MAS 964: Common Sense Reasoning for Interactive Applications
What is Common Sense?

- Everyday knowledge about the world
- The stuff that’s “too obvious to say”
  - Things fall down, not up
  - A wedding has a bride and a groom
  - If someone yells at you, they’re probably angry
  - If you are hungry, you can go to a restaurant to eat
- ... and the ability to use it easily when appropriate
Facts about Common Sense

There’s a lot of it
How much, nobody knows
You get it by learning and/or experiencing it
It is essential for understanding and acting
Common Sense in Story Understanding

John went to a restaurant.
He sat down.
He waited 45 minutes.
He left in a hurry and slammed the door on his way out.

Why was John angry?
Common sense in the restaurant story

A restaurant is a place you go to eat.

People eat in a restaurant sitting down.

When people go to a restaurant, they expect a waiter to serve them within a few minutes.

People become angry when their expectations are not met.

If you slam a door, it is a way of expressing anger.
Common sense is shared knowledge

Common sense might be shared between

Almost everybody

People in a particular culture only

A human and a computer

In communication, it is what you don’t have to say [or write down] because you expect the other party to know it already
Common sense is not exact

Almost all statements of common sense are “wrong”

There are always exceptions, contingencies

Birds can fly, except: penguins, injured birds, stuffed birds, ...

Maybe John got an important cell phone call

Common sense is about defaults, plausibility, assumptions

Common sense is about broad, but shallow reasoning
A big reason why computers seem so dumb is that they lack common sense.

Common sense is the major bottleneck in making significant progress in Artificial Intelligence.

Minsky, Lenat: We can make progress only by attacking the Common Sense problem directly.

Collecting Common Sense Knowledge

Finding new ways of putting it to use.
Objections to the Common Sense enterprise

There’s way too much of it
  Maybe the “small size of infinity”
It’s too squishy
  Well, so are people
We can’t trust computers to use it
  We should be careful, but we’ve got to take some risks
Why now?

Previous efforts in Common Sense have had only limited success

Now, we have

Several very large common sense knowledge bases

Better ways of using common sense knowledge

Motivation to use it in interactive applications

... so maybe it’s time to give Common Sense another chance
Collecting Common Sense knowledge

The big three:

- CYC, Doug Lenat: ~3 million assertions
- Open Mind, Push Singh: 0.5 million assertions
- Thought Treasure, Eric Mueller: 0.2 million assertions
Today’s computer interfaces lack Common Sense
What could we do if interfaces had Common Sense?

Cell phones should know enough not to ring during a concert

Calendars should warn you if you schedule a business meeting at 2am

Transfer the files I need for this trip to my laptop
What kinds of applications are good candidates for Common Sense?

Conversational applications
  Question answering, Story understanding
    (in general domains)

Software agents
  Proactive, “reconnaissance” agents
    (in interactive applications)
Conversational applications

Show me a picture of someone who's disappointed.

Jen Racine and Gea Johnson, the favorites in the US Women's Olympic Bobsled, were defeated by upstarts Jill Bakken and Vonetta Flowers.
Conversational applications

User is expecting an accurate answer to the question
System has only one chance to answer user’s question
If the system doesn’t get it right, the user will be disappointed
Software agents for interactive applications

Agent cast in the role of giving help or suggestions
Agent continuously running. If it doesn’t get it now, it might later
Agent expected to be helpful once in a while, not always
If agent is not helpful, user continues with their task
Many user interface situations are underconstrained

System could present *any* directory, *any* files
Use common sense to provide context for better UI heuristics

Simple example: Most recently used files
Better: Who is the user? What’re we working on?

System can anticipate what user is most likely to do
System can make most likely thing easiest to do
System can integrate applications, remove UI steps
Aria: Annotation and Retrieval Integration Agent

Aria = Email/Web editor + Photo database + Agent

"Last weekend, I went to Ken and Mary's wedding..."
Aria: Annotation and Retrieval Integration Agent

Agent uses the **context** of the message to infer relevance of photos to text.

Agent automatically **retrieves** relevant photos as message is typed.

Agent automatically **annotates** photos with relevant text from message.

Streamlined interaction: No dialog boxes, file names, cut and paste, load and save, typed queries, multiple applications, etc. etc. etc.
User input fed as query to Open Mind
User input fed as query to Personal Repository
Results used for query expansion in Aria’s retrieval

*Angela, the bride’s sister, helped with decorations*
*The bridesmaid is often the bride’s sister*
*The bride is Meloni. Meloni’s sister is Angela.*
What Open Mind knows about weddings

Search Results for wedding

<table>
<thead>
<tr>
<th>Author</th>
<th>Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vassil</td>
<td>A bride wears a wedding gown</td>
</tr>
<tr>
<td>Vassil</td>
<td>A bride and groom are married in a wedding</td>
</tr>
<tr>
<td>Konoro</td>
<td>You can use a wedding ring to marry</td>
</tr>
<tr>
<td>jncrica</td>
<td>going for a haircut is for a wedding</td>
</tr>
<tr>
<td>sheldon</td>
<td>Things that are often found together are wedding gown, bouquet, bride, veil, groom</td>
</tr>
</tbody>
</table>
Common sense knowledge in Aria - Hugo Liu, Kim Waters

Parsing natural language with WALI
Recognizing expressions:
  Temporal
  Referring to picture
  Who/What/Where/When/Why

Henry Lieberman - MIT Media Lab
I want to find someone online who likes movies

Movies are a type of interest that a person might have.

People might talk about their interests on their homepage

People’s homepages might contain the string “my homepage”

+ ‘movies’

+ ‘my interests’

+ ‘my homepage’
Common Sense vs. Mathematical inference

**Mathematical inference**
- Universally true statements
- Complete reasoning
- Depth-first exploration
- Batch processing
Common Sense vs. Mathematical inference

Common sense inference
  Contingent statements
  Incomplete reasoning
  Breadth-first exploration
  Incremental processing
Common Sense vs. Statistical techniques

Some large-scale, IR, numerical and statistical techniques have achieved success recently.

Will statistical techniques “run out”?  

Not necessarily opposed to knowledge-based approaches.

Could we use these techniques to “mine” Common Sense knowledge?
Common Sense and the Semantic Web

There’s now a movement to make “The Semantic Web” -- turn the Web into the world’s largest knowledge base

Could this be a vehicle for capturing or using Common Sense?

We’ve got to untangle the Semantic Web formalisms

Could this be a way to integrate disparate Common Sense architectures (to solve the software eng. problems of Minsky’s proposals)?