Automatic Generation of Web Interfaces from Discourse Models

Institut für Computertechnik
ICT
Institute of Computer Technology

Hermann Kaindl
Vienna University of Technology, ICT
Austria
kaindl@ict.tuwien.ac.at

Outline

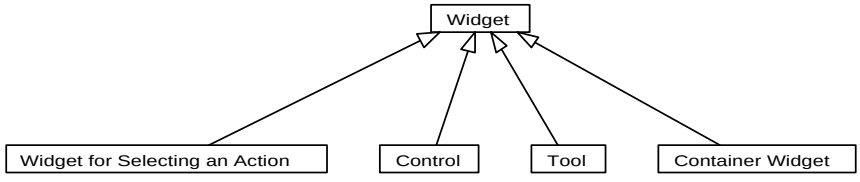
- Background
- AI theories underpinning discourse modeling for HCI
- Other theories underpinning discourse modeling for HCI
- Interaction design based on discourse modeling
- Exercise
- Sketch of automated user-interface generation

Traditional UI development

- Based on toolkits employing widgets
- Widgets grouped according to their graphical appearance
- Highly-specialized designers and programmers needed
- Lots of UI code
- Error-prone, low maintainability
- Expensive

Widgets

- Interactive objects presented on the display
  - windows
  - buttons
  - scroll bars
- User interface elements
- Classification hierarchy of widgets



Interaction design

- Design of interactions between human and computer
- Relation to requirements engineering
- Relation to task analysis
- No commitment to specific user interface

Scenarios – Stories and narratives

- For representation of
  - cultural heritage
  - explanations of events
  - everyday knowledge
- Human understanding in terms of specific situations
- Human verbal interactions by exchanging stories

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Scripts

- Schank and Abelson
- Script: structure that describes appropriate sequences of events in a particular context
- Handles well-known everyday situations
- Predetermined and stereotyped sequence of actions

Scripts – Restaurant script example

Sketch of stereotypical sequence of actions in (U.S.) restaurant:

A customer enters a restaurant and waits to be seated.

A waiter guides the customer to an empty table and hands over a menu.

The customer studies the food list in the menu and chooses something.

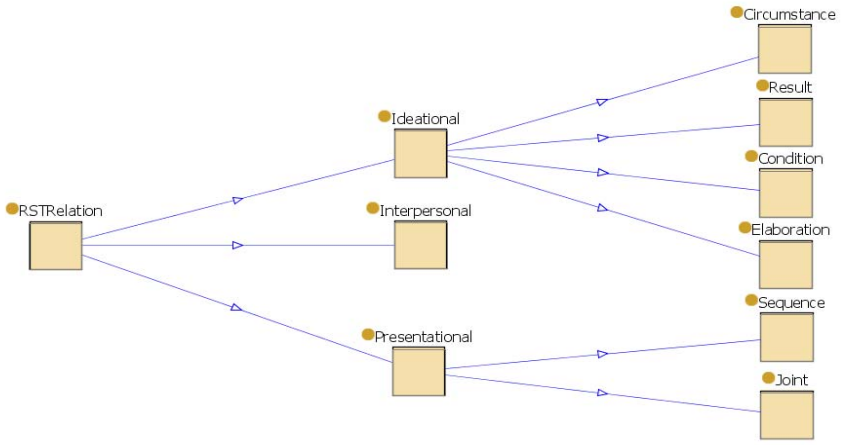
The waiter comes to the table and takes the order.

…

Rhetorical Structure Theory (RST)

- Mann and Thompson
- Linguistic theory
- Internal relationships among text portions and associated constraints and effects
- Relationships in a text are organized in a tree structure
- Rhetorical relations associated with non-leaf nodes, and text portions with leaf nodes

RST Taxonomy (selection)

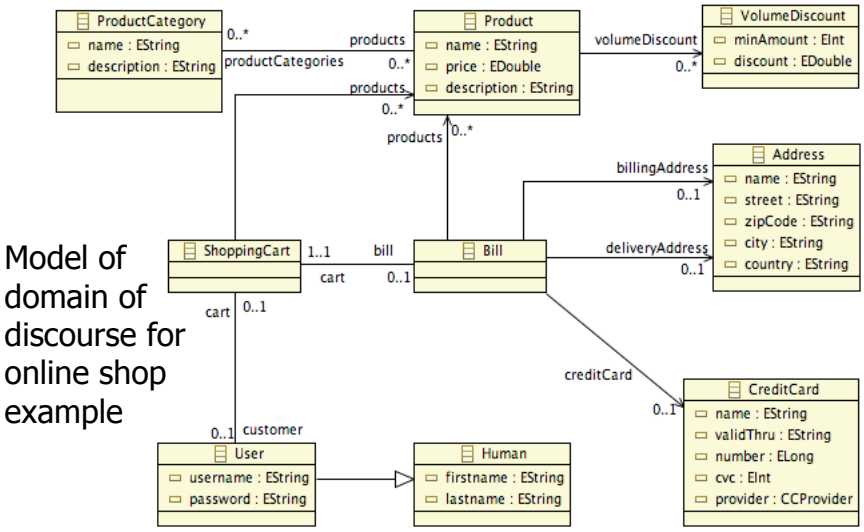


Ontologies

- Tom Gruber
- Actually, the old Greeks
- Domain models
- Conceptualizations of a domain
- Often using taxonomies and object-based ideas
- Ontology languages based on knowledge-representation theories
- E.g., OWL based on description logic

Ontologies

Model of domain of discourse for online shop example



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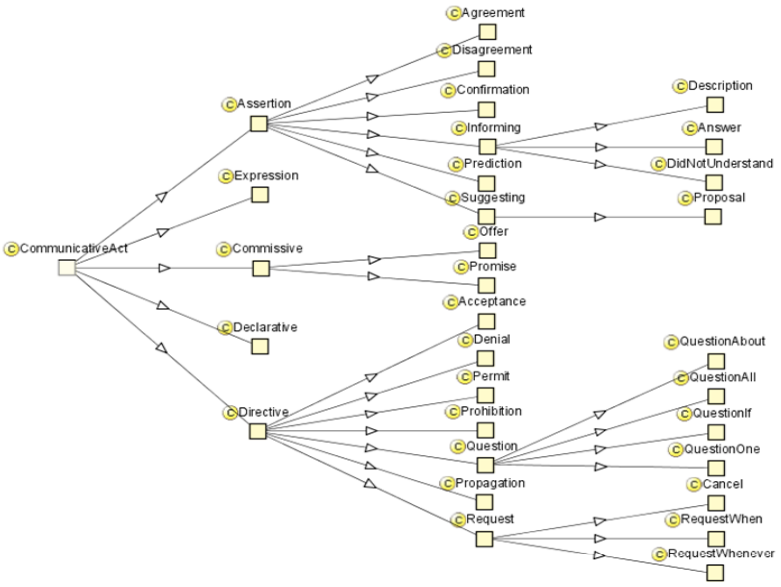
Speech acts

- John R. Searle
- Theory from philosophy of language
- Human speech also used to do something with intention — to act
- "Speaking a language is performing speech acts, act such as making statements, giving commands, asking questions and so on"
- Speech acts: basic units of language communication
- Communicative acts: abstraction from speech

Communicative Acts Taxonomy (selection)



Conversation Analysis

- Harvey Sacks; Luff, Gilbert and Frohlich
- Theory from sociology
- Focus on sequences of naturally-occurring talk "turns"
- To detect patterns that are specific to human oral communication
- Adjacency pair: e.g., a question should have a related answer
- Inserted sequence: subordinate interactions

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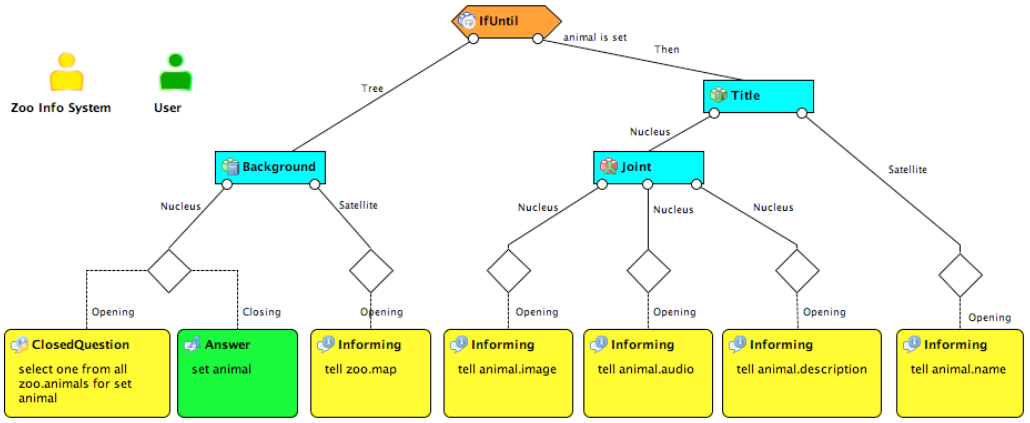
Discourse Example



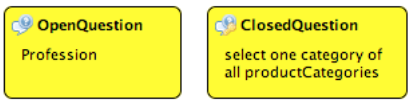
Discourse Model

Discourse "atoms" and "molecules"

- Metaphorical view
  - Communicative acts as atoms
  - Adjacency pairs as molecules
- Communicative acts instead of RST text portions
  - Interaction instead of text
- Two dimensions
  - Tree with discourse relations (monologue)
  - Adjacency pair (dialogue)
- Integration of RST and procedural constructs with Conversation Analysis

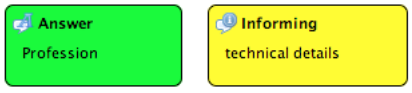
Communicative Acts – Open & Closed Question

- Open Questions enable asking for a particular type of information, respectively, an instance of a domain class.
- Closed Questions restrict the possible answer to a list of provided domain instances to choose from.



Communicative Acts – Informing & Answer

- Both are used to convey information.
- Answer communicative acts are always directly related to questions, whereas Informing is uttered standalone or together with acknowledgment.



Communicative Acts – Request

Used to request the communication partner to act. Thus, the propositional content of a request is always an action that has to be carried out. The action can be defined either for the given application, or it can be the request to utter a particular communicative act.

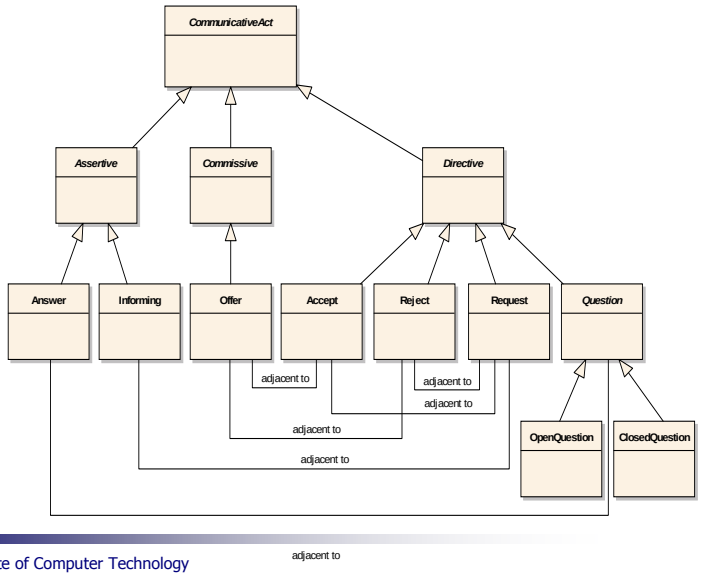
Communicative Acts – Offer

Offers to carry out an action or to add information to the shared knowledge.

Communicative Acts – Accept & Reject

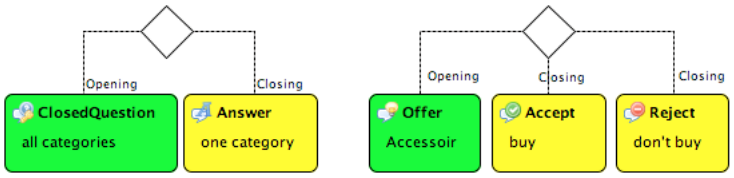
Accept and Reject provide for accepting or rejecting a particular request or offer.

Communicative Acts Taxonomy



Adjacency Pair

- Relates an initial communicative act with one subsequent communicative act or two alternative subsequent communicative acts.
- Typical adjacency pairs of communicative acts are:
  - ClosedQuestion–Answer, OpenQuestion–Answer
  - Offer–Accept, Offer–Reject
  - Request–Informing, Request–Accept, Request–Reject

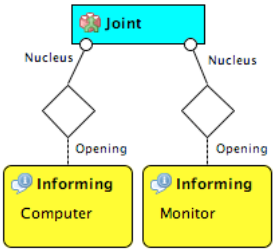


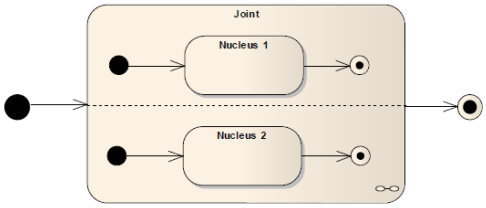
RST relations (in our approach)

- Nucleus: the main part of the communication
- Satellite: the helper part
- Communicative acts instead of text portions

RST relation – Joint

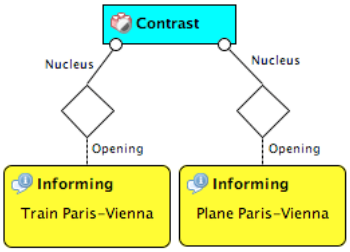
Relates independent subtrees with communicative acts of the same kind. It does not imply any order. So, it is also possible to issue both nuclei concurrently (e.g., on a GUI).





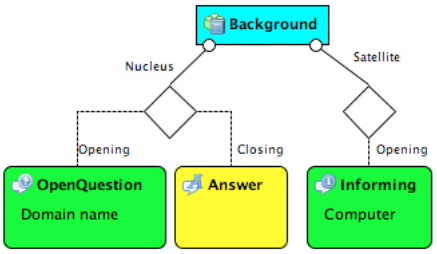
RST relation – Contrast

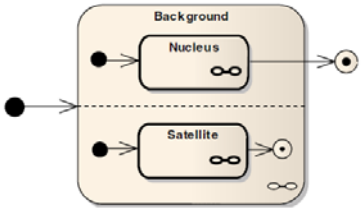
Relates similar subtrees and compares them with respect to differences.



RST relation – Background

- General information of any sort that is likely to help understand the nucleus.
- Thus, satellite of the background relation shall only contain Informing communicative acts.

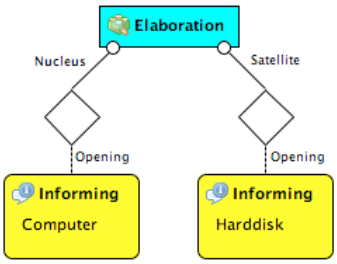


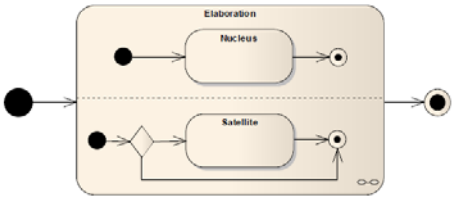


RST relation – Elaboration

- Satellite contains additional detail about some element of subject matter which is presented in the nucleus, in one or more of the ways listed below (nucleus :: satellite):
  - set :: member
  - abstraction :: instance
  - whole :: part
  - process :: step
  - object :: attribute
  - generalization :: specific
- The communicative acts can also be questions, for example, if one communicative partner wants to figure out additional details about the subject matter.

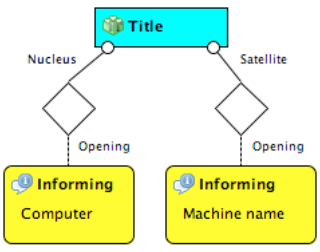
RST relation – Elaboration (cont.)





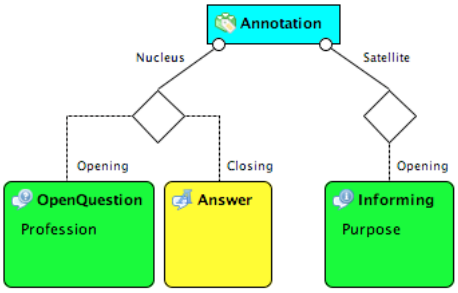
RST relation – Title

Specialization of Elaboration, restricting the additional detail of some element of subject matter to a short description, either title or caption.

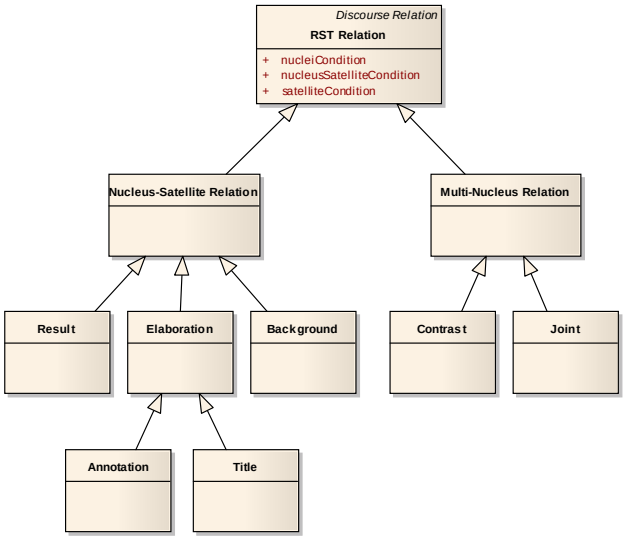


RST relation – Annotation

Another specialization of Elaboration, restricting the additional detail of some element of subject matter to meta information.

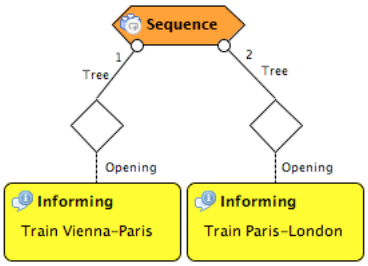


Taxonomy of RST relations



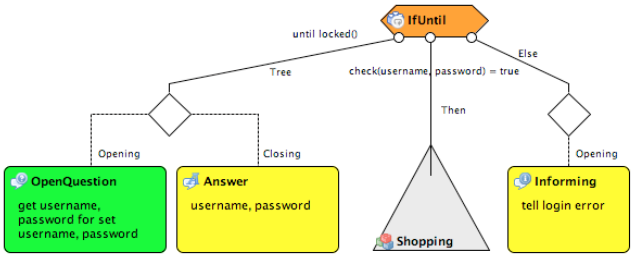
Procedural construct – Sequence

Defined order of uttering the communicative acts or subtrees.

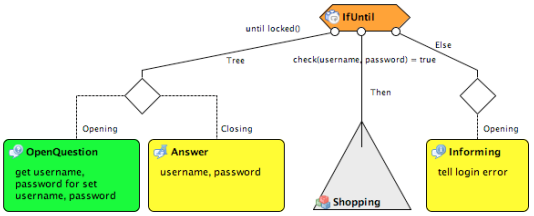


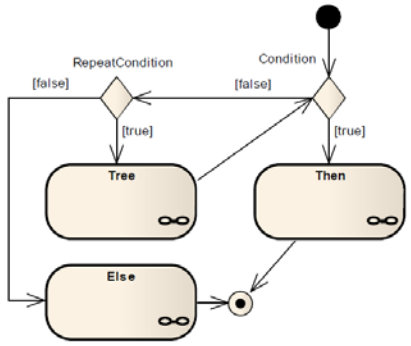
Procedural construct – IfUntil

- If-statement combined with a conditional loop
- Utterance of the <Then> subtree depends on successful execution of the related Condition.
- Repetition of the <Tree> branch until Condition becomes fulfilled, while RepeatCondition is fulfilled



Procedural construct – IfUntil (cont.)





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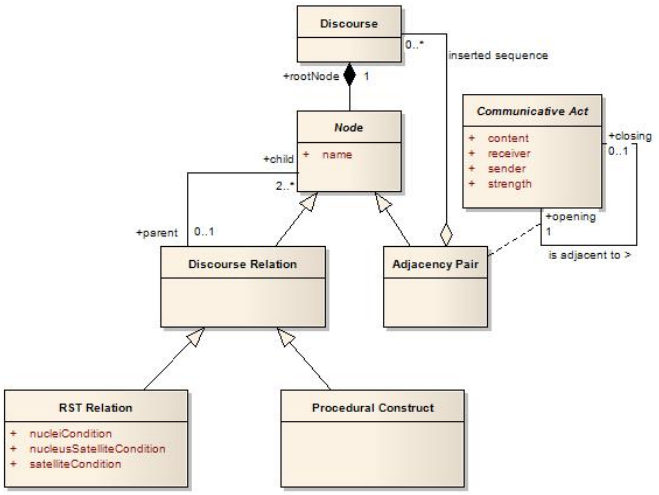
Conceptual Discourse Metamodel



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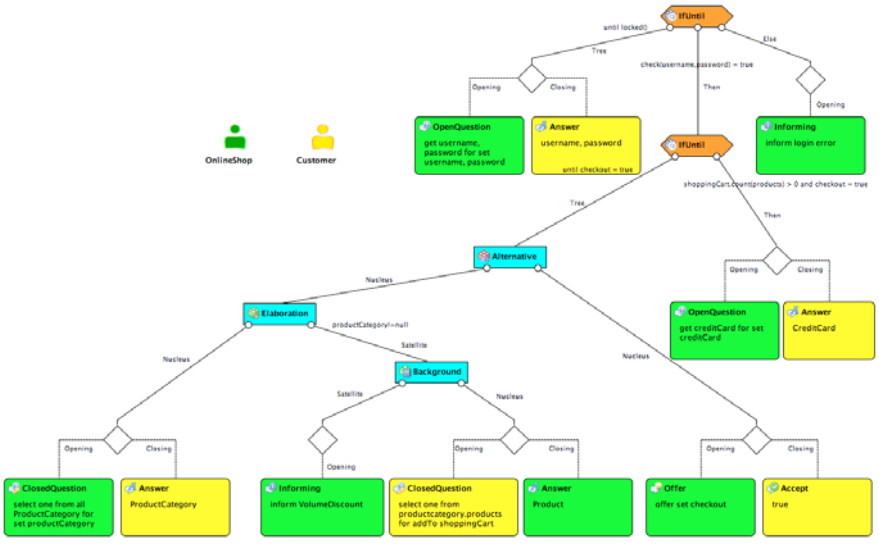
Domain representation

- Speech act usually talks about something in the domain of discourse
- Model of the domain
- Integration and use of ontologies

Example model



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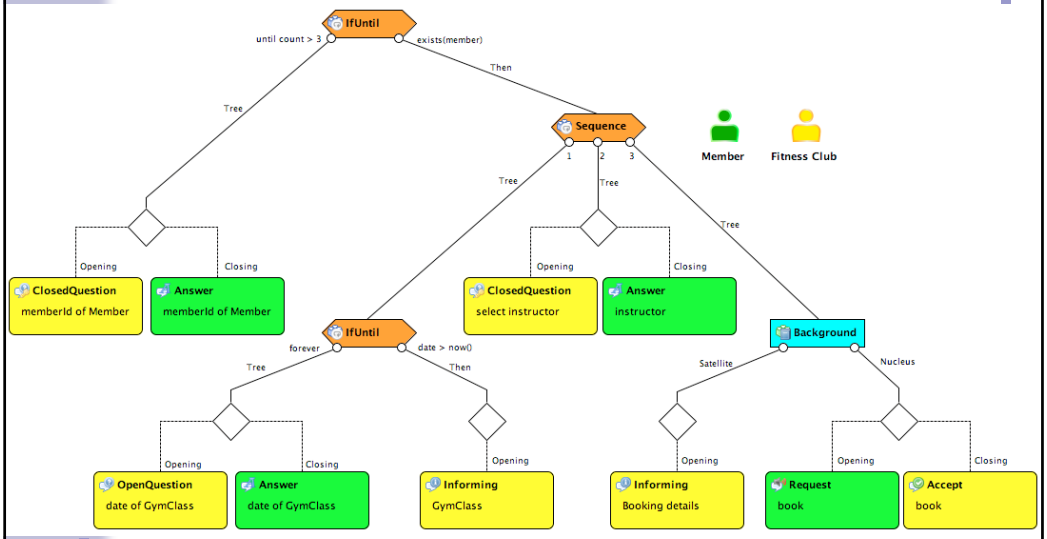
Exercise – Fitness Studio

- Interaction design model according to our approach, for the website of a fitness club which should allow registered users to book the various courses that the club offers.
- Try to understand the model sketch of a discourse for this application!

Fitness Studio Discourse Model



Questionnaire

Voluntarily, please fill in the subjective questionnaire at http://ontoucp.org/cms/technology/questionnaire.html

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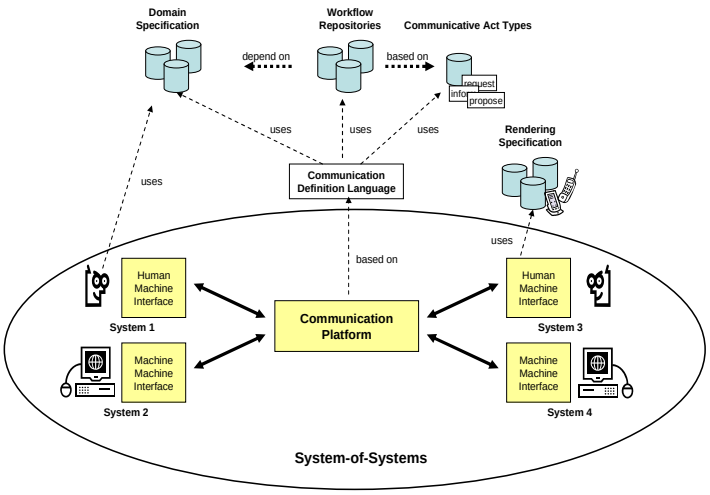
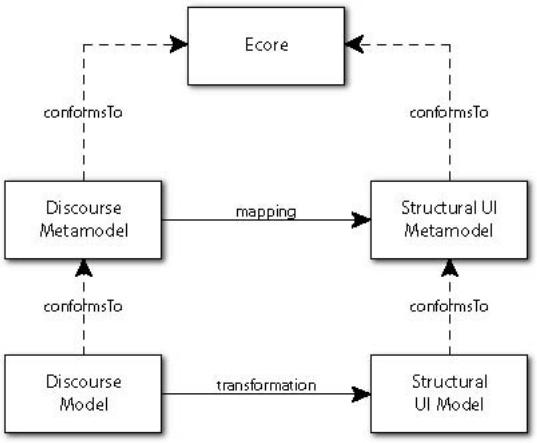
Unified Communication Platform



Automated generation of user interfaces

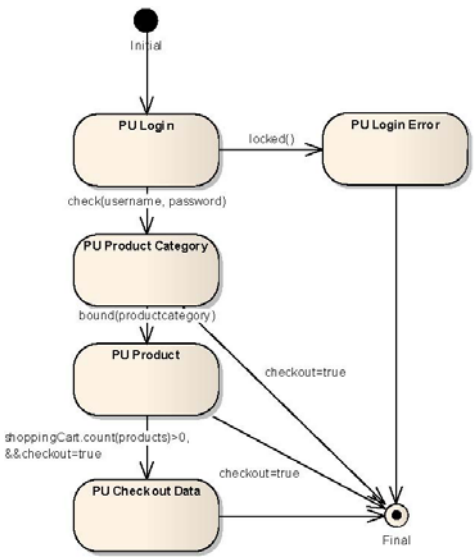
- Essential steps
  - Generation of structural UI model
  - Generation of finite state machine
  - Rendering of UI
- Even for multiple platforms

Generation of structural UI model



Transformation process according to MDA (model-driven architecture)

Finite State Machine



Maximum presentation unit state machine for the online shop example

Rendered User Interface

Guide in Kunsthistorisches Museum Wien

Summary and Conclusion

- Human-computer interaction can be based on discourse modeling.
- Discourse model represents interaction design.
- Discourse model used for automatic user-interface generation.

Thank you for your attention!

???

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Literature

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Selected work of this tutorial presenter

- Bogdan, C., Falb, J., Kaindl, H., Kavaldjian, S., Popp, R., Horacek, H., Arnautovic, E., and Szep, A., "Generating an Abstract User Interface from a Discourse Model Inspired by Human Communication". In *Proceedings of the Forty-first Annual Hawaii International Conference on System Sciences (HICSS-41)*, p. 10, Hawaii, 2008, IEEE Computer Society Press.
- Bogdan, C., Kaindl, H., Falb, J., and Popp, R., "Modeling of interaction design by end users through discourse modeling". In *Proceedings of the 2008 ACM International Conference on Intelligent User Interfaces (IUI'08)*, Gran Canaria, Spain, 2008. ACM Press, pp. 305–308.
- Falb, J., Kaindl, H., Horacek, H., Bogdan, C., Popp, R., and Arnautovic, E., "A discourse model for interaction design based on theories of human communication". In *CHI '06 Extended Abstracts on Human Factors in Computing Systems*, New York, NY, USA, 2006. ACM Press, pp. 754–759.
- Falb, J., Kavaldjian, S., Popp, R., Raneburger, D., Arnautovic, E., and Kaindl, H., "Fully Automatic User Interface Generation from Discourse Models". In *Proceedings of the 2009 ACM International Conference on Intelligent User Interfaces (IUI'09)*, ACM. Sanibel Island, Florida, USA, 2009. ACM Press. Tool demo paper.

Selected work of this tutorial presenter (cont.)

- Falb, J., Popp, R., Röck, T., Jelinek, H., Arnautovic, E., and Kaindl, H., "Fully-automatic generation of user interfaces for multiple devices from a high-level model based on communicative acts". In *Proceedings of the Fortieth Annual Hawaii International Conference on System Sciences (HICSS-40)*, p. 10, Hawaii, 2007, IEEE Computer Society Press.
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