

Connected and Automated Vehicles Problem Solving Course

University of Michigan
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Professors:

Dan Crane (dancrane@umich.edu)

Anuj K. Pradhan (anujkp@umich.edu)

Bryant Walker Smith (bryantws@newlypossible.org)

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We are delighted that you have enrolled in this this course. This memo provides some background on our expectations and the problem that we will be collectively confronting.

The Law School's Interdisciplinary Problem-Solving Initiative

In the Winter 2017 semester, the Law School launched a new problem-solving initiative with two pilot courses, including one on connected and automated vehicles (“CAV”). A team of fifteen graduate students from law, business, engineering, and public policy accepted the challenge of coming up with commercial use cases for data generated by connected vehicles using dedicated short-range communication (“DSRC”) technology. At the conclusion of the course, three teams of five students presented their proposed use cases to a panel of industry and government experts in a capstone session.

In the Fall of 2017, we offered our second PSI Course in CAV—this one to 23 graduate students. That course focused on the problem of Level 3 autonomy, as defined by the Society of Automotive Engineers (“SAE”). Level 3 autonomy, or conditional automation, is defined as a vehicle driving itself in a defined operational design domain (“ODD”), with a human driver always on standby to take over the vehicle upon short notice when the vehicle exits the ODD. As with the first course, our student teams spent the semester collecting information from industry, governmental, and academic experts and proposing a series of innovative solutions to various obstacles to the deployment of Level 3 systems.

As we embark on our third semester in the PSI with a new CAV topic (described below), we look forward to welcoming graduate students from business, engineering, information, law, and public policy and interacting with faculty from other University units. Our goal is for students to develop cross-disciplinary cultural competence and learn to operate in collaborative spaces with an appreciation for the language, norms, perspectives, and practices of other disciplines. The program also offers students a chance to apply their subject matter expertise in practical ways in the service of solving big, emerging problems that matter.

We are also extremely grateful for the support and help of Mcity and administrators in various other graduate departments.

The Focus of this Course

Our course this semester is entitled Connected and Automated Vehicles: Preparing for a Mixed Fleet Future. Our focus will be on the potential multiple problems created by the unavoidable future interactions between automated vehicles and other road users, such as non-automated, human-driven vehicles, pedestrians, and bicyclists.

Although cars can be programmed to follow rules of the road, at its core, driving and roadway use are *social* activities. Roadway users rely heavily on social cues, expectations, and understandings to navigate shared transportation infrastructure. For example, although traffic circles are in principle governed by a simple rule of priority to vehicles already in the circle, their actual navigation tends to be governed by a complex set of social interactions involving perceptions of the intentions, speed, and aggressivity of other vehicles. Similarly, while most states require bicyclists to obey stop signs and traffic lights, most bicyclists do not; prudent drivers should not expect them to.

Can cars be programmed to behave “socially?” Should they be, or is the advent of robotic driving an opportunity to shift norms and expectations toward a greater degree of adherence to roadway rules? Will programming vehicles to be strictly rule compliant make CAVs “roadway wimps,” always giving in to more aggressive roadway users? Would that kill the acceptance of CAVs from a business perspective? Is reform legislation required to permit CAVs to mimic human drivers?

More generally, is the advent of CAVs an opportunity to reshape the way that all roadway users access roadways? For example, could the introduction of automated vehicles be an opportunity to reduce urban speeds? Or to prohibit larger private vehicles from some streets (since people may no longer be dependent only on their individually owned car)?

These questions are simply illustrative of the sorts of problems our class may choose to tackle. Working in interdisciplinary groups, our class will attempt to identify and solve the key legal, regulatory, technological, business, and social problems created by the interaction between CAVs and other roadway users.

Professor Roles and Availability

Professors Crane and Pradhan are the primary instructors for this course and will be present in class each week. Professor Walker Smith is assisting with the class, primarily remotely from the University of South Carolina. He will participate in some, but not all, classes, and mostly by videoconference. He will also be available outside of class time to answer student questions by e-mail or telephone.

Bridget Carr, Associate Dean for Strategic Initiatives (carrb@umich.edu), heads the PSI program. Andrea Quinn (amquinn@umich.edu), Assistant Director of the Problem Solving Initiative, is available to work with teams on various aspects of course organization and logistics.

Course Goals, Expectations, and Deliverables

Our class will be broken into four or five teams. Each team will be expected to begin developing a solution to a particular challenge related to the mixed fleet future. The schedule below provides more detail, but the gist is as follows: After the first four class sessions, each group will come up with a list of three potential aspects of the “mixed fleet future problem” that they might choose to address. Two weeks later, after consultation with the professors and further discovery, each team will select a final topic and pursue that for the remainder of the course. Professors will work with teams on topic selection to ensure that, collectively, our class is addressing the most pressing legal, regulatory, technological, business, and social issues related to interactions between CAV and other roadway users. On October 23, we will have a mid-term presentation session where each group will present its ideas in draft to an internal panel (e.g., University of Michigan professors, Mcity faculty, etc.). Feedback from this session, in combination with ongoing class sessions and further group research and work, will prepare you for the capstone presentations in which you share your solutions with a panel of distinguished external experts from industry, academia, and government during the last class session.

Schedule and Logistics

Our class meets on Tuesdays in Room 1020 of South Hall (FYI for students from other units, this is the “new” law school building just across Monroe Street from the main law quad). There are nominally two sessions on Tuesdays, a “lab” session from 3:15-4:15 and a “class” session from 4:30-6:30. In principle, the lab time is “internal time,” meaning working in groups, logistical discussion, in house matters, whereas the class time is “external time” dedicated to outside speakers. However, we may erase the lines sometimes to accommodate outside speaker schedules or just to make things work more fluidly. So please think about 3:15-6:30 on Tuesdays as a block devoted to our class.

Also, an important logistical and cultural note: We are aware that in many units, classes tend to begin five or ten minutes after the appointed start time. Not so in the law school! We expect to begin on time and will make every effort not to hold you over after 6:30. Also, attendance at all classes is mandatory and unexcused absences could affect your grade.

In the preliminary schedule below, you will see some speakers or content penciled in for some dates. You will also see that most dates are open. This is intentional. This is not a traditional lecture class in which a set order of speakers or content is predetermined. It is a problem solving course in which we, as a class, will deliberate over the resources we need to address the problem as we proceed. This means that your ideas on what speakers

to invite will be critical (and interviews with early speakers should lead to ideas for further speakers). Nonetheless, please do pay particular attention to dates already established on the calendar.

- September 4: Introductions, team-building exercises. Introduction to legal and technological issues, with introductory discussions by Matthew Johnson-Roberson (<http://droplab.engin.umich.edu/matthew-johnson-roberson/>) and Bryant Walker Smith.
- September 7: Boot Camp with Patrick Barry and Andy Burnett will run from 1:00-5:00 in SH 0225
- September 11: Discovery sessions with people in municipal government; introduction to human factors analysis by Anuj Pradhan.
- September 18: Discovery sessions with industry (car companies, transportation service providers)
- September 25:
- September 27: Not a class date—deadline for each group to submit list of three potential problems mixed fleet environments their group might address.
- October 2:
- October 9:
- October 11: Not a class date—deadline for each group to submit final problem topic.
- October 16: NO CLASS
- October 23: Mid-course presentation to internal panel (i.e., Mcity, Michigan faculty)
- November 30:
- November 6:
- November 13:
- Nov 20:
- Nov 27:
- Dec 4” Capstone presentation, followed by dinner and debrief.

Background Readings and Class Presentations

By September 4 (the first day of class), you should have completed your first assignment, which has two parts.

The first part is to carefully review the following background readings listed as assigned for the first day in Canvas. (There is a separate file called Resources with some additional readings that may be helpful over the course of the semester).

The second part is to prepare to take the lead in discussing each of the following questions in small groups during our first class session.

- At first blush, what do you think are the most significant problems that will arise from mixed fleet environments?
- Are the problems primarily technological, legal, regulatory, business, social or something else? Are they amenable to being solved from just a technological, legal, regulatory, or business perspective?
- Do some problems involving CAV/other roadway user interaction require segregating CAVs and other categories of roadway users? If so, how do we begin thinking about priority and allocation rules?
- Can robots ever replicate the complex social actions of people? Should we want them to?
- Keeping in mind that the fleets of the future will be both automated and *connected*, how does the connectedness or communication feature of CAV feature in your analysis of the key problems faced by mixed fleet environments?

Beginning September 11, we will offer weekly slots for individual students to make a short presentation of no more than three minutes on a reading or other material that you believe is relevant to the problems we are trying to solve. An online sign-up system will be utilized. Each student will be expected to present at least once over the course of the semester. Further presentations are optional. The ideal presentation would: (1) Briefly summarize the key point or points of the reading; (2) Explain its relevance to the course; and (3) Suggest any follow-up steps for the presenter, a group, or the class. It is up to each presenter to select the reading. It could be any material you feel relevant. Examples include, but are not limited to:

- Article in popular media.
- Technical report about a new technology.
- Article in a professional or technical journal or publication.
- Judicial decision, statute, or regulation.
- Government report.
- Analyst report.
- Patent application.
- Chapter of a book.
- Conference or webinar presentation.
- Interview with a subject matter expert.

Presentations will count toward your final course grade.

Team Organization, Work Product Sharing

By the second class (September 11), each team should have selected a team representative to serve as a liaison with other teams regarding shared work product. In consultation with their respective teams, the representatives should select and set up a method for sharing documents, drafts, and information within the group. We leave it to you to select your own preferred method of working. You own it! The only requirement we will impose is

that whatever work product you create must be made available on our class's Canvas site during the semester and permanently thereafter. (Having a class archive is important administratively for various reasons). Team representatives should work with Andrea Quinn to make this happen.

As individuals or teams create work product—e.g., interview memos, article collections, shared presentation drafts, etc.—they should post them in appropriate folders in the shared site. Instructors, students, and administrators should have shared access to the class's work as it unfolds.

Grading Expectations

We recognize that grading a non-traditional course largely based on collaborative work and team presentations is challenging. However, it is not unprecedented, and we have worked with CRLT to develop grading metrics that we believe are workable and fair. This course is not bound by the Law School's grading curve, so grading is not a zero sum game.

We will provide further details about aspects of grading as the course progresses, but here are the key components that will be reflected in assessing final grades.

1. **Reading presentations (10%):** Assessment of 3-minute presentations based on relevance of article presented and clarity and effectiveness of presentation.
2. **Team work product (40%):** Did the team's work product demonstrate excellent judgment and superior research, analysis, critical thinking, and problem-solving skills? Did the team express its thoughts in an organized manner? Did the team's written and oral work product employ proper grammar, sentence structure, and vocabulary? Did the team's work product respond effectively to potential challenges and positions expressed by others? Did the team contribute significantly to the success of the overall plan or strategy?
3. **Team functioning (10%):** Did the team display cooperation and effective communication? Did the team function effectively and utilize skills and knowledge of all team members? Did the team consult with the professors and other knowledgeable experts appropriately? Did the team meet established deadlines?
4. **Individual effort and interaction with group (20%):** [Note: Input for this portion of the grade will be obtained from peer assessment forms, but the ultimate responsibility for this assessment will be the professors']. Did you attend group meetings consistently and arrive on time? Did you contribute meaningfully to group discussions? Were you open to, and respectful of, other points of view? Did you complete group assignments on time? Was the work you prepared for the team high quality? Did you demonstrate a cooperative and supportive attitude? Did you contribute significantly to the success of the project?
5. **Individual participation and professional relationships (20%):** Did you participate regularly in class discussions and pose questions to speakers? Were you prepared to discuss developments in your projects in an effective manner with other students? Did you respond courteously and with due consideration to professors, guests speakers, consultants, and classmates? Did you strive for cross-disciplinary

cultural competence (i.e., and appreciation for the language, norms, perspectives, and practices of other disciplines) and understanding of other differences among your classmates? Did you display honesty and integrity?

Course Philosophy

We are deliberately *not* structuring this course as a conventional graduate course involving linear delivery of prepared content. The goal is for *you, the students*, to come up with solutions to big problems in the world, working on a multidisciplinary team. We, the instructors, aren't sitting back hiding the answers. We don't have them. Really. We see ourselves as facilitators, conveners, project leaders, and (occasionally) experts, but *you* are ultimately running the show.

Further, we haven't mapped out how this will go from beginning to end. We have spent a lot of time researching the background questions, interviewing industry and academic experts, and lining up potential discovery resources, but we have not yet sketched out the entire agenda because we need to steer the ship based on the questions you ask, the ideas you have, and the information that materializes during our shared discovery process.

Consequently, this will occasionally get a bit chaotic. Many of the government, industry, and academic experts who we want to make available to the class are very busy people with shifting schedules. It may turn out that some of the people we most want to talk with are only available by phone at times other than our class sessions, and that some of the discovery may be led by sub-teams meeting at odd hours. Important interviewees may cancel at the last minute or tell us that the questions we most want answered are proprietary. That's ok. It may turn out that we pursue solutions to mixed fleet environment issues that turn out not to make any sense. That's ok. Learning by failing is part of the game.

Usage of class time will vary over the course of the semester. Early in the semester, there will be more of an emphasis on discovery from outside speakers and learning basic information; as the semester progresses, an increasingly large share of time will be spent in group work time and class-wide work on presentations leading up to the capstone. (Again, don't hold the 3:15-4:15 "lab," 4:30-6:30 "class" designation very tightly; we will use our time flexibly to meet our course goals).

Some outside speakers may choose to make formal presentations. Many will simply show up and be available to answer our questions about what their organization is doing on a particular issue. Students will be expected to take the lead in pursuing questions or discussions that help our groups and class as a whole discover the information necessary to solve the problems we've undertaken.

In short, please enter this course with a spirit of flexibility, creativity, and ingenuity. Remember that our goal is to mimic the best kind of problem solving in the real world: teams combining people with different expertise, ideas, strengths, and backgrounds pooling their ideas, time, sweat, and muscle to get things done.

We are tremendously excited about this course and the future of CAV. We hope that you are, too.

D.A.C.

A.K.P

B.W.S.