NATIONAL UNIVERSITY OF SAN MARCOS

FACULTY OF MATHEMATICAL SCIENCES

SYLLABUS

1. GENERAL INFORMATION

1.1 Course name	:	Advanced Data Visualization
1.2 Code	:	CS254
1.3 Academic Program	:	Scientific Computing
1.4 Credits	:	4
1.5 Prerrequisites	:	CS253. Exploratory data analysis. (8^{th} Sem)
1.6 Type of Course	:	Elective
1.7 Area of Studies	:	Estudios Generales
1.8 Number of Weeks	:	16
1.9 Hours per week	:	2 HT; 4 HP;
1.10 Cycle	:	I
1.11 Learning modality	:	Face to face
1.12 Academic Period	:	2026-I
1.13 Semester Start Date	:	
1.14 Semester End Date	:	

2. PROFESSORS

Meetings after coordination with the professor

3. INTRODUCTION TO THE COURSE

In the Big Data era, the ability to communicate complex information visually and effectively is fundamental. This course delves into the principles of visual perception, interactive dashboard design, and the use of advanced tools for data storytelling. It focuses on transforming abstract analysis into visual representations that facilitate strategic decision-making, integrating aesthetics, functionality, and ethics in information management.

4. GOALS

- Apply principles of Gestalt psychology and visual perception to graphic design.
- Develop interactive visualizations using cutting-edge libraries.
- Design data narratives (storytelling) that facilitate the understanding of complex problems.
- Implement visualizations for multidimensional and geospatial data.
- Critically evaluate the effectiveness and ethics of visual representations.

5. COMPETENCES

ABET-3) An ability to develop and conduct experiments or test hypotheses, analyze and interpret data, and use scientific judgment to draw conclusions. (Usage)

ABET-2) An ability to formulate or design a system, process, procedure, or program for the intended purpose. (Usage)

6. TOPICS

Unit 1: Visual Perception and Design Principles (8 hours)	
Competences Expected: ABET-2,ABET-3	
Topics	**Learning Outcomes**
• Color theory and luminance in visualization. • Gestalt principles applied to information design. • Pre-attentive attributes and cognitive load. • Visualization criticism: Clarity vs. Decoration (Chartjunk).	• Explain how the human visual system processes graphic information [Familiarizarse]. • Select color palettes and typographies that improve readability [Usar].
Readings : [**Cairo2016**], [**Ware2020**]	

Unit 2: Interactive and Dynamic Visualization (8 hours)	
Competences Expected: ABET-2,ABET-3	
Topics	**Learning Outcomes**
• Introduction to D3.js and advanced grammar of graphics. • Interactions: Filtering, zoom, brushing, and linking. • Animation to show temporal changes. • Responsive design for different devices.	• Implement interactive elements that allow user exploration [Usar]. • Build functional prototypes of dynamic visualization [Evaluar].
Readings : [**Munzner2014**], [**Murray2017**]	

Unit 3: Spatial and Temporal Data Visualization (8 hours)	
Competences Expected: ABET-2,ABET-3	
Topics	**Learning Outcomes**
• Map projections and choropleth maps. • Bubble maps, density maps (heatmaps), and flows. • Advanced time series: Horizon charts and streamgraphs. • Network and graph visualization.	• Represent geographic data avoiding common distortions [Usar]. • Analyze complex temporal patterns using specialized charts [Evaluar].
Readings : [**Wilke2019**], [**Cairo2016**]	

Unit 4: Multivariate and High-Dimensional Data (8 hours)	
Competences Expected: ABET-2,ABET-3	
Topics	**Learning Outcomes**
• Parallel coordinates and radar charts. • Scatterplot matrices (SPLOM). • Projection techniques: t-SNE and UMAP for visualization. • Hierarchy visualization: Treemaps and sunbursts.	• Reduce dimensionality to visualize hidden structures [Usar]. • Design representations for large-scale hierarchical data [Evaluar].
Readings : [**Munzner2014**], [**Wilke2019**]	

Unit 5: Dashboard Design and Business Intelligence (8 hours)	
Competences Expected: ABET-2,ABET-3	
Topics	**Learning Outcomes**
• Information architecture in control dashboards. • Key Performance Indicators (KPI) and visual alerts. • BI Tools: Tableau, PowerBI, and their extensibility. • Usability and user experience (UX) in visualization.	• Integrate multiple visualizations into a coherent dashboard [Usar]. • Evaluate the effectiveness of a dashboard through usability testing [Evaluar].
Readings : [**Few2013**], [**Cairo2019**]	

Unit 6: Data Storytelling and Communication (8 hours)	
Competences Expected: ABET-2,ABET-3	
Topics	**Learning Outcomes**
• Narrative structures for data: Scrollytelling. • Noise removal and emphasis on the main message. • Annotations and visual guidance for the viewer. • The role of the analyst as a scientific communicator.	• Create a compelling story from statistical findings [Usar]. • Design visual presentations for non-technical audiences [Evaluar].
Readings : [**Knaflic2015**], [**Cairo2019**]	

Unit 7: Ethics and Visual Deception (8 hours)	
Competences Expected: ABET-2,ABET-3	
Topics	**Learning Outcomes**
• Misleading charts and axis manipulation. • Cognitive biases in visual interpretation. • Accessibility: Design for color blindness and functional diversity. • Responsibility in representing sensitive data.	• Identify and correct visualizations that distort reality [Evaluar]. • Implement accessibility standards in visual products [Usar].
Readings : [**Cairo2019**], [**Few2013**]	

Unit 8: Final Project: Visualization Portfolio (8 hours)	
Competences Expected: ABET-2,ABET-3	
Topics	**Learning Outcomes**
• Selection of a complex and real-world dataset. • Iterative design process and feedback. • Technical documentation and aesthetic justification. • Project defense before a specialized jury.	• Build a complete professional-level visualization solution [Evaluar]. • Support technical and design decisions based on theory [Evaluar].
Readings : [**Knaflic2015**], [**Murray2017**]	

7. WORKPLAN

7.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

7.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

7.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

8. EVALUATION SYSTEM

********* EVALUATION MISSING ********

9. BASIC BIBLIOGRAPHY