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The Effect of Predicate Order on Curriculum Learning in ILP

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Motivation

- FOIL mid-term report [Quinlan, 1993] Sequential predicate learning degrades performance.
- Progol - admissable single-clause search [Srinivasan, 1995] avoids degradation for single-clause search space
- Meta-Interpretive Learning - admissable search avoids degradation in multi-clause search?

Implementation of Meta-Interpreter

```
prove([], Prog, Prog).
prove([Atom|As], Prog1, Prog2) :-
  metarule(Name, MetaSub, (Atom :- Body), Order),
  Order,
  abduce(metasub(Name, MetaSub), Prog1, Prog3),
  prove(Body, Prog3, Prog4),
  prove(As, Prog4, Prog2).
```

Universal Metarules [Cropper+Muggleton, 2015]

Name	Metarule	Order
Inverse	$P(x,y) \leftarrow Q(y,x)$	$P \succ Q$
Chain	$P(x,y) \leftarrow Q(x,z), R(z,y)$	$P \succ Q, P \succ R$
TailRec	$P(x,y) \leftarrow Q(x,z), P(z,y)$	$P \succ Q, x \succ z \succ y$

Metagol Web-interface

Examples

- Grandparent
- Great-Grandparent
- Ancestor

Metagol Web Interface

Metagol is an inductive logic programming (ILP) system based on the meta-interpretive learning framework.
Download on Github. (https://github.com/metagol/metagol)

Predicates to use in background knowledge

Name	Number of arguments

add new

Arguments to use in background knowledge

Name

add new

Edit background knowledge

Predicate	Argument 1	Argument 2

add row

Experimental domain

Materials. Hindi family relationships - 43 family relations, 5000 individuals from US Bureau Census data.

Family relationship	Hindi	English
Father's brother	Taaoo	Uncle
Mother's brother	MaaMaa	Uncle
Brother's sister's son	Beta	Nephew
Sister's sister's son	Bhaanjaa	Nephew
Daughter of mother's brother	Deedee	Cousin

Experimental hypotheses

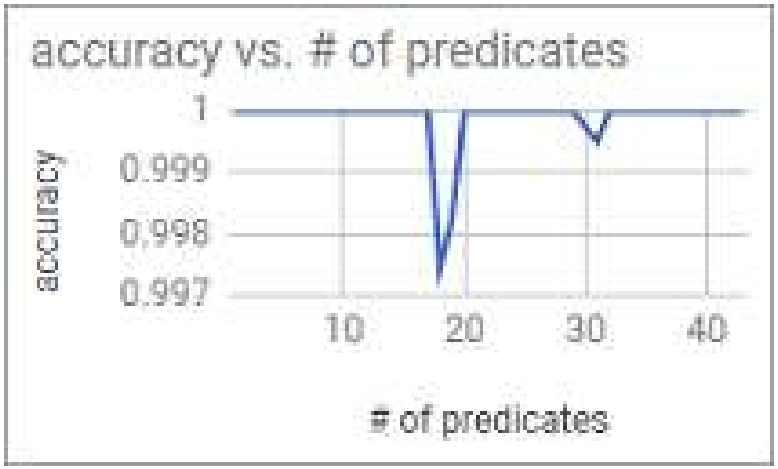
Hypothesis 1. Number of predicate definitions does not decrease Metagol performance.

Experiment 1. 50 trials, 43 predicates in each trial. Training on 1% positives and negatives. Testing on 10% positives and negatives.

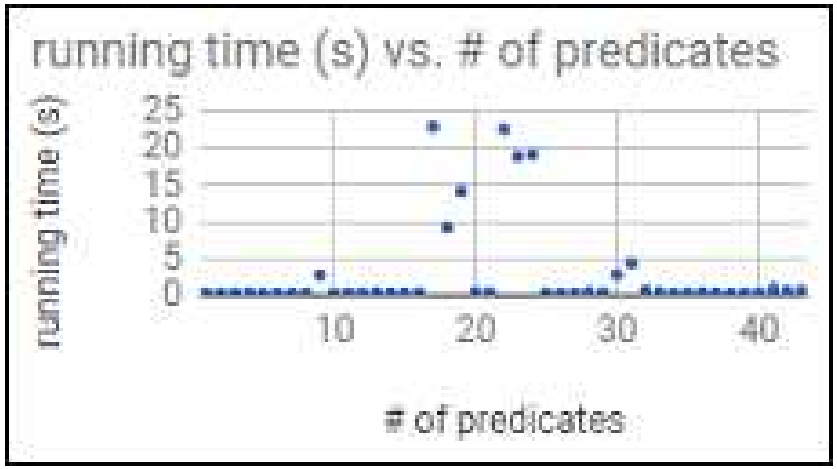
Hypothesis 2. Learning with randomized order lowers predictive accuracy.

Experiment 2. Increasing number of random swaps. 50 trials, 43 predicates. Training on 20% positives and negatives. Testing on remaining 80% positives and negatives.

Experiment 1 - Well-Ordered

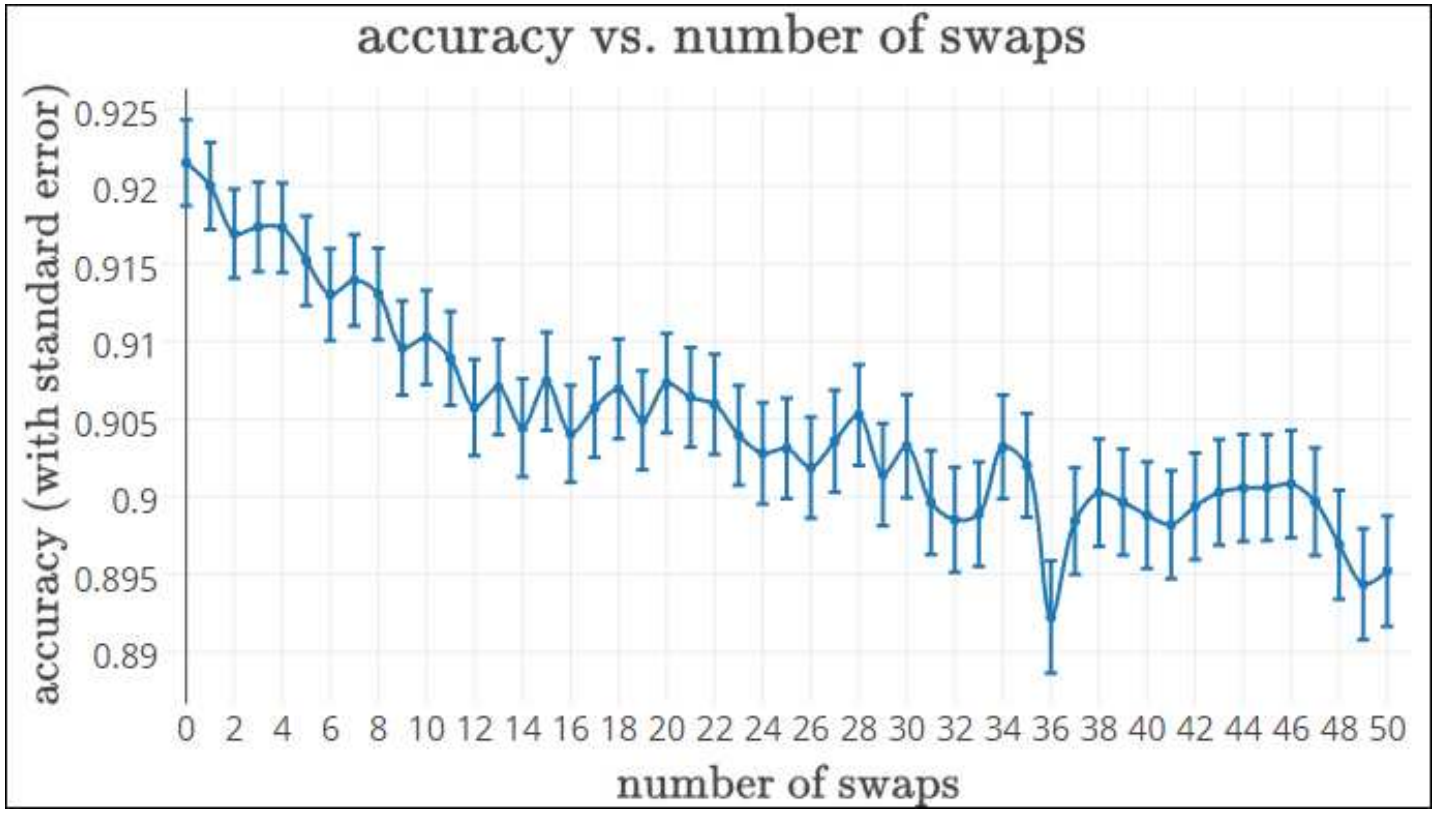


Accuracy



Learning time

Experiment 2 - Permuted



Predictive accuracy

Conclusions and further work

Quinlan and Cameron-Jones - FOIL mid-term report

Good ordering - admissable multi-clause search does not degrade

Random still does degrade search

Further work - dependent discovers reasonable ordering?

Bibliography

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