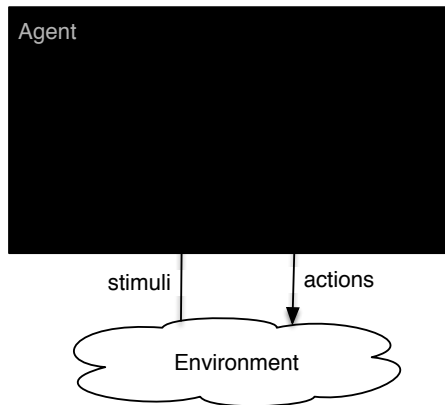


Overview:

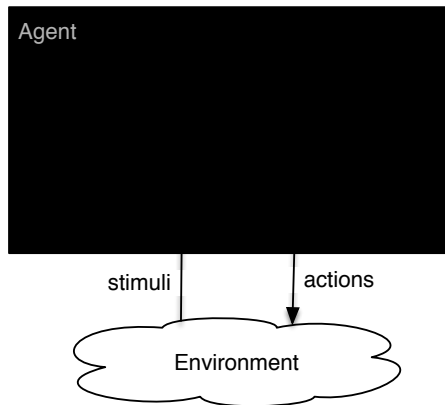
- Agents and Robots
- Agent systems and architectures
- Agent controllers
- Hierarchical controllers

Agent Systems



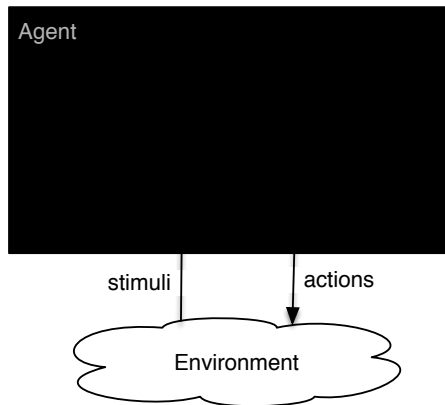
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Agent Systems



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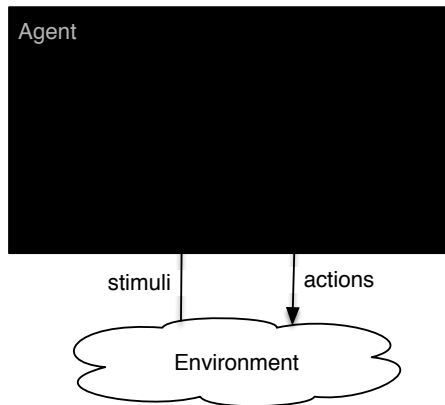
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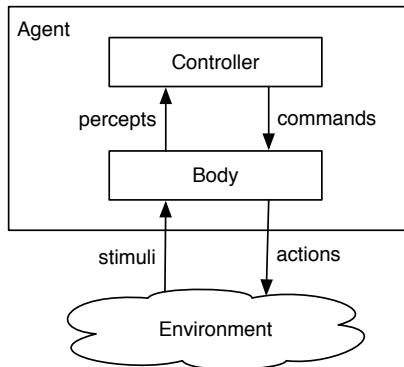


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- An agent receives **stimuli** from the environment
- An agent carries out **actions** in the environment.

Agent System Architecture

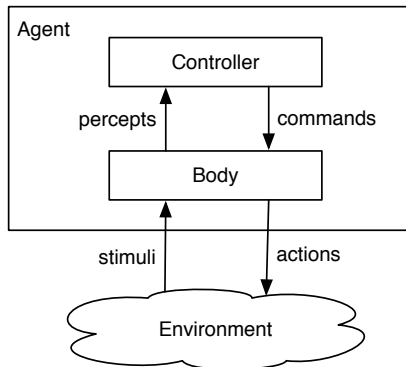
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Agent System Architecture

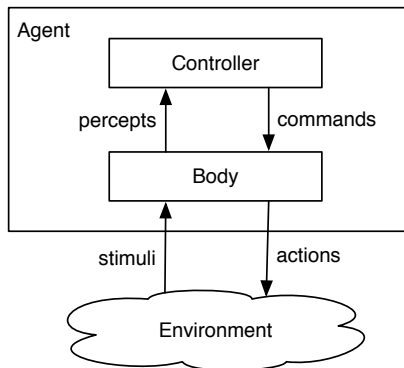
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- An agent interacts with the environment through its body.



Agent System Architecture

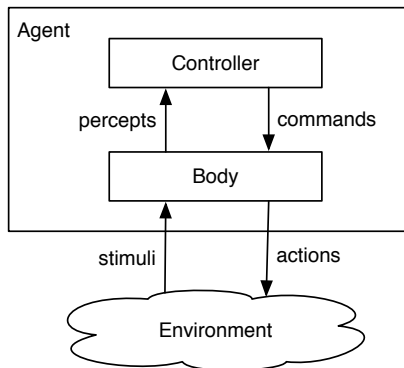
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- The **body** is made up of:

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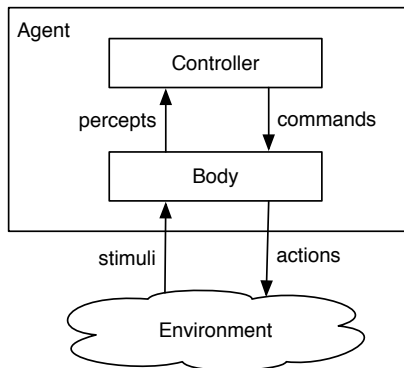
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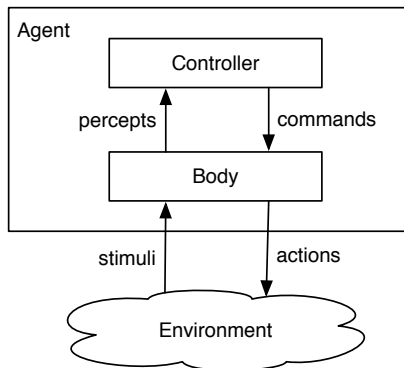
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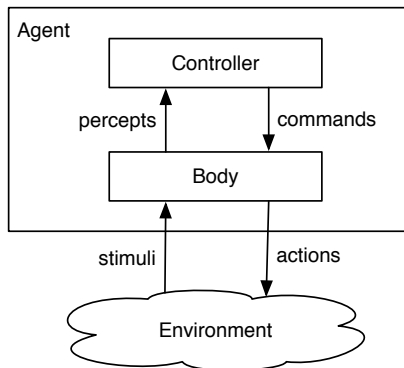
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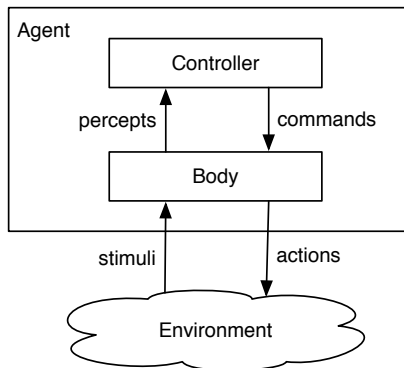
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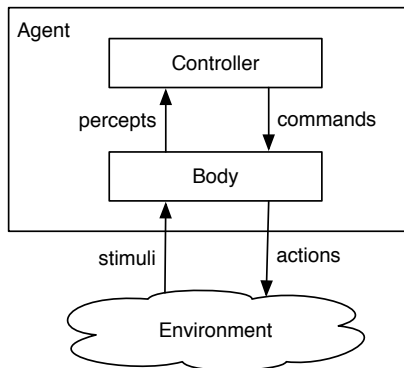
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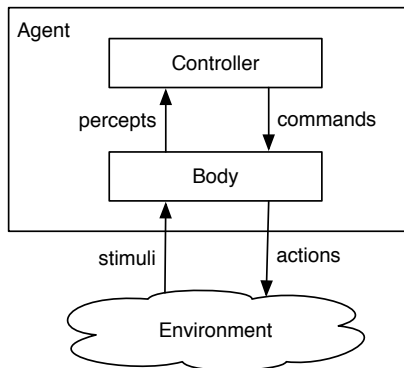
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- The controller sends **commands** to the body.
- The body can also have reactions that are not controlled.

Implementing a controller

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- The command at any time can depend on the current and previous percepts.

Example: smart home

- A smart home will monitor your use of essentials, and buy them before you run out.
Example: snack buying agent:

▶ abilities:

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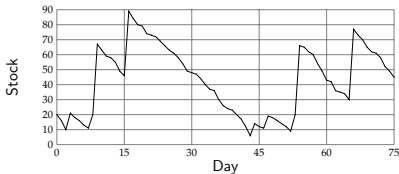
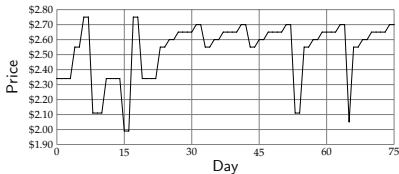
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- ▶ **prior knowledge:** range of prices, consumption rates

The Agent Functions

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

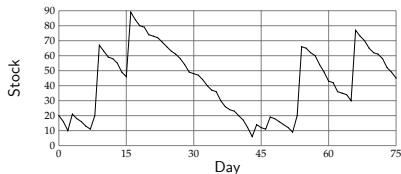
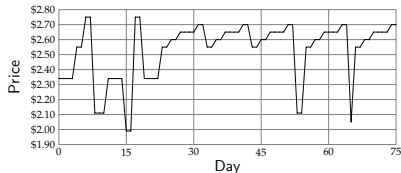
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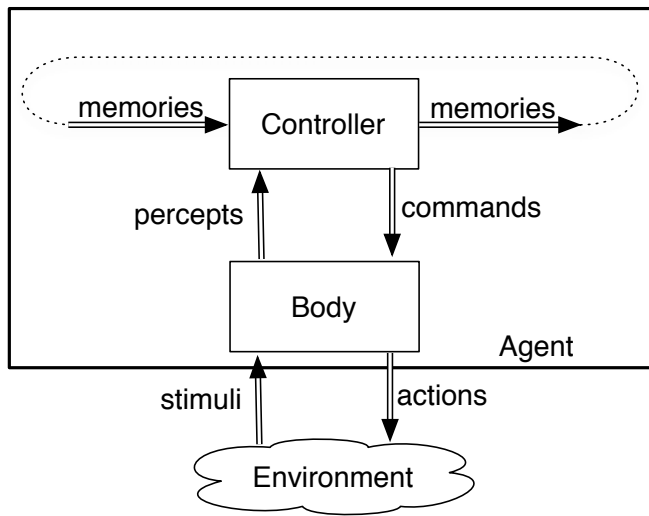
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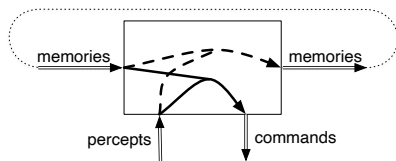
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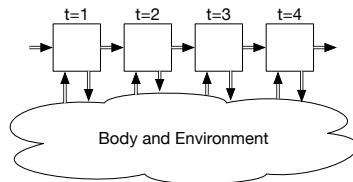
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(How should it update its memory?)— as a function of its percepts and its memory.



Functions implemented in a controller

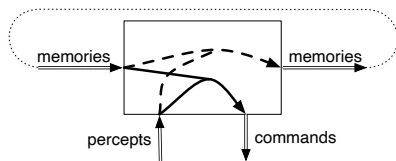


(a)

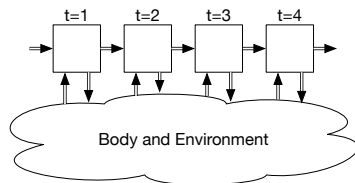


(b)

Functions implemented in a controller



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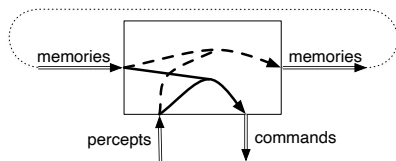


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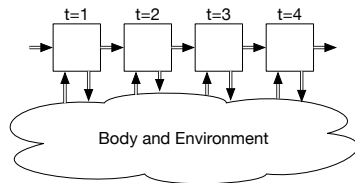
For discrete time, a controller implements:

- **belief state function** $remember(belief_state, percept)$, returns the next belief state.

Functions implemented in a controller



(a)



(b)

For discrete time, a controller implements:

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

Chip buying controller

- Percepts:

Chip buying controller

- Percepts: price, number in stock

Chip buying controller

- Percepts: price, number in stock
- Action:

Chip buying controller

- Percepts: price, number in stock
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Chip buying controller

- Percepts: price, number in stock
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- Belief state: (approximate) running average

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 - ▶ if $price < 0.9 * average$ and $instock < 60$ buy 48
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- Belief state transition function:

$$average := average + (price - average) * 0.05$$

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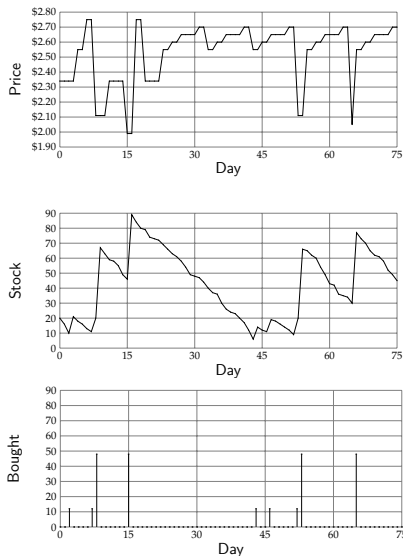
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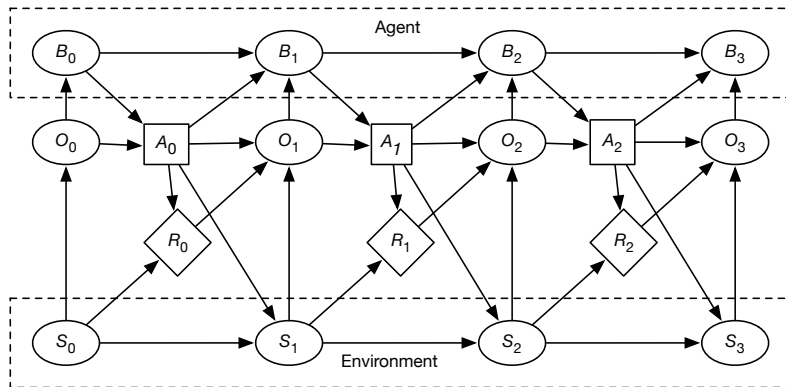
This maintains a discounting rolling average that (eventually) weights more recent prices more.

(see `agents.py` in AI Python distribution <http://aipython.org>)

Percept and Command Traces (POMDP)

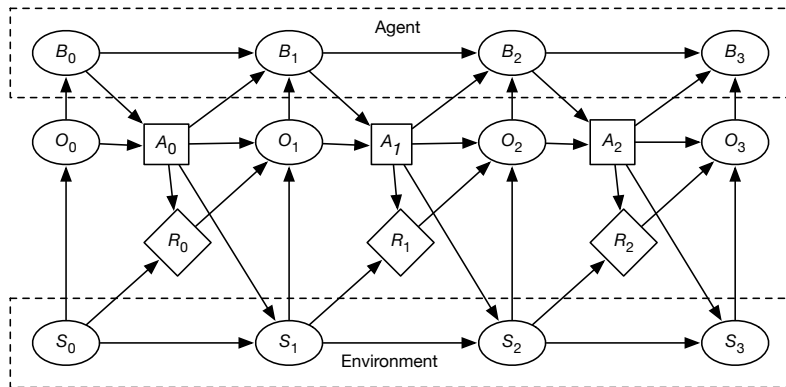


Agents acting in time



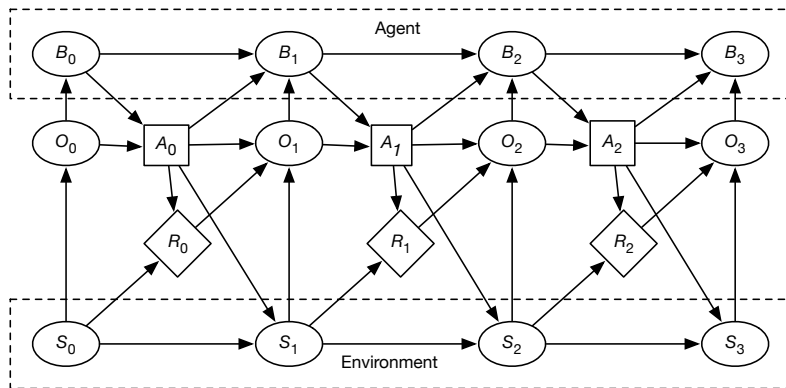
B_i agent's belief state at time i .

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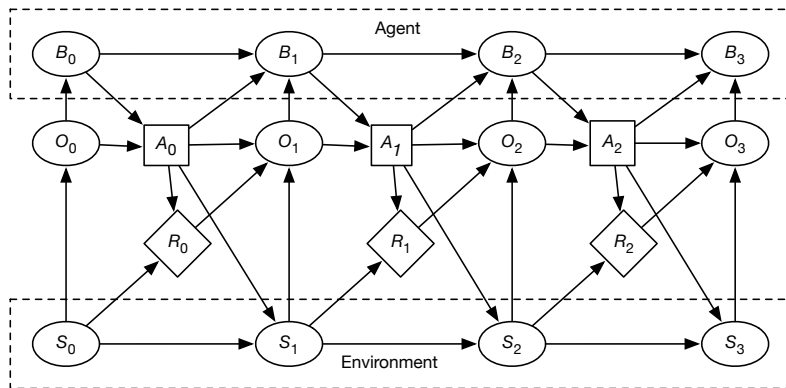
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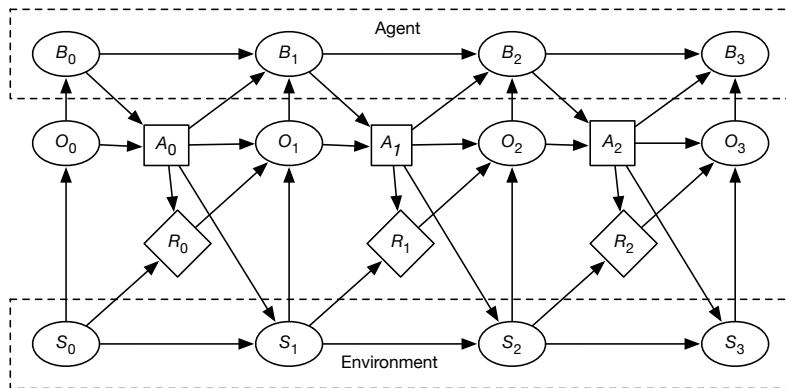
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Agents acting in time



B_i agent's belief state at time i . A_i agent's action. O_i is what the agent observes. R_i is the reward.

Agents acting in time



B_i agent's belief state at time i . A_i agent's action. O_i is what the agent observes. R_i is the reward. S_i is the world state.