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How does Predicate Invention affect Human Comprehensibility?

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Motivation

- Michie (1988) - definition of **Machine Learning** in terms of predictive accuracy and **Comprehensibility**
- Mitchell (1997) - definition of Machine Learning in terms of **Predictive Accuracy** alone
- ILP and symbolic AI generally need **operational definition** of comprehensibility to distinguish communicable and non-communicable knowledge
- Testability in age of Mechanical Turk

Text comprehension tests

“For many years people believed the cleverest animals after man were chimpanzees. Now, however, there is proof that dolphins may be even cleverer than these big apes.”

Question: Which animals do people think may be the cleverest?

[<http://englishteststore.net>]

Program comprehension tests

$p(X,Y) :- p1(X,Z), p1(Z,Y).$

$p1(X,Y) :- \text{father}(X,Y).$

$p1(X,Y) :- \text{mother}(X,Y).$

$\text{father}(\text{john},\text{mary}). \text{mother}(\text{mary},\text{harry}).$

Question: $p(\text{john},\text{harry})?$

Experimental Variables

- Comprehensibility - proportion of correct answers after inspection of program [C]
- Inspection time [T] - time taken to read program
- Predicate recognition [R] - mean proportion predicates correctly recognised
- Naming time [N] - time to name predicate
- Textual complexity [Sz] - program size

Experimental Hypotheses

H1 $C \propto \frac{1}{T}$ - long inspection time related to incomprehension

H2 $C \propto R$ - comprehension related to recognition of predicate

H3 $C \propto \frac{1}{S_z}$ - long programs hard to understand

H4 $R \propto \frac{1}{N}$ - long naming time related to lack of recognition

Experimental Results - Family Relations

H1	Statistically confirmed
H2	Statistically confirmed
H3	Partially confirmed
H4	Partially confirmed - recursive ancestor exception

Discussion - recognition strategy

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p(X,Y) :- p1(X,U), p1(U,Z), p1(Z,Y). } grandgrand parent
p1(X,Y) :- father(X,Y). } parent }
p1(X,Y) :- mother(X,Y). }
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Tentative finding: Annotation strategy appears to beat tabulation and manual inference.

Conclusions and further work

- First operational definition of comprehensibility
- Confirmation of hypotheses
- Difficulties in understanding ancestor/2 - recursive
- Further work on comprehension of concepts not already known to human participants
- Value of operational definition of comprehension to AI systems development