Decision and Optimization

Note Title 9/3/2019

See ICS253 ppt slides on Basic Concepts (P01)

Sorting Algorithms (Review)

	Avg.	worst	Storage
Quicksort:	$\Theta(n \log n)$	$\Theta(n^2)$	pointers/stack
Heapsort:	$\Theta(n \log n)$		in-place
Mergesort:	$\Theta(n \log n)$		needs buffer

insertion : $0+1+2+3+\cdots+(n-1) = \frac{(n-1)n}{2} = \Theta(n^2)$ } in-place

Selection : $\frac{(n-1)n}{2} = \Theta(n^2)$

§ 9. NP-Complete Problems

1] Def^n. Polynomial time problems (tractable problems):

Let Π be a problem that can be solved in $O(n^k)$, where n is the input size and $k \geq 1$. Then Π is tractable. otherwise Π is intractable.

2] NP-Complete Problems class (NPC)

the class of all intractable problems

- many problems $\Pi \in$ NP-Complete
- if any NP-complete problem is solved in poly-time, then all NPC will be solved in poly-time, and $P = NP$.

3] Decision Vs. Optimization problems

Decision → Yes / No (e.g. Uniqueness)

Optimization → find min / max (e.g. knapsack § 6.6)

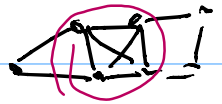
4] Decision to Optimization:

e.g. Graph coloring : Given $G = (V, E)$, assign colors to V.

Decision : is $G = (V, E)$ colorable using k colors?

Optimization: find the chromatic number of G, $\chi(G)$.

Do binary search on k from 1 to n. $\Rightarrow O(n^p \cdot \log n)$

e.g. Clique : Complete subgraph of G. 

Desicion : Does G have a clique of size k ?

Optimization : find max-clique of G.

Do binary search on k from 1 to n $\Longrightarrow O(n^c \cdot \log n)$