

# Road Networks: Graphs and Their Types

Road networks are the backbones of transportation systems, enabling the efficient movement of people and goods. Understanding how to model these complex networks using graph theory is crucial for urban planning, traffic management, and infrastructure development.







# What are Road Networks and Why Model Them?

## Understanding Traffic Patterns

Modeling road networks as graphs allows us to analyze traffic flow, identify bottlenecks, and optimize routing.

## Infrastructure Planning

Graph-based models can guide the strategic placement of roads, bridges, and other transportation infrastructure.

## Emergency Response

Graph-based road networks can help emergency services quickly navigate and respond to incidents.

## Logistics Optimization

Modeling road networks as graphs enables efficient route planning for delivery and distribution services.

# Representing Road Networks Using Graphs

## Nodes

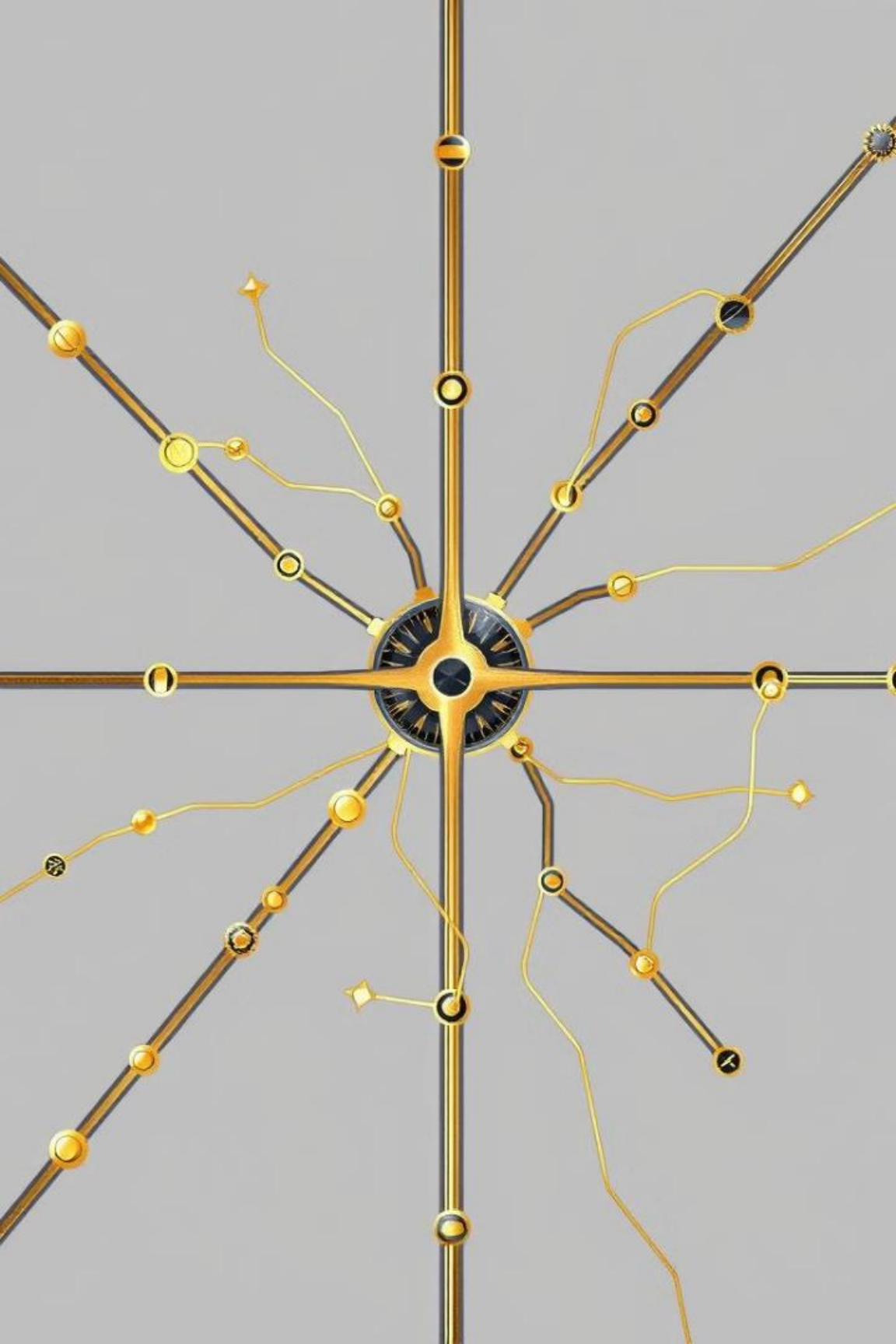
In a road network graph, nodes represent intersections, junctions, or key locations.

## Edges

Edges in the graph represent the roads or streets connecting the nodes.

## Weights

Edges can be weighted to represent factors like distance, travel time, or traffic volume.



# Undirected Graphs for Two-Way Roads

1

## Bidirectional Connections

In an undirected graph, edges represent two-way roads where traffic can flow in both directions.

2

## Symmetrical Weights

The weights on the edges are typically symmetrical, as the time or distance to travel in either direction is the same.

3

## Simplified Modeling

Undirected graphs provide a more straightforward representation of road networks with two-way streets.





# Directed Graphs for One-Way Roads

# Unidirectional Edges

Directed graphs use edges with arrows to represent one-way roads where traffic can only flow in a single direction.

## Accurate Modeling

Directed graphs provide a more realistic representation of road networks with one-way streets and turn restrictions.

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## Asymmetrical Weights

Edge weights in a directed graph can be different for each direction, reflecting the varying travel times or distances.

# Real-World Applications of Road Network Graphs



## Traffic Management

Analyzing road network graphs can help optimize traffic signals, identify congestion hotspots, and improve overall mobility.



## Urban Planning

Graph-based models aid in the design and development of new roads, highways, and transportation infrastructure.



## Logistics

Road network graphs enable efficient route planning and optimization for delivery services, supply chains, and emergency response.

