An Improved Genetic Algorithm for the Inference of Finite State Machine

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Introduction
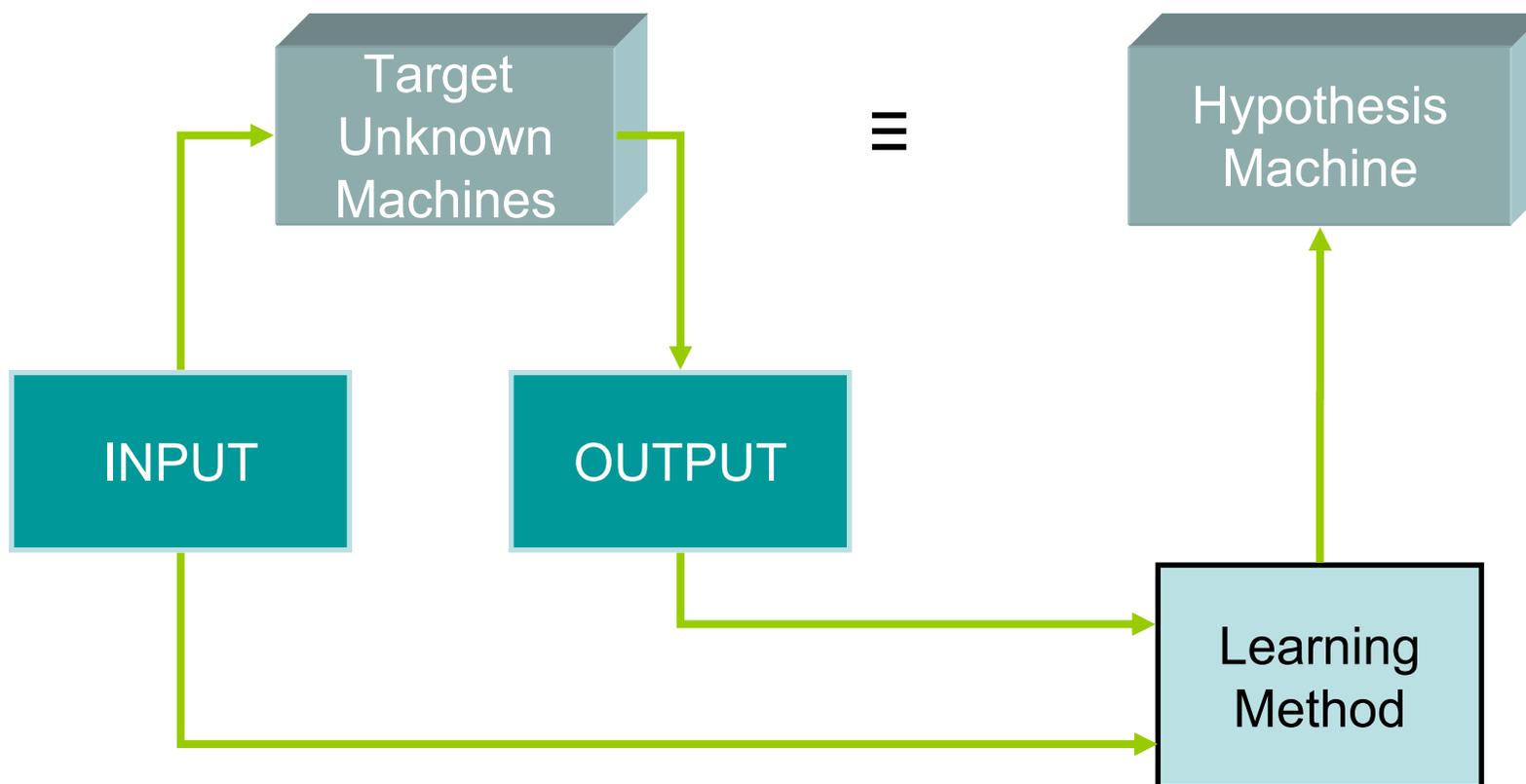
- Learn the target machine
  - by mimicking I/O behavior

Introduction

- The problem of inferring a compact finite automaton that is consistent with a set of input/output sequence.

- NP-Complete problem.

- Genetic Algorithm were used by many researcher to solve the problem.

- We propose a new efficient Genetic Algorithm for the problem.

Former Method

- Encodes δ and λ in bit string
- Single point crossover
- Evaluates by counting different output bit
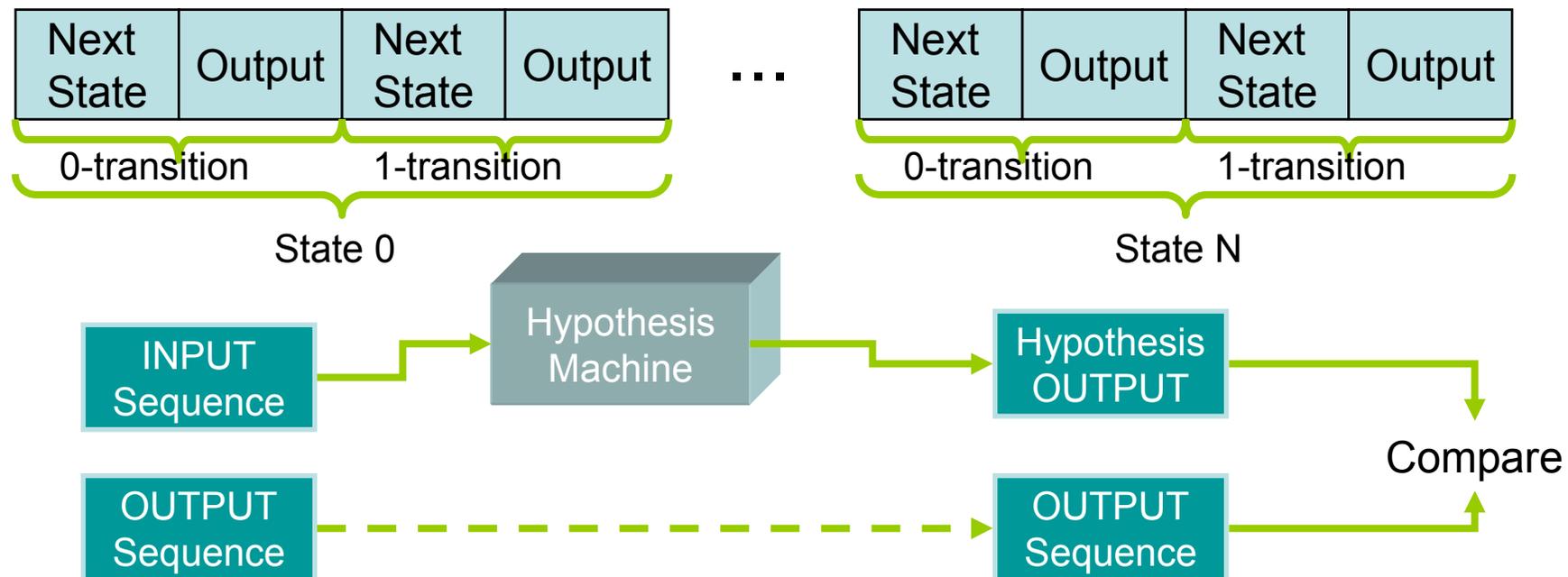
Flaw in the Former Method

0/B

0/A   A   B   1/A

1/B

Target Machine

0/A

0/B   A   B   1/B

1/A

Hypothesis
Machine
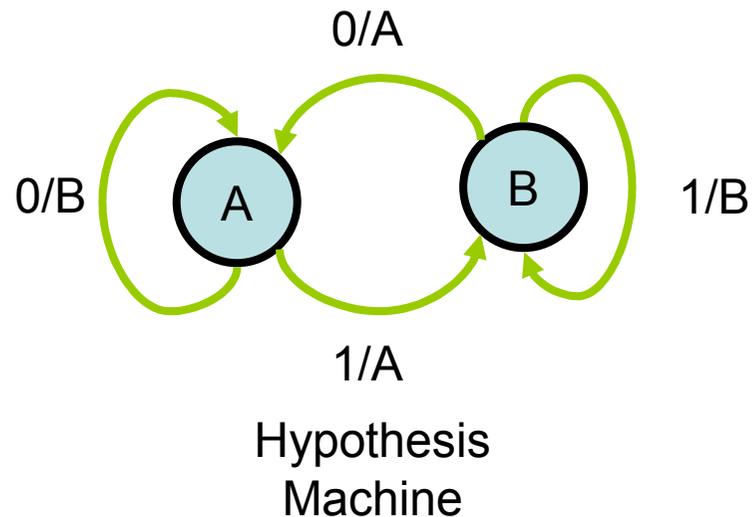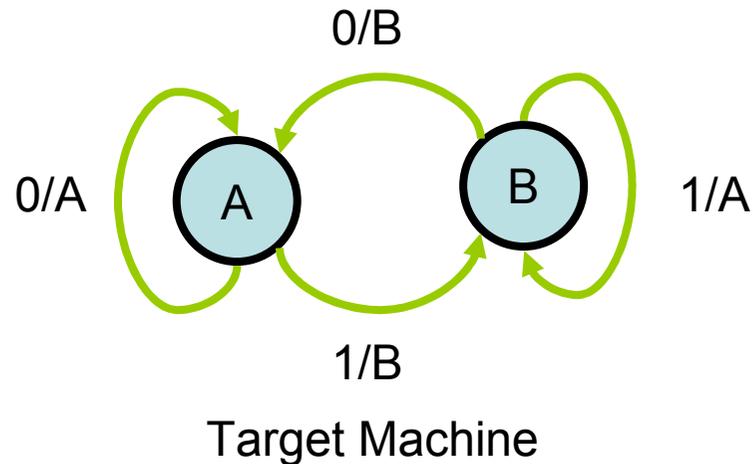
- Former method does not effectively evaluates the FSM

- Output function of the machine is not needed to be evolved

The New Method

- Evolves a partial mealy machine
- Encodes only δ
  - λ will be defined later
- Evaluates by considering conflicts of outputs

Evaluation

(b) 1   (c) 0

(a) 0

(d) 1
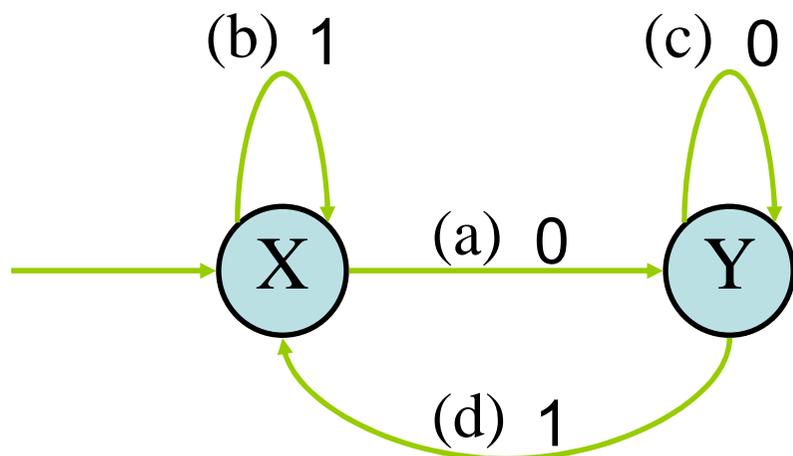
Input : 0 0 1 0 1 0 1

Output : 0 1 1 0 0 0 0

a c d a d a d

Input	State X		State Y	
	Output 0	Output 1	Output 0	Output 1
0	3			1
1			2	1

Evalutaion value = 3 + 0 + 1 + 2 = 6

Output Definition
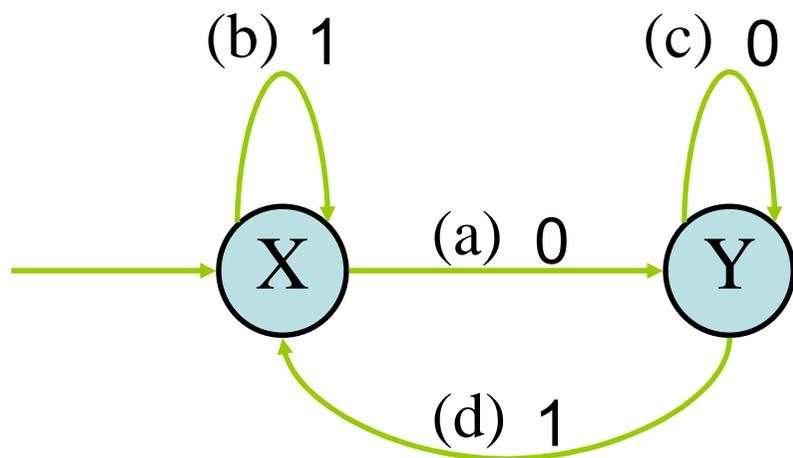
Input	State X		State Y	
	Output 0	Output 1	Output 0	Output 1
0	3			1
1			2	1

Output:

(a) → 0

(b) → N/A (arbitrary value)

(c) → 1

(d) → 0

Improvement

- Reduce effect of misleading evaluation
- Reduce inference of output

Result : 1 Bit Output
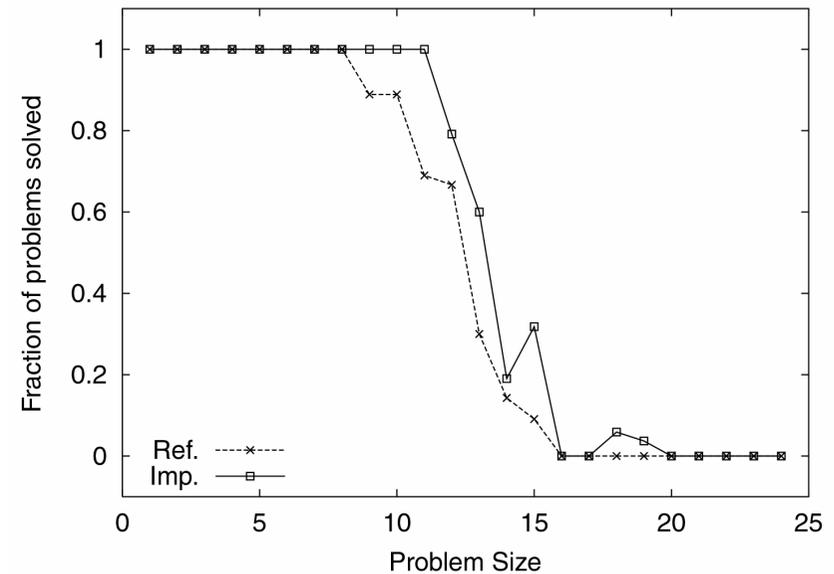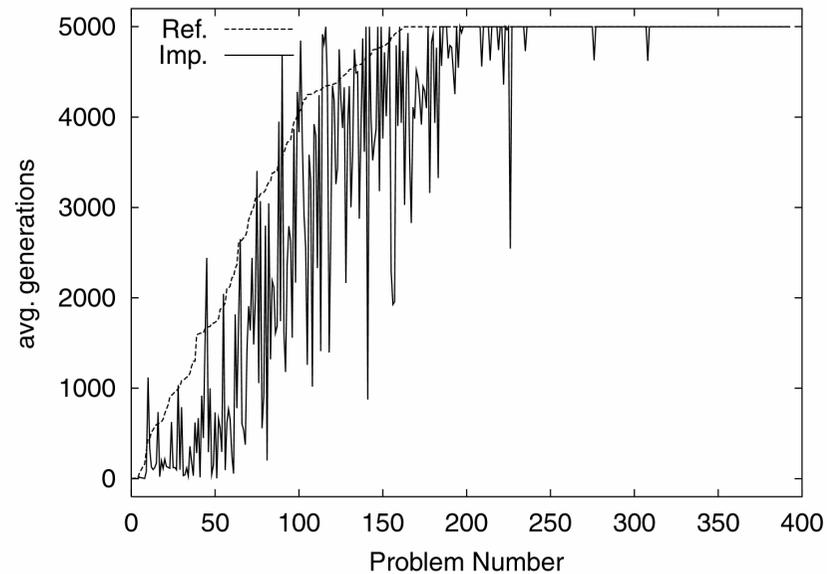
Result : 2 Bits Output
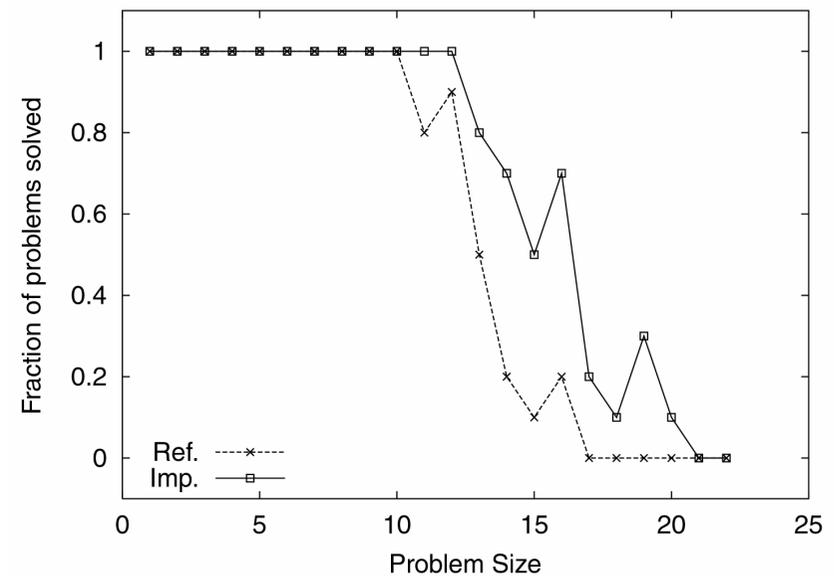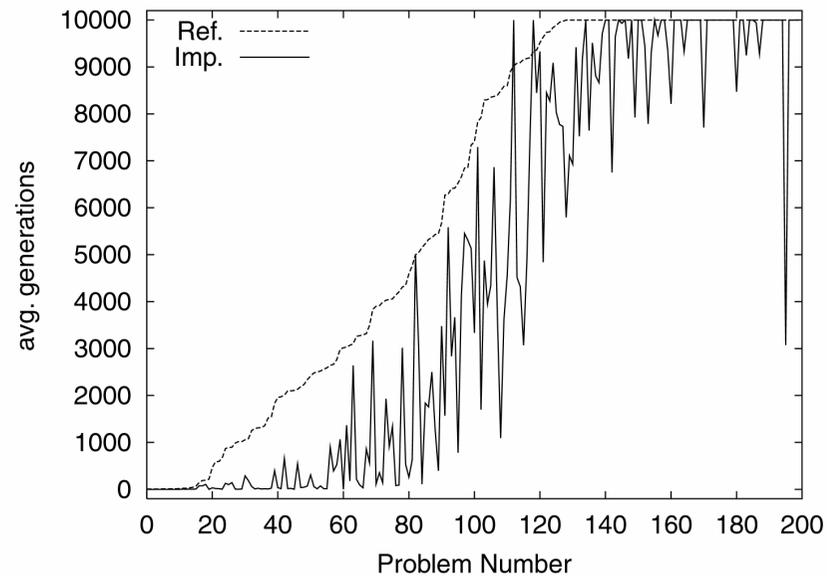
Result : 3 Bits Output
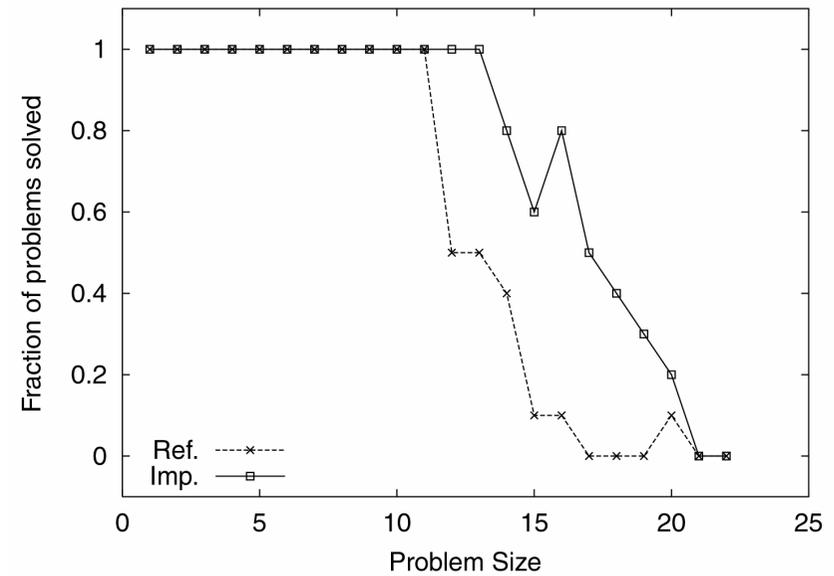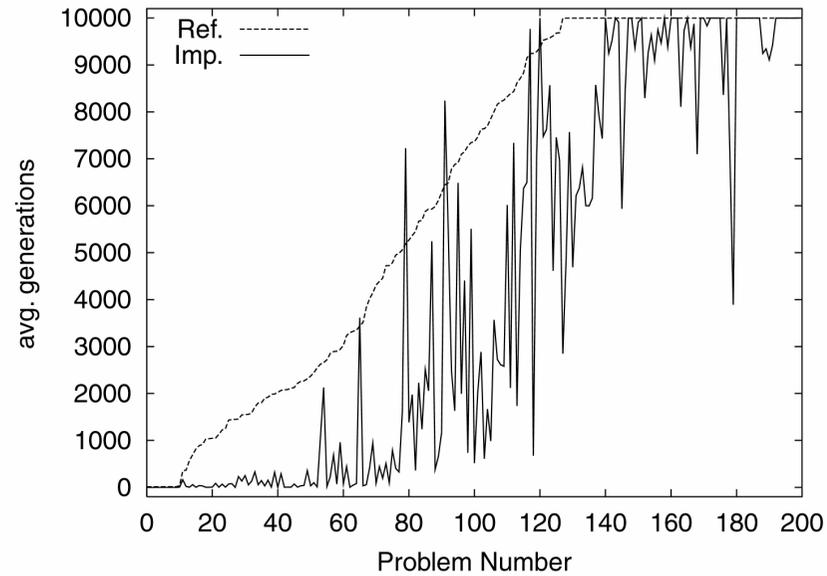
Conclusion

- A new GA method for inferring FSM

- Reduce search space, more accurate search guidance

- Results confirm the validity of the method