



FACULTY OF ENGINEERING AND TECHNOLOGY

COMPUTER SCIENCE DEPARTMENT

COMP1310

Introduction to Computer and Computing Ethics

ALGORITHMS

How to think about solving a problem

Terminology

- Algorithm: the steps we take to solve a problem.
- Pseudocode: a structured form of language – usually English – that allows us to describe an algorithm without focusing on the language syntax (grammar).
- Flow charts are another way of describing algorithms, but we don't cover it in this course.

Characteristics of a Good Algorithm

- **Unambiguous:** an algorithm must have specific, exact, outlined steps.
- **Well-Ordered:** The exact order of operations performed in an algorithm should be concretely defined.
- **Feasible:** All steps of an algorithm should be possible.
- **Well-Defined:** an algorithm should be able to accept a well-defined set of inputs and produce result as an output.
- **Finite:** an algorithm should terminate after a finite number of instructions.

Common Pseudocode Syntax and Keywords

- **BEGIN, END**
 - Begin is the first statement and end is the last statement of any pseudocode.
- **INPUT, GET, READ**
 - Used to input data from the user.
- **COMPUTE, CALCULATE**
 - Used for calculation of the result of the given expression.
- **SET, INITIALIZE**
 - *Used for giving a variable some value.*
- **ADD, INCREMENT, SUBTRACT, DECREMENT**
 - Used for addition, subtraction.
- **OUTPUT, PRINT, DISPLAY**
 - Used to display the output of the program.
- **IF, ELSE, ENDIF**
 - Used to make decision.
- **WHILE, ENDWHILE, FOR, ENDFOR**
 - Used for iterative statements.
- **//**
 - This keyword used to represent a comment.

Algorithms in our Daily Life

- Imagine your friend calls you and asks you to explain how to fry an egg. How would you describe the process to them in detail? Imagine your friend is a dumb robot.
 - *Get the pan out of the cupboard.*
 - *Turn on the stove on medium high heat.*
 - *Put the pan on the stove.*
 - *Take out the egg and the butter from the fridge.*
 - *Put one teaspoon of butter in the pan.*
 - *Crack the egg in the pan.*
 - *Add a pinch of salt and a pinch of pepper to the egg.*
 - *Wait five minutes until the egg is cooked.*
 - *Turn off the stove.*
 - *Take a plate out of the cupboard.*
 - *Remove egg from the pan.*
 - *Put the egg on the plate.*

Algorithms in our Daily Life – cont.

- If you look at things you do everyday, you can find algorithms hidden everywhere.
 - *Sorting your bag before you come to class.*
 - *Figuring out the way to get from your house to campus.*
 - *Planning out your day on campus.*
 - *Planning out how to solve an assignment.*

Example 1

- Write an algorithm to add two numbers.

BEGIN

 READ first number from the user

 READ second number from the user.

 ADD the first number and the second number

 DISPLAY the result to the user.

END

Example 1 – cont.

- This previous example is of a sequential algorithm.
- A sequential algorithm is an algorithm that is executed sequentially – once through, from start to finish.
- A sequential algorithm is an algorithm that consists mainly of:
 - *Input operations.*
 - *Output operations.*
 - *Mathematical operations.*

Example 2

- Write an algorithm to find the largest of three numbers

BEGIN

 READ three numbers from the user and save them as n1, n2, and n3

 IF n1 is larger than n2 and n1 is larger than n3

 DISPLAY n1 is the largest number

 ELSE if n2 is larger than n1 and n2 is larger than n3

 DISPLAY n2 is the largest number

 ELSE

 DISPLAY n3 is the largest number

 ENDIF

END

Example 2 – cont.

- The previous example is of a conditional algorithm.
- A conditional algorithm is an algorithm where a decision must be made based on a specific logical operation.

Example 3a – WHILE

- Write an algorithm to calculate the average of 10 numbers

BEGIN

 SET sum equal to 0

 SET counter equal to 0

 WHILE counter is less than 10

 READ number from the user

 ADD number to sum

 INCREMENT counter by 1

 ENDWHILE

 SET average equal to sum divided by 10

 DISPLAY average to the user

END

Example 3b – FOR

- Write an algorithm to calculate the average of 10 numbers

BEGIN

 SET sum equal to 0

 FOR i = 1 to 10

 READ number from the user

 ADD number to sum

 INCREMENT counter by 1

 ENDWHILE

 SET average equal to sum divided by 10

 DISPLAY average to the user

END

Example 3 – cont.

- The previous example is of an iterative algorithm.
- An iterative algorithm is an algorithm where a repeating action will be performed until a continuation condition becomes false.
- Iterative algorithms can be written as
 - *while/endwhile*: an iteration that has a condition at the beginning
 - *for/endfor*: an iteration for a specific number of times, often called a "counting" loop

Exercises

- The solution to all the following exercises will be provided later today on the lecture's ITC page.
- Keep in mind that there maybe multiple ways to do one thing, and therefore there might be several different algorithms that solve the same problem.
- Several algorithms may be correct, but they may differ in complexity and speed. These topics will be studied in full detail in future courses. For this course, we are satisfied with a correct algorithm, not necessarily an optimal algorithm.

Area of a Square

- Write an algorithm that will accept the values of the sides of a square and display its area where the formula is: $\text{area} = \text{side} * \text{side}$

Sum of Numbers with Stopping Condition – Example 1

- Write an algorithm to calculate the sum of a set of values (we don't know their count). When 0 is entered this means that the algorithm should stop receiving data and print the sum.

Sum of Numbers with Stopping Condition – Example 2

- Write an algorithm to calculate the sum of a set of values (we don't know their count). When the sum exceeds 25 this means that the algorithm should stop receiving data and print the number of values that were entered.

Perfect Number

- Write an algorithm to decide and print whether a given number is perfect or not. A perfect number is that which equals the sum of all its divisors excluding itself (e.g., 6 is a perfect number since its divisors are 1, 2, 3, and their sum equals 6).

First Three Perfect Numbers

- Modify the previous algorithm such that it will print the first three positive perfect numbers