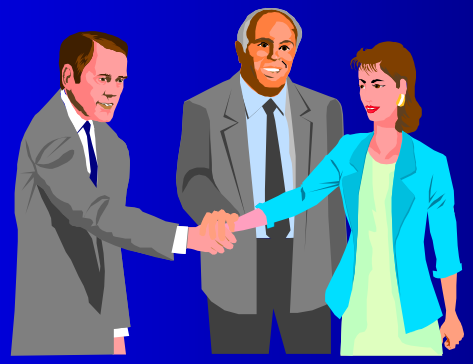
Πανεπιστήμιο Αθηνών
Τμήμα Πληροφορικής - Μεταπτυχιακό

Χάρης Γεωργίου, ΑΜ: Μ-177
mailto:grad0177@di.uoa.gr

ΕΠΙΚΟΙΝΩΝΙΑ ΜΕ ΟΜΙΛΙΑ

«The Structure of Multimodal Dialogue»

Speech Acts in Multimodal Dialogues & Knowledge for Communication.



Αθήνα, Φεβρουάριος 2000

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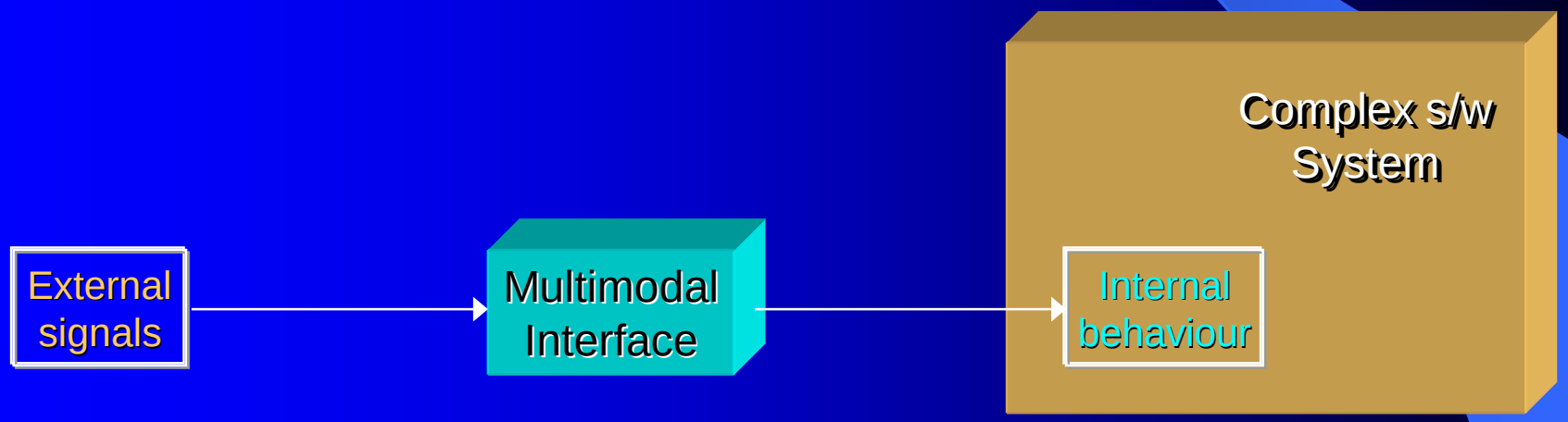
Multimodal Interfaces

Basic Idea: interconnection of multiple external signals with internal behaviour (intentions) in complex software systems.

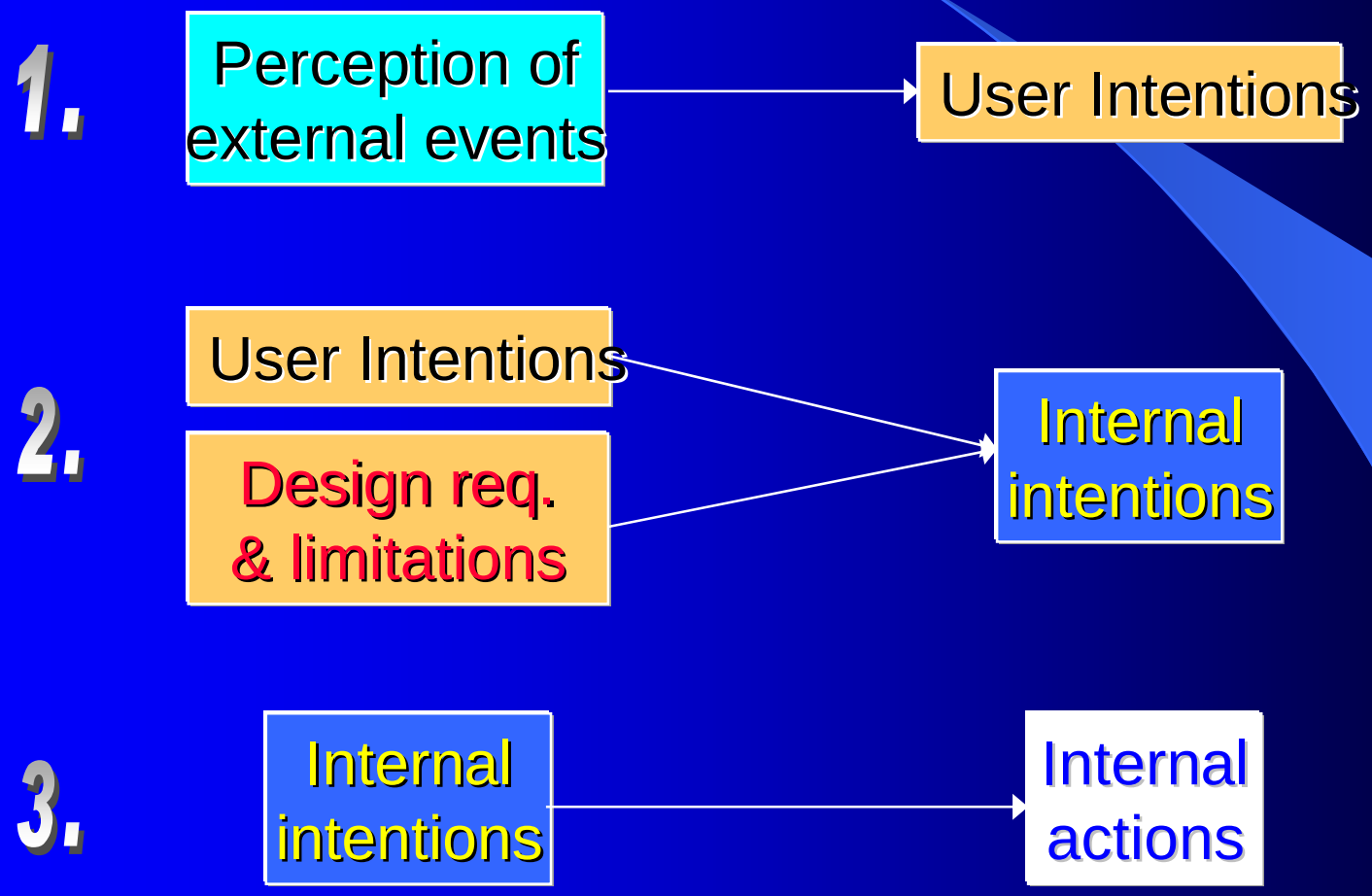


- Classic U.I. : keyboard typewriter
- "Smart" U.I. : speech act ("Can you take me to the bank?")

The «Context» advantage:

- ✓ Take advantage of the current context (mental state) to reduce the required input size from the user.
- ✓ Small input ⇨ Reduce bandwidth
- ✓ Complex Systems ⇨Context-based directions & commands
- ✓ *Help the user define his intentions by gradual refinement of the execution instructions, using a context-based approach for user input.*

INTERFACE SYSTEM DESIGN



SPEECH ACT THEORY

- **Speech Act = Communicative Act**
- **Language:** *actions to affect "mental state" (beliefs, desires, intentions)*
- **Actions:** *distimguish to Communicative or not*

Communicative actions: *the goal is to show intentions, in a way conceivable by the receiver.*

SPEECH ACTS:

- Illocutionary: acts **IN** performing (assert, warn, …)
- Perlocutionary: acts **BY** performing (convince, scare, …)

- Illocutionary acts: successful by doing
- Perlocutionary acts: successful(?)

- Illocutionary acts: basis of communication
- Perlocutionary acts: without direct communication

Assert: «The time is 10:35'» - Convince: ???

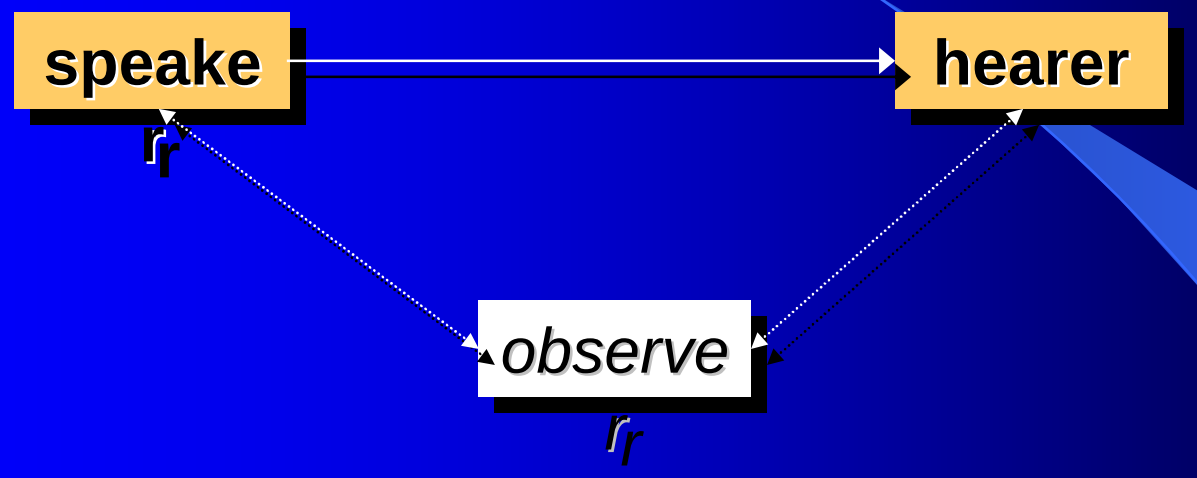
Speech Act Theory

- **Reduces to**: characterize correct performance for illocutionary & perlocutionary acts

PROBLEMS

- No 1-to-1 relation of sentence forms & speech acts
- 1 sentence to many illocutionary acts («It's hot in here»)
- Acts performed by several sentences
- Ironic utterances
- Compound sentences

C&L Model for Speech Acts:



Speaker: says (p), so believes (p)

Hearer: hears (p), ensure to believe (p)

C&L model ➔ *monotonic logic*

Reiter's model ➔ *(**Default Logic**) non-monotonic logic*

DEFAULT LOGIC (Reiter's model)

- Declerative sentense scheme is assumed.

Default Logic («how-to» for agents)

- adopt the attitudes of another
- observer's mental state changes
- assume actions are intentional
- sentenses reveal aspects of speaker's mental state

Default Rules - Language

r[t]	: proposition [r] is true at time [t]
DO[x,t](a)	: agent [x] does action [a] at time [t]
B[x,t](p)	: agent [x] believes proposition [p] at time [t]
I[x,t](p)	: agent [x] intends proposition [p] at time [t]

DEFAULT RULES for Speech Acts (D0 rule set)

Consistency : $B[x,t](p) \supset \neg B[x,t](\neg p)$

Closure : $B[x,t](p) \ \& \ B[x,t](p \supset q) \supset B[x,t](q)$

Memory : $B[x,t](p) \supset B[x,t+1](B[x,t](p))$

Persistence : $B[x,t+1](B[x,t](p)) \supset B[x,t+1](p)$

Observability : $DO[x,t](a) \ \& \ DO[y,t](Obs(x)) \supset B[y,t+1](DO[x,t](a))$

Belief Transfer: $B[x,t](B[y,t](p)) \Rightarrow B[x,t](p)$

Declarative : $DO[x,t](p.) \Rightarrow B[x,t](p)$

(p.) = propositional content

RECOGNITION OF INTENTIONS

***Illocutionary acts**: successful only if the hearer recognizes the speaker's intentions*

Intentions Consistency

- I-Consistency : $I[x,t](p[t']) \supset \neg I[x,t](\neg p[t'])$
- BI-Consistency : $I[x,t](p[t']) \supset \neg B[x,t](\neg p[t'])$

DEFAULT RULES - Revised (D1 rule set)

{additions to the D0 rule set}

Intentionality : $DO[x,t](a) \Rightarrow I[x,t](DO[x,t](a))$

Declerative : $I[x,t](DO[x,t](p.)) \supset B[x,t](p)$

(p.) = propositional content

SPEECH ACT

- *begin from starting conditions (known mental state)*
- *extend using default logic rules (D1)*
- *final state: consistent with starting conditions*

Asserting : S asserts that believes (p), so finally both S and H come to believe that S believes (p) (mutual belief).

Lying : insincere assertions

Convincing : sincere assertions

Informing : assert with intention to be believed

SPEECH ACTS - CONCLUSIONS

GRAMMARS OF DISCOURSE:

Linguistic models that describe real human dialogue processes

? *Possible*

? *Useful*

Discourse Linguistics: *extend semantic account of single sentenses to larger discourses (extended context).*

- *Interpretate simple main clauses with illocutionary acts*
- *Extend to explicit performative sentenses*
- *Extend to multi-sentense context (no explicit relations)*
- *Use «cue» words to adjust extended context*

DISCOURSE GRAMMARS

- *Tool to process and understand syntactical ambiguous utterances, just like context-based (real) grammars do.*
- *Very difficult to implement*
- *Cue-words successfully guide the process (context extent)*
- *Usually applicable to task-oriented dialogues*
- *If no cue-words, only sentence ordering is in use (more difficult)*

KNOWLEDGE FOR COMMUNICATION

AIM: Develop a computational model of the cognitive process of human communication

Relation of Speech act & AI: building & understanding action plans

Knowledge in Communication (consists of):

- dialogue rules in specific situations
- illocutionary acts (question, assertion, promise, …)
- linguistic games
- conversational games
- behavioural games

Competence vs. Computational Models

Theory of Human Behaviour

- Competence Model (Chomsky - 1957)
Minimal set of general assumptions
- Computational Model (Pylyshyn - 1984)
Cognitive processes producing performance

Illocutionary Acts & Mental States

Communicative act $\Rightarrow$ reach mutual belief (affect mental states)

Bind illocutionary acts with mental states (speaker's commitment)

Serious Conversational Situation: commit speaker to the expressed illocutionary act.

MODELLING INTERACTIVE BEHAVIOUR

Complex Performances ⇨ representation of stereotyped patterns of behaviour (possible ?)

«GAME» : **Communicative act knowledge structure**

- represent interpersonal plans
- shared among «actors» (agents)

Communicative Games:

- Linguistic
- Conversational
- Behavioural

COOPERATION

- Actors (agents) perform actions with common goals, with a shared plan.
- Crucial in any theory of dialogue

Conversational Cooperation $\Rightarrow$ in Linguistic and/or Conversational games
Behavioural Cooperation $\Rightarrow$ in Behavioural games

A: «At what time will the President arrive?»
B: «I cannot tell you.»

Refuse to give informative answer:
conversational: OK, behavioural: DENY

LINGUISTIC GAMES

A: «How old are you?»
B: «28»
Not context-free, answer content depends heavily on the question

A: «How old are you?»
B: «I am 28 years old»
Context-free answer, content is not ambiguous

GENERIC FORM OF A LINGUISTIC GAME:
wh-question : A asks B the reference of (the x) Fact(x)
answer : B informs A about the reference of (the x) Fact(x)

- Move in two-step act to achieve specific goal
- Goal of illocutionary act is its perlocutionary act

Examples of Linguistic Games:

- wh-question → answer
- yes-no-question → answer
- request → response
- inform → accept
- assert → agree/disagree
- propose → accept
- promise →accept

Notes on Liguistic Games

request-response

- In the present : Communicative act = executive or linguistic
- In the future : Communicative act = linguistic (only)

assert-agree/disagree

- Disagree : B accepts A's beliefs
- Negation : B does not accept A's beliefs (A is insincere)

Indirect Speech Acts:

- combine multiple lignuistic games
- extensive use in real human dialogues

CONVERSATIONAL GAMES

A: «How old are you?»
B: «Why do you ask me?»
A: «Top secret!»
B: «What is your social security naumber?»

<u>Last question:</u> request for clarification or refusal to answer?

Conversational (speech) act:

- **?** Relevant
- **?** Cooperative (Grice - 1967)

Basic Hypothesis:

Conversational cooperation relies on the shared knowledge of the ***conversational game****, which includes the rules actually used by actors for generating conversations.*

1st move (A) : A's request

2nd move (B) : B's response

- accept (compliance)
- reject (no compliance)
- negotiate (comply under conditions)

- *It is not possible to define at this level how the negotiation is carried on.*

Speech Act Sequences

Conversations:

Communicative acts in succesive turns, each cosisting of multiple speech acts connected across turns by linguistic games.

Conversational game - possibilities:

1. Speech act = 1st move, no linguistic game open
2. Speech act = 2nd move, linguistic game already open
3. Speech act = 2nd move of old, 1st move of new linguistic game
4. Speech act = opening for 2nd game, previous game still active (**nesting**)

BEHAVIOURAL GAMES

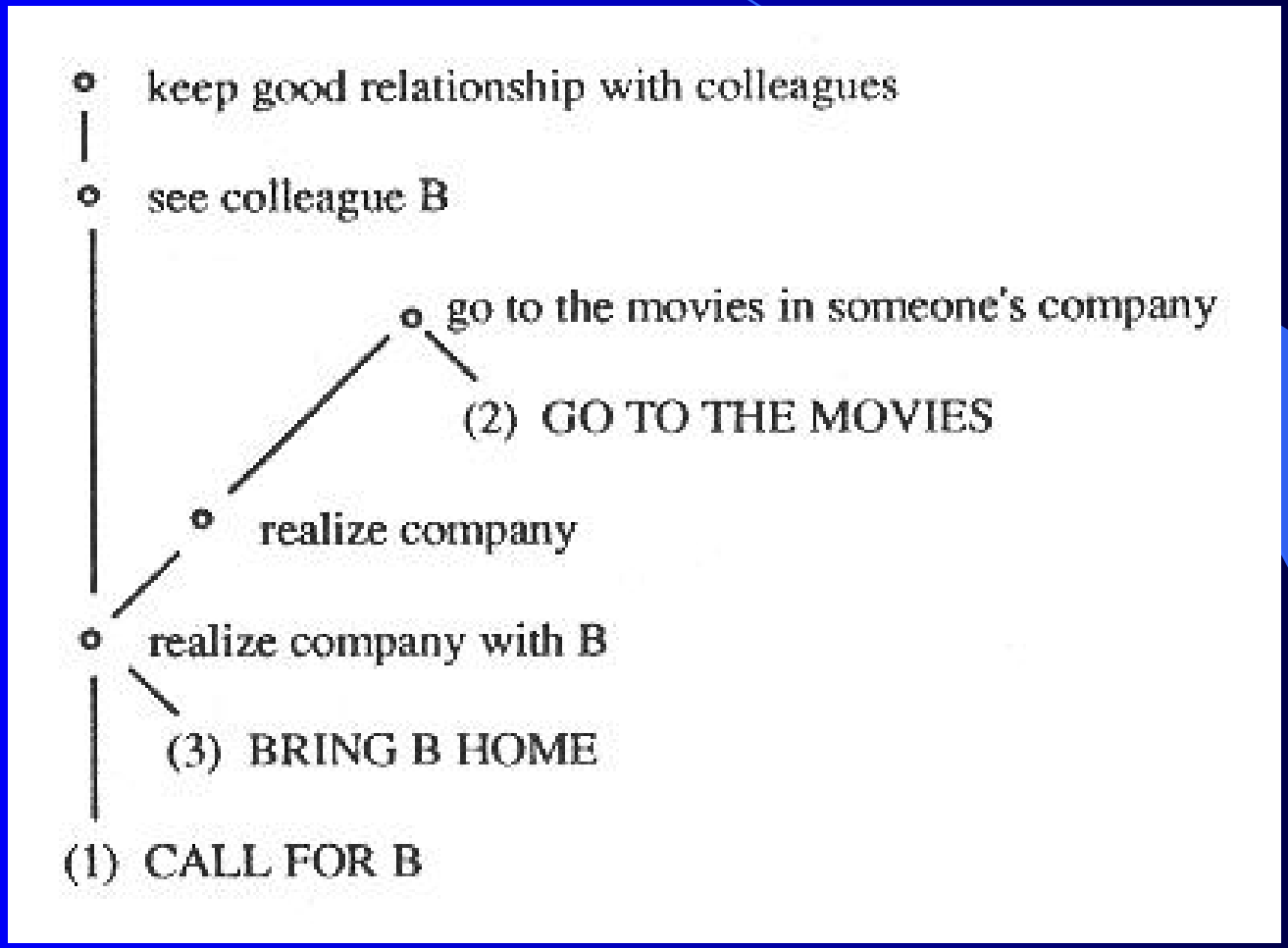
A: «Will you come to the party tonight?»
B: «Yes, I will.»

<u>Response:</u> informative answer or acceptance?

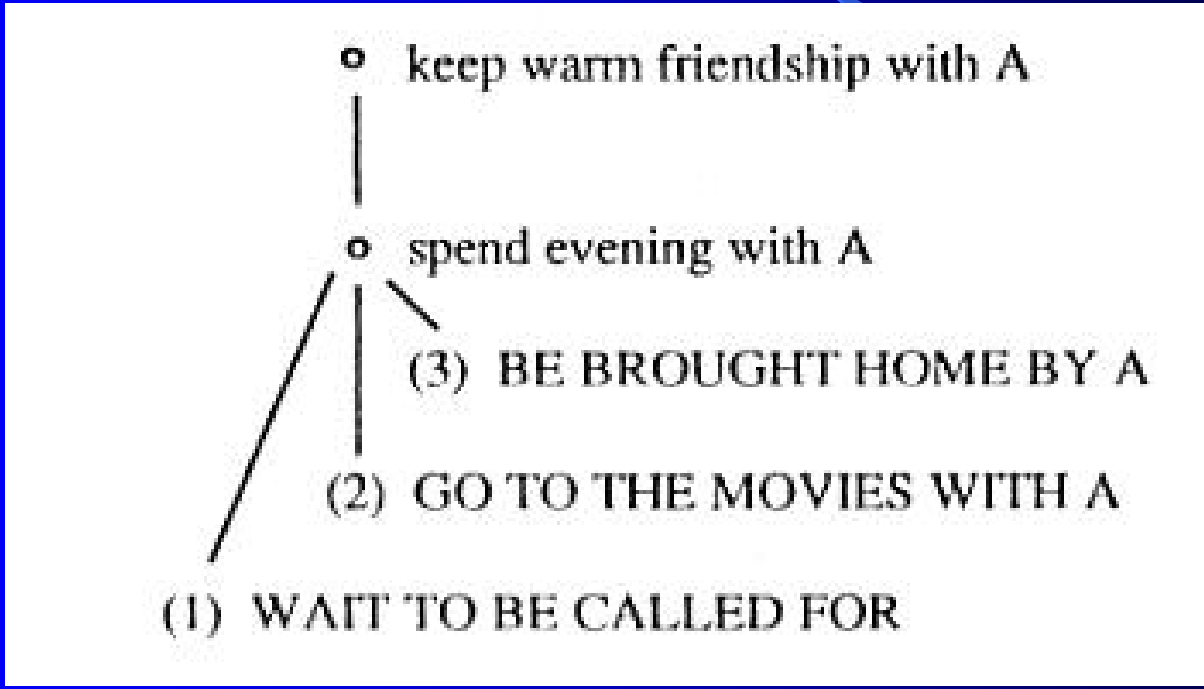
Behavioural game:

- ? Context knowledge (interpersonal relationships)
- ? Stereotyped patterns of interaction (plan description)

A Behavioural Game from A's Point of View:



A Behavioural Game from B's Point of View:



Comments on Behavioural Games

A can perform his speech act because he assumes that his representation of the behavioural plan is shared with **B**.

A : «Let's go to the movies tonight»
B : «I'm quite tired. I would prefer to have dinner together»
A : «Take a rest tonight, we can go to the movies tomorrow»
B : «Well, we could have dinner at my place»

Terminal actions are the same, but behavioural plans are **behaviourally compatible**, not the same.

Behavioural games ⇒ in general use for managing different aspects of **interpersonal behaviour** (communicative interactions)

NOTES ON GAMES

- **Games**: necessary to account for important processes as **recoveries from communication failures**.

- **Games**: can be used as **action plans**:
  A: «Did you come by car?»
  B: «Sorry, this time I need it»

- **Linguistic Games**: capture actor's standard expectations of partner's responses, not to define strict dialogue grammars.

SUMMARY

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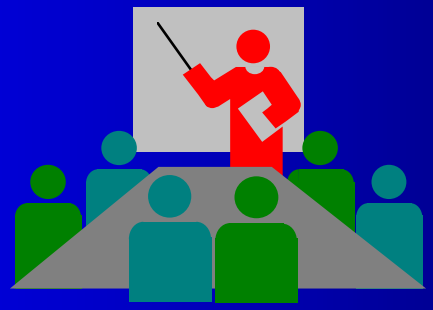
Contact:

E-mail: mailto:grad0177@di.uoa.gr (Χάρης Γεωργίου, AM:M-177)

WWW: http://www.di.uoa.gr/~grad0177/files/speech1.zip

(Presentation files, MS-PowerPoint 7.0)