

# Foundations of Language Interaction

HANDOUT FOUR

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## 1 Introduction

Today we turn from FORMING INTENTIONS to RECOGNIZING INTENTIONS.

## 2 Recap

Intentions in deliberation:

- (1) a Any PLAN is a representation that maps out what choices the agent makes and what actions it does;
- b it shows that the choices would lead to certain hypothetical effects under certain hypothetical circumstances.
- c If the plan effects what the agent wants —
- d If the agent believes the circumstances obtain —
- e The agent can commit to the plan – this is the agent’s intention – and act to follow it.

The examples got a bit ugly...

```
(2) (find look
      (know self
        ((k self (sm x\((food x)::nil))):nil)
        (whatever ((sm x\((food x)::nil))):nil)
        (x\((food x)::nil))
        (f\((step ((food f)::nil)
                  self look
                  (find (eat f)
                    (know self ((k self (food f))):nil)
                    (step ((food f)::nil)
                      self (eat f)
                        (know self ((k self full)):nil)
                        (finish (full::nil))))))))))
```

But you can read out the important bits:

- (3) a The choices and actions are, in the first step, to look; and in the next step, when you know about some food *f*, to eat *f*.
- b The hypothetical effects are that the agent feels *full*; the hypothetical circumstances are that the agent knows that there is some food—*k self (sm x\((food x)::nil))*.
- c If there are goals that this plan achieves:

```
goals Plan PlanGoals,  
member G AgentsGoals,  
entail_one PlanGoals G
```

- d If the agent believes these circumstances obtain:

```
circ Plan PlanCirc,  
entail_all AgentsBeliefs PlanCirc
```

- e The agent commits to the plan and performs the first action  
choose Plan Action Next

### 3 Recognizing Intentions

When you recognize an agent's action as intentional, you describe all these steps.

- (4) a You build a plan that is a consistent representation of choice, action and effect.  
b The actions in the plan must be consistent with the actions you observe.  
c The circumstances that the plan supposes must be consistent with what you know of the agent's beliefs.  
d The effects that the plan achieves must be consistent with what you know of the agent's goals.

For each of these constraints, you can point to a step of the agent's deliberation which could not have used this plan if the constraint was not met.

- (5) a Sandy says "I'm hungry." Later you observe Sandy in the kitchen opening cabinets and peering inside.  
b You attribute to Sandy the intention in (2).

Note how consistency is the right condition.

- (6) a You may assume that the agent has done or will do more actions that you don't know about. For example, you may assume a later event where Sandy eats the food she hopes to find.  
b You may assume that the agent believes something when you might not otherwise have any reason to attribute any opinion to the agent one way or another. For example, you might know yourself that there is no food in the kitchen, and so you might have no idea whether Sandy thinks this is a typical kitchen, with food, or whether she knows the deal.  
c In other cases, the agent may have goals that you don't know about ahead of time, as well.

Note also that, in plan recognition, there's one right answer, and you have to entertain all the possibilities. By contrast, planning is a satisficing problem. You can choose any plan that works.

- (7) Chris is standing on the sidewalk with his hand in his pocket. Is he
- Getting his car keys to drive away?

- Getting his house keys to go inside?
- Getting some change to put into a parking meter?
- About to light a cigarette?

We can't just assume one—the situation is really ambiguous.

#### 4 Intention Recognition in Collaboration

Playing catch.

- (8)
- a Kim throws the frisbee.
  - b Sandy attributes an intention to Terry. Here is the content of this intention. Terry throws, Sandy catches, Sandy throws, Terry catches. As a result of these actions, the frisbee goes from Terry to Sandy and back again, achieving goal of fun.
  - c Sandy thinks this intention can be realized, so Sandy commits to it herself.
  - d Sandy performs two steps of deliberation and action guided by her current intentions. That is, Sandy catches and then Sandy throws. Meanwhile, Terry recognizes Sandy's action as meeting his expectations, and Terry remains committed to these intentions, too.
  - e Finally, Terry catches, completing their joint execution of the original intention.

Questions and answers.

- (9)
- a Terry asks whether  $p$  is true.
  - b Sandy attributes an intention to Terry. Here is the content. Terry asks whether  $p$  is true, Sandy replies with the answer. As a result of these actions everybody knows whether  $p$  is true.
  - c Sandy thinks this intention can be realized, because she knows whether  $p$  is true (say it's true). So Sandy commits to this intention herself.
  - d Sandy deliberates, and decides to reply yes based on matching up the information required in Terry and Sandy's intention with the information Sandy actually has now.
  - e Terry recognizes Sandy's reply as meeting his expectation and completing their joint execution of the original intention. Everyone knows  $p$  is true.