Part 4 out of 4

Last week, we showed the
equivalence of DFA, NFA and REX

is equivalent to

$$\text{DFA} \asymp \text{NFA}$$

$$\asymp$$

$$\text{REX}$$

We also started to look at
non-regular languages

Pumping lemma

If A is a regular language, then

there exist a number p s.t.

Any string in A whose length is at least p

can be divided into three pieces xyz s.t.

- $xy^iz \in A$, for each $i \geq 0$ and
- $|y| > 0$ and
- $|xy| \leq p$

To prove that a language A is not regular:

1. Assume that A is regular
2. Since A is regular, it must have a pumping length p
3. Find one string s in A whose length is at least p
4. For any split $s=xyz$,
   Show that you cannot satisfy all three conditions
5. Conclude that s cannot be pumped

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1 Assume that A is regular

2 Since A is regular, it must have a pumping length p

3 Find one string s in A whose length is at least p

4 For any split $s=xyz$,
Show that you cannot satisfy all three conditions

5 Conclude that ***s* cannot be pumped** → **A is not regular**

Wait…

What happens if A is a finite language?!

Pumping lemma

If ***A*** is a regular language, then

there exist a number p s.t.

Any string in A whose length is at least p

can be divided into three pieces xyz s.t.

- $xy^iz \in A$, for each $i \geq 0$ and
- $|y| > 0$ and
- $|xy| \leq p$

Pumping lemma

If ***A* is a regular language**, then

there exist a number *p* s.t.

As we saw two weeks ago,

all finite languages are regular…

So what's ***p***?

p **:= len(longest_string) + 1**

makes the lemma hold vacuously

Non-regular languages are not closed under most operations

if L_1 and L_2 are regular,

then so are

$L_1 \cup L_2$

$L_1 . L_2$

L_1^*

if L_1 and L_2 are not regular,

then

$L_1 \cup L_2$

$L_1 . L_2$

L_1^*

may or may not be regular!

$(L_1)^C$ is not regular

non RL are closed under complement

This week is all about

Context-Free Languages

a superset of Regular Languages