Summary:

In this project, I created a post office simulation using threads and semaphores. There are 50 customer threads and 3 postalWorker threads. The customer threads and postalWorker threads communicate with each other to simulate a task that is randomly assigned to the customer at creation and then the customer thread is joined. The postalWorker threads are set to Daemon so that they exit when all the customers are joined. The customer thread adds its information to a queue and then signals the postalWorker thread using a semaphore to ensure that only the postalWorker thread that is serving that specific customer is able to access the task and id. The postalWorker thread then gets that data and then performs the task by sleeping to simulate the task and then releases a semaphore to signal the end of the task. The customer thread then acquires this semaphore, signaling that the task is finished and then the customer leaves the queue and exits the post office.

Some difficulties I encountered was that at first I did not understand the topic well enough to create the design. To solve this, I looked at the barbershop example in the textbook and also looked at the slides more to fully understand the topic. Then I read the Java documentation for the Semaphore class to understand how Java implements them and how to use them in my program.

I learned how to use semaphores and how to cu=ommnuciate between threads. I also learned how to coordinate thread actions using counting semaphores and use queues to store data that can be accessed by multiple threads. I also learned to simulate concepts in an operating system in Java and further understood how operating systems are operated.

Results:

Simulating Post Office with 50 customers and 3 postal workers

Postal Worker 0 created

Postal Worker 1 created

Postal Worker 2 created

Customer 0 created

Customer 1 created

Customer 2 created

Customer 0 enters post office

Customer 1 enters post office

Customer 3 created

Customer 4 created

Customer 2 enters post office

Customer 5 created

Postal worker 2 serving customer 2

Postal worker 0 serving customer 1

Customer 4 enters post office

Postal worker 1 serving customer 0

Customer 2 asks postal worker 2 to mail a letter

Customer 1 asks postal worker 0 to buy stamps

Customer 6 created

Customer 3 enters post office

Customer 5 enters post office

Customer 0 asks postal worker 1 to mail a letter

Customer 7 created

Customer 8 created

Customer 6 enters post office

Customer 9 created

Customer 7 enters post office

Customer 10 created

Customer 8 enters post office

Customer 11 created

Customer 9 enters post office

Customer 12 created

Customer 13 created

Customer 14 created

Customer 15 created

Customer 16 created

Customer 17 created

Customer 18 created

Customer 19 created

Customer 20 created

Customer 21 created

Customer 22 created

Customer 23 created

Customer 24 created

Customer 25 created

Customer 26 created

Customer 27 created

Customer 28 created

Customer 29 created

Customer 30 created

Customer 31 created

Customer 32 created

Customer 33 created

Customer 34 created

Customer 35 created

Customer 36 created

Customer 37 created

Customer 38 created

Customer 39 created

Customer 40 created

Customer 41 created

Customer 42 created

Customer 43 created

Customer 44 created

Customer 45 created

Customer 46 created

Customer 47 created

Customer 48 created

Customer 49 created

Postal worker 0 finished serving customer 1

Customer 2 has finished mailing a letter

Customer 2 leaves post office

Postal worker 0 serving customer 4

Customer 10 enters post office

Joined Customer 2

Customer 4 asks postal worker 0 to mail a package

Scales in use by postal worker 0

Postal worker 1 finished serving customer 0

Postal worker 2 finished serving customer 2

Customer 1 has finished buying stamps

Customer 1 leaves post office

Postal worker 2 serving customer 5

Customer 11 enters post office

Customer 3 asks postal worker 2 to buy stamps

Postal worker 1 serving customer 3

Customer 0 has finished mailing a letter

Customer 5 asks postal worker 1 to buy stamps

Joined Customer 1

Customer 12 enters post office

Customer 0 leaves post office

Joined Customer 0

Postal worker 2 finished serving customer 5

Customer 4 has finished mailing a package

Customer 4 leaves post office

Joined Customer 4

Postal worker 1 finished serving customer 3

Customer 13 enters post office

Postal worker 1 serving customer 6

Customer 3 has finished buying stamps

Customer 14 enters post office

Customer 6 asks postal worker 1 to buy stamps

Customer 3 leaves post office

Joined Customer 3

Postal worker 2 serving customer 7

Customer 7 asks postal worker 2 to buy stamps

Scales released by postal worker 0

Postal worker 0 finished serving customer 4

Customer 5 has finished buying stamps

Customer 5 leaves post office

Joined Customer 5

Customer 15 enters post office

Postal worker 0 serving customer 8

Customer 8 asks postal worker 0 to mail a letter

Postal worker 2 finished serving customer 7

Postal worker 1 finished serving customer 6

Customer 7 has finished buying stamps

Customer 7 leaves post office

Joined Customer 7

Customer 17 enters post office

Postal worker 1 serving customer 9

Scales in use by postal worker 1

Customer 6 has finished buying stamps

Customer 6 leaves post office

Customer 9 asks postal worker 1 to mail a package

Postal worker 2 serving customer 10

Customer 16 enters post office

Customer 10 asks postal worker 2 to mail a letter

Joined Customer 6

Postal worker 0 finished serving customer 8

Customer 8 has finished mailing a letter

Customer 8 leaves post office

Joined Customer 8

Customer 18 enters post office

Postal worker 0 serving customer 11

Customer 11 asks postal worker 0 to mail a letter

Postal worker 2 finished serving customer 10

Customer 9 has finished mailing a package

Customer 19 enters post office

Postal worker 2 serving customer 12

Customer 9 leaves post office

Joined Customer 9

Customer 12 asks postal worker 2 to mail a package

Scales released by postal worker 1

Postal worker 1 finished serving customer 9

Scales in use by postal worker 2

Customer 10 has finished mailing a letter

Customer 10 leaves post office

Joined Customer 10

Postal worker 1 serving customer 13

Customer 20 enters post office

Customer 13 asks postal worker 1 to buy stamps

Postal worker 0 finished serving customer 11

Customer 11 has finished mailing a letter

Customer 11 leaves post office

Customer 21 enters post office

Joined Customer 11

Postal worker 0 serving customer 14

Customer 14 asks postal worker 0 to mail a package

Postal worker 1 finished serving customer 13

Customer 12 has finished mailing a package

Customer 22 enters post office

Customer 12 leaves post office

Joined Customer 12

Postal worker 1 serving customer 15

Customer 15 asks postal worker 1 to mail a letter

Scales released by postal worker 2

Postal worker 2 finished serving customer 12

Scales in use by postal worker 0

Customer 13 has finished buying stamps

Customer 13 leaves post office

Joined Customer 13

Postal worker 2 serving customer 17

Customer 17 asks postal worker 2 to mail a package

Customer 23 enters post office

Postal worker 1 finished serving customer 15

Customer 14 has finished mailing a package

Customer 14 leaves post office

Joined Customer 14

Postal worker 1 serving customer 16

Customer 24 enters post office

Customer 16 asks postal worker 1 to mail a package

Scales released by postal worker 0

Postal worker 0 finished serving customer 14

Scales in use by postal worker 2

Customer 25 enters post office

Customer 15 has finished mailing a letter

Customer 15 leaves post office

Joined Customer 15

Postal worker 0 serving customer 18

Customer 18 asks postal worker 0 to mail a package

Scales released by postal worker 2

Scales in use by postal worker 1

Postal worker 2 finished serving customer 17

Customer 17 has finished mailing a package

Customer 17 leaves post office

Joined Customer 17

Customer 26 enters post office

Postal worker 2 serving customer 19

Customer 19 asks postal worker 2 to buy stamps

Postal worker 2 finished serving customer 19

Customer 16 has finished mailing a package

Customer 16 leaves post office

Joined Customer 16

Postal worker 2 serving customer 20

Customer 27 enters post office

Customer 20 asks postal worker 2 to buy stamps

Scales released by postal worker 1

Postal worker 1 finished serving customer 16

Scales in use by postal worker 0

Customer 18 has finished mailing a package

Customer 18 leaves post office

Joined Customer 18

Postal worker 1 serving customer 21

Customer 28 enters post office

Customer 21 asks postal worker 1 to buy stamps

Postal worker 2 finished serving customer 20

Customer 19 has finished buying stamps

Customer 29 enters post office

Customer 19 leaves post office

Postal worker 2 serving customer 22

Customer 22 asks postal worker 2 to buy stamps

Joined Customer 19

Postal worker 1 finished serving customer 21

Customer 20 has finished buying stamps

Customer 20 leaves post office

Joined Customer 20

Customer 30 enters post office

Postal worker 1 serving customer 23

Customer 23 asks postal worker 1 to buy stamps

Postal worker 2 finished serving customer 22

Customer 21 has finished buying stamps

Customer 21 leaves post office

Joined Customer 21

Customer 31 enters post office

Postal worker 2 serving customer 24

Customer 24 asks postal worker 2 to buy stamps

Scales released by postal worker 0

Postal worker 0 finished serving customer 18

Customer 22 has finished buying stamps

Customer 22 leaves post office

Customer 32 enters post office

Joined Customer 22

Postal worker 0 serving customer 25

Scales in use by postal worker 0

Customer 25 asks postal worker 0 to mail a package

Postal worker 1 finished serving customer 23

Customer 23 has finished buying stamps

Customer 23 leaves post office

Joined Customer 23

Customer 33 enters post office

Postal worker 1 serving customer 26

Customer 26 asks postal worker 1 to buy stamps

Postal worker 2 finished serving customer 24

Customer 24 has finished buying stamps

Customer 24 leaves post office

Joined Customer 24

Customer 34 enters post office

Postal worker 2 serving customer 27

Customer 27 asks postal worker 2 to buy stamps

Postal worker 1 finished serving customer 26

Customer 25 has finished mailing a package

Customer 25 leaves post office

Joined Customer 25

Postal worker 1 serving customer 28

Customer 35 enters post office

Customer 28 asks postal worker 1 to mail a letter

Postal worker 2 finished serving customer 27

Customer 26 has finished buying stamps

Customer 26 leaves post office

Joined Customer 26

Postal worker 2 serving customer 29

Customer 36 enters post office

Customer 29 asks postal worker 2 to mail a letter

Scales released by postal worker 0

Postal worker 0 finished serving customer 25

Customer 27 has finished buying stamps

Customer 27 leaves post office

Customer 37 enters post office

Joined Customer 27

Postal worker 0 serving customer 30

Customer 30 asks postal worker 0 to buy stamps

Postal worker 1 finished serving customer 28

Customer 28 has finished mailing a letter

Customer 28 leaves post office

Joined Customer 28

Customer 38 enters post office

Postal worker 1 serving customer 31

Customer 31 asks postal worker 1 to mail a package

Scales in use by postal worker 1

Postal worker 2 finished serving customer 29

Customer 29 has finished mailing a letter

Customer 29 leaves post office

Joined Customer 29

Customer 39 enters post office

Postal worker 2 serving customer 32

Customer 32 asks postal worker 2 to mail a package

Postal worker 0 finished serving customer 30

Customer 30 has finished buying stamps

Customer 30 leaves post office

Joined Customer 30

Customer 40 enters post office

Postal worker 0 serving customer 33

Customer 33 asks postal worker 0 to mail a letter

Postal worker 0 finished serving customer 33

Customer 31 has finished mailing a package

Customer 31 leaves post office

Joined Customer 31

Customer 41 enters post office

Postal worker 0 serving customer 34

Customer 34 asks postal worker 0 to mail a letter

Scales released by postal worker 1

Scales in use by postal worker 2

Postal worker 1 finished serving customer 31

Customer 32 has finished mailing a package

Customer 32 leaves post office

Joined Customer 32

Customer 42 enters post office

Postal worker 1 serving customer 35

Customer 35 asks postal worker 1 to mail a letter

Postal worker 0 finished serving customer 34

Customer 33 has finished mailing a letter

Customer 33 leaves post office

Joined Customer 33

Customer 43 enters post office

Postal worker 0 serving customer 36

Customer 36 asks postal worker 0 to mail a letter

Postal worker 1 finished serving customer 35

Customer 34 has finished mailing a letter

Customer 34 leaves post office

Joined Customer 34

Postal worker 1 serving customer 37

Customer 44 enters post office

Customer 37 asks postal worker 1 to buy stamps

Scales released by postal worker 2

Postal worker 2 finished serving customer 32

Customer 35 has finished mailing a letter

Customer 35 leaves post office

Joined Customer 35

Postal worker 2 serving customer 38

Customer 46 enters post office

Customer 38 asks postal worker 2 to mail a letter

Postal worker 1 finished serving customer 37

Customer 36 has finished mailing a letter

Customer 36 leaves post office

Joined Customer 36

Customer 45 enters post office

Postal worker 1 serving customer 39

Scales in use by postal worker 1

Customer 39 asks postal worker 1 to mail a package

Postal worker 0 finished serving customer 36

Customer 37 has finished buying stamps

Customer 37 leaves post office

Joined Customer 37

Customer 47 enters post office

Postal worker 0 serving customer 40

Customer 40 asks postal worker 0 to mail a letter

Postal worker 2 finished serving customer 38

Customer 38 has finished mailing a letter

Customer 38 leaves post office

Joined Customer 38

Customer 48 enters post office

Postal worker 2 serving customer 41

Customer 41 asks postal worker 2 to mail a package

Postal worker 0 finished serving customer 40

Customer 39 has finished mailing a package

Customer 39 leaves post office

Joined Customer 39

Customer 49 enters post office

Postal worker 0 serving customer 42

Customer 42 asks postal worker 0 to mail a package

Scales released by postal worker 1

Postal worker 1 finished serving customer 39

Scales in use by postal worker 2

Customer 40 has finished mailing a letter

Customer 40 leaves post office

Joined Customer 40

Postal worker 1 serving customer 43

Customer 43 asks postal worker 1 to mail a package

Scales released by postal worker 2

Scales in use by postal worker 0

Postal worker 2 finished serving customer 41

Customer 41 has finished mailing a package

Customer 41 leaves post office

Joined Customer 41

Postal worker 2 serving customer 44

Customer 44 asks postal worker 2 to mail a package

Scales released by postal worker 0

Postal worker 0 finished serving customer 42

Scales in use by postal worker 1

Customer 42 has finished mailing a package

Customer 42 leaves post office

Joined Customer 42

Postal worker 0 serving customer 46

Customer 46 asks postal worker 0 to buy stamps

Postal worker 0 finished serving customer 46

Customer 43 has finished mailing a package

Customer 43 leaves post office

Joined Customer 43

Postal worker 0 serving customer 45

Customer 45 asks postal worker 0 to mail a letter

Scales released by postal worker 1

Scales in use by postal worker 2

Postal worker 1 finished serving customer 43

Customer 44 has finished mailing a package

Customer 44 leaves post office

Joined Customer 44

Postal worker 1 serving customer 47

Customer 47 asks postal worker 1 to mail a letter

Postal worker 0 finished serving customer 45

Customer 46 has finished buying stamps

Customer 46 leaves post office

Joined Customer 46

Postal worker 0 serving customer 48

Customer 48 asks postal worker 0 to buy stamps

Postal worker 1 finished serving customer 47

Customer 45 has finished mailing a letter

Postal worker 1 serving customer 49

Customer 45 leaves post office

Customer 49 asks postal worker 1 to buy stamps

Joined Customer 45

Postal worker 0 finished serving customer 48

Customer 47 has finished mailing a letter

Customer 47 leaves post office

Joined Customer 47

Scales released by postal worker 2

Postal worker 2 finished serving customer 44

Customer 48 has finished buying stamps

Customer 48 leaves post office

Joined Customer 48

Postal worker 1 finished serving customer 49

Customer 49 has finished buying stamps

Customer 49 leaves post office

Joined Customer 49

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