Computer Networks

Exercise Session 12

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General Schedule

All exercises will follow this general schedule

- Identify potential understanding problems
  → Ask your questions
  → Recap of the lecture
- Address the understanding problems
  → Answer your questions
  → Repeat certain topics
- Walk through the exercises/solutions → Some hints and guidance
  → Work time or presentation of results

Network Layer: Routing Schemes

You have seen . . .

- the requirements for a routing protocol
- how routing algorithms can be categorized
- flooding and hot-potato as examples for local routing algorithms
- the difference between source routing and hop-by-hop routing
- the difference between reactive and proactive routing algorithms
- how metrics are used to calculate the path costs

Network Layer: Distance Vector Routing

You have seen . . .

- that distance vector routing protocols exchange forwarding tables between neighbors
- RIP as an example for a distance vector routing protocol
- how the Bellman-Ford Algorithm works
- what the Count-to-Infinity problem is
- how Split Horizon (with Poison Reversed) can be used to mitigate this problem

Network Layer: Link State Routing

You have seen . . .

- that link state routing protocols exchange information between all routers
- OSPF as an example for a link state routing protocol
- that OSPF allows for routing hierarchies
- how the Dijkstra Algorithm works

Network Layer: More Routing Protocols

You have seen ...

- IS-IS as another example for a link state routing protocol
- RPL as routing protocol for resource-constrained node networks (aka IOT networks)
- OLSR as link state routing protocol for wireless ad-hoc networks
- BGP as an example for an inter-domain routing protocol

Transport Layer: Characteristics

You have seen ...

- the properties, tasks, and challenges of transport layer protocols
- how port numbers are used for addressing on the transport layer
- which ranges for these port numbers are defined by the IANA
- that the common interface on the transport layer is a socket

Transport Layer: TCP

You have seen . . .

- the functioning and segment structure of TCP
- how flow control works in TCP

Exercise 1: Forwarding and Path Calculation

1. What is an **autonomous system**?

2. Which two major classes for **adaptive, dynamic routing protocols** exist?

3. Which **algorithms** are implemented by each of the routing protocol classes from subtask 2?

4. The **Border Gateway Protocol** (BGP) is a protocol for...

5. Which **routing protocol class** from subtask 2 implements the BGP?

6. **Open Shortest Path First** (OSPF) is a protocol for...

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   Each AS consists of a group of logical networks, which use the Internet Protocol, are operated and managed by the same organization (e.g. an Internet Service Provider, a corporation or university) and use the same routing protocol.

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8. The **Routing Information Protocol** (RIP) is a protocol for...

9. Which **routing protocol class** from subtask 2 implements the RIP?

10. When RIP is used, each Router communicates only with its **direct neighbors**. What are the **advantages** and **drawbacks** of method?

11. When RIP is used, the path cost (metric) depend only on the number of Routers (**hops**), which need to be passed on the way to the destination network. What is the **drawback** of this method?

12. When OSPF is used, **all Routers** communicate with each other. What are the **advantages** and **drawbacks** of method?

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12 When OSPF is used, **all Routers** communicate with each other. What are the **advantages** and **drawbacks** of method?

Advantage: Short convergence time.
Drawback: The network is flooded $\Longrightarrow$ protocol causes strong overhead.

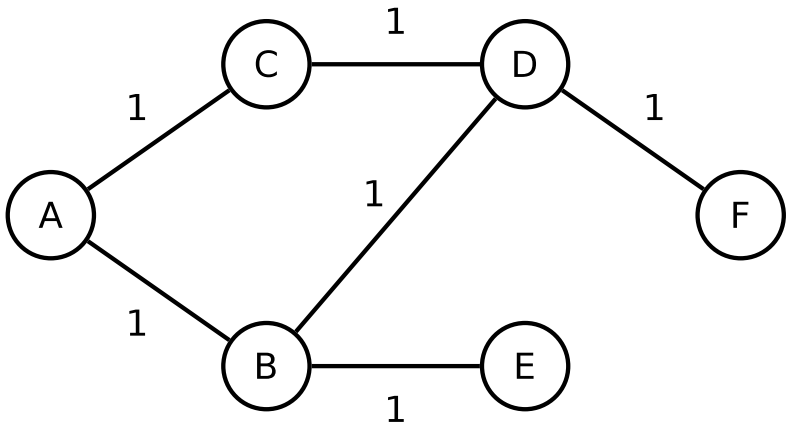
Exercise 2: Bellman-Ford Algorithm

Step 1:

Dest.	Hop	Metric
A	?	∞
B	?	∞
C	C	0
D	?	∞
E	?	∞
F	?	∞

Dest.	Hop	Metric
A	?	∞
B	?	∞
C	?	∞
D	D	0
E	?	∞
F	?	∞

Dest.	Hop	Metric
A	A	0
B	?	∞
C	?	∞
D	?	∞
E	?	∞
F	?	∞



Dest.	Hop	Metric
A	?	∞
B	?	∞
C	?	∞
D	?	∞
E	?	∞
F	F	0

Dest.	Hop	Metric
A	?	∞
B	B	0
C	?	∞
D	?	∞
E	?	∞
F	?	∞

Dest.	Hop	Metric
A	?	∞
B	?	∞
C	?	∞
D	?	∞
E	E	0
F	?	∞

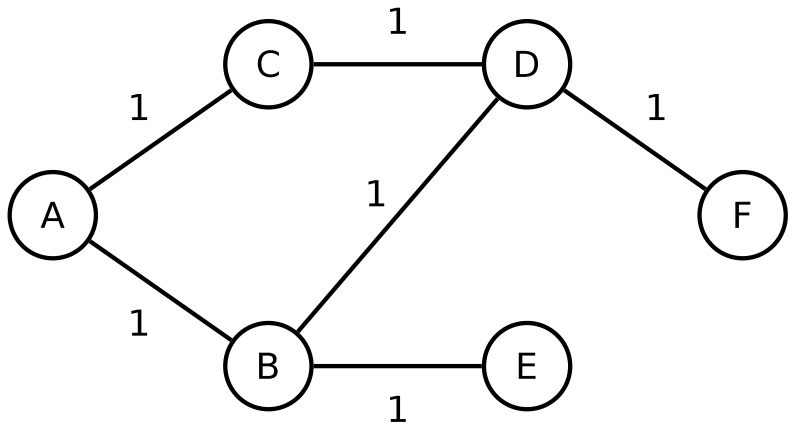
Exercise 2: Bellman-Ford Algorithm

Step 2:

Dest.	Hop	Metric
A	A	1
B	?	∞
C	C	0
D	D	1
E	?	∞
F	?	∞

Dest.	Hop	Metric
A	?	∞
B	B	1
C	C	1
D	D	0
E	?	∞
F	F	1

Dest.	Hop	Metric
A	A	0
B	B	1
C	C	1
D	?	∞
E	?	∞
F	?	∞



Dest.	Hop	Metric
A	?	∞
B	?	∞
C	?	∞
D	D	1
E	?	∞
F	F	0

Dest.	Hop	Metric
A	A	1
B	B	0
C	?	∞
D	D	1
E	E	1
F	?	∞

Dest.	Hop	Metric
A	?	∞
B	B	1
C	?	∞
D	?	∞
E	E	0
F	?	∞

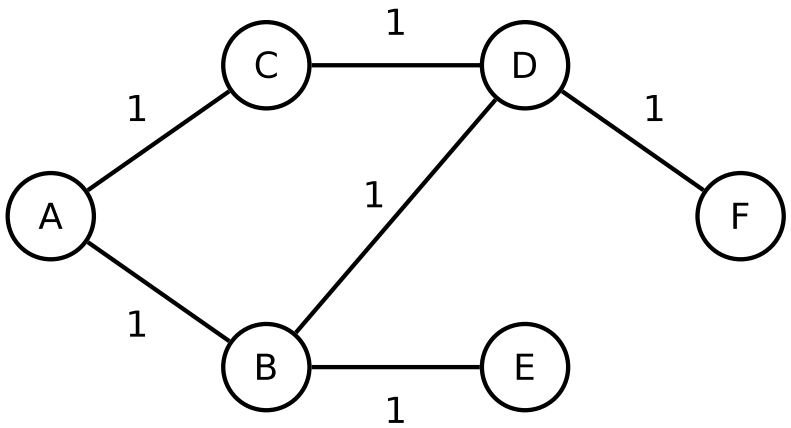
Exercise 2: Bellman-Ford Algorithm

Step 3:

Dest.	Hop	Metric
A	A	1
B	A	2
C	C	0
D	D	1
E	?	∞
F	D	2

Dest.	Hop	Metric
A	B	2
B	B	1
C	C	1
D	D	0
E	B	2
F	F	1

Dest.	Hop	Metric
A	A	0
B	B	1
C	C	1
D	B	2
E	B	2
F	?	∞



Dest.	Hop	Metric
A	?	∞
B	D	2
C	D	2
D	D	1
E	?	∞
F	F	0

Dest.	Hop	Metric
A	A	1
B	B	0
C	D	2
D	D	1
E	E	1
F	D	2

Dest.	Hop	Metric
A	B	2
B	B	1
C	?	∞
D	B	2
E	E	0
F	?	∞

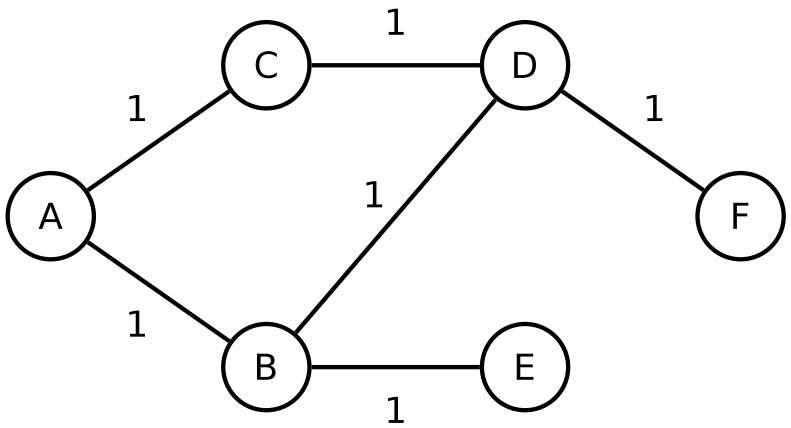
Exercise 2: Bellman-Ford Algorithm

Step 4:

Dest.	Hop	Metric
A	A	1
B	A	2
C	C	0
D	D	1
E	A	3
F	D	2

Dest.	Hop	Metric
A	B	2
B	B	1
C	C	1
D	D	0
E	B	2
F	F	1

Dest.	Hop	Metric
A	A	0
B	B	1
C	C	1
D	B	2
E	B	2
F	B	3



Dest.	Hop	Metric
A	D	3
B	D	2
C	D	2
D	D	1
E	D	3
F	F	0

Dest.	Hop	Metric
A	A	1
B	B	0
C	D	2
D	D	1
E	E	1
F	D	2

Dest.	Hop	Metric
A	B	2
B	B	1
C	B	3
D	B	2
E	E	0
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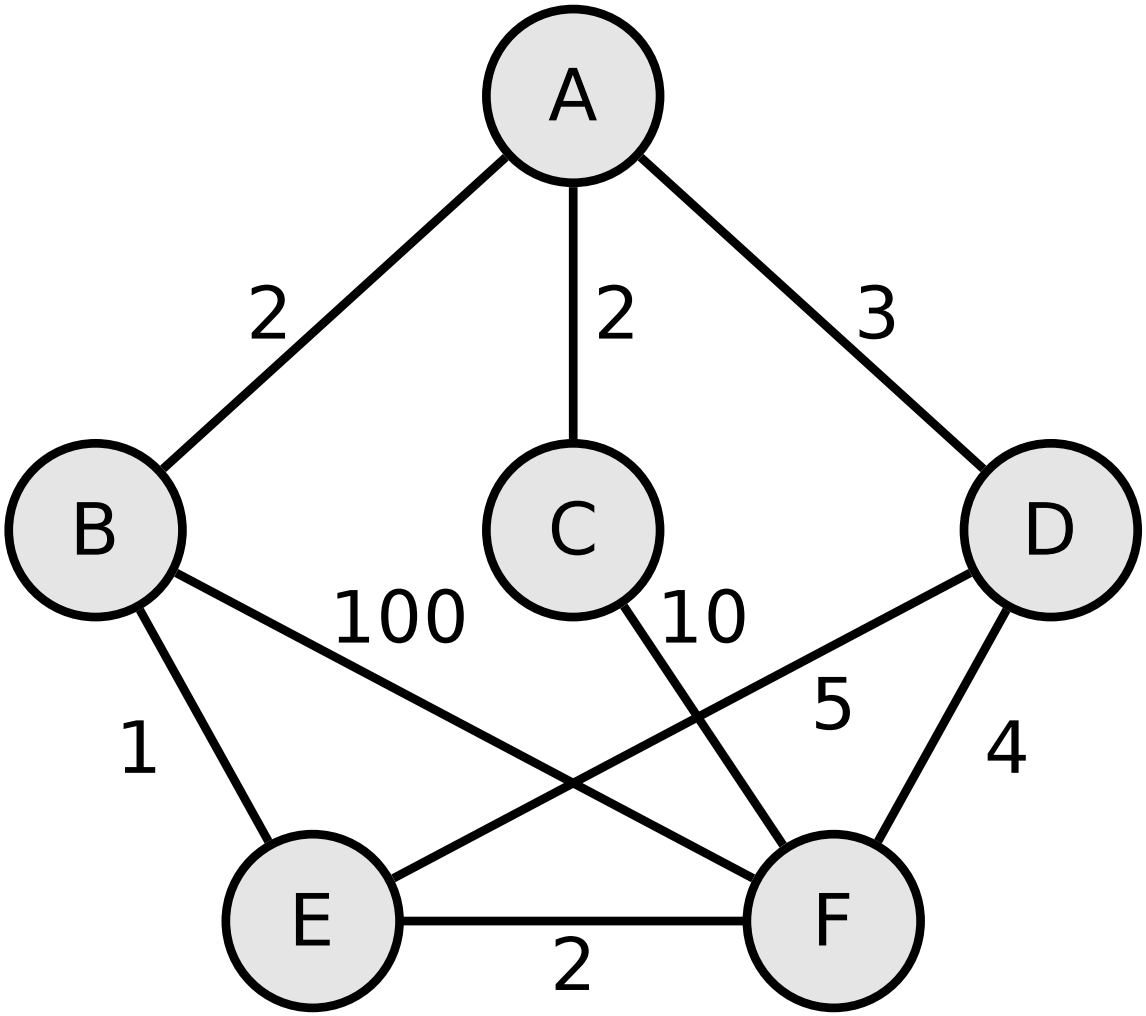
Exercise 3.1: Dijkstra's Algorithm



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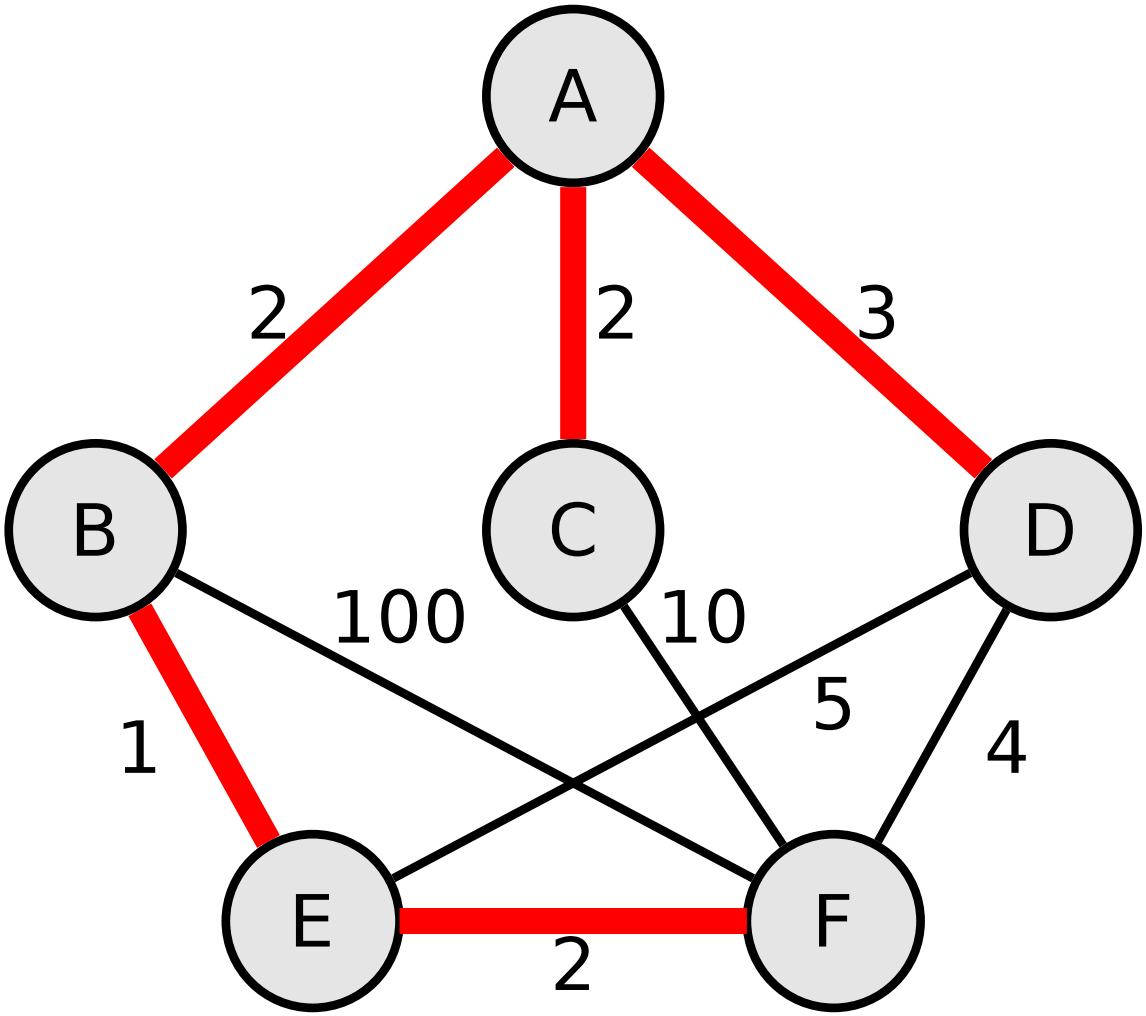

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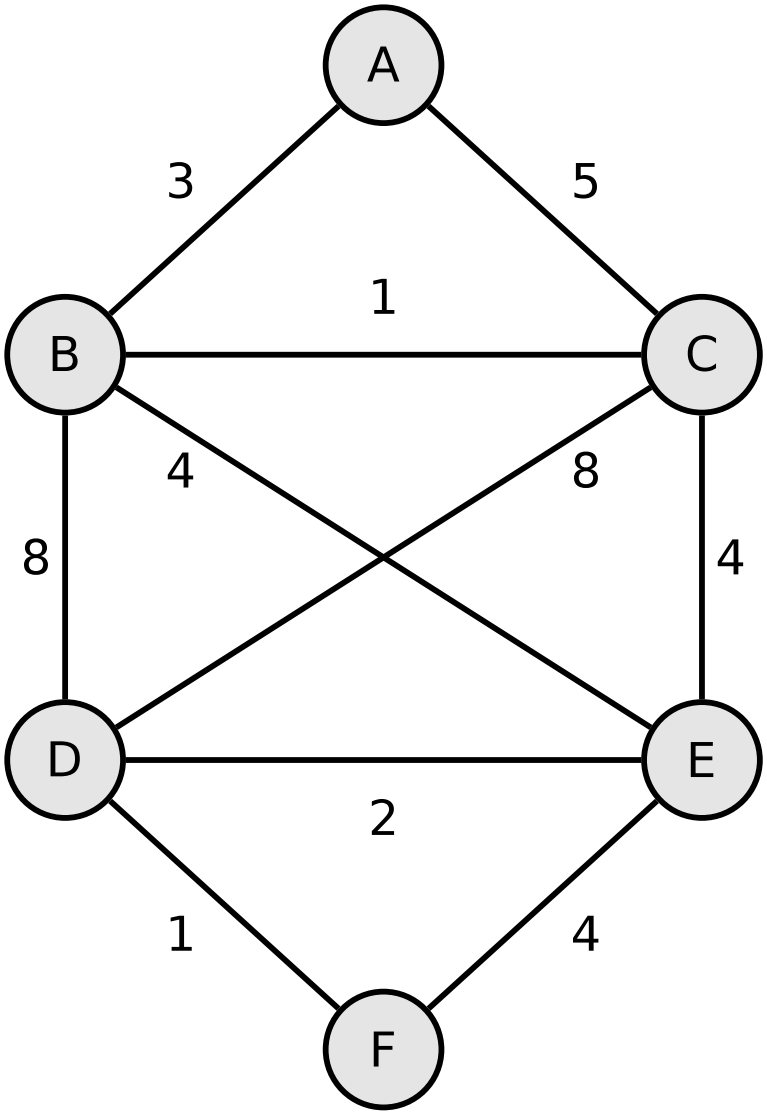

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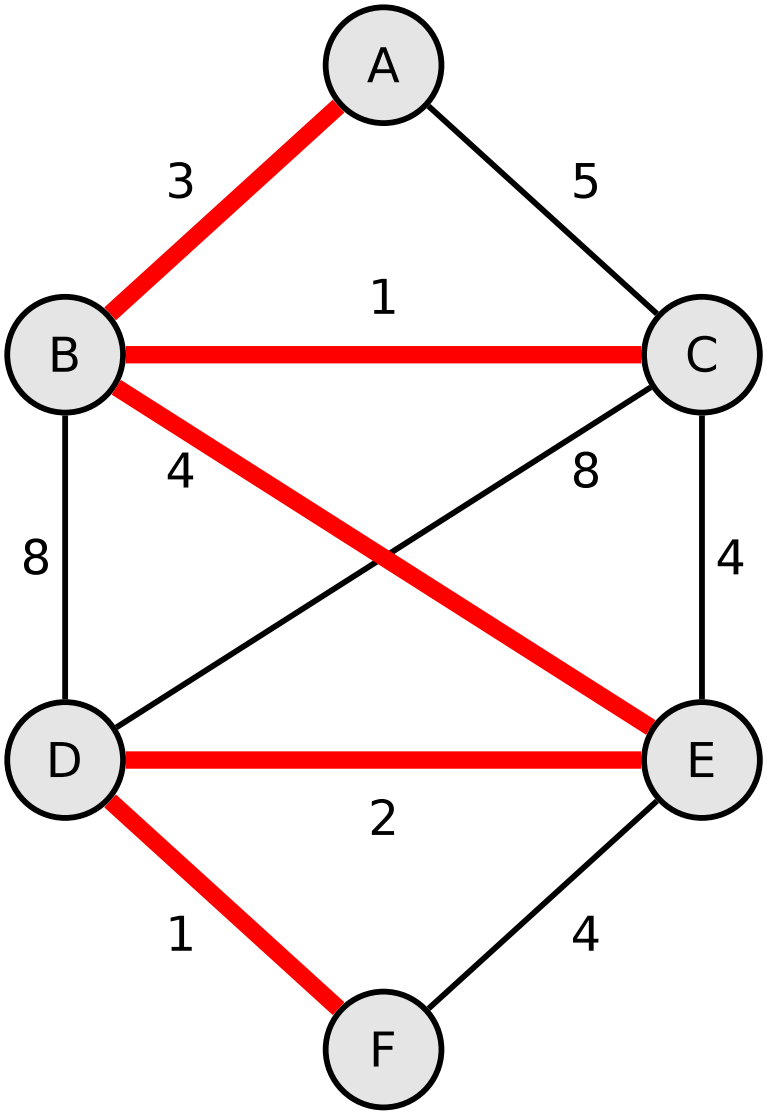

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   Stub networks, multi-connected networks, and transit networks.

Exercise 4.3: Do some research

4. Explain what **BGP hijacking** is and list two popular incidents where it was used and why.

5. What is the **ASN** our university's network reside in?

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   BGP hijacking is the incidental or malicious takeover of IP ranges by corrupting routing tables maintained using BGP.

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   AS680 - Verein zur Foerderung eines Deutschen Forschungsnetzes e.V.
   → `https://www.bigdatacloud.com/asn-lookup/AS680`