Agent architectures and hierarchical control

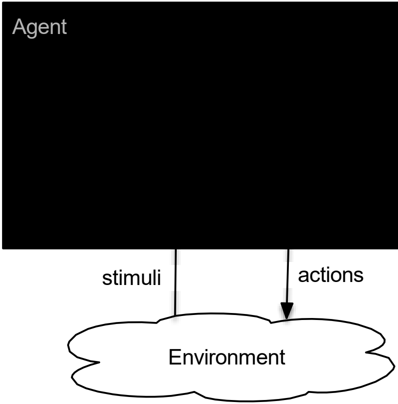
Overview:

- Agents and Robots
- Agent systems and architectures
- Agent controllers
- Hierarchical controllers

Example: smart house

- A smart house will monitor your use of essentials, and buy them before you run out.
  Example: snack buying agent that ensures you have a supply of chips:
  - abilities: buy chips (and have them delivered)
  - goals:
  - stimuli:
  - prior knowledge:

Agent Systems

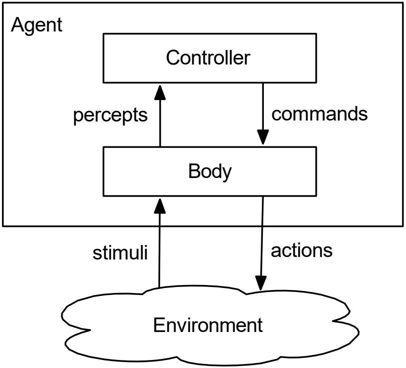


A agent system is made up of a agent and an environment.

- An agent receives stimuli from the environment
- An agent carries out actions in the environment.

Agent System Architecture

An agent is made up of a body and a controller.



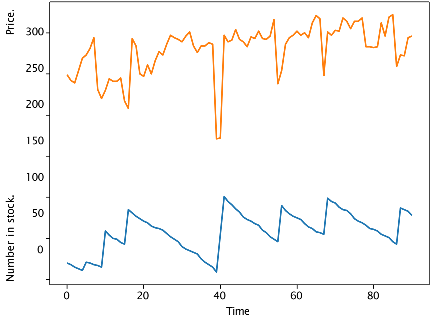
- An agent interacts with the environment through its body.
- The body is made up of:
  - sensors that interpret stimuli
  - actuators that carry out actions
- The controller receives percepts from the body.
- The controller sends commands to the body.
- The body can also have reactions that are not controlled.

Implementing a controller

- A controller is the brains of the agent.
- Agents are situated in time, they receive sensory data in time, and do actions in time.
- Controllers have (limited) memory and (limited) computational capabilities.
- The controller specifies the command at every time.
- The command at any time can depend on the current and previous percepts.

The Agent Functions

- A percept trace is a sequence of all past, present, and future percepts received by the controller.



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- An agent's history at time t is sequence of past and present percepts and past commands.
- A causal transduction specifies a function from an agent's history at time t into its action at time t.

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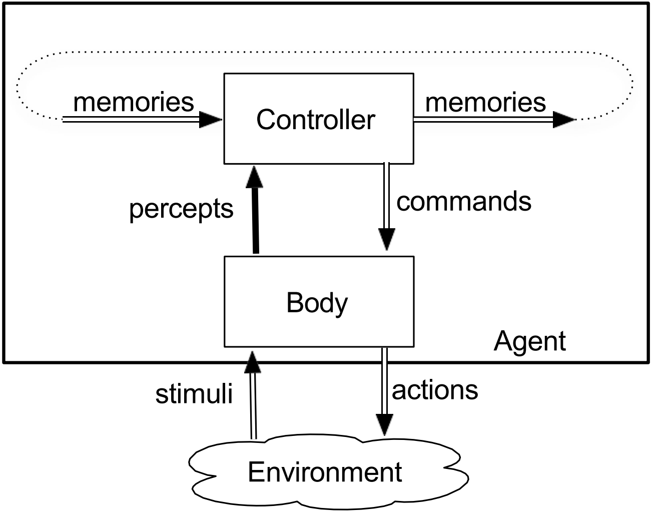
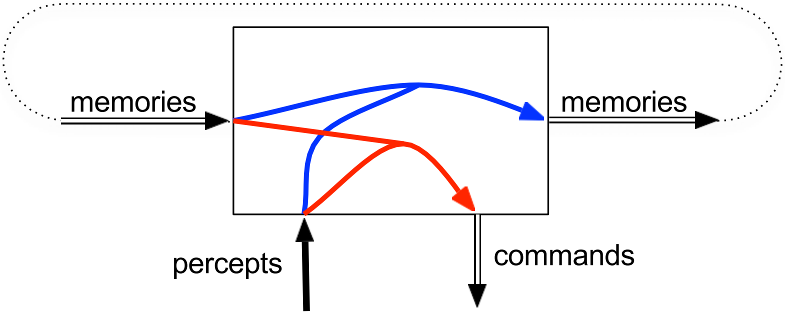
- At every time a controller has to decide on:
  - What should it do?
  - What should it remember?
    (How should it update its memory?)

— as a function of its percepts and its memory.

Controller


memories
Controller
memories
percepts
commands
Body
Agent
stimuli
actions
Environment

Functions implemented in a controller



For discrete time, a controller implements:

- belief state function *remember*(*belief_state*, *percept*), returns the next belief state.
- command function *command*(*memory*, *percept*) returns the command for the agent.

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  - goals: mimimize price, don't run out of chips
  - stimuli: price, number in stock
  - prior knowledge: ??
- Percept trace:
- Control trace:
- Transduction:
- Belief state:
- Belief state transition function:
- Control Function:

Implemented Example

- Percepts: price, number in stock
- Action: number to buy
- Belief state: (approximate) running average
- controller:
  - if $price < 0.9 * average$ and $instock < 60$ buy 48
  - else if $instock < 12$ buy 12
  - else buy 0

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This maintains a discouning rolling avergage that (eventually) weights more recent prices more.