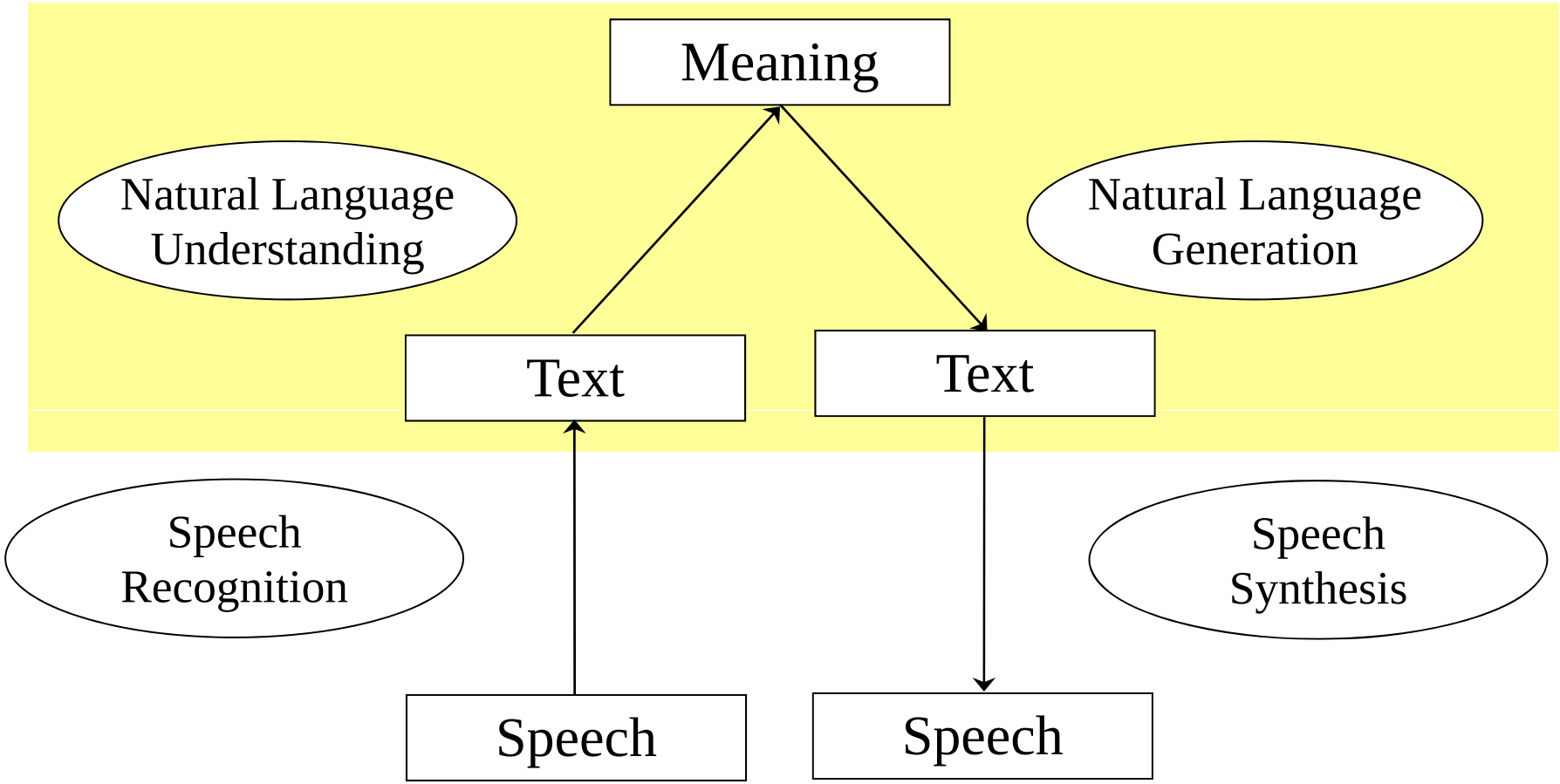
Session 3

- basic theoretical tools of computational linguistics
  - finite state machines + transition networks
  - information state
- Dialogue Systems
  - representing dialogue
  - putting the pieces together

Language Processing Tasks



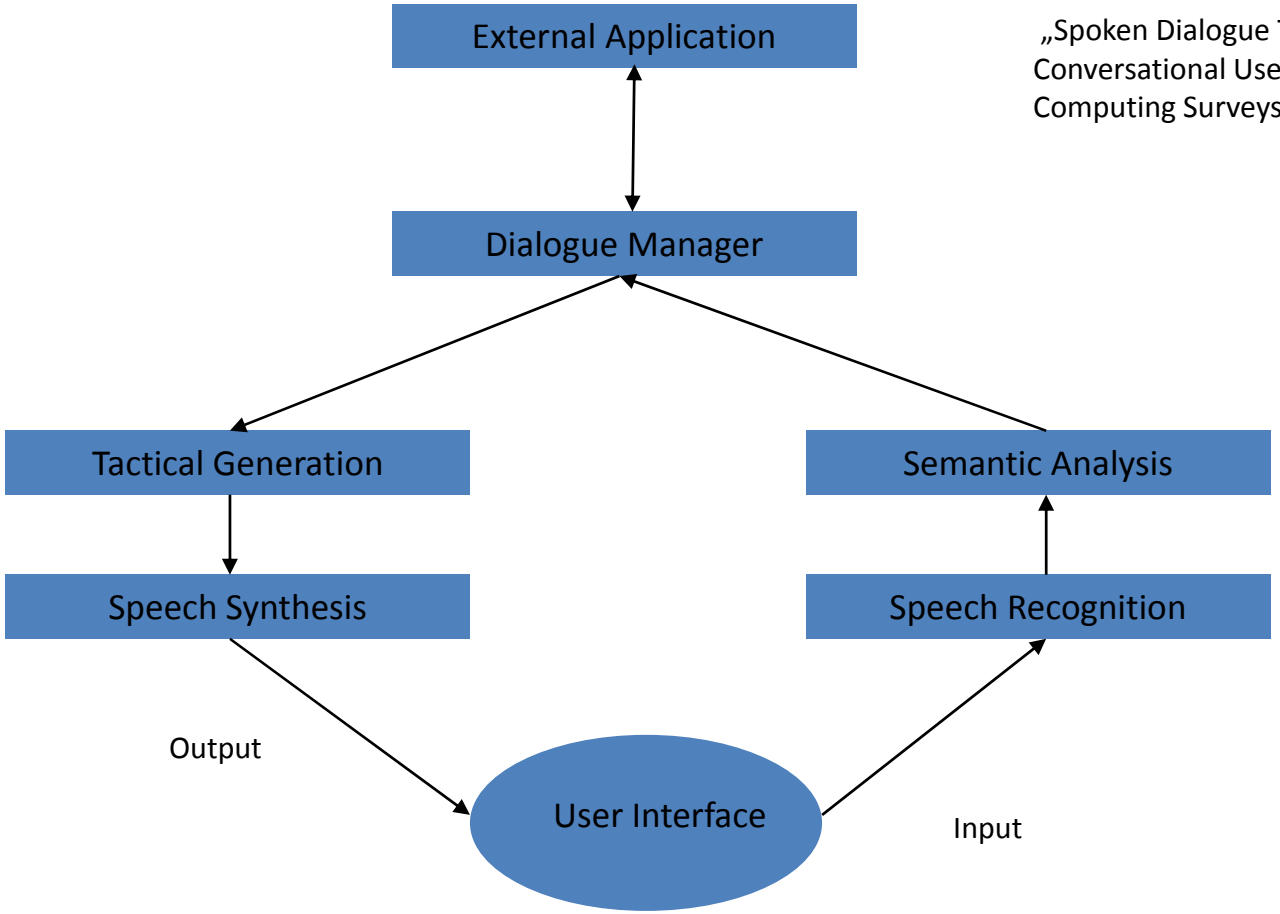
Brief Overview

- What are the components of a dialogue system?
- What approaches have been applied?
- One example of an experimental dialogue system

Components of a speech dialogue system

Mc Tear, Michael F.:

„Spoken Dialogue Technology: Enabling the Conversational User Interface“, ACM Computing Surveys 34(1), 2002.



Approaches to Dialogue Management

- Finite-State Transition Models
- Frame-based Dialogue Control
- Agent-based Dialogue Control
- Information-State Dialogue Control

Finite-State Dialogue Model

System: Where do you want to go?

User: Bremen.

System: Did you say „Berlin“?

User: No.

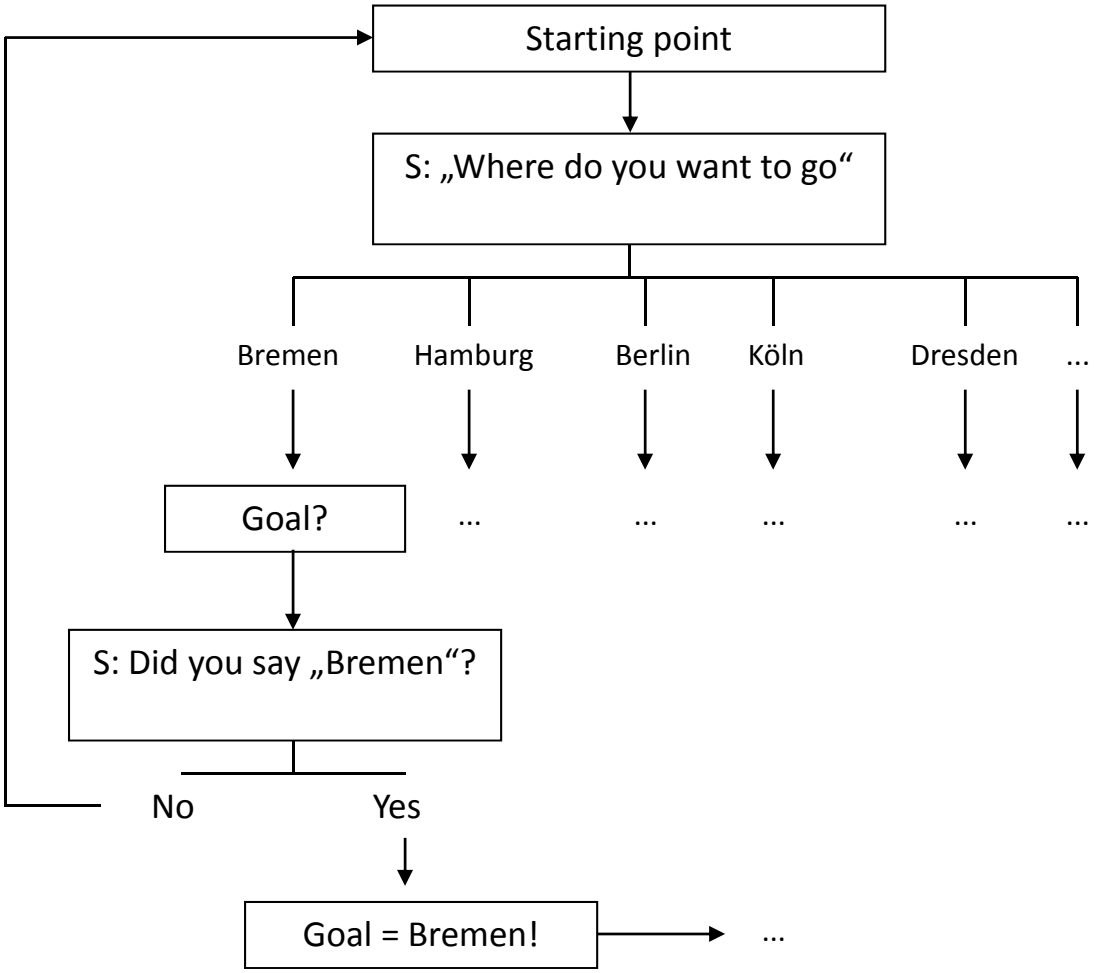
System: Where do you want to go?

User: Bremen.

System: Did you say Bremen?

User: Yes.

System: When...



Frame-based Dialogue Control

System: What can I do for you?

User: I'd like to go to Bremen tomorrow.

System: From where would you like to travel, tomorrow, the 9th March, to Bremen?

User: *From Günne..*

System: You'd like to travel tomorrow from Günne to Bremen. Please tell me your desired departure or or arrival times.

User: I'd like to arrive around 7 pm.

System: You'd like to travel tomorrow from Günne to Bremen and arrive in Bremen at around 1900 hours. Please confirm whether this is correct by saying „yes" or „Correction".

Start	Günne
Goal	Bremen
Date	9.3.2009
Departure	
Arrival	~ 19.00h

Agent-based dialogue control

- Treats many components of a dialogue system as autonomous agents
- Each agent may have its own Beliefs, Desires, Intentions
- Modelled using planning methods from AI

Distinct kinds of knowledge necessary for effective dialogue

- World or Domain Knowledge
- Knowledge of the Dialogue History
- Knowledge about the User
- Dialogue ‘competence’

- Grammatical, Lexical, Semantic, etc. competence

Information-State Based Dialogue Control

- Generally recognised that more flexibility is required for dealing with dialogue
- But it is difficult to coordinate the diverse sources of information and control
- Current proposals assume that dialogue proceeds with respect to
  - **an information state**

  and a set of **update rules** for moving between information states

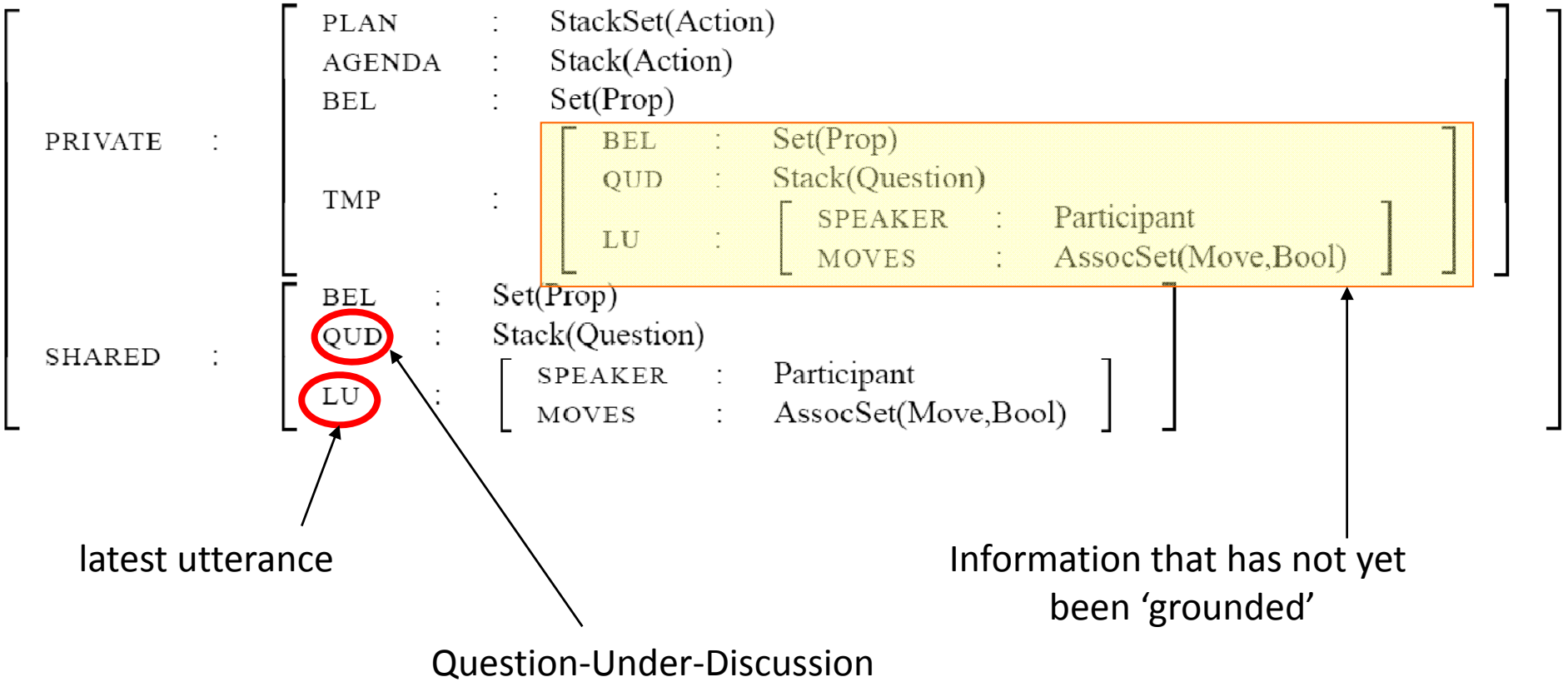
TRINDIKIT: Larsson et al.1999

Information State

- allows a natural combination of information and processes well-known from empirical approaches to dialogue
  - accomodation
  - grounding
  - ‘dialogue games’
  - mutual belief
  - multithreaded dialogue

Information State Organisation

Larsson/Cooper



Update Rules

- Update rules make changes to the information state depending on the **dialogue moves** that are recognised
- For example:
  - if a question is asked, the Question-Under-Discussion update rule pushes the semantic content of the question on to the information in the QUD attribute
  - When the question is answered, there is a corresponding QUD-”Downdate” rule (Ginzburg)

Update Rules

- RULE: **QUD-downdate**

  PRE:
  - member(SHARED.LU.MOVES, answer(A))
  - fst(SHARED.QUD, Q),
  - answer_to(Q, A)

- EFF:
  - pop(SHARED.QUD)
  - reduce(Q, A, P)
  - add(SHARED.BEL, P)

Q: who runs? λx. runs(x)
A: John runs(j)

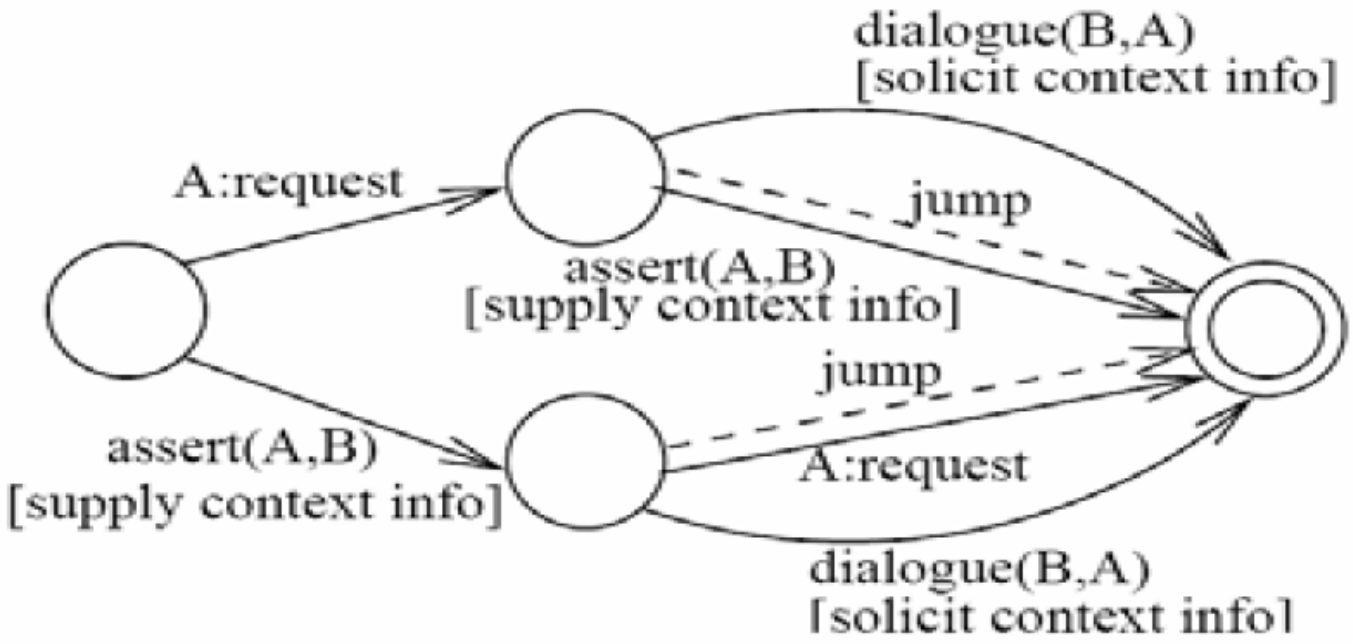
  - When the question is answered, there is a corresponding QUD-”Downdate” rule (Ginzburg)

Problems…

- While powerful, the IS-based approach does not bring out particularly clearly that dialogues **do** have a regular structure
- The dialogue structure is ‘implicit’ in how the rules are written
- So, in our current work, we have combined information state with a finite-state ‘backbone’

Example State Transition Network for Dialogue

Sitter/Stein

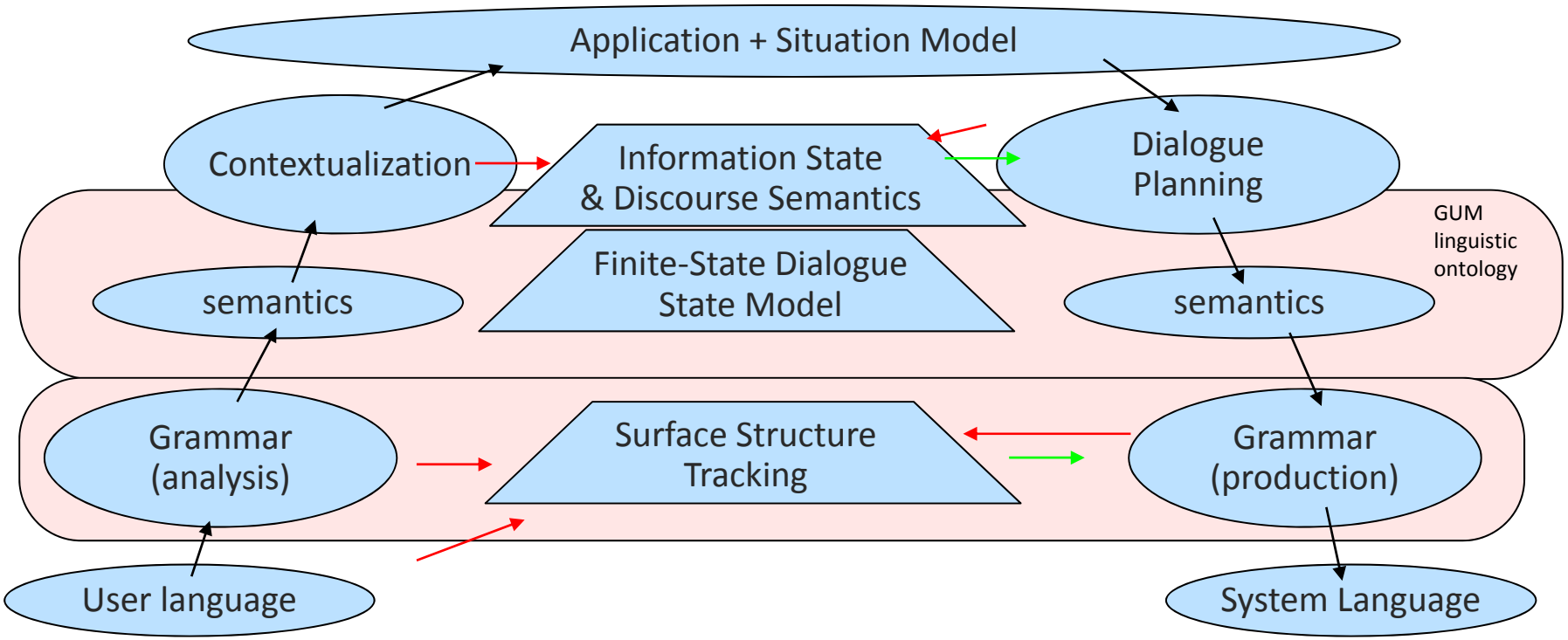


(c) The Request Network

Putting the components together

- OpenCCG/CCG provides semantic analysis, producing HLDS using the semantic types of our Generalized Upper Model linguistic ontology
- KPML/SFG provides generation of strings from semantic SPL input using the semantic types of the GUM linguistic ontology
- The dialogue control is managed by following transitions in a finite state diagram
- Matching semantics against context and retrieving information is performed via a two-level information-state
- Semantic and domain knowledge is represented using description logic (Racer / Pellet)

A Modern State of the Art Dialogue System



Computational Linguistics

- History
  - what is computational linguistics?
  - where did it come from?
  - what does it have to do with linguistics?
- To come: Theoretical + Practical Work
  - some frameworks and basic tools used in computational linguistics ✓
  - grammars and semantics ✓
  - some examples: analysis, generation, dialogue ✓

Levels of language technology

- Phonetic / Phonological → speech processing / speech synthesis
- Syntactic / Grammatical → tactical generation / parsing technology
- Semantics → reasoning, logic, knowledge representation, ontologies
- Pragmatics → dialogue acts, dialogue processing

Accompanying Reading

- Dale / Moisl / Somers (Hrgg)(2000) *A handbook of natural language processing: techniques and applications for the processing of language as text.* Dekker.

  Chapters:

  Preface, pp.iii-viii
  5. Semantic Analysis (Poesio)
  7. Natural Language Generation (McDonald)
  13. Machine Translation (Somers)
  14. Dialogue Systems: from theory to practice (Allen)

- Mitkov (Hrg)(2002) *Oxford Handbook of Computational Linguistics.* OUP.

  Chapter:

  25. Ontologies (Vossen)

- Meyer (2002) *Synchronic English Linguistics: An introduction.* GNV.

  Chapter:

  4.5 Formal Semantics (pp118—132)

if you want to know more,
come and ask!

there’s lots to do!