On The Thresholds of Knowledge

(Lenat & Feigenbaum, 1987)

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What is this?

- Apt in many ways:
  - So much in the paper, so fast
  - Understanding needs much knowledge
  - We share this knowledge

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The Point

"We all know about electricity, but few of us have flown kites in thunderstorms."

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The Knowledge Principle

- Knowledge is Power
- A system exhibits intelligent understanding and action at a high level of competence primarily because of the *specific* knowledge it can bring to bear.

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Questions they Raise (and Answer)

- What is intelligence?
- Intelligence is in the eye of the (uninformed) beholder

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- What is the well-formedness threshold?
- The mininal knowedge needed to formulate a problem

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- What is the competence threshold?
- The minimal knowledge required to solve most problems the reasoner will encounter

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How Does the Value of Added Knowledge Change?

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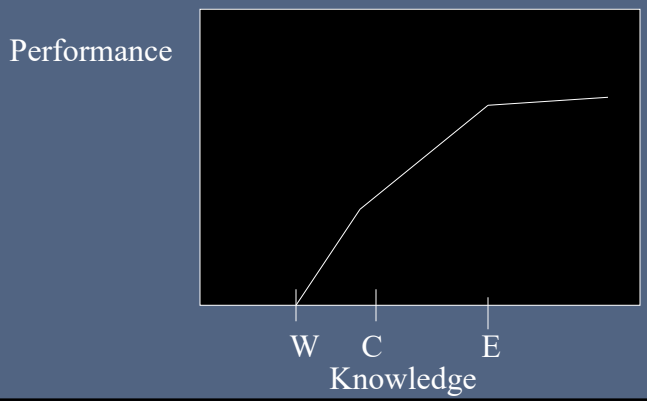
- Difficult tasks succumb nonlinearly to knowledge.



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Some Tenets

- *The Explicit Knowledge Principle:* Much of the knowledge in an intelligent system needs to be represented explicitly (Why?)
- *The Knowledge is all there is hypothesis*: No new control structures are needed
  - "When searching a space of size 1, it is not crucial in what order you expand the nodes"
- *The Breadth Hypothesis*: Intelligent performance often requires falling back on general knowledge or analogizing to specific knowledge from far-flung domains

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Some Tenets (Continued)

- *Knowledge facilitates learning*: If you don't know much, you won't learn quickly
- *The Empirical Inquiry Hypothesis:* AI should embody hypotheses in programs, gather data by running them, and to revise based on surprising behaviors
- *The Difficult Problems Hypothesis:* There are too many ways to solve simple problems. Raising required system level and breadth of competence makes it easier to test and raise its intelligence

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Problems

1. Possible "in principle" limitations
2. How do we get the knowledge?
3. How do we adequately represent it?
4. How will it be used? (Synergy between representation and process)

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5. How can someone interact "naturally" with KB systems?
6. How can you combine several enterers knowledge?
7. How can builder and user not get lost?
8. How big a fraction of the million pieces of consensus reality do you need to represent?

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Breadth is Within Our Grasp

- A KB of under a million frames will provide a significant performance increase
- A sufficient research agenda is
- Slowly hand-code a broad knowledge base
- When enough knowledge is present, system will assimilate from reading, data bases, etc.
- System will then be able to go beyond frontiers of human knowledge by carrying out its own R&D projects

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The Hoped-For Result: Man-Machine Synergy

- In the "second era" of knowledge systems,
  - the system will be a colleague
  - intelligence will emerge from the interaction

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Breakout groups: Applying "AI as Empirical Inquiry" to Unpack Section 8

- We'll split into breakout groups for 15 minutes
- Discuss the following and then write one answer per group to hand in (be sure to include all participant names):
  1. Select one of the problems in Section 8 of the paper
  2. Propose a concrete task context in which to study/assess the claim
  3. Sketch the behavior of a system, or another computational strategy, to address it
  4. How could performance be evaluated?

Submit one writeup per group. Designate one participant to submit on canvas.

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