HUMAN-LEVEL AI IS HARDER THAN IT SEEMED

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• I hoped the 1956 Dartmouth summer workshop w
major progress.

• John von Neumann was busy dying. Anyway he disa
the Newell-Simon work on chess, probably of AI in ge

• If my 1955 hopes had been realized, human-level AI
been achieved before many (most?) of you were born

• Marvin Minsky, Ray Solomonoff, and I made progress
mer. Newell and Simon showed their previous work o
the logic theorist. Lisp was based on IPL+Fortran+a

AI is OK—mostly

• Chess programs catch some of the human chess playi
but rely on the limited effective branching of the chess
The ideas that work for chess are inadequate for go.

• alpha-beta pruning characterizes human play, but it
ticed by early chess programmers—Turing, Shannon,
Ulam, and Bernstein. We humans are not very good a
ing the heuristics we ourselves use. Approximations to
used by Samuel, Newell and Simon, McCarthy. Prov
lent to minimax by Hart and Levine, independently b
Knuth gives details.

• Theorem proving—Newell-Simon, Boyer-Moore, resc
solvers for propositional calculus.

- Logical AI, reduced logical AI in various forms.
- CYC
- RKB?, Semantic web?
- DARPA car race

but it could be better.

OBSTACLES

• One's time estimates are based on the obstacles or

• My 1958 "Programs with common sense" made
(promises?) that no-one has yet fulfilled.

• That paper proposed that theorem proving and probl
programs should reason about their own methods.
unsuccessfully. Unification goes in the wrong directio

• There has been considerable progress in logical A
enough.

BAD IDEAS—alias my prejudices

- Basing machine learning on linear discriminations.

- Basing ontology on hierarchies of unary predicates mantic networks.

- Basing theorem proving on resolution. Getting state clausal form throws away information.

- Entering knowledge without logic (RKF).

- Also: XML (They should have used Lisp lists), Te committee science

EXCUSES

- We aren't smart enough. An Einstein might have d
- They didn't give us enough money. Not the main p
- It was 100 years from Mendel to the genetic code.
- Inadequate idea, e.g. GPS (general problem solver)
- The neural net people aren't there either.
- Too much grabbing for what could be applied in term. The call for this symposium exhibits that fault

COMMITTEE SCIENCE

• "This formula $E = mc^2$ is all very well, Herr Einste don't see it increasing the German GDP in the next 20 years. Develop some applications and then subm proposal."

• "We are forming a committee on theory and appl co-ordinate transformations. We suggest, Herr Ein you contact the chairman of the committee."

• I was treated to a talk this morning that emphasize funders want. That's not the path to scientific prog it wasn't even clear that the funders know what the hope NSF stays out of these committee science cor

concentrates on proposals from individuals. Comput
and especially AI, seems particularly afflicted with
science.

WHITHER?

- Provers that reason about their methods.

- Adapt mathematical logic to express common sens
tinuing problem.

COMMON SENSE IN MATHEMATICAL LOGIC—m

- Example formula (not a whole theory):

$Cblocks : (\forall x\ l\ s)(Clear(x, s) \wedge Clear(l, s) \rightarrow Location(x,$

- Problems:

Non-monotonic reasoning

Contexts

Approximate objects and theories

If the above explanation is perfectly clear, you don't ne
a course in logical AI.

• People who put knowledge into computers need ma
logic, including quantifiers, as much as engineers nee
Alas, logic for freshman isn't developed beyond pr
calculus.