Sept 12 Class
Jameson and Horvitz papers

Overview

- Functions and Forms of Adaptive IUIs
- Components
- Usability and Evaluation

UAI: Functions and Forms (some)

Functions

- Support System Usage
- Support Info Acquisition/ Decision Making
- Support Learning
- Support Collaboration
- Support Entertainment

- Take Over Routine Tasks
- Adapt the Interface
- Advice on System Usage
- Retrieve Info/ Recommend Objects
- Tailor Info Presentation
- Advice on task

Forms of Adaptation

Overview

- Functions and Forms of Adaptive IUIs
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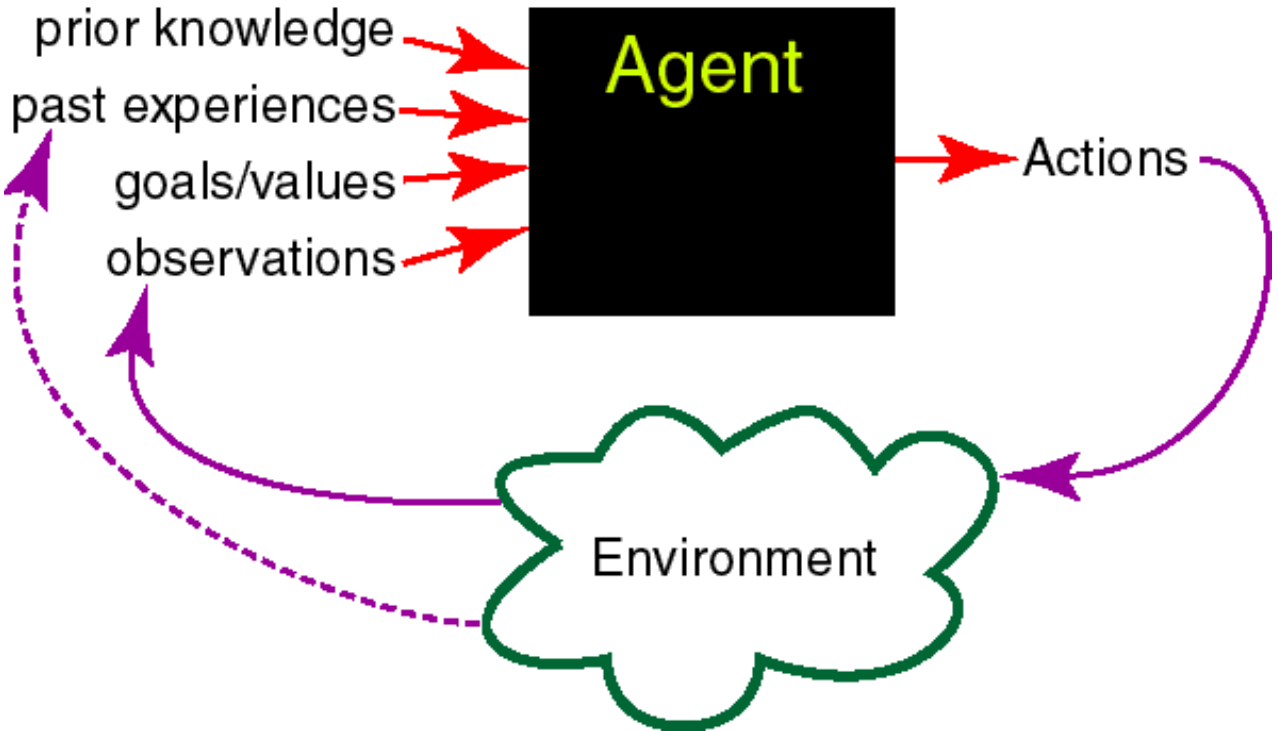
- Usability and Evaluation

Intelligent Agent (Poole and Mackworth 2010)

- Its actions are *appropriate* for its goals and circumstances
  - Including limited resources
- It is *flexible* to changing environments and goals
- It *learns* from experience



Representation and Reasoning

- To reason about the environment an agent needs to represent it => ***knowledge***

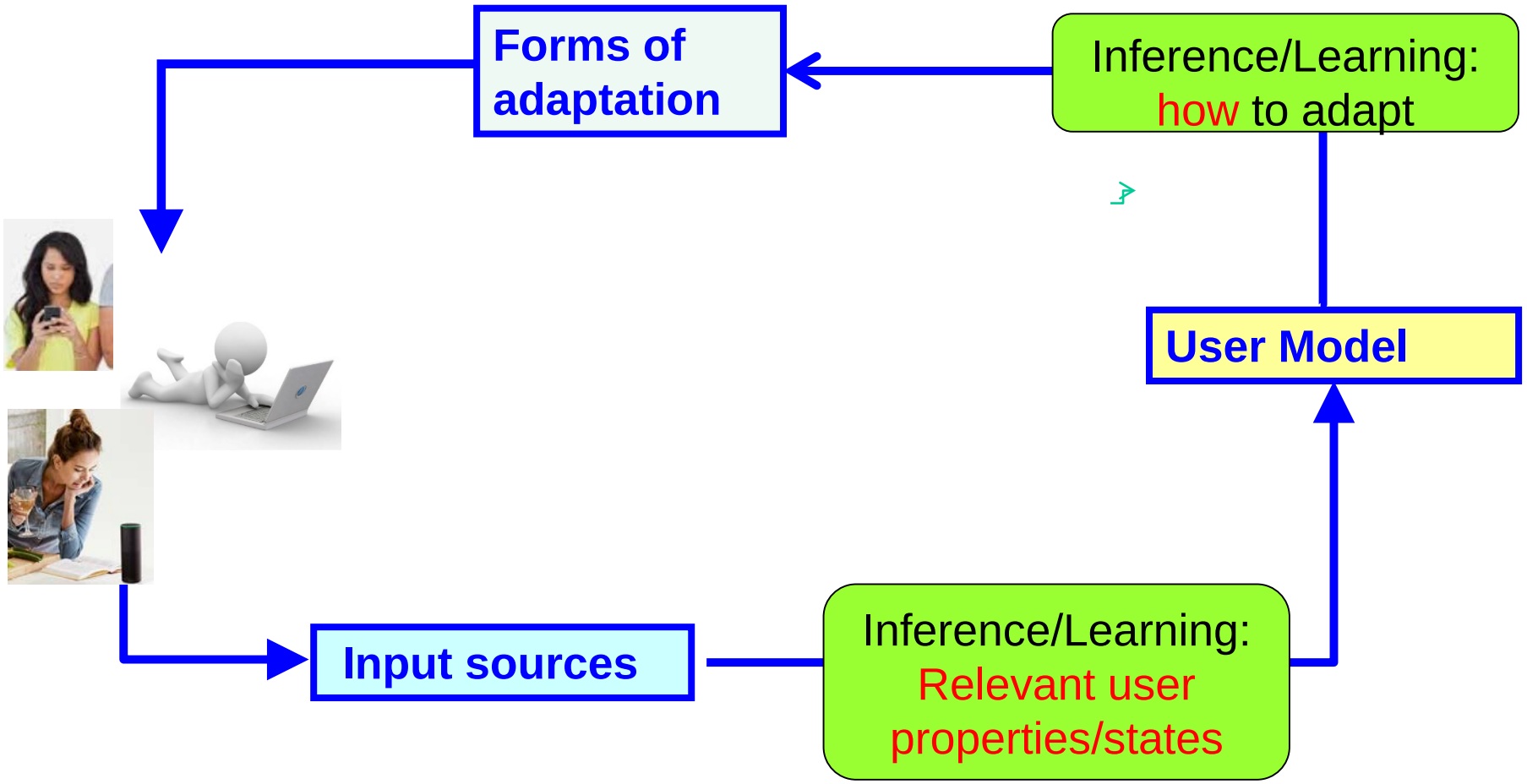
- One of AI goals: specify techniques to
  - Acquire and represent knowledge about a domain
  - Use the knowledge to solve problems in that domain

Knowledge in UAI

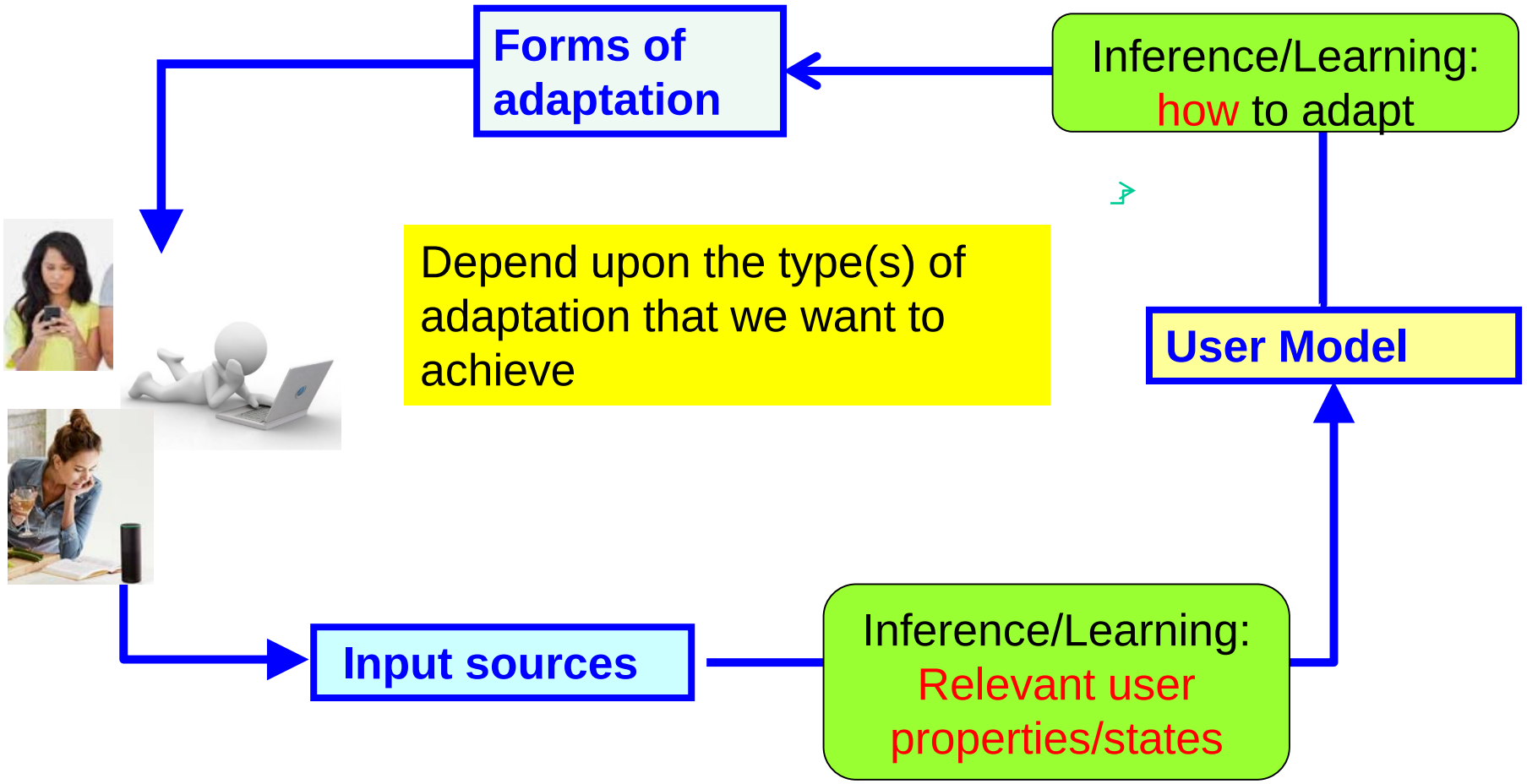
Knowledge in UAI

- Knowledge about the user (*user model*)
- Knowledge about the application domain/task (*domain model*)
- Knowledge about the communication process (*interaction model*)

User Model: Which User Properties Should be Represented?



User Model: Which User Properties are Represented?



Example: SETA

7 - *Facile*

Lit. 108000

put *Facile* in the cart

technical info

- **Message storage on digital memory** (help)
- **Maximum length of the initial message: 60 sec.** (help)
- **Maximum length of the stored messages: 25 min.** (help)
- **Available colors: grey, black** (help)
- Size: 150x70x210 (help)
- Exhausted Memory warning message (help)
- Filtering function (help)
- Led (help)
- Possibility to remotely listen to messages and delete them (help)
- Memo facility (help)

Figure 14. Detail of a presentation page describing the "Fac
tailored to an expert user.

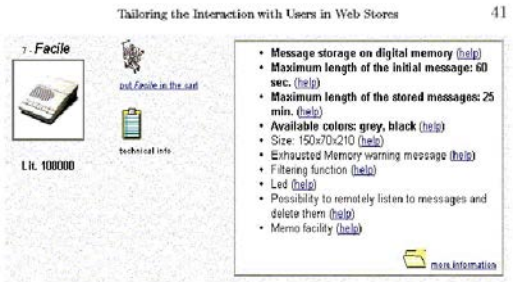


Figure 14. Detail of a presentation page describing the "Facile" answering machine, tailored to an expert user.

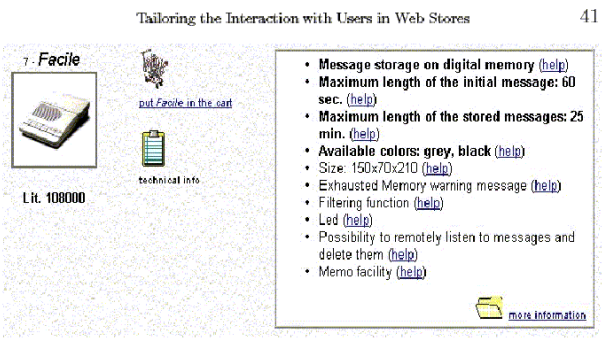
SETA: Which User Properties are Represented?

Forms of adaptation

Inference/Learning: how to adapt

User Model

Expertise on items


Tailoring the Interaction with Users in Web Stores 41

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Lit. 108000

put Facile in the cart

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more information

Figure 14. Detail of a presentation page describing the "Facile" answering machine, tailored to an expert user.

Input sources

Inference/Learning: Relevant user properties/states

Example: DiamondHelp

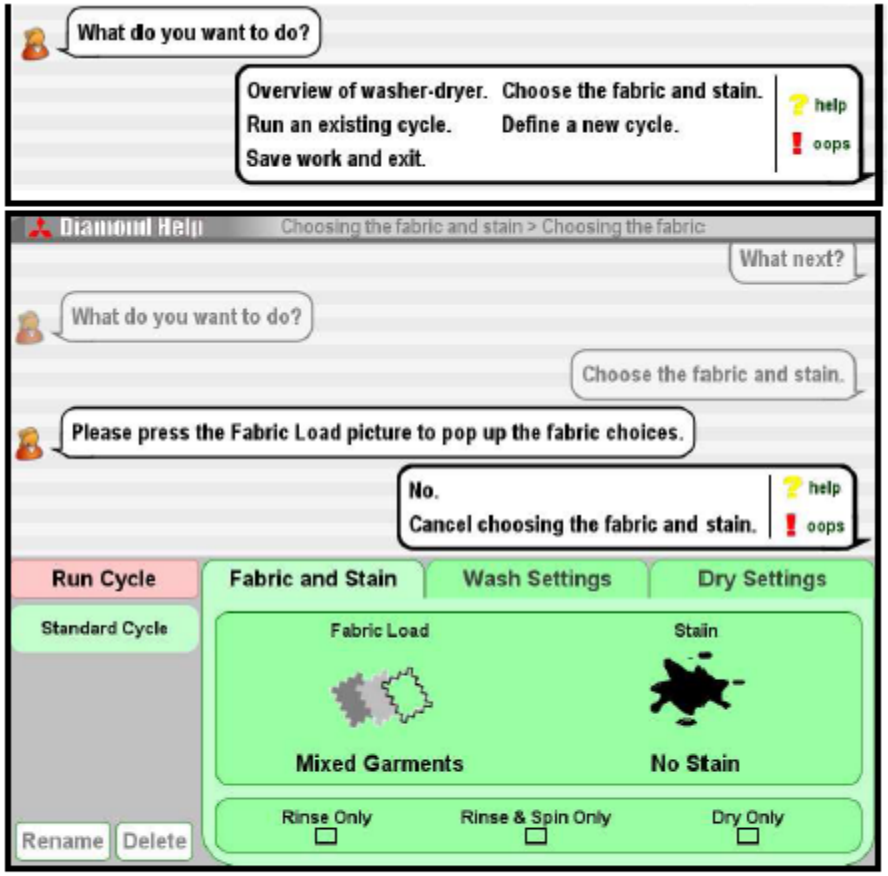


Figure 15.8. Example of collaborative assistance offered by DIAMONDHELP.

DE: Which User Properties are Represented?

Forms of adaptation

Inference/Learning: how to adapt

User Model

Goals and subgoals in during machine operation

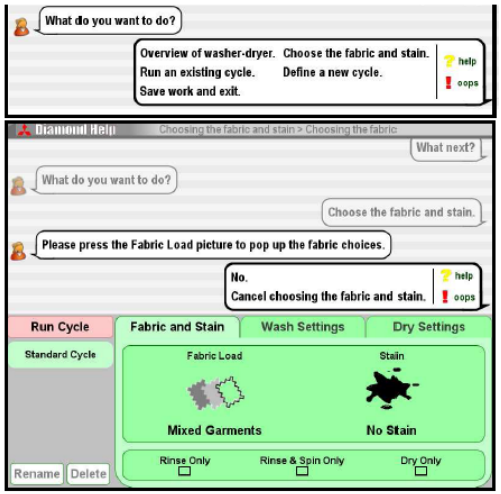


Figure 15.8. Example of collaborative assistance offered by DIAMONDHELP.

Input sources

Inference/Learning: Relevant user properties/states

User Model: Types of Properties

- Goals
- Beliefs/Domain knowledge
- Proficiencies (e.g. in using a particular application)
- Behavioral regularities
- Interests
- Preferences
- Personality
- Affective state
- Context of interaction
- ……

User Model: Acquisition

User’s input + inference/learning mechanisms

User’s input

- Explicit

- Non Explicit

User's input

- Explicit
  - Self-reports (personal characteristics, proficiencies, interests)
  - Tests
  - Evaluations of specific objects
- Non Explicit
  - Naturally occurring actions (e.g., mouse clicks, scrolling..)
  - Low level measures of psychological states (e.g. facial expressions, eye-gaze, hart rate).
  - Low-level measures of context (e.g., position via GPS)

Acquisition mechanisms

- Knowledge-Based (or Expert-Based)
  - Define rules (deterministic or probabilistic) to identify relevant user properties based on existing theories/knowledge
- Data-Based
  - Learn relevant user features from data (e.g labeled or unlabelled example behaviors)
- Hybrid

Knowledge-Based Example

A computer tutor can use expert-defined rules to infer student's knowledge of a particular topic from her correct or incorrect answers, or from knowledge of related topics

If answer to question *X* is correct

Then there is a probability *p(c)* that the user knows topic T

If answer to question *X* is incorrect

Then there is a probability *p(i)* that the user knows topic T

Knowledge-Based Example
ACT-R Models for Intelligent Tutoring Systems

Eq: 5x+3=30 ; Goals: [Solve for x]

- Rule: To solve for x when there is only one occurrence, unwrap (isolate) x.

Eq:5x+3=30 ; Goals: [Unwrap x]

- Rule: To unwrap ?V, find the outermost wrapper ?W of ?V and remove ?W

Eq: 5x+3=30; Goals: [Find wrapper ?W of x; Remove ?W]

- Rule: To find wrapper ?W of ?V, find the top level expression ?E on side of equation containing ?V, and set ?W to part of ?E that does not contain ?V

Eq: 5x+3=30; Goals: [Remove “+3”]

- Rule: To remove “+?E”, subtract “+?E” from both sides

Eq: 5x+3=30; Goals: [Subtract “+3” from both sides]

- Rule: To subtract “+?E” from both sides ….

Eq: 5x+3-3=30-3

Data-based example

Agent that helps users discriminate which newsgroup (or tweeter) postings to read and which ones to skip

.

	Action	Author	Thread	Length	Where
e1	skips	known	new	long	home
e2	reads	unknown	new	short	work
e3	skips	unknown	old	long	work
e4	skips	known	old	long	home
e5	reads	known	new	short	home
e6	skips	known	old	long	work

Learn how to classify new postings on property ***Action*** *(skip, read)* from attributes *Author, Thread, Length*, and *Where,* based on existing labeled examples

Example: DiamondHelp

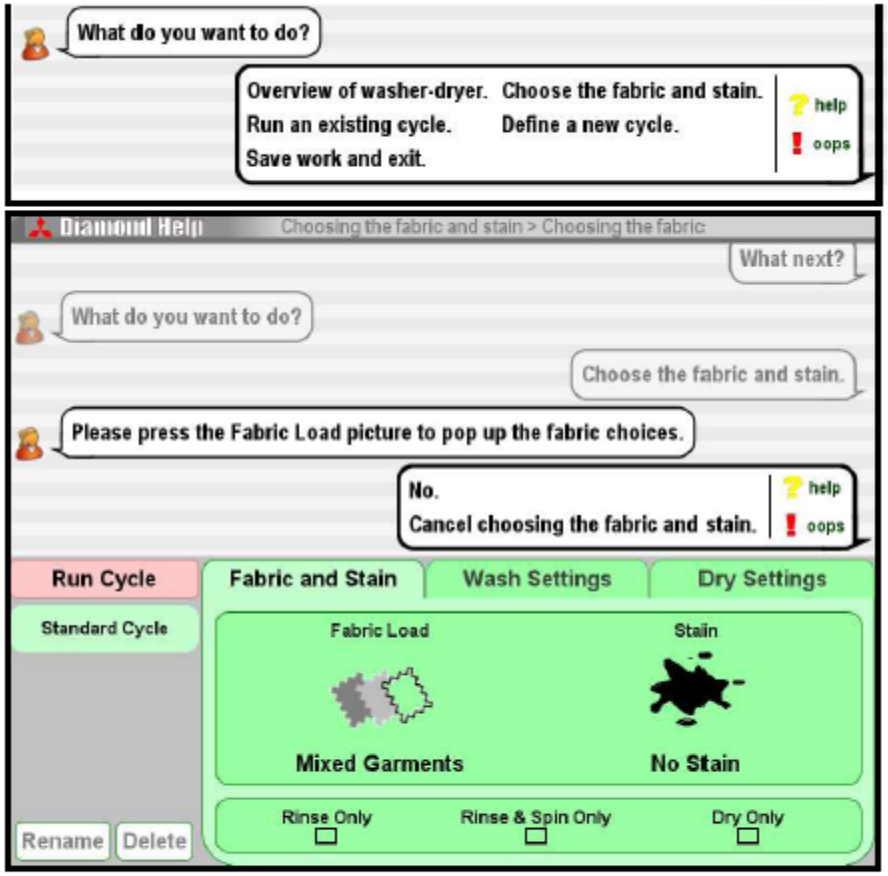


Figure 15.8. Example of collaborative assistance offered by DIAMONDHELP.

DE: Inferences

Forms of adaptation

Inference/Learning:

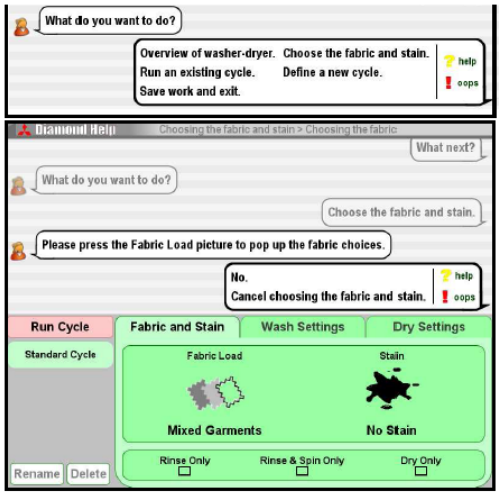


Figure 15.8. Example of collaborative assistance offered by DIAMONDHELP.

User Model

Goals/subgoals

-Self-reports on goals
- Interface actions

Inference/Learning:

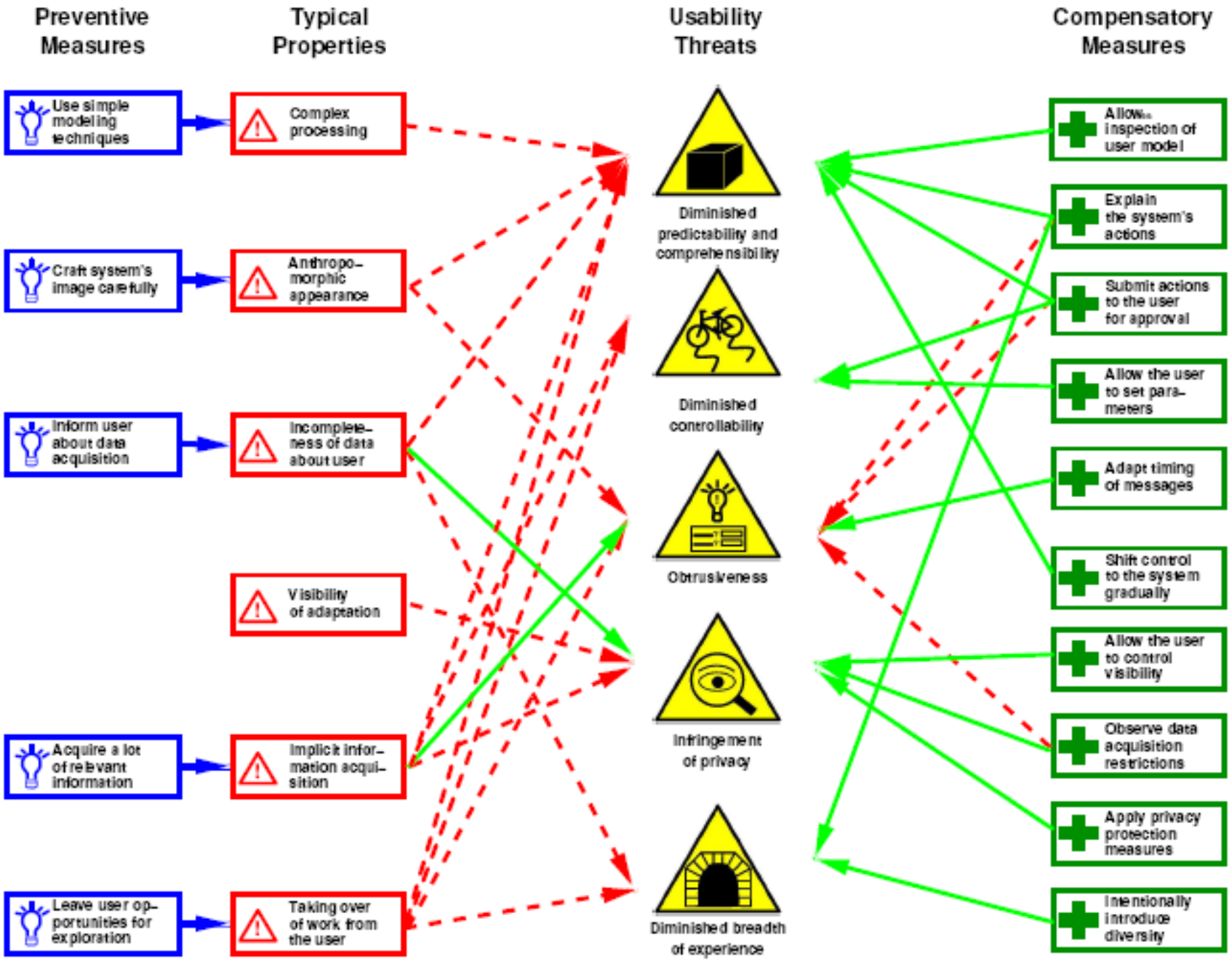
Pros and Cons of Knowledge-based vs. Data-based acquisition methods?

Domain Model

- *Closed World* (e.g. domain to be taught in educational application)
  - Usually well defined
  - Rich representations are possible
- *Open World* (e.g. the Web)
  - Ill defined
  - Requires to deal with lower levels of representation

Communication Model

- How different forms of adaptation are actually implemented in the interface
- Must follow HCI design principles for usability
  - Predictability and Transparency
  - Controllability
  - Unobtrusiveness
  - *Privacy*


Preventive Measures
Typical Properties
Usability Threats
Compensatory Measures
Use simple modeling techniques
Craft system's image carefully
Inform user about data acquisition
Acquire a lot of relevant information
Leave user opportunities for exploration
Complex processing
Anthropomorphic appearance
Incompleteness of data about user
Visibility of adaptation
Implicit information acquisition
Taking over of work from the user
Diminished predictability and comprehensibility
Diminished controllability
Obtrusiveness
Infringement of privacy
Diminished breadth of experience
Allow inspection of user model
Explain the system's actions
Submit actions to the user for approval
Allow the user to set parameters
Adapt timing of messages
Shift control to the system gradually
Allow the user to control visibility
Observe data acquisition restrictions
Apply privacy protection measures
Intentionally introduce diversity

Overview

- Functions and Forms of Adaptive IUIs
- Components
- Usability and Evaluation

Evaluation of Adaptive IUI

- For performance and user satisfaction
  - Wizard of Oz Studies
  - Simulations using data from a non-adaptive system
  - Controlled studies
  - Field Studies

Some Topics

- Supporting System Use:
  - Taking Over Routine Tasks
  - Providing Help
  - Tailoring the Interface
- Adaptive Support to Learning
  - Student Modeling
  - Model Tracing and Issue Tracing Tutors
  - Decision Theoretic Tutors
- Supporting Info Acquisition/Decision Making
  - Support for Browsing
  - Recommending Products
  - Adapting Info Presentation
- Explanation, Trust, Transparency, Fairness in UAI
- Conversational Agents
- Modeling and adapting to
  - User Affect
  - Cognitive Measures (cognitive load, attention)
  - Meta-Cognition

Can add specific topics students are interested in

LookOut

LookOut

Functions

- Support System Usage
- Support Info Acquisition/ Decision Making
- Support Learning
- Support Collaboration
- Support Entertainment

Forms of Adaptation

- Take Over Routine Tasks
- Adapt the Interface
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Horvitz Mixed-Initiative principles

1. Significant value-added automation
2. Consider uncertainty about user goals
3. Consider status of user attention in timing services
4. Infer ideal action in light of costs, benefits and uncertainties
5. Use dialogue to resolve uncertainty
6. Allow direct invocation and termination
7. Minimize cost of poor guesses
8. Match precision of services with goal uncertainty
9. Mechanisms for user-system collaboration to refine results
10. Socially appropriate behaviors for agent-user interaction
11. Maintaining working memory of recent interactions
12. Continuous learning via observation

Taking over routine tasks: Microsoft Lookout

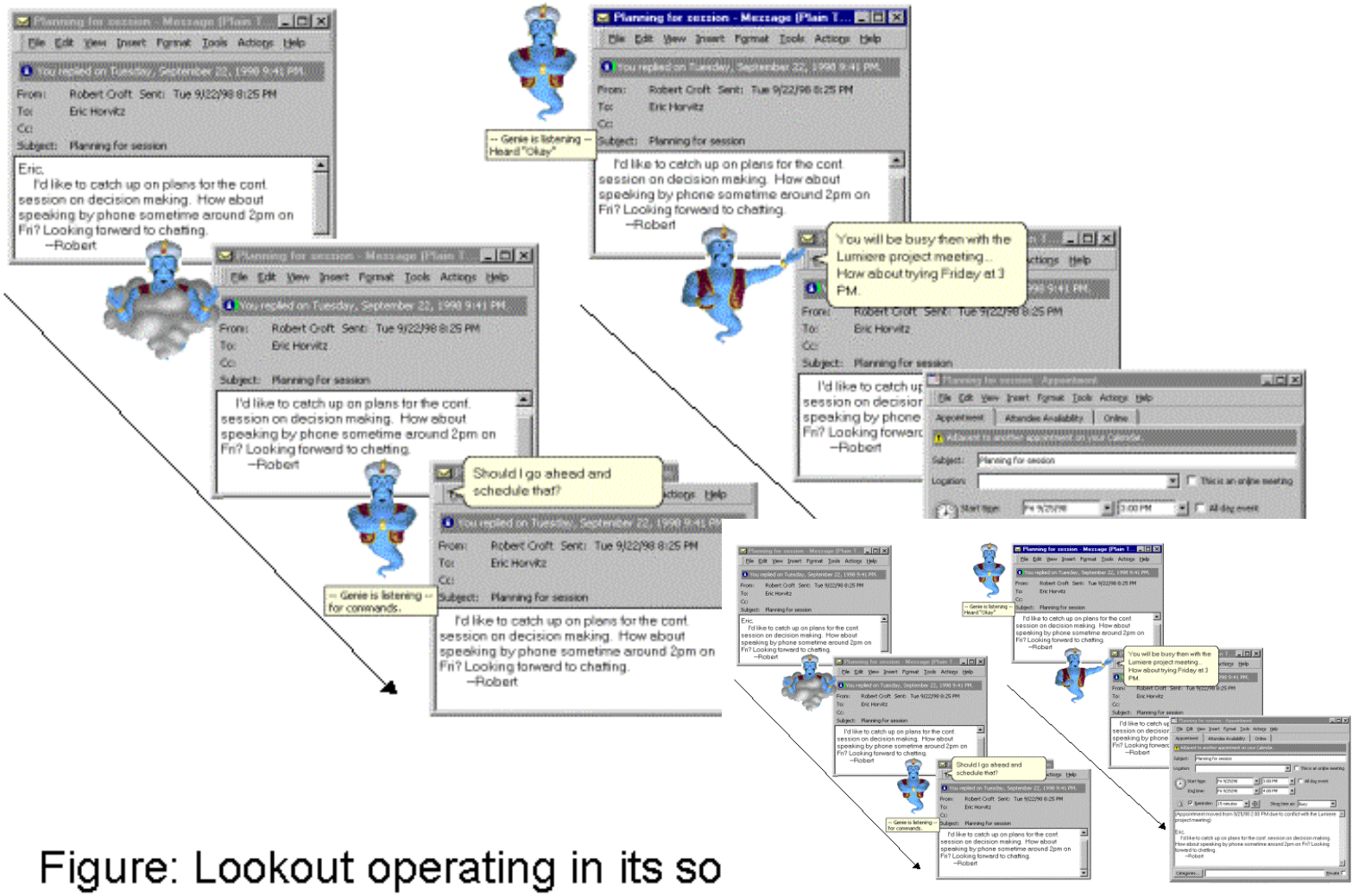


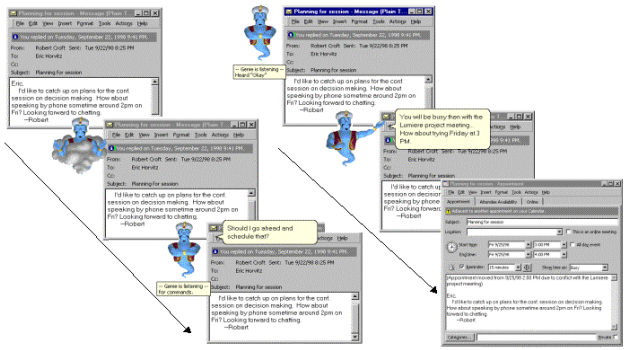
Figure: Lookout operating in its so

Figure: Lookout operating in its social user-interface modality.

Inference/Learning

:

Forms of adaptation



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User Model

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Inference/Learning:

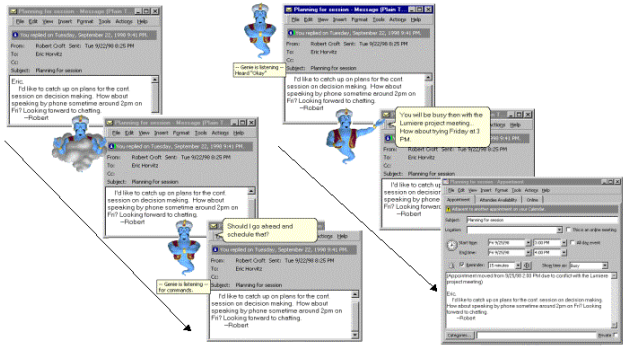


Figure: Lookout operating in its social user-interface modality.

Forms of adaptation

Inference/Learning

:

User Model

Let’s start from this part

Inference for Model Application

- Based on Utility Theory

	Goal	No Goal
Action	*U(A,G)*	*U(A,noG)*
No action	*U(noA,G)*	*U(noA,noG)*

$$eu(A|E) = p(G|E)u(A,G) + p(\neg G|E)\,u(A,\neg G) =$$

$$p(G|E)u(A,G) + [1-p(G|E)]\,u(A,\neg G)$$

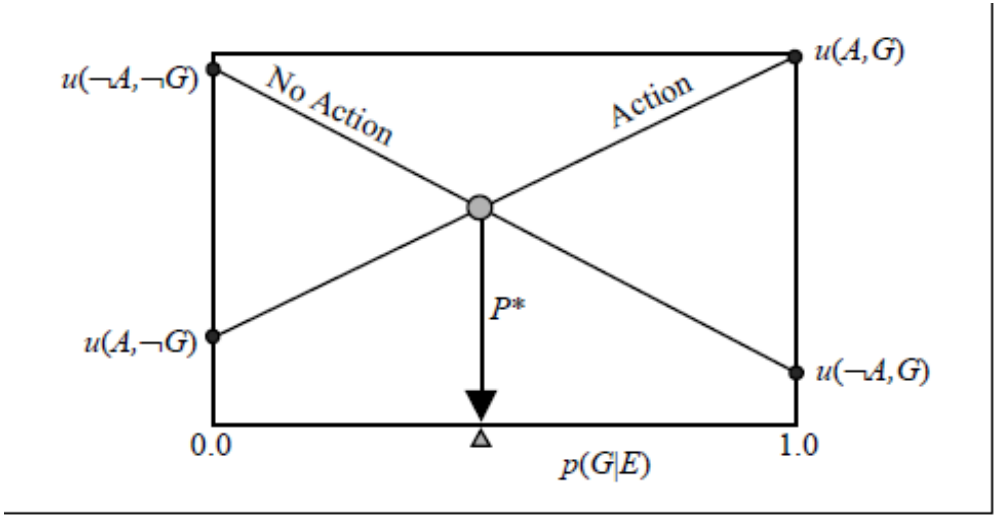
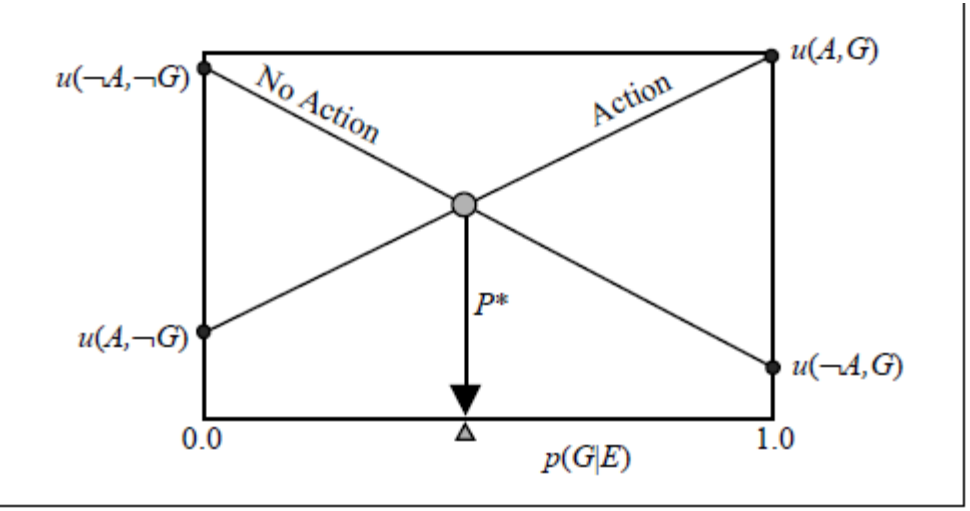


Figure 4. Graphical analysis of the expected utility of action versus inaction, yielding a threshold probability for action.

Similar equation for No Action (¬A)

Chose the behavior with Max Expected Utility (EU)

Inference for Model Application



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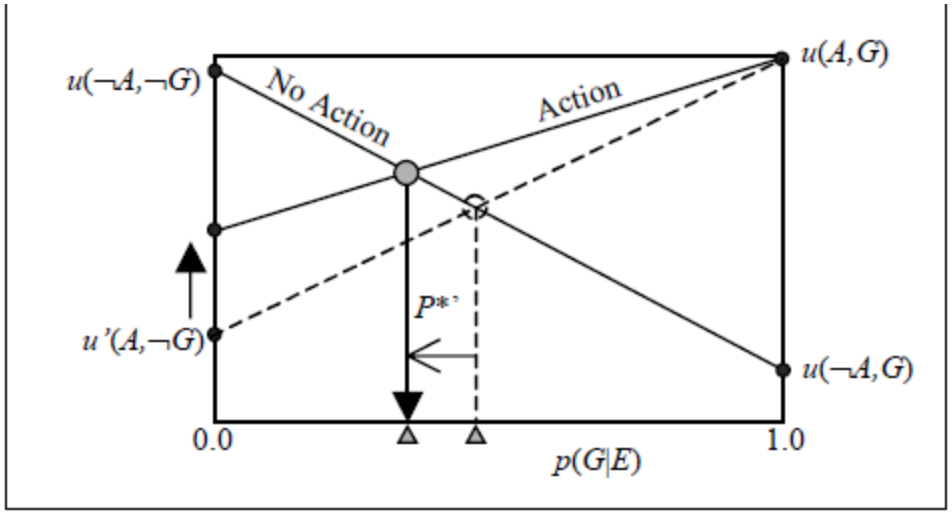
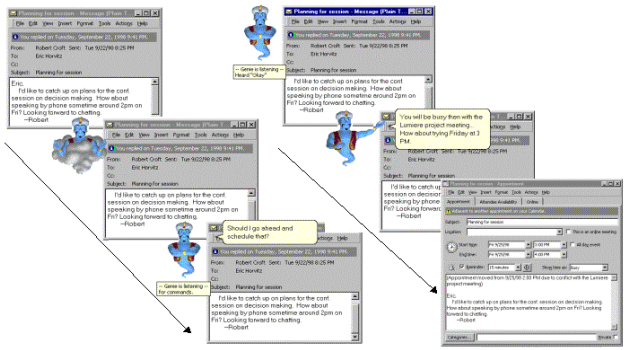


Figure 5. The result of increasing the value of taking erroneous action. Context-dependent shifts in any of the utilities can change the probability threshold for action.



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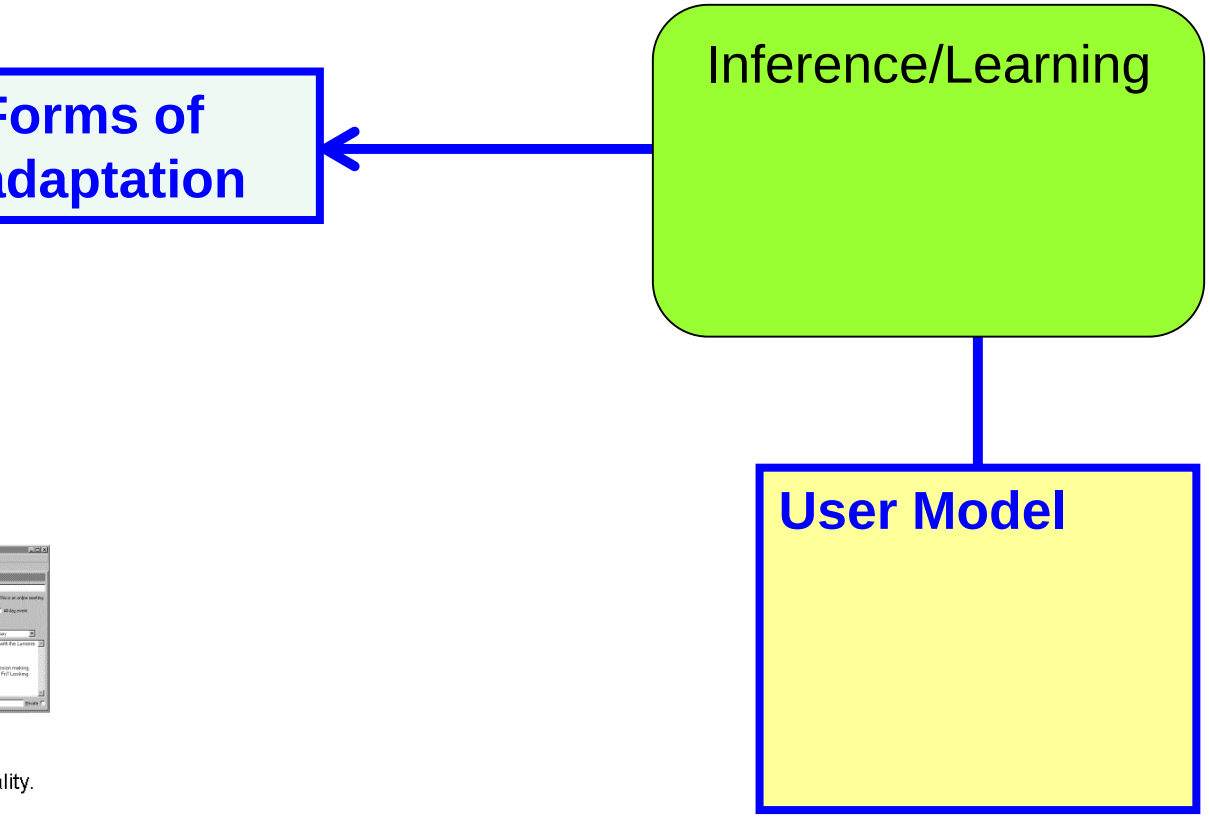


Let’s start from this part

Forms of adaptation

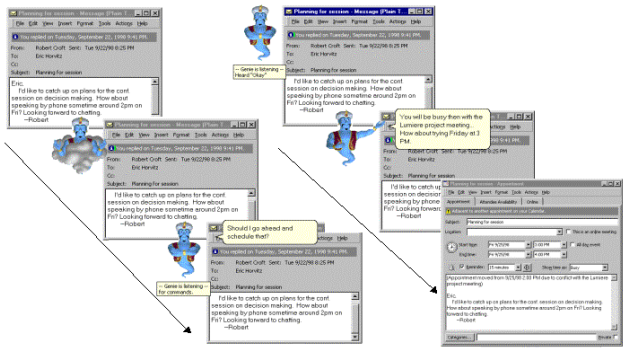
Inference/Learning

Find action with Max EU

:

User Model

U(A, G),
U(A notG),
U(not A, G)
U(not A, notG)
P(G/E)



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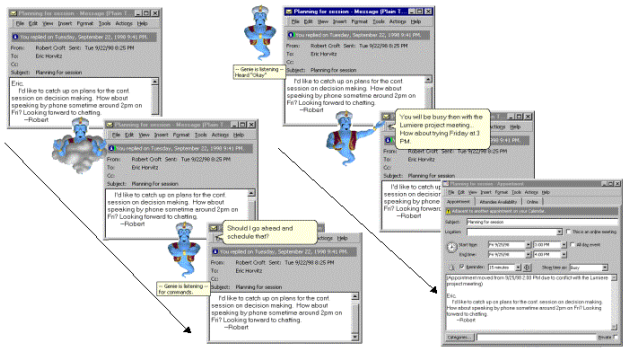
Inference/Learning

Find action with Max EU

Forms of adaptation



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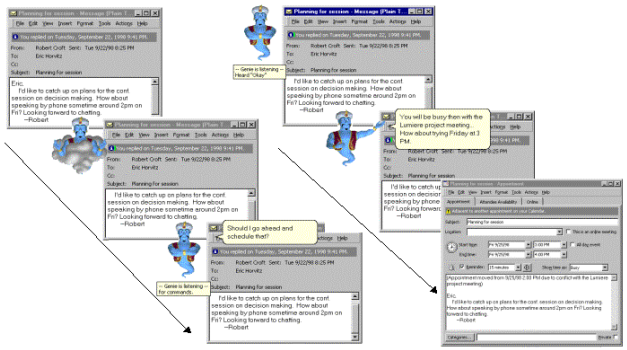
-

Inference/Learning:

Inference/Learning

Find action with Max EU

Forms of adaptation



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User Model

U(A, G),
U(A notG),
U(not A, G)
U(not A, notG)
P(G/E)

scheduling/not scheduling behavior with previous emails

Inference/Learning:

SVM text classifier

Inference for Model Application

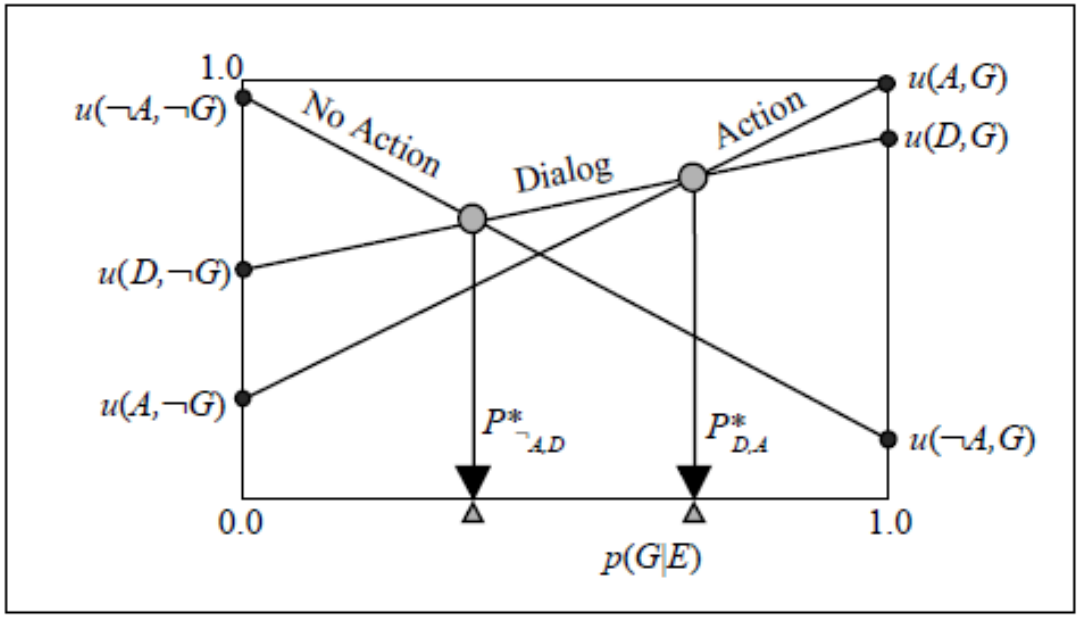

Figure 6. Adding a second action option consisting of dialog with users about their goals. In this case, the graphical analysis higlights the origin of two threshold probabilities for guiding the action of autonomous services.

User's input in LookOut

- Explicit
  - Self-reports on U(G, A)

- Non Explicit
  - Previous scheduling behaviors

Acquisition mechanisms in LookOut

- Knowledge-Based (or Expert-Based)
  - Define rules (deterministic or probabilistic) to identify relevant user properties based on existing theories/knowledge
- Data-Based
  - Learn relevant user features from data (e.g labeled or unlabelled example behaviors)
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Domain Model in LookOut

- *Closed World* (e.g. domain to be taught in educational application)
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  - Ill defined
  - Requires to deal with lower levels of representation

Interface Features Important for Mixed Initiative

Interface Features Important for Mixed Initiative

- Multiple interaction modalities
- Variable dwell time for a response
- Don’t take final action without user approval