Jameson
paper
Create Al-driven interactive systems that support personalized interaction by:
- capturing a user’s specific needs/states/abilities
- adapting the interaction accordingly
- while preserving transparency, user control and trust

Al-driven interactive is also known as User-Adaptive-Interaction (UAI)
Adaptation Cycle

- Adapt behavior to user $U$ on the basis of nontrivial inferences from information about $U$

**Forms of adaptation**

**Inference/Learning:**
- how to adapt

**Input sources**

**Inference/Learning:**
- Relevant user properties/-states

**User Model**
Why UAI?
Why UAI?

- High functionality applications: feature overload
  - E.g. word processors, media editors, learning-management systems
  
    Hard to design them to work well for each individual user

- Specialized applications where personalization is highly valuable
  - web-browsing, recommender systems, e-commerce,
  - education, health
  - computer-supported collaborative work
  - digital entertainment, social media

- And users often do not know/want to personalize (customize) their application
Overview

- Functions and Forms of UAI
- Components
- Usability and Evaluation

UAI: Functions and Forms (some)

Functions

Support System Use
Support Info Acquisition/Decision Making
Support Learning
Support Collaboration
Support Entertainment

Forms of Adaptation

Take Over Routine Tasks
Adapt the Interface
Advice on System Usage
Retrieve Info/Recommend Objects
Tailor Info Presentation
Advice on task
Support System Use: High Functionality Applications

- $F = \text{All functionalities available in the application}$
- $F_M = \text{functionalities the user has mastered}$
- $F_A = \text{functionalities the user is aware of but does not use}$
- $F_B = \text{functionalities the user believes are available}$
Support System Use: Some Forms of Adaptation

- Give advice on system usage
  - e.g. suggest unknown or seldom used functionalities
  - on demand or unsolicited
- Adapt the interface itself
- Take over routine tasks
UAI: Functions and Forms (some)

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Give Advice on System Usage: the Microsoft Office Assistant
Advice on System Usage:
Recommend Commands to IDE Users


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**Open Resource**

ctrl + shift + r

Enables quick finding and opening of project resources.

**Usage example of Open Resource:**

```java
package yourprojects;
public class HelloWorld {
    public static void main(String[] args) {
        System.out.println("Hello World!");
    }
}
```

**Step-by-step guide video**

Why is it recommended to me?

_Open Resource_ is used by 48% of competent users who are interacting with the IDE in a similar way as you. It is often used in JSP-HTML editor when users are editing Java methods.
Adapting the Interface: Promote Most Relevant Commands

Gajos, Czerwinski, Tan, Weld: Exploring the design space for adaptive graphical user interfaces. AVI 2006: 201-208
Adapting the interface:

Gmail Folder List

Windows “Quick Access”
Adapting the Interface: Appearance

Figure 1: Four GUIs automatically generated under the same size constraints for four different users: (a) a typical mouse user, (b) a mouse user with impaired dexterity, (c) a low vision user and (d) a user with a combination of low vision and impaired dexterity. All but (a) were generated using SUPPLE++ described herein.

Gajos, Wobbrok, Weld: Automatically generating user interfaces adapted to users' motor and vision capabilities. UIST 2007: 231-240
Taking over routine tasks: PAL
(Personalized Assistants that Learn)

- Large research initiative sponsored by USA - DARPA to devise all-encompassing personalized assistance

Ptime System for Scheduling Assistance (Berry et al, Knowl. Inf. Syst. 52(2): 379-409 (2017))

- PAL generated several commercial applications, including SIRI
Why UAI?

- **High functionality applications:** feature overload
  - E.g. word processors, media editors, learning-management systems
  - Hard to design them to work well for each individual user

- **Specialized applications where personalization is highly valuable**
  - web-browsing, recommender systems, e-commerce,
  - education, health
  - computer-supported collaborative work
  - digital entertainment, social media

- And users often **do not know/want** how to personalize (customize) their application
Web Browsing, recommender systems, e-commerce applications

- Adaptivity as a solution to the problem of information overload
  - Supporting Info Acquisition and Decision Making
- Some forms of adaptation
  - Retrieve relevant information/recommend objects
  - Tailor the information presentation
UAI: Functions and Forms (some)

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
- Advice on System Usage
- Retrieve Info/Recommend Objects
- Tailor Info Presentation
- Advice on task
Finding Information

About 25,270,000,000 results (0.43 seconds)

Top stories

Smart speakers just a fad? Think again. The year ahead for Alexa, Goo...
CBC.ca
2 days ago

Anker’s Roav Bolt is a USB car charger with Google Assistant built...
The Verge
2 hours ago

Apple burns Google in giant billboard touting privacy at CES
The Hamilton Spectator
1 day ago

More for google
## Recommending objects: MovieLens

![Image of MovieLens website](image)

- **Welcome conati | Logout**
- You've rated 18 movies.

### Movie List

<table>
<thead>
<tr>
<th>Predictions for you</th>
<th>Your Ratings</th>
<th>Movie Information</th>
<th>Wish List</th>
</tr>
</thead>
<tbody>
<tr>
<td>★★★★★ 5.6 stars</td>
<td>Adventures of Priscilla, Queen of the Desert, The (1994) DVD, info</td>
<td>Comedy, Drama</td>
<td></td>
</tr>
<tr>
<td>★★★★★ 5.6 stars</td>
<td>Almost Famous (2000) DVD, VHS, info</td>
<td>Comedy, Drama</td>
<td></td>
</tr>
<tr>
<td>★★★★★ 5.6 stars</td>
<td>Some Like It Hot (1959) DVD, info</td>
<td>Comedy, Crime</td>
<td></td>
</tr>
<tr>
<td>★★★★★ 5.6 stars</td>
<td>To Die For (1995) info</td>
<td>Comedy, Drama</td>
<td></td>
</tr>
<tr>
<td>★★★★★ 4.5 stars</td>
<td>Bullets Over Broadway (1994) info</td>
<td>Comedy, Drama</td>
<td></td>
</tr>
<tr>
<td>★★★★★ 4.6 stars</td>
<td>In the Name of the Father (1993) info</td>
<td>Drama</td>
<td></td>
</tr>
<tr>
<td>★★★★★ 4.6 stars</td>
<td>To Kill a Mockingbird (1962) info</td>
<td>Drama</td>
<td></td>
</tr>
<tr>
<td>★★★★★ 3.5 stars</td>
<td>Erin Brockovich (2000) DVD, VHS, info</td>
<td>Drama</td>
<td></td>
</tr>
<tr>
<td>★★★★★ 3.5 stars</td>
<td>Mask of Zorro, The (1998) DVD, info</td>
<td>Action, Adventure, Romance</td>
<td></td>
</tr>
<tr>
<td>★★★★★ 3.5 stars</td>
<td>Mummy, The (1999) DVD, info</td>
<td>Action, Adventure, Horror, Thriller</td>
<td></td>
</tr>
<tr>
<td>★★★★★ 3.5 stars</td>
<td>Striptease (1996) DVD, info</td>
<td>Comedy, Crime</td>
<td></td>
</tr>
<tr>
<td>★★★★★ 3.0 stars</td>
<td>High Fidelity (2000) DVD, VHS, info</td>
<td>Comedy</td>
<td></td>
</tr>
<tr>
<td>★★★★★ 3.0 stars</td>
<td>Talented Mr. Ripley, The (1999) DVD, VHS, info</td>
<td>Drama, Mystery, Thriller</td>
<td></td>
</tr>
<tr>
<td>★★★★★ 2.5 stars</td>
<td>Patriot, The (2000) DVD, VHS, info</td>
<td>Action, Drama, War</td>
<td></td>
</tr>
<tr>
<td>★★★★★ 1.5 stars</td>
<td>Green Mile, The (1999) DVD, VHS, info</td>
<td>Drama, Thriller</td>
<td></td>
</tr>
</tbody>
</table>
Recommending Objects: Ads!

E.g. Google/Gmail ads

How Gmail ads work

When you open Gmail, you'll see ads that were selected to show you the most useful and relevant ads. The process of selecting and showing personalized ads in Gmail is fully automated. These ads are shown to you based on your online activity while you're signed into Google. We will not scan or read your Gmail messages to show you ads.
Tailoring Information Presentation: SETA *(Ardissono & Goy, 2000)*
Figure 14. Detail of a presentation page describing the “Facile” answering machine, tailored to an expert user.
Support to Learning/Training

- Which forms of adaptation are relevant?

**Forms of Adaptation**

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

Support Learning
AutoTutor (Graesser et al 2000, 2010)

- Helps students learn a variety of topics by guiding them in question-answering dialogues
Andes (Conati et al 2002, Vanlhen et al 2005)

- Provides an interface for students to solve physics problems
- Interactively monitors the student’s problem solution and intervenes with adaptive suggestions when the student needs help (coached problem solving)

\[ F_w = m_c \times g \]
UAI: Functions and Forms (some)

**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
- Advice on System Usage
- Retrieve Info/Recommend Objects
- Tailor Info Presentation
- Advice on task
Support to Learning/Training

- Most forms of adaptations are relevant
  - Provide help on both interface usage and learning tasks
  - Take over routine tasks not crucial for learning
  - Adapt the interface to facilitate learning
  - Help finding information
  - Recommend learning material (lessons, exercises, activities)
  - Tailor content/presentation of learning material
UAI: Functions and Forms (some)

**Functions**

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- Support Info Acquisition/Decision Making
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**Forms of Adaptation**

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UAI: Functions and Forms (some)

**Functions**

- Support System Usage
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**Forms of Adaptation**

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

- Help people interact effectively
  - Computer-Supported Collaborative Work (CSCW)
  - Computer-Supported Collaborative Learning (CSCL)

- Specific forms of adaptation for collaboration?
Forms of Adaptation

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
Support Collaboration

- Recommend suitable collaborators
- Give advice on collaboration process
- Adapt the interface to facilitate collaboration
  - E.g., enforce specific roles
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
Support Entertainment/Social media

- Explosion of applications
  - User-Adaptive Games
  - Adaptive TV (e.g. Netflix, Amazon Prime)
  - Social Media

- Again, many forms of adaptation can be relevant
  - Recommend games, partners, friends, TV programs, tweets
  - Adapt the interface to maintain engagement
  - Adapt information presentation
  - Advice on task
**Forms of Adaptation**

- Support System Usage
  - Take Over Routine Tasks
  - Adapt the Interface
  - Advice on System Usage

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

- Functions
  - Retrieve Info/Recommend Objects
  - Tailor Info Presentation
  - Advice on task

**UAI**
Overview

- Functions and Forms of Adaptive IUIs
- Components
- 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?

Forms of adaptation

Inference/Learning: how to adapt

Input sources

Inference/Learning: Relevant user properties/states

User Model
User Model: Which User Properties are Represented?

- **Forms of adaptation**
  - Depend upon the type(s) of adaptation that we want to achieve
- **Input sources**
- **User Model**
  - Inference/Learning: how to adapt
  - Relevant user properties/states
Example: SETA

Tailoring the Interaction with Users in Web Stores

7. Facile

- 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 “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

Input sources

Inference/Learning: Relevant user properties/states
Figure 15.8. Example of collaborative assistance offered by DIAMONDHELP.
DH: Which User Properties are Represented?

- **Forms of adaptation**
  - Inference/Learning: how to adapt
  - User Model: Goals and subgoals in during machine operation
  - Input sources

- **Inference/Learning:** Relevant user properties/states

Figure 15.8. Example of collaborative assistance offered by DIAMONDHELP.
Which User Properties are Represented?

Forms of adaptation

Input sources

Inference/Learning: Relevant user properties/states

User Model
- Goals
- Beliefs/Domain knowledge
- Proficiencies
- Behavioral regularities
- Interests
- Preferences
- Personality
- Affective state
- Context of interaction
- .............

Inference/Learning: how to adapt
User Model: Acquisition

User’s input + inference/learning mechanisms
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, heart 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
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 $x$]

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

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.

<table>
<thead>
<tr>
<th>Action</th>
<th>Author</th>
<th>Thread</th>
<th>Length</th>
<th>Where</th>
</tr>
</thead>
<tbody>
<tr>
<td>e1</td>
<td>skips</td>
<td>known</td>
<td>new</td>
<td>long</td>
</tr>
<tr>
<td>e2</td>
<td>reads</td>
<td>unknown</td>
<td>new</td>
<td>short</td>
</tr>
<tr>
<td>e3</td>
<td>skips</td>
<td>unknown</td>
<td>old</td>
<td>long</td>
</tr>
<tr>
<td>e4</td>
<td>skips</td>
<td>known</td>
<td>old</td>
<td>long</td>
</tr>
<tr>
<td>e5</td>
<td>reads</td>
<td>known</td>
<td>new</td>
<td>short</td>
</tr>
<tr>
<td>e6</td>
<td>skips</td>
<td>known</td>
<td>old</td>
<td>long</td>
</tr>
</tbody>
</table>

Learn how to classify new postings on property **Action** *(skip, read)* from attributes **Author, Thread, Length, and Where**, based on existing labeled examples.
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 design principles for usability
  - Predictability and Transparency
  - Controllability
  - Unobtrusiveness
  - Privacy
  - Breadth of Experience
Vision: Personalized XAI

- Intelligent systems that understand to whom, when and how to provide explanations
- Good UI tools for users to access then on demand

**Forms of adaptation**
- Give help
- Adapt interface
- Tailor Information
- Recommend Objects
- EXPLANATIONS

**Input sources**
- Interface Actions
- Facial Expressions
- Physiological Signals
- Speech

**User Model**
- Goals ?
- Knowledge ?
- Behavioral ?
- Regularities
- Preferences ?
- Emotions ?
- Cognitive Load ?
- what else??

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
Next Time

Tu. 18

Mixed-Initiative Interaction


One question | by noon Monday
No summary


One Question and summary by noon Monday
(post questions in Piazza folder "Jan18")
Please take the survey

CPSC 532C/554C 201 2021W2 Topics in Artificial Intelligence - HUMAN-CENTRED AI

532C / 554C (cross-listed)

Human-Centred AI

Spring 2022

Cristina Conati

Survey for students

https://www.surveymonkey.com/r/BTYVN73