

## CS 310

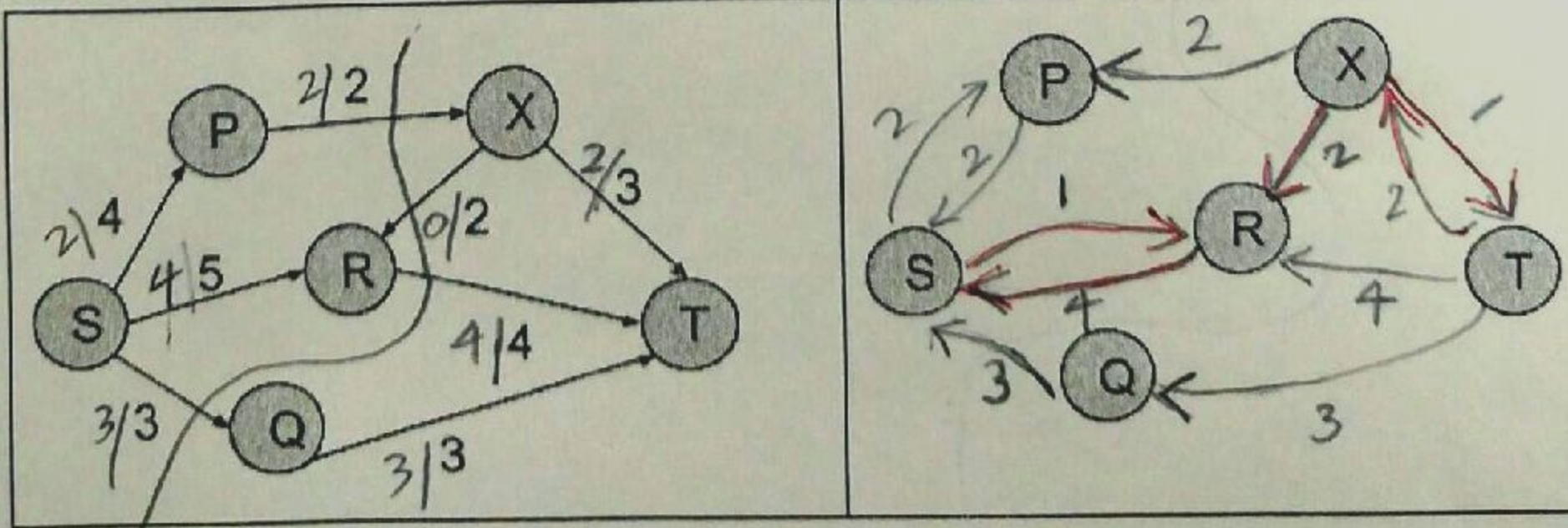
*“I Hear and I Forget,  
I See and I Remember,  
I Do and I Understand.”*

- Chinese Proverb

# Homework 8

Iteration-4: Ford Fulkerson algorithm selects path S-R-X-T

[2]



Max s-t flow = Capacity of min cut = 9

## An application of network flow

LUMS has 'g' guards and observes 'h' public holidays. There must at least one guard on duty on each of the holidays. The guards have informed LUMS about their availability during these holidays. E.g. suppose  $h=10$ , one guard may be available during 6 of the 10 days, another may be available 7 out of 10 days etc.

You have to determine if its possible to assign one guard to each of the 'h' holidays so that the following constraints are met. None of the guards should work for more than 'x' holidays during a year, where  $x < h$ . Note that these 'x' days must be from among those days when the guard has indicated that he is available. Some holidays are part of the same festival (e.g. three days of Eid). A guard should not work for more than one day of such holidays that are joined together.

# NP and Computational Intractability



*I can't find an efficient algorithm, but neither can all these famous people.*

## NP-complete problems

- Knapsack / subset sum

### In general graphs:

- Longest path
- Maximum Independent Set
- Hamiltonian Path
- Travelling Salesman Problem
- Chromatic number of a graph
- Max clique
- ...

## Optional reading

The war that changed your world: The science and technology of WWII

<https://www.ww2sci-tech.org/essays/essay2.html>

My slingshot is bigger than yours: The science and technology of warfare through the ages

<https://www.ww2sci-tech.org/essays/essay1.html>

# Reference reading

Algorithm Design by Tardos et. al. 2006

Chapter 7:

**§7.5** The bipartite matching problem (extensions excluded)

**§7.6** Disjoint paths in graphs (extensions excluded)