Esame 19/7/2012

martedì 14 maggio 2019 13:19

Esercizio n.3

Web service 50 requests per second λ

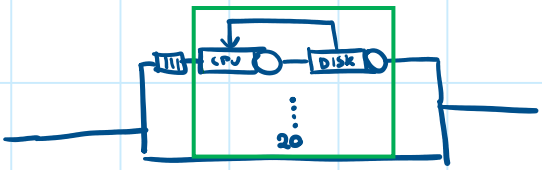
Workload is equally distributed across

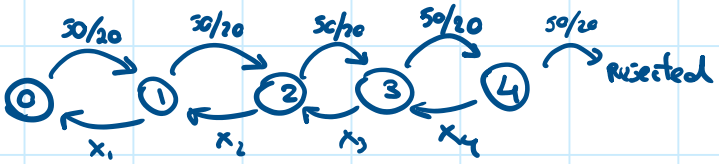
Max concurrent requests is 4

Requests require 8 CPU msec and 5 disks read (10 msec)

Average request service time? Throughput? Percentage of rejected requests?

Performance improvement with cache (access time of 100 μsec) hit 70%?





$S_{CPU} = 8$ msec

$D_{DISK} = 50$ msec $= \overbrace{V_i}^{5} \cdot S_{DISK}$

Caso 1: (n=1) (MVA)

$R_{CPU_1} = D_{CPU} = 8$ msec

$R_{DISK1} = D_{DISK} = 50$ msec

$R_{TOT_1} = 58$ msec

$x(1) = \frac{1}{R_{TOT_1}}$

$N_{CPU_1} = R_{CPU_1} \cdot X_0(1) = 0.14$

$N_{DISK} = R_{DISK_1} \cdot X_0(1) = 0.86$

Caso 2 (n=2):

$R_{CPU_2} = D_{CPU_2} = 16$ msec

$R_{DISK_2} = 93$

$R_{TOT_2} = 102$

$x(2) = 2/R_{TOT}$

$N_{CPU_2} = R_{CPU_2} \cdot X(2) = 0,18$

$N_{DISK} = R_{DISK_2} \cdot X(2) = 1,82$

$D_{CPU}(1 + N_{CPU;i-1})$

$50\ (1 + N_{CPU;i-1})$

Caso n.3

$R_{CPU_3} = 9,44$

$R_{DISK_3} = 141$

$R_{TOT_3} = 150.44$

$X(3) = 19.94$

$N_{CPU_2} = 0,189$

$N_{DISK_2} = 2,81$

Caso n.4

$R_{CPU_4} = 0,504$ msec

$R_{DISK_4} = 190$ msec

$R_{TOT_4} = 200,004$ msec

$X(4) = 19,99$ msec

$N_{CPU_4} = 0,19$

$N_{DISK} = 3,81$

$$\begin{cases} P_0 \cdot \frac{5}{2} = P_1 \cdot X_{01} \\ P_1 \cdot \frac{5}{2} = P_2 \cdot X_{02} \end{cases}$$

$$P_1 = \frac{P_0 \cdot \frac{5}{2}}{X_0(1)}$$

$$P_0 \left[1 + \frac{2.5}{17,24} \dots\right]$$

$$\begin{cases} P_1 \cdot \frac{5}{2} = P_2 \cdot X_{o2} \\ P_3 \cdot \frac{5}{2} = P_3 \cdot X_{o3} \\ P_4 \cdot \frac{5}{2} = P_4 \cdot X_{o4} \\ P_1 + P_2 + P_3 + P_4 + P_0 = 1 \end{cases}$$

$$P_2 = \frac{P_1 \cdot 5/2}{X_o(2)}$$

$$P_3 = \frac{P_2 \cdot 5/2}{X_o(3)}$$

$$P_4 = \frac{P_3 \cdot 5/2}{X_o(4)}$$

$$P_0 \left[1 + \frac{2.5}{12,4} \dots\right]$$

$P_0 = 0.85$

$P_1 = 0,12$

$P_2 = 0,015$

$P_3 = 1,9 \cdot 10^{-3}$

$P_4 = 2,4 \cdot 10^{-4}$

& è conto

Probabilità Loss = $1 - (P_0 + P_1 + P_2 + P_3 + P_4)$

Throughput media = $X(1) \cdot P_1 + X(2) \cdot P_2 + X(3) P_3 + X(4) P_4$

Average response time $\frac{N}{X} = \frac{P_1 \cdot 1 + P_2 \cdot 2 + P_3 \cdot 3 + P_4 \cdot 4}{P_1 \cdot X(1) + P_2 \cdot X(2) + P_3 \cdot X(3) + P_4 \cdot X(4)} = \frac{\bar{N}}{2.4}$

Considering cache

$R_{DISK_i} = P_{miss} (D_{DISK} + D_{cache}) + (1 - P_{miss}) (D_{cache})] (1 + u_{i-1})$

Esercizio 11.1

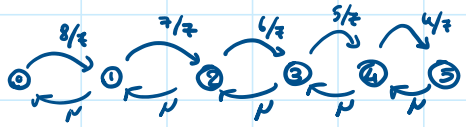
Esercizi 20/6/2012

mercoledì 15 maggio 2019 13:03

Server composed of a single with max 5 users in queue, finited 8 users

$\frac{1}{\lambda} = 30$ sec

$S = 20$ sec



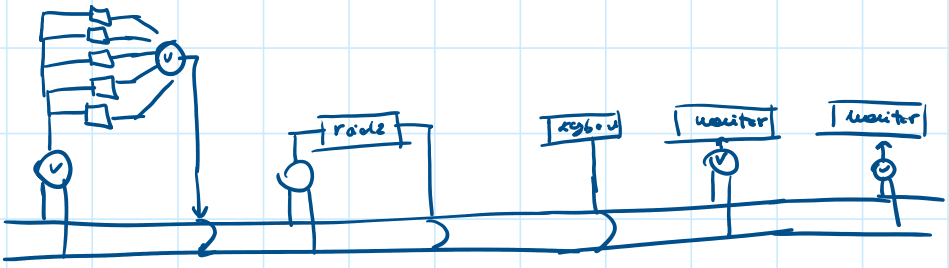
$\mu = \frac{1}{S} = \frac{1}{20} = 0.05$

$$\begin{cases} P_0 \frac{8}{7} = P_1 \mu \\ P_1 \frac{7}{7} = P_2 \mu \\ P_2 \frac{6}{7} = P_3 \mu \\ P_3 \frac{5}{7} = P_4 \mu \\ P_4 \frac{4}{7} = P_5 \mu \\ P_1 + P_2 + P_3 + P_4 + P_5 = 1 \end{cases} \Rightarrow \begin{cases} P_1 = 3{,}95 \cdot 10 \\ P_2 = 18{,}43 \cdot 10^{-} \\ P_3 = 73{,}73 \\ P_4 = 245{,}77 \cdot 10^{-} \\ P_5 = 655{,}40 \cdot 10^{-} \end{cases} \qquad P_0 = 0{,}000742$$

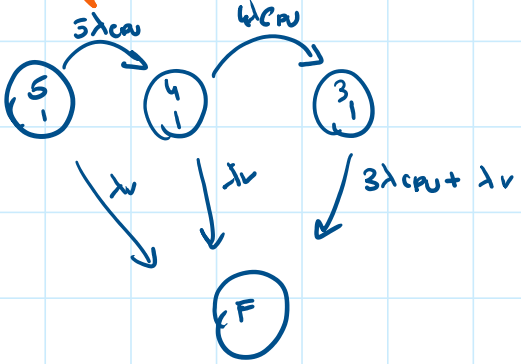
$\bar{X} = \sum P_i \cdot \mu_i = P_1 \cdot \mu + P_2 \cdot \mu + P_3 \cdot \mu + P_4 \cdot \mu + P_5 \cdot \mu = 49{,}85$ richieste/sec

$\bar{N} = \sum_{i=1}^{5} i P_i$ $\qquad R = \bar{N} / \bar{X}$

Esercizio 1



Reliability



$\dot{P}_{5,1}(t) = P_{5,1}(t) \cdot (-5\lambda_{cpu} - \lambda_v)$

$\dot{P}_{4,1}(t) = P_{4,1}(t) \cdot (-4\lambda_{cpu} - \lambda_v) + P_{5,1}(t) \cdot 5\lambda_{cpu}$

$\dot{P}_{3,1}(t) = P_{3,1}(t) \cdot (-3\lambda_{cpu} - \lambda_v) + P_{4,1}(t) \cdot 4\lambda_{cpu}$

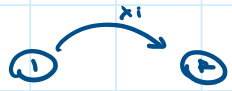
$\dot{P}_F(t) = -\lambda_v (P_{5,1}(t) + P_{4,1}(t) + P_{3,1}(t)) - 3\lambda_{cpu} P_{3,1}(t)$

$P_{5,1}(t) + P_{4,1}(t) + P_{3,1}(t) + P_F(t) = 1$

$P_{5,1}(0) = 1$

$R_{cpu} = 1 - P_F(t) = P_{5,1}(t) + P_{4,1}(t) + P_{3,1}(t)$

Keyboard - Printer - Monitor



$\dot{P}_1(t) = P_1(t) \cdot (-\lambda_i)$

$\dot{P}_F(t) = P_1(t) \cdot \lambda_i$

$P_1(t) + P_F(t) = 1$

$P_1(0) = 1$

$R_{KPM} = 1 - P_F(t) = P_1(t)$

Bus + voters

$R_{BV} = 1 - P_F(t) = P_{BV}(t)$

$P_{BV}(t) = P_{2 bus + v}(t) (-2\lambda_v - 4\lambda_v)$

$R(0) = 1$

$R_{KFT} = 1 - P_F(t) = R(t)$

Raid

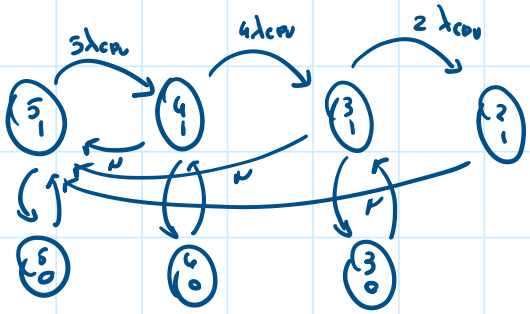
Availability: ΠR_i

$\dot{P}_7(t) = -7\lambda_{DISK} \cdot P_7(t)$

$P_6'(t) = +7\lambda_{DISK} P_7(t) - 6\lambda_{DISK} P_6$

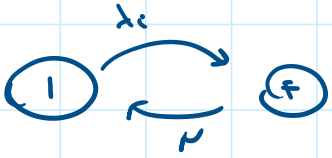
$P_F'(t) = 6\lambda_{DISK} P_6(t)$

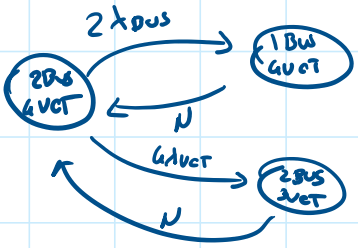
Availability

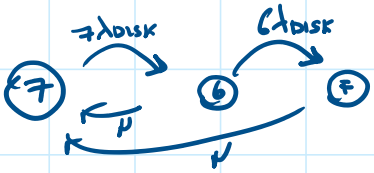


$\dot{P}_{5,1}(t) = -P_{5,1}(t)(5\lambda_{CPU} + \lambda_v) + \mu(P_{5,0}(t) + P_{4,1}(t) + P_{3,1}(t) + P_{2,1}(t)$

$\vdots$







Availability totale:

$\Pi_i A_i$

Safety:

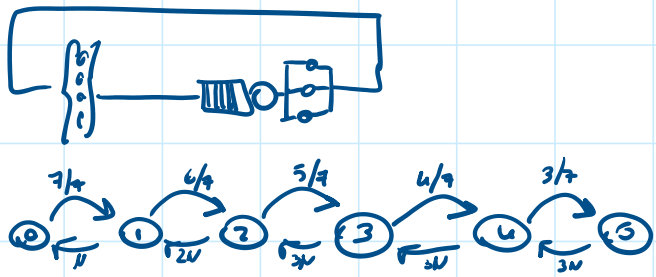
Sempre uguale ma con meno

Esercizi 15/04/2013

mercoledì 15 maggio 2019 15:15

Esercizio 4.3

Response time, throughput, probability of loss?



$$\begin{cases} P_0 \tfrac{7}{2} = P_1 4\mu \\ P_1 \tfrac{6}{7} = P_2 2\mu \\ P_2 \tfrac{5}{7} = P_3 3\mu \\ P_3 \tfrac{4}{7} = P_4 3\mu \\ P_4 \tfrac{3}{7} = P_5 3\mu \\ P_0 + P_1 + P_2 + P_3 + P_4 = 1 \end{cases} \Rightarrow \begin{aligned} P_0 &= 0,054 \\ P_1 &= 0,189 \\ P_2 &= 0,2835 \\ P_3 &= 0,23625 \\ P_4 &= 0,1575 \\ P_5 &= 0,07875 \end{aligned}$$

$\bar{X} = \sum_{i=1} P_i \mu_i$ // throughput medio

$\bar{N} = \sum i \cdot P_i$ // numero di utenti medi

Esercizio 4.3

100 requests x second

4 identical servers (CPU + RAM)

Fileserver: CPU + 8 disks // connected with Ethernet 8 Gb/s

connected with Router (no delay)

File dimension: 100 kb/s

Request: 500 bytes

$D_{CPU}^{HTF} = 5$ min (Hit)

$D_{CPU}^{miss} = 10$ msec HTTF = 1000 hours

$D_{CPU+FS}^{miss} = 10$ msec HTTR = 1 hour

$D_{Disk}^{miss} = 10$ msec

average service time, throughput, final bottleneck

$F_{ETH}^{req} = \frac{500}{65515} = 1$ fragments ETH

$F_{ETH}^{res} = \frac{100.000}{65515} = 2$ fragments ETH

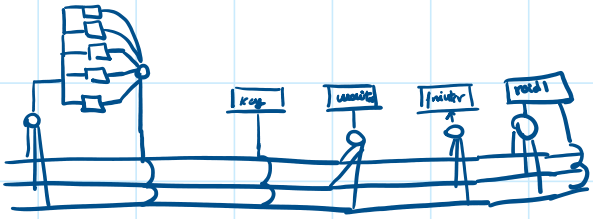
Frame = datagrammi = $\frac{100000}{1460} = 69+3$

Overhead = $(69+3)(20+20+18) = 4176$

$D_{ETH}^{req} = \frac{100.000 + 4176}{2 \cdot 10^9} = 5208 \cdot 10^{-5}$

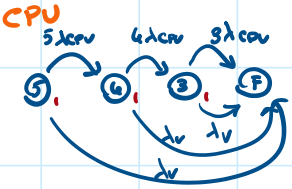
R,S

Esercizio n.1



Reliability

CPU



$$\begin{cases} \dot{P}_5(t) = P_5(t)\cdot -5\lambda_{CPU} + P_5(t)\cdot -\lambda_V \\ \dot{P}_4(t) = P_5(t)\cdot 5\lambda_{CPU} - P_4(t)\cdot 4\lambda_{CPU} - P_4(t)\cdot \lambda_{voter} \\ \dot{P}_3(t) = -P_4(t)\cdot 4\lambda_{CPU} - P_3(t)\cdot \lambda_V + P_4(t)\cdot 4\lambda_{CPU} \\ \dot{P}_F(t) = P_5\lambda_V + P_4\lambda_V + P_3\lambda_V + P_3(t)\cdot 3\lambda_{CPU} \\ P_5(t) = 1 \end{cases}$$

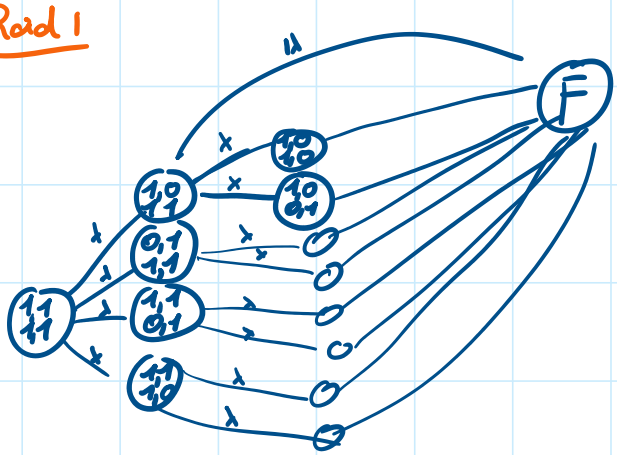
$$\text{Reliability}(t) = 1 - P_F(1)$$

Keyboard / Monitor / Printer

$$\begin{cases} \dot{P}_1(t) = -P_1(t)\cdot \lambda_{Fi} \\ \dot{P}_F(t) = P_1(t)\cdot \lambda_{Fi} \\ P_1(t) = 1 \end{cases}$$

$$\text{Reliability}(t) = 1 - P_F(t)$$

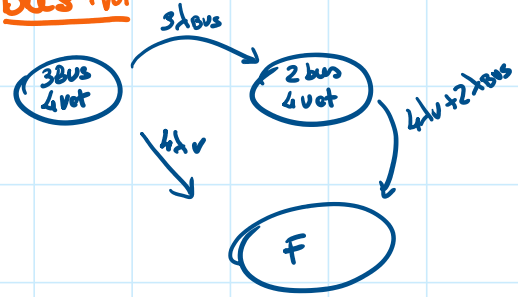
Raid 1



2-5 1 failure

raid 0 0 failure

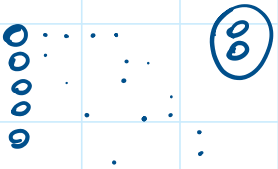
Bus + Voter



$$\begin{cases} \dot{P}\left(\frac{3}{4}\right)(t) = -P\left(\frac{3}{4}\right)(3\lambda_{bus} + 4\lambda_V) \\ \dot{P}\left(\frac{2}{4}\right)(t) = P\left(\frac{3}{4}\right)t\cdot(3\lambda_{bus}) + -P\left(\frac{2}{4}\right)t\cdot(4\lambda_V + 2\lambda_{bus}) \\ \dot{P}(F)t = (4\lambda_V)\cdot P\left(\frac{3}{4}\right)t + (4\lambda_V + 2\lambda_{bus})P\left(\frac{2}{4}\right)t \\ P\left(\frac{3}{4}\right)(t) = 1 \end{cases}$$

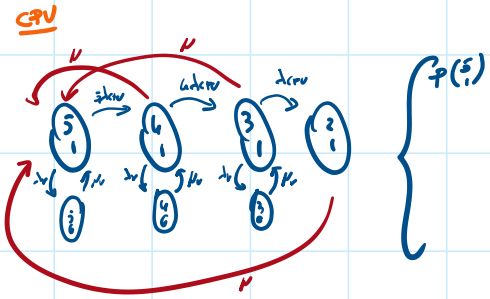
Availability

N ripara tutto il componente

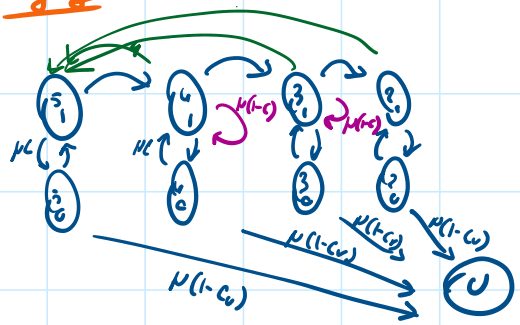


CPU

CPU



Safety



$\mu(1-c)^2$ * coverage factor * cov

Esame 13-09-2013

mercoledì 15 maggio 2019 16:49

Esercizio 2

Sempre uguale per quanto riguarda calcolo di $\bar{x}$ e $\bar{N}$

Se tengo conto delle rotture come indipendenti

$$A = \frac{MTTR}{MTTF+MTTR} = 0.98$$

$$q_3 = 1 \cdot A^3 \qquad q_2 = A^2(1-A) \qquad q_1 = 3A(1-A)^2$$

$$q_0 = (1-A)^3$$

$$\bar{R} = q_1 \cdot R_1 + q_2 \cdot R_2 + q_3 \cdot R_3$$

$$\bar{x} = q_1 \bar{x}_1 + q_2 \bar{x}_2 + q_3 \bar{x}_3$$

Esercizio 6/15

giovedì 16 maggio 2019 10:44

1 Gbps FDDI

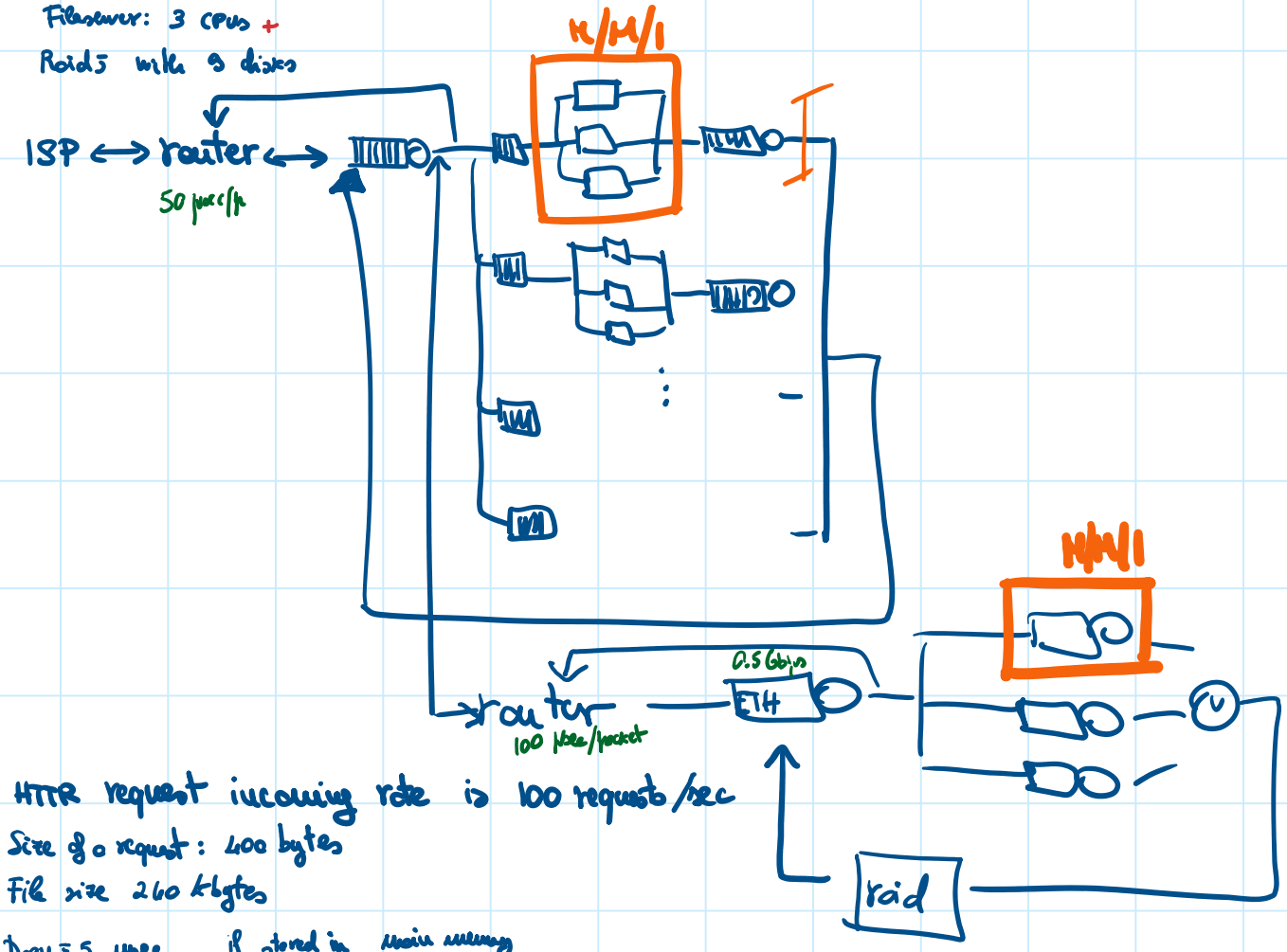
50 msec/packet latency

FDDI-Router 1,44 Gbps

4 ~~Web~~ Servers : 4 cores, local mem, local disk

Fileserver: 3 CPUs +

Raid5 with 9 disks



HTTP request incoming rate is 100 requests/sec

Size of a request: 400 bytes

File size 260 kbytes

D_{CPU} = 5 msec if stored in main memory

$D_{CPU-DISK}$ = 10 msec if local-disk

$D_{CPU-NOFILE}$ = 30 msec

D_{DISCO} = 10 msec

$S_{single\ disk\ or\ RAID5}$ = 10 msec × 20 kbytes

$D_{RAID5} = \frac{200}{20} \cdot 10 = 120$

NETWORKing Course MTU

packets = $\frac{260.000}{1460} = 165$ (1460 = 1500 − 20 − 20)

packet/request = $\frac{400}{1460} = 1$

D_{FDDI} = rete sovraccaricata

$$\frac{1+3(20+20+28)+400 + (165+3)(20+20+28) + 260\,000}{1,44 \cdot 10^{9}} = 2 \text{ msec}$$

HP: assumo 3 pacchetti ogni richiesta

D_{router} = 172 · 50 μ/sec = 8,6 μ/sec

Dcontroller = 172.50 µ/sec = 8,6 µ/sec

Ddisk = uguale o quella prima ma con 1 Gbyte = 2,01 msec

$P_{raw} = \sum_{i=1}^{5} k_i$ 20 % hit raw, 80 % miss

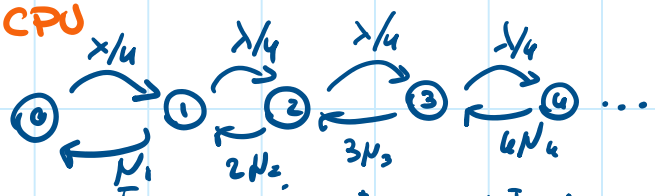
$P_{disk} = \sum_{i=1}^{10} k_i$ 60 % hit disk, 40 % miss

Average response time:

$\bar{R}_i = \frac{D}{1-U_i}$ $R_{TOT} = \sum_i R_i$

$U = X \cdot D$

CPU



$P_0 = \left[1 + \sum_{k=1}^{3} \frac{\lambda^0}{\mu(k)} + \frac{\lambda^I}{\mu(s)} \frac{\rho}{1-\rho}\right]^{-1}$

Disk

$X_1 = P_1$

$X_2 = P_2$ $\Rightarrow \bar{X}$

$X_3 = P_3$

$X_4 = P_4$

Raster:

percentile

Esame 11/02/2016

sabato 18 maggio 2019 15:56

Esercizio n 1

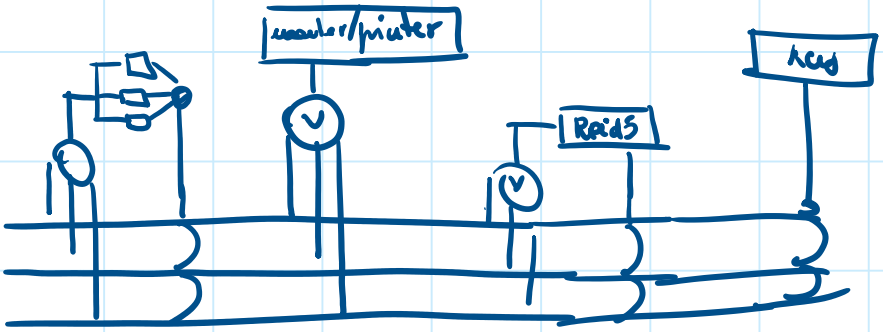
3 CPU in parallelo with voter

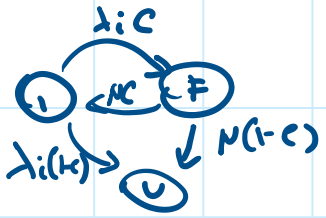
Raid 5 with 8 disks

3 bus

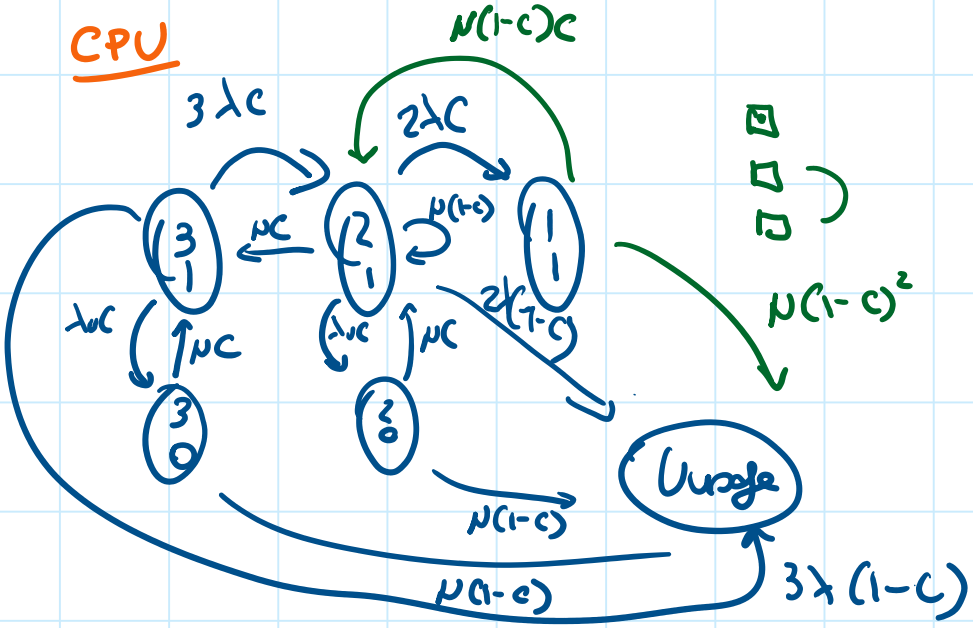
1 keyboard

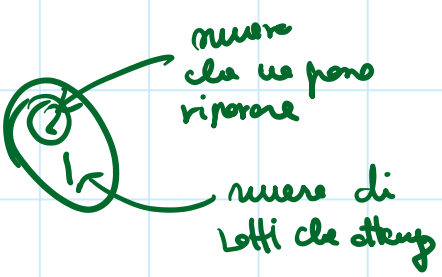
1 monitor

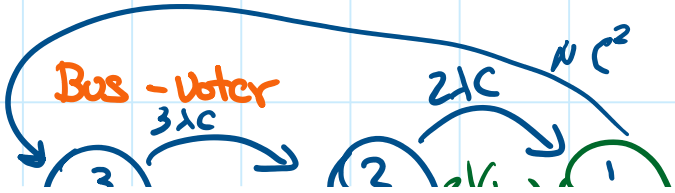


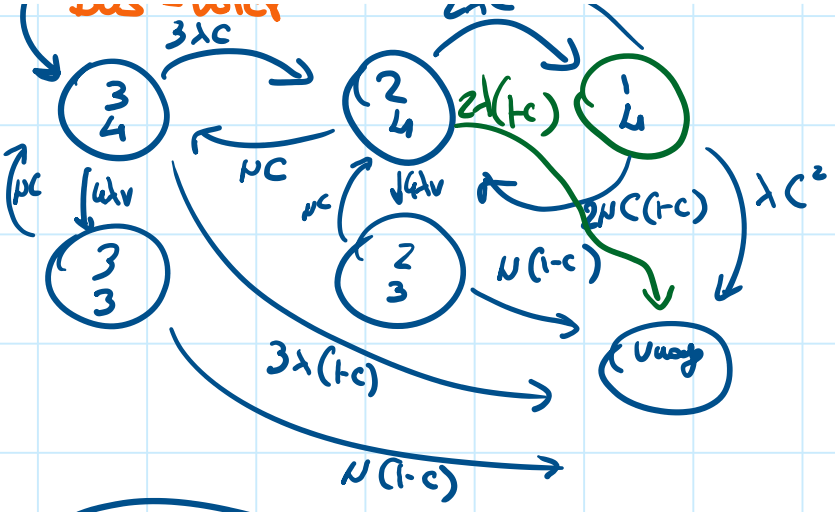


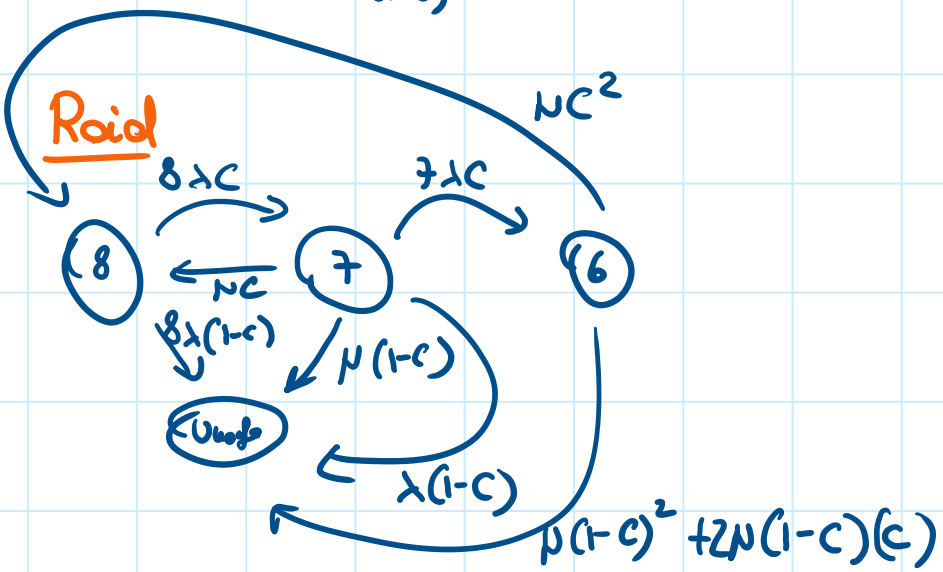
$$\begin{cases} \dot{P}_1(t) = P_1(t)\cdot(-\lambda_i C) + P_F(\mu C) \\ \dot{P}_F(t) = P_F(t)\cdot(-\mu C - N(1-C)) + P_1(t)\lambda_i C \\ U(t) = 1 P_F(t) N(1-C) + P_1(t)\cdot\lambda_i(1-C) \end{cases}$$





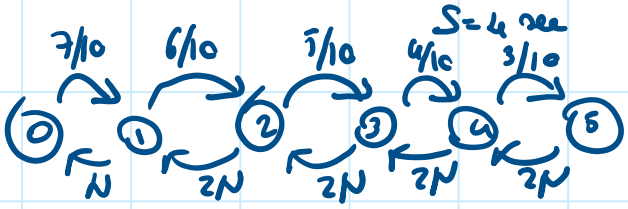


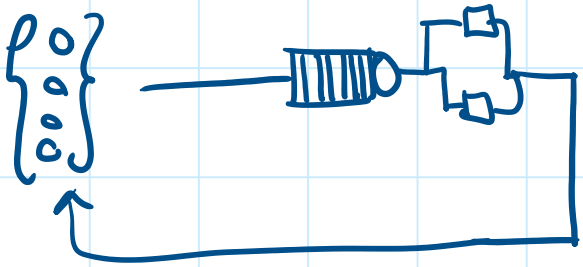




Esercizio 4.2

$\bar{R}$ $\bar{x}$? 1a sec first time





2 funzionanti

$P_0\,7/10 = P_1\,N$
$P_1\,6/10 = P_2\,2N$
$P_2\,5/10 = P_3\,2N$
$P_3\,4/10 = P_4\,2N$
$P_4\,3/10 = P_5\,2N$
$P_0+P_1+P_2+P_3+P_4+P_5=1$

$\Rightarrow$

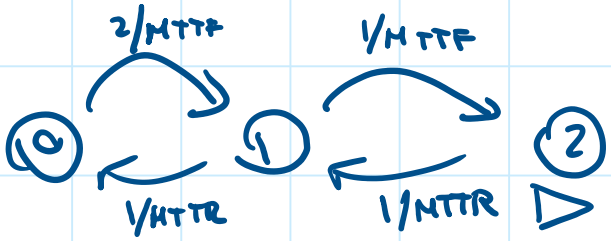
$P_0 = x_{1,2}$
$P_1 = a_{1,2}$
$P_2 = a_{2,2}$
$P_3 = a_{3,2}$
$P_4 = a_{4,2}$

X

1 funzionante

1 Esercizio

$$\begin{cases} P_0 \cdot 7/10 = P_1 \mu \\ P_1 \cdot 6/10 = P_2 \mu \\ P_2 \cdot 5/10 = P_3 \mu \\ P_3 \cdot 4/10 = P_4 \mu \\ P_4 \cdot 3/10 = P_5 \mu \\ P_0 + P_1 + P_2 + P_3 + P_4 + P_5 = 1 \end{cases} \Rightarrow \begin{aligned} P_0 &= x_{1,1} \\ P_1 &= a_{1,1} \\ P_2 &= a_{2,1} \\ P_3 &= a_{3,1} \\ P_4 &= a_{4,1} \\ P_5 &= a_{5,1} \end{aligned}$$



Ip: 1 riparatore x entrambi

$$\begin{cases} P_0 \cdot 2/MTTF = P_1 \cdot 1/MTTR \\ P_1 \cdot 1/MTTF = P_2 \cdot 1/MTTR \\ P_0 + P_1 + P_2 = 1 \end{cases} \Rightarrow P_0^*, P_1^F, P_2^F$$

$$X_0^2 = \sum w_i P_i = \mu R + 2\mu P_2 \dots$$

$$X_0^1 = \sum \mu_i P_i = \mu R_1 + 2\mu P_2 \dots$$

$$N^2 = \sum_i P_i = P_1^2 + 2P_2^2 + 3P_3^2$$

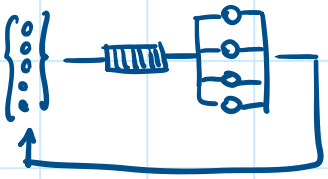
$$\bar{R}^2 = \frac{N^2}{X_0}$$

$$\bar{R}^1 = \frac{N^1}{X_0}$$

$$\bar{R} = P_0 \cdot \bar{R}^2 + P_1 \cdot \bar{R}^1$$

Esercizi 19/02/15

lunedì 20 maggio 2019 14:47



$\tau = 10$ sec

$S = 2$ sec $\quad \mu = \frac{1}{S} = 0.5$

MTTF = 10 settimane = $10 \cdot 7 \cdot 24 = 1680$

MTTR = 2 ore

Caso 4/4

$$\begin{cases} P_0\ 8/10 = P_1 \cdot 0.5 \\ P_1\ 7/10 = P_2 \\ P_2\ 6/10 = P_3 \cdot 1,5 \\ P_3\ 5/10 = P_4 \cdot 2 \\ P_4\ 4/10 = P_5 \cdot 2 \\ P_5\ 3/10 = P_6 \cdot 2 \\ P_0 + P_1 + P_2 + P_3 + P_4 + P_5 + P_6 = 1 \end{cases}$$

$P_0 = 0.232$

$P_1 = 0.391$

$P_2 = 0,259$

$P_3 = 0,103$

$P_4 = 0,025$

$P_5 = 5 \cdot 10^{-3}$

$P_6 = 7,5 \cdot 10^{-4}$

$\bar{N}_4 = \sum i P_i = 1,327$

$\bar{X}_4 = \sum \mu P_i = 0,66$

$$\bar{P} = \frac{\bar{N}_4}{\bar{X}_4} = 2,01$$

Caso 3/4

Caso 3/4

$$\begin{cases} P_0\ 8/10 = P_1 \cdot 0.5 \\ P_1\ 7/10 = P_2 \\ P_2\ 6/10 = P_3 \cdot 1,5 \\ P_3\ 5/10 = P_4 \cdot 1.5 \\ P_4\ 4/10 = P_5 \cdot 1.5 \\ P_5\ 3/10 = P_6 \cdot 1.5 \\ P_0 + P_1 + P_2 + P_3 + P_4 + P_5 + P_6 = 1 \end{cases}$$

Availability

If: Riparazioni a guasti dipendenti

If: Spengo dopo 2

$P_{B\ 1/MTTR} = P_{4\ 1/MTTF}$

$$P_4 = P_3 \cdot \frac{MTTF}{4\,MTTR} \qquad P_3 = \frac{4\,MTTR}{4\,MTTF} \cdot P_4$$

$$\begin{cases} P_3 \frac{1}{\mu_{TTR}} = P_4 \frac{1}{\mu_{TTF}} \\ P_2 \frac{1}{\mu_{TTR}} = P_3 \frac{1}{\mu_{TTF}} \\ P_3 + P_2 + P_4 = 1 \end{cases}$$

$$P_4 = P_3 \cdot \frac{\mu_{TTF}}{4\,\mu_{TTR}}$$

$$P_3 = P_2 \cdot \frac{\mu_{TTF}}{3\,\mu_{TTR}}$$

$$P_3 + P_2 + P_4 = 1$$

$$P_3 = \frac{4\,\mu_{TTR}}{\mu_{TTF}} \cdot P_4$$

$$P_2 = \frac{3\,\mu_{TTR}}{\mu_{TTF}} \cdot \frac{4\,\mu_{TTR}}{\mu_{TTF}} \cdot P_4$$

$$\left(\frac{4\,\mu_{TTR}}{\mu_{TTF}} + \frac{3\,\mu_{TTR}}{\mu_{TTF}} \cdot \frac{4\,\mu_{TTR}}{\mu_{TTF}} + 1 \right) P_4 = 1$$

$$\frac{8}{168} + \frac{6}{168} \cdot \frac{8}{168} + 1$$

$P_4 = 0.995$

$P_3 = 4{,}76 \cdot 10^{-3}$

$P_2 = 2{,}256 \cdot 10^{-5}$

$$\bar{R} = P_4^S \bar{R}_4 + P_8^S \bar{R}_8$$

Esercizio 06/06/13

lunedì 20 maggio 2019 15:25

Request 5 workstations (users)

$Z = 5000$ msec

$D_{CPU} = 20$ ms

$D_{DISK} = 10 \cdot 5 = 50$ ms

At most 3 users

R ? $\bar{X}$ = ? percentage_of_refused_requests = ?

Caso N = 1

$R_{CPU} = 20$ msec

$R_{DISK} = 50$ msec

$R_{TOT} = 70$ msec

$\bar{X}_0 = 1/R_{TOT} = 0,014$

$N_{CPU} = R_{CPU} \cdot X_0(1) = 0,28$

$N_{DISK} = R_{DISK} \cdot X_0(1) = 0,72$

Caso N = 2

$R_{CPU} = D_{CPU}(1 + M_{CPU,1}) = 26,6$ msec

$R_{DISK} = D_{DISK}(1 + M_{DISK,1}) = 86$ msec

$\bar{X}_2 = 2/R_{TOT} = 2/116,6 = 0,018$

$M_{CPU,2} = 25,6 \cdot 0,018 = 0.46$

$M_{disk,2} = 86 \cdot 0,018 = 1.54$

Caso N = 3

$R_{CPU} = D_{CPU}(1 + M_{CPU,2}) = 29,2$

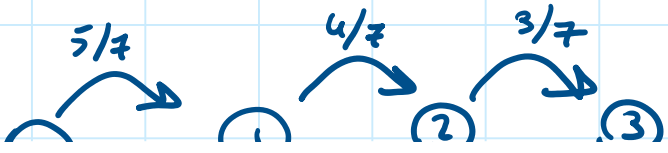
$R_{DISK} = D_{DISK}(1 + M_{DISK,2}) = 127$

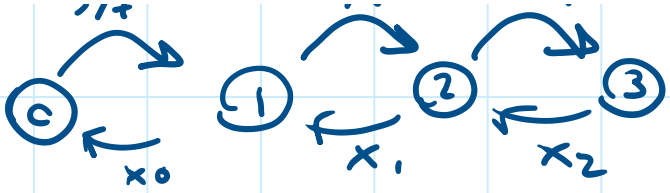
$R_{TOT} = 156,2$

$N_{CPU,3} = 0,554$

$N_{DISK,3} = 2,413$

$X_3 = 3/R_{TOT} = 0,0192$





$$\begin{cases} P_0 \cdot \frac{3}{7} = P_1 \cdot x_0 \\ P_1 \cdot \frac{4}{7} = P_2 \cdot x_1 \\ P_2 \cdot \frac{3}{7} = P_3 \cdot x_2 \\ P_0 + P_1 + P_2 + P_3 = 1 \end{cases}$$

$P_0 = 0{,}930$

$P_1 = 0.066$

$P_2 = 2{,}353 \cdot 10^{-3}$

$P_3 = 9{,}828 \cdot 10^{-5}$

$$\bar{x} = x_i \cdot P_i = 9{,}79 \cdot 10^{-4} = 0.$$

$$\bar{R} = \frac{N}{\bar{x}} = \frac{0.072}{9{,}79 \cdot 10^{-4}} = 73{,}55$$

Controllo unità di misura

$0{,}013902 +$

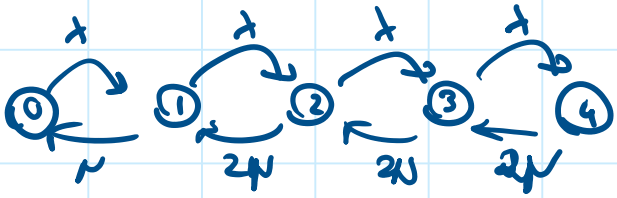
Esame 7/7/2015

lunedì 20 maggio 2019 16:29

2 server, max 4 users

$\lambda = 0.5$ (service rate)

$X = ?$ $U = ?$



flussi in = flussi out

$$\begin{cases} \cdot \\ \cdot \\ \cdot \end{cases} \Rightarrow \begin{cases} p_0 \\ p_1 \\ p_2 \\ p_3 \\ p_4 \end{cases}$$

p_4 ← packet loss percentage

$$X = \sum_1^4 \mu_i p_i =$$

$$N = \sum_1^4 i p_i =$$

$$p_0 = \frac{\lambda}{N}$$

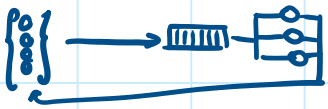
$$U = 1 - p_0 = 0.24$$

Esame 20/2/2013

martedì 21 maggio 2019 09:21

Esercizio 2

$\bar{R} = ?$,



$\mu = 10$

$1/\text{MTTF} = 1/12 \text{ months} = \frac{1}{365 \cdot 24}$

$1/\text{MTTR} = 1/12 \text{ hours} =$

$$\begin{cases} P_0 \cdot 8/20 = P_1 \cdot 0.1 \\ P_1 \cdot 7/20 = P_2 \cdot 0.2 \\ P_2 \cdot 6/20 = P_3 \cdot 0.3 \\ P_3 \cdot 5/20 = P_4 \cdot 0.3 \\ P_4 \cdot 4/20 = P_5 \cdot 0.3 \end{cases}$$

$P_0 + P_1 + P_2 + P_3 + P_4 + P_5 = 1$

$P_0 = 0.03$

$P_1 = \frac{P_0 \cdot 8/20}{0.1} = 0,12$

$P_2 = \frac{P_1 \cdot 7/20}{0.2} = 0,21$

$P_3 = \frac{P_2 \cdot 6/20}{0.3} = 0,21$

$P_4 = \frac{P_3 \cdot 5/20}{0.3} = 0,175$

$P_5 = 0,116$

$N_3 = \sum i \cdot P_i = 2,45$

$\bar{X}_3 = \sum \mu_i \cdot P_i = 0,20$

$\bar{R}_3 = N_3 / X_3 = 12$

Caso 2 server

$$\begin{cases} P_0 \cdot 8/20 = P_1 \cdot 0.1 \\ P_1 \cdot 7/20 = P_2 \cdot 0.2 \\ P_2 \cdot 6/20 = P_3 \cdot 0.2 \\ P_3 \cdot 5/20 = P_4 \cdot 0.2 \\ P_4 \cdot 4/20 = P_5 \cdot 0.2 \end{cases} \Rightarrow$$

$P_0 + P_1 + P_2 + P_3 + P_4 + P_5 = 1$

$P_0 = \frac{1}{[P_1 + P_2 + P_3 \ldots]}$ (sommiamo fino a 0.1) $= 0,02$

$P_{1T} = 4$

$P_{2T} = \frac{4 \cdot 7/20}{0.2} = 7$

$P_{3T} = 10.5$

$P_{4T} = 13,12$

$P_{5T} = 13,12$

$P_1 = 0,08$

$P_2 = 0,14$

$P_3 = 0,21$

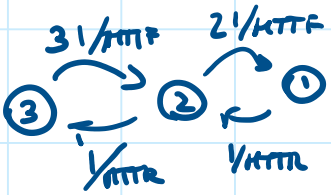
$P_4 = 0,26$

$P_5 = 0,26$

$P_{SF} = 13,12$

$\overline{N_2} = 3,33$ $\quad X_2 = 0,18$ $\quad R_2 = 18.29$

Availability



$$\begin{cases} P_3 \, 1/HTTF = P_2 \cdot 1/HTTR \\ P_2 \, 1/HTTF = P_1 \cdot 1/HTTR \\ P_3 + P_2 + P_1 = 1 \end{cases}$$

$P_3 = 0,995$

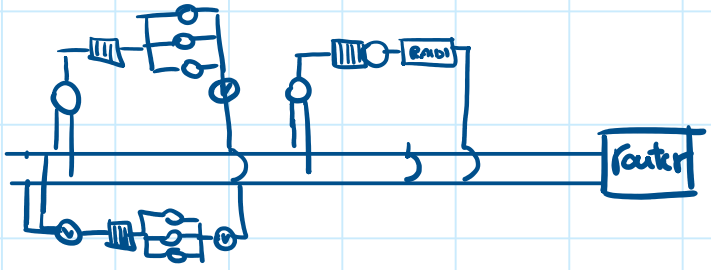
$P_2 = 4,08 \cdot 10^{-3}$

$P_1 = 9.2 \cdot 10^{-6}$

$\overline{X} = P_3 \cdot \overline{X_3} + P_2 \cdot \overline{X_2} = 0,203$

$\overline{R} = P_3 \cdot \overline{R_3} + P_2 \cdot \overline{R_2} = 12,01$

Esercizio 1



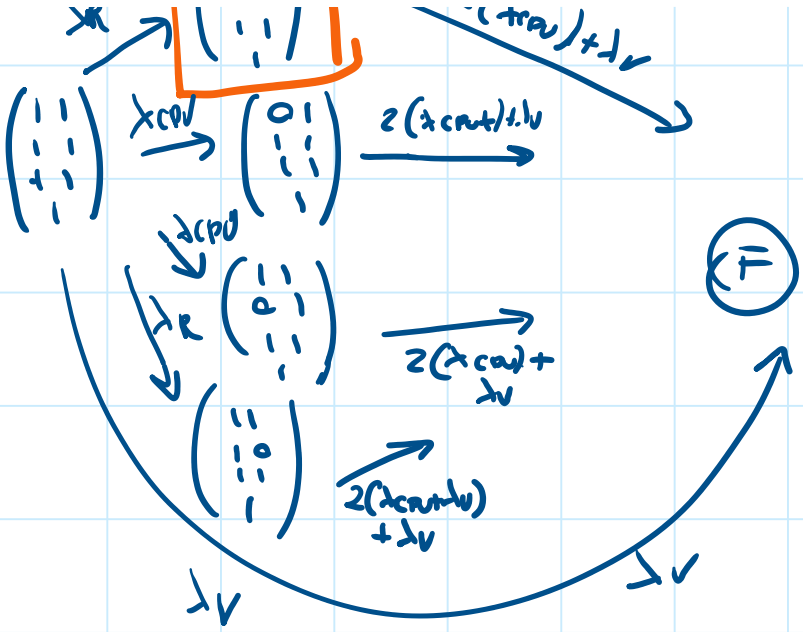
Reliability

$\begin{pmatrix} 3 & 2 \\ 1 & \end{pmatrix}$ → F

F

$\begin{pmatrix} 1 & 0 \\ 1 & \\ 1 & \\ 1 & \end{pmatrix}$

$2(tras)+1_r$

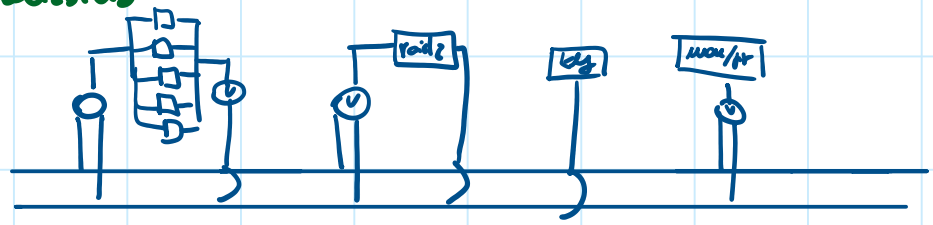


Esame 13/9/13

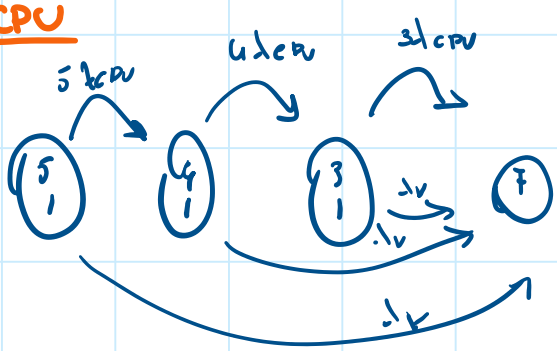
martedì 21 maggio 2019 11:04

Esercizio 1

Reliability

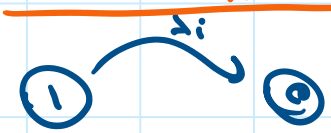


CPU



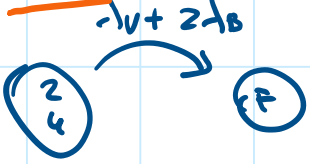
$$\begin{cases} \dot{P}_{3,1}(t) = P_{3,1}(t) \cdot (-3\lambda_{CPU}) \\ \vdots \\ P_{3,1}(0) = 1 \end{cases}$$

MONITOR PRINTER Kyboard

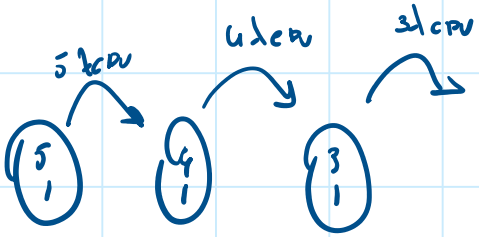


RAID

BUS



Availability



Esercizio casa

martedì 21 maggio 2019 16:08

SLA: $\lambda = 100$ requests/sec

$\bar{R} = 1$ sec

Disp = 95 % loss = 2 %.

S_{CPU} = 10 unità max 4 utenti

S_{DISK} = 20 unità

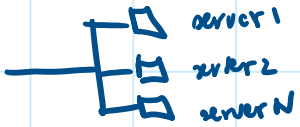
4 utenti max

$MTTF_{CPU}$ = 1 year = 52

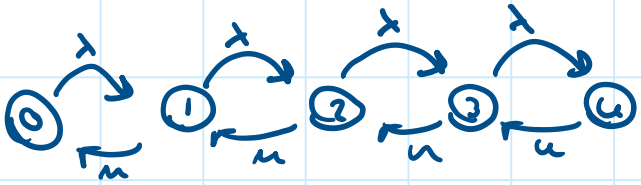
$MTTF_{disk}$ = 6 months = 26 sett

$MTTR_{CPU}$ = 1 week

$MTTR_{DISK}$ = 1 week



manutenzioni indipendenti



$$A_{CPU} = \frac{MTTF}{MTTR_{CPU} + MTTF_{CPU}} = \frac{52}{1+52} = 0.98$$

$$A_{DISK} = \frac{MTTF}{MTTR_{DISK} + MTTF_{DISK}} = \frac{26}{1+26} = 0.96$$

singolo

$A_{1/2\ disk} = 2A_{sing}(1 - A_{sing\ disk}) = 0.076$

$A_{2/2\ disk} = 0.96 \cdot 0.96 = 0.92$

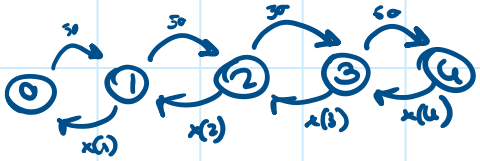
$A_S = A_{CPU} \cdot A_{1/2} = 0.074$ % singolo disco, ignoro

$A_S = A_{CPU} \cdot A_{2/2} = 0.90$ % caso concreto, ogni disco ha il suo controller

$A_{TOT} = 1 - (1 - 0.90)^2 = 0.99$ %

$A_{tutti\ e\ 2} = 0.81$ ↔ P_2

$A_{solo\ 1} = 2(1 - 0.90)(0.90) = 0.18$ P_1

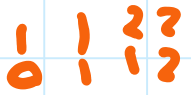


Caso u1

$R_{CPU} = 10$
$R_{DISK} = 20$
$R_{TOT} = 30$
$X_1 = 1/3 \cdot 10^{-2}$
$N_{CPU} = D_{CPU} X_1 = 0{,}33$
$N_{DISK} = D_{DISK} X_1 = 0{,}66$

Caso u2

$R_{CPU} = 10(1 + N_{CPU_1}) = 13{,}3$
$R_{DISK} = 20$
$R_{TOT} = 33{,}3$
$X_2 = 1/33{,}3 = 3$
$N_{CPU_2} = D_{CPU} X_1 =$
$N_{DISK} = D_{DISK} \cdot X_1 =$



Caso u3

$R_{CPU} = 10(1 + N_{CPU_2})$
$R_{DISK} = 20(1 + N_{DISK_2})$
$X_3 =$
N_{CPU_3}

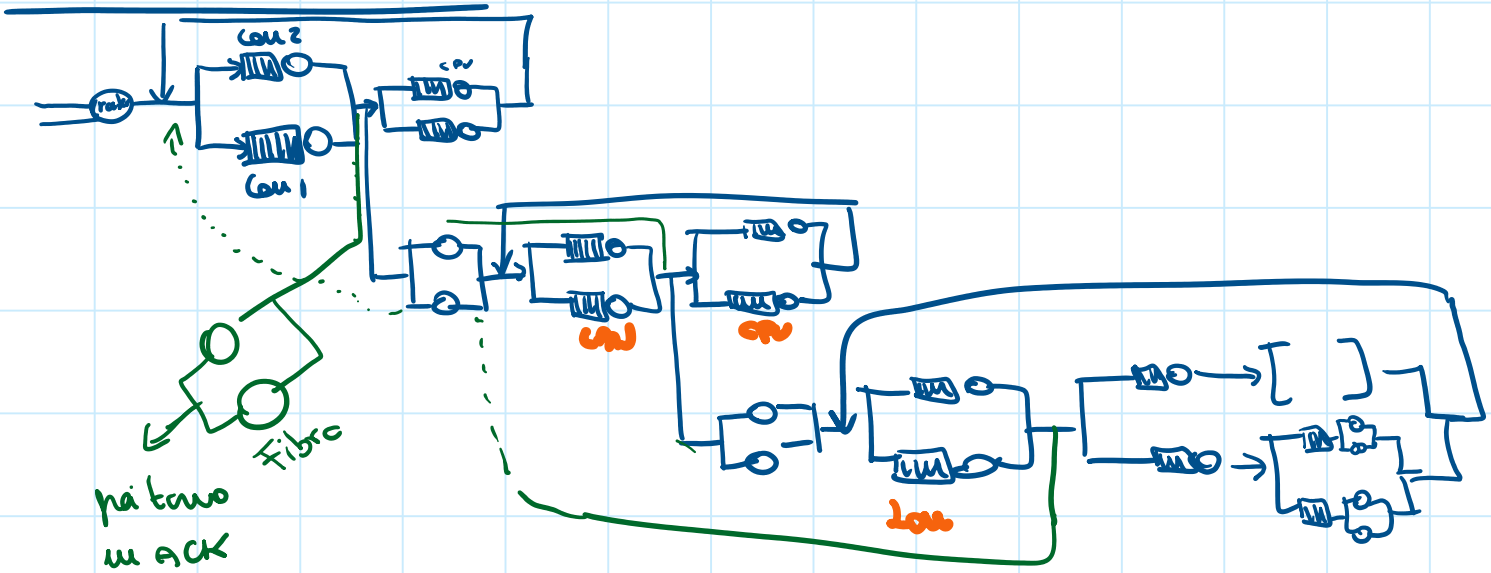
Caso u4

$R_{CPU} =$
$R_{DISK} = R_{DISK_3}$
X_4

$\bar{R}_2 = \sum P_i \cdot R_i$

Fibre con i dati funzionante ($\lambda = 100$)

→ Normalizzo con $(1 - P_0)$ se richiede che nel periodo funzionante
→ Non normalizzo altrimenti



Esercizio performability Alex

sabato 25 maggio 2019 17:29

$\bar{R} = ?$ $\bar{X} = ?$

4 server → 1 CPU, RAM, RAID 1 (4+4)

$MTTF_D = 500$ ore $MTTF_C = 1000$ ore

$MTTR_D = 50$ ore $MTTR_C = 10$ ore

6 utenti con $Z = 10$ sec

$A_{CPU} = \frac{1000}{1010} = 0.99$ $\mu = 1/5$

$A_{DISK} = \frac{500}{550} = 0.90$

$A_{raid} = (1-(1-A_{DISK})^2)^4 = 0.96$

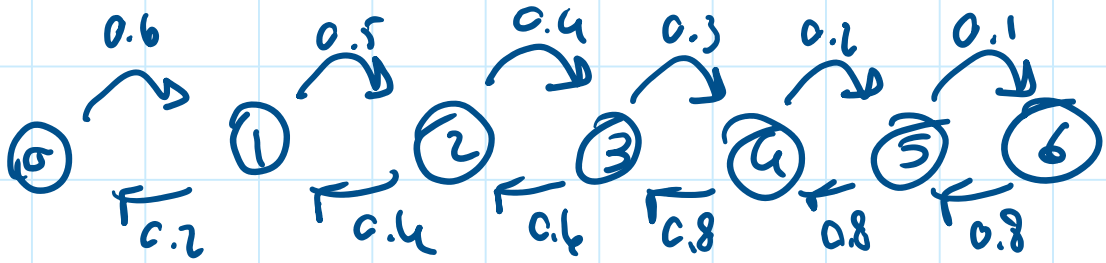
$A_{server} = A_{CPU} \cdot A_{server}$

$q_4 = 0.95^4 = 0.81$

$q_3 = 4 \cdot 0.95^3(1-0.95) = 0.17$

$q_2 = 6 \cdot 0.95^2(1-0.95)^2 = 0.013$

$\binom{4}{1} = \frac{4!}{1(3!)} = \frac{4 \cdot 3!}{6} = 4$ 4 oggetti presi 1 a 1



$N_4 = \sum i P_i = 1,57$

$\bar{X}_4 = \sum_N p_i = 0,39$

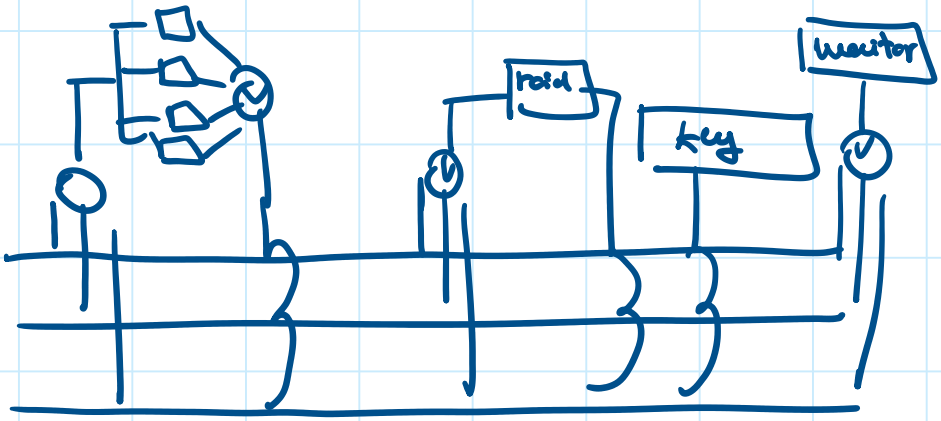
$\bar{R}_4 = 5,05$

Fondo 4 3 gemme, 2 gemme, 1 gemma

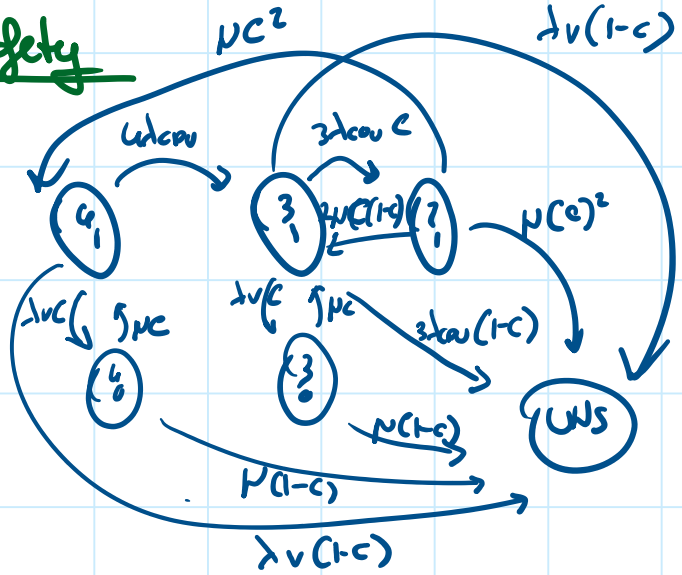
$R_{TOT} = q_4 \cdot R_4 + q_3 \cdot R_3 + q_2 \cdot R_2 + q_1 \cdot R_1$

Esame 21/12/04

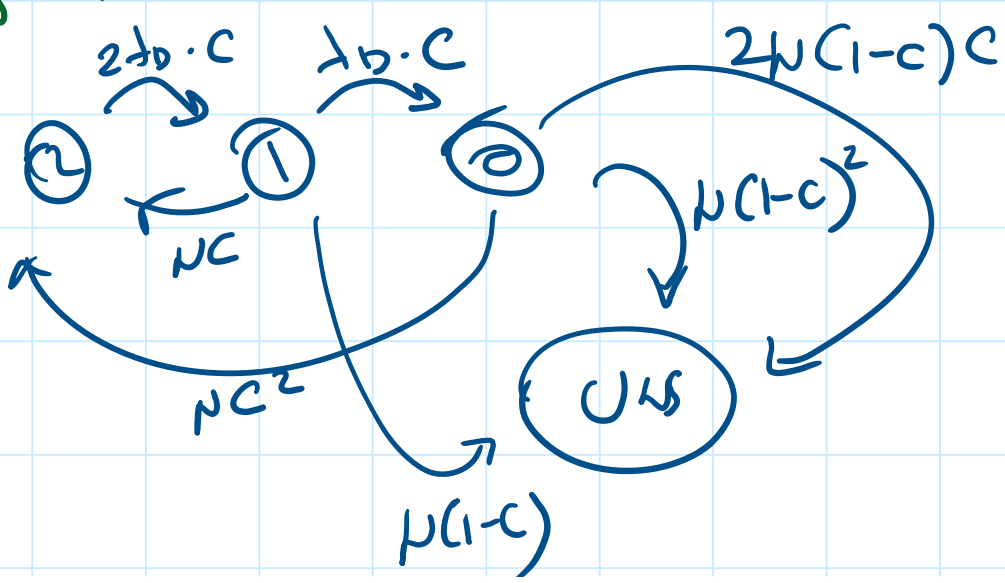
sabato 25 maggio 2019 17:40



Safety

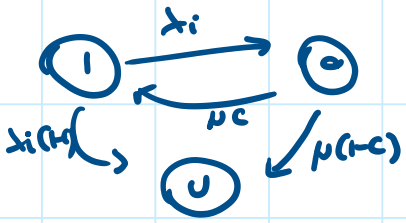


Safety RAID



$\mu(1-c)$

Safety Monitor/Printer



Esame 20/02/2013

sabato 25 maggio 2019 18:45

$\bar{R} = ?$ $\bar{X} = ?$

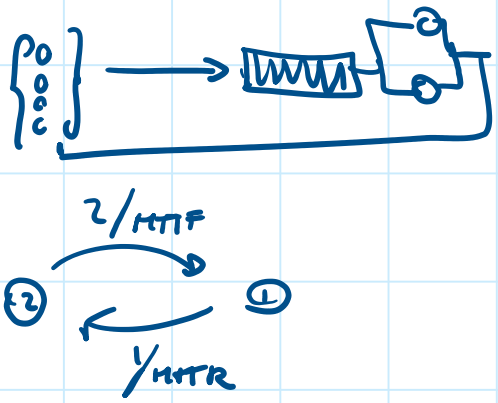
2 parallel systems

at most 4 users

$Z = 100$ sec

$MTTF = 3$ week

$MTTR = 1$ hour



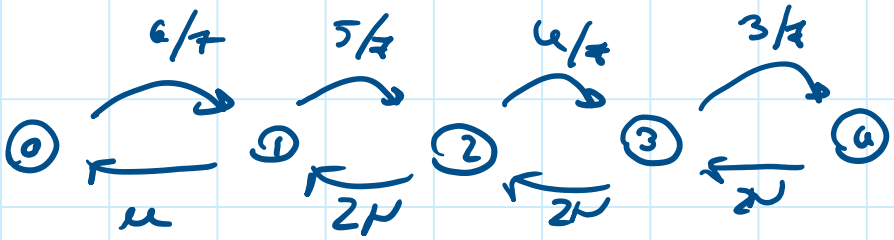
$$\begin{cases} P_2 \, 2/50 = P_1 \, 1/1 \\ P_1 \, 1/50 = P_0 \, 1/1 \\ P_2 + P_1 + P_0 = 1 \end{cases}$$

$$P_2 = 1/[1 + 2/50 + 2/50 \cdot 1/50] = 0{,}936$$

$$P_1 = 3{,}93 \cdot 10^{-3}$$

$$P_0 = 7{,}8 \cdot 10^{-6}$$

μ: sistema funziona solo se entrambi funzionano



P_0
P_1
P_2
P_3
P_4

$$N = \sum_i i \cdot P_i$$

$$X = \sum \mu_i \cdot P_i$$

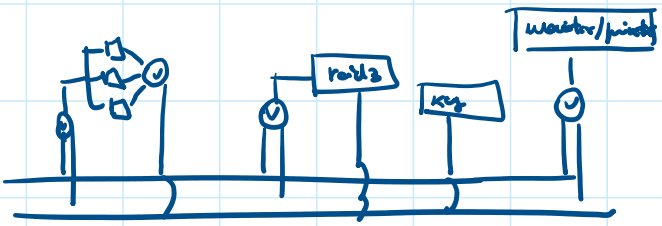
$$R = N/X$$

Esame 13/1/2012

domenica 26 maggio 2019 12:05

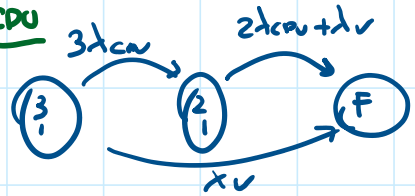
Esercizio n.1

3 cpu
Raid 3 4 disk
1 keyboard
1 Printer
1 monitor
2 bus



Reliability

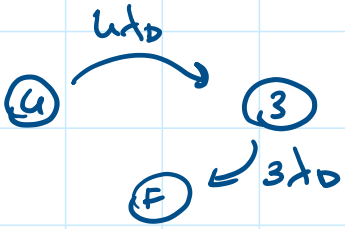
CPU



$$\begin{cases} \dot{P}_{3,1}(t) = -P(3_1)(3\lambda_{CPU}+\lambda_V) \\ \dot{P}_{2,1}(t) = -P(2_1)(2\lambda_{CPU}+\lambda_V) + P(3_1)\,3\lambda_{CPU} \\ \dot{P}_F(t) = +P(2_1)(t)(2\lambda_{CPU}+\lambda_V) + P(3_1)(t)(\lambda_V) \\ \dot{P}(3_1)(0) = 1 \end{cases}$$

$$R_{CPU} = 1 - P_F(t)$$

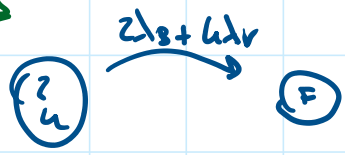
DISK



$$\begin{cases} \dot{P}_4(t) = -P(4)(t)\,4\lambda_D \\ \dot{P}_3(t) = +P(4)(t)\,4\lambda_D - 3\lambda_D P_F(t) \\ \dot{P}_F(t) = P(3)\,3\lambda_D \\ P(4)(0) = 1 \quad 0 \text{ otherwise} \end{cases}$$

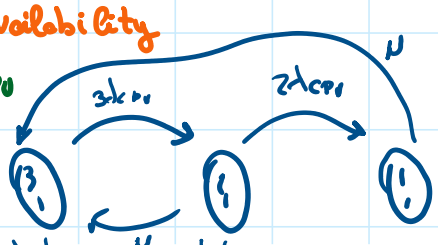
MON / PRINTER / key

BUS

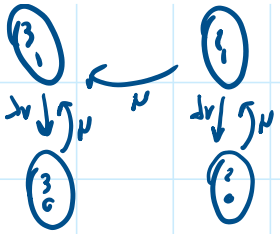


Availability

CPU



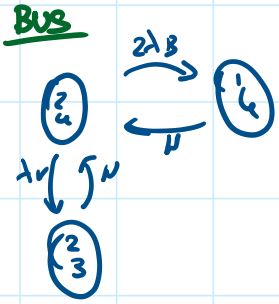
$$\begin{cases} P_{3,1}(3\lambda_C+\lambda_V) = P(4_1)N + P(3_1)N + P(3_0)N \\ P_{2,1}(2\lambda_{CPU}+N+\lambda_V) = P(2_0)N + P(3_1)\,3\lambda_C \\ P_{1,1}(N) = P(2_1)2\lambda_{CPU} \end{cases}$$



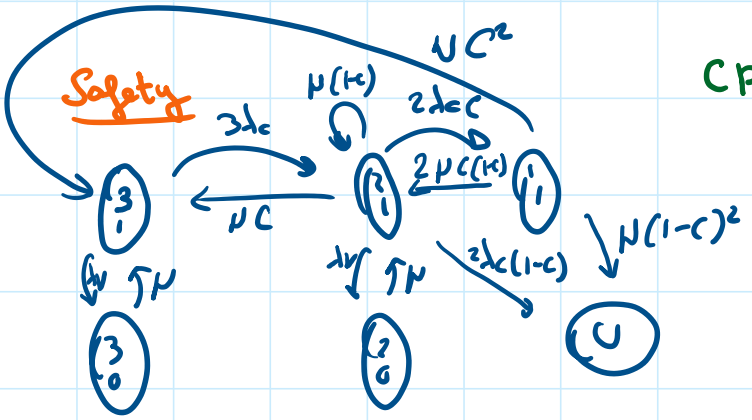
$$\begin{cases} P_{1,1}(N) = P(1_1)\,2\lambda_{CPU} \\ P_{3,0}(N) = P(3_1)\,\lambda_V \\ P_{2,0}(N) = P(1_1)\,\lambda_V \\ \sum_i P_i = 1 \end{cases}$$

$Ac \rightarrow P(3_1) + P(1_1)$

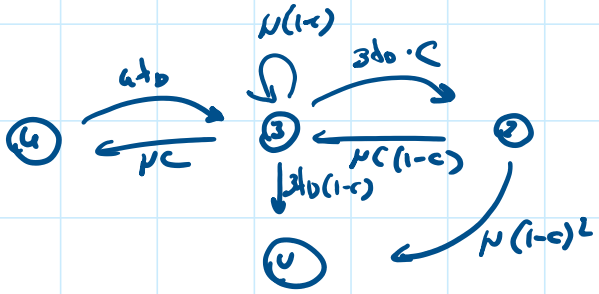
BUS



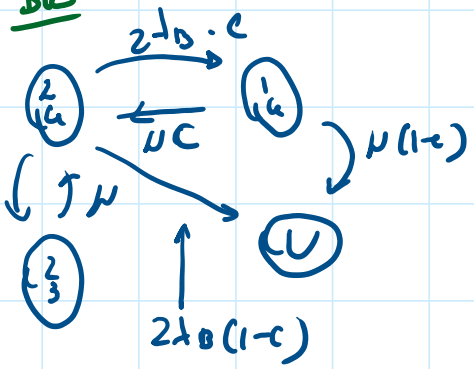
$$\begin{cases} P(2_4)\,(2\lambda_B + \lambda_V) = P(1_4)\,(N) + P(3_3)\,N \\ P(1_4)\,N = P(2_4)\,2\lambda_B \\ P(3_3)\,N = P(1_4)\,\lambda_V \\ \sum_i P_i = 1 \end{cases}$$



DISK



BUS



Esercizio 11.3

$\bar{R}$, $\bar{x}$ M/M/1/4/6

$t = 30$ sec $S = 20$ sec

$N = 1/S = 0{,}05$ rq/s

$$\begin{cases} 6/7\, P_0 = \mu P_1 \\ 5/7\, P_1 = \mu P_2 \\ 4/7\, P_2 = \mu P_3 \\ 3/7\, P_3 = \mu P_4 \\ \sum_i P_i = 1 \end{cases}$$

$$P_0 = 1/\left[1 + \frac{6}{7\mu} + \frac{6}{7\mu}\cdot\frac{5}{7\mu} + \frac{6}{7\mu}\cdot\frac{5}{7\mu}\cdot\frac{4}{7\mu} + \frac{6}{7\mu}\cdot\frac{5}{7\mu}\cdot\frac{4}{7\mu}\cdot\frac{3}{7\mu}\right]$$

P_0 P_1 P_2 P_3 P_4

$$\overline{X} = \Sigma_i \cdot P_i$$

$$N = \Sigma_i \cdot P_i$$

$$\overline{R} = N/X$$

Esercizio 4

$\lambda = 10$ req/s

$S_{CPU} = 10$ ms

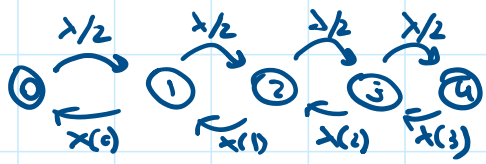
$V = 2$

$S_{IO} = 10$ ms

max 4 users

HTTP = 100000 B

HTTR = 10 B



Caso $\mu = 1$

Esercizio 20/02/2013

lunedì 27 maggio 2019 10:21

Esercizio 2

Hp: guasti e riparazioni indipendenti

2 postili server

$Z = 100$ sec

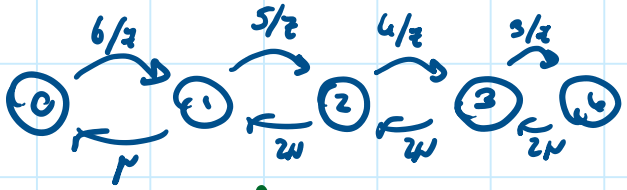
MTTF = 3 weeks

MTTR = 1 hour

$A = \frac{72}{73} = 0.98$

$A_2 = 0.98^2 = 0.96$

$A_1 = (0.98)(1-0.98) = 0.03$



Due server online

$$\begin{cases} P_0\, 6/7 = P_1 \mu \\ P_1\, 5/7 = P_2\, 2\mu \\ P_2\, 4/7 = P_3\, 2\mu \\ P_3\, 3/7 = P_4\, 2\mu \end{cases}$$

$P_0 = 1/[1 + 0.06 + 1.5 \cdot 10^{-3} + 3 \cdot 10^{-5} + 4{,}5 \cdot 10^{-7}]$

$P_1 = 0.05$

$P_2 = 1.41 \cdot 10^{-3}$

$P_3 = 2{,}88 \cdot 10^{-5}$

$P_4 = 4{,}23 \cdot 10^{-7}$

$N = \sum i P_i = 0.07$

$X = \sum \mu \cdot P_i = 0.05$

$R = 1$

Un server online

$$\begin{cases} P_0\, 1/7 = P_1 \mu \\ P_1\, 5/7 = P_2 \mu \\ P_2\, 4/7 = P_3 \mu \\ P_3\, 3/7 = P_4 \mu \end{cases}$$

$P_0 = 1/[1 + 0.06 + 3 \cdot 10^{-3} + 1{,}2 \cdot 10^{-4} + 3{,}6 \cdot 10^{-6}] = 0.94$

$P_1 = 0.05$

$P_2 = 2{,}5 \cdot 10^{-3}$

$P_3 = 1 \cdot 10^{-4}$

$P_4 = 3 \cdot 10^{-6}$

$P_{3\frac{1}{2}} = P_{4\frac{1}{2}}$

$P_3 = 1.10^{-4}$

$P_4 = 3.10^{-6}$

$N = \sum i \cdot P_i = 0.05$

$X = \sum N \cdot P_i = 0.05$

$R_i \geq 1$

$R = (A_2)(R_2) + (A_{single})(R_1) = 1$

Esercizio 4/11/2014

lunedì 27 maggio 2019 10:47

SLA:

0.2 seconds Response time

2% request loss

$\begin{cases} 10 \text{ rps} & 0:00 - 12:00 \\ 20 \text{ rps} & 12:00 - 24:00 \end{cases}$

Prima provider

$D_{CPU} = 10$ ms

$D_{DISK} = 30$ ms di I/O disk

3 client max

1 euro x day

Seconda provider

$D_{CPU} = 20$ ms

$D_{DISK} = 20$ ms

4 client max

0.5 euro

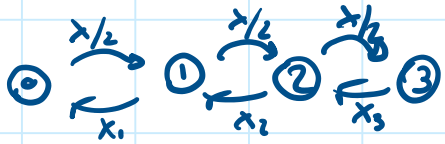
Availability:

$A = \frac{24}{25} = 0.96$

$A_{1/2} = 0.92$

$A_{1/1} = 0.0768$ falso

Prima provider



Caso u=1

$D_{CPU} = 10$

$D_{DISK} = 30 \cdot 10^{-3}$

$R_{TOT} = 40 \cdot 10^{-3}$

$X_1 = 1/40 = 25$

$N_{CPU,1} = X \cdot R_{CPU} = 0.25$

$N_{DISK,1} = X \cdot R_{DISK} = 0.75$

Caso u=2

$D_{CPU} = R_{CPU}(1+0.25) = 12,5 \cdot 10^{-3}$

$D_{DISK} = 30(1+0.25) = 52,5$

$X_2 = 30,7$

$N_{CPU,2} = 30,7 \cdot 12,5 \cdot 10^{-3} = 0.38$

$N_{DISK} = 30,7 \cdot 52,5 \cdot 10^{-3} = 1,61$

Caso u=3

$D_{CPU} = R_{CPU}(1+0.38) = 13,8 \cdot 10^{-3}$

$D_{DISK} = R_{DISK}(1+1,61) = 78,3 \cdot 10^{-3}$

$X_3 = 32,4$ falso

$N_{CPU_3} = 32,4 \cdot 13,8 \cdot 10^{-3} = 0,45$

$N_{DISK_3} = 32,4 \cdot 78,3 \cdot 10^{-3} = 2,55$

$$\begin{cases} P_0 \lambda/2 = P_1 \cdot X_1 \\ P_1 \lambda/2 = P_2 \cdot X_2 \\ P_2 \lambda/2 = P_3 \cdot X_3 \\ \sum_i P_i = 1 \end{cases}$$

$P_0 = 1/[1 + 0.4 + 0,13 + 0,03] = 0,64$

$P_1 = 0.25$

$P_2 = 0,08$

$P_3 = 0.02$

$N = \sum_i i \cdot P_i = 0,47$

$X = \sum \mu \cdot P_i = 9,35$

$R = N/X = 0.05$

$$\begin{cases} P_0 \lambda = P_1 X_1 \\ P_1 \lambda = P_2 X_2 \\ P_2 \lambda = P_3 X_3 \end{cases}$$

$P_0 = 1/[1 + 0.8 + 0,53 + 0,30] = 0,39$

$P_1 = 0.304$

$P_2 = 0.2$

$P_3 = 0.11$

$$\begin{cases} P_1 x = P_2 x_2 \\ P_2 x = P_3 x_3 \end{cases}$$

$P_1 = 0.300$

$P_2 = 0.2$

$P_3 = 0,11$

$N = 1,01$

$X = 17,11$

$R = 0,96$

$$\overline{R} = A_2(R_2) + A_{1/2}(R_1) = 0,05\ \text{Rc}$$

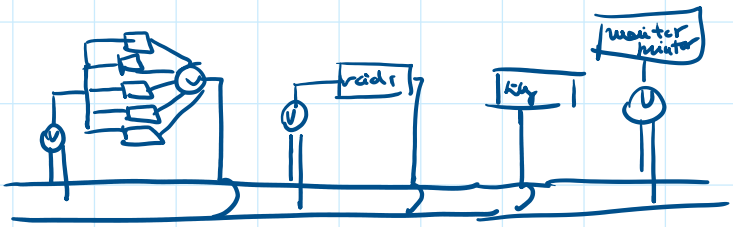
$$b_m = A_{2/2}\ 0.02 + A_{1/2} \cdot 0.11 = 0,026$$

Costo 26 euro

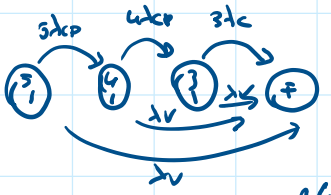
Esame 15/4/2013

lunedì 27 maggio 2019 15:17

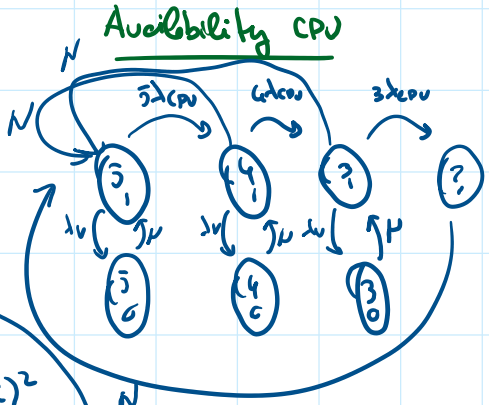
Esercizio 1



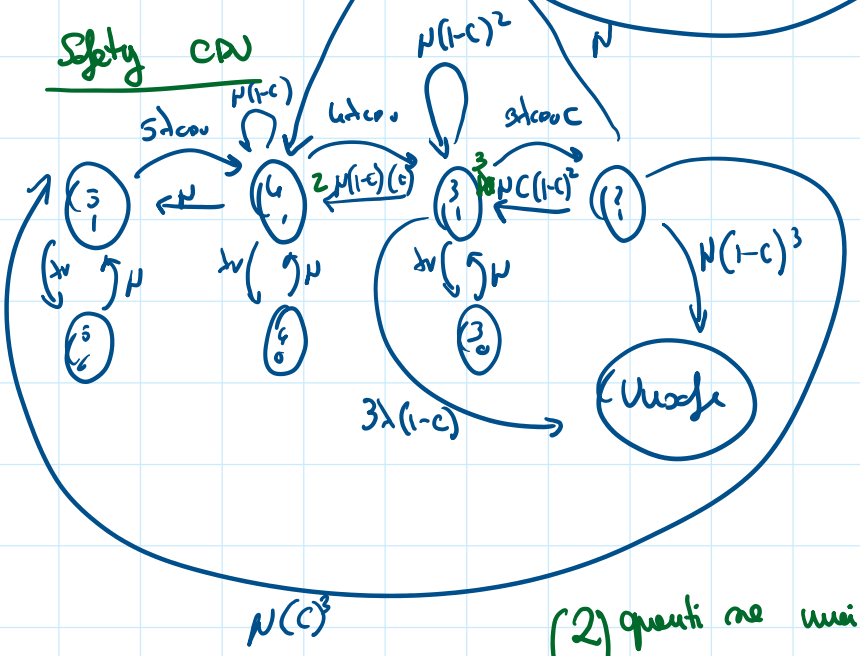
Reliability CPU



Availability CPU



Safety CPU



$$\binom{5}{2} \qquad 5\cdot 4\cdot 3\cdot 2$$

$$\frac{5!}{(5-2)!\,2!} = \frac{120}{12} = 10$$

$$\frac{5!}{(5-3)!\,3!} = \frac{120}{2\cdot 6} = 10$$

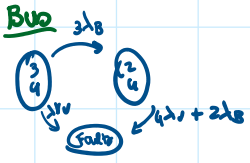
$\binom{2}{1}$ quanti ne usci rirorso

quanti te de ne rompono

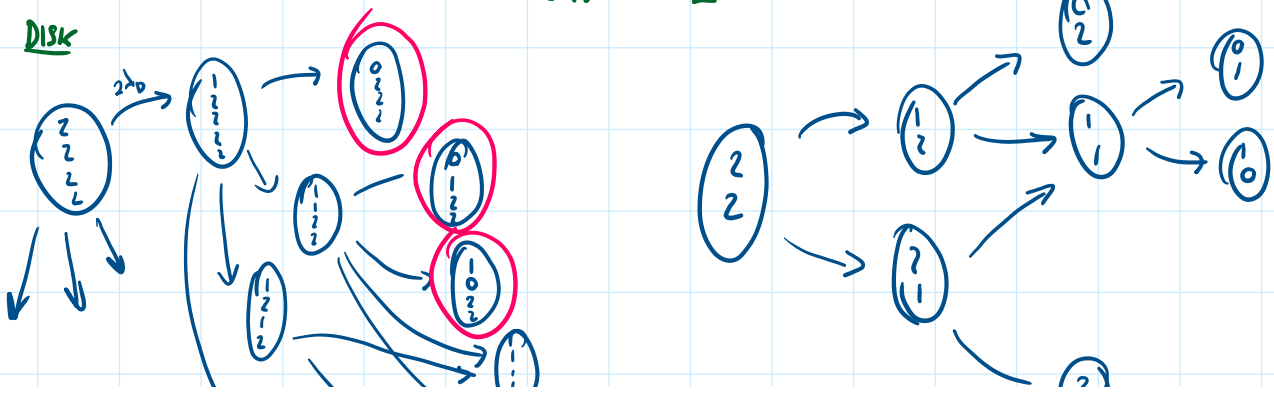
$$\binom{3}{2} = \frac{6}{2}$$

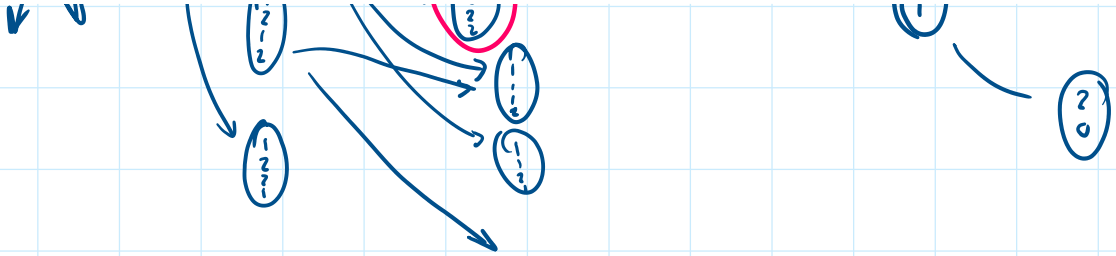
$$\binom{3}{1} = \frac{6}{2} = 3$$

Bus

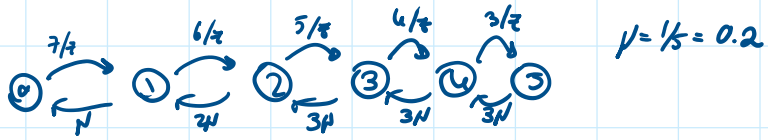


Disk





Esercizio 2



$\mu = 1/5 = 0.2$

$$\begin{cases} P_0 \, 7/4 = P_1 \mu \\ P_1 \, 6/4 = P_2 2\mu \\ P_2 \, 5/4 = P_3 3\mu \\ P_3 \, 4/4 = P_4 3\mu \\ P_4 \, 3/4 = P_3 3 \end{cases}$$

$$P_0 = \frac{1}{[1 + 3.5 + 3.25 + 4.37 + 2.18 + 1.46]} = 0.05$$

$P_1 = 0{,}175$

$P_2 = 0{,}24$

$P_3 = 0{,}21$

$P_4 = 0{,}14$

$P_5 = 0{,}07$

$N = \sum_i i \cdot P_i$

$X = \sum_i \mu \cdot P_i$