Ore's Theorem

CS 111 Presentation

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Questions

Introduction: Background Knowledge

To understand **Ore's theorem**, we must briefly recapitulate what it means for a graph to be **Hamiltonian**.

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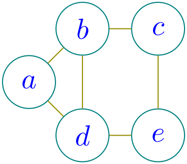
Example:



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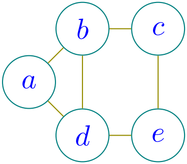
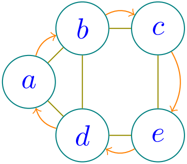




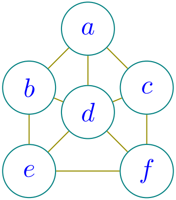
$T = \{a, b, c, e, d, a\}$

Introduction: Ore's Theorem Statement

Example I

First Case

$G_1(V, E)$ **satisfies** Ore's theorem Ω and **has** a Hamiltonian cycle T.



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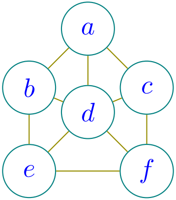

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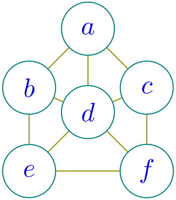

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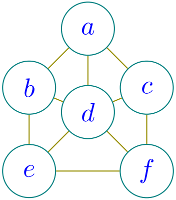

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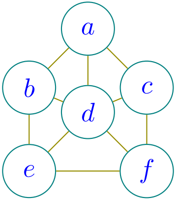

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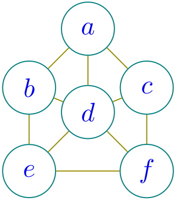

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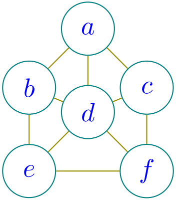

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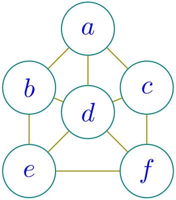

$$|V| = 6 \geq 3 \quad \vdash \quad \Omega_1$$

$$\begin{gathered}
\deg(a) + \deg(e) = 6 \\
\deg(a) + \deg(f) = 6 \\
\deg(b) + \deg(c) = 6 \\
\deg(b) + \deg(f) = 6 \\
\deg(c) + \deg(e) = 6 \\
\vdash \Omega_2
\end{gathered}$$

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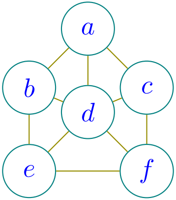


$$|V| = 6 \geq 3 \quad \vdash \quad \Omega_1$$

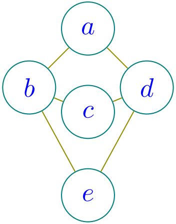
$$\begin{gathered}\deg(a) + \deg(e) = 6 \\ \deg(a) + \deg(f) = 6 \\ \deg(b) + \deg(c) = 6 \\ \deg(b) + \deg(f) = 6 \\ \deg(c) + \deg(e) = 6 \\ \vdash \Omega_2\end{gathered}$$

This graph **satisfies** Ω and **has** a Hamiltonian cycle $T = \{d, a, b, e, f, c, d\}$.

Example II

Second Case

$G_2(V, E)$ **does not satisfy** Ω and **does not have** a Hamiltonian cycle T.



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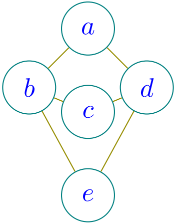

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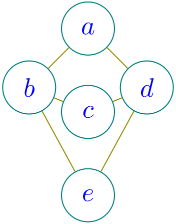

$$|V| = 5 \geq 3 \quad \vdash \quad \Omega_1$$

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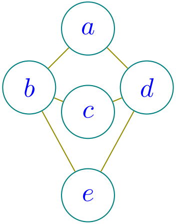

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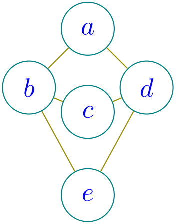

$$|V| = 5 \geq 3 \quad \vdash \quad \Omega_1$$

$$\deg(a) + \deg(c) = 4$$
$$\deg(a) + \deg(e) = 4$$
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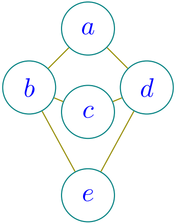

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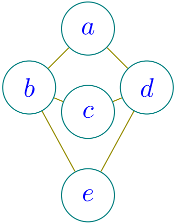

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$$\nvdash \Omega_2$$

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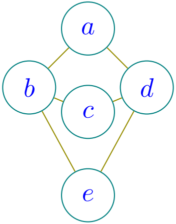

$$|V| = 5 \geq 3 \quad \vdash \quad \Omega_1$$

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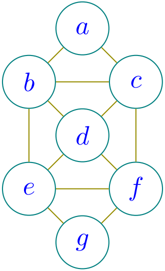
$$\not\vdash \Omega_2$$

This graph **does not satisfy** Ω and **does not have** a Hamiltonian cycle.

Example III

Third Case

$G_2(V, E)$ **does not satisfy** Ω and **has** a Hamiltonian cycle T.



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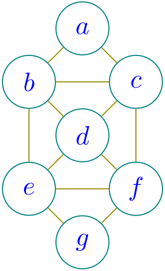

$$|V| = 7 \geq 3 \quad \vdash \quad \Omega_1$$

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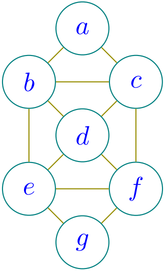

$$|V| = 7 \geq 3 \quad \vdash \quad \Omega_1$$

$$\deg(a) + \deg(d) = 6 \qquad \deg(a) + \deg(e) = 8 \qquad \deg(a) + \deg(f) = 8$$

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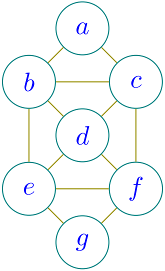

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$\deg(a) + \deg(d) = 6$	$\deg(a) + \deg(e) = 8$	$\deg(a) + \deg(f) = 8$
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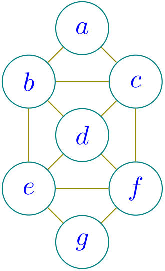

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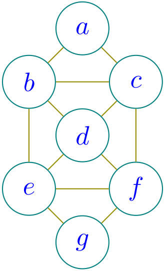

$$|V| = 7 \geq 3 \quad \vdash \quad \Omega_1$$

$$\begin{array}{ccc} \deg(a) + \deg(d) = 6 & \deg(a) + \deg(e) = 8 & \deg(a) + \deg(f) = 8 \\ \deg(a) + \deg(g) = 4 & \deg(b) + \deg(f) = 8 & \deg(b) + \deg(g) = 8 \\ \deg(c) + \deg(e) = 8 & \deg(c) + \deg(g) = 8 & \deg(d) + \deg(g) = 6 \end{array}$$

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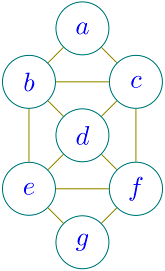

$$|V| = 7 \geq 3 \quad \vdash \quad \Omega_1$$

$$\begin{array}{ccc} \deg(a)+\deg(d)=6 & \deg(a)+\deg(e)=8 & \deg(a)+\deg(f)=8 \\ \deg(a)+\deg(g)=4 & \deg(b)+\deg(f)=8 & \deg(b)+\deg(g)=8 \\ \deg(c)+\deg(e)=8 & \deg(c)+\deg(g)=8 & \deg(d)+\deg(g)=6 \end{array}$$

$$\nvdash \Omega_2$$

This graph **does not satisfy** Ω but still **has** a Hamiltonian cycle $T = \{a, b, d, e, g, f, c, a\}$.

Applications

Conclusion: Summary

Conclusion: Questions