Poznan University of Technology
Faculty of Computing and Telecommunications

Simulation Techniques
Project

Final Project Report

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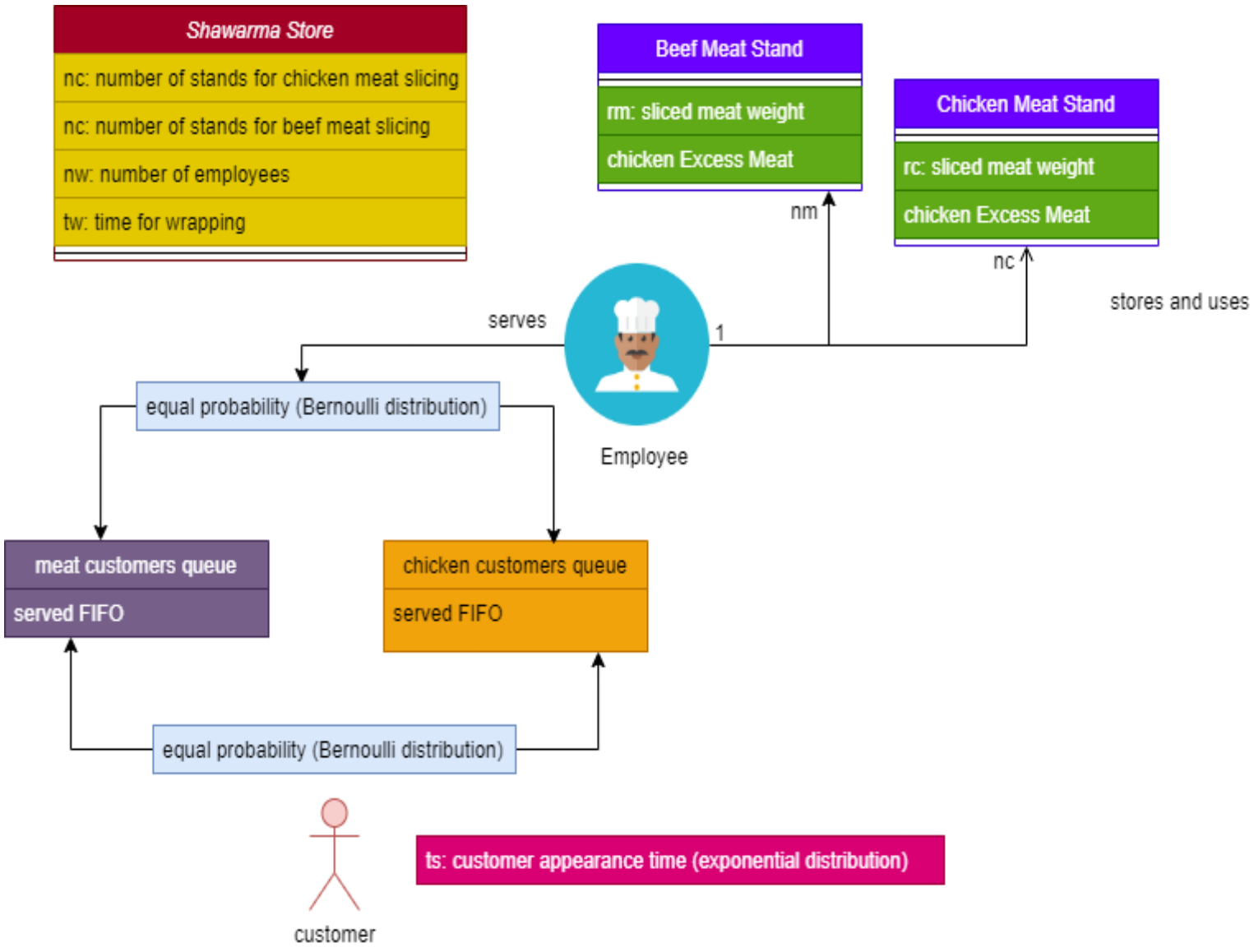
1. Simulation Model Scheme



2. Objects Description

Object	Class name	Attributes | types	Description
Shawarma Store	ShawarmaStore	numberOfChickenStands int numberOfBeefStands int numberOfEmployees int wrappingTime int averageWaitingTime int averageStorageTime int averageFreeTime int	Instance to introduce input parameters and create the initial state of the simulation and store output parameters
Customer	Customer	customerId int arrival_time int serviced_time int	Instance to manage the customers attributes
Employee	Employee	employeeId int isFree bool freeTime int	Instance to manage the employees attributes
MeatStand	MeatStand	meatStandId int slicedMeatQuantity int isChicken bool currentQuantity int storageTime int	Instance to manage the meat stands attributes

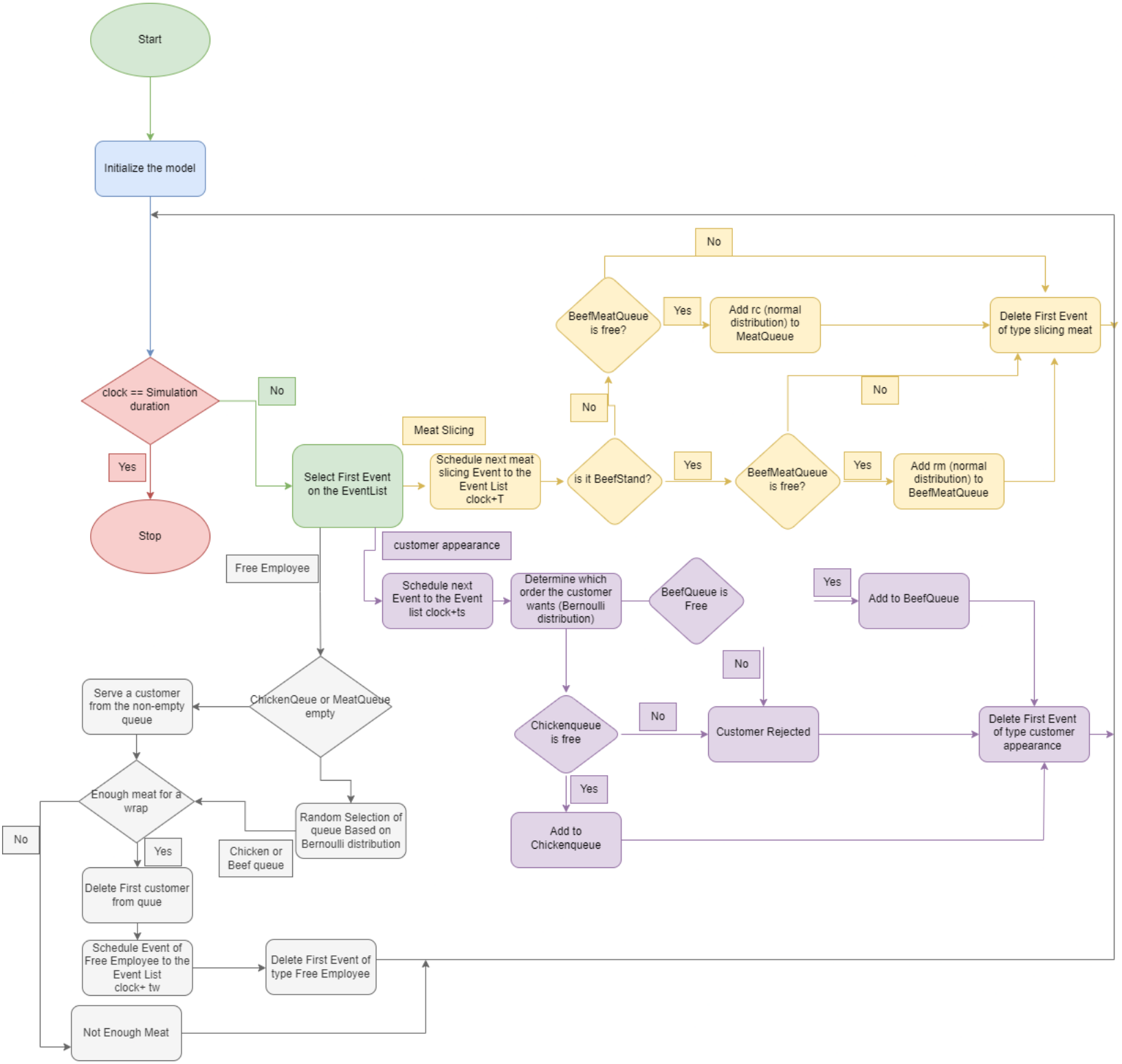
3. Event Description

- Time Events
  - Meat Slicing (each T)
  - Customer appearance (each ts: exponential distribution)
  - Free Employee (start service+tw: wrapping time)
- Conditional Events
  - Begin of Service (if customer queue is not empty)
  - Employee Serving choice (to serve either chicken or meat queue)
  - Enough meat on the queue to make a wrap
  - Begin of Meat Slicing
  - Checking the Meat queue (Excess Meat) before slicing.

4. Processes Description

- Customer Process
  - Start: Customer arrives
  - waits until: Customer starts service
  - End: Customer completion
- Meat Slicing Process
  - Start: Each period T.
  - waits if storedMeatQuantity==max (N)
  - End: End of Simulation

- Block Diagram



3. Simulation Progress

Since the Simulation Technique used for the implementation is Event Scheduling, which means that we have to manage events inside an agenda where each time we execute the first on the sorted agenda in activation time, meaning that we execute always the smallest value of the clock, we have three time events which are :

- Customer arrival: when executed a customer is created and added to the customers queue (chicken or beef) and schedule the next customer arrival event as shown in the prints resulted when running the simulation shown in the next figure:

```
################################ - customer Arrival event has been scheduled  at 12.755656211827315- ##############################
##########

################################ - customer cad11.776654664768474 has been created - ########################################

################################ - customer_arrival event has been executed  at 11.776654664768474- ##############################
##########
```

- Employee Freed or Employee end of service: scheduled when the conditional event Start of Service is executed which activation time is the sum of the current clock and wrapping time, when executed it checks the meat stands quantity to start serving the customer, as shown in the print of the following Figure:

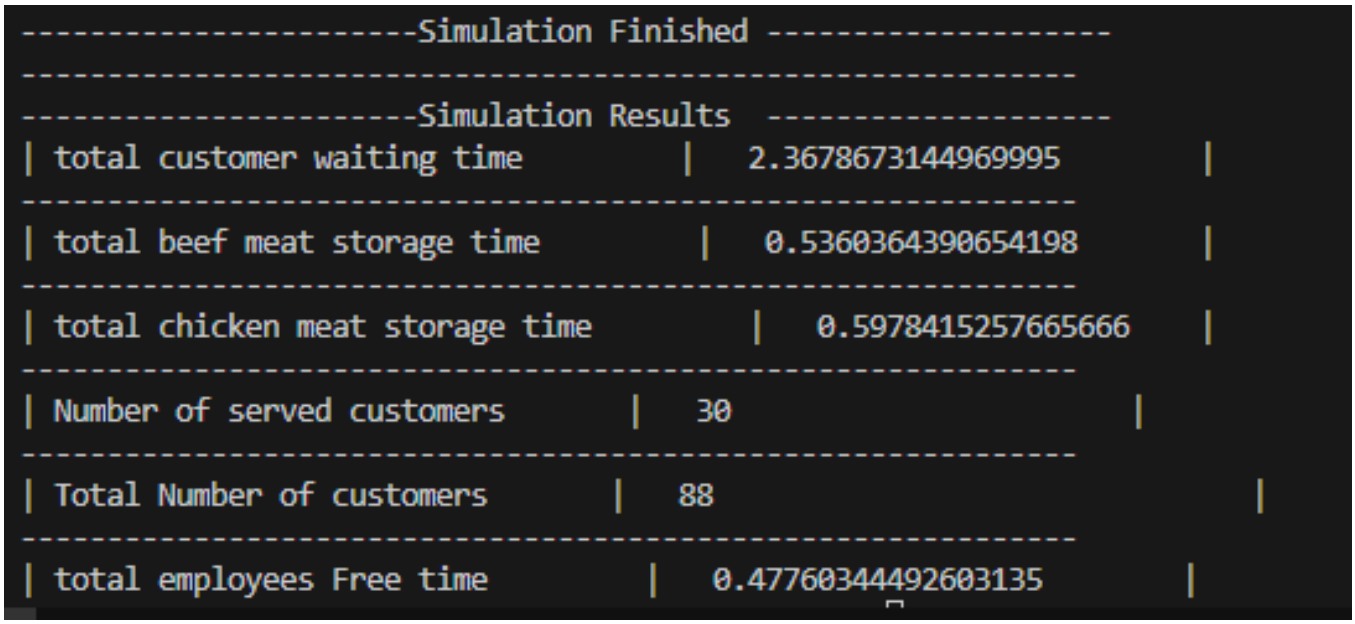
```
################################ - employee_freed event has been executed  at 38.91565615121842- ######################################

cutomer dropped ---- not enough beef meat
################################ - employee End of Service event has been scheduled  at 40.01565615121842- ######################################
```

- Slicing Event: scheduled each period T and when executed it checks the cummulated quantity in meat stands if it's smaller than the maximum allowed quantity, as shown in the print of the following Figure:

```
################################ - slicing event has been scheduled at 28- ###################################

################################ - We've reached the max cummulated quantity of chicken, we should sell some :( ######################################

################################ - beef meat Stand Id bms0- has been added by 3.856716826355786 ######################################

################################ - slicing event has been executed  at 24- ###################################
```

4. Simulation Final Result

Finally we print the most important statistics of the simulation as shown in the next figure, we notice that the difference between the total number of clients and the number of served client is big, and this is caused by the low frequency of slicing meat when not enough beef meat quantity is available (beef meat stands) the customers are not served, since it doesn't produce enough sliced quantity to serve the clients.



5. Random Generators description

- **Exponential distribution generator**: generates each time a value from an exponential according to the inputed mean and deviation.
- **Normal distribution generator**: generates each time a value from a normal according to the inputed mean and deviation.
- **Bernoulli distribution generator**: generates each time a value either 0 or 1 with an equal probability (p=0.5).

6. Initial parameters description

- Simulation Duration
- Frequency of Customer Appearance (customer appearance time)

- Frequency of meat Slicing (Slicing Period)
- number of meat stands
- number of employees