

CS350-fall2020-hw1

easyabi

September 2020

1 Question 1

Figure 1¹ shows the corresponding graph

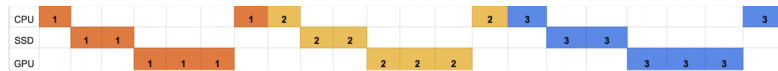


Figure 1: $MPL = 1$

1.1 a

$$\text{Utilization(CPU)} = \frac{2}{7}$$

$$\text{Utilization(SSD)} = \frac{2}{7}$$

$$\text{Utilization(GPU)} = \frac{3}{7}$$

1.2 b

$$\text{Throughput} = \frac{1}{7}$$

1.3 c

Given the current information, GPU has the highest utilization. Therefore, it is the bottleneck of the system.

1.4 d

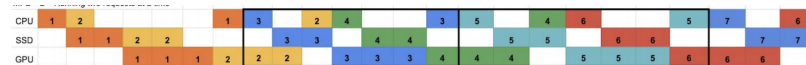


Figure 2: $MPL = 2$

¹Figures are from a student's solution

$$\begin{aligned} \text{Utilization(CPU)} &= \frac{4}{7} \\ \text{Utilization(SSD)} &= \frac{4}{7} \\ \text{Utilization(GPU)} &= \frac{6}{7} \end{aligned}$$

1.5 e

$$\text{Throughput} = \frac{2}{7}$$

1.6 f

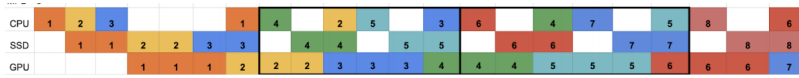


Figure 3: MPL = 3 and MPL = 4

For MPL= 3 and MPL = 4, we see the same pattern, meaning that the achievable throughput is as follows:

$$\text{Maximum Throughput} = \text{Capacity} = \frac{2}{6}$$

2 Question 2

2.1 a

f is 3/7 and N=x is equal to 3.

$$x = \frac{1}{1 - f(1 - \frac{1}{x})} = \frac{1}{1 - \frac{3}{7}(1 - \frac{1}{3})} = 1.4$$

2.2 b

using the old GPU, the capacity is 2/6. Using the new GPU the capacity is 2/4. Therefore, the new system is $\frac{2/4}{2/6} = \frac{6}{4}$ faster.

2.3 c

GPU is no longer the bottleneck because CPU and SSD are now have the highest utilization .

$$\text{Utilization}(CPU) = \frac{2}{5}$$

$$\text{Utilization}(SSD) = \frac{2}{5}$$

$$\text{Utilization}(GPU) = \frac{1}{5}$$

2.4 d

At steady state, each request takes 8ms to be processed. Give that the request arrives 10ms before it is executed, the response time is 18ms.



Figure 4:

3 Question 3

3.1 a

$$speedup = \frac{1}{1 - f(1 - \frac{1}{N})} = \frac{1}{1 - \frac{4}{10}(1 - \frac{1}{1.25})} = 1.087$$

3.2 b

$$speedup = \frac{1}{1 - f(1 - \frac{1}{N})} = \frac{1}{1 - \frac{25}{100}(1 - \frac{1}{1.2})} = 1.043$$

3.3 c

Option A = 1.087/10000 = 0.0001087

Option B = 1.043/35000 = 0.0000298

Therefore, option A is better.

3.4 d

$$Speedup = \frac{oldspeed}{newspeed} = \frac{5.5}{(0.4 * \frac{1}{1.25} + 0.25 * \frac{1}{1.2} + 0.35) * 5.5} = 1.14$$

3.5 e

$$speedup = \frac{1}{1 - f(1 - \frac{1}{N})} = \frac{1}{1 - \frac{4}{10}(1 - \frac{1}{\infty})} = \frac{10}{6}$$

3.6 f

$$speedup = \frac{1}{1 - f(1 - \frac{1}{N})} = \frac{1}{1 - \frac{25}{100}(1 - \frac{1}{\infty})} = \frac{100}{75}$$