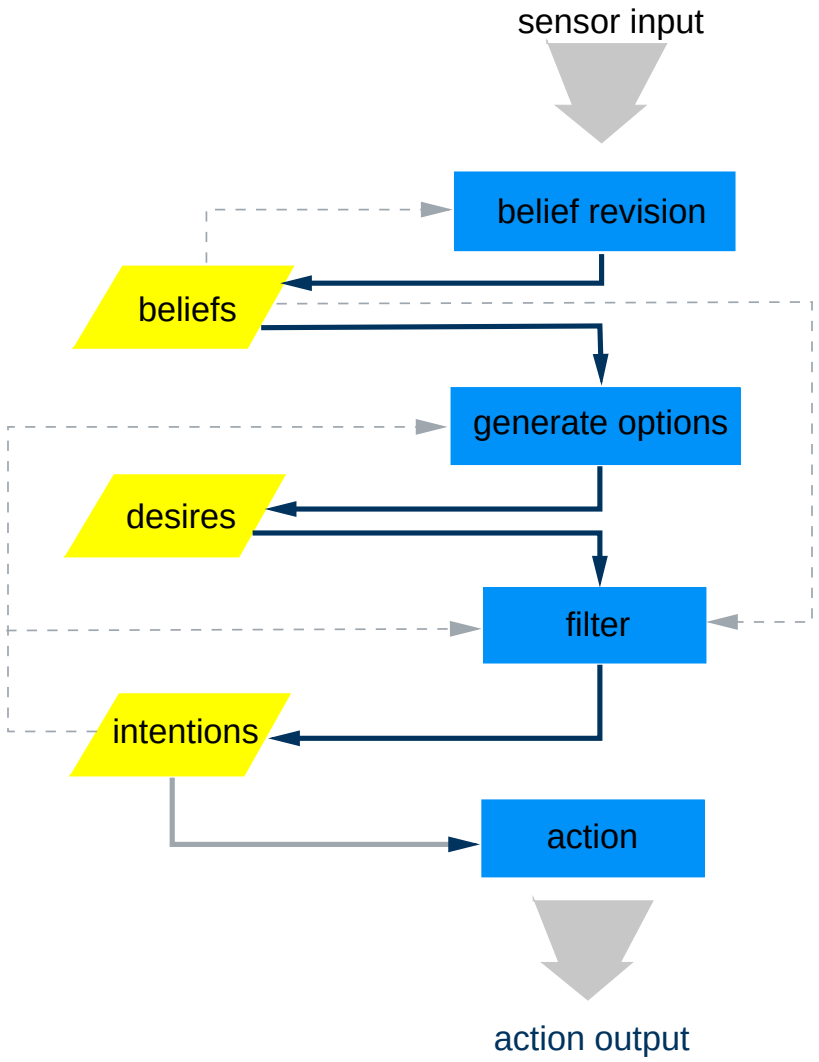
The BDI Architecture

Control process in the BDI model:



An Example: Passing CSE304

- A student agent perceives the following beliefs:

$$Beliefs_1 = brf\left\{\varnothing, \left\{\begin{array}{l} workhard \rightarrow passCourse \\ attendLectures \cap completeCoursework \cap review \\ \rightarrow workhard \end{array}\right\}\right\}$$

- The agent has an initial intention to pass the course:

$$Intentions_0 = \{passCourse\}$$

- The agent's desires are freshly generated each for cycle (they do not persist). The option generation function leads to desires to pass the course and its consequence:

$$Desires_1 = options\left(Belief_1, Intentions_0\right) =$$

$$\{workhard, attendLecture, completeCoursework, review\}$$

Generating intentions

- The filter function leads to some new intentions being added:

$$Intentions_1 = filter\left(Belief_1, Desires_1, Intentions_0\right)$$

$$= \left\{ \begin{array}{l} passCourse, workHard, attendLectures, \\ completeCoursework, review \end{array} \right\}$$

- One or more of which will then be executed before the agent's deliberation cycle recommences.

Obtaining new beliefs

- Suppose the agent perceives new information which leads to his beliefs being revised:

$$Beliefs_2 = brf\left(Beliefs_1, \begin{Bmatrix} cheat \rightarrow passCourse, \\ cheat \prec workhard \end{Bmatrix}\right)$$

$$= \begin{Bmatrix} workHard \rightarrow passCourse, \\ attendLecture \cap completeCoursework \cap review \\ \rightarrow workHard, \\ cheat \rightarrow passCourse, \\ cheat \prec workHard \end{Bmatrix}$$

Revising desires and intentions

- The agent recomputes his current desires

$$Desires_2 = options\left(Beliefs_1, Intentions_1\right) = \left\{cheat\right\}$$

- And intentions

$$Intentions_2 = filter\left(Beliefs_2, Desires_2, Intentions_1\right)$$

$$= \left\{passCourse, cheat\right\}$$

- The agent drops his original intention to work hard (and its consequences) and adopts a new one to cheat

Adding even more beliefs…

- Subsequently, the agent perceives that if caught cheating, he will no longer pass the course. What's more, he is certain to be caught

$$Beliefs_3 = brf\left(Beliefs_2, \begin{Bmatrix} cheat \cap caught \rightarrow \neg passCourse, \\ caught \end{Bmatrix}\right)$$

$$= Beliefs_2 / \{cheat \rightarrow passCourse\} \cup$$

$$\{cheat \cap caught \rightarrow \neg passCourse, caught\}$$

- Because the new beliefs lead to an inconsistency, the agent has had to drop his belief in

$$cheat \rightarrow passCourse$$

Revising desires and intentions: again

- The agent recomputes his desires and intentions

$$Desires_3 = options(Beliefs_2, Intentions_2)$$

$$= \{workHard, attendLectures, completeCoursework, review\}$$

$$Intentions_3 = filter(Beliefs_3, Desires_3, Intentions_2)$$

$$= \begin{Bmatrix} passCourse, workHard, \\ attendLectures, completeCoursework, review \end{Bmatrix}$$

- Because it's not longer consistent to cheat (even through it may be preferable to working hard), the agent drops that intention and re-adopts workHard (and consequences)

Summary of BDI architecture

- It is a practical reasoning architecture.
- Basic component are data structures representing beliefs, desires and intentions of agent, and functions representing its deliberation and means-ends reasoning.
- Intentions play a central role: proving stability for decision-making and focus for practical reasoning (or planning).

Summary of BDI architecture

- Must decide on type of environment (rate of world change) to enable a good balance between being committed to intentions and reconsidering them.
- BDI model is appealing because:
  - It is intuitive – we can recognize decision process
  - It gives a clear functional decomposition, indicating what sorts of subsystems are required to build an agent
- Main drawback – how to implement efficiently.