# Performance Evaluation and Applications Projects

2022 / 2023

# Project Type A

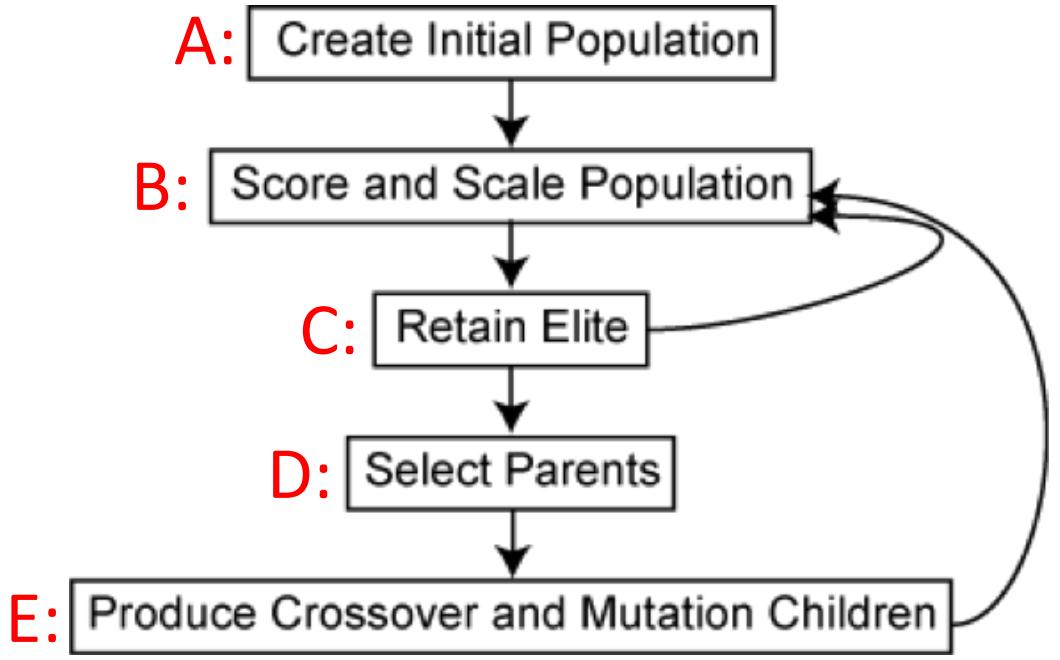
For students with ID (Codice Persona) ending with 0 or 9

# Performance of a Genetic Algorithm

A genetic algorithm is composed by five stages, and they are executed according to the figure.

The probability of repeating stage B or continue to stage D after stage C, and the one of returning to stage B or finish the algorithm after stage E, have been computed:

- $p_{CtoB} = 0.9$
- $p_{EtoB} = 0.8$

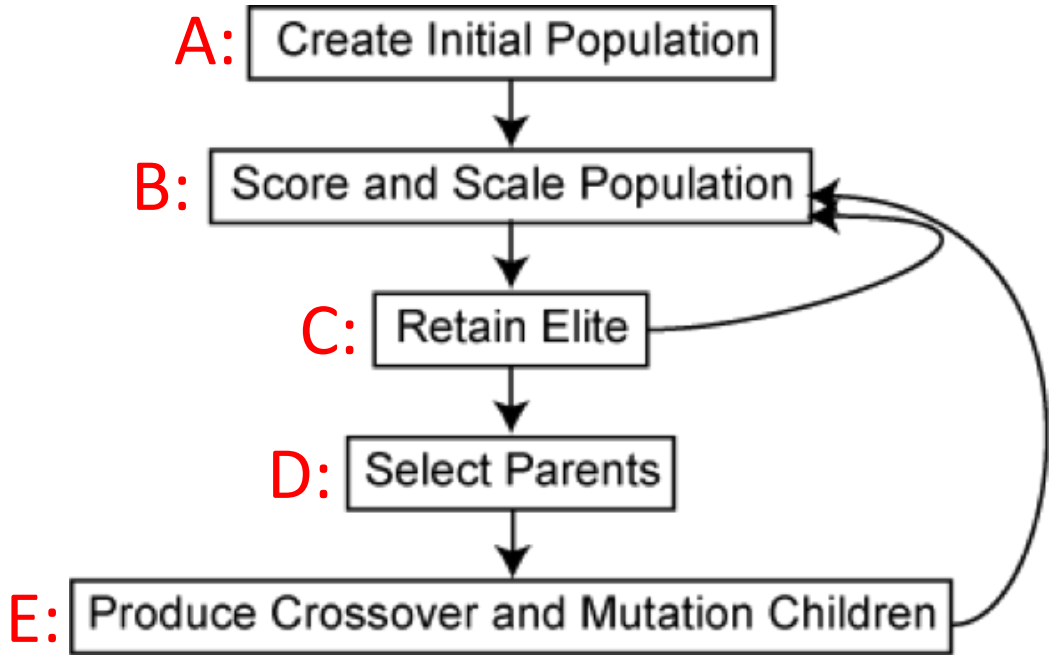


# Performance of a Genetic Algorithm

The algorithm is continuously repeated: as soon as solution has been found, it is run again on a new problem.

The runtime of execution of the stages (in milliseconds) is collected in trace files:

- `TraceA-A.txt`,
- `TraceA-B.txt`,
- `TraceA-C.txt`,
- `TraceA-D.txt`,
- `TraceA-E.txt`



# Performance of a Genetic Algorithm

- If the algorithm is run on a multi-core machine, stages B and E can be *fully parallelized*: the run time will be *perfectly divided by the number of cores*. The other stages would not obtain any benefit from parallelization, and would run on a single CPU, taking exactly the same time.
- The system administrator would like to know the minimum number of cores required to provide an average of more than 30 solutions per second. Which would be the average utilization of the CPU in this case?

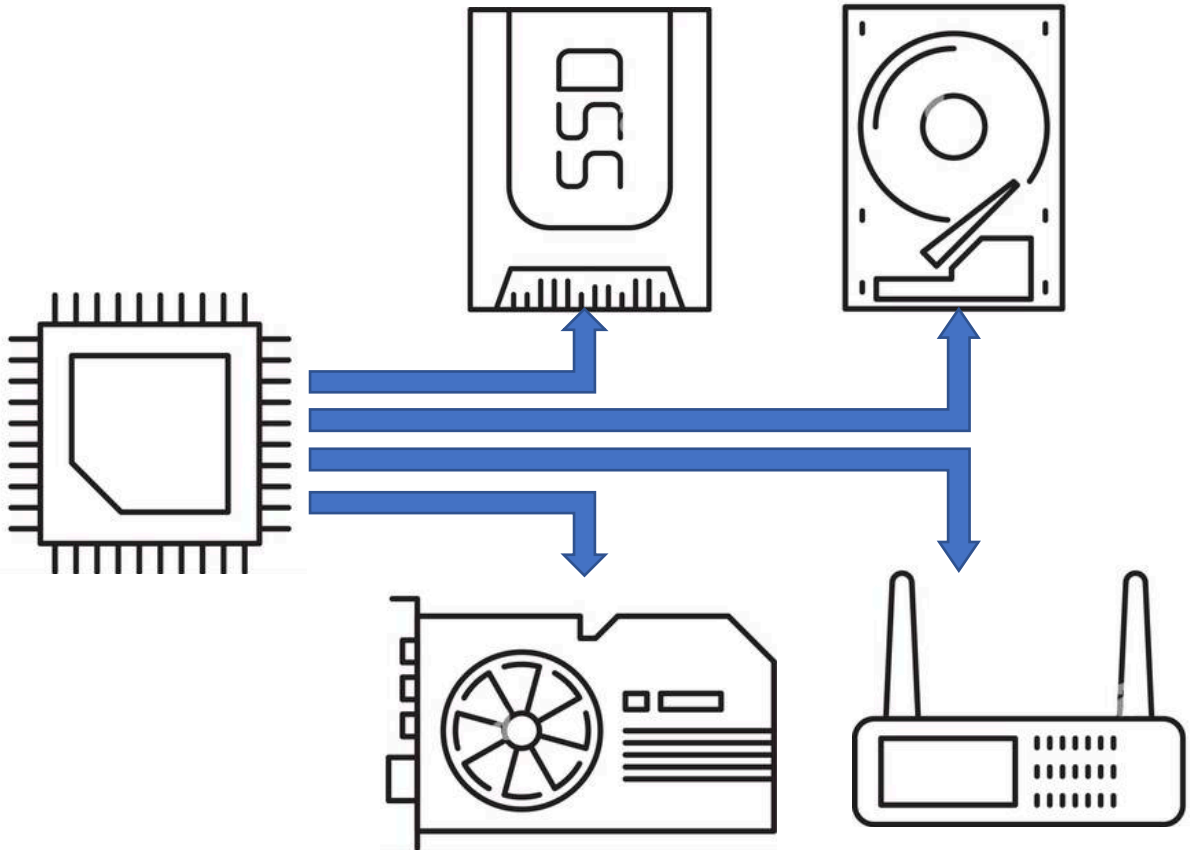
# Project Type B

For students with ID (Codice Persona) ending with 1, 3 or 7

# Optimizing a video processing workstation

A video processing workstation is composed by:

- An 8 core CPU
- A GPU
- Two different disks
- A network interface



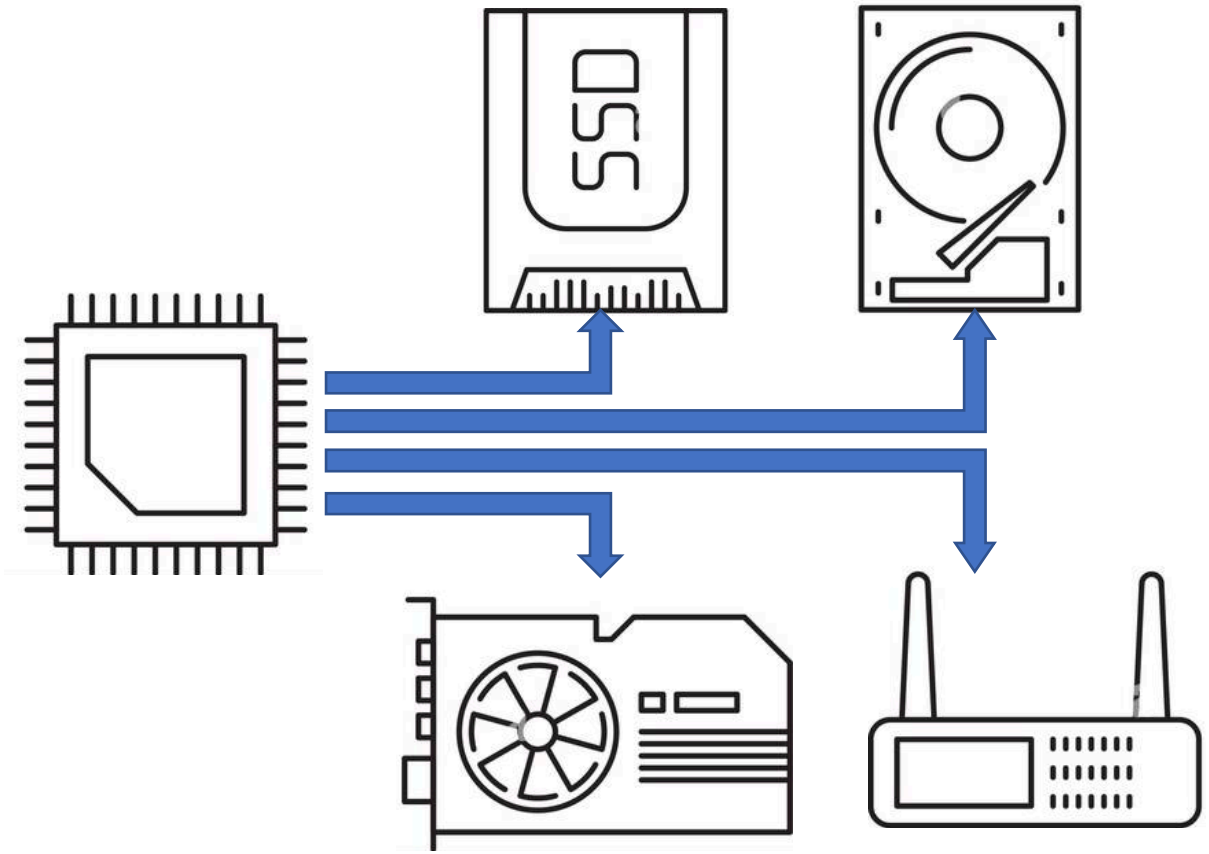

It processes two types of videos:

- Full HD
- 4K

# Optimizing a video processing workstation

Videos are continuously processed: as soon as one has been finished, a new one is fetched and immediately elaborated.

All the nodes could be considered working in *processor sharing* and each video uses only one core of the CPU.



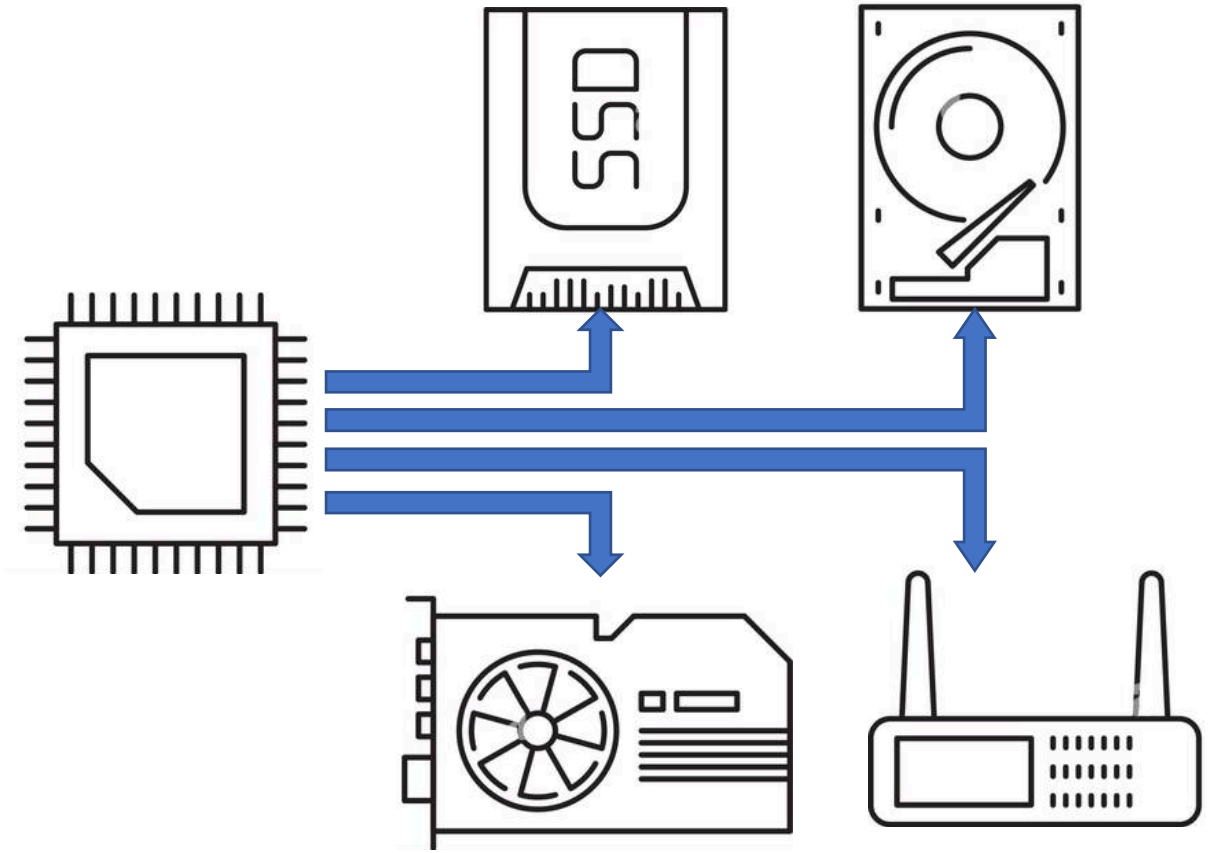
# Optimizing a video processing workstation

The total time spent at the disks (in seconds) is given in the following traces files:

- `TraceB-SSD-FHD.txt`,
- `TraceB-SSD-4K.txt`,
- `TraceC-HDD-FHD.txt`,
- `TraceC-HDD-4K.txt`

The demand of the other nodes are the following:

| | FullHD | 4K |
|---|---|---|
| ***CPU*** | 8 sec. | 32 sec. |
| ***GPU*** | 4 sec. | 16 sec. |
| ***Network*** | 3 sec. | 12 sec. |



# Optimizing a video processing workstation

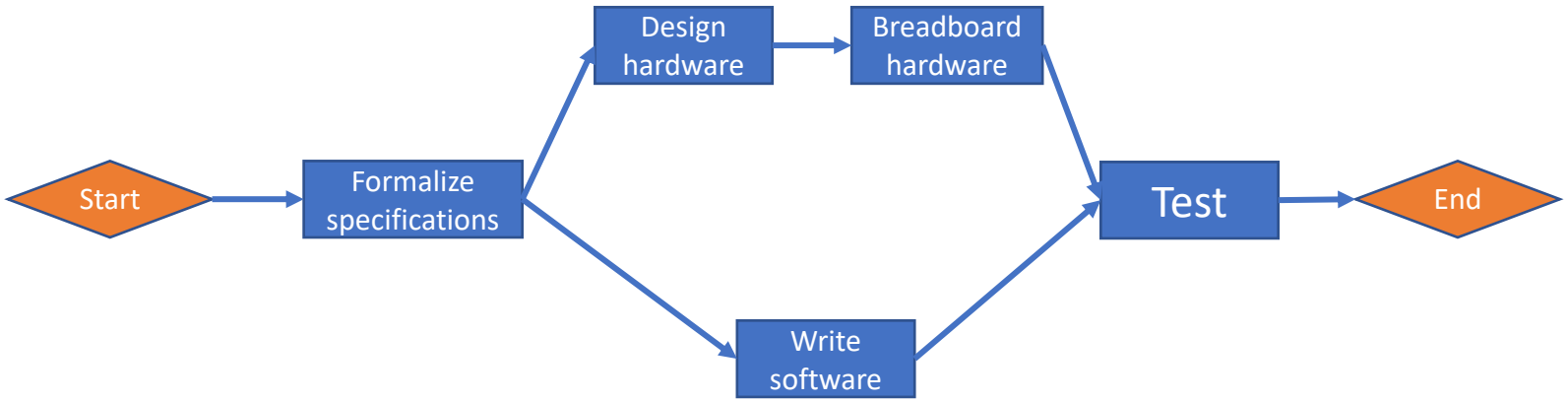
- The company is targeting a total of $N = 40$ videos at a time.
- In particular, it is interested in knowing which could be the best proportion of $N_{FHD}$ Full HD videos and $N_{4K}$ 4K videos, with $N_{FHD} + N_{4K} = N$, to obtain the maximum throughput of their system.

# Project Type C

For students with ID (Codice Persona) ending with 2, 5 or 8

# Embedded system development cycle

An embedded system company creates its boards with five different departments, each one capable or working independently of the others, according to the following PERT diagram:



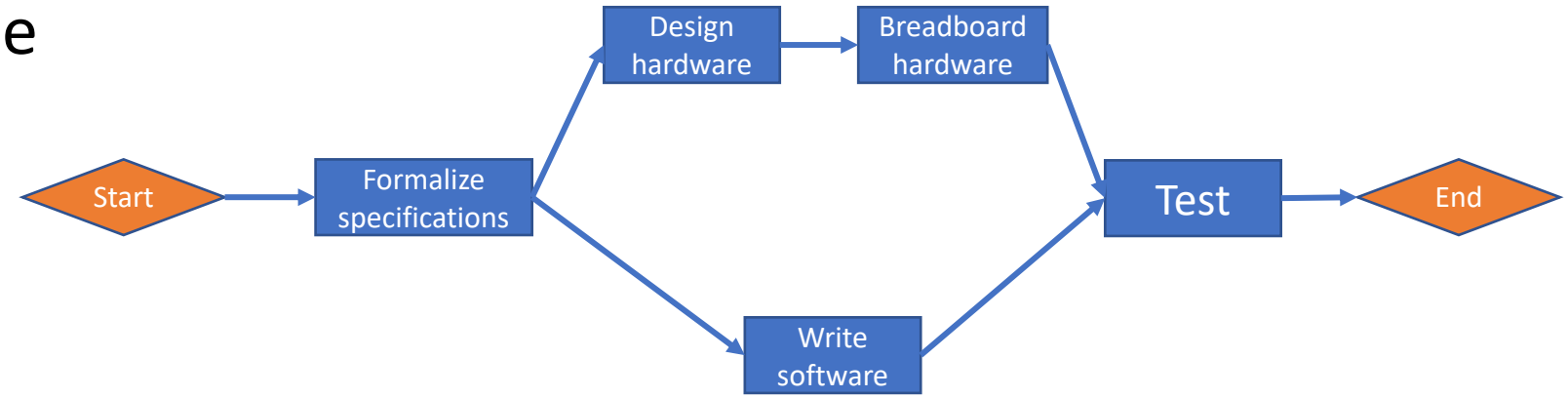
# Embedded system development cycle

As soon as one one department finishes working on its project, it starts the next one (if available).

Data traces in files

- `TraceC-Spec.txt`,
- `TraceC-Design.txt`,
- `TraceC-Breadbrd.txt`,
- `TraceC-Software.txt`,
- `TraceC-Test.txt`,

shows samples of the durations of the corresponding phases [in hours].



# Embedded system development cycle

- The company would like to know the best number of projects *N* that they should work on at the same time, to produce the best tradeoff between throughput and project completion time.

# Project Type D

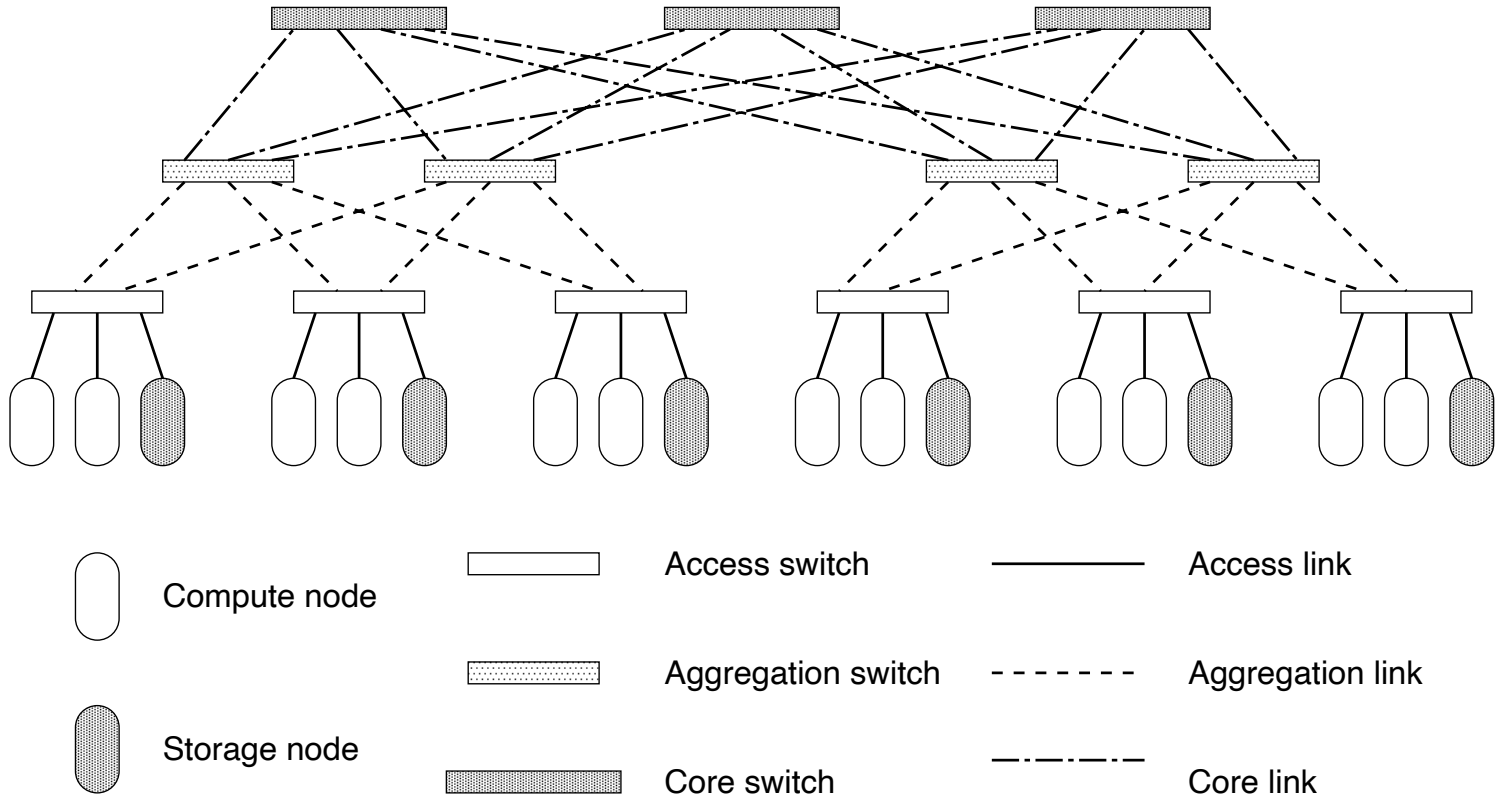
For students with ID (Codice Persona) ending with 4 or 6

# Performance of the LAN in a cloud datacenter

A three layer cloud architecture is composed by three layers of switches:

- Access – *112 MB/s*
- Aggregation – *280 MB/s*
- Core – *1.12 GB/s*

Services can be considered exponentially distributed. Data can be routed among different parallel redundant paths.



# Performance of the LAN in a cloud datacenter

Consider two nodes per layer, and four type of traffic:

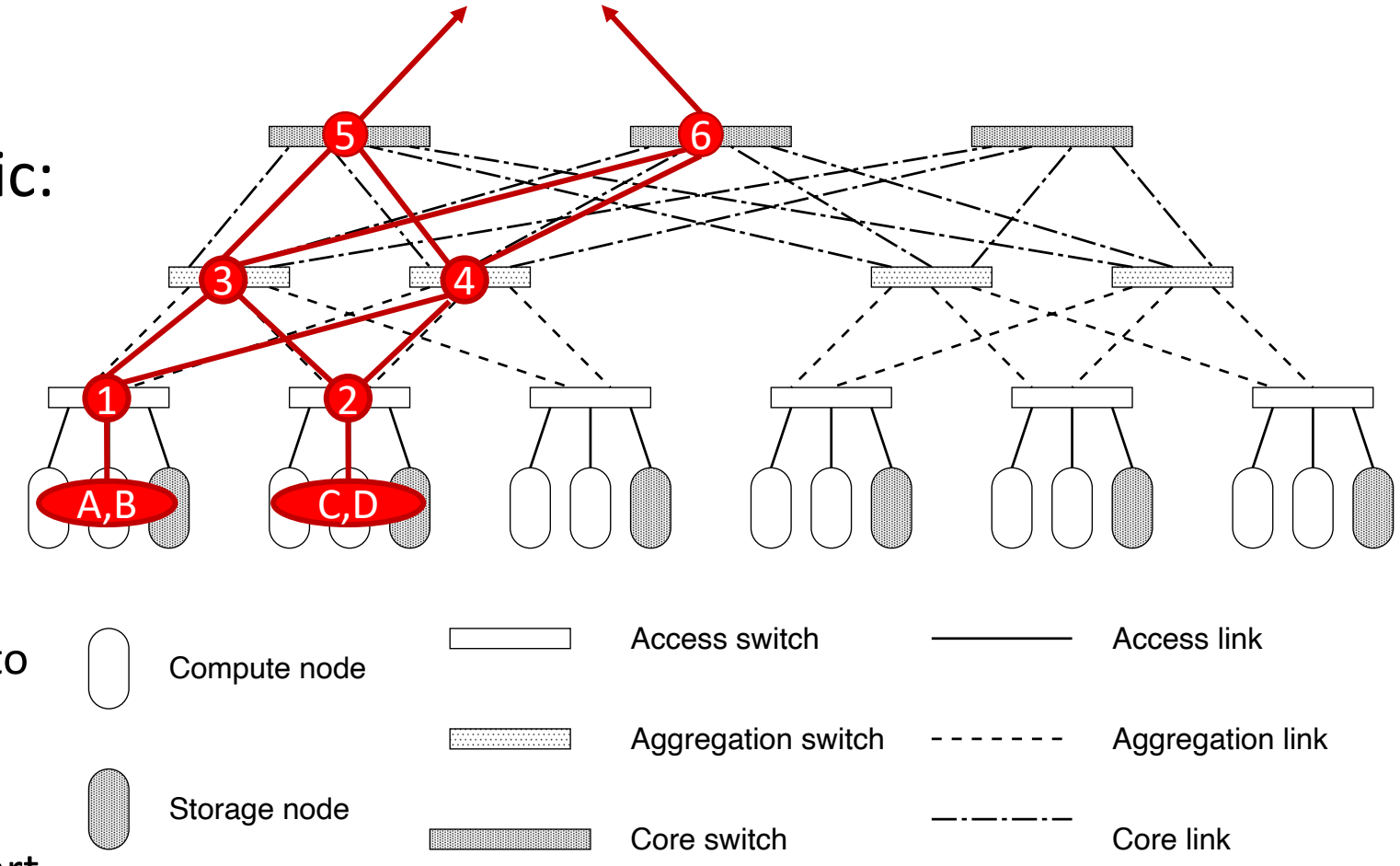
A: 1 -> 3 -> 5

B: 1 -> 4 -> 5

C: 2 -> 4 -> 6

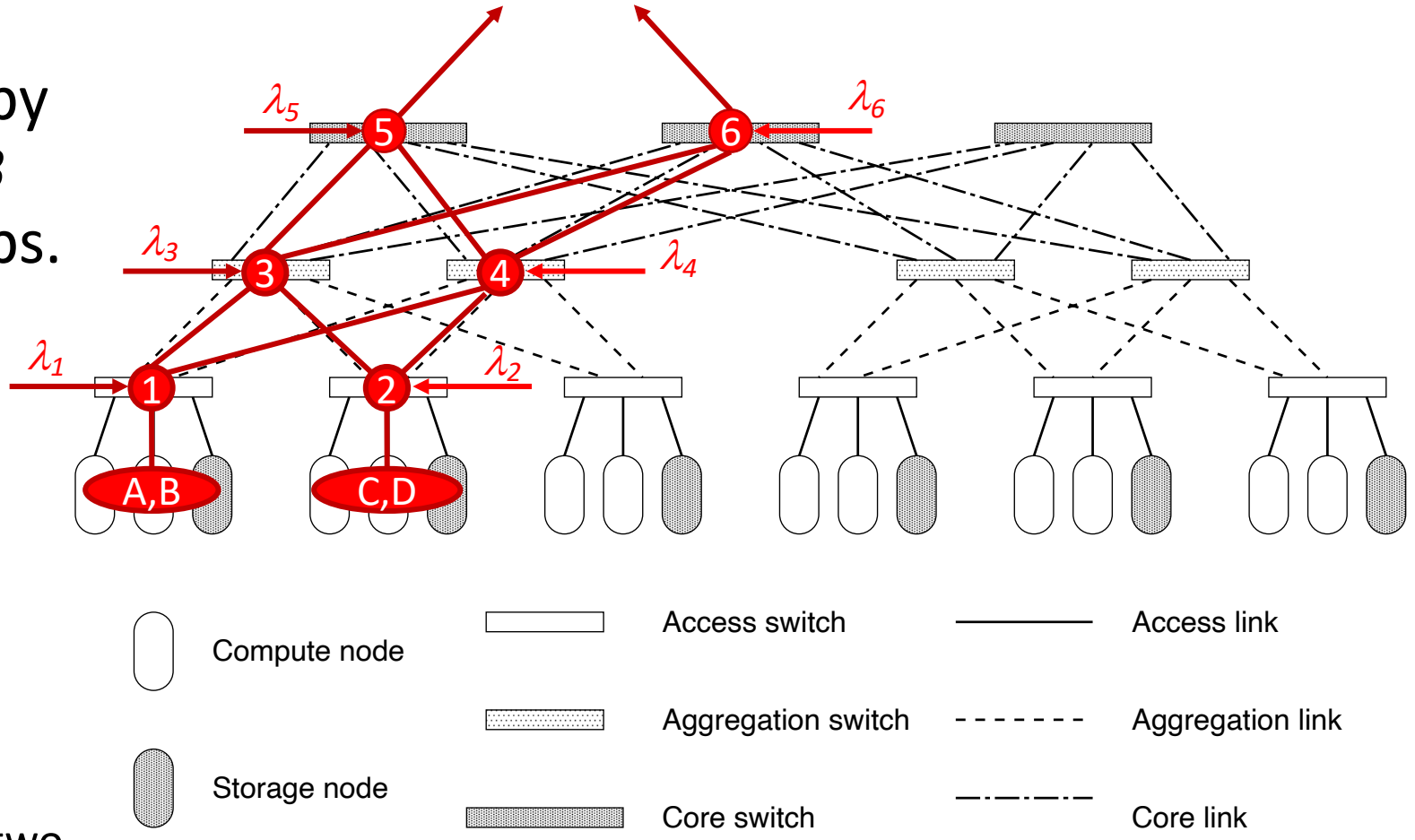
D: 2 -> 3 -> 6

Data traces in files `TraceD-D.txt` to `TraceD-D.txt` shows *the time instant* when a 1MB block of data is received for each of the traffic types, expressed in milliseconds from the start of the logging.



# Performance of the LAN in a cloud datacenter

Nodes are characterized by a finite capacity of ***16 MB*** (at all the levels) and drops.




Nodes are also characterized by background traffic, $\lambda_1$ to $\lambda_6$:

- $\lambda_1 = \lambda_2 =$ *40 MB/s*
- $\lambda_1 = \lambda_2 =$ *180 MB/s*
- $\lambda_1 = \lambda_2 =$ *600 MB/s*

Background traffic is routed to the two upstream nodes with equal probability. It can be considered a Poisson process.

# Performance of the LAN in a cloud datacenter

The system is experiencing too many losses: the manager would like to add an extra link, with the same characteristics as the existing nodes.

- Which type of link (access, aggregation or core) should be added? How traffic of the four classes should be re-routed to take advantage of the new node?