

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

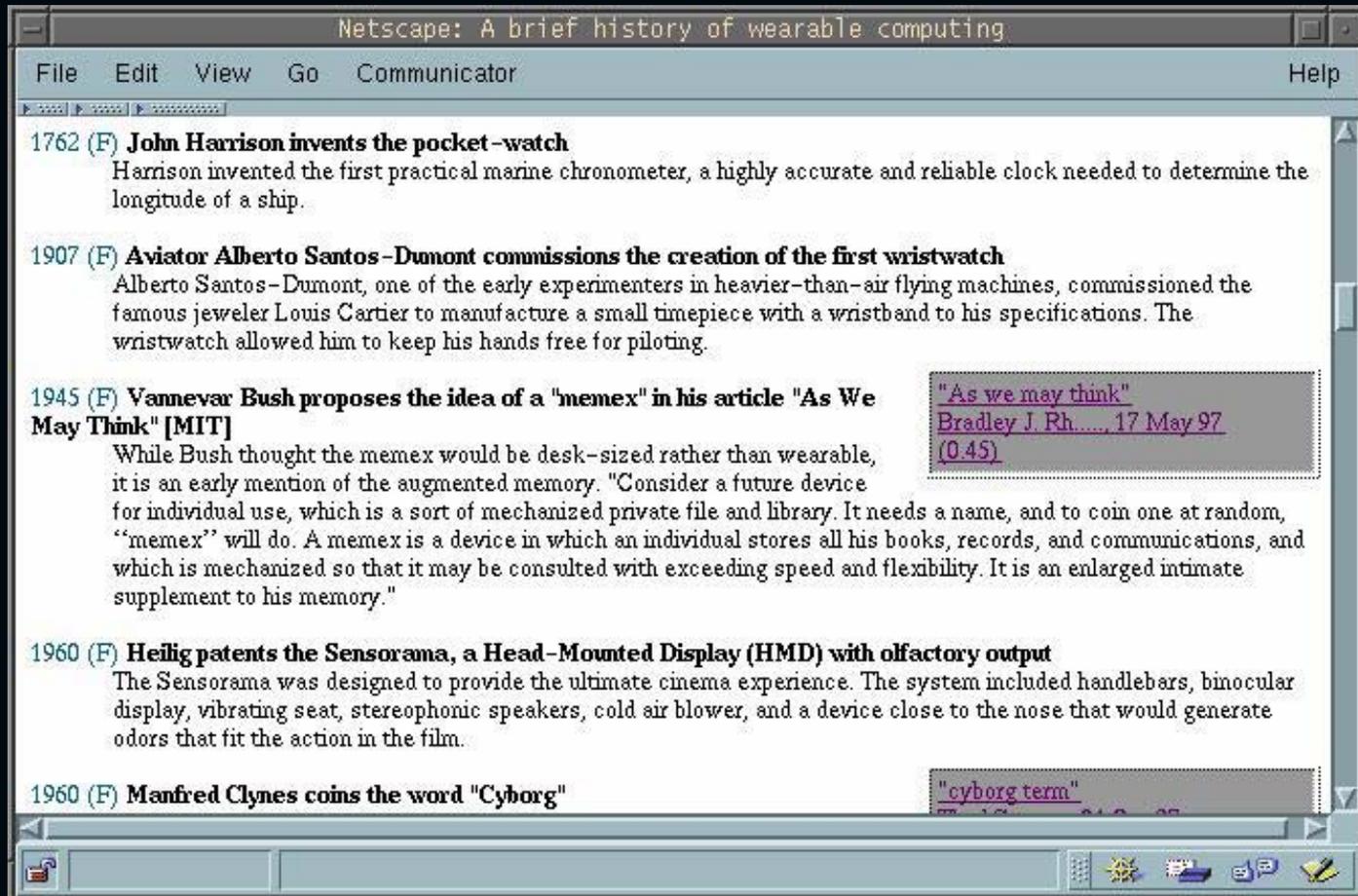
Remembrance agent (Emacs version, Rhodes '99)

```
Emacs 20.0.1 (Text Remembrance Fill)
Buffers File Edit Help

As a user collects a large database of private knowledge, his RA becomes an expert on that knowledge base through constant re-training. A goal of the RA is to allow co-workers to conveniently access the ``public'' portions of this database without interrupting the user. Thus, if a colleague wants to know about augmented reality, he simply sends a message to the user's Remembrance Agent, for example, thad-ra@media.mit.edu. The RA can then return its best guess at an appropriate file. Thus, the user is never bothered by the query, never has to format his knowledge (i.e. some mark-up language), and the colleague feels free to use the resource as opposed to knocking on an office door. Knowledge transfer may occur in a similar fashion. When an engineer trains his replacement, he can also transfer his RA database of knowledge on the subject so that his replacement may continually get the benefit of his experience even after he has left. Finally, if a large collective of people use Remembrance Agents, queries can be sent to communities, not just individuals. This allows questions of the form ``How do I reboot a Sun workstation?''

--*-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)



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 Δ price stocks
 - has certain site changed?
 - need more milk?
 - is there fresh coffee?
 - ...

Automation behavior patterns (Kozierok, 90)

The screenshot shows a classic Mac OS-style window titled "Calendar Planner". The menu bar at the top includes "File", "Edit", "Eval", "Tools", and "Windows". The application interface features three main buttons at the top: "Schedule a Meeting", "Add Outside Appointment", and "Cancel or Change Meetings". Below these are two rows of day and date buttons: "DAYS" (SUN, MON, TUES, WEDNES, THURS, FRI, SAT) and "DATES" (SEPT. 27, SEPT. 28, SEPT. 29, SEPT. 30, OCT. 1, OCT. 2, OCT. 3). The main area is a grid with time slots from 8:00 to 15:00. Several appointments are visible, each represented by a blue-bordered box with a course number: "6.858J" (Sept 28-30), "6.821R" (Oct 2), and "6.821" (Sept 29-30). At the bottom of the grid are navigation arrows and buttons for "Update", "Thresholds", "Rules", "Reports", "Messages", and "DONE". To the right of the calendar is a vertical panel containing a blue square icon with a white face and the word "ALERT" below it.

Time	SEPT. 27	SEPT. 28	SEPT. 29	SEPT. 30	OCT. 1	OCT. 2	OCT. 3
8:00							
9:00							
10:00		6.858J		6.858J			
11:00						6.821R	
12:00							
13:00			6.821		6.821		
14:00							
15:00							

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?

6.858J

6.82

eye doctor

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)

HOMR
The program formerly known as RINGO

HOMR Recommendation

In making your recommendations, I consulted 200 other users. I considered 1223 artists.

You may like to check out:

Artist	Predicted Rating	Confidence	# Ratings
Indigo Girls	6.0594	Medium	36
Thompson, Richard	6.0186	Medium	14
Lovett, Lyle	5.9379	Medium	16
Bach, JS	5.9188	Medium	11
Shocked, Michelle	5.8358	Medium	11

...And you might want to avoid:

Cinderella	1.0000	Low	13
Poison	1.0861	Low	12
Vanilla Ice	1.1316	Medium	52
The 2 Live Crew	1.2320	Low	13
Marky Mark And The Funky Bunch	1.2890	Medium	24

To rate these artists, click [here](#).

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

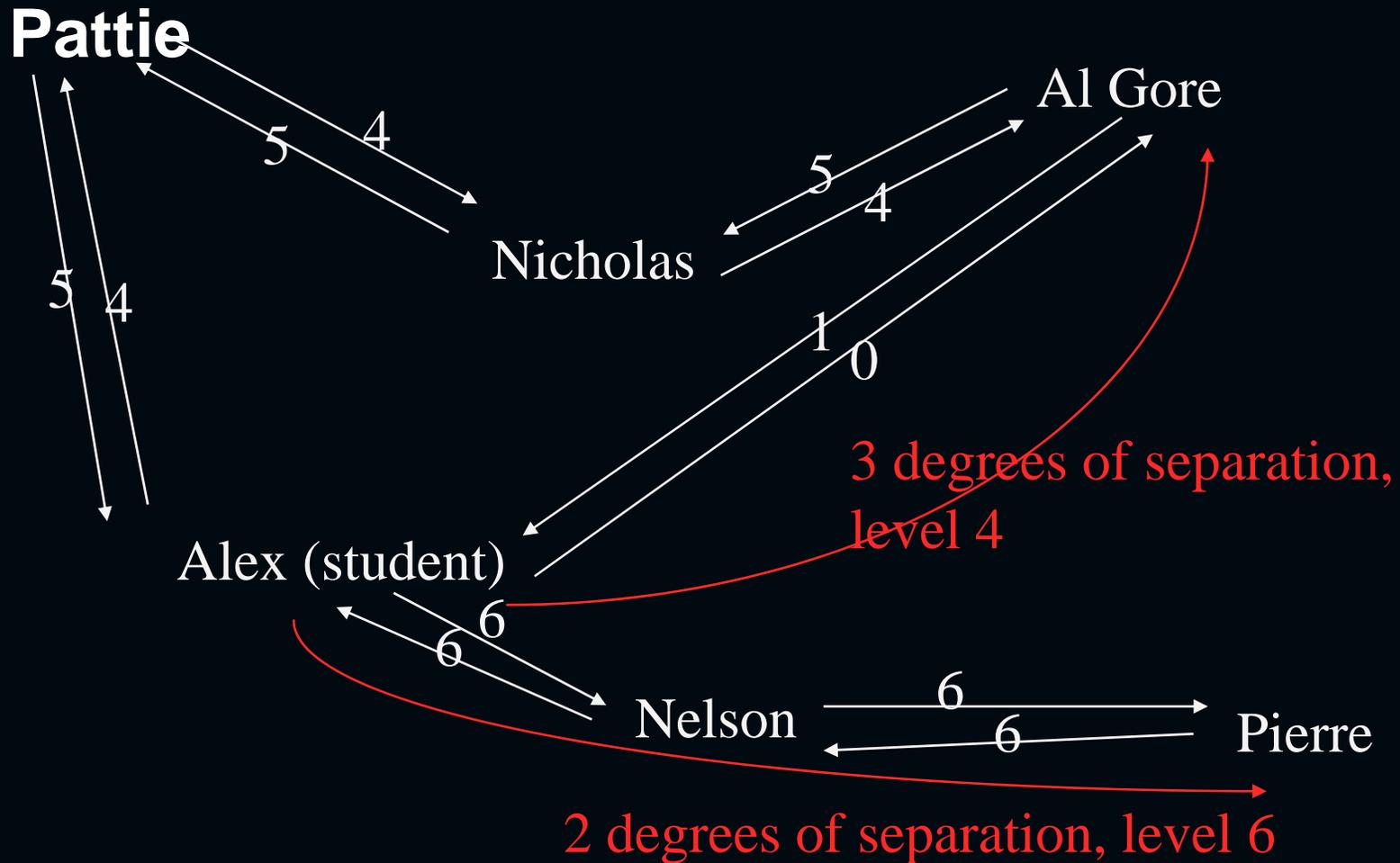
Open a commlink

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	I am a SkrodeRider. (3 signatories) My Skrode is of the traditional design. (no signatories!)
Who initiated	We did

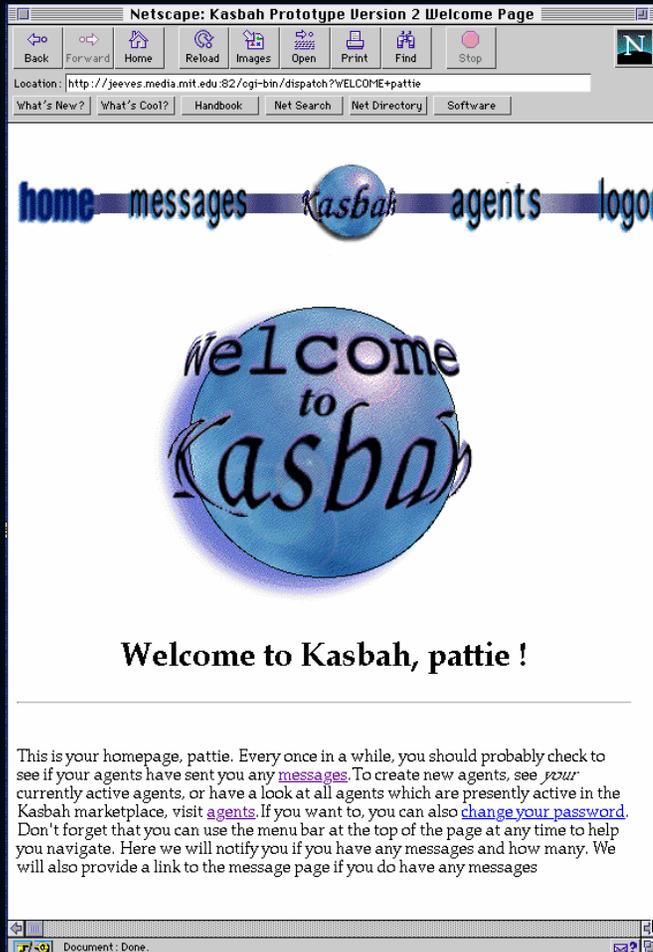
Cluster contents	Cluster number	Top words	Number of documents	Visibility		
				ignore	careful	carefree
	3	one-time-pad, shipping, contract	24	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Submit Preferences

Friend of Friend Finder (Maes & Minar, 98)



Transactions: Kasbah (Chavez, 97)



Kasbah example selling agent

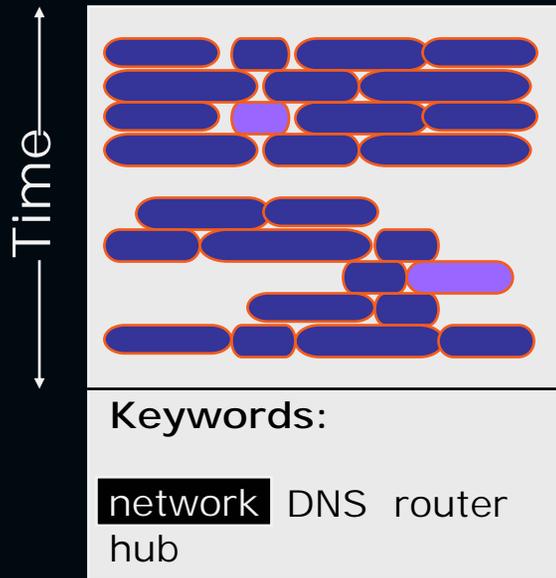
■ Sell: **Macintosh Ilci**

- 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

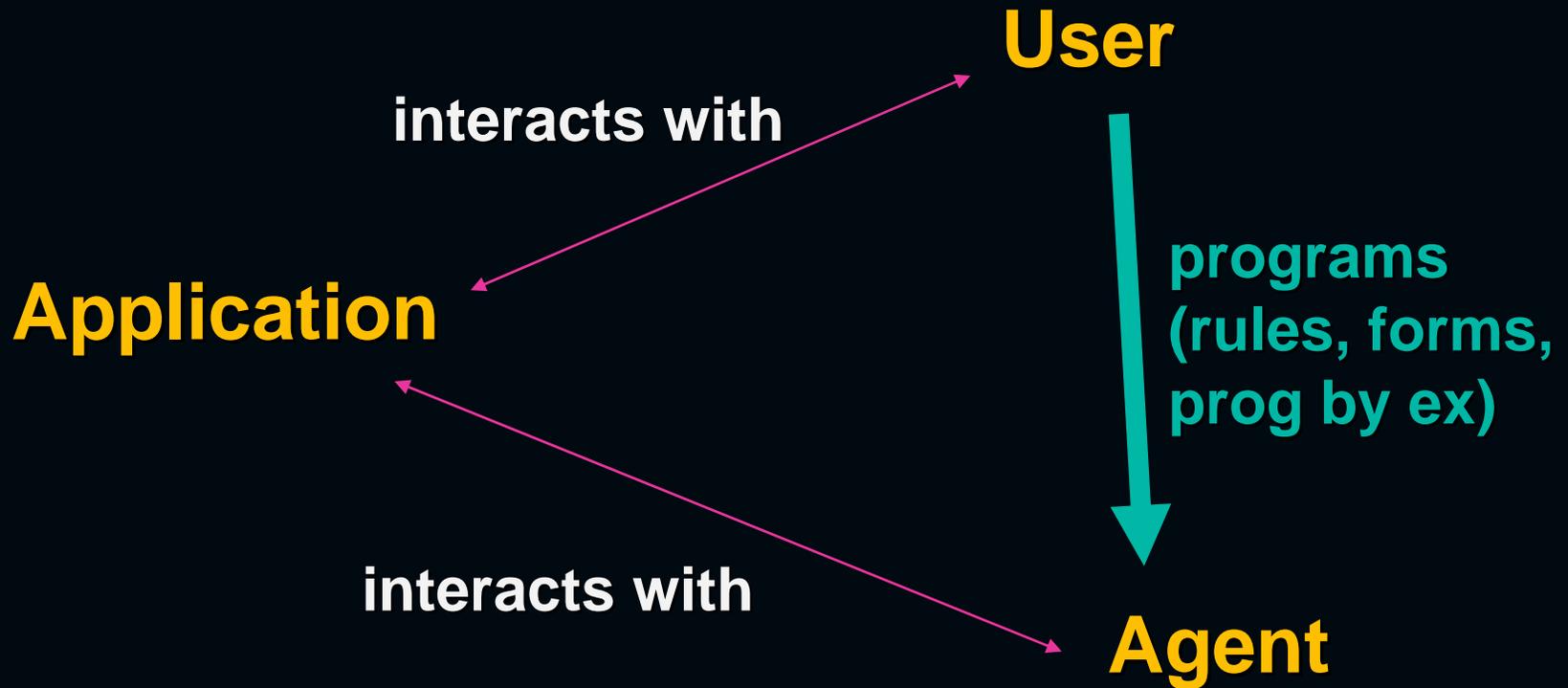
Software that is:

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

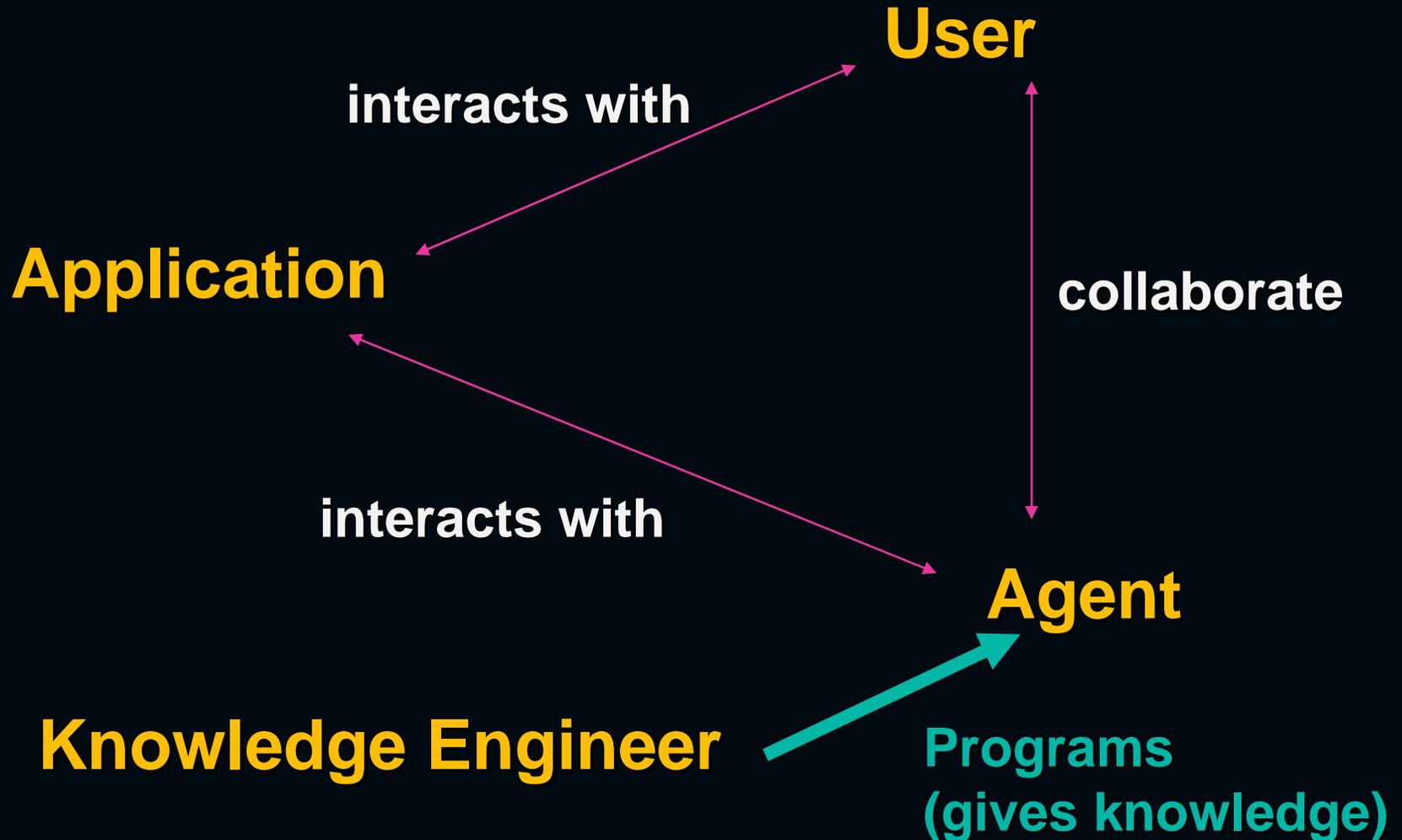
How are agents programmed?

- **user-instructed**
- **knowledge-engineered**
- **learned**

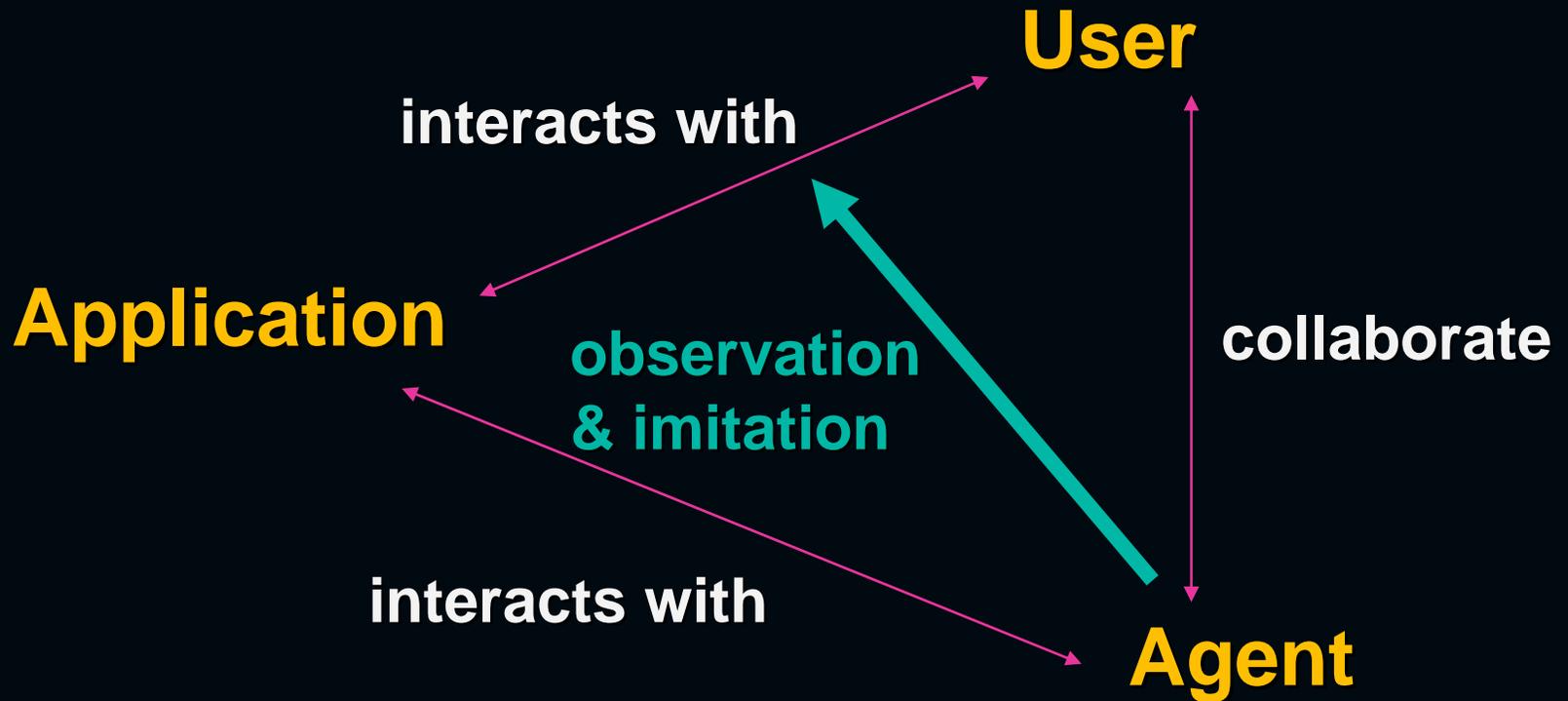
User-Instructed Agents



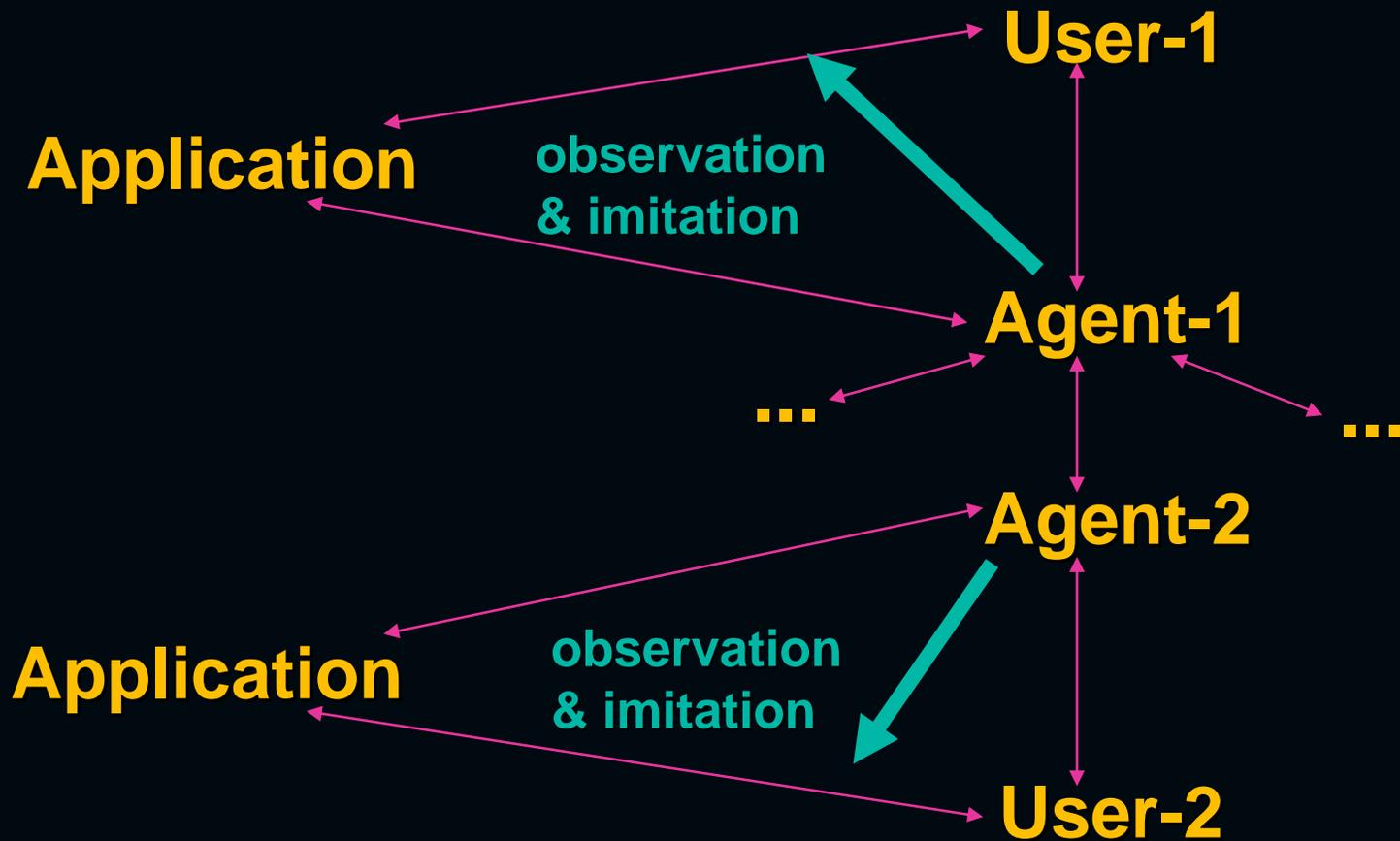
Knowledge-Engineered Agents



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 etal **Francis**
 - UCSD ActiveCampus **Francis**
 - ...

Next week: Context-Aware Systems

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