Exercises for module 8: 2-3, 6-8, 10-12, 14-16, 19-20

Exercise 2

```
Simulation results:
  numArrivals:     1000
  numDepartures:   998
  avg Wait:        1.8906618446580803
  avg System Time: 2.814388534740915
```

- A linked list and a priority queue is used
- In `randomInterarrivalTime` , from an exponential distribution
- In `randomServiceTime` , from an exponential distribution

Exercise 3

- `avg arrival time= 1.3558307457972822`
- it seemed that $avgArrivalTime = \frac{1}{arrivalRate}$

Exercise 6

- Yes, in `Event e = eventList.poll ();`
- Yes, `scheduleArrival` provides the first event in the queue. Then `scheduleArrival` is called in `handleArrival` like a recursive program

Exercise 7

`avg System Time: 2.814388534740915`

Exercise 8

`avg Wait:        1.890661844658080`

- 2.814388534740915-1.8906618446580803= 0.92372
- This is the time spent at the server. This rate is near the 1/serviceRate so is in my expectation.

Exercise 10:

`avg service rate= 1.0825712959645295`

This value is approximate equal to the stated rate in the program.

Exercise 11:

There's a significant delay in wait and system time. a congestion might have happened

Exercise 12

use $\lambda = 0.01$, the avg wait time is very small

Exercise 14:

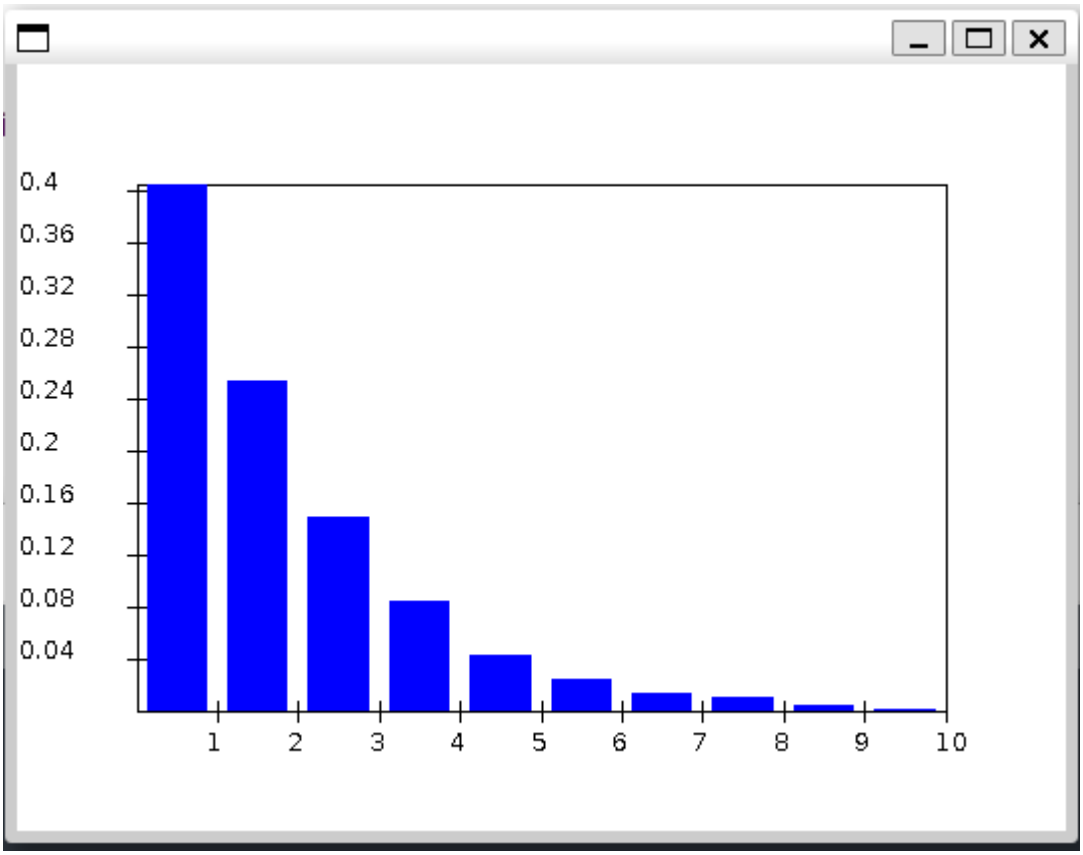
`M= 1.944`

`M/d= 0.6907361851440171`

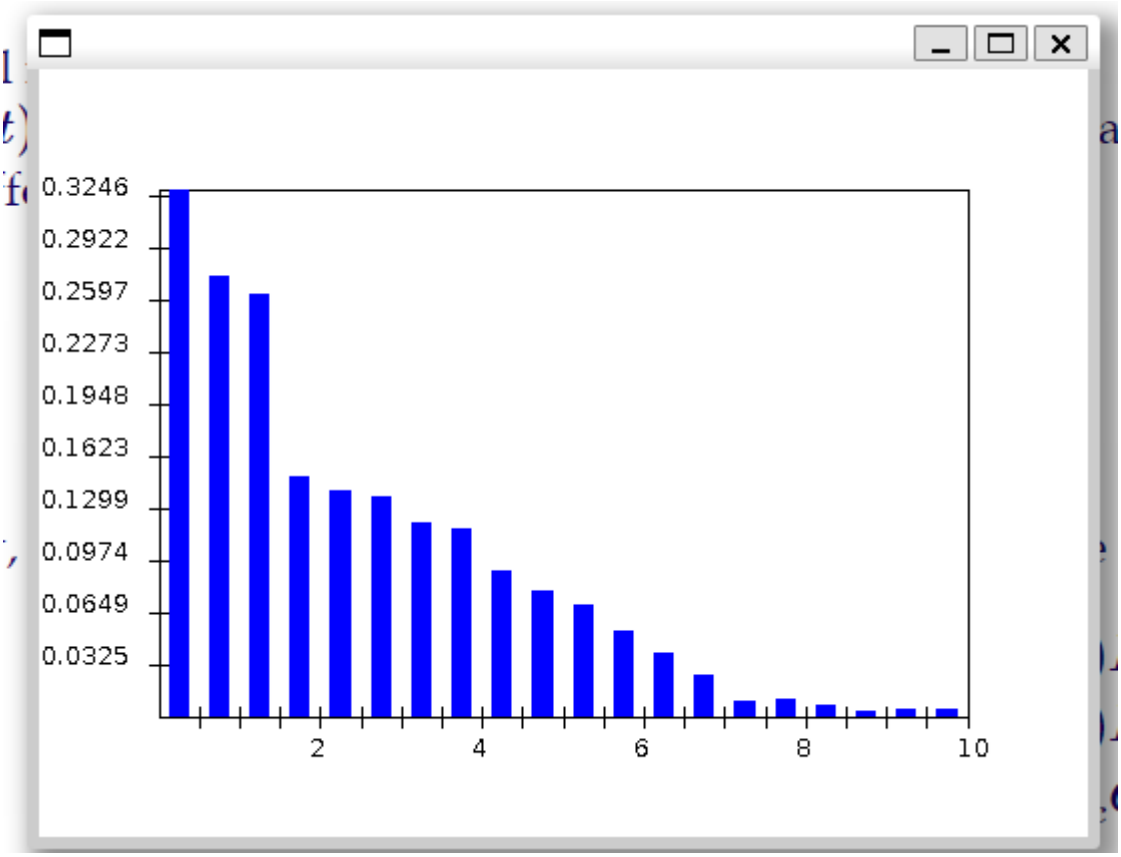
Exercise 15:

λ	**no wait prob**
0.5	0.483
0.6	0.4
0.75	0.312

Exercise 16:

- M is discrete. D is continuous. The range of M and D is not absolute, it changes with the $\lambda \; and \; \mu$
- M
  - 

    - Seemed to be exponential distribution
- D



- Seemed to be exponential distribution as well.

Exercise 19:

No it doesn't work, only one boid is moving at a same time.

Exercise 20:

molecular simulation in `Molecule` uses a single thread, so it's synchronous.

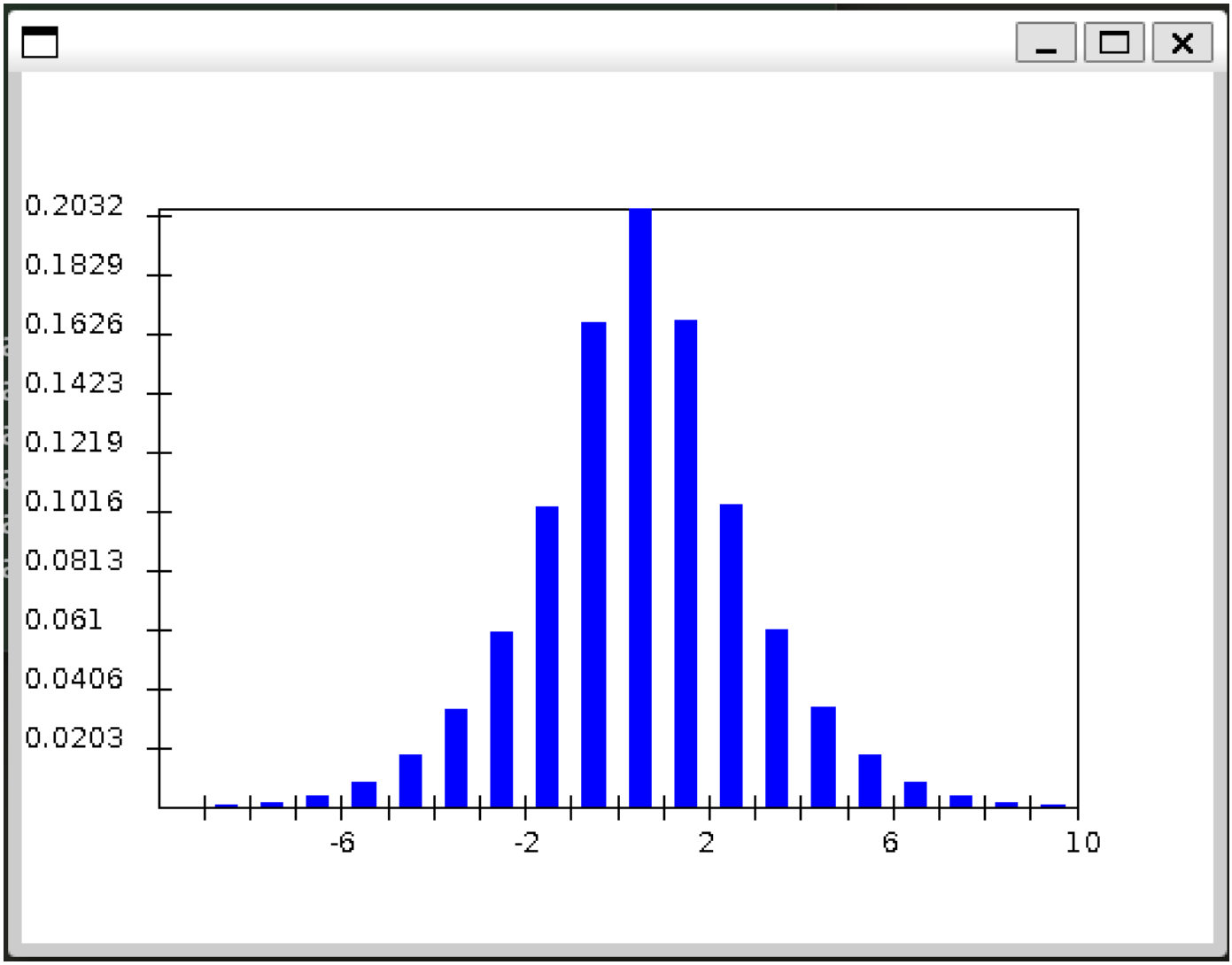
21-25

Exercise 21:

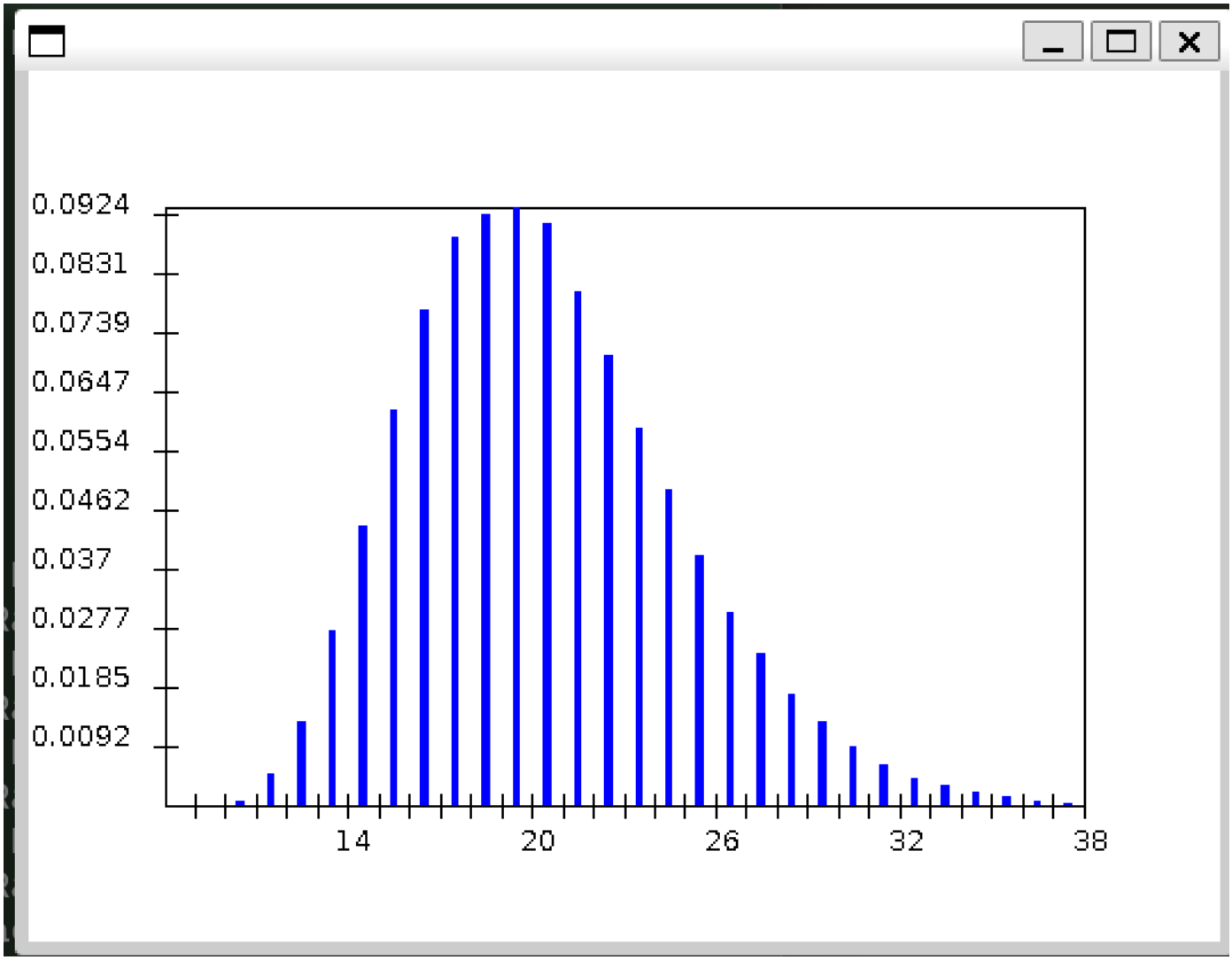
Game of life is a synchronous simulation. Every step depends on the result of previous step.

Exercise 22:

X


0.2032
0.1829
0.1626
0.1423
0.1219
0.1016
0.0813
0.061
0.0406
0.0203
-6
-2
2
6
10

T



- h is the lower bound of E(T)

Exercise 23

- X is a typical gaussian distribution
- T is a Poisson distribution

Exercise 24:

The size of the the event list in single queue is all arrival and departure events.(before they are removed)

Exercise 25:

Log(N) time needed for each operation