

A Cognitive Model of Interaction for Software Agents

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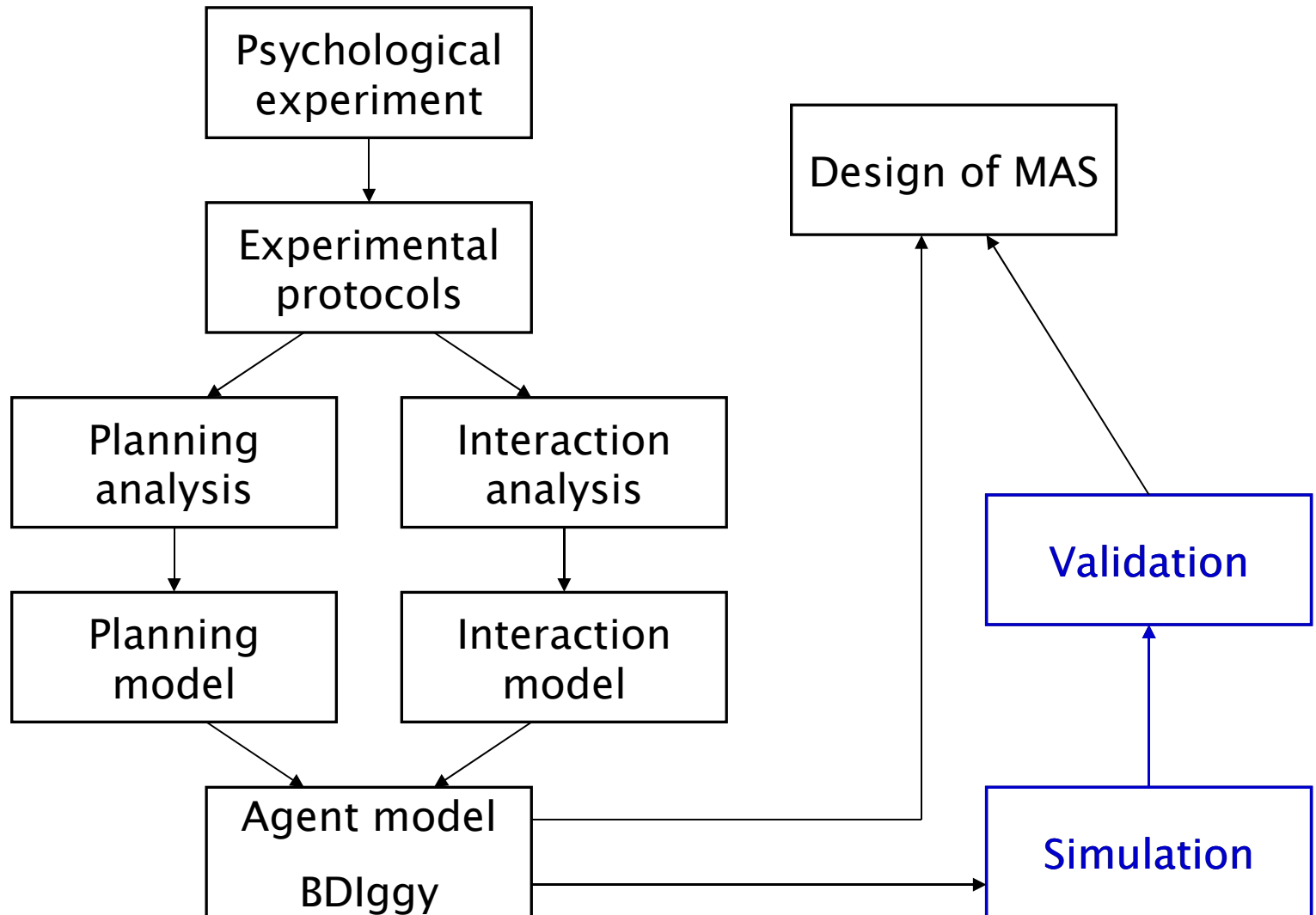
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Cognitive modelling and Multi-Agent Systems (MAS)

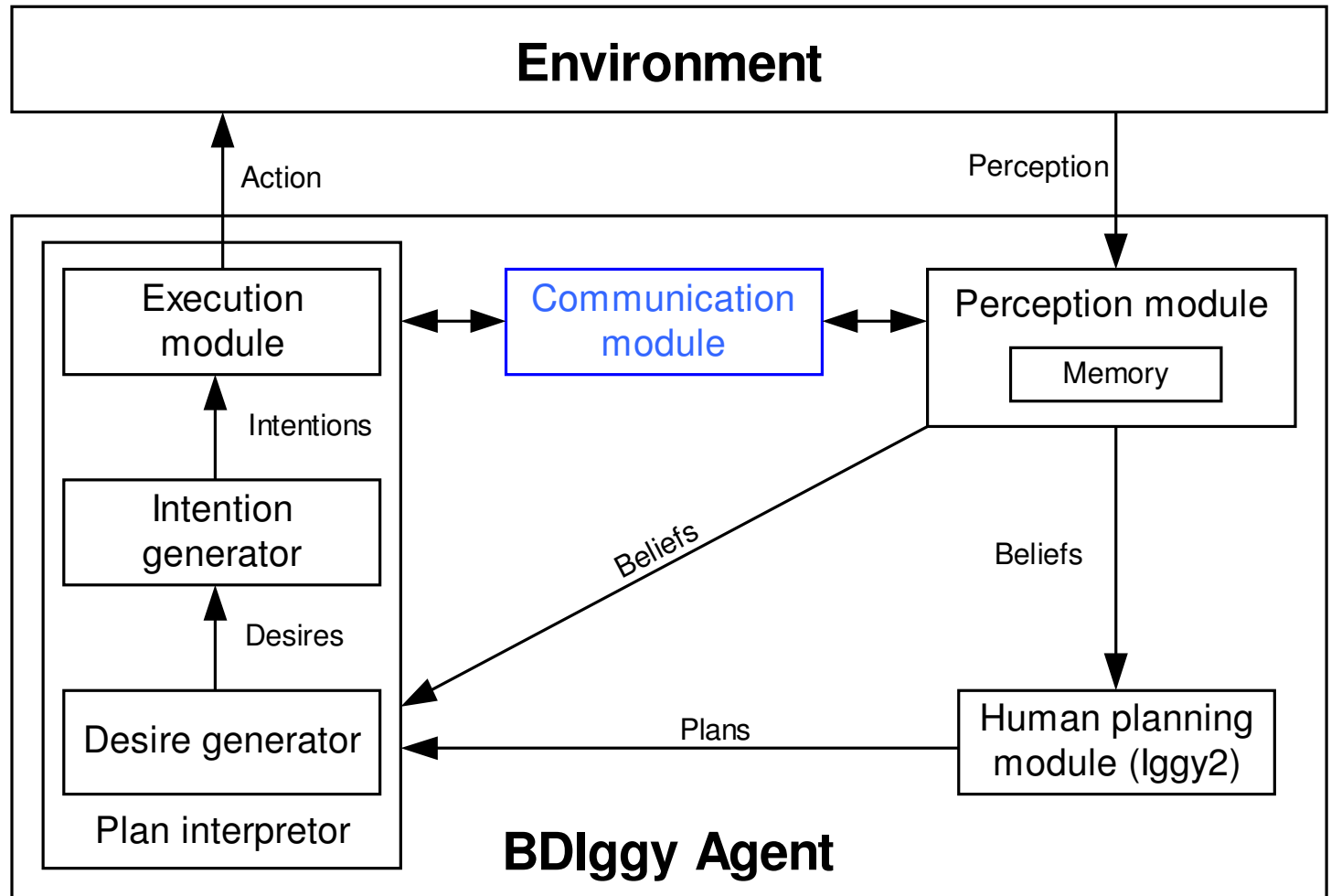
Aim : analyzing, modelling and simulating human capabilities of planning and interaction

- Design systems able to well interact with human beings
- Benefit from the robustness of human communication and reasoning processes in MAS

Approach



Agent architecture: BDIggy [IAT'03]



Cognitive modelling of human interaction

- Analysis of the e-mail corpus, from the psychological experiment:

at the utterance level

- List of pertinent performatives
- Performatives applied to mental states

at the discourse level

- Grouping together linked performatives into an *intervention*
- Represented by timed automata

discourse and utterance levels

- Semantics of the performatives

Modelling human interaction (1/5)

List of observed performatives

Performatives	Speech act	Occurrence
<i>query</i>	directive	474 (42.97%)
<i>reply</i>	descriptive	437 (39.62%)
<i>refine</i>	directive	60 (5.44%)
<i>thank</i>	descriptive	30 (2.72%)
<i>propose</i>	commissive	29 (2.63%)
<i>inform</i>	descriptive	26 (2.36%)
<i>cancel</i>	directive	18 (1.63%)
<i>acceptProposal</i>	directive	10 (0.91%)
<i>notUnderstood</i>	descriptive	9 (0.82%)
<i>refuseProposal</i>	directive	3 (0.27%)

Modelling human interaction (2/5)

Utterance

Speech Act Theory : $F(P)$

→ **performative(mental state)**

○ **directive(locutor's desire) :**

air→railway : *query(pD(air pStage(Orleans Paris ? <10h30 train ?? false)))*

○ **descriptive(belief) :**

railway→air : *reply(pB(pStage(Orleans Paris 08h25 09h30 train 1 80 false)))*

○ **commissive(interlocutor's desire) :**

railway→air : *propose(pD(air pStage(Orleans Paris ? ? ? ? train ?? false)))*

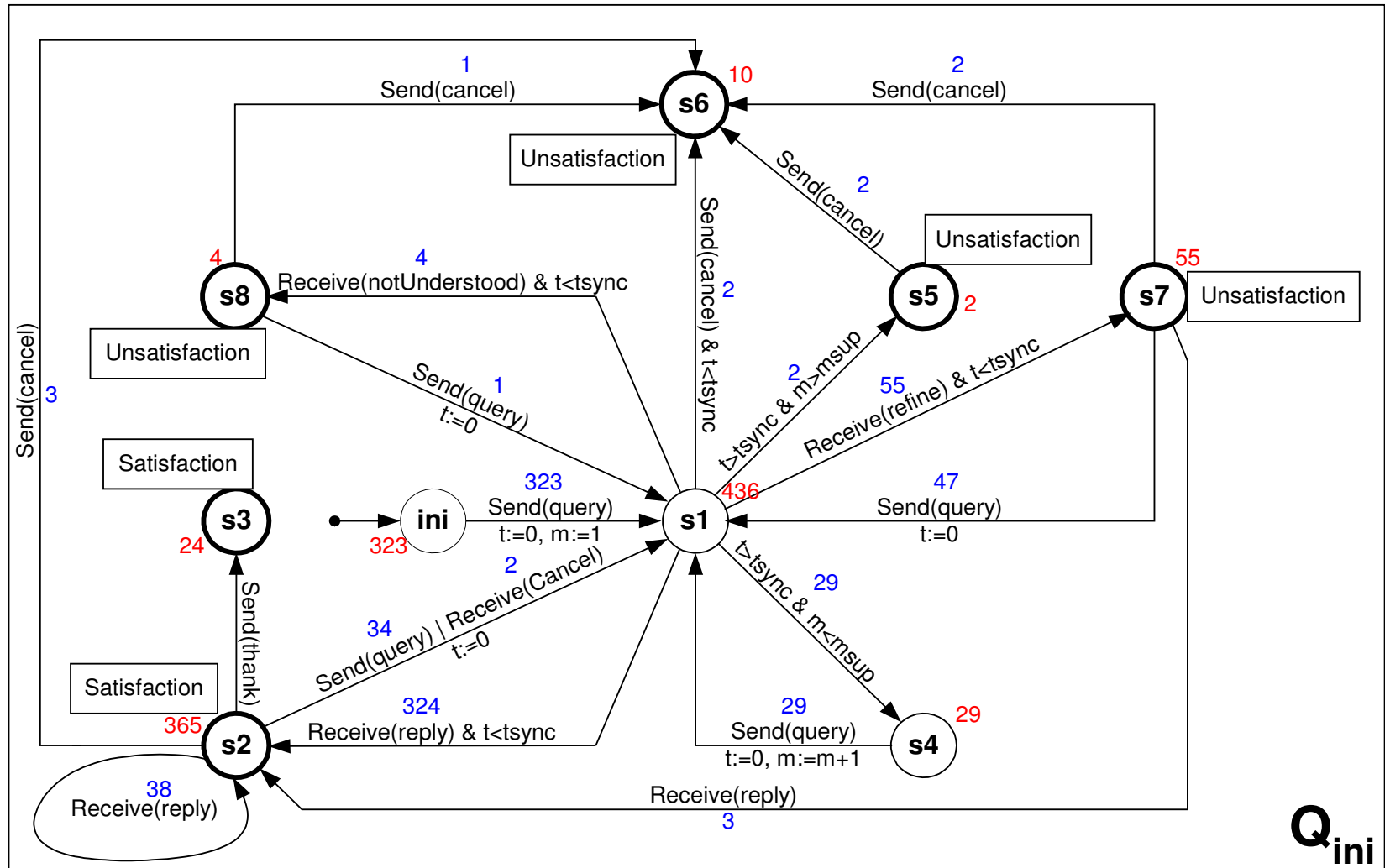
Modelling human interaction (3/5)

Timed automata

- **Intervention:** series of utterances guided by the discourse goal
- Represented by timed automata
- Timed automata direct the agent:
 - to generate a message
 - to interpret a message

Modelling human interaction (4/5)

Example of a timed automaton



Modelling human interaction (5/5)

Semantics of performatives : *query*

$pMessage(A_s A_r \text{ query } pD(A_s S))$

$$\frac{\left| \begin{array}{l} pD(A_s, S) \\ \neg pMeans(S) \\ \neg pB(S) \\ \neg pB(\neg S) \end{array} \right| \quad Q_{ini}(ini, S_2, S_4, S_7, S_8) \xrightarrow{\text{send(query)}} Q_{ini}(S_1)}{aUpdateTA(M)}$$

$$\frac{Q_{int}(ini, S_1, S_2, S_4) \xrightarrow{\text{receive(query)}} Q_{int}(S_1)}{aAdd(pB(pD(A_s, S))); aUpdateTA(M)}$$

Conclusions...

- Cognitive model of human planning (Iggly2)
- Cognitive model of human interaction :
 - Performatives applied to mental states
 - Timed automata
 - Semantics of performatives
- Planning and interaction integrated in an homogeneous agent architecture (BDIggly)
- Implementing BDIggly
- Parametrizing our system



... and perspectives

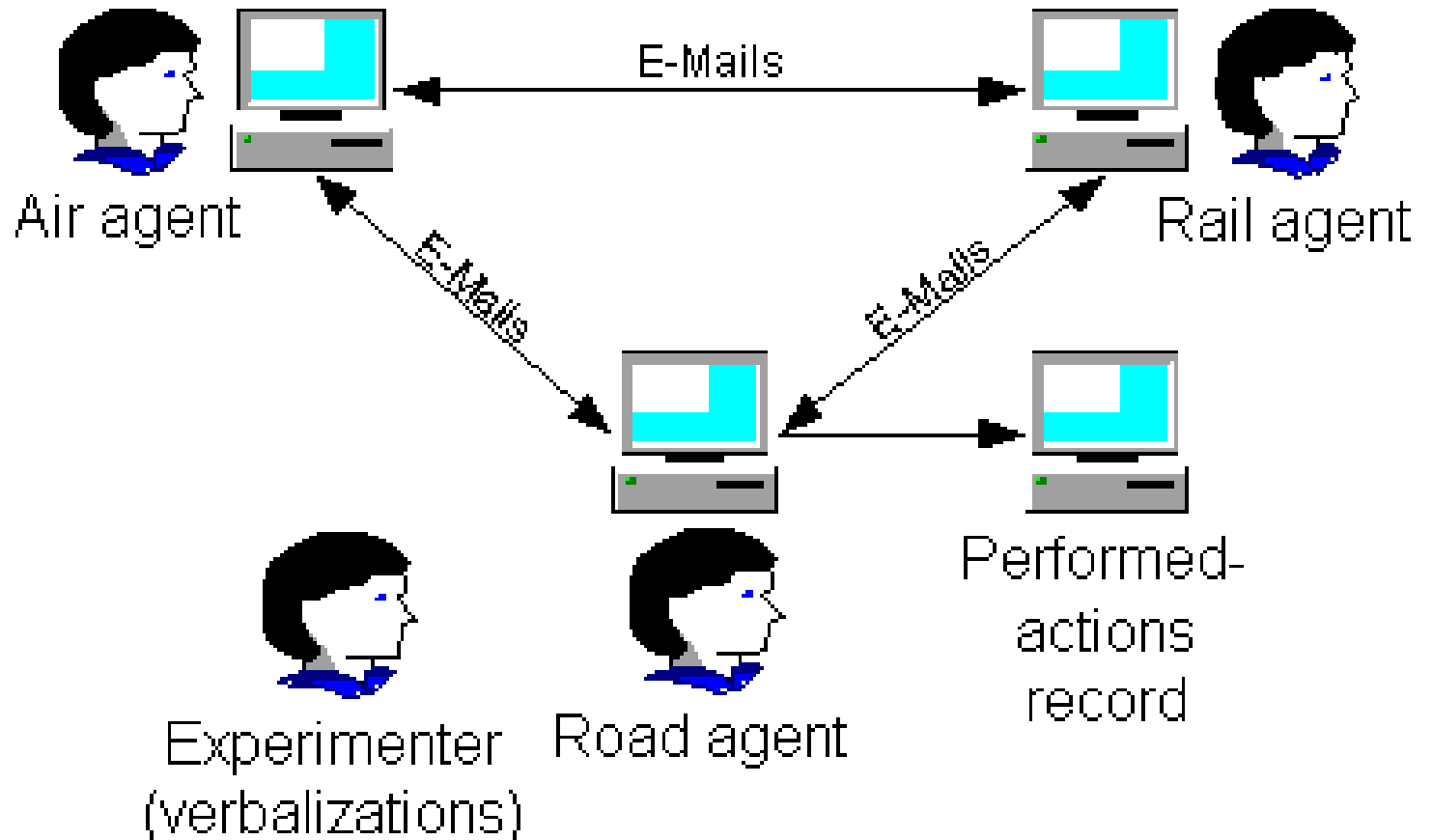
- Implementing BDlggy
- Parametrizing our system
- Simulation
- Validating the cognitive models
(Turing-like test)



That's all folks...

?

Psychological experiment



Example of conversation

Messages	Performatives	
<p>[08:23:48] From: Air-agent To: Railway-agent I have just learnt that it is possible to travel from Paris to Montpellier by train! Could you please give me some timetables?</p>	query	
<p>[08:28:45] From: Railway-agent To: Air-agent Yes, it's possible, there are 7 different departures from 8:12 until 18:28 (departure time). Are you interested in them? Could you be more precise on the time departure? Thanks.</p>	reply + propose-information + query	
<p>[08:29:52] From: Air-agent To: Railway-agent Yes, from 10:15.</p>	reply	
<p>[08:33:18] From: Railway-agent To: Air-agent Here is the first =====Time table===== Paris-Montpellier (train) Date: Tomorrow -- 1 person 10:30/14:39 - 590 F</p>	reply	
<p>[08:33:49] From: Railway-agent To: Air-agent Now number 2, do you want any others? =====Time table===== Paris-Montpellier (train) Date: Tomorrow -- 1 person 12:06/16:21 - 590 F</p>	reply + propose-information	