ECM2433: Coursework Report

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1 Design decisions

1.1 Program structure

Program was structured into a multiple files with supporting libraries to allow for modularity and better code readability.

1.1.1 Core files

The main body of the program is contained within the *runSimulations.c* file that parses command line input, runs the necessary number of simulations, averages the results obtained and prints them to the user.

runOneSimulation.c file contains the actual body of the simulation contained within a single function and one support function.

1.1.2 Supporting libraries

The files *car.c*, *coniguration.c*, *leftright.c*, *queue.c* and *results.c* then contain supporting structures and functions for operating them.

The struct within *car.c* represents a single car along with all properties it has. Currently that is only its arrival time, but organising them into a struct allows for greater modularity for the future, should the code be expanded.

The struct in the *configuration.c* represents a specific configuration of the initial properties for a single simulation. Combining them into a structure may make the future modifications of the code or reuse of the *runOneSimulation* function slightly more difficult as it is not readily obvious what variables go into it, but it also allows for neat and easily understood code.

leftright.c simply contains an enum with values LEFT and RIGHT that is useful for better readability of the code when distinguishing which side currently has green light.

queue.c and its accompanying *queue.h* are the biggest supporting files as they contain implementations and definitions for a stack that is used to represent the queue of waiting cars at the lights.

Purpose of *result.c* is identical to the purpose of *configuration.c* except for results of the simulation rather than initial configuration.

2 Assumptions

2.1 Constant number of simulations

It is assumed that the number of simulations ran over which the average is constructed will remain constant. This useful assumption allowed to define the number of simulations as a constant.

2.2 Arrival rate is in whole percents

Probably the part least defined in the initial document was what is understood by arrival rate. For the purpose of writing this program, arrival rate was understood to be the probability of a car arriving within a single time slice expressed in whole percents.

2.3 Whole numbers for average

An integer division is used when calculating the average performance over multiple simulations. The reason for that being is that it is assumed that decimal numbers are not of sufficient importance.

3 Experiments

After a series of experiments was ran, a following conclusion was found; the best system performance is reached when the light period is at the same ration as is the ratio between the probability of car arrival, expressed in smallest numbers possible.

However, it worth pointing out that the preference for smaller light periods is further exaggerated by the fact that changing of the lights prevents car arrivals, thereby reducing the number of the cars in the system, (because cars can only arrive up to the 500th cycle.)

4 Example output

```
$ ./runSimulations 50 50 2 2

Entering simulation block.
Parameter values:
    from left:
        traffic arrival rate:   50
        traffic light period:    2
    from right:
        traffic arrival rate:   50
        traffic light period:    2
Simulation n001 finished.
```

```
Simulation n002 finished.
Simulation n003 finished.
[...]
Simulation n098 finished.
Simulation n099 finished.
Simulation n100 finished.
Parameter values:
    from left:
        traffic arrival rate:   50
        traffic light period:    2
    from right:
        traffic arrival rate:   50
        traffic light period:    2
Results (average over 100 runs):
    from left:
        number of vehicles:    166
        average waiting time:   13
        maximum waiting time:   30
        clearance time:          0
    from right:
        number of vehicles:    168
        average waiting time:   15
        maximum waiting time:   34
        clearance time:          0
```