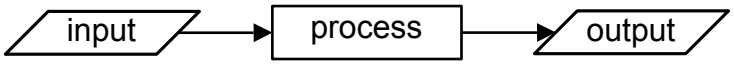
Topic 16 Machines and Computational Models – Summary

Vocabulary

embedded (adj): fixed firmly into another object
format (n): the way in which something is arranged or set out
input (v): to enter data into a computer
output (v): to display or output data that has been processed
process (v): to change the meaning or format of some data
function machine (n): a metaphor or diagram that represents a machine that takes an input, applies a rule (such as a set of operations) and delivers the answer as an output
sequential (adj): one after the other (not in *parallel*)
parallel (adj): processes distributed between two or more processors
coordination (n): organizing different activities so that they all work together effectively
negotiation (n): a discussion in order to reach an agreement
autonomous (adj): acting without help or guidance; self-directed
agent (n): a *goal-oriented* computer system that can *perceive* its environment (through *sensors*) and act *autonomously* upon that environment (via *effectors*)
sensor (n): a device that is able to obtain information from the environment
effector (n): a device that can manipulate the environment
computational model (n): defines the components of a system and the rules of behavior, and is designed to be simulated on a computer to predict behavior
complexity (n): the level of difficulty of something

Concepts

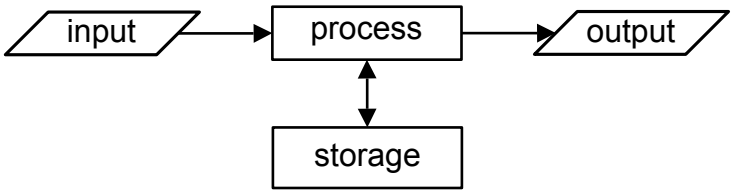
Computer



A computer is a machine that takes some kind of ***input*** from its surroundings, ***processes*** the input according to given rules, and provides some kind of ***output***.

Unlike a ***functional machine***, a ***computer*** is a concrete, physical device built with hardware.

All but the most simple algorithm will require the computer to have external storage:



A ***computer*** is usually considered a general-purpose device. An ***embedded system*** is a computer put into a device and configured for a specific purpose.

Computational Model

A ***computational model*** is a high-level view of the components of a system and the rules governing their behavior and relationships over time. A *computational model* is designed to be simulated on a computer to predict behaviour.

- ***equation-based models***: use numerical methods to solve equations that describe the system's dynamics. Examples: weather prediction; physics engine
- ***agent-based models***: define autonomous, decision-making entities (agents) that are allowed to interact within an environment. The global behavior of the system *emerges* as the model is run. Examples: simulation of the prisoner's dilemma

An ***agent*** is a computational entity that is *goal-oriented*, acts *autonomously*, and is able to perceive its environment through ***sensors*** and act upon that environment through ***effectors***.

A *rational agent* is one that acts so as to achieve the best outcome given the evidence provided by the input and its own knowledge.

Examples of agents:

- A software daemon, such as a print queue. A print queue receives print jobs from other devices and sends them to the printer when the printer is able to receive them.
- A self-driving car.
- A human being (homo sapiens).
- In economics, *homo economicus* is a theoretical rational economic agent. This "species" of agent may be used to simulate the macroscopic behavior of an economy.

An ***algorithm*** is a step-by-step procedure for solving a problem or accomplishing a task. Some may argue that an algorithm is a type of simple computational model, while others may argue an algorithm can be at most a component of a computational model.

Although the Pearson textbook suggest that ***sequential*** and ***parallel*** computing may be considered *computational models*, they are more accurately *execution models*. For the exam, be aware that Pearson may refer to these as *computational models*.