



## 教學計劃表 Syllabus

課程名稱(中文) Course Name in Chinese	機器導航與探索		學年/學期 Academic Year/Semester	114/2
課程名稱(英文) Course Name in English	Robotic Navigation and Exploration			
科目代碼 Course Code	TCAI50030	系級 Department & Year	碩士	開課單位 Course-Offering Department
修別 Type	學程 Program	學分數/時間 Credit(s)/Hour(s)	3.0/3.0	
授課教師 Instructor	/簡暉哲/清華大學胡敏君教授			
先修課程 Prerequisite				
課程描述 Course Description				
<p>本課程模組分為三個主要的部分，分別為即時追蹤與地圖建置(SLAM)、基於機器學習之場景理解(Scene Understanding)與探索導航的動作控制(Action Control)。即時追蹤與地圖建置部分包含機率模型與相機模型等理論基礎，也包含基於深度學習之RGB-based的3DSLAM方法。場景理解的部分包含機器學習的基本概念，再帶到深度學習的技術與目前的物件偵測與語意切割技術。動作控制的部分則包含路徑規劃與導航演算法，並帶入強化學習的概念來引導行進的路徑。</p>				
課程目標 Course Objectives				
圖示說明Illustration：● 高度相關 Highly correlated ○ 中度相關 Moderately correlated				
授課進度表 Teaching Schedule & Content				
週次Week	內容 Subject/Topics			備註Remarks
1	Introduction to Robotic Navigation and Exploration			
2	Kinematic Model and Path Tracking Control * Control System Basics * PID Control * Basic Kinematic Model * Differential Drive Vehicle * Pure Pursuit Control * Kinematic Bicycle Model			Lab 1
3	Motion Planning * Motion Planning Introduction * Path Planning * Curve Interpolation * Trajectory Planning * Path Planning			Lab 2
4	Reinforcement Learning (I) * MDP * Value Function * Bellman Equation * Reinforcement Learning			
5	Reinforcement Learning (II) * Q-Learning / Sarsa / DQN * Policy Gradient / Actor-Critic			
6	Project Environment Building (I)			Lab3

7	Project Environment Building (I)	Lab4
8	Project Environment Building (III)	Lab5
9	期中考試週 Midterm Exam	
10	SLAM Back-end (I) * State Estimation and SLAM Problem * Probability Theory and Bayes Filter * Kalman Filter / Extended Kalman Filter	
11	SLAM Back-end (II) * Graph based Optimization * Graph Optimization for 2D SLAM (Bundle Adjustment)	
12	3D SLAM (I) * Feature Descriptor * Multi-view Geometry * Lie Group & Lie Algebra	
13	3D SLAM (II) * 3D SLAM: ORB-SLAM * Direct Method * DNN-based SLAM	
14	3D Embodied Agent	
15	Paper Presentation (I)	
16	Paper Presentation (II)	
17	Project Presentation & Demo	
18	彈性授課	

### 教學策略 Teaching Strategies

- 課堂講授 Lecture                       分組討論 Group Discussion                       參觀實習 Field Trip  
 其他 Miscellaneous:

### 教學創新自評 Teaching Self-Evaluation

#### 創新教學 (Innovative Teaching)

- 問題導向學習 (PBL)                       團體合作學習 (TBL)                       解決導向學習 (SBL)  
 翻轉教室 Flipped Classroom                       磨課師 Moocs

#### 社會責任 (Social Responsibility)

- 在地實踐 Community Practice                       產學合作 Industry-Academia Cooperation

#### 跨域合作 (Transdisciplinary Projects)

- 跨界教學 Transdisciplinary Teaching                       跨院系教學 Inter-collegiate Teaching

- 業師合授 Courses Co-taught with Industry Practitioners

其它 other:

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學期成績計算及多元評量方式 Grading & Assessments

配分項目 Items	配分比例 Percentage	多元評量方式 Assessments							
		測驗 會考	實作 觀察	口頭 發表	專題 研究	創作 展演	卷宗 評量	證照 檢定	其他
平時成績(含出缺席) General Performance (Attendance Record)									
期中考成績 Midterm Exam									
期末考成績 Final Exam	30%								自走車期末專題(含 實作、書面報告、 口頭報告)
作業成績 Homework and/or Assignments	60%								
其他 Miscellaneous (論文閱讀報告)	10%								

評量方式補充說明  
Grading & Assessments Supplemental instructions

教科書與參考書目 (書名、作者、書局、代理商、說明)  
Textbook & Other References (Title, Author, Publisher, Agents, Remarks, etc.)

- Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, Second Edition, MIT Press, Cambridge, MA, 2018
- Sebastian Thrun, Wolfram Burgard, and Dieter Fox, Probabilistic Robotics, 2005. (Intelligent Robotics and Autonomous Agents series)
- Kevin Murphy, Machine Learning: A Probabilistic Perspective.
- Daphne Koller and Nir Friedman, Probabilistic Graphical Models: Principles and Techniques, 1st Edition, 2009.
- Ian Goodfellow, Yoshua Bengio and Aaron Courville: Deep Learning.

課程教材網址(含線上教學資訊, 教師個人網址請列位於本校內之網址)  
Teaching Aids & Teacher's Website(Including online teaching information.  
Personal website can be listed here.)

其他補充說明 (Supplemental instructions)

- 建議學生需已修過Python程式設計、影像處理、深度學習。
- 學生須自備具GPU顯卡之電腦。
- 本課程期末專題採分組開發，為避免影響同組修課同學之權益，本課程不接受期中退選，請謹慎評估可投入的時間再選課。