Computer Performance Evalution csc 641

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Homework 6

Open queuing networks

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1. An average quantum of processor time assigned by a processor scheduler is S=20 ms. An average transaction needs 100 ms and makes multiple visits to central processor. Compute and plot the response time R(X).

T= s/1-p, p = -s/t +1, p = -20/100 +1, p = 0.8

R = s/1-p-sx

R =100ms , x =0

R =114.286 ms, x =0.5

R =133.333 ms , x =1

R =160 ms , x =1.5

R =200 ms , x =2

R =266.66 ms 7 , x =2.5

R =400 ms , x =3

R =800 ms, x =3.5

R =-3.60288e+017 , x =4

R =-800 , x =4.5

R =-400 , x =5

R =-266.667 , x =5.5

R =-200 , x =6

R =-160 , x =6.5

R =-133.333 , x =7

R =-114.286 , x =7.5

R =-100 , x =8

R =-88.8889 , x =8.5

R =-80 , x =9

R =-72.7273 , x =9.5

R =-66.6667 , x =10

R =-61.5385 , x =10.5

R =-57.1429 , x =11

R =-53.3333 , x =11.5

R =-50 , x =12

R =-47.0588 , x =12.5

R =-44.4444 , x =13

R =-42.1053 , x =13.5

R =-40 , x =14

R =-38.0952 , x =14.5

R =-36.3636 , x =15

R =-34.7826 , x =15.5

R =-33.3333 , x =16

R =-32 , x =16.5

R =-30.7692 , x =17

R =-29.6296 , x =17.5

R =-28.5714 , x =18

R =-27.5862 , x =18.5

R =-26.6667 , x =19

R =-25.8065 , x =19.5

R =-25 , x =20

1. A storage system consists of three disk drives sharing a common queue. The average time to service an I/O request is 50 ms. The I/O requests arrive to the storage system at the rate of 30 requests per second. Using an M/M/3 model for this system, determine the following:
   1. Average disk drive utilization (Ud)

Ud = (S/n)/X, N=3

Ud = 30\*.05/3 = 0.5%;

* 1. Probability of the system being idle, p0 (see the formula on p. 116 of the reader)

p0= (1-q2)/(1+q2), q2 = x/3s = 30/150=.2

p0 = .8/1.2 = 0.66%

* 1. Average number of jobs in the system (J)

J=3U/1-U^3 = 3\*.5/1-.5^3=1.71

* 1. Average number of jobs waiting in the queue ( QW )

Qw = Ud \* J = 0.5\*1.71 = 0. 85

* 1. Mean response time (R)

R = S/1-U^3 = 50/1-0.5^3 = 57.14ms

1. For this system the disk load is balanced so that the utilization of each disk is 60%. Compute:
   1. Utilization of all servers (Up , Ud1 , Ud2 )

Ud1=60%, Ud2=60%

Up=S1X1,Ud1=Sd1Xd1,Xd1 =Ud1/Sd1=0.6/20= 0.03

Xd1\*p2=x = 0.03\*.4 =0.012

X1\*1-p1-p2 =X , X1 = = 0.06

Up=S1X1 = 4\*0.06 = 0.24%

* 1. Queue lengths for all queues (Qp , Qd1 , Qd2 )

Qp = Up/1-Up = 0.24/1-0.24 = 0.31

Qd1 = .6/1-.6 = 1.5, Qd2 = .6/1-.6 = 1.5

* 1. Average number of jobs in the system (J)

J= Qp + Qd1 + Qd2 = 0.31 +1.5+1.5 = 3.31

* 1. Response time (R) for this specific throughput (X) and plot the curve R(X)

Up = Sp (X/1-p1-p2)

Xd1+Xd2 = X/p2,

Ud1 = Sd1((X/P2)-X2, Ud2 = Sd2((X/P2)-X1

Rp =Sp/1-Up,Rd1 = Sd1/1-Ud1,Rd2=Sd2/1-Ud2

result

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X = 0

Up : 0 Ud1 : 0 Ud2 : 0

Rp : 4 Rd1 : 10 Rd2 : 20

5Rp20 3.75Rd137.5 7.5Rd2150

total\_Response : 207.5

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X = 0.005

Up : 0.1 Ud1 : 0.0833333 Ud2 : 0.0833333

Rp : 3.9 Rd1 : 9.91667 Rd2 : 19.9167

5Rp19.5 3.75Rd137.1875 7.5Rd2149.375

total\_Response : 206.062

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X = 0.01

Up : 0.2 Ud1 : 0.166667 Ud2 : 0.166667

Rp : 3.8 Rd1 : 9.83333 Rd2 : 19.8333

5Rp19 3.75Rd136.875 7.5Rd2148.75

total\_Response : 204.625

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X = 0.015

Up : 0.3 Ud1 : 0.25 Ud2 : 0.25

Rp : 3.7 Rd1 : 9.75 Rd2 : 19.75

5Rp18.5 3.75Rd136.5625 7.5Rd2148.125

total\_Response : 203.188

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X = 0.02

Up : 0.4 Ud1 : 0.333333 Ud2 : 0.333333

Rp : 3.6 Rd1 : 9.66667 Rd2 : 19.6667

5Rp18 3.75Rd136.25 7.5Rd2147.5

total\_Response : 201.75

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X = 0.025

Up : 0.5 Ud1 : 0.416667 Ud2 : 0.416667

Rp : 3.5 Rd1 : 9.58333 Rd2 : 19.5833

5Rp17.5 3.75Rd135.9375 7.5Rd2146.875

total\_Response : 200.312

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X = 0.03

Up : 0.6 Ud1 : 0.5 Ud2 : 0.5

Rp : 3.4 Rd1 : 9.5 Rd2 : 19.5

5Rp17 3.75Rd135.625 7.5Rd2146.25

total\_Response : 198.875

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X = 0.035

Up : 0.7 Ud1 : 0.583333 Ud2 : 0.583333

Rp : 3.3 Rd1 : 9.41667 Rd2 : 19.4167

5Rp16.5 3.75Rd135.3125 7.5Rd2145.625

total\_Response : 197.438

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X = 0.04

Up : 0.8 Ud1 : 0.666667 Ud2 : 0.666667

Rp : 3.2 Rd1 : 9.33333 Rd2 : 19.3333

5Rp16 3.75Rd135 7.5Rd2145

total\_Response : 196

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X = 0.045

Up : 0.9 Ud1 : 0.75 Ud2 : 0.75

Rp : 3.1 Rd1 : 9.25 Rd2 : 19.25

5Rp15.5 3.75Rd134.6875 7.5Rd2144.375

total\_Response : 194.562

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X = 0.05

Up : 1 Ud1 : 0.833333 Ud2 : 0.833333

Rp : 3 Rd1 : 9.16667 Rd2 : 19.1667

5Rp15 3.75Rd134.375 7.5Rd2143.75

total\_Response : 193.125

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X = 0.055

Up : 1.1 Ud1 : 0.916667 Ud2 : 0.916667

Rp : 2.9 Rd1 : 9.08333 Rd2 : 19.0833

5Rp14.5 3.75Rd134.0625 7.5Rd2143.125

total\_Response : 191.688

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X = 0.06

Up : 1.2 Ud1 : 1 Ud2 : 1

Rp : 2.8 Rd1 : 9 Rd2 : 19

5Rp14 3.75Rd133.75 7.5Rd2142.5

total\_Response : 190.25

* 1. Maximum throughput of the system (Xmax)

Xmax = 0.05 ms = 50 request per second, and the bottle neck in the central processor

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1. What are the probabilities that individual processors are idle?

p0= (1-q2)/(1+q2), q2 = x/s

C11=c12=c21= =c24=c32, q2=x/s = (x/3)/s=(30/3)/20 = 0.5%

P0 =0.5/1.5 =0.33.

C23 , q2=x/s = (x/4)/s=(60/4)/20 =0.75;

= 0.25/1.75= 0.14;

c22=c31 =(60/8)/20 =0.375;

0.625/1.375 = 0.45;

1. What is the average propagation time from A to B?

Response time of the top line

U1 +U2 = (X\*p)/s , p =0.33,u=0.5.

top= 2(s1/1-u1) = 2(20/1-0.5)= 80ms

R2=s1/1-0.75 = 80ms

R3 = s1/1-0.375 =32

Middle = 80ms +80ms+32 =192

Bottom = 40ms +80ms+32=152

Average response = top+middle+bottom /3 = 125ms

1. What is the maximum input arrival rate Xmax for the above packet distribution policy?

Since the c23 is the bottle neck, 2x/3\*.75 =x23=s23, 2x/3\*.75 =20, X=40, Xmax = 40 request per second

1. What increase of Xmax can be achieved if we change the packet distribution policy?

When Utop = U23, it can max the Xmax, which the top line take ½ of x, middle line take 1/6(1/2\*1/3), and bottom line take 1/3(1/2\*2/3), x/2\*.75 =s23 = 53.5 request per second