Why You Should Buy an Emotional Planner

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Central Question

♦ What is relationship between plans and emotions?

    – How might plans influence our emotions?

    – How might the act of planning change emotions over time?

    – How might emotions influence the process of planning?

   – What general mechanisms support a computational account?

Cognitive Appraisal

◆ **How do circumstances relate to our goals?**

- There are a number of computational models
- Existing models don't (really) reason about plans
- How might they be extended
- What implications does this have for the model

◆ **Extend Elliott's Construal Theory**

- Based on Ortony et. al Cognitive Appraisal Theory
- Models emotional response to events
- Reasons about multiple agents
- Has simple model of expectations/predictions

Why be Emotional?

♦ **To inform the design of planning algorithms**

   – Integrating planning and execution in dynamic, multi-agent, uncertain, collaborative and adversarial domains   (broad agents)

   – Raises a number of problems

       • When do you plan Vs. when do you act Vs. when do you react

       • How do you focus limited computational resources

       • How do you manage conflicting goals

   – Emotion researchers claim this is what emotions are good for

♦ **To make believable agents**

   – Application to training human decision makers

   – Train people how to act in an organization

Architecture
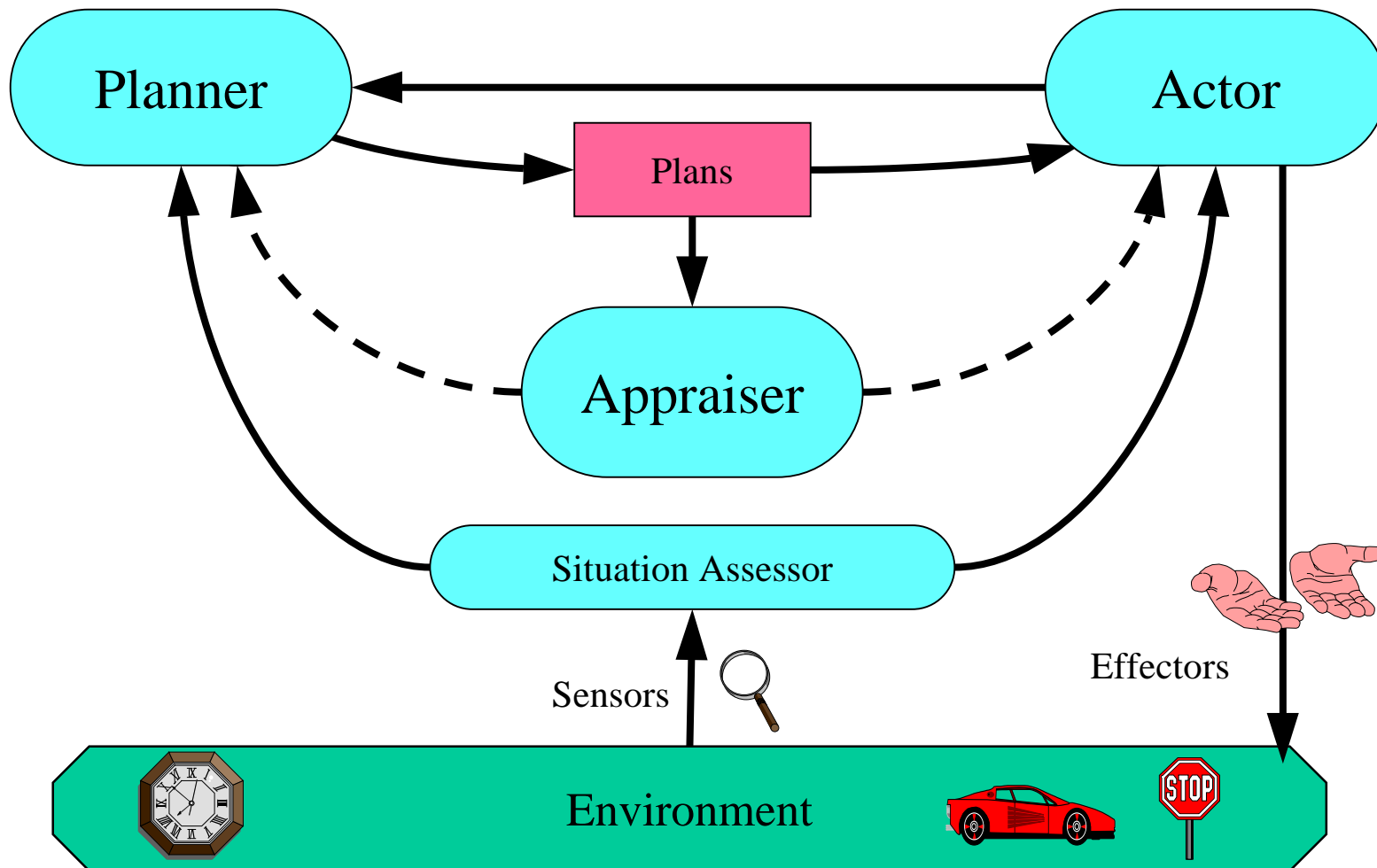
Extend Construal Theory

♦ **The appraisal part of Elliott's Affective Reasoner**

  – Events matched against database of *construal frames*

  – Frames extract set of features of the event (emotion eliciting conditions)

  – Domain-independent theory maps features into emotion

  – Frames encapsulate relationship between events and goal

  – Theory doesn't say how to derive features

    • Requires domain-specific knowledge and mechanism

  – Theory doesn't (explicitly) allow plans to influence construals

♦ **Relate events to plans as well as goals**

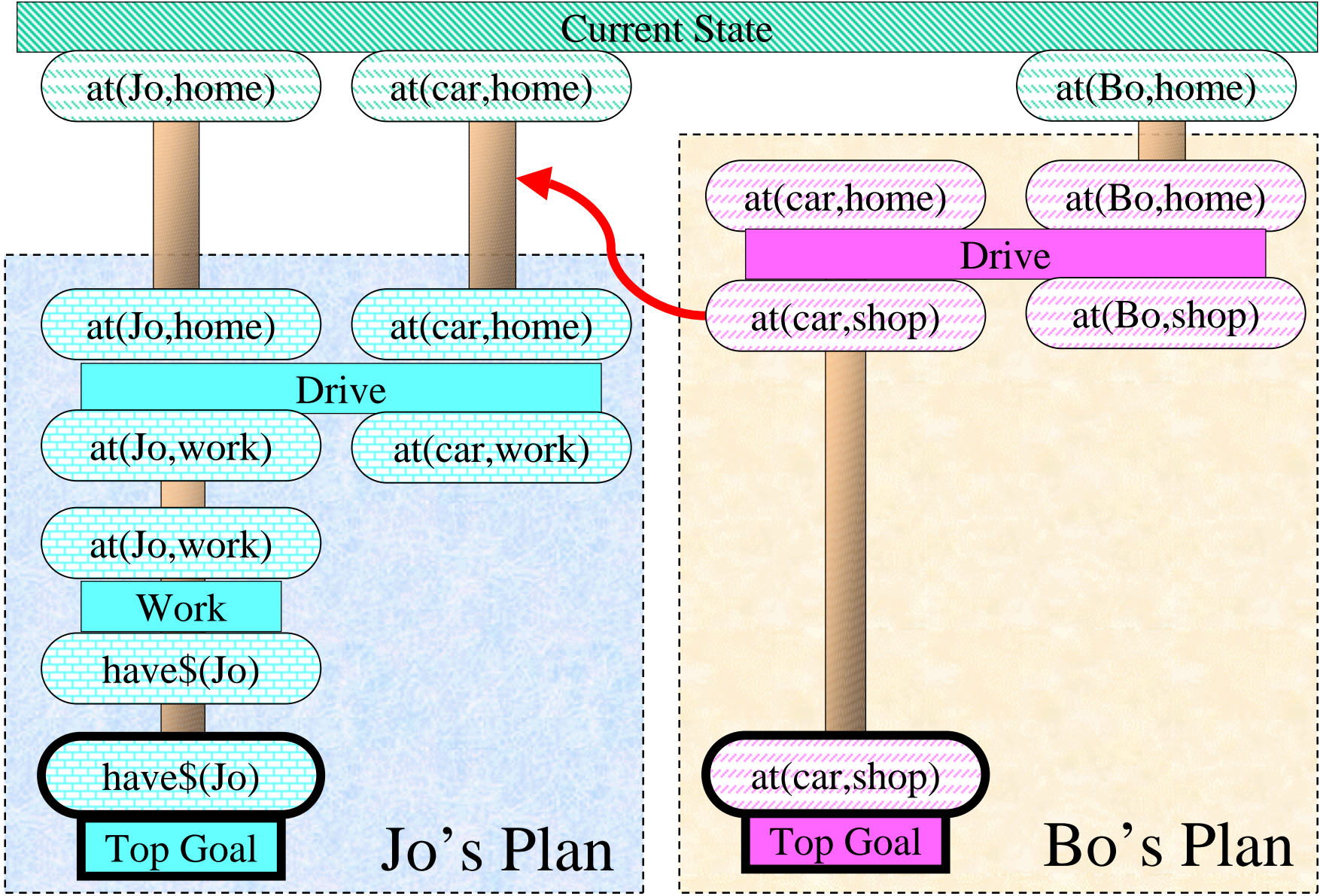♦ **Make process more domain-independent**

  – are there general mechanisms?

The Problem With Plans

♦ Plans complicate things
Example:

- Jo's Goal is to have money

- Bo tells Jo he wants to take the car to the shop

- Doesn't appear to be any relationship between these statements.

- Can be if we consider the agents' plans

Current State

at(Jo,home) at(car,home) at(Bo,home)

Jo's Plan

at(Jo,home) at(car,home)

Drive

at(Jo,work) at(car,work)

at(Jo,work)

Work

have$(Jo)

have$(Jo)

Top Goal

Bo's Plan

at(car,home) at(Bo,home)

Drive

at(car,shop) at(Bo,shop)

at(car,shop)

Top Goal

Plan-based Appraisal

♦ Don't think of a planning algorithm as a black box

♦ Much of what a planner does is related to appraisal

  – Represents goals, actions, and dependencies between them

  – Forms expectations, Makes predictions

  – Given new information, automatically computes implications

    • Identifies expectations violations, some opportunities

    • Implications augmented as planning proceeds

♦ Idea: use these general mechanisms for construals

  – Redefine Elliott's event features in terms of plan structures

  – Use planner's generic mechanisms to derive these features

    • base features on domain-independent (syntactic) properties of plans

Construal Features

♦ Construal theory has has nine.

♦ Desire-self: Is the event desirable?

– Elliott: Does the event achieve or block a goal?

– Me: Do I have a plan for goal and is the plan likely to succeed?

Is there some problem with achieving my goal?

• E.g. I don't have a plan or some event invalidated my plans

♦ Evaluation: Is the event praise/blameworthy?

(Multi-agent case)

– Elliott: use domain-specific notion of behavioral principles

– Me: define principles in terms of features of plans

Ex: don't cause *threats* in other people's plans
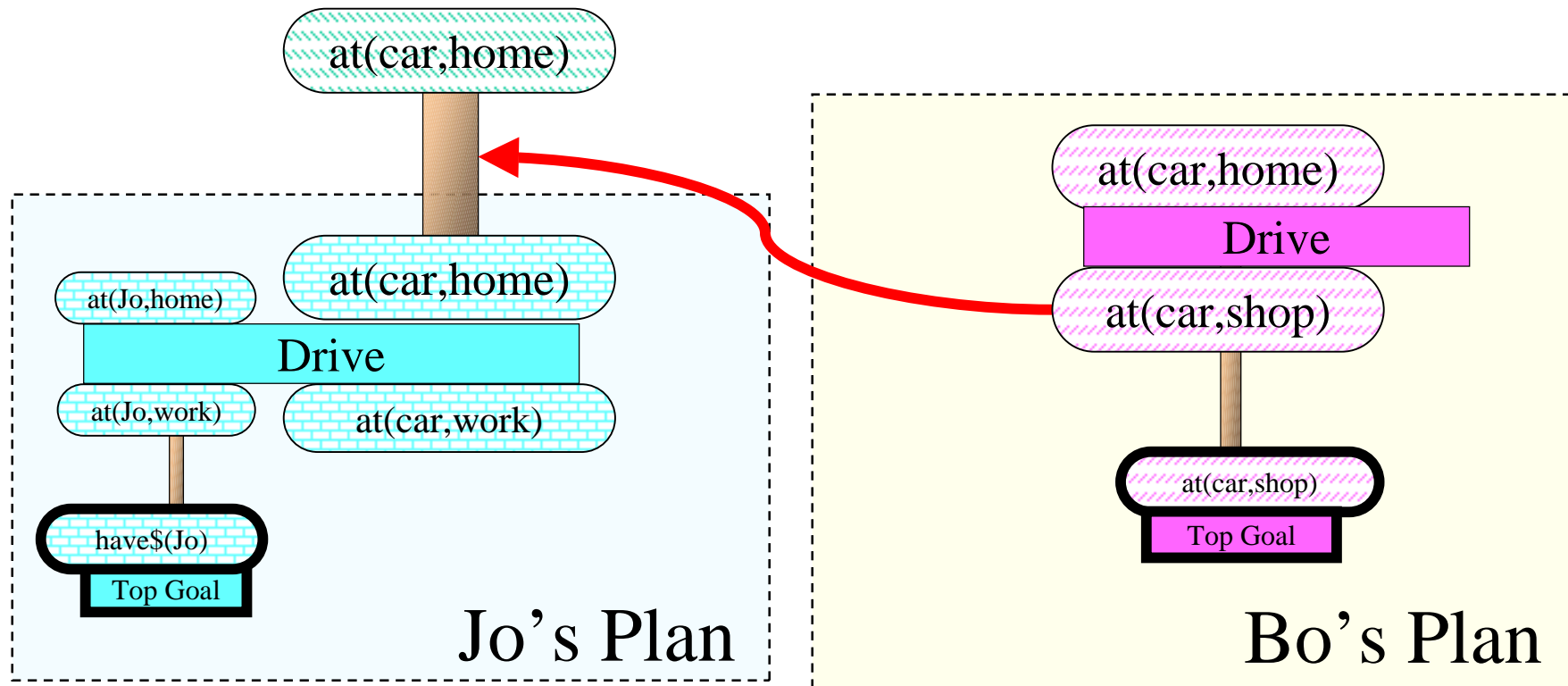
- ◆ Desire-self: undesirable that there's a threat in Jo's plans
- ◆ Evaluation: Bo is blameworthy for causing the threat
- ◆ Appraisal => Jo is angry at Bo

Implications

- ♦ Elliott centers appraisals on events
- ♦ I found it more natural to base appraisals on goals
  - – Essentially implements goal monitors (Oatley & Johnson-Laird)
  - – "Events" are really changes in the state of goal's plan (mental)
      - via additional planning
      - via recognizing *the implications of* external events
  - – Events may or may not be triggered by external stimuli

- ♦ Model separates knowledge and mechanism
  - – more of process of appraisal made concrete/domain-independent
- ♦ Forces juxtaposition between emotion and planning
  - – What are differences/similarities of different concepts

How does this help planning?

♦ **Inform search control**
- focus planning effort on goals that elicit strongest appraisal
- act on pressing goals before flesh out consequences
- assert preferences over classes of actions
  - angry actions vs. fearful actions vs. ...

♦ **Increase efficiency/believability**
- Don't do complete bookkeeping (constraint propagation)

  Focus of parts of plan memory eliciting strong appraisal

♦ **Modulate social interactions**
- Planning stances

Open Questions

♦ **Intensity: why is one threat worse than another?**

 – Purely syntactic approaches (Sloman'87, Beaudoin'95)

   • how many ways are there to achieve a goal?

   • How deeply nested is the problem

 – Relationship to planning search control theories

   • Heuristic estimates of probability of goal attainment

 – Domain-specific knowledge

   • Quantitative *concerns* (Moffat'95)

♦ **Emotion Decay / Mixed Emotions**

 – decay functions (Velásquez'97)

♦ **Reasoning about belief and intent**