Course Title	ONLINE LEARNING ALGORITHMS	Instructor	CHUANG-CHIEH LIN
Course Class	TEIBM1A MASTER'S PROGRAM, DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION ENGINEERING (ENGLISH-TAUGHT PROGRAM),	Details	◆ General Course ◆ Selective ◆ One Semester
Relevance to SDGs	1A SDG4 Quality education		

Departmental Aim of Education

Ⅰ. Cultivate the ability to conduct independent research and problem solving.

Ⅱ. Strengthen creativity and research capacity.

Ⅲ. Build profound professional knowledge in computer science and information engineering.

Ⅳ. Engage in self-directed lifelong learning.

Subject Departmental core competences

A. Independent problem solving ability.(ratio:20.00)

B. Independent innovative thinking ability.(ratio:20.00)

C. Research paper writing and presentation ability.(ratio:20.00)

D. Research & development (R&D) ability in information engineering.(ratio:20.00)

E. Project execution and control ability.(ratio:10.00)

F. Lifelong self-directed learning ability.(ratio:10.00)

Subject Schoolwide essential virtues

1. A global perspective. (ratio:10.00)

2. Information literacy. (ratio:20.00)

3. A vision for the future. (ratio:20.00)

4. Moral integrity. (ratio:10.00)

5. Independent thinking. (ratio:10.00)

6. A cheerful attitude and healthy lifestyle. (ratio:10.00)

7. A spirit of teamwork and dedication. (ratio:10.00)

8. A sense of aesthetic appreciation. (ratio:10.00)

No.	Course Introduction	Often, forecasting a stochastic process that providing different outcome each time might not be easy to handle with tolerable loss. In this course, we aim at the concept of "regret" and focus on the design of online algorithms that can minimize the regret in terms of minimizing the difference between algorithm outputs and best decisions in the hindsight. We will go over well-known no-regret online learning algorithms as well as state-of-the-art approaches in this field and also have students to read SOTA literatures and implement such algorithms for specific problems.

The correspondences between the course's instructional objectives and the cognitive, affective, and psychomotor objectives.

Differentiate the various objective methods among the cognitive, affective and psychomotor domains of the course's instructional objectives.

 I. Cognitive : Emphasis upon the study of various kinds of knowledge in the cognition of
          the course's veracity, conception, procedures, outcomes, etc.
II.Affective : Emphasis upon the study of various kinds of knowledge in the course's appeal,
          morals, attitude, conviction, values, etc.
III.Psychomotor: Emphasis upon the study of the course's physical activity and technical
          manipulation.

No.	Teaching Objectives	objective methods
1	Understanding the concept of online learning	Cognitive
2	Online Convex Optimization	Cognitive
3	No Regret Dynamics	Cognitive
4	Understanding gradient descent or ascent based approaches	Cognitive
5	Understanding multiplicative weight update algorithms	Cognitive
6	Follow The Regularized Leader Algorithms	Cognitive
7	Understanding mirror descent algorithms	Cognitive
8	Understanding bandit problems and algorithms	Cognitive
9	Understanding Follow the Perturbed Leader Algorithms	Cognitive
10	Knowing Bandit Problems and Understanding Bandit Algorithms	Cognitive

The correspondences of teaching objectives : core competences, essential virtues, teaching methods, and assessment

No.	Core Competences	Essential Virtues	Teaching Methods	Assessment
1	ABCDEF	12345678	Lecture, Discussion	Study Assignments, Discussion(including classroom and online)

2	ABCDEF	12345678	Lecture, Discussion	Study Assignments, Discussion(including classroom and online)
3	ABCDEF	12345678	Lecture, Discussion	Study Assignments, Discussion(including classroom and online)
4	ABCDEF	12345678	Lecture, Discussion	Study Assignments, Discussion(including classroom and online), Practicum
5	ABCDEF	12345678	Lecture, Discussion	Study Assignments, Practicum, Report(including oral and written)
6	ABCDEF	12345678	Lecture, Discussion	Study Assignments, Discussion(including classroom and online), Report(including oral and written)
7	ABCDEF	12345678	Lecture, Discussion	Study Assignments, Discussion(including classroom and online), Report(including oral and written)
8	ABCDEF	12345678	Lecture, Discussion	Study Assignments, Discussion(including classroom and online), Report(including oral and written)
9	ABCDEF	12345678	Lecture, Discussion	Discussion(including classroom and online), Report(including oral and written)
10	ABCDEF	12345678	Lecture, Discussion	Discussion(including classroom and online), Report(including oral and written)

Course Schedule

Week	Date	Course Contents	Note
1	112/02/13 ~ 112/02/19	Course Introduction	
2	112/02/20 ~ 112/02/26	Online Convex Optimization	
3	112/02/27 ~ 112/03/05	No Regret Dynamics	
4	112/03/06 ~ 112/03/12	Gradient Descent/Ascent Algorithms	
5	112/03/13 ~ 112/03/19	Gradient Descent/Ascent Algorithms	
6	112/03/20 ~ 112/03/26	Multiplicative Weight Update Algorithms	

7	112/03/27 ~ 112/04/02	Follow The Regularized Leader Algorithms	
8	112/04/03 ~ 112/04/09	Follow The Perturbed Leader Algorithms	
9	112/04/10 ~ 112/04/16	Mirror Descent Algorithms	
10	112/04/17 ~ 112/04/23	Mirror Descent Algorithms	
11	112/04/24 ~ 112/04/30	Multi-Armed Bandit and Algorithms	
12	112/05/01 ~ 112/05/07	Multi-Armed Bandit and Algorithms	
13	112/05/08 ~ 112/05/14	Extra-Gradient and Optimistic Gradient Methods	
14	112/05/15 ~ 112/05/21	Extra-Gradient and Optimistic Gradient Methods	
15	112/05/22 ~ 112/05/28	Literature Study (Paper Presentations)	
16	112/05/29 ~ 112/06/04	Literature Study (Paper Presentations)	
17	112/06/05 ~ 112/06/11	Literature Study (Paper Presentations)	
18	112/06/12 ~ 112/06/18	Literature Study (Paper Presentations)	

Requirement	Basic probability theory and calculus background knowledge. Basic Python/PyTorch Programming skill is a plus.
Teaching Facility	Computer, Projector
Textbooks and Teaching Materials	A Modern Introduction to Online Learning. Francesco Orabona. Boston University. Monograph. 2022. Introduction to Online Convex Optimization. Elad Hazan. 2017.
References	
Number of Assignment(s)	5 (Filled in by assignment instructor only)
Grading Policy	◆ Attendance： 20.0 % ◆ Mark of Usual：40.0 % ◆ Midterm Exam： % ◆ Final Exam： 40.0 % ◆ Other〈 〉： %
Note	This syllabus may be uploaded at the website of Course Syllabus Management System at http://info.ais.tku.edu.tw/csp or through the link of Course Syllabus Upload posted on the home page of TKU Office of Academic Affairs at http://www.acad.tku.edu.tw/CS/main.php . ※ **Unauthorized photocopying is illegal. Using original textbooks is advised. It is a crime to improperly photocopy others' publications.**