The Model Inference System

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I he Model Inference System is an interactive Prolog program [1] that infers theories from facts It implements the general model inference algorithm, described in [2], specialized to infer theories in Horn form from atomic tacts

The abstract setting in which the system operates, and from which it derives its name, is the following the system is intially given some first order language L_n I here is some unknown model M f or $L,$ and an oracle (user) that can supply facts and answer queries on the truth or falsity of ground atoms in M I he goal of the system is to find a finite set of true Horn clauses, which imply all true ground atoms and no false ones

I he user inputs the predicate to be inferred and the terms (predicate symbols, function symbols and constants) to be used in the intended axiomatization ol this predicate After receiving the initial input, the system starts prompting the user for new facts At each stage, the system maintains a set of hypotheses that are sufficient to derive all true atoms and none of the false atoms supplied so far

When an inconsistency is discovered between the hypotheses and the tacts, the contradiction backtracing algorithm is invoked In order to resolve this contradiction, the algorithm may query lor the truth of atoms not supplied b\ the user yet When the hypotheses fan not derive some atom known to be true, the system adds to the conjecture refinements of previously refuted hypotheses.

I he user sees the axiomatization as it is developed by the system When he thinks the system has converged to a correct and sufficient axiomatization of the predicate, he can terminate the inference process It is his responsibility to terminate the system, since it is an inherent property of an inductive inference algorithm that M can never determine whet her it has converged

Below are examples ol the performance ol the system Furthcr examples can be found in (2) I he system runs compiled using the in-core compiler of the Edinburgh Prolog-10 version .V I he computer is a DECsystcm-2060. running Prolog-10 under the compatibility package PA 1050 In the following, the running time in CPU seconds measured the time the system took to converge to a correct and sufficient axiomatization of the intended model *Facts arc* the number of facts read therein, and *hypotheses generated* is the number of hypotheses generated by the refinement operator during the inference. I he numbers lollowmg an axiom are its sequential number as it was generated, and the number of refinement operations needed to generate it

Exponentiation: $exp(X,Y,Z) \leftarrow X$ to the Y is Z
2X CPU seconds, 1X facts, 252 hypotheses generated.

(exp(X,0,s(0)) - true), 78, 2
(exp(X,s(Y),Z) - exp(X,Y,W),times(W,X,Z)), 129, 2
(exp(0,s(X),0) - true), 148, 2

Member: $member(X,Y) \leftarrow X$ is a member ol the list Y.
2 CPU seconds, 23 facts, 13 hypotheses generated

(member(X,[Y|Z]) - member(X,Z)), 6, 3
(member(X,[X|Y]) - true), 7, 3

Subset: $subset(X,Y) \leftarrow X$ is a subset of Y.
31 CPU seconds, 82 facts, 152 hypotheses generated

(subset([],X) - true), 1, 1
(subset(X,[Y|X]) - true), 32, 3
(subset(X,[Y|Z]) - subset(X,Z)), 34, 3
(subset([X],[X|Y]) - true), 97, 5
(subset([X|Y],[X|Z]) - subset(Y,Z)), 103, 5
(subset([X|Y],Z) - subset(Y,Z),member(X,Z)), 113, 3

Interchange. $int(X,Y) \leftarrow Y$ is a list of pairs of X, where the order in each pair is interchanged
19 CPU seconds, 21 facts, 110 hypotheses generated

(int([],[]) - true), 6, 1
(int([[X|Y]|Z],[[Y|X]|W]) - int(Z,W),true), 104, 9

Tree isomorphism: $isotree(X,Y) \leftarrow X$ is isomorphic to Y
20 CPU seconds, 110 facts, 117 hypotheses generated

(isotree(X,X) - true), 5, 1
(isotree(t(X,Y),t(Y,X)) - true), 35, 5
(isotree(t(X,Y),t(Y,Z)) - isotree(X,Z)), 38, 5
(isotree(t(X,Y),t(Z,W)) - isotree(Y,Z),isotree(X,W)), 41,
(isotree(t(X,Y),t(Z,X)) - isotree(Y,Z)), 44, 5
(isotree(t(X,Y),t(Z,Y)) - isotree(X,Z)), 103, 5
(isotree(t(X,Y),t(Z,W)) - isotree(Y,W),isotree(X,Z)), 108

References

[1] L Pereira, F Pereira and D Warren
     User's Guide to DECsystem-10 PROLOG
     Technical Report 03 13 5570, Laboratorio Nacional De
        Ingenharia Civil, Lisbon, September, 1978.
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[2] Thud Y Shapiro
     An Algorithm that Infers Theories from Facts.
     IJCAI-81, this volume