6.1

ANS

a)

10% faster server means that fewer servers are required to achieve the goal.

From the numbers in Figure 6.13, there are initially 45,978 servers.

For Base Servers we can assume normalized behavior as 1

So, the total performance will be

45,978 x 1 = 45,978.

The new servers provide a normalized performance of 1.1

the total servers required, y, is

y x 1.1 = 45,978.

y = 41,799.

The price of each server is 20% more than the baseline, and is 1.2 x 1450 = $1,740.

So, the server CAPEX = $72,730,260.

b)

The servers use 15% more power, but there are fewer servers as a result of their higher performance.

The used power on monthly bases is somewhat around $ 475,000 for 45978 servers.

$10.33 per server which is mentioned in table.

So the faster servers monthly power use $10.33 x 1.15 = $11.88.

But there are only 41799 servers

So which results into monthly power use OPEX will be 11.88 x 41799 = $496,600.

c)

The original monthly costs were $ 3,530,920. The new monthly costs with the faster servers is $ 3,736,648, assuming the 20% higher price. Testing different prices for the faster servers, we find that with a 9% higher server price, the monthly costs are $ 3,536,834, or roughly equal to original costs.

6.3

ANS

a)

The baseline WSC used 45,978 servers. At medium performance, the performance is

75% of the original.

So the required number of servers, X, is

0.75 x X = 45,978.

X = 61,304 servers.

6.14

ANS

a)

In Figure 6.6 it is given that disk bandwidth is 200 MB/s.

So according to problems given in presentation here we can assume the dataset is broken up into an equal number of files as there are nodes. With 5 nodes, each node will have to process 300 GB/5 = 60 GB.

So we can say that 60 GB x 0.3 = 18 GB must be read remotely,

and 42 GB must be read from disk.

Using the disk bandwidths from Figure 6.6, we calculate the time for remote data access as 18 GB/100 MB/s = 180 seconds, and similarly the time for local data access as 42 GB/200 MB/s = 210 seconds;

the data must be accessed for both the map and the reduce.

Given the map rate, the map will take 60 GB x 10 s/GB = 600 seconds;

given the reduce rate, the reduce will take 60 GB x 20 s/GB = 1200 seconds.

Total Expected Execution Time:

(180 + 210) x 2 + 600 + 1200 = 2508 seconds.

The primary bottleneck is the reduce phase, while the total data transfer time is the secondary bottleneck.

At 1,000 nodes, we have 300 GB/1000 = 300 MB per node.

So 300 MB x 0.3 = 90 MB must be read remotely, and 210 MB must be read from localdisk.

These numbers give the following access times:

90 MB/100 MB/s = 0.9 seconds, and disk = 210 MB/200 MB/s = 1.05 seconds.

The map time is 300 MB x 10 s/GB = 3 seconds,

And the reduce time is 300 MB x 20 s/GB = 6 seconds.

The bottlenecks actually remain identical across the different node sizes as all communication remains local within a rack and the problem is divided up evenly.