Subject Code:	**Data Visualization**	**L,T,P,J,C** **2,0,2,4,4**
Objectives	1. To understand the various types of data, apply and evaluate the principles of data visualization 2. Acquire skills to apply visualization techniques to a problem and its associated dataset 3. To apply structured approach to create effective visualizations 4. To learn how to bring valuable insight from the massive dataset using visualization 5. To learn how to build visualization dashboard to support decision making 6.To create interactive visualization for better insight using various visualization tools	
Expected Outcome	After successfully completing the course the student should be able to 1. Identify the different data types, visualization types to bring out the insight. 2. Relate the visualization towards the problem based on the dataset to analyze and bring out valuable insight on large dataset. 3. Design visualization dashboard to support the decision making on large scale data. 4. Demonstrate the analysis of large dataset using various visualization techniques and tools.	
SLOs	2, 4, 7, 12 and 14	

Module	**Topics**	**L Hrs**	**SLO**
1	**Introduction to Data Visualization** Overview of data visualization - Data Abstraction - Task Abstraction - Analysis: Four Levels for Validation	4	2, 4
2	**Visualization Techniques** Scalar and point techniques – vector visualization techniques – multidimensional techniques – visualizing cluster analysis – matrix visualization in Bayesian data analysis	4	4
3	**Visual Analytics** Networks and Trees – Heat Map - Map Color and Other Channels-	5	7

	Manipulate View – Visual Attributes		
4	**Visualization Tools & Techniques** Introduction to various data visualization tools - Visualization using R	4	7
5	**Diverse Types Of Visual Analysis** Time- Series data visualization – Text data visualization – Multivariate data visualization and case studies	5	7
6	**Integration of Data Visualization with Hadoop** Integration of visualization tools with Hadoop **Visualization Dashboard Creations** Dashboard creation using visualization tools for the use cases: Finance-marketing-insurance-healthcare etc.,	6	7
7	**Recent Trends**	2	
Lab (Indicative List of Experiments (in the areas of) 1. Acquiring and plotting data 2. Statistical Analysis – such as Multivariate Analysis, PCA, LDA, Correlation, regression and analysis of variance 3. Financial analysis using Clustering, Histogram and HeatMap 4. Time-series analysis – stock market 5. Visualization of various massive dataset - Finance - Healthcare - Census - Geospatial 6. Visualization on Streaming dataset (Stock market dataset, weather forecasting) 7. Market-Basket Data analysis-visualization 8. Text visualization using web analytics		**30**	12
Project # Generally a team project [2 to 4 members] Projects may be given as group projects The following is the sample project that can be given to students to be implemented using appropriate visualization tools. 1. Analysis of social media data using visualization (Sentiment Analysis, Opinion Mining, Recommender Systems) 2. Visualization of Fraudulent Behaviour in finance and insurance sectors 3. Creating dashboard using visualization to enable quick decision making on IOT (data will be received from different sensors & stored in data centers. It will help us to identify & take quick decision according to the real time and historic data trends and alarms displayed in the dashboard)		**60** [Non Contact hrs]	14

Text Books 1. Tamara Munzer, Visualization Analysis and Design -, CRC Press 2014 2. Stephen Few, Now You See It -, Analytics Press, 2009 **Reference Books** **1.** Dr.Chun-hauh Chen, W.K.Hardle,A.Unwin, Handbook of Data Visualization, Springer publication,2008 2. Ben Fry, Visualizing Data -, O'Reilly Media, 2008 3. John Verzani, Simpler- Using R for introductory statistics, Taylor&Francis, 2005 4. A little book of R for multivariate analysis-Avril Coghlan, 2013		

Data Visualization

Knowledge Areas that contain topics and learning outcomes covered in the course

Knowledge Area	**Total Hours of Coverage**
CS: GV - Graphics and Visualization/ CE – HCI9 - Graphics and Visualization	18
CS: HCI – Human Computer Interaction	12

Body of Knowledge coverage

[List the Knowledge Units covered in whole or in part in the course. If in part, please indicate which topics and/or learning outcomes are covered. For those not covered, you might want to indicate whether they are covered in another course or not covered in your curriculum at all. This section will likely be the most time-consuming to complete, but is the most valuable for educators planning to adopt the CS2013 guidelines.]

KA	**Knowledge Unit**	**Topics Covered**	**Hours**
CS: HCI	Human Computer Interaction	Overview of data visualization - Data Abstraction - **Data Types, Dataset Types, Attribute Types** Task Abstraction – Analysis tasks abstractly – Designer or User action - How: A Preview Analyzing and Deriving: Examples Analysis: Four Levels for Validation - Four Levels of Design Angles of Attack Threats and Validation Approaches Validation Examples	4
CS: HCI	Human Computer Interaction	**Visualization Techniques** Scalar and point techniques – vector visualization techniques – multidimensional techniques – visualizing cluster analysis – matrix visualization in Bayesian data analysis Arrange Spatial Data - n Geometry Scalar Fields: 1 Value	4

		Vector Fields: Multiple Values Tensor Fields: Many Values	
CS: GV/CE-HCI9	Human Computer Interaction	**Visual Analytics: -** **Arrange Networks and Trees –** Connection: Link Marks, Matrix Views, Costs and Benefits: Connection vs. Matrix, Containment: Hierarchy **Heat Map - Map Color and Other Channels -** Color Theory Colormaps Other Channels - **Manipulate View-** Change View over Time Select Elements Navigate: Changing Viewpoint Navigate: Reducing Attributes - **Visualization Attributes**	5
CS:GV / CE-HCI9	Graphic Visualization	**Visualization Tools & Techniques** Introduction to various data visualization tools **Introduction to R Visualization -** Statistical analysis and Visualization using R	4
CS:GV / CE-HCI9	Graphic Visualization	**DIVERSE TYPES OF VISUAL ANALYSIS** Time- Series Analysis – Ranking Analysis – Deviation Analysis – Distribution Analysis – Correlation Analysis – Multivariate Analysis	5
		Integration of Data Visualization with Hadoop Integration of various visualization tools (R, Tableau, QlickView) with Hadoop using Hotnworks and **Visualization Dashboard Creations** Dashboard creation using various visualization tools (Tableau, QlickView) for the use cases: Finance-marketing-insurance-healthcare ect.,	6
		Recent Trends	2
		Total hours	**30**

Where does the course fit in the curriculum?
[*In what year do students commonly take the course? Is it compulsory? Does it have pre-requisites, required following courses? How many students take it?*]

This course is a

- Elective Course.
- Suitable from 4th semester onwards.
- Knowledge of any one programming language is preferred.

What is covered in the course?
[A short description, and/or a concise list of topics - possibly from your course syllabus.(This is likely to be your longest answer)]

Part 1: Introduction to Data Visualization
This section introduces the concept and importance of data visualization. It also introduces the different types of data and the types of visualization techniques for the same.

Part II: Data Visualization tools
This section introduces some of the tools that are popularly used for visualization. It also introduces statistical visualization using 'R'.

Part III: Visualization Dashboards
This section deals with the creation of visualization dashboards that display live information like stock exchange, weather etc.

What is the format of the course?
[*Is it face to face, online or blended? How many contact hours? Does it have lectures, lab sessions, discussion classes?*]
This Course is designed with 100 minutes of in-classroom - 2 sessions per week, 100 minutes of lab hours per week, as well as 200 minutes of non-contact time spent on implementing course related project. Generally this course should have the combination of lectures, in-class discussion, case studies, guest-lectures, mandatory off-class reading material.

How are students assessed?
[*What type, and number, of assignments are students are expected to do? (papers, problem sets, programming projects, etc.). How long do you expect students to spend on completing assessed work?]*

- Students are assessed on a combination group activities, classroom discussion, projects, and continuous, final assessment tests.

- Students can earn additional weightage based on certificate of completion of a related MOOC course.

Additional topics
[List notable topics covered in the course that you do not find in the CS2013 Body of Knowledge]

Other comments
[optional]

Session wise plan

Student Outcomes Covered: 2, 11, 14, 17

S.No	Topic Covered	Class Hour	Lab Hour	levels of mastery	Reference Book	Remarks
1.	Introduction to Data Visualization Overview-Data Abstraction	2		Usage	1	
2	Analysis: Four Levels of Validation	1		Usage	1,	
3	Data Visualization Using Geo Spatial Properties	3	2	Usage	1	LAB Component
4	Arrange Networks and Trees	2	2	Usage	1	LAB Component
5	Heat Map - Map Color and Other Channels- Manipulate View	2	2	Familiarity	1	LAB Component
6	Visualization Attributes	3			1	
7	Visualization Tools & Techniques	2	2	Familiarity	1	LAB Component
8	Statistical Visualization using R	3	6	Usage	4	LAB Component

9	Time- Series Analysis – Ranking Analysis	2	1	Usage	2	LAB Component
10	– Deviation Analysis – Distribution Analysis	2	1	Usage	2	LAB Component
11	Correlation Analysis – Multivariate Analysis	1	1	Usage	2	LAB Component
12	Integration of Data Visualization with Hadoop	2	6	Usage	1	LAB Component
13	Visualization Dashboard Creations	1	6	Usage	1	LAB Component
		30 Hours (2 Credit hours /week ✍ 15 Weeks schedule)	30 Hours (2 Credit hours / week)			