Traffic Flow Simulator: Requirements Document  
1. Background  
 The client needs to know, for a grid whose intersections are roundabouts,  
 the average number of time units cars spend in the grid before   
 leaving the grid for all cars that leave the grid. The client intends to   
 use the software to find out how quickly one or more cars can move from   
 one edge to another edge of the boundary of the grid when each intersection   
 is a roundabout. Eventually the software may be modified to enable the   
 client to answer the following questions: Which traffic control devices are   
 best at increasing traffic flow? Can a single car more quickly move from   
 one edge to another edge of the boundary of the grid that contains   
 roundabouts, stop sign intersections, or traffic light intersections?   
 In general, how does the rate of traffic flow, number of cars in the grid,  
 and type of intersection impact how fast a single car can move from one edge  
 to another edge of the boundary of the grid?  
2. Description of Software  
 The software models a grid that contains roundabouts.   
 Eventually the software may be modified to include other traffic control   
 devices such as stop signs and stop lights. The software will allow the   
 user to run multiple simulations and collect output data. The purpose of   
 these simulations is to analyze the effect of roundabouts on the number   
 of time units it takes one or more cars to move from one edge to another   
 edge of the boundary of the grid, given different numbers of cars in the   
 grid.  
3. Environmental Characteristics  
4. Simulation Characteristics  
 4.1 Geographic layout  
 4.1.1 Grid: Refer to 7.4.  
 4.2 Traffic control devices  
 4.2.1 Modern roundabouts at intersections  
 4.2.1.1 A roundabout consists of exactly 8 Slots, plus 0 or more   
 multiples of 4, (eg: 8, 12, 16, etc.).  
 4.2.1.2 For any two cars A and B, if A is in a Lane Exit Slot and  
 B is in a Roundabout Exit Slot, and if both A and B intend  
 to move to the same Roundabout Entry Slot in the same time  
 unit, then A will yield to B: A will not move in that time  
 unit, and B will move to the Roundabout Exit Slot.  
 4.2.1.3 To traverse a roundabout, a car always moves in a

counterclockwise direction from its current slot to the

next adjacent slot in the roundabout.   
 4.2.1.4 A roundabout consists of 3 types of slots: entry slots,   
 exit slots, and slots that populate the roundabout   
 between entry and exit slots. Refer to 7.10.  
 4.2.1.5 The roundabout contains exactly one lane  
 4.2.1.6 If a car in a Roundabout Exit Slot cannot exit from the   
 roundabout into a Lane Entry Slot because the Lane Entry  
 Slot is occupied by a car that will not move during the current

the unit, then the car in the Roundabout Exit Slot  
 will move to the next adjacent slot in the roundabout   
 until it again moves to the intended Roundabout Exit Slot,  
 at which point it will either move to the unoccupied Lane

Entry Slot or continue to the next adjacent slot. The car will

repeat this cycle until it occupies the Lane Entry Slot.

4.2.2 Stop signs at intersections  
 4.2.3 Traffic lights at intersections  
 4.2.4 Sensors at intersections  
 4.2.5 Implicit control devices at entry to city section  
 4.3 Traffic flow   
 4.3.1 Speed of traffic  
 4.3.1.1 All cars move one slot per time unit, when they are able   
 to move.  
 4.3.2 Patterns of traffic flow  
 4.4 Stochastic properties  
 4.4.1 The user will determine whether to use random numbers or fake   
 random numbers.  
 4.4.2 Random numbers will be used to determine:  
 4.4.2.1 the distribution of roundabouts in the grid  
 4.4.2.2 the number of slots a car will move before it turns  
 4.4.2.3 the direction cars will turn  
5. Input/Output  
 5.1 Input  
 5.1.1 Grid size  
 5.1.2 Length of simulation in time units  
 5.1.3 Roundabout size in number of slots  
 5.1.4 Rate of addition of cars to the grid  
 5.2 Output   
 5.2.1 Traffic congestion  
6. Life Cycle Considerations  
 6.1 Subsets  
 6.1.1 Requirements document 9/14/16  
 6.1.2 Requirements document 9/16/16  
 6.1.3 Requirements document 9/21/16  
 6.1.4 Requirements document 9/23/16  
 6.1.5 Requirements document 9/28/16  
 6.1.6 Requirements document 9/30/16  
 6.1.7 Requirements document 10/3/16  
 6.1.8 Requirements document 10/6/16

6.1.9 Requirements document 10/26/16

6.1.10 Requirements documents 11/7/16  
 6.2 Possible extensions  
7. Glossary  
 7.1 Car:   
 7.1.1 A car occupies one slot   
 7.1.2 A car will intend to move from one slot to an adjacent slot in the   
 beginning of a time unit, and move to an adjacent slot or yield

in the same time unit.  
 7.1.3 A car can only move from one slot to an adjacent slot.

7.1.4 A car will turn at most once while within the boundary of the grid  
 7.1.5 A car will move either 0 or 1 slot each time unit (0 slots if it must yield

and 1 slot if it does not have to yield).

7.1.6 The user will determine:   
 7.1.6.1 How many intersections the car will move straight through

before turning, though the car is not required to turn.  
 7.1.6.2 What cardinal direction the car will turn if it is instructed to turn

7.2 Cardinal Direction: North, south, east, or west. While on the grid, a

car can only move in one cardinal direction (e.g. the car can move

north but it cannot move northwest).

7.3 Direction: Cardinal Direction

7.4 Grid:   
 7.4.1 The grid consists of at least 1 and at most 20 north-south two-way  
 columns, and at least 1 and at most 20 east-west two-way rows.   
 7.4.2 Any two consecutive, parallel rows or columns are separated by a   
 number of slots determined by user input - the length of a street.  
 7.4.3 The grid has a rectangular boundary.  
 7.5 Intersection: The junction of a row and a column in the grid.   
 7.6 Lane: All contiguous slots aligned in the same direction between two   
 intersections adjacent horizontally or vertically.

7.6.1 A car that occupies a slot within a lane (that is not a Lane Exit

Slot) can only move to an adjacent slot in the same lane, in the

same cardinal direction as the lane.

7.6.2 If a car occupies the Lane Exit Slot, it can only move to an intersection slot.

7.7 Modern Roundabout: A traffic control device used at intersections.  
 7.8 Yield: A car stops for 1 or more time units until the car is able to   
 move to the slot it intends to move to.

7.8.1 A car that occupies a Lane Exit Slot will yield to a car that occupies

a Roundabout Exit Slot if both cars intend to move to the same

Roundabout Entry Slot in the same time unit.

7.8.2 If, during the current time unit, a car (hereby referred to as the

“first car” for the rest of section 7.8.2) intends to move to a slot

that contains another car that will yield during the current

time unit, then the first car will also yield, unless the first car is

in a Roundabout Exit Slot and intends to exit, then the first car

will follow the rules outlined in 4.2.1.6.

7.8.3 If a car does not yield because of 7.8.1 or 7.8.2 then it will move to

its intended slot during the current time unit.  
 7.9 Roundabout: Modern roundabout intersection  
 7.10 Slot: One unit of space which can be occupied by at most one car.   
 7.10.1 Some slots are of particular importance, and have special names:  
 7.10.1.1 Lane Entry Slot: The first slot in exactly one lane of a street,

moving in a given direction (north-south, east-west,

south-north, west-east) that a car will move to after it leaves

an intersection. See 7.10.3.

7.10.1.2 Lane Exit Slot: The last slot in exactly one lane of a street,

moving in a given direction (north-south, east-west,

south-north, west-east) that a car occupies before it

moves to a Roundabout Entry Slot (defined in 7.10.1.3). See

7.10.3.

7.10.1.3 Roundabout Entry Slot: The first slot in a roundabout that a  
 car will occupy after it moves from a Lane Exit Slot. See 7.10.2.  
 7.10.1.4 Roundabout Exit Slot: The last slot in a roundabout that

a car will occupy before it moves to a Lane Entry Slot. See 7.10.2.  
 7.10.1.5 Grid Entry Slot: The first slot in each lane that is adjacent to

the grid border that a car will occupy in the first time

unit when it enters the grid.

7.10.1.6 Grid Exit Slot: The last slot in each lane that is adjacent to the

grid border that a car will occupy immediately before it leaves

the grid.  
 7.10.2 Each Roundabout has exactly one Entry Slot corresponding to each  
 cardinal direction, and exactly one Exit Slot corresponding to   
 each cardinal direction.  
 7.10.3 Each Lane has exactly one Lane Entry Slot and exactly one Lane   
 Exit Slot.  
 7.11 Street: 2 parallel, adjacent lanes aligned in opposite directions that  
 are confined, in length, by two intersections or one intersection and   
 the boundary of the grid.  
 7.12 Time Unit: an instant in the simulation such that 1 event occurs in the  
 simulation for each unit (such as a car moving to another slot).   
 7.13 Traffic Congestion: the average number of time units that cars that   
 both entered and exited the grid spent on the grid.  
 7.14 Traffic Control Device: A roundabout, traffic light intersection, or   
 stop sign intersection  
 7.15 Traffic Flow: the rate of change of the number of cars in the grid   
 during one or more time units.   
 7.16 Turn: A car is considered to have turned if it exited an intersection   
 moving in a different direction than the direction that it was moving   
 immediately before it entered the intersection.