Performance Modeling of Computer Systems and Networks

Prof. Vittoria de Nitto Personè

Size-based Priority

Università degli studi di Roma Tor Vergata
Department of Civil Engineering and Computer Science Engineering

1

Analytical models
priority scheduling

Not penalties if $T_Q \leq 0.45$;
gain revenue if $T_Q < 0.4$

$E(S) = 0.4$ s, exponential

Low load	medium load	high load	
$\rho =$ 0.4	0.6	0.8	
$\lambda =$ 1	1.5	2	job/s
$E(T_Q) =$ 0.26	0.6	1.6	job/s without priority classes

2 priority class

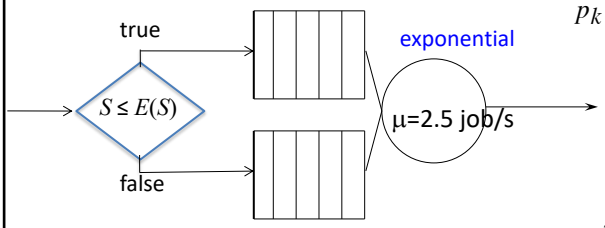
medium load

ρ_1=0.3	ρ_2=0.3	ρ_1=0.18	ρ_2=0.42	ρ_1=0.42	ρ_2=0.18
$E(T_{Q1})$ 50%	$E(T_{Q2})$ 50%	$E(T_{Q1})$ 30%	$E(T_{Q2})$ 70%	$E(T_{Q1})$ 70%	$E(T_{Q2})$ 30%
0.342857	0.85714	0.2926829	0.731707317	0.413793	1.03448

high load

ρ_1=0.4	ρ_2=0.4	ρ_1=0.24	ρ_2=0.56	ρ_1=0.56	ρ_2=0.24
$E(T_{Q1})$ 50%	$E(T_{Q2})$ 50%	$E(T_{Q1})$ 30%	$E(T_{Q2})$ 70%	$E(T_{Q1})$ 70%	$E(T_{Q2})$ 30%
0.5333333	2.6666666	0.4910526	2.105263	0.727272	3.636363

2



$$p_k = F(x_k) - F(x_{k-1})$$

$$p_1 = F\left(\frac{1}{\mu}\right) - F(0) = 0.63212$$

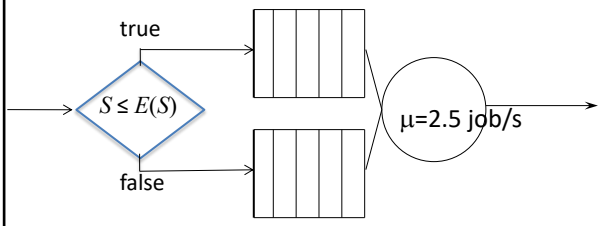
$$p_2 = F(\infty) - F\left(\frac{1}{\mu}\right) = 0.36788$$

$$\lambda_k = \lambda\left(F(x_k) - F(x_{k-1})\right)$$

	Low load	medium load	high load	
$\rho =$	0.4	0.6	0.8	
$\lambda =$	1	1.5	2	job/s
$\lambda_1 =$	0.63212	0.94818	1.26424	job/s
$\lambda_2 =$	0.36788	0.55182	0.73576	job/s

consistency check:

$$\lambda = \sum_{i=1}^{r} \lambda_i$$

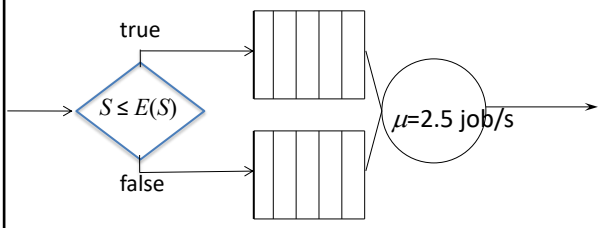


$$E(S_k) = \int_{x_{k-1}}^{x_k} t f^n(t)dt = \int_{x_{k-1}}^{x_k} t \frac{\mu e^{-\mu t}}{F(x_k) - F(x_{k-1})} dt$$

$$E(S_1) = \int_0^{1/\mu} t \frac{\mu e^{-\mu t}}{p_1} dt = 0.1672 \qquad E(S_2) = \int_{1/\mu}^{\infty} t \frac{\mu e^{-\mu t}}{p_2} dt = 0.8$$

consistency check:

$$E(S) = p_1 E(S_1) + p_2 E(S_2) = 0.63212 \times 0.1672 + 0.36788 \times 0.8 = 0.399999$$

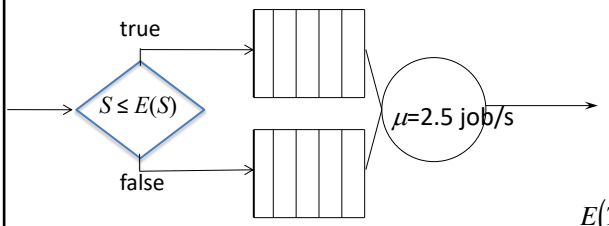


Low load medium load high load

$\rho =$	0.4	0.6	0.8
$\lambda =$	1	1.5	2 job/s
$\lambda_1 =$	0.63212	0.94818	1.26424 job/s
$\lambda_2 =$	0.36788	0.55182	0.73576 job/s
$\rho_1 =$	0.10569	0.15854	0.21139
$\rho_2 =$	0.29431	0.44146	0.58861

consistency check:

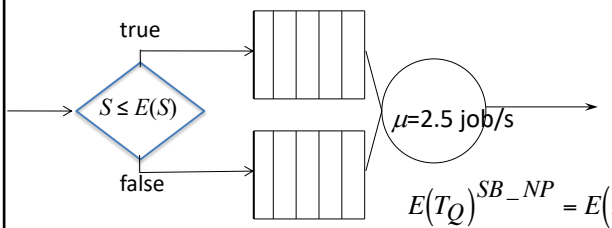
$$\rho = \sum_{i=1}^{r} \rho_i$$



$\rho_1 =$	0.10569	0.15854	0.21139
$\rho_2 =$	0.29431	0.44146	0.58861

$$E(T_{Q_1})^{SB\_NP} = \frac{\rho E(S)}{(1-\rho_1)}$$

$$E(T_{Q_2})^{SB\_NP} = \frac{\rho E(S)}{(1-\rho)(1-\rho_1)}$$



$$E(T_Q)^{SB\_NP} = E(E(T_{Q_k})) = p_1 E(T_{Q_1}) + p_2 E(T_{Q_2})$$

ρ_1 = 0.10569 0.15854 0.21139

ρ_2 = 0.29431 0.44146 0.58861

low load

$E(T_{Q1})$	$E(T_{Q2})$
0.1789	0.29818

$E(T_Q)$=0.22278

$E(T_Q)_{KP}$ = 0.26

medium load

$E(T_{Q1})$	$E(T_{Q2})$
0.28522	0.71305

$E(T_Q)$=0.44261

0.6

high load

$E(T_{Q1})$	$E(T_{Q2})$
0.40578	2.02889

$E(T_Q)$=1.00289 job/s

1.6 job/s

7

Size based vs abstract priority
(without preemption)
Waiting times

abstract

medium load

ρ_1=0.3	ρ_2=0.3	ρ_1=0.18	ρ_2=0.42	ρ_1=0.42	ρ_2=0.18
$E(T_{Q1})$ 50%	$E(T_{Q2})$ 50%	$E(T_{Q1})$ 30%	$E(T_{Q2})$ 70%	$E(T_{Q1})$ 70%	$E(T_{Q2})$ 30%
0.342857	0.85714	0.2926829	0.731707317	0.413793	1.03448

high load

ρ_1=0.4	ρ_2=0.4	ρ_1=0.24	ρ_2=0.56	ρ_1=0.56	ρ_2=0.24
$E(T_{Q1})$ 50%	$E(T_{Q2})$ 50%	$E(T_{Q1})$ 30%	$E(T_{Q2})$ 70%	$E(T_{Q1})$ 70%	$E(T_{Q2})$ 30%
0.5333333	2.6666666	0.4910526	2.105263	0.727272	3.636363

size-based

medium load

high load

ρ_1=0.15854	ρ_2=0.44146	ρ_1=0.21139	ρ_2=0.58861
$E(T_{Q1})$ 63%	$E(T_{Q2})$ 37%	$E(T_{Q1})$ 63%	$E(T_{Q2})$ 37%
0.28522	0.71305	0.40578	2.02889

8

Size based vs abstract priority
(without preemption)
Waiting times

$$E(T_{Q_k})^{SB\_NP} \leq E(T_{Q_k})^{abstract\_NP}$$

$E(T_Q)$ (job/s)

0.26	0.6	1.6	abstract
0.22278	0.44261	1.00289	size-based

$$E(T_Q)^{SB\_NP} \leq E(T_Q)^{abstract\_NP}$$

Size based vs abstract priority
(without preemption)
Response times

medium load — abstract

$E(T_{S1})$ 50%	$E(T_{S2})$ 50%	$E(T_{S1})$ 30%	$E(T_{S2})$ 70%	$E(T_{S1})$ 70%	$E(T_{S2})$ 30%
0.742857	1.25714	0.6926829	1.131707317	0.813793	1.43448

high load

$E(T_{S1})$ 50%	$E(T_{S2})$ 50%	$E(T_{S1})$ 30%	$E(T_{S2})$ 70%	$E(T_{S1})$ 70%	$E(T_{S2})$ 30%
0.9333333	1.0666666	0.8910526	2.505263	1.127272	4.036363

size-based

medium load		high load	
$E(T_{S1})$ 63%	$E(T_{S2})$ 37%	$E(T_{S1})$ 63%	$E(T_{S2})$ 37%
0.45242	1.51305	0.57298	2.82889

$$E(T_{S_k})^{SB\_NP} \lesseqgtr E(T_{S_k})^{abstract\_NP}$$

Size based vs abstract priority

(without preemption)

Response times

$$E(T_{S_k})^{SB\_NP} \lesseqgtr E(T_{S_k})^{abstract\_NP}$$

medium load

$$E(T_{S_1})^{SB\_NP} = 0.28522 + 0.1672 = 0.45242$$

$$E(T_{S_2})^{SB\_NP} = 0.71305 + 0.8 = 1.51305$$

abstract: 30-70%

$$E(T_{S_1})^{abstract\_NP} = 0.2927 + 0.4 = 0.6927$$

$$E(T_{S_2})^{abstract\_NP} = 0.7317 + 0.4 = 1.1317$$

$E(T_S)$ (job/s)

0.66	1	2	abstract
0.62278	0.84261	1.40289	size-based

$$E(T_S)^{SB\_NP} \leq E(T_S)^{abstract\_NP}$$

Exercises

1. Extend all the exercises and the comparison to the case with preemption
2. Evaluate the SJF discipline for the same parameters as the case study for medium and high loads and compare with the SB-P case
3. Evaluate the SRPT discipline for a given size (e.g. $x_1=E(S_1)$ and $x_2=E(S_2)$)
4. Evaluate the slowdown for all cases above.