Stephen Chambers
smx227
9/21/15
CS823

Assignment 1

Chapter 1 Problem 1:

I used the command "**iostat –d -w5 -c 40**" to generate my results. Only a snapshot is shown. The last line is the calculated averages for the entire two minutes.

	disk0		
KB/t	tps	MB/s	KB/s
21.71	3	0.07	65.13
0	0	0	0
15.19	9	0.14	136.71
16.31	18	0.28	293.58
20.8	1	0.02	20.8
11.12	10	0.11	111.2
17.84	7	0.13	124.88
13.24	9	0.12	119.16
15.1	61	0.9	921.1
32.22	11	0.34	354.42
14.79	13	0.18	192.27
6	1	0.01	6
16.71	111	1.82	1854.81
13.23	5	0.07	66.15
14.92	62	0.91	925.04
…………….			
21.22375	66.3	2.075	2123.1995

Therefore, the throughput of disk0 for my system is 2123.1995KB/second or 66.3 transactions/second.

You can successfully use average service time per transaction to compute the utilization of the disk. If average service time was D, the formula for utilization would be as follows:

S = average service time

$U = X_0 * S$
$U = 66.3 * S$

Chapter 1 Problem 3:

Number of minutes in two days = 2 * 24 * 60 = 2880
Total downtime (minutes) = 34 minutes.

Availability = (2880 – 34) / 2880 = 0.98819444 = **98.819%**

Chapter 1 Problem 4:

Number of minutes in two days = 2 * 24 * 60 = 2880
Total downtime (minutes) = 34 minutes.

Availability = (2880 – 34) / 2880 = 0.98819444 = **98.819%**

The availability was the same for the online trading site in both cases. However, the downtimes in the second section were at more inconvenient times, as they were when consumers would normally be accessing the service.

Chapter 2 Problem 1:

$D = \frac{1500 * 8\ bits}{56 * 1000\ bits} = \frac{12000}{56000} = 0.214\ seconds$

No, the service demand of the packet does not change with the traffic on the link, as it is load independent.

Chapter 2 Problem 3:

A *mixed model* should be used for this computer system. This computer system has characteristics of both an open QN(a workload with an arrival rate and unbounded number of customers in the system), as well as a closed QN(a workload with a bounded and known number of customers and workload intensity specified by the customer population.)

Chapter 2 Problem 4:
Disk 1 is replaced by a disk that is 40% faster.
The service demand of disk1 would increase by 40%, so it would take:

D_{disk1} = (1-0.4) * 100 = 60ms.

Enough main memory is installed so that the hit rate on the database server's cache is 30%.
D_{disk1} = (0.3) * 0 + 0.7 * 100 = 70ms
D_{disk2} = (0.3) * 0 + 0.7 * 150 = 105ms

The log option of the database management system is enabled. A log record is generated on disk 2 for each update transaction. Updates account for 30% of the transactions and recording a log takes 15 msec.

D_{disk2} = 165 * 0.3 + 150 * 0.7 = 154.5ms

Chapter 3 Problem 1:

T = 1 hour
m = N = 5
C_0 = 7200
R?

$X_0 = \frac{C_0}{T} = \frac{7200}{1*60*60} = 2$ tps

$R = \frac{N}{x_0} = \frac{5}{2} =$ **2.5 seconds** *By Little's law*

Chapter 3 Problem 2:
T = 1 hour
U_{CPU} = 0.25
U_{disk1} = 0.35
U_{disk2} = 0.30
C_0 = 21,600

X_0 = ?
D_{CPU} = ?
D_{disk1} = ?
D_{disk2} = ?
R = ?

$X_0 = \frac{C_0}{T} = \frac{21600}{1*60*60} = \mathbf{6\ tps}$

$D_{CPU} = \frac{U_{CPU}}{X_0} = \frac{U_{CPU}}{X_0} = \frac{0.25}{6} = \mathbf{0.04167\ seconds}$ *By the service demand law*

$D_{disk1} = \frac{U_{disk1}}{X_0} = \frac{U_{disk1}}{X_0} = \frac{0.35}{6} = \mathbf{0.05833\ seconds}$ *By the service demand law*

$D_{disk2} = \frac{U_{disk2}}{X_0} = \frac{U_{disk2}}{X_0} = \frac{0.30}{6} = \mathbf{0.05\ seconds}$ *By the service demand law*

R >= $\sum_{i=1}^{3} D_i$ >= **0.15 seconds**

Chapter 3 Problem 4:

T = 30 minutes
C_0 = 5400 transactions
C_{disk1} = 18,900 I/O operations
U_{disk1} = 0.40

V_{disk1} = ?
S_{disk1} = ?

$V_{disk1} = \frac{C_{disk1}}{C_0} = \frac{18,900}{5400} = \mathbf{3.5\ I/O\ operations\ per\ transaction}$

$X_0 = \frac{C_0}{T} = \frac{5400}{30*60} = 3$ tps

$X_{disk1} = V_{disk1} * X_0 = 3.5 * 3 = 10.5$ tps *By the forced flow law*

$S_{disk1} = \frac{U_{disk1}}{X_{disk1}} = \frac{0.40}{10.5} = \mathbf{0.0381\ seconds\ per\ visit}$ *By the Utilization law*

Chapter 3 Problem 5:

T = 1 hour
C_0 = 5400 transactions
S_{disk1} = 30ms
V_{disk1} = 3

U_{disk1} = ?

$X_0 = \frac{C_0}{T} = \frac{5400}{1*60*60} = 1.5$ tps

$X_{disk1} = V_{disk1} * X_0 = 3 * 1.5 = 4.5$ tps = 0.0045 tpms *By the forced flow law*

$U_{disk1} = X_{disk1} * S_{disk1} = 0.0045 * 30ms = 0.135 =$ **13.5%**

Chapter 3 Problem 6:

X = 128 packets/sec = 0.128 packets/ms
T = 100ms

N = ?

N = XT = 0.128*100 = **12.8 packets** *By Little's law*

Chapter 3 Problem 7:

T = 60 minutes
C_0 = 7200
U_{disk1} = 0.30
S_{disk1} = 30ms

V_{disk1} = ?

$X_0 = \frac{C_0}{T} = \frac{7200}{1*60*60} = 2$ tps = 0.002 tpms

$\frac{U_{disk1}}{X_0} = V_{disk1} * S_{disk1}$ *The service demand law*

$\frac{0.30}{0.002*30ms} = V_{disk1}$ *By the service demand law*

V_{disk1} = **5 visits**

Chapter 3 Problem 10:

M = 50
Z = 5 sec = 5000 ms
U_{disk1} = 0.60
S_{disk1} = 30ms
V_{disk1} = 4 visits

R = ?

$X_{disk1} = \frac{U_{disk1}}{S_{disk1}} = \frac{0.60}{30} = 0.02$ tpms *By the utilization law*

$X_0 = \frac{X_{disk1}}{V_{disk1}} = \frac{0.02}{4} = 0.005$ tpms *By the forced flow law*

$R = \frac{M}{X_0} - z = \frac{50}{0.005} - 5000 = 5000ms = \textbf{5 seconds}$ *By the Interative Response Time law*

Chapter 3 Problem 11:

X_{disk} = 0.0285ms (average)
S_{disk} = 9ms (average)

U_{disk} = ?

$U_{disk} = X_{disk} * S_{disk}$ = 0.0285 * 9 = 0.2565 = **25.65%** *By the Utilization law*

kpms	tps	serv(ms)	utilization
0.025	3	6	15.00%
0.032	4	7	22.40%
0.028	2	7	19.60%
0.018	2	8	14.40%
0.029	3	9	26.10%
0.033	4	12	39.60%
0.035	4	8	28.00%
0.025	4	10	25.00%
0.026	3	11	28.60%
0.034	4	12	40.80%

T = 100
I_{CPU} = 0.74 (average time CPU spent idle)

U_{CPU} = ?

$B_{CPU} = (1- I_{CPU}) * T$ = (1-0.74)*5 = 1.3 seconds

$U_{CPU} = \frac{B_{CPU}}{T} = \frac{1.3}{5} = 0.26 = 26\%$

us	sy	wt	id	utilization
19%	3%	0	78%	22%
13%	4%	0	83%	17%
20%	3%	0	77%	23%
24%	2%	0	74%	26%
18%	5%	0	77%	23%
23%	3%	0	74%	26%
25%	5%	0	70%	30%
32%	4%	0	64%	36%
28%	4%	0	68%	32%
22%	6%	0	72%	28%

Chapter 3 Problem 12:

Z = 5 seconds
X = 20 request/second
R = 2 seconds

M = ?

$M = X_0(R+Z) = 20(2 + 5) = 140$ virtual users
By the interactive reposnse time law