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CSCI 3302 HW 2

1. Driving route
   a. To minimize the number of turns on my route I would use a discrete algorithm like Dijkstra that treats cost as the number of turns (0 if straight to next node and 1 for turning left or right) rather than distance between nodes, that way the algorithm would find the path with the least turns to the destination rather than the shortest path.
   b. Possible cost function (want to minimize) f = $l + l * t$
      i. Where $l$ is length of the path and $t$ is the number of turns, the two terms will scale each other for an overall cost, and this gives turning a heavy weight… For example if you drive 5 miles and make 10 turns you'll have a cost of 55 but if you drive 10 miles and only make 2 turns you'll have a cost of 30. The solo $l$ is mainly for the case of driving a long distance without making any turns (like freeways) such that you still have a distance cost rather than a cost of zero.

2. Ratio (# of points in tree) / (# of points sampled) converges to the area of free space divided by total space, or ($A_{free}$ / $A_{total}$) as the tree only grows in free space while the samples will be the total area.

3. K-d-tree insertion time O(k*N*log(N))

4. Bandwidth – speed with which measurements are delivered, dynamic range –ratio of lowest and highest reading.
   The bandwidth of an ultra-sound sensor decreases when you in increase its dynamic range because with increased range the sensor has to wait longer on each ping sent out for it to reach a distant object and return. Therefore the bandwidth for an ultra-sound sensor is directly correlated to the max distance of the ping, or essentially the dynamic range. For the case of the laser range scanner, light travels much faster than sound so increasing the dynamic range shouldn't make much of a difference in the frequency of incoming data.

5. Autonomous car
   a. Time it takes to hear back from US sensor: traveling 300m/s takes .1 s to cover 30m (15m to object and 15m back), or 100ms.
   b. Laser scanner has bandwidth of 10Hz (10 cycles per second) so converting to time that is .1 s every cycle or again 100ms.

6. GPS sensor
   a. Accuracy – staying within a 30 meter radius of the true location of the receiver
      Precision – position estimates within a circle of approximately 3m diameter
   b. (18000 readings/hour) * (hour/3600s) = 5 readings/s -> that's 5 cycles per second, thus the bandwidth is 5Hz.