# CAPACITY PLANNING
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**Name of the student**

## Exercise n. 1

Evaluate the safety of a system composed of 3 CPUs (working in parallel and whose output is given by a voter), a RAID 5 system with 8 disks, 3 bus system (working in parallel and whose outputs are given by voters), one keyboard, one printer and one monitor, with the hypothesis that the faults happen according to an exponential distribution with rate equal to $\lambda_{CPU}$, $\lambda_{DISK}$, $\lambda_{BUS}$, $\lambda_{KEY}$, $\lambda_{MON}$, $\lambda_{PRI}$, $\lambda_{VOTER-CPU}$, $\lambda_{VOTER-BUS}$. A single repair technician for component type is available and the repair rate is equal to, the single repair technician for component type is able to repair at most 2 components at time. Moreover the two coverage factors for each component are the same and equal to: $C_{CPU}$, $C_{DISK}$, $C_{BUS}$, $C_{KEY}$, $C_{MON}$, $C_{PRI}$, $C_{VOTER-CPU}$, $C_{VOTER-BUS}$

## Exercise n. 2

Evaluate the average response time and throughput for a system composed of 2 servers working in parallel with a finite queue (at most 5 users in the system), with a finite number of users (number of users equal 7), given that the think time for each user is 10 sec and the service rate is 4 sec, assuming that the server can be faulty and repaired, the faults happen with an exponential distribution with rate equal to $\lambda_{server}$ = 1 fault/24 months and with a repair rate $\mu_{server}$ = 1 repair/4 hours.

## Exercise n. 3

A Web site receives 500 requests per second. These HTTP requests (of 400 bytes) are served by a cluster of 10 identical servers, each server is composed by a CPU and by a RAM, working as cache. In case of miss the requests are forwarded to a file system composed by a 4 CPUs (CPU_FS) and by a RAID1 system composed of 10 disks. Each server is connected the ISP through a router (with a latency of 10 µsec per packet and connected to the ISP through a 256 Mbit/sec full duplex line) and a 1 Gbit Ethernet Lan, instead the file system is connected to a 2 Gbit FFDI Lan, the two Lans are connected to a router with the same delay of the previous one. A workload balancer divides in equal parts the load among the servers. Every request needs 10 msec of CPU in case of hit, and 20 msec in case of miss; in the latter case the CPU-FS needs of 10 msec, the requested files are of 100Kbyte and each disk needs of 10 msec to read 10Kbytes. Every server can manage at most 4 users at the same time. The probability of hit is 50%. Evaluate the average response time and the probability to lose a request.