

COURSE INFORMATION

1.	Name of Course	Data Visualization													
2.	Course Code	TDS3401													
3.	Type of Course	Specialization Core													
4.	Synopsis	With the large amounts of data being made available through the Internet and Social Media, data visualization can be an effective means for combating information overload as it can support cognitive calculations with simpler perceptual inferences and improve comprehension, memory, and decision making. This course aims to introduce techniques and algorithms for creating effective visualizations based on principles from graphic design, visual art, perceptual psychology, and cognitive science. The main topics addressed the visualization basics, graphics perception, visualization design and tools, multidimensional data visualization, interaction and animation, using space effectively, data visualization techniques and collaborative visual analysis.													
5.	Version (State the date of the Senate's approval - previous and the current approval date)	Current: January 2018 Previous: June 2016													
6.	Name(s) of Academic Staff	Lim Tek Yong Wong Lai Kuan John See Su Yang													
7.	Semester and Year Offered	Trimester 2 (Delta)													
8.	Credit Value	4 credit hours													
9.	Pre-Requisite	TCP1101 Programming Fundamentals													
10.	Objective of the course in the programme: To equip students with the fundamental concepts and techniques in data visualization and to provide exposure towards the design and application of suitable data visualization techniques to build effective visualization systems.														
11.	Justification for including the course in the programme: Data visualization provides a visual representation of data that enables people to understand information more easily and quickly. As data science involves dealing with large amount of data (big data), data visualization is even more important as it capacitate the decision makers to find relationship among the millions of variables, make big data accessible to large audience, and predict the future.														
12.	Course Learning Outcomes (CLO)	Domain				Level									
	CLO1: Describe and understand key techniques and theory used in visualization, including data models, graphical perception and techniques for visual encoding and interaction.	Cognitive								2					
	CLO2: Apply suitable data analysis and visualization techniques to accomplish specific visualization tasks.	Cognitive								3					
	CLO3: Develop visualization systems to visualize and analyze large datasets.	Cognitive								5					
13.	Mapping of the Course Learning Outcomes to the Programme Learning Outcomes, Teaching Methods and Assessment:														
	Course Learning Outcomes (CLO) (Must tally with CLOs in item 12)	Programme Learning Outcomes (PLO)											Teaching Methods	Assessment Method	
		PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11			PLO12
		1	2	3	4	5	6	7	8	9	0	1			2
	CLO1													Lecture/Practical	Test/Class Participation
	CLO2													Lecture/Practical	Test/Assignment/Project
	CLO3													Lecture/Practical	Project
	Total		1					1	2	1				Indicate the relevancy between the CLO and PLO by ticking "✓" the appropriate relevant box (This description must be read together with standards 2.1.2, 2.2.1, and 2.2.2 in Area 2 – pages 16 & 18 of COPPA 2.0)	
14.	Transferable Skills: Transferable Skill: Critical thinking How it is developed: Through discussion on given case study and report writing Assessment: Presentation and written report Transferable Skill: Teamwork, Communication and Listening How it is developed: Through group project and discussion Assessment: Project														
15.	Distribution of Student Learning Time (SLT)														
	Course Content Outline	**CLO	Teaching and Learning Activities				Guided Learning (NF2F)*	Independent Learning (NF2F)*	Total SLT						
			Guided Learning (F2F)*												
			*L	*T	*P	*O									
1	Data Visualization Basics What is visualization, why do we create visualization, functions of visualization, data and image models (properties of data or information, properties of the image, mapping data to images); review of exploratory data analysis (data diagnostics, graphical methods, data transformation, incorporating statistical models, statistical hypothesis testing using graphics and models in tandem)	1	4		4			8	16						
2	Visualization Design and Visualization Tools Visualization design (design criteria, design considerations, visualization designs); Visualization Tools (how do people create visualizations, graphics API, component model architectures, chart typologies, visual analysis languages, choosing the right software – expressiveness VS effectiveness)	1,2	2		0			2	8						

3	Multidimensional Data Visualization Separation to small multiples, multiple coordinated views, dimensionality reduction, visualizing multiple dimensions, parallel coordinates, Inselberg's principles, Tableau / Polaris.	2,3	0		0		8	0	8
4	Graphical Perception Signal detection, magnitude estimation, pre-attentive visual processing, using multiple visual encodings, Gestalt grouping, Feature Integration Theory, Color (perception of color, purpose of color, color in information visualization).	1	2		2			4	8
5	Interaction and Animation Interactive visualization techniques, how can we visualize and interact with billion+ record databases in real-time, interactive visualization on the web, introduction to developing data products	1,2,3	4		2		12	6	24
6	Using Space Effectively How can we use space effectively, strategies to transform space effectively - Focus+Context, transform data, transform visualization, and optimize layout, examples of using space effectively in 2D and 3D	2,3	2		2			4	8
7	Data visualization techniques Data visualization techniques for different data domains, with focus on four selected visualization techniques: (i) Geospatial Data Visualization Gathering, display, and manipulation of imagery, GPS, satellite photography and historical data; described explicitly in terms of geographic coordinates or implicitly. (ii) Tree Visualization Overview of techniques to visualize trees (indented lists, node-link trees, layered diagrams and treemaps), and their strengths & weaknesses. (iii) Graph Visualization Overview of techniques to visualize graphs, and their strengths & weaknesses; two representations: node-link diagrams, and matrix-based representation (iv) Text Visualization What is text data, why visualize text data, summarizing with words, visualizing themes in a document collection, quantifying textual content and performing text analysis	1,2	8		4		8	12	32
8	Collaborative Visual Analysis Social data analysis, how and where collaborators can contribute, design consideration, designing for social data analysis, case studies	2	2					2	4
Total SLT									108
SUMMATIVE ASSESSMENT									
1. Continuous Assessment			Percentage %				Total SLT		
Class participation			10%						
Test			20%				12		
Assignment			30%				20		
Project			40%				20		
Total SLT for Continuous Assessment							52		
2. Final Assessment			Percentage %				Total SLT		
							F2F		ILT
Total SLT for Final Assessment (F2F + NF2F)							0		
Grand Total			100%				160		
**Indicate the CLO based on the CLO's numbering in Item 12. *L= Lecture, *T= Tutorial, *P= Practical, *O= Others, F2F*= Face to Face, NF2F*= Non Face to Face									
16	Identify Special Requirement to Deliver the Course (e.g., software, nursery, computer lab, simulation room): computer lab, softwares (Notepad++, Tableau, Qlik)								
17	Main References: 1. M Tufte, E. (2001). The Visual Display of Quantitative Information (2nd Edition). Graphics Press. 2. Borner, K. and Polley, D.E. (2014), Visual Insights: A Practical Guide to Making Sense of Data, MIT Press.								
18	Additional References: 1. Meirelles, I. (2013), Design for Information: An Introduction to the Histories, Theories, and Best Practices Behind Effective Information Visualizations, Rockport Publishers. 2. Hearst, M. (2009). Search User Interfaces. Cambridge University Press. 3. Murray, S. (2013). Interactive Data Visualization for the Web. O'Reilly Media. 4. The Science of Science (Sci2) Tool. https://sci2.cns.iu.edu/user/index.php								

Note:

Cells shaded light grey contain formulas / fixed values. Edit these formulas only if needed.