

Computer Science

CPSC 532c/544c

Human-Centred AI

Cristina Conati

Artificial Intelligence Today

'Whoever leads in AI will rule the world':
Putin to Russian children on Knowledge
Day

rt.com, Sep 5 2017



Inside Waymo's Secret World for Training
Self-Driving Cars



Arm Leads Project to Develop an Armpit-Sniffing Plastic AI Chip

In a quest for penny-priced plastic sensors, Arm and its partners are demonstrating a stripped-down form of machine learning

By Samuel K. Moore



Alexa talks down to
voice rivals at IFA
2017



Amazon Alexa now
responds to certain
questions with
skills that can help yo...

An AI lie detector will interrogate travellers at some EU borders

A digital border guard will be trialled at some borders in Hungary, Latvia and Greece for six months. It includes an AI lie detector, but some doubt it will work



Detecting Depression: Phone Apps Could Monitor Teen Angst
Associated Press
Lindsey Tanner
January 3, 2019

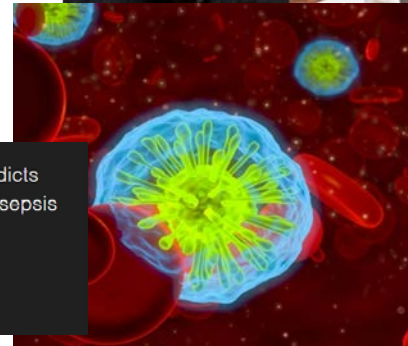
ICT HEALTH

Memory-jogging robot to keep people sharp in 'smart' retirement homes

25 September 2018

by Steve Gillman

Republish



A new machine-learning model predicts whether ER patients suffering from sepsis may need to be switched to certain medications.

MIT News Office

For Up to Date AI News



AAAI AI-Alert

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acm.org

FROM THE ACM SPECIAL INTEREST GROUP ON COMPUTER HUMAN INTERACTION

MEMBERNET ARCHIVES CAREERNEWS CONTACT US

The banner features a blue background with a white grid pattern. The text 'ACM TechNews SIGCHI Edition' is in white. Below it is the ACM logo (a diamond with 'acm' inside) and the URL 'acm.org'. To the right is the SIGCHI logo (a stylized orange figure). A yellow bar contains the text 'FROM THE ACM SPECIAL INTEREST GROUP ON COMPUTER HUMAN INTERACTION'. At the bottom, a yellow bar contains four links: 'MEMBERNET', 'ARCHIVES', 'CAREERNEWS', and 'CONTACT US'.

Welcome to the January 2019 SIGCHI edition of ACM TechNews.

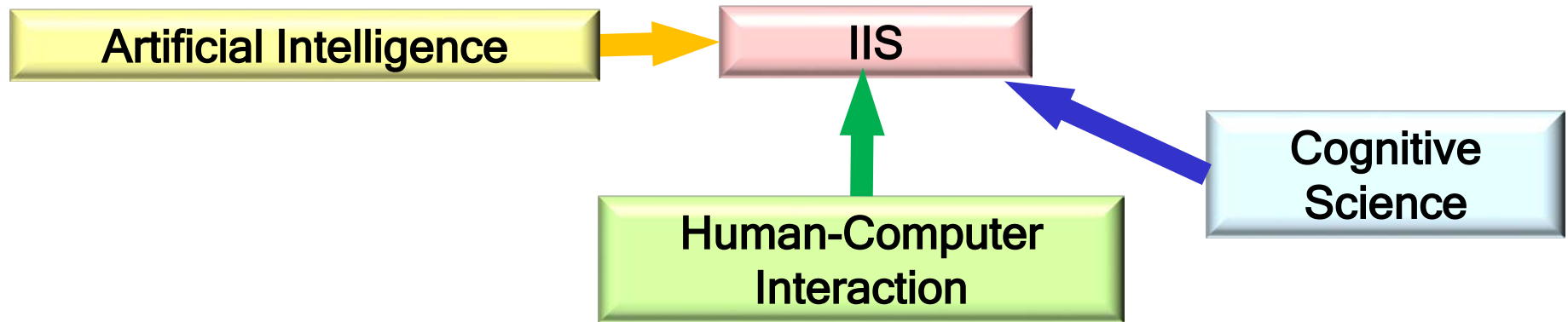
[Calendar of Events](#)

AI in the Future

- Since 2014, Stanford University is hosting a long-term initiative to examine the effects of Artificial Intelligence
 - One Hundred Year Study on Artificial Intelligence (AI100).
- Will examine impacts of AI on society, including on the economy, war and crime, over the course of a century
 - 2016 Report (next report to appear sometime this year)
- Next step: two focused studies
 - *Prediction in Practice*, will focus on the rising uses and importance of advisory systems built via machine learning.
 - *Coding Caring: Human Values for an Intimate AI*, will explore uses of AI technologies in such intimate settings as healthcare and personal advice.

This Course

Intelligent Interactive Systems (IIS)



Provide **enhanced human-agent** interaction by

- Supporting sophisticated forms of communication
 - E.g. natural language, vision (CPSC 503, 505, 532s)
speech/gesture recognition
- Supporting **personalized** interaction by capturing and adapting to a user's specific **needs/states/abilities**

User-Adaptive Interaction (UAI)
FOCUS of THIS COURSE

Course Logistics

Class Data

Instructor Office: ICCS 107

Office Hours: By appointment

Email: conati@cs.ubc.ca

Course mailing list: cpssc532c@cs.ubc.ca

- Subscribe to the list by sending the message
"subscribe cpssc532c" to Majordomo@cs.ubc.ca.

Piazza class _register at

piazza.com/ubc.ca/winterterm12020/cpssc532c554c

Need to be registered for both the mailing list and Piazza class

Send me email if you have problems signing up

Coursework

- **Readings.** Most classes will be devoted to the discussion of a selection of papers, to be **read in advance**.
- **Summary/Questions** on the readings.
- **Presentation** and **discussion leading** of papers.
- **Term project.**

Beside improving participation to class discussion, the objective of the first three activities is to help participants learn **how to read research papers** with a critical eye.

Paper Summaries

- Each paper summary (no more than **2 pages**) should address the following points (also listed in the following template)
 1. What are motivations for this work?
 2. What is the proposed solution?
 3. Has the proposed solution been evaluated, and if so how ?
 4. What are the contributions of this work?
- More info on the above points can be found in “How to read a research paper”
- All pointers available in course page

Questions on Papers

- **Generate** at least **two questions** on each assigned reading
 - Can also view these as “**discussion points**”
 - For some papers the minimum number of questions might change - will be specified in class schedule
- **Post them** in Piazza (in the appropriate folder) by **deadline** specified in class schedule and syllabus.
 - Material sent after the deadline will be marked as zero. However
 - Each student has **2 "no paper" bonuses**: can avoid sending the material for 2 papers with no penalty.
- Clarification questions are welcome, but there **should be at least two questions** on each paper that
 - address **weaknesses** in the presented research or,
 - relate the research to **general issues** in the field, or
 - make **connections/comparisons** with other readings.

Leading Paper Presentation and Discussion

- Each participant will **present** and **lead** the discussion on X papers
 - X depends on final number of participants
- Paper presentation:
 - A few slides with **a critical summary**, including the same points to be covered in a regular paper summary
 - No more than **10'-15' long!**
 - **Rehearse** your presentation to make sure that you will not go overtime
- Lead the discussion for that class.
 - This will include **collecting**, **structuring** and **proposing answers** to (some of) the questions posed by the rest of the class.

Presenters do not need to send summaries and questions on their assigned papers

Project

Decided in consultation with the instructor

Some options

- Implementing a simple UA system
- Extending an existing UA system
- Doing an extensive evaluation of an existing UA system

Project Stages

- A project proposal (max. 3 pages), by mid October
 - Short presentation of the proposal during that class
- Presentation of project progress toward mid November
- Final project due at the end of the course

For next class

		<p>Discussion of Jameson's paper 2 questions: by 12noon on Monday Sept 9 No summary (post in folder "sept9" in Piazza)</p>
		<p>E. Horvitz. Principles of Mixed-Initiative User Interfaces. CHI '99, 159166 2 questions: by 12noon on Monday Sept 9 No summary (post in folder "sept9" in Piazza)</p>
12	Mixed-Initiative Interaction	<p>Bunt A., Conati C. and McGrenere J. (2007). Supporting Interface Customization Using a Mixed-Initiative Approach. <i>IUI 2007, International Conference on Intelligent User Interfaces</i>, 92-101. 2 questions: by 9pm, Wed Sept 11 Summary</p> <p>RADAR: A Personal Assistant that Learns to Reduce Email Overload (2008). AAAI 2008: Int. Conf. on the Advancement of Artificial Intelligence 1287-1293 2 questions: by 9pm, Wed Sept 11 No summary (post in folder "sept11" in Piazza)</p>

Back to AI and Human-Centred AI

What is Artificial Intelligence?

What is Artificial Intelligence?

- Four **definitions** that have been proposed (Artificial Intelligence: A Modern Approach, Russel S. and Norvig P., 2009)
 1. Systems that **think** like **humans**
 2. Systems that **act** like **humans**
 3. Systems that **think** **rationally**
 4. Systems that **act** **rationally**

Thinking Like Humans

Model the cognitive functions and behaviors of humans

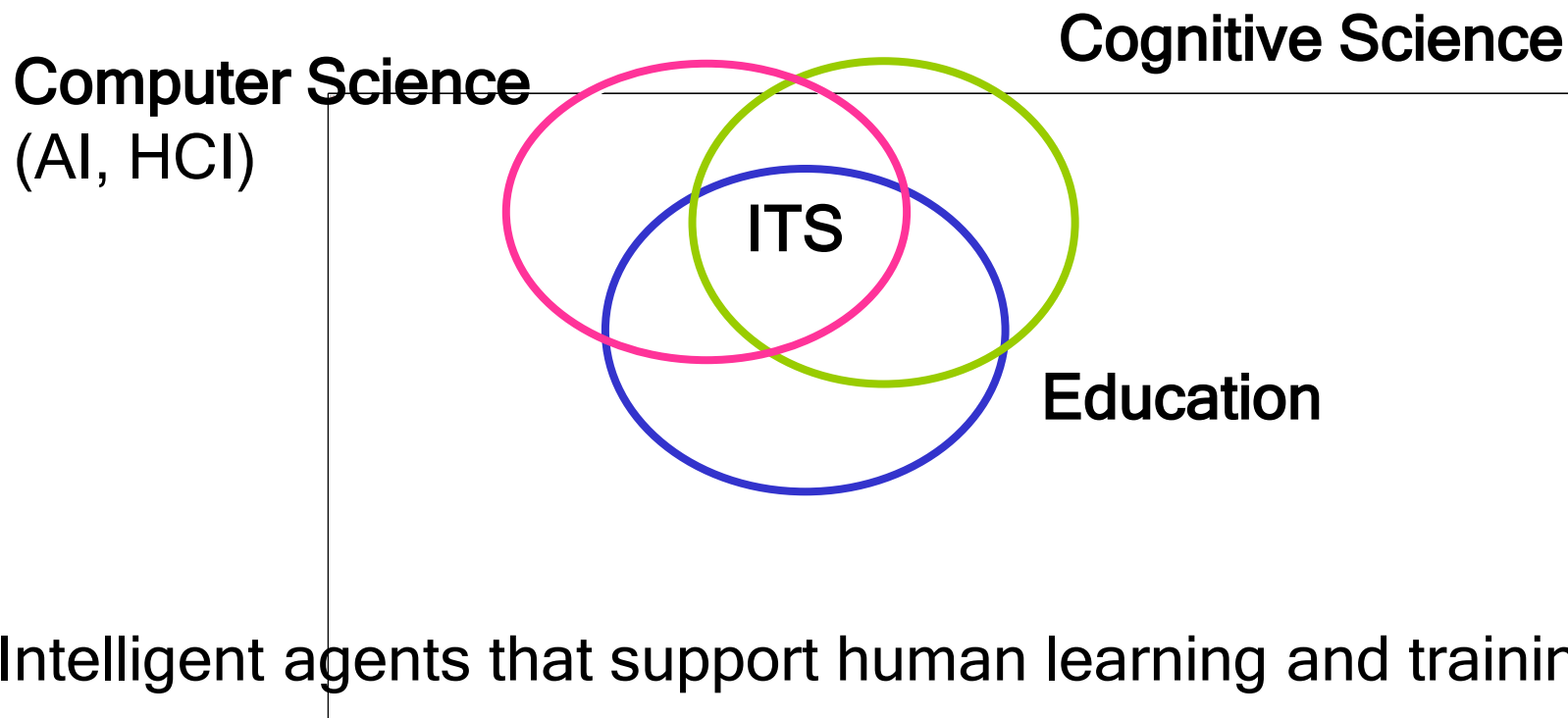
- Human beings are our best example of intelligence
- We should use that example!

Example: ACT-R cognitive architecture <http://act-r.psy.cmu.edu/>

Anderson, J. R., Bothell, D., Byrne, M. D., Douglass, S., Lebiere, C., & Qin, Y . (2004). An integrated theory of the mind. *Psychological Review* 111, (4). 1036-1060.

ACT-R Models for Intelligent Tutoring Systems

Intelligent Tutoring Systems (ITS)



- ◆ Intelligent agents that support human learning and training
- ◆ By **autonomously** and **intelligently** adapting to learners' specific needs, like good teachers do

ACT-R Models for Intelligent Tutoring Systems

- One of ACT-R main assumptions:
 - Cognitive skills (procedural knowledge) are represented as production rules:
IF this situation is TRUE, THEN do X
- ACT-R model representing expertise in a given domain:
 - set of production rules mimicking how a human would reason to perform tasks in that domain
- An ACT-R model for an ITS encodes all the reasoning steps necessary to solve problems in the target domain
 - Example: rules describing how to solve

$$5x+3=30$$

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

Cognitive Tutors

- ITS that use Act-R models of target domains (e.g. algebra, geometry), in order to
 - **trace** student performance by **firing** rules and do a stepwise comparison of rule outcome with student action
 - **mismatches** signal incorrect student knowledge that requires tutoring
- These models showed good fit with student performance, indicating the value of the ACT-R theory
- **Cognitive Tutors** are great examples of AI success - used in thousands of high schools in the USA
(<http://www.carnegielearning.com/>)

Acting Like Humans

- Turing test (1950)
 - operational definition of intelligent behavior
 - Can a human interrogator tell whether (written) responses to her (written) questions come from a human or a machine?
- No system has fully passed the test yet
 - Yearly competition: Loebner Prize

From “<https://medium.com/pandorabots-blog/mitsuku-wins-loebner-prize-2018-3e8d98c5f2a7>”

“To win the silver medal and a prize of \$25,000, a program must fool at least half of the judges that it was a real person if any bot manages to do this, the contest moves into an audio/visual stage where the winner would get the gold medal and \$100,000. There are no details about this stage, as it isn’t likely to ever happen. The prize that we can realistically expect to see awarded at each event is a₂₅ bronze medal to the bot that is most humanlike”

Acting Like Humans

Humans often think/act in ways we don't consider intelligent

- Then why replicate human Behavior, including its limitations?

Why Replicate Human Behavior, Including its Limitations?

Why Replicate Human Behavior, Including its Limitations?

- AI and Entertainment

- E.g. *Façade*, a one-act interactive drama

- Sometime these limitations can be useful, e.g.

- Supporting human learning via teachable agents

(Leelawong, K., & Biswas, G. Designing Learning by Teaching Agents: The Betty's Brain System, *International Journal of Artificial Intelligence in Education*, vol. 18, no. 3, pp. 181-208, 2008

- Simulations for military training

(<http://www.alelo.com/>)



Thinking Rationally

- **Rationality**: an **abstract ideal of intelligence**, rather than “whatever humans think/do”
 - Ancient Greeks invented **sylogisms**: argument structures that always yield correct conclusions given correct premises
 - This led to **logic**, and **probabilistic reasoning** which are the foundations on many AI paradigms for knowledge representation and reasoning
- Is rational **thought** enough?
 - A system that only thinks and doesn't do anything is quite useless
 - Any means of communication would already be an **action**
 - And it is hard to measure thought in the first place ...

Acting Rationally

- Rationality is **more cleanly defined** than human behaviour, so
 - ✓ it's a better design objective
 - ✓ in cases where human behaviour is not rational, often we'd prefer rationality
 - Example: you wouldn't want a shopping agent to make impulsive purchases!
 - ✓ And once we have a rational agent, we can always tweak it to make it irrational!
- It's easier to define rational action than rational thought

Acting Rationally

- AI as study and design of **intelligent agents** that **act rationally** in their environment
 - Their **actions** are **appropriate** for their goals and circumstances
 - They are **flexible** to changing environments and goals
 - They **learn** from experience
 - They make **appropriate choices** given **perceptual limitations** and **limited resources**
- This definition drops the constraint of *cognitive plausibility*
 - Same as building flying machines by understanding general principles of flying (aerodynamic) vs. by reproducing how birds fly

Acting Rationally

- Interestingly, this is a view that even Google is embracing

Why Google defined a new discipline to help humans make decisions

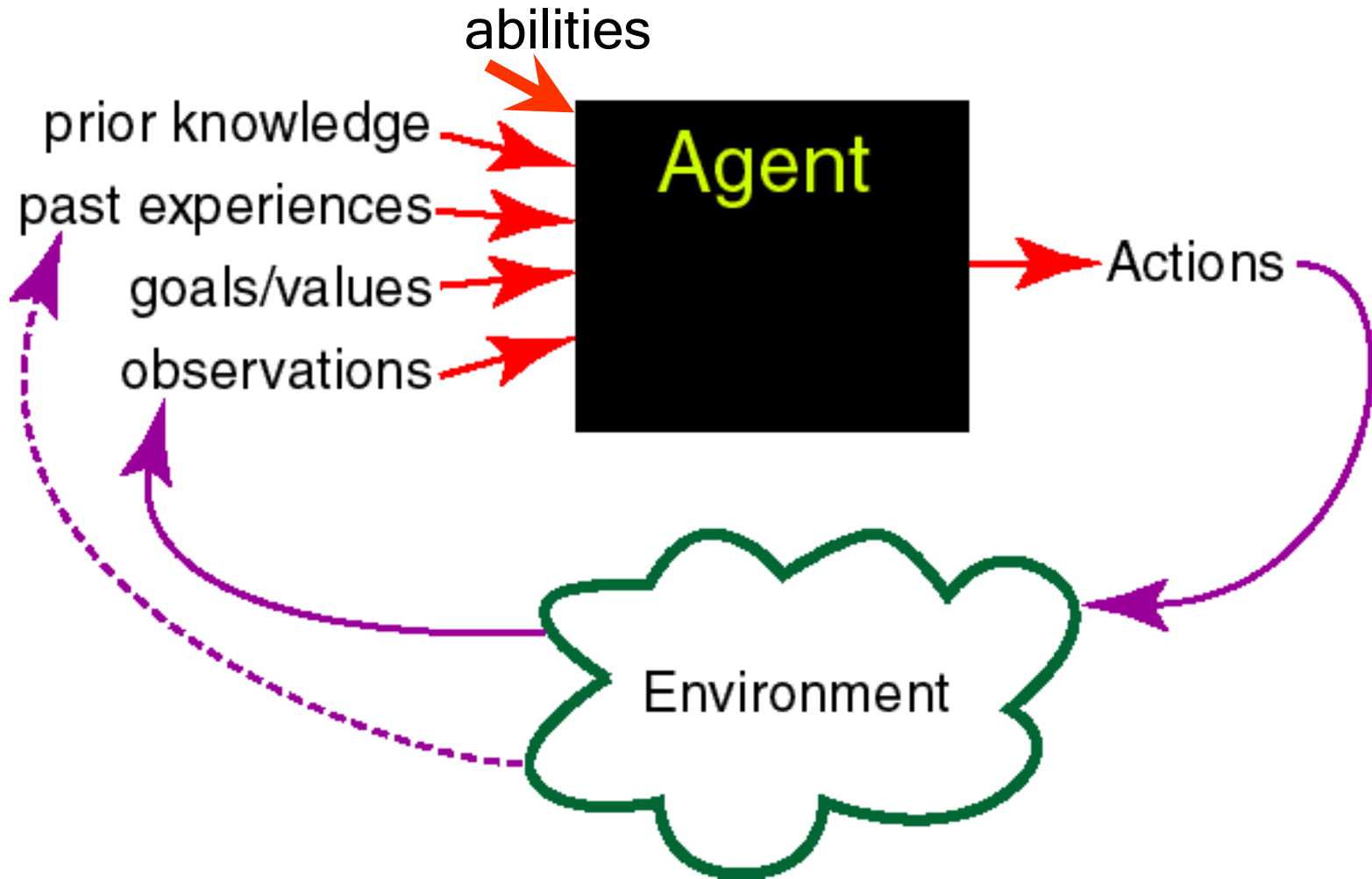
Machine-learning systems are only as smart as their training data. So Google formalized the marshaling of hard and soft sciences that go into its decisions...Now Google wants to share this new discipline-which it calls Decision Intelligence Engineering-with the world.

....

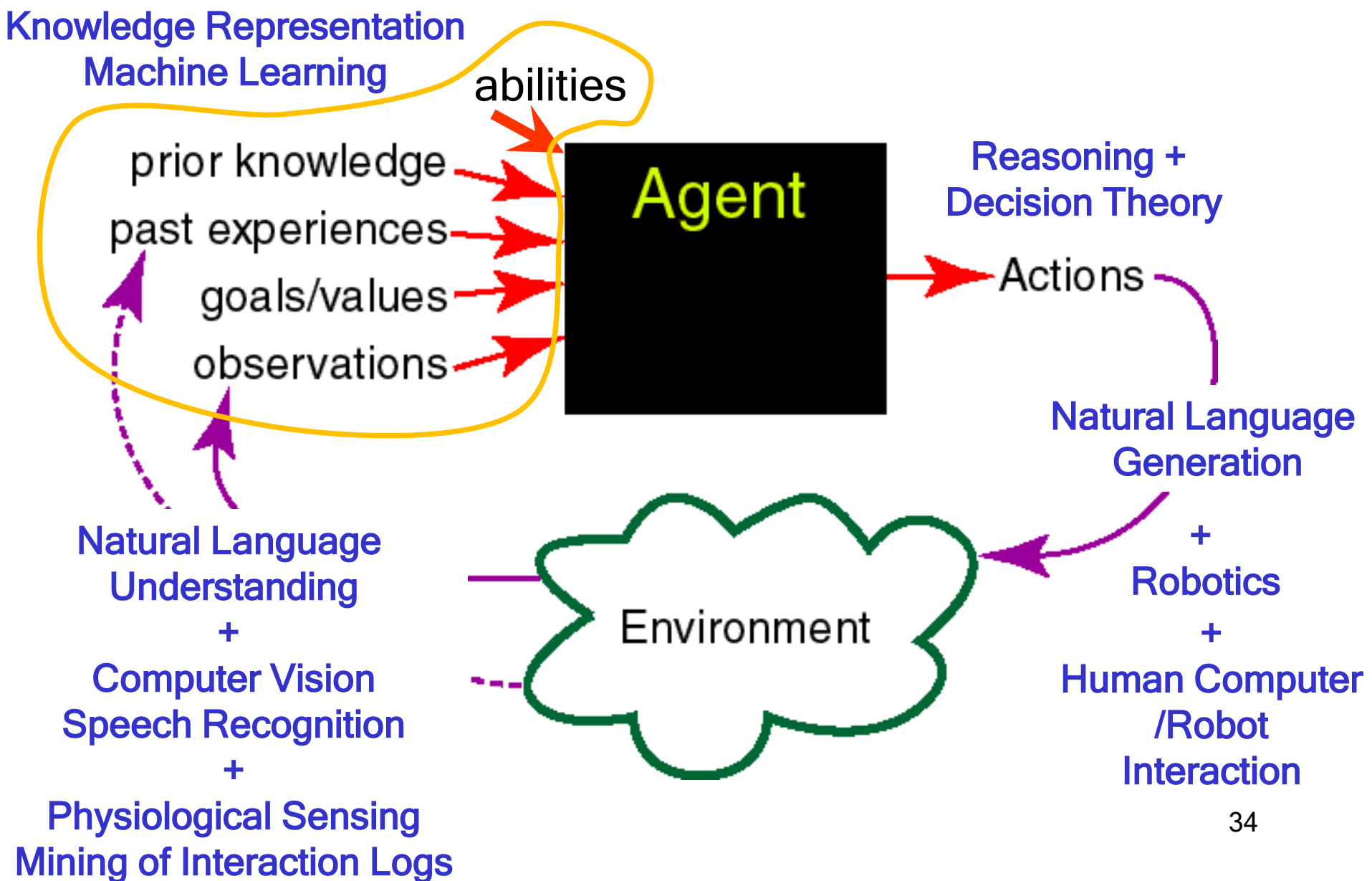
AI researchers have been working on this new discipline for decades (e.g., see Artificial Intelligence: A Modern Approach, Russel S. and Norvig P., 2009)

Intelligent Agents in the World

(Poole and Macworth 2010)



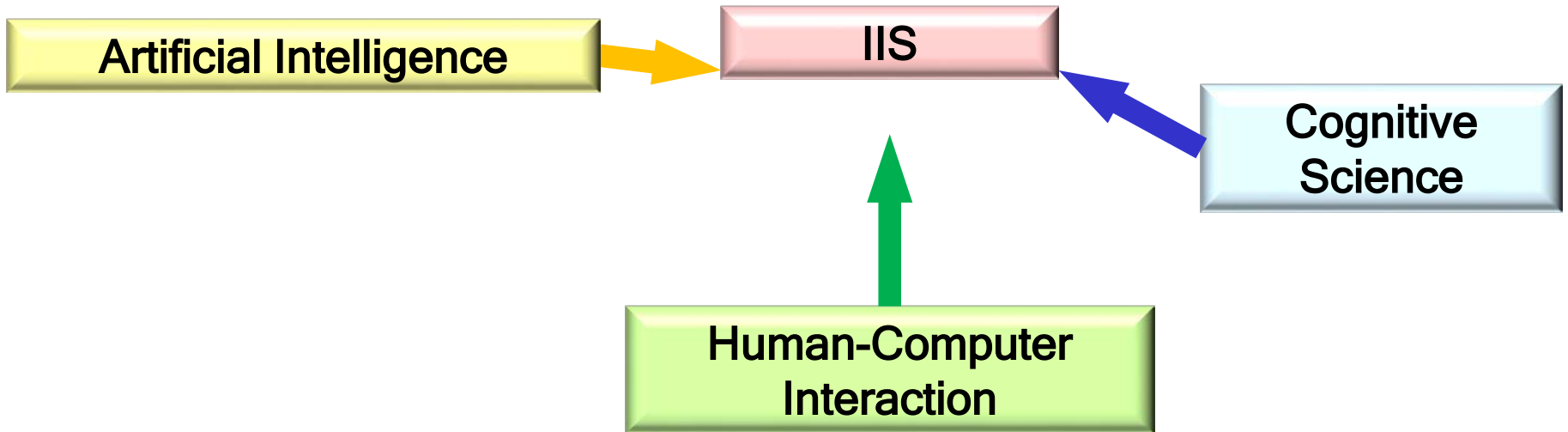
Intelligent Agents in the World



Robots vs. Other Intelligent Agents

- In AI, artificial agents that have a physical presence in the world are usually known as **robots**
 - Robotics is the field primarily concerned with the implementation of the physical aspects of a robot
 - ✓ I.e., perception of and action in the physical environment
 - ✓ Sensors and actuators
- Agents without a physical presence: **software agents**
 - E.g. desktop assistants, decision support systems, web crawlers, text-based translation systems, intelligent tutoring systems, etc
 - They also interact with an environment, but not the physical world
- Software agents and robots
 - differ in their interaction with the environment
 - share all other fundamental components of intelligent behavior

Intelligent Interactive Systems (IIS)



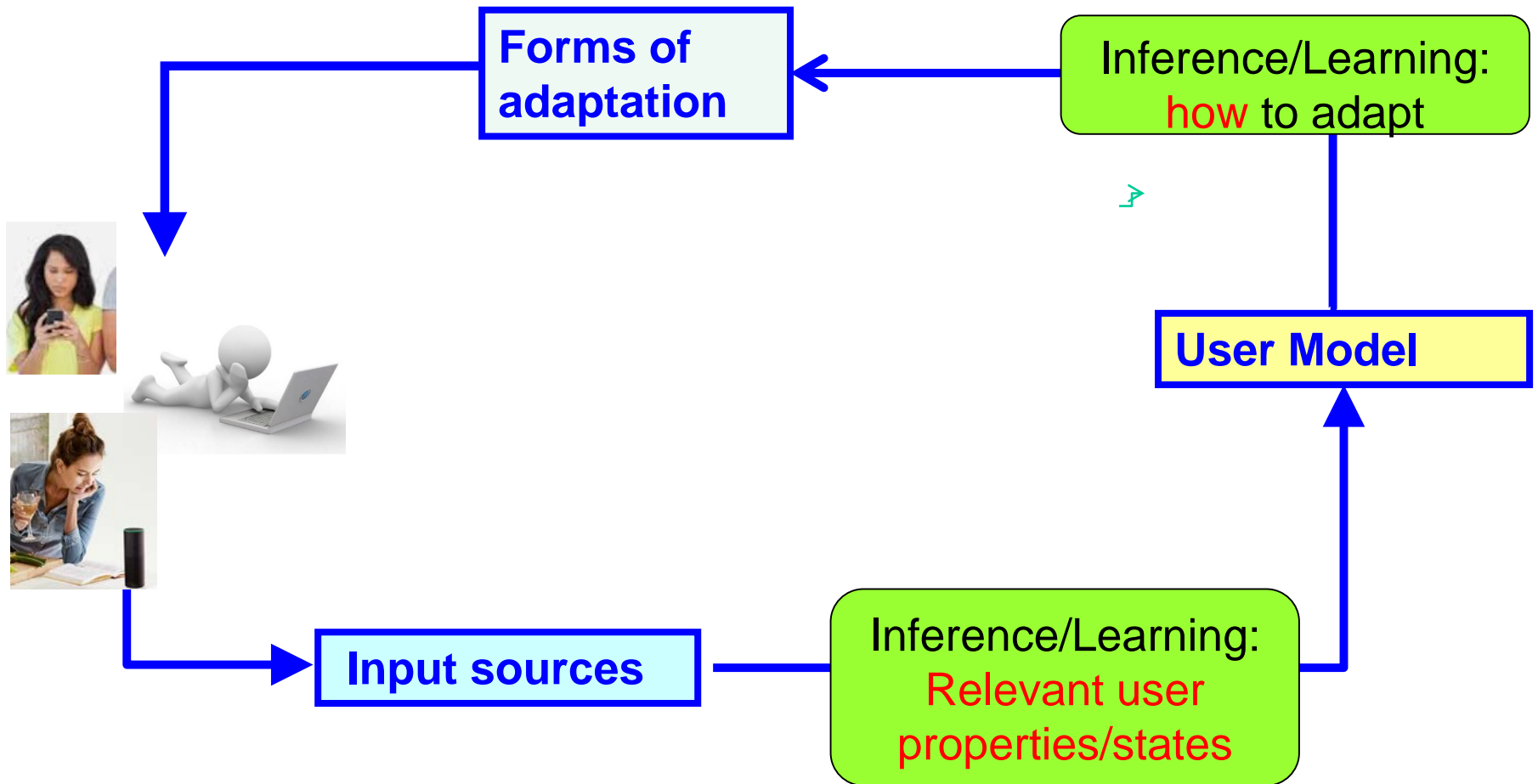
- ❑ Provide **enhanced human-agent** interaction by
 - Supporting sophisticated forms of communication - e.g.,
 - natural language (cpsc 503), speech/gesture recognition

- Supporting **personalized** interaction by capturing and adapting to a user's specific **needs/states/abilities**

User-Adaptive Interaction (UAI)

Adaptation Cycle

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



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** how to personalize (**customize**) their application

Overview

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

Reference paper: A. Jameson. "Adaptive Interfaces and Agents" in *Human-Computer Interface Handbook*, eds J.A. Jacko and A. Sears, 2008. (pointer in reading list)

Questions due Monday @ noon.

UAI: Functions and Forms (some)

Functions

Support
System
Use

Support
Info Aquisition/
Decision Making

Support
Learning

Support
Collaboration

Support
Entertainment

Take Over
Routine
Tasks

Adapt
the
Interface

Advice
on
System
Usage

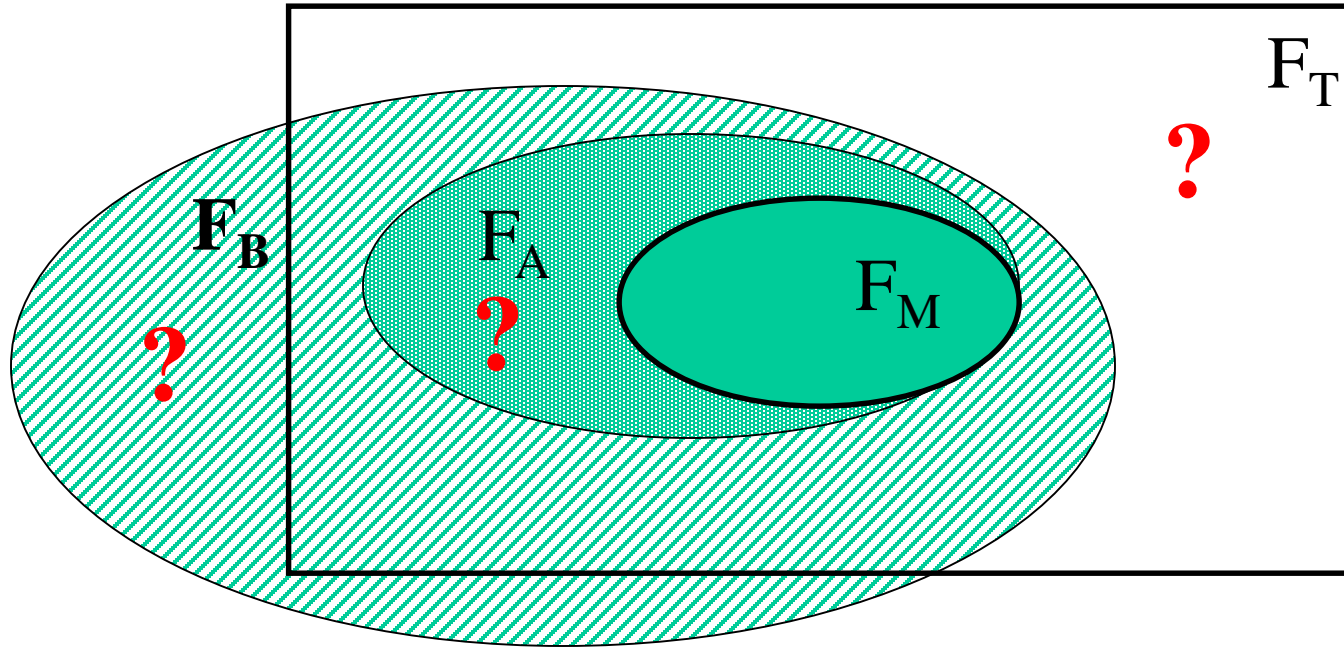
Retrieve Info/
Recommend Objects

Tailor
Info
Presentation

Advice
on
task

Forms of Adaptation

Support System Use: High Functionality Applications



□ F_T = All functionalities available in the application

■ F_M = functionalities the user has mastered

■ F_A = functionalities the user is aware of but does not routinely use

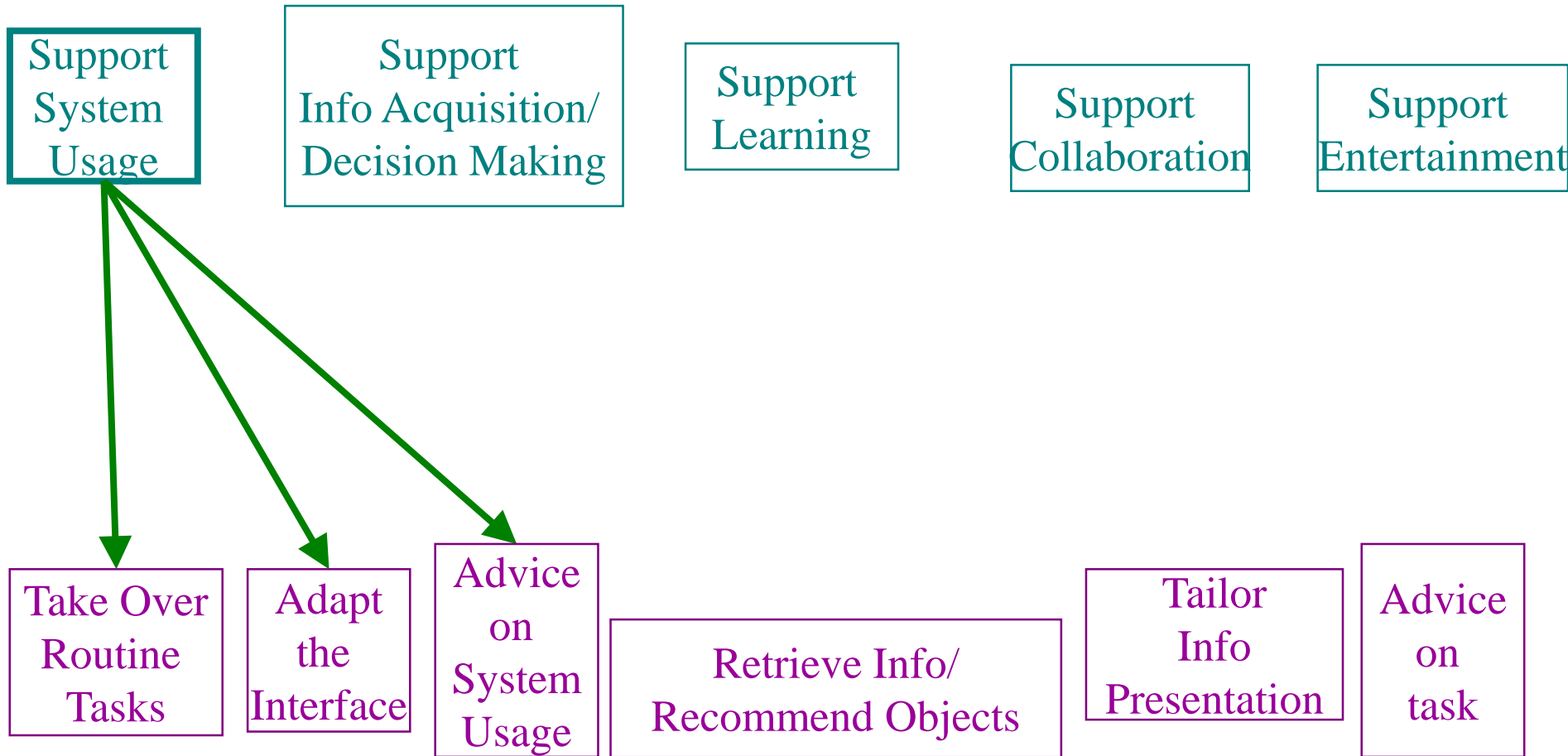
▨ F_B = functionalities the user believes are available

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

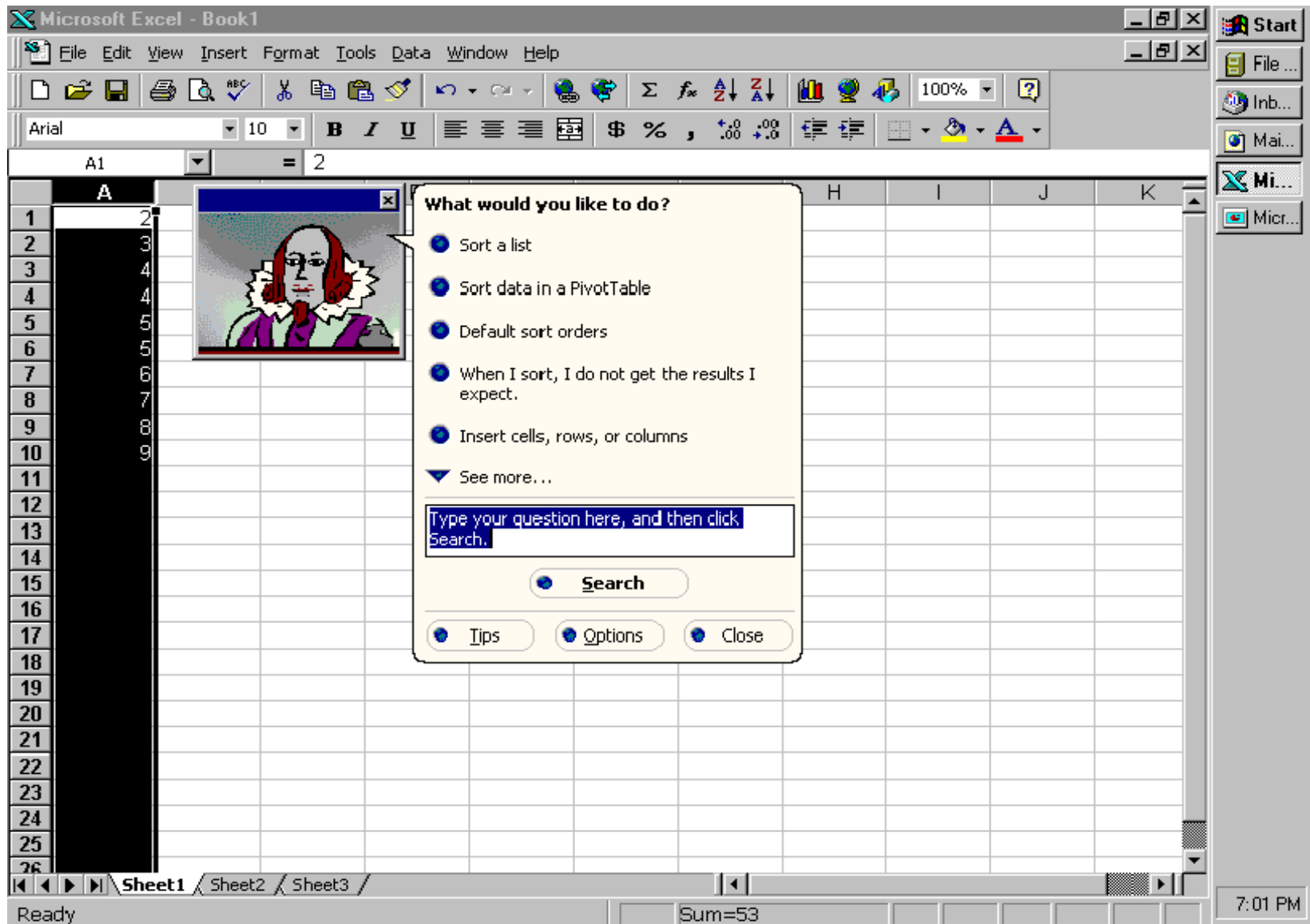
UAI: Functions and Forms (some)

Functions



Forms of Adaptation

Give Advice on System Usage: the Microsoft Office Assistant



The screenshot displays the Microsoft Excel 2003 interface. The title bar reads "Microsoft Excel - Book1". The menu bar includes "File", "Edit", "View", "Insert", "Format", "Tools", "Data", "Window", and "Help". The toolbar contains various icons for file operations, editing, and data manipulation. The status bar at the bottom shows "Ready" and "Sum=53".

The Microsoft Office Assistant dialog box is open, titled "What would you like to do?". It features a cartoon character of a woman with red hair and a white collar. The dialog box contains the following text and options:

- Sort a list
- Sort data in a PivotTable
- Default sort orders
- When I sort, I do not get the results I expect.
- Insert cells, rows, or columns
- See more...

Below the list is a text input field with the placeholder text "Type your question here, and then click Search." and a "Search" button. At the bottom of the dialog box are three buttons: "Tips", "Options", and "Close".

Advice on System Usage: Recommend Commands to IDE Users

Gasparic, Janes, Ricci, Zanellati: GUI Design for IDE Command Recommendations. IUI 2017: 595-599

Open Resource
ctrl + shift + r

1)

Enables quick finding and opening of project resources.

Usage example of Open Resource:

```
1 package yourproject;
2
3 public class HelloWorld {
4
5     public static void main(String[] args) {
6
7     }
8
9 }
10
11
```

Open Resource

Select an item to open (? = any character, * = any string):

GUI

Matching items:

- /GUIHelloWorld.java

yourproject/src/yourproject

Show In Open With Open

2)

[Step-by-step guide video](#)

Why is it recommended to me?

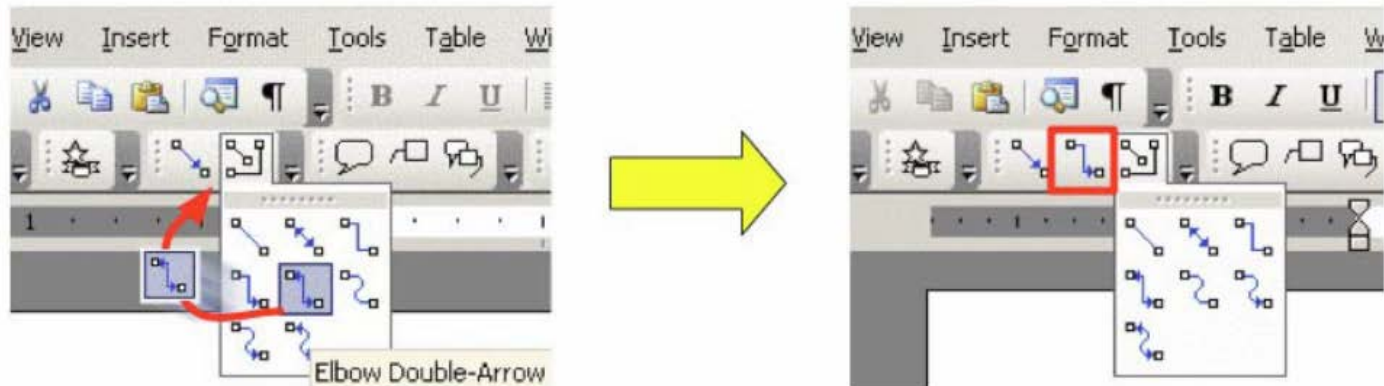
Open Resource is used by 48% of competent users who are interacting with the IDE in a similar way as you. It is often used in JSP-HTML editor when users are editing Java methods.

3)

Adapting the Interface: Promote Most Relevant Commands



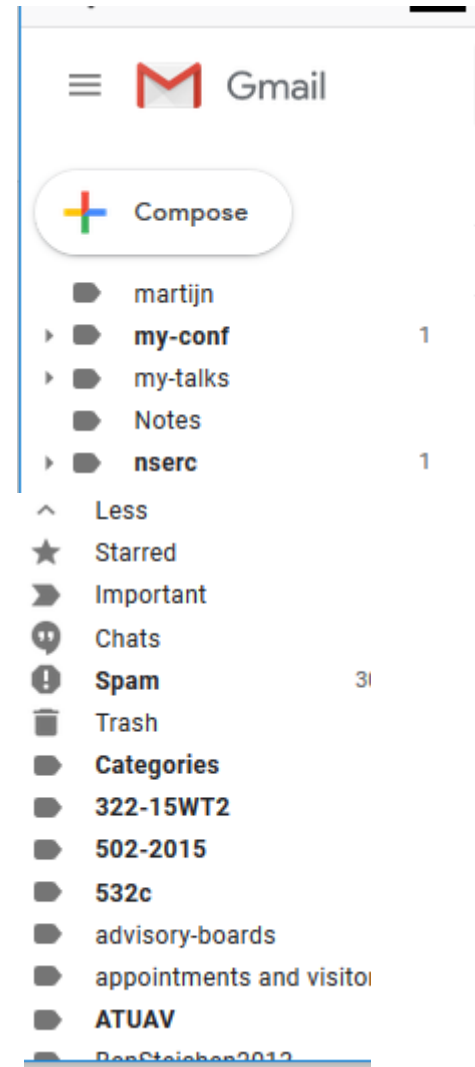
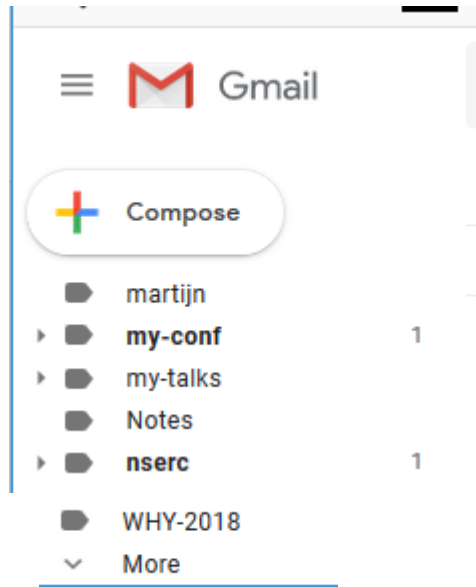
(a)



(b)

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

Adapting the interface: Gmail Folder List



Adapting the Interface: Appearance

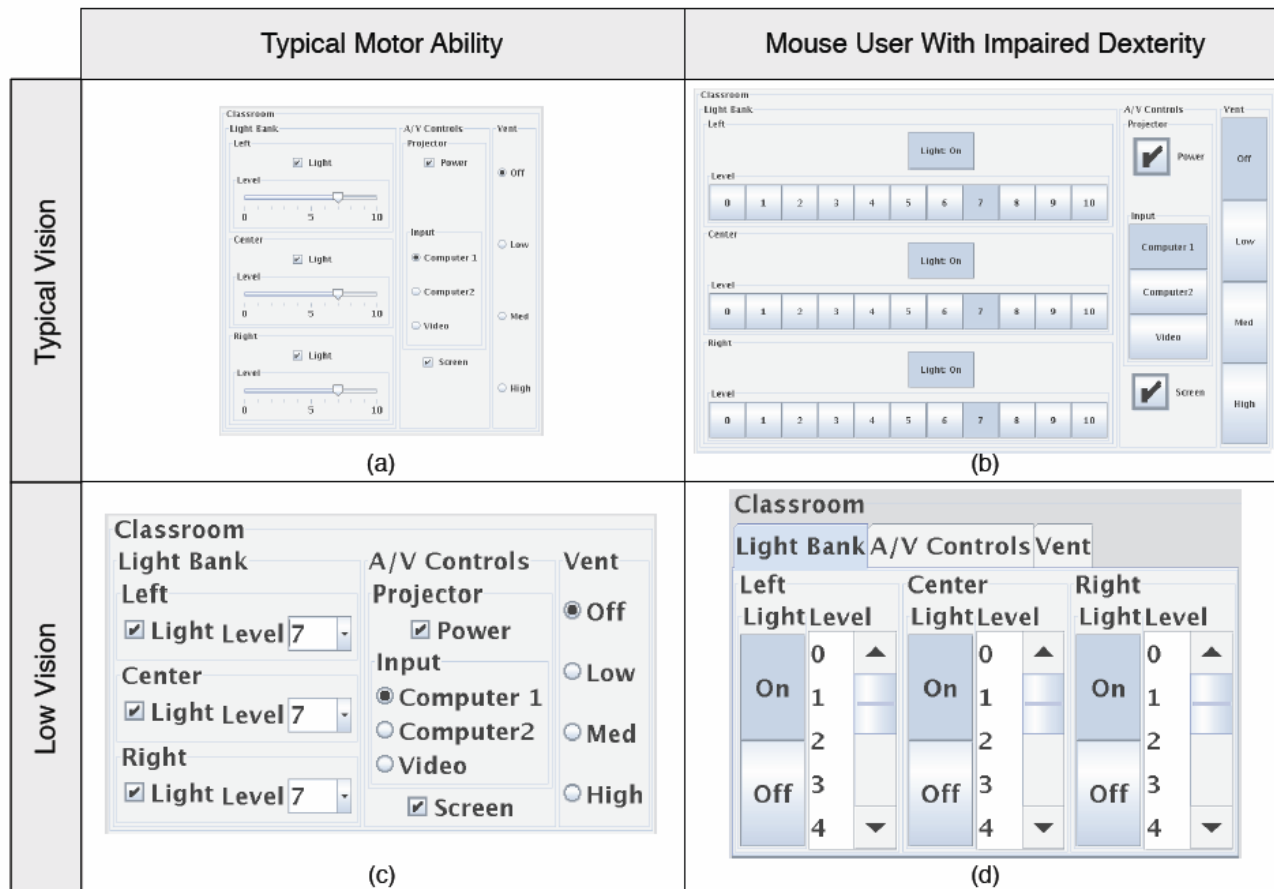
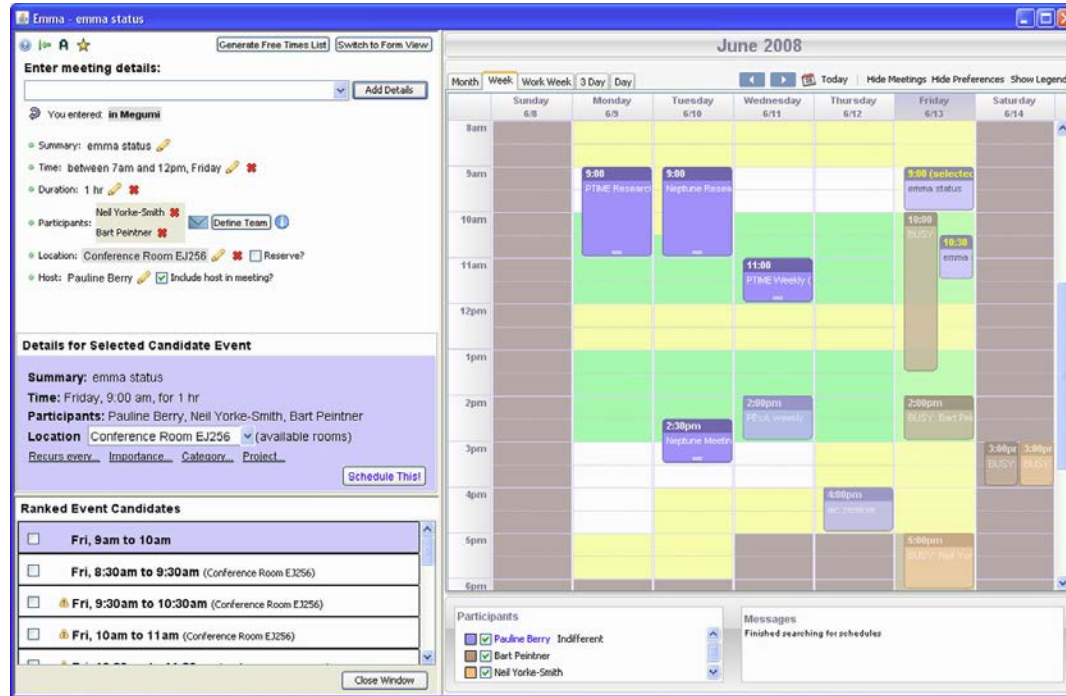


Figure 1: Four GUIs automatically generated under the same size constraints for four different users: (a) a typical mouse user, (b) a mouse user with impaired dexterity, (c) a low vision user and (d) a user with a combination of low vision and impaired dexterity. All but (a) were generated using SUPPLE++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

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

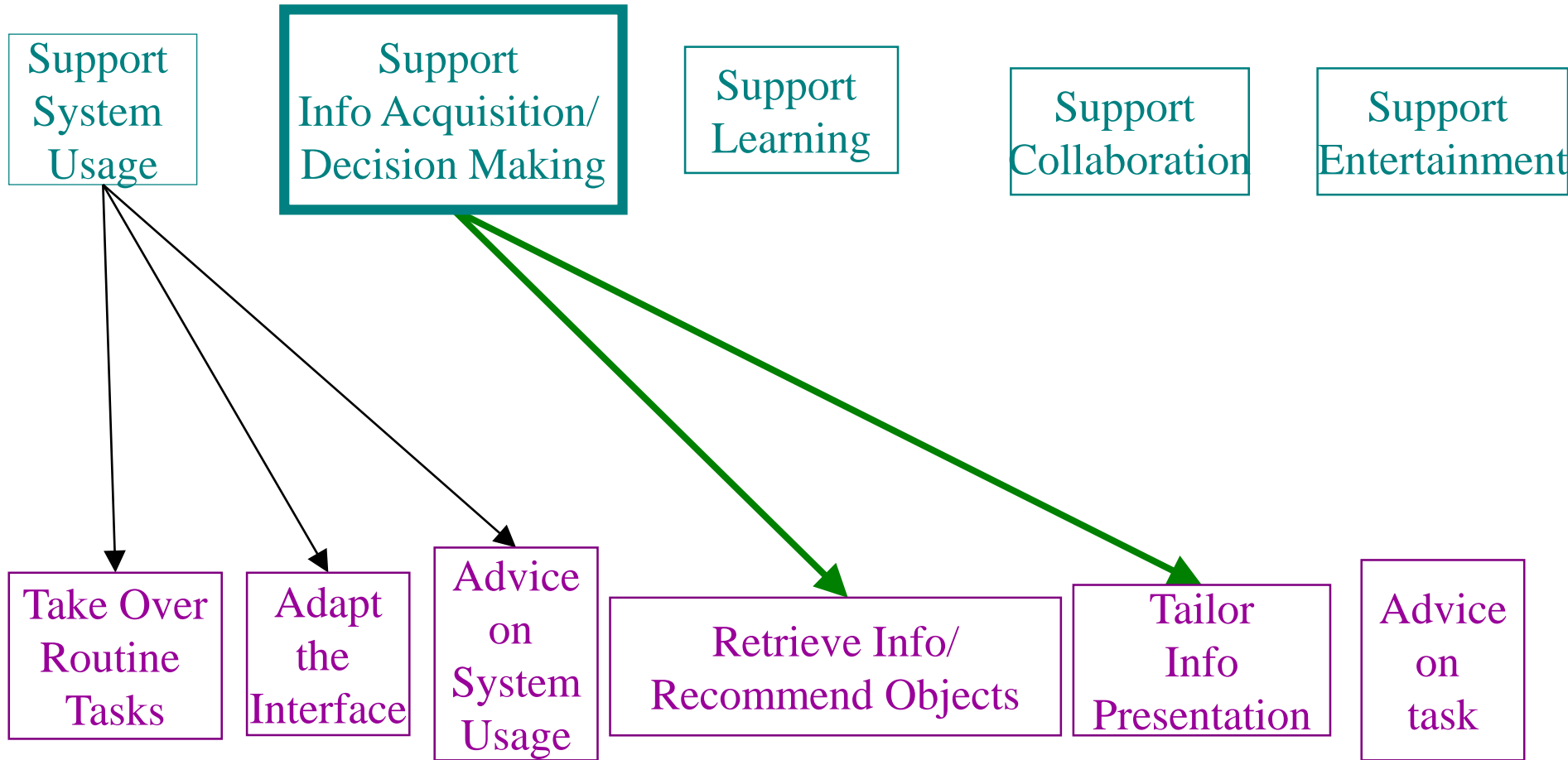
- Specialized applications where personalization is highly valuable
 - web-browsing, recommender systems, e-commerce,
 - education, health
 - computer-supported collaborative work
 - digital entertainment, social media
- And users often **do not know/want** how to personalize (**customize**) their application

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



Forms of Adaptation

Finding Information



google



All

News

Maps

Videos

Images

More

Settings

Tools

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

movielens helping you find the *right* movies

Welcome conati | Logout
You've rated 15 movies.

★★★★★ = Must See
★★★★ = Will Enjoy
★★★ = It's OK
★★ = Fairly Bad
★ = Awful

Home | Manage Buddies | Your Preferences | Help

Found 15 movies | Domain: Ratings | Genres: All | Dates: All
[Show Printer-Friendly List](#) | [Suggest a Title](#)

Page 1 of 1

Predictions for you ↕	Your Ratings	Movie Information	Wish List
★★★★★	5.0 stars	Adventures of Priscilla, Queen of the Desert, The (1994) DVD, info imdb Comedy, Drama	<input type="checkbox"/>
★★★★★	5.0 stars	Almost Famous (2000) DVD, VHS, info imdb Comedy, Drama	<input type="checkbox"/>
★★★★★	5.0 stars	Some Like It Hot (1959) DVD, info imdb Comedy, Crime	<input type="checkbox"/>
★★★★★	5.0 stars	To Die For (1995) info imdb Comedy, Drama	<input type="checkbox"/>
★★★★☆	4.5 stars	Bullets Over Broadway (1994) info imdb Comedy	<input type="checkbox"/>
★★★★	4.0 stars	In the Name of the Father (1993) info imdb Drama	<input type="checkbox"/>
★★★★	4.0 stars	To Kill a Mockingbird (1962) info imdb Drama	<input type="checkbox"/>
★★★☆☆	3.5 stars	Erin Brockovich (2000) DVD, VHS, info imdb Drama	<input type="checkbox"/>
★★★☆☆	3.5 stars	Mask of Zorro, The (1998) DVD, info imdb Action, Adventure, Romance	<input type="checkbox"/>
★★★☆☆	3.5 stars	Mummy, The (1999) DVD, info imdb Action, Adventure, Horror, Thriller	<input type="checkbox"/>
★★★☆☆	3.5 stars	Striptease (1996) DVD, info imdb Comedy, Crime	<input type="checkbox"/>
★★★☆☆	3.0 stars	High Fidelity (2000) DVD, VHS, info imdb Comedy	<input type="checkbox"/>
★★★☆☆	3.0 stars	Talented Mr. Ripley, The (1999) DVD, VHS, info imdb Drama, Mystery, Thriller	<input type="checkbox"/>
★★☆☆	2.5 stars	Patriot, The (2000) DVD, VHS, info imdb Action, Drama, War	<input type="checkbox"/>
★☆☆☆	1.0 stars	Green Mile, The (1999) DVD, VHS, info imdb Drama, Thriller	<input type="checkbox"/>

Recommending Objects: Ads!


E.g. Google/Gmail ads

Tailoring Information Presentation: SETA (Ardissono & Goy, 2000)

Url: <http://silk.dl.unibo.it:8081/setaZone/newShell negozio.SnMgr?action=next&next=facile> Arg correlati


[phones](#) [answering machines](#) [fax](#) [multi-line phones](#) [switchboards](#)

4 - **Facile**



Lit. 108000

 [put Facile in the cart](#)


 [technical info](#)

- The size of the item is: 150x70x210 ([help](#))
- It is available in the following colors: grey, black ([help](#))
- The initial message of the answering machine can be at most 60 seconds long ([help](#))
- It stores the received messages using a secure technology, which enables you to listen to them without rewinding the tape ([help](#))
- The answering machine stores messages lasting, all together, at most 25 minutes ([help](#))


 [more information](#)

Tailor Information Presentation: 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](#))



[more information](#)

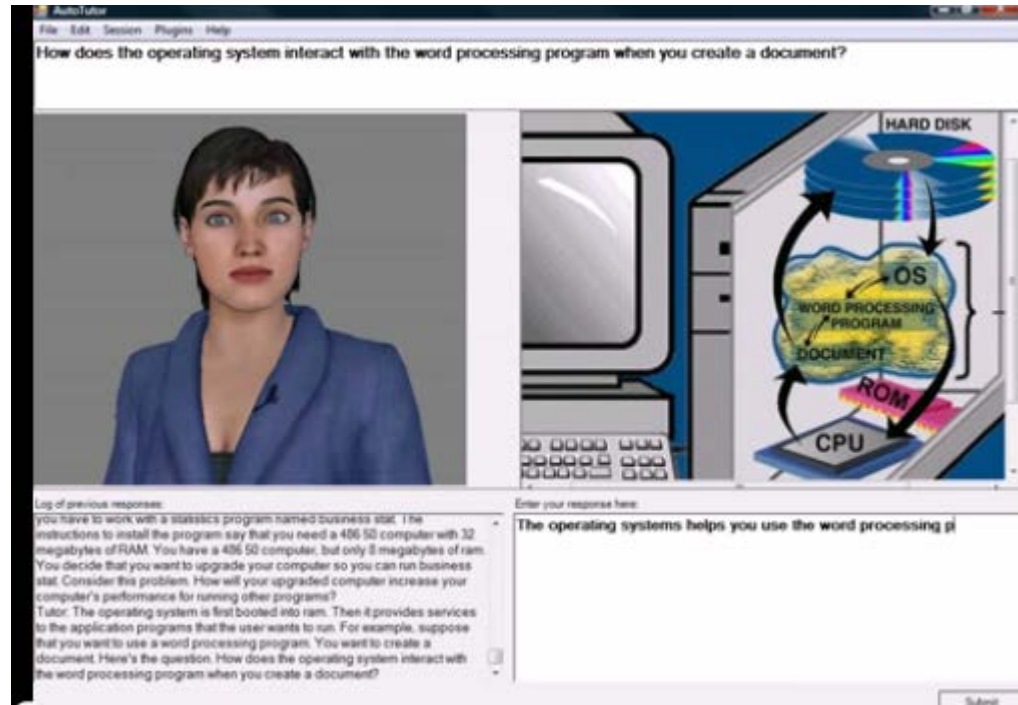
Figure 14. Detail of a presentation page describing the “Facile” answering machine, tailored to an expert user.

Support to Learning/Training

- ❑ Which forms of adaptation are relevant?

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**)

The screenshot shows the ANDES Physics Workbench interface for a physics problem. The window title is "ANDES Physics Workbench - [P11-2-Solution.fbd]". The menu bar includes "File", "Edit", "Diagram", "Variable", "View", and "Help". The toolbar contains various icons for file operations and problem-solving tools.

The main problem text reads: "A 2000-kg car in neutral at the top of a 20-degree inclined driveway 20 m long slips its parking brake and rolls down. Assume that the driveway is frictionless. At what speed will it hit the garage door?"

Below the text is an "Answer:" field with an empty input box. To the right is a diagram of a red car on a 20-degree inclined driveway of length 20 m. To the left is a free-body diagram for the car, showing a green circle labeled 'c' with a red arrow pointing up labeled 'N' and a green arrow pointing down labeled 'Fw'.

At the bottom of the problem area, there is a prompt: "Think about what you need to do in order to have a complete free body diagram for the car." with buttons for "Explain further" and "Hide".

On the right side, there is a "Variables" table:

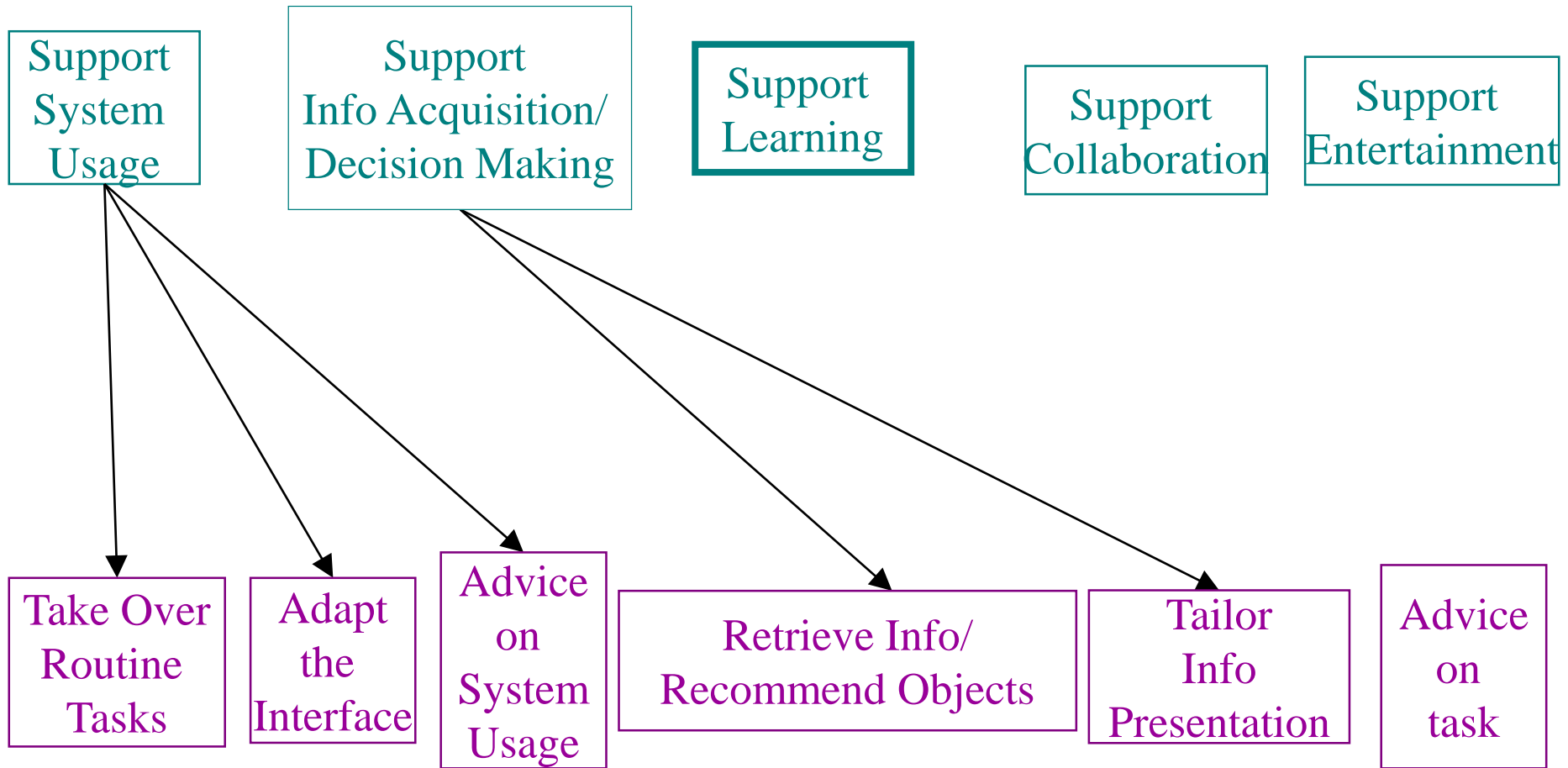
Name	Definition	X-Comp	Y-Comp
☺ T0	car starts rolling		
☺ T1	car hits garage door		
✓ mc	mass of car		
✓ Fw	magnitude of the Weight For...		

Below the table is a list of seven empty input fields for equations. The first field contains the equation $F_w = mc * g$.

At the bottom of the window, there is a status bar with "For Help, press F1", a "NUM" button, and a timer showing "00:02:11".

UAI: Functions and Forms (some)

Functions



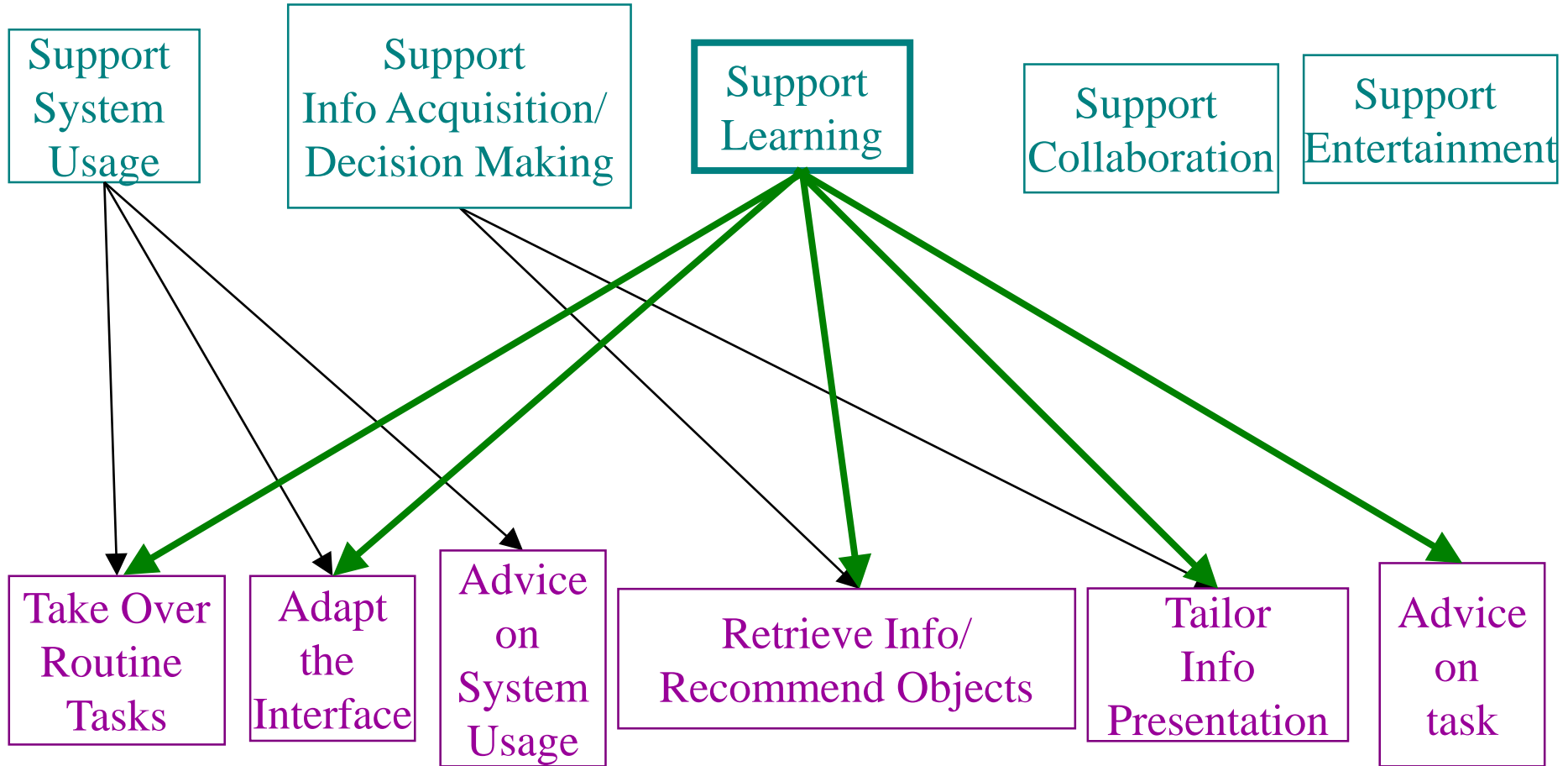
Forms of Adaptation

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



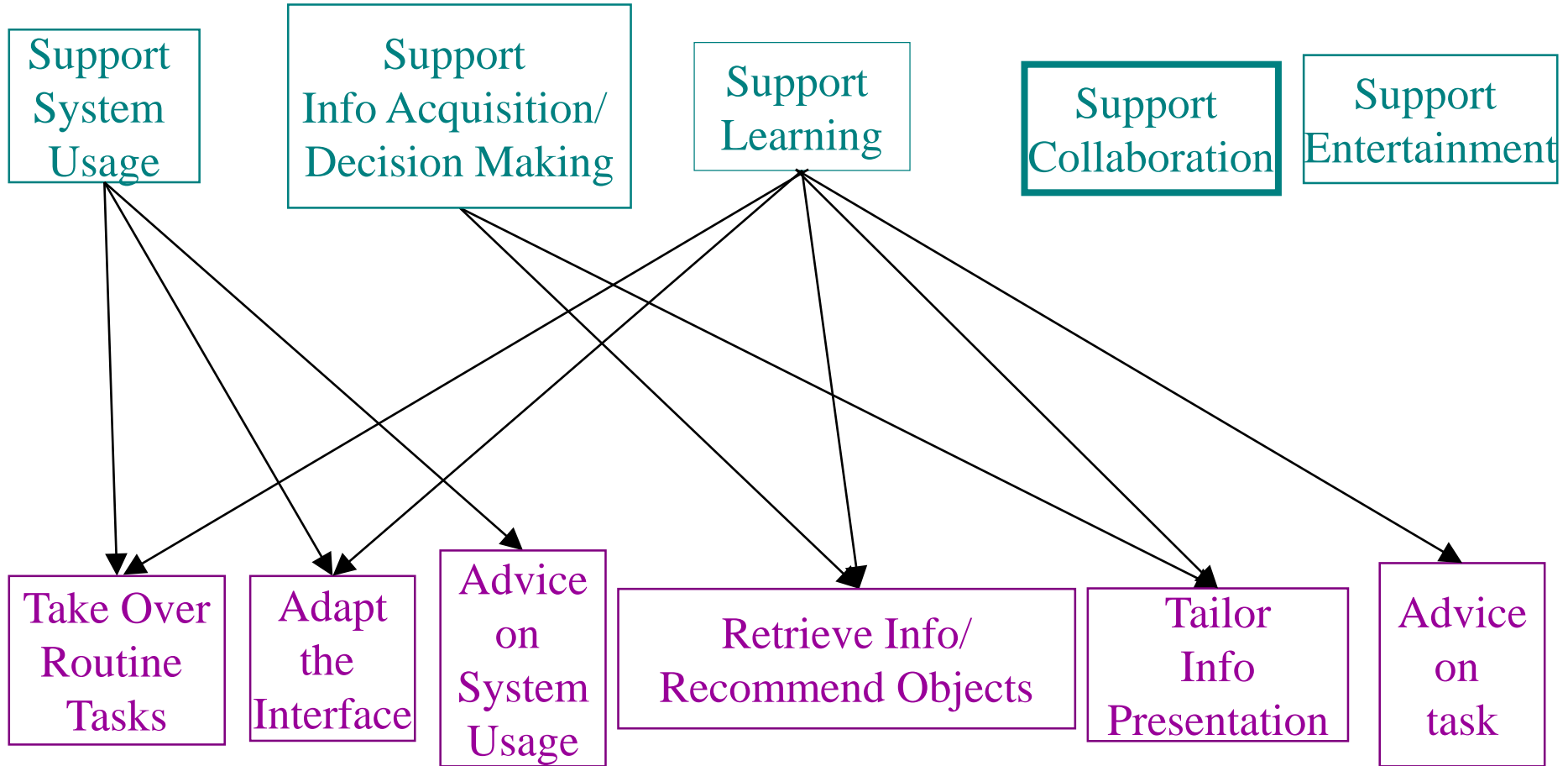
Forms of Adaptation

Support Collaboration

- Help people interact effectively
 - Computer-Supported Collaborative Work (CSCW)
 - Computer-Supported Collaborative Learning (CSCL)
- Specific forms of adaptation for collaboration?

UAI

Functions



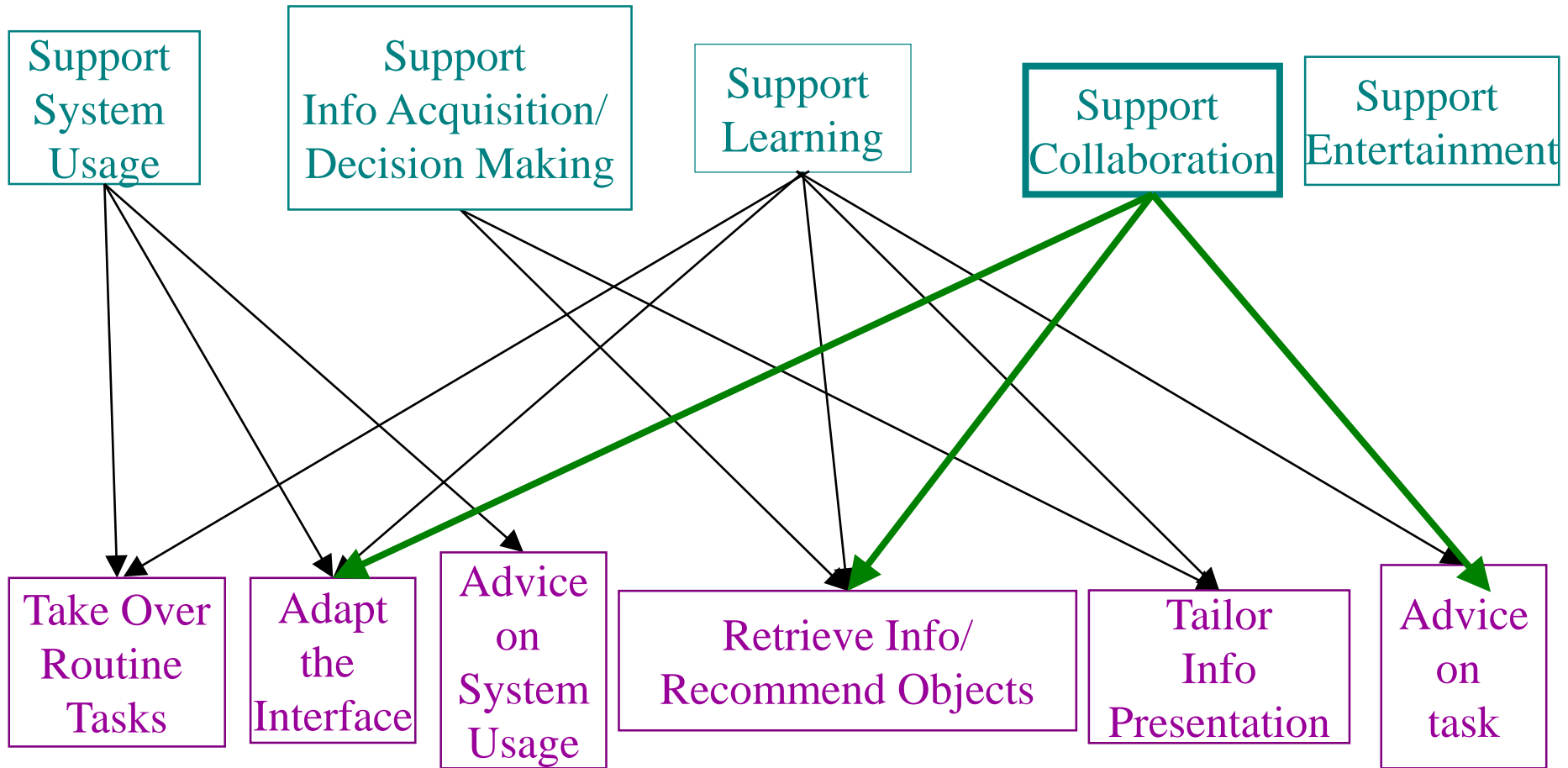
Forms of Adaptation

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



Forms of Adaptation

Support Entertainment/Social media

□ Explosion of applications

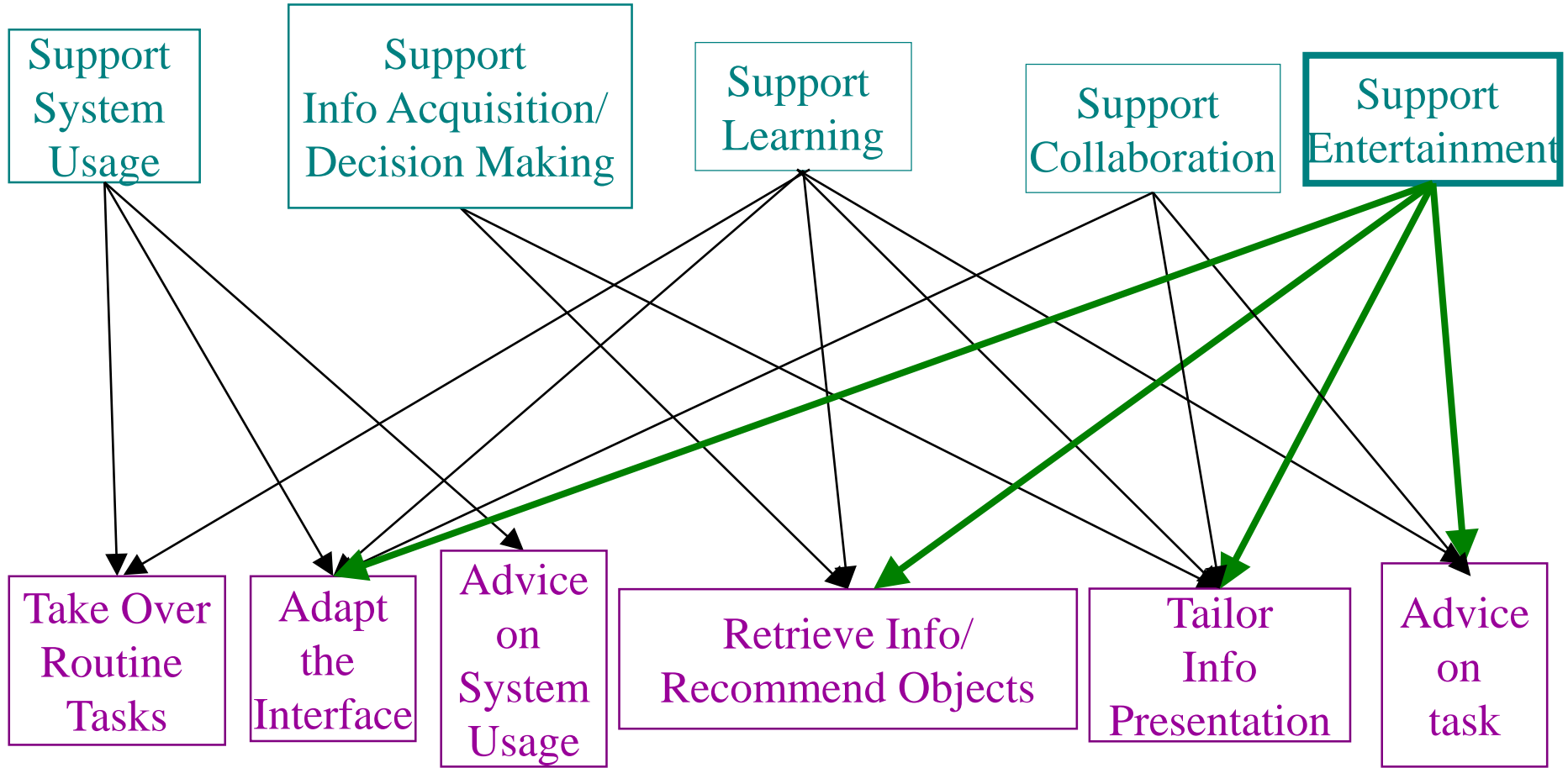
- User-Adaptive Games
- Adaptive TV (e.g. Netflix, Amazon Prime)
- Social Media

□ 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

UAI

Functions



Forms of Adaptation

Overview

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