Orf 467

Term Exam

Monday, November 25, 2013

**Instructions**

1. This exam is **Closed Book/Everything (except Brain & Cheat Sheet)** to be taken under a **strict** definition of the honor code. You have 80 minutes to complete the exam, starting at 1:30pm, ending promptly at 2:50pm. The exam is printed below.
2. By **Closed Book/Everything** I mean that you are allowed to use your brain, a single 8.5”x11” sheet of paper, a pencil, and an eraser. **Nothing else!**

If you bring a phone, electronic device, computer, iPod, iPad, iXxx, notebook, book, calculator or anything else, all of those items MUST be place in a bag or back pack (not your pockets) and remain there during the entire exam. If you do not have a bag or back pack in which to place these devices, you MUST place them on the desk in front of the room before you start the exam and retrieve them after you have completed the exam. You may not take a call, respond to a tweet, or check Facebook at any time during the exam. Non-compliance will be considered as a violation of the honor code. Do NOT sign the pledge if you are non-compliant.

1. There are 4 questions having many parts. This is a long exam and will take some time, especially #4! Be concise and please answer MY questions; don’t add some of your own! (That makes the exam even longer!!)
2. Please use pencil and write neatly. I can’t grade what I can’t read.
3. You are permitted a 2-sided 8.5x11 inch “cheat sheet”. It MUST have your name on it. Its preparation is subject to the University’s honor code. (Basically, you wrote and prepared it; it is not a copy of someone else’s. It does NOT need citations. You can create it electronically using “cut & paste”.). It MUST be turned in with your exam. If you choose to take the exam without using a cheat sheet you MUST write in big letters on the front page of the exam: “I Am NOT using a Cheat Sheet.” This must be written BEFORE you start the exam. If your exam booklet does not contain your cheat sheet and does not have the “NOT using” declaration written on the front, I will NOT grade your exam.
4. You need NOT transcribe an answer from your cheat sheet. Simply circle the answer and mark it with the question number. Indicate on your exam booklet “see cheat sheet”. If I find it and can read it, I will grade it; else, zero!
5. I will only grade exams that have a signed pledge.
6. Good Luck!

1. (20 pts.) **Generalities**

1. (2pts.) What fundamental value does transportation deliver to society?
2. (3pts.) Given a linear network of N nodes and A arcs. What is produced by Dykstra’s algorithm (and other shortest path algorithms) that makes the determination of the optimal path from any node to the source node so easy to determine?
3. (3pts.) How does a turn-by-turn navigation system, for example CoPilot, know where it is?
4. (2pts.) How does the Google self-driving car know its current position?
5. (3pts.) How accurately does a turn-by-turn navigation system, for example CoPilot, **need** to know its current position? Why does it only need this level of accuracy?
6. (2pt.) What is really elegant about Dyksta’s algorithm?
7. (3pts) What are the fundamental technological characteristics that differentiate Personal Rapid Transit (PRT) from conventional light-rail transit?
8. (2pts) What are the fundamental technological characteristics that differentiate aTaxis from Personal Rapid Transit (PRT)?

2. (25 pts.) **Transportation Policy and Plans**

1. (3 pts.) According to Kornhauser, what transportation project would be most beneficial to Princeton University, why?
2. (2 pts.) Federal legislation promoting the construction of a nation-wide system of limited-access highways failed to get congressional approval when originally proposed in 1954. Two years later a similar bill passed overwhelmingly. What were the two major elements that were added to the 1954 legislation that have been generally credited for the passage of the bill in 1956?
3. (20 pts) Last May, NHTSA released a Preliminary Statement of Policy Concerning Automated Vehicles. NHTSA identified 5 “Levels” of automation (Level 0 -> 4) focused on roadway vehicles

i. (4pts) List the salient feature that characterizes each of the 5 levels. For example: Level 0, No automation. The human driver is in complete control all of the time.

ii. (16 pts) For Levels 1, 2, 3 and 4 individually:

1. (4pts) Describe/name the most important value/utility that this level of automation delivers to the **Purchaser** of this Level of automated vehicle.
2. (4pts) Describe/name the most important value/utility that this level of automation delivers to **Society** if this Level of automation is a market success.
3. (8pts) What is the maximum price per vehicle ($/vehicle) that the car-buying market will bear for each of these levels (ie., what is the perceived dollar value of each of these Levels of automation by the potential purchasers of these so-equipped vehicles)? Justify your answer with few, rather than many, words.
4. (30 pts.) **Transportation Planning Models** 
   1. (10pts) The “classical 4-step” transportation planning model.
      1. (5 pts.) Name the steps and list the typical data elements that are INPUT to each step?
      2. (5 pts.) List the typical data elements that are OUTPUT by each step.
   2. (20pts) You’ve decided that the MyCity Homework should be upgraded to address the disaggregate rather than aggregate travel behavior of the city so you have decided to build an activity-based individual trip synthesizer that will generate each of the million or so daily trips taken by the residents of MyCity. Your objective is to have the spatial “granularity” of each trip be precise enough to be able to measure walk accessibility to either a PRT station or an aTaxi stand. Also, the temporal “granularity” of each trip needs be precise enough to assess the propensity of the opportunity for ride-sharing and its changes with the length of the delay in departing a vehicle to wait for potential ride sharers (“DD”).
      1. (10pts) Describe the process that you will use to generate this individual trip file for your MyCity. Be sure to give examples of the distributions that you will use and the potential source for these distributions (or the source data from which you might generate the distributions)
      2. (10pts) How will the land use data need to change to make this process yield a typical day’s million or so trips. Give a couple of concrete examples.
5. (25 pts.) **Operational Design, Analysis & Assessment of an Area-Wide aTaxi Systems**

For a while now, I have been trying to motivate you to work as a team in the design and analysis of an area-wide autonomousTaxi (aTaxi) system for New Jersey. The hope was to do a good job for New Jersey, then extend the effort to the whole country.

1. (5 pts.) To those ends, previous classes and other students at Princeton have developed an “activity-based” Trip Synthesizer the main output of which are “NN” files.
   1. (1 pts.) List the data elements (“columns”) contained in the “NN” files (I don’t expect you to have memorized them, but you should be able to describe the important data elements contained in these files)
   2. (2 pts.) Approximately how many “NN” files were created for NJ and how many records (“rows”) are contained in all of the files (estimate of the total over all the files)
   3. (2 pts.) When we do this for the whole nation, approximately how many “NN” files will we look to create? How many records will be contained in all of those files?
2. (5 pts.) Chenyi used the “NN” files to create “oTrip” files
   1. (1 pts.) List the data elements (“columns”) contained in the “oTrip” files (I don’t expect you to have memorized them, but you should be able to describe the important data elements contained in these files)
   2. (2 pts.) Approximately how many “oTrip” files were created for NJ and how many records (“rows”) are contained in all of the files (estimate of the total over all the files)
   3. (2pts.) When we do this for the whole nation, approximately how many “oTrip” files will Chenyi look to create? How many records will be contained in all of those files?
3. (5 pts.) In creating the “NN” files for the whole Nation, briefly describe
   1. (1 pts.) what will be straightforward about the process (easy to do can or can be “borrowed” from the NJ effort)
   2. (2 pts.) what will be “most challenging”?
   3. (2 pts.) suggest a simplification that might make the “most challenging” doable.
4. (6 pts.) When Chenyi creates the “oTrip” files for the whole Nation, briefly describe
   1. (2 pts.) what will be straightforward about the process (easy to do can or can be “borrowed” from the NJ effort)
   2. (2 pts.) what will be “most challenging”?
   3. (2pts.) suggest a simplification that might make the “most challenging” doable.
5. (4 pts.) Estimating the spatial and temporal distributions of the Shared Ridership potential is a major objective of both the NJ and the Nationwide analysis.
   1. (2 pts.) What is the fundamental difference between a national vs NJ shared ride analysis?
   2. (2 pts.) What aTaxi operational (level-of-service) characteristics do you expect will tend to maximize Average Vehicle Occupancy without substantially degrading “level-of-service”?