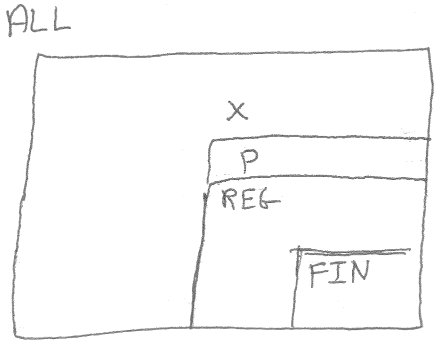
8-1



REG = DFA = NFA = REX

$\exists x \in ALL.\ x \notin REG.$

"A set that can be defined but not by a DFA."

"A problem not solvable by a real computer" (even if it had the whole universe as memory)

Suppose x were "Foo" $y \in REG := \exists d \in DFA.\ L(d) = y$

↳ $x \notin REG := \forall d \in DFA.\ L(d) \neq x$

a. Make P. $P : Lang \to Prop$

1. $\forall d \in DFA.\ P(L(d))$ (Make P.) $P' : DFA \to Prop$

2. $\neg P(x)$

"There is a start state." (about DFAs, invalid)

"Has one element only." (not universal to DFAs)

"Has a finite # of elements." "

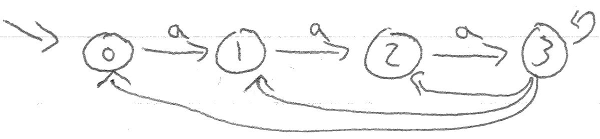
"Has zero or more elements"

"Has a countable # of elements"

DFAs have finite states ⇒ X about the language of the DFA

Suppose d has 4 states. How many are visited with string ~~0000~~ 00?

[1, 3]   000? [1, 4]   0000? [1, 4]



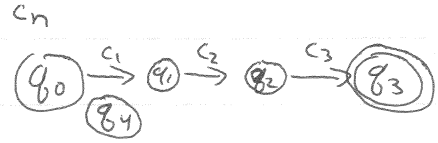
Machine always runs out of states

w # visit is $[1, \min(|Q|, |w|+1)]$

DFAs must have loops on paths longer than $|Q|-1$

Suppose w is accepted. $w = c_0 \dots c_n$

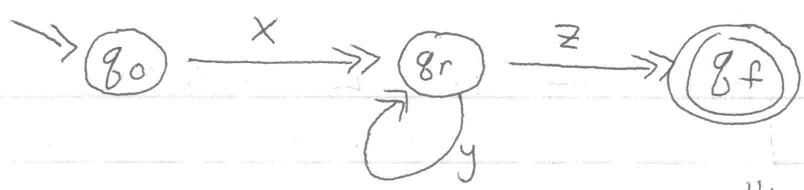
If $n < |Q|-1$: there might not be a loop



If $n \geq |Q|$: there must be a loop (some state repeats)

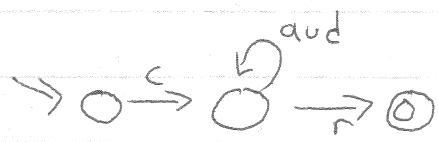
8-2

$w \in L(d)$ and $|w| \geq |Q| \implies$



$w = x \circ y \circ z$

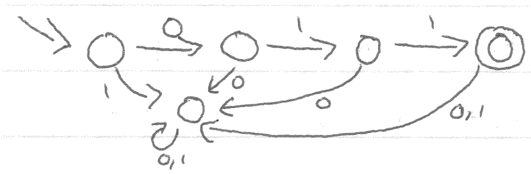
x is "before the 1st occ of qr"
y is "before the 2nd occ of qr"
z is "after the 2nd occ"



car ∈   cdr ∈   cadr ∈, caar ∈ cddr ∈ $x = c$ $y = ad$ $z = r$

Therefore : $xyyz \in L(d)$ also!   cadadr ∈

$\forall i \in \mathbb{N}.\ xy^iz \in L(d)$



$L(\cdot) = \{011\}$

$P'(\text{DFA } d) :=$

$\forall (w \in L(d) \mid |w| > |Q^d|).$

$\exists (xyz \in \Sigma^* \mid w = xyz).$ $|y| > 0$, $|xy| \leq |Q|$

$\forall (i \in \mathbb{N})$

$xy^iz \in L(d)$

$P'(d) = P(L(d))$ w/ $p = |Q| + 1$

$P(\text{Lang } A) :=$

$\exists p \in \mathbb{N}.$

$\forall (w \in A \mid |w| \geq p).$

$\exists (xyz \in \Sigma^* \mid w = xyz).$ $|y| > 0$, $|xy| \leq p$

$\forall (i \in \mathbb{N}).$

$xy^iz \in A$

Regular Pumping Property = RPP

8-3 / $\exists x \in ALL.\ \neg RPP(x).$

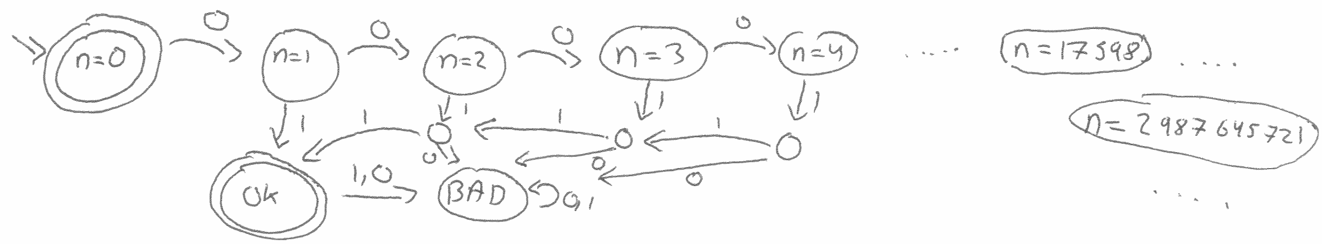
$\{(([\ ]))\}$ — PLs have balanced delims

$((((()))))$ — One kind is enough

$(()(()))$ — real-PLs have them mixed but balanced

$(^n\ )^n$ — first special case

$0^n\ 1^n$ — more readable




```
int n=0;
while (getc() = '0') {n++;}
while (getc() = '1') {n--;}
return (n==0)
```

$\neg(A \wedge B) = \neg A \vee \neg B$

$\neg(A \vee B) = \neg A \wedge \neg B$

$\neg(\neg A) = A$

$\neg(\forall x.\ A) = \exists x.\ \neg A$

$\neg(\exists x.\ A) = \forall x.\ \neg A$

$\neg RPP(\{w \in \{0,1\}^* \mid w = 0^n 1^n \text{ for some } n \in N\})$

RPP:	¬RPP:
$\exists p \in N$	$\forall p \in N.$
$\forall (w \in A \mid \lvert w\rvert \geq p)$	$\exists (w \in A \mid \lvert w\rvert \geq p)$
$\exists (xyz \in \Sigma^* \mid w = xyz \wedge \lvert y\rvert > 0 \wedge \lvert xy\rvert \leq p)$	$\forall (xyz \in \Sigma^* \mid w = xyz \wedge \lvert y\rvert > 0 \wedge \lvert xy\rvert \leq p)$
$\forall (i \in N)$	$\exists (i \in N)$
$xy^iz \in A$	$xy^iz \notin A$

Given: a p