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 $\delta$ and $\lambda$ in bit string
- Single point crossover
- Evaluates by counting different output bit
Flaw in the Former Method

- 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 $\delta$
  – $\lambda$ will be defined later
• Evaluates by considering conflicts of outputs
Evaluation

Input: 0 0 1 0 1 0 1
Output: 0 1 1 0 0 0 0
a c d a d a d

<table>
<thead>
<tr>
<th>Input</th>
<th>State X</th>
<th>State Y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Output 0</td>
<td>Output 1</td>
</tr>
<tr>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>2</td>
</tr>
</tbody>
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Evaluation value = 3 + 0 + 1 + 2 = 6
Output Definition

Output:
(a) \( \rightarrow 0 \)
(b) \( \rightarrow \text{N/A (arbitrary value)} \)
(c) \( \rightarrow 1 \)
(d) \( \rightarrow 0 \)
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