$$(0+1) = \{0\} \cup \{1\} = \{0,1\}$$

$$0 \in \underset{\varepsilon}{(0+1)^*}\ \underset{0}{(0+1)^*}$$

$$\Big(\underbrace{(0+1)(0+1)}\Big)^*$$

$$(00+01+10+11)^*$$

## Regular Languages

A language $L$ is regular if and only if:

- $L = \emptyset$
- $|L| = 1$
- $L = A \cup B$ for $A, B$ regular
- $L = A \circ B$ for $A, B$ regular
- $L = A^*$ for reg. lang. $A$

## Questions

Are all languages regular?

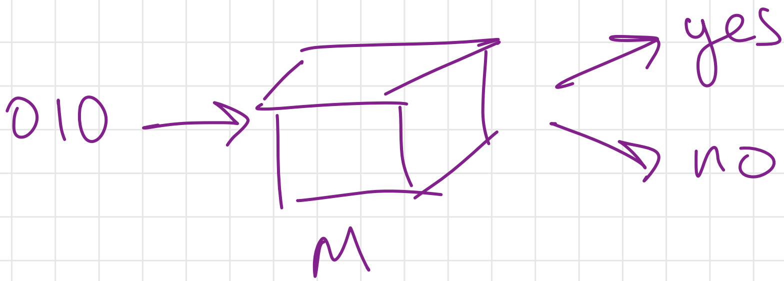
If not, what kinds of langs are 'regular'?

Is the set of all Python programs printing "Hello, world" regular?

Is the set of all binary represent. of even integers regular?

↳ div by k?

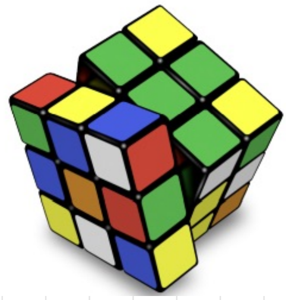
## Finite State Machines




$L(M)$ = the set of all strings accepted by $M$

"the language of $M$"

"$M$ recognizes $L$"



machine to recognize

$L = \{w \in \{0,1\}^* : |w| \bmod 5 = 0\}$

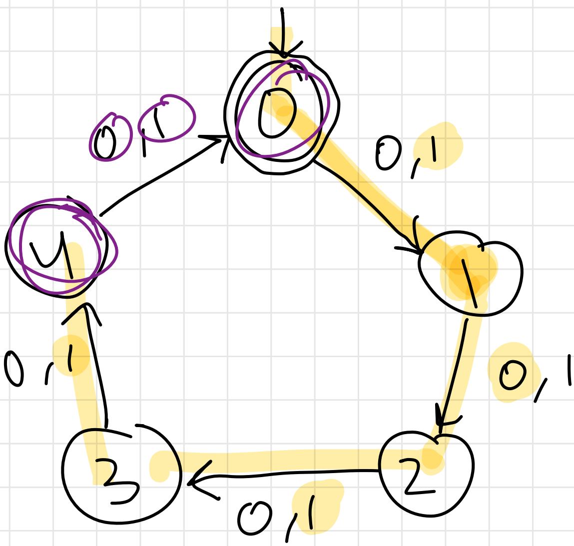
$\varepsilon$ ✓

01 ✗

```
rem = 0
for i = 1 to i = |w| :
    rem = (rem+1) mod 5
return (rem == 0)
```

= M

## Deterministic Finite Automata (DFAs)

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$Q$ : set of states $\{0,1,2,3,4\}$

$s \in Q$ : start state $0$

$\Sigma$ : input alphabet $\{0,1\}$

$A \subseteq Q$ : accepting states $\{0\}$

$\delta : Q \times \Sigma \to Q$ transition function

takes in (state, symbol)

maps to state

$\delta(2,1) = 3$

$\delta$ :

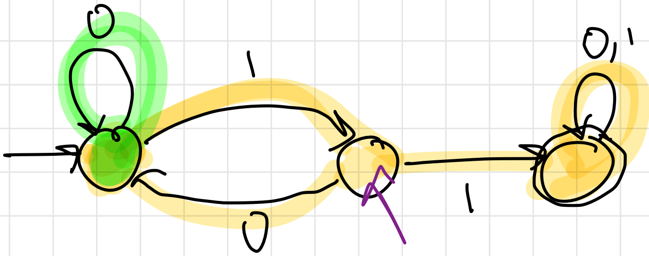
| | 0 | 1 |
|---|---|---|
| 0 | 1 | 1 |
| 1 | 2 | 2 |
| 2 | 3 | 3 |
| 3 | 4 | 4 |
| 4 | 0 | 0 |

state symol

$$\delta(q, a) = (q+1) \bmod 5$$

with table:

what strings does this machine accept?

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ε

0 0

what do the states mean?