

# Intelligent User Interfaces

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# Intelligent User Interfaces (IUI)

- **User interfaces** – a software interface for human users
  - Very concrete but open-ended

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- **User interfaces** – a software interface for human users
  - Very concrete but open-ended
- **Intelligent** – does something the user wants, even when not asked
  - Completely subjective

# Why IUI?

- Increasing complexity in software
- Less time to do stuff
- Lower cost of development
- Increase software acceptance
- Application for AI techniques

# Evolution of Email

# Pine Email

toCheck — ssh — 111x36

**ALPINE 2.02(1266) MESSAGE INDEX Folder: INBOX Message 292 of 300 NEW**

```

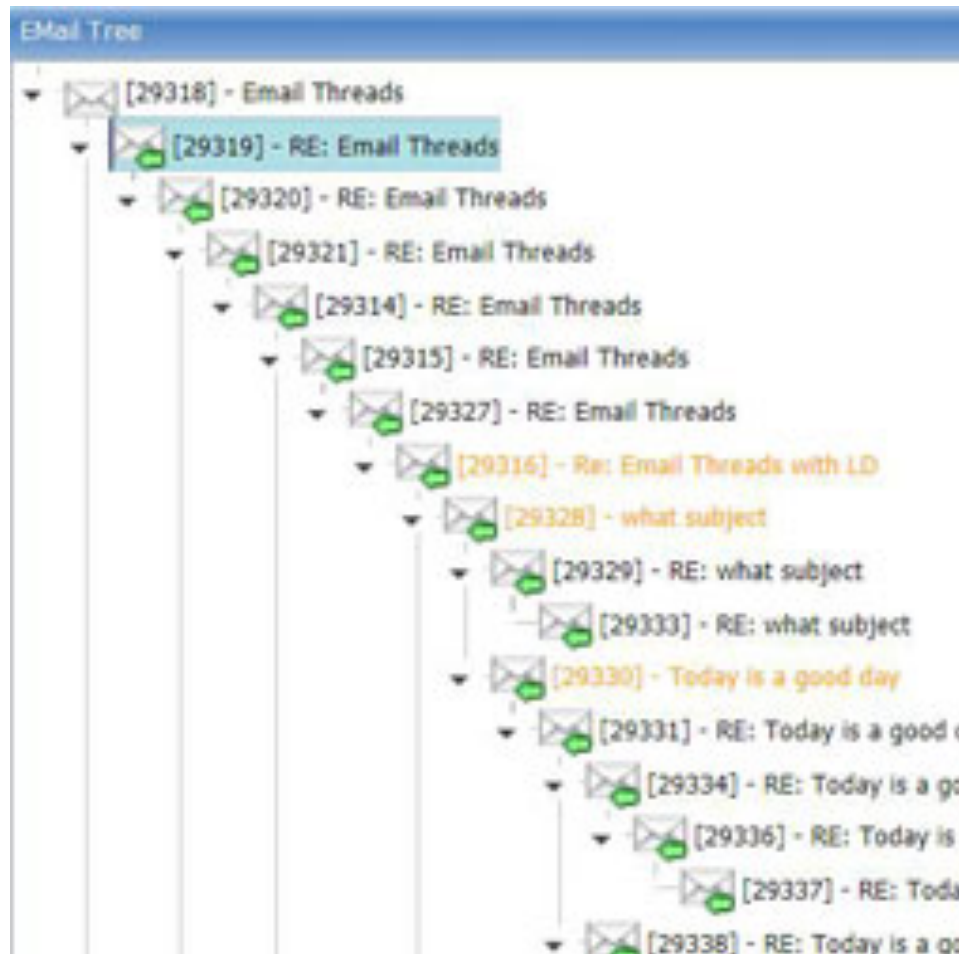
+ 280 09/14/2011 Artificial Intelligence Rese (29K) [2] new discussions, [15] new comments and [1] new job on
+ 281 09/14/2011 University Of Toronto - MSDN (3K) Your account has been reactivated
+ 282 09/16/2011 Anthony Jameson (5K) Materials on choice, decision making, and recommender sys
283 10/19/2011 Sara Burns (2K) Mail Options for Convocating Students - November 2011
284 10/20/2011 Office of Convocation Genera (10K) URGENT: PLANNING TO THE ATTEND THE JUNE 2011 CONVOCATION
285 10/25/2011 Sara Franca (2K) Special Convocation Event for Computer Science Grads - No
286 10/28/2011 Craig Boutilier (2K) convocation
287 11/11/2011 Georgios Chalkiadakis (42K) [UAI] New book: Computational Aspects of Cooperative Game
288 11/11/2011 Vikas Sindhwani (9K) [UAI] 2012-2013 IBM Herman Goldstine Memorial Postdoctora
+ 289 11/11/2011 SGS Doctoral Examinations Of (25K) Congratulations on the Completion of Your Doctoral Degree
290 11/14/2011 Georgios Chalkiadakis (3K) hei, bowen?
291 11/16/2011 Sara Franca (2K) DCS Convocation - Nov 2011
+ N 292 15:10 Intell. Control and Automa. (13K) Dr. Bowen Hui, Manuscripts are Invited to "Intelligent Co
+ N 293 3:14 OJMSi (11K) "Open Journal of Modelling and Simulation" Invites Bowen
N 294 9:40 Alisa Slavens (4K) RE: Hello
N 295 Friday Frank Rudzicz (17K) [UAI] Postdoctoral fellowship in speech communication and
N 296 Yesterday Matthias Nickles (14K) [UAI] CFP: ISWC workshop on Uncertainty Reasoning for the
N 297 Friday Russell Almond (16K) [UAI] UAI Applications Workshop: Deadline Approaching
N 298 Yesterday Sicco Verwer (16K) [UAI] BeneLearn call for participation
N 299 Thursday Partha Pratim Talukdar (24K) [UAI] CFP: Automated Knowledge Base Construction (AKBC) 2
N 300 Yesterday Pascal Hitzler (10K) [UAI] CFP: Semantics for Big Data AAAI Fall Symposium 201

```

[Folder "INBOX" opened with 300 messages - 9 new]

? Help      < FldrList      P PrevMsg      < PrevPage      D Delete      R Reply  
 0 OTHER CMDS      v [ViewMsg]      N NextMsg      Spc NextPage      U Undelete      F Forward

# Email Threads



# Email Priorities

The screenshot shows the Microsoft Outlook interface with the 'C-Mail View' window. The 'Mail' menu bar at the top includes options for 'V:High', 'High', 'Medium', 'Low', and 'Someday', which are circled in red. A yellow callout box on the right contains the text: 'Adjust priority with a simple click' and 'Priority is configurable to business rules'. A large red arrow points from the 'High' priority icon in the callout box down to a specific email in the list, which is labeled 'Reprioritized Email'.

From	Subject	Received	Size	Mirage	Categories
<b>Categories: 1: V:High (3 items)</b>					
Katz, Ric...	Re: Sorry missed your vm	Sun 7/13/2008 9:28 AM	10 KB		1: V:High
Mike Son...	Delivery: CKS Blurb - Inf...	Sun 7/13/2008 9:41 AM	68 KB		1: V:High
Gegoni, ...	RE: Sorry missed your vm	Sat 7/12/2008 5:38 PM	9 KB		1: V:High
<b>Categories: 2: High (4 items)</b>					
LinkedIn ...	LinkedIn Network Updat...	Sun 7/13/2008 5:29 AM	12 KB		2: High
Everhar...	K&L Gates Invitation: Th...	Sat 7/12/2008 3:04 PM	79 KB		2: High
Mike Son...	Question: Are you goin...	Sat 7/12/2008 9:00 AM	18 KB		2: High
Thiru An...	Re: Address	Sat 7/12/2008 5:44 AM	12 KB		2: High
<b>Categories: 3: Med (5 items, 1 unread)</b>					
Aberdee...	Weekly Research Recap	Sun 7/13/2008 11:12 PM	28 KB		3: Med
Business ...	Quarantine Summary 7/...	Sun 7/13/2008 4:01 PM	14 KB		3: Med
Nasim Na...	Reminder to connect wit...	Sun 7/13/2008 3:37 PM	0 KB		3: Med
Informati...	Tuesday is the Informati...	Sun 7/13/2008 3:35 PM	0 KB		3: Med
Informati...	Tuesday is the Informati...	Sun 7/13/2008 3:35 PM	0 KB		3: Med
<b>Categories: 4: Low (3 items)</b>					
Intel Pre...	Seminar registration con...	Sun 7/13/2008 2:43 PM	10 KB		4: Low
Quality T...	IN000000057051 Major...	Sun 7/13/2008 8:34 AM	0 KB		4: Low
Quality T...	IN000000057051 Major...	Sun 7/13/2008 12:26 AM	9 KB		4: Low
<b>Categories: 5: S:Day (12 items, 11 unread)</b>					
GoToMe...	Your GoToMeeting Rec...	Sun 7/13/2008 10:08 PM	20 KB	05	5: S:Day
Rajiv	Senior SAP ABAP Conso...	Sun 7/13/2008 4:15 PM	23 KB	05	5: S:Day
Dice Tale...	Data Model Candidates ...	Sun 7/13/2008 8:24 AM	27 KB	06	5: S:Day
Dice Tale...	Windows lan ADMIN Ca...	Sun 7/13/2008 8:24 AM	25 KB	06	5: S:Day
hadelbit...	Paychex FSA Debit Card...	Sat 7/12/2008 11:51 AM	12 KB	05	5: S:Day
Web Buy...	Ten tips for fighting off ...	Sat 7/12/2008 9:29 AM	12 KB	05	5: S:Day
Dice Tale...	Business Analyst Candid...	Sat 7/12/2008 8:24 AM	71 KB	06	5: S:Day
Dice Tale...	BA in NJ and NY Candid...	Sat 7/12/2008 8:24 AM	77 KB	06	5: S:Day
Dice Tale...	Data Model Candidates ...	Sat 7/12/2008 8:24 AM	58 KB	06	5: S:Day
Dice Tale...	Windows lan ADMIN Ca...	Sat 7/12/2008 8:24 AM	25 KB	06	5: S:Day
Best of ...	The Best of Web Buyer's...	Sat 7/12/2008 7:13 AM	13 KB	05	5: S:Day
Radhika	**Excellent Mainframe ...	Fri 7/11/2008 11:48 PM	37 KB	05	5: S:Day



# Email Tracking

The screenshot shows a Gmail interface in a browser window. The address bar displays `https://mail.google.com/mail/u/0/#inbox?compose=new`. The browser's tab bar includes several open tabs: 'Inbox (8 x)', 'Microso...', 'Pedago...', 'Lua: doc...', 'All Coro...', 'Java Swi...', 'COSC 4...', 'email th...', and 'Email O...'. The Gmail header features the Google logo, a search bar, and the user's email address 'bohuie@gmail.com'. The main content area shows an inbox with a list of emails. A 'New Message' dialog box is open, displaying the 'To' field with a dropdown menu, the 'From' field with ' Bowen Hui <bohuie@gmail.com>', and the 'Subject' field. The dialog box also includes 'Send' and 'Tag' buttons at the bottom.

Sender	Subject	Time
Tomas, bowen (2)	meetings - Hi Tomas, Welcome back! Hope you had a great trip. I'm a litt	9:29 am
Hui, Bowen	book sug	
bowen hui	books - b	
me, Shirley (4)	asian herit	
me	fms_nque	
Hui, Bowen	FW: FMS	
Lynne McPherson	2012-2013	
Wayne, me (2)	Fwd: com	
me	cibc servi	
me	patterns -	
WestJet	Save 25%	
Wayne Kelly	Fwd: Com	
Wayne Kelly	Fwd: Com	
message	UBC Broa	
EasyChair	Welcome	
reservations, me (3)	Sandman	
me	ubc 45th	
Brad Reid	Fwd: PAR	
Brad Reid	confirmati	

# Objectives of IUI

- Increase productivity
- Decrease expenditures
- Lower level of expertise required to use software
- Overall: to improve efficiency, effectiveness, and naturalness of interaction
- How?
  - Use AI representation, reasoning, models

# Ex: Mail Filters



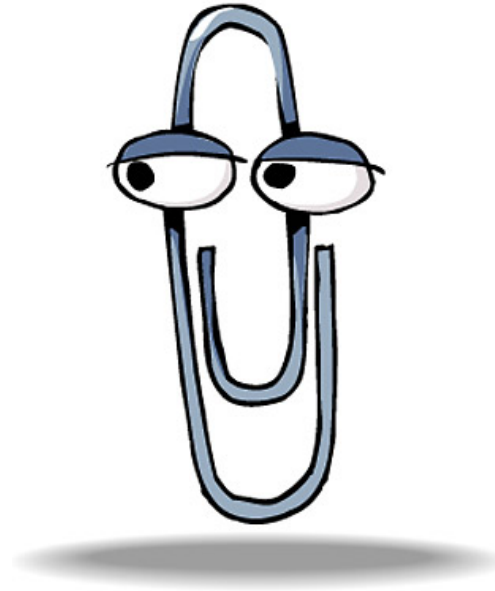
- What is the UI aspect?
- What is the intelligent aspect?
- What are the potential user benefits?

# Ex: Speech Recognition Software



- What is the UI aspect?
- What is the intelligent aspect?
- What are the potential user benefits?

# Ex: Desktop Assistant Software



- What is the UI aspect?
- What is the intelligent aspect?
- What are the potential user benefits?

# What Could Go Wrong?

- Risks:

# What Could Go Wrong?

- Risks:
  - Don't do what the user wants
    - Sometimes this is okay
  - Interrupt the user at a bad time
  - Frustrate user
  - Lose user trust/loyalty
- How should the system decide?

# Design Opportunities

- Needs-driven:
  - Consider interface aspects
  - Consider domains of applications
  - What can be better?
    - Faster, cheaper, more “naturally”
- Technique-driven:
  - How can I use *XX* technique fruitfully?



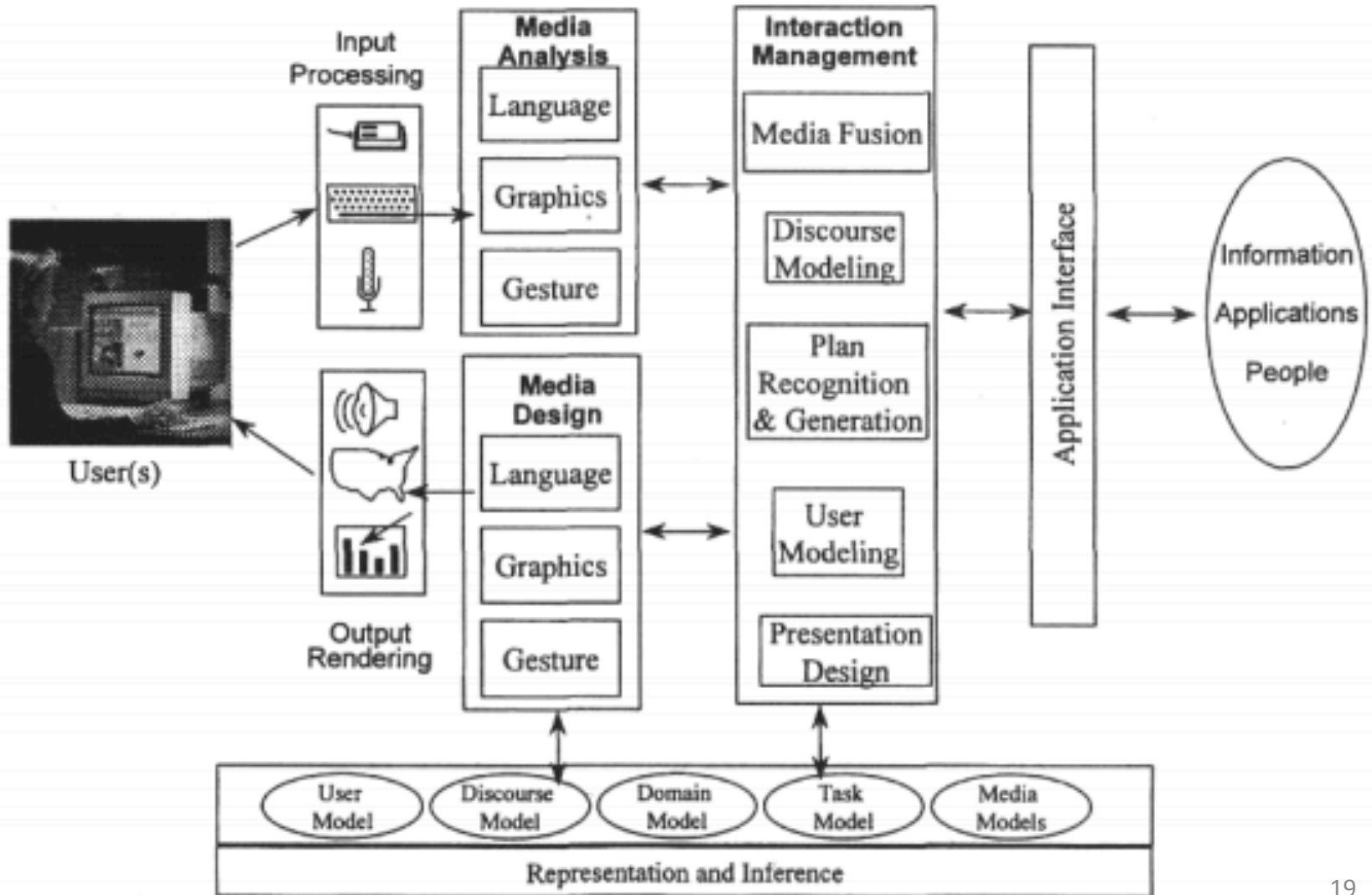
# User Interface Components?

- What are some specific UI components that you/others interact with?
  - Desktop/Web apps
  - Ubiquitous and pervasive apps
  - Mobile apps
  - Very large displays

# Application Domains?

- What do you use software for?
  - School
  - Work
  
- What do you want to use software for?
  - Games
  - Entertainment
  - Socialization

# IUI Architecture (1999)



# Medium and Modality

- **Medium**
  - Material object used for presenting, saving, or handling information
  - E.g., paper, CD, microphone, mouse
- **Modality**
  - Human senses used to process information
    - Vision, audition, olfaction, touch, taste
  - Also called **mode**

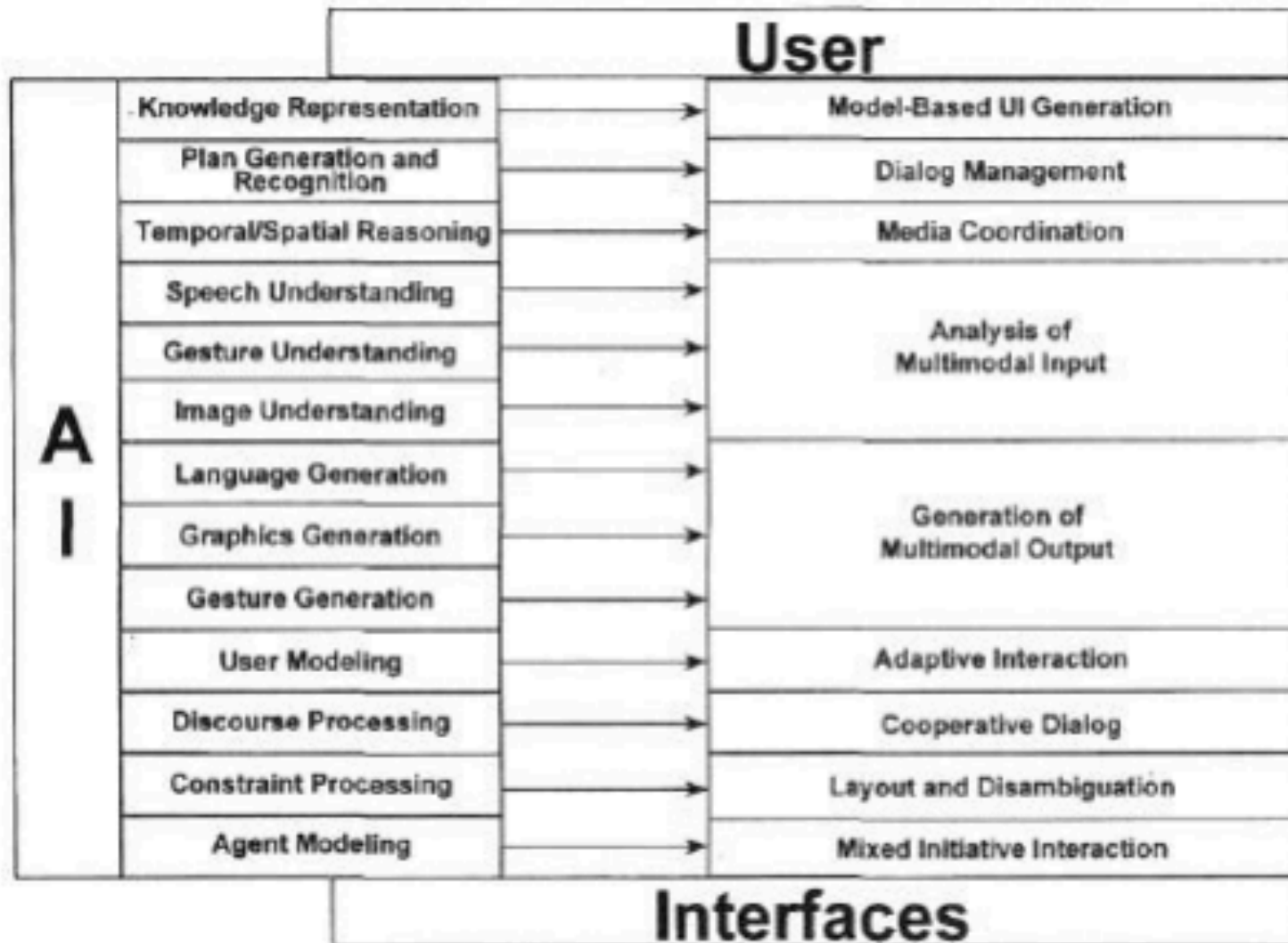
# Why So Complex?

- How would you respond to someone saying to you, “I want to go to the bank”?

# Why So Complex?

- How would you respond to someone saying to you, “I want to go to the bank”?
  - **Disambiguation**: Which bank?
  - **Task**: What for?
  - **Planning**: By when?
  - **Formality**: How do you respond back?
  - **Relevant Context**: ...?

# AI Meets HCI



# Movement Towards Automation

- Roughly, input processing requires system to “*understand*” input
- Likewise, output display requires system to “*generate*” output
  - Historically, **canned** output used
  - Generation on the fly
  - Requires common **representation** of knowledge
  - Towards **model-based** solutions



# The Famous Eliza Agent

- Psychotherapist who repeats your thoughts
  - “Yes, tell me more about \_\_\_\_\_”
  - “Do you think it is \_\_\_\_\_ to \_\_\_\_\_”
  - “I understand. I am listening.”
- Try it out at: <http://nlp-addiction.com/eliza/>

# Sample Conversation with Eliza

> Hello. My name is Eliza. How may I help you?  
\* I feel sad but I don't know why.  
> Why don't you know why?  
\* It's a hard problem  
> Come, come, elucidate your thoughts.  
\* I don't even know where to start  
> Does that trouble you?  
\* Maybe  
> Why the uncertain tone?  
\* I just can't seem to figure out why I am sad  
> Do you believe it is normal to be sad?  
\* I think it's normal that everyone is sad sometimes  
> But you are not sure you it's normal that everyone is sad sometimes?

chat: |

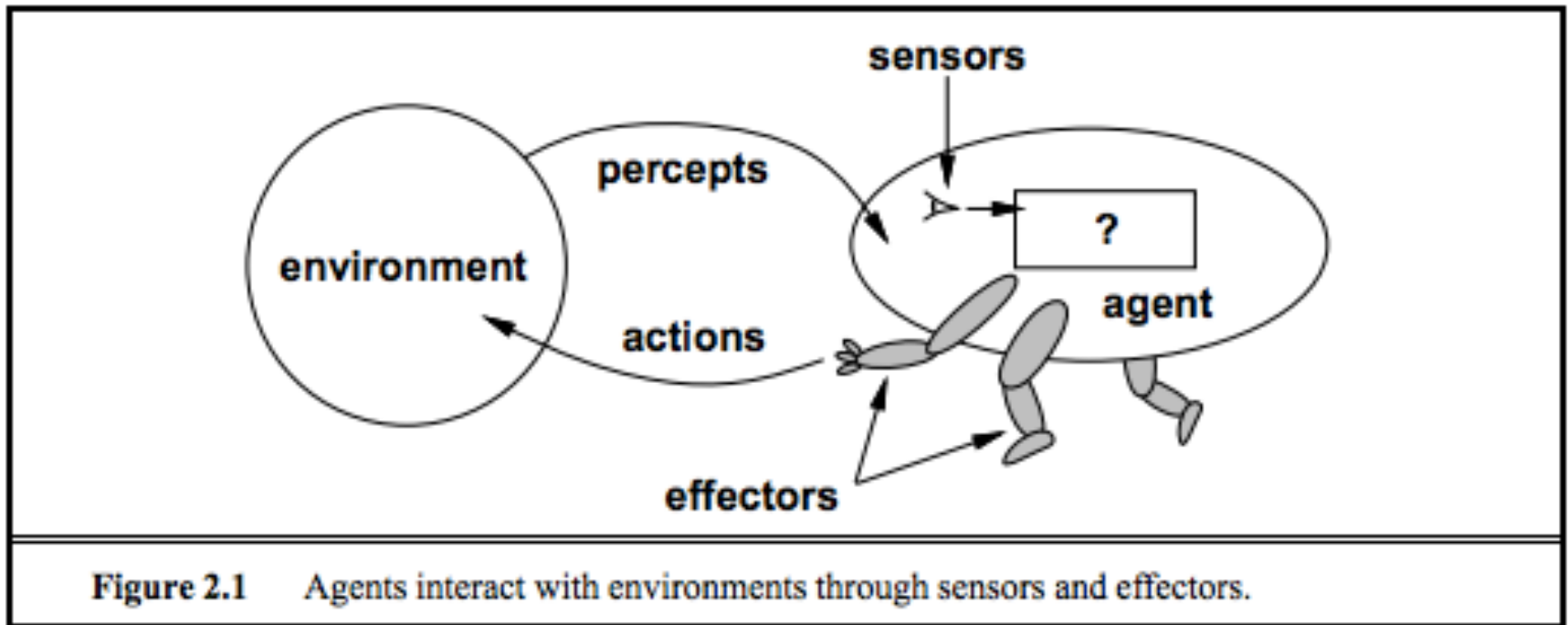
# Ex: Sentence Generation

- Solution 1: Hardcode a bunch of sentences
- Solution 2:
  - Define  $S = N V NP$
  - Specify list of nouns, verbs, model for NP, etc.
- Benefits
  - More structure (better understanding)
  - Easier to change
  - Easier to extend

# Range of Information Presentation

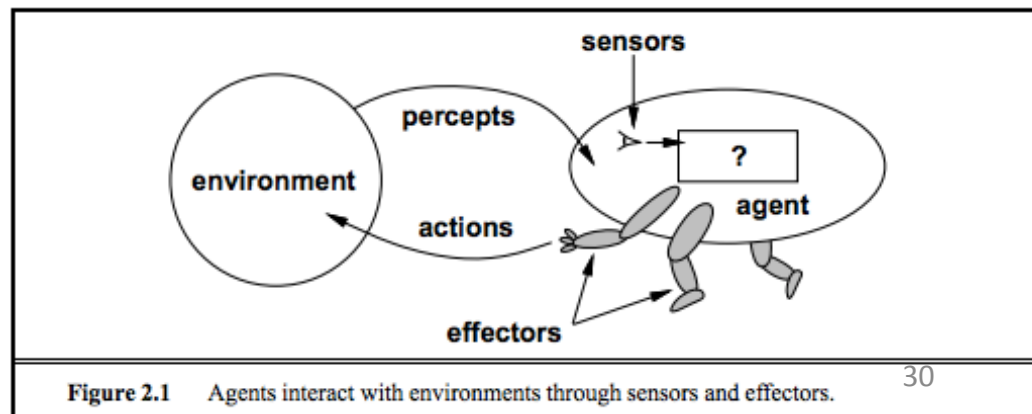
- Formal representation of info to be conveyed (1999)
  - Pure linguistic form
  - ... (spectrum)
  - Pure visualization
- Missing dimensions beyond the visual modality

# Design of Basic Intelligent Agent



# Environment?

- Everything “outside” the agent software
- Examples:
  - Operation system
  - Other software
  - The Internet
  - Input and output devices
  - User



# Percepts?

- Anything that can be monitored (**observable**)
- Examples:
  - Keystrokes and mouse movements
  - Gestures
  - Facial expressions
  - Conversational syntax
  - Dialogue structure

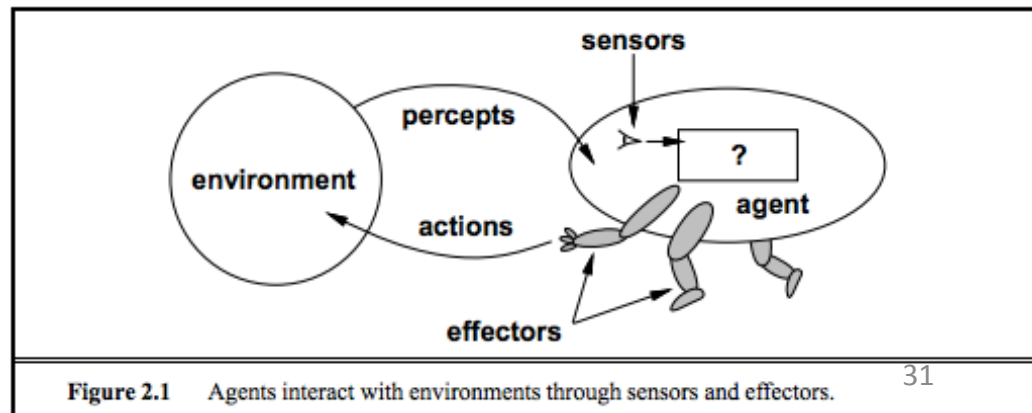


Figure 2.1 Agents interact with environments through sensors and effectors.

# Actions?

- Anything that the agent software can do to the environment
- Examples:
  - Pop up dialog box
  - Ask question or follow-up question
  - Show hint balloon
  - Auto-completion
  - Change layout

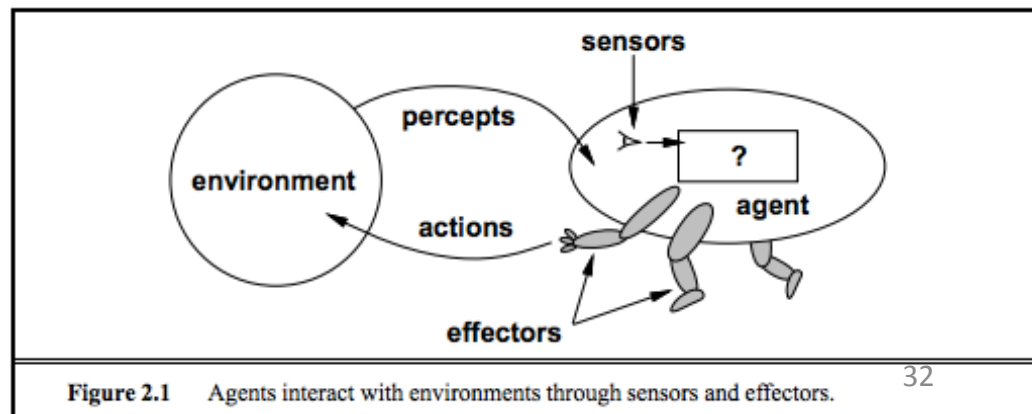
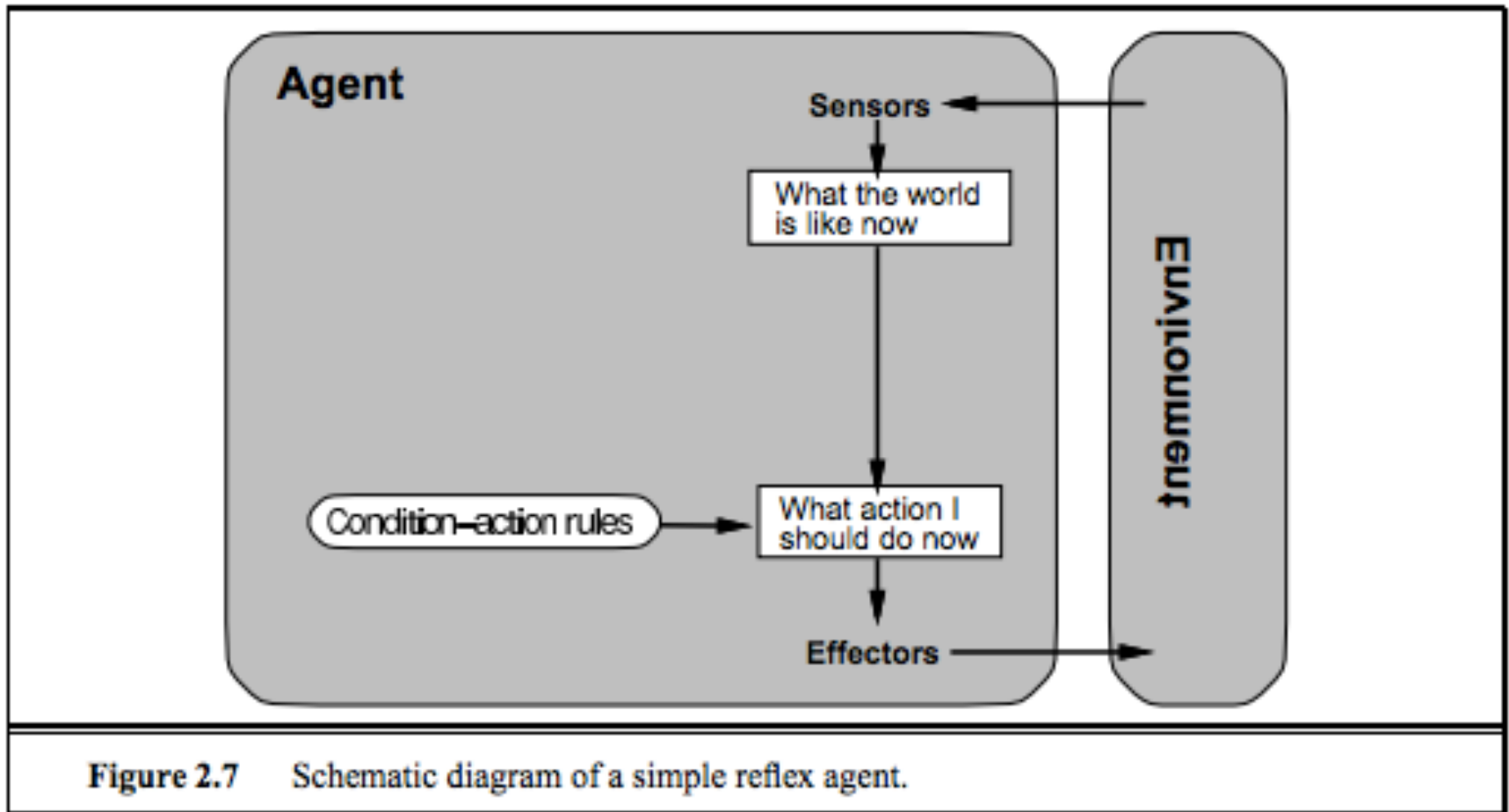


Figure 2.1 Agents interact with environments through sensors and effectors.



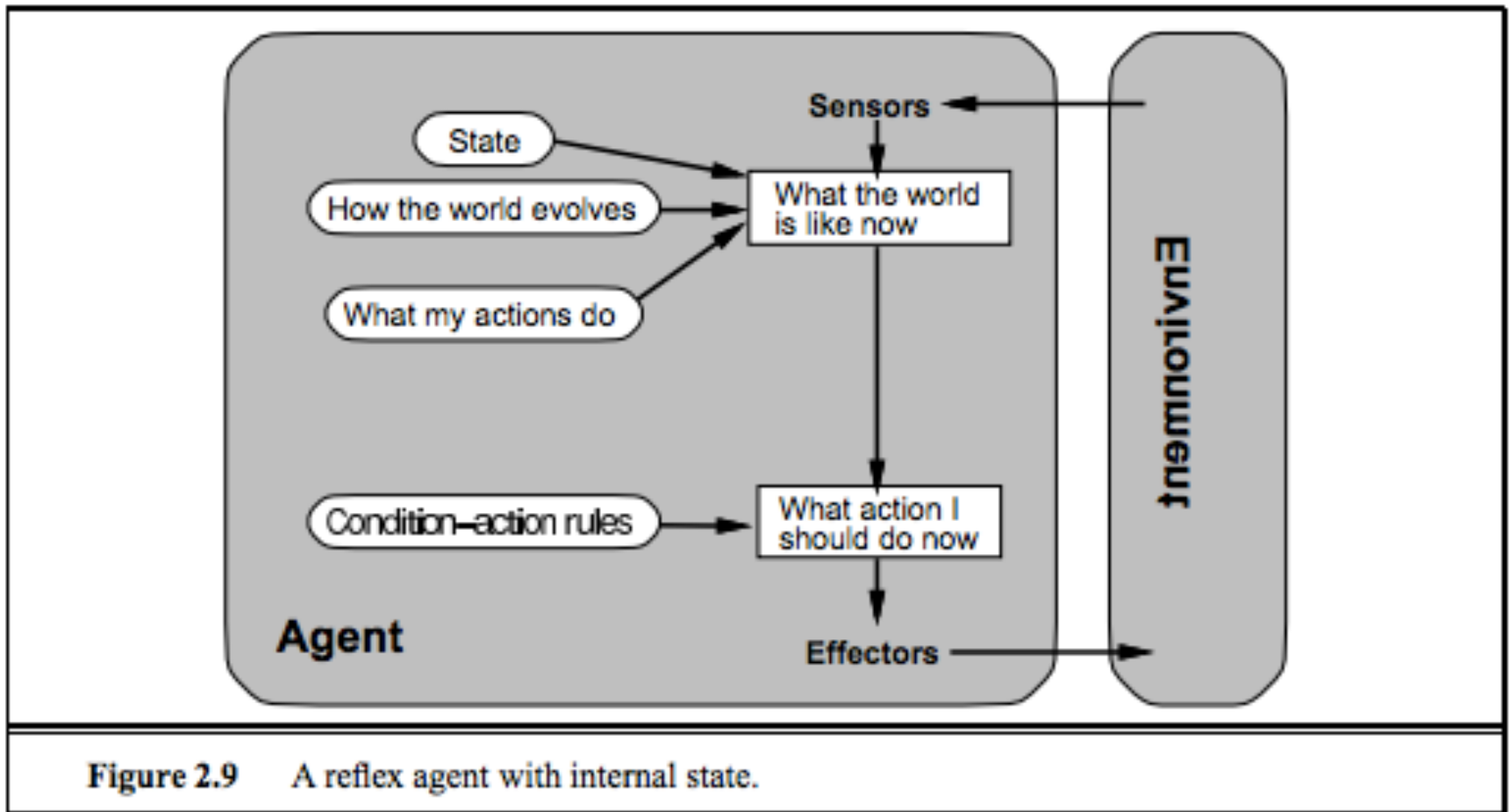
# Ex: Simple Reflex Agent



**Figure 2.7** Schematic diagram of a simple reflex agent.

Look up table implementation

# Ex: Reflex Agent with Internal State



Gives memory capability

# Ex: Goal-Based Agent

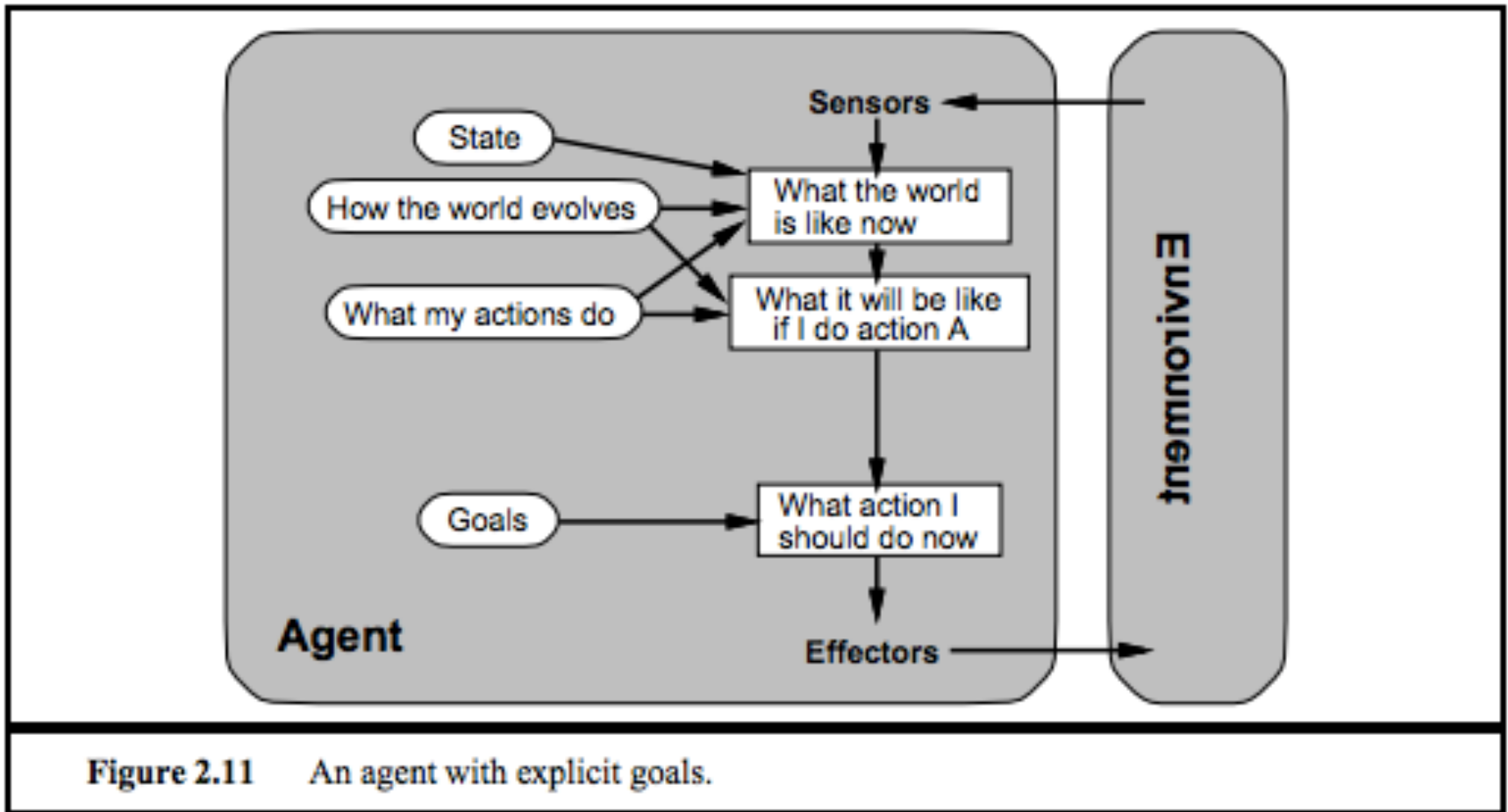
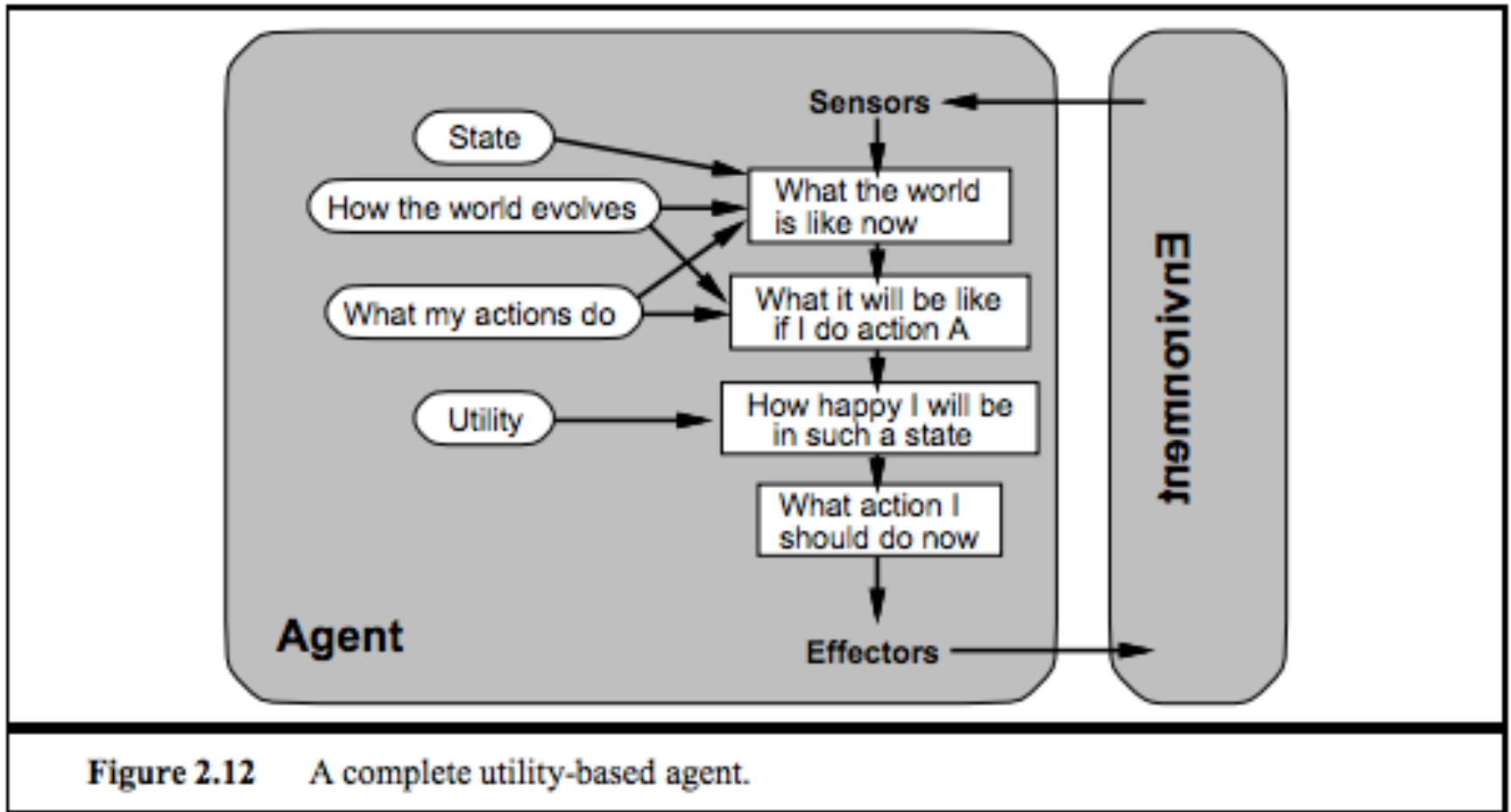


Figure 2.11 An agent with explicit goals.

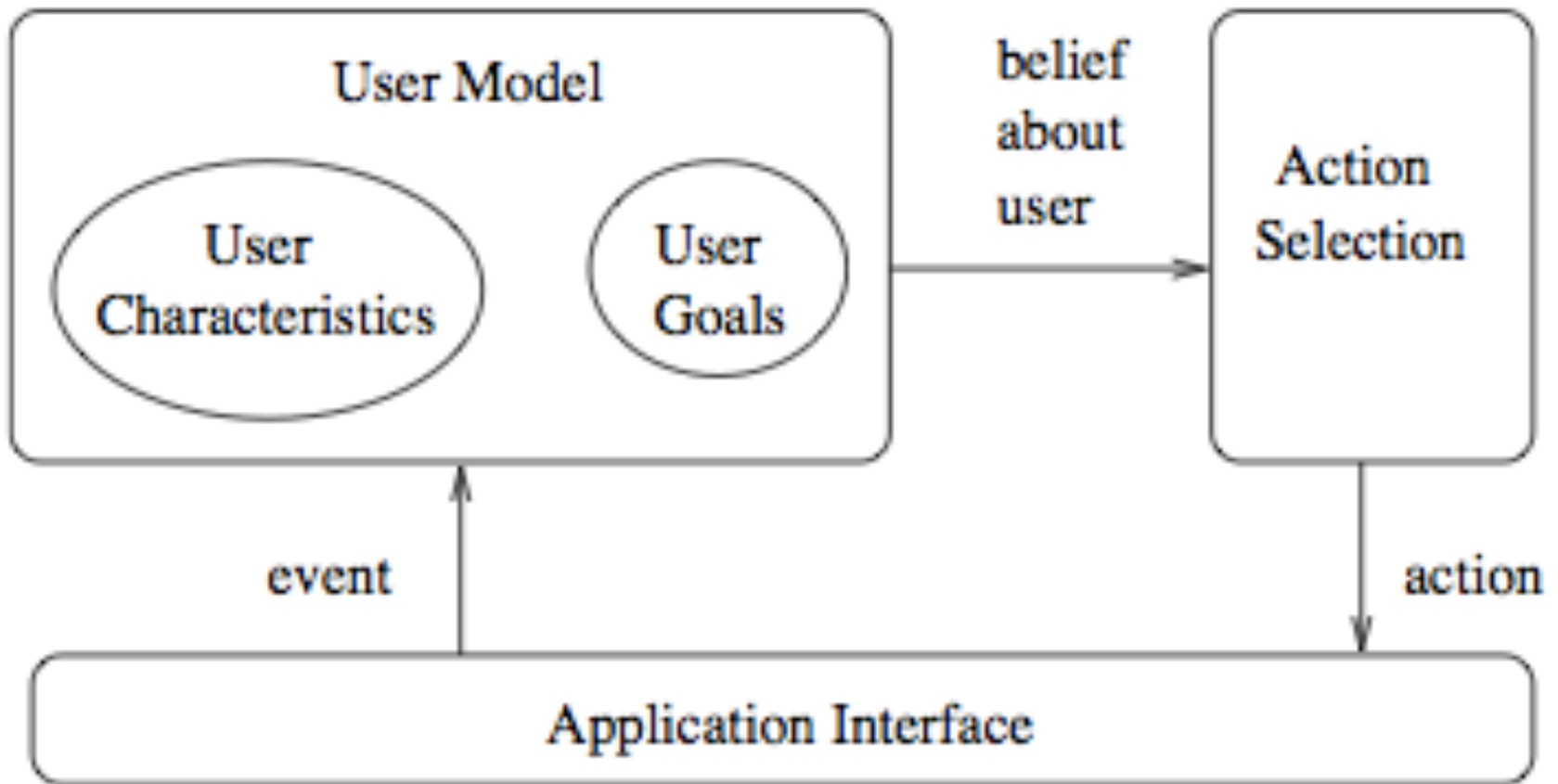
Gives goals modeling + planning capability

# Ex: Utility-Based Agent

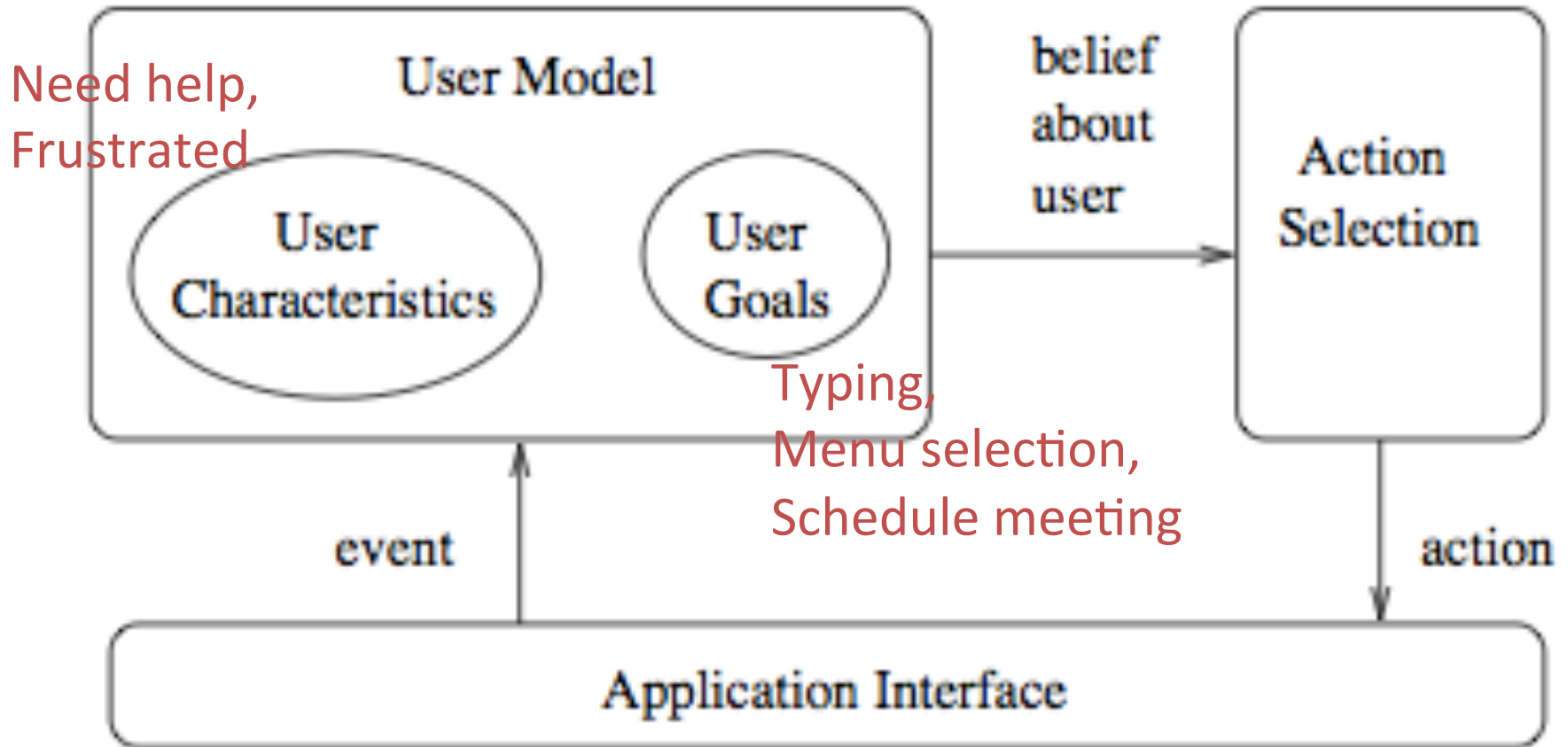


Gives decision making capability

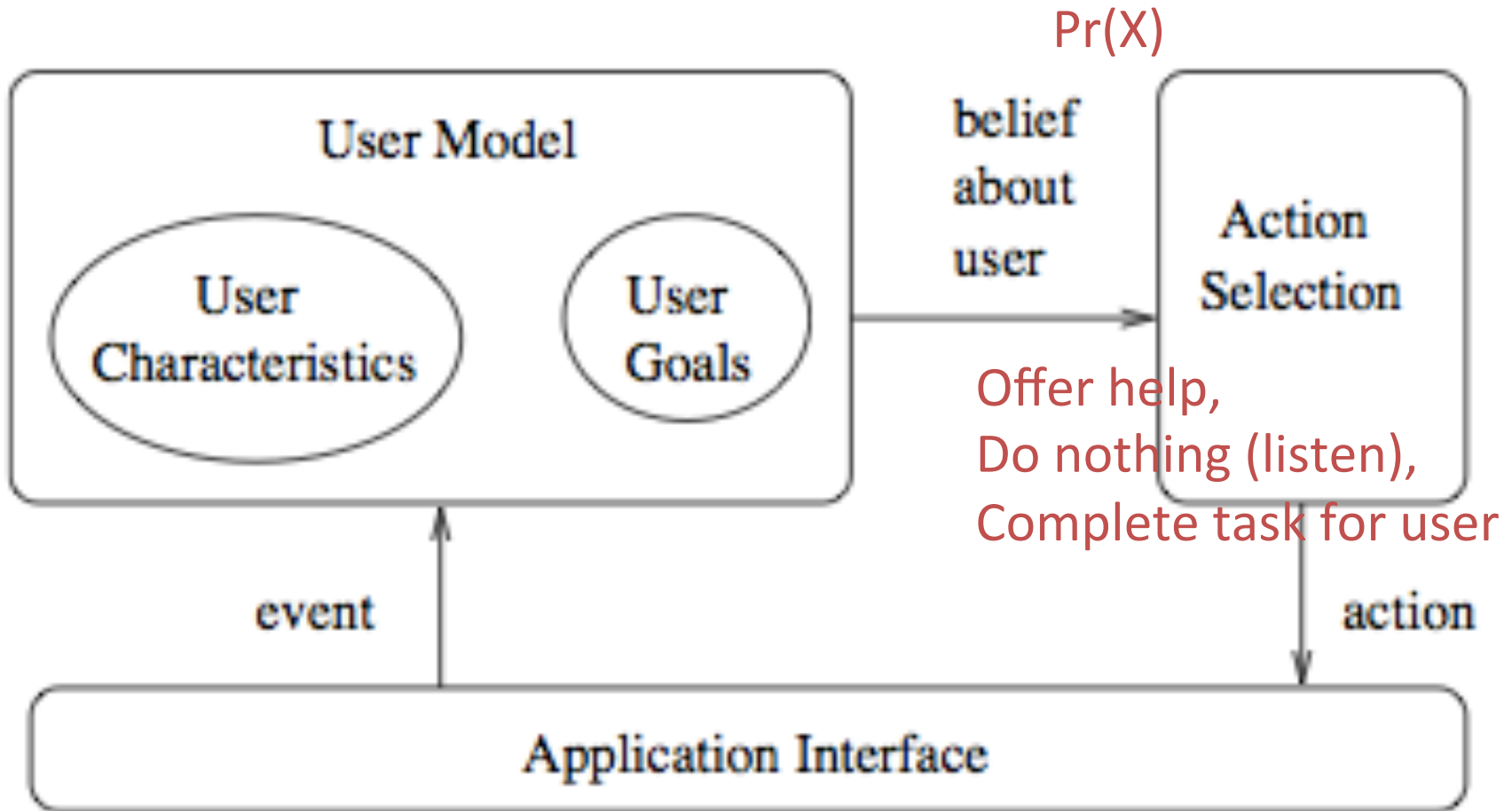
# General IUI Architecture



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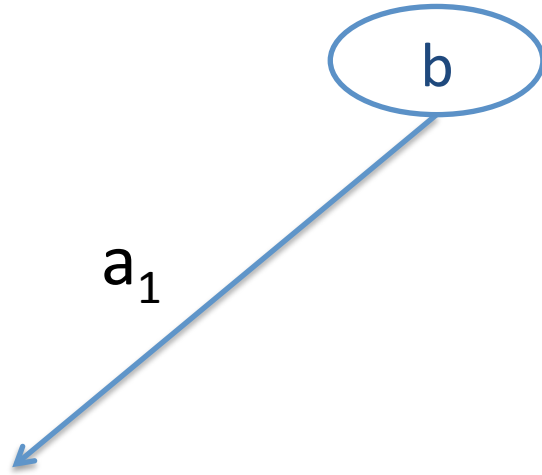
# General IUI Architecture

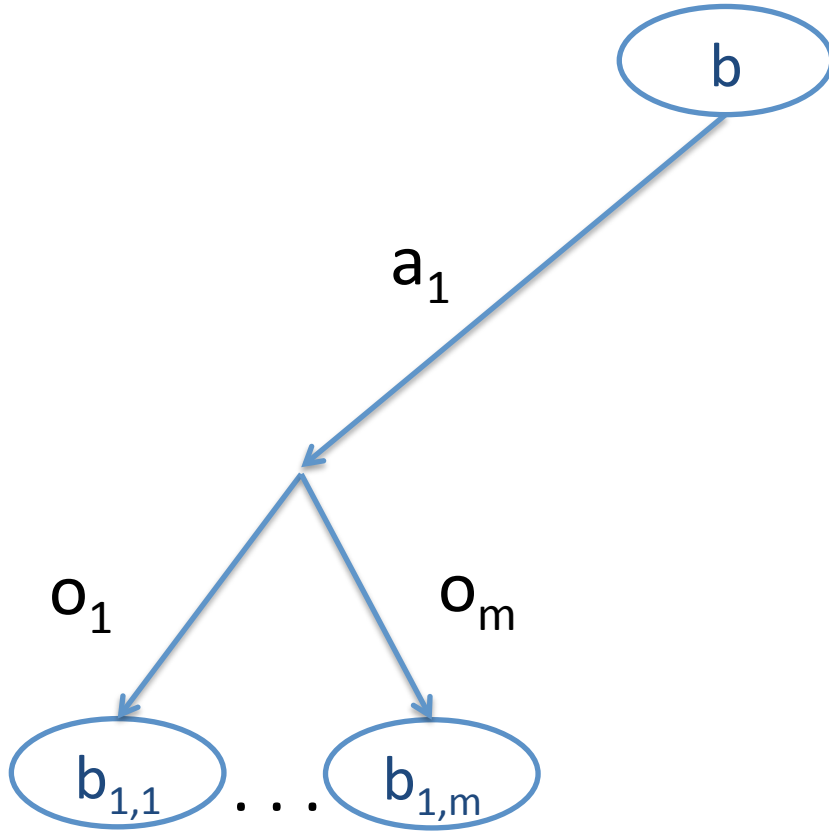


Motto: Agent is happy if the user is happy

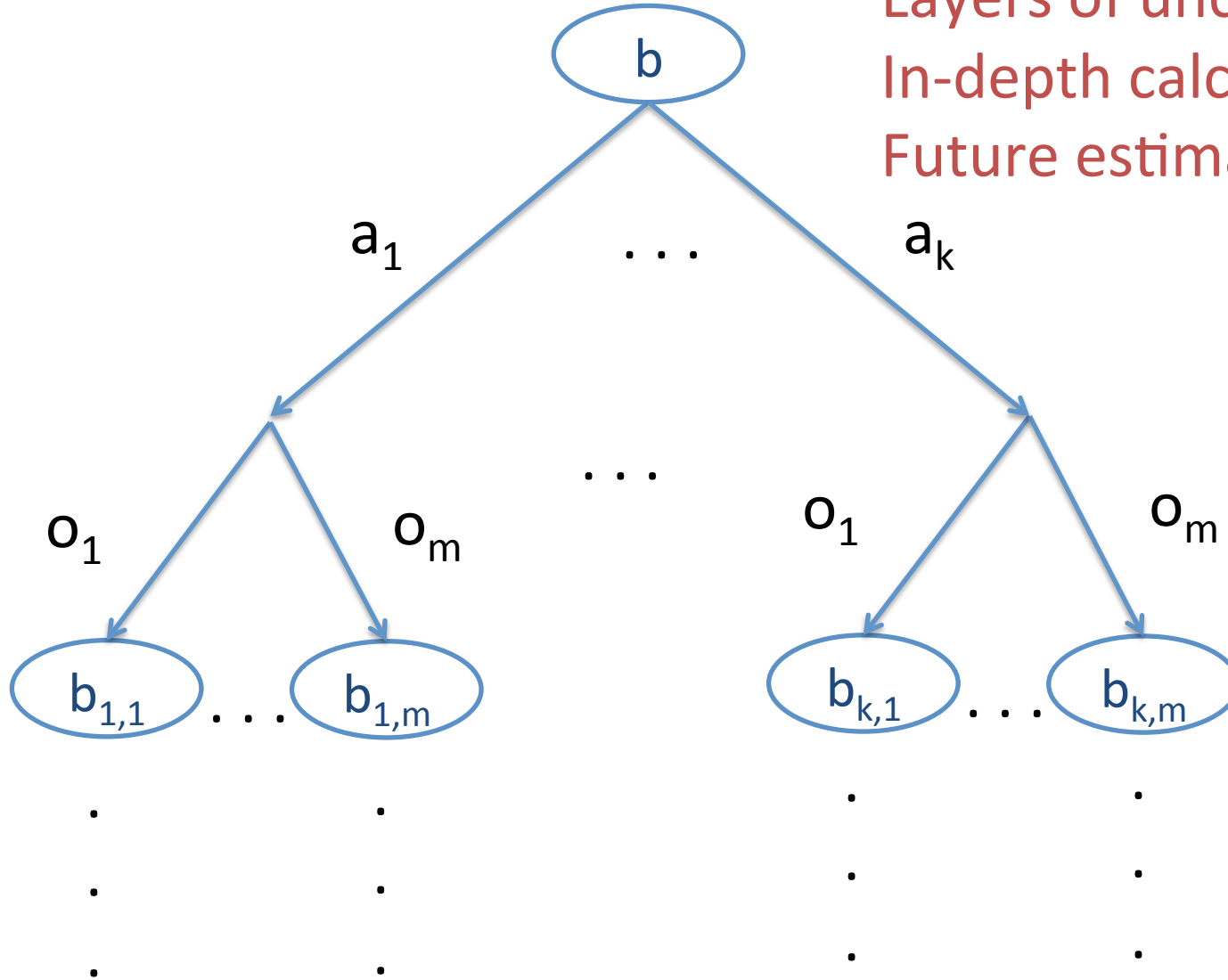
b





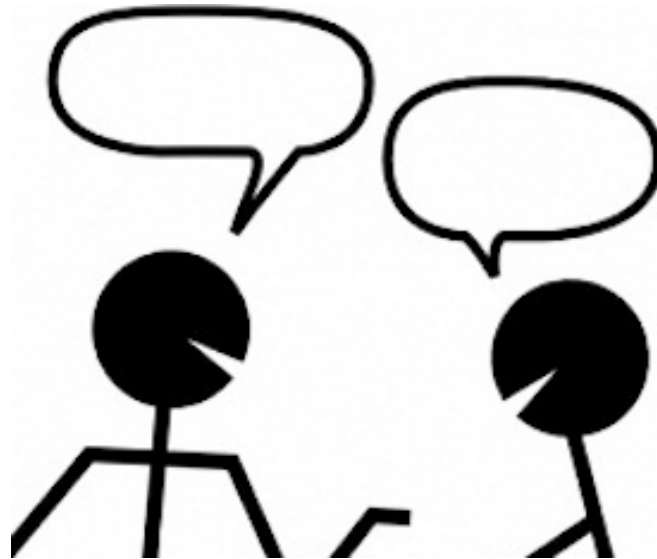


Complex!  
Layers of uncertainties!  
In-depth calculations!  
Future estimations!



# Mixed-Initiative (MI) Interaction

- Historically, user-initiated commands only
- Intelligent aspect is to have **mixed-initiation**
- **D**ialogue analogy:



- Imagine system-initiated commands only!

# Ex: Command Line Interface

```
toCheck — bash — 111x36
-rw-r--r-- 1 bowen 7709 Aug 15 2002 groupware.eps
-rw-r--r-- 1 bowen 8571 Aug 17 2002 influenceC.eps
-rw-r--r-- 1 bowen 11153 Aug 17 2002 influence.eps
-rw-r--r-- 1 bowen 40140 Jun 15 2002 llncs.cls
-rw-r--r-- 1 bowen 122393 Aug 18 2002 maze.ps
drwxr-xr-x 2 bowen 29 Oct 26 2003 papers/
-rw-r--r-- 1 bowen 6076 Jul 26 2002 partialtax.eps
drwxr-xr-x 2 bowen 56 Aug 22 2002 pix/
-rw-r--r-- 1 bowen 7034 Aug 21 2002 ptree.eps
-rw-r--r-- 1 bowen 5276 Aug 21 2002 Rdistribution.eps
-rw-r--r-- 1 bowen 31142 Aug 14 2002 Rdistribution.ps
-rw-r--r-- 1 bowen 7739 Aug 14 2002 regcon.eps
-rw-r--r-- 1 bowen 6630 Aug 14 2002 regconG.eps
-rw-r--r-- 1 bowen 3892 Aug 14 2002 regconP.eps
-rw-r--r-- 1 bowen 4632 Aug 17 2002 RL.eps
-rw-r--r-- 1 bowen 6420 Aug 18 2002 RLtwoagents.eps
-rw-r--r-- 1 bowen 9942 Jul 25 2002 scheduling.eps
-rw-r--r-- 1 bowen 14770 Aug 17 2002 states.eps
-rw-r--r-- 1 bowen 10274 Aug 17 2002 statespaceC.eps
-rw-r--r-- 1 bowen 9920 Aug 17 2002 statespace.eps
-rw-r--r-- 1 bowen 12572 Aug 21 2002 suboptexplore.eps
(41)apps0:~/courses/2534/project>ls
actionpair.eps  draft.ps.gz      figure2.eps      llncs.cls        Rdistribution.ps  states.eps
bib-full.bib    draft.tex        figure3.eps      maze.ps          regcon.eps        statespaceC.eps
draft2.ps       elicitorinterface.ps  final.tex       papers/          regconG.eps       statespace.eps
draft.bib       email.txt        floatfig.sty    partialtax.eps  regconP.eps       suboptexplore.eps
draft.dvi       faces.eps        groupware.eps   pix/             RL.eps
draft.pdf       faces-v.eps      influenceC.eps  ptree.eps       RLtwoagents.eps
draft.ps        figure1.ps       influence.eps    Rdistribution.eps  scheduling.eps
(42)apps0:~/courses/2534/project>rm draft2.ps
(43)apps0:~/courses/2534/project>rm dr
draft.bib  draft.dvi  draft.pdf  draft.ps  draft.ps.gz  draft.tex
(43)apps0:~/courses/2534/project>rm draft.ps
(44)apps0:~/courses/2534/project>ls
actionpair.eps  elicitorinterface.ps  final.tex  papers/  regconG.eps  statespace.eps
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```

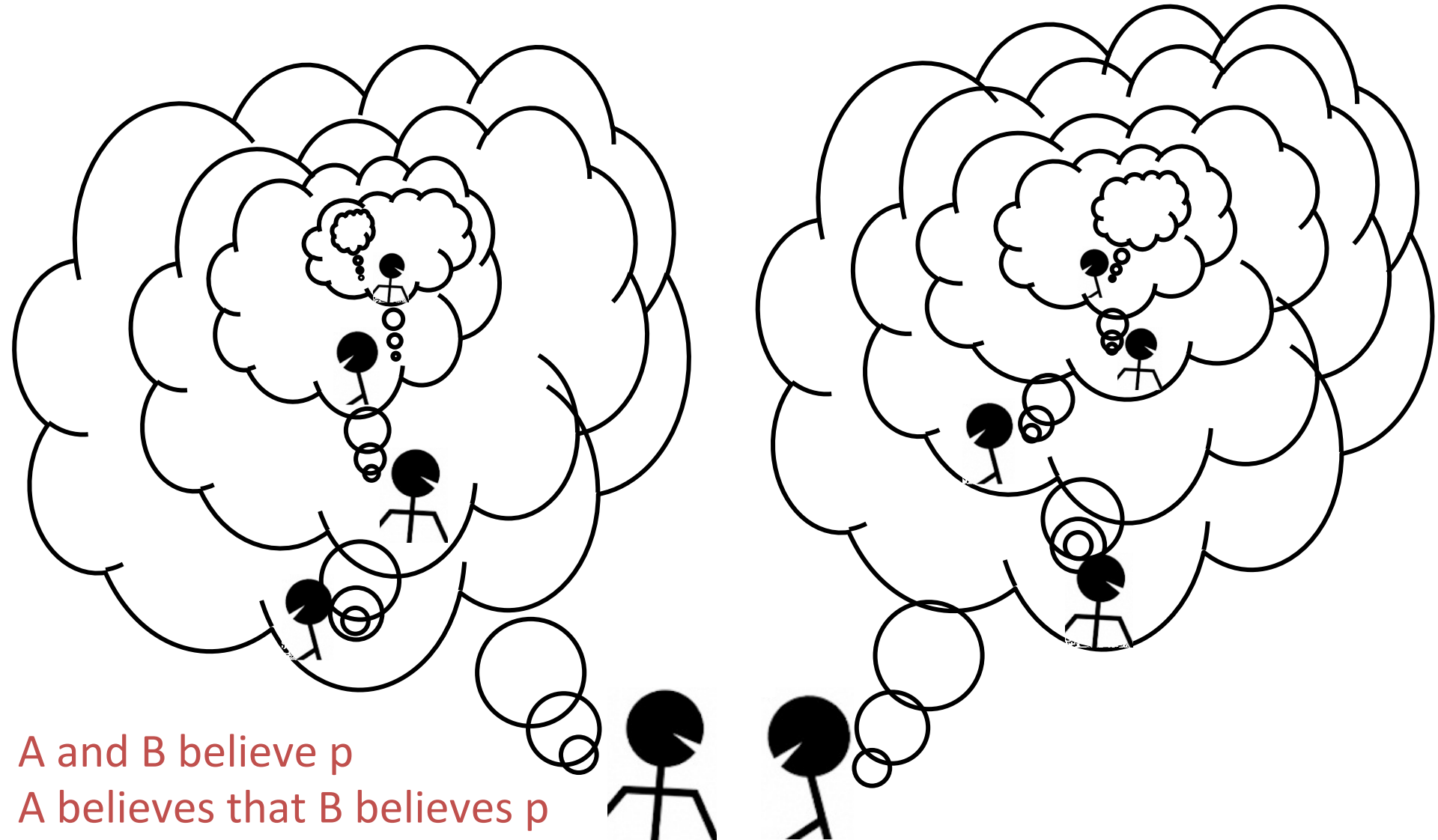
# MI Goals

- Aims to support efficient, naturally interleaving contributions of work
- Both parties converge to same solution for a problem
- Objectives:
  - Solve a problem together
  - Achieve the same goal
  - Come to a common understanding
- Improve quality of interaction flow when working with computers

# Difficulties

- How to establish common ground?
- What is the user's current focus of attention?
- What is the user's level of understanding of the problem?
- What are the user's beliefs?
- What are the user's abilities and intentions to contribute to solution?

# Mutual Beliefs between A and B



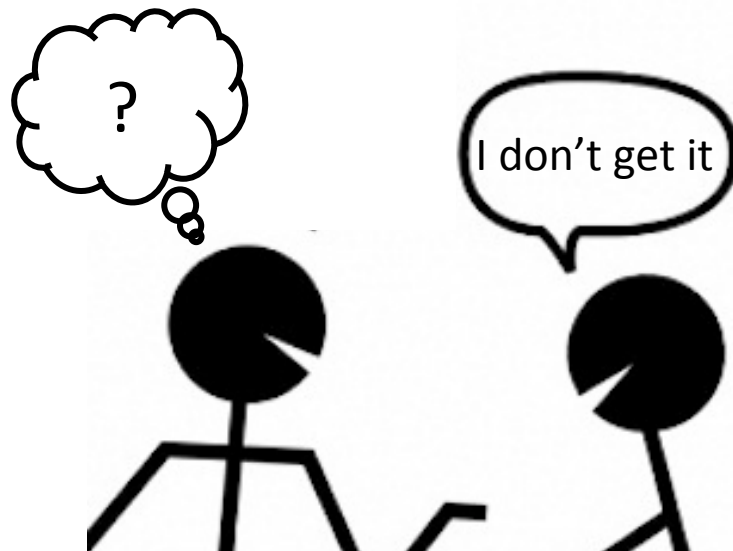
A and B believe p

A believes that B believes p

A believes that B believes that A believes p ...

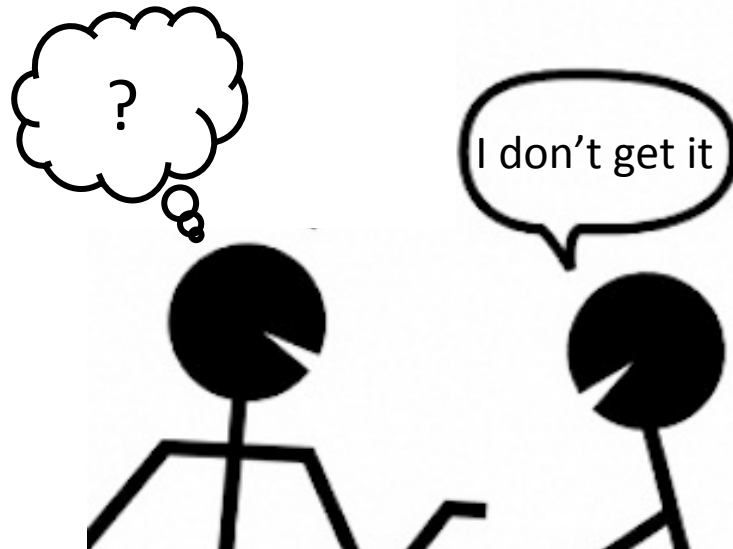


# Ex: Intelligent Tutoring System



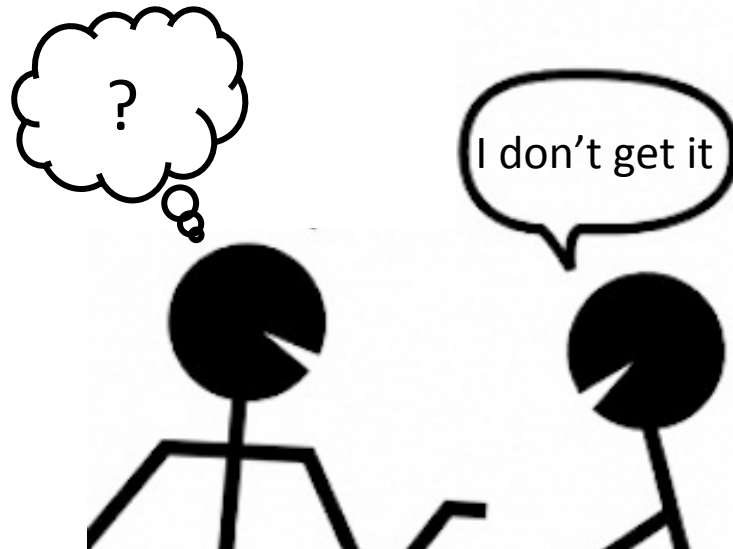
# Ex: Intelligent Tutoring System

- Student's current level of understanding?
  - Student's focus, abilities, intentions
  - Student's past successes, mistakes, learning patterns



# Ex: Intelligent Tutoring System

- Student's current level of understanding?
- How best to help student?
  - Watch, show similar example, give hint, give complete solution



# Is It Any Good?

- Recall: IUIs do what users want
- General evaluation methods
  - **Simulation** across variety of scenarios
  - **Empirical studies** with variety of users
- Criteria based on **metrics**
  - E.g., time to select target
  - E.g., accuracy percentage in target selection
  - E.g., level of frustration perceived
- Comparisons of methods (**benchmarking**)

# Major Challenges

- Modeling what users want
- Eliciting what users want
- Not knowing the “true” world state
- Planning and reasoning ahead
- Continually learning model parameters

# Major Challenges

- Modeling what users want
  - Quantifying using a **utility** function
  - Shape of function? **Additivity**?
  - Based on what interaction principles?
  - Learning model parameters **offline** vs. **online**

# Major Challenges

- Modeling what users want
- Eliciting what users want
  - What to ask, when, how often
  - What is the **value of information**?
  - What if they change? How do you know?

# Major Challenges

- Modeling what users want
- Eliciting what users want
- Not knowing the “true” world state
  - **Partial observability** vs. full observability
  - **Uncertainty** about the state
  - **Noise** in the model
  - Complex mathematical models required



# Major Challenges

- Modeling what users want
- Eliciting what users want
- Not knowing the “true” world state
- Planning and reasoning ahead
  - Expected costs and benefits of each action
  - **Myopic** decision making vs. N-step **look-ahead** vs. long term decision making
  - Complex mathematical models required

# Class Topics

- Adaptable vs. adaptive interfaces
- Natural language interfaces
- Social media analysis
- User types
- Activity recognition

# Logistics

- Next class:
  - Systems that Adapt to their Users (Bowen)
  - Socially-Adaptable Interfaces: Crowdsourcing Customization (?)
- Presentation rotation
- Paper review form
- Study material: logic, probability

# Additional Image References

- <http://www.deepakarora.com/how-to-hide-your-email-address-from-spam-robots/>
- <http://media-dis-n-dat.blogspot.ca/2010/07/speech-recognition-software-continues.html>
- [http://www.time.com/time/specials/packages/article/0,28804,1991915\\_1991909\\_1991755,00.html](http://www.time.com/time/specials/packages/article/0,28804,1991915_1991909_1991755,00.html)
- <http://www.cs.berkeley.edu/~russell/aima1e/chapter02.pdf>
- <http://thediaonline.co.za/2012/01/fun-client-conversations-or-nobody-likes-to-be-first/>
- <https://www.msimaging.com/services/ediscovery/advanced-review-tools/>
- [http://email-organization.com/email\\_productivity\\_solutions/email\\_productivity\\_best\\_practices.html](http://email-organization.com/email_productivity_solutions/email_productivity_best_practices.html)