**Comment 1**

The project proposes the use of a distributed convex optimization problem for the purpose of minimizing energy consumption across all vehicles for a ride-sharing platform. The project is an interesting and novel one, although there are certain limitations to the formulation that are discussed below. In particular, the formulation does not consider more complex pick up and drop off patterns. Additionally, experimental validation of the algorithm and comparison of energy consumption to other scheduling algorithms would be interesting.

**CLARITY/PRESENTATION**

Describes the problem clearly – 5  
Clearly identifies the problem as a global energy minimization problem.

Information is well organized – 5  
Abstract/background/introduction clearly summarizes the motivation for the project and highlights the goals that the authors intend to achieve.

The problem is clearly separated into a rider pickup and dropoff problem, which provides for an intuitive flow of ideas.

Accurately and objectively presents results – 4  
Mathematical results are well formulated, although experimental data is not present. Limitations of the proposed approach should be discussed (discussed below).

Properly cites resources – 5  
Previous literature on scheduling and permutation spaces is properly cited.

**TECHNICAL CONTENT**

Work is complete and self-contained – 5  
The authors clearly address the goals indicated in the abstract, primarily energy use minimization.   
Results are mathematically correct – 4  
The argument that the overall energy minimization problem can be reduced to a per-vehicle distributed energy minimization problem is mathematically sound only in certain situations.

Note that the formulation does not assign vehicles to passengers based on whether the passengers are headed in the same direction. Such a problem cannot be solved with a distributed optimization problem since it would involve having to compare the existing passengers across all vehicles. Additionally, the formulation does not consider interleaving pickups and dropoffs. Instead, the formulation decides drop off order after deciding which passengers to pick up. These considerations understandably make the problem more complex and may not be a reasonable ask for the purposes of the final project. However, I believe that these limitations should be clearly stated (or suggested as a future direction). The proposed approach may nonetheless be a useful heuristic for these more complex scenarios - perhaps a simulated comparison is warranted.

Experimental results are sufficient - 1

Experimental results are currently missing from the report, although I presume the authors will be working on this front for the purpose of the final report. In particular, I would be curious to see the optimization problem applied to an artificially generated problem in an environment with varying road types and vehicles. I would also be interested in comparing the energy consumption obtained with the proposed algorithm to, say, the energy consumption associated with a random ride assignment algorithm or another existing ride assignment algorithm that is not necessarily aiming to minimize energy consumption but has the same constraints.

The approach is original - 5  
The authors address how their current work is unique by indicating that no prior literature focuses on the problem of energy minimization.

**Comment 2**

The report starts with a background that explains the state of art of the ride-sharing algorithm, which is the focus of this project. Then it provides an in-depth description of the two major parts of solving a ride-sharing optimization problem, the rider pick-up and scheduled drop-off, and the team’s focus on incorporating energy efficiency to be part of the optimization. Next, the team’s formulation of the pickup and drop-off problem is introduced and thoroughly explained in the Mathematical Formulation section.

The report provides a detailed introduction and explanation of concepts relative to the project so that it is very easy to follow and understand the team’s take on the problem. Moreover, the explanation on the formulation of the proposed problem formulation is also very thorough. One potential improvement would be elaborate a bit more on how the drop-off problem is planning on utilizing the distributed method. I see that it is briefly stated that the master problem will be to minimize system-wide energy use and the subproblems are to find the optimal drop-off for a specific vehicle and customer. It would be nice to include a little bit on how the subproblem result will get fed into the master problem, and how does master problem handle these results. Moreover, the performance of the model on some data and evaluation of result would be nice for the final report.

Clarity/Presentation - 5   
The problem is stated very clearly, report is easy to follow and well organized.

Technical content - 4 Approach is complete and self-contained, and original. However, lack some preliminary results

**Comment 3**

He commented on our pdf so I took just the comments out.

**Brief**

While this is one way to formulate the problem, it does not consider interleaving pick-ups/drop-offs and furthermore does not consider how several passengers headed in the same direction should be in the same vehicle. Example:

Car A and car B want to pick up passengers P1 and P2.

Assuming gas consumption/road conditions are the same but distance to P1 and P2 are different, car A is 3 miles from P1 and car B is 4 miles from P1. Car A is 4 miles from P2 and car B is 3 miles from P2. P1 and P2 are going to the same place 50 miles away. With the current formulation, car A would pick up P1 and car B would pick up P2 and 2 cars would then head in the same direction to the passengers' mutual direction. It would have been more efficient for a single car to pick them both up.

For the

Is this constraint correct? What would prevent y\_i from taking on decimal values that sum to 1, i.e.

y = [0.3 0.5 0.2] which satisfies the constraint but is not a unit vector?

**Comment 4**

Summary: An approach for globally minimizing energy consumption in a rideshare application is considered. The authors present the problem as a two-phase problem: rider pick-up and drop-off. Each of these phases is solved using a distributed convex optimization algorithm (distributed to each vehicle) that relies on a simple model for fuel consumption. While experimental validation is not provided, the appropriate tools for setting up an experiment (such as the Google Maps API) is mentioned. The authors build on existing work involving scheduling algorithms and combinatorial problems.

**Comment 5**

Jayakrishnan and Sakthivelu present the problem of carbon minimal routing for so-called ride-sharing services like Uber Pool and Lyft Line. They construct a distributed optimization problem, which is in part combinatorial, in order to assign passengers to vehicles in a way that allows for each car to minimize carbon production. Notably, this can respond to dynamically arriving passengers in order to update routes online. Their notation is in a few moments deeply confusing. They switch between $y\_i$ being a boolean and a vector repeatedly throughout the document often within a single sentence. Also the paragraph beginning "Whenever a new customer", took me a number of reads to understand fully. Terms like "psuedo roll-outs" were not ones I was familiar with. Further, I think this project would greatly benefit from experiments on how often it is tractable. They repeatedly optimize over permutations and use factorials in indexing variables, which makes me concerned that this algorithm is not practically useable.

**Clarity Score: 4**

There were some sections that were hard to follow and there is a significant amount of variable name dumping without much help following what they all mean. I had some difficulty following the writing.

**Technical Content Score: 4**

There problem formulation is fascinating and well done, but I am deeply concerning about its tractability.

**Comment 6**

**Constructive feedback:**

(a) The report looks great and is well-written to explain the motivation behind the problem. The technical contributions are however unclear and could use more highlighting/sign-posting.

(b) If your main result relies on prior work on the distributed convex optimization, it would be great to include additional detail about their proofs / derivations.

(c) Experimental evaluation would help validate the approach. Designing a simulation to convince readers that your algorithm is correct would greatly contribute to the report.

**Alternative Approaches:**

(a) Experimental simulation would probably be the best addition to the report. It would let you simulate the types of vehicles and ridership, showing the (near) optimally of your algorithm. You could vary the number / type of cars / locations to show di↵erent scenarios.

(b) The di↵erence between your algorithm and baselines would really help quantify the degree of improvement. For example, how much worse is a greedy approach of choosing whose total trip is the shortest.

(c) Are you treating the simulation as a continuous process? You may consider rollouts where there is an expectation of a rider showing up in specific locations, as I believe this is more similar to current rider-driver matching schema.

(d) In light of the limited carpool trips (due to Covid) is there another way to formulate the problem so that next-pickups are economical?

**Questions/comments for the final report:**

(a) Does routing (i.e. directions from Maps) e↵ect eco-friendliness? Does the newly released eco-directions match your cost function?

(b) Could you reformulate the problem to allow drivers to pickup riders after a dropoff ?

(c) Please include details about the efficiency of carpooling on these systems. In personal experience, I was often not matched with others on trips.

**Tentative Score:**

**(a) Clarity/organization: 4**

The report does a great job of describing the problem of rider-driver matching. Sections are well-organized and allow novice readers to understand the motivation and formulation. The only caveat is the lack of clarity in what is prior work vs. what is novel contribution.

**(b) Technical Score: 3**

It is not immediately clear to me what the technical contribution of the report is in relation to prior work. On the understanding that the main result is the reformulation of the objective, I rate this as a 3 as it simplify redefines an objective without making use of the structure. The approach appears unoriginal, and there are little to no experimental results to support the claims.