Learning in a Connectionist Network

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Introduction

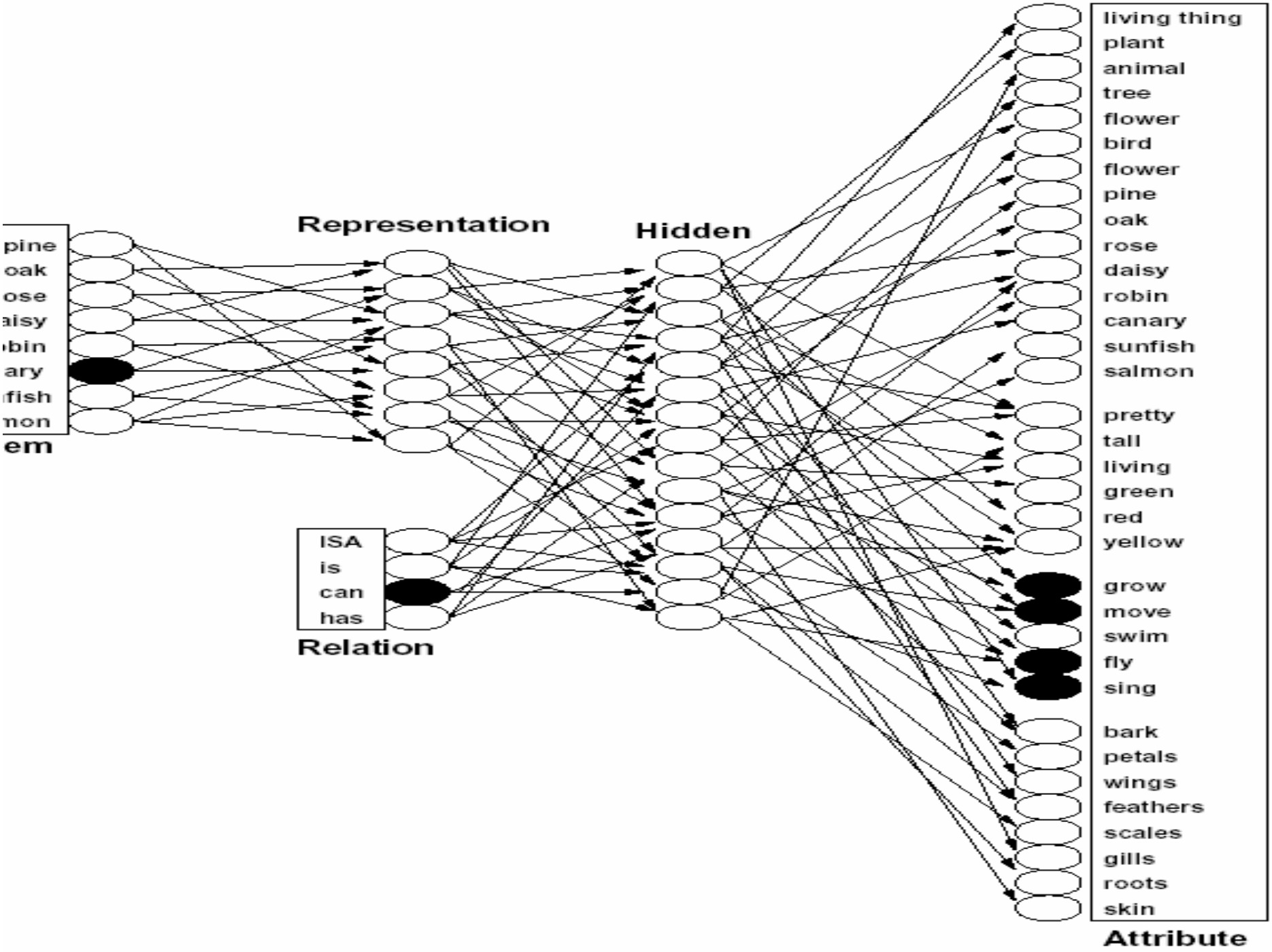
- How can connectionist framework can model child language acquisition?
- How good is the network in generalizing features?
- Is it better in learning an organized data?
- How consistently the system learns if the learning new representation implies modifying existing representation ?

Introduction

- What if it is trained with data sort of like normal human beings are trained with?
  - Positive Examples
  - Negative Examples
  - Don’t Cares

Earlier Work

- Rumelhart Feed-forward network
  - Taxonomic hierarchy could also be captured by distributed representation acquired by backpropagation.
  - The network could perform inferences that can be Quillian's hierarchial propositional network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tall
living
green
red
yellow
grow
move
swim
fly
sing
bark
petals
wings
feathers
scales
gills
roots
skin
Attribute

Network Structure

- Network structure was similar to earlier network
- In order to simulate the new representation modifying the existing representation we tried to make the representation in our model static
- The number of nodes of representation an input can effect was a fixed parameter(1,2,3..n)

Network Structure

- Our network is similar to Rumelhart's network if we add another hidden layer.

  and add a few changes.

- Data set used by us was same as that by Rumelhart

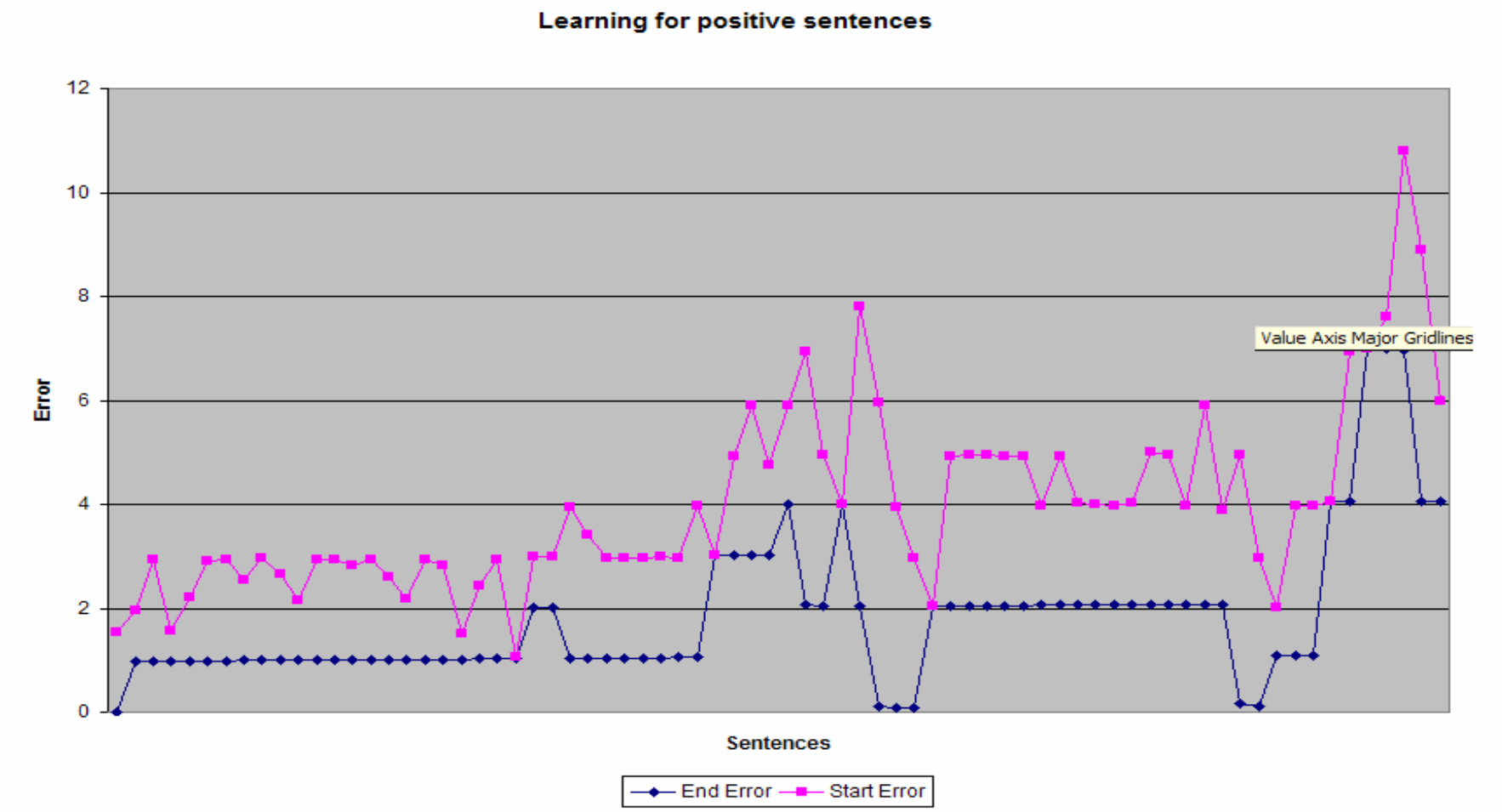
Experiments

- We tried our simulations with following experimental parameters :-
  - Activation function was sigmoid
  - 0.9 the threshold
  - 1 Hidden Layer with 18 nodes
  - Representation of any input activated two nodes.
  - 12 inputs,26 outputs for the neural-network

Experimental Setup

- Learning with random data
- Block learning
- Learning with negative examples

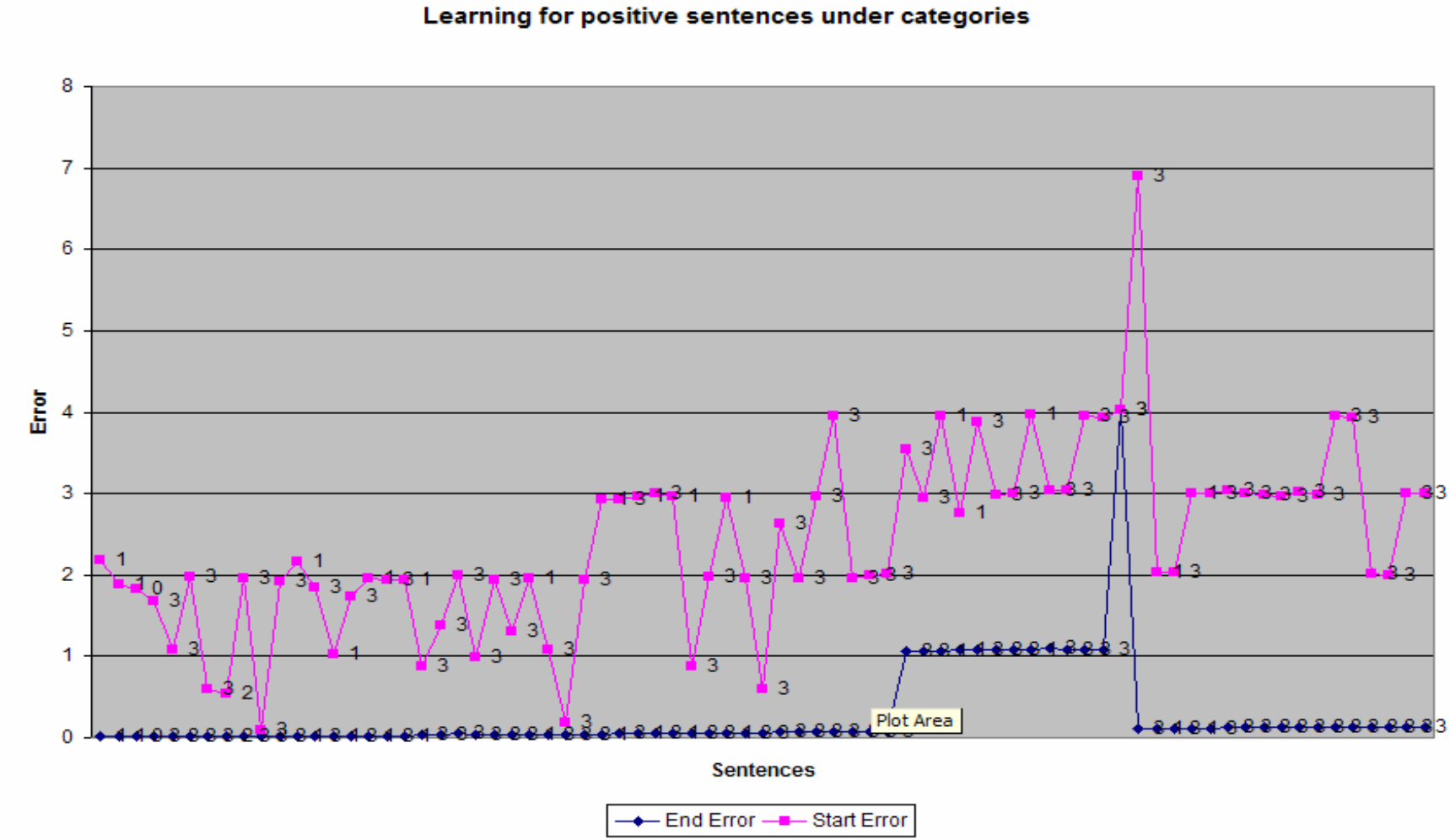
Experimental Results and Observations



Experimental Results and Observations

- Number of iterations required is huge (>50000)
- Error size is increasing with increase in Learning Set Size.
- More and more difficult to learn new concepts and predicates with increasing base knowledge (unusual)
- Start error is the same as end error in certain cases
- Happens when neural net is stuck in a loop

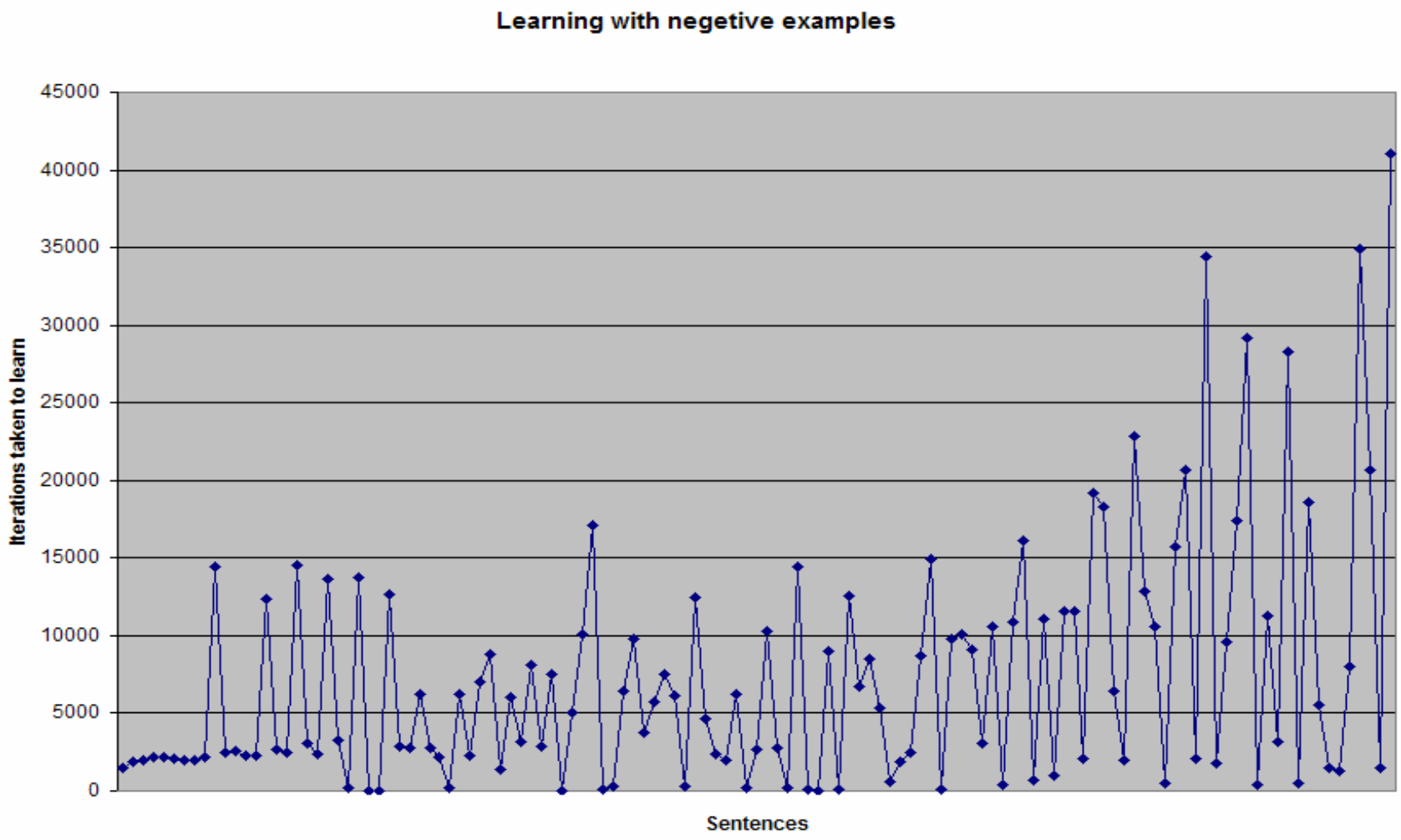
Experimental Results and Observations



Experimental Results and Observations

- The categorization of the sentences in Learning Set does not reveal much
- Simulation failed to distinguish between the categories –
  - Both concept and predicated are used for the first time – 0
  - The concept is new but the predicate is old – 1
  - The predicate is new but the concept is old – 2
  - Both the predicate and concept are old – 3

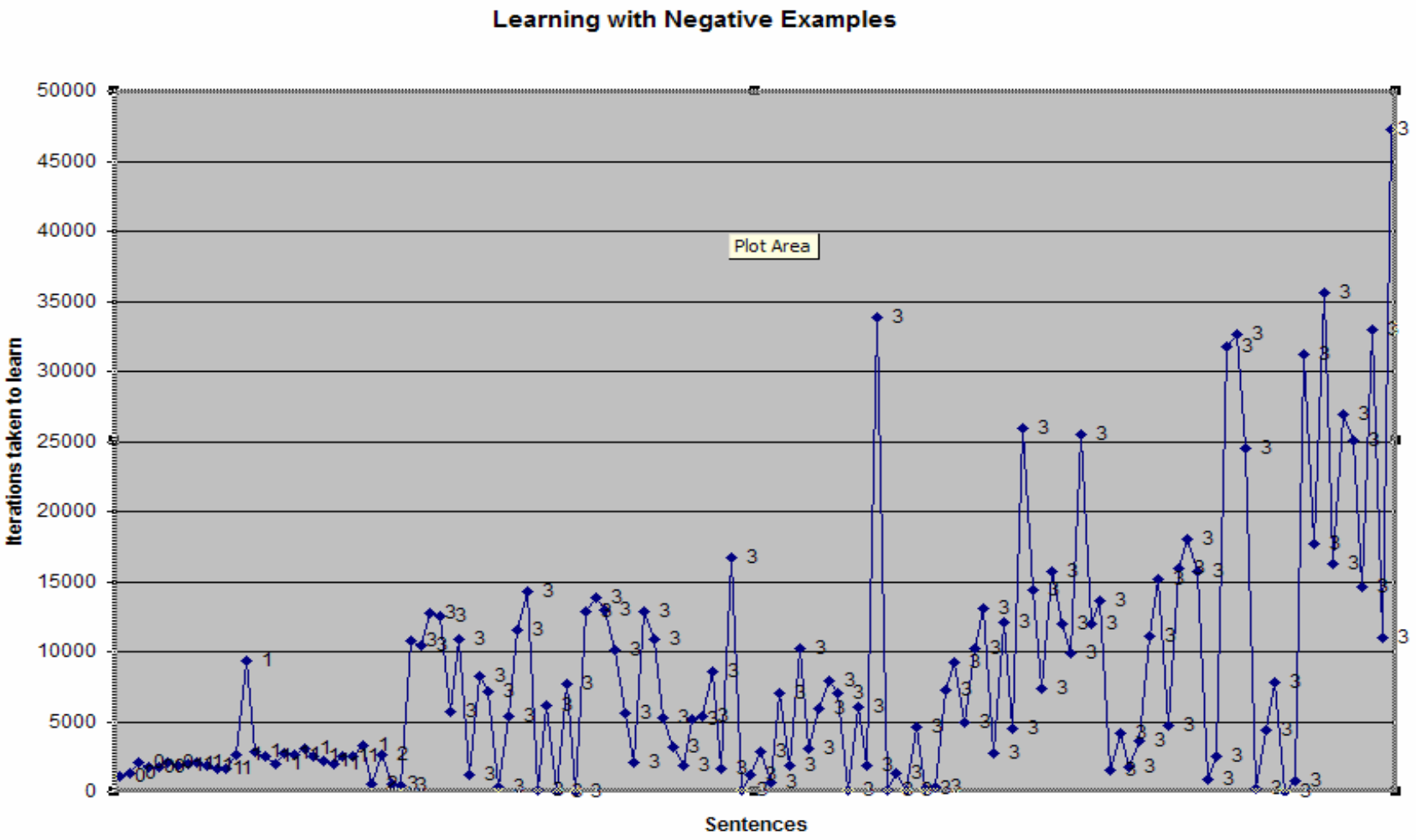
Experimental Results and Observations



Experimental Results and Observations

- Number of iterations required to learn have come down
- With increasing size of learning set, the peaks get higher and higher
- Might maintain an abridged structure which is checked and modified
- Modification made to a specific concept’s or predicate’s knowledge based on the modification in the abridged representation

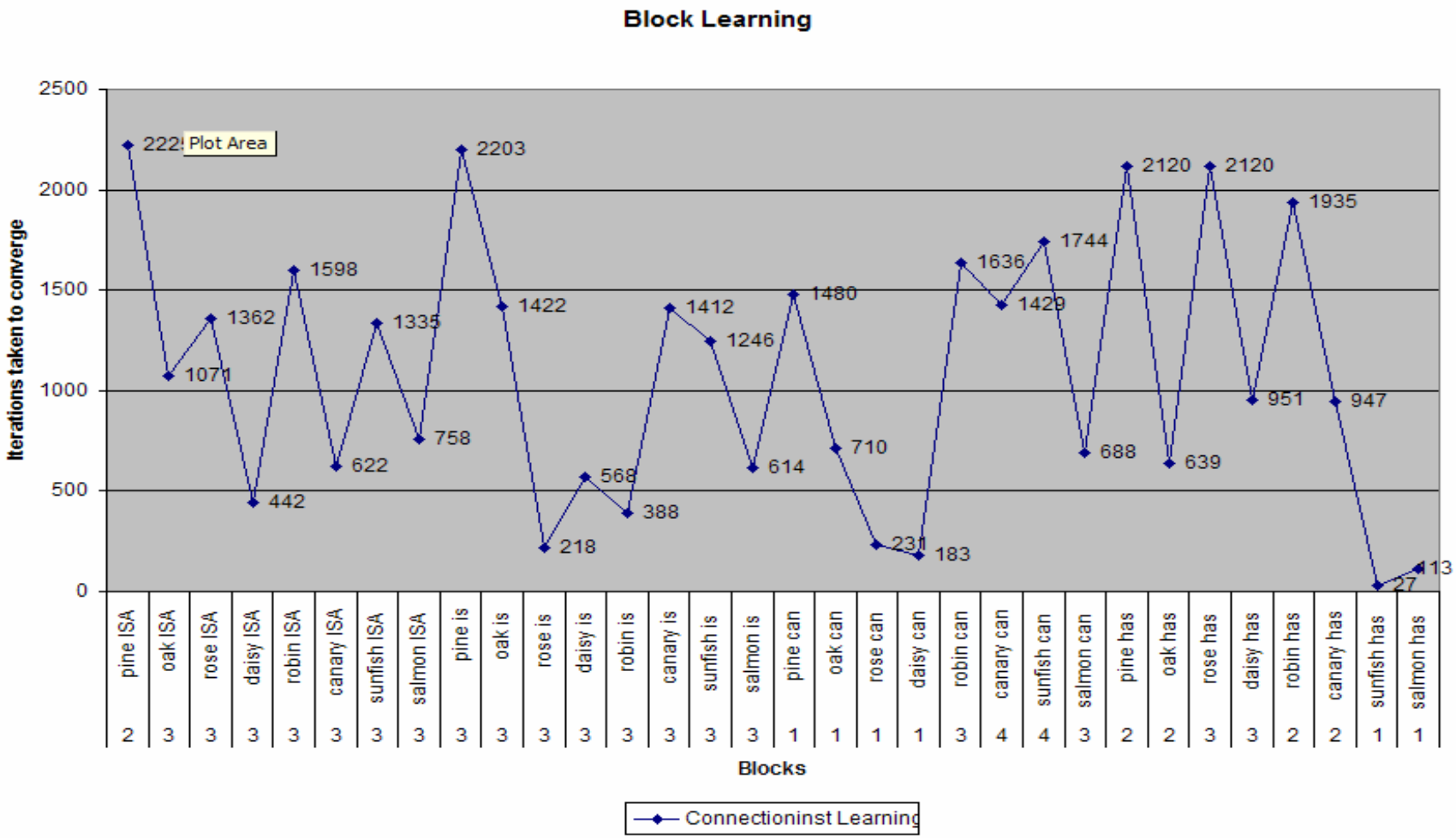
Experimental Results and Observations



Experimental Results and Observations

- In case of category 0 and 1, the number of iterations required is roughly the same, while it is highly erratic in the case of category 3
- In case of categories 0, 1 and 2 something new is learnt, which makes it equally difficult in all cases
- In the case of category 3, the iterations required depend on –
  - *Directly Related concept*
  - *Indirectly Related concept*
  - *Unrelated concept*

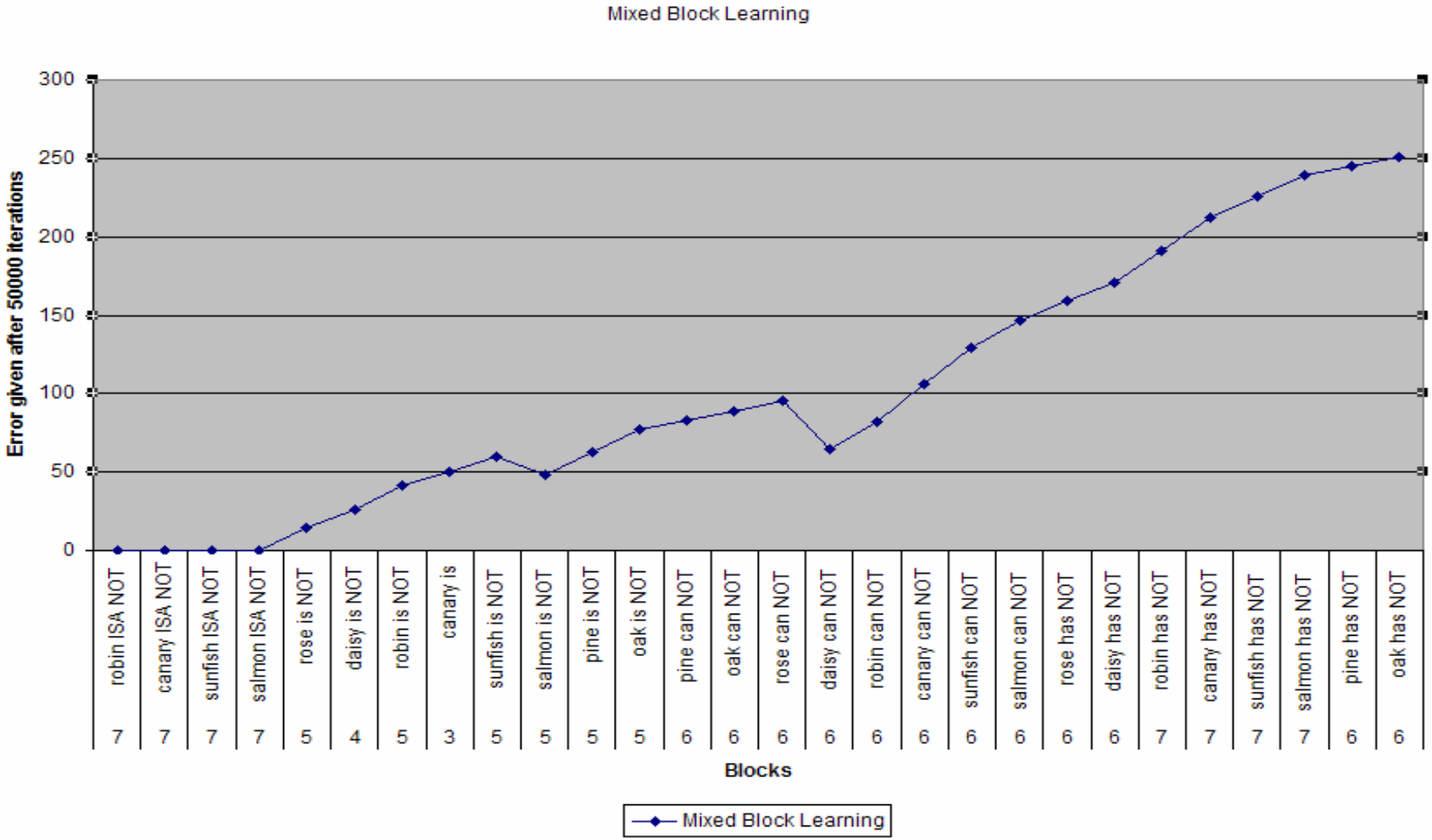
Experimental Results and Observations



Experimental Results and Observations

- Block learning required significantly less number of iterations
- Whenever a new relation is introduced, iterations required are more
- Not a high increase in iterations required with increasing Learning Set Size
- Zig Zag curves are observed in the graphs.
- Less number of iterations was required for small blocks

Experimental Results and Observations



Experimental Results and Observations

- Increase in the number of iterations required with increasing Learning Set size
- End error keeps increasing almost monotonically, and so does the start error
- Increase is uniform

Conclusions

- Learning time increases with increasing Learning Set in connectionist system
- Since, not observed in reality, concepts might be stored in an abridged manner and only this structure modified.
- Learning of new Concepts, Predicates takes large and similar amounts of time
- With known concept and known predicate, learning time is reduced only if the concepts are related
- For block learning the efforts required are considerably lesser

Conclusions

- Complex concepts difficult to learn
- Complexity is proportional to the predicates linked with the concept
- When one concept has been learnt, another similar concept can be learned very easily

Thus, preference for batch learning and also for having a mixed set of positive and negative examples for Child Language Acquisition

Also, children can learn simple concepts easily, but have problems in learning complex concepts

References

- http://www.cnbc.cmu.edu/ibsc/papers/RogersMcC.pdf