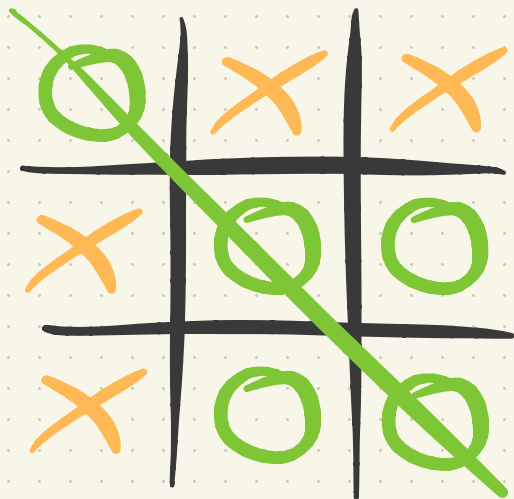


How to play in a team?

Advanced Automata Theory

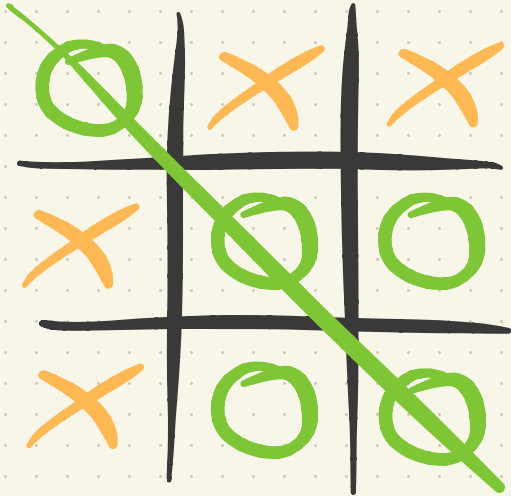


14 July 2023

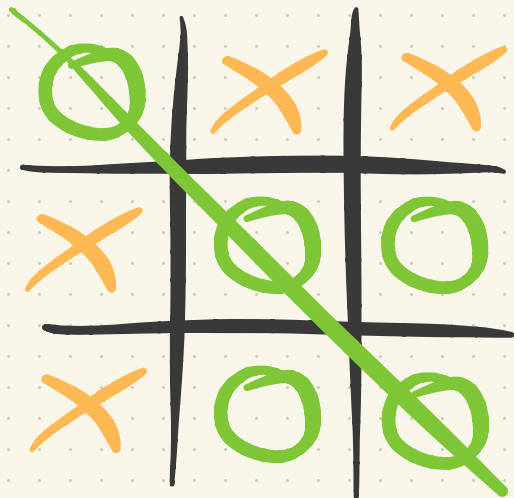
Ashwani Anand

with K. Mallik (ISTA), S.P. Nayak (MPI-SWS), and A.-K. Schüvck (MPI-SWS)

A Game



A Game

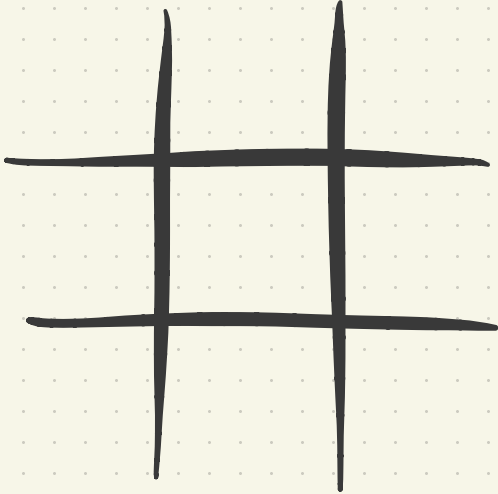


Tic-Tac-Toe,

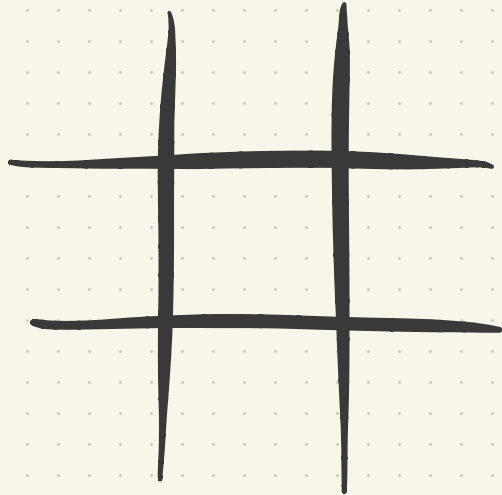
Noughts and Crosses,

Xs and Os

A Game

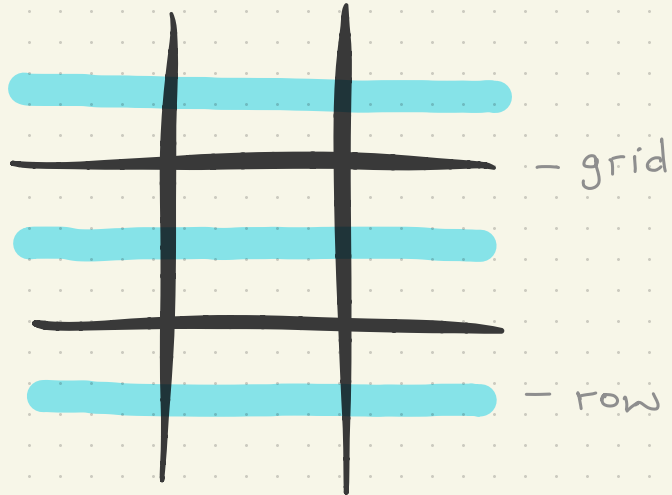


A Game

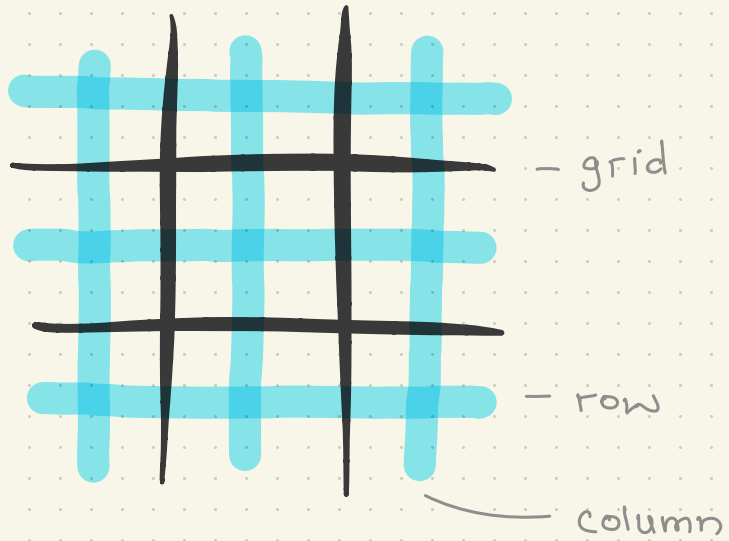


- grid

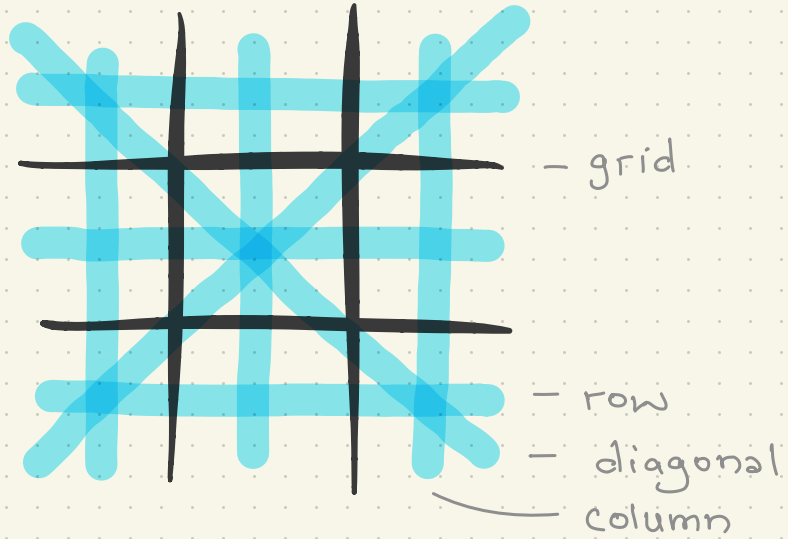
A Game



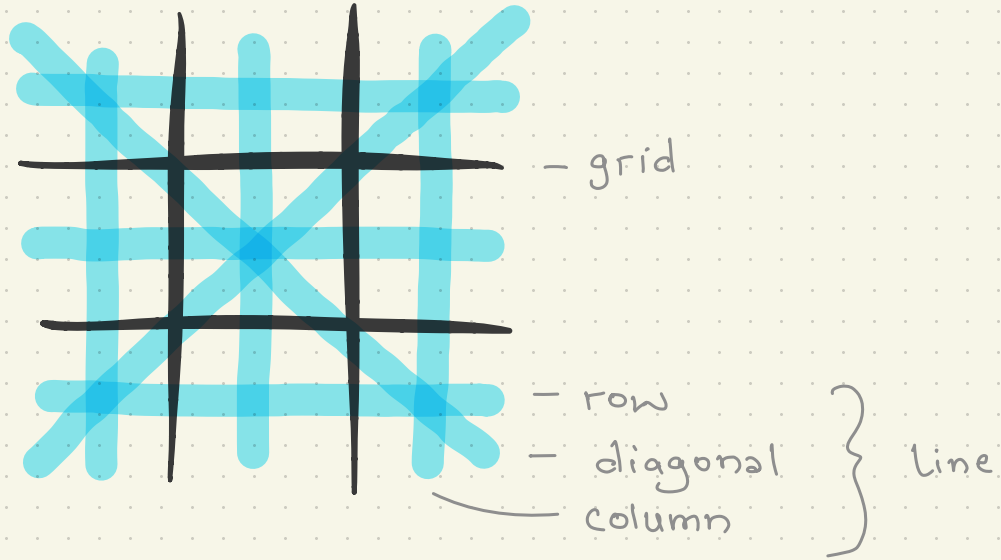
A Game



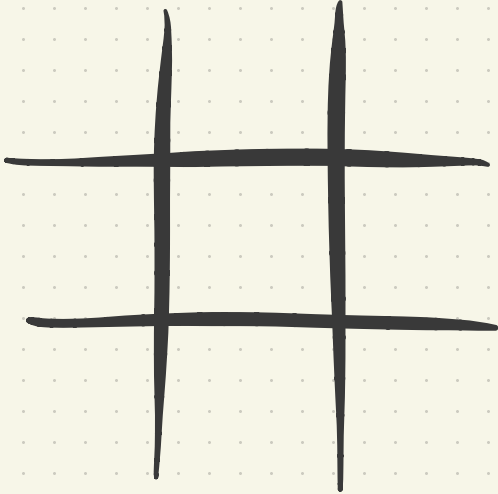
A Game



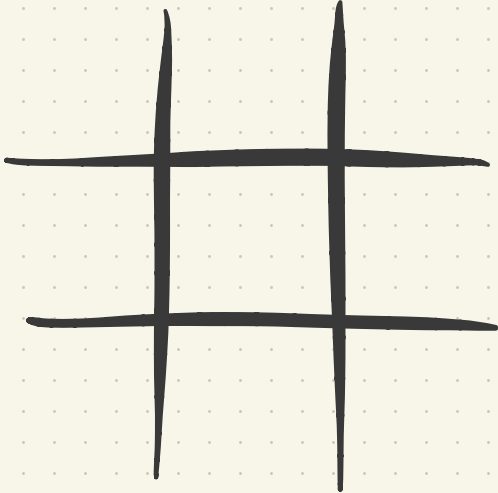
A Game



A Game



A Game



Alice



Bob

A Game

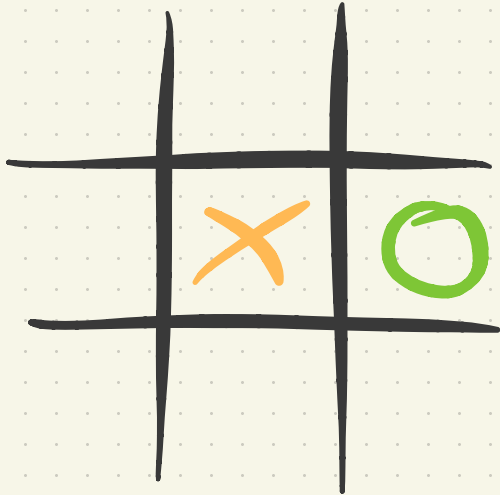


Alice



Bob

A Game

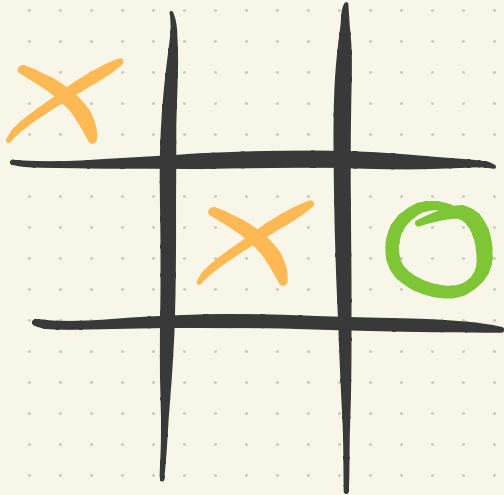


Alice



Bob

A Game

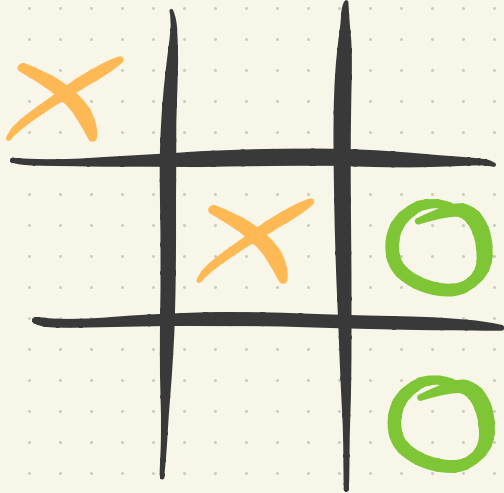


Alice



Bob

A Game

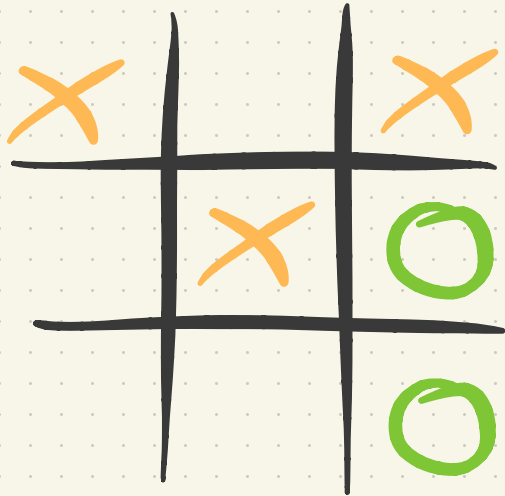


Alice



Bob

A Game

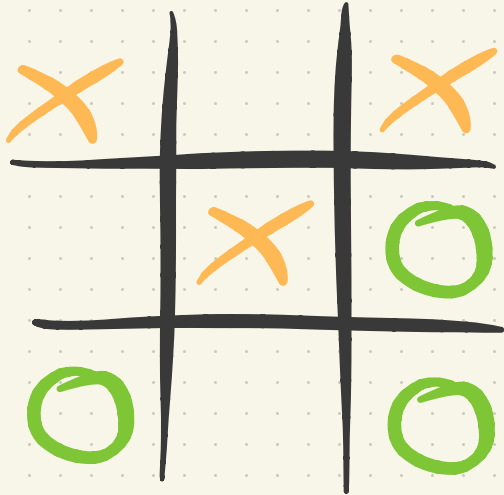


Alice



Bob

A Game

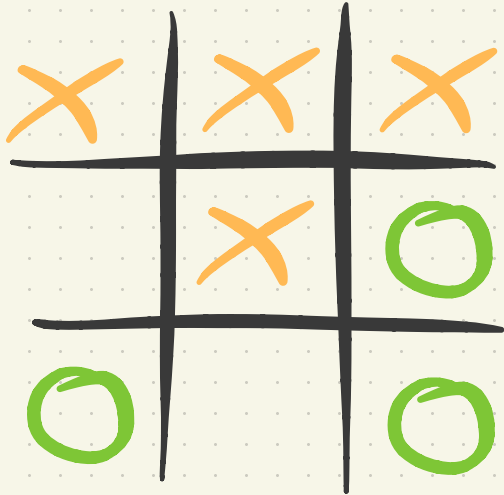


Alice



Bob

A Game

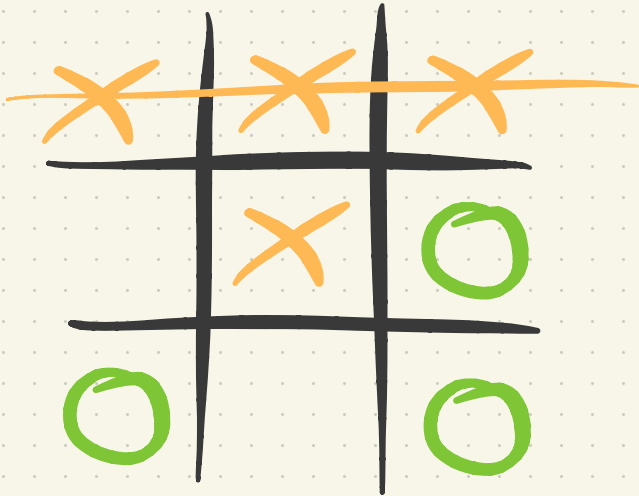


Alice



Bob

A Game

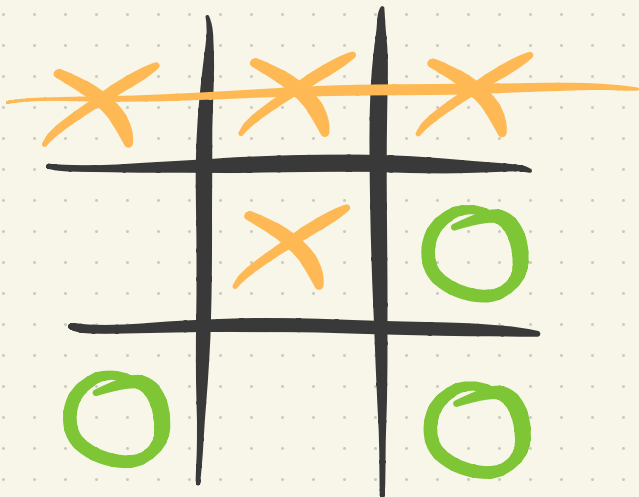


Alice



Bob

A Game



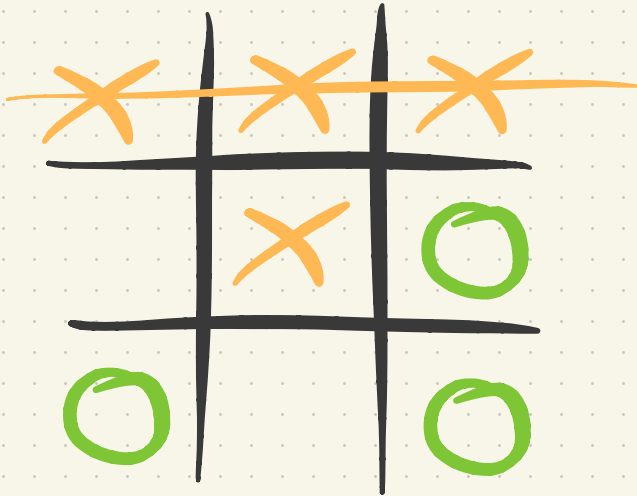
Alice



Bob

Bob wins if he fills
a "line" with 3 X's.

A Game



Alice

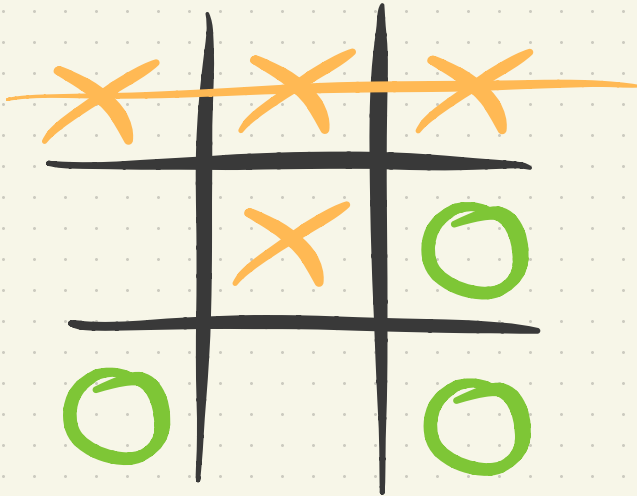


Bob

Can Bob win the game?

If yes, find a winning strategy.

A Game



Alice



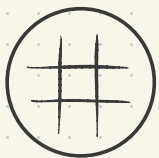
Bob

Can Bob win the game?

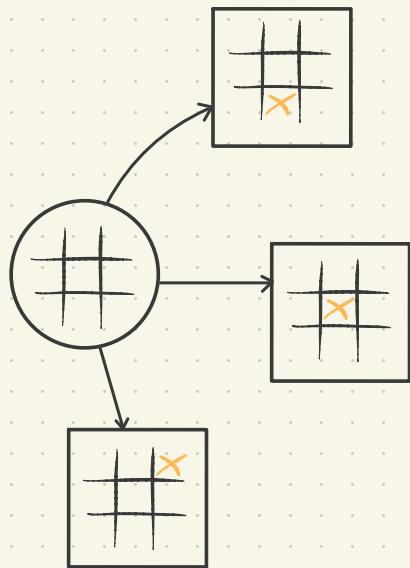
If yes, find a winning strategy.

A synthesis problem.

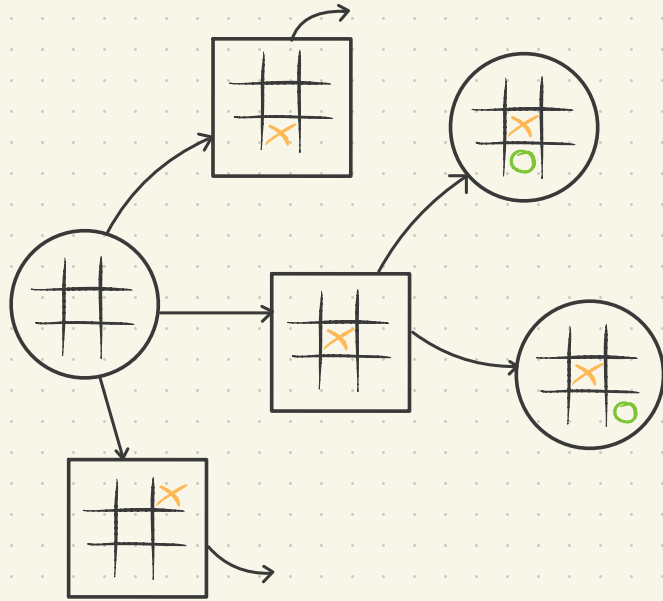
Game to Graph



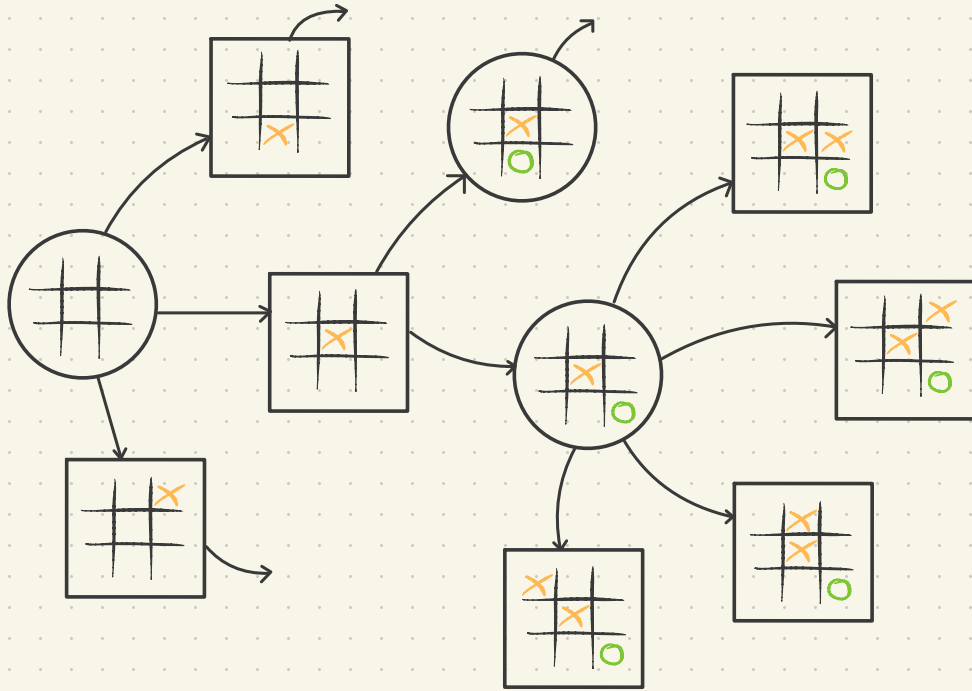
Game to Graph



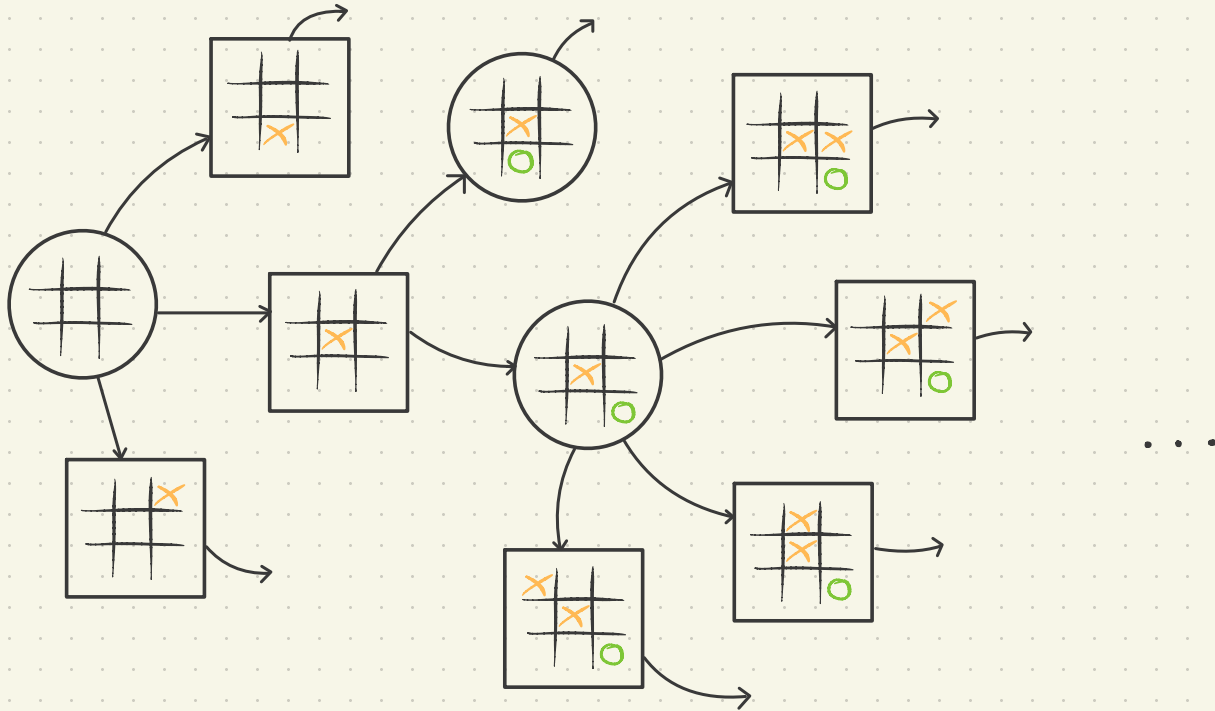
Game to Graph



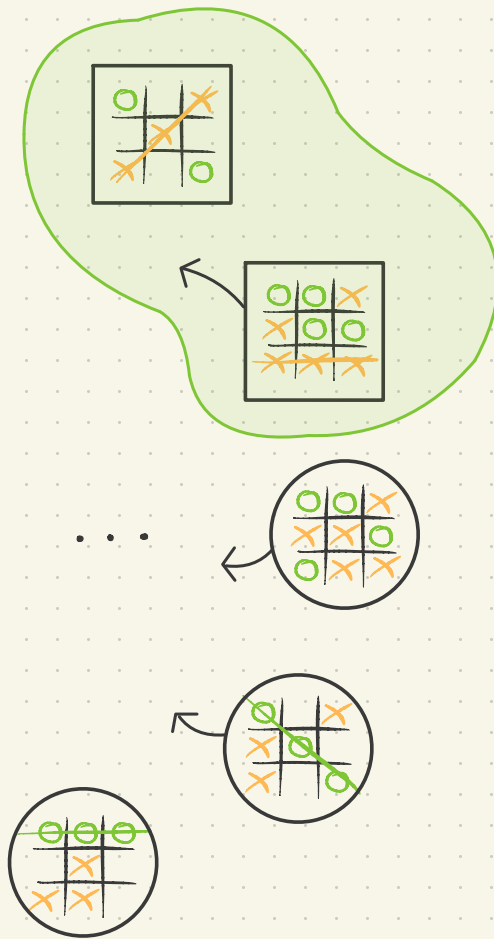
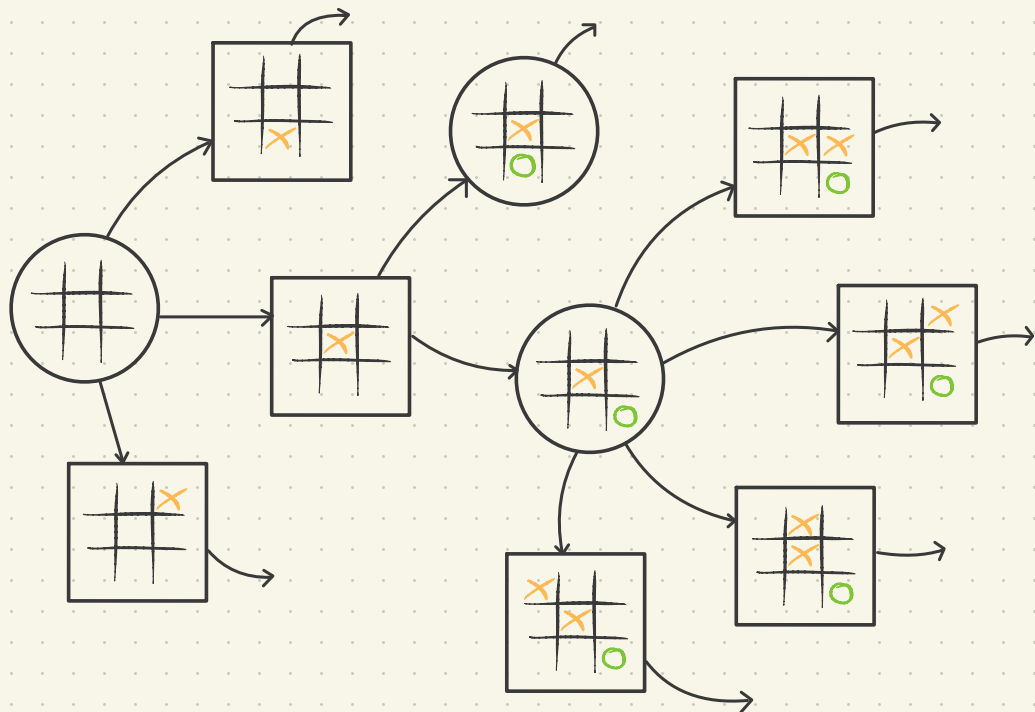
Game to Graph



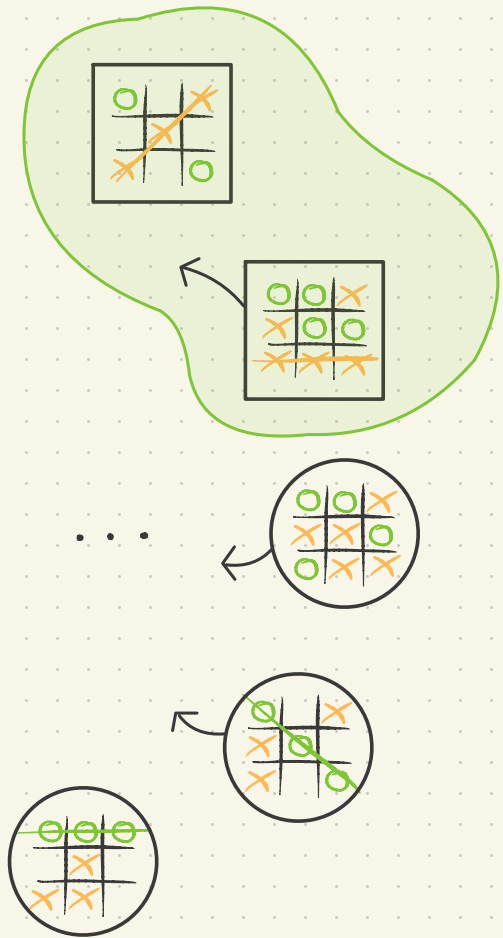
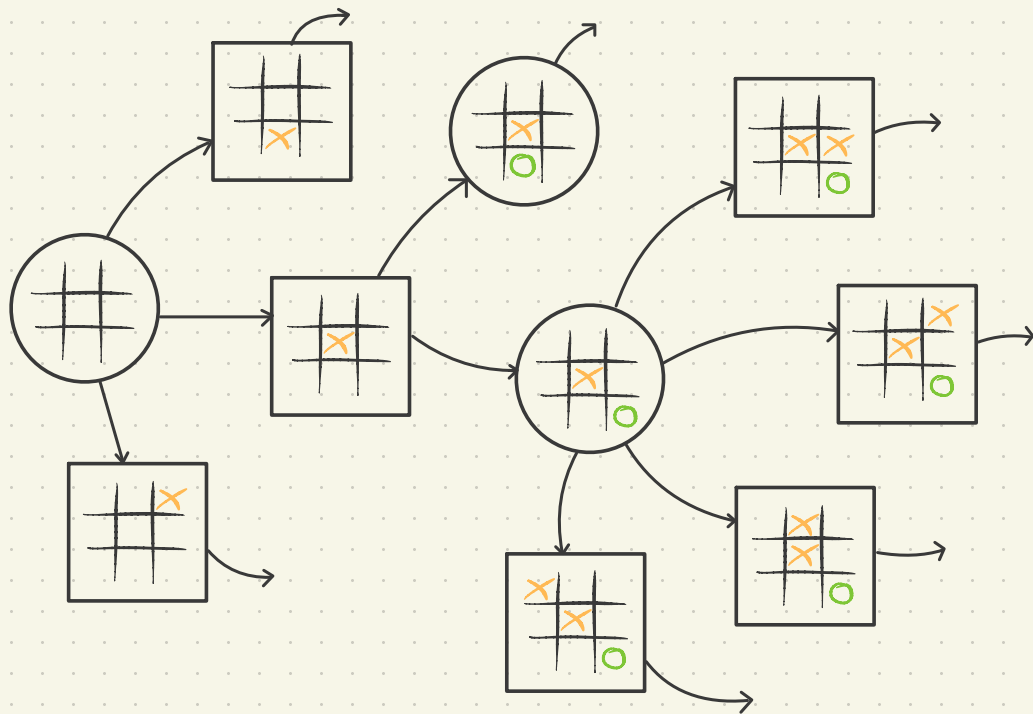
Game to Graph



Game to Graph

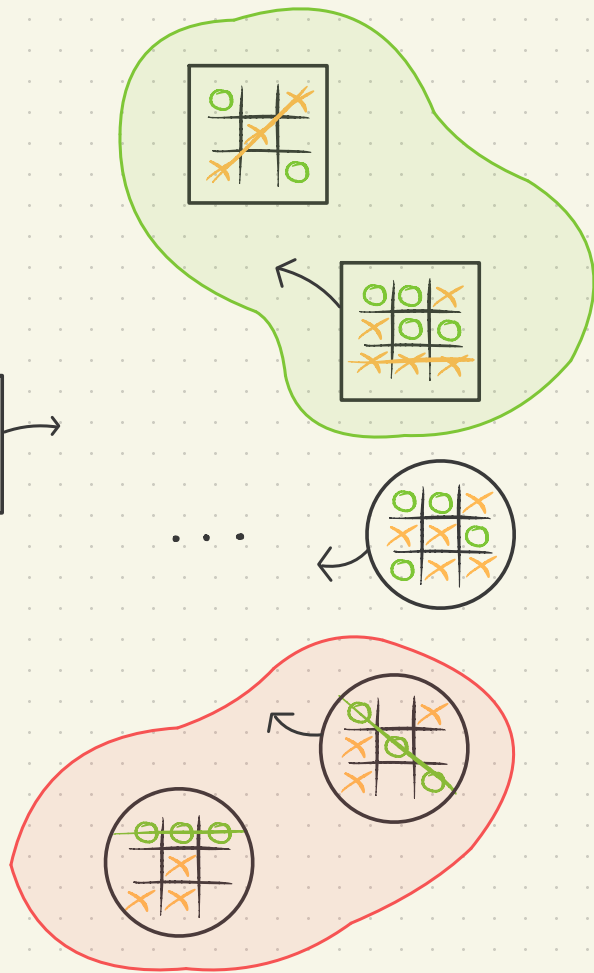
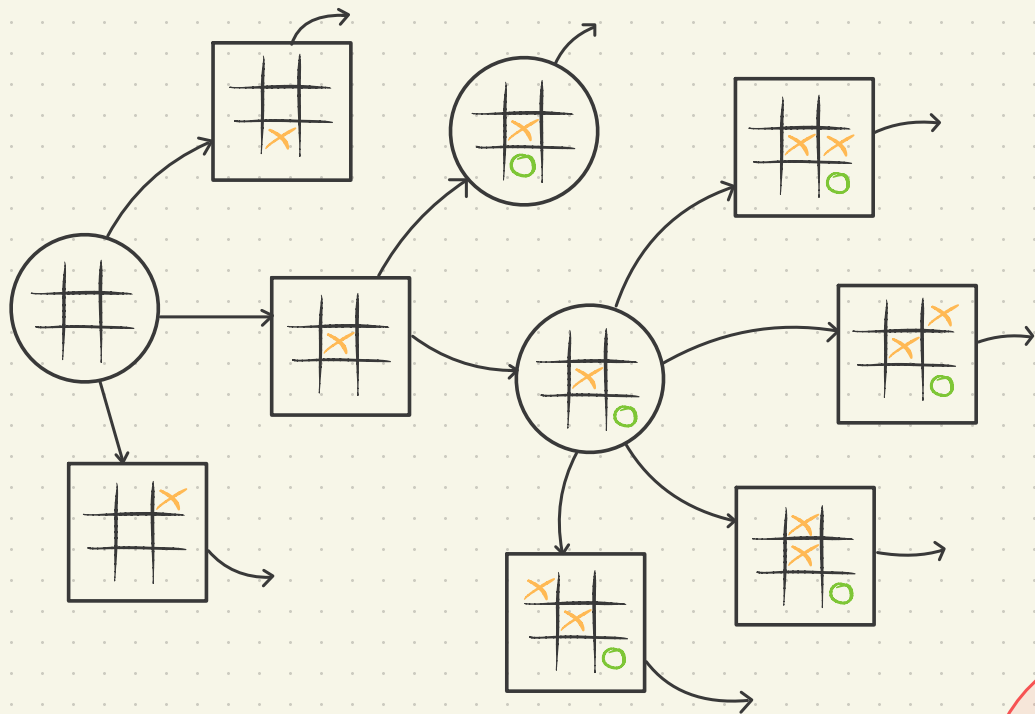


Game to Graph Game

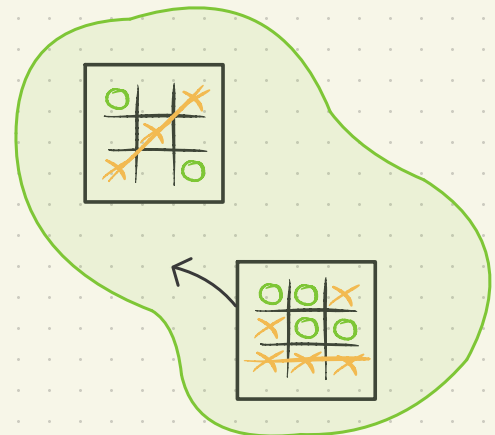
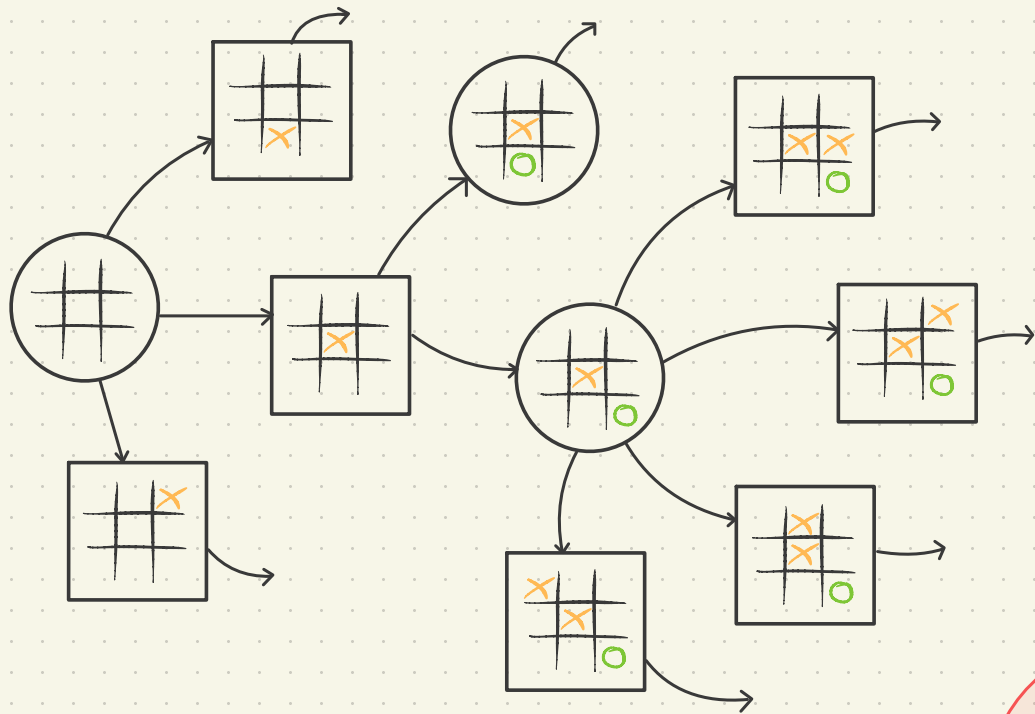


Reachability objective
Reach 

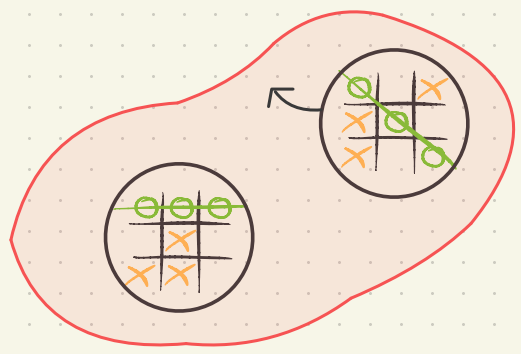
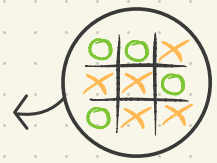
Game to Graph Game



Game to Graph Game

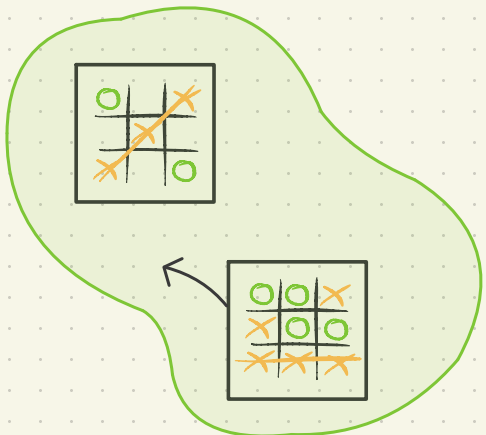
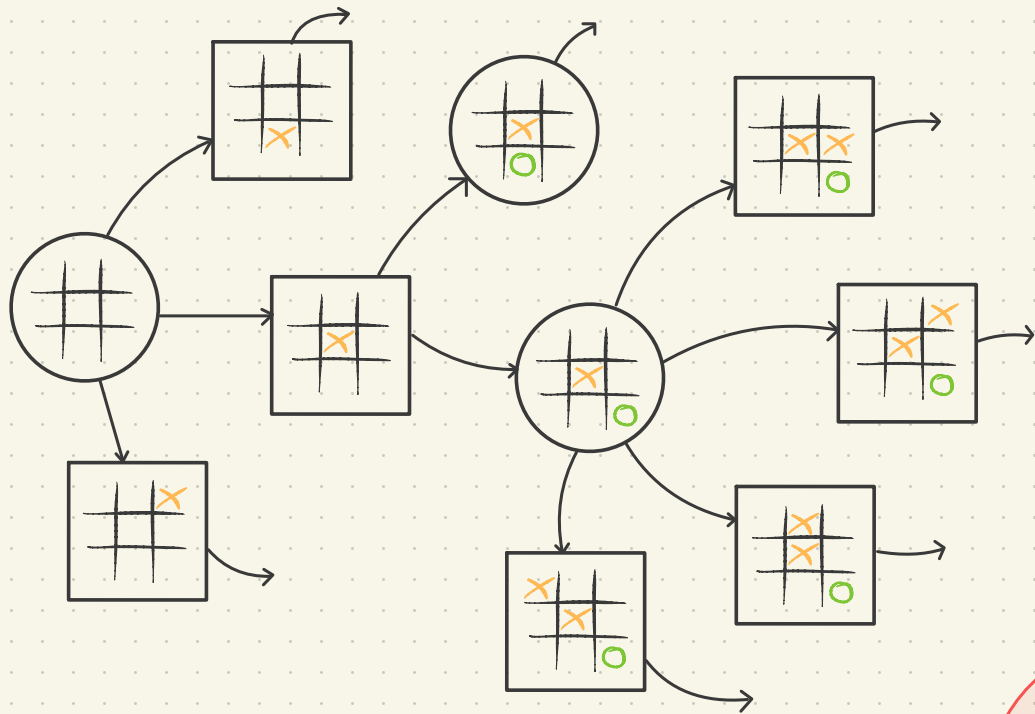


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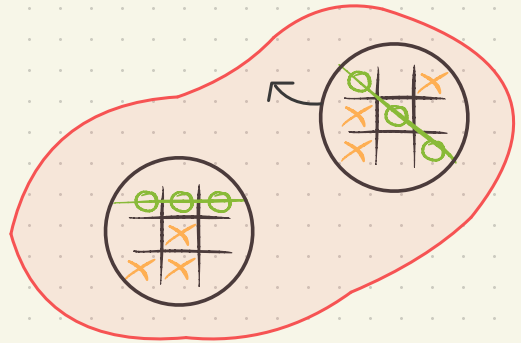
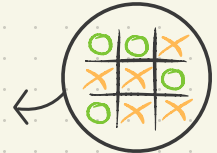


Safety objective
Never visit ☹️

Game to Graph Game

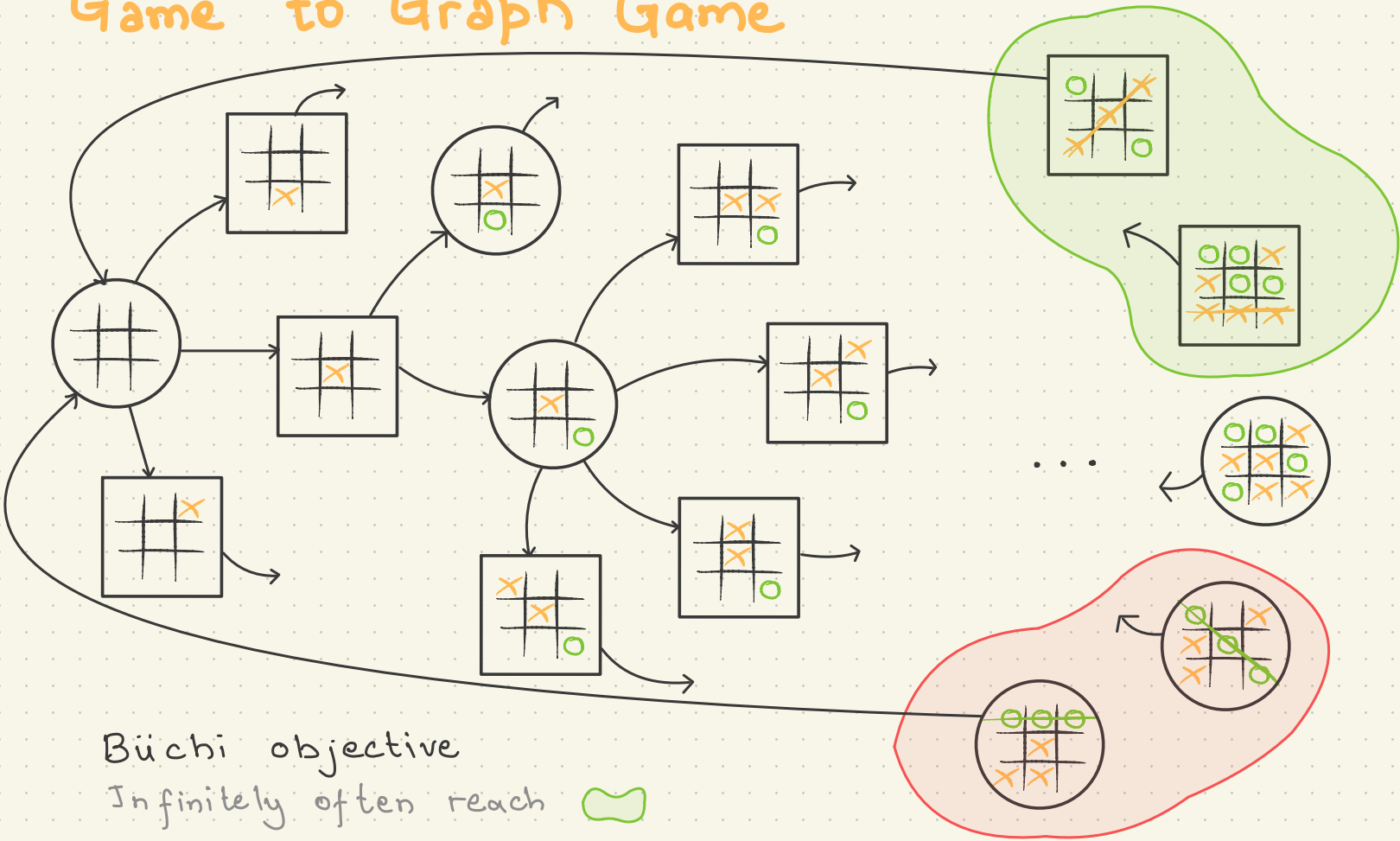


...



Safety objective
Bob can ensure winning

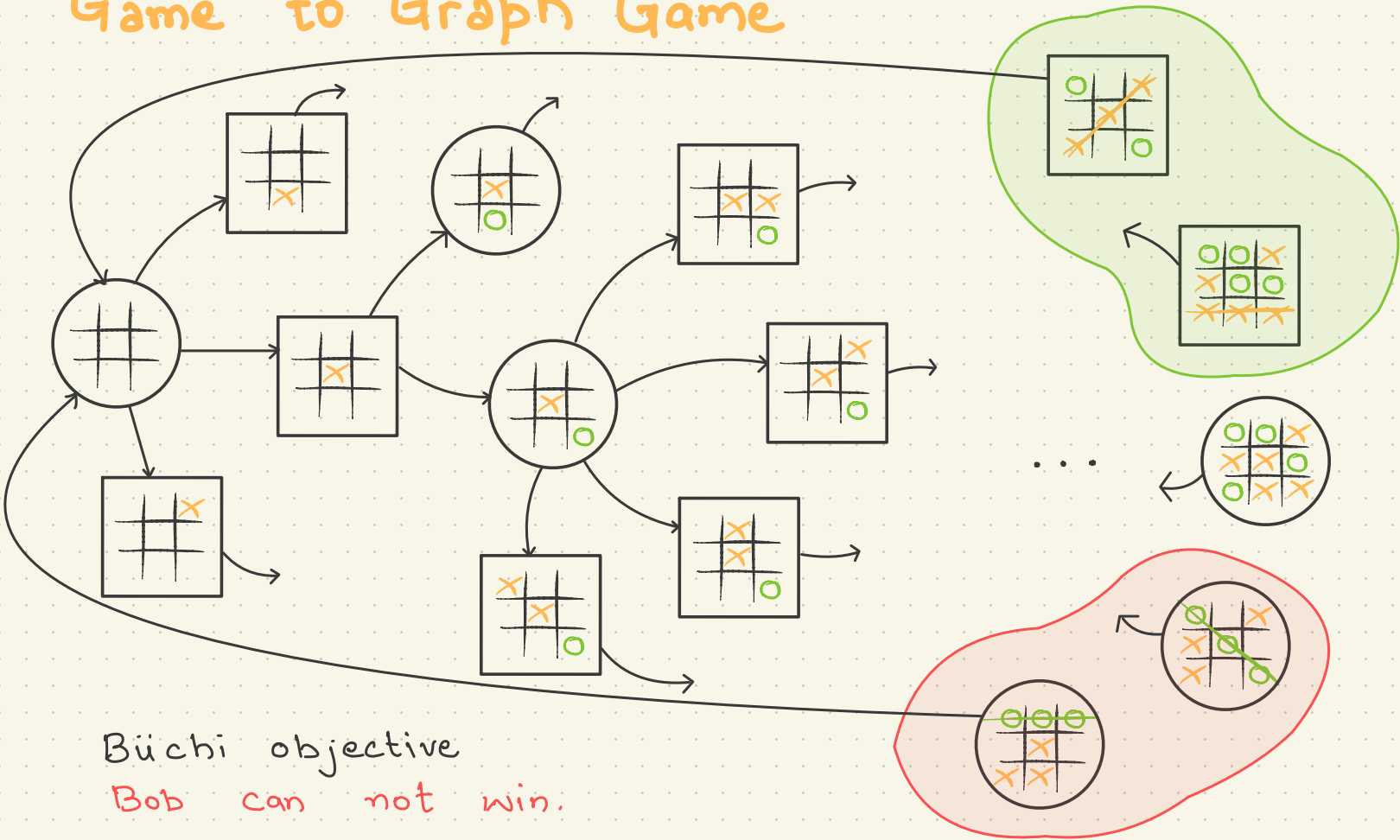
Game to Graph Game



Büchi objective
Infinitely often reach



Game to Graph Game



Büchi objective

Bob can not win.

Games with Cooperation

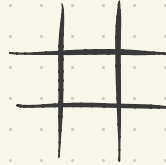


Games with Cooperation



Games with Cooperation

€ for every win



Games with Cooperation

€ for every win



I want money

Games with Cooperation

€ for every win



I want money

You can't win any game.

Games with Cooperation

€ for every win



I want money

You can't win any game.

Neither can you.

Games with Cooperation

€ for every win



I want money

You can't win any game.

Neither can you.

Ok! Let me win in my grid.

Games with Cooperation

€ for every win



I want money

You can't win any game.

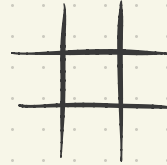
Neither can you.

Ok! Let me win in my grid.

Then let me win in my grid.

Games with Cooperation

€ for every win



I want money

You can't win any game.

Neither can you.

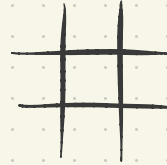
OK! Let me win in my grid.

Then let me win in my grid.

OK! Let's get rich.

Games with Cooperation

€ for every win



I want money

You can't win any game.

Not very helpful.

Neither can you.

OK! Let me win in my grid.

Then let me win in my grid.

OK! Let's get rich.

Games with Cooperation

€ for every win



I want money

You can't win any game.

Neither can you.

OK! Let me win in my grid.

Then let me win in my grid.

OK! Let's get rich.

Not very helpful.

Needs both people to solve both games.

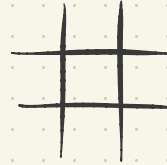
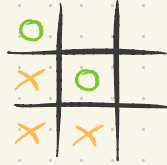
Games with Cooperation

€ for every win



Games with Cooperation

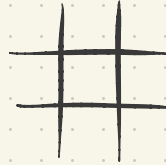
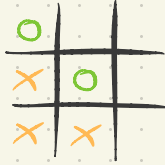
€ for every win



If there are two
○s in a line,
never put the third.

Games with Cooperation

€ for every win

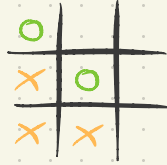


If there are two
O's in a line,
never put the third.

If there are two
X's in a line,
eventually leave the
third cell for me.

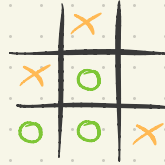
Games with Cooperation

€ for every win



If there are two
O's in a line,
never put the third.

If there are two
X's in a line,
eventually leave the
third cell for me.

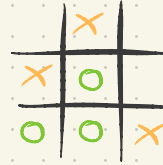
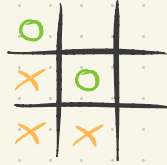


If there are two
X's in a line,
never put the third.

If there are two
O's in a line,
eventually leave the
third cell for me.

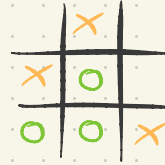
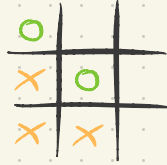
Games with Cooperation

€ for every win



Games with Cooperation

€ for every win

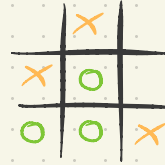


Such local requests can be computed in polytime.

- A., Mallik, Nayak, Schmuck, 2023

Games with Cooperation

€ for every win



Such local requests can be computed in polytime.

- A., Mallik, Nayak, Schmuck, 2023

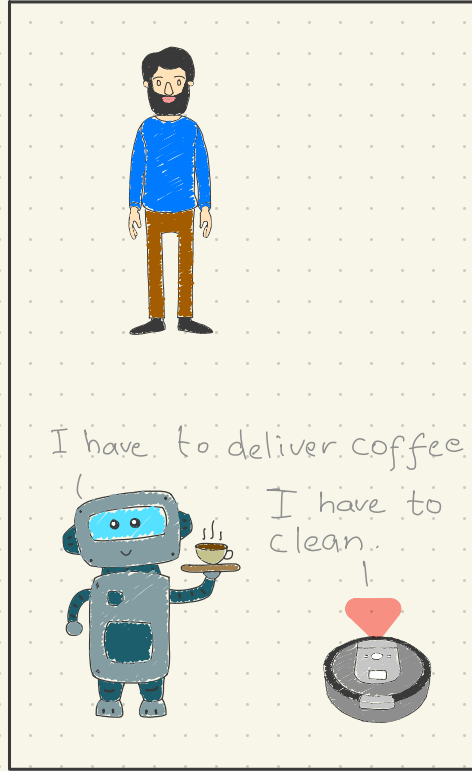
These requests can be used to negotiate a contract such that both players can satisfy their specifications

- A., Nayak, Schmuck, 2023

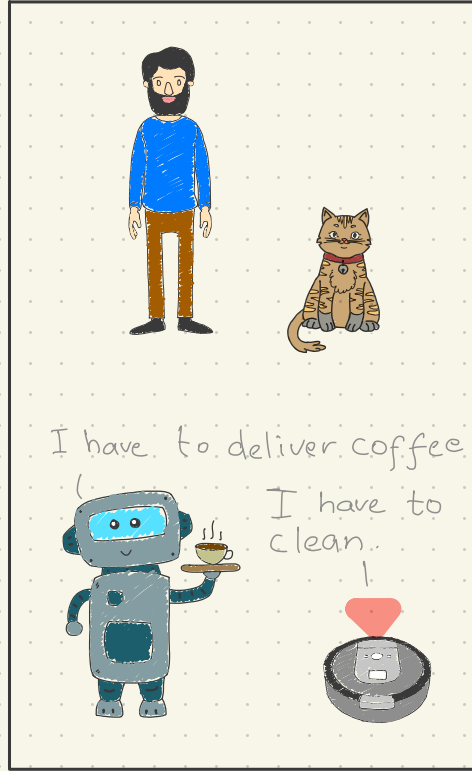
Other Applications



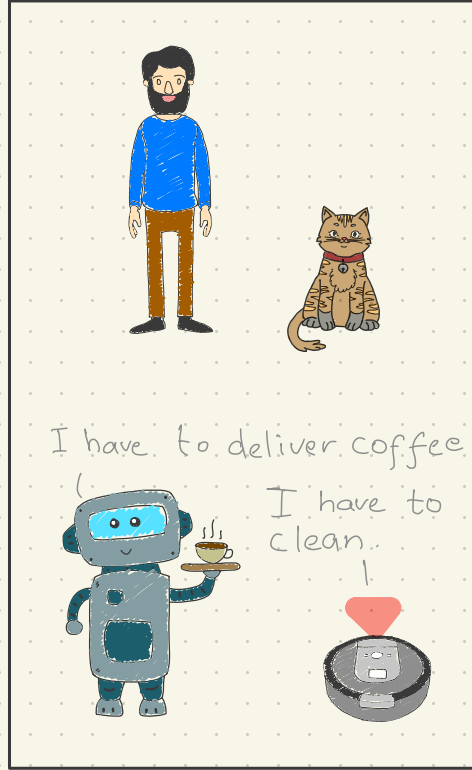
Other Applications



Other Applications



Other Applications



- 2 agents,
- working in shared environment,
- own objectives,
- willing to cooperate.

Conclusion

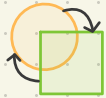


Synthesis of correct-by-construction systems

Conclusion



Synthesis of correct-by-construction systems

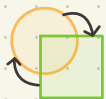


Game on graphs are important tools

Conclusion



Synthesis of correct-by-construction systems



Game on graphs are important tools

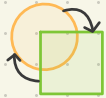


There are more games to be played

Conclusion



Synthesis of correct-by-construction systems



Game on graphs are important tools



There are more games to be played



There are more applications to be found