# ATNoSFERES revisited

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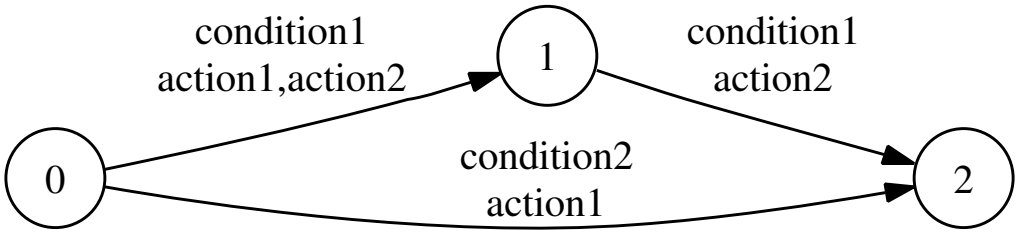
1 from ATNoSFERES...
- Evolving finite automata
- Use of an automaton for control
- Equivalence between an ATN and a rule-based LCS
- Application in partially observable environments (POMDP)

2 ...to ATNoSFERES-II
- Modifications
- Results
- Analysis

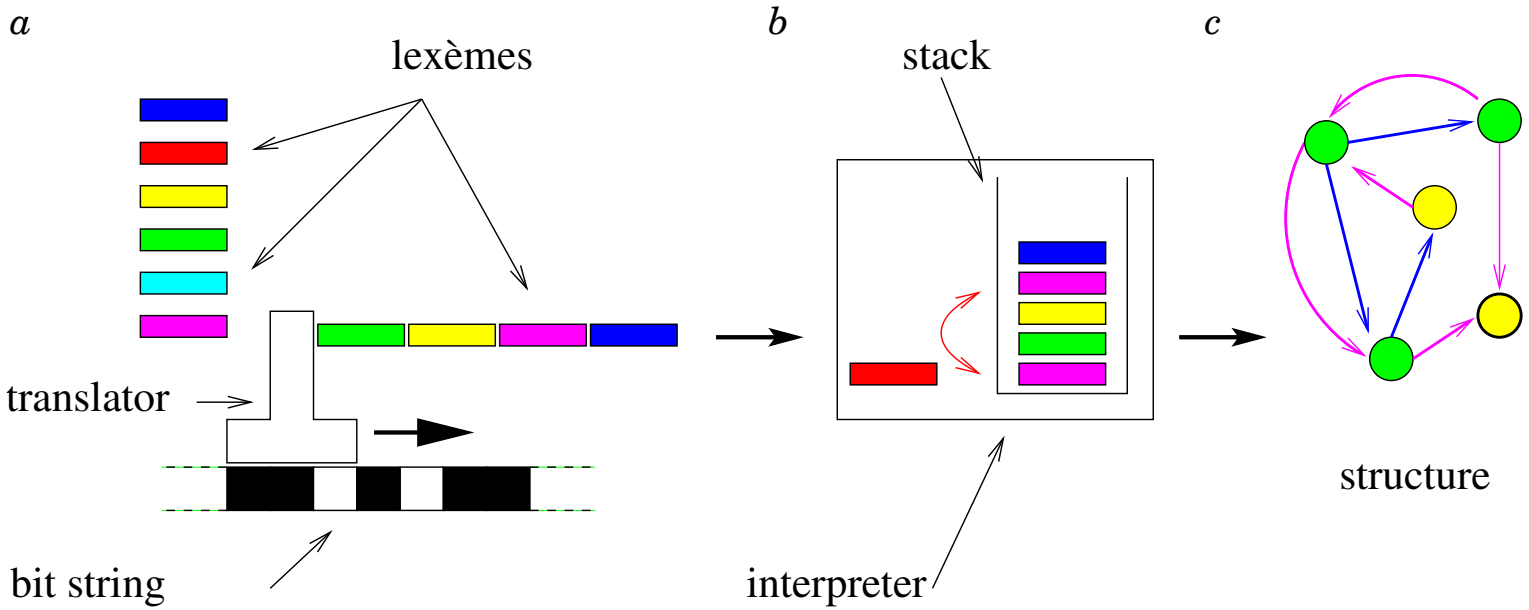
3 Conclusion

# Augmented Transition Network



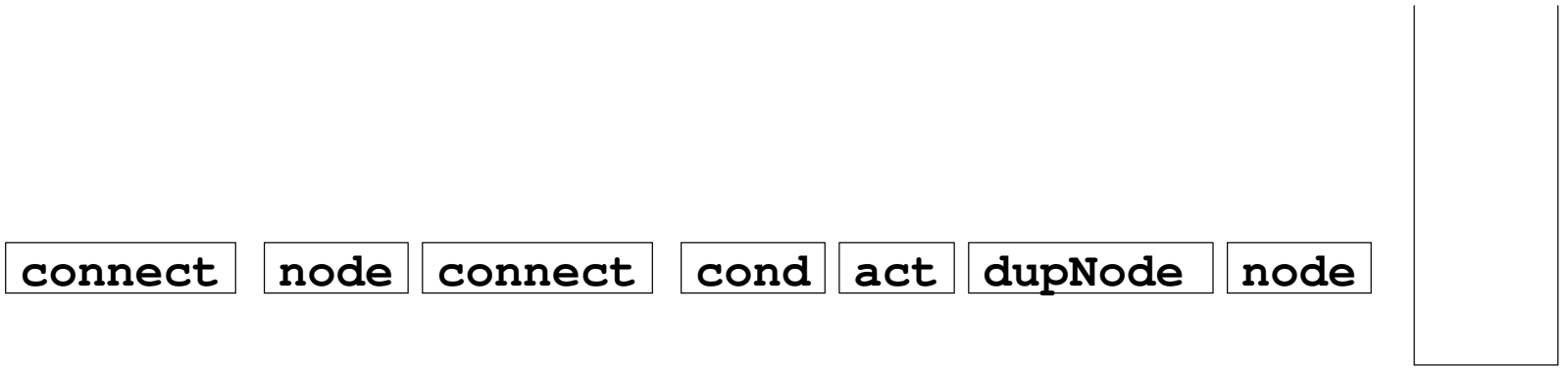

- labelled graphs
- grammars, in natural language processing [Woods, 1970]
- then, descriptions of interactions and behavior in multi-agent systems

# Stack-Based Gene Expression [Landau and Picault]




- genotype : bit-string
- structure built according to a context-sensitive grammar (stack language)
  - locality
  - quasi-continuity

# Building an ATN




**interpreter**

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**ATN**

<empty>

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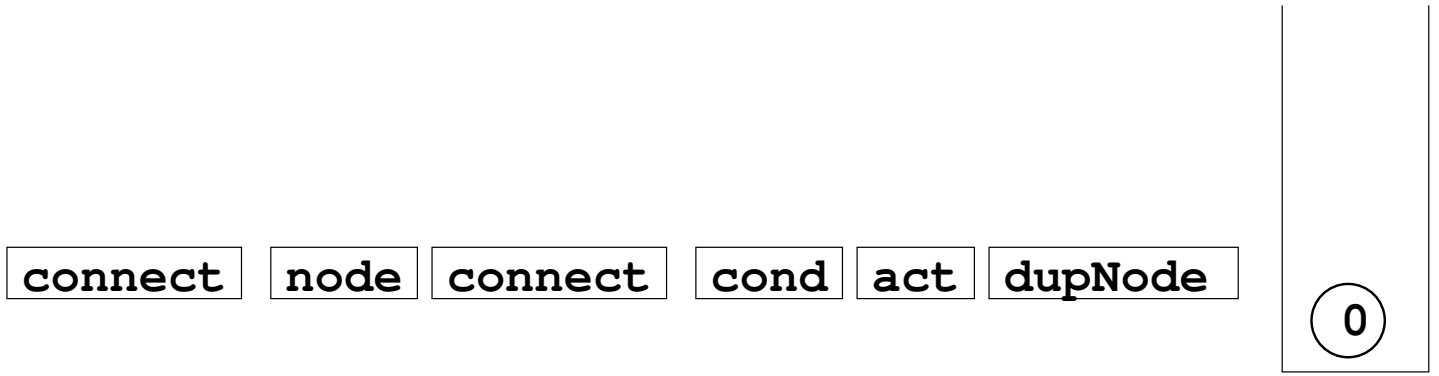


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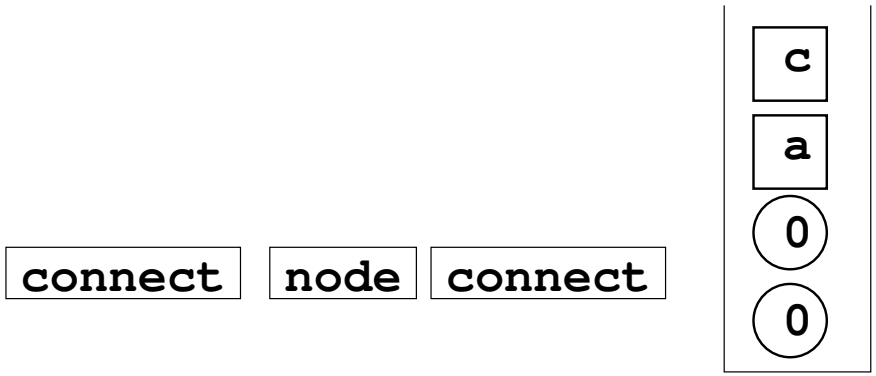


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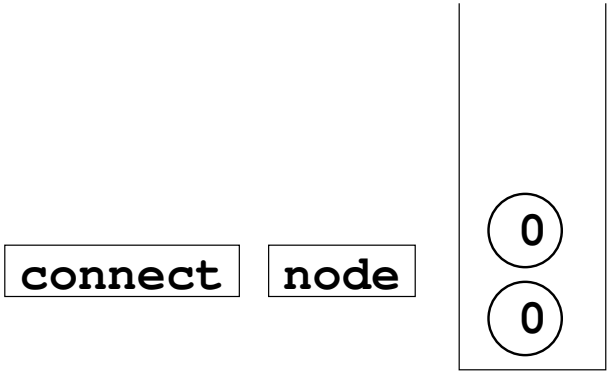


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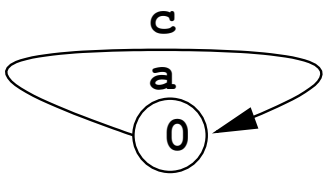

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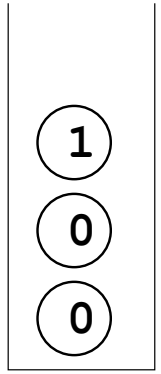


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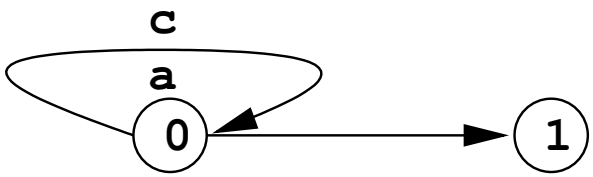
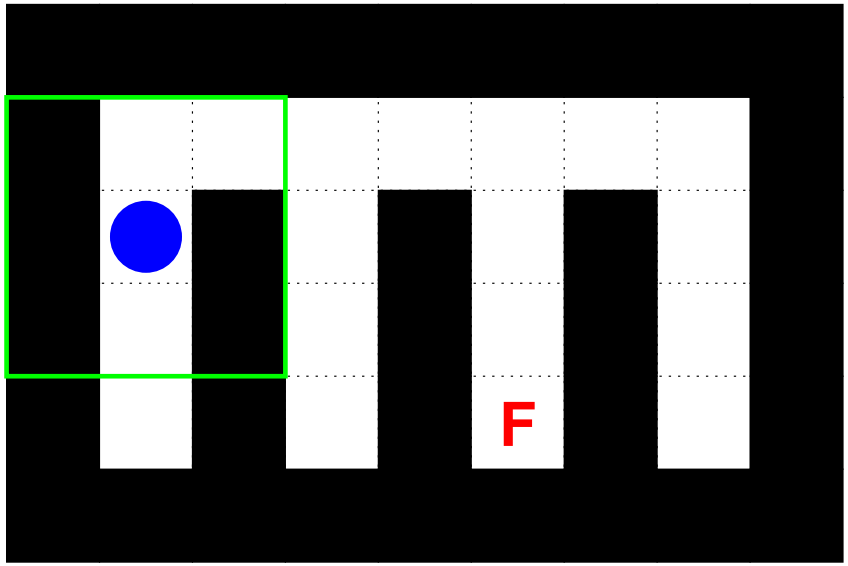
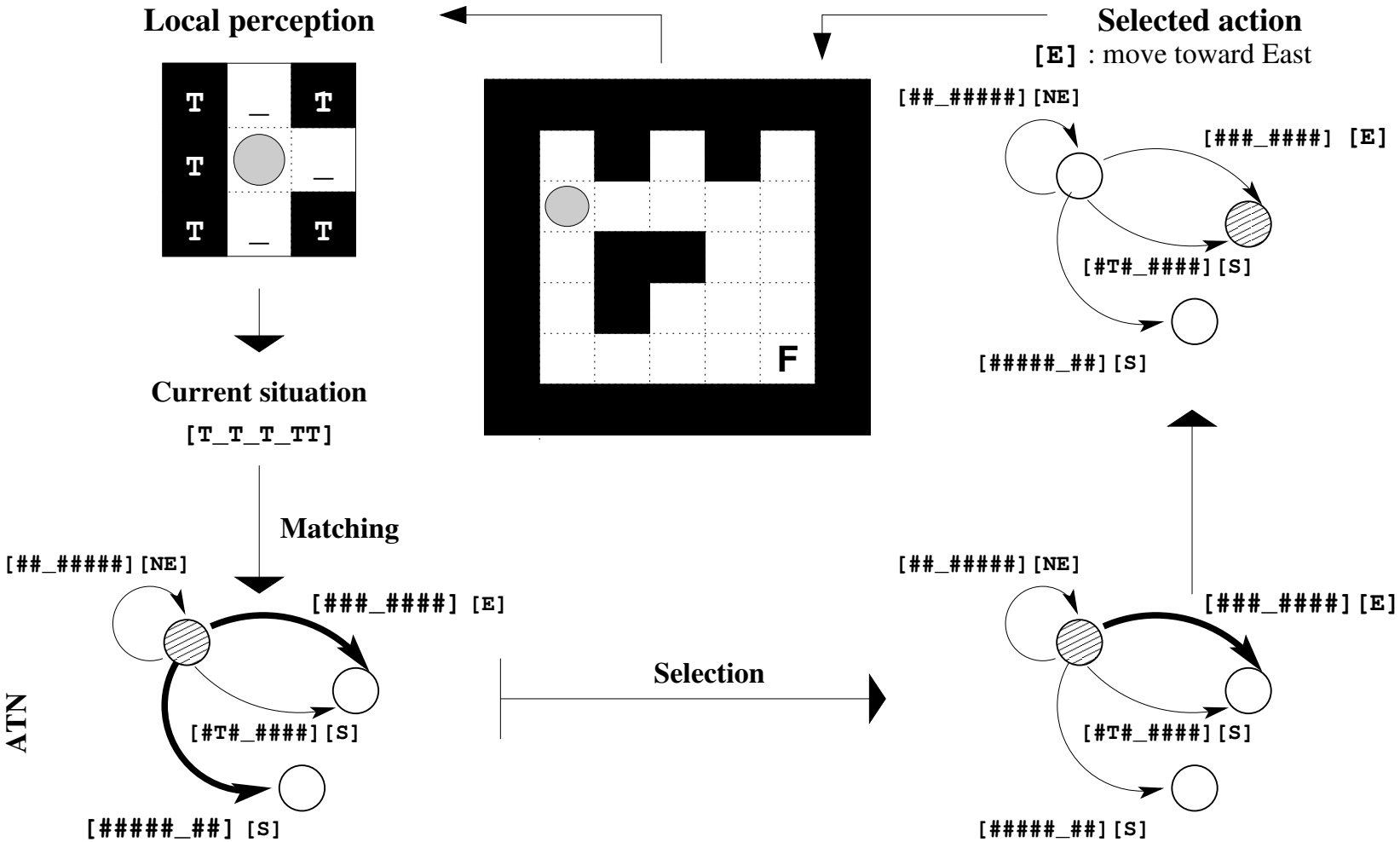


# "Maze" environement

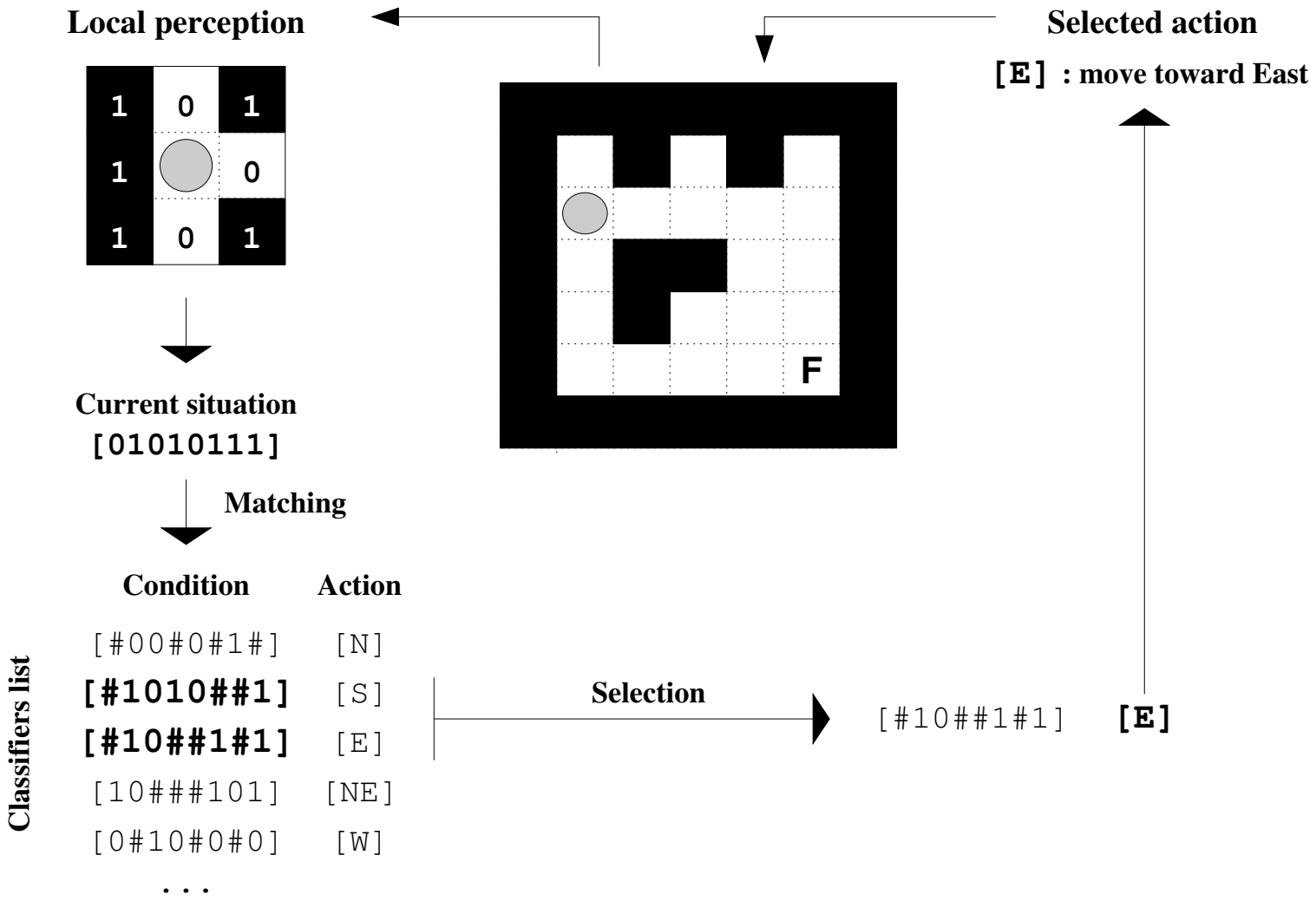



- goal : reach **F** from any start cell
- local perception only

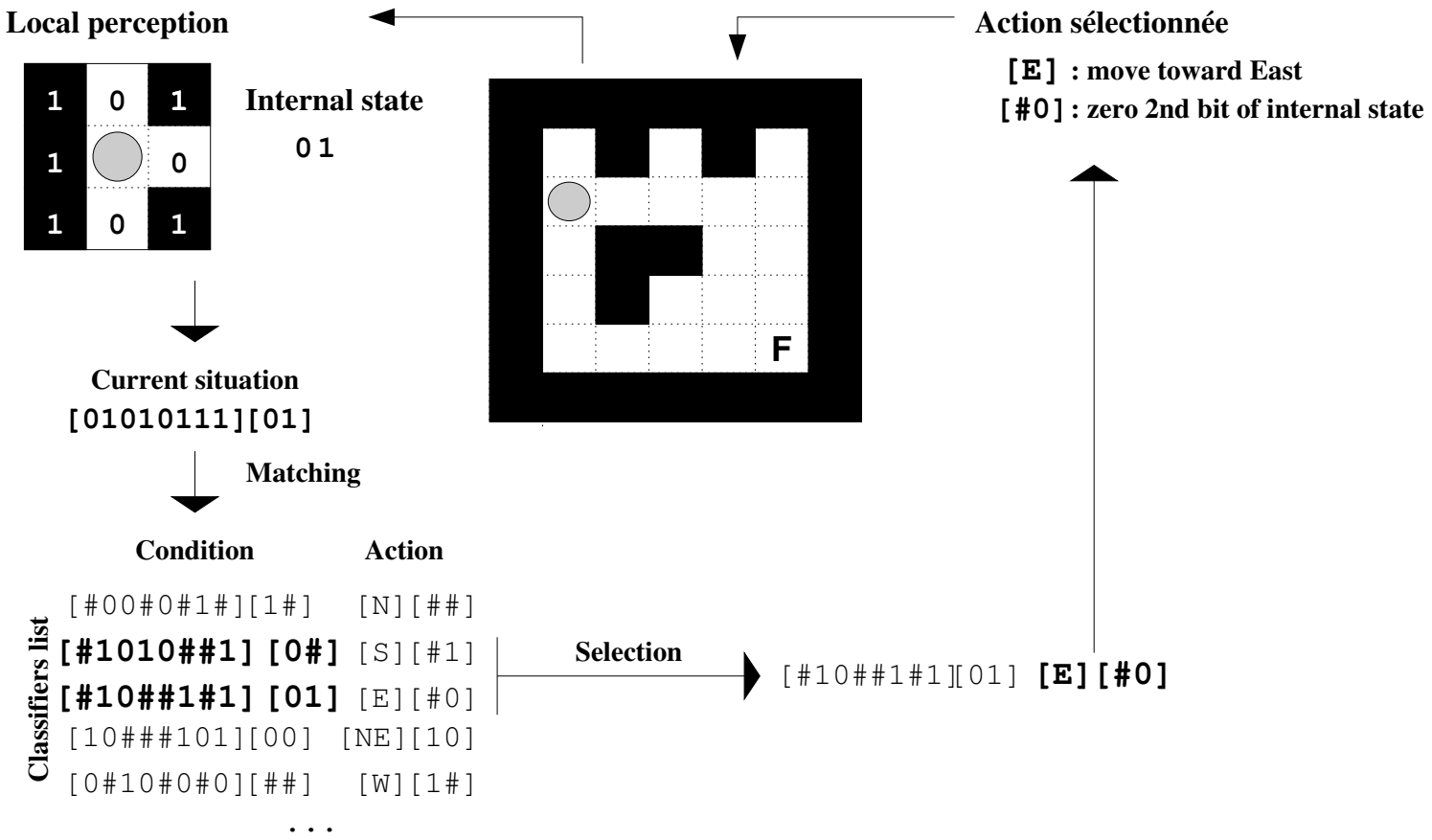
# ATNoSFERES in use



# Learning Classifier System [Holland]

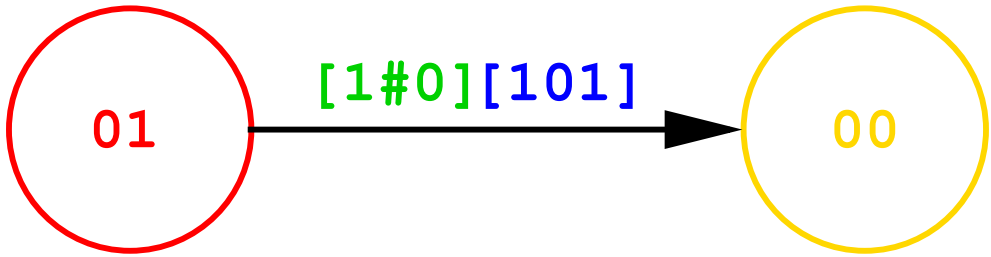


# LCS with memory




- e.g. ZCSM [Wilson], XCSM [Wilson and Lanzi]

# Formal equivalence between an ATN and a LCS with memory




| conditions | | | | actions | | | |
|---|---|---|---|---|---|---|---|
| external | | | internal | external | | | internal |
| 1 | # | 0 | 0 1 | 1 | 0 | 1 | 0 0 |

- by restricting to one action per edge
- *Pittsburgh*-style LCS, with internal states

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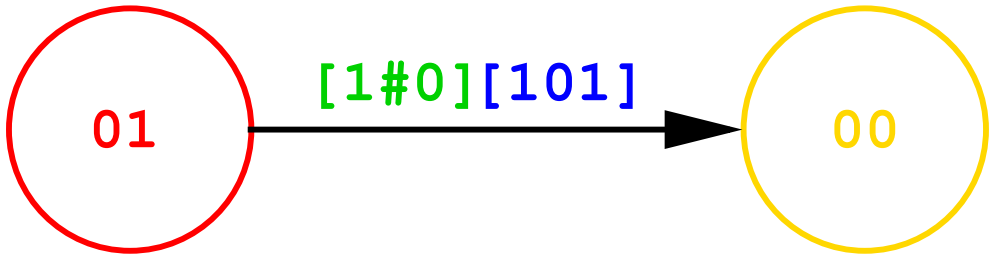


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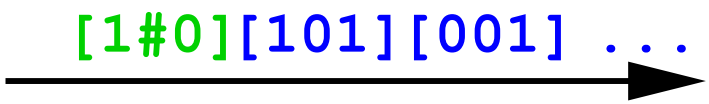


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- chain of actions, similar to ACS [Stolzmann]
- equivalent to *not* restricting to one action per edge
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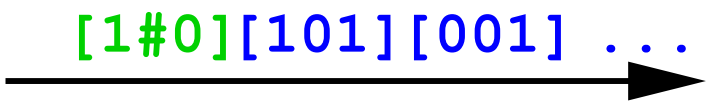


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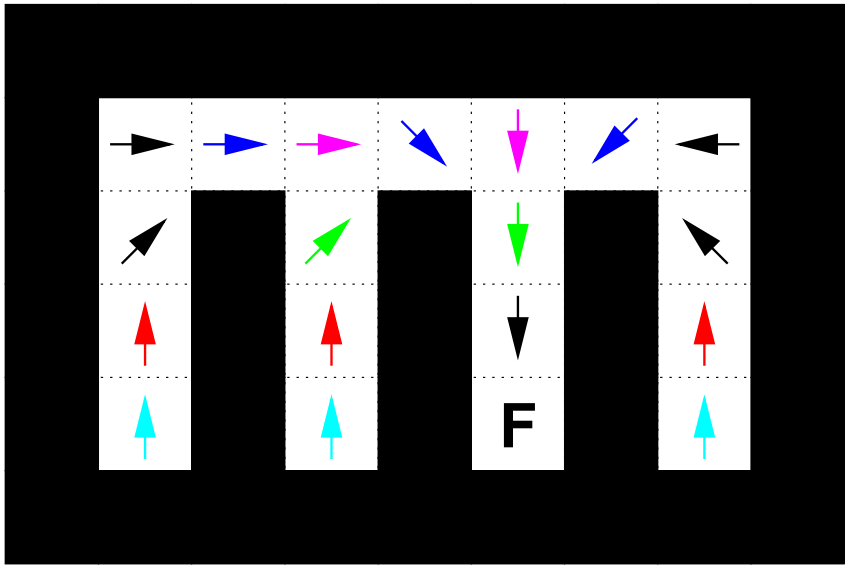
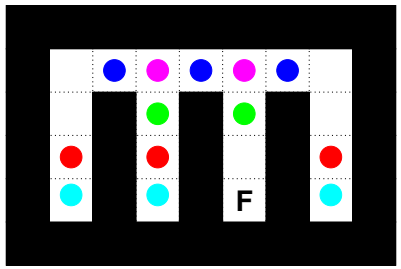
# Example of partially observable environment



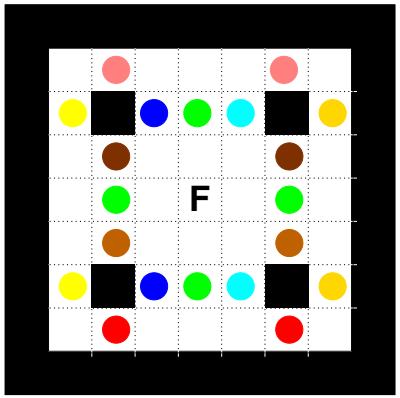

- ideal policy (unreachable)
- colored arrows = perceptual aliasing

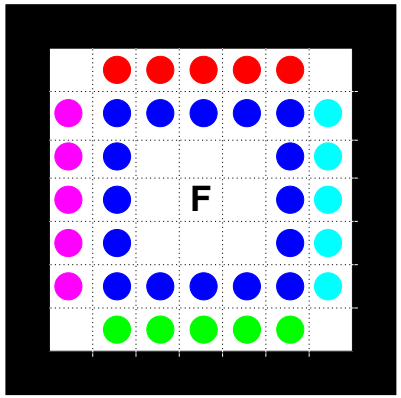
# Comparisons with some LCSs

- with XCSM and XCSMH :




- with ACS :



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- bit-string $\longrightarrow$ integer string
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# Language

- stack operators : all → node or labels
  - operators concerned : Swap, Roll, Unroll, Del, Dup
  - more flexibility
- conditions : possibly contradictory → non-contradictory
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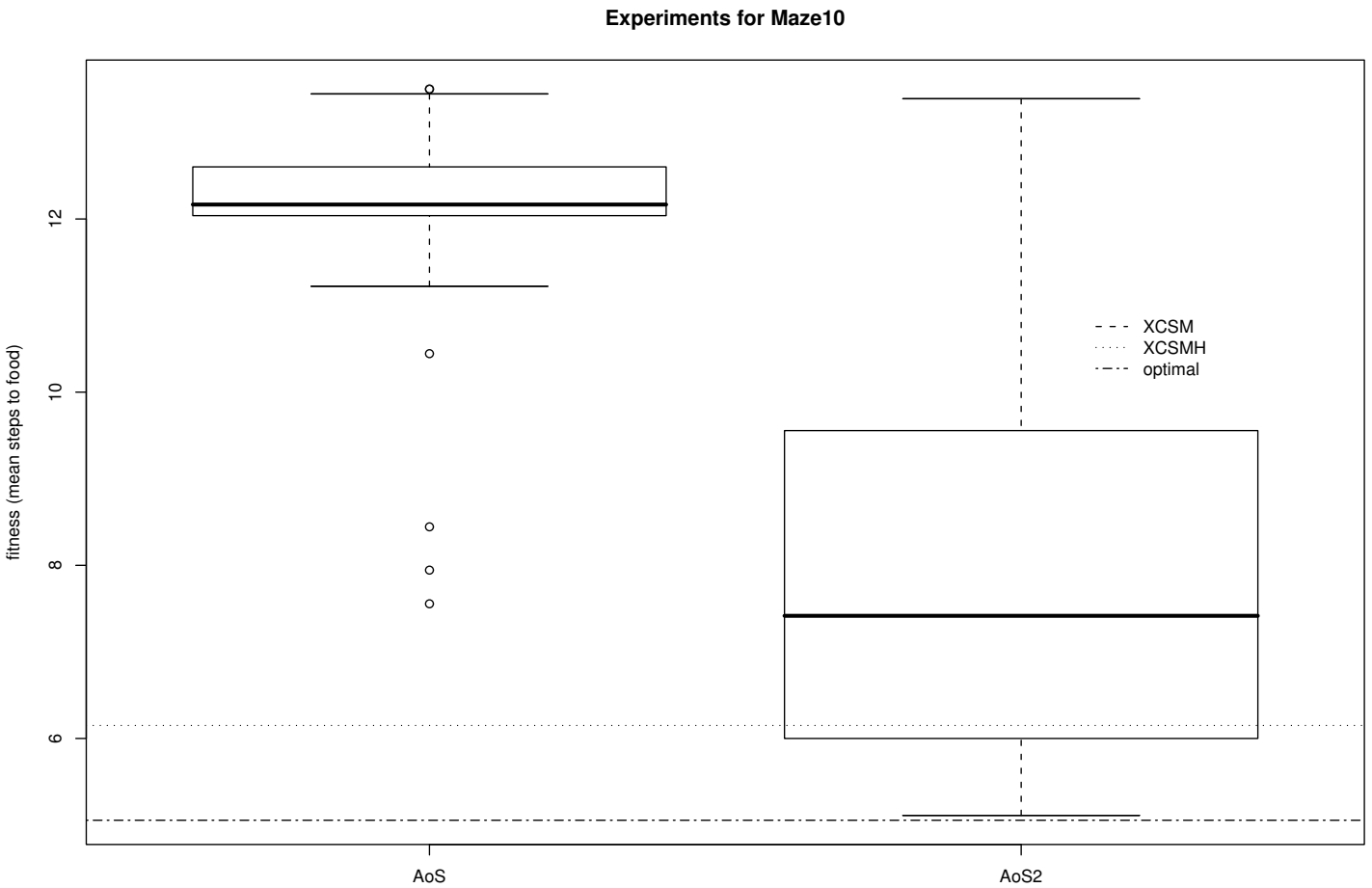
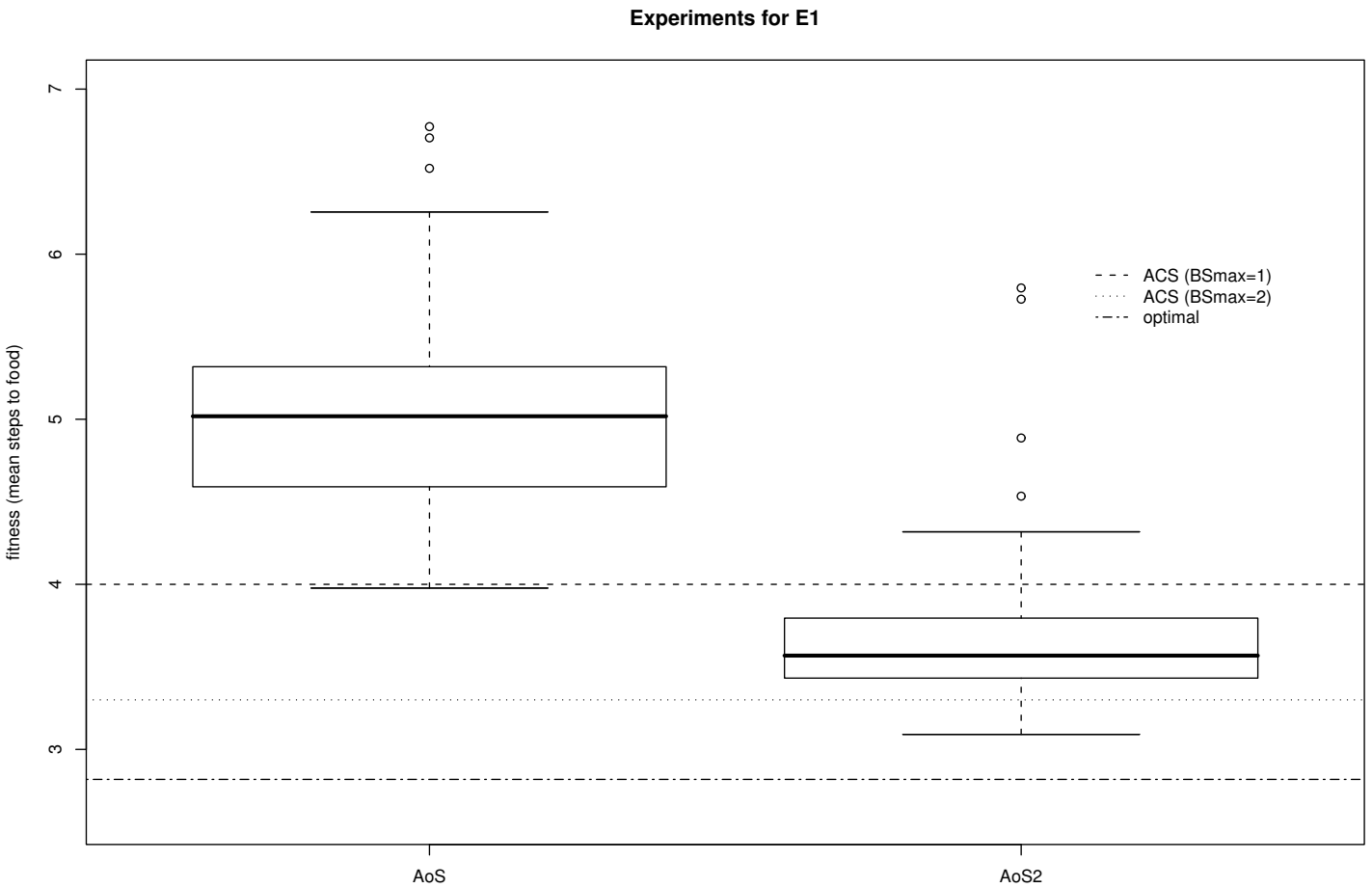
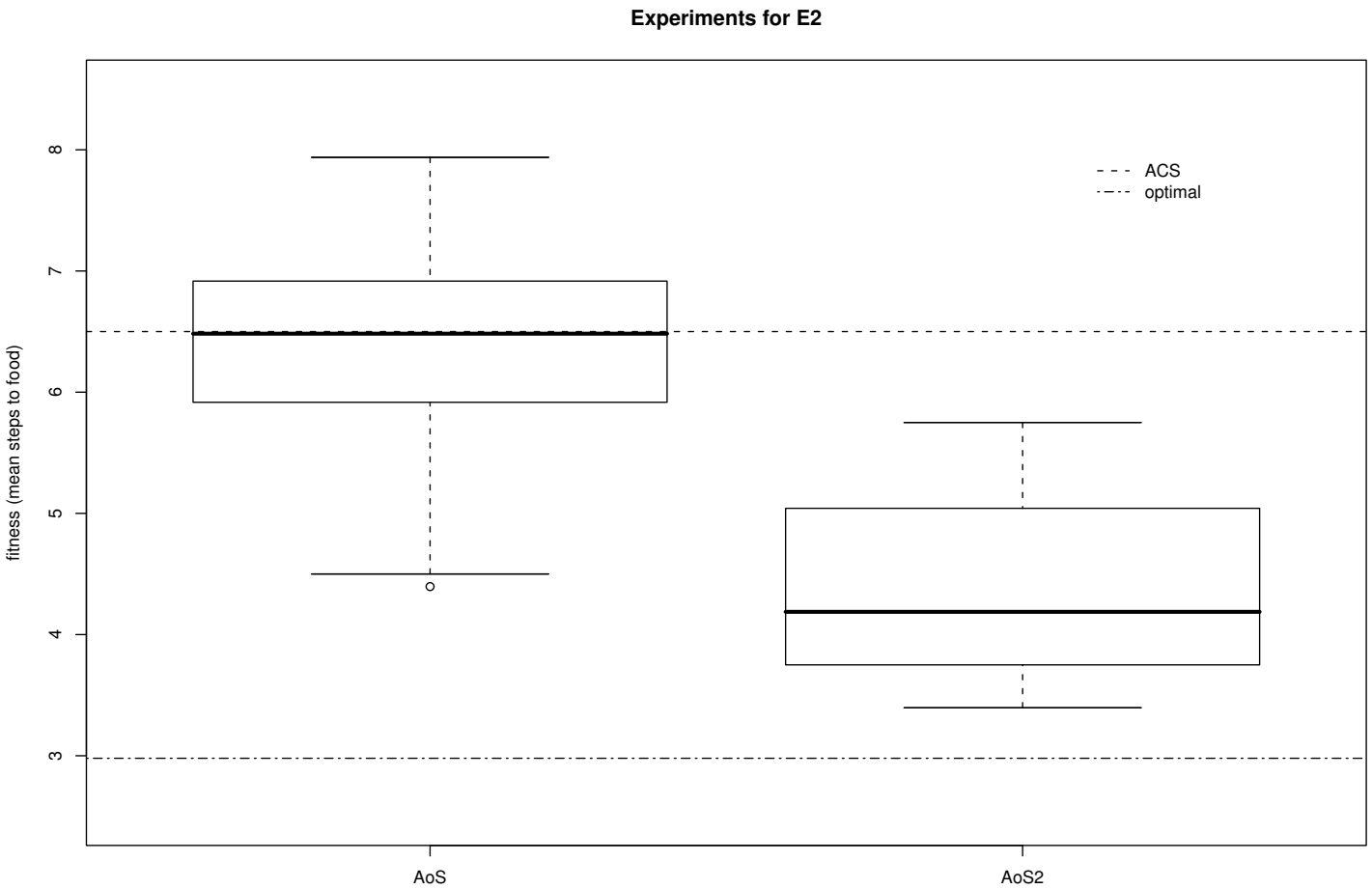
# ATNoSFERES vs ATNoSFERES II on Maze10



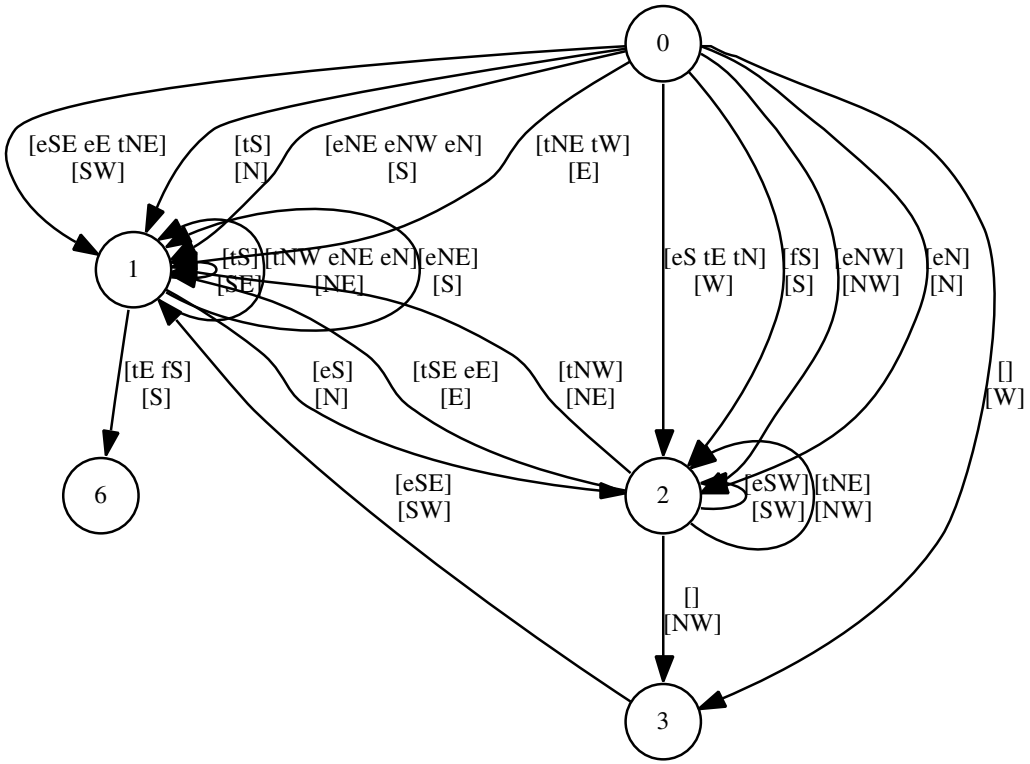
# ATNoSFERES vs ATNoSFERES II on E1



# ATNoSFERES vs ATNoSFERES II on E2

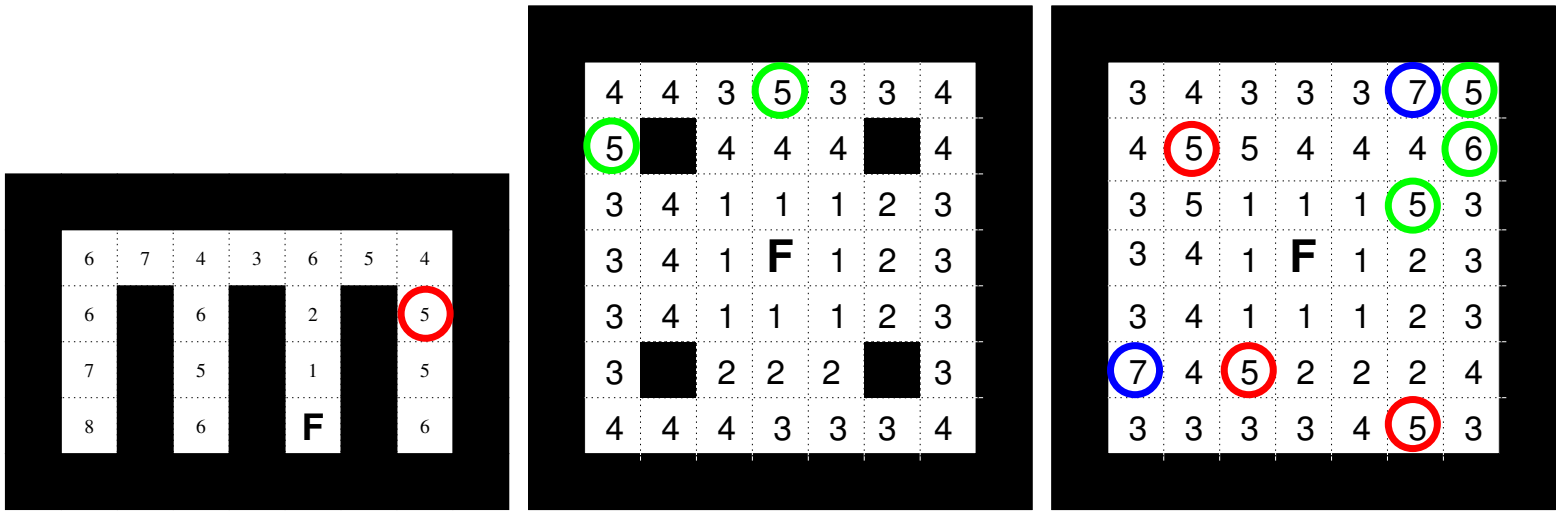


# Best ATN for Maze10




- 19 edges (3 nodes) that were never matched (reached) are not represented

# Best policies




- error compared to best attainable policies : 1, 2, 3

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- Most significant variable

→ exploration bias with bit-flip mutation and binary string encoding

  - left-most bit was a label indicator
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- stable policies / no ad hoc exploration/exploitation compromise
- best to-date policies on some POMDP LCS benchmarks
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