Dialogue and Consciousness

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(with many slides from Oliver Lemon, James Henderson, and Geert-Jan Kruijff)
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Language and Computers
Communication breakdown

- SNL skit: http://www.rjauburn.com/files/SpeechRecoDate.wmv
- Excerpt from Daniel Tammet’s book “Born on a Blue Day”, regarding the difficulties of having conversation when one has Asperger’s.
The Turing Test and Loebner Prize

- **Turing test:** a test for machine intelligence (Alan Turing, “Computing Machinery and Intelligence”, 1950)
  - engage a computer in open domain natural language conversation (through text) with a human judge who then must say whether they were talking to a real person or a computer

- **Loebner Prize:** Turing test competition for chatterbots with a yearly prize ($2000) and a full Turing Test prize ($100,000, not yet awarded).

- **Previous winners of the yearly prize:**
  - 2010: Suzette: seems to use a lot of topic changing
  - 2009: Do-Much-More: moves conversation from specific to general
  - 2007: Ultra HAL Assistant: pattern matching with some sophisticated linguistics and storing of state information
  - 2006: Jabberwacky: uses learning from previous dialogs to respond
Loebner Prize

- 2012: Chip Vivant: another Eliza++
- 2010: Suzette: seems to use a lot of topic changing
- 2009: Do-Much-More: moves conversation from specific to general
- 2008: Elbot [http://www.elbot.com/] (Seems like Eliza++ to me...)
- 2007: Ultra HAL Assistant: pattern matching with some sophisticated linguistics and storing of state information
- 2006: Jabberwacky: uses learning from previous dialogs to respond

- As users talk with Jabberwacky and Cleverbot, they store their utterances and uses them in the future.
- Can “learn” any language if given examples: they choose a “canned” utterance based on some simple probabilities. This is similar to spam/ham identification.
- Uses no deep representations: maps utterances to utterances.
- Interestingly, this is deeply connected to how machine translation works.
Chatbots have uses

- Entertainment: make robots more enjoyable, make characters in videogames more interactive

- Could collect information about people in a friendly way: talking to real people, but guide the conversation toward learning about closed domain of ages, locations, etc (automated knowledge extraction)

- Digital secretary: retrieve information about appointments, web pages, etc.

- Customer service: based on past help center conversations, provide contextually appropriate answers

Clearly, we have a LOOOONG way to go...

The latest in chatbots: going beyond being diversions

- Google, Facebook and many others are creating more sophisticated chatbots.

<table>
<thead>
<tr>
<th>Helpdesk</th>
<th>Waxing philosophical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine: <em>hi</em></td>
<td>Human: <em>what is the purpose of life?</em></td>
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<tr>
<td>Human: <em>hello</em></td>
<td>Machine: <em>to serve the greater good.</em></td>
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<tr>
<td>Machine: <em>could you please let me know what are the operating systems you are using?</em></td>
<td>Human: <em>what is the purpose of living?</em></td>
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<tr>
<td>Human: <em>i am using linux</em></td>
<td>Machine: <em>to live forever.</em></td>
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<tr>
<td>Machine: <em>ok it was in the ssl vpn on which you stated it was broken</em></td>
<td>Human: <em>what is the purpose of existence?</em></td>
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<tr>
<td>Machine: <em>please check if you are logged in to corp network</em></td>
<td>Machine: <em>to find out what happens when we get to the planet earth.</em></td>
</tr>
<tr>
<td>Machine: <em>what is the error that you are running please</em></td>
<td>Human: <em>where are you now?</em></td>
</tr>
<tr>
<td>Human: <em>i am seeing an error related to vpn</em></td>
<td>Machine: <em>i ’m in the middle of nowhere.</em></td>
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<tr>
<td>Machine: <em>what is the error message that you are getting when connecting to vpn using network connect?</em></td>
<td>Human: <em>what is the purpose of dying?</em></td>
</tr>
<tr>
<td>Human: <em>connection refused or something like that</em></td>
<td>Machine: <em>to have a life.</em></td>
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<tr>
<td>Machine: <em>may i know the version of network connect you connect?</em></td>
<td>Human: <em>what is the purpose of being intelligent ?</em></td>
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<td></td>
<td>Machine: <em>to find out what it is.</em></td>
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<tr>
<td></td>
<td>Human: <em>what is the purpose of emotions ?</em></td>
</tr>
<tr>
<td></td>
<td>Machine: <em>i don ’t know.</em></td>
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Markus Dickinson’s dialogue slides
The next set of slides are from a course taught by Oliver Lemon and James Henderson.

Original Edinburgh slides available from Oliver Lemon’s website:

What is a Dialogue System?

- An interface that supports natural language input, responds using natural language, and emulates (some) human conversational skills:
  - Recognising dialogue structures
  - Contextual interpretation
  - Turn taking
  - Managing conversational obligations
  - Response planning
  - ......

See http://www.sigdial.org/

August 2006
Vision for end-users

Natural dialogue communication requires:

- **Content:** users say *what* they want
- **Flexibility:** users say it *the way* they want to, with no need to learn the specific commands a device or service “expects”
- **Adaptivity:** system *adapts* to preferences, knowledge, and ability of user, and to context
- **Learning:** systems use dialogue strategies learned from experience, and *continue* to learn from interactions with users

» Automatic optimisation

August 2006
Task Complexity

Application dependent

Call Routing
- Weather Information
- Ordering Pizza
- Automatic Banking
- ATIS
- Travel Planning, Robot control
- Training/Tutorial dialogue
- E-companion

Simple

Complex

Directly affects:
- Dialogue complexity
- Types and quantity of system knowledge
- Complexity of system’s reasoning abilities

August 2006
Spoken Dialogue Systems

- TTS (Text-to-Speech Synthesis)
- ASR (Automatic Speech Recognition)
- SLG (Spoken Language Generation)
- SLU (Spoken Language Understanding)
- DM (Dialogue Management)

August 2006
WITAS demo: http://www-csli.stanford.edu/semlab-hold/witas/
More recently...

Ford and Microsoft: SYNC for in-car entertainment

- hands-free calling
- voice control of MP3 player
  - “play artist Rolling Stones”, “play track ‘Sour Times’
- text-to-speech: reads incoming text messages
- English, Spanish, and Canadian French
<p>| | |</p>
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| **000** | **S**: Hello. Welcome to the Carnegie Mellon Communicator. Are you a registered user?  
**U**: "HI THIS IS ALEX RUDNICKY I'D LIKE TO FLY TO CHARLESTON PLEASE" |
| **001** | **S**: Hello, dr Rudnicky, i'm glad to hear from you again. You can ask me for help at any time. You can fly to charleston in south carolina or charleston in west virginia.  
**U**: "SOUTH CAROLINA" |
| **002** | **S**: a flight to charleston. departing pittsburgh on what day  
**U**: "ON THE FIFTEENTH " |
| **003** | **S(1)**: I'm sorry. I must have misheard the date.. a flight on Tuesday, February fifteenth. okay what day would you be traveling?  
**U**: "ON MARCH FIFTEENTH" |
| **004** | **S(1)**: traveling on Wednesday, March fifteenth.  
**S(2)**: One Moment Please.... Let's see .... ..... flights from pittsburgh to charleston .... .... ..... if you'll just hold on, this shouldn't take too long .... .... .... Gosh, the network has been slow all day .... .... I'm glad you called, though .... .... .... I'm not sure how long this will take .... .... This has been a long day, but I'm glad you called .... .... hummmmm... this is taking longer than usual .... .... i wonder if something is wrong .... .... i'll bet the network is down again!  
**S(3)**: i have a nonstop on US Airways departing Pittsburgh at eleven thirty five a.m., arrives Charleston at one thirty five p.m.  
**U**: "HOW 'BOUT SOMETHING LATER" |
| **005** | **S**: the flight after that departs Pittsburgh at two ten p.m. arriving in Charleston at four ten p.m. Is that OK?  
**U**: "OKAY THAT'S FINE" |
Embodied agents

- Telephone based dialog systems connect the user to a database of information.
- The WITAS demo included a visual map that was being discussed, but the agent was still disembodied.
- Opportunities and challenges arise when we put a face and/or body to the voice!
An interlude...

Dialog systems with robots: slides from CoSy project by Geert-Jan Kruijff
What is the problem? Why?

- We’d like to be able to talk with robots
  - ... it is a natural way of interacting with social agents
  - ... it is an intuitive means of coordination & control, even in teams

- Unfortunately, robots don’t always see the world like we do
  - To have a meaningful conversation with a robot, it needs to understand
  - But understanding goes well beyond linguistic understanding!
  - We talk about the world, and doing things there
  - The big issue is thus, how we can relate what we say, to an understanding of what we can do where, and why, and how; i.e. to situated understanding
How robots tend to see reality

Understanding spatial organization

- Observing
- Learning
- Recognizing
- But what does it really recognize?

Sequences of affordances
- For pouring
- For holding
- For storing

Generalization?

Robots see things differently

Sensors give data points

How to interpret data points?

Between human and robot

Human understanding is qualitative, vague

Understanding "what it is" as "what can I do?"

Grounded in experience, perspective

This is a gap we need to bridge!
A simple robot

- Legos! (Who said we can’t play. Serious)
  - Fixed dialogue sequence(s): FSAs model dialogue
  - Limited domain speech recognition
  - Very limited sensor input

http://www.coli.uni-saarland.de/courses/lego-04/page.php?id=barkeeper
“Slightly” more complex ‘bots
What does he know?
Sure he knows ...
Spoken language analysis

Dialogue context meaning

structural dialogue analysis
[ SDRT+paradigmatic choice ]

Linguistic meaning

natural language grammar analysis
[ OpenCCG ]

String

(String) speech recognition
[ Sphinx4, Nuance ]

Audio signal

(@d0:dvp(body ^
  <AType>informative.attribute.endurant.perspective.spatial ^
  <TurnT>continuous ^
  <Mood>ind ^
  <ContentBody>(b3:state ^ be ^
    <Mood>ind ^
    <Restr>(w3:person ^ we) ^
    <Scope>(....)))))

@b1:state(be ^
  <Mood>ind ^
  <Restr>(w1:person ^ we) ^
  <Scope>(i1:region ^ in ^
    <Plane>horizontal ^
    <Positioning>static ^
    <Dir:Anchor>(o1:location ^ office ^
      <Delimitation>unique ^
      <Quantification>specific_singular))))

“We are in the office”
There are still a few issues ...

- How do we link language to “reality”?  

  - What different aspects of “reality” do we link to?  

  - What is in a link? (coordination; cross-modal association; hierarchical processing)  

  - What does a link affect? (expectations, attention; spatiotemporal interpretability)  

- What can we learn from all this?  

  - Understanding language means more than understanding language  

  - What does that mean for how language reflects reality, and affects our perception, understanding of reality?  

  - What does that mean for how language is learnt?  

- What does human-robot interaction look like?
Robots are situated expert dialog systems

- These robots are expert systems designed to work with a particular domain.

- Unlike an expert system that works entirely in the computer (e.g. interfacing to a database), robots must ground their conceptual representations to real objects: (some portion of) the real world is the database.

  - Expressions like “the door” must be mapped to specific door (e.g. DOOR_42) that is an object with certain boundaries at a certain location in the robot’s map.

- Dialog systems for robots thus must ground their concepts in reality and also know how linguistic expressions refer to those concepts.
Understanding is more than this...

- It is important to map linguistic expressions (like words) to a formal representation, but this is not understanding.

- We need to connect those representations to things in our domain (as on the previous slide), and furthermore be able to connect them with our current understanding.

- A famous system from the 70’s called SHRDLU provides an excellent view into this.
SHRDLU

- Dialog system for interacting with a blocks world
- Circumscribed domain: easy to encode its current state
  - red, blue, and green things
  - pyramids and cubes
  - relative position of objects
SHRDLU: example conversation

Person: PICK UP A BIG RED BLOCK.
Computer: OK. (does it)
Person: GRASP THE PYRAMID.
Computer: I DON'T UNDERSTAND WHICH PYRAMID YOU MEAN.
Person: FIND A BLOCK WHICH IS TALLER THAN THE ONE YOU ARE HOLDING AND PUT IT INTO THE BOX.
Computer: BY "IT", I ASSUME YOU MEAN THE BLOCK WHICH IS TALLER THAN THE ONE I AM HOLDING.
Computer: OK. (does it)
Person: WHAT DOES THE BOX CONTAIN?
Computer: THE BLUE PYRAMID AND THE BLUE BLOCK.
Person: WHAT IS THE PYRAMID SUPPORTED BY?
Computer: THE BOX.
Person: HOW MANY BLOCKS ARE NOT IN THE BOX?
Computer: FOUR OF THEM.
Person: IS AT LEAST ONE OF THEM NARROWER THAN THE ONE WHICH I TOLD YOU TO PICK UP?
Computer: YES, THE RED CUBE.
Person: IS IT SUPPORTED?
Computer: YES, BY THE TABLE.
Person: CAN THE TABLE PICK UP BLOCKS?
Computer: NO.
Person: CAN A PYRAMID BE SUPPORTED BY A BLOCK?
Computer: YES.
Person: CAN A PYRAMID SUPPORT A PYRAMID?
Computer: I DON'T KNOW.
Person: STACK UP TWO PYRAMIDS.
Computer: I CAN'T.
Person: WILL YOU PLEASE STACK UP BOTH OF THE RED BLOCKS AND EITHER A GREEN CUBE OR A PYRAMID?
Computer: OK. (does it)
Person: WHICH CUBE IS SITTING ON THE TABLE?
Computer: THE LARGE GREEN ONE WHICH SUPPORTS THE RED PYRAMID.
Person: IS THERE A LARGE BLOCK BEHIND A PYRAMID?
Computer: YES, THREE OF THEM: A LARGE RED ONE, A LARGE GREEN CUBE, AND THE BLUE ONE.
SHRDLU: example (cont’d)

Ambiguity of meaning

Person: HOW MANY THINGS ARE ON TOP OF GREEN CUBES?
Computer: I'M NOT SURE WHAT YOU MEAN BY "ON TOP OF "IN THE PHRASE "ON TOP OF GREEN CUBES ".
DO YOU MEAN:
1 - DIRECTLY ON THE SURFACE
2 - ANWHERE ON TOP OF ?

Elided response

Person: 2
Computer: THREE OF THEM.

Temporal understanding

Person: HAD YOU TOUCHED ANY PYRAMID BEFORE YOU PUT THE GREEN ONE ON THE LITTLE CUBE?
Computer: YES, THE GREEN ONE.
Person: WHEN DID YOU PICK IT UP?
Computer: WHILE I WAS STACKING UP THE RED CUBE, A LARGE RED BLOCK AND A LARGE GREEN CUBE.
Person: WHY?
Computer: TO GET RID OF IT.

Explanation: why

Person: WHY DID YOU DO THAT?
Computer: TO CLEAN OFF THE RED CUBE.
Person: WHY DID YOU CLEAR OFF THAT CUBE?
Computer: TO PUT IT ON A LARGE GREEN CUBE.
Person: WHY DID YOU DO THAT?
Computer: TO STACK UP THE RED CUBE, A LARGE RED BLOCK AND A LARGE GREEN CUBE.
Person: WHY DID YOU DO THAT?
Computer: BECAUSE YOU ASKED ME TO.
Person: HOW DID YOU DO IT?
Computer: BY PUTTING A LARGE RED BLOCK ON THE TABLE; THEN LETTING GO OF IT; THEN PUTTING A LARGE GREEN CUBE ON IT; THEN LETTING GO OF THAT CUBE; THEN PUTTING THE RED CUBE ON THAT CUBE; THEN LETTING GO OF THAT CUBE.

Explanation: how
SHRDLU: example (cont’d)

Person: HOW MANY OBJECTS DID YOU TOUCH WHILE YOU WERE DOING IT?
Computer: FOUR OF THEM.
Person: WHAT DID THE RED CUBE SUPPORT BEFORE YOU STARTED TO CLEAN IT OFF?
Computer: THE GREEN PYRAMID.
Person: THERE WERE FIVE BLOCKS TO THE LEFT OF THE BOX THEN.
Computer: NO, ONLY FOUR OF THEM: THE RED CUBE, TWO LARGE GREEN CUBES AND A LARGE RED BLOCK.
Person: PUT THE BLUE PYRAMID ON THE BLOCK IN THE BOX.
Computer: OK. (does it)
Person: IS THERE ANYTHING WHICH IS BIGGER THAN EVERY PYRAMID BUT IS NOT AS WIDE AS THE THING THAT SUPPORTS IT?
Computer: YES, THE BLUE BLOCK.
Person: DOES A STEEPLE
Computer interrupting: SORRY, I DON'T KNOW THE WORD "STEEPLE".
Person: A "STEEPLE" IS A STACK WHICH CONTAINS TWO GREEN CUBES AND A PYRAMID.
Computer: I UNDERSTAND.
Person: ARE THERE ANY STEEPLES NOW?
Computer: NO.
Person: BUILD ONE.
Computer: OK. (does it)
Person: CALL THE BIGGEST BLOCK "SUPERBLOCK"
Computer: OK.
Person: HAVE YOU PICKED SUPERBLOCK UP SINCE WE BEGAN?
Computer: OK.
Person: WHY DID YOU DROP IT?
Computer: BY "IT", I ASSUME YOU MEAN THE SUPERBLOCK. I CAN'T EXPLAIN A NON-EXISTENT EVENT.
Person: IS THERE ANYTHING TO THE RIGHT OF THE RED PYRAMID?
Person: THANK YOU.
Computer: YOU'RE WELCOME!
We have seen a number of shallow methods:

- statistical text classification based on bags of words
- machine translation alignment based on bags of words
- ELIZA, Jabberwacky, and other chatbots

And deep methods:

- SHRDLU
- The CoSy robot
Depth of analysis

- Presumably humans perform a fairly deep analysis. Should we be trying to model how humans process language?

- Deep methods may not reflect how humans do it, but they derive in spirit from it: attempt to represent meaning abstractly, connect it to the world, and reason about it.

- Shallow methods play on strengths of computers: fast pattern matching, accurate counting, access to much larger volumes of data.
What are we building anyway?

- Think about transportation: how to get from point A to point B?
  - Fly: like a bird? like a plane? some other way?
  - Travel virtually

- How we solve the problem depends on the needs
  - information exchange, physical contact

- Also depends on the resources:
  - fuel costs, internet infrastructure
Computational linguistics: deep vs shallow?

- Work until the 80’s was dominated by deep approaches.
- Statistical methods based on shallow analyses became dominant in the 90’s.
- Now deep and shallow methods are coming back together as the statistical methods have become more sophisticated and efficient (along with increase in cheap computing power).
- Almost all work now is on a continuum between shallow and deep, often mixing deep and shallow methods.
- Most are building airplanes, not birds: creating models that do not necessarily bear a direct relationship with how humans process language.
How deep do we go?

- A “deep” syntactic analysis can still be seen as quite shallow: we may translate a sentence into a formal representation, but rarely is that connected to actual things in the world (they are not grounded).
  - So, a meaning representation is just that: a representation -- it doesn’t “mean” anything unless it is connected to a model of the world

- The robots you’ve seen are good examples of depth achieved in a (very) limited domain.
  - They hear a sentence, turn it into a formal representation, connect the symbols to things in the world, and take action
  - But: are they thinking?
Consciousness

- What does it mean to think, or to be intelligent, or be conscious? Is it enough to manipulate symbols and produce the right kind of response and behaviors?

- Somehow, most people feel it isn’t, and that consciousness lies at the heart of the issue.

- This issue is a part of the question of monism versus dualism: are mind and body the same kind of thing or are they different?
  
  - **material monism**: only material things exist; consciousness emerges from material processes and structures
  
  - **dualism**: both material and mental/spiritual realms exist; consciousness is generated from the mental realm
Golems

- The idea of a body without a mind is an old one.
- **Golems** were soulless beings created from inanimate matter (e.g. clay) by men.
  - *golem*: “cocoon”, modern Hebrew, derived from *gelem* “raw material”
- Interestingly, a common feature of golems in stories is that they lacked the ability to speak.
The Chinese Room

- Actually, the robots are “just” doing symbol manipulation -- is that really thinking?

- John Searle argued that these sorts of applications of computational “intelligence” in fact aren’t intelligent at all, using the Chinese Room

  • A man who doesn’t speak Chinese sits in a room and responds to messages in Chinese by using a rule book to transform those into (Chinese) responses.

  • Does the man “know” Chinese? How about the room?
The argument attacks what is termed “strong AI”:

The appropriately programmed computer with the right inputs and outputs would thereby have a mind in exactly the same sense human beings have minds.

Searle’s thought experiment can be pulled apart, attacked, and defended from various angles. He claims that the Chinese room can (in theory) pass the Turing test: Searle argues that it is not conscious of what it is doing and is thus not truly understanding its inputs and outputs.

Much ink has been spilled on this topic: see the summary on Wikipedia for some highlights: http://en.wikipedia.org/wiki/Chinese_room
Responses to the Chinese room

- **Systems reply**: the whole room understands Chinese, including the rulebooks, pencils, etc.

- **Robot reply**: embed the Chinese room in a robot that interacts with the physical world, thus providing it with a causal connection to its inputs and outputs. The man in the room is trapped, manipulating symbols that are meaningless to him, yet they are grounded for the robot via its sensors.

- **Brain simulator reply** (redesigning the room): write a program that simulates the action of every neuron in a Chinese speaker’s brain. (Or replace each neuron of a speaker, one at a time. Does he lose consciousness? If so, at what point?)
Other responses have focused not on suggesting how the Chinese room actually does or could have a mind, but instead on raising doubts about the very nature of the thought experiment and its reliance on our intuition.  

**Speed and complexity:** the room is overly simplistic and could never pass muster because responses would take far too long and would require storage of astronomical proportions.  

**Other minds:** it is hard to tell whether other people are actually thinking! (I.e., the Chinese room “proves” that humans don’t have minds.)  

- Daniel Dennett: natural selection would prefer zombies (people who act just like us, but don’t actually have minds, and are thus simpler)
So, where does that leave us? Somehow, most people seem to have an intuition that there needs to be some sense in which a sentient being is conscious of their thought processes -- that they are not just following a system of rules that were pre-specified, e.g., by some programmer. Is there a ghost in the machine, a homunculus?

**Homunculus:** literally, means “little man” and refers to scale models of human beings in general. In consciousness studies, it refers to the idea that there is a person within a body who is perceiving and interpreting input from the body’s various senses.

Homunculi have an obvious problem: how do they perceive and interpret the input they receive?

An alternative is to consider consciousness as an emergent property of many small and simple, unaware computational units, i.e. neurons.
Emergence and the computational theory of mind

- Radiolab: The Unconscious Toscanini of the Brain:

  - [http://www.wnyc.org/shows/radiolab/episodes/2005/02/18](http://www.wnyc.org/shows/radiolab/episodes/2005/02/18)


Emergence

  
  **Emergence**: An emergent behaviour or emergent property can appear when a number of simple entities (agents) operate in an environment, forming more complex behaviours as a collective.

- Recall the Radiolab discussion of coffee, in which the recognition of coffee by the brain involves many individual, connected neurons firing “smell”, “color”, “taste”.

- Neural networks are one way of simulating such effects, and are used for many practical pattern recognition tasks.
Still, there is a sense in which we “experience” things very directly, *including* our thought processes and how we feel about them. These senses are defined as **qualia**: “the way things seem to us”

David Chalmers: distinguishes “easy” and “hard” problems of consciousness studies:

- The easy problems are those of finding neural mechanisms and explaining cognitive functions: the ability to discriminate and categorize environmental stimuli, the capacity to verbally report mental states... The hard problem is that of *experience*: why does all this processing give rise to an experienced inner life at all?

- Again, this may very well be tackled as an emergent property of brain activity.
Learning versus programming

- Back to talking, possibly thinking machines... What about the question of programming behaviors and whether the machine actually is aware?

- Does it make a difference if we instead set a bunch of initial conditions and then let the robot learn from experience?
  - Think back to rule-based versus statistically-based spam filters? What representations did they use? What interactions did they assume?

- Is thinking meat fundamentally different from thinking machines?
"They're made out of meat."

"Meat?"

"Meat. They're made out of meat."

"Meat?"

"There's no doubt about it. We picked up several from different parts of the planet, took them aboard our recon vessels, and probed them all the way through. They're completely meat."

"That's impossible. What about the radio signals? The messages to the stars?"

"They use the radio waves to talk, but the signals don't come from them. The signals come from machines."

"So who made the machines? That's who we want to contact."

"They made the machines. That's what I'm trying to tell you. Meat made the machines."

"That's ridiculous. How can meat make a machine? You're asking me to believe in sentient meat."

"I'm not asking you, I'm telling you. These creatures are the only sentient race in that sector and they're made out of meat."

"Maybe they're like the orfolei. You know, a carbon-based intelligence that goes through a meat stage."

(continued -- see the web link above)
Are we really so different? http://xkcd.com/876/
What is going on in human heads anyway?

- We are still in the dark on our own mental processes.
  - Were we programmed?
  - Are we actually aware of how we work?
  - Can we ever figure out just how we tick?
  - How objectively do we interpret the real world?

- Colorblind people definitely see things differently. There are more extreme varieties of mental experience, such as synesthesia, a condition in which information and perceptions from different senses overlap, such as associating colors and textures with letters and numbers.
  - Listen in class to excerpt from Daniel Tammet’s *Born on a Blue Day* regarding the perception of numbers for a person with synesthesia.

What if we can do it?

The biologists are already engineering new life. Artificial intelligence is still pretty much unintelligent, in the general sense. But what if we could actually do it?

- What if they don’t play nice? (Terminator, etc.)
- What if they are smarter than us? (Stanislaw Lem, Imaginary Magnitude, Golem XIV)
- What rights would they have? (Bladerunner)
- Would they be moral individuals? (What does that mean?)
- Can we encode ourselves in digital form, and possibly embed our mental experience in other bodies? (Avatar, Surrogates)
Are we just “building stuff”?

- Listen to segment from Radiolab’s “(So-called) Life” episode: genetic engineering making bacteria smell better: http://www.wnyc.org/shows/radiolab/episodes/2008/03/14

- The implications of what is done with science and technology reach far and wide, in all areas of life.