CSC373 Worksheet 7 Solution

August 14, 2020

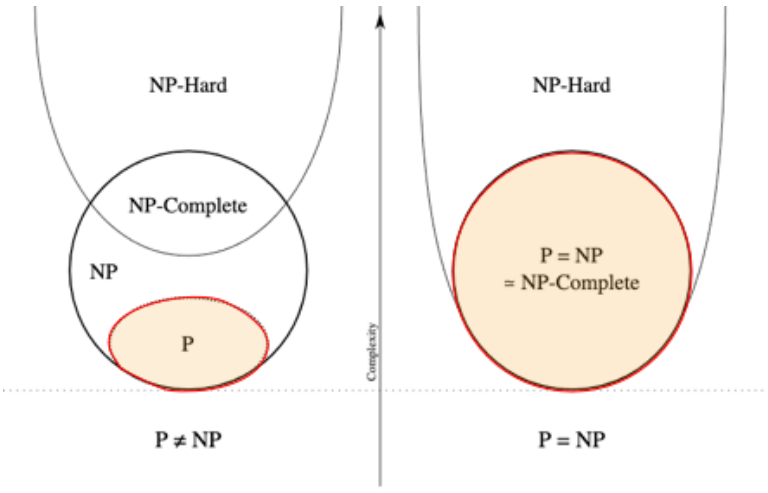
1. **Notes**

- **Decision Problem**
  - Is the problem if determining ansewr to a class of yes/no questions about some objects of interest

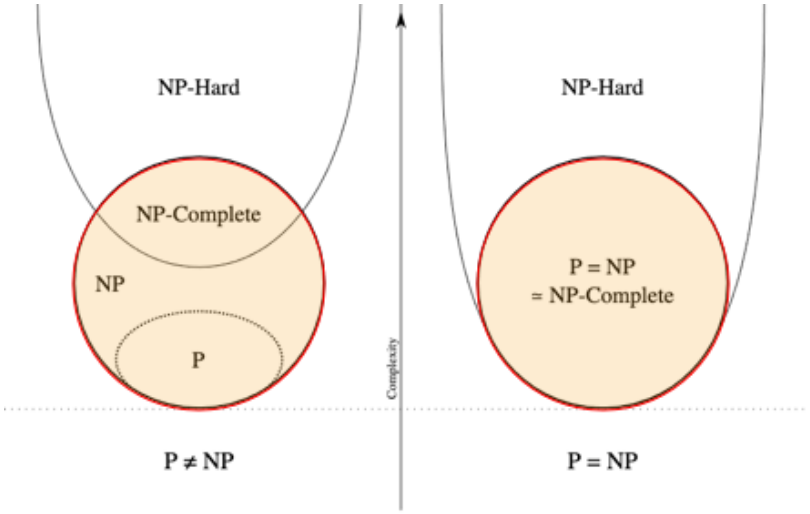
  Example:
- **P**
  - Is set of problems that can be solved by a deterministic Turing machine in Polynomial time (i.e. $\mathcal{O}(n^k)$) [2].

    Example:

    1) Shortest path problems
    2) Calculating the greatest common divisor
    3) Finding maximum bipartite matching



- **NP (Non-deterministic Polynominal):**



  - Is set of decision problems that can be solved by a Non-deterministic Turing Machine in Polynomial time.[2]
  - Has no particular rule is followed to make a guess [1].
  - Can be solved in polynominal time via a "lucky algorithm", a magical algorithm that always make a right guess [2]
  - $P \subseteq NP$
- **NP-Complete:**
  - A decision problem is **NP-complete** if
    1) Decision problem L is in NP
       * A certificate (a solution constructed by student) can be verified (can be checked) to have polynominal time
    2)
  - Is not likely that there is an algorithm solving it in polynominal number of steps [3]
- **NP-Hard:**

  Example:

  1) Alan Turing's Halting Problem

References

1) Encyclopedia Britannica, NP-Complete Problem, link
2) Geeks for Geeks, NP-Completeness, link
3) Wikipedia, NP-complete, link