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
In 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 “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

- CommunicativeAct
  - Assertive
  - Commissive
  - Directive
  - Informing
  - Offer
  - Request
  - Question
  - Accept
  - Reject
  - adjacent to
  - adjacent to
  - adjacent to
  - adjacent to
  - adjacent to
  - adjacent to
  - adjacent to
  - adjacent to
  - adjacent to
  - adjacent to
  - adjacent to
**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.
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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.
Human-Computer Interaction based on Discourse Modeling

Taxonomy of RST relations

- Nucleus-Satellite Relation
  - Result
  - Elaboration
  - Background
  - Annotation
  - Title

- Multi-Nucleus Relation
  - Contrast
  - Joint

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
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](http://ontoucp.org/cms/technology/questionnaire.html)
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Unified Communication Platform

- Domain Specification
- Workflow Dependencies
- Communication Act Types
- Communication Definition Language
- Rendering Specifications
- Communication Platform
- System-of-Systems
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 automated user-interface generation.

Thank you for your attention!
Human-Computer Interaction based on Discourse Modeling

Literature


Selected work of this tutorial presenter

Selected work of this tutorial presenter (cont.)