Subject Description Form

Subject Code	LSGI3801
Subject Title	**GeoAI**
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	The objectives of this subject are: 1. To frame any geospatial problem using a machine learning approach, 2. To enable students become proficient in the use of conventional and modern geovisualization techniques, 3. To enable students properly apply geovisualization principles and methods to practical problems 4. To enable students to know how to create and extract relevant and useful features of a given geospatial problem, 5. To introduce common machine learning approaches to perform classification and estimation, and 6. To enable students properly apply qualitative indices to assess the results and the model.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: 1. Define various types of visual representations (L1) 2. Explain the techniques for thematic mapping and visualization (L2) 3. Extract or create useful features from a geospatial dataset (L3), 4. Improve the geospatial data quality by data pre-processing (L3) , 5. Construct a machine learning workflow to extract information of a geospatial problem (L4), 6. Assess the results using different qualitative indicator (L3), and 7. Handle different geospatial data collected from different platforms and understand the pros and cons of each covered approach (L4).
Subject Synopsis/ Indicative Syllabus	**A. Problem Definition** Framing and understanding a geospatial problem (e.g., number of classes), desirable accuracy/outcomes, choice of geospatial data, data resolution, etc. **B. Principles and theories for symbol and map design.** Visual variables, colour scheme, visual information processing, perceptional theories, map perception, map evaluation.

	C. Scale and generalization: Theories and principles of map generalization in digital environment, algorithms for various operations in both vector and raster modes, automated systems. **D. Geo-Visualization:** Variables for visualization (dynamic variable, screen variables, exploration acts, web-specific variables), cartograms, pictorial maps, dynamic maps, rendering and animations, virtual reality, augmented reality **E. Data Preparation and Pre-processing** Outlier removal, data cleaning, data/coordinate transformation, etc. **F. Feature Selection and Extraction** Preparation of features based on location, time, attributes and/or semantic information, dimension reduction, principal component analysis, etc. **G. Machine Learning/Classification Model** Supervised and unsupervised learning, parametric and non-parametric models, clustering and segmentation, etc. **H. Model Validation and Accuracy Assessment** Confusion matrix, accuracy, F-measures, quantity disagreement and allocation disagreement, receiver operating characteristic (RoC) curve, etc. **I. Case Studies and Applications** LiDAR point clouds, spatial-temporal dataset, urban big data, etc.
Teaching/Learning Methodology	• Lectures will be used to introduce the subject materials. • Lab sessions will be broken down into different stages of machine learning process using Python. • A final group project will be introduced to enhance the team spirit, communication skills, problem solving skill, and presentation skill.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						
		1	2	3	4	5	6	7
1. Lab assignments	30%	✓	✓	✓	✓	✓		✓
2. Mid-term test	30%	✓	✓	✓	✓		✓	✓
3. Project (Report and presentation)	40%	✓	✓	✓	✓	✓	✓	✓
Total	100%							

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Continuous assessment consists of two components: lab assignments and a group project. Four lab assignments will be given to the students covering different stages of the machine learning process. The group project (upon discussion with the subject lecturer) will let students work on a specific geospatial problem (e.g. point cloud classification, urban big data analysis, information extraction from spatial-temporal images, etc.) with a submission of a group report and a final presentation.

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Practical	26 Hrs.
Other student study effort:	
▪ Reading of textbook and journal papers	23 Hrs.
▪ Project completion and writing	40 Hrs.
Total student study effort	115 Hrs.

Reading List and References

1. Yamagata, Y., & Seya, H. (Eds.). (2019). Spatial analysis using big data: Methods and urban applications. Academic Press. 302 pp.
2. Shan, J., & Toth, C. K. (Eds.). (2018). Topographic laser ranging and scanning: principles and processing. CRC Press. 637 pp.
3. Pedregosa, F., et al., (2011). Scikit-learn: Machine learning in Python. *Journal of Machine Learning Research*, 12, 2825-2830.
4. VanderPlas, J. (2016). Python data science handbook: Essential tools for working with data. O'Reilly Media, Inc. 743 pp.
5. Dent, B. 1999. *Cartography: Thematic Map Design*. 5th edition, Wm

	C. Brown Publishers. 417pp. 6. Robinson, A. et al., (1995). *Elements of Cartography*. 6th edition, John Wiley & Sons Inc. 674pp. 7. Slocum, T., McMaster, R., Kessler, F. and Howard, H., 2004. *Thematic Cartography and Geographic Visualization*, Second Edition, Jul 2004, Pearson Education, 528 pages. 8. MacEachren, A. and D. Taylor (eds.) (1994). *Visualization in Modern Cartography*. Pergamon. 345pp. 9. Kraak, M.-J., and Brown, A. (eds.), Web Cartography. Taylor and Francis, 213pp. 10. Keates, J., (1989). *Cartographic Design and Production*. 2nd edition, Longman. 261pp.