

AP Computer Science Principles | Unit 4

4.1 Internet Architecture

Solutions

Reference scenario

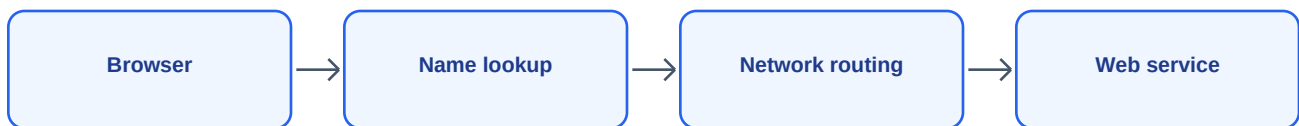
Explain the roles in a browser request without assigning all delivery to DNS.

Name lookup -> destination address

Routing -> next-hop decisions

Packets -> pieces of transmitted data

Application -> requested web content



4.1.1

Can a successful DNS lookup prove a website is online and responding? Explain.

No. It establishes a name-resolution result. The route, server, application, or service policy may still prevent a successful request.

4.1.2

Distinguish the internet from the World Wide Web.

The internet is interconnected network infrastructure and protocols. The web is an application system of linked resources accessed through web protocols over that infrastructure.

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4.2 Protocols and Packets

Solutions

Reference scenario

Interpret packet switching and reliable application delivery.

Message packets sent: 1, 2, 3

Observed arrival order: 2, 1

Packet 3: not yet received

4.2.1

Why can two packets from the same message take different network paths?

Routers make forwarding decisions using current routing information and network conditions. Packet switching does not require one permanently reserved end-to-end path for the message.

4.2.2

What responsibilities are distinct between IP routing and a reliable transport mechanism?

IP supports addressing and packet forwarding. A reliable transport mechanism additionally manages ordered delivery and recovery of missing data, subject to the protocol and connection conditions.

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4.3 Fault Tolerance and Scalability

Solutions

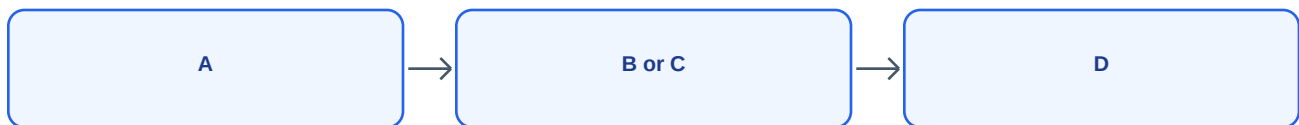
Reference scenario

Find which single-link failure a small network can tolerate.

Links: A-B, B-D, A-C, C-D

Source: A

Destination: D



4.3.1

If B-D fails, give a remaining A-to-D path. If D fails, can either listed path still deliver to D?

A-C-D remains after losing B-D. If D itself fails, neither path can deliver to that destination; path redundancy does not duplicate the endpoint.

4.3.2

Explain one benefit and one cost of replicating a service across independent servers.

Replication can reduce the impact of a server failure or distribute load. It adds cost and coordination requirements such as consistent data and failover testing.

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4.4 Parallel and Distributed Computing

Solutions

Reference scenario

Compute an idealized parallel speedup while respecting sequential work.

Sequential setup: 2 seconds

Independent tasks: 4 tasks of 3 seconds each

Processors: enough for all four tasks

Communication overhead: ignored

4.4.1

An application has 4 seconds of sequential work and three independent 2-second tasks. Find serial time and ideal parallel time with three available processors.

Serial time is $4 + 3 \times 2 = 10$ seconds. Ideal parallel time is $4 + 2 = 6$ seconds. The sequential portion remains.

4.4.2

Why might dividing a tiny task among many remote machines be slower than doing it on one machine?

Communication, coordination, data transfer, and combining results may cost more than the work saved. Parallelizable work is not automatically faster after distribution.

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4.5 Cybersecurity Basics

Solutions

Reference scenario

Choose a control for a password-phishing risk without claiming that one tool solves every security problem.

Risk: stolen account password

Sensitive action: export saved records

Transport: HTTPS already enabled

4.5.1

Does HTTPS alone prove that the operator of a website is honest? Explain.

No. Encrypted transport protects the connection to the identified site under its certificate conditions; a malicious site can also use HTTPS.

4.5.2

Name a control that supports recovery after accidental deletion and a different control that limits who can read stored records.

Tested backups support recovery. Appropriate authorization and protected storage limit reading. Recovery and confidentiality are distinct goals.