Motivations and Goal-Directed Autonomy

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Overview

- Autonomy and Motivations
- AgentSpeak(L) and AgentSpeak(MPL)
- Motivation Model
  - Functions
  - Control Cycle
  - Integration with AgentSpeak
- Research Directions and Conclusions

Autonomy

- Here, I mean “Independence of Control”
- Features needed for autonomy:
  - Capability to generate own goals independently
  - Capability to switch between goals
  - Capability to try alternative ways to achieve a goal
- Meta-reasoning

Motivations

- Root-cause of future-directed behavior
- Studied by a number of other disciplines
  - Orientation towards particular goals
  - Associated with drives and incentives
  - Controls focus of attention
- Abstraction of meta-reasoning
  - Goal generation
  - Representation of dynamic priorities

AgentSpeak(L)

- Procedural agent language
- Based on the BDI model
- Designer specifies plans in a plan library
  - Plans encode procedures
  - Plans are characterized by trigger and context conditions
  - Goals are implicit in the plans

AgentSpeak(MPL)

- AgentSpeak(L) + Motivations
  - Stantard AgentSpeak(L)
  - External motivation specification
- Motivation model for
  - Goal generation
  - Plan selection
- Motivation model based on mBDI

Motivation Model

- Tuple that includes:
  - Motivation name
  - Intensity
  - Threshold value
- Motivation functions:
  - Intensity Update
  - Goal Generation
  - Mitigation

$$\langle m, i, t, f_i, f_g, f_m \rangle$$

Intensity Update Function

- Invoked when beliefs are updated
- Controls motivational intensity based on belief base updates
- Mapping of beliefs to intensity values

$$f_i(Beliefs) = \begin{cases} over(P,bay1) \wedge batt(10) \rightarrow 2 \\ occupied(agent) \rightarrow -1 \end{cases}$$

Goal Generation Function

- Invoked when threshold value is exceeded
- Posts new goal events to agent

$$f_g(Beliefs) = \{over(Packet, bay1) \rightarrow +!sort(Packet)$$

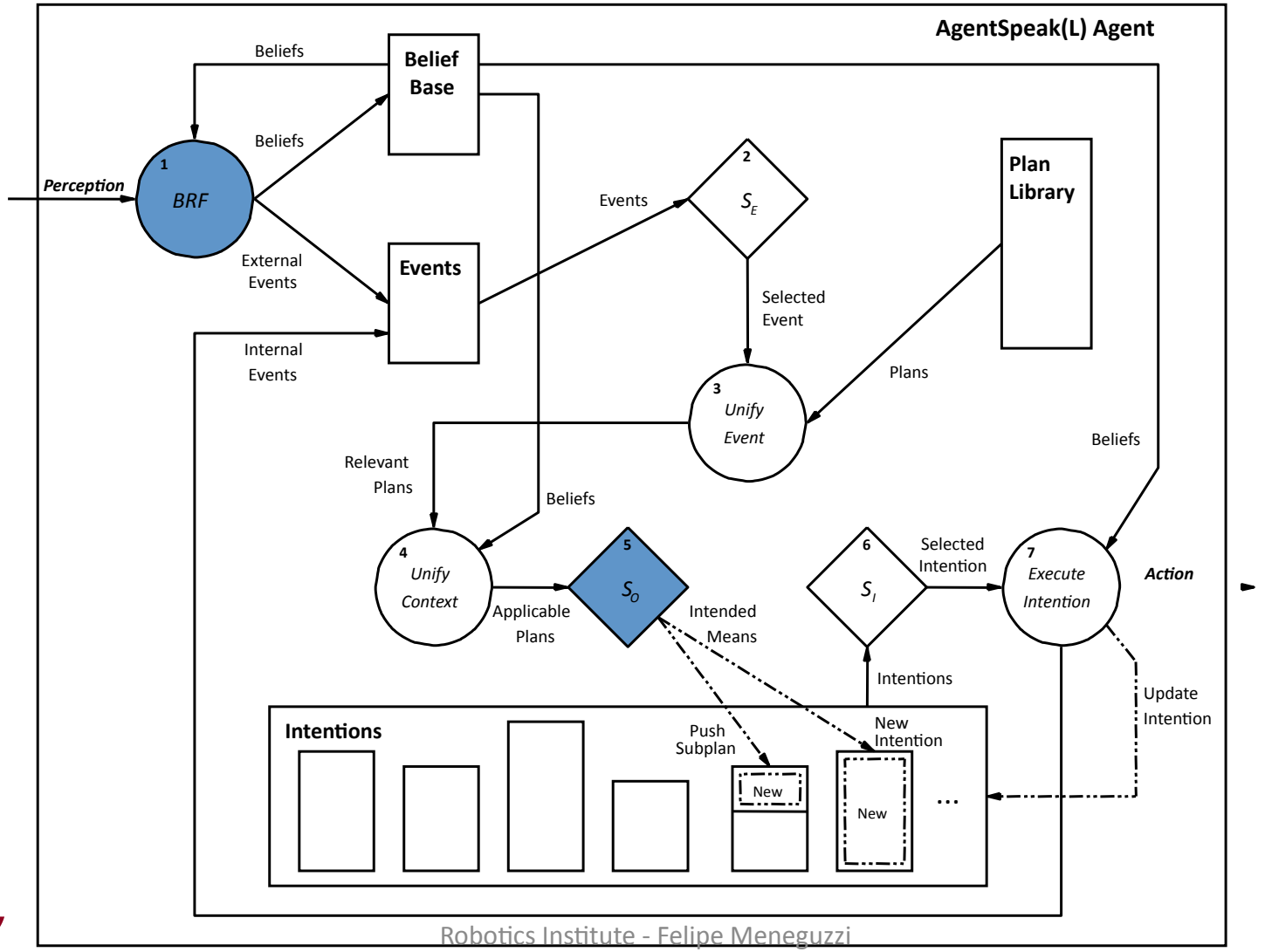
Mitigation Function

- Invoked after goals are generated
- Updates motivational intensity when a motivation is active
- Similar to Intensity Update Function
  - Also based on belief updates

mBDI Control Cycle

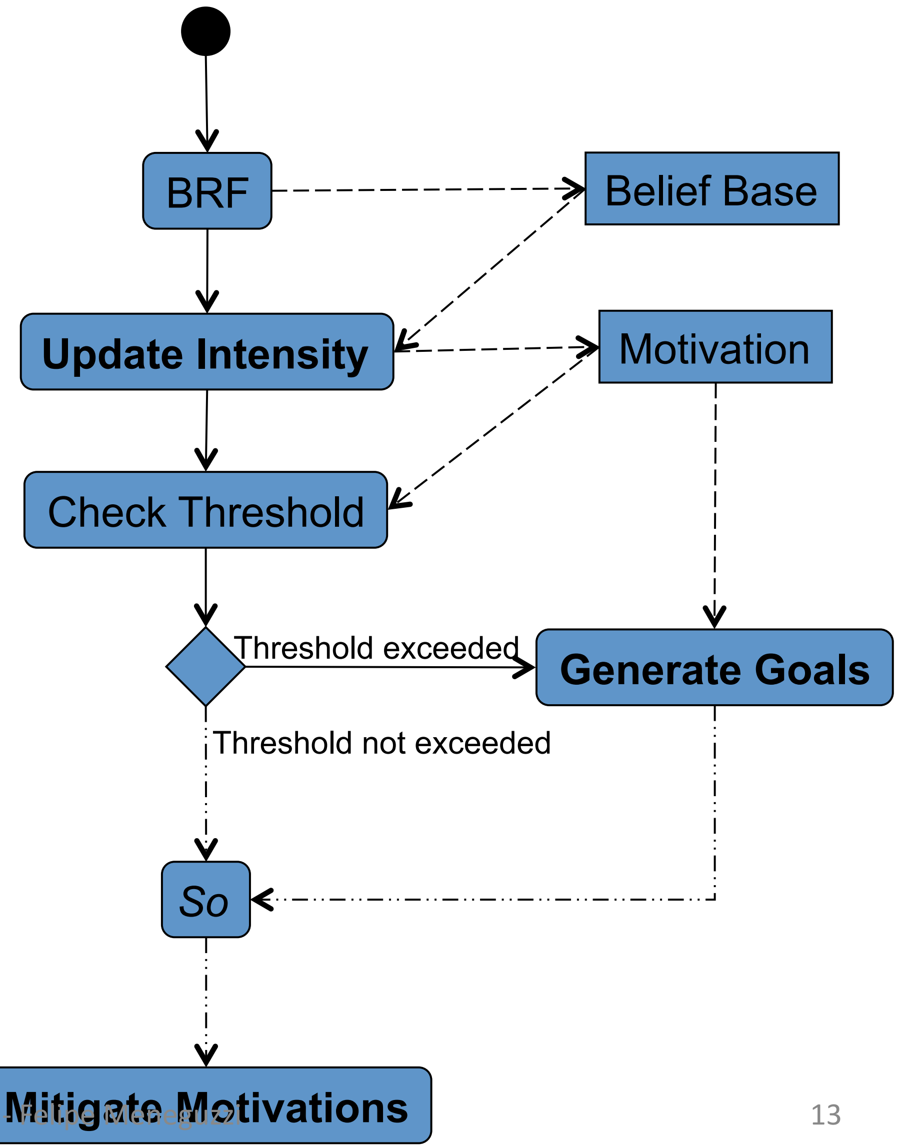
loop
  perceive the environment and update beliefs;
  for all motivation *m* **do**
    apply f_i to *m* to update *i*;
    if $i > t$ **then**
      apply f_g to *m* to generate new goals;
    end if
  end for
  select a plan for the most motivated new goal and adopt it;
  select the most motivationally valuable intention and perform the next step in its plan;
  on completion of an intention apply f_m to each motivation;
end loop

AgentSpeak Control Cycle



Integration with AgentSpeak

- *Belief Revision Function* associated with motivation functions
- Motivated goals are posted as new achievement goals
- Motivation values are used in the *Option Selection Function*



Conclusions

- Architecture easily integrated to BDI-type languages
- Provides an intuitive abstraction for meta-reasoning
- Separates meta-reasoning from action-directed plans

Direction for Future Research

- Reasoning about 3rd parties through motivations
- Planning moderation
- As a reward function for normative reasoning

Questions?

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Implementation at:

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