

Discourse & Natural Language Generation

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What is a discourse?

- The linguistic term for a contextually related group of sentences or utterances
- Basic discourse types
 - Monologue
 - Dialogue
 - HCI turn taking / "dialogue"

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Cohesion and Coherence

- Cohesion
 - The bond that ties sentences to one another on a textual level
- Coherence
 - The application of cohesion in order to form a discourse

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Reference Phenomena 1

- Indefinite noun phrases
 - an apple, some lazy people
- Definite noun phrases
 - the fastest computer
- Demonstratives
 - this, that
- *One*-anaphora

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Reference Phenomena 2

- Inferrables
 - car \Rightarrow engine, door
- Discontinuous sets
 - they, them
- Generics
 - they

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Referential Constraints

- Agreement
 - Number
 - Person and case
 - Gender
- Syntactic constraints
- Selectional restrictions

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Coreferential Expressions

- Coreference
 - Expressions denoting the same discourse entity corefer
- Anaphors
 - Refer *backwards* in the discourse
 - The referent is called the antecedent
- Cataphors
 - Refer *forwards* in the discourse

Although *he* loved fishing, *Paul* went skating with Mary.

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Pronouns

- Seldom refer more than two sentences back
- Requires a salient referent as antecedent
- Antecedent Indicators:
 - Recency
 - Grammatical role
 - Parallellism
 - Repeated mention
 - Verb semantics

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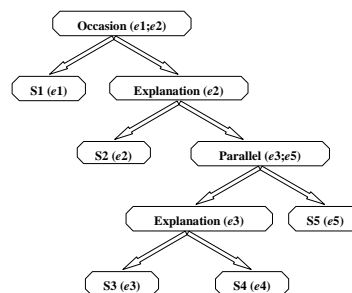
Text Coherence

- Coherence relations
 - Result
 - Explanation
 - Parallel
 - Elaboration
 - Occasion

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A Discourse Tree



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Discourse Structure

- John went to the bank to deposit his paycheck (S1)
- He then took a train to Bill's car dealership (S2)
- He needed to buy a car (S3)
- The company he works for now isn't near any public transportation (S4)
- He also wanted to talk to Bill about their softball league (S5)

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Inference 1

Rule: If it rains the ground gets wet
 Observation: It rains
 Conclusion: The ground gets wet

Deduction: rule + observation → conclusion (modus ponens)
 Induktion: observation + conclusion → rule (modus tollens)
 (Abduktion: rule + conclusion - (!) → observation)

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Inference 2

- John hid Bill's car keys. He was drunk.
 1. ⇐ John usually does stupid things when drunk
 2. ⇐ Bill often drives when drunk
- Bill was drunk. John hid his car keys.
 1. ⇐ Bill tends to "borrow" cars when drunk
 2. ⇐ Bill often drives his car when drunk

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Background Knowledge

- The problem of encoding inference is usually said to AI-complete
- AI-completeness indicates that the problem requires all of the knowledge – and utilities to utilize it – that humans possess

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Different Levels

- Syntax
 - Rules for constructing grammatical sentences
- Semantics
 - Rules for assigning meaning to statements
- Pragmatics
 - Rules (of thumb) for applying contextual constraints on the semantics of a statement

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Pragmatics

- The study of meaning contained by utterances in situations (Leech, 1983)
- Relates the content of a clause (semantics) with the content of an utterance of that clause (pragmatics)
- Pragmatic rules often rules of thumb
- Dialogues – Cooperative Principles

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Grice's Cooperative Principle

- **Quantity**
 - Don't say more than necessary
- **Quality**
 - Don't say anything you do not believe in or have proof of
- **Relevance**
 - A response should be an answer to the question
- **Form**
 - Be clear / avoid ambiguity
 - Be concise
 - Be methodical

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Discourse, what for?

- Information Retrieval
- Summarization
- Pronoun Resolution
- ...
- Natural Language Generation

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What Is Natural Language Generation?

A process of constructing a natural language output from non linguistic inputs that maps meaning to text.

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Related Simple Text Generation

- Canned text
 - Outputs predefined text
- Template filling
 - Outputs predefined text with predefined variable words/phrases

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Areas of Use

NLG techniques can be used to:

- generate textual weather forecasts from representations of graphical weather maps
- summarize statistical data extracted from a database or spreadsheet
- explain medical info in a patient-friendly way
- describe a chain of reasoning carried out by an expert system
- paraphrase information in a diagram for inexperienced users

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Goals of a NLG System

To supply text that is:

- correct and relevant information
 - non redundant
- suiting the needs of the user
- in an understandable form
- in a correct form

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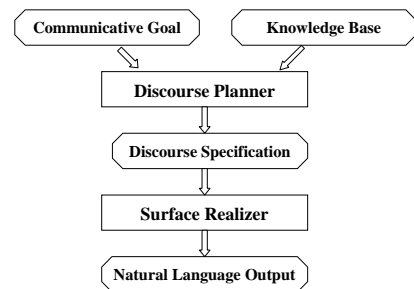
Choices for NLG

- Content selection
- Lexical selection
- Sentence structure
 - Aggregation
 - Referring expressions
 - Orthographic realisation
- Discourse structure

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Example Architecture



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Discourse Planner

1. Text shemata
 - Use consistent patterns of discourse structure
 - Used for manuals and descriptive texts
2. Rhetorical Relations
 - Uses the Rhetorical Structure Theory
 - Used for varied generation tasks

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Discourse Planner – Rhetorical Relations

Rhetorical Structure Theory (Mann & Thompson 1988)

- Nucleus
 - Multi-nuclear
- Satellite

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Discourse Planner Rhetorical Relations

23 rhetorical relations, among these:

• Cause	• List
• Circumstance	• Occasion
• Condition	• Parallel
• Contrast	• Purpose
• Elaboration	• Result
• Explanation	• Sequence

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Surface Realisation

1. Systemic Grammar
 - Using functional categorization
 - Represents sentences as collections of functions
 - Directed, acyclic and/or graph
2. Functional Unification Grammar
 - Using functional categorization
 - Unifies generation grammar with a feature structure

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Surface Realisation – Systemic Grammar

- Emphasises the functional organisation of language
- Surface forms are viewed as the consequences of selecting a set of abstract functional features
- Choices correspond to minimal grammatical alternatives
- The interpolation of an intermediate abstract representation allows the specification of the text to accumulate gradually

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Surface Realisation – Systemic Grammar

```

graph LR
    Mood --- Major
    Mood --- Minor
    Major --- Indicative
    Major --- Imperative
    Minor --- Present-Participle
    Minor --- Past-Participle
    Minor --- Infinitive
    Indicative --- Declarative
    Indicative --- Interrogative
    Declarative --- BoundRelative[Bound Relative]
    Declarative --- Ellipsis[...]
    Declarative --- Polar
    Interrogative --- Wh-
    
```

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Surface Realisation – Functional Unification Grammar

Basic idea:

- Input specification in the form of a FUNCTIONAL DESCRIPTION, a recursive <attribute,value> matrix
- The grammar is a large functional description with alternations representing choice points
- Realisation is achieved by unifying the input FD with the grammar FD

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Surface Realisation – Functional Unification Grammar

```
((cat clause)
 (process ((type composite)
           (relation possessive)
           (lex 'hand'))))
 (participants ((agent ((cat pers_pro)
                        (gender feminine)))
               ((affected ((cat np)
                           (lex 'editor'))))
               ((possessor ((cat np)
                             (possessed ((cat np)
                                           (lex 'draft'))))))))
```

She hands the draft to the editor.

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Microplanning 1

- Lexical selection
- Referring expression generation
- Morphological realization
- Syntactic realization
- Orthographic realization

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Microplanning 3 Aggregation

Some possibilities:

- Simple conjunction
- Ellipsis
- Set introduction

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Aggregation

Without aggregation:

- It has a snack bar.
- It has a restaurant car.

With set introduction :

- It has {a snack bar, a restaurant car}.
- It has a snack bar and a restaurant car.

Caution! Need to avoid changing the meaning:

- John bought a TV.
 - Bill bought a TV.
- ≠ John and Bill bought a TV.

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Further Reading

- Siggen
 - <http://www.dynamicmultimedia.com.au/siggen/>
- Allen 1995: Natural Language Understanding
 - <http://www.uni-giessen.de/~g91062/Seminare/gk-cl/Allen95/al1995co.htm>

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