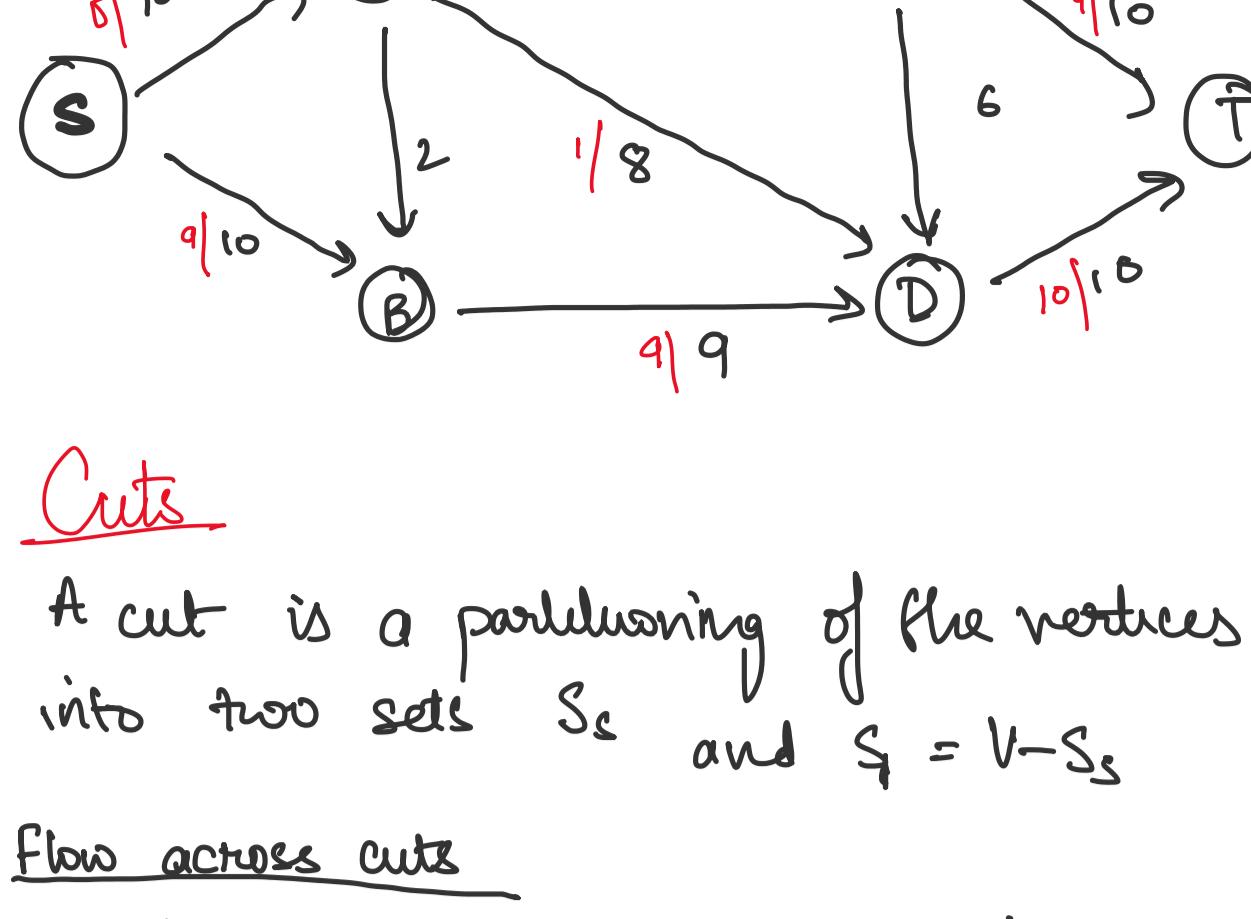


Max flow problems

Tuesday, 19 March 2024 11:05 AM

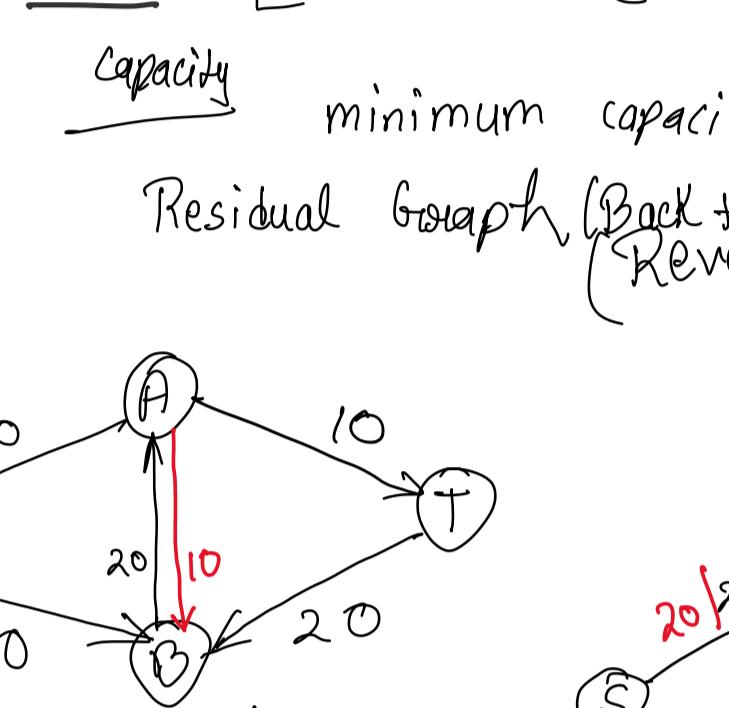


Cuts

A cut is a partitioning of the vertices into two sets S_s and $S_t = V - S_s$.

Flow across cuts

The flow ~~across~~ across a cut is the total flow from nodes in S_s to nodes in S_t minus the total nodes in S_s to ∞ S_t .



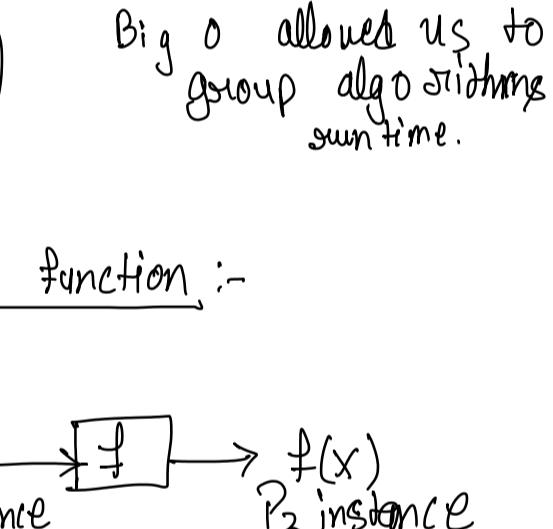
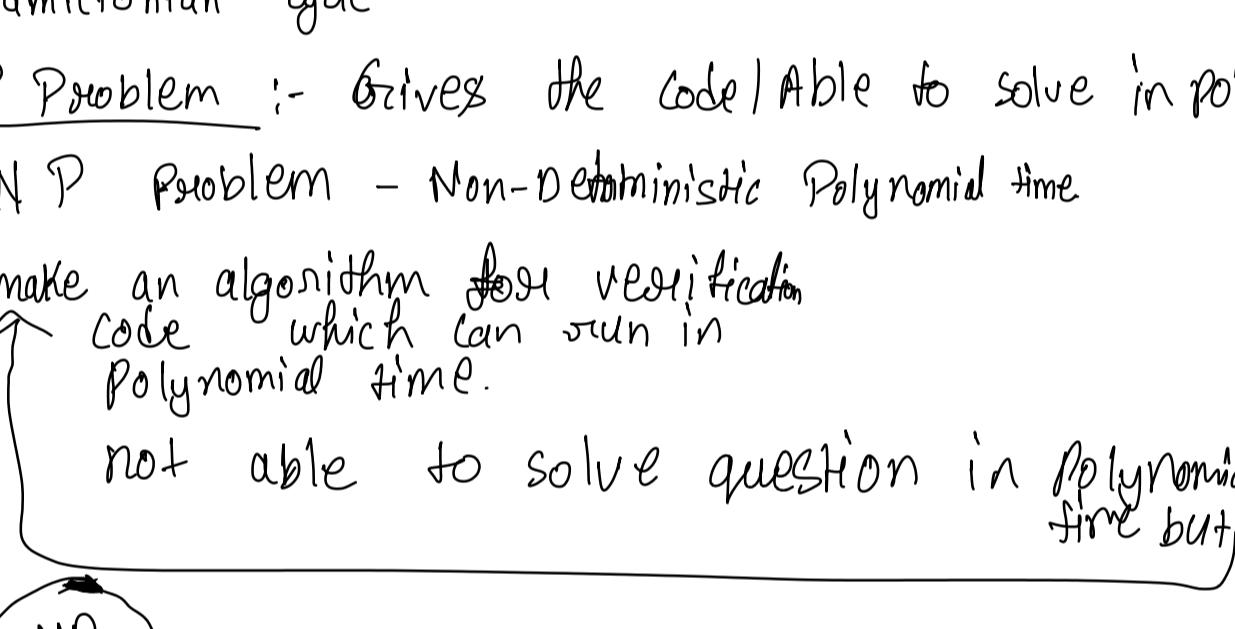
Cut: left-inflow(x) - left-outflow(x)

Cut: right-outflow(x) - right-inflow(x)

Capacity of a cut: Max. flow that we could send from nodes ~~to~~ in S_s to node in S_t .

max flow [Maximum Flow]

capacity minimum capacity
Residual Graph (Backtracking)
(Reverse)



Ford Fulkerson:

Time Runtime: $O(\text{max. flow} \cdot k)$

Bipartite graph matching.

Edge Disjoint Path problem

Find the max no. of edge-disjoint paths from S to T .

NP-Complete Problem :-

Run-time Analysis:-

- ① Tractable and intractable Problem?
- ② Solvable or not?

Hamiltonian cycle

P Problem :- Gives the code/able to solve in polynomial time.

NP Problem - Non-Deterministic Polynomial time

make an algorithm for verification
code which can run in
Polynomial time.

not able to solve question in polynomial time but

NP

P

Big O allowed us to group algorithms by
run time.

Reduction function :-

$$P_1 \xrightarrow{f} P_2$$

- ① Bipartite matching reduced to flow problem
- ② All pair shortest path through a particular vertex reduced Problem.
- allow us to solve Problem P_1 when a solver P_2 exist.

NP-Complete

- ① L is NPC if it can be verified in polynomial time
- ② $L' \leq_p L$, $L' \in NP$

{ any NP-complete problem can be reduced to problem in polynomial time. (is NP-hard)

NP-Complete

NP-Hard

NP

P

NP-Complete Problem

- Longest Path
- 3D matching - Bipartite matching

Proof of NPC :-

1. show that NEW is in NP.
2. Show that all NP-C problem are reducible to NEW in polynomial time.

NP-C : 3SAT

In CNF

- It is expressed as AND
- each clause is an OR of more than n variables.

3SAT: Given a 3CNF boolean formula, is it satisfiable?

3-SAT is an NP-Complete.

Independent set :-

Independent set revisited :-

• Reducing independent set to clique.

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