

Tamkang University Academic Year 112, 1st Semester Course Syllabus

Course Title	RANDOMIZED ALGORITHMS	Instructor	CHUANG-CHIEH LIN
Course Class	TEIBM1A MASTER'S PROGRAM, DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION ENGINEERING (ENGLISH-TAUGHT PROGRAM),	Details	<ul style="list-style-type: none"> ◆ General Course ◆ Selective ◆ One Semester
Relevance to SDGs	1A SDG4 Quality education		
Departmental Aim of Education			
<ul style="list-style-type: none"> 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			
<ul style="list-style-type: none"> 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			
<ul style="list-style-type: none"> 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) 			

Course Introduction	<p>This course focuses on theoretical aspects and applications of randomized algorithms. Compared to heuristic algorithms which do not have accuracy or time complexity guarantee, randomized algorithms have rigorous guarantees so that the outputs turn out to be convincing. We will also cover the topics of randomized algorithms in machine learning and expect the students to learn solid theoretical foundation and also be capable of implementing several projects on applying randomized algorithms or study on the state-of-the-art papers on algorithm design or machine learning.</p>
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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	Introduction to Randomized Algorithms	Cognitive
2	Las Vegas and Monte Carlo	Cognitive
3	Chernoff Bounds	Cognitive
4	The Secretary Problem	Cognitive
5	The Coupon Collector's Problem	Cognitive
6	Randomized Quicksort	Cognitive
7	Markov Chains and Random Walks	Cognitive
8	Property Testing	Cognitive
9	Balls and Bins	Cognitive
10	Case Studies	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)
5	ABCDEF	12345678	Lecture, Discussion	Study Assignments, Discussion(including classroom and online)
6	ABCDEF	12345678	Lecture, Discussion	Study Assignments, Discussion(including classroom and online)
7	ABCDEF	12345678	Lecture, Discussion	Study Assignments, Discussion(including classroom and online), Practicum
8	ABCDEF	12345678	Lecture, Discussion	Study Assignments, Discussion(including classroom and online)
9	ABCDEF	12345678	Lecture, Discussion	Study Assignments, 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	112/09/11 ~ 112/09/17	Introduction	
2	112/09/18 ~ 112/09/24	Examples of Probability Paradoxes	
3	112/09/25 ~ 112/10/01	Probability Prerequisites	
4	112/10/02 ~ 112/10/08	The Coupon Collector's Problem	
5	112/10/09 ~ 112/10/15	The Secretary Problem	
6	112/10/16 ~ 112/10/22	Randomized Quicksort	
7	112/10/23 ~ 112/10/29	Moments and Deviations	
8	112/10/30 ~ 112/11/05	Midterm Paper Presentations	
9	112/11/06 ~ 112/11/12	Midterm Paper Presentations	

10	112/11/13 ~ 112/11/19	Chernoff and Hoeffding Bounds	
11	112/11/20 ~ 112/11/26	Chernoff and Hoeffding Bounds	
12	112/11/27 ~ 112/12/03	Balls and Bins	
13	112/12/04 ~ 112/12/10	Balls and Bins	
14	112/12/11 ~ 112/12/17	Continuous Distributions and the Poisson Process	
15	112/12/18 ~ 112/12/24	Markov Chains and Random Walks	
16	112/12/25 ~ 112/12/31	Markov Chains Monte Carlo	
17	113/01/01 ~ 113/01/07	Final Paper Presentation	
18	113/01/08 ~ 113/01/14	Final Paper Presentation (Online @MS Teams)	
Key capabilities	self-directed learning Information Technology Problem solving		
Interdisciplinary	STEAM course (S:Science, T:Technology, E:Engineering, M:Math, A field:Integration of Art and Humanist) Competency-based education 'competency exploration' sustained competency or global issues STEEP (Society, Technology, Economy, Environment, and Politics) In addition to teaching content of the teacher's professional field, integrate other subjects or invite experts and scholars in other fields to share knowledge or teaching		
Distinctive teaching			
Course Content	Logical Thinking AI application		
Requirement	Prerequisites on Probability Theory and programming.		
Textbooks and Teaching Materials	Self-made teaching materials:Presentations, Handouts Using teaching materials from other writers:Textbooks Name of teaching materials: Probability and Computing: Randomization and Probabilistic Techniques in Algorithms and Data Analysis. Second Edition. M. Mitzenmacher and E. Upfal, Cambridge University Press, 2017.		
References	The Probabilistic Method. 3rd Edition. N. Alon and J. H. Spencer, 2008. Randomized Algorithms. Motwani, R. and Raghavan, P., Cambridge University Press, 1995.		

Grading Policy	◆ Attendance : 10.0 % ◆ Mark of Usual : 30.0 % ◆ Midterm Exam : 30.0 % ◆ Final Exam : 30.0 % ◆ 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.