

Exercise walk-through

4.3

Parallel and Distributed Computing

AP Computer Science Principles

Parallel & distributed computing

Sequential

one step at a time

Parallel

several **processors**,
one machine

Distributed

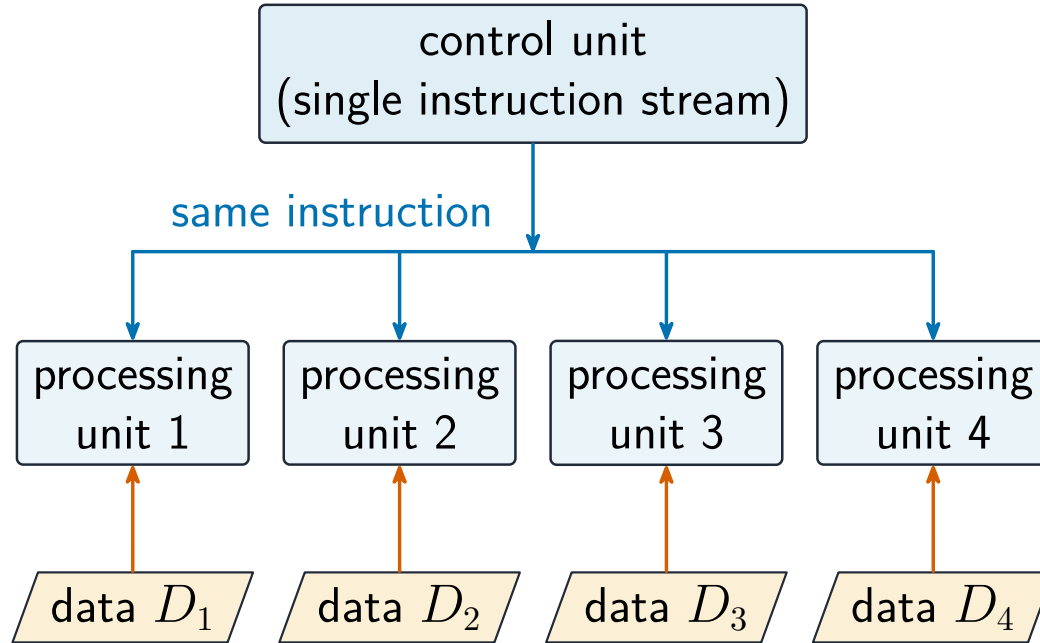
many separate machines

Speedup $= \frac{\text{one-processor time}}{\text{many-processor time}}$. The **sequential part** caps it – a 100 s task with 20 s sequential can never beat 5×



Distributed systems run across many machines

Parallel computing



Parallel computing: many processors work at the same time

Speedup, and the limit on it

sequential computing

one step after another, on one processor

parallel computing

several steps at the same time, on several processors

speedup

the **sequential** time divided by the **parallel** time

the limit

parts that **must** run in sequence cannot be sped up by adding processors, so speedup is bounded by that fraction

the consequence

a task that is 30% sequential can never exceed a speedup of about 3.3, however many processors you add

Doubling the processors never halves the time. Say *why* – the sequential portion – and the mark is yours.

Key points

The **Internet** routes independent **packets** via protocols

Redundancy makes a system **fault tolerant**

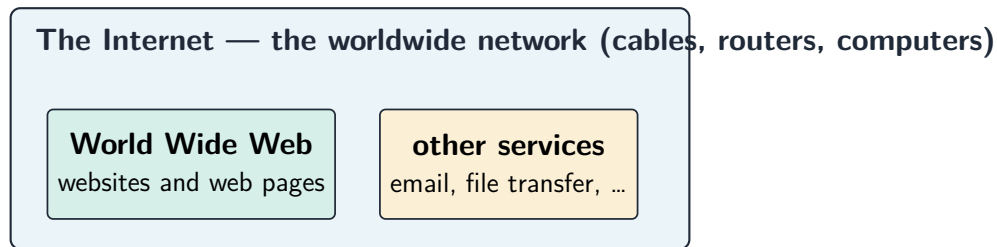
Parallel = one machine;
distributed = many

The **sequential part**
caps parallel speedup

The Internet is not the Web

The **Internet** is the *network of networks* – the wires, routers and protocols. The **World Wide Web** is *one service running on top* of it.

Email, video calls and games also ride the Internet *without* touching the Web.



one is the road, the other is one kind of traffic

Exercises 2.1-2.3

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]

Exercises 2.1-2.3

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

2.1

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

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

2.2

- $\text{speedup} = \frac{40}{10} = 4$
-

2.3 State what distributed computing does. [1]

2.3

- it spreads a task across multiple computers

Exercises 3.1-3.2

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 $\div$ parallel time

C parallel $\times$ sequential time

D always 1

Exercises 3.1-3.2

3.1 Parallel computing runs steps

[1]

☐

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

3.1 B

- at the same time.

3.2 Speedup is

[1]

☐

- A parallel time – sequential time
- B sequential time $\div$ parallel time
- C parallel $\times$ sequential time
- D always 1

3.2 B

- sequential time $\div$ parallel time.

Exercise 3.3 (a)

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

(a) Find the speedup.

[2]

Exercise 3.3 (a)

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

(a) Find the speedup.

[2]

(a)

- $\frac{100}{25} = 4$

Exercise 3.3 (b)

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

(b) State what limits parallel speedup.

[1]

Exercise 3.3 (b)

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

(b) State what limits parallel speedup.

[1]

(b)

- the parts of the task that must run sequentially