

# Generating Instructions in Virtual Environments

Session I: Introduction

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15 October 2009

# Welcome!

- Software project, WS 09/10
- BSc, MSc students: German vs. English
- Let's start with a demo!

# Today: Introduction

- Organization of this course
- Introduction to natural language generation (NLG)

# Organization

- Software project:  
Teams of students implement a medium-sized piece of NLP software.
- Here: Design and implement an NLG system that generates instructions in virtual worlds.
- Goal: Enter system into GIVE-2 Challenge.

# Schedule

- Part 1: Introductory lectures
  - ▶ Oct 22: GIVE
  - ▶ Oct 29: Implementing GIVE systems; tool support
  - ▶ Nov 5, 12: Topics in situated communication
- Part 2: Project
  - ▶ you design and implement GIVE systems
- Last meeting: February 5 - this is when your system needs to be finished.

# Project phase

- now - Nov 12:
  - ▶ Come up with an interesting idea for a GIVE system (be creative!).
  - ▶ Please come talk to me at any time.
- Nov 12 - Nov 18:
  - ▶ Come discuss your idea with me.
- Nov 19:
  - ▶ Present your idea to the class.

# Project phase

- Nov 19 - Feb 4:
  - ▶ design and implement your system
  - ▶ weekly meetings to track progress and discuss problems
- Feb 5:
  - ▶ present your finished system to the class
- Feb 5 - Apr 30:
  - ▶ GIVE-2 evaluation

# Beyond the semester

- February?
  - ▶ present your systems to the interested public
- March 31
  - ▶ seminar papers due
- July
  - ▶ GIVE results presented at INLG conference in Ireland
  - ▶ I might be able to support one student's trip to present our GIVE systems



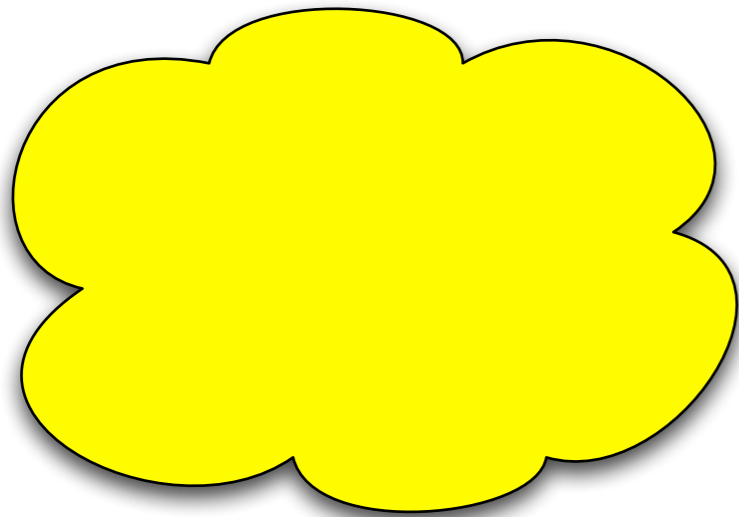
# Course requirements

- Your grade:
  - ▶ 50% project work
  - ▶ 30% seminar paper
  - ▶ 20% talk
- Keep in mind: Course is worth 12 CP (for BSc) / 8 CP (for MSc); expect to work accordingly hard.

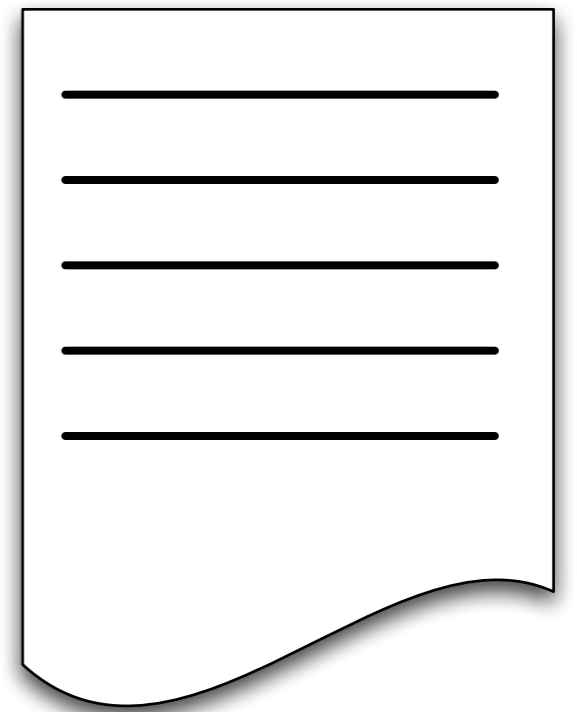
# That's it for organization

- Questions?

# Natural language generation



whatever



text

# NLG: Example applications

Input Data			Output Text	
Hour of the day	Wind Direction	Wind Speed		
0	S	10.0		
3	S	12.0		
6	N	15.0		
9	S	20.0		
12	S	15.0		
15	S	13.0		
18	S	12.0		
21	S	10.0		
24	S	10.0		

Generate >>>

**S 8-13 backing N 13-18 by early morning, then veering S 18-23 by morning, and easing 8-13 by midnight.**

# NLG: Example applications



“This exhibit is a lekythos, created during the archaic period. It dates from circa 500 BC. It was painted by Amasis with the red figure technique and it originates from Attica.”

“... Unlike the previous exhibit, it originates from Attica.”

“Questo reperto è una lekythos.”

“Αυτο' το ε'κθεμα ει'ναι μια λη'κυθος.”

# NLG: Example applications

S: *I found 28 round trips from Edinburgh to Brussels on October 31st and returning Edinburgh on November 6th. For option 1, I have an outbound flight with KLM departing at 7 am and arriving at 8:49 am non-stop. A return flight is with KLM departing at 10:30 am and arriving at 11:28 am with 1 stopover. Ticket price is £165. Please say "next option", or, "flight details", or, "I'll take it".*

U: Next option

S: *For option 2, I have an outbound flight with KLM departing at 3:30 pm and arriving at 5:19 pm nonstop. A return flight is with KLM departing at 8:25 pm and arriving at 12:28 pm with 1 stopover. Ticket price is £165 please say "next option", or, "flight details", or, "I'll take it."*

U: Next option

S: ...

naive system

U: Hello. I'd like to book a flight from Edinburgh to Brussels for tomorrow arriving at around 3pm.

S: *There are four flights with availability in business class. None are on KLM. The only direct flight arrives at 5:30 pm, which is later than you requested. To arrive earlier, you'll have to make a connection.*

*If you're willing to travel economy, there is a direct flight on BMI, arriving at 1:10 pm. There's also a KLM flight arriving at 1:50 pm, but it requires a connection in Amsterdam. All other economy flights take longer or arrive after 4 pm.*

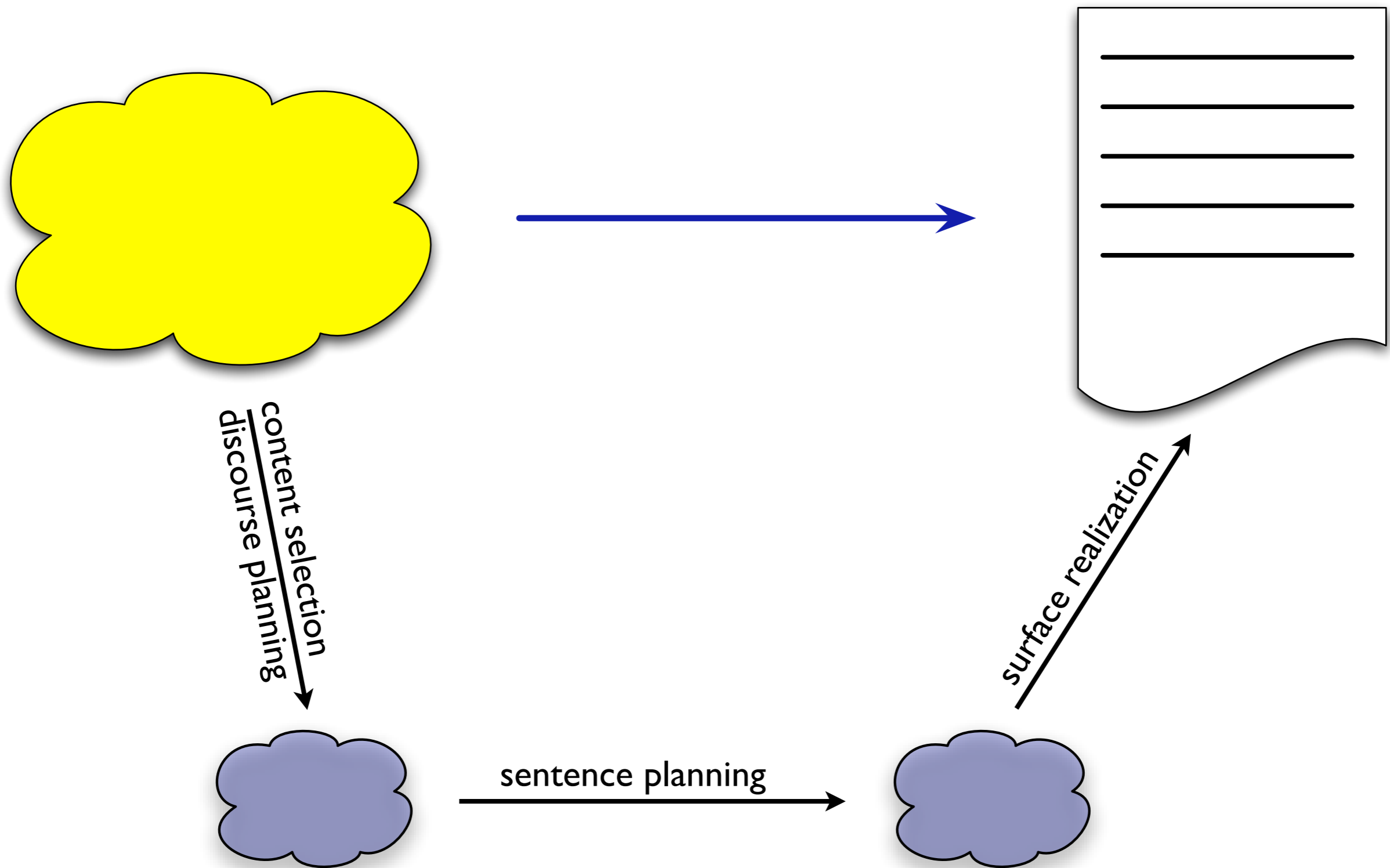
U: Can you tell me more about the business class flights that arrive earlier?

S: *The two flights with shortest travel time are both on British Airways and cost 308 pounds. The first takes 4 hours and 20 minutes and arrives at 1:20 pm. The other takes 4 hours and 30 minutes and arrives at 3:30pm.*

*There's a cheaper flight on Lufthansa. It arrives at 3:10pm and costs just 270 pounds, but it takes 5 hours and 35 minutes. All other business class flights arrive very early or too late.*

Demberg & Moore (2006)

# How do we do this?



# Content determination

- Content selection:
  - ▶ what objects do we want to talk about?
  - ▶ what do we want to say about them?
  - ▶ if necessary, interpret domain data
- Discourse planning:
  - ▶ how to arrange information into a discourse?
  - ▶ how to break information up into sentence-sized chunks?
- Both are typically domain-specific.



# Content selection

	depart	arrive	airline	business	direct	price
1	9:00	13:20	BA	+	-	308
2	9:27	13:50	KLM	-	-	200
3	10:00	15:10	Lufthansa	+	-	270
4	11:00	15:30	BA	+	-	308
5	11:10	13:10	BMI	-	+	150
6	15:30	17:19	KLM	-	+	165
7	15:40	17:30	BMI	+	+	350

Demberg & Moore (2006)

User model: + direct, + business, + KLM

Input: arrive around 3pm

# Discourse planning

## 1. Flights in business class: 4

a) KLM: none

b) describe f7: +direct, arrives 17:30, too late

## 2. Flights in economy class

a) describe f5: BMI, arrives 13:10

b) describe f2: KLM, arrives 13:50, *but* -direct

# Surface realization

- Take specification of each sentence and translate it into the actual sentence in the output language.
- Input:
  - ▶ specification of sentence (e.g., semantic representation)
  - ▶ a grammar or something similar
- Output:
  - ▶ one sentence

# Surface realization

## 1. Flights in business class: 4

a) KLM: none

b) describe f7: +direct, arrives 17:30, too late

## 2. Flights in economy class

a) describe f5: BMI, arrives 13:10

b) describe f2: KLM, arrives 13:50, *but* -direct

# Template-based realization

Hard-coded rule:

“flights in business class:  $X$ ”

→ “There are  $X$  flights in business class”.

Flights in business  
class: 4



“There are four flights  
in business class.”

# Surface realization

1. There are four flights with availability in business class.

a) KLM: none

b) describe f7: +direct, arrives 17:30, too late

2. Flights in economy class

a) describe f5: BMI, arrives 13:10

b) describe f2: KLM, arrives 13:50, *but* -direct

# Surface realization

1. There are four flights with availability in business class.

a) None are on KLM.

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2. Flights in economy class

a) describe f5: BMI, arrives 13:10

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# Surface realization

1. There are four flights with availability in business class.

a) None are on KLM.

b) describe f7: +direct, arrives 17:30, too late

2. Flights in economy class

a) describe f5: BMI, arrives 13:10

b) describe f2: KLM, arrives 13:50, but -direct



don't want separate template  
for each combination

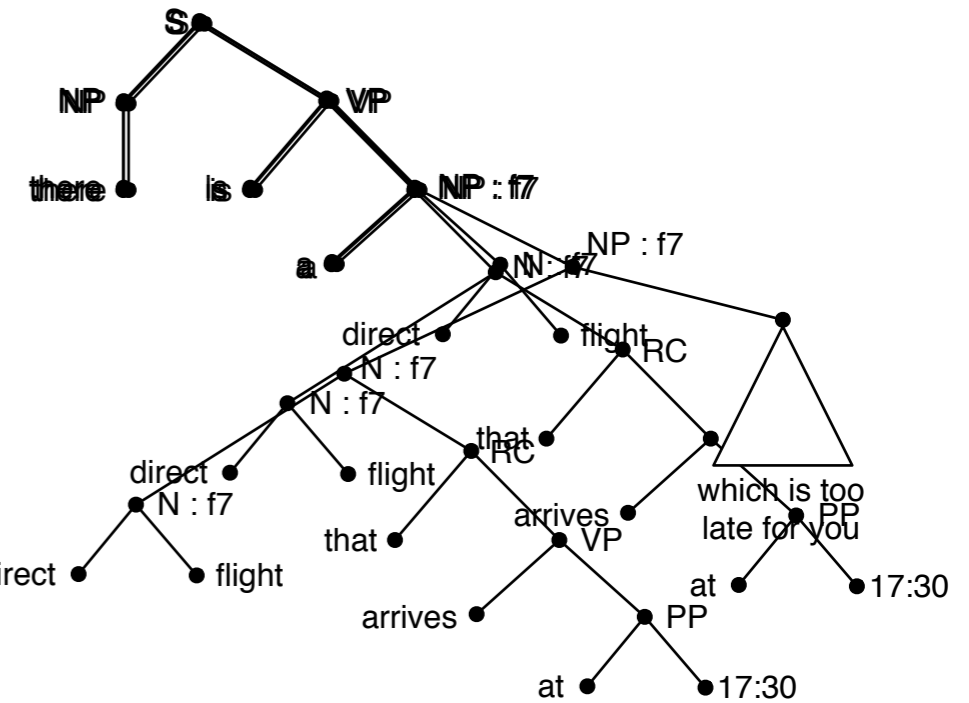
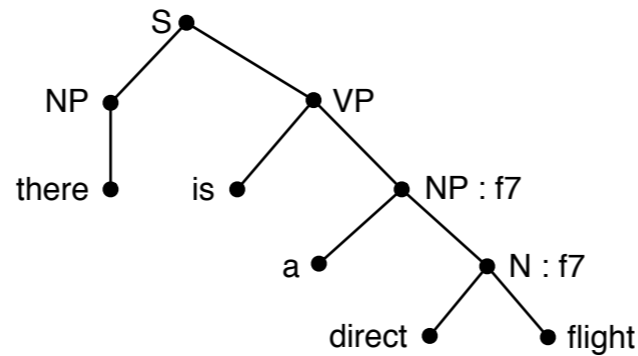


# Surface realization with TAG

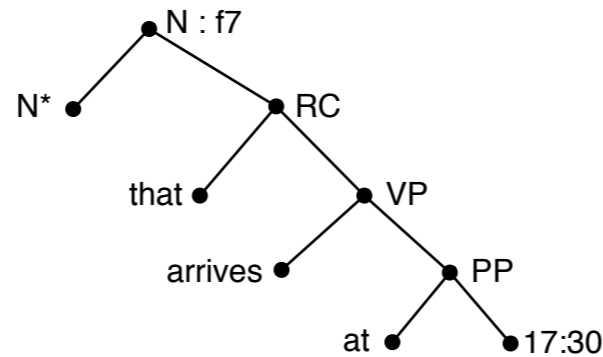
semantics

syntax

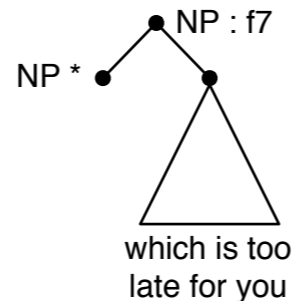
direct(f7)



arrives(f7, 17:30)



too\_late(f7)



“There is a direct flight that arrives at 17:30, which is too late for you.”

# Surface realization

1. There are four flights with availability in business class.

a) None are on KLM.

b) describe f7: +direct, arrives 17:30, too late

2. Flights in economy class

a) describe f5: BMI, arrives 13:10

b) describe f2: KLM, arrives 13:50, *but* -direct

# Surface realization

1. There are four flights with availability in business class.
  - a) None are on KLM.
  - b) There is a direct flight that arrives at 17:30, which is too late for you.
  
2. Flights in economy class
  - a) describe f5: BMI, arrives 13:10
  - b) describe f2: KLM, arrives 13:50, *but* -direct

# Surface realization

1. There are four flights with availability in business class.
  - a) None are on KLM.
  - b) There is a direct flight that arrives at 17:30, which is too late for you.
  
2. **If you're willing to travel economy,**
  - a) describe f5: BMI, arrives 13:10
  - b) describe f2: KLM, arrives 13:50, *but* -direct

# Surface realization

1. There are four flights with availability in business class.
  - a) None are on KLM.
  - b) There is a direct flight that arrives at 17:30, which is too late for you.
  
2. If you're willing to travel economy,
  - a) There is a direct flight on BMI, arriving at 13:10.
  - b) describe f2: KLM, arrives 13:50, *but* -direct

# Surface realization

1. There are four flights with availability in business class.
  - a) None are on KLM.
  - b) There is a direct flight that arrives at 17:30, which is too late for you.
  
2. If you're willing to travel economy,
  - a) There is a direct flight on BMI, arriving at 13:10.
  - b) There's also a KLM flight arriving at 13:50, but it requires a connection in Amsterdam.

# Surface realization

1. There are four flights with availability in business class.
  - a) None are on KLM.
  - b) There is a direct flight that arrives at 17:30, which is too late for you.

2. If you're willing to travel economy,

a) There is a direct flight on BMI, arriving at 13:10.

b) There's also a KLM flight arriving at 13:50, but it requires a connect

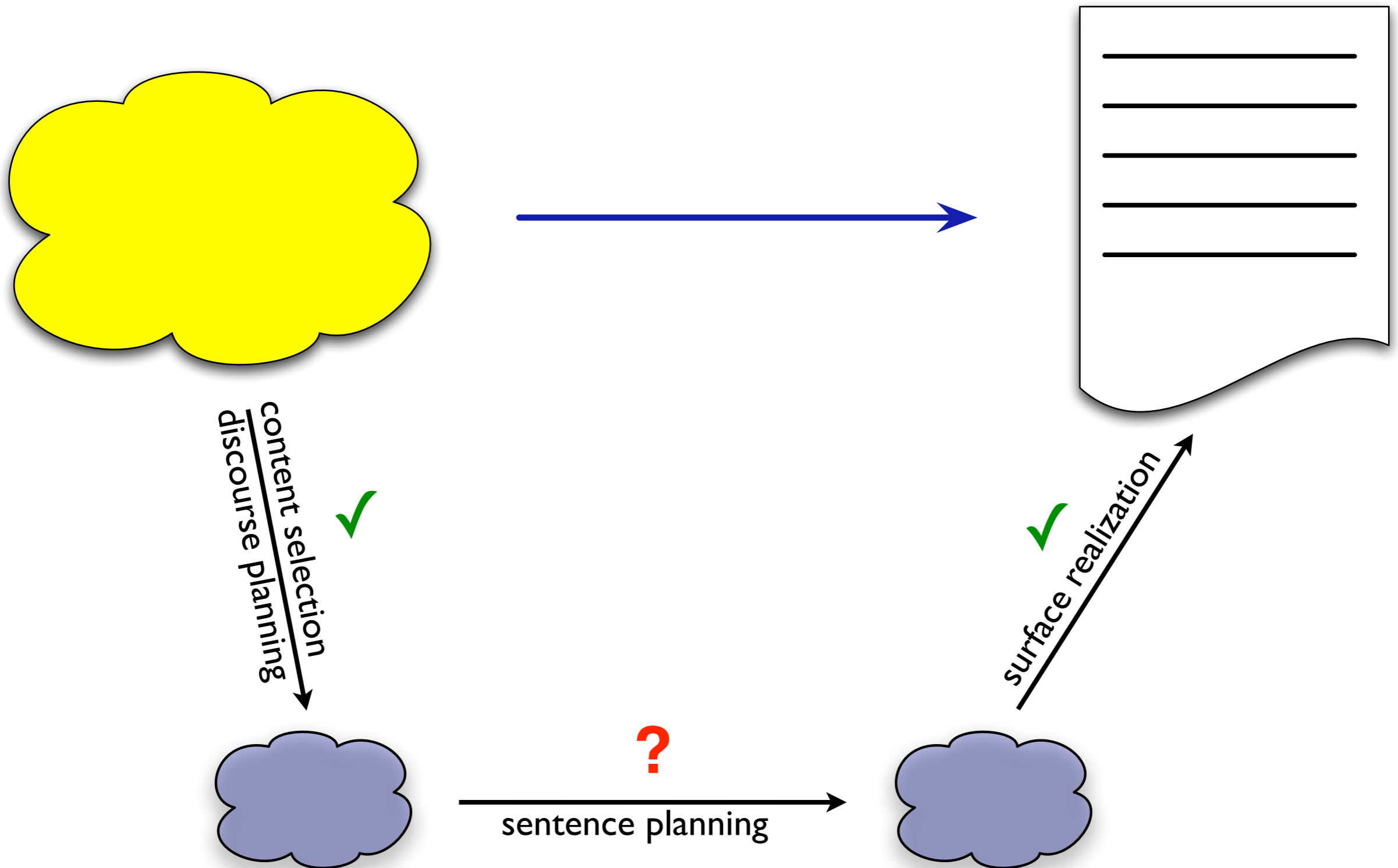
**Merge these two sentences:  
Aggregation.**

# Surface realization

1. There are four flights with availability in business class.
  - a) None are on KLM.
  - b) There is a direct flight that arrives at 17:30, which is too late for you.
2. If you're willing to travel economy,
  - a) there is a direct flight on BMI, arriving at 13:10.
  - b) There's also a KLM flight arriving at 13:50, but it requires a connection in Amsterdam.



# Where are we now?



# Sentence planning

- Output of content determination may be not quite suitable as input of surface realizer.
- Sentence planning: Everything that needs to happen to map CD output to SR input.
- Typically:
  - ▶ referring expression generation
  - ▶ lexical choice
  - ▶ etc.

# Referring expressions

Knowledge base:



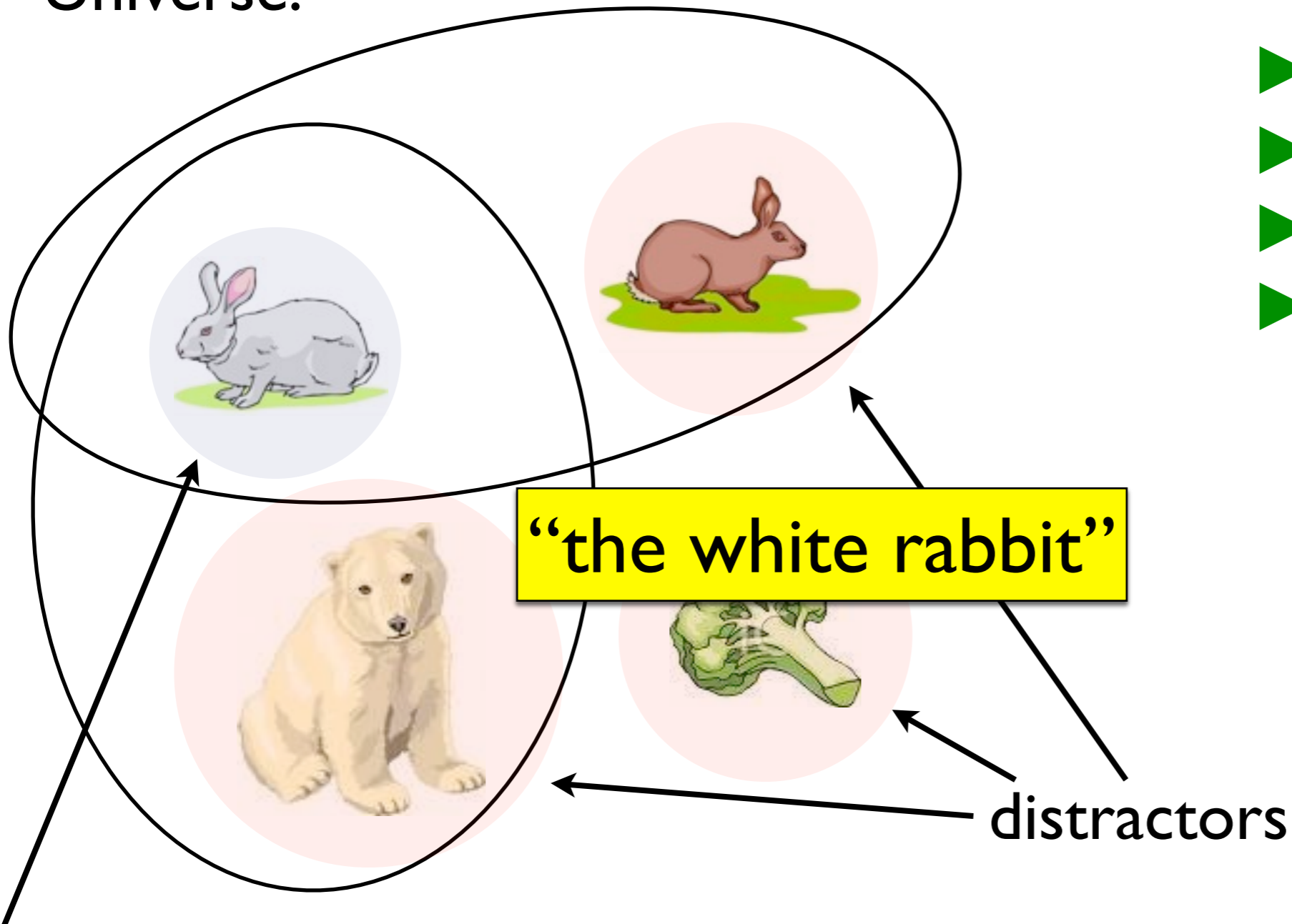
We want to say that  
this guy sleeps.

“The white rabbit sleeps.”

Is this content determination?      Surface realization?

# RE generation

Universe:



List of properties:

- ▶ - rabbit ✓
- ▶ - polar bear
- ▶ - broccoli
- ▶ - white ✓

....

target referent

# RE generation

- Until recently, very active research area.
- 1990s, early 2000s: algorithms for more expressive REs, dominated by logicians
- Recently: focus shift towards cognitive models of “good” REs

# Lexical choice

- Lexical choice: Mapping semantic concepts to content words.
- Not as trivial as it sounds at first glance.
- How to realize generic concepts based on what they apply to?
  - ▶ The temperature **rose**.
  - ▶ The rain got **heavier**.
  - ▶ The revenue **increased**.

# Lexical choice

- How to map real-world values to words?
  - ▶ what RGB values accepted as “red car”?
  - ▶ as “red wine”?
  - ▶ as “red hair”?
- How to distribute bits of meaning over different words?
  - ▶ swim across the lake
  - ▶ traverser le lac à la nage

# Summary

- NLG systems: map stuff to text
- Typical components:
  - ▶ content determination / discourse planning
  - ▶ sentence planning
  - ▶ surface realization
- Suggestion: Play around with these components at home.



# Homework

- Until next Thursday, please read:
  - ▶ Have a look around the GIVE website:  
<http://www.give-challenge.org/research/>
  - ▶ Byron et al. 09, Report on the GIVE-I Challenge:  
<http://www.coli.uni-saarland.de/~koller/showpaper.php?id=give-report-09>
- Next week: The GIVE Challenge.