BDI ARCHITECTURE

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BE4M36MAS - Multiagent systems
Model-based goal-based agents

How to implement them and get actions from goals effectively?
BELIEF-DESIRE-INTENTION
Model for programming autonomous agents using three concepts:

- Beliefs
- Desires
- Intentions
Beliefs

- An agent’s model of the world (what he supposes to be true)

Example:
Beliefs

~ agent’s model of the world (what he supposes to be true)

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Example: What are agent’s beliefs?
∼ agent’s model of the world (what he supposes to be true)

*Example:* What are agent’s beliefs?

breeze(0, 1). stench(1, 0).
pos(0, 0). safe(0, 0).
safe(0, 1). safe(1, 0).
Belief = Knowledge?
Beliefs are not knowledge!

- An agent may believe facts that are not true.

Example:
Weather forecast announces nice weather for the weekend.

\[
\text{nice\_weather(sat). nice\_weather(sun).}
\]

→ You can believe that, but you cannot take it for granted.
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Example: Communication between agents
Desires

Agent need not succeed in achieving all his desires, e.g.:

- Situation may not allow completing some of the desires
- Desires may be mutually exclusive

Example:
Vacuum cleaner — what desires does the agent have?
~ state of the world agent is **dreaming** about

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\textit{Example}: Vacuum cleaner — what desires does the agent have?
Intentions

Active goals of the agent (should not contradict beliefs)

Agent commits to fulfilling some of his desires. He must do everything he can to complete his intentions (unless specified otherwise).

Properties:

- Agent must believe that it is possible to realize the intention.
- Intention does persist.
- Agent need not intend side effects
~ **Active** goals of the agent (should *not contradict* beliefs)

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PRACTICAL REASONING
How do we turn *desires* into *actions* the agent performs?
Components of Practical Reasoning

1. Deliberation (strategic thinking)
   - Decide what desires we want to accomplish at the moment
   - Result: intentions
     - the agent is committed to accomplish

2. Means-ends Reasoning (tactical planning)
   - What actions should we perform to accomplish intentions we are committed to?
   - Result: plans
     - and actions

Intentions bridge these two processes
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Components of Practical Reasoning

BDI?
What if Roomba finds out that cables prevents it from going to another room?
Commitments

∼ indicate that an agent has committed to some intention

Optional: Situation in which an agent may forget about his intention (i.e. decommit)

• Individual commitments
• Social commitments
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- Social commitments
INDIVIDUAL COMMITMENTS

- **Blind commitment** — the only way to decommit is to succeed
- **Single-minded commitment** — agent may decommit when he believes it is no longer possible to succeed
- **Open-minded commitment** — agent may decommit when he no longer believes it is possible to succeed
Example:

Assume !organize_picnic(sat). and nice_weather(sat).
Picnic can be organized only in good weather conditions.
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- **Blind commitment**
Example:

Assume $\neg\text{organize\_picnic(sat)}$. and $\text{nice\_weather(sat)}$. Picnic can be organized only in good weather conditions.

- **Blind commitment** — Agent will be organizing the picnic event. Once he realizes that it’s raining whole Saturday, he crashes.
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- **Open-minded commitment** — Agent drops his intention as soon as the updated forecast is released.
IMPLEMENTING BDI
- Beliefs
- Desires
- Intentions
• Beliefs
• Desires
• Intentions
• Events
• Plans
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An event is triggered when agent commits to an intention/goal

- Agent **must** respond to such an event
  → ensures persistance of an intention
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Agent responds to an event by executing appropriate **plan**
A plan has:

- **trigger** – what event (i.e., intention) it is able to handle
- **context** – under what circumstances the plan is applicable
- **body** – what actions/subgoals should the agent perform
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*Example:* Think of a plan for realizing ![cleanup] intention of a Roomba.
Assignment of the 1st semestral project

If possible, bring your computer with working Java environment (JDK + IDE), please