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
- ...

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)

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*
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.”

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"
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)
INVITATION request from CALVIN

Meeting Details

Date: MONDAY, 10/19/1992
Time: 13:00 – 14:30
Length: 1 hour 30 minutes
Frequency: ONCE

Participants:

CALVIN
HOBBES
ROBYN

Description:

Discuss calendar scheduling agent

Please Choose One:

accept
decline
request-renegotiation

Done & Chosen
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 Recommendation**

In making your recommendations, I consulted 206 other users. I considered 1223 artists.

**You may like to check out:**

<table>
<thead>
<tr>
<th>Artist</th>
<th>Predicted Rating</th>
<th>Confidence</th>
<th># Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaline Girls</td>
<td>6.8594</td>
<td>Medium</td>
<td>36</td>
</tr>
<tr>
<td>Thompson, Rich</td>
<td>6.9066</td>
<td>Medium</td>
<td>14</td>
</tr>
<tr>
<td>Lovett, Iyle</td>
<td>5.9379</td>
<td>Medium</td>
<td>16</td>
</tr>
<tr>
<td>Bach, If</td>
<td>5.9100</td>
<td>Medium</td>
<td>11</td>
</tr>
<tr>
<td>Shocked, Michelle</td>
<td>5.8358</td>
<td>Medium</td>
<td>11</td>
</tr>
</tbody>
</table>

**...And you might want to avoid:**

<table>
<thead>
<tr>
<th>Artist</th>
<th>Predicted Rating</th>
<th>Confidence</th>
<th># Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cinderella</td>
<td>1.0600</td>
<td>Low</td>
<td>13</td>
</tr>
<tr>
<td>Poison</td>
<td>1.0861</td>
<td>Low</td>
<td>12</td>
</tr>
<tr>
<td>Vanilla Ice</td>
<td>1.1316</td>
<td>Medium</td>
<td>53</td>
</tr>
<tr>
<td>The 2 Live Crew</td>
<td>1.2220</td>
<td>Low</td>
<td>13</td>
</tr>
<tr>
<td>Funky Mark And The Funky Bunch</td>
<td>2.890</td>
<td>Medium</td>
<td>24</td>
</tr>
</tbody>
</table>

To rate these artists, click here.
Footprints: Finding popular paths on a website (Wexelblat, 99)
### Current cluster memberships

<table>
<thead>
<tr>
<th>Cluster number</th>
<th>Top words</th>
<th>Number of documents</th>
<th>Visibility</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ignore</td>
<td>careful</td>
</tr>
<tr>
<td>2</td>
<td>agent, paper, conference, author</td>
<td>11</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>3</td>
<td>one-time-pad, shipping, contract</td>
<td>24</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
I've got someone you might want to meet!

Introduction:

**ID**: 7A 34 56 D1 8C 91 EA 0A 30 DC D3 2A S2 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

<table>
<thead>
<tr>
<th>Cluster contents</th>
<th>Cluster number</th>
<th>Top words</th>
<th>Number of documents</th>
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<tbody>
<tr>
<td></td>
<td>3</td>
<td>one-time-pad, shipping, contract</td>
<td>24</td>
<td>carefree</td>
</tr>
</tbody>
</table>
Friend of Friend Finder (Maes & Minar, 98)

- Pattie
- Nicholas
- Alex (student)
- Al Gore
- Nelson
- Pierre

3 degrees of separation, level 4

2 degrees of separation, level 6
Transactions: Kasbah
(Chavez, 97)

Welcome to Kasbah, pattie!

This is your homepage, pattie. Every once in a while, you should probably check to see if your agents have sent you any messages. To create new agents, see your currently active agents, or have a look at all agents which are presently active in the Kasbah marketplace, visit agents. If you want to, you can also change your password. Don’t forget that you can use the menu bar at the top of the page at any time to help you navigate. Here we will notify you if you have any messages and how many. We will also provide a link to the message page if you do have any messages.

Hi pattie, now you can create your New Selling Agent.

Fill out the form below to create a selling agent that will sell your music for you. Please enter all information as accurately as possible, so that your agent will be able to find matches for you more easily. Remember to click the "Create Agent" button at the bottom of the form when you’ve finished.

Click to clear form: Clear

Description of Music to sell:

I am trying to sell the following: CD

Genre: __________

Title: __________

Artist: __________

Condition: Used but not damaged

Description:

Enter anything which you think might help your agent find matches.
Kasbah example selling agent

- **Sell:** Macintosh IIci
  - 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)

Time collects & reflects user’s habits over time

Keywords:
- network
- DNS
- router
- hub
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

User interacts with Application

Application interacts with Agent

Agent interacts with programs (rules, forms, prog by ex)
Knowledge-Engineered Agents

Application interacts with User

User interacts with Agent

Agent collaborates with User

Knowledge Engineer programs Agent (gives knowledge)
Learning from the User

Application interacts with User

User observes and imitates Agent

Agent collaborates with User
Learning from other Agents

Application

Agent-1

User-1

observation & imitation

Agent-2

User-2

observation & imitation

......
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

- 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)
   - ...