

Natural Computation and Self Organisation - Spring 2014

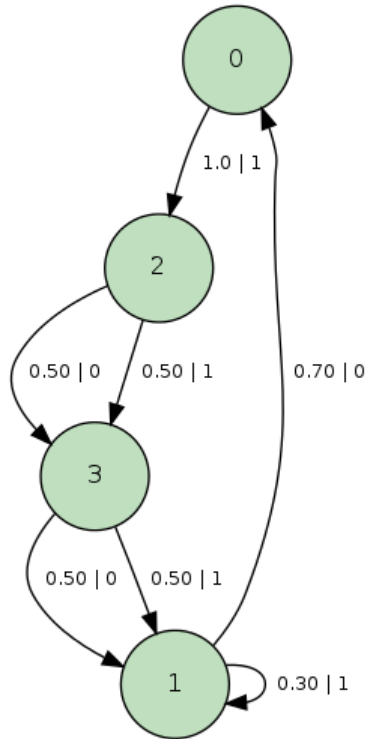
Irreversibility What and Why?

Gorm Gruner Jensen

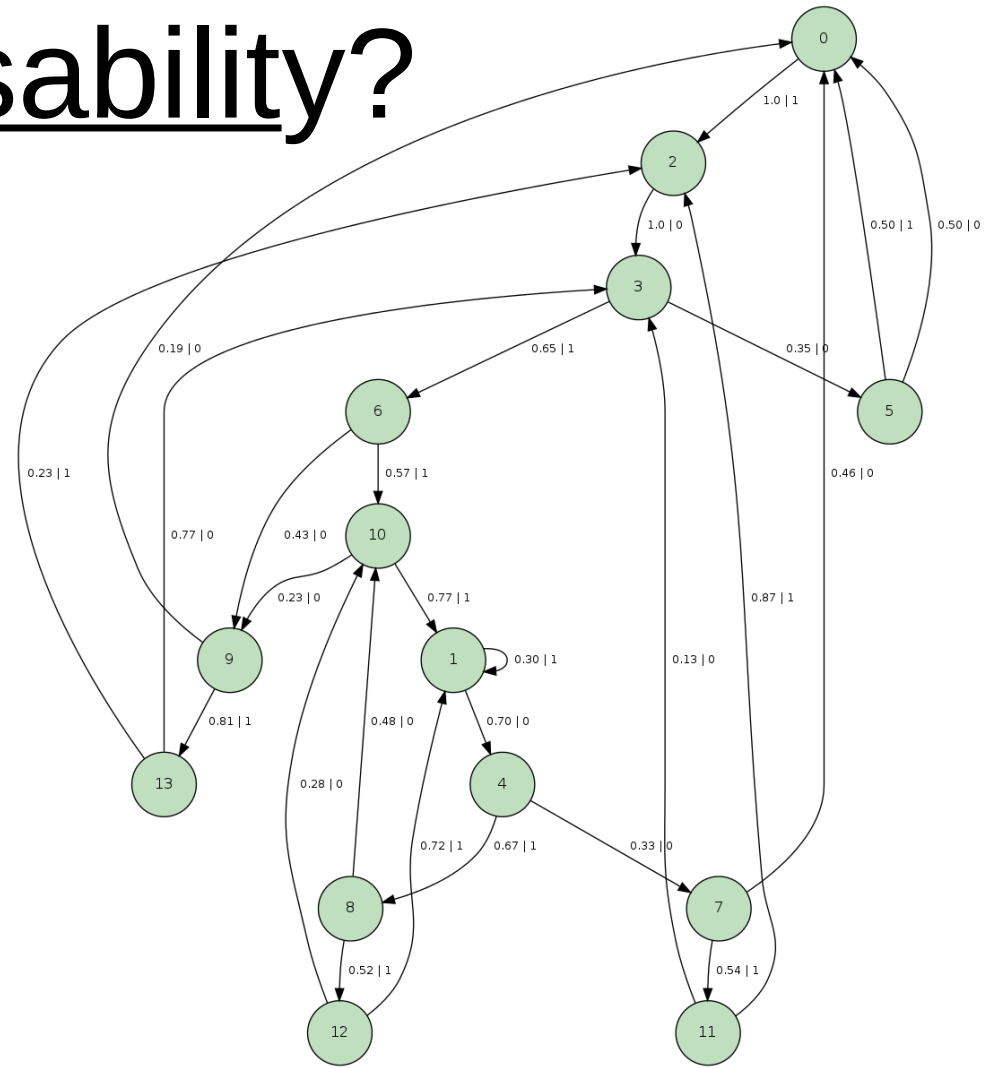
Niels Bohr Institutet, Københavns Universitet
Complexity Science Center, UC Davis

May 29th 2014

What is irreversibility?



ϵ -Machine of forwards process

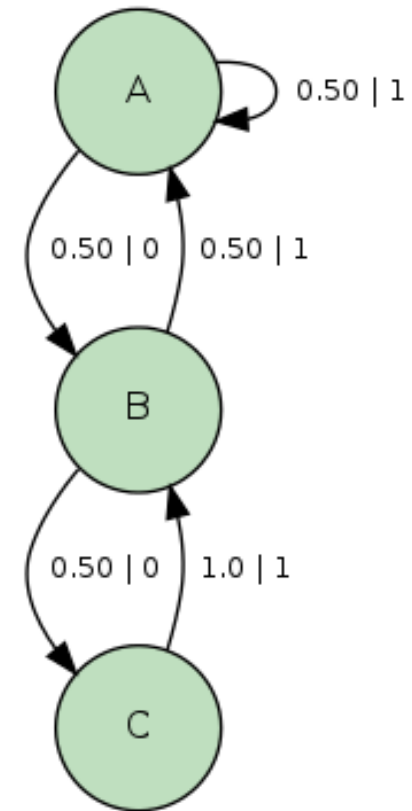


ϵ -Machine of reverse process

- How common is this?

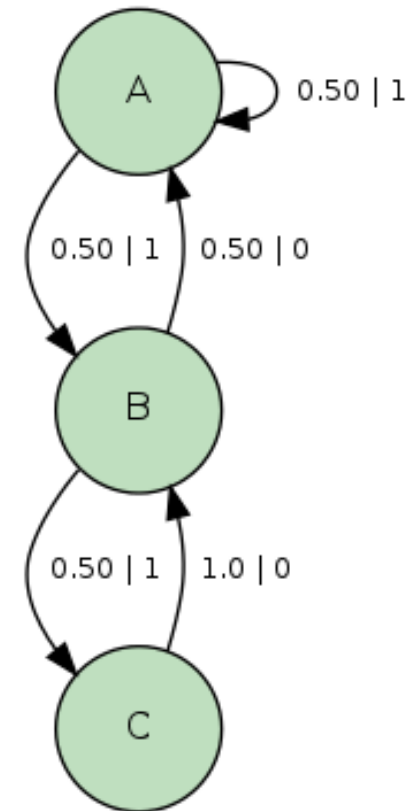
Finding the reverse ϵ -Machine

- Start with some ϵ -Machine
- Flip the arrows
- Renormalize transition probabilities
- Find the mixed-state machine
- Minimize



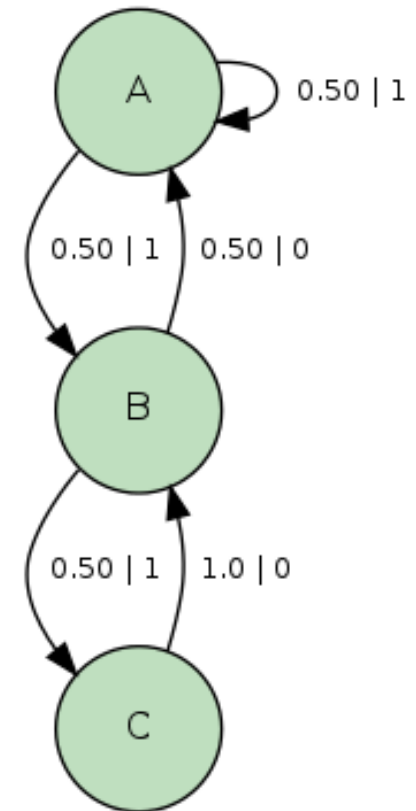
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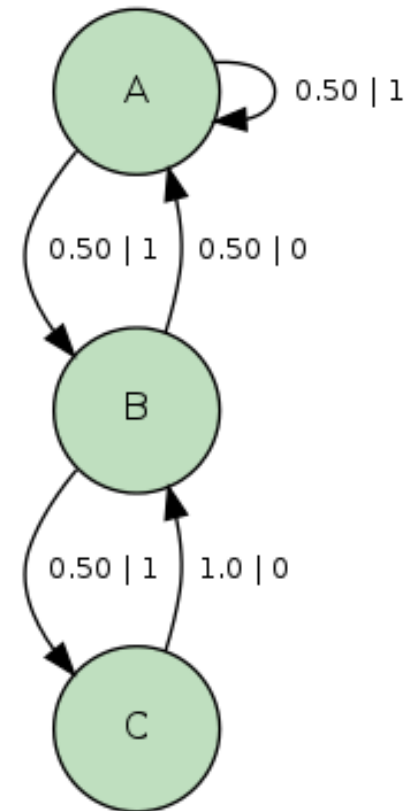
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Finding the reverse ϵ -Machine

- Start with some ϵ -Machine
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- Find the mixed-state machine !!!
- Minimize

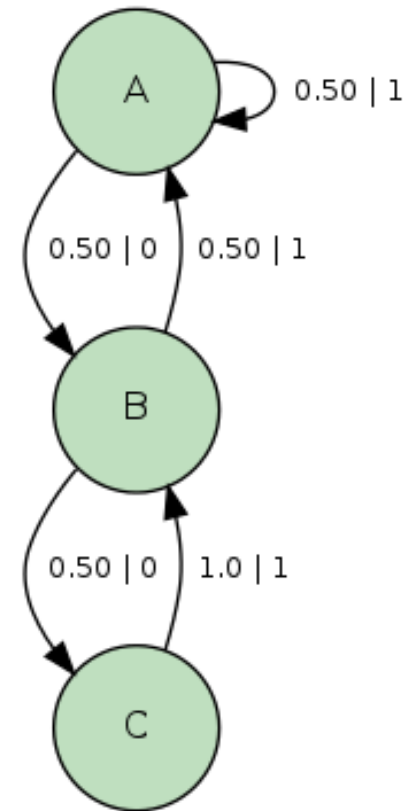


!!! `CMPyException`: Maximum word length exceeded. !!!

Topological

Finding the reverse ϵ -Machine

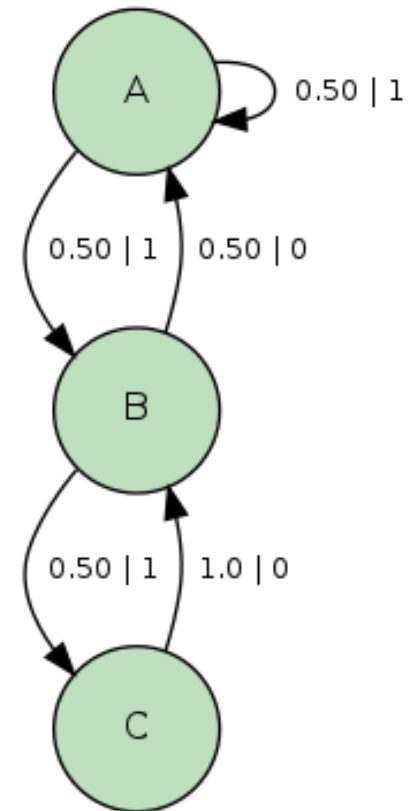
- Start with some ϵ -Machine
- Flip the arrows
- Drop probabilities
- Find topological mixed-state machine
- Minimize



Topological

Finding the reverse ϵ -Machine

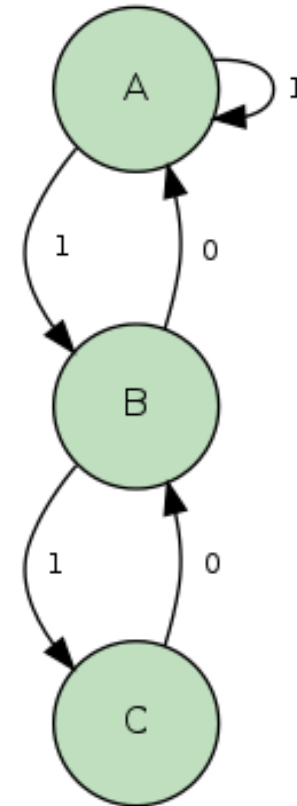
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Topological

Finding the reverse ϵ -Machine

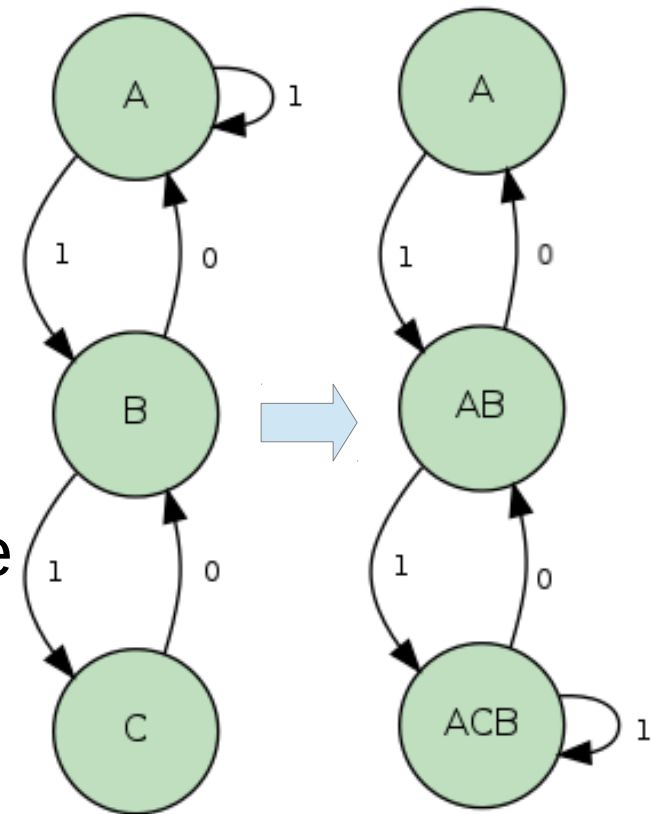
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Topological

Finding the reverse ϵ -Machine

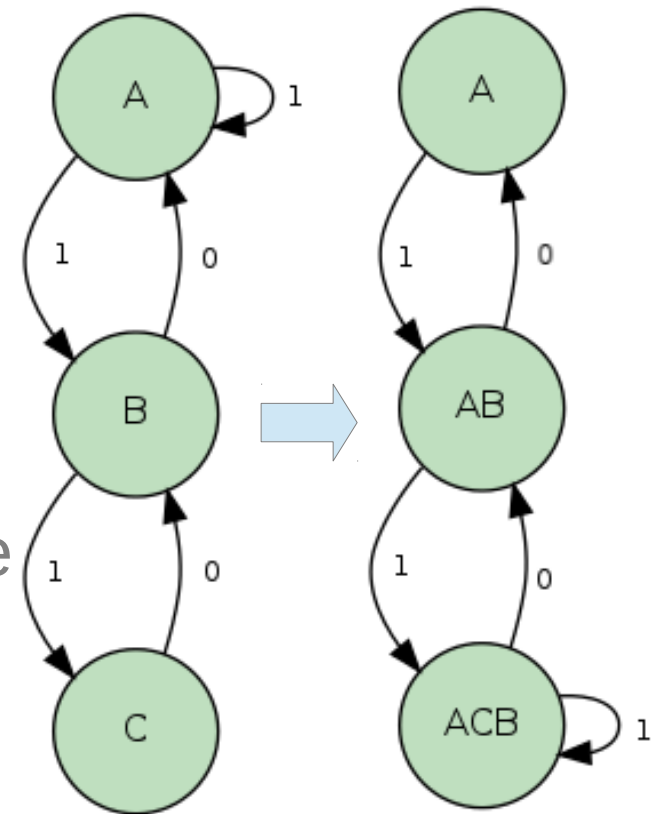
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Topological

Finding the reverse ϵ -Machine

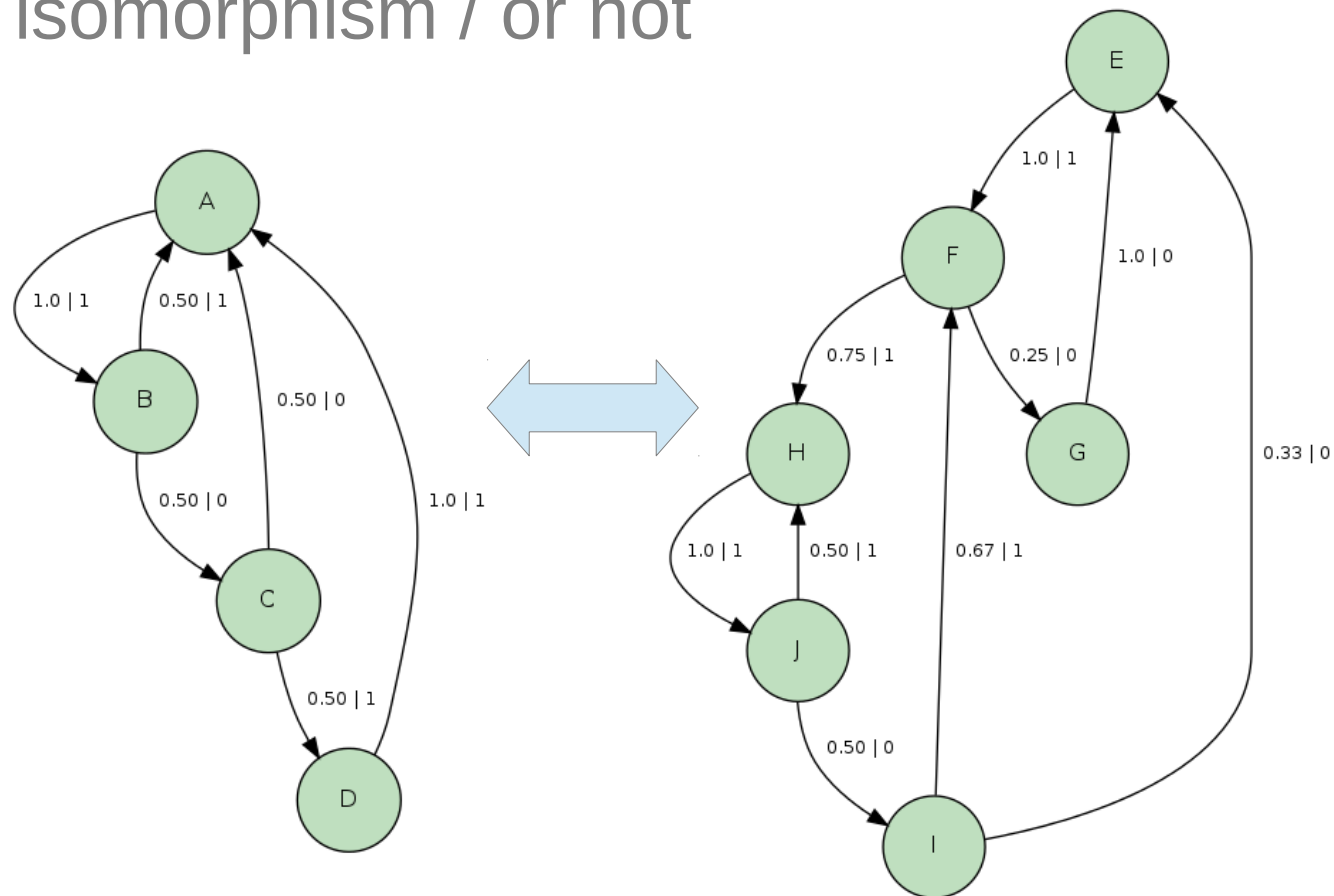
- Start with some ϵ -Machine
- Flip the arrows
- Drop probabilities
- Find the topological mixed-state machine
- Minimize ??



?? I haven't had to do this yet, and I have reversed the entire library up to 6 states

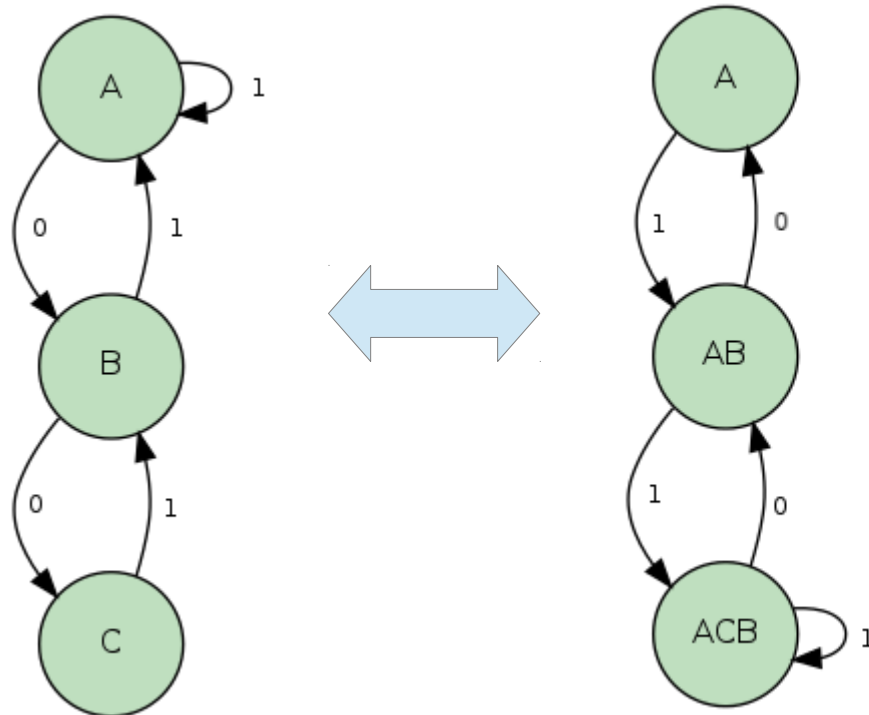
Different kinds of irreversibility

- Support driven irreversibility
- Probability driven irreversibility
- Symbol isomorphism / or not



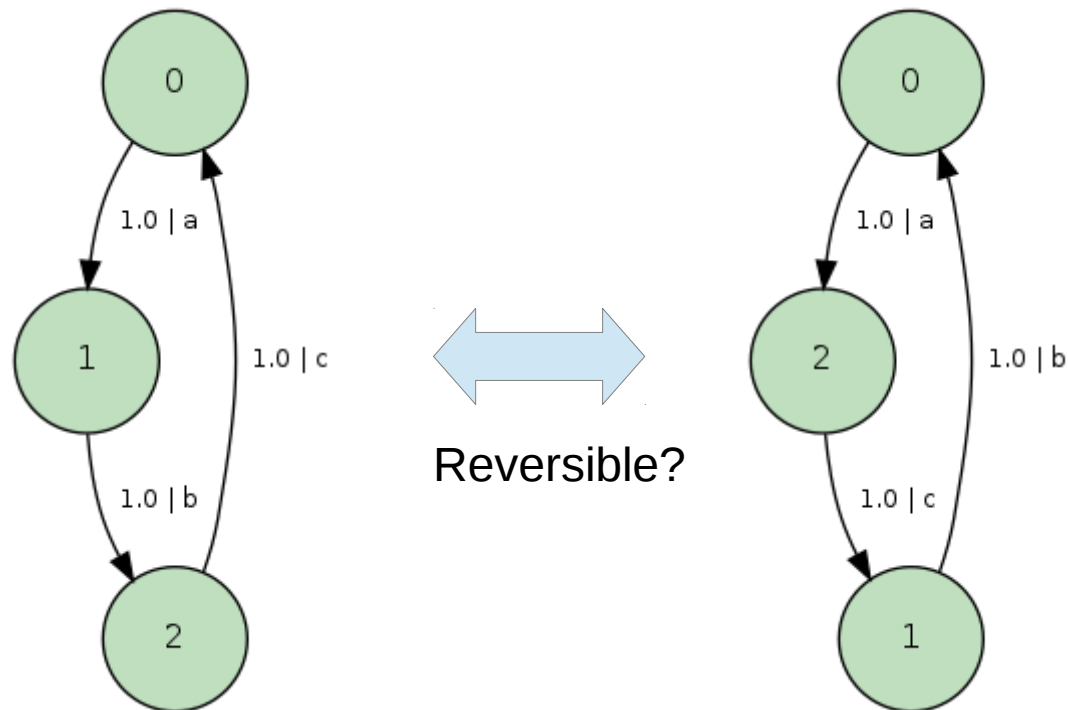
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Different kinds of irreversibility

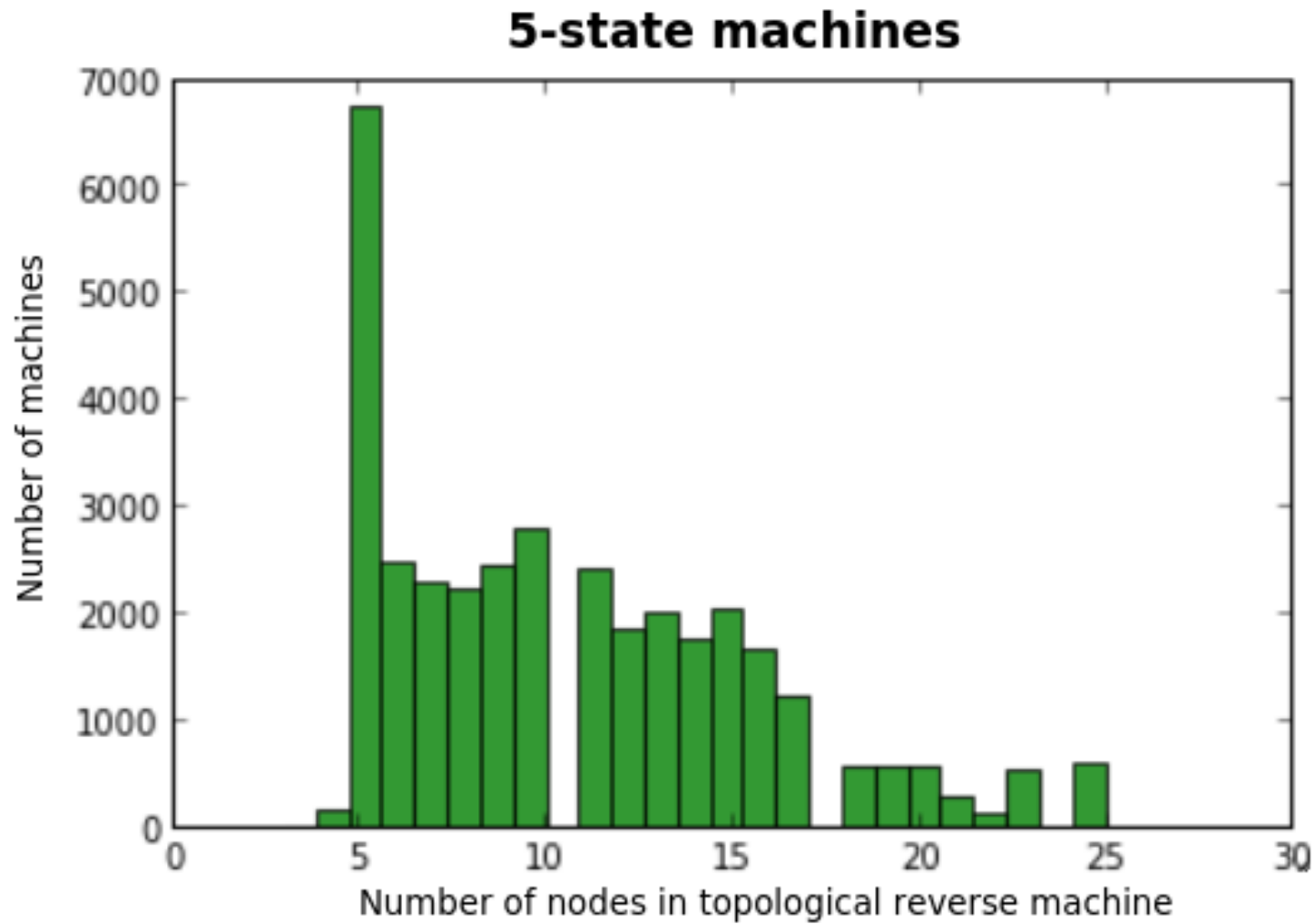
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How common is irreversibility?

States	# Machines	Reversible word support	Same number of states (top ϵM)	f- ϵM and r- ϵM share state
1	3	3	3	3
2	7	7	7	7
3	78	60 (~77%)	64 (~82%)	70 (~90%)
4	1388	364 (~26%)	590 (~43%)	1322 (~95%)
5	35186	2604 (~7.5%)	6736 (~19%)	33970 (~97%)
6	1.132.613	17108 (~ 1.5%)	84174 (~7.5%)	1111897 (~ 98%)

Number of reverse states?



Conclusion:

Reversibility

What and Why?

Thanks for listening