

Automata Architects -

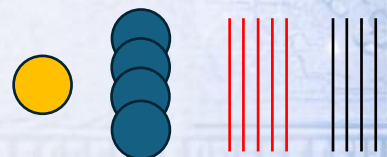
The Rules

Overview

You are newly-qualified automata architects, tasked with building Discrete Finite Automata to recognise languages, scoring points for every language you can recognise in the time limit.

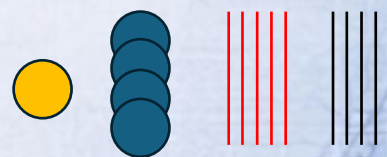
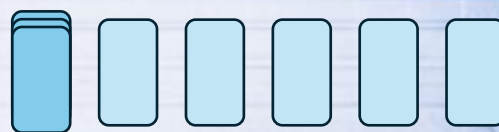
What's in the box?

- 48 language cards.
- 8 regex cards.
- 21 special protocol cards.
- 2 start states.
- 8 other states.
- 20 wires, 10 of each colour.
- 1 minute timer.



Setup

1. Give each player 1 start state, 4 other states, 5 red wires and 5 black wires.
2. Shuffle the language cards and use 20-48 of them for a 20-40 minute game (dep. on experience).
3. Deal out 5 face-up in a line next to the pile.



Learning Objectives

After playing this game, students will be able to:

- Understand what a DFA is and how it works.
- Quickly simulate a DFA to determine if a particular word is accepted or rejected.
- Adapt existing DFAs to recognise new languages.
- Construct DFAs from regexes.

Intro to DFAs

A DFA is a basic model of computation for regular languages.

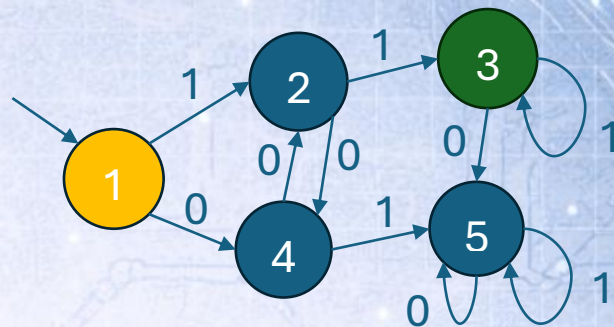
In this game, a DFA will have 5 states. One of these is designated the start state, which can't be changed. Every state must have two wires coming out of it – one for 0 and one for 1.



Inputs to this computer are strings of 0s and 1s, like 101 or 0110. When processing an input, the computer uses the wires to determine which state to go to next. At the end of the input, the computer outputs reject on a normal state and accept on an accepting state (denoted 'A').

As an example, let's run our DFA on 101.

- Start at state 1.
- Read a 1 – go to state 2.
- Read a 0 – go to state 4.
- Read a 1 – go to state 5.
- State is not accepting - reject.



Now try: 1111, 001, 1010, 00110. If you found the first two accept and the last two reject, you're ready to play!

One last thing – the starting minigame uses **regex cards**, which describe a language. This isn't anything complicated, but you will need to understand the syntax. If you're new to regex, have a look through all the regex cards now and discuss what they mean. Use this table to help.

Symbol	Meaning	Example Regex	Example Words in Language
*	Zero or more occurrences	1*	[empty string], 1, 11, 111, 111...
+	One or more occurrences	(01)+	01, 0101, 010101...
Σ	A zero or a one	Σ	0, 1

Starting Minigame

Deal each player one starting language card. Both players turn these over simultaneously and race to build a DFA accepting this language as quickly as possible. As soon as you are done, shout "done!" and step backwards, then wait for the other player to finish.

Once both players are done, check each other's DFAs:

- All words in the language must accept.
- All words that aren't in the language must reject.
- Every state must have exactly two wires coming out of it.

If both players are correct, the player who finished first wins. If just one player is correct, they win (both players work together to fix the losing player's DFA before proceeding). If neither player is correct, dismantle your DFAs, deal out two different regex cards and start again.

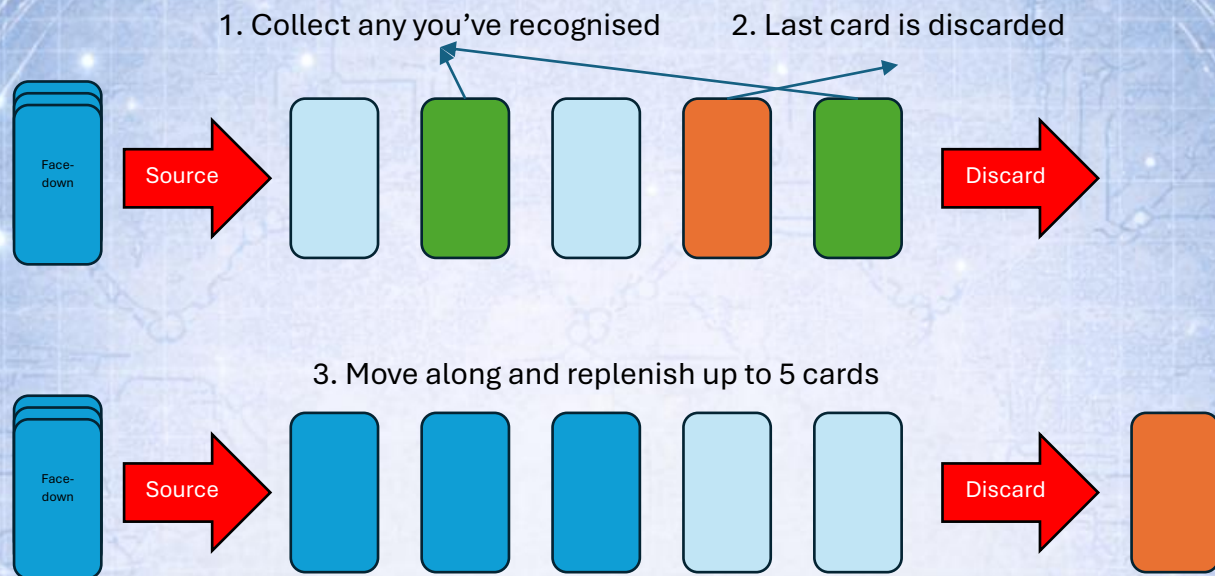
The player that wins this minigame goes first.

On Your Turn

Start a 1-minute timer. Once the timer is already running, choose **one** action:

- Move the outputs of up to *three* wires to different states.
- Swap *one* state between accepting/rejecting.
- Pass.

At the end of the 1-minute timer, both players discuss which languages are recognised – pick these cards up and keep them for scoring. The last card is now discarded, and all cards are shuffled along. Turn over new card(s) so that there are now 5 cards face-up. You can then flip the timer straight away to start your opponent's turn!



Game End

The game ends when there are no more language cards. Count how many points you have scored from your language cards – most points wins!

Special Protocols

You are advised to play without protocols on your first game.

Protocols add some excitement and reward players for advanced play. Every protocol has an explanation on the card, and a number of points in the corner – if you don't play it, add these points on at the end of the game. Protocols can be played at any time during your 1-minute time-limit. To play with protocols, simply shuffle the deck and draw using the below table:

Languages recognised	Protocols to draw
0, 1, 2	0
3	1
4	2
5	3

Attribution

Designed by Josh Humphriss.

Background image by ChatGPT.