

PRAGMATICS, DISCOURSE AND DIALOGUE

Introduction

Dave Bowman: Open the pod bay doors, HAL

HAL (The robot): I'm sorry Dave, I'm afraid I can't do that.

***Stanley Kubrick and Arthur C. Clarke,
Screenplay of 2001: A Space Odyssey***

Introduction

The knowledge needed

- **Morphology**: Meaningful components of words. **Lexicon**
e.g., *doors* is plural
- **Syntax**: Structural relationships between words. **Grammars**
e.g., many sentences consists of a noun phrase followed by a verbal phrase
- **Semantics**: Meaning of words and how they combine.
Grammar, domain knowledge
e.g., *Open, you, the pod bay door*
- **Pragmatics**: How language is used to accomplish goals.
Domain and dialogue knowledge
e.g., to be polite
- **Discourse**: How single utterances are structured
e.g., How the interventions of participants in a conversation are related

Introduction

- **Semantics** => meaning
 - Combining the meaning of several parts of a sentence
- **Pragmatics** => using language in context
 - Using language to achieve goals
 - Inferring participant desires

Introduction

- Discourse: a related group of sentences
- Types of discourse:
 - Monologue
 - Communication flows from the speaker to the hearer
 - Dialogue
 - Participants takes turns being a speaker and hearer
 - They consists of several communicative acts:
 - Asking questions, giving answers, making corrections
 - Human-computer interaction is different from human-human interaction

AMBIGUITY

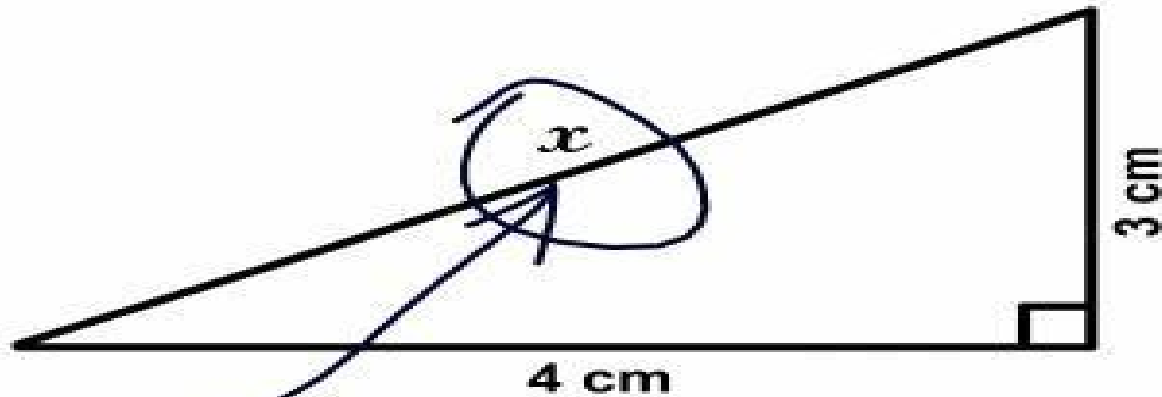
- Resolving ambiguous input
 - Multiple alternative syntactic and semantic structures can be built
 - ***I made her duck***
 - *I cooked waterfowl for her*
 - *I cooked waterfowl belonging to her*
 - *I created the (plaster?) duck she owns*
 - *I caused her to quickly lowed her head or body*
 - *I waved my magic wand and turned her into undifferentiated waterfowl*

AMBIGUITY

- Resolving ambiguous input
 - Multiple alternative syntactic and semantic structures can be built
 - *I made her duck*
 - Syntactic and semantic ambiguities
 - **Duck** can be a verb (waterfowl) or a (go down) -> syntactic ambiguity
 - **Her** can be a dative pronoun or a possessive pronoun -> syntactic ambiguity
 - **Make** can be create or cook -> semantic ambiguity
 - Pragmatic – Intention recognition
 - **She has already have dinner**
 - **He/she is taking care of her**

Pragmatic Ambiguity

3. Find x .



Here it is

Which kind of ambiguity?

After explaining to a student through various lessons and examples that:

$$\lim_{x \rightarrow 8} \frac{1}{x-8} = \infty$$

I tried to check if she really understood that, so I gave her a different example.

This was the result:

$$\lim_{x \rightarrow 5} \frac{1}{x-5} = 5$$

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Resolving ambiguous input

- Using models and algorithms
- Using knowledge
 - Using linguistic knowledge
 - Using domain and context knowledge.
(Shallow or Partial analysis)
- Using data-driven methods

Semantic Representation

Representing domain concepts following a formalism
Logic, frames, ontologies,...

Ontologies

It is an appropriate formalism to represent concepts and supporting reasoning

exists (X, instance (X, cat),
exists (Y, instance (Y, fish),
eats (X,Y)))

cat, fish, eat belong to an ontology

Reification of predicates (Hobbs)

Predicates in the logical forms are represented as entities (classes and instances) in the Ontology.

Then the predicates in the logical form can be substituted by binary relations associated to each of the parameters:

$P(X_1, X_2, \dots, X_n)$

instance (p, P),
arg1 (p, X1),
arg2 (p, X2),
...
argn (p, Xn)

exists (X, instance (X, cat),
exists (Y, instance (Y, fish),
exists (Z, instance (Z, eat),
arg1 (Z, X),
arg2 (Z, Y))))

Reification of the relations (Hobbs)

```
exists (X,instance (X, cat),
        exists (Y, instance (Y, fish),
                exists (Z, instance (Z, eat),
                        agent (Z, X),
                        patient (Z, Y))))
```

```
exists (X,instance (X, cat),
        exists (Y, instance (Y, fish),
                exists (Z, instance (Z, eat),
                        propval (Z, agent, X),
                        propval (Z, patient ,Y))))
```

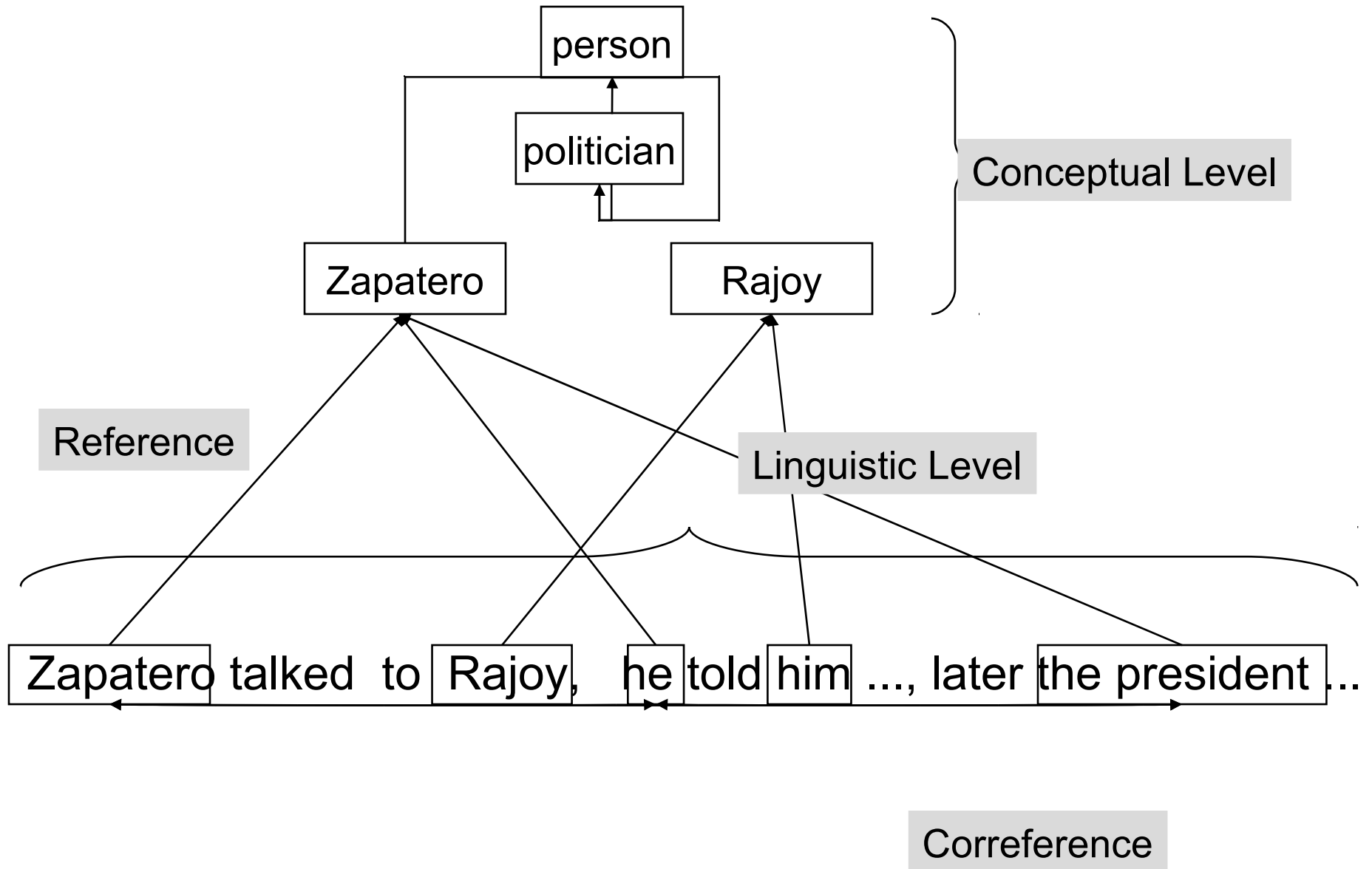
instance

==> relate the particular item to the class it belongs

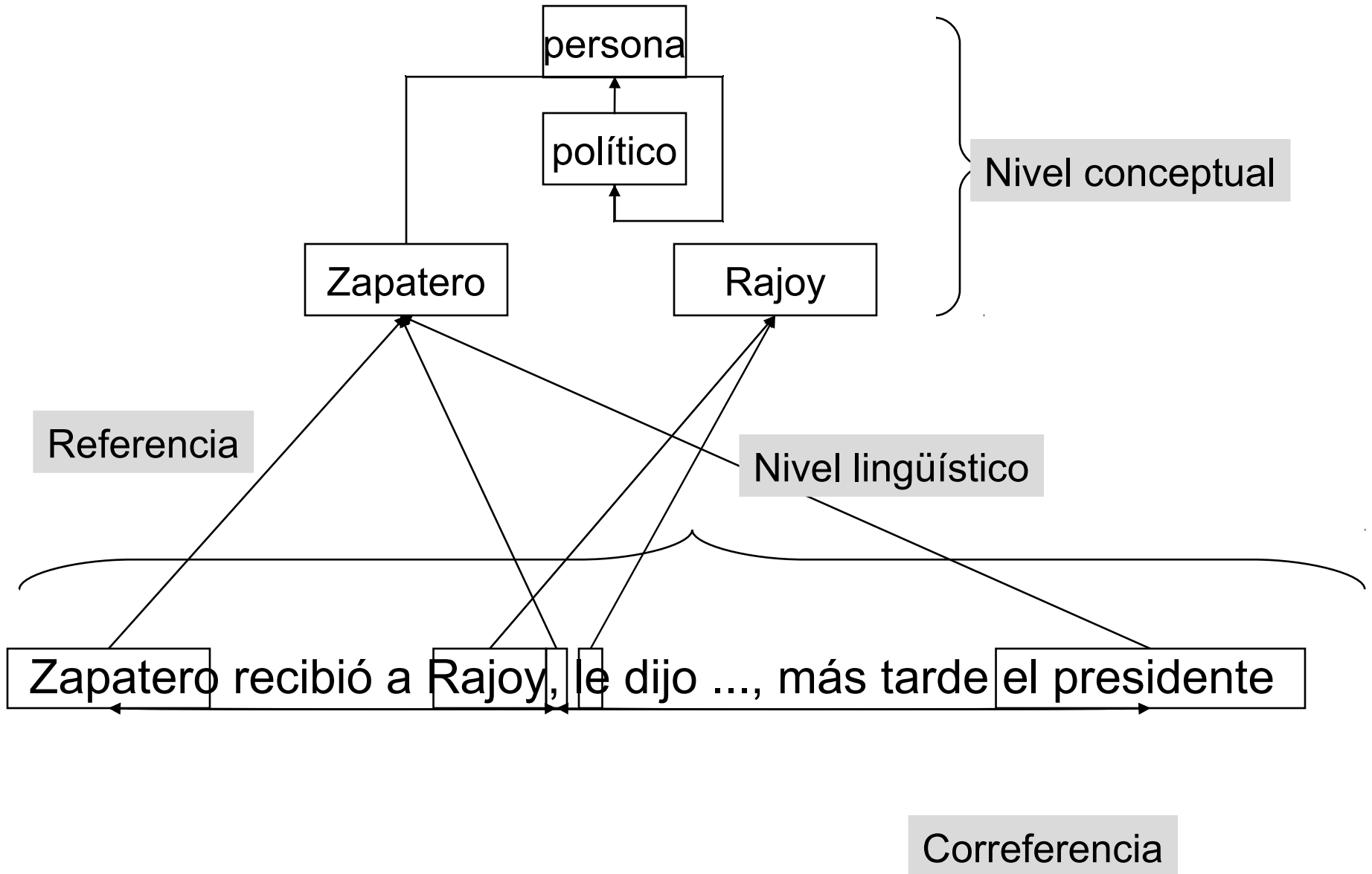
propval

==> associate a value with the relation of an instance

Semantic Representation



Semantic Representation (II)



Pragmatics

Intention Recognition in Dialogue

- User's interventions are interpreted as one (or more) **dialogue act** (*speech act* or *dialogue move*)
- Examples of dialogue acts
 - Greet/Thank you/Goodbay
 - Opinion
 - Confirming/Accepting
 - Recognizing
 - Question/Answer/Yes-No
 - Quit
- Efforts for standard definition

Pragmatics

Intention Recognition in Dialogue (II)

Knowledge Sources

- Application Specification
 - Consulting information, transaction
- Linguistic information
 - Punctuation
 - Words/cue words: *but*, *because*
- Dialogue knowledge (or history)
- Dialogue Structure
 - Subdialogues
 - Subject shift
- Prosody information
 - Duration, pauses

Pragmatics

Intention Recognition in Dialogue (III)

Empirical methods

- Statistical classifiers of dialogue acts
 - Methods based on ***Hidden Markov Models***
 - Using several types of information
 - words, punctuation, dialogue history
- Rule based dialogue acts recognizers
- Machine learning techniques

Discourse (I)

Anaphora: Reference to a previous entity

Coherence: Relations between sentences and paragraphs

- Justification, result, etc.
- The meaning of a fragment is more than meaning of the parts

Structure: Hierarchical structure. Discourse segments are related

Several theories and algorithms to deal with these phenomena

Discourse (II)

Several processes

- Discourse segmentation (considering events)
- Representing and processing the discourse events (and objects involved in them)
- Detecting and representing main focus
- Solving references

Discourse (III)

- Example: Do you know how to get there?
 - What “there” refers to?
 - Is it a question about your capacities or is a demand for an action?- Pragmatics

The reference (I)

What it is?

- It is relationship between a domain entity and the linguistic objects representing it
- First it is the presentation of the entity, next it is the reference to this entity
- It is a pragmatic phenomenon

The reference (II)

How to solve it?

- First, central elements of the sentences have to be selected
 - They are grammatically related to the main verb (subject, object,...)
 - They can connect a sentence with previous
 - They can connect a sentence with next

The reference (III)

How to solve it?

- Second, when pronouns are found conceptual expectatives have to be established
 - Using morfosyntactic information
 - Exemple: She arrives today
She refers to **one female person**
- Third, rules are applied to filter and rang the possible candidates (central elements) satifying the expectatives

The reference (IV)

- *I let the book at the table. One hour later I took it .*
- *I let the book at the table. Then I clean it.*
- *I gave the book to Pedro. A week later I asked it to him.*
- *I gave the book to Pedro. A week later I asked another one.*
- *I bought a cat. The animal did not let me sleep.*
- *I bought a car. The wheels were burnt.*

The reference (V)

- *Puse el libro en la mesa. Más tarde lo cogí.*
- *Puse el libro en la mesa. Más tarde la limpié.*
- *Dejé el libro a Pedro. Luego se lo pedí.*
- *Dejé el libro a Pedro. Luego le pedí otro.*
- *Compré un gato. El animal no me dejaba dormir.*
- *Compré un coche. Las ruedas estaban gastadas.*

Discourse Model (I)

- Theory used to interpret the expressions
- Elements of all Discourse theories:
 - **Common ground (Shared knowledge)**
 - Participants actions on common ground
 - Expanding, asking , negation,...

Discourse Model (II)

- Contributions of participants
==> modify the common ground
- Presentation by one participant
- Acceptation by other(s) participant(s)

Discourse Model (V)

- **Hobbs Theory (78)**

- Coherence relations between sentences
 - Result
 - *Maria is from Barcelona. Joana from Mallorca*
 - Explication
 - Parallelism
 - *Maria is from Barcelona. Joana from Mallorca*
 - Elaboration The proposition inferred from two different sentences is the same
 - Occasion
 - *Pere brought his computer. They worked until late.*
- There is a hierarchical structure between relations
Discourse coherence
- Domain knowledge is used to determine relations

Discourse Model (VI)

Mann, Matthiessen and Thompson Theory (87)

Rhetorical Structure Theory (RST)

Hierarchical organization of the relations

- Nucleus and Satellite:
 - Evidence
 - » Kevin must be here. His car is parked outside.
 - Elaboration
 - Contrast
 - Condition
 - List
 - Background

23 rhetorical relations are defined

Automatic Coherence Assignment

Cue based. Using explicit marks

- Splitting items
 - *First, second*
- Elaboration
 - *In particular, additionally, ...*
- Parallel constructions
 - *In a similar form*
- Changing the focus
 - *A different problem, ...*
- Ending
 - *In summary, concluding, ...*

Automatic Coherence Assignment

- Using several features
 - Syntactic structure
 - Order
 - Time in verbs
 - Entonation
 - Cue words

Discourse Model

- **Kamp Theory (81)**

Discourse Representation Theory (DRT)

- Focus in anaphora **between sentences**

- **McKeown Theory(85)**

Focus in discourse structure

- Used in text generation

DIALOGUE

The dialogue is a type of discourse

Main features in discourse

Anaphora: Reference to a previous entity

Coherence: Relations between sentences

- Justification, result, etc.
- The meaning of a fragment is more than meaning of the parts

Structure: Hierarchical structure. Discourse segments are related

Several theories and algorithms to deal with these phenomena

What makes dialogue different?

- Turn-taking
 - Turn-taking Rules
 - Participant A, Participant B, Participant A
 - A turn does not necessary consist of a sentence
 - Dialogue segmentation is not easy
- Common ground
 - Speaker and hearer perform a joint action
 - They constantly establish common ground
- Utterance can be considered as (dialogue) actions
 - They are classified: directives, assertive,...

What makes dialog different (II)

- Dialogues are short
 - Interventions are usually clauses
 - Subjects are usually pronouns
- New phenomena appear
 - Pauses
 - Errors, rectifications
 - Confirmations
 - New beginning
- Human-machine dialogs and human-machine dialogues are different
 - Users try to be clearer and more direct

Dialogue SystemTasks

- Interpreting user intervention
 - Using dialog and domain knowledge
- Dialogue Management
 - Determine next system action considering user's intention
- Answer Generation
 - Generation of the appropriate sentences to achieve the system's goals.

Interpretation of the user intervention

- Goal: understanding user's intention
- The complexity of this process depends on the system
 - Complete (deep) syntactic and semantic analysis
 - Partial (shallow) syntactic and semantic analysis
 - *Processing key words*
- This process is restricted by considering limited applications tasks

Reference resolution

U: On fan **Heroes** a **Sant Cugat**?

S: **Heroes** la passen al **Cinema Cinesa de Sant Cugat**

U: Quan **la** fan?

S: La fan a les 8:30pm, a les 10pm, i a les 11:30pm.

U: Vull 2 entrades per **adults** i 2 per **nens** per la **primera sessió**.
Quant serà en **total**?

- Knowledge Sources:
 - **Domain Knowledge**
 - **Dialogue Knowledge**
 - **Domain (world) knowledge**

Reference resolution

U: Where the movie **Heroes** is shown in **Sant Cugat**?

S: **Heroes** is shown at **Cinema Cinesa in Sant Cugat**

U: At what time is **it** shown?

S: It is shown at 8:30pm, 10pm and 11:30pm.

U: I want 2 tickets for **adults** and 2 for children **nens** for **first session**

How much is **it**?

- Knowledge Sources:
 - Domain Knowledge
 - Dialogue Knowledge
 - Domain (world) knowledge

Reference resolution(II)

- Central elements of the sentences have to be selected
 - They are grammatically related to the main verb (subjecte, objecte,...)
 - They can connect a sentence with previous
 - They can connect a sentence with next
- When pronouns are found several rules are used to rang and filter the possible central elements

Reference resolution (III)

- Most references are solved using knowledge discourse
- Central elements (focus) are stored in a stack
 - Only last nominal groups are stored
- Objects satisfying syntactic, semantic and pragmatic restrictions are selected
 - Starting by the stack top
 - “There ” is a place
 - Considering discourse structure
 - Relating objects and subdialogs

Intention Recognition

- User's interventions are interpreted as one (or more) **dialogue act** (*speech act* or *dialogue move*)
- Examples of dialogue moves
 - **Switchboard DAMSL**
 - Ini/final conventional
 - Opinion
 - Confirming/Accepting
 - Recognizance
 - Question/Answer/Yes-No
 - No-verbal
 - Quit
 - **Verbmobil**
 - Greet/Thank you/Goodbay
 - Suggestion
 - Acceptation/Rebuig
 - Confirmation
 - question/
clarification/Answer
 - Giving the reason
 - Thinking
- Efforts for standard definition

Dialogue Management

- Controlling dialog to help user to achieve his goals
 - At each step of the conversation
 - **Who can speak**
 - What can be said
 - Used information
 - Interpretation of the user intervention
 - Application (domain) knowledge

Dialogue Management (II)

- Determine the next system's action(s)
 - Answer user's questions
 - Ask the user for more information
 - Confirm/Clarify user's interventions
 - Notify problems when accessing the application
 - Suggest alternatives
- Generation of the system's messages
 - The content
 - The presentation