Performance Modeling of Computer Systems and Networks

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Multiserver and Priority scheduling

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esempio:

Assumptions:
- Arrival rate 1 j/s random
- Average demand Z=4x10^5 oxat, expo, do not know size

(Non è che tutti chiedono uguale)

Possible configurations:
- 1 server of capacity C=10^6 oxat/s
- Dual-core of C/2 each one

QoS requirements:
- Average waiting $T_Q < 0.15$ s
- For at least 35% of arrivals average response time $T_S < 0.5$ s

Def. $E(S) = Z/C = 0.4$ s (Z indipendente da C, C è caratteristica fisica, Z no!)
↳ costante ↳ variabile

Capacità processamento macchina != quanto chiede job. alcuni elementi sono caratteristiche fisiche della macchina, non modellabile.

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"il job" = domanda media, quanto chiede?

QoS requirements:
- Average waiting $T_Q < 0.15$ s

Analytical models
priority scheduling

$\lambda = 1$ j/s, $E(S) = 0.4$ s ⟹ $\rho = 0.4$

- 1 server of capacity C=10^6 oxerat/s

(M/M/1 KP) $E(T_Q) = 0.26$ s = $\frac{\rho E(S)}{1-\rho}$ $E(T_Q)^{\text{Abstract-P}} = 0.2243$ s

- Dual-core of C/2 each one

ogni coda è dimezzato!

$$E(S_i) = \frac{Z}{\frac{C}{2}} = 2\frac{Z}{C} = 2E(S) = 0.8\ s$$

$$E(T_Q)_{Erlang} = \frac{P_Q E(S)}{1-\rho} = 0.15238 \text{ s} > 0.15$$

$$\begin{cases} p_1 = 0.35 \cdot \rho = 0.14 \\ E(T_{a_1}) = \frac{p_1 E(S)}{1-0.14} = 0.065 \\ E(T_{a_2}) = \frac{\rho E(S)}{(1-p_1)(1-\rho)} = 0.31 \end{cases}$$

NON SI INTERROMPE

$E(T_a) = 0.065 \cdot 35\% + 0.31 \cdot 65\% = 0.2243$ s

NB: $\frac{\lambda}{2} E(S^2) = \rho E(S)$ se EXP

- P_a = tutti e due pieni ; $m = 2$, $p(0) = \left[\sum_{i=0}^{1} \frac{(2\rho)^i}{i!} + \frac{(2\rho)^2}{2!(1-\rho)}\right]^{-1} = \left[1 + 2\rho + \frac{(2\rho)^2}{2!(1-\rho)}\right]^{-1} =$ Prob. centro vuoto

e calcolo $P_a = \frac{(m\rho)^m}{m!(1-\rho)} p(0)$, utile per E(Ta along)

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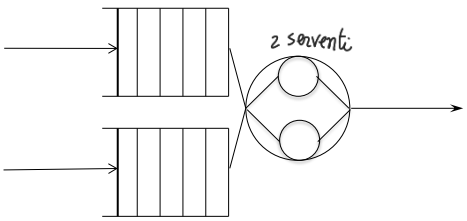
in E(Tq) erlang calcolo Pq e P0 con le formule citate, usando rho = 0.4 ed E(s) = 0.4

QoS requirements:
- Average waiting $T_Q < 0.15$ s

Analytical models
priority scheduling

$\lambda = 1$ j/s, $E(S) = 0.4$ s ⟹ $\rho = 0.4$

- Dual-core of C/2 each one, classi priorità con multi server



Con due code verrebbe molto più complesso, sconsigliato.

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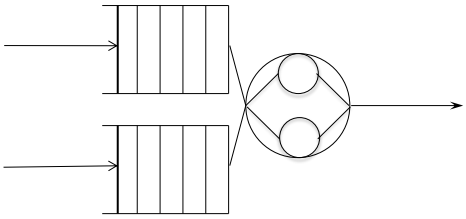
Multiserver with priority classes



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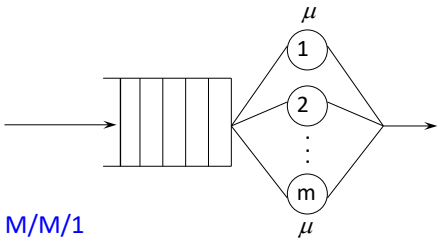
The *Erlang* formula



M/M/m

$$E(T_Q)_{Erlang} = \frac{P_Q E(S)}{1-\rho}$$

M/M/1

$$E(T_Q)_{KP} = \frac{\rho E(S)}{1-\rho} = \frac{E(S_{rem})}{1-\rho}$$

$$E(S) = \frac{E(S_i)}{m}$$

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Multiserver with priority classes

$$E(T_Q) = p_1 \frac{\rho_1 E(S)}{(1-\rho_1)} + p_2 \frac{\rho E(S)}{(1-\rho)(1-\rho_1)}$$

$$E(T_Q) = p_1 \frac{P_{Q1} E(S)}{(1-\rho_1)} + p_2 \frac{P_Q E(S)}{(1-\rho)(1-\rho_1)}$$

C'è prelazione, poichè il primo rapporto vede Pq1, ed è in funzione di rho1, non rho generico.

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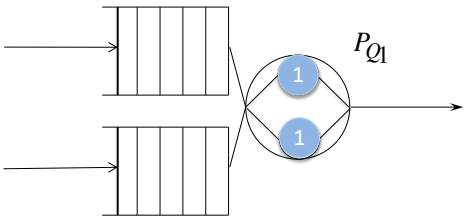
Multiserver with priority classes



m=2
p_1=0.35
p_2=0.65
ρ = 0.4
ρ_1=0.14
ρ_2=0.26

2 classi, 2 server.
indici '1' e '2' associati alle classi, non ai server!
Classe 1 occupa centro al 14%.

$P_{Q1} = Erlang(\rho_1) = 0.03438$ = tutti server occupati da job di classe 1, usando erlang.

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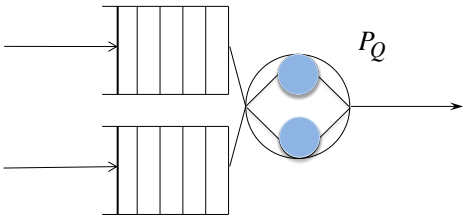
Multiserver with priority classes



$P_{Q1} = Erlang(\rho_1) = 0.03438 \qquad P_Q = 0.22857$ (pieni indipendenti dalle classi: solo classe 1, solo classe 2, misti...)

$$E(T_Q) = p_1 \frac{P_{Q1} E(S)}{(1-\rho_1)} + p_2 \frac{P_Q E(S)}{(1-\rho)(1-\rho_1)} = 0.12077$$

(il peso usato per P_Q è sempre p_1)

← classe 1, con prelazione, vede solo il "suo P_1", gli altri NON li vede.

(dual core + prelazione) QoS requirements:

- Average waiting $T_Q < 0.15$ s !! "bound" rispettato

GLOBALMENTE sono sotto il requisito, non solo la classe 1.

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QoS requirements: (altro requisito)

- For at least 35% of arrivals average response time $T_S < 0.5$ s

Analytical models
priority scheduling

$\lambda = 1$ j/s, $E(S) = 0.4$ s ⟹ $\rho = 0.4$

- 1 server of capacity C=10^6 oxerat/s

$E(T_Q) = 0.26$ s + 0,4 > 0,5, devo dividere le code!

- Dual-core of C/2 each one

$$E(S_i) = \frac{Z}{\frac{C}{2}} = 2\frac{Z}{C} = 2E(S) = 0.8\ s > 0{,}5,$$ senza contare E(Ta)

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QoS requirements:

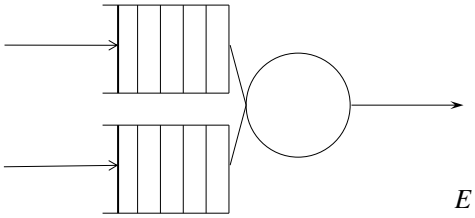
- For at least 35% of arrivals average response time $T_S < 0.5$ s

$\lambda =$ 1 j/s, $E(S) = 0.4$ s ⟹ $\rho =$ 0.4

- 1 server of capacity C=10^6 oxerat/s

p_1=0.35
p_2=0.65
$\rho = 0.4$
ρ_1=0.14
ρ_2=0.26

Abstract-P



$E(T_{S1}) = 0.4651162$

∀ obiettivo ∃ soluzione diversa.

servente singolo + abstract priority