

Tamkang University Academic Year 114, 1st Semester Course Syllabus

Course Title	AI AND DATA SCIENCE IN ASTRONOMY	Instructor	HSI-AN PAN
Course Class	TGSXB0A ELECTIVES COURSES BY COLLEGE OF SCIENCE, 0A	Details	◆ General Course ◆ Selective ◆ One Semester ◆ 2 Credits
Relevance to SDGs	SDG4 Quality education		
D e p a r t m e n t a l A i m o f E d u c a t i o n			
I . To convey professional knowledge. II. To enhance presentation skill. III. To cultivate team spirit. IV. To promote self-actualization. V . To develop international view.			
Subject Departmental core competences			
A. To learn the basic core knowledge in science.(ratio:35.00) B. To cultivate the ability to discover, analyze and solve problems.(ratio:45.00) C. To develop the spirit and ability of teamwork.(ratio:10.00) D. To acquire a global view through international exchanges.(ratio:10.00)			
Subject Schoolwide essential virtues			
1. A global perspective. (ratio:10.00) 2. Information literacy. (ratio:25.00) 3. A vision for the future. (ratio:10.00) 4. Moral integrity. (ratio:5.00) 5. Independent thinking. (ratio:25.00) 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:5.00)			

Course Introduction	<p>This course offers an introduction to AI and data science in the context of astronomy. Students will learn to apply techniques such as classification, regression, and clustering to real astronomical data using Python. Emphasis is placed on practical applications, including the analysis of images and catalogs. Through hands-on exercises and projects, students will explore how AI is increasingly used to address key questions in modern astronomy.</p> <p>*Important Note* A basic to intermediate level of Python programming is required. This course does not provide instruction on Python syntax or usage.</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	Process and analyze astronomical images and catalogs.	Cognitive
2	Evaluate the performance of AI models in an astronomical context.	Cognitive
3	Design and execute small-scale data-driven projects using real astronomical datasets.	Cognitive
4	Select appropriate AI methods for different types of astronomical problems.	Psychomotor
5	Interpret model outputs and communicate scientific findings effectively.	Psychomotor
6	Critically assess the limitations and ethical considerations of AI applications in astronomy.	Affective

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

No.	Core Competences	Essential Virtues	Teaching Methods	Assessment
1	AB	1234	Lecture, Discussion, Practicum	Testing, Study Assignments, Discussion(including classroom and online), Practicum, Activity Participation

2	ABCD	45678	Lecture, Discussion, Practicum	Testing, Study Assignments, Discussion(including classroom and online), Practicum, Report(including oral and written), Activity Participation
3	ABCD	12345678	Lecture, Discussion, Practicum	Testing, Study Assignments, Discussion(including classroom and online), Practicum, Report(including oral and written), Activity Participation
4	ABCD	12345678	Lecture, Discussion, Practicum	Testing, Study Assignments, Discussion(including classroom and online), Practicum, Report(including oral and written), Activity Participation
5	ABCD	12345678	Lecture, Discussion, Practicum	Testing, Study Assignments, Discussion(including classroom and online), Practicum, Report(including oral and written), Activity Participation
6	BC	45678	Lecture, Discussion, Experience, Imitation	Testing, Study Assignments, Discussion(including classroom and online), Practicum, Report(including oral and written), Activity Participation

Course Schedule

Week	Date	Course Contents	Note
1	114/09/15 ~ 114/09/21	Course Overview	
2	114/09/22 ~ 114/09/28	Introduction to Astro Data	
3	114/09/29 ~ 114/10/05	Data Handling and Preprocessing	
4	114/10/06 ~ 114/10/12	Data Handling and Preprocessing	
5	114/10/13 ~ 114/10/19	Large Surveys & Big Data	
6	114/10/20 ~ 114/10/26	Anomaly Detection in Astronomy	

7	114/10/27 ~ 114/11/02	Anomaly Detection in Astronomy	
8	114/11/03 ~ 114/11/09	Midterm Exam (subject to change)	
9	114/11/10 ~ 114/11/16	Midterm Exam (subject to change)	
10	114/11/17 ~ 114/11/23	Introduction to Machine Learning in Astronomy	
11	114/11/24 ~ 114/11/30	Introduction to Machine Learning in Astronomy	
12	114/12/01 ~ 114/12/07	Regression Techniques and Applications	
13	114/12/08 ~ 114/12/14	Classification and Cross-Validation	
14	114/12/15 ~ 114/12/21	Classification and Cross-Validation	
15	114/12/22 ~ 114/12/28	Clustering and Dimensionality Reduction	
16	114/12/29 ~ 115/01/04	Final Exam (subject to change)	
17	115/01/05 ~ 115/01/11	Lecture with discussion-based participation	
18	115/01/12 ~ 115/01/18	Lecture with discussion-based participation	
Key capabilities			
Interdisciplinary			
Distinctive teaching			
Course Content		Computer programming or Computer language (students have hands-on experience in related projects) Logical Thinking AI application	
Requirement		A basic to intermediate level of Python programming is required. This course does not provide instruction on Python syntax or usage.	
Textbooks and Teaching Materials		Self-made teaching materials:Presentations Using teaching materials from other writers:Presentations	

References	Statistics, Data Mining, and Machine Learning in Astronomy, Ivezić, Zeljko/ Connolly, Andrew J./ Vanderplas, Jacob T./ Gray, Alexander, Princeton University Press
Grading Policy	<p>◆ Attendance : % ◆ Mark of Usual : 30.0 % ◆ Midterm Exam : 35.0 %</p> <p>◆ Final Exam : 35.0 %</p> <p>◆ Other < > : %</p>
Note	<p>This syllabus may be uploaded at the website of Course Syllabus Management System at https://web2.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.</p> <p>※"Adhere to the concept of intellectual property rights" and "Do not illegally photocopy, download, or distribute." Using original textbooks is advised. It is a crime to improperly photocopy others' publications.</p>