The Hong Kong University of Science and Technology

UG Course Syllabus

APPLICATION OF GEOGRAPHICAL INFORMATION SYSTEMS

SOSC 3240

3 Credits

Perquisites: Basic computer & computing skills and fundamental geographic knowledge.

The structure of the course is a lecture section followed by a lab tutorial section. The lab section comprises a series of short presentations and computer-based practical trainings. Patience and high concentration are needed for such kind of learning.

GIS projects can be both technical demanding and time consuming.

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Course Description

Geographic Information Systems (GIS) is a set of computer-based systems integrated for collecting, checking, storing, integrating, analyzing, and presenting spatial information. This course provides students with comprehensive knowledge of GIS from its basic concepts to its application. The lecture covers GIS as geo-referenced information systems, the history and trends of GIS, GIS data and data presentation, and GIS data structures. In the lab exercises, we use the most popular GIS software - ArcGIS Pro to study its basic functions, data displaying and mapping, data operations, and analyze feature relationship through the software.

LECTURE:	Thursday: 3:00-4:20 PM	Room 5506
LAB:	Thursday: 4:30-5:50 PM	Room 4402 (Computer Barn A) by Lift 17-18

TENTATIVE COURSE SCHEDULE

Week 1: **Perquisites Test**

Lecture: Introduction to GIS and GIS basics

- What is GIS? Why use a GIS? Who uses a GIS?
- Applications of GIS to Social Science and other fields

Lab: Introduction to lab section (in Computer Barn A)

- Introduction to ArcGIS Desktop and ArcCatalog/ArcMap
- Getting start with maps and scenes

Week 2: Lecture: Major Components of GIS

- GIS, computer systems, and information systems

Lab: Basic functions of ArcGIS Pro

- Introduction to ArcGIS Pro and ArcTools
- Creating your first map

Week 3: Lecture: GIS data and data presentation

- Spatial information, spatial data, data models, and maps
- GIS coordinate and projection systems
- GIS Data input and output

Lab: Basic functions of ArcGIS Pro

- Data input, storage output in ArcGIS
- Navigating layers and tables in ArcGIS
- Data selection and querying for social analysis

Week 4: Lecture: GIS Data Structures I

- Basic data structures and algorithms in GIS (raster data and vector data)

Lab: Data displaying

- Symbolizing data
- Labeling features
- Mapping (layers and layouts)

i. Project Grouping

Week 5: Lecture: Feature relationship and topology

Lab: Data operations in ArcGIS Pro

- Creating new data
- Editing spatial data and social data
- Joining and relating tables of socio-demographic attributes

ii. Project Topic Submission

Week 6: Lecture: GIS Applications (Case studies)

- Resource planning and management - Case 1: Conservation studies.
- Marketing and network planning - Case 2: Precise marketing.
- Social Science - Case 3: Clinton-Gore election

Lab: Analyzing feature relationship using ArcGIS Processing

- Union and intersect
- Merge and dissolve
- Buffering data
- Spatial join

iii. Project Topic Improving and Proposal Preparing

Week 7: Lecture: GIS Applications (Case studies) and Project Topic Discussion

- Resource planning and management - Case 1: Conservation studies.
- Marketing and network planning - Case 2: Precise marketing.
- Social Science - Case 3: Clinton-Gore election

Lab: Georeferencing

- Georeferencing with XY data
- Adding background by using GoogleEarth map

iv. Project Proposal Discussion

Week 8: Lecture: Project Topic discussion with instructors

Lab: Analyzing Spatial Data using ArcGIS

- Spatial Analysis in social science and other fields

v. Project Topic Finalizing

Week 9-11: Project Progress discussion with instructors

Lab: Project data collection, input, and analysis

vi. Project Processing

Week 12-13: PowerPoint Presentation of Project Report (to be announced)

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Master fundamental understanding and comprehensive knowledge of GIS basic concepts.

2. Analyze social contexts to choose and apply the appropriate ArcGIS packages and techniques through practical training.

3. Utilize ArcGIS tools to visualize and analyze spatial information to solve social issues.

4. Demonstrate the ability to generate reports incorporating GIS results and explaining their meanings in various fields, such as marketing, planning, social and environmental studies.

Assessment and Grading

Assessments:

Attendance & quizzes (10%): Random in-class exercises

Lab exercises & assignments (20%): Lab exercises will be held in Computer Barn A with practical training of using ArcGIS Pro. The results of the exercises and assignments will be submitted under request.

Assessment Task	Contribution to Overall Course grade (%)	Due date
Attendance & quizzes	10%	Week 1 to Week 11
Lab exercises & assignments	20%	Week 2 to Week 9
Group presentation	20%	Week 9 to Week 13
Final project discussion	5%	Week 12 to Week 13
Project Report (extended PPT)	17%	Week 13 to week 14
Final examination	28%	TBA

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Lab exercises & assignments	ILO1, ILO2, ILO3.	This task not only helps students further understand GIS basic concepts (ILO 1), but also enriches students' knowledge in the application of ArcGIS packages and techniques (ILO2), and basic skills with GIS tools (ILO3).
Quizzes	ILO1. ILO2	Quizzes are designed to assess students' foundational understanding of GIS basic concepts (ILO 1) and their ability to decide the appropriate ArcGIS packages and techniques for the analysis of regional societal issues (ILO 2).
Project proposal discussion, Project demonstration, Group presentation, Project report	ILO1, ILO2, ILO3, ILO4.	The integration of practical GIS skills and societal issues study enriches students' knowledge (ILO1) in the application of GIS tools (ILO2) and the capability of social problem solving (ILO3) through their tailor-made project. Additionally, it focuses on project planning, effective teamwork, and leadership skills. The presentation and discussion assess students' systematic understanding on GIS application (ILO3), the project report demonstrates students' higher-order thinking skills of spatial analysis and decision making (ILO4).
Final Examination	ILO1, ILO2, ILO3.	The exam aims to test students' understanding of GIS knowledge and its basic concepts (ILO1), and the ability of utilizing the appropriate ArcGIS techniques (ILO2) and tools to solve regional societal issues (ILO3).

Grading Rubrics

Use the following rubrics for the grading of your Group Project.

Group Presentation and Project Report

	Outstanding (85% or above)	Good (75-84%)	Satisfactory (65-74%)	Acceptable (50-64%)	Unsatisfactory (49% or below)
Problem Description (20%)	Exceptionally clear and insightful description of the geographic problem to be solved, drawing extensively on background material from outside the lectures and practical.	Very clear and logical description of the geographic problem to be solved, drawing on background material from outside the lectures and practical.	Clear and logical description of the geographic problem to be solved, but with some minor errors or omissions.	Clear description of the geographic problem to be solved, but with some errors or omissions.	Incorrect or no description of the geographic problem to be solved.
Methodology/GIS Analysis (25%)	Exceptionally innovative and correct integration of the suitability criteria, data selection, GIS analysis methods and implementation of those methods to solve the geographic problem.	Innovative and correct integration of the suitability criteria, data selection, GIS analysis methods and implementation of those methods to solve the geographic problem.	Correct integration of the suitability criteria, data selection, GIS analysis methods and implementation of those methods to solve the geographic problem, but with some minor errors.	Broadly correct integration of the suitability criteria, data selection, GIS analysis methods and implementation of those methods to solve the geographic problem, but with some errors.	Incorrect integration of the suitability criteria, data selection, GIS analysis methods and implementation of those methods to solve the geographic problem.
Results, including maps and visualization (25%)	Exceptionally clear and meaningful presentation of results, including the use of tables and maps/figures. Mapping is cartographically correct with innovative use of mapping techniques.	Very clear and meaningful presentation of results, including the use of tables and maps/figures. Mapping is cartographically correct.	Clear presentation of results, including the use of tables and maps/figures. Mapping is cartographically correct, but with some minor errors.	Adequate presentation of results, including limited use of tables and maps/figures. Mapping has cartographic errors but overall generally correct.	Inadequate presentation of results, with incorrect use of tables and maps/figures. Mapping has major cartographic errors.
Interpretation and Discussion (20%)	Exceptionally insightful and correct	Insightful and correct interpretation of	Correct interpretation of the results	Broadly correct interpretation of the results	Incorrect or no interpretation of the results

	interpretation of the results and very clear identification of the limitations of the analysis, drawing extensively on material from outside the lectures and practical. GIS analysis and problem solving to each spatial issue across the study area is adequately achieved and well discussed.	the results and clear identification of the limitations of the analysis, drawing on material from outside the lectures and practical. GIS analysis and problem solving to each spatial issue across the study area is almost achieved and discussed.	and identification of the limitations of the analysis, but with some minor errors or omissions. GIS analysis and problem solving to each spatial issue across the study area is partially achieved and inadequately discussed.	and identification of the limitations of the analysis, but with some errors or omissions. GIS analysis and problem solving to each spatial issue across the study area is slightly achieved and discussed.	and identification of the limitations of the analysis. GIS analysis and problem solving to each spatial issue across the study area is wrongly performed and lacks discussion.
Presentation (10%)	Delivers all important messages in an effective and creative way, clearly and logically presents messages, attracts the most attention by showing interest and enthusiasm in the speech with eye contact and appropriate gestures.	Delivers most important messages effectively, clearly and logically presents messages, attracts some attention with eye contact and appropriate gestures.	Delivers some important messages effectively but not all of them, clearly presents messages with eye contact and appropriate gestures but a bit boring.	Presents messages logically and clearly, but the most important ones are missing. Speech is boring and tedious.	Presents messages illogically and even misleadingly, speech is ill-structured and hard to understand.

Discussion

Score (Level achieved)	Answer Questions	Ask Question	Productivity
Advanced (5%)	Actively and correctly answers audiences' questions.	Actively asks challenging questions with extensive thinking and comprehensive understanding.	Highly contributes to the project by raising useful suggestions to key spatial issues
Good (4%)	Actively and correctly answers audiences' questions.	Actively asks questions to presenters with comprehensive understanding.	Contributes to the project by raising helpful suggestions to some spatial issues

Acceptable (3%)	Actively answers audiences' questions with small errors.	Occasionally asks questions to presenters with some understanding.	Help improve the project by raising spatial issues
Basic (2%)	Partially answers audiences' questions with some errors.	Occasionally asks questions to presenters, but with a little understanding.	Help improve the project by optimizing the project organization.
Attempted (1%)	Try to answer audiences' questions, but incorrectly.	Seldom asks questions to presenters and lacks basic understanding.	Not so useful to improve the project.
Not Shown (0%)			

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of GIS basic concepts and GIS tools, expertise in spatial analysis and problem-solving. Exhibits a high capacity for GIS application and decision making, meticulous project planning, efficient teamwork, and effective leadership abilities.
B	Good Performance	Shows good knowledge and understanding of GIS basic concepts and GIS tools, competence in spatial analysis and problem-solving. Displays satisfactory progress in project stages and the ability to work effectively with others.
C	Satisfactory Performance	Possesses adequate knowledge of GIS basic concepts and GIS tools, competence in dealing with familiar problems, and some capacity for spatial analysis and critical thinking. Makes acceptable progress in project stages. Shows persistence and effort to achieve broadly defined learning goals.
D	Marginal Pass	Has threshold knowledge of GIS basic concepts, inconsistent use of tools, incomplete or inconsistent performance in laboratory experiments, and low ability to make basic spatial analysis. Benefits from the course and exhibit limited skills in project operation.
F	Fail	Demonstrates insufficient understanding of GIS basic concepts, inadequate use of tools, lacks the necessary problem-solving skills and unsuccessful completion of laboratory experiments. Shows limited ability to analyze spatial information and no progress in project stages.

Communication and Feedback

Marks and feedback on assignments will be provided via Canvas within three weeks of submission.
Quizzes marks will be released via Canvas within a week of submission.
Comments on final project will be provided within a week of the project presentation through private group discussion.
Students who have further questions about the feedback, including marks should consult the instructor within five working days after the feedback is received.

Required Texts and Materials

We will not use a required textbook for this course, but instead use material we created or available on Canvas:

1. Lecture notes and Lab tutorials
2. ESRI. 2012. *What is GIS*. ESRI.
3. ESRI. 2018. Introducing GIS. *Getting to Know ArcGIS Desktop, Chapter 1, Fifth Edition*.
4. ESRI. Getting to Know ArcGIS. *Getting Started with ArcGIS, Chapter 1.*

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

USEFUL Spatial Data WEBSITES:

http://hub.arcgis.com/pages/open-data https://earthexplorer.usgs.gov/

http://sedac.ciesin.columbia.edu/ https://opentopography.org/ http://www.diva-gis.org/