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Assignment 5

CS361

1b. **Program coded in Go with following functions:**

Main() : Entry point of code, starts 'c' customer goroutines and 'e' employee go routines. Also creates a waitGroup that closes the employee goroutines after all customers have been helped.

Employee.employees(): The employee goroutine function. Loops forever. Contains a select case which accepts an object sent from customers() function. This ensures that an employee is not waiting at a desk where no customer ever goes to, hence, causing deadlock. In this case employees only go to the desk where service is required. After going to the desk, employees help customer, then send a reference to themselves to the customer func that is waiting to receive.

Customer.customers(): Allows 's' number of customer threads to enter the store, blocks the other threads trying to gain access until the previous customer removes object from channel buffer. Each thread, After gaining access randomly chooses to wait at register, home theatre or cell desk and sends an object to employee() then waits to receive an Employee object back from employees() func. The Customer then exits the store, unblocking the next customer.

Running the Program:

Run the program using Go as:

go run hw5.go

There is also a makefile included with the following commands included

build: Builds the program

run: builds and runs the program

Proof of correctness:

Example: no. of employees: 4, No of registers: 5, store capacity: 15, no of customers: 50

Points of interest in output:

1. No Deadlock error
2. All customers from 1 to 50 eventually get helped after asking for help for all desks:
    a. Each employee is waiting to receive an object on one of 3 channels (1 for each desk)
    b. When a customer arrives at a desk, it sends an object to the employee on the respective channel and then waits to receive an object on one of the respective help channels (1 for each desk)

    c. Employee receives this object, and then sends a reference to itself back on the respective help channel to the customer that is waiting.
    d. After customer receives channels, prints output then exits store
3. All employees have their moment to shine
4. All employees help a few customers then go on break
    a. Employees randomly decide to help between 1 to 5 customers before leaving for a break.
5. All customers eventually enter the store
    a. Customers get a time ticket then try to enter the store by sending on a channel.
    b. Channel has a buffer size as size of store.
    c. If buffer is full, customer is blocked from entering
    d. Once a customer inside the store is helped, the customer removes an object from the channel buffer, allowing another customer to enter
    e. Since all customers are eventually helped, all customers eventually "exit the store" unblocking the next customer waiting to enter.

Output:

customer 1 has entered the store
customer 3 has entered the store
employee 3 going on break
employee 1 going on break
customer 3 helped after 0.000000 ms by employee 1 at Register
customer 4 has entered the store
customer 4 helped after 0.000000 ms by employee 4 at Cell Desk
customer 5 has entered the store
customer 5 helped after 0.000000 ms by employee 2 at Register
customer 7 has entered the store
employee 4 going on break
customer 9 has entered the store
customer 11 has entered the store
customer 6 has entered the store
customer 9 helped after 0.000000 ms by employee 2 at Home Theatre desk
customer 2 has entered the store
customer 16 has entered the store
customer 17 has entered the store
customer 8 has entered the store
employee 2 going on break
customer 12 has entered the store
customer 14 has entered the store
customer 10 has entered the store
customer 15 has entered the store
customer 1 helped after 0.000000 ms by employee 3 at Register
customer 20 has entered the store

customer 18 has entered the store
customer 19 has entered the store
customer 7 helped after 0.000000 ms by employee 4 at Register
customer 21 has entered the store
customer 13 has entered the store
employee 4 back from break
customer 14 helped after 1.000812 ms by employee 4 at Cell Desk
employee 4 going on break
employee 4 back from break
customer 22 has entered the store
customer 12 helped after 1.000812 ms by employee 4 at Cell Desk
customer 8 helped after 1.000812 ms by employee 4 at Cell Desk
customer 24 has entered the store
customer 23 has entered the store
customer 11 helped after 1.000812 ms by employee 4 at Home Theatre desk
customer 2 helped after 1.000812 ms by employee 4 at Register
customer 26 has entered the store
employee 4 going on break
customer 25 has entered the store
employee 3 back from break
customer 19 helped after 1.999340 ms by employee 3 at Home Theatre desk
customer 27 has entered the store
customer 16 helped after 2.000339 ms by employee 3 at Register
customer 28 has entered the store
employee 3 going on break
customer 6 helped after 2.000339 ms by employee 3 at Home Theatre desk
customer 29 has entered the store
customer 10 helped after 2.000339 ms by employee 3 at Cell Desk
customer 30 has entered the store
employee 2 back from break
employee 2 going on break
employee 4 back from break
employee 4 going on break
customer 24 helped after 2.000779 ms by employee 2 at Register
customer 17 helped after 3.001590 ms by employee 4 at Home Theatre desk
customer 32 has entered the store
customer 25 helped after 2.000779 ms by employee 4 at Register
customer 33 has entered the store
customer 31 has entered the store
employee 1 back from break
customer 18 helped after 3.999283 ms by employee 1 at Cell Desk
customer 34 has entered the store
customer 15 helped after 3.999283 ms by employee 1 at Cell Desk
customer 22 helped after 2.999471 ms by employee 1 at Home Theatre desk
customer 36 has entered the store
customer 35 has entered the store

employee 1 going on break
customer 26 helped after 2.999471 ms by employee 1 at Home Theatre desk
customer 37 has entered the store
employee 4 back from break
employee 4 going on break
employee 3 back from break
employee 3 going on break
customer 27 helped after 2.001942 ms by employee 4 at Register
customer 20 helped after 4.001282 ms by employee 3 at Cell Desk
customer 38 has entered the store
customer 39 has entered the store
employee 1 back from break
customer 33 helped after 2.999371 ms by employee 1 at Home Theatre desk
customer 40 has entered the store
customer 32 helped after 2.999371 ms by employee 1 at Register
customer 41 has entered the store
customer 23 helped after 5.000150 ms by employee 1 at Home Theatre desk
customer 42 has entered the store
customer 34 helped after 2.000679 ms by employee 1 at Register
customer 43 has entered the store
employee 1 going on break
employee 3 back from break
customer 37 helped after 2.002683 ms by employee 3 at Home Theatre desk
customer 44 has entered the store
customer 36 helped after 2.002683 ms by employee 3 at Register
customer 45 has entered the store
customer 29 helped after 4.002626 ms by employee 3 at Home Theatre desk
customer 46 has entered the store
employee 3 going on break
customer 21 helped after 6.001966 ms by employee 3 at Cell Desk
customer 47 has entered the store
employee 2 back from break
employee 2 going on break
customer 13 helped after 7.002042 ms by employee 2 at Cell Desk
customer 48 has entered the store
employee 4 back from break
customer 41 helped after 2.001558 ms by employee 4 at Home Theatre desk
customer 49 has entered the store
employee 4 going on break
customer 31 helped after 5.000929 ms by employee 4 at Home Theatre desk
customer 50 has entered the store
customer 35 helped after 4.002237 ms by employee 4 at Register
customer 39 helped after 4.000239 ms by employee 4 at Register
employee 2 back from break
customer 40 helped after 2.002596 ms by employee 2 at Cell Desk
customer 28 helped after 6.003218 ms by employee 2 at Cell Desk

employee 2 going on break
customer 43 helped after 2.002596 ms by employee 2 at Register
customer 38 helped after 4.001276 ms by employee 2 at Home Theatre desk
employee 2 back from break
employee 2 going on break
customer 30 helped after 7.003552 ms by employee 2 at Cell Desk
customer 46 helped after 3.000925 ms by employee 2 at Register
customer 47 helped after 3.000925 ms by employee 2 at Home Theatre desk
customer 50 helped after 1.001371 ms by employee 2 at Register
employee 1 back from break
employee 1 going on break
customer 42 helped after 4.000461 ms by employee 1 at Cell Desk
employee 3 back from break
employee 3 going on break
customer 44 helped after 4.000613 ms by employee 3 at Cell Desk
employee 4 back from break
customer 49 helped after 3.000365 ms by employee 4 at Cell Desk
customer 48 helped after 3.999843 ms by employee 4 at Cell Desk
employee 4 going on break
customer 45 helped after 4.999920 ms by employee 4 at Cell Desk
Success: process exited with code 0.