Trees

Alexander Golovnev

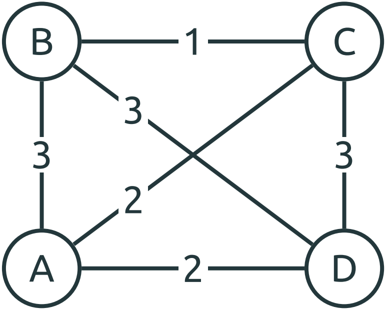
Outline

Road Repair

Trees

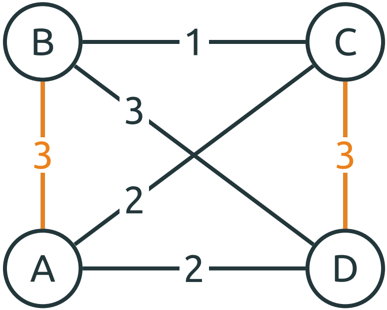
Minimum Spanning Tree

Road Repair



Road Repair

No pair of edges can connect all cities



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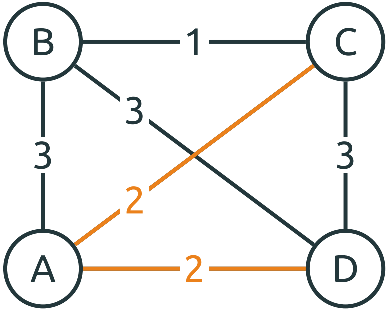
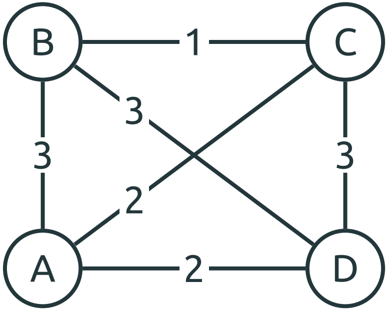


Road Repair

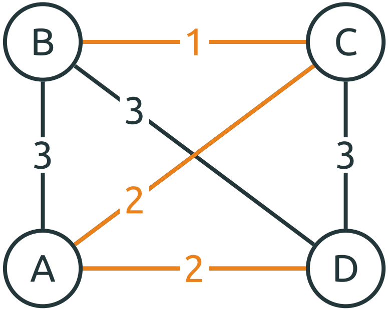
We need at least three edges



Road Repair

We need at least three edges

Three shortest edges work!



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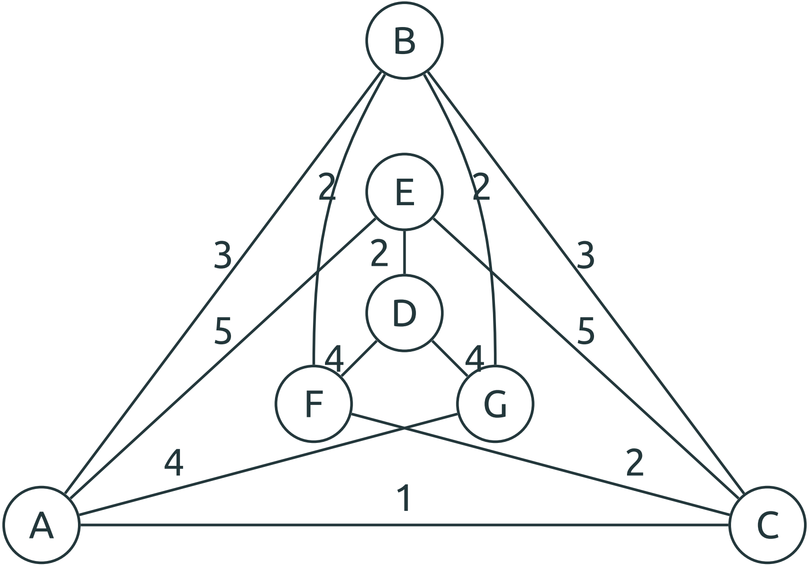

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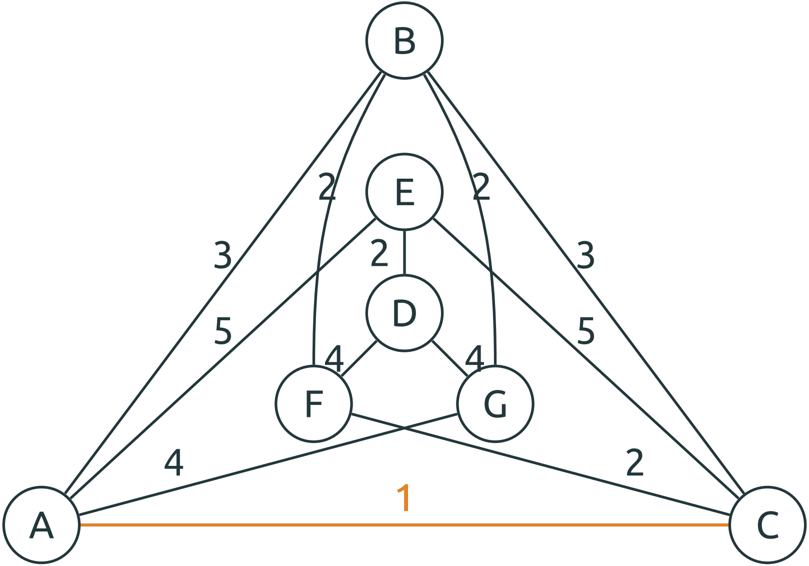

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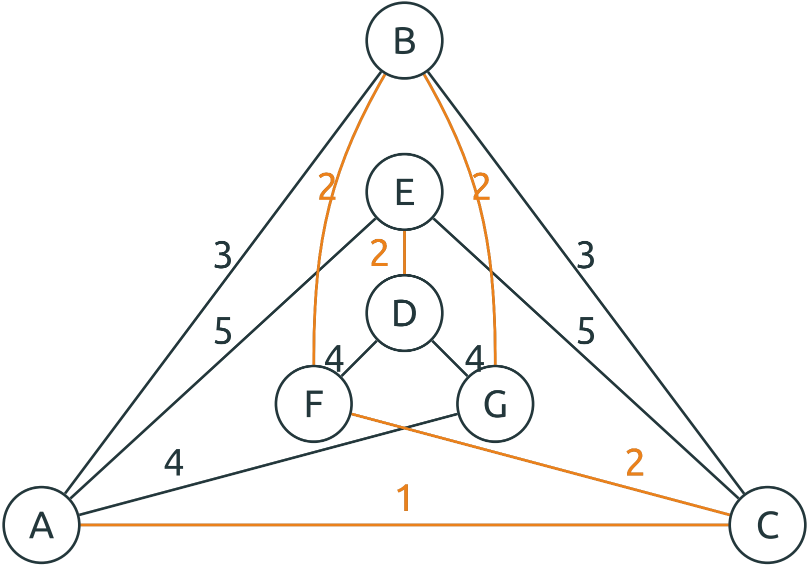

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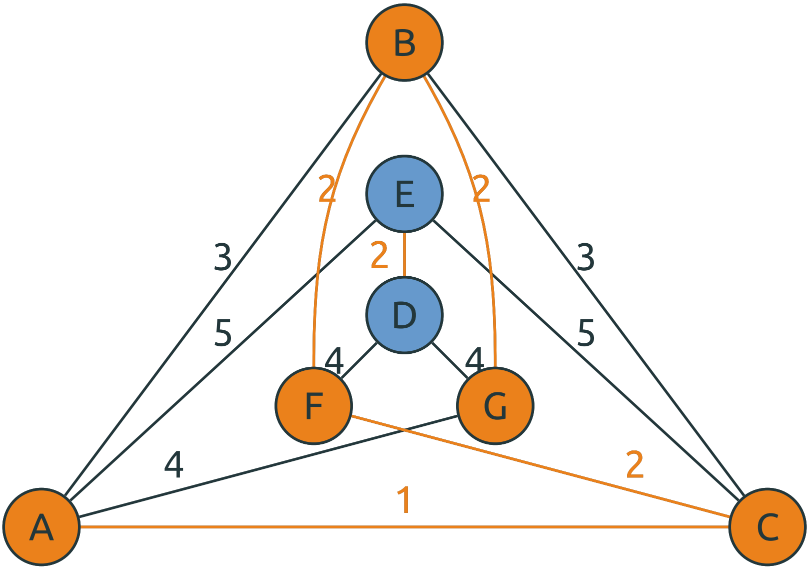

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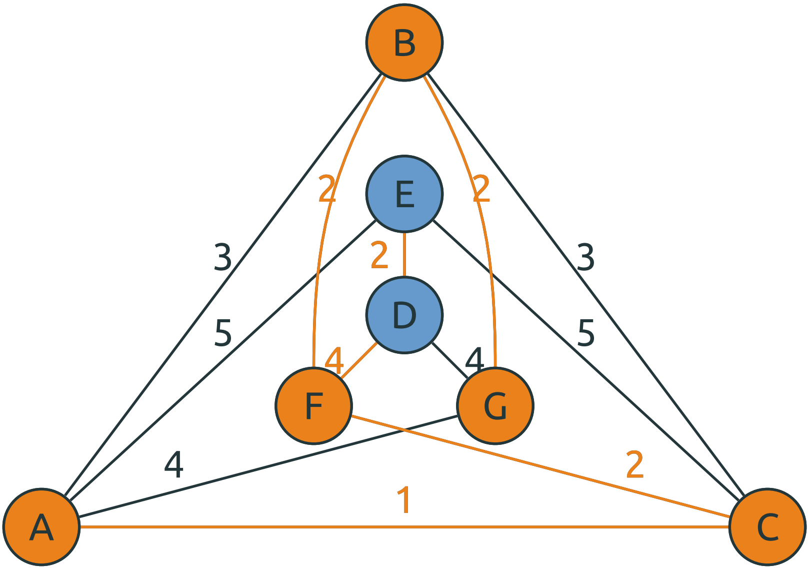

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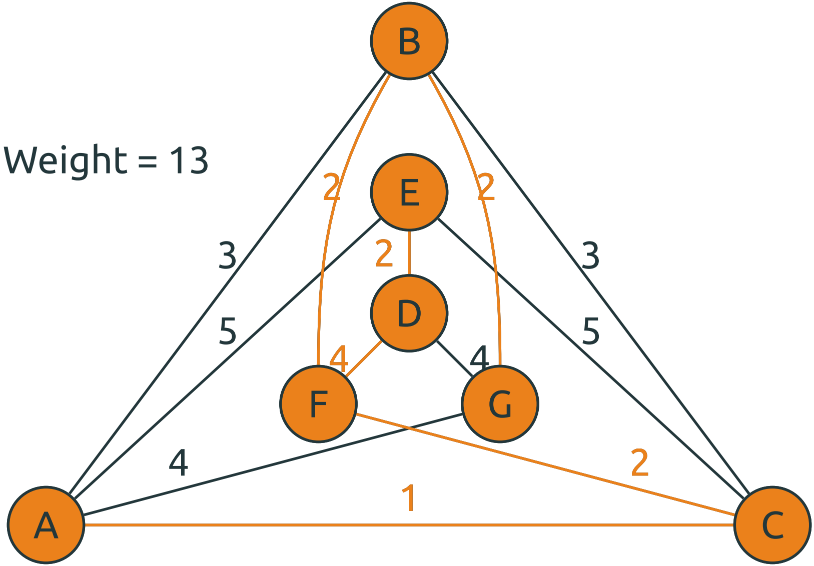

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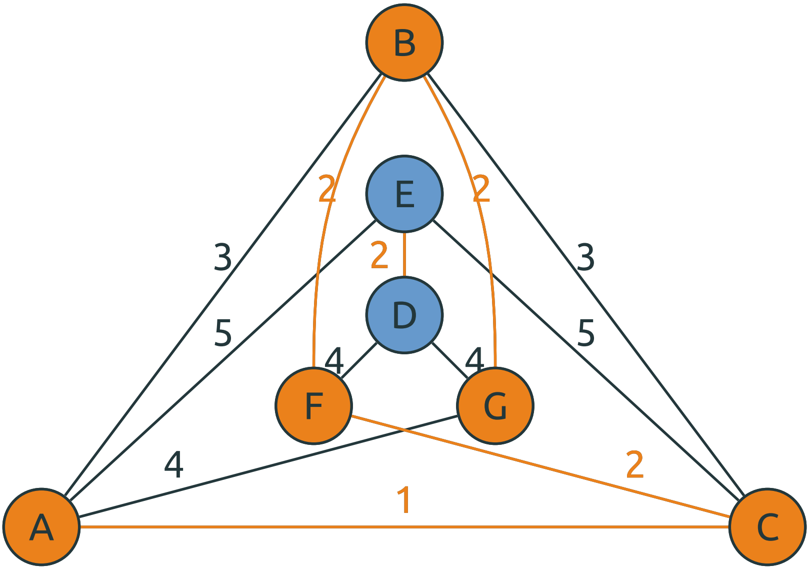

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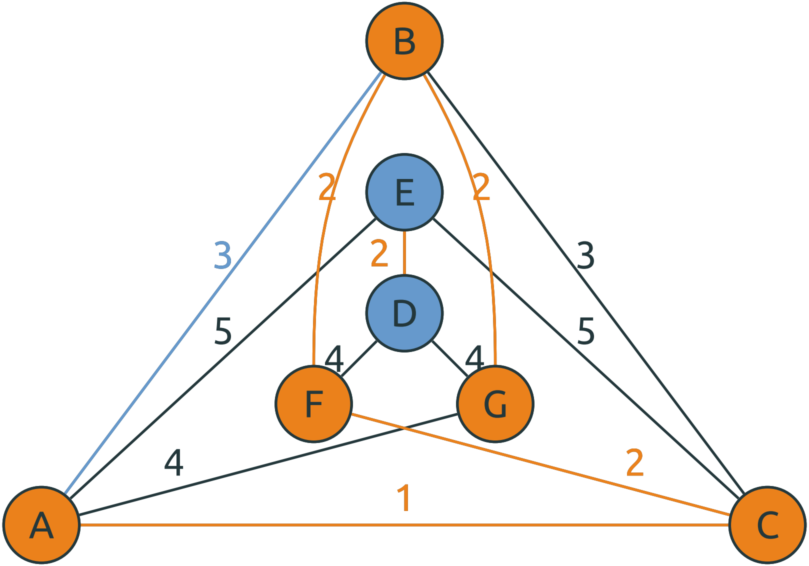

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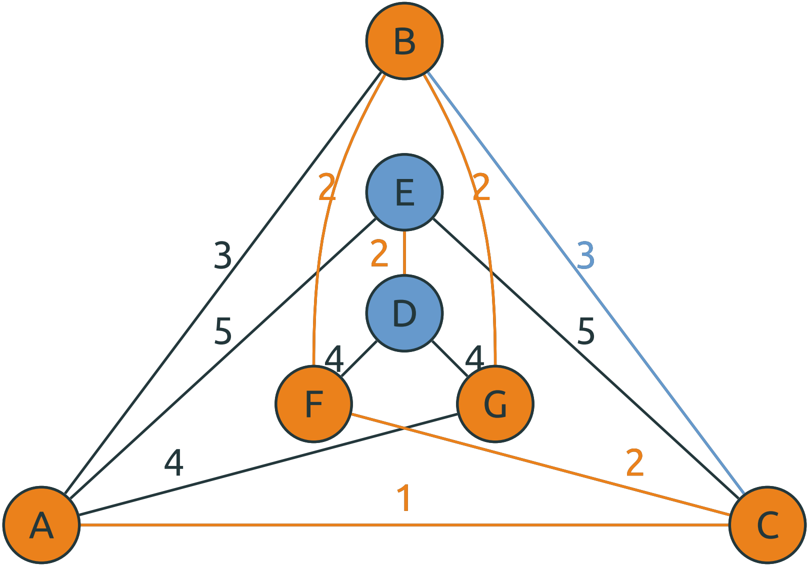

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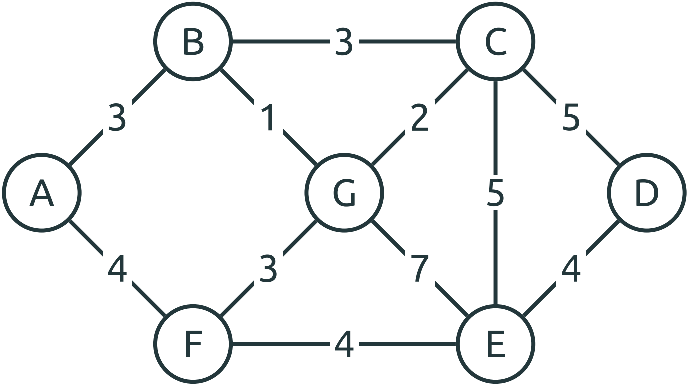

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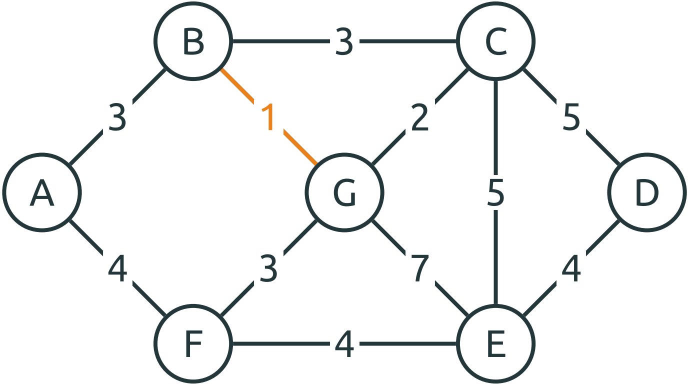

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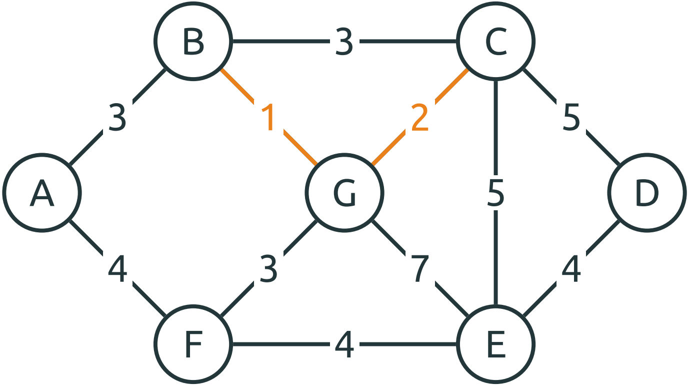

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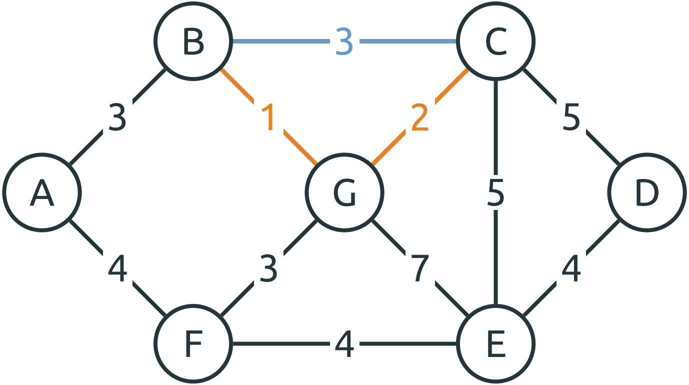

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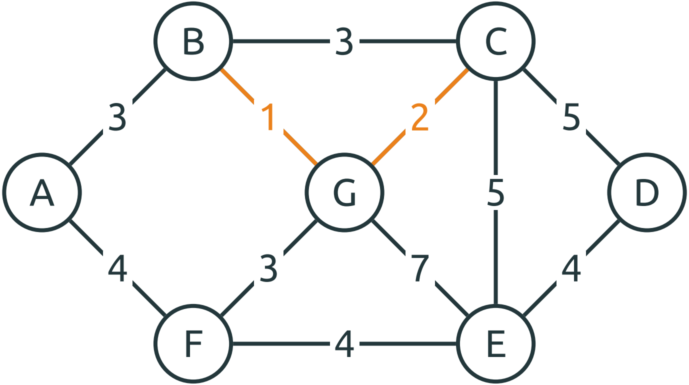

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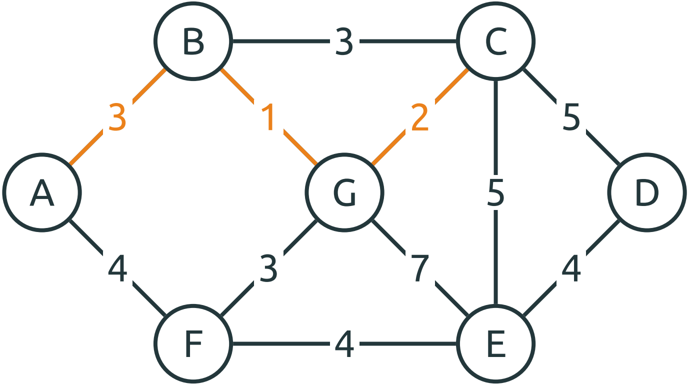

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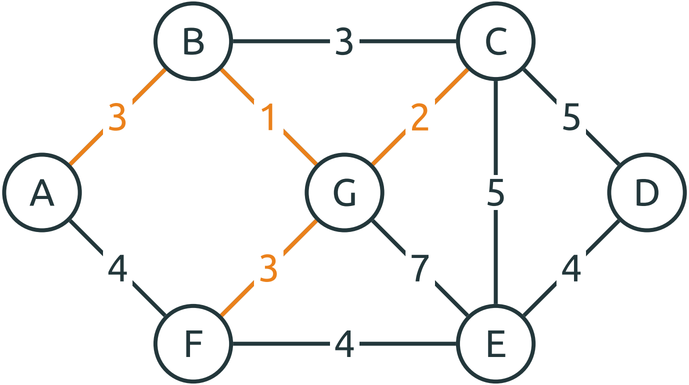

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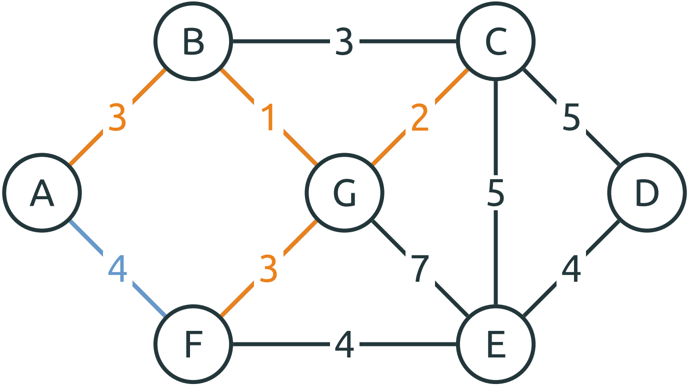

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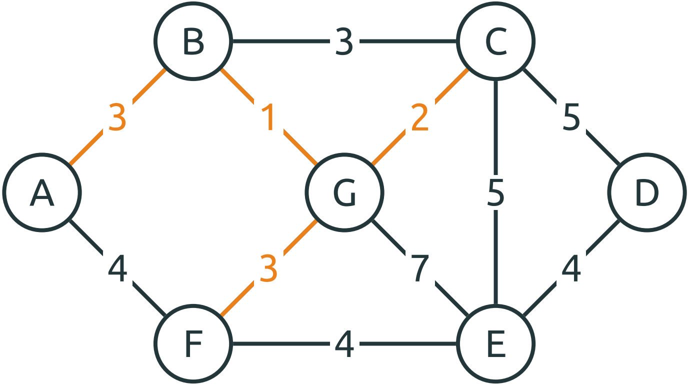

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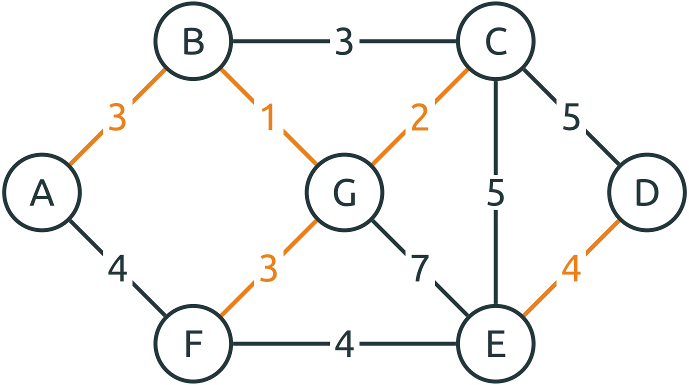

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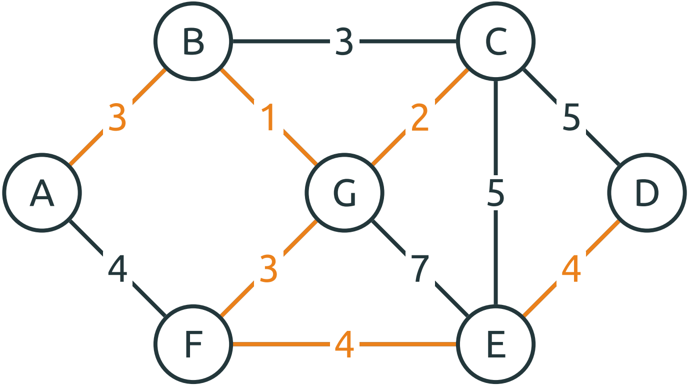

Outline

Road Repair

Trees

Minimum Spanning Tree

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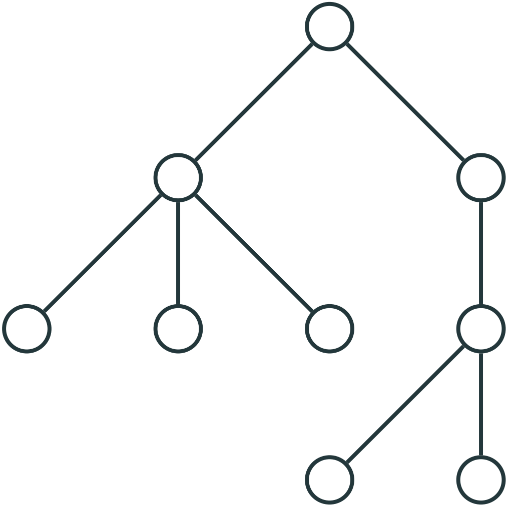
Trees: Examples



Equivalent Definitions

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- We'll prove that (I) $\rightarrow$ (II) $\rightarrow$ (III) $\rightarrow$ (I)

(I) $\rightarrow$ (II)

- A connected graph on n vertices without cycles has $n - 1$ edges

(I) $\to$ (II)

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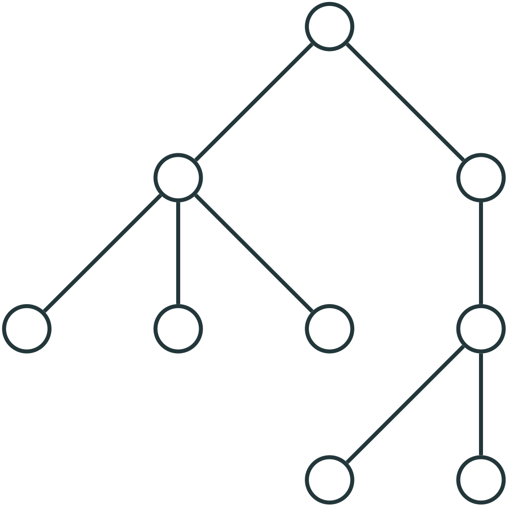
- Induction step. Every connected graph on $k + 1$ vertices has k edges

(I) → (II)



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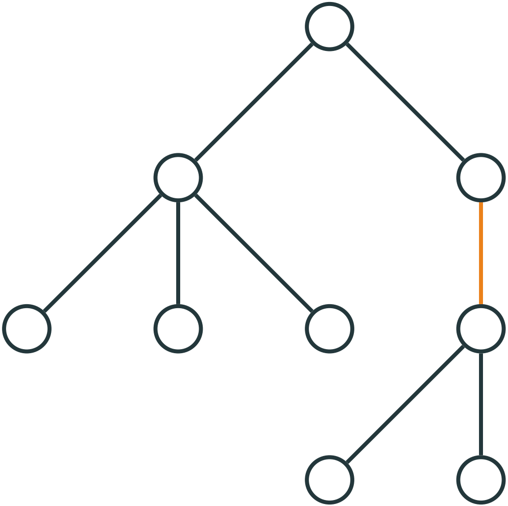
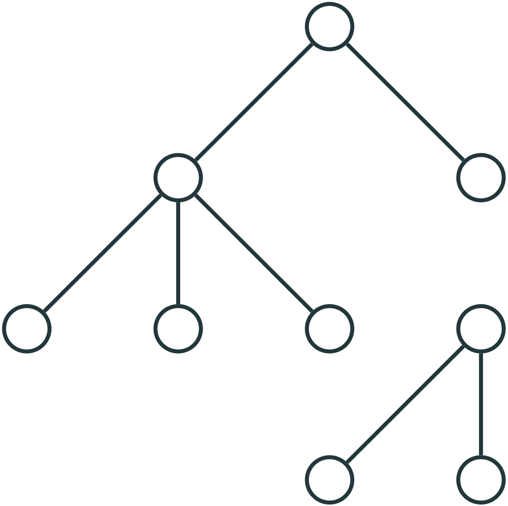


(I) $\rightarrow$ **(II)**



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- Thus, the original graph has $(n_1 - 1) + (n_2 - 1) + 1 = n - 1$ edges

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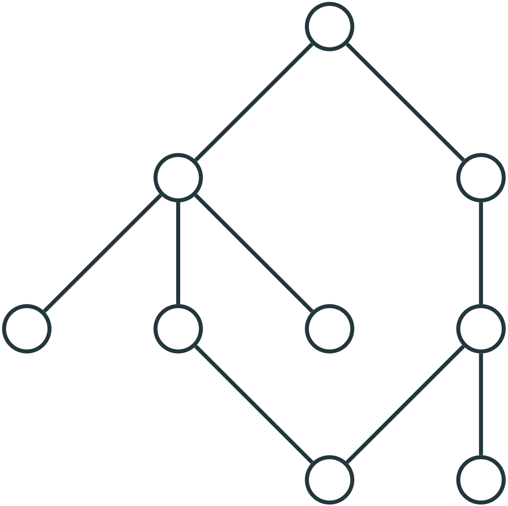
- Then the number of edges is n

(II) $\rightarrow$ (III)



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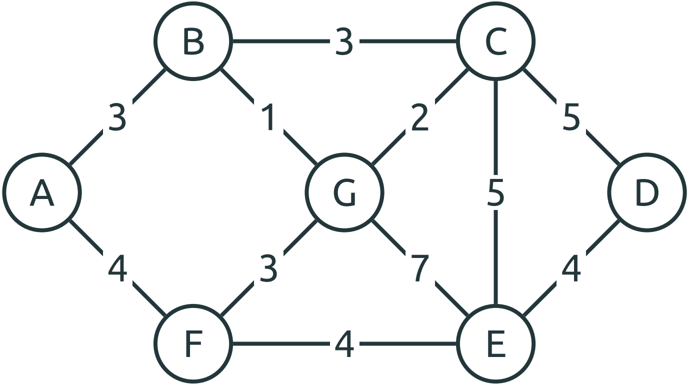
Minimum Spanning Tree: Examples



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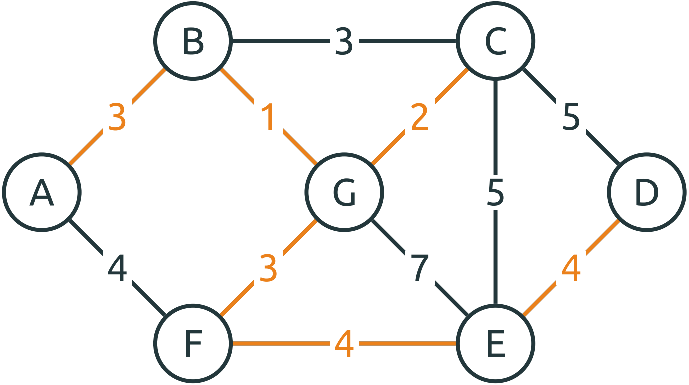

Kruskal's Algorithm

- Start with an empty graph T

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- Repeat $n - 1$ times:

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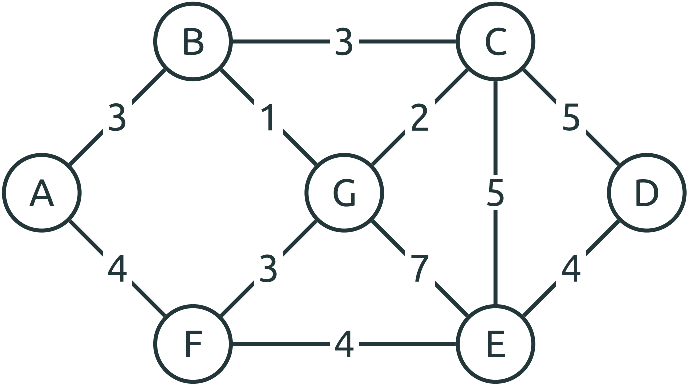
- Add to T an edge of the smallest weight which doesn't create a cycle in T

Kruskal's Algorithm: Examples



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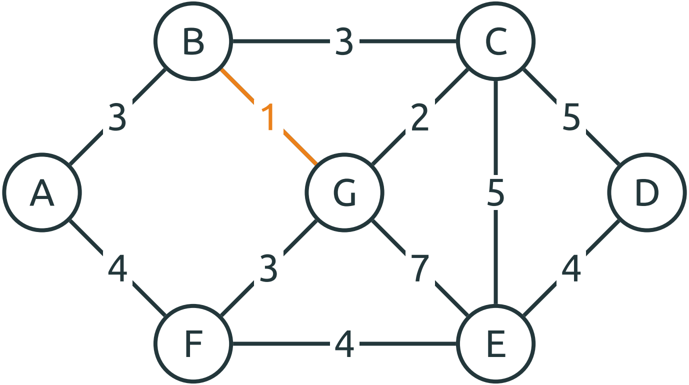

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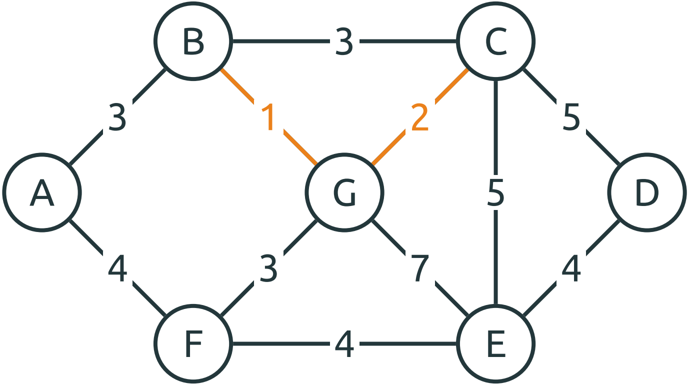

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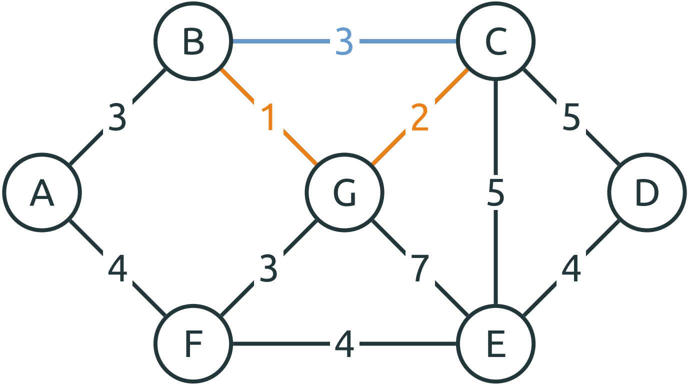

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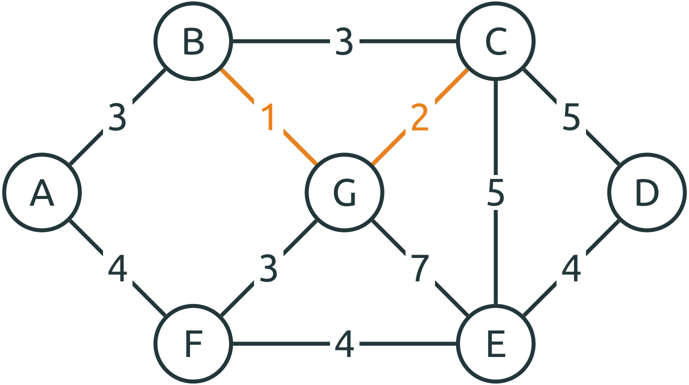

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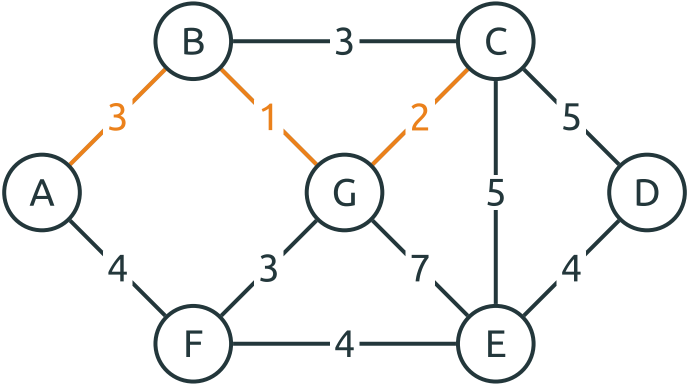

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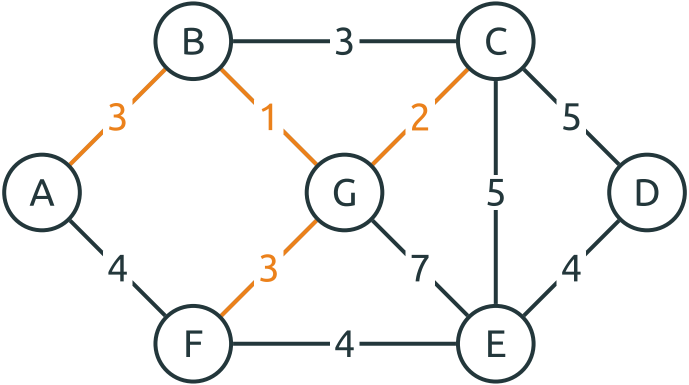

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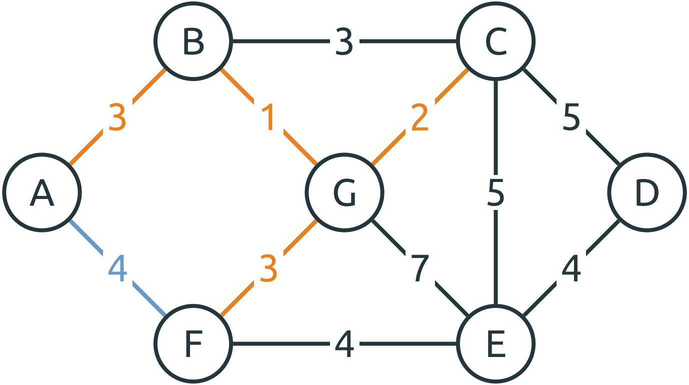

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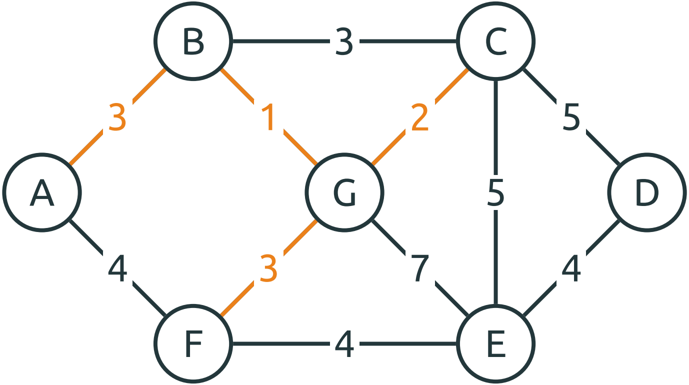

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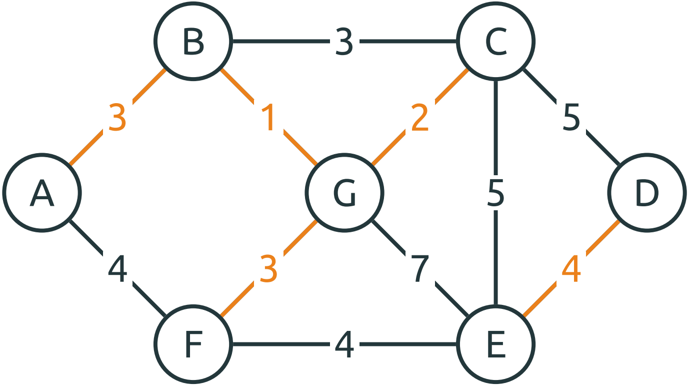

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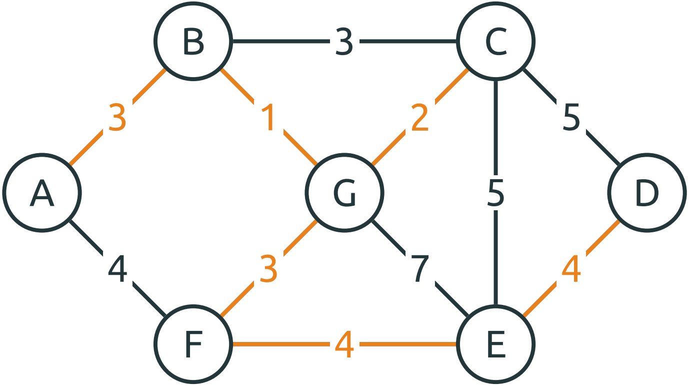

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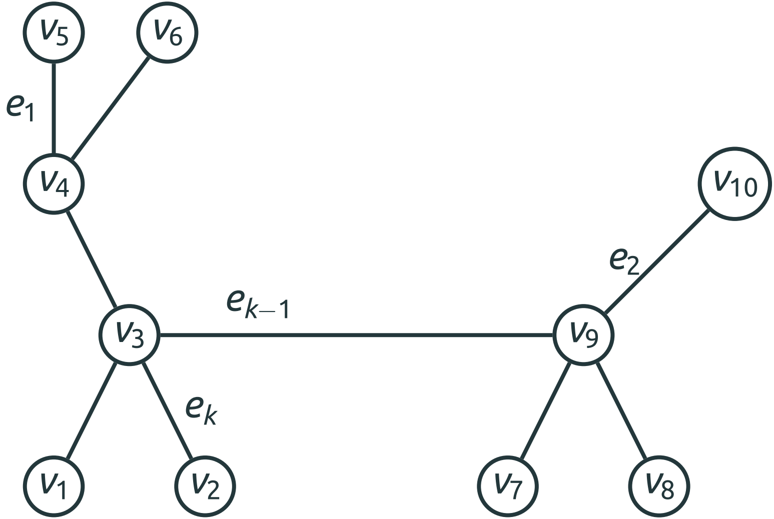

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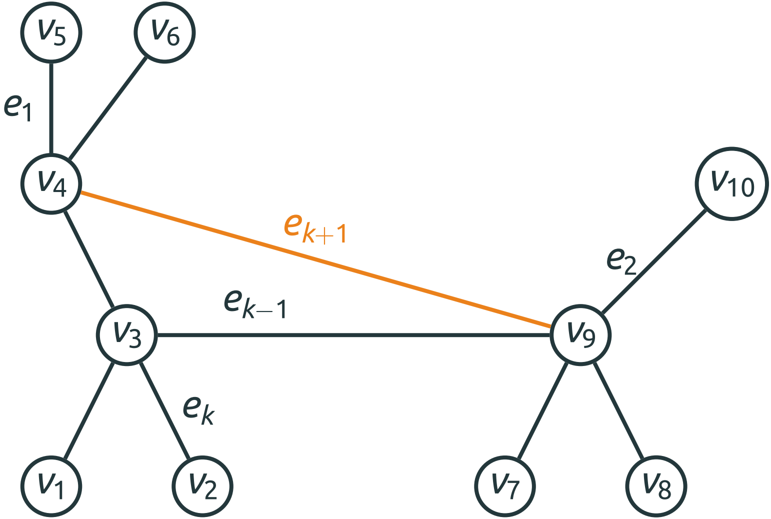

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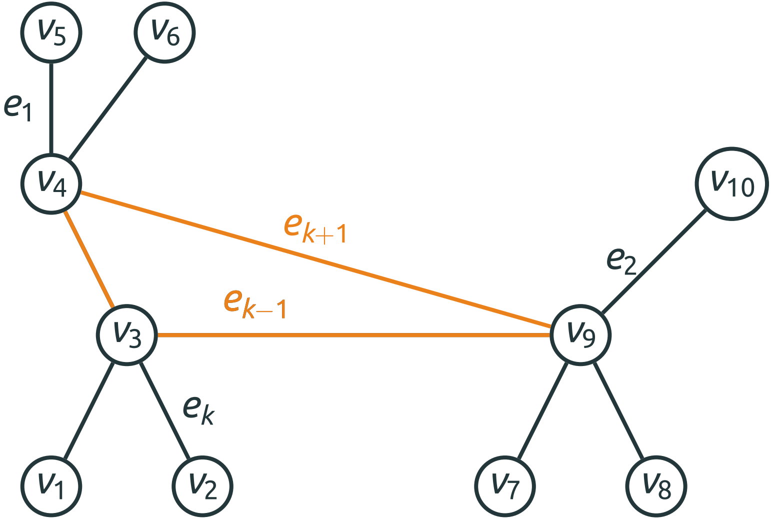

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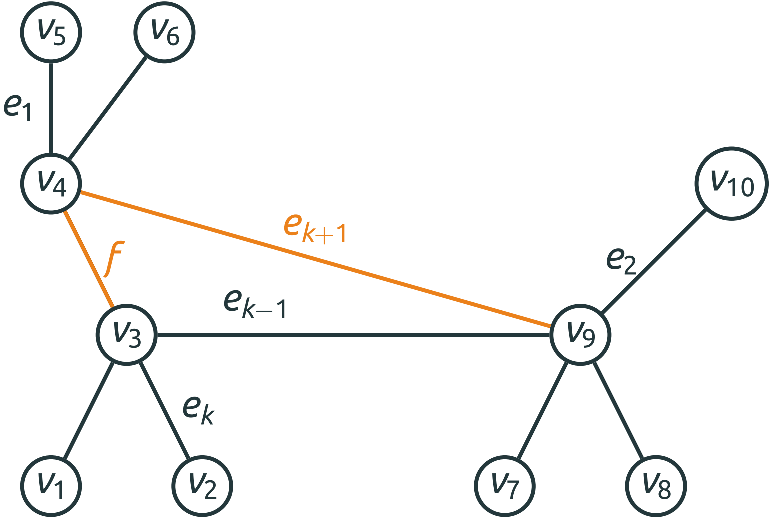

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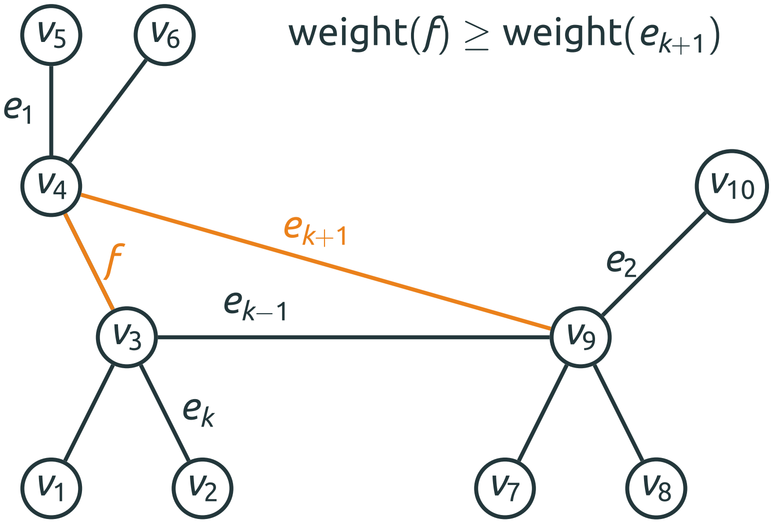

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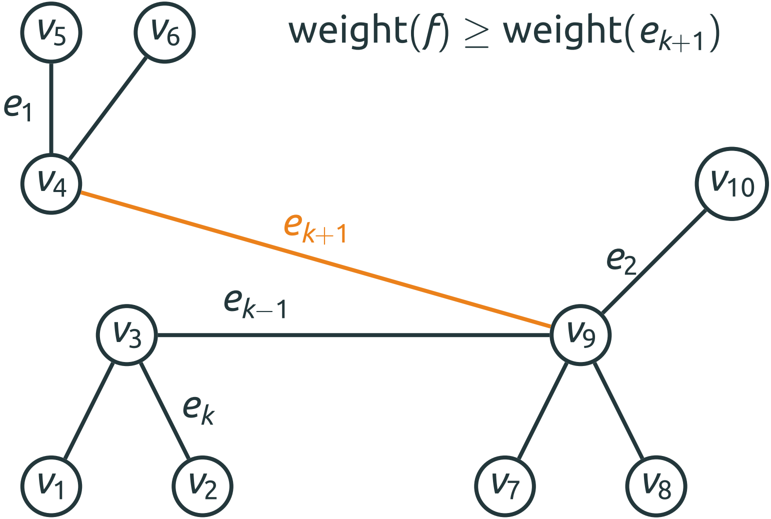
$\text{weight}(f) \geq \text{weight}(e_{k+1})$



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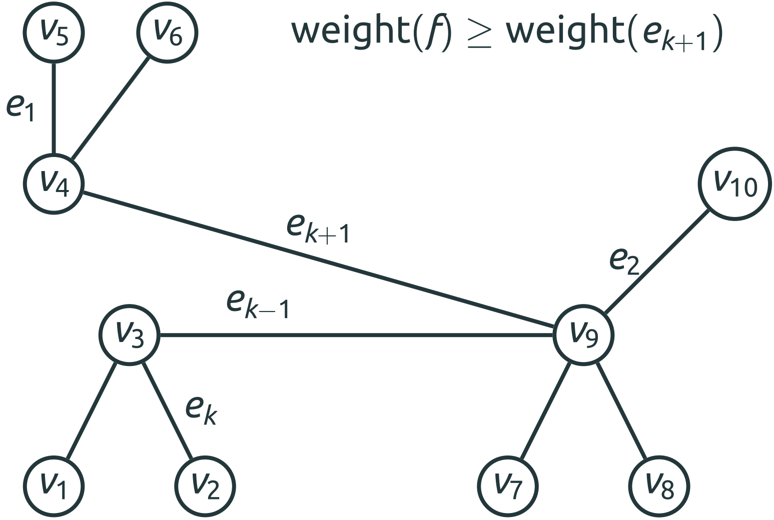

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