Systems Programming HW3 Report
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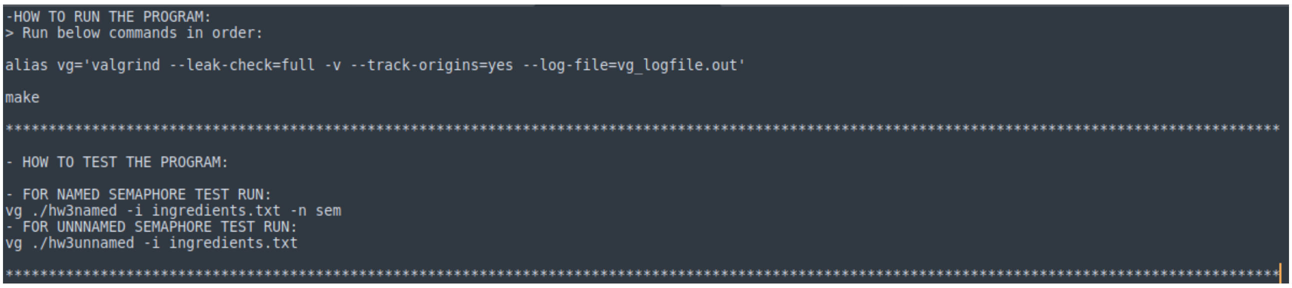
- HOW TO RUN AND TEST THE PROGRAM ?

- You can find the instructions in README.txt in order to run and test the program.



```
-HOW TO RUN THE PROGRAM:
> Run below commands in order:

alias vg='valgrind --leak-check=full -v --track-origins=yes --log-file=vg_logfile.out'

make

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- HOW TO TEST THE PROGRAM:

- FOR NAMED SEMAPHORE TEST RUN:
vg ./hw3named -i ingredients.txt -n sem
- FOR UNNNAMED SEMAPHORE TEST RUN:
vg ./hw3unnamed -i ingredients.txt

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```

Implemented Concepts:

- File read, write,syscalls.
- Signal handeling, parent child signal relations.
- Multiple child process, fork.
- Make files.
- Waiting for the child process to finish their task.
- Named and unnamed semaphores.
- Producer and consumer paradigm.
- Cigarette smoker problem variant.

Working Cases:

- This program works for cases all the cases.
- Works on **relative path**.

Note Working Cases:

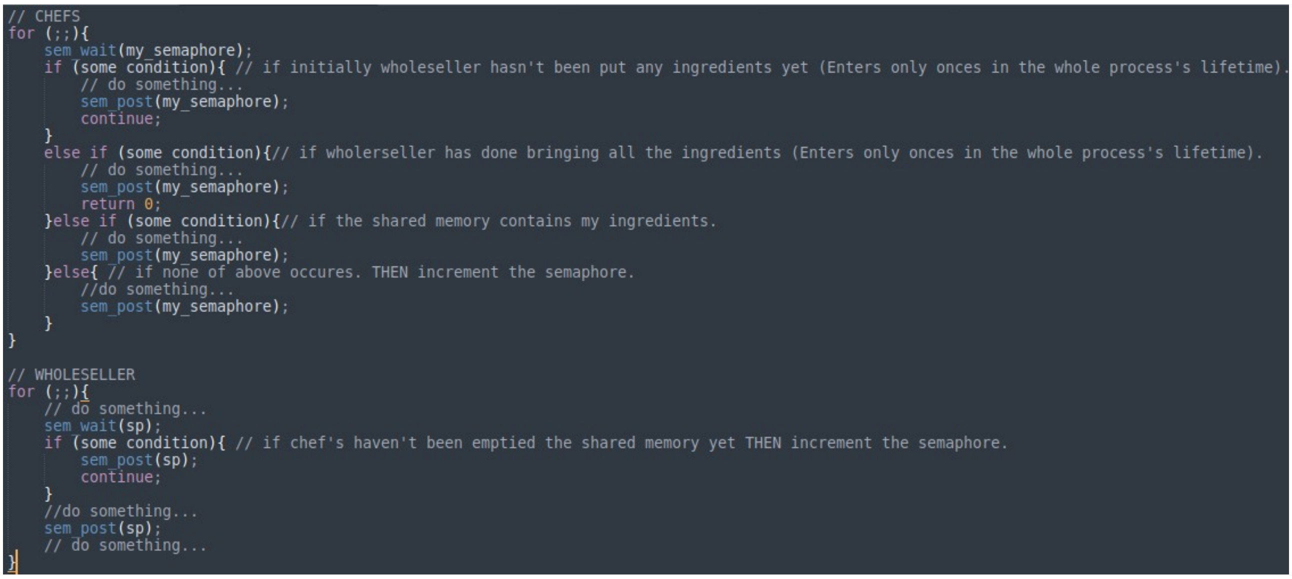
- NONE

Design Explanation:

- All the System-Calls and their possible return error values are checked with detailed errno checks.

- The program start by setting some variables and setting the signal handler mechanism to catch in SIGINT signal.

- I implemented both the named and unnamed semaphores with separate running files.
- I used shared memory in order to produce ingredients into and consume ingredients from.
- As a whole, I have 6 process for chefs and 1 process for wholesaler and one semaphore in order to synchronize the processes.
- My design for each chef and for wholesaler is as:

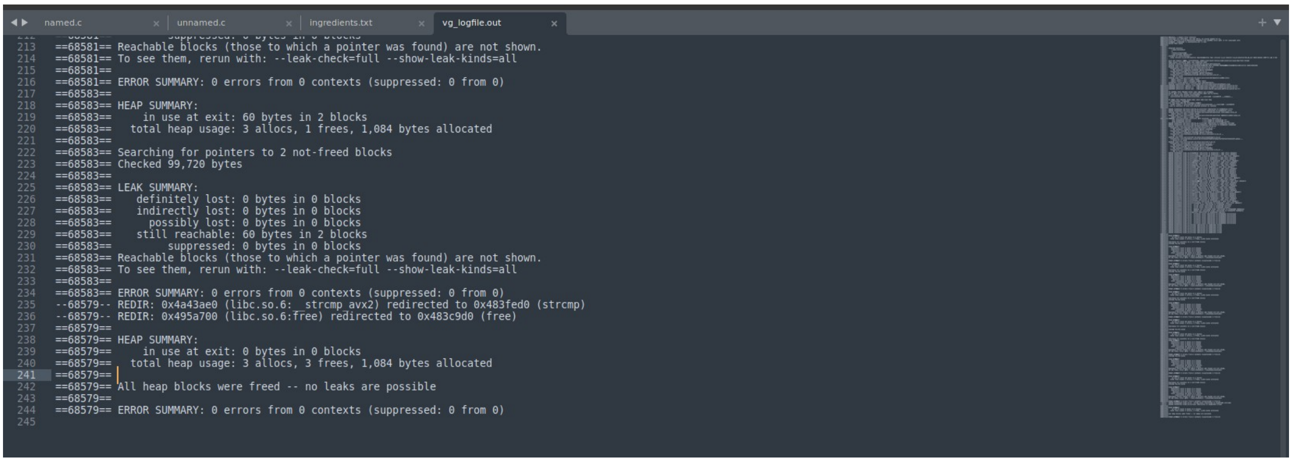


```
// CHEFS
for (;;){
    sem_wait(my_semaphore);
    if (some condition){ // if initially wholeseller hasn't been put any ingredients yet (Enters only onces in the whole process's lifetime).
        // do something...
        sem_post(my_semaphore);
        continue;
    }
    else if (some condition){// if wholerseller has done bringing all the ingredients (Enters only onces in the whole process's lifetime).
        // do something...
        sem_post(my_semaphore);
        return 0;
    }else if (some condition){// if the shared memory contains my ingredients.
        // do something...
        sem_post(my_semaphore);
    }else{ // if none of above occures. THEN increment the semaphore.
        //do something...
        sem_post(my_semaphore);
    }
}

// WHOLESELLER
for (;;){
    // do something...
    sem_wait(sp);
    if (some condition){ // if chef's haven't been emptied the shared memory yet THEN increment the semaphore.
        sem_post(sp);
        continue;
    }
    //do something...
    sem_post(sp);
    // do something...
}
```

- In above design: wholesaler creates 6 process as it’s child process each process indicating for one process.
And produces the ingredient by storing it into the shared memory and waits for chefs to consume it.
- CHEFS design: each chef waits for the ingredients to arrive and check if the shared memory contains the ingredients that they want, if yes then they consume the ingredients and release the semaphore. If not then release the semaphore again and keep waiting(NO BUSY WAITING).
- I create the chefs process's as below in which I attach a function for teach chef and when ever the process runs the corresponding function runs:

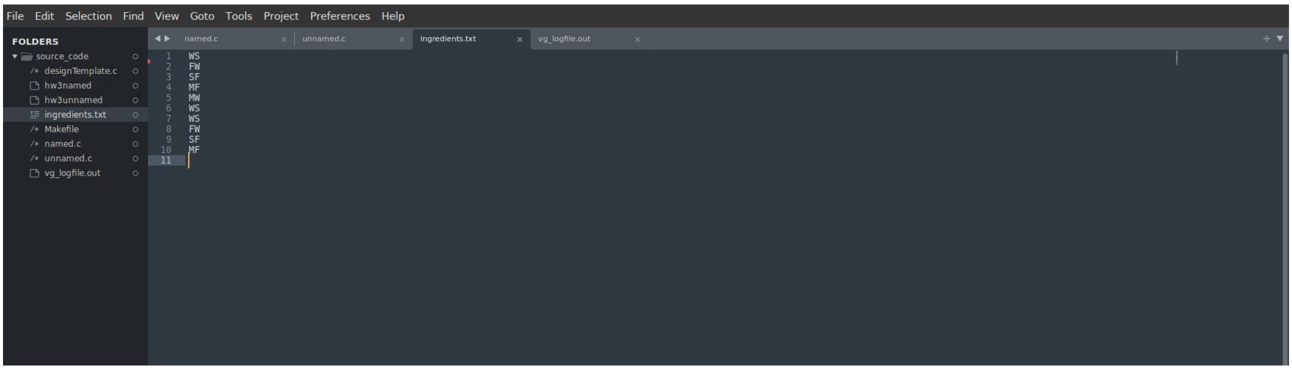
```
for (int i = 0; i < chefCount; ++i){

        forkVal = fork();
        if (forkVal == -1){// if error occured.
            perror("fork:");
            close(sharedMemFd);
            close(inpfd);
            sem_close(sp);
            sem_unlink(semName);
            exit(EXIT_FAILURE);
        }else if (forkVal == 0){ // if child processes
            childPidsArr[i] = getpid(); // store childs pids.
            if (i == 0 ){ // if chef0
                return chef0(i,addr);
            }else if(i == 1){// if chef1
                return chef1(i,addr);
            }else if(i == 2){// if chef2
                return chef2(i,addr);

            } else if(i == 3){// if chef3
                return chef3(i,addr);
            } else if(i == 4){// if chef4
                return chef4(i,addr);
            } else if(i == 5){// if chef5
                return chef5(i,addr);
            }}}
```

MEMORY LEAK CHECK OF THE PROGRAM:



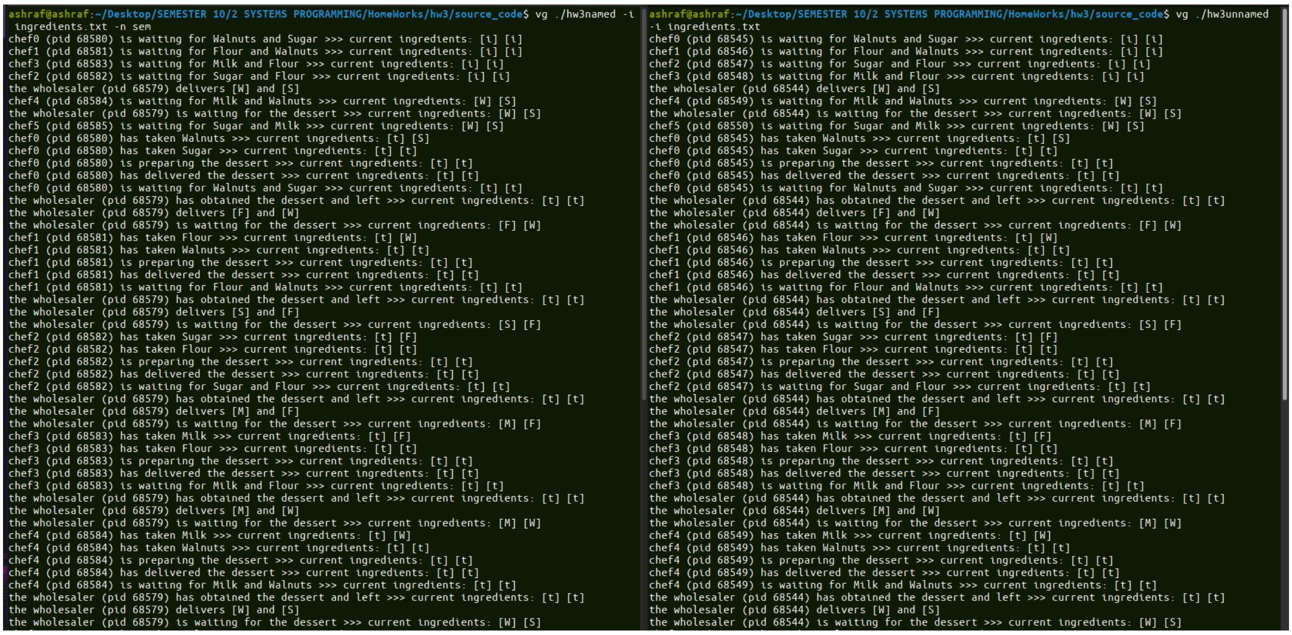
```
==68581== Reachable blocks (those to which a pointer was found) are not shown.
==68581== To see them, rerun with: --leak-check=full --show-leak-kinds=all
==68581==
==68581== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
==68583==
==68583== HEAP SUMMARY:
==68583==     in use at exit: 60 bytes in 2 blocks
==68583==   total heap usage: 3 allocs, 1 frees, 1,084 bytes allocated
==68583==
==68583== Searching for pointers to 2 not-freed blocks
==68583== Checked 99,720 bytes
==68583==
==68583== LEAK SUMMARY:
==68583==    definitely lost: 0 bytes in 0 blocks
==68583==    indirectly lost: 0 bytes in 0 blocks
==68583==      possibly lost: 0 bytes in 0 blocks
==68583==    still reachable: 60 bytes in 2 blocks
==68583==         suppressed: 0 bytes in 0 blocks
==68583== Reachable blocks (those to which a pointer was found) are not shown.
==68583== To see them, rerun with: --leak-check=full --show-leak-kinds=all
==68583==
==68583== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
--68579-- REDIR: 0x4a43ae0 (libc.so.6:__strcmp_avx2) redirected to 0x483fed0 (strcmp)
--68579-- REDIR: 0x495a700 (libc.so.6:free) redirected to 0x483c9d0 (free)
==68579==
==68579== HEAP SUMMARY:
==68579==     in use at exit: 0 bytes in 0 blocks
==68579==   total heap usage: 3 allocs, 3 frees, 1,084 bytes allocated
==68579==
==68579== All heap blocks were freed -- no leaks are possible
==68579==
==68579== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
```

INPUT FILE AS:



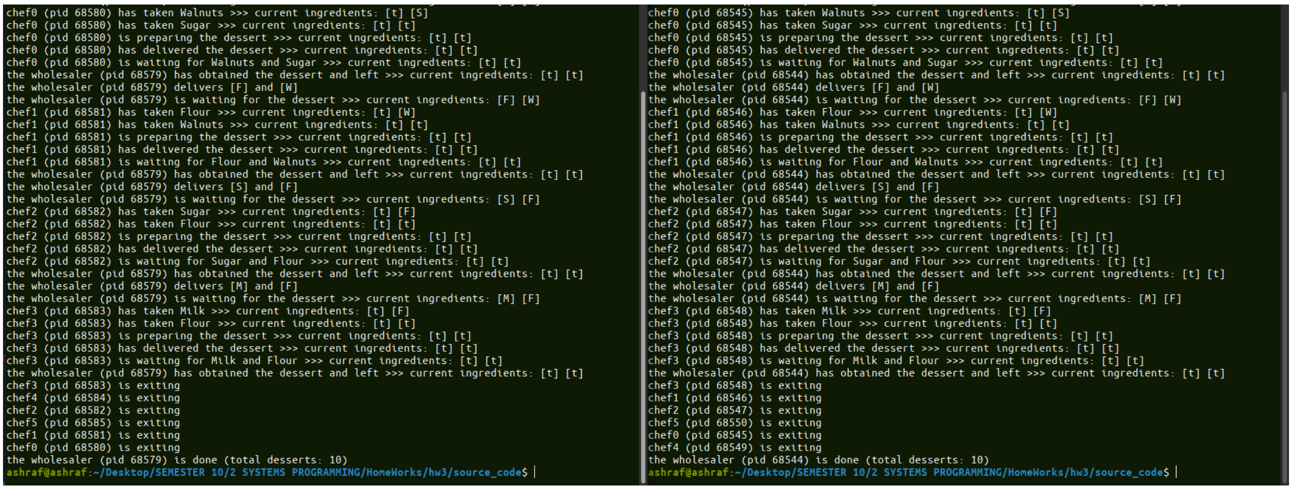
```
WS
FW
SF
MF
MW
WS
WS
FW
SF
MF

```

SCREEN SHOTS FROM THE PROGRAMS:



```
ashraf@ashraf:~/Desktop/SEMESTER 10/2 SYSTEMS PROGRAMMING/HomeWorks/hw3/source_code$ vg ./hw3named -i
 ingredients.txt -n sem
chef0 (pid 68580) is waiting for Walnuts and Sugar >>> current ingredients: [i] [i]
chef1 (pid 68581) is waiting for Flour and Walnuts >>> current ingredients: [i] [i]
chef3 (pid 68583) is waiting for Milk and Flour >>> current ingredients: [i] [i]
chef2 (pid 68582) is waiting for Sugar and Flour >>> current ingredients: [i] [i]
the wholesaler (pid 68579) delivers [W] and [S]
chef4 (pid 68584) is waiting for Milk and Walnuts >>> current ingredients: [W] [S]
the wholesaler (pid 68579) is waiting for the dessert >>> current ingredients: [W] [S]
chef5 (pid 68585) is waiting for Sugar and Milk >>> current ingredients: [W] [S]
chef0 (pid 68580) has taken Walnuts >>> current ingredients: [t] [S]
chef0 (pid 68580) has taken Sugar >>> current ingredients: [t] [t]
chef0 (pid 68580) is preparing the dessert >>> current ingredients: [t] [t]
chef0 (pid 68580) has delivered the dessert >>> current ingredients: [t] [t]
chef0 (pid 68580) is waiting for Walnuts and Sugar >>> current ingredients: [t] [t]
the wholesaler (pid 68579) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68579) delivers [F] and [W]
the wholesaler (pid 68579) is waiting for the dessert >>> current ingredients: [F] [W]
chef1 (pid 68581) has taken Flour >>> current ingredients: [t] [W]
chef1 (pid 68581) has taken Walnuts >>> current ingredients: [t] [t]
chef1 (pid 68581) is preparing the dessert >>> current ingredients: [t] [t]
chef1 (pid 68581) has delivered the dessert >>> current ingredients: [t] [t]
chef1 (pid 68581) is waiting for Flour and Walnuts >>> current ingredients: [t] [t]
the wholesaler (pid 68579) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68579) delivers [S] and [F]
the wholesaler (pid 68579) is waiting for the dessert >>> current ingredients: [S] [F]
chef2 (pid 68582) has taken Sugar >>> current ingredients: [t] [F]
chef2 (pid 68582) has taken Flour >>> current ingredients: [t] [t]
chef2 (pid 68582) is preparing the dessert >>> current ingredients: [t] [t]
chef2 (pid 68582) has delivered the dessert >>> current ingredients: [t] [t]
chef2 (pid 68582) is waiting for Sugar and Flour >>> current ingredients: [t] [t]
the wholesaler (pid 68579) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68579) delivers [M] and [F]
the wholesaler (pid 68579) is waiting for the dessert >>> current ingredients: [M] [F]
chef3 (pid 68583) has taken Milk >>> current ingredients: [t] [F]
chef3 (pid 68583) has taken Flour >>> current ingredients: [t] [t]
chef3 (pid 68583) is preparing the dessert >>> current ingredients: [t] [t]
chef3 (pid 68583) has delivered the dessert >>> current ingredients: [t] [t]
chef3 (pid 68583) is waiting for Milk and Flour >>> current ingredients: [t] [t]
the wholesaler (pid 68579) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68579) delivers [M] and [W]
the wholesaler (pid 68579) is waiting for the dessert >>> current ingredients: [M] [W]
chef4 (pid 68584) has taken Milk >>> current ingredients: [t] [W]
chef4 (pid 68584) has taken Walnuts >>> current ingredients: [t] [t]
chef4 (pid 68584) is preparing the dessert >>> current ingredients: [t] [t]
chef4 (pid 68584) has delivered the dessert >>> current ingredients: [t] [t]
chef4 (pid 68584) is waiting for Milk and Walnuts >>> current ingredients: [t] [t]
the wholesaler (pid 68579) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68579) delivers [W] and [S]
the wholesaler (pid 68579) is waiting for the dessert >>> current ingredients: [W] [S]
```

```
ashraf@ashraf:~/Desktop/SEMESTER 10/2 SYSTEMS PROGRAMMING/HomeWorks/hw3/source_code$ vg ./hw3unnamed
-i ingredients.txt
chef0 (pid 68545) is waiting for Walnuts and Sugar >>> current ingredients: [i] [i]
chef1 (pid 68546) is waiting for Flour and Walnuts >>> current ingredients: [i] [i]
chef2 (pid 68547) is waiting for Sugar and Flour >>> current ingredients: [i] [i]
chef3 (pid 68548) is waiting for Milk and Flour >>> current ingredients: [i] [i]
the wholesaler (pid 68544) delivers [W] and [S]
chef4 (pid 68549) is waiting for Milk and Walnuts >>> current ingredients: [W] [S]
the wholesaler (pid 68544) is waiting for the dessert >>> current ingredients: [W] [S]
chef5 (pid 68550) is waiting for Sugar and Milk >>> current ingredients: [W] [S]
chef0 (pid 68545) has taken Walnuts >>> current ingredients: [t] [S]
chef0 (pid 68545) has taken Sugar >>> current ingredients: [t] [t]
chef0 (pid 68545) is preparing the dessert >>> current ingredients: [t] [t]
chef0 (pid 68545) has delivered the dessert >>> current ingredients: [t] [t]
chef0 (pid 68545) is waiting for Walnuts and Sugar >>> current ingredients: [t] [t]
the wholesaler (pid 68544) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68544) delivers [F] and [W]
the wholesaler (pid 68544) is waiting for the dessert >>> current ingredients: [F] [W]
chef1 (pid 68546) has taken Flour >>> current ingredients: [t] [W]
chef1 (pid 68546) has taken Walnuts >>> current ingredients: [t] [t]
chef1 (pid 68546) is preparing the dessert >>> current ingredients: [t] [t]
chef1 (pid 68546) has delivered the dessert >>> current ingredients: [t] [t]
chef1 (pid 68546) is waiting for Flour and Walnuts >>> current ingredients: [t] [t]
the wholesaler (pid 68544) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68544) delivers [S] and [F]
the wholesaler (pid 68544) is waiting for the dessert >>> current ingredients: [S] [F]
chef2 (pid 68547) has taken Sugar >>> current ingredients: [t] [F]
chef2 (pid 68547) has taken Flour >>> current ingredients: [t] [t]
chef2 (pid 68547) is preparing the dessert >>> current ingredients: [t] [t]
chef2 (pid 68547) has delivered the dessert >>> current ingredients: [t] [t]
chef2 (pid 68547) is waiting for Sugar and Flour >>> current ingredients: [t] [t]
the wholesaler (pid 68544) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68544) delivers [M] and [F]
the wholesaler (pid 68544) is waiting for the dessert >>> current ingredients: [M] [F]
chef3 (pid 68548) has taken Milk >>> current ingredients: [t] [F]
chef3 (pid 68548) has taken Flour >>> current ingredients: [t] [t]
chef3 (pid 68548) is preparing the dessert >>> current ingredients: [t] [t]
chef3 (pid 68548) has delivered the dessert >>> current ingredients: [t] [t]
chef3 (pid 68548) is waiting for Milk and Flour >>> current ingredients: [t] [t]
the wholesaler (pid 68544) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68544) delivers [M] and [W]
the wholesaler (pid 68544) is waiting for the dessert >>> current ingredients: [M] [W]
chef4 (pid 68549) has taken Milk >>> current ingredients: [t] [W]
chef4 (pid 68549) has taken Walnuts >>> current ingredients: [t] [t]
chef4 (pid 68549) is preparing the dessert >>> current ingredients: [t] [t]
chef4 (pid 68549) has delivered the dessert >>> current ingredients: [t] [t]
chef4 (pid 68549) is waiting for Milk and Walnuts >>> current ingredients: [t] [t]
the wholesaler (pid 68544) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68544) delivers [W] and [S]
the wholesaler (pid 68544) is waiting for the dessert >>> current ingredients: [W] [S]
```



```
chef0 (pid 68580) has taken Walnuts >>> current ingredients: [t] [S]
chef0 (pid 68580) has taken Sugar >>> current ingredients: [t] [t]
chef0 (pid 68580) is preparing the dessert >>> current ingredients: [t] [t]
chef0 (pid 68580) has delivered the dessert >>> current ingredients: [t] [t]
chef0 (pid 68580) is waiting for Walnuts and Sugar >>> current ingredients: [t] [t]
the wholesaler (pid 68579) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68579) delivers [F] and [W]
the wholesaler (pid 68579) is waiting for the dessert >>> current ingredients: [F] [W]
chef1 (pid 68581) has taken Flour >>> current ingredients: [t] [W]
chef1 (pid 68581) has taken Walnuts >>> current ingredients: [t] [t]
chef1 (pid 68581) is preparing the dessert >>> current ingredients: [t] [t]
chef1 (pid 68581) has delivered the dessert >>> current ingredients: [t] [t]
chef1 (pid 68581) is waiting for Flour and Walnuts >>> current ingredients: [t] [t]
the wholesaler (pid 68579) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68579) delivers [S] and [F]
the wholesaler (pid 68579) is waiting for the dessert >>> current ingredients: [S] [F]
chef2 (pid 68582) has taken Sugar >>> current ingredients: [t] [F]
chef2 (pid 68582) has taken Flour >>> current ingredients: [t] [t]
chef2 (pid 68582) is preparing the dessert >>> current ingredients: [t] [t]
chef2 (pid 68582) has delivered the dessert >>> current ingredients: [t] [t]
chef2 (pid 68582) is waiting for Sugar and Flour >>> current ingredients: [t] [t]
the wholesaler (pid 68579) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68579) delivers [M] and [F]
the wholesaler (pid 68579) is waiting for the dessert >>> current ingredients: [M] [F]
chef3 (pid 68583) has taken Milk >>> current ingredients: [t] [F]
chef3 (pid 68583) has taken Flour >>> current ingredients: [t] [t]
chef3 (pid 68583) is preparing the dessert >>> current ingredients: [t] [t]
chef3 (pid 68583) has delivered the dessert >>> current ingredients: [t] [t]
chef3 (pid 68583) is waiting for Milk and Flour >>> current ingredients: [t] [t]
the wholesaler (pid 68579) has obtained the dessert and left >>> current ingredients: [t] [t]
chef3 (pid 68583) is exiting
chef4 (pid 68584) is exiting
chef2 (pid 68582) is exiting
chef5 (pid 68585) is exiting
chef1 (pid 68581) is exiting
chef0 (pid 68580) is exiting
the wholesaler (pid 68579) is done (total desserts: 10)
ashraf@ashraf:~/Desktop/SEMESTER 10/2 SYSTEMS PROGRAMMING/HomeWorks/hw3/source_code$ 
```

```
chef0 (pid 68545) has taken Walnuts >>> current ingredients: [t] [S]
chef0 (pid 68545) has taken Sugar >>> current ingredients: [t] [t]
chef0 (pid 68545) is preparing the dessert >>> current ingredients: [t] [t]
chef0 (pid 68545) has delivered the dessert >>> current ingredients: [t] [t]
chef0 (pid 68545) is waiting for Walnuts and Sugar >>> current ingredients: [t] [t]
the wholesaler (pid 68544) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68544) delivers [F] and [W]
the wholesaler (pid 68544) is waiting for the dessert >>> current ingredients: [F] [W]
chef1 (pid 68546) has taken Flour >>> current ingredients: [t] [W]
chef1 (pid 68546) has taken Walnuts >>> current ingredients: [t] [t]
chef1 (pid 68546) is preparing the dessert >>> current ingredients: [t] [t]
chef1 (pid 68546) has delivered the dessert >>> current ingredients: [t] [t]
chef1 (pid 68546) is waiting for Flour and Walnuts >>> current ingredients: [t] [t]
the wholesaler (pid 68544) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68544) delivers [S] and [F]
the wholesaler (pid 68544) is waiting for the dessert >>> current ingredients: [S] [F]
chef2 (pid 68547) has taken Sugar >>> current ingredients: [t] [F]
chef2 (pid 68547) has taken Flour >>> current ingredients: [t] [t]
chef2 (pid 68547) is preparing the dessert >>> current ingredients: [t] [t]
chef2 (pid 68547) has delivered the dessert >>> current ingredients: [t] [t]
chef2 (pid 68547) is waiting for Sugar and Flour >>> current ingredients: [t] [t]
the wholesaler (pid 68544) has obtained the dessert and left >>> current ingredients: [t] [t]
the wholesaler (pid 68544) delivers [M] and [F]
the wholesaler (pid 68544) is waiting for the dessert >>> current ingredients: [M] [F]
chef3 (pid 68548) has taken Milk >>> current ingredients: [t] [F]
chef3 (pid 68548) has taken Flour >>> current ingredients: [t] [t]
chef3 (pid 68548) is preparing the dessert >>> current ingredients: [t] [t]
chef3 (pid 68548) has delivered the dessert >>> current ingredients: [t] [t]
chef3 (pid 68548) is waiting for Milk and Flour >>> current ingredients: [t] [t]
the wholesaler (pid 68544) has obtained the dessert and left >>> current ingredients: [t] [t]
chef3 (pid 68548) is exiting
chef1 (pid 68546) is exiting
chef2 (pid 68547) is exiting
chef5 (pid 68550) is exiting
chef0 (pid 68545) is exiting
chef4 (pid 68549) is exiting
the wholesaler (pid 68544) is done (total desserts: 10)
ashraf@ashraf:~/Desktop/SEMESTER 10/2 SYSTEMS PROGRAMMING/HomeWorks/hw3/source_code$ 
```