

Summary: Lecture 5

Summary for the chapters X and X . [2]

Reduction

Examples of NP-problems:

- Travelling Salesman Problem
- SATISFIABLE
- REACHABILITY (in P)
- CIRCUIT VALUE (in P)

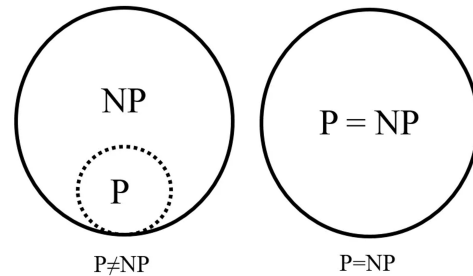


Figure 1: P and NP sets [1]

- reduction: a problem is at least as hard as another
- problem A is at least as hard as problem B if B reduces to A
- B reduces to A if there is a transformation R
 $\rightarrow R$ produces for every input x of B an equivalent input $R(x)$ of A

Reduction

Problem A is at least as hard as problem B if B reduces to A .

TODO

Questions:

Reduction HAMILTONIAN PATH to SATISFIABLE

- instance: Graph G
question: Is there a path in G that visits each node one?
- log space reduction from HP to S
- demonstrates HP not significantly harder than SAT
- write a logical formula that only becomes true when it is HP
- 4, 3, 1, 2 as path
 $x_{1,4} = T, x_{2,3} = T, x_{3,1} = T, x_{4,2} = T,$
- slide is not quite correct
- $(\text{not } x_{1,1} \text{ or not } x_{2,1}) \text{ and } (\text{not } x_{1,1} \text{ or not } x_{3,1})$
 $\text{and } (\text{not } x_{1,1} \text{ or not } x_{4,1}) \text{ and } (\text{not } x_{2,1} \text{ or not } x_{3,1})$
 $\text{and } (\text{not } x_{2,1} \text{ or not } x_{4,1}) \text{ and } (\text{not } x_{3,1} \text{ or not } x_{4,1}) \text{ and } \dots$
first index: step, second: node

TODO

Questions:

Boolean Circuits

TODO

Questions:

Reduction REACHABILITY PATH to CIRCUIT VALUE

TODO

Questions:

Further examples

TODO

Questions:

Closedness under Composition

TODO

Questions:

References

- [1] *Image source: P-NP sets.* <https://www.techno-science.net/actualite/np-conjecture-000-000-partie-denouee-N21607.html>.
- [2] Christos H. Papadimitriou. *Computational Complexity*. Addison-Wesley Publishing Company, 1994.