UBC OKANAGAN

COSC 122

Computer Fluency

Algorithmic Thinking

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Key Points

1) There are five essential properties for algorithms.

2) The five basic steps of development are a general approach for solving problems using a computer.

Algorithm

An ***algorithm*** is a precise, systematic method for producing a specified result.

We use algorithms all the time to complete tasks.

A common example is following assembly directions (as with IKEA assembly) or using a **recipe**. Simpler examples include how to perform arithmetic or look up a person's name in a list.

Some algorithms are so simple or ingrained that we do not consciously remember the steps. However, precision is required when communicating the algorithm to others.

Five Essential Properties of Algorithms

1) ***Inputs specified*** – must specify the **type, amount,** and **form** of **data** to be used during the algorithm

2) ***Outputs specified*** – must describe the result of the algorithm (it is possible to have no output).

3) ***Precision*** – specify precisely the **sequence of steps** to be performed including how to handle errors.

4) ***Reasonable Operations*** - The operations are doable.

5) ***Finite*** – The algorithm must eventually stop (terminate).

Five Essential Properties of Algorithms

Question: The algorithm on the shampoo bottle says: "Apply shampoo. Lather. Rinse. **Repeat**." Which one of the five essential properties does this algorithm not meet?

A) inputs specified

B) outputs specified

C) precision

D) reasonable operations

E) finiteness

Group Discussions

Provide an algorithm for brushing your teeth.

Specifying Algorithms using Language

An algorithm must be written using a **language understood** by both the ***writer*** of the algorithm and the ***reader*** who will use it.

For computer algorithms, the writer is a human programmer, and the reader is the computer. Natural languages like English are easy for humans, but are ambiguous and often require domain knowledge and context. Instead, we **use precise programming languages** (e.g. HTML/JavaScript).

A common barrier for students with programming is that the language is unfamiliar and that the computer requires precision. Remember, **have patience!**

- Learning a computer language is similar to learning a foreign language like Spanish.

★*The 5 Basic Steps of Software Development*

1) Specification
   - Determine the scope of your problem and **what** you want your program to do.
2) Design
   - Determine the structures and algorithms necessary (**how**) to solve your problem at a high-level of abstraction.
3) Implementation
   - Start implementing your algorithms/structures on the computer.
4) Testing, Execution, and Debugging
   - Test your program on various data sets and fix any problems.
5) Maintenance
   - Over time, modify your program as necessary to handle new data or more complicated problems.

Software Development Steps

Question: Which of the 5 steps is most often the cause of projects being unsuccessful?

A) Specification

B) Design

C) Implementation

D) Testing

E) Maintenance

Programming - Art or Science?

There is a debate whether programming is an art or a science.

- It is similar to a **science** because **algorithms** and data structures can **be analyzed for performance** and chosen with respect to their relevance to a particular problem.
- It is like an **art** or craft because **skills of programmers vary** widely, even with similar training, and the **"best" solution to the problem is often open to debate**.

In computer science, we teach you the "science" component.

- We want you to understand the **choices you make** and the reasons for them.
- However, students will all have different **natural abilities and talents** with respect to programming.
  - ⇨ If it is easy or natural for you, great! If not, then fall back on the science and the techniques we teach to help you. And PRACTICE as much as you can.

Programming: Art or Science?

Question: What do YOU think programming is most like?

A) Art (creativity)

B) Science (experimentation)

C) Engineering (construction)

D) All of the above

E) Other or none of the above

Programming: Experience

Question: What is your programming experience?

A) I have never programmed before.

B) I have wrote instructions, recipes, manuals, or other precise information before (maybe not electronic).

C) I have wrote HTML or created web sites before this class.

D) I have experimented on my own with programming.

E) I have taken a programming class in high school or university.

Conclusion

An ***algorithm*** is a precise sequence of steps to produce a result that is encoded in a language to produce a ***program***.

The five essential properties of an algorithm are:

- Inputs specified
- Output specified
- Precision
- Reasonable operations
- Finite

Following the five basic steps for developing solutions to problems on a computer will make you more successful and efficient while programming.

Objectives

- Define: algorithm, program
- List and explain the five essential properties of an algorithm.
- Explain why special programming languages are used to communicate algorithms to the computer instead of English.
- List and explain the five basic steps of software development.