you have a few basics to work with: variables, assignment statements, and input/output routines. You might also have some subroutines, objects, or other building blocks that have already been written by you or someone else. (Input/output routines fall into this class.) You can build sequences of these basic instructions, and you can also combine them into more complex control structures such as while loops and if statements.

Suppose you have a task in mind that you want the computer to perform. One way to proceed is to write a description of the task, and take that description as an outline of the algorithm you want to develop. Then you can refine and elaborate that description, gradually adding steps and detail, until you have a complete algorithm that can be translated directly into programming language. This method is called stepwise refinement, and it is a type of top-down design. As you proceed through the stages of stepwise refinement, you can write out descriptions of your algorithm in code—informal instructions that imitate the structure of programming languages without the complete detail and perfect syntax of actual program code. As an example, let's see how one might develop the program from the previous section, which computes the value of an investment over five years. The task that you want the program to perform is: "Compute and display the value of an investment for each of the next five years, where the initial investment and interest rate are to be specified by the user." You might then write—or more likely just think—that this can be expanded as:

Get the user's input Compute the value of the investment after 1 year Display the value Compute the value after 2 years Display the value Compute the value after 3 years Display the value Compute the value after 4 years.

Display the value Compute the value after 5 years Display the value

Two final notes on this program: First, you might have noticed that the first term of the sequence—the value of N input by the user—is not printed or counted by this program. Is this an error? It's hard to say. Was the specification of the program careful enough to decide? This is the type of thing that might send you back to the boss/professor for clarification. The problem (if it is one!) can be fixed easily enough. Just replace the line "counter = 0" before the while loop with the two lines:

It would be nice if, having developed an algorithm for your program; you could relax, press a button, and get a perfectly working program. Unfortunately, the process of turning an algorithm into Java source code doesn't always go smoothly. And when you do get to the stage of a working program, it's often only working in the sense that it does something. Unfortunately not what you want it to do.

After program design comes coding: translating the design into a program written in Java or some other language. Usually, no matter how careful you are, a few syntax errors will creep in from somewhere, and the Java compiler will reject your program with some kind of error message. Unfortunately, while a compiler will always detect syntax errors, it's not very good about telling you exactly what's wrong. Sometimes, it's not even good about telling you where the real error is. A missing or extra brace can be one of the hardest errors to find in a large program. Always, always indent your program nicely. If you change the program, change the indentation to match. It's worth the trouble. Use a consistent naming scheme, so you don't have to struggle to remember whether you called that variable `interestrates` or `interestRate`. In general, when the compiler gives multiple error messages, don't try to fix the second error message from the compiler until you've fixed the first one. Once the compiler hits an error in your program, it can get

confused, and the rest of the error messages might just be guesses. Maybe the best advice is: Take the time to understand the error before you try to fix it. Programming is not an experimental science.

When your program compiles without error, you are still not done. You have to test the program to make sure it works correctly. Remember that the goal is not to get the right output for the two sample inputs that the professor gave in class. The goal is a program that will work correctly for all reasonable inputs. Ideally, when faced with an unreasonable input, it should respond by gently chiding the user rather than by crashing. Test your program on a wide variety of inputs. Try to find a set of inputs that will test the full range of functionality that you've coded into your program. As you begin writing larger programs, write them in stages and test each stage along the way. You might even have to write some extra code to do the testing—for example to call a subroutine that you've just written. You don't want to be faced, if you can avoid it, with 500 newly written lines of code that have an error in there somewhere.

The point of testing is to find bugs—semantic errors that show up as incorrect behavior rather than as compilation errors. And the sad fact is that you will probably find them. Again, you can minimize bugs by careful design and careful coding, but no one has found a way to avoid them altogether. Once you've detected a bug, it's time for debugging. You have to track down the cause of the bug in the program's source code and eliminate it. Debugging is a skill that, like other aspects of programming, requires practice to master. So don't be afraid of bugs. Learn from them. One essential debugging skill is the ability to read source code—the ability to put aside preconceptions about what you think it does and to follow it the way the computer does—mechanically, step-by-step—to see what it really does. This is hard. I can still remember the time I spent hours looking for a bug only to find that a line of code that I had looked at ten times had a "1" where it should have had an "i", or the time when I wrote a subroutine named Window Closing which would have done exactly what I wanted except that the computer

was looking for window Closing (with a lower case "w"). Sometimes it can help to have someone who doesn't share your preconceptions look at your code.

Often, it's a problem just to find the part of the program that contains the error. Most programming environments come with a debugger, which is a program that can help you find bugs. Typically, your program can be run under the control of the debugger. The debugger allows you to set "breakpoints" in your program. A breakpoint is a point in the program where the debugger will pause the program so you can look at the values of the program's variables. The idea is to track down exactly when things start to go wrong during the program's execution. The debugger will also let you execute your program one line at a time, so that you can watch what happens in detail once you know the general area in the program where the bug is lurking.

And finally, remember the golden rule of debugging: If you are absolutely sure that everything in your program is right, and if it still doesn't work, then one of the things that you are absolutely sure of is wrong.