1. Using the framework for spatial and tem- poral scheduling presented in class, find an allocation (spatial schedule) that leads to a temporal fair schedule with a 0% idling ratio.

Time	π1	π2	π3	π4	π5
Time Slice 1	1	2	1	1	2
Time Slice 2	1	3	5	3	2
Time Slice 3	3	4	5	5	3
Time Slice 4	5	5	6	6	5
Time Slice 5	5				

Fig1: Spatial Scheduler

Above spatial scheduler has the idling ratio of 4/25 = 0.16. We can fill in the **4 VPs of Job1 in the 4 empty slots in time slice5 in order to get the idling ratio of 0** as follows:

Time	π1	π2	π3	π4	π5
Time Slice 1	1	2	1	1	2
Time Slice 2	1	3	5	3	2
Time Slice 3	3	4	5	5	3
Time Slice 4	5	5	6	6	5
Time Slice 5	5	**1**	**1**	**1**	**1**

Fig2: Temporal Scheduler with idling ratio 0

Above temporal schedule will have a period of 5 cycles and job 1 will be executed twice in each period, while the rest all jobs will be executed just once in each period.

2a: Below is one of examples of new spatial schedule after the **failure of processor 3**

Time	π1	π2	π4	π5
Time Slice 1	1	2	1	**1**
Time Slice 2	**2**	**1**	3	**5**
Time Slice 3	3	**2**	3	4
Time Slice 4	5	5	**3**	5
Time Slice 5	5	**6**	6	**5**
Time Slice 6	5			

Fig3: Spatial Scheduler after failure of processor 3

Above spatial scheduler has the idling ratio of 3/24 = 1/8 = 0.125 . This can be improved by filling in the **3 VPs of Job2 in the 3 empty slots in time slice 6 in order to get the idling ratio of 0** as follows:

Time	π1	π2	π4	π5
Time Slice 1	1	2	1	1
Time Slice 2	2	1	3	5
Time Slice 3	3	2	3	4
Time Slice 4	5	5	3	5
Time Slice 5	5	6	6	5
Time Slice 6	5	**2**	**2**	**2**

Fig4: Temporal Scheduler with idling ratio 0 after failure of processor 3

2b: Below is the new spatial schedule after the failure of processor 3 by migrating **only the VPs from processor 3:**

Time	π1	π2	π4	π5
Time Slice 1	1	2	1	2
Time Slice 2	1	3	3	2
Time Slice 3	3	4	5	3
Time Slice 4	5	5	6	5
Time Slice 5	5	**1**	**5**	**5**
Time Slice 6	**6**			

Fig5: Spatial Scheduler after failure of processor 3 by migrating VPs from processor 3

Above spatial scheduler has the idling ratio of 3/24 = 1/8 = 0.125. This can be improved by filling in the **3 VPs of Job2 in the 3 empty slots in time slice 6 in order to get the idling ratio of 0** as follows:

Time	π1	π2	π4	π5
Time Slice 1	1	2	1	2
Time Slice 2	1	3	3	2
Time Slice 3	3	4	5	3
Time Slice 4	5	5	6	5
Time Slice 5	5	**1**	**5**	**5**
Time Slice 6	**6**	**2**	**2**	**2**

Fig6: Temporal Scheduler with idling ratio 0 after failure of processor 3 by migrating VPs from processor 3

3. Compare the cost in number of "migrating VPs" between the two options of item 2 above.

No. of VP migrations using the step mentioned in **2a** can be found by comparing the **Figure3** with **Figure1**. **We see the total number of VP migration is 10. (Highlighted VPs in Figure3 represents the VPs which have been migrated compared to spatial scheduler in Figure1)**

No. of VP migration using the step mentioned in **2b** can be found by comparing the **Figure5** with **Figure1**. **We see the total number of VP migration is 4 since only the VPs from processor 3 are migrated. (Highlighted VPs in figure5 represents the VPs which have been migrated compared to spatial scheduler in Figure1).**