Algorithms & Data Structures I Week 1 Lecture Note

Notebook:	Algorithms & Data Structures I
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Cornell Notes	**Topic:** Problems, algorithms, and flowcharts Part 1	Course: BSc Computer Science Class: CM1035 Algorithms & Data Structures I [Lecture] Date: October 15, 2020

Essential Question:

What are problems and algorithms in Computer Science?

Questions/Cues:

- What is a problem?
- What is an algorithm?
- What is a computer program?
- What is Heron's Method?

Notes

- Problem = In computing, the problems to be explored must addressable by a computer. The language used to frame the problem to the computer must be mathematical, with each idea translated into a mathematical concept like a number or a truth value. In addition to this, a problem must have well-defined mathematical input and output. A problem in a sense then poses a question about the input, so as to give an answer in the form of the output. In summary, a problem consists of an input and a question that tells us the form of the expected answer or output.
- Algorithm = is a general and simple set of step-by-step instructions, which if followed, solve a problem.
    1. The outputs of an algorithm is the correct solution to a problem
    2. The algorithm can be described in terms of steps of basic instructions like terms of basic arithmetic (addition, subtraction, multiplication and division) or simple logical operations like if-then statements that can be easily checked using basic arithmetic
        - In summary, an algorithm is a step-by-step method for generating the correct output
- Computer Program = is a set of instructions telling a computer what to do. So it resembles an algorithm, programs can implement algorithms when we translate our algorithm into a programming language that a computer can interpret and understand.
    - In summary, an algorithm is a mathematical concept that can be instantiated as a computer program. So it's a more general concept, it's independent of whatever programming language or machine code that we choose to use

If $x^2 = 2$, give x in decimal

$$\sqrt{2}$$

irrational

$$|\sqrt{2} - \frac{x}{y}| \leq \eta$$

approximation

If $x^2 = 2$, give x to 1 d.p.

Useful information: $1 < x < 2$

Take mean to get candidate: $x_g = 1.5 \rightarrow x_g^2 = \frac{9}{4} > 2$

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Take mean to get candidate: $x_g = 1.5 \rightarrow x_g^2 = \frac{9}{4} > 2$

Thus $\frac{2}{x} = x < x_g \longrightarrow \frac{2}{x_g} < x$

$$\longrightarrow 1.\dot{3} = \frac{4}{3} < x < \frac{3}{2} = 1.5$$

Take mean to get new candidate: $x_g' = \frac{17}{12} = 1.41\dot{6}$

Correct to 1 d.p.

Take mean to get new candidate: $x_g' = \frac{17}{12} = 1.41\dot{6}$

Correct to 1 d.p.

If we wanted more accuracy... $(x_g')^2 = \left(\frac{17}{12}\right)^2 > 2$

Thus $\frac{2}{x} = x < x_g' \longrightarrow \frac{2}{x_g'} < x$

$$\longrightarrow 1.41176... = \frac{24}{17} < x < \frac{17}{12} = 1.41\dot{6}$$

Take mean to get new candidate and so on...

Can you describe this process for the square root of any integer?
How do we know when to stop for a particular precision?

Summary

In this week, we learned about what is a problem is in computing terms, what an algorithm is, what a computer program is and finally we looked at Heron's Method as an algorithm.