

# *Intelligence Augmentation*

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# *Artificial Intelligence (AI)*

goal: build intelligent machines

justification:

- understand intelligence
- practical applications

# **CYC project (Lenat, MCC)**

- 10-15 person team
- over course of last 18 years
- entered all “common sense knowledge” a typical 10-year old would have in computer

# *Intelligence Augmentation (IA)*

human

+ machine

= “super intelligence”

# *Technological inventions that overcome physical/perceptual limitations*

- glasses
- hearing aids
- cars
- bicycles
- voice synthesizers
- ...

# *Why do we need technology to overcome cognitive limitations?*

- lousy memory (short term as well as long term)
- only good at dealing with one thing at a time
- probabilities, logic non-intuitive
- slow to process large amounts of information
- bad at self-knowledge, introspection
- ...

# *Modern Man's Environment*

Vs

# *Cave Man's Environment*

Has the natural evolution of our brains not kept up with the rapid changes in our environment???

# *Mismatch complexity of our lives & our cognitive abilities*

- too many things to keep track of
- information overload
- learn & remember more
- ...

# *Some old examples of intelligence augmentation*

- notes
- reminders
- watches
- alarm clocks
- ...

# *Some newer examples of intelligence augmentation*

- memory augmentation
- “extra eyes, ears”
- automation behavior patterns
- information filtering
- problem solving
- matchmaking
- transactions
- introspection

# *Memory augmentation*

- help remember people, places, names, actions, ...
- provide "just-in-time" information

# *Remembrance agent (Emacs version, Rhodes '99)*

The screenshot shows a vintage-style terminal window with a dark background and light-colored text. At the top, there's a menu bar with "Buffers", "File", "Edit", and "Help". Below the menu, the main area contains a block of text describing the Remembrance Agent's function as a knowledge base for users. The text discusses how users can collect private knowledge, which the RA then uses to answer public queries without interrupting the user. It also mentions knowledge transfer between users and the ability for communities to ask collective questions. At the bottom of the window, there's a command-line interface showing the file name "wearables.paper" and its status as a "Text Remembrance Fill". The command-line also lists three numbered items: 1. 0.31 Boston local: Wearable Computing talk take 2, 2. 0.25 mobile Linux web page, and 3. 0.51 rebooting workstations in the agents area. The prompt "\*remem-display\*" is visible at the end of the command line.

```
--***-Emacs: wearables.paper      (Text Remembrance Fill)--Bot-----
1 0.31 Boston local: Wearable Computing talk take 2
2 0.25 mobile Linux web page
3 0.51 rebooting workstations in the agents area
*remem-display*
```

# *RA (Web version, Rhodes '99)*

Netscape: A brief history of wearable computing

File Edit View Go Communicator Help

1762 (F) **John Harrison invents the pocket-watch**  
Harrison invented the first practical marine chronometer, a highly accurate and reliable clock needed to determine the longitude of a ship.

1907 (F) **Aviator Alberto Santos-Dumont commissions the creation of the first wristwatch**  
Alberto Santos-Dumont, one of the early experimenters in heavier-than-air flying machines, commissioned the famous jeweler Louis Cartier to manufacture a small timepiece with a wristband to his specifications. The wristwatch allowed him to keep his hands free for piloting.

1945 (F) **Vannevar Bush proposes the idea of a "memex" in his article "As We May Think" [MIT]**  
While Bush thought the memex would be desk-sized rather than wearable, it is an early mention of the augmented memory. "Consider a future device for individual use, which is a sort of mechanized private file and library. It needs a name, and to coin one at random, "memex" will do. A memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory."

"As we may think"  
Bradley J. Rh...., 17 May 97  
(0.45)

1960 (F) **Heilig patents the Sensorama, a Head-Mounted Display (HMD) with olfactory output**  
The Sensorama was designed to provide the ultimate cinema experience. The system included handlebars, binocular display, vibrating seat, stereophonic speakers, cold air blower, and a device close to the nose that would generate odors that fit the action in the film.

1960 (F) **Manfred Clynes coins the word "Cyborg"**  
"cyborg term"

The screenshot shows a vintage Netscape browser window with a light blue header bar containing the title 'Netscape: A brief history of wearable computing'. Below the header is a menu bar with 'File', 'Edit', 'View', 'Go', 'Communicator', and 'Help'. The main content area displays a list of historical events in a timeline format. The first event is '1762 (F) John Harrison invents the pocket-watch' with a brief description. The second event is '1907 (F) Aviator Alberto Santos-Dumont commissions the creation of the first wristwatch' with a description. The third event is '1945 (F) Vannevar Bush proposes the idea of a "memex" in his article "As We May Think" [MIT]' with a detailed description and a callout box containing the title and author of the original article. The fourth event is '1960 (F) Heilig patents the Sensorama, a Head-Mounted Display (HMD) with olfactory output' with a description. The fifth event is '1960 (F) Manfred Clynes coins the word "Cyborg"' with a description. The bottom of the browser window features a toolbar with various icons and a status bar.

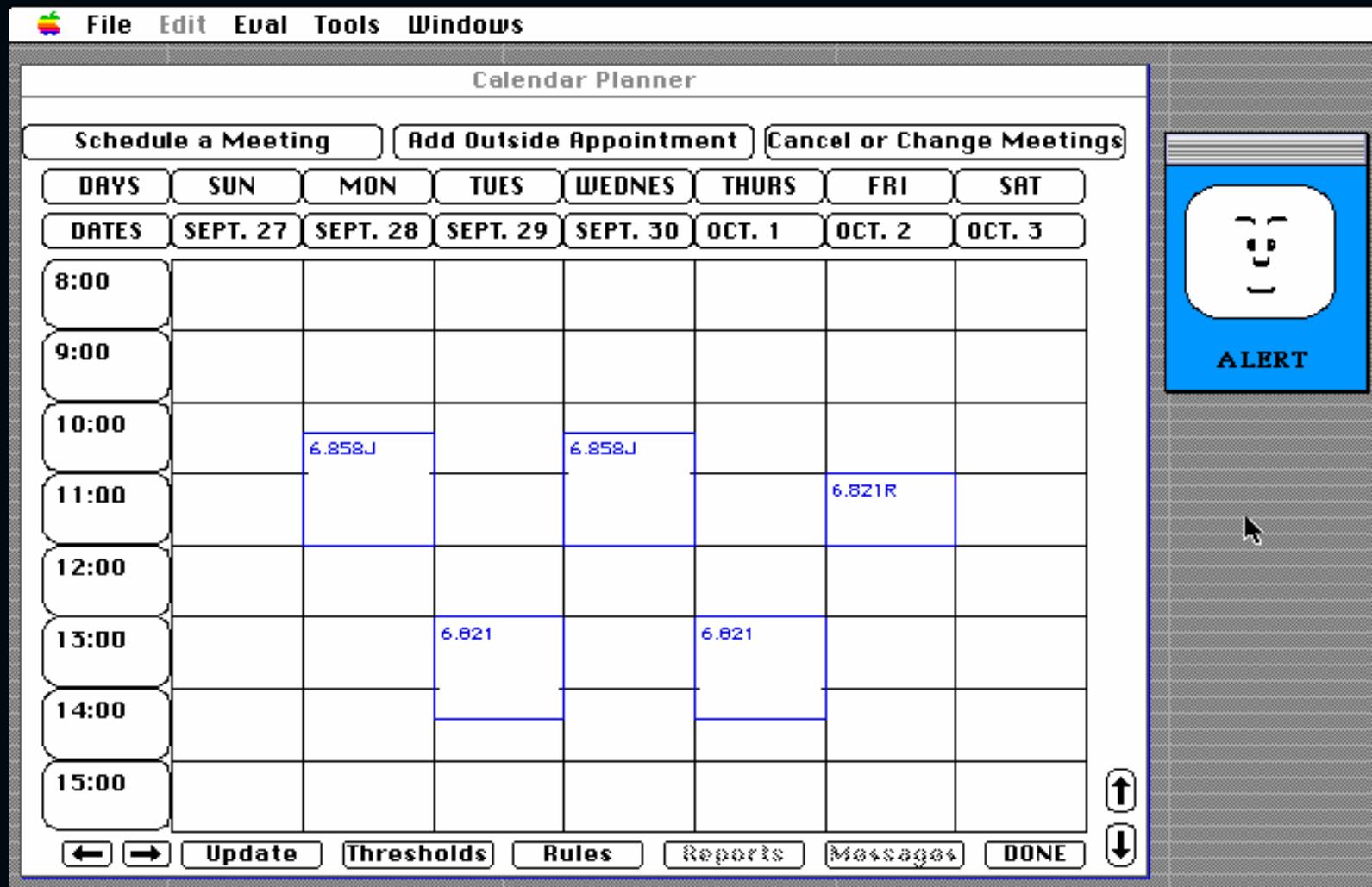
# *Discussion on Remembrance Agent*

- What are your thoughts on the paper?
- Would you want to “wear” a RA if it was more “fashionable”?

# *Extra eyes, ears, ... (Hive, Minar '98)*

- monitors for changing bits as well as atoms:
  - unusual  $\Delta$  price stocks
  - has certain site changed?
  - need more milk?
  - is there fresh coffee?
  - ...

# *Automation behavior patterns (Kozierok, 90)*



eting

Add 0

	MON	T
8	OCT. 19	OC

## INVITATION request from CALVIN

### *Meeting Details*

Date: MONDAY, 10/19/1992

Time: 13:00 –14:30

Length: 1 hours 30 minutes

Frequency: ONCE

### Participants:

CALVIN  
HOBBS  
ROBYN

### Description:

Discuss calendar scheduling agent

### Please Choose One:

accept  
decline  
request-renegotiation

**Done & Chosen**



SUGGESTION

I predict that you will  
ACCEPT  
confidence:  
0.351

Done

Why?

# *Benefiting from the problem solving done by others*

- few problems are original
- why not benefit from problem solving done by others
  - buying a car example:
    - select a car
    - select dealer
    - find out about “fair” price
    - negotiate price

# *Finding relevant products, services (Shardanand, Metral, 93)*

The screenshot shows a vintage-style Netscape browser window titled "Netscape: HOMR - Get Recommendation". The URL in the address bar is <http://rg.media.mit.edu/scripts/ringo-bin/getrecmd.pl?username=pattie@media.mit.edu&password=50T52KagtKmCA&recalc=1>. The main content area displays the HOMR logo and the heading "HOMR Recommendation". Below this, a message states: "In making your recommendations, I consulted 200 other users. I considered 1223 artists." A section titled "You may like to check out:" lists artists with their predicted ratings, confidence levels, and number of ratings:

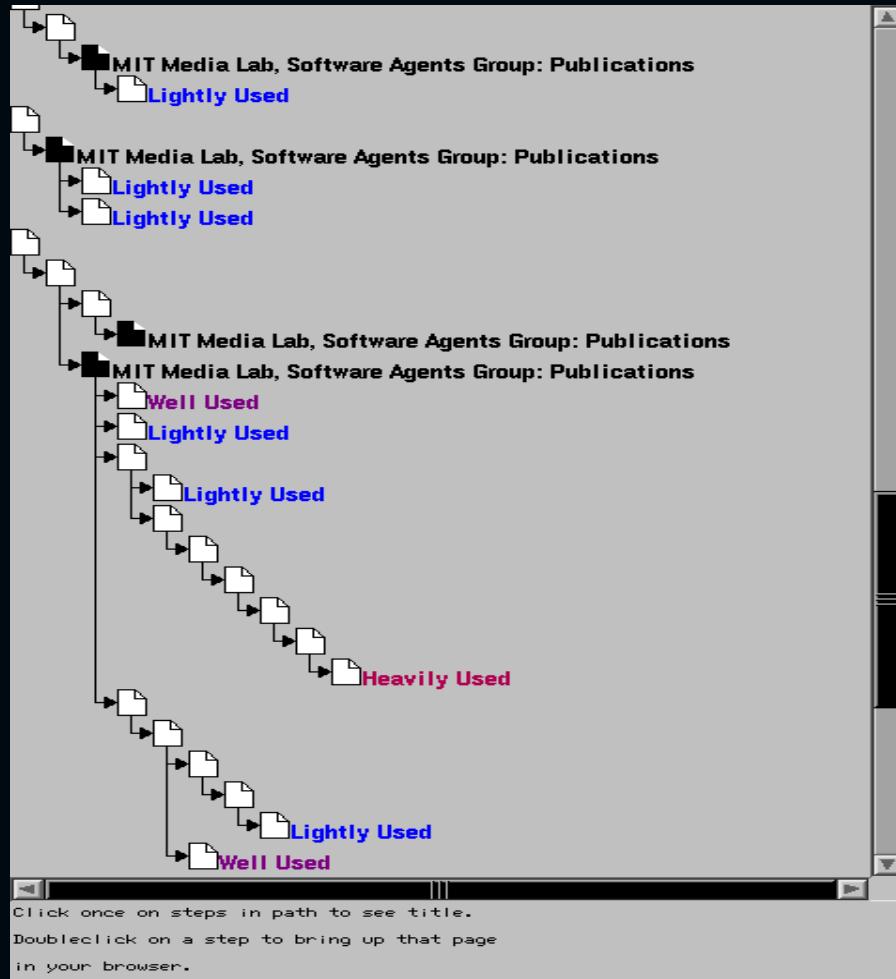
Artist	Predicted Rating	Confidence	# Ratings
<a href="#">Indigo Girls</a>	6.0594	Medium	36
<a href="#">Thompson, Richard</a>	6.0186	Medium	14
<a href="#">Lovett, Lyle</a>	5.9379	Medium	16
<a href="#">Bach, JS</a>	5.9188	Medium	11
<a href="#">Shocked, Michelle</a>	5.8358	Medium	11

A section titled "...And you might want to avoid:" lists artists with their predicted ratings, confidence levels, and number of ratings:

Artist	Predicted Rating	Confidence	# Ratings
<a href="#">Cinderella</a>	1.0000	Low	13
<a href="#">Poison</a>	1.0861	Low	12
<a href="#">Vanilla Ice</a>	1.1316	Medium	52
<a href="#">The 2 Live Crew</a>	1.2320	Low	13
<a href="#">Marky Mark And The Funky Bunch</a>	1.2890	Medium	24

At the bottom, a note says "To rate these artists, click [here](#)". The browser interface includes a menu bar (File, Edit, View, Go, Bookmarks, Options, Directory, Help), a toolbar with standard icons, and a sidebar on the right showing a file tree with "new-max", "misc", "bie's External", and "arts-card-2".

# *Footprints: Finding popular paths on a website (Wexelblat, 99)*



# *Matchmaking: Yenta (Foner, 99)*



## Current cluster memberships

Cluster number	Top words	Number of documents	Visibility			Status
			ignore	careful	carefree	
2	agent, paper, conference, author	11	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Searching (tried for 4 hours)
3	one-time-pad, shipping contract	24	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Found and joined: (37 known, ~400 estimated members)

[Submit Preferences](#)



I've got someone you might want to meet!

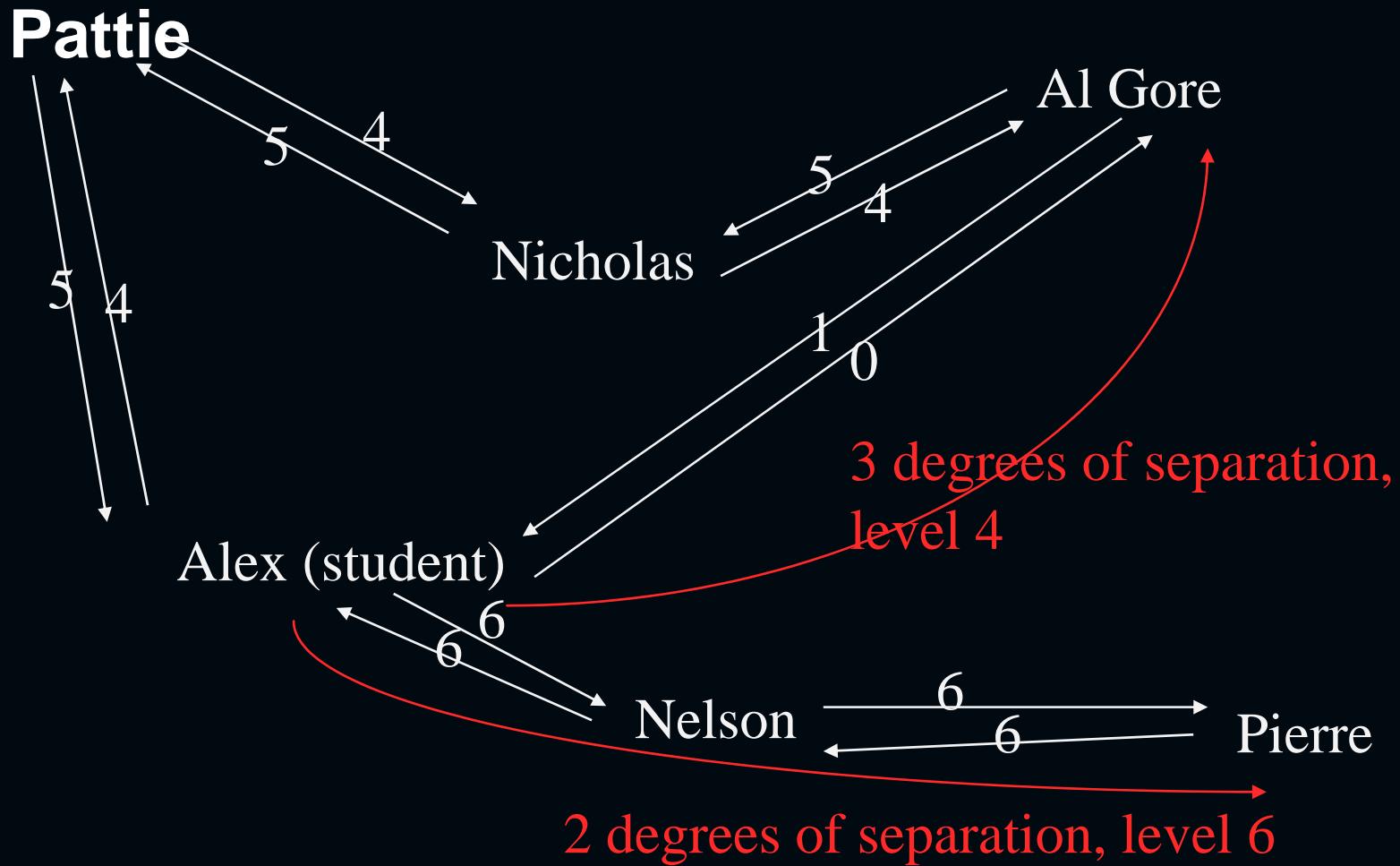


[Introduce me](#)

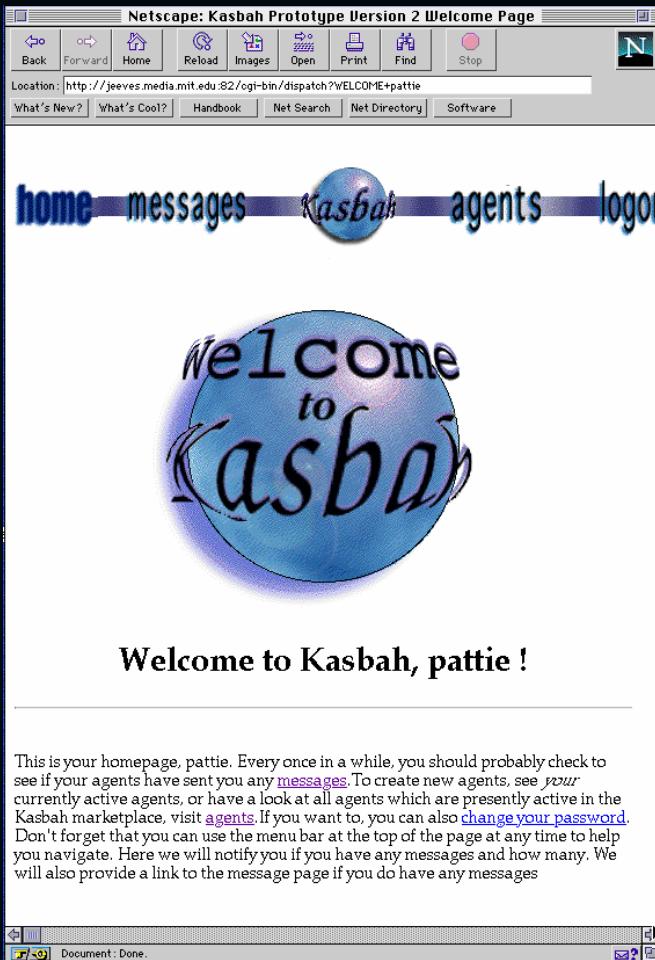
[Open a commlink](#)

ID	7A 34 56 D1 8C 91 EA 0A 30 DC D3 2A 52 E8 09 FA				
Handle	Blueshell				
Known age	At least 2 years 3 months 1 week				
Attestations	<a href="#">I am a SkrodeRider. (3 signatories)</a> <a href="#">My Skrode is of the traditional design. (no signatories!)</a>				
Who initiated	We did				
Cluster contents	Cluster number	Top words	Number of documents	Visibility	
	3	one-time-pad, shipping, contract	24	<input type="radio"/>	<input type="radio"/>
<a href="#">Submit Preferences</a>					

# *Friend of Friend Finder* (Maes & Minar, 98)



# *Transactions: Kasbah (Chavez, 97)*



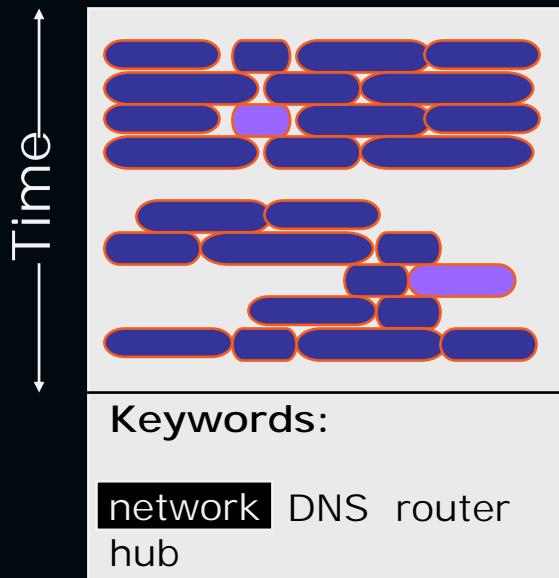
# *Kasbah example selling agent*

- **Sell: Macintosh Ilci**
  - Deadline: March 10th,1997
  - Start price: \$900.00
  - Min. price: \$700.00
  - Strategy: tough bargainer
  - Location: local
  - Level of Autonomy: check before transaction
  - Reporting Method: event driven

# *Impulse: Agents that assist & automate transactions* (Youll, Morris, 01)



# *Segue: Agents that help with self knowledge (Shearin, 01)*



collects & reflects  
user's habits over  
time

# *People are good at:*

- judgement
- understanding
- reasoning, problem solving
- creativity

# *Computers are good at:*

- remembering lots of facts
- searching & processing huge amounts of information
- being in many places at once
- multi-tasking
- being precise and organized
- objectivity

# *Software Agents*

An “agent” acts on your behalf

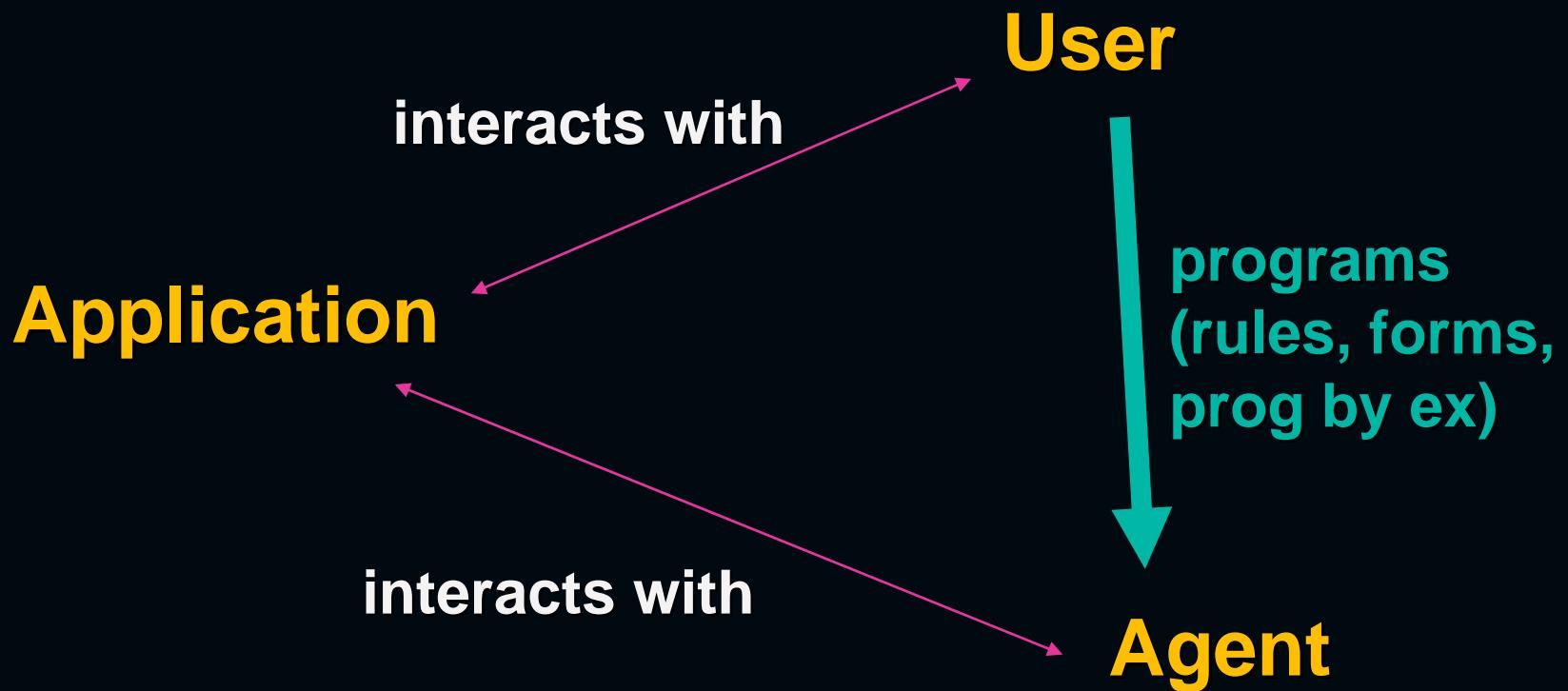
**Software that is:**

- personalized
- proactive, more autonomous
- long-lived, continuously running

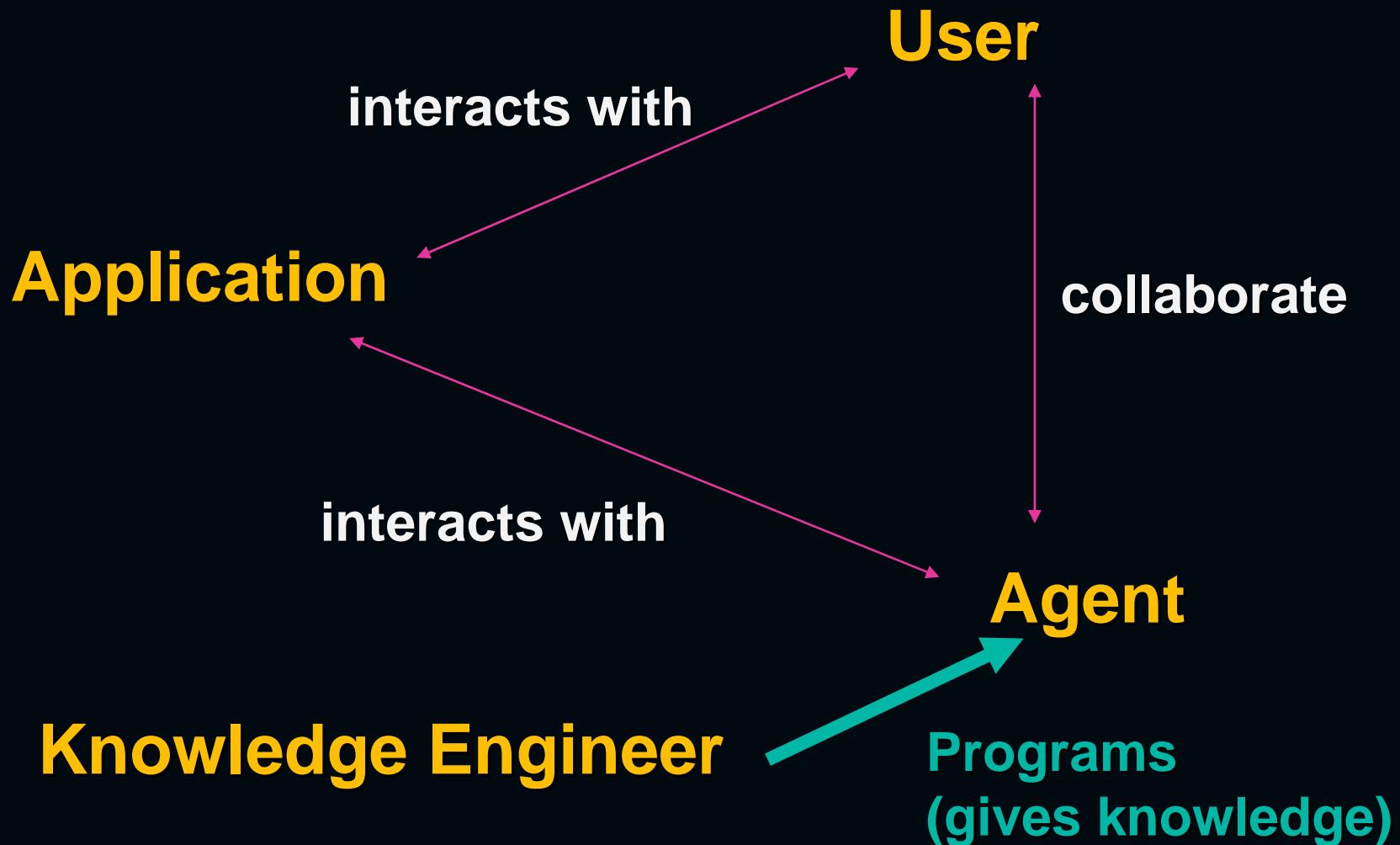
# *How are agents programmed?*

- user-instructed
- knowledge-engineered
- learned

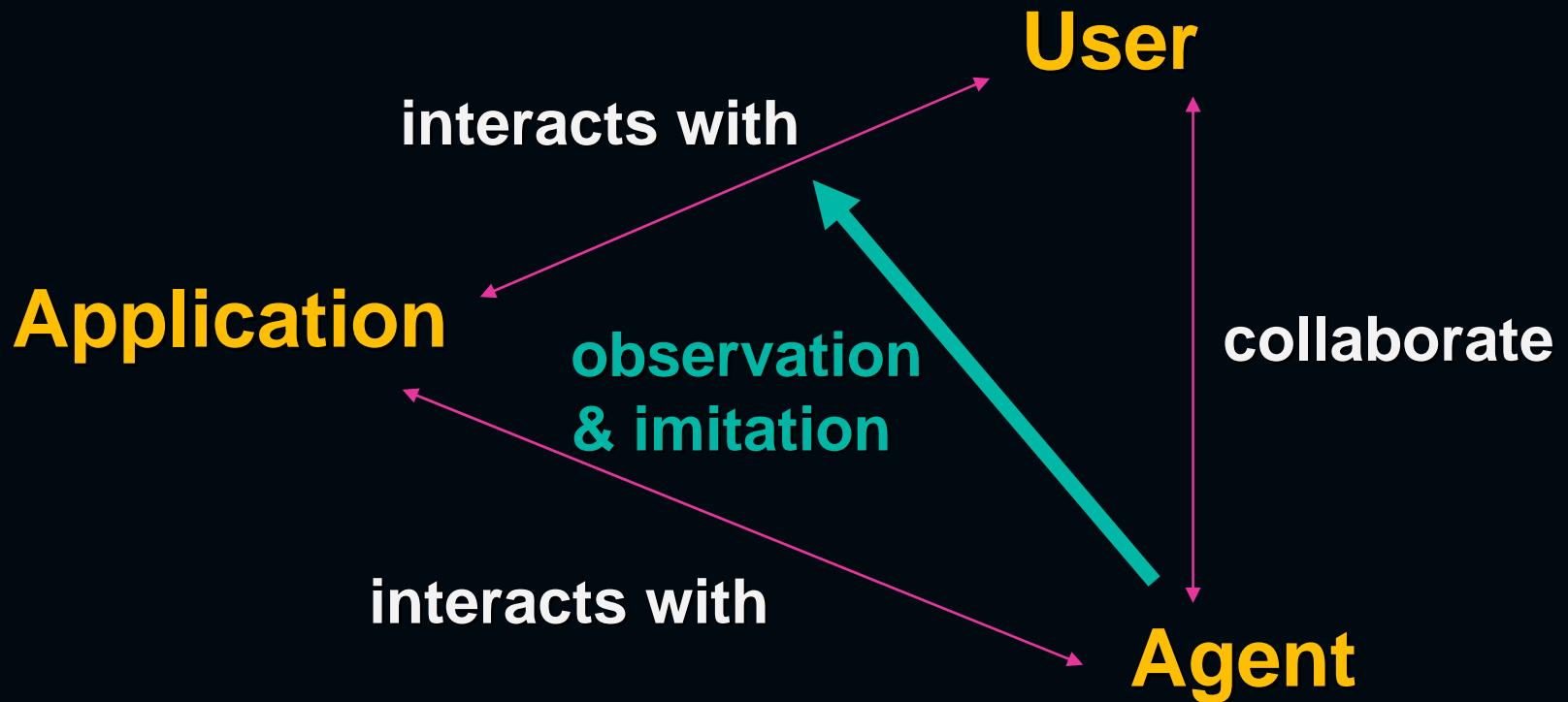
# *User-Instructed Agents*



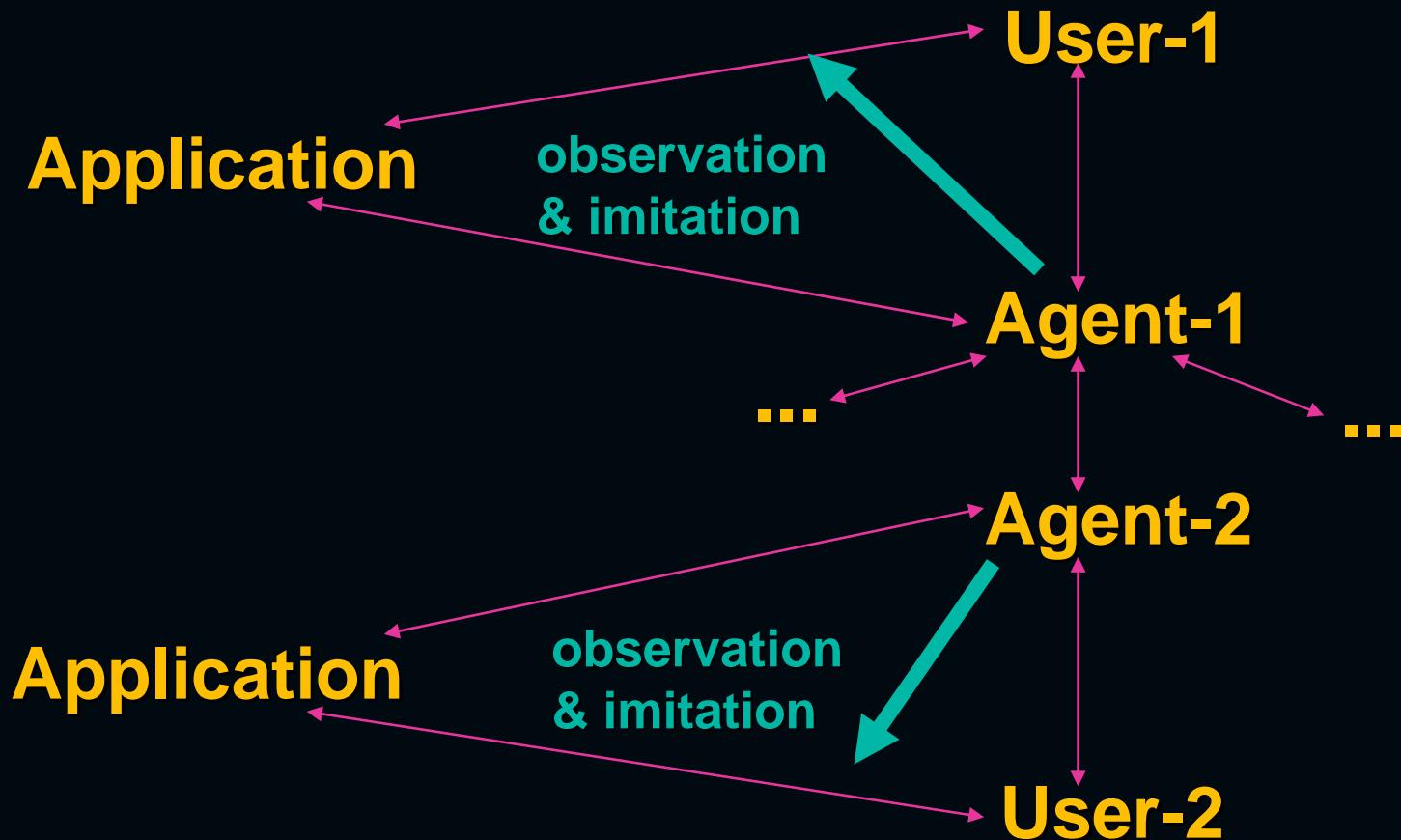
# ***Knowledge-Engineered Agents***



# *Learning from the User*



# *Learning from other Agents*



# *Which approach is best?*

Combination of 3 approaches:

- give agent access to **background knowledge** which is available & general
- allow **user to program** the agent, especially when the agent is new or drastic changes occur in user's behavior
- **agent learns** to adapt & suggest changes

# *Design challenges for IA*

- trust
- responsibility
- privacy
- UI issues
- avoid making people “dumber”

# *Trust*

**user needs to be able to trust the agents and other people s/he delegates to/interacts with**

- awareness of functionality
- understanding limitations
- predictability of outcome
- Explanations available
- ...

# *Responsibility*

- responsibilities for actions should be clear
- user should feel in, be in control

# *Privacy*

- Self ownership of data
- no subpoenas
- user determines what is made available and to whom
- anonymity an option
- ...

# **UI Issues**

- Tricky balance between proactive help & agent being annoying
  - Use “ambient” & minimal interface for agent suggestions
  - Allow user to decide when to pay attention to agent suggestions
  - Integrate suggestions in interface with minimal intrusion

# *Avoid making people dumber*

“every extension is an amputation”

*Marshall McLuhan*

Pick the right type of extension for the task at hand:

- automating (eg milk)
- assisting (eg memory)
- teaching (eg probabilities)

# *Discussion*

- What are the limits of direct manipulation?
- What tasks do you want help with?
- What level of help? Automation? Assistance, teaching/tutoring?

# *Conclusions*

- Computers can do more to help us cope with our busy lives
- Are we solving one problem and creating another?

# *How does this relate to Ambient Intelligence?*

Ambient Intelligence =

Intelligent interfaces

+

Ubiquitous computing

# *Ambient Intelligence Versions of Intelligence Augmentation Examples*

- memory augmentation
- “extra eyes, ears”
- automation behavior patterns
- information filtering
- problem solving
- matchmaking
- Transactions

# *Next week: Context-Aware Computing*

- Required Readings:
  - **Context-aware computing applications by Schilit et al**  
<http://www.ubiq.com/want/papers/parctab-wmc-dec94.pdf>
  - **A survey of Context-aware Mobile Computing Research by Chen & Kotz**

# **Next week: Context-Aware Systems**

- 1. City & museum tour guides -  
**Christine & Nick**
  - Hippie: A Nomadic Information System, Oppermann et al, Proceedings of the 1st international symposium on Handheld and Ubiquitous Computing **Christine**
  - Cyberguide by Abowd et al **Christine**
  - GUIDE project by Cheverst, Davies, et al  
**Nick**
  - ...

# **Next week: Context-Aware Systems**

- 2. Virtual Graffiti systems/Location Based Messaging – **Francis & Pattie**
  - Hanging Messages, Chang **Pattie**
  - ComMotion, Marmasse **Pattie**
  - Etherthreads, Lassey **Pattie**
  - Mobile cinema, P. Pan **Pattie**
  - Geonotes, Persson et al **Francis**
  - UCSD ActiveCampus **Francis**
  - ...

# *Next week: Context-Aware Systems*

- 3. Memory systems - **Nick**
  - Forget-me-not Mick Lamming  
Europarc
  - (Remembrance agent, Rhodes)
  - ...