Introduction to Intelligent Vehicles
[0. Course Introduction]

Chung-Wei Lin

cwlin@csie.ntu.edu.tw

CSIE Department

National Taiwan University

Fall 2019

Introduction to Myself

❑ **B.S. Student**
➢ 2001.09--2005.06, CSIE Department, NTU

❑ **M.S. Student**
➢ 2005.09--2007.06, GIEE (EDA Group), NTU

❑ **Ph.D. Student**
➢ 2009.08--2015.08, EECS Department, UC Berkeley
  • Some interesting teaching experience here

❑ **Researcher**
➢ 2015.09--2018.07, Systems and Software Division, Toyota InfoTechnology Center (Mountain View, CA)

❑ **Assistant Professor**
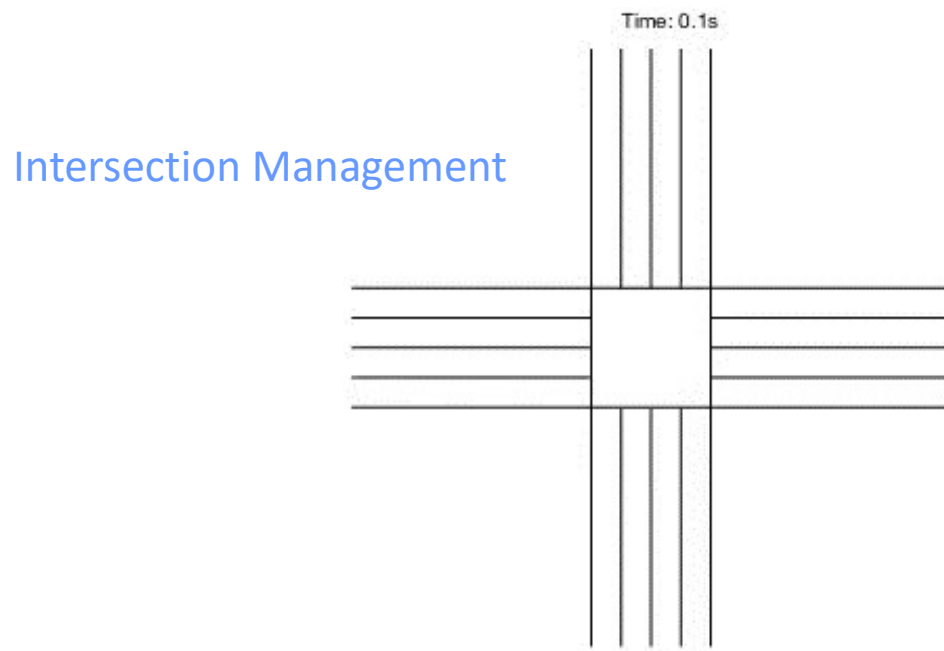➢ 2018.08--, CSIE Department, NTU

And You Are?

- ❑ Department?
- ❑ Year?
- ❑ Enrolled or Auditing?
- ❑ Waiting List?
- ❑ Programming Skill?
- ❑ Research Topic?
- ❑ Career Goal?

Intelligent Vehicles

❑ **Connected** and **Autonomous** Vehicles (CAV)

➢ A good application may need both of "connectivity" and "autonomy"

Intersection Management

Time: 0.1s

➢ What if the intersection management does not have connectivity?
➢ What if the intersection management does not have autonomy?

Learning Goals (1/2)

❑ Skills in

  ➢ Modeling

   • We will work (design and analyze) upon models rather than real vehicles

  ➢ Design

   • We will optimize some objectives (performance, robustness, security, etc.)

  ➢ Analysis

   • How good are the designs?

❑ Philosophy behind technology (which may expire soon)

  ➢ Example

   • The Controller Area Network (CAN) is old and slow (~500kbps)

   • **Why** is it still the most popular in-vehicular network protocol?

Learning Goals (2/2)

❑ **NOT covered in this course**

  ➢ The mechanics of vehicles

  ➢ The physics of vehicles

  ➢ The chemistry of vehicles

  ➢ Electric vehicles

❑ **Covered a little in this course**

  ➢ Machine learning

https://www.thehenryford.org/

https://www.formula1.com

Calendar (Tentative)

Date	Topic	Note
Sep 9	[0] Course Introduction [1] System Architecture	Homework 0 Posted
Sep 16	[2] Timing Analysis I	---
Sep 23	[3] Timing Analysis II	Homework 1 Posted
Sep 30	[4] System Design	---
Oct 7	[5] Advanced Driver-Assistance Systems [6] Cooperative Adaptive Cruise Control	Homework 1 Due (Noon)
Oct 14	TBD	Homework 2 Posted
Oct 21	[7] Intersection Management	---
Oct 28	[8] Connectivity	Homework 2 Due (Noon)
Nov 4	[9] Sensing and Perception	Homework 3 Posted
Nov 11	[10] Planning and Control	---
Nov 18	[11] Verification and Testing	Project Proposal Due (Noon)
Nov 25	[12] Security	Homework 3 Due (Noon)
Dec 2	[12] Security	---
Dec 9	Midterm	---
Dec 16	[13] Edge Computing [14] Certification	---
Dec 23	Project Presentation	---
Dec 30	Project Presentation	---
Jan 6	Project Presentation [15] Summary	Project Report Due

2 Weeks for HW1

2 Weeks for HW2

3 Weeks for Proposal and HW3

2 Weeks for Midterm

4 Weeks for Project Presentation and Report

7

Lecture Plan

❑ Four parts in sequence
  ➢ [Part 1] Preliminary
  ➢ [Part 2] Applications
  ➢ [Part 3] Intelligent Technology
  ➢ [Part 4] Advanced Topics

❑ However, please expect that topics will be "discrete"
  ➢ May exchange the order of topics
  ➢ May have a business trip

❑ Third hours in the second half of the semester
  ➢ May have discussion, practice, project presentation, or random talks
  ➢ Reason
    • Three-hour knowledge is too much

Websites and TAs

❑ Basic information
   ➢ https://www.csie.ntu.edu.tw/~cwlin/teaching/5452.html
❑ Slides, homework assignments, homework solutions, announcement, and discussion
   ➢ NTU COOL: https://cool.ntu.edu.tw/courses/366
   ➢ You are mandatory to check the announcement there
❑ Homework submission and grading
   ➢ Gradescope: https://www.gradescope.com/courses/54496
   ➢ You can use the entry code MVWNX8 to sign up
   ➢ You can use Homework 0 to practice it

❑ TAs: Yi-Ting Lee and Pin-Yen Huang

Grading (1/2)

❑ Homework: 20%
  ➢ Homework 1: 7%
  ➢ Homework 2: 6%
  ➢ Homework 3: 7%

❑ Midterm: 40%

❑ Project: 40%
  ➢ Proposal: 5%
  ➢ Presentation: 10%
    • Earlier? (you do not need to complete your work to present)
    • December 23 and 30 (you do not need to complete your work to present)
    • January 6 (you should complete your work to present)
  ➢ Report: 25%

❑ Bonus

Grading (2/2)

❑ Please

   ➢ Do not negotiate your final grade
- Some philosophy

   ➢ Follow the policy on academic honesty
- Any student found to be cheating risks automatically failing the class

Homework

❑ Homework is due at **<u>noon</u>**

  ➢ **No late homework is accepted**

    • Though the submission site will be open until 1pm

  ➢ Exception: you email Chung-Wei and **get the approval before the deadline (noon)**

❑ You will need to do some programming

  ➢ Example: read numbers from files and compute something

❑ You are encouraged to work on homework in study groups, but you must write up the solutions on your own

Midterm

❑ You can bring 1 page of single sided A4 note

❑ You can ask (= challenge) for regrading (based on problems) before a deadline, and Chung-Wei will regrade them

➢ For each problem

- If your score becomes higher, you win the challenge
- If your score becomes lower, you lose the challenge
- Starting from the 3rd failed challenge, you get a deduction of midterm score

Project

❑ A team can have 1 up to 3 members

  ➢ More members, higher expectation

  ➢ The contribution of each member needs to be specified clearly in the report

❑ A project can be survey, implementation, or research

  ➢ You can propose your own topic

    • Of course, it must be related to intelligent vehicles

❑ It is highly encouraged to combine your project with your current research, your thesis, or another course project (if the instructor agrees)

  ➢ This must be specified clearly in the proposal and the report

  ➢ Anything you have completed before the semester is not counted

Selection of Project Topics

❑ Survey

➢ If you want to have the safest choice

❑ Implementation

➢ If you are a programming enthusiast

❑ Research

➢ If you are a graduate student or thinking to pursue Ph.D. abroad

Examples of Project Topics (1/3)

❑ Machine learning

➢ Behavior prediction

➢ Image recognition, traffic sign recognition

➢ Pedestrian recognition, objective detection

➢ Play around some data (check https://www.its.dot.gov/data/)

❑ Applications

➢ Advanced Driver-Assistance Systems (ADAS)

➢ Cooperative Adaptive Cruise Control (CACC)

➢ Intersection management

• Payment with blockchains?

Examples of Project Topics (2/3)

❑ **Networking**

➢ Performance evaluation

➢ Comparison between different communication protocols

❑ **Security**

➢ Adversary classification

➢ Intrusion detection

➢ Applications of blockchain

❑ **Human-computer interaction**

➢ Augmented reality and virtual reality?

➢ "Safe" interface

➢ Language understanding

Examples of Project Topics (3/3)

❑ **Software architecture and engineering**

  ➢ Edge computing

  ➢ Architecture (https://local.iteris.com/arc-it/)

  ➢ Open source software

❑ **Theory**

  ➢ Scheduling

  ➢ Timing analysis

  ➢ Game theory analysis

❑ **Design methodology and tools**

  ➢ Simulation environment (e.g., Simulink, Unity)

  ➢ Data collection and creation

  ➢ Modeling, optimization, formal verification

Q&A