L = { <R1, R2> | R1, R2 are regular expressions over the operations concat, union, * and square and L(R1) = L(R2) }

$$w^2 = ww \qquad (ww)^*$$

$$(w^2)^2 = wwww$$
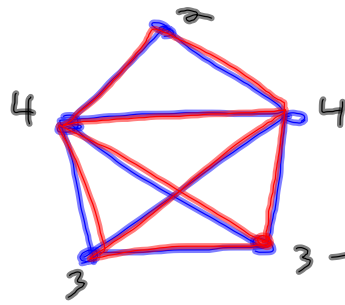
the class P
  – problems solved in
      polynomial time.

$$P = \bigcup_k TIME(n^k)$$

Problem: sort a list
algorithm: bubble sort $O(n^2)$
quick sort $O(n^2)$
merge sort $O(n \log n)$
heap sort $O(n \log n)$

NP : non-deterministic
polynomial.

Euler paths

visit each edge
exactly once

a

4   4

3   3 — degree of node

in P

Hamiltonian Path
- go through each node
  exactly once

currently no one has
found an algorithm in
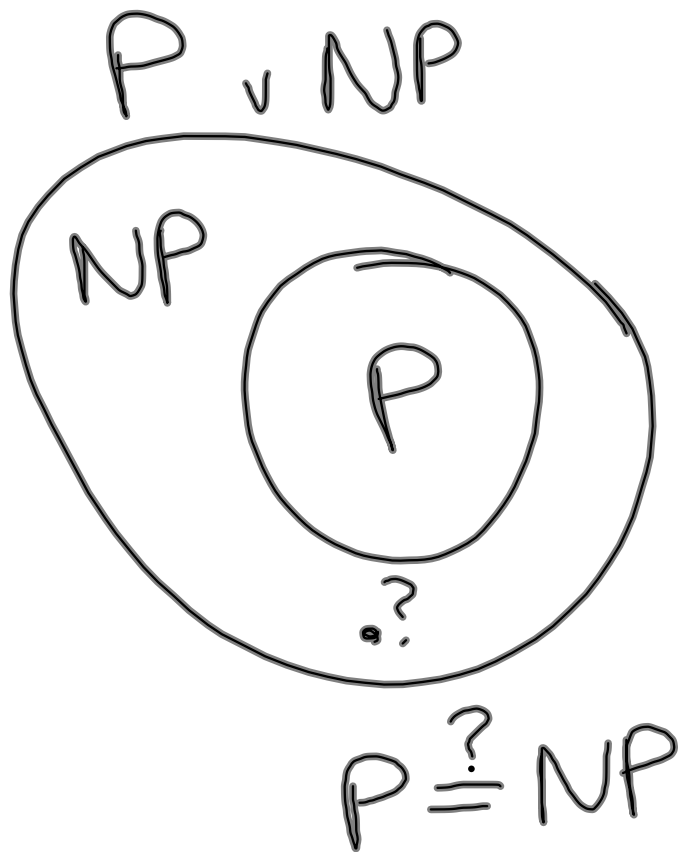P for Hamiltonian paths.

Exponential algorithm
- for each ordering of nodes
  - check if the ordering
    is a Ham. path.

Non-deterministic Alg.
for all orderings (at once)
- check if there is
  a Ham. Path

$\in NP$

P v NP

NP

P

?

$P \overset{?}{=} NP$

P: Languages computable by det. poly. time Tm.

NP: non-det. poly time Tm.

NP — class of languages w/ P time verifiers.

Verifier: given a string, is that string in the language.

$$\text{HAMPATH} = \{\langle G, s, t\rangle \mid G \text{ is}$$

a directed graph w/
a Hamiltonian path from
node s to node $t\}$

A verifier for a language L
is an algorithm V

where
$$L = \{w \mid V \text{ accepts } \langle w, c\rangle$$
for some string $c\}$