NUS National University of Singapore

School of Computing

# Algorithm Design
## (What is an Algorithm)
## Video 6.3a


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*Algorithm is Cool. Learn Algorithms.*

# Computational Thinking (1)

Computational Thinking (CT) is the *thinking processes* involved in formulating a problem and expressing its solution(s) in such a way that a human or other information-processing agent can effectively carry out.

CT supports problem solving across *all* disciplines, including the humanities, sciences and engineering.

https://en.wikipedia.org/wiki/Computational_thinking



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# Computational Thinking (2)

CT is an iterative process based on three stages:
(1) Problem Formulation (abstraction),
(2) Solution Expression (automation), and
(3) Solution Execution & Evaluation (analyses).

https://en.wikipedia.org/wiki/Computational_thinking

# Computational Thinking (3)

**Some key elements in CT:**

- **Decomposition:** breaking down complex problem, data, or system into smaller, more manageable parts
- **Pattern Recognition:** observing patterns, trends, and regularities among and within problems
- **Abstraction:** focusing on the important information only, ignoring irrelevant detail
- **Algorithm design:** developing the step-by-step instructions for solving this and similar problems

http://www.bbc.co.uk/education/guides/zp92mp3/revision

# CT: Thinking Processes

Problem Formulation

Abstraction

Thinking Abstractly, Algorithmically, Recursively…

Algorithm Design

Decomposition Composition

Finding a Pattern

…

Developing ITeMS

# CT: Learning Attitudes

**CT enhances**
**5 Learning Attitudes (Mindsets)**

**Tinkering**
(experimenting & playing)

**Debugging**
(finding & fixing errors)

**Collaboration**
(working together)

**Creating**
(designing & making)

**Persevering**
(keeping going)

# Outline

## Overview:

- Definition of Algorithm
- Algorithms in Everyday Life
- Some Old Algorithms
- Some Simple Algorithms
- Abstraction & Decomposition

# CT (Algorithm) is *everywhere*

| | | |
|---|---|---|
| Google Search is algorithm | Algorithms In Engineering | Data Analytics Is algorithms |
| Path Finding is algorithms | Algorithms In OR, Logistics | Social Network Analysis Is algorithms |
| Algorithms Trading | Camera Photo-Stitching Anti-Jitter | Self-Driving Car Is algorithms |

**CT (Algorithm) is Anywhere and Everywhere**

# Definition of Algorithm (1)

**Algorithm (my adopted definition):**

a *sequence* of *unambiguous* and *executable* step-by-step *instructions* for *accomplishing a given task* in a *finite number of steps*.

# Definition of Algorithm (2)

**Important Keywords in the definition:**

- ***Sequence*** of ***step-by-step instructions***
- Instructions are ***unambiguous***
  (meaning is clear, no ambiguity)
- Instructions are ***executable***
  (can be performed)
- Finish in a ***finite number of steps***
  (must terminate, cannot go on forever)
- ***Accomplishes the given task***
  (solves the intended problem)

# (End of video 6.3a)

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