Computational Thinking Concepts Guide

1. Overview
2. Concepts, Definitions, and Teaching Tips

Overview
In this guide you will find eleven terms and definitions for Computational Thinking (CT) concepts. These concepts can be incorporated into existing lesson plans, projects, and demonstrations in order to infuse CT into any disciplinary subject.

Concepts, Definitions, and Teaching Tips

**Abstraction** is identifying and extracting relevant information to define main idea(s)

**Teaching Tips:**
- Show how a daily planner uses abstraction to represent a week in terms of days and hours, helping us to organize our time
- Find the main idea (thesis) of a short story or article to help students understand the important information

**Algorithm Design** is creating an ordered series of instructions for solving similar problems or for doing a task

**Teaching Tips:**
- Give the example of how in mathematics, when we add and subtract fractions with different denominators, we follow an algorithm
- Give the example of when a chef writes a recipe for a dish, she is creating an algorithm that others can follow to replicate the dish

**Automation** is having computers or machines do repetitive tasks

**Teaching Tips:**
- Show how automation can be used to perform tasks that would take a very long time to complete using a manual process, such as identifying the migration patterns of a specific demographic based on census data

**Data Collection** is gathering information

**Teaching Tips:**
- Have students engage in the process of collecting data by having them gather the birthday and gender of their peers and record it in a spreadsheet

**Data Analysis** is making sense of data by finding patterns or developing insights

**Teaching Tips:**
- Ask students to formulate their own questions that can be addressed with data collection; work through data together to answer them
- Using data sets with anonymized personal data, such as height, shoe size, favorite color, etc., show how data analysis can be used to highlight information that is meaningful and relevant to your students

**Data Representation** is depicting and organizing data in appropriate graphs, charts, words, or images

**Teaching Tips:**
- Plot data manually on the whiteboard or via projector so that your students can see the process of how the organization unfolds
- Ask your students which visual representation is best for a given data set and work through some less relevant visualizations first. Discuss as a class why the data should be represented in one way or another.
**Decomposition** is breaking down data, processes, or problems into smaller, manageable parts

**Teaching Tips:**

- In mathematics, we can decompose a number such as 256.37 as follows: $2 \times 10^2 + 5 \times 10^1 + 6 \times 10^0 + 3 \times 10^{-1} + 7 \times 10^{-2}$
- In science we decompose a projectile’s velocity into its components along the x- and y-axis

**Parallelization** is simultaneous processing of smaller tasks from a larger task to more efficiently reach a common goal

**Teaching Tips:**

- An example of parallelization in computing is when a single task (such as the analysis of a DNA sequence) is broken into smaller tasks and simultaneously analyzed by different computers so that the analysis can be processed more efficiently
- Define the common goal at the outset, and then have your students work in groups. Assign different tasks to each group to work toward the common goal.

**Pattern Generalization** is creating models, rules, principles, or theories of observed patterns to test predicted outcomes

**Teaching Tips:**

- In mathematics, we write generalized formulas in terms of variables instead of numbers so that we can use them to solve problems involving different values
  - The slope of any straight line can be described as a function of $y = mx + b$
- In science, we use theories to describe the generalized mechanism by which natural phenomena occur

**Pattern Recognition** is observing patterns, trends, and regularities in data

**Teaching Tips:**

- Have your students identify trends in stock price cycles that may suggest when they should be bought and sold

**Simulation** is developing a model to imitate real-world processes

**Teaching Tips:**

- Have your students illustrate the movement of a solar system by modeling the gravitationally curved path of an object around a point in space

More reference docs, lesson plans, and demonstrations can be found on Google’s Exploring Computational Thinking website ([g.co/exploringCT](http://g.co/exploringCT))

Except as otherwise noted, the content of this reference doc is licensed under the [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/), and code samples are licensed under the [Apache 2.0 License](https://www.apache.org/licenses/LICENSE-2.0).