Peter Fabens
Professor Pfaffmann
CS150
4/24/2022

Project 2 Program Analysis

Methodology:

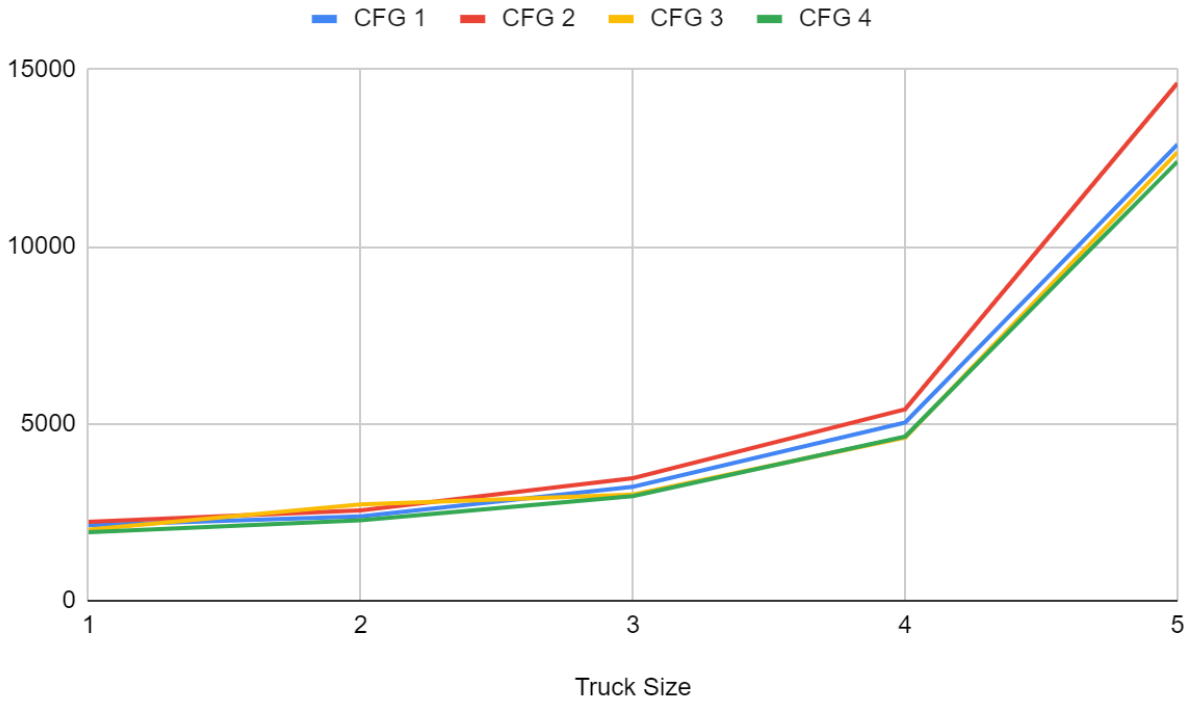
In order to effectively quantify the efficiency of a given configuration of the truck simulation, it is important to pinpoint a relatively small number of metrics which give meaningful information about what is happening in the simulation. To start simply, we can choose from the actions available to a given truck at the top of each hour. Tracking the number of pickups and dropoffs made by trucks is relatively meaningless, as it is predetermined by the number of items in the manifest. That leaves two actions: waiting for a cargo bay to free up, and traveling to the next destination. The time spent waiting at a cargo bay ought to reflect the ratio of trucks to warehouses as defined by the current model configuration, and the number of hours spent traveling ought to indicate how the tradeoff between speed and size affects a truck's efficiency. A truck with a lower number of hours will have been able to maximize how much cargo is being moved at once while minimizing the time taken to get to a destination.

Configurations:

All configurations have trucks that make 50 deliveries each.

- 20 trucks, 5 warehouses
  - 4:1 truck-to-warehouse ratio
  - Balanced, trucks don't often have to wait but warehouses are usually active
- 100 trucks, 5 warehouses
  - 20:1 truck-to-warehouse ratio
  - Trucks are starved for space, warehouses are always active
- 10 trucks, 6 warehouses
  - 5:3 truck-to-warehouse ratio
  - Not very many of either, trucks have little competition
- 50 trucks, 5 warehouses
  - 10:1 truck-to-warehouse ratio
  - Warehouses are far outnumbered

Average Time Traveling vs. Truck Size:

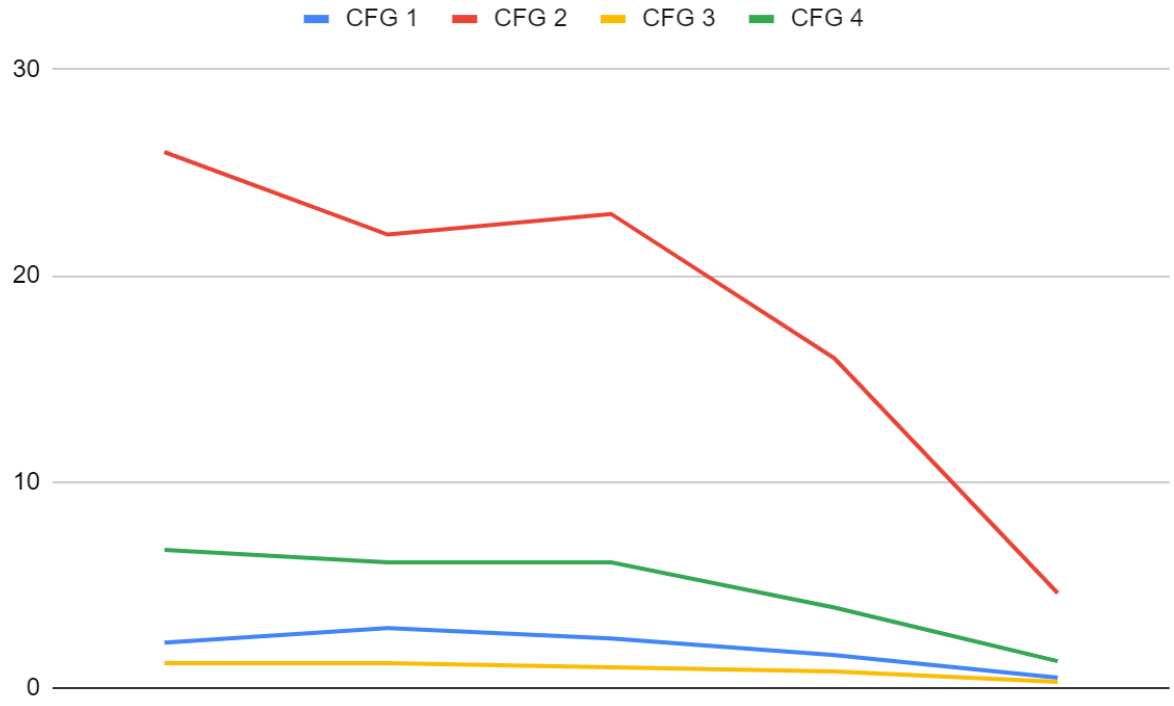


Average Hours Spent Traveling:

		Configuration			
		1	2	3	4
Size	1	2130	2228	2006	1937
	2	2380	2550	2721	2274
	3	3216	3459	2995	1937
	4	5035	5408	4611	2274
	5	12886	14617	12664	2953

As shown in the table and graph, the configurations had little effect on the actual time spent traveling by trucks. This is to be expected, as trucks don't move more or less as a result of congestion at warehouses. What is notable about this data is the curve showing that trucks of size 3 perform comparably to trucks of size 1, indicating that size 3 trucks may be the optimal size for moving the largest amount of freight in the least time.

Average Time Waiting vs. Truck Size:



Average Hours Spent Waiting:

		Configuration			
		1	2	3	4
Size	1	2.2	26	1.2	6.7
	2	2.9	22	1.2	6.1
	3	2.4	23	1.0	6.1
	4	1.6	16	0.8	3.9
	5	0.5	4.6	0.3	1.3

The large majority of waiting is done by smaller trucks, since they are all active at once, buzzing between warehouses and clogging up cargo ports. Once the smaller trucks finish their business, the larger trucks have increasingly empty warehouses to dock at, meaning they are much less likely to have to wait as the simulation goes on.