Week One, Discussion

What can computers NOT do?

- Intuition?
  - Arguably, intuition can be programmed through deep learning
- Winograd schema

What does it mean for a computer to compute something?

- Flip bits?
- Take an input and perform an action?

What is a computer?

We have to be very precise in this definition. What is a "machine"? What is an "operation"?

A starting point is the observation that all computers occupy finite space. This finite space can occupy only a finite number of states. Given this, computers can be described as **finite state machine** (FSM) or **deterministic finite automata** (DFA) where state transformations are binary data.

FSM/DFAs

An FSA/DFA model *how we move through a graph* given an input and cover the class of **decision problems** which is defined as:

```
f: X -> Y is a decision problem iff:
Y = {0, 1} = {NO, YES} = {Rejecting, Accepting}
```

i.e. a decision problem is any problem which maps inputs to either a "yes" or a "no."

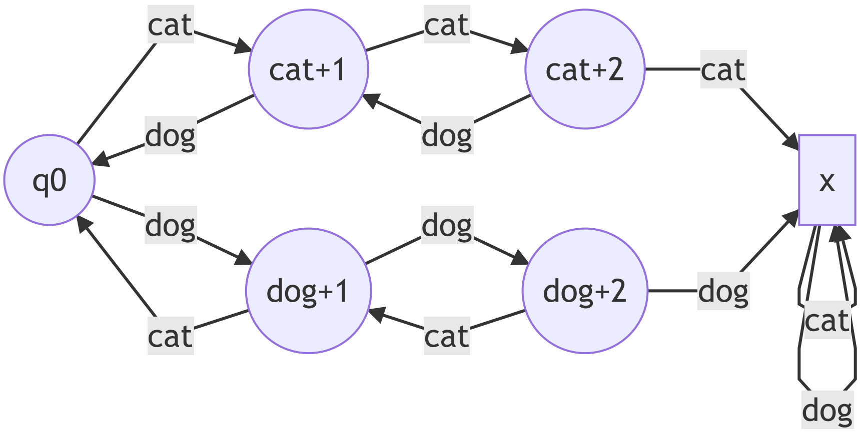
Alphabet = Nonempty finite set of symbols **Language** = The set of strings that an FSM/DFA will accept

- A language of only zeroes can be defined as `L = {0^n | n ε N_0}`

DFA is defined by the following parameters:

- Q = a set of states (i.e. the nodes in the DFA)
  - ex: Q = {q0, q1, q2}
- ∑ = finite alphabet (i.e. the possible symbols in our input)
  - ex: ∑ = {0, 1}

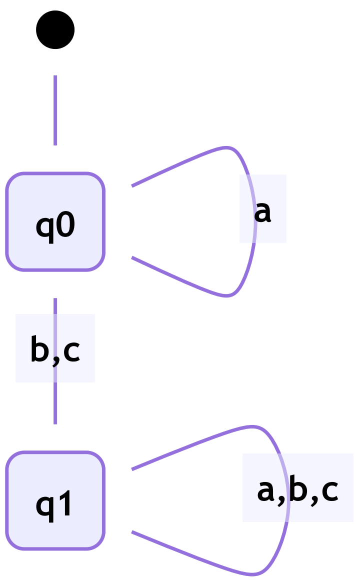
- q0 = initial state
- ∂ = transition function such that `∂ : Q x ∑ -> Q` where `x` is the Cartesian product
  - `x` : {q0, q1} x {0, 1} = {(q0, 0), (q0, 1), (q1, 0), (q1, 1)}
  - ∂ has "two inputs": a state and the next symbol
  - i.e. ∂ is a pure function which transitions to the next state solely from the current state and the next symbol
- F = accepting states (F is a subset of Q of just the accepting states)
  - so, Q - F = rejecting states

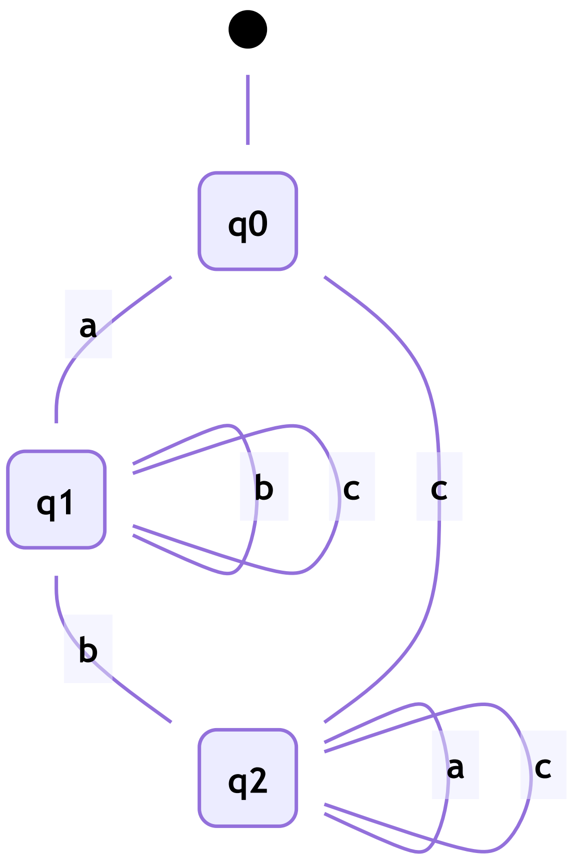


Let ∑ = {a, b, c}. Create a DFA that decides the language `L = {w = xyz | x ε {a}*, y ε {abc}*, z ε {c}*}`.

Sample input:

```
aaa...aabcabcabc...abcccc...c
^x     ^y               ^z
```




q0
a
c
q1
b
c
b
q2
a
c