

Week 21

AP Computer Science Principles

Homework bundle for this week

本周作业合集

exercises.lol

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4. Computer Systems and Networks

Starter Quiz · 课前小测

AP Computer Science Principles

Name: _____ Score: _____

- The Internet is:
 - ☐ a network of interconnected networks
 - ☐ a single computer
 - ☐ one website
 - ☐ a programming language
- A fault-tolerant system:
 - ☐ keeps working even if part of it fails
 - ☐ never has any parts
 - ☐ stops at the first error
 - ☐ runs only once
- In sequential computing:
 - ☐ each step must finish before the next begins
 - ☐ all steps happen at once
 - ☐ steps run on many computers
 - ☐ there are no steps
- An agreed set of rules for how systems exchange data is a _____.

- Having more than one path or copy so a backup takes over is called _____.

- A task takes 100 s on one processor and 40 s on several. What is the speedup?
_____ times
- Data is sent across the Internet as:
 - ☐ small packets that travel independently
 - ☐ one large block on one cable
 - ☐ a single letter at a time
 - ☐ nothing
- A single point of failure is:

- ☐ one part whose failure stops the entire system
- ☐ a backup server
- ☐ an extra network route
- ☐ a fast connection

9. If 20 s of a 100 s task must run sequentially, what is the maximum possible speedup?
_____ times
10. Because the Internet has many routes, packets can go around a broken link.
- ☐ True ☐ False

4. Computer Systems and Networks

AP Computer Science Principles

1. a network of interconnected networks

Millions of smaller networks joined into one global system.

2. keeps working even if part of it fails

No single failure brings the whole system down.

3. each step must finish before the next begins

One step at a time, in order.

4. protocol

Protocols let different machines cooperate.

5. redundancy

Redundancy is the main way to achieve fault tolerance.

6. 2.5 times

$\text{speedup} = 100 / 40 = 2.5\times$.

7. small packets that travel independently

Packets take possibly different routes and are reassembled in order.

8. one part whose failure stops the entire system

A network with one central router has a single point of failure.

9. 5 times

Even with infinite processors, 20 s remains: $100 / 20 = 5\times$.

10. True

Alternate routes are what make it fault tolerant.

4.1 The Internet

Name: _____ Class: _____ Date: _____

Total: 9 marks

KEY WORDS internet 互联网 • packets 数据包 • world wide web 万维网 • protocols 协议

Objective

Build the skills to answer exam questions on **the Internet**.

You must be able to:

- explain how the **Internet** 互联网 is a network of networks using shared **protocols** 协议
- describe how data is divided into **packets** 数据包
- explain the role of an **IP address** IP 地址
- distinguish the **Internet** from the **World Wide Web** 万维网

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ The Internet

A **network of interconnected networks** that communicate using shared **protocols** (agreed sets of rules).

■ Packets and IP addresses

Data is split into **packets** that travel **independently** and are **reassembled** at the destination. An **IP address** identifies each device on the network.

■ Internet vs Web

The **World Wide Web** is a **service** (of web pages) that runs **on** the Internet — they are not the same thing. **Redundant** paths help data reach its destination reliably.

2 Practice

2.1 Define the Internet. [1]

2.2 State what a packet is. [1]

2.3 State the difference between the Internet and the World Wide Web. [2]

3 Exam-style questions

3.1 An IP address is used to [1]

- **A** compress data
- **B** identify a device on the network
- **C** sort packets
- **D** encrypt a file

3.2 Data sent over the Internet is divided into [1]

- **A** bytes only
- **B** packets
- **C** pixels
- **D** strings

3.3 A file is sent across the Internet.

(a) State how it travels. [1]

(b) State what a protocol is. [1]

(c) State one benefit of redundant network paths. [1]

Solutions

2.1 a network of interconnected networks that use shared protocols.

2.2 a small piece of data that travels independently and is reassembled at the destination.

2.3 the Internet is the network of networks; the World Wide Web is a service of linked pages that runs on it.

3.1 B.

3.2 B.

3.3 (a) as packets that travel independently and are reassembled. (b) an agreed set of rules for communication. (c) data can still reach its destination if one path fails.

4.2 Fault Tolerance

Name: _____ Class: _____ Date: _____

Total: 8 marks

KEY WORDS fault tolerance 容错 • redundancy 冗余 • single point of failure 单点故障
• internet 互联网 • packets 数据包

Objective

Build the skills to answer exam questions on **fault tolerance**.

You must be able to:

- explain how **fault tolerance** 容错 lets a system keep working when part fails
- describe how **redundancy** 冗余 supports fault tolerance
- explain why the Internet is fault tolerant
- identify a **single point of failure** 单点故障

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Fault tolerance

A **fault-tolerant** system keeps working even when **part of it fails**.

■ Redundancy

Redundancy — having more than one path or copy — supports fault tolerance. The Internet is fault tolerant because packets can take **alternate routes** when a path goes down.

■ Single point of failure

A **single point of failure** is one component whose failure brings down the whole system. Redundancy removes it, but at extra **cost**.

2 Practice

2.1 Define fault tolerance.

[1]

2.2 State how redundancy supports fault tolerance. [1]

2.3 Define a single point of failure. [1]

3 Exam-style questions

3.1 Fault tolerance lets a system [1]

- **A** fail completely
- **B** keep working when part of it fails
- **C** run faster
- **D** compress data

3.2 The Internet is fault tolerant because packets can [1]

- **A** take alternate routes
- **B** be deleted
- **C** be encrypted
- **D** be sorted

3.3 A network has only one cable connecting two cities.

(a) Name this weakness. [1]

(b) State how to make the connection fault tolerant. [1]

(c) State the trade-off of adding redundancy. [1]

Solutions

2.1 the ability of a system to keep working when part of it fails.

2.2 it provides more than one path or copy, so a backup takes over when one fails.

2.3 a single component whose failure brings down the whole system.

3.1 B.

3.2 A.

3.3 (a) a single point of failure. (b) add a second (redundant) path or cable. (c) the extra cost of the redundancy.

4.3 Parallel and Distributed Computing

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS parallel 并行 • sequential 顺序 • speedup 加速比 • distributed 分布式
• distributed computing 分布式计算

Objective

Build the skills to answer exam questions on **parallel and distributed computing**.

You must be able to:

- distinguish **sequential** 顺序 from **parallel** 并行 computing
- explain how **distributed** 分布式 computing spreads a task across computers
- calculate the **speedup** 加速比 from parallel processing
- explain why speedup is limited by the parts that must run sequentially

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Sequential vs parallel

Sequential computing runs steps one after another; **parallel** computing runs steps **at the same time** on multiple processors.

■ Distributed computing

Spreads a task across **multiple computers** working together.

■ Speedup

$$\text{speedup} = \frac{\text{sequential time}}{\text{parallel time}}.$$

A 60 s job done in 20 s has a speedup of 3. Speedup is **limited** by the parts that must still run sequentially.

2 Practice

2.1 State the difference between sequential and parallel computing. [2]

2.2 A task takes 40 s sequentially and 10 s in parallel. Find the speedup. [2]

2.3 State what distributed computing does. [1]

3 Exam-style questions

3.1 Parallel computing runs steps [1]

- **A** one after another
- **B** at the same time
- **C** never
- **D** in random order

3.2 Speedup is [1]

- **A** parallel time – sequential time
- **B** sequential time ÷ parallel time
- **C** parallel × sequential time
- **D** always 1

3.3 A job takes 100 s on one processor and 25 s split across four.

(a) Find the speedup. [2]

(b) State what limits parallel speedup. [1]

Solutions

2.1 sequential runs steps one after another; parallel runs steps at the same time.

2.2 $\text{speedup} = \frac{40}{10} = 4$.

2.3 it spreads a task across multiple computers.

3.1 B.

3.2 B.

3.3 (a) $\frac{100}{25} = 4$. (b) the parts of the task that must run sequentially.