Topic V0F

Relative Performance

Readings: (Section 1.6)

Understanding Performance

Algorithm

Determines number of operations executed

Programming language, compiler, architecture

Determine number of machine instructions executed per operation

Processor and memory system

Determine how fast instructions are executed

I/O system (including OS)

Determines how fast I/O operations are executed

How to NOT solve a CMPUT assignment

Defining Performance

Which airplane has the best performance?

Boeing 777

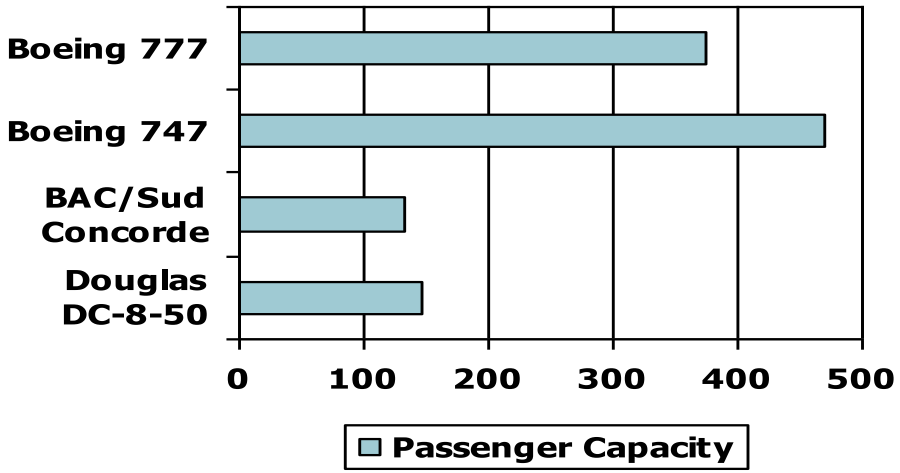
Boeing 747

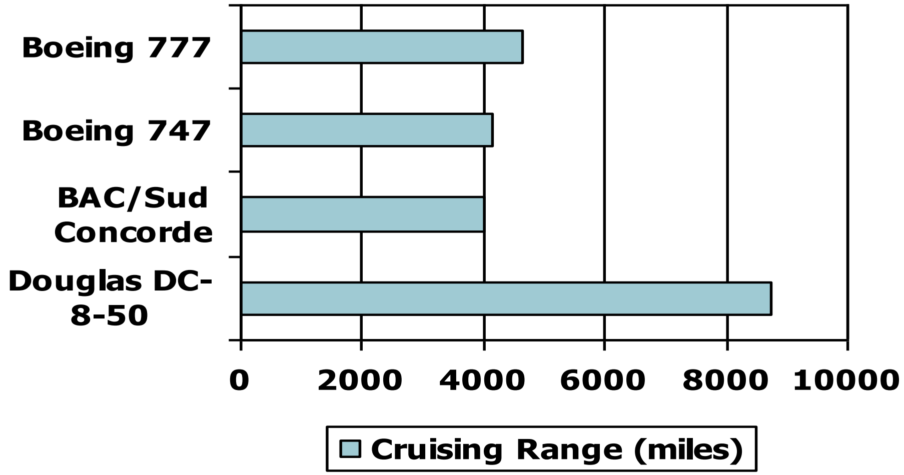
Bac/Sud Concorde

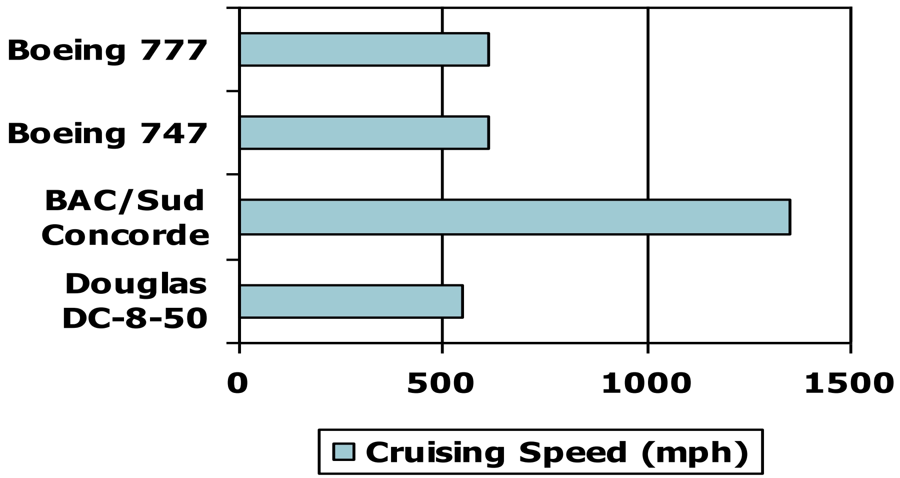
Douglas DC-8-50

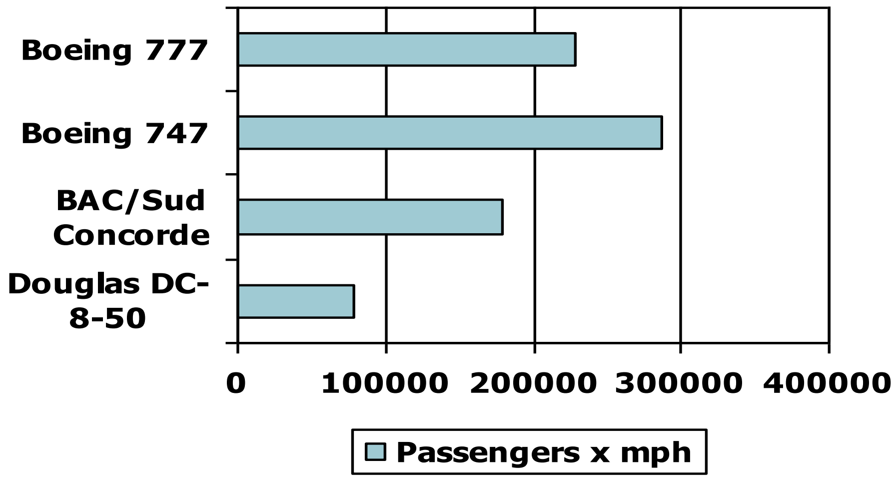
Defining Performance

Which airplane has the best performance?









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Response Time and Throughput

Response time

How long it takes to do a task

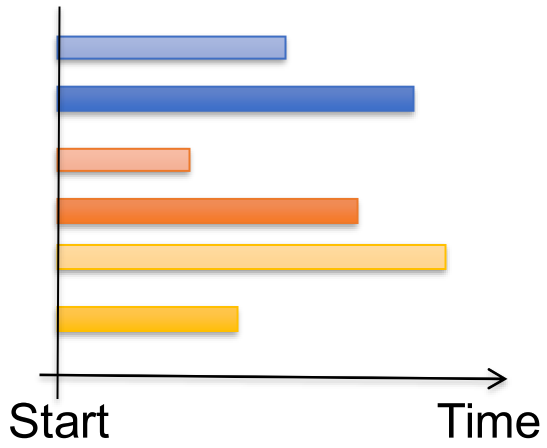
Throughput

Total work done per unit of time

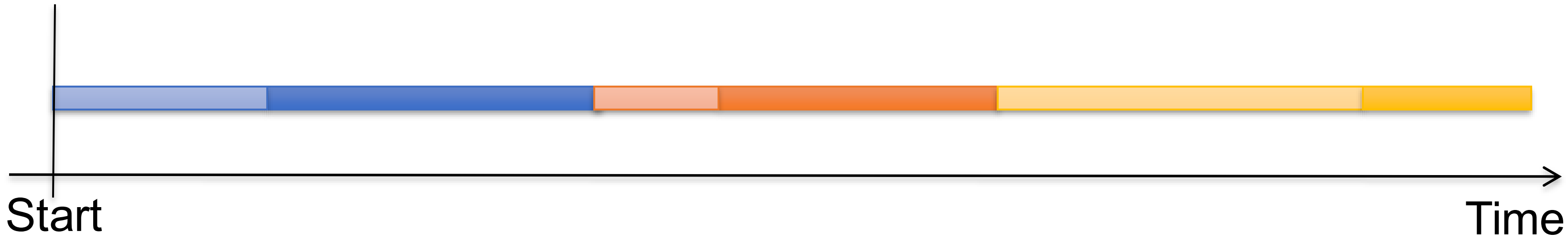
- e.g., tasks/transactions/… per hour

Latency (Response Time) × Throughput

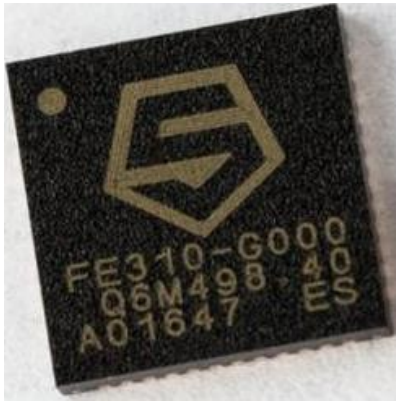
What matters is latency:



What matters is throughput:



Response Time and Throughput



RISC-V FE310(320 MHz)

RISC-V FU540(1.5 GHz)

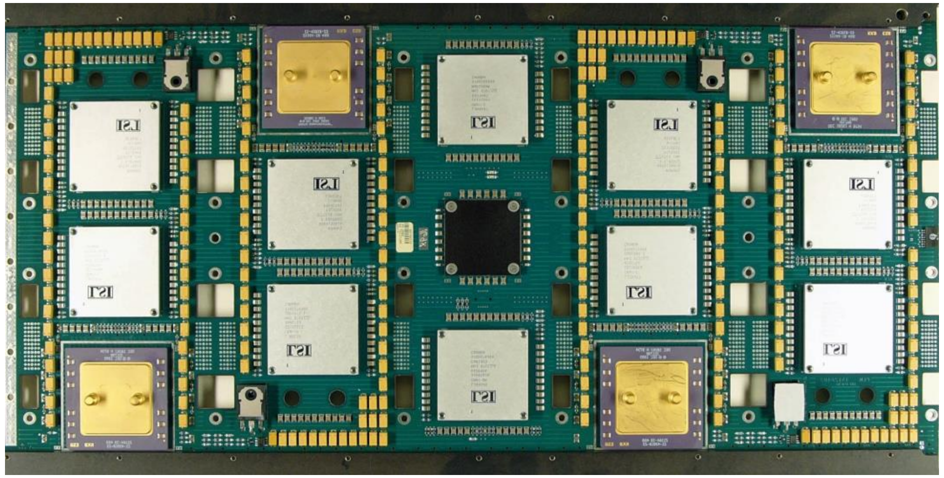
Faster Processor

Response Time?

Lower

Throughput?

Higher



Multiple processors of the same kind.

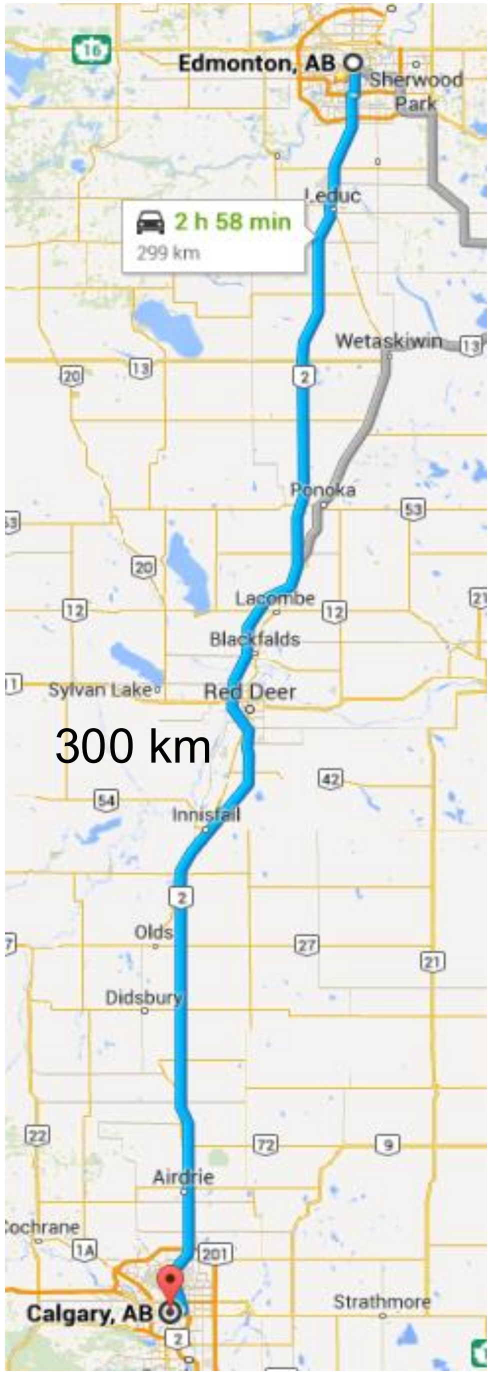
Response Time?

Same

Throughput?

Higher

Relative Performance



100 km/h

Time: 180 minutes

200 km/h

Time: 90 minutes

$$\text{Performance} = \frac{\text{Distance}}{\text{Execution Time}}$$

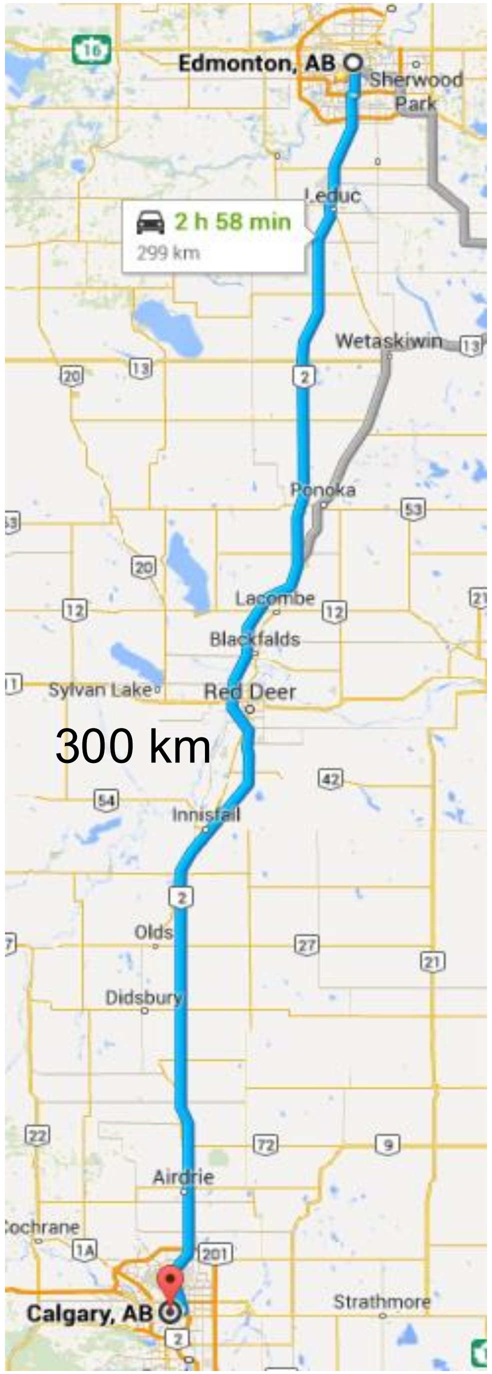
$$\text{Performance}_{\text{yellow}} = \frac{300\ km}{180\ \text{min}}$$

$$\text{Performance}_{\text{red}} = \frac{300\ km}{90\ \text{min}}$$

$$\text{Performance}_{\text{yellow}} = \frac{1\ \text{trip to calgary}}{180\ \text{min}}$$

$$\text{Performance}_{\text{red}} = \frac{1\ \text{trip to calgary}}{90\ \text{min}}$$

Which car is faster and by how much?



100 km/h

Time: 180 minutes

200 km/h

Time: 90 minutes

$$\text{Performance} = \frac{\text{Task}}{\text{Execution Time}}$$

$$\text{Performance}_{\text{yellow}} = \frac{\text{1 trip to calgary}}{\text{180 min}}$$

$$\text{Performance}_{\text{red}} = \frac{\text{1 trip to calgary}}{\text{90 min}}$$

$$\frac{\text{Performance}_{\text{red}}}{\text{Performance}_{\text{yellow}}} = \frac{\frac{\text{1 trip to calgary}}{\text{90 min}}}{\frac{\text{1 trip to calgary}}{\text{180 min}}} = \frac{\text{180 min}}{\text{90 min}} = 2.0$$

Red car is 2 times faster than yellow car

Iris Pro P580

Time: 180 minutes

GEFORCE GTX

Time: 90 minutes

$$\text{Performance} = \frac{\text{Task}}{\text{Execution Time}}$$

$$\text{Performance}_{\text{Iris}} = \frac{1 \text{ explosion}}{180 \text{ min}}$$

$$\text{Performance}_{\text{GTX}} = \frac{1 \text{ explosion}}{90 \text{ min}}$$

$$\frac{\text{Performance}_{\text{GTX}}}{\text{Performance}_{\text{Iris}}} = \frac{\frac{1 \text{ explosion}}{90 \text{ min}}}{\frac{1 \text{ explosion}}{180 \text{ min}}} = \frac{180 \text{ min}}{90 \text{ min}} = 2.0$$

GEFORCE GTX is 2 times faster than Iris Pro P580

Relative Performance

$$\text{Performance} = \frac{1}{\text{Execution Time}}$$

$$\frac{\text{Performance}_{red}}{\text{Performance}_{yellow}} = n$$

$$\frac{\text{Performance}_{red}}{\text{Performance}_{yellow}} = \frac{\text{Execution Time}_{yellow}}{\text{Execution Time}_{red}} = n$$

"Red is n times faster than yellow."

Measuring Time

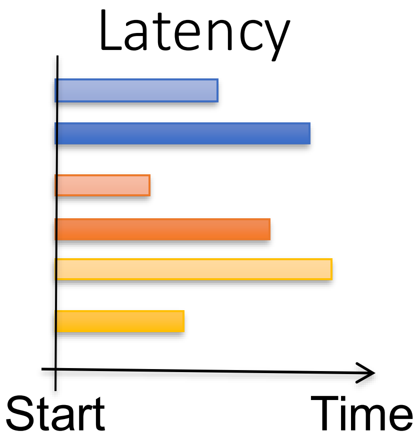
```
Air studentTable]$ time antlr4 bibEntries.g4

real    0m1.743s
user    0m2.329s
sys     0m0.167s
Air studentTable]$
```

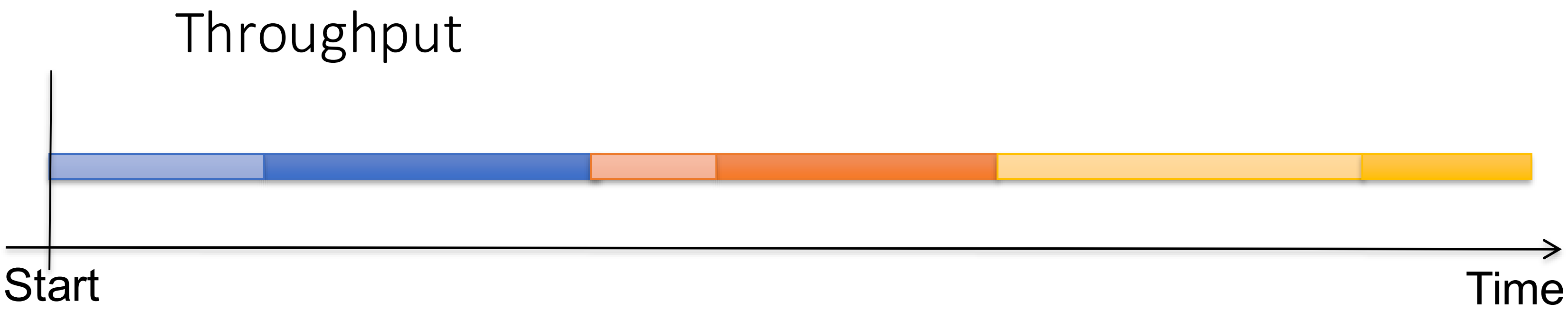
In a machine with multiple cores the CPU time can be longer than the real time.

Elapsed Time: processing + I/O + system + idle

CPU Time: processing

System Time: system





$$\text{Performance} = \frac{1}{\text{Execution Time}}$$

$$\frac{\text{Performance}_X}{\text{Performance}_Y} = \frac{\text{Execution Time}_Y}{\text{Execution Time}_X} = n$$

Recap