



## Lecture 16

# More problems on the Greedy Method

CS 161 Design and Analysis of Algorithms

Ioannis Panageas

# Greedy method

The **greedy method** is a general algorithm design technique, in which given:

- **configurations**: different choices we need to make
- **objective function**: a score assigned to all configurations, which we want to either **maximize** or **minimize**

We should make choices **greedily**: We can find a **globally-optimal solution** by a series of **local improvements** from a starting configuration.

# Scheduling jobs/tasks

**Problem 1:** Given: a set  $T$  of  $n$  tasks, each having a start time  $s_i$  and a finish time  $f_i$  (where  $s_i < f_i$ )

**Goal:** Perform all the tasks using a **minimum** number of **machines**.  
A machine can **serve one task at a given time**.

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**Idea:** Sort tasks in **increasing order** of their **start** time. Assign **first** task to **machine 1** and set  $K = 1$ .

When considering a **new task**, if **all machines are busy**, create a **new machine**, set  $K = K + 1$  and assign the **new task to the new machine** otherwise assign the **new task to an available machine**.

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**Problem 2:** Given: a set  $T$  of  $n$  tasks, each having a start time  $s_i$  and a finish time  $f_i$  (where  $s_i < f_i$ )

**Goal:** Perform **as many tasks as possible** using one machine.  
In other words, find the **maximum number of non-overlapping intervals**.

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**Example:** 7 Tasks,  $[1,4]$ ,  $[1,3]$ ,  $[2,5]$ ,  $[3,7]$ ,  $[4,7]$ ,  $[6,9]$ ,  $[7,8]$

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Schedule task (5\$,3) between times 2-3.

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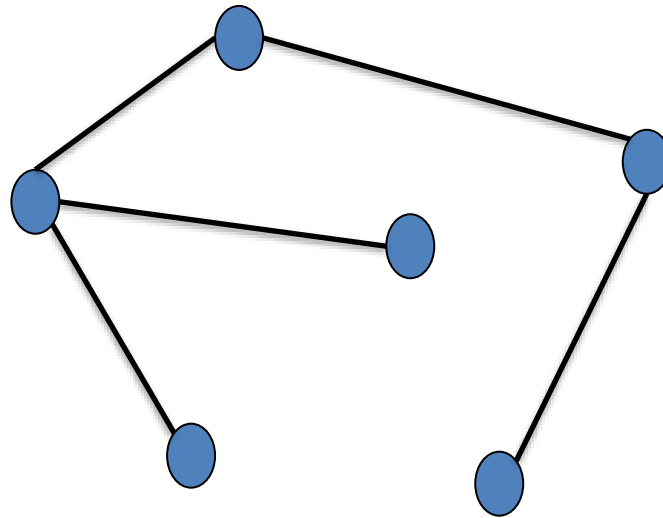
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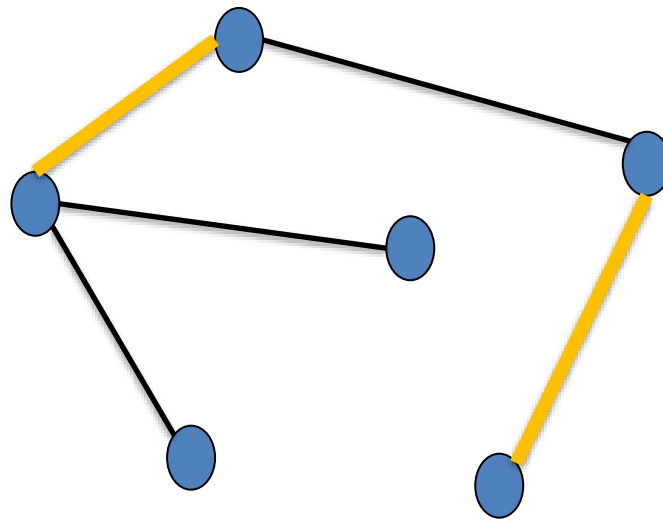
# Problems on trees using Greedy

**Definition:** Given a graph  $G$ , a **matching** is a collection of edges that do not share a vertex.



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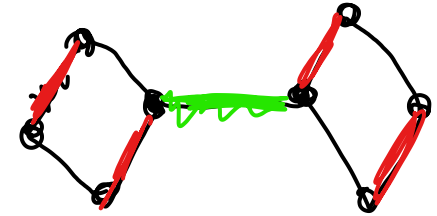
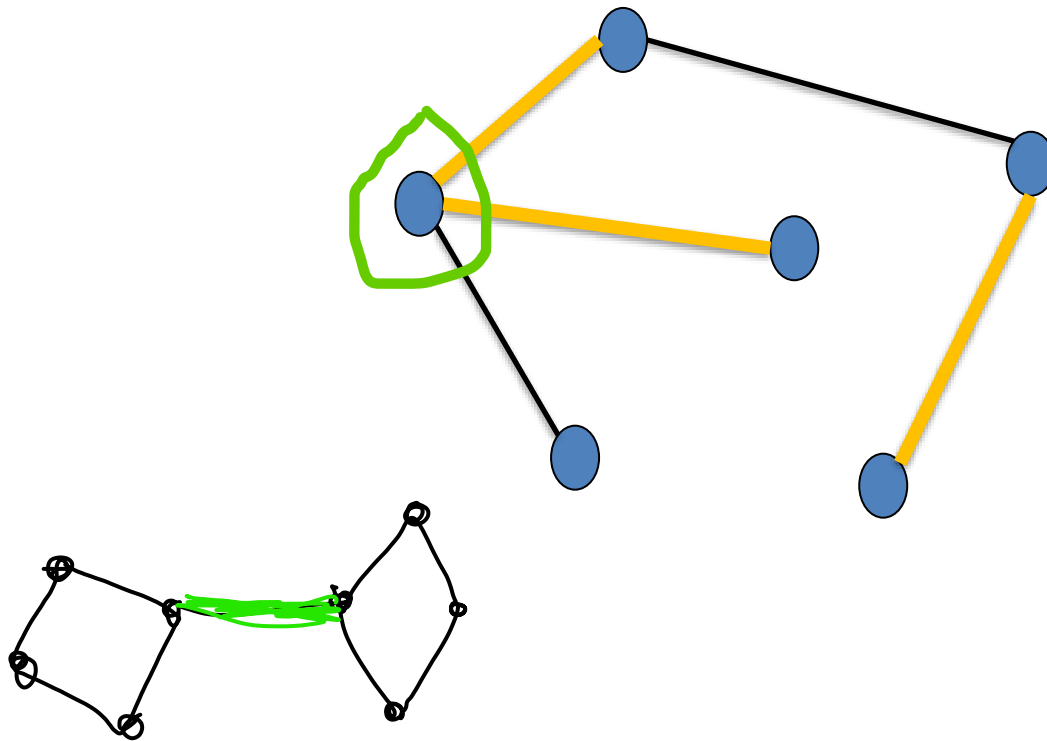
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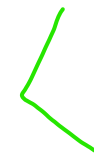
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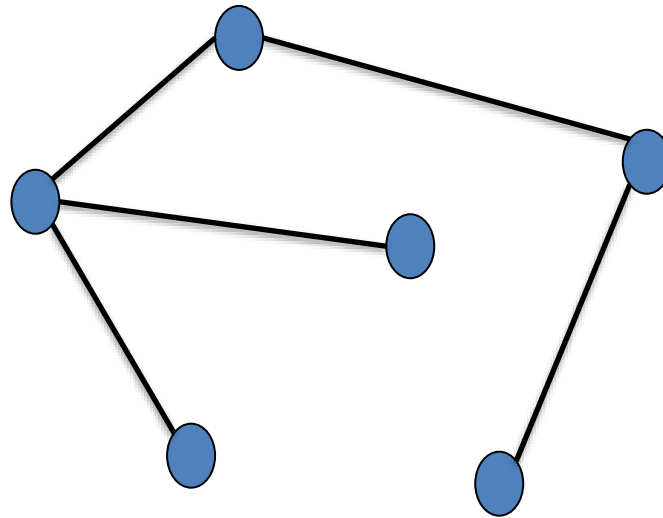


Not a Matching



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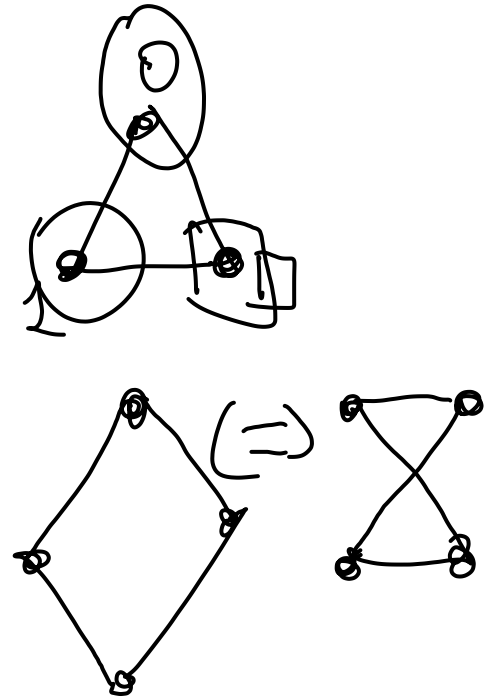
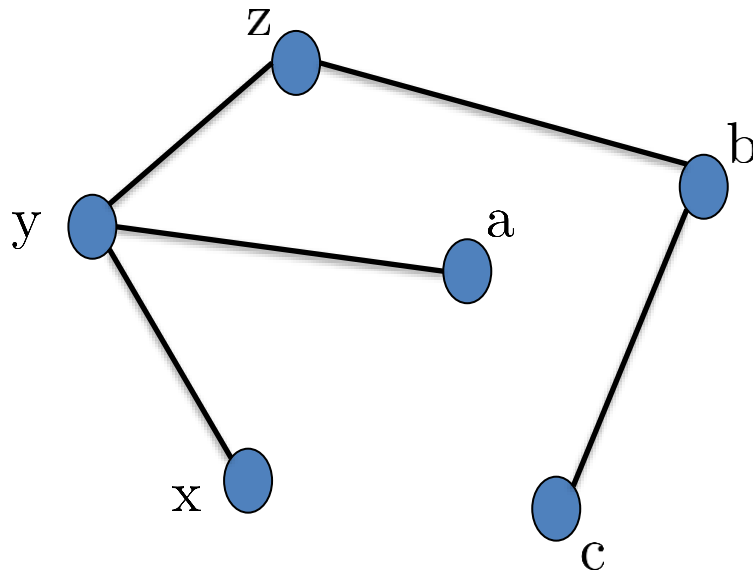
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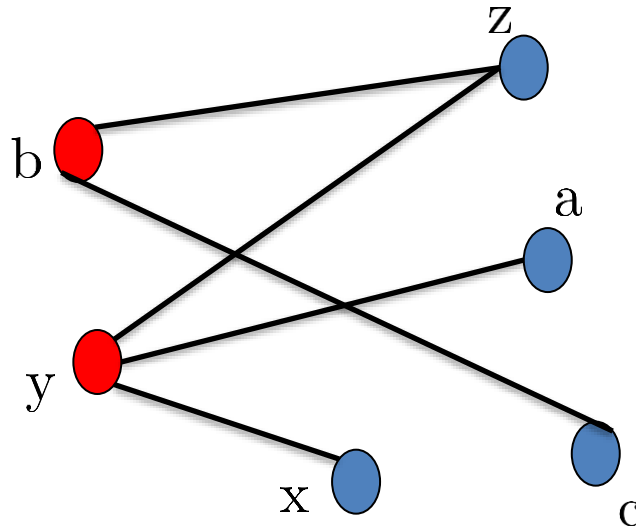
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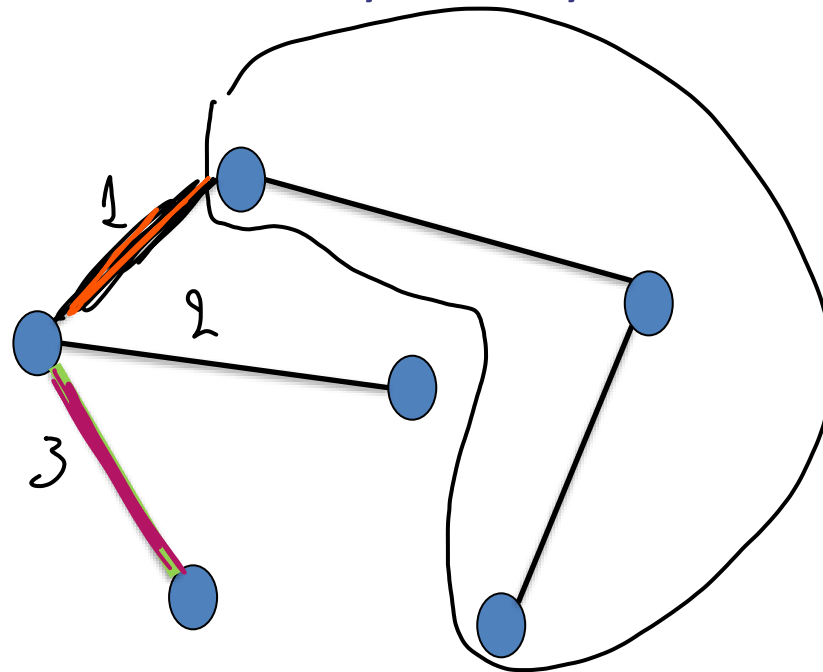
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**Trees are bipartite!**



# Maximum Matching on trees

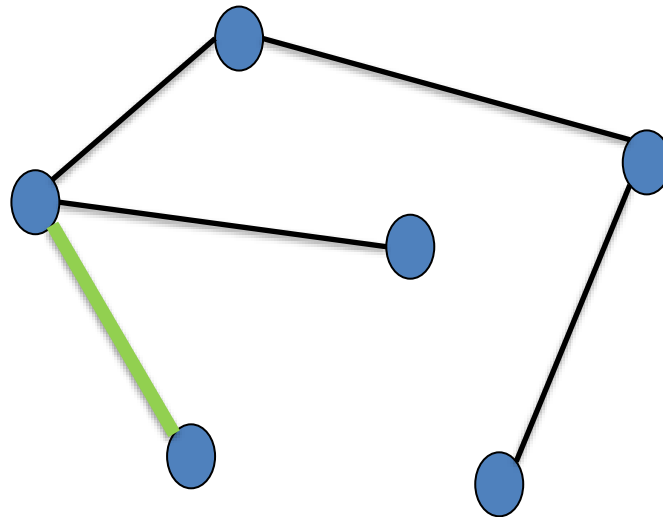
**Problem:** Given a **tree** graph, compute/find a **maximum matching**.  
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**Question:** The green edge has a **leaf** as an endpoint. Should it be **in** the matching?

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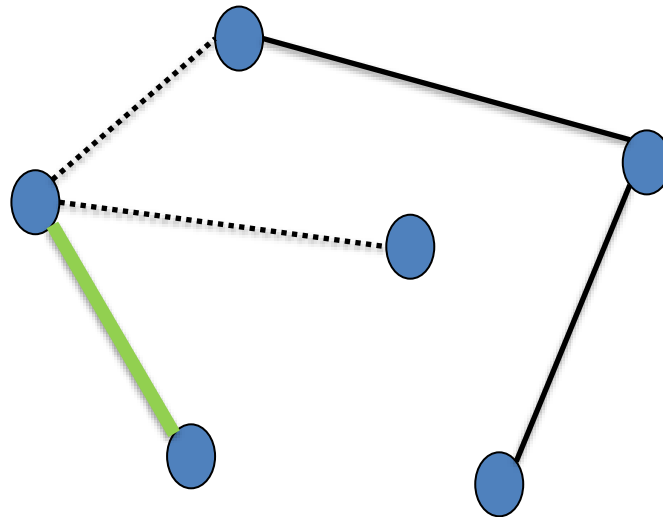
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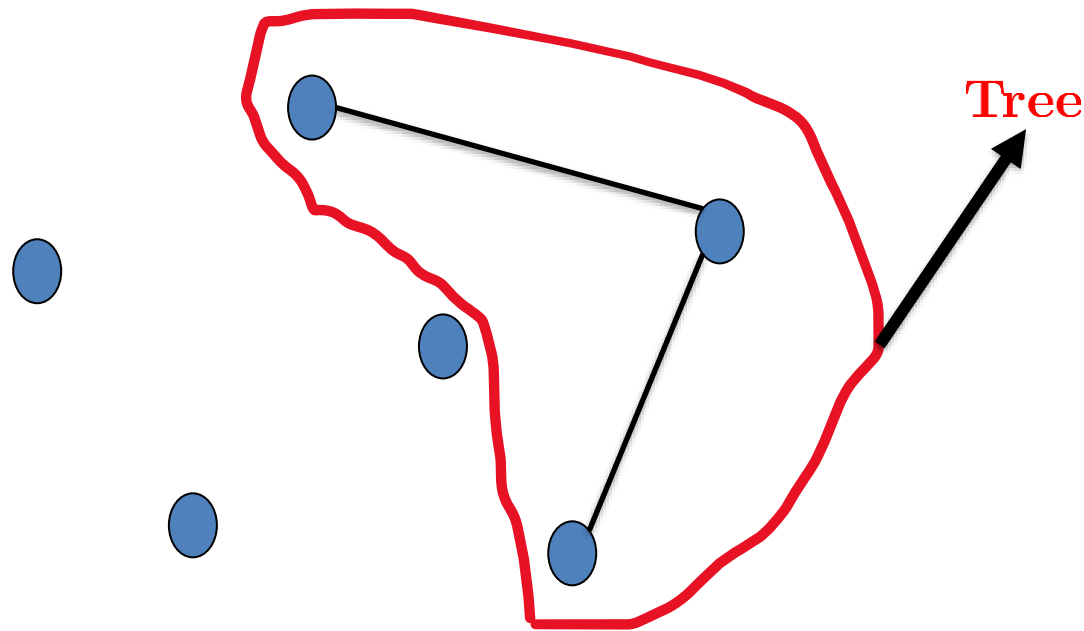
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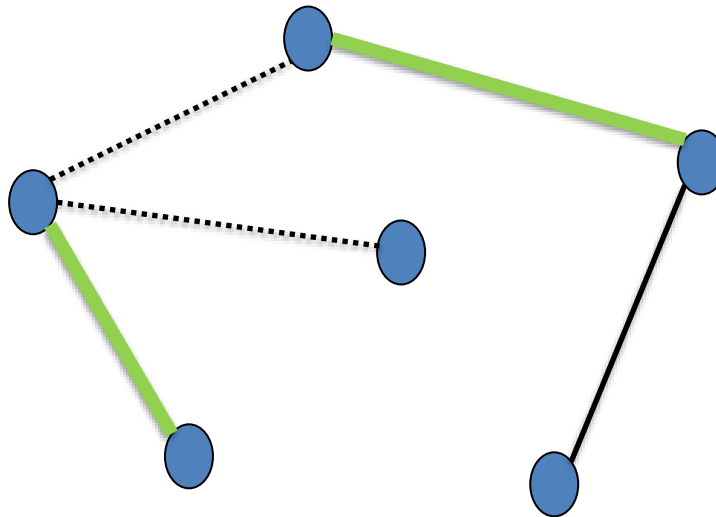
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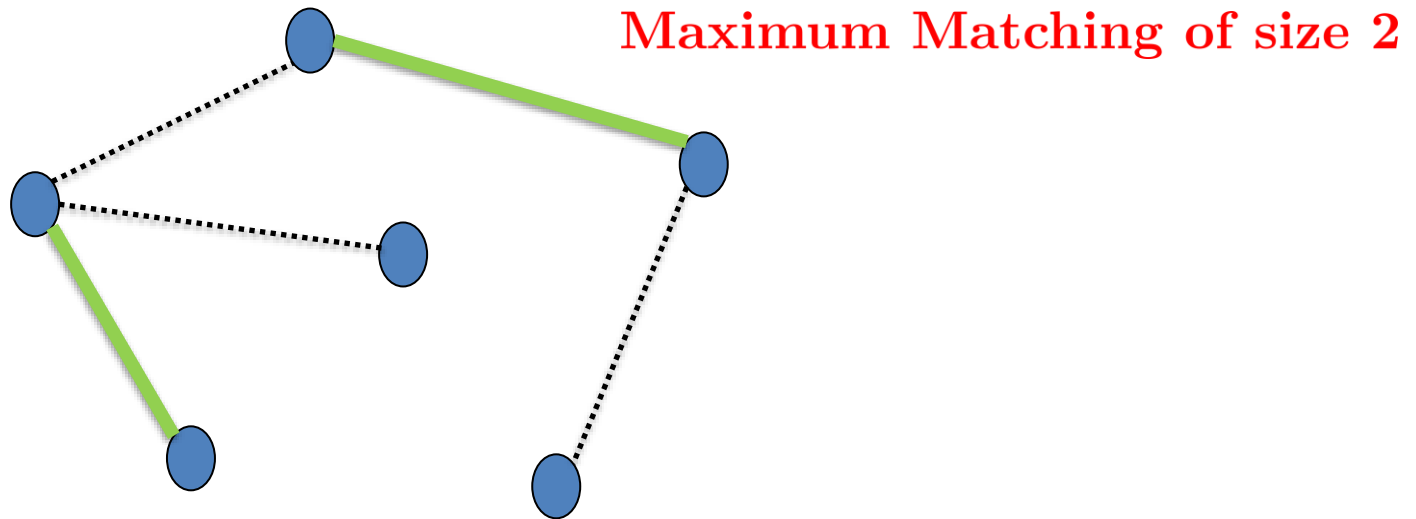


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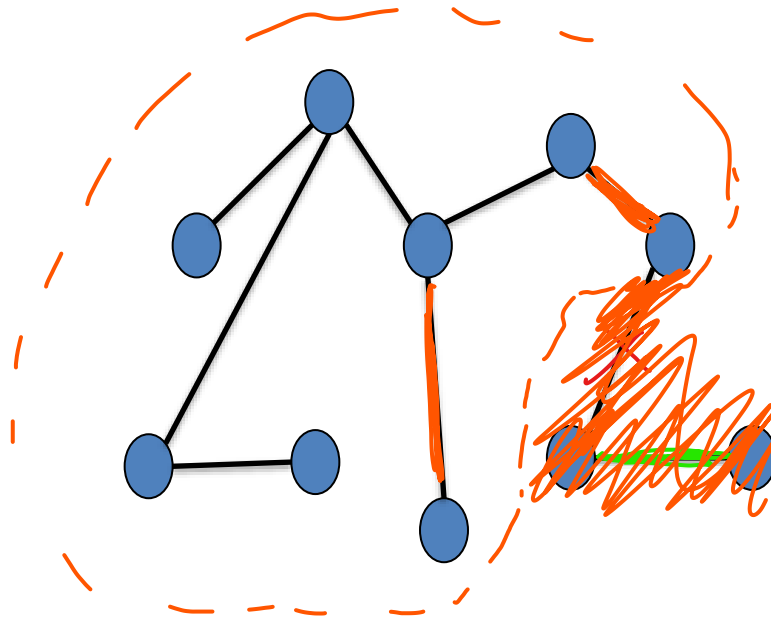


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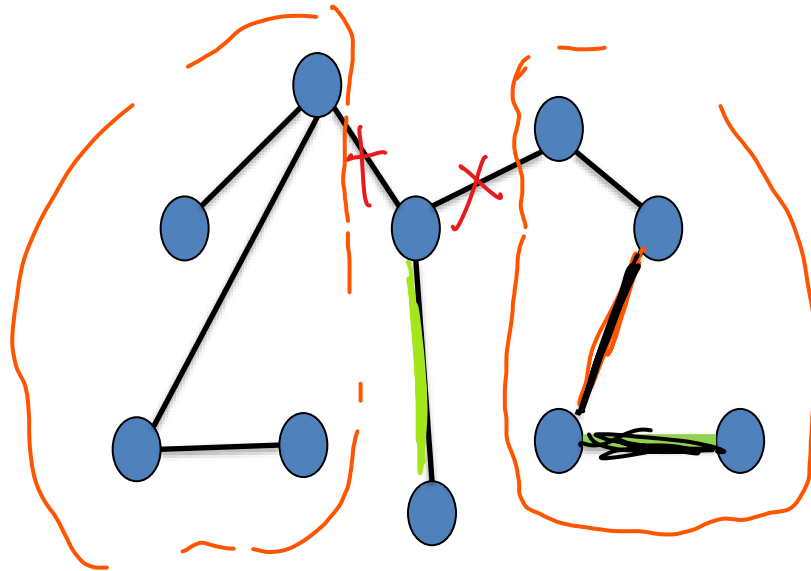
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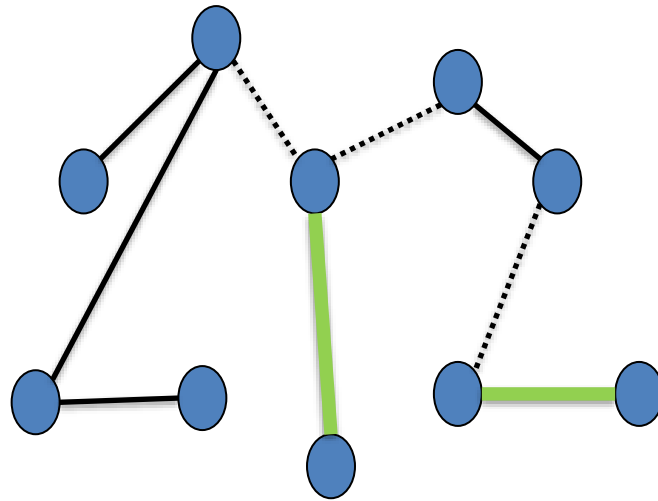


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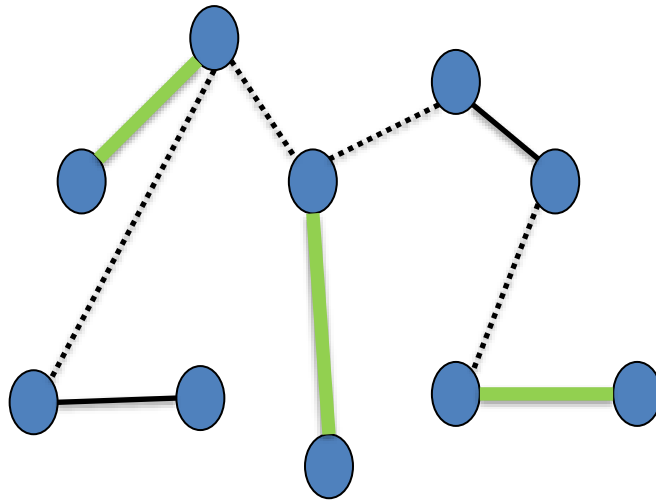
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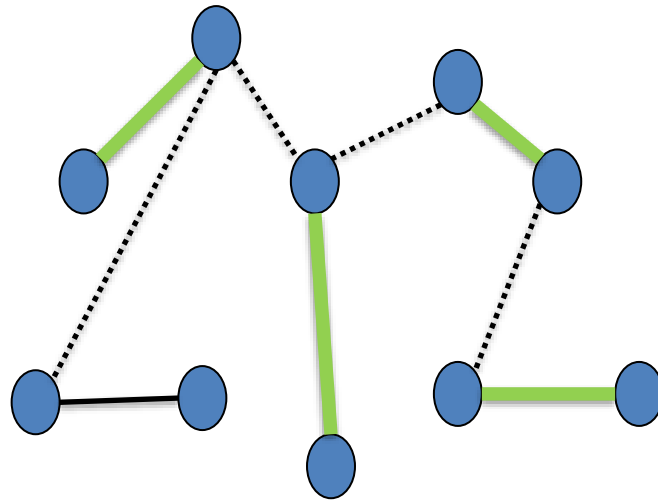
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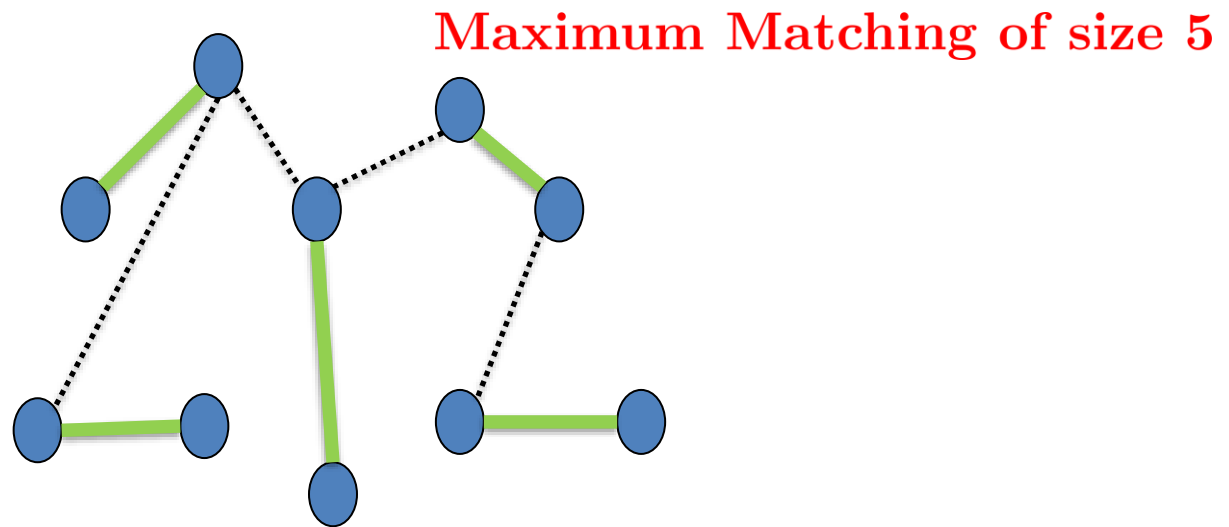
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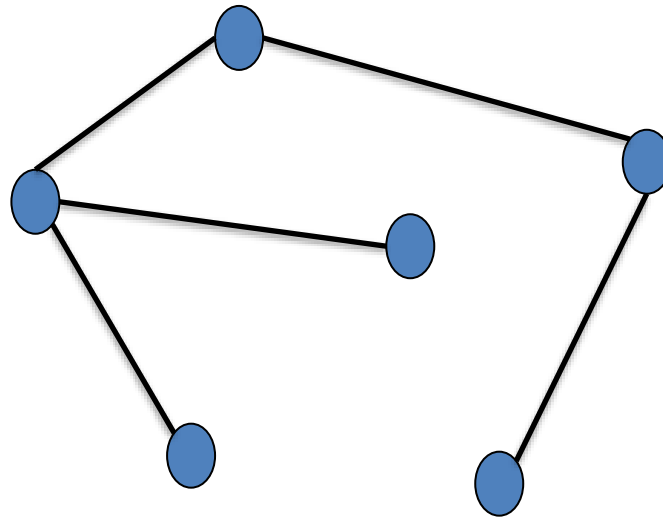
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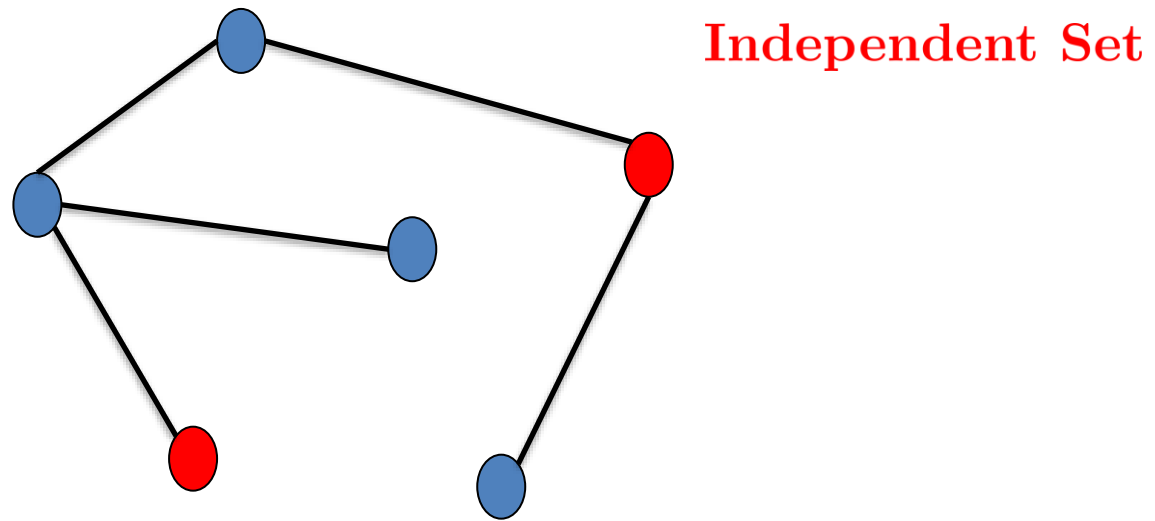
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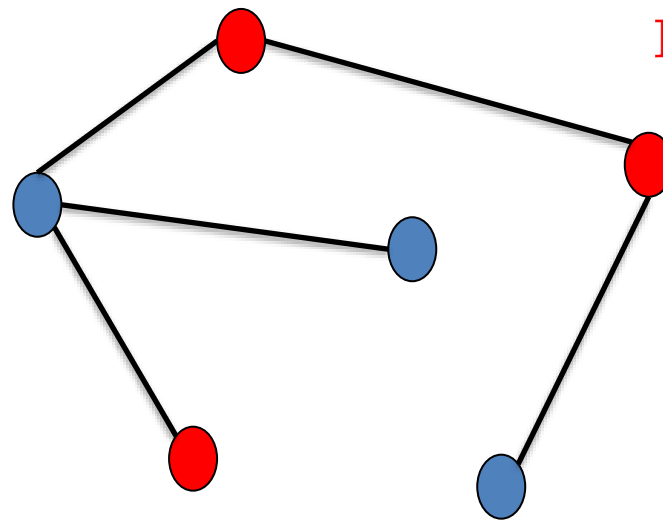
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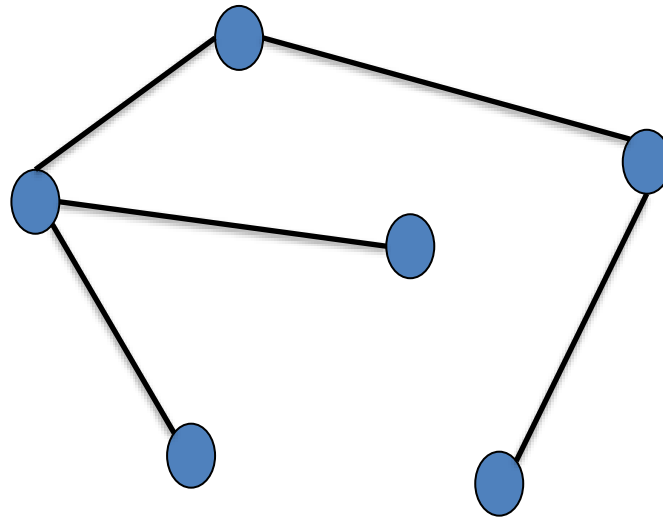
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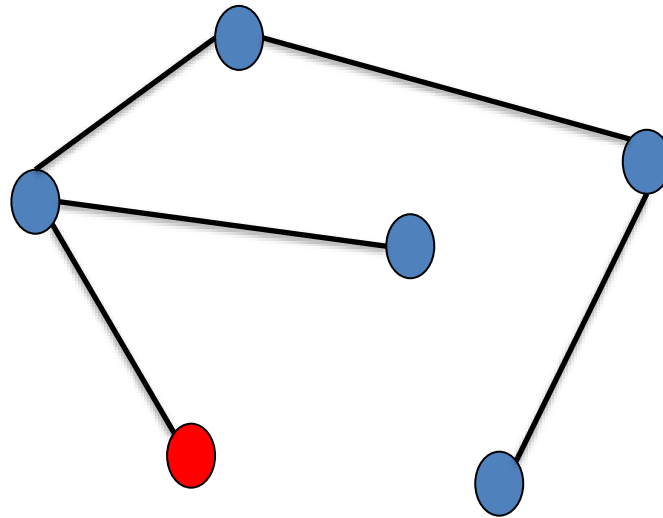


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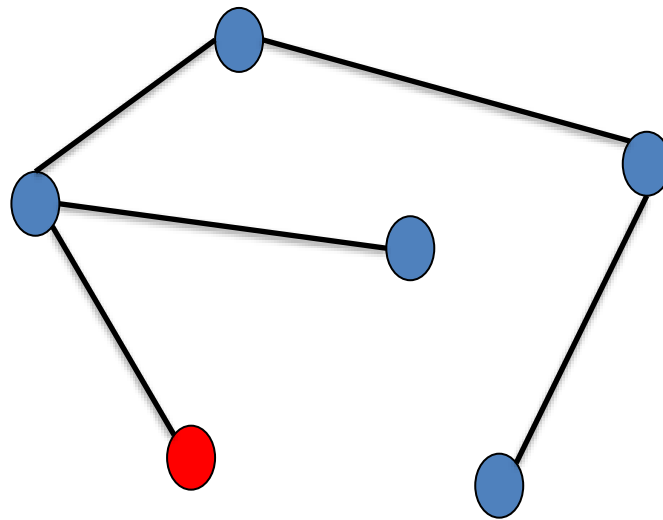
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**Question:** Should a **leaf** be part of the independent set?

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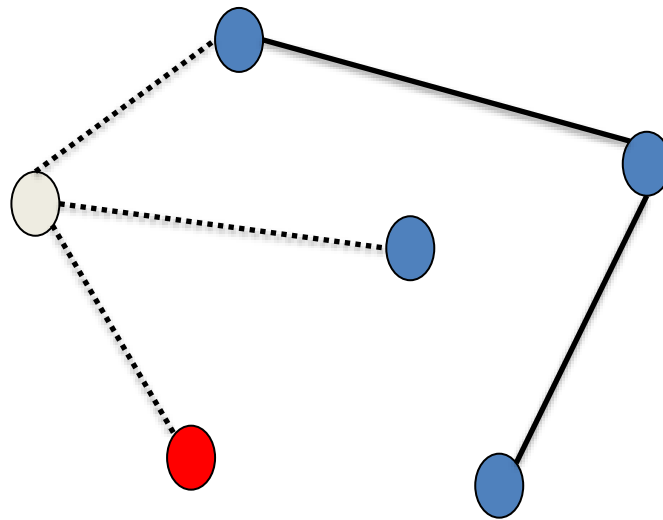
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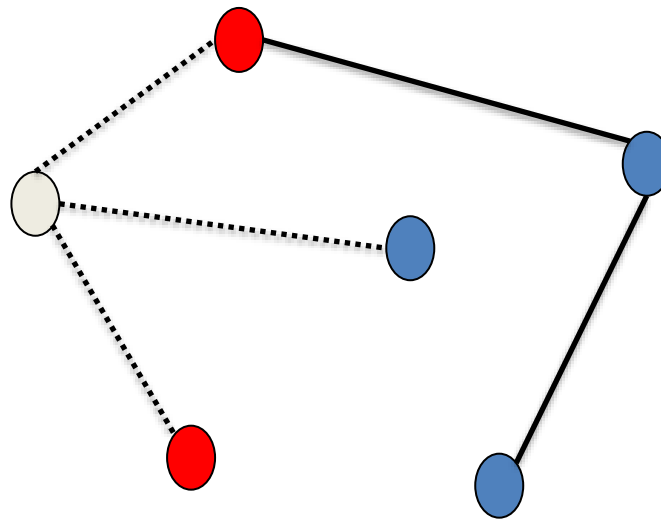
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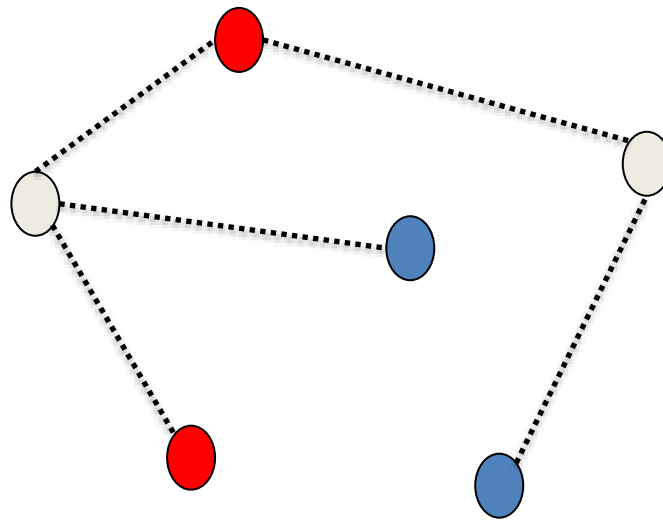
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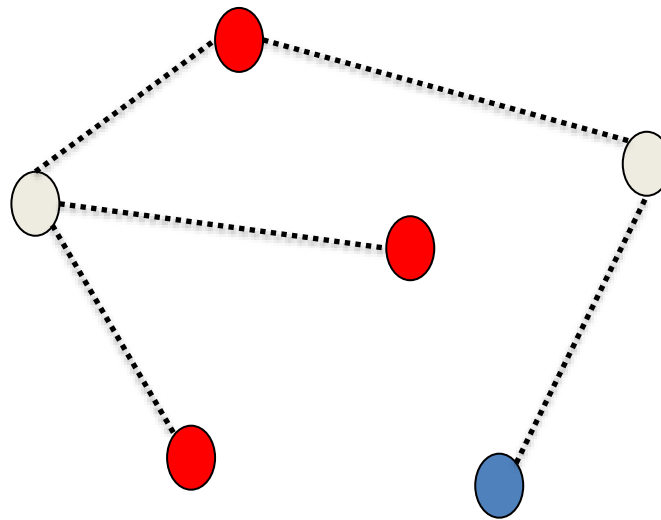
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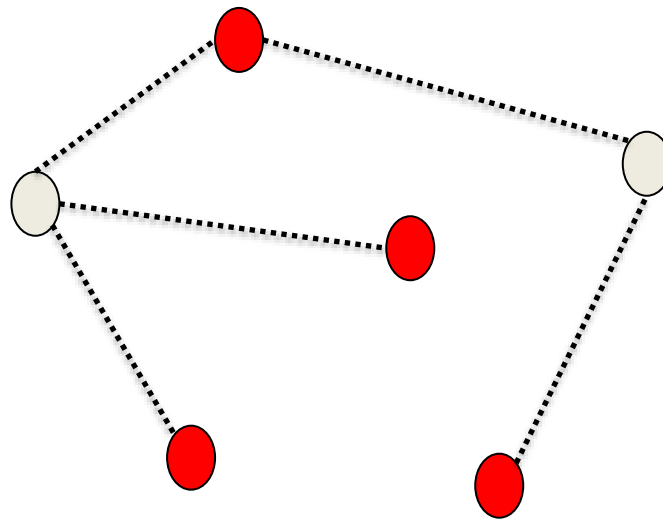
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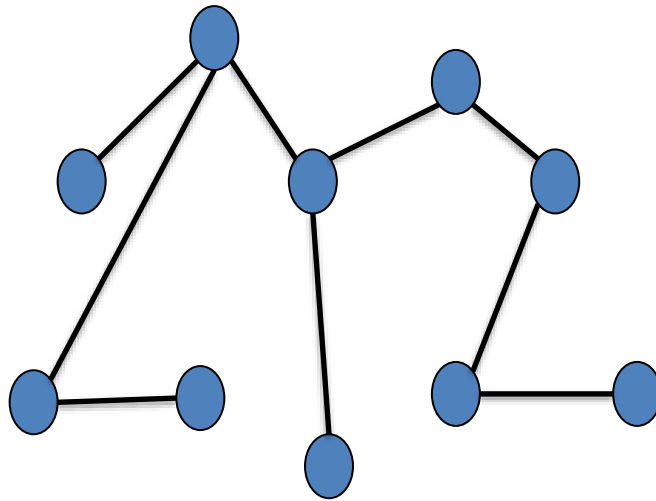
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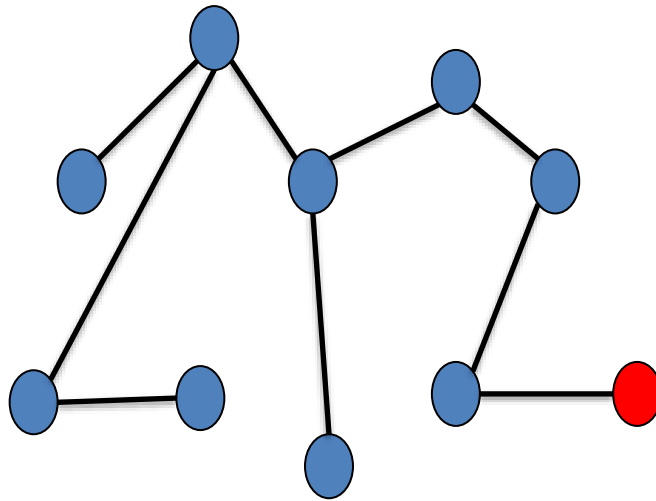


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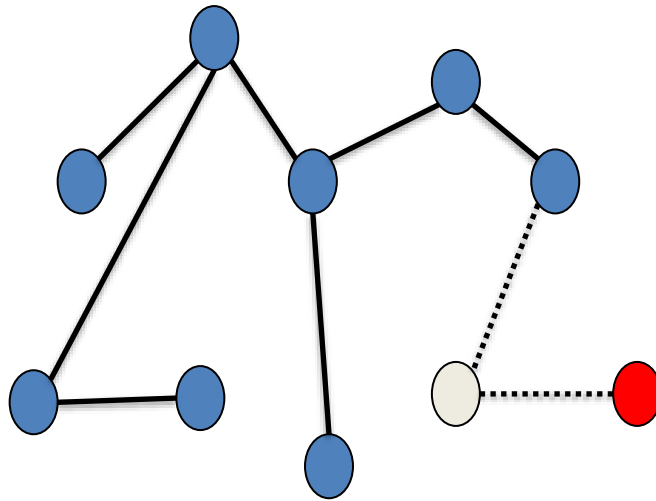
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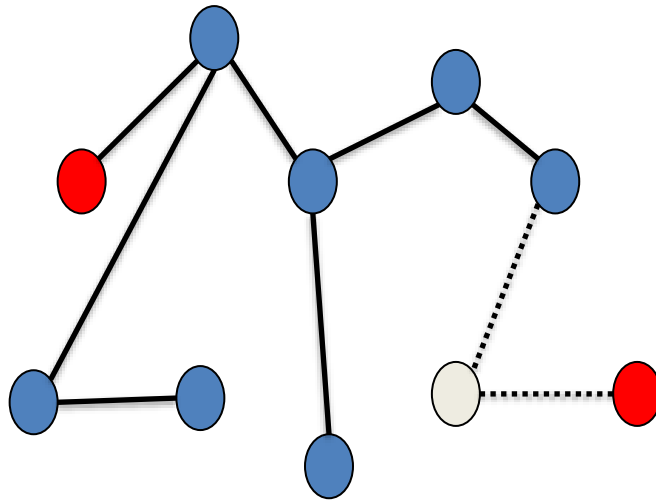
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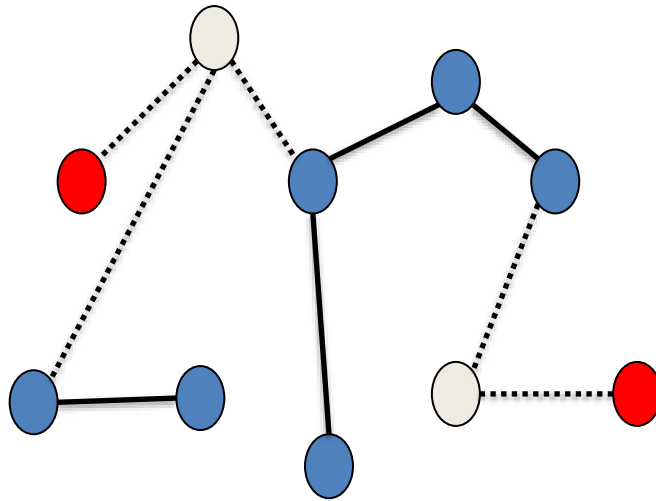
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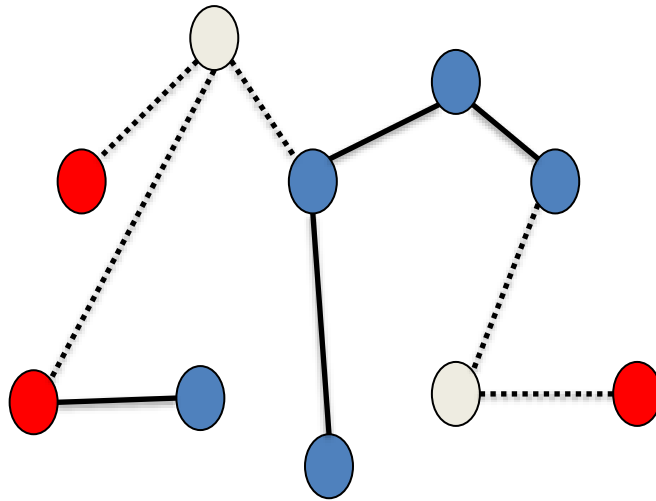
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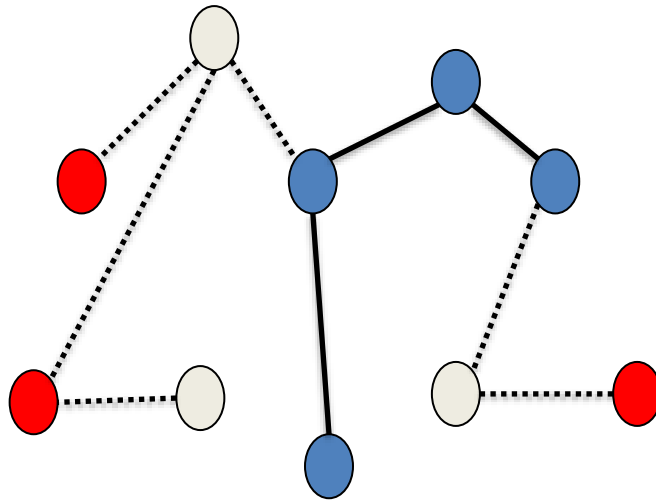
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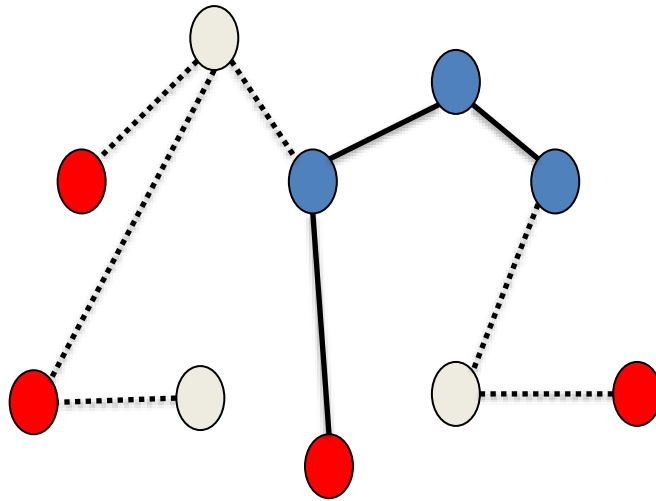
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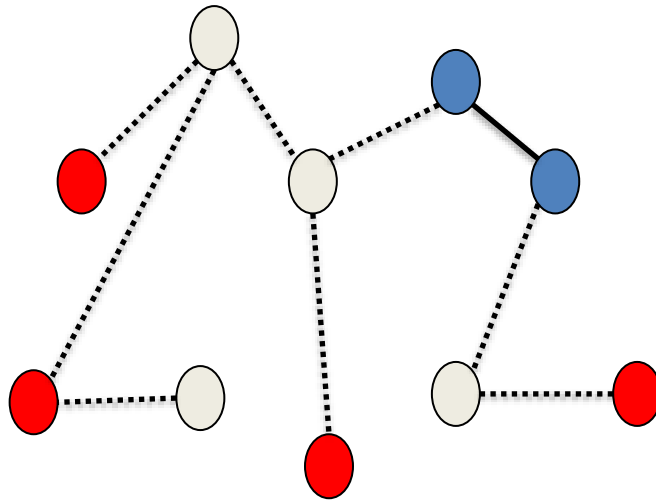
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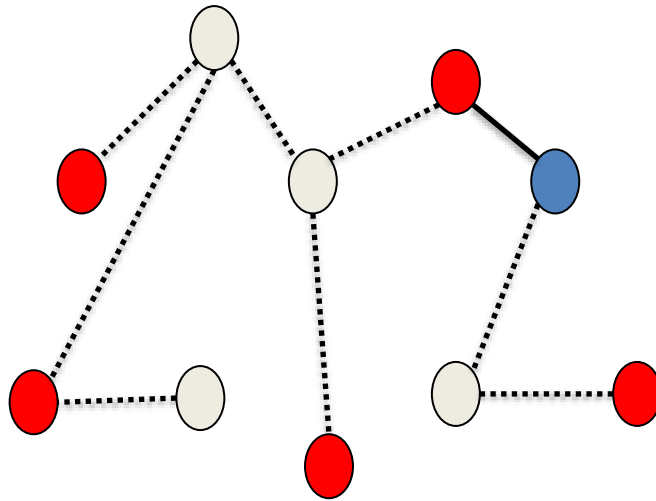


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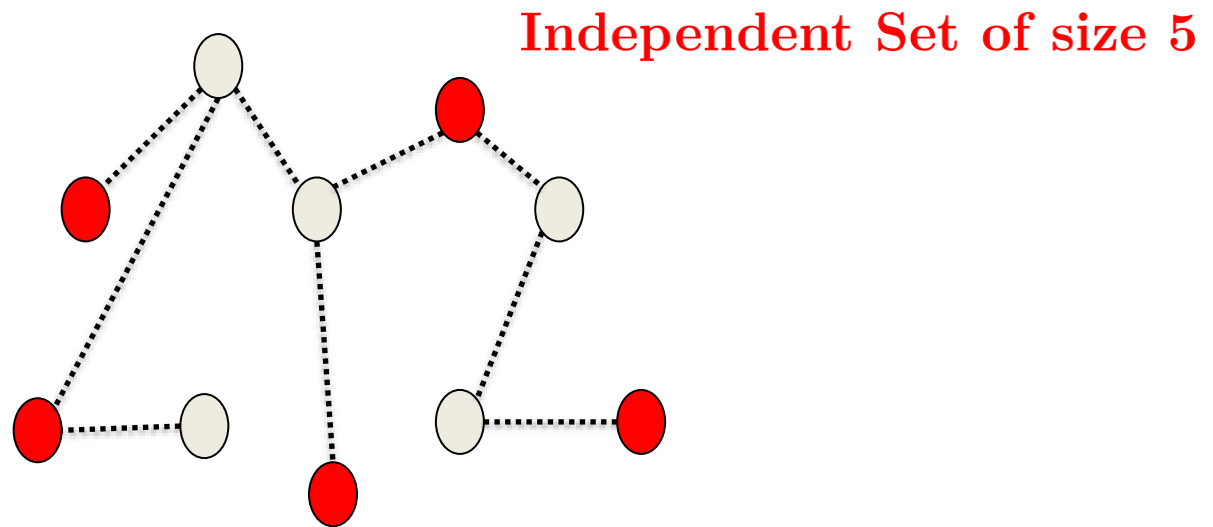
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