PART A :

1. I tested the program for 10 philosophers :

ID	EATING TIME 1-5	WAITING & EATING	Start time
0	4	4	14
1	2	2	12
2	3	4	13
3	1	1	11
4	4	4	14
5	1	1	11
6	2	2	12
7	3	4	13
8	5	7	15
9	2	2	12

Data from the terminal

DATA ANALYSIS :

ID	11	12	13	14	15	16	17	19	19	20	21	22	23
0	THINKING			EATING									
1	THIN	EATING											
2	THINKING		WAIT	EATING									
3	EAT												
4	THINKING			EATING									
5	EAT												
6	THIN	EATING											
7	THINKING		WAIT	EATING									
8	THINKING				WAITING		EATING						
9	THIN	EATING											

This table shows the philosophers that eating at every time and the others who are waiting .

* Because the number of philosophers is 10 , the maximum number of them that can be eat at the same time is 5 . and we can notice the number not exceed 5 .
* And we can notice that no two neighbors philosophers can eat at the same time .for example , we can notice at time = 15 there is just 4 philosophers eating and there is one still waiting , this happen because no 2 neighbors can eat at the same time .
* |And we notice that when one finished its neighbors tested before the others if they want to eat .

2 . test for 15 philosophers :

ID	EATING TIME 1-5	WAITING & EATING	Start time
0	4	4	35
1	2	6	35
2	3	3	35
3	1	5	35
4	4	4	35
5	1	5	35
6	2	2	35
7	3	8	35
8	5	5	35
9	2	7	35
10	3	3	35
11	3	6	35
12	1	1	35
13	5	6	35
14	4	10	35

Data from terminal

DATA ANALYSIS :

ID\t	35	36	37	38	39	40	41	42	43	44	45
0	EATING										
1	WAITING				EATING						
2	EATING										
3	WAITING				EAT						
4	EATING										
5	WAITING				EAT						
6	EATING										
7	WAITING					EATING					
8	EATING										
9	WAITING					EATING					
10	EATING										
11	WAITING				EATING						
12	EAT										
13	WAIT	EATING									
14	WAITING						EATING				

* Because the number of philosophers is 15 , the maximum number of them that can be eat at the same time is 7 . and we can notice this in the table.
* And we can notice that no two neighbors philosophers can eat at the same time . So we can notice at time = 39 there is just 6 philosophers eating and there is three (7 ,9 ,14) still waiting , this happen because no 2 neighbors can eat at the same time .for example philosophers number 7 & 9 will not start until 8 is finished and this clear in the table.
* we notice that thread 14 still waiting until 13 in finished and so 13 can started after getting fork 13 .

3 . test for 5 philosophers :

ID	EATING TIME	WAITING & EATING	Start time
0	2	2	17
1	4	4	19
2	1	1	16
3	3	3	18
4	4	6	19

Data from the terminal

data analysis :

ID	15	16	17	18	19	20	21	22	23	24
0	THINKING		EATING							
1	THINKING				EATING					
2	THINK	EAT								
3	THINKING			EATING						
4	THINKING				WAITING		EATING			

* max floor(N/2) philosopher can eat at the same time .
* no neighbors eating at the same time.
* we notice #4 waits for #3 because three philosophers cant eat at the same time .

PART B :

1 . testing the program with fix # of threads and different number of buckets :

```
for (i = 0; i <1000; ++i) {
                hash_insert(number * i);
        }

        for (i = 20; i < 300; ++i) {
                hash_delete(number * i);
        }
```

5 Threads		10 Threads		15 Threads		20 Threads	
# Buckets	time	# Buckets	time	# Buckets	time	# Buckets	time
1	0.053103	1	0.191555	1	0.338331	1	0.635372
2	0.059841	2	0.138882	2	0.290135	2	0.623948
3	0.038648	3	0.133705	3	0.250710	3	0.380111
4	0.037374	4	0.093170	4	0.228429	4	0.243090
5	0.031206	5	0.101453	5	0.164800	5	0.314054
8	0.024289	8	0.079938	8	0.163370	8	0.241125
10	0.023742	10	0.068244	10	0.148515	10	0.245086
15	0.013322	15	0.051251	15	0.112018	15	0.169275
17	0.010926	17	0.043237	17	0.095521	17	0.142656
20	0.014593	20	0.047879	20	0.085133	20	0.132019

This table contain a very important data :

* * As we increase the number of buckets for the same number of threads , we notice that the execution time decreases , and this is happens because the number of collisions decreases and so threads will not wait for each others a lot .

** As we increase the number of threads for the same number of buckets , we notice that the execution time increases , this happens because the number of insertion or deletion will increase on every bucket , and so it will increase the wait time .