

Natural Language Generation for Embodied Conversational Agents

Day 4

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ESLLI 2008
Hamburg, Germany

Today

- Discourse and its verbal and non-verbal correlates
- Features of Dialogue (and modeling them in ECAs)
- NLG in dialogue systems - architecture

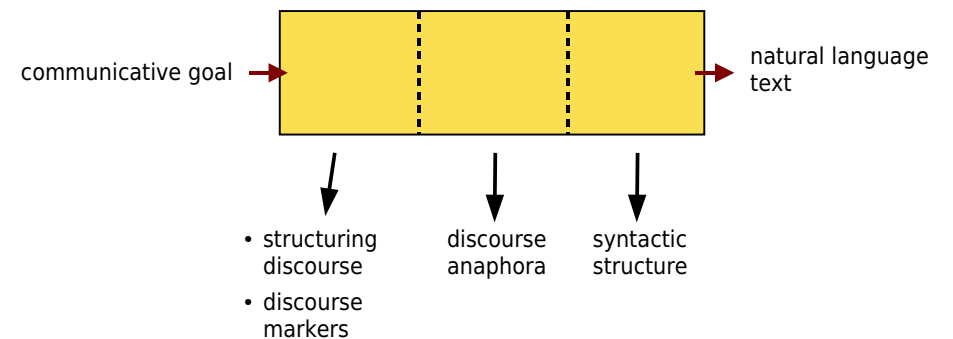
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Discourse

- sequence of connected sentences → coherence
- verbal correlates of coherence
 - discourse markers
 - discourse anaphora
 - reuse of lexical items
 - syntactic structures and intonation expressing information structure
- non-verbal correlates of coherence
 - anaphoric gestures
 - reuse of gesture
 - posture
 - rhythmic elements expressing emphasis/information structure

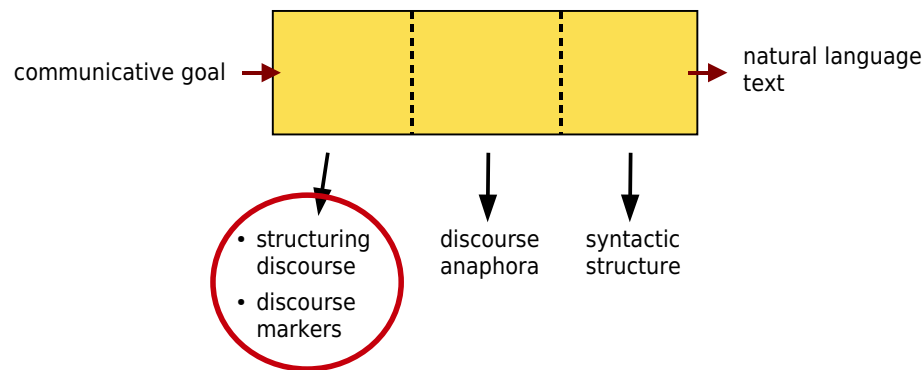
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Discourse generation



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Discourse generation



⇒ schemata (McKeown 1985): templates for how to arrange information

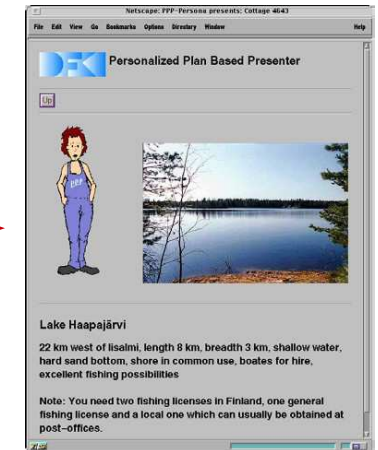
⇒ planning based (Hovy 1991, Paris & Moore 1993): discourse relations as planning operators

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Discourse Planning for multimodal media presentations

Andre et al. 1998

- goal: automatically generate
 - 1) a web site presenting a certain object
 - 2) a script for a virtual presenter

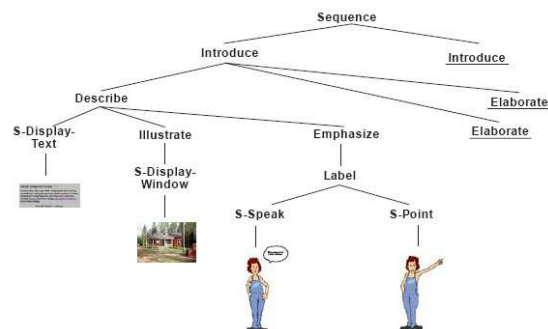


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Discourse Planning for multimodal media presentations

Andre et al. 1998

- presentation pieces (text, pictures, actions of the presenter) are related by discourse relations
- planning operators specify how (which pieces can be related through which discourse relation to fulfill which goal)



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Coherence in dialogue

- within turns
- and across turn units

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Special dialogue features

- turn-taking
- grounding
- collaborative utterances

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Turn-taking

- dialogue participants take turns speaking
- speaking turns are not pre-determined but assigned dynamically during the conversation
 - very little overlap
 - few long pauses
- turn-taking follows rules
- participants use cues to coordinate speaking turn

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Turn-taking rules (Sacks et al. 1974)

- The current speaker can select the next speaker (through verbal or non-verbal cues). At the next turn transition point.
- If the current speaker does not select the next speaker, any participant can take the turn at the next turn transition point.
- If no one takes the turn at the next turn transition point the current speaker can re-claim the turn.

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Turn-taking cues

[Duncan 1972, 1974, Argyle & Cook 1976,
Novick et al. 1996]

- turn-yielding cues:
 - intonation
 - drawl of final syllable
 - moving hands out of gesture space
 - certain expressions “or something”, “you know” (and trailing off)
 - completion of clause
 - gaze at addressee
- turn-keeping cues:
 - continue to gesture
 - look away from speaker

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Turn-taking cues

[Duncan 1972, 1974, Argyle & Cook 1976,
Novick et al. 1996]

- turn wanting/taking cues:
 - bring hands into gesture space
- turn transitions:
 - mutual gaze (previous speaker and next speaker); then new speaker looks away
- turn avoiding:
 - backchannel feedback

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Gaze for turn-taking in a talking head

[van Es et al. 2002]

- 3 versions of a talking head:
 - gaze for turn taking cues: look away when starting to speak; look at addressee when ending
 - stare at addressee
 - change gaze randomly
- task: make reservations for concert tickets
- results: Subjects like the turn-taking version better and complete the task faster.

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Grounding

- process of ensuring mutual understanding
- contributions to dialogue consist of two phases: presentation and acceptance [Clark & Schaefer 1989]

Alan: Now, - um, do you and your husband have a j- car
Barbara: - have a car?
Alan: Yeah
Barbara: No -

[Clark & Brennan 1991]

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Evidence for understanding

- acknowledgement (verbal feedback, continuers, head nods)
- relevant next contribution
- continued attention
- demonstration (reformulating, pointing)
- display (repeating)

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Non-understanding

- reasons:
 - addressee didn't notice utterance
 - noticed but didn't correctly hear
 - heard but didn't understand
- evidence (depends on reason)
 - not attentive (looking away)
 - question, other verbal feedback
 - facial expression, head movement, gaze

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The speaker's role

- obviously: react to negative feedback
- prompt for feedback

– installment presentation

A: [looking down] you know there is the arch right
[look at B] right
B: Mhm
A: at the curve?
[look down] ahm if you were to go south
[look at B] there is a church
B: right

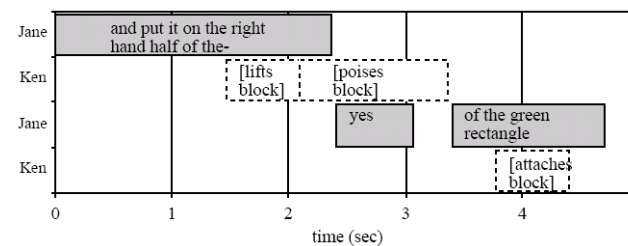
– trial constituents

A: [looking down] and you know you are veering left if you
you know like
[look at B] those gates that come down
you know like for cars like those
B: ah okay yah
A: you know gate
you'll go through one of those
B: okay

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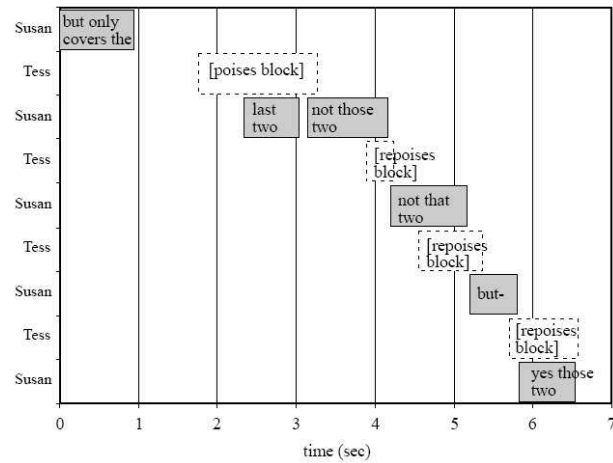
Collaborative contributions

A. um the problem is a that you(('ve)) got to get planning consent -
B. before you start -
A. before you start on that part, yes
A. you can do anything internally, you wish
B. but the big stuff is, the external stuff [continues]



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Collaborative contributions



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Eye gaze cues for grounding

[Nakano et al. 2003]

- Agent's gaze behavior is determined by dialog moves.
- Mimics patterns of humans found in data.
- User's gaze behavior is monitored and used to assess understanding.
 - continuously looking at map → understanding
 - looking up and back at map before a certain (time) threshold → understanding
 - looking up for longer → not understanding → elaborate
- Test subjects interact with the agent with this grounding behavior and an agent without this grounding behavior.
 - gaze patterns of the subjects interacting with the grounding agent are much more similar to gaze patterns in human-human data

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MACK: Eye gaze cues for grounding

[Nakano et al. 2003]

Example

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MAX: Giving feedback

[Kopp et al. 2007]

<i>Underst.</i>	1.0	0.8	0.8	0.6	0.6	1.0
<i>Verbal</i>						“Ja, ich bin begeistert.”
<i>Head</i>		Tilt		Tilt		Nod
<i>Browes</i>					Frown	
<i>Human</i>	“Bielefeld ist eine tolle Stadt”					

<i>Underst.</i>	1.0	1.0	0.8	0.8	0.8	0.4	0.4	0.4	
<i>Verbal</i>						“Wie bitte?”			
<i>Head</i>						Nod	Tilt	Tilt	
<i>Browes</i>								Frown	
<i>Human</i>	“Bielefeld liegt direkt am Totoburger Wald glaube ich”								

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REA: Non-verbal behavior for discourse structure, conversation structure and information structure

[Cassell et al. 2001]

Discourse level info.	functions	non-behavior cues
Discourse structure	new segment	Posture_shift
Conversation structure	turn giving	eye_gaze & (stop_gesturing hand_gesture)
	turn keeping	(look_away keep_gesture)
	turn taking	eye_gaze posture_shift
Information structure	emphasize information	eye_gaze & (beat_gesture other_hand_gestures)

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SASO: A rich gaze model

[Lee et al. 2007]

goal: use gaze to convey internal state of the agent

conversational function of gaze:

Cognitive Operation	Behavior	Quality	Reference
Planning speech	Gaze aversion	Slower, offset from eyes	[2]
Start an utterance	Look at hearer	Focus, track	[2]
During speech	Look at hearer	Slow, focus, track	[11, p.99]
Utterance is a rejection or counter-proposal	Gaze aversion (Avoid threat)	Slow, Sideways-down	[11, p.92-99]
Utterance is reluctant acceptance	Gaze aversion	Slow, Sideways-down	[2]
Utterance is about past event	Gaze aversion	Slow, Sideways-up	[2]
Done speaking	Look at hearer	Slow	[2]
Hold turn	Gaze aversion	Slow, offset from eyes	[2]
Listen to speaker	Look at speaker	Weak-focus, track	[11, p.101]
Interpret speaker's utterance	Look at speaker	Weak-focus, track	[11, p.121]
Expect speech from the other	Look at speaker	Weak-focus, track	[11, p.121]
Wait for grounding (acknowledgement or repair)	Look at other	Weak-focus, track	[2]

gaze is also used to express monitoring of changes in the environment and "thinking" (updating believes)

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Consequences for generation architecture

- utterances often fulfill multiple communicative goals
 - up to now: communicative-goal = propositional content to express
 - in dialogue: propositional content + taking/keeping/giving turn
 - giving/requesting feedback
- timing important → time for planning limited
- (self-)interruptions

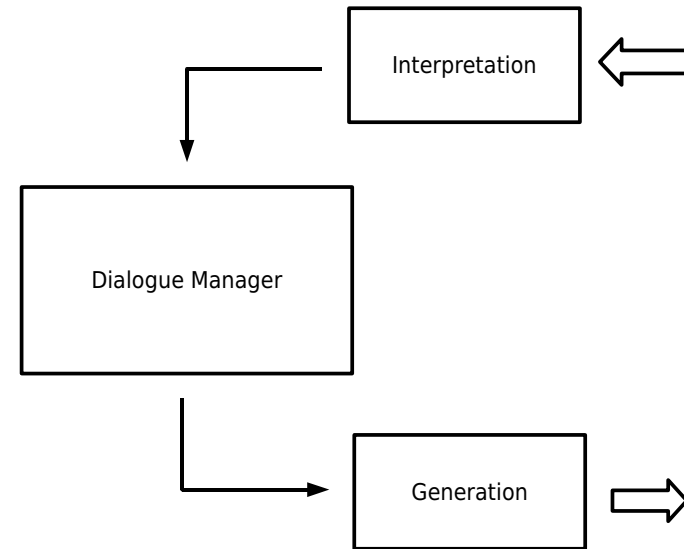
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Modeling communicative intentions in dialogue: dialogue acts

- the actions(s) performed by an utterance (e.g., assert, acknowledge, info-request)
- can have to do with conveying information and also with conversational functions (grounding, turn taking)
- different classifications have been proposed
- an utterances often performs more than one dialogue acts
 - the communicative goal for an utterance can ask for several dialogue acts to be performed

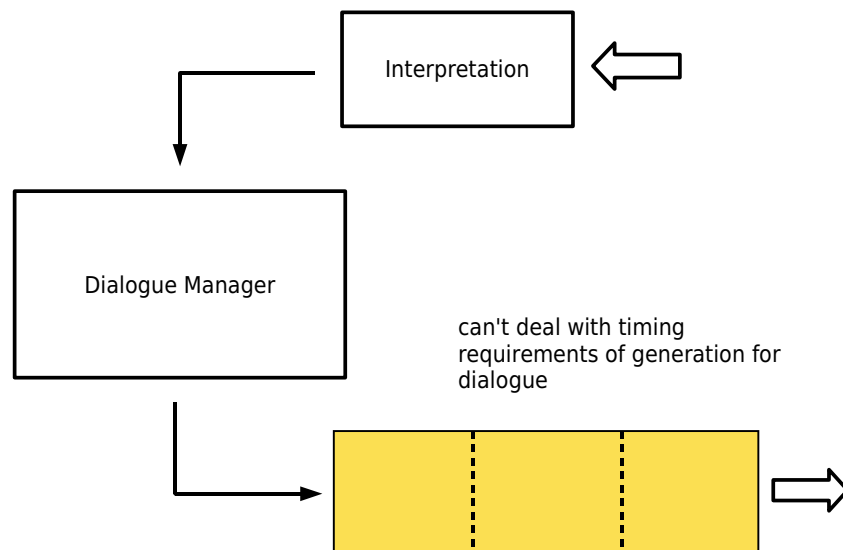
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Dialogue system architecture



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Dialogue system architecture



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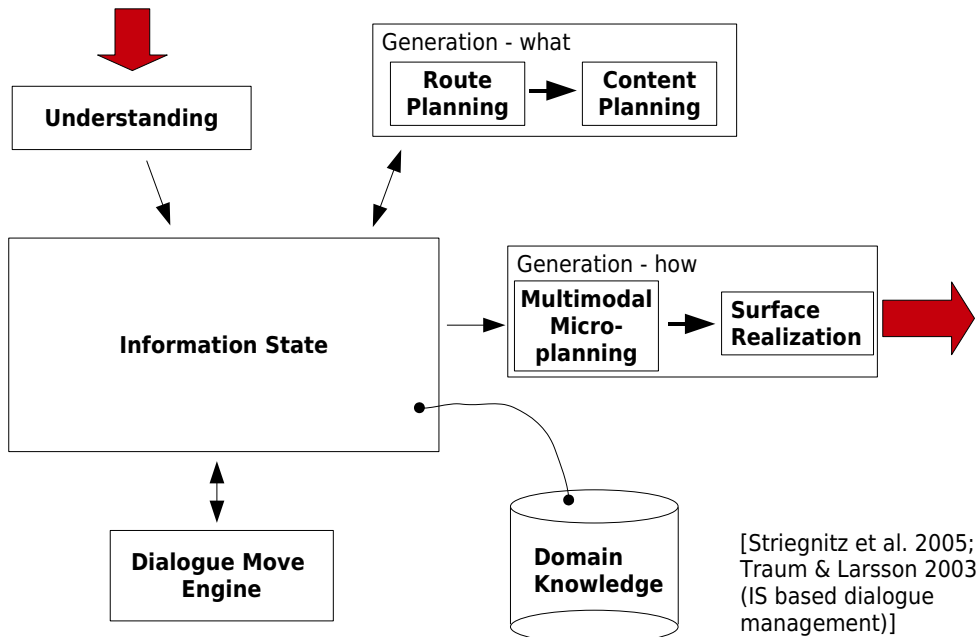
NUMACK: integration of generation and dialogue management

- typical structure of our dialogues:
 - 1) *usr greets*
 - 2) *sys introduces itself and asks for destination*
 - 3) *usr provides destination*
 - 4) *sys give route description*
- route descriptions are several sentences long (monologic)
- but user should be able to interrupt to ask for clarification



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NUMACK: integration of generation and dialogue management



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NUMACK: integration of generation and dialogue management

- information state contains a dialogue plan:
 - 1.findout(?x.destination(x))
 - 2.call_content_planner
 - 3.realize_content_plan
- generation-how adds content plan to information state:
 - exit(Norris)
 - turn(left)
 - go_straight
 - pass(Library,right)
 - observe(AMS,right),big(AMS)
- Agenda of next system moves can be refilled from the content plan (if the current item in the dialogue plan is *realize content plan*).
- Obligations to answer negative user feedback get pushed onto the agenda as they come in.

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Online direction giving

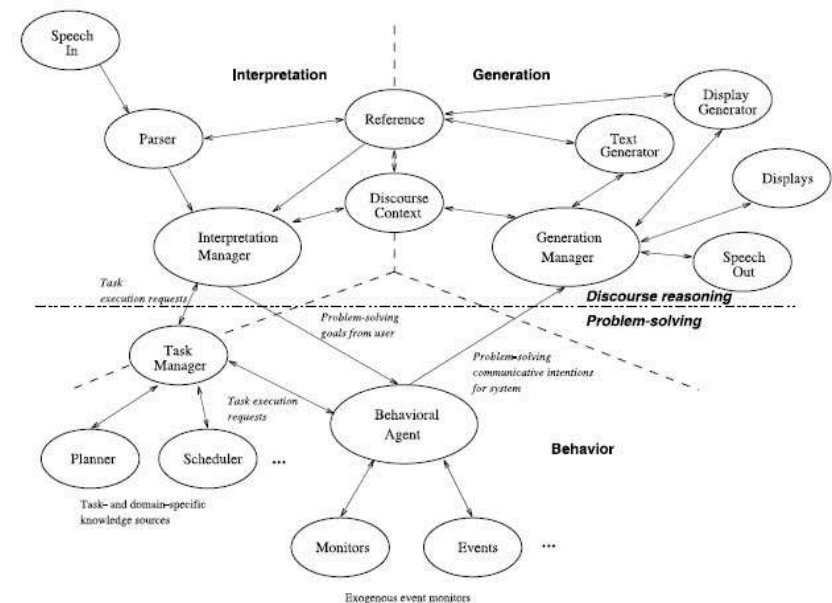
- GIVE (Giving instructions in virtual environments) www.give-challenge.org
- task: generate instructions to guide a human user/player through a 3D environment
- need to react fast to user going wrong
- involves replanning actions and interrupting/abandoning current plan



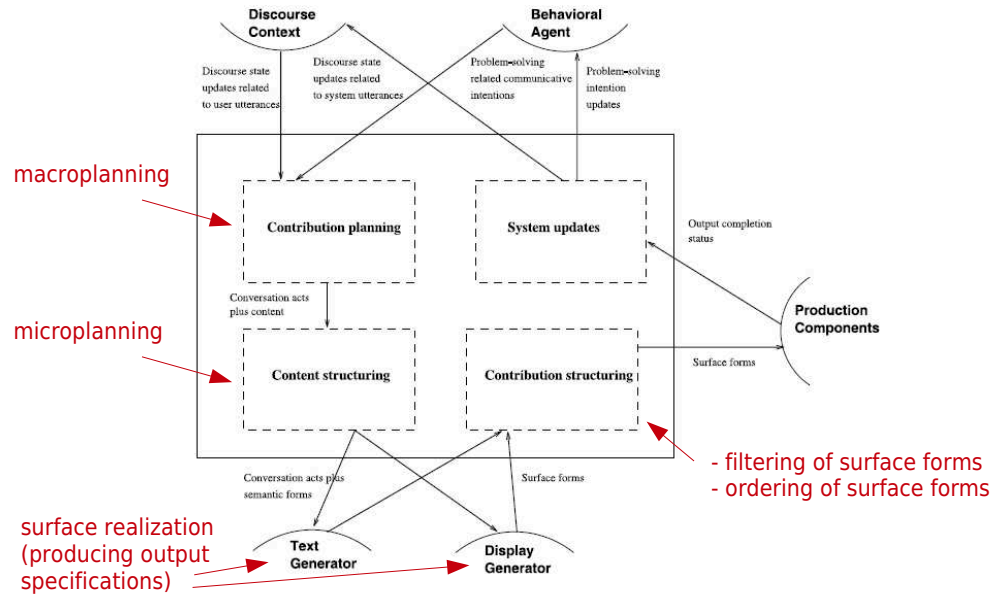
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Example: TRIPS - NLG in a dialogue system

[Stent 2002]



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Tomorrow: ECAs as social actors - expressing emotion and personality
Evaluating ECAs

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