# DISCRETE MATHEMATICS
## IN COMPUTER SCIENCE

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January 26, 2022

# Administrivia

- Midterm 1
  - Jan 31 (Mon) 6–9PM
  - Moore Hall B13 Filene Auditorium
- Conflict Midterm 1
  - Feb 1 (Tue) 5–8PM
  - Place to be updated
- SAS/Conflict Conflict
  - Come talk to me

- Closed-book written exam
- Scope: Module P on proofs
- One-page two-sided cheatsheet
  - Must be hand-written

# BOOKS

- **Introduction to Graph Theory**
  by Dougalas B. West
  - Pros: Clear writing style, lots of exercises
  - Cons: Expansive



INTRODUCTION TO
GRAPH THEORY

SECOND EDITION

DOUGLAS B. WEST
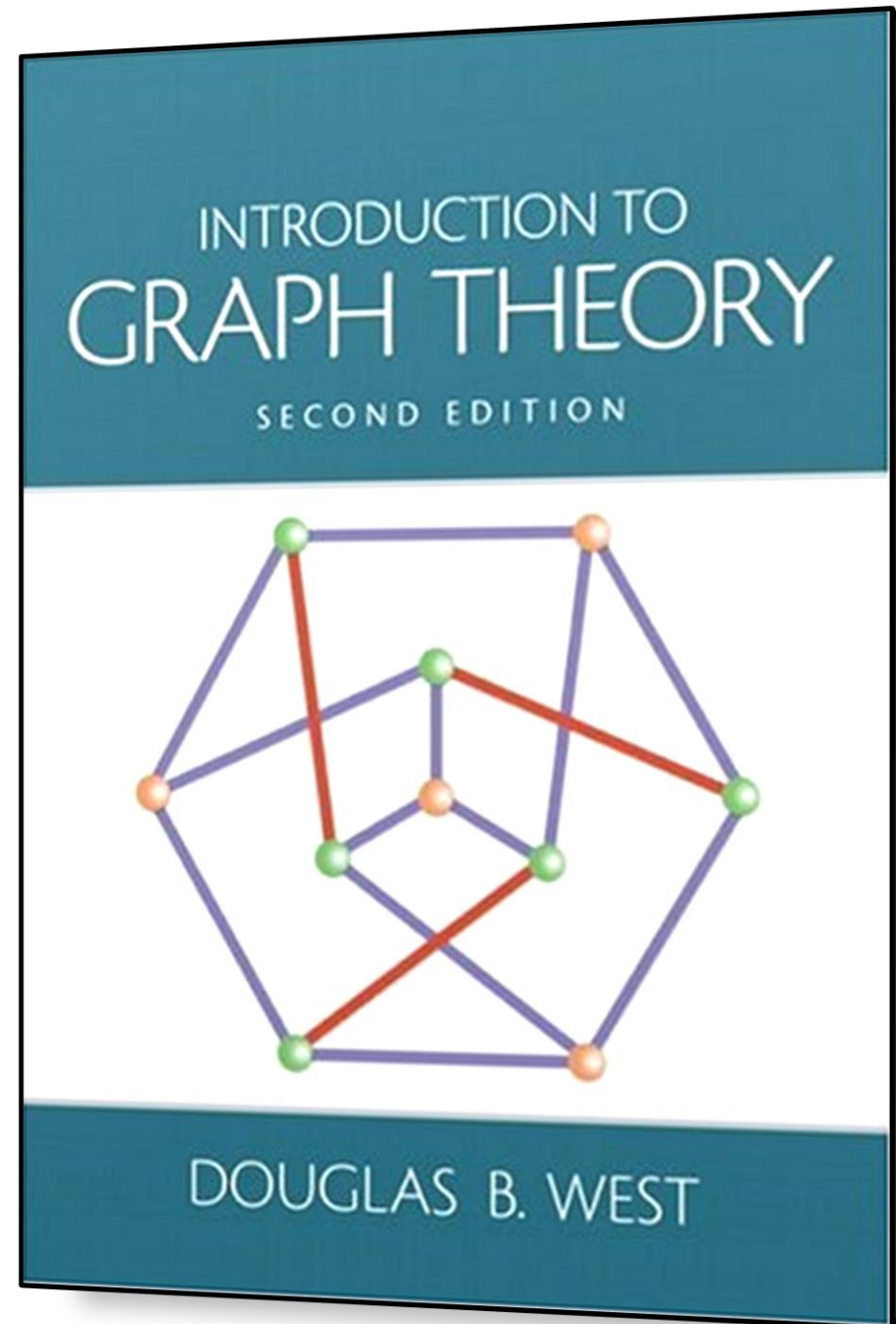
# Books

- **Graph Theory**
  **by Reinhard Diestel**
  - Pros: Free, modern in topics
  - Cons: A bit dense, more advanced

Graduate Texts in Mathematics

GTM

Reinhard Diestel

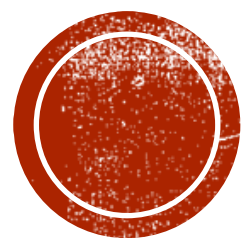**Graph Theory**

*Fifth Edition*

Springer
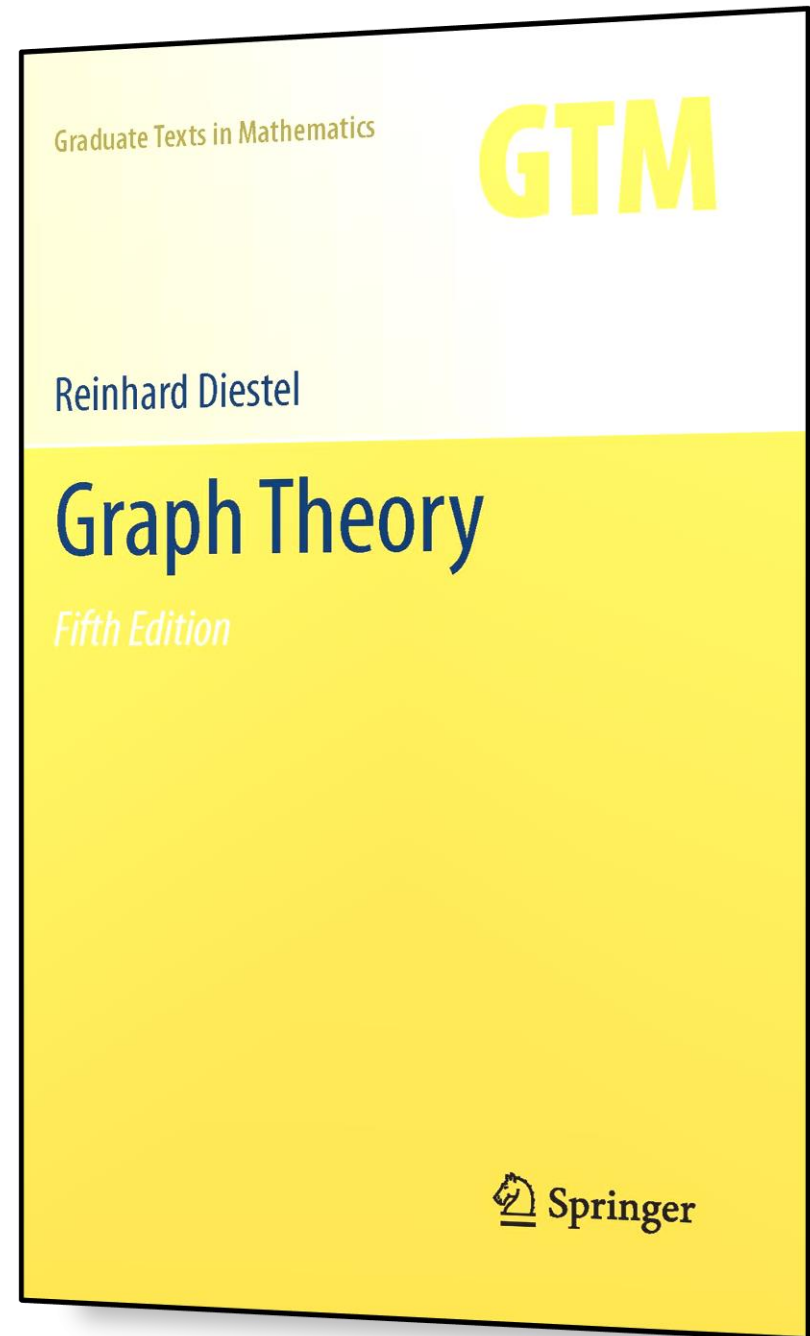
# Books

- **Algorithms**
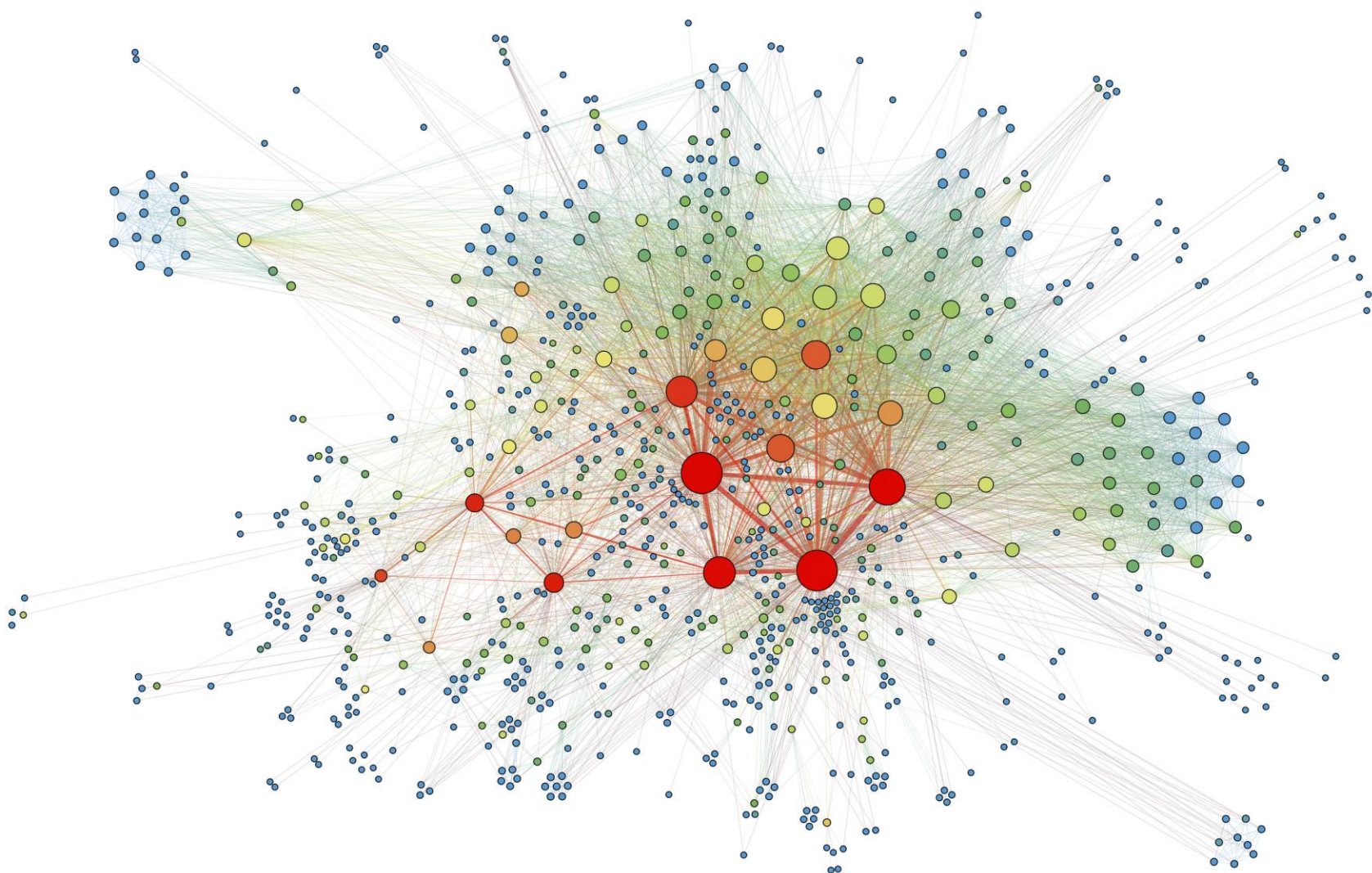  by Jeff Erickson
  - Pros: Free, chapters on graphs and recursion
  - Cons: Really a textbook for COSC 31
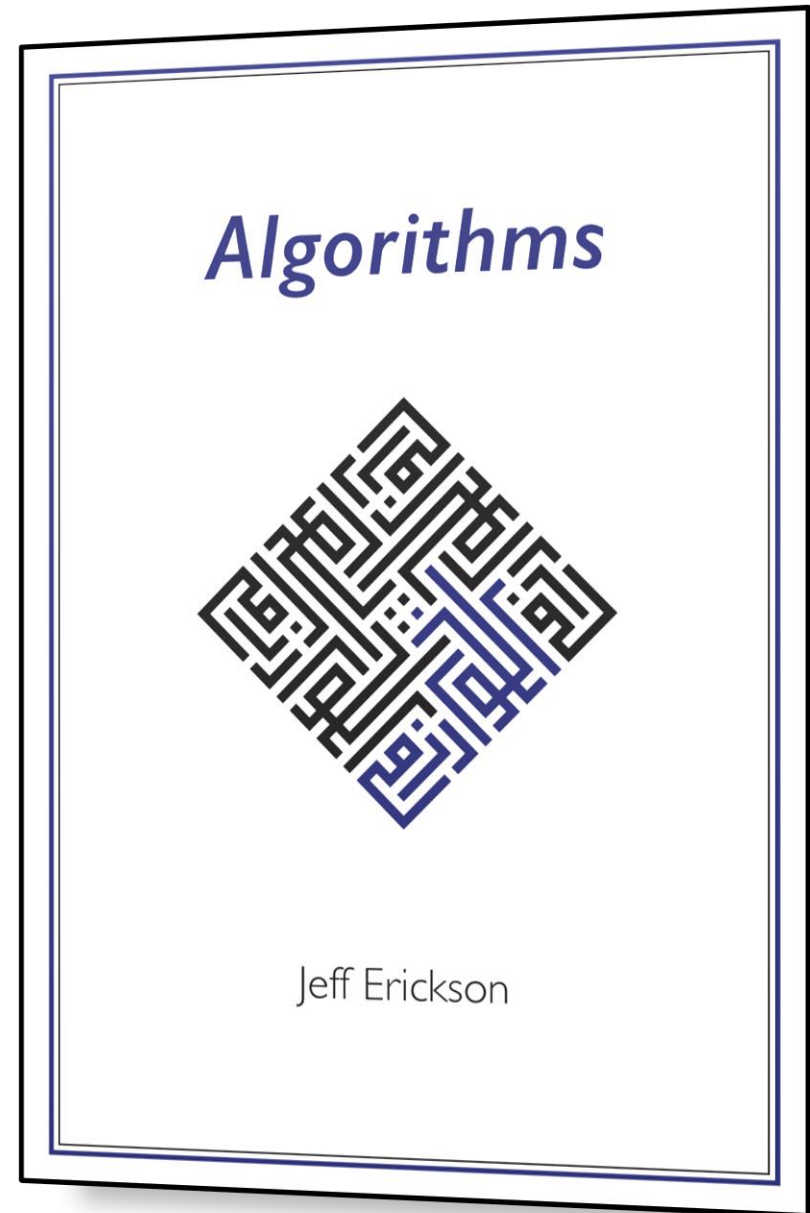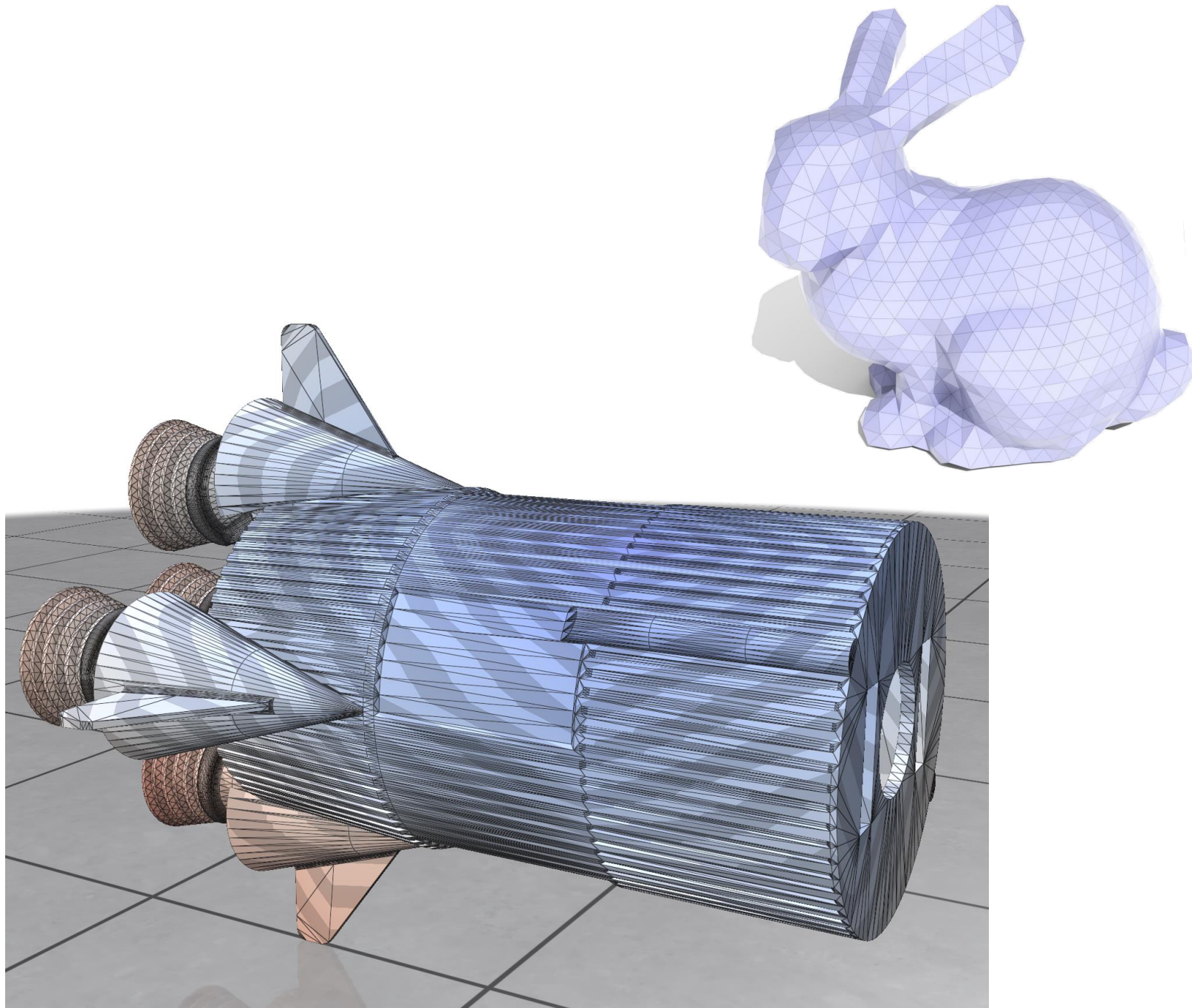
# GRAPHS

# Jargon

graph
vertex / node
edge / arc
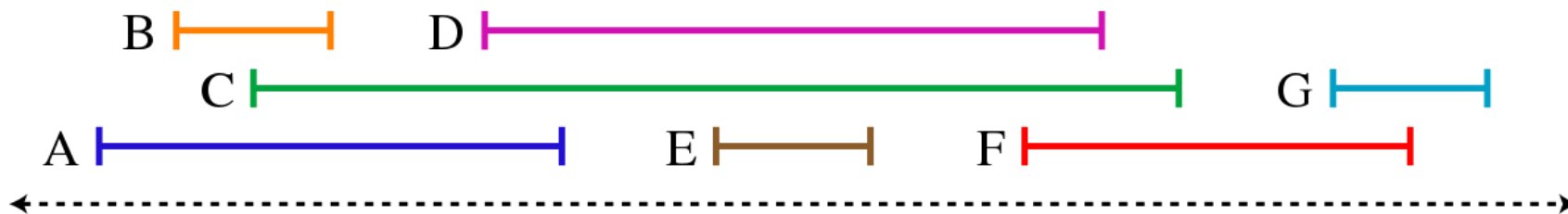undirected / directed
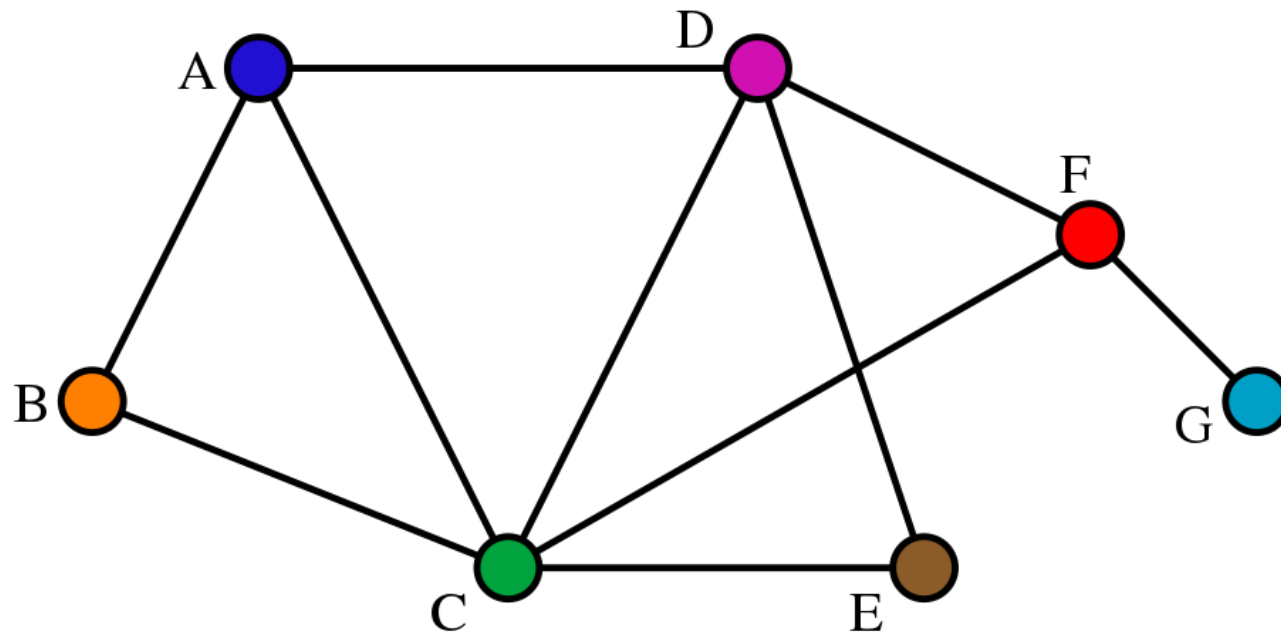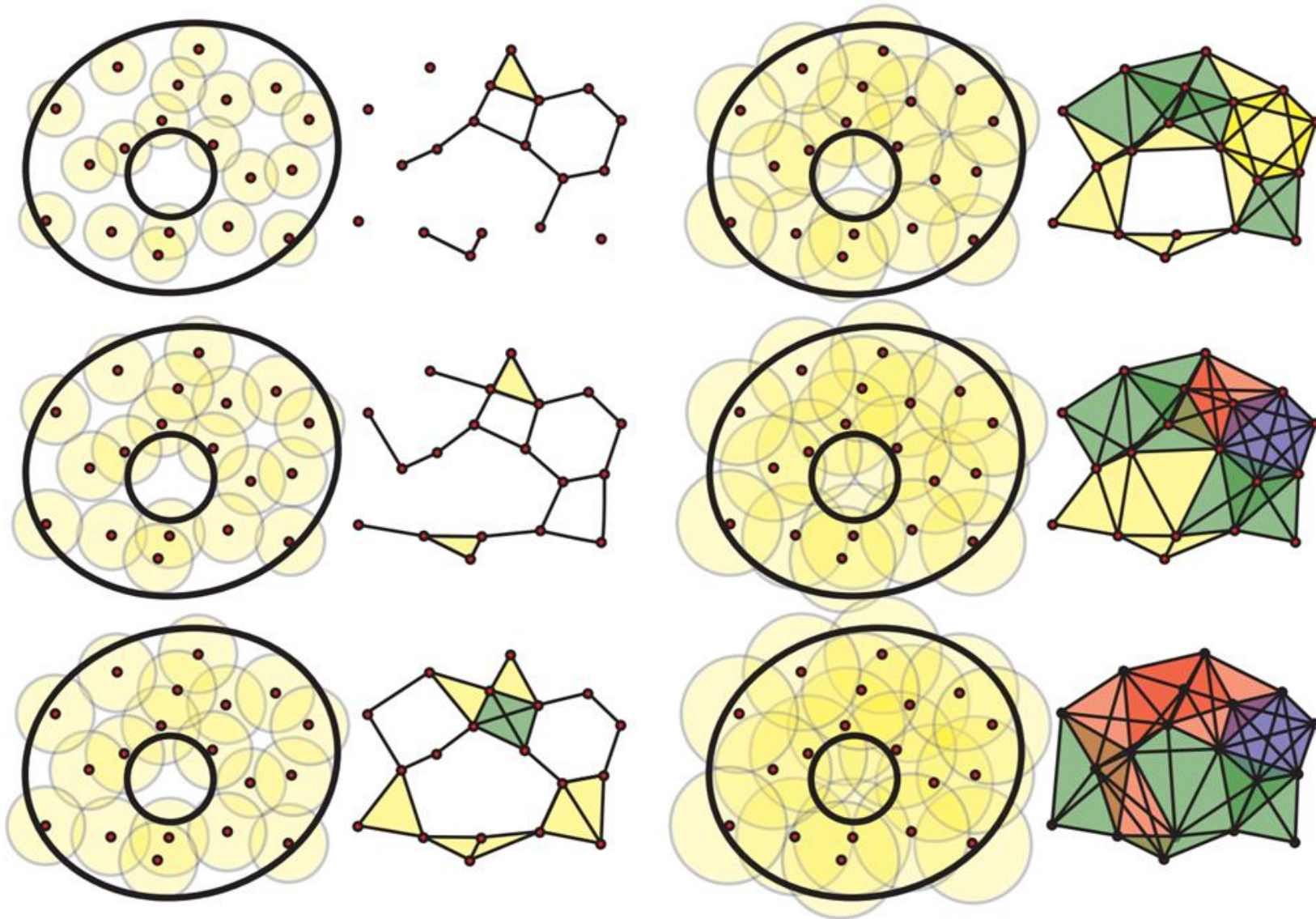
simple graph
loop
multi-edges

# EXAMPLE
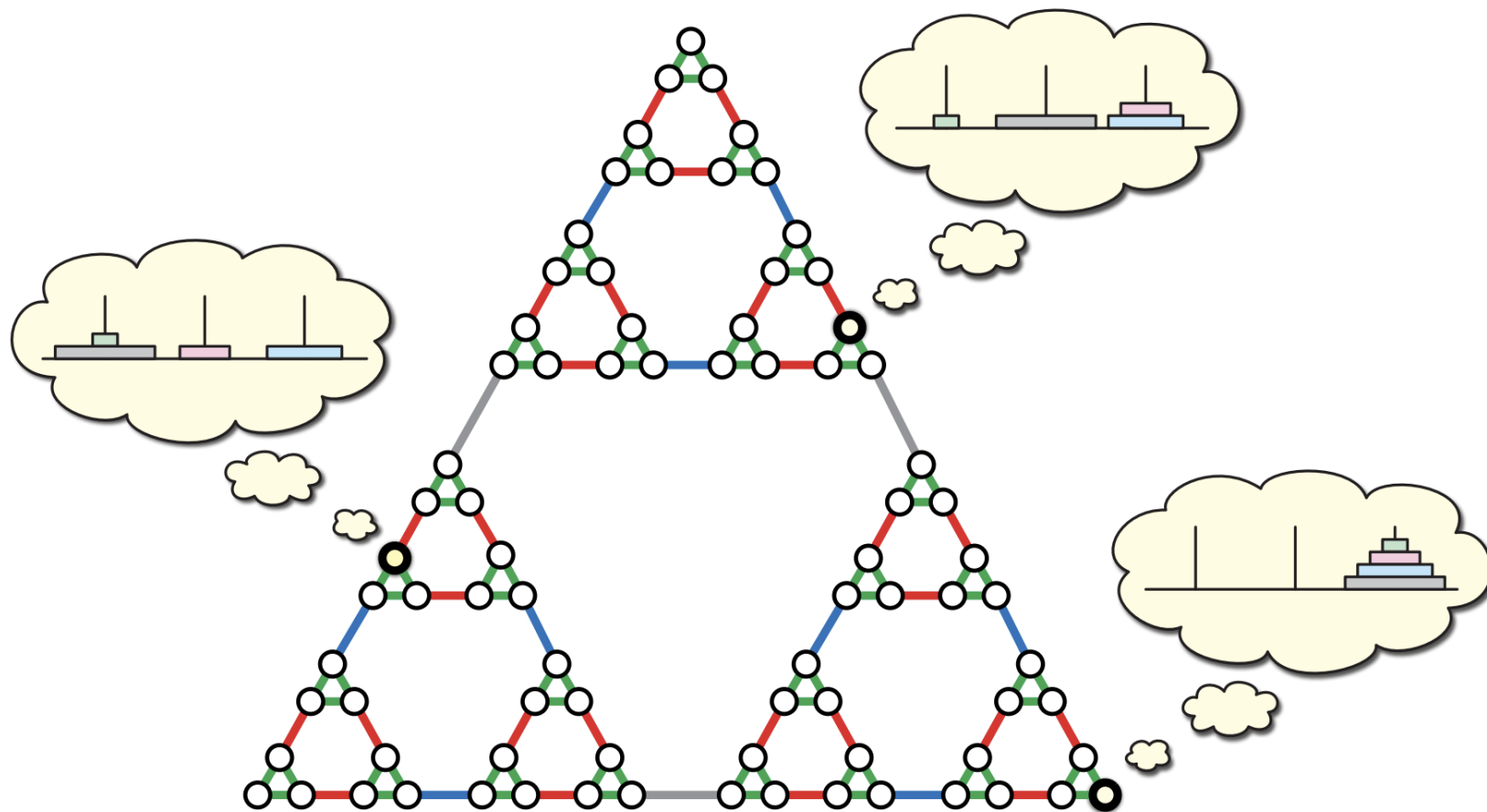
## Meshes

# EXAMPLE

Scheduling problem as interval graph

Reconstructing underlying space through sampling
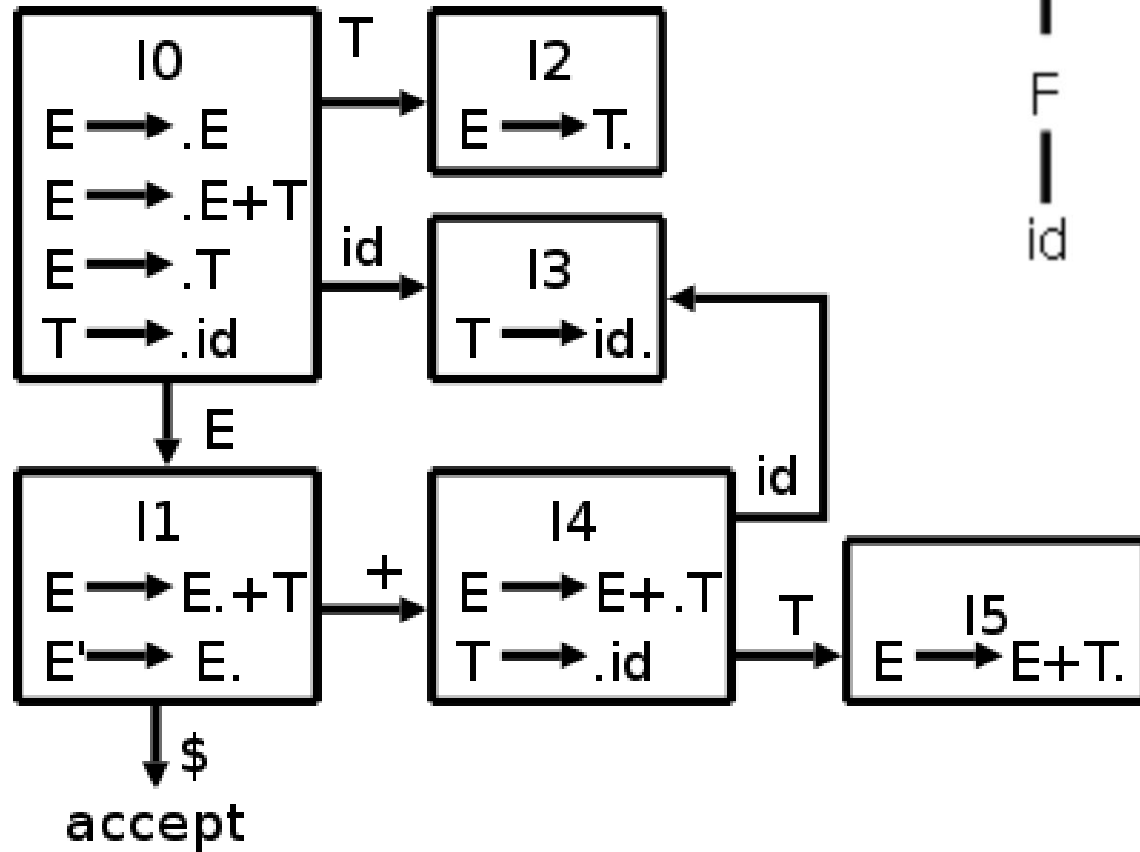
# EXAMPLE

State diagram for Tower of Hanoi
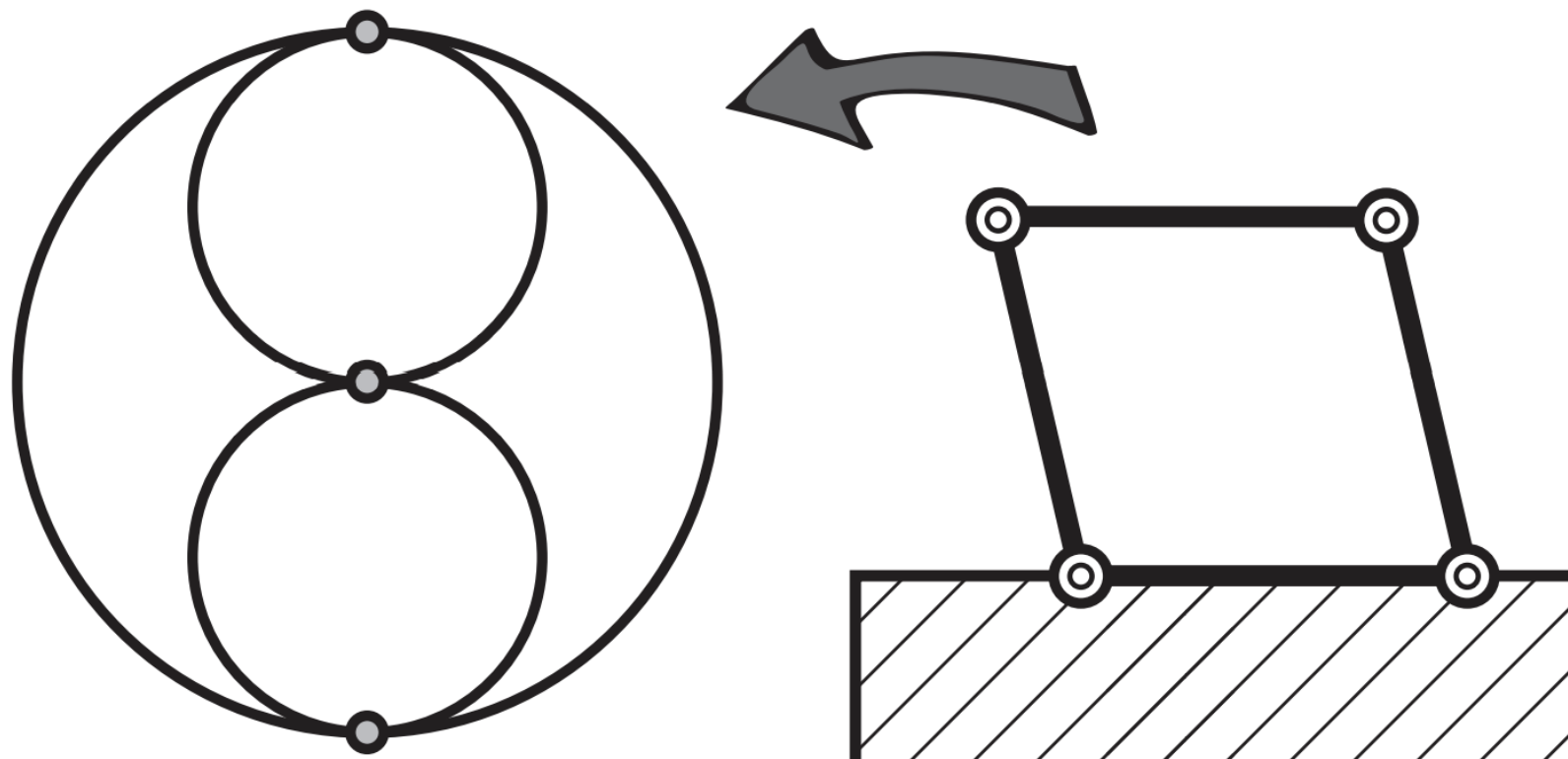
# EXAMPLE

Configuration of 4-bar mechanism

EXAMPLE

Parsing grammar

String = ACAABBABA
Pattern = ABA
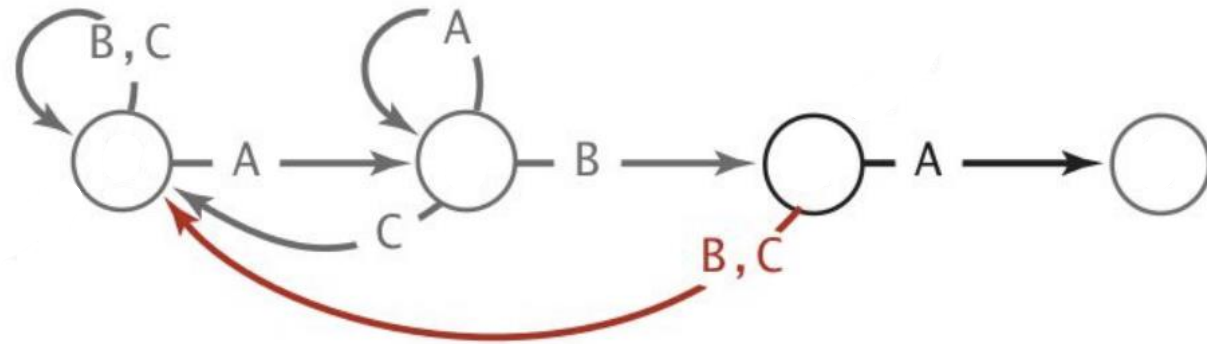
# More Jargon

neighbor / neighborhood

incident / adjacent

endpoint

vertex degree
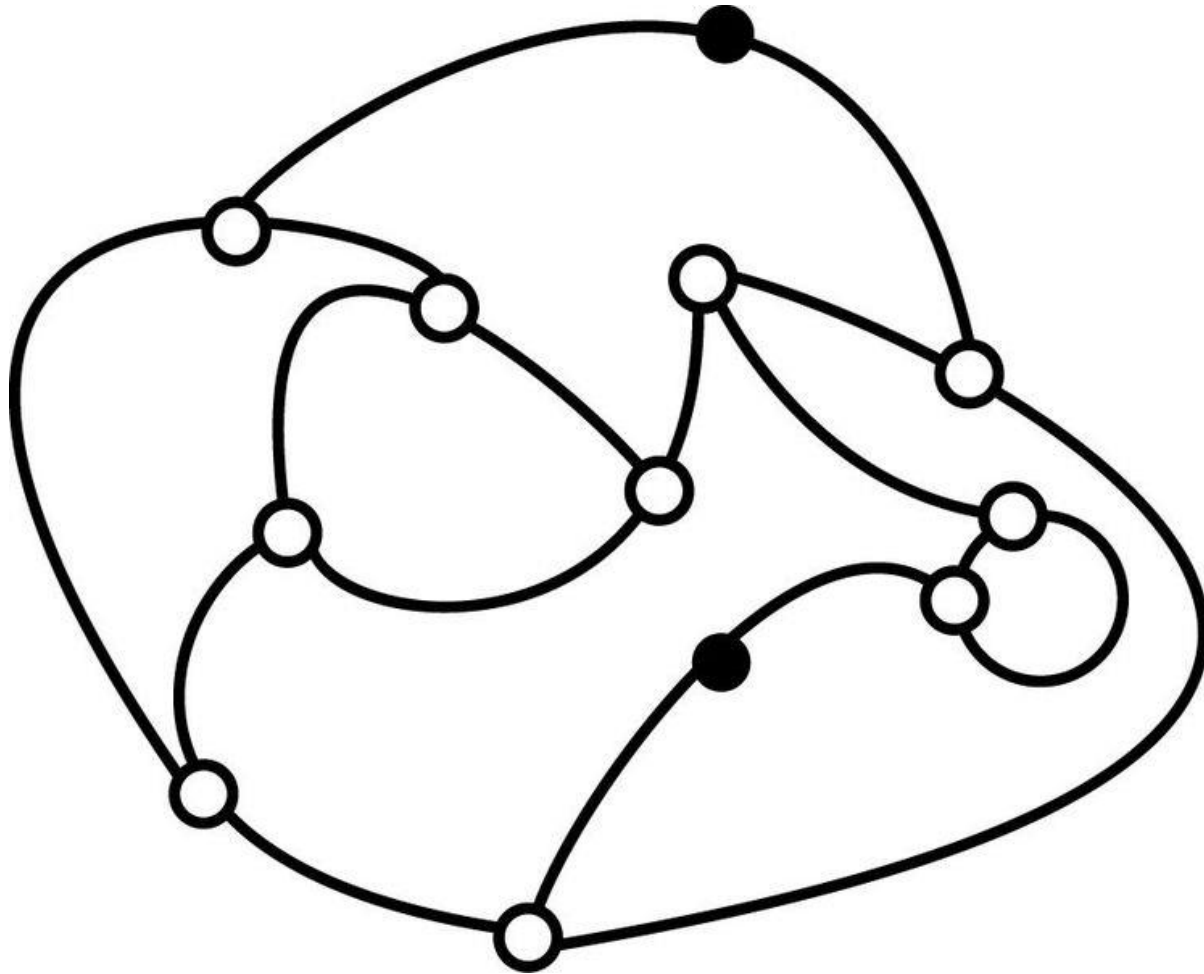
isolated

regular

subgraph

induced subgraph

# Handshake Lemma

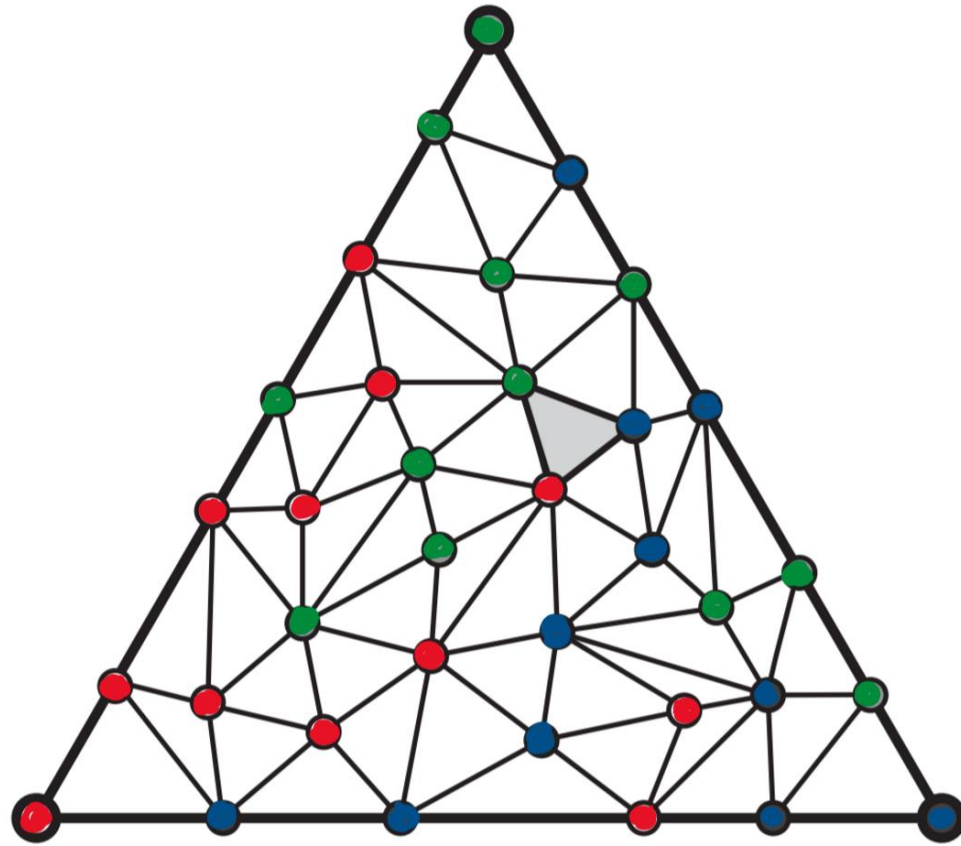For any graph G,

$$\sum_{v \text{ in } V(G)} \deg_G v = 2\,|\,E(G)\,|$$

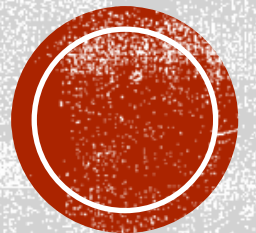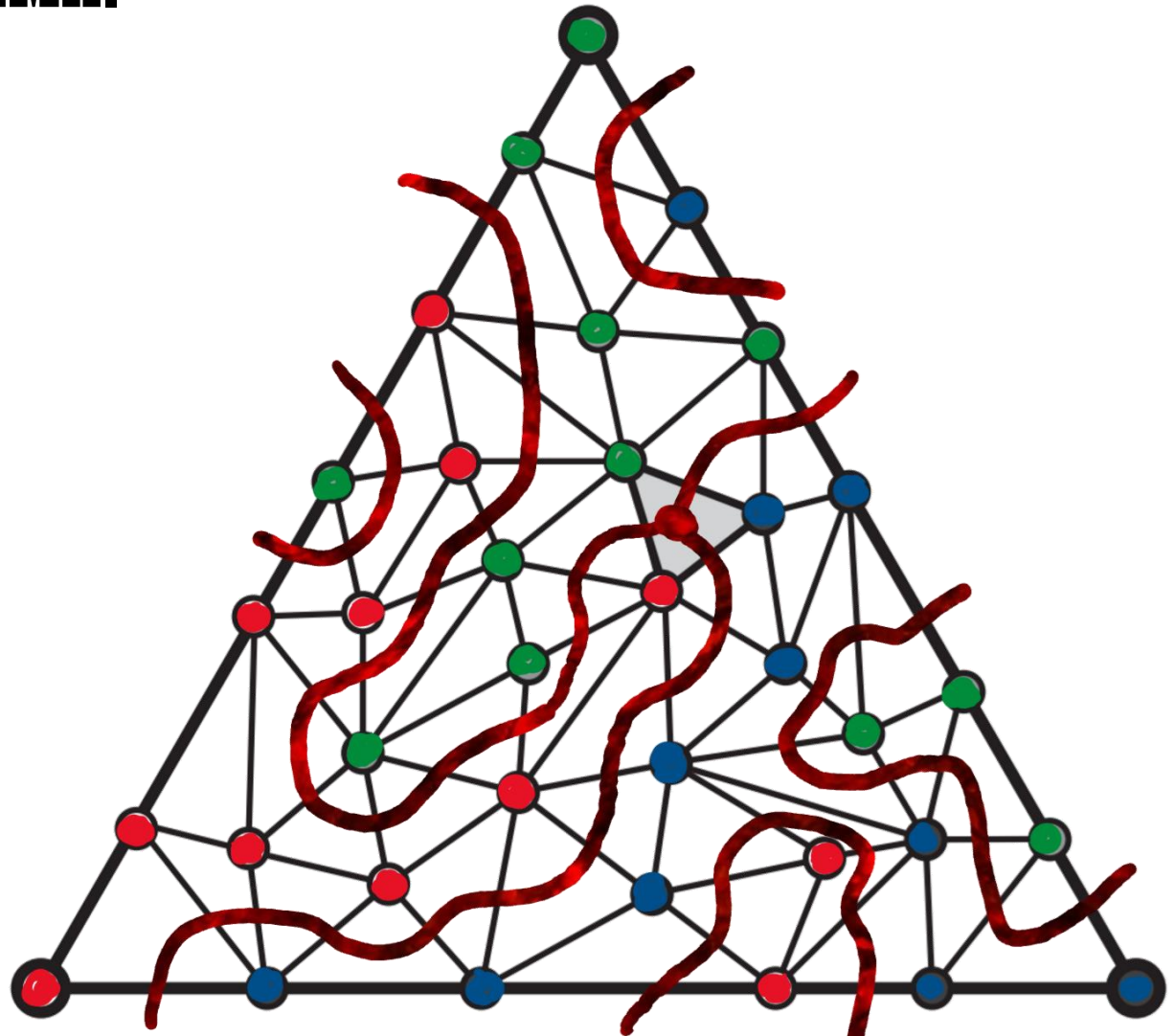# There are even number of odd-degree vertices.

## Corollary

# Sperner's Lemma

Every properly 3-colored triangulation of $\Delta$ contains a triangle with all the colors

# Proof of Sperner's Lemma.

# Some vertex has degree at most $2|E|/|V|$.

My wife and I recently attended a party with **four other married couples.** Various handshakes took place. **No one shook hands with one's own spouse,** and no two people shook hands more than once. After all the handshakes were over, I asked everyone **how many times they had shaken hands.** To my surprise, **each person gave a different answer.** How many times did my wife shake hands?