

CS E10
Knowledge Representation

Winter Quarter, 1998

Outline

- Contact information
- Expectations
- Motivation
- Syllabus
- Tools
- Projects
- Your first assignment

Contact Information

- Lectures, other course information posted on class web site
 - Should be up by the end of the day
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 - x1-7699

Expectations

- You want to learn how to represent knowledge
- You aren't afraid of using computer software
 - Even flaky software still under development!
- What is not assumed:
 - Lisp programming skills
 - Deep background in logic

Motivation

- A brief history of knowledge representation
- The coming Golden Age
 - For building amazing software
 - For exploring new territory in Cognitive Science

Prehistory

- Philosophers started it all
- Attempts to formalize argumentation
 - rhetoric
- Thought as calculation
 - Boole's Laws of Thought
 - Leibnitz and others

Early AI enthusiasms

- Logic and theorem proving eagerly adopted
- Computational issues forced consideration of how to package up knowledge, control inference
 - Frame languages
 - Special-purpose KR languages
 - Formalists versus Hackers

Form minus content

- Movement in 1980s: KR = Formal KR
 - Reaction to lack of clear semantics
 - Identification of formality with precision
 - Focus on general logical schemes, not specific domains
- Consequences
 - Common perception of sterility in many areas, e.g. non-monotonic logics
 - Most exciting KR work didn't appear in KR community, e.g., qualitative physics, CYC project, ...

The Dark Years

- Various anti-representation/representation lite trends declare the end of KR
 - Connectionism, Behaviorism, Fuzzy logic, Feature-based representations...
 - All fine things as part of a balanced approach, but look out for those boom and bust cycles!
- As limitations become clearer, expectations become more realistic
- Fads turn into serious research efforts, willing to interact with other approaches

The Representation Resurgence

- “Representation Lite” hits too many walls
 - Web search engines adding more semantics along with statistical techniques
 - Do you want to spend your life looking for cheap wins?
- Dramatic success stories in narrow areas
 - Scheduling: Desert Shield, I2, ...
- Steady scientific progress in AI
 - KR now embracing content again
- Moore’s law is making it all practical
 - Computer graphics now bigger black hole for computational resources than AI

The Coming Golden Age

- Ideas, technologies, and tools now coming together
- Clear perception arising of need for common sense knowledge bases
 - Keeping up with the Web -- NLP rises again!
 - Software that you treat as a collaborator
 - Knowledge management
- The infrastructure is being created today

New territory for Cognitive Science

- Most cognitive theories make assumptions about representation
 - Sometimes explicit, sometimes implicit, often untested
- Most cognitive simulations tested only with small descriptions, generated expressly for that purpose
 - Fine for early testing, but more robust testing would be useful
- Large, off-the-shelf knowledge bases will make new kinds of cognitive simulations possible

Syllabus

- Week 1: Introduction, How logic works
- Week 2: Ontologies and KB structure
- Week 3: No class -- first large exercise instead
- Week 4: Space & Time
- Week 5: Qualitative physics
- Week 6: Analogy and KR
- Rest of the time: In-class representation exercises and brainstorming, plus project work

Tools

- Cyc
 - The HPKB version, provided courtesy CycCorp
 - Includes upper ontology, plus middle-level theories developed during HPKB project
 - Web-based interface, with good tutorial materials
- DTE
 - In-house KR environment
 - Integrates our spatial, qualitative, and analogical reasoning work
 - Still in flux

Grading

- Homework assignments
 - Some traditional, some ad hoc
 - Once projects start, weekly one page progress reports, submitted via email
- In-class participation *essential*
 - You'll learn more bouncing ideas off each other
- Projects
 - Not programming projects nor paper projects
 - Representations, plus argumentation for them

Project ideas

- Projects can be done by individuals or by pairs of people
- Ideally, relevant to your thesis work or some other interest

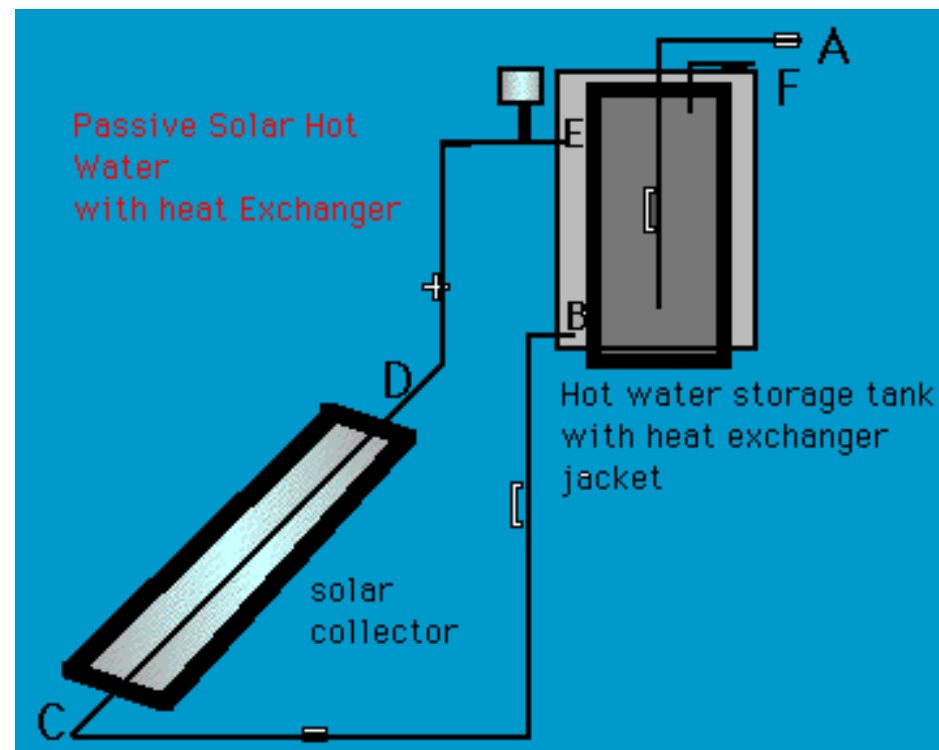
Robot Zoo

- Naïve biophysics
 - Structure and function of the parts of animals
 - Technological analogies



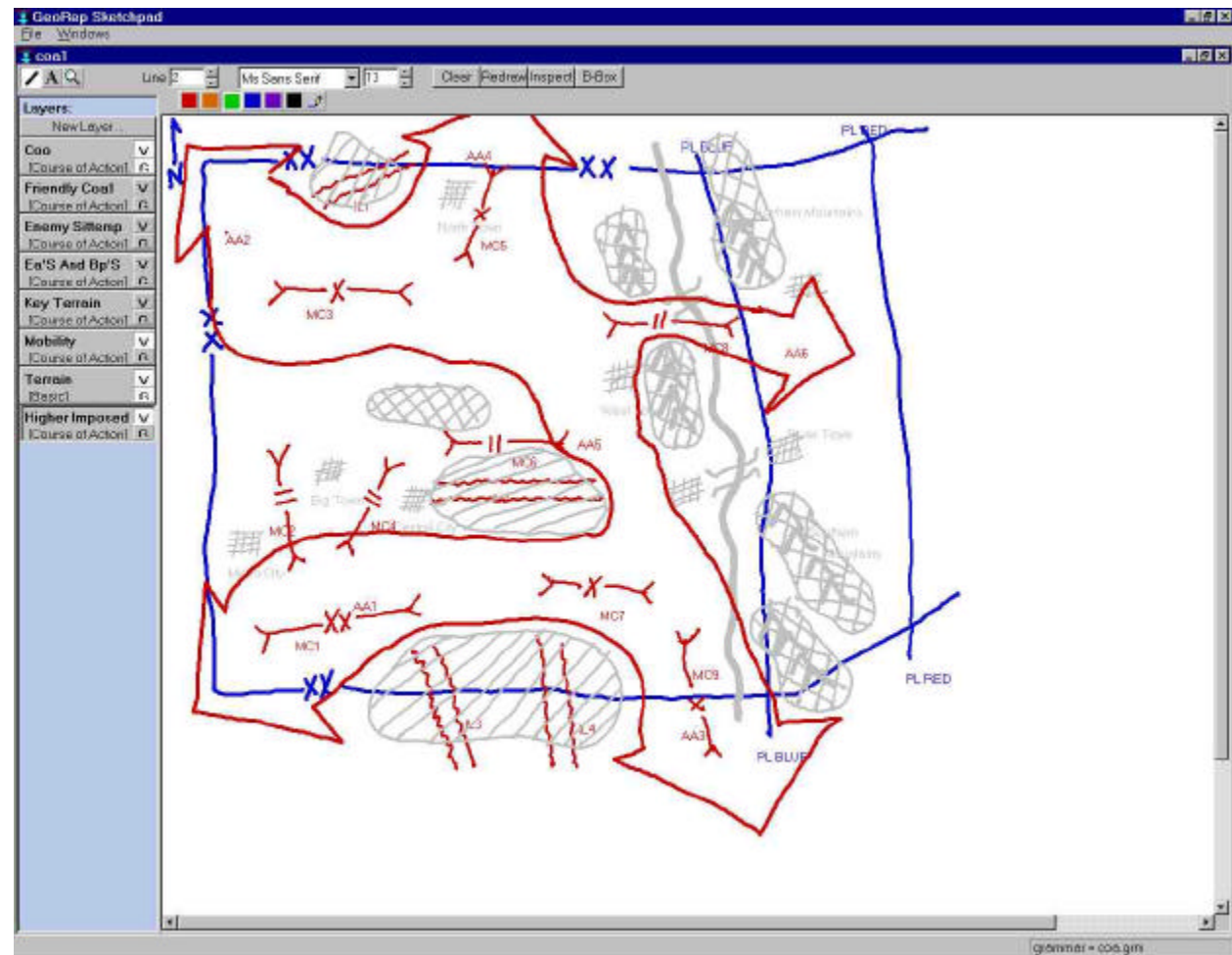
Naïve Thermodynamics

- Concepts needed to understand popular science book on solar energy
 - How houses work
 - What the sun does
 - Different kinds of solar heating



Geographic Reasoning

- Qualitative spatial reasoning about maps
- Battlefield applications
- Development of spatial cognition



International Relations

PQ226 Who/what is <SituationItem> in {<EventSpec1> <ContextSpec1>, <SituationSpec1>} similar to in {<EventSpec2> <ContextSpec2>, <SituationSpec2>}? How so, and how are they different?

(SQ226a) Who is Iraq in the Persian Gulf War similar to in the Y1 Phase II Persian Gulf Scenario? How so, and how are they different?

Answer:

- Iran.
- Like Iraq in the Persian Gulf War case, Iran engages in aggressive actions that spur a crisis and that are threatening to GCC and US interests in the Persian Gulf region.
- The most important difference is that Iran does not invade, occupy, and annex another country, as Iraq did prior to the Persian Gulf War.

Source(s):

- Y1 P2 Scenario.
- Persian Gulf War Historical Case.

Natural Language Semantics

- Connecting qualitative physics to verb semantics
- Connecting spatial/diagrammatic representations to spatial language
- Challenge: Provide a formal semantics for the 850 words of BASIC English
 - Invented as universal language in 1930s
 - 100 Operators, 600 Things (400 general + 200 pictured), 100 Qualities, 50 Opposites
 - Whole books have been written in it

Plausible reasoning about weather

- WHY project:
Effort by Collins & Stevens in 1970s to build intelligent tutor for weather and climate
 - Failed for variety of reasons, including state of KR, NLP, QR, and analogical reasoning
 - We could do much better today...



Your first assignment

- Readings
 - The 2-day tour of Cyc
- Email (due by 5pm Friday)
 - Subject line: E10 HW0
 - Answers to the following questions:
 1. What would you like to get out of this course?
 2. Which of the projects most interest you?
 3. What would you most like to use a common sense knowledge base for?