ADS

- Not all decidable problems are in NP.
- NP问题：可在多项式时间内证明解正确性的问题
- an undecidable problem is a decision problem for which it is known to be impossible to construct a single algorithm that always leads to a correct yes-or-no answer. https://en.wikipedia.org/wiki/Undecidable_problem
- All NP problems can be solved in polynomial time in a non-deterministic machine. https://en.wikipedia.org/wiki/Non-deterministic_Turing_machine
- NPC:
  - Hamiltonian cycle problem
    - Given a graph G=(V, E), is there a simple cycle that visits all vertices?
  - traveling salesman problem
    - Given a complete graph G=(V, E), with edge costs, and an integer K, is there a simple cycle that visits all vertices and has total cost £ K?
  - Satisfiability problem (Circuit-SAT)
  - clique problem
    - Given an undirected graph G = (V, E) and an integer K, does G contain a complete subgraph (clique) of (at least) K vertices?
  - vertex cover problem
    - : Given an undirected graph G = (V, E) and an integer K, does G contain a subset V' Í V such that |V'| is (at most) K and every edge in G has a vertex in V' (vertex cover)?
- np hard
  - A decision problem H is NP-hard when for every problem L in NP, there is a polynomial-time reduction from L to H https://en.wikipedia.org/wiki/NP-hardness
  - Class of decision problems which are at least as hard as the hardest problems in NP. Problems that are NP-hard do not have to be elements of NP; indeed, they may not even be decidable.

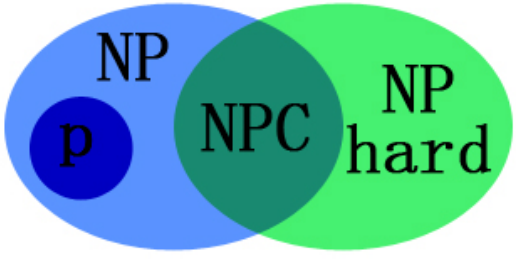

图1 P NP NPC NPhard关系的图形表示

- Turing Machine
  - 确定图灵机

        - A Deterministic Turing Machine executes one instruction at each point in time. Then depending on the instruction, it goes to the next unique instruction.
        - 确定型图灵机仅有一个转移函数
    - 不确定图灵机
        - A Nondeterministic Turing Machine is free to choose its next step from a finite set. And if one of these steps leads to a solution, it will always choose the correct one.
        - 多个转移函数
- fully polynomial-time approximation scheme or FPTAS, which requires the algorithm to be polynomial in both the problem size n and 1/ε. All problems in FPTAS are fixed-parameter tractable. Both the knapsack problem and bin packing problem admit an FPTAS.[3] https://en.wikipedia.org/wiki/Polynomial-time_approximation_scheme
- 斜堆
    - The null path length, Npl(X), of any node X is the length of the shortest path from X to a node without two children. Define Npl(NULL) = –1.
    - A leftist tree with r nodes on the right path must have at least 2^r – 1 nodes.
    - A node p is heavy if the number of descendants of p’ s right subtree is at least half of the number of descendants of p, and light otherwise. Note that the number of descendants of a node includes the node itself.
- Amortized Analysis 摊还分析
    - Aggregate analysis
    - Accounting method
        - 进行摊还分析时，摊还的代价有可能多于实际的代价，也有可能少于实际的代价，多于实际代价的差额会存进一个数据结构中，称为信用，而当遇到少于实际代价的时候就可以用这些信用来填充了。
    - Potential method

$$\hat{c}_i - c_i = Credit_i = \Phi(D_i) - \Phi(D_{i-1})$$

- 准确率与召回率

$$\textbf{Precision}\ P = R_R / (R_R + I_R)$$
$$\textbf{Recall}\ \ \ R = R_R / (R_R + R_N)$$

    - 准确率：针对预测结果
    - 召回率：针对原样本