

Lingnan University

Course Syllabus

Course Title	:	Visualization
Course Code	:	CDS3104
Recommended Study Year	:	Year 3
No. of Credits	:	3
Mode of Tuition	:	Sectional Approach
Class Contact Hours	:	3 hours per week
Category	:	Major Required
Discipline	:	Nil
Prerequisite(s)	:	CDS1001 Introduction to Programming for Data Science
Co-requisite(s)	:	Nil
Exclusion(s)	:	Nil
Exemption Requirement(s)	:	Nil

Brief Course Description:

As data-driven decision-making and product design become increasingly important in science, engineering, and industry, the ability to transform complex information and models into clear, interactive visual representations is essential. This course introduces the principles, techniques, and tools for effective data and product visualization. Students will learn the fundamentals of visual perception, design principles, and graphical representation of data, focusing on how to communicate information accurately and intuitively. The course covers a range of visualization methods, including charts, graphs, interactive dashboards, and advanced techniques for visualizing multidimensional and large-scale datasets. In addition, students will explore product visualization, which involves creating realistic and interactive visual models for design, manufacturing, and marketing purposes. Topics include colour theory, layout design, 3D modelling, and best practices for storytelling with data and product visuals. Students will also work with visualization frameworks and libraries and modern interactive tools, as well as software for 3D product visualization. Hands-on exercises and projects will involve designing and implementing visualizations using real-world datasets and product models.

Aims:

This course aims to:

1. Develop students' understanding of fundamental visualization principles, including human visual perception, visual encoding, and design theory.
2. Equip students with practical skills to design and implement effective visualizations for data exploration and communication.

3. Cultivate critical thinking in evaluating visualization quality, accuracy, and ethical implications.
4. Enable students to communicate complex data-driven insights clearly to both technical and non-technical audiences.

Learning Outcomes (LOs)

Upon successful completion of this course, students will be able to:

1. Understand and explain core principles of visualization, including visual perception, colour theory, layout, and visual encoding. (PILO1, PILO3)
2. Design and implement effective visualizations using appropriate tools and techniques for different data types and tasks. (PILO2, PILO5)
3. Critically evaluate existing visualizations, identifying strengths, weaknesses, biases, and potential ethical issues. (PILO1, PILO7)
4. Use visualization as a medium for storytelling and communication, tailoring visual designs to different audiences and contexts. (PILO3, PILO6)

Indicative Contents:

Foundations of Visualization

This module introduces the role of visualization in data-driven contexts, with a focus on human visual perception, cognition, and visual variables (e.g., position, color, size, shape). Students will learn how perceptual principles influence visualization design and effectiveness.

Data and Visual Encoding

Students explore different data types and structures, and learn how to map data to appropriate visual forms. The module covers common chart types, encoding strategies, and design trade-offs, supported by hands-on exercises in constructing basic visualizations.

Design Principles and Ethics

This module focuses on principles for designing clear, accurate, and effective visualizations. Students will critically analyze real-world examples to identify misleading representations, biases, and ethical issues, and learn frameworks for evaluating visualization quality.

Information Visualization Techniques

Students are introduced to techniques for visualizing multivariate and large-scale data, as well as core concepts in interactive visualization and visual analytics. Practical exercises will involve exploring data through interactive tools and refining visualization strategies.

Visualization Tools and Implementation

This module provides hands-on experience with commonly used visualization libraries and tools (e.g., Python-based frameworks). Students will learn practical workflows for implementing visualizations, including data preprocessing, visual design, and basic interaction techniques.

Visual Storytelling and Communication

Students learn how to transform visualizations into effective narratives for different audiences. Topics include storytelling structures, dashboard design, and decision-oriented communication. Students will apply these concepts to communicate insights clearly and persuasively.

Project Presentation and Critique

In the final stage, students complete a comprehensive visualization project using real-world data. They will design, implement, and present their work, followed by peer critique and reflection to evaluate design decisions, effectiveness, and communication quality.

Teaching Methods:

The course adopts a combination of lectures, in-class exercises, discussions, and projects to support both theoretical understanding and practical skill development. Lectures introduce core theoretical concepts, design principles, and real-world visualization examples, while in-class exercises provide hands-on practice with visualization techniques and tools. Discussions encourage critical reflection on visualization cases, ethical issues, and design choices, and individual or group-based projects emphasize applying visualization methods to real-world problems.

Measurement of Learning Outcomes:

Assessment LOs	In-class Participation and Exercises	Individual Assignments	Mid-term Test	Final Visualization Project (Report + Presentation)
	(15%)	(25%)	(20%)	(40%)
LO1	✓	✓	✓	
LO2		✓		✓
LO3	✓	✓	✓	✓
LO4				✓

1. Participation activities and in-class exercises primarily assess students' understanding and discussion of fundamental visualization concepts (LO1) and their ability to engage

in analytical and critical evaluation of visualizations (LO3).

2. Assignments provide structured opportunities for students to apply visualization principles and techniques to practical tasks. Assignments will typically involve creating visualizations from real-world datasets and submitting a short written report (approximately 800–1,200 words) to explain design choices and reflect on effectiveness. These assignments assess conceptual understanding (LO1), design and implementation skills (LO2), and critical evaluation (LO3).
3. The mid-term assessment focuses on students' comprehension of core theories, design principles, and analytical concepts introduced in the first half of the course (LO1, LO3).
4. The final project serves as a comprehensive assessment that evaluates students' ability to design and implement effective visualizations (LO2), conduct critical analysis (LO3), and communicate insights through visualization-based storytelling tailored to specific audiences and contexts (LO4).

Assessment:

In-class Participation and Exercises	15%
Individual Assignments	25%
Mid-term Test	20%
Final Visualization Project (Report + Presentation)	40%
Total	100%

Required/Essential Readings:

1. Munzner, T. Visualization Analysis and Design. CRC Press.
2. Cairo, A. The Functional Art. New Riders.
3. Wilke, C. O. Fundamentals of Data Visualization. O'Reilly Media.

Recommended/Supplementary Readings:

1. Few, S. Show Me the Numbers: Designing Tables and Graphs to Enlighten. Analytics Press.
2. Knaflic, S. N. Storytelling with Data: A Data Visualization Guide for Business Professionals. Wiley.
3. Ware, C. Information Visualization: Perception for Design. Morgan Kaufmann.
4. Kirk, A. Data Visualization: A Handbook for Data Driven Design. SAGE Publications.
5. Healy, K. Data Visualization: A Practical Introduction. Princeton University Press.
6. Murray, S. Interactive Data Visualization for the Web. O'Reilly Media.

Important Notes:

- (1) Students are expected to spend a total of 9 hours (i.e. 3 hours of class contact and 6 hours of personal study) per week to achieve the course learning outcomes.
- (2) Students shall be aware of the University regulations about dishonest practice in course work, tests and examinations, and the possible consequences as stipulated in the Regulations Governing University Examinations and Course Work. In particular, plagiarism, being a kind of dishonest practice, is “the presentation of another person’s work without proper acknowledgement of the source, including exact phrases, or summarised ideas, or even footnotes/citations, whether protected by copyright or not, as the student’s own work”. Students are required to strictly follow university regulations governing academic integrity and honesty.
- (3) Students are required to submit writing assignment(s) using Turnitin.
- (4) To enhance students’ understanding of plagiarism, a mini-course “Online Tutorial on Plagiarism Awareness” is available on <http://pla.ln.edu.hk/>.
- (5) Students must adhere to the University’s guidelines and practices when using Generative Artificial Intelligence (GAI) tools. The official documents “Guidelines for Using GAI Tools at Lingnan University” and “Best Practices for Ethical and Responsible Use of GAI Tools in Course Assessments” can be found here: <https://www.ln.edu.hk/tlc/generative-artificial-intelligence/gai-guidelines-best-practices>.

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Course Rubrics

Rubric for In-class Participation and Exercises (15%)

Criteria	Excellent (90–100)	Very Good (80–89)	Good(70–79)	Pass (50–69)	Fail (0–49)
Attendance and Participation (6%)	Attends over 90% of classes and actively participates in discussions and exercises.	Attends over 85% of classes with consistent participation.	Attends at least 80% of classes with regular participation.	Attends at least 70% of classes with limited participation.	Attends less than 70% of classes with minimal or no participation.
Engagement in Exercises (5%)	Completes all exercises accurately with strong understanding.	Completes most exercises correctly with minor errors.	Completes exercises with some errors and partial understanding.	Completes basic exercises with noticeable gaps.	Fails to complete exercises or shows little understanding.
Classroom Interaction (4%)	Frequently contributes insightful questions and critiques.	Regularly contributes relevant questions and comments.	Occasionally participates with some relevant input.	Rarely participates; contributions are superficial.	No meaningful interaction or engagement.

Rubric for Individual Assignments (25%)

Criteria	Excellent (90–100)	Very Good (80–89)	Good (70–79)	Pass (50–69)	Fail (0–49)
Understanding of Visualization Principles (10%)	Applies $\geq 90\%$ of core principles accurately.	Applies 80–89% of principles correctly.	Applies 70–79% with some gaps.	Applies 60–69% with noticeable gaps.	Applies $< 60\%$ or shows major misconceptions.
Design and Implementation Quality (10%)	Designs highly effective and appropriate visualizations.	Designs are effective with minor issues.	Designs are generally appropriate with some limitations.	Designs are basic with limited effectiveness.	Designs are unclear, inappropriate, or incomplete.
Clarity and Communication (5%)	Clear, coherent, and audience-appropriate communication.	Mostly clear with minor issues.	Generally understandable with some inconsistencies.	Somewhat unclear explanations or layout issues.	Poorly communicated with confusing or misleading visuals.

Rubric for Mid-term Test (20%)

Criteria	Excellent (90–100)	Very Good (80–89)	Good (70–79)	Pass (50–69)	Fail (0–49)
Conceptual Knowledge (10%)	Comprehensive and accurate understanding.	Strong understanding with minor inaccuracies.	Good understanding with some gaps.	Basic understanding with several gaps.	Little understanding of core concepts.
Critical Evaluation (10%)	Insightful critique with strong justification.	Well-reasoned critique with good justification.	Reasonable critique with some analysis.	Mostly descriptive with limited analysis.	Unable to critically evaluate.

Rubric for Final Visualization Group Project (40%)

Criteria	Excellent (90–100)	Very Good (80–89)	Good (70–79)	Pass (50–69)	Fail (0–49)
Analytical Insight (15%)	In-depth analysis with strong, well-supported insights.	Strong analysis with relevant insights.	Reasonable analysis with some meaningful insights.	Basic analysis with limited insights.	Weak or irrelevant analysis.
Visualization Design and Storytelling (20%)	≥90% alignment with communication goals; highly effective visuals.	80–89% alignment; effective visualizations.	70–79% alignment; generally appropriate visuals.	50–69% alignment; basic visualizations.	Poorly designed or misaligned (<50%).
Presentation and Organization (5%)	Clear, well-structured, and coherent presentation.	Well-organized with minor issues.	Generally organized with some clarity issues.	Some organizational weaknesses.	Poorly organized and difficult to follow.