Visual Analytics Course

Syllabus

1 Overview

In today's data-driven era, there is an unprecedented amount of data generated daily from applications in different domains including business, healthcare, education, national security, and many more. This has led to an increasing demands for more mature and effective way to gain analytical insights out of these data. The emerging field of Visual Analytics focuses on handling these massive, heterogeneous, and dynamic volumes of information by integrating human judgment by means of visual representation and interaction techniques in the analysis process. This integration has allowed us to use the outstanding capabilities of humans in terms of visual information exploration and today's enhanced computing power to form a powerful knowledge discovery environment. In this course we will introduce this multi-disciplinary field by discussing its key issues of analytical reasoning, perception and cognition, visualization and interaction, computation and mining, the visual analysis process, and show potential application areas.

This why the course will combine suitable theory and Practical classes. The primary focus of the theory will be on the fundamentals of Visual Analytics as well as the basic concepts of data visualization and interactive visualization. In addition to the integration of machine learning techniques into Visual Analytics and an overview of its applications in visual computing for industry 4.0, medicine, and video analytics. The practical classes will include hands-on experiences on data visualization and interactive visualization. We will explore several visualization libraries in Python – from the standard Matplotlib, to more advance frameworks like Seaborn, Plotly, and Dash. This part also includes practical sessions on biomedical image analysis in Python. Also we will explore Streamlit framework for developing interactive machine learning application in Python. We will see how to combine these visual tools in streamlit with machine learning libraries like Scikit-Learn to support more informed predictive modelling from preliminary feature analysis through model selection, evaluation, and parameters tuning.

2 Objectives

- Learn what Visual Analytics is and why it is relevant.
- Explore the potential application areas of Visual Analytics Technologies, trends, and research directions.
- Understand the basics of Data Visualization and its relationship with Visual Analytics Visualization.
- Learn about Interactive Data Visualizations and the different ways to involve users into the data analysis loop.
- Explore the topic of Visual Computing and its applications for Industry 4.0 and medicine.
- Overview the basics of Video Analytics and its main development components.

Upon completion of the course, we will understand how to perform visual exploration of data using Python tools for data visualization. We will developed the ability to quickly graph, chart, summarize, and analyze any type of data either from a CSV or DataFrame. We will also understand how to integrate machine learning into visual analytics application to support feature engineering and feature selection, to diagnose common problems, evaluate models, and to conduct visual steering for improved results.

2.1 Course Requirements

Participants should be familiar with Python and with the command line before participating in this course. They should also have the required software/libraries installed and operational on their computers.

2.2 Duration

3 hours / week - (Theory (1 hour) + Practical (2 hours))

2.3 Course repo

https://github.com/CVIG-CCG/VisualAnalytics.git

3 Learning Outcomes

	Learning Outcomes	
Week 1 **Lesson One**	**Introduction to Visual Analytics**	• Explain what Visual Analytics is and why it is relevant. • Learn the fundamentals of data visualization and design • Learn to select the most appropriate data visualization based on the goal of the analysis • Understand the important design elements for graphically representing data • Notes for Designing Effective Visualizations. • Learn how to make and use basic charts such as bar charts and scatter plots **Practical**: • Data Visualization in Python.
Week 2 **Lesson Two**	**Interaction Data Visualization**	• Learn the fundamentals of Interactive Data Visualizations. • Understand how to use Plotly to build interactive and engaging Visual analytics dashboards. **Practical**: • Build Interactive Visualizations using Dash and Plotly in Python. •
Week 3 **Lesson Three**	**Visual Analytics and Machine Learning**	• Integration of Machine Learning into Visual Analytics.

		• Learn about Interactive Model Analysis and how Visual Analytics has been used for understanding, diagnosing, refining machine learning models as well as learning and recommending visualization. • Explore the basics of user interaction intent and semantic interaction in Visual Analytics. • Application domains of Visual Analytics and Machine learning. • Learn about the challenges of integrating ML into Visual Analytics **Practical**: • Basic of Streamlit framework (web and mobile apps) https://www.streamlit.io/ • Develop a simple Visual Analytics app using streamlit framework.
Week 4 **Lesson Four**	**Visual Analytics and Visual Computing**	• An introduction about Visual Computing as an enabling technology for Industry 4.0 applications. • The main technologies of Visual Computing and their relationships with Visual Analytics. • Overview about Visual Computing for Medicine applications and Medical Data Acquisition, analysis, and interpretation • Learn about Medical Volume Data Visualization and Exploration. • Basics of Video Analytics and examples of existing solutions and their main features and capabilities. • Explore the emerging concept of immersive analytics and the technologies involved. **Practical**: • Practical Hands-on experience on Biomedical Image Analysis in Python