**Course Title: Visual Programming**

Course No.: ICT. Ed 535 Nature of course: Theoretical + Practical

Level: M.Ed. Credit Hour: 3 hours (2T+1P)

Semester: Third Teaching Hour: 64 hours (32+32)

1. **Course introduction**

This course provides modern software development skills with a graphical user interface using C# with ASP.net. The course covers most of the C# language. Students will build window- and web-based forms, add controls, and set their properties.

1. **Objective of the course**

* Allows students to create user controls in Windows Forms applications using the Visual Programming Platform.
* The student will prove proficiency in Flow Control and Decision-Making using C# code syntax and language elements.
* Provide students with the knowledge and skills needed to validate user input in Windows Forms applications
* To enable students to link Windows Forms applications to various data sources using Microsoft ADO.NET
* Enhance students' ability to create ASP.NET Web Application projects using .NET.
* To enable student to work with new .NET technologies using Blazor and Xamarin

1. **Course Outlines**

|  |  |  |
| --- | --- | --- |
| **Specific objectives** | **Course contents** | **Teaching hours (T+P)** |
| Explain the concept of visual programming, its need  To know about different visual programming techniques. | **Unit 1: Introduction to Visual Programming**   * 1. Overview of Visual Programming, The need of Visual Programming   2. Graphical User Interface and different types of Visual Programming Practices   3. Rapid Application Development (RAD) Tools and Techniques   4. Event driven programming paradigm and C#   5. Advantages and disadvantages of visual programming | **2T** |
| Explain C# and .NET Framework  To identify and set up an appropriate working environment | **Unit 2: C# and .NET Framework**   * 1. Overview to C#, .NET and .NET Framework   2. .NET Features, programming model and Architecture   3. .NET packages and Frameworks   4. BCL, CLR, MSIL, CLS   5. Environment and IDE Setup and Configuration: Visual Studio and VS Code | **2T + 2P** |
| To work with basic C# language related programming applications. | **Unit 3: C# Language Basics**   * 1. Data Types and namespaces   2. Type Conversion   3. Boxing & Unboxing   4. Conditional Statements   5. Looping   6. Methods in C#   7. Properties   8. Arrays   9. Structures, Enumerations   10. Strings   11. Regular Expressions   12. Collections | **2T + 2P** |
| Develop the basic application with object oriented programming concept. | **Unit 4: Object Oriented Concepts in C#**   * 1. Overview of Object-Oriented Programming Structure   2. Class and Object   3. Method Overloading   4. Method Overriding   5. Abstract Classes   6. Abstract Methods   7. Early binding, Late binding   8. Constructors   9. Destructors   10. Inheritance   11. Interfaces   12. Encapsulation   13. Polymorphism   14. Exceptional handling   15. System defined exceptions and custom exceptions   16. Throwing Exceptions   17. Try, Catch, Finally   18. Parallel Programs   19. Concurrent Collections | **5T + 5P** |
| Develop the database application using ADO.net  Understands the integration concept of database in C# | **Unit 5: ADO.NET and WPF (Windows Presentation Foundation)**   * 1. Data access Tecnnologies   2. ADO.NET Architecture   3. Data access using ADO.NET   4. ADO.NET Connections: .NET Data providers, Connection classes, Strings, Pooling, Events   5. ADO.NET commands: Command object, creating, executing commands,   6. Batch queries and stored procedures   7. Datasets, DataTable, DataRow, DataColumn and updating database from a DataSet   8. LINQ to SQL and DataSet   9. WPF Controls, Layouts, Dialogs, Menus, Commands and Data bindings | **4T + 6P** |
| Work with ASP.NET and ASP.NET core Razor pages with MVC,  CRUD applications, REStful APIs | **Unit 6: ASP.NET and ASP.NET Core**   * 1. C# and ASP.NET with ASP.NET Core   2. ASP.NET architecture   3. Web applications using ASP.NET and ASP.NET MVC   4. RESTful APIs with ASP.NET Web API   5. ASP.NET Core Razor templates   6. Razor pages and CRUD Operation   7. Authentication and Authorization   8. ASP.NET Core middleware   9. Deployment (Azure, Docker, AWS) | **5T + 5P** |
| Design and develop web applications with Blazor. | **Unit 7: Web Applications with Blazor**   * 1. Blazor overview   2. Building a web app with Blazor: UI, Components, Data binding, data sharing, events and event handlings   3. Blazor pages, layouts, routing, navigation   4. Reusable Blazor components using Layouts   5. DOM events with Blazor event handlers   6. Server-side and client-side validation to the form   7. Application interactivity with lifecycle events   8. Razor class library concept and creation. | **5T + 5P** |
| Design and develop the Cross-Platform applications with the help of Xamarin, XAML  Understand how Xamarin is used for Android development and deploy applications | **Unit 8: Cross-Platform Development with Xamarin**   * 1. Overview of Xamarin and Cross-Platform Development   2. MVC and MVVM design patterns for Cross-Platform Development   3. XAML Basics: Layouts, Controls, Text, Data bindings, Styles and Graphics   4. XAML and Xamarin   5. Xamarin vs Xamarin.Forms   6. Xamarin Form Controls: Layout, Page, Views, Cells   7. Navigation: Patterns, Modal Views, Drill-downs, Tabbed views, Master-Detail views.   8. User Interface (Styles, Navigations, Maps, ListView) and Themes (Light, Dark and Custom build)   9. Working with SQLite.NET database   10. Android Development with Xamarin: Creating views, Calling Services, OAuth 2.   11. Deploying application | **7T + 7P** |

1. **Instructional Techniques**

The techniques taught for this course are divided into two groups. The first group covers general teaching techniques that apply to most lessons. The second group covers specific teaching techniques applied to specific units.

* 1. **General techniques**
* Provide reading material to familiarize students with the units.
* Lectures, Q&A, discussions, brainstorming, practice and buzz sessions.
  1. **Special Instructional techniques**

Demonstration is an essential teaching technique for all units of this course in the teaching and learning process. In particular, illustration by real work will be a specific teaching technique in this course. Details of suggested teaching techniques are presented below.

**Lab works:** Students must create a fully functional dynamic website that reflects all of the core technologies studied in this course.

*Note: Specific teaching techniques may or may not be required for each unit covered in the course outline.*

1. **Evaluation**

|  |  |  |  |
| --- | --- | --- | --- |
| **Internal Assessment** | **Semester Examination** | **External Practical Exam/ Viva** | **Total Marks** |
| 40 Points | 40 Points | 20 Points | 100 Points |

**Note:** *Students must pass an internal assessment, an external practice exam, and a separate semester exam.*

* 1. **Internal evaluation (40 Points)**

Internal assessment will be conducted by the subject teacher based on the following criteria:

1. Class Attendance 5 points
2. Learning activities and class performance 5 points
3. First assignment (Written assignment) 10 points
4. Second assignment (Case Study/Project work with presentation) 10 points
5. Terminal Examination 10 Points

Total 40 Points

* 1. **Semester examination (20 Points)**

The Examinations Department, Dean office will conduct and organize the final examination at the end of semester.

1. Objective question (Multiple choice 10 questions x 1mark) 10 Points
2. Subjective answer questions (6 questions x 5 marks) 30 Points

Total 40 Points

* 1. **External practical Exam/ Viva (40 Points)**

The practical part of the course will be assessed by an external examiner. Practical exam will be based on following criteria.

1. Record Book 6 points
2. Lab work Exam/ Case / Project 9 points
3. VIVA 5 points

Total 20 Points

1. **Recommended books and Reference materials (including relevant published articles in nation and international journals)**

Alessandro Del Sole (2022). Xamarin with Visual Studio: Launch your mobile development career by creating Android and iOS applications using .NET and C# (English Edition), BPB Publications.

David Pine (2022). Learning Blazor, O’Reilly.

Albahari, J., Albahari, B., & Drayton, P. (2012). C# 5.0 in a nutshell (5th ed). Beijing ; Sebastopol: O’Reilly.

Esposito, D. (2014). Programming Microsoft ASP.NET MVC (Third edition). Sebastopol, California: O’Reilly Media, Inc.

Ian Griffiths (2012), Programming C# 5.0, O’Reilly Media, Inc.

Evjen, B., Hanselman, S., & Rader, D. (2010). Professional ASP.NET 4 in C# and VB. Indianapolis, IN: Wiley Pub.

Sharp, J. (2013). Microsoft Visual C# 2013 step by step.

Stellman, A., & Greene, J. (2013). Head first C# (Third edition). Beijing: O’Reilly.

Course Title: **Software Project Management** Nature of Course: Practical

Course No. : ICT Ed 537 Credit Hour: 3 hours

Level: Master in Education Teaching Hour: 64

Semester: Third

1. **Course Description:**

The purpose of the course is to give students a thorough understanding of the development process. This course provide analytical ideas and methods of project management will be demonstrated by students. Learner will then set what they have learned to use on realistic software development projects. To complete a software project from beginning to end, students will collaborate in teams and build expertise in all facets of project management, including requirements gathering, design, programming, testing, and deployment. Under the guidance of an instructor or supervisor, students are required to develop a real-world problem-solving software project.

1. **General Objectives:**

The general objectives of the course are

* To advance understanding about the software development process and project management principles.
* To prepare a proposal for a software project which includes undertaking a review of existing software.
* To develop skills in project planning, scheduling, budgeting, analyze requirements, design, implement, test, and maintain software.
* To develop skills ability of a student to manage project, role of project management tools and methodologies.
* To create an analytical report that outlines the project's work and analyzes the outcome and the student's contributions

1. **Teaching Learning Strategies**

**Task 1:** **Project Management Plan:** Project management plan and project selection make up this task. Students must critically integrate their project management knowledge and abilities at deeper levels for this project to be successful. Your team must create a project management plan for this assessment job. The proposal should be around 2500 words long and include every element that is relevant to this project.

**Task 2:** **Project Presentation and Demonstration:** This work entails a number of software sprint submissions, a final project presentation, and a system demonstration. Students must finish all planned software releases for this task, presenting the finished product, consider their project's development process.

**Task 3: Project Report:** This task consists of a final project report. The report should be approximately 8000-10000 words and document the details of development frameworks, technologies, and tools, all software processes involved, specification, design, testing and evaluation reports, and impact of the project processes/outcomes in prescribe format.

1. **Description of the Project Work:**

The work carried out must be a practical, problem-solving convincing project. It should be a real world project in the sense that the product should be useful practically as far as possible.

**4.1 Group formation**

Students can perform project individually or in a group (maximum of 4 students).

**4.2 Procedure**

The students should exercise the following three phases for this course.

1. Project selection and project proposal submission (task 1)
2. Mid-Term Defense (task 2)
3. Final Project Submission and Defense (Task 2 and 3)
4. Project selection and project proposal submission

* Students(s) prepares proposal document in the prescribed format and submits to the Department of Education in the College
* The HOD/Program Coordinator or a panel coordinated by him/her evaluates the proposal with or without a presentation from the student(s)
* If the proposal is accepted; a Supervisor is assigned by HOD/Coordinator depending upon the nature of the project

1. Mid Term Defense

* The project team has to face a Mid Term Defense after first 40% to 60% of the project duration so that the supervisor and internal evaluator are assured of the progress of the project.

1. Final Defense

Project team submits a complete project report in the prescribed format to the department

* The department then Schedules the day for final defense
* External Supervisor will be decided and will be called for the final defense
* The project team needs to give presentation, followed by viva question answer session.

**4.3 Prescribed Format of the Proposal**

1. Introduction
2. Problem Statement
3. Objective
4. Scope and Limitation
5. Literature Review
6. Methodology
7. Requirement Identification

* Study of existing system
* Requirement collection

1. Feasibility Study

* Technical
* Operational
* Economical

1. Tools

* Analysis and Design Tools
* Implementation tools (Front End, Back End)

1. High level design of Proposed System (by system flow chart, use cases or other appropriate diagrams
2. Gantt Chart to show the projected time planning
3. Budget
4. Expected Outcome
5. References

**4.4 Prescribed Format of the Project Report**

The sequence in which the project report material should be arranged is as follows:

Cover page and Title

Candidate's Declaration

Supervisor's Certificate/ Recommendation

Internal, External Examiners' Approval

Acknowledgements

Abstract

Table of Content

List of Figures / Tables / Listings

Abbreviations

1. Chapter ONE Introduction
   1. Background
   2. Problem Statement
   3. Objective
   4. Scope and Limitation
2. Chapter TWO Literature Review
3. Chapter THREE Methodology
   1. Requirement Identification
      1. Study of existing system
      2. Requirement collection
   2. Feasibility Study
      1. Technical
      2. Operational
      3. Economical
   3. Tools
      1. Analysis and Design Tools
      2. Implementation tools (Front End, Back End)
4. Chapter FOUR High level design (by system flow chart, use cases or other appropriate diagrams
5. Chapter FIVE Testing and Evaluation: (testing methodology and results, including test cases, test plans and performance metrics.)
6. Chapter SIX Conclusion and Future Work

References /Bibliography

Appendix

**5. Number of Copies to be submitted to the Department**

Three hard copies of the report are to be submitted to the Department after corrections done as suggested by guide/Department at any time when report submission is called by guide/Department. The total numbers of reports to be prepared are three

• One copy to the college

• One copy for University

• One copy to candidate

Before taking the final printout, the approval of the concerned guide is mandatory and Suggested corrections, if any, must be incorporated. The reports submitted to the department/guide(s) must be hard bounded with black cover with golden color alphabets.

**5.1 Standard to be followed**

The report must be printed on one side only. Please use a high-resolution printer, preferably a laser printer with at least 300 dpi.

1. Page Layout

Your paper must use a page size corresponding to A4 which is 210mm (8.27") wide and 297mm (11.69") long.

The margins must be set as follows:

* Top = 1 inch
* Bottom = 1 inch
* Left = 1.25 inch
* Right = 1 inch

1. Page Style

* All paragraphs must be indented. All paragraphs must be justified aligned with 1.5 spacing

1. Text Font of Entire Document

* The entire document should be in Times New Roman.
* The font size has to be 12 throughout

1. Section Headings

* No more than 3 levels of headings should be used.
* Font size for the headings will be 16, 14, 12

1. Figures and Tables

* Position figures and tables at the tops and bottoms pages. Tables and figures may be full-page width or may be partial page.
* Width with wrap on either side.
* Figure captions should be centered below the figures. Table captions should be centered above.

1. References

* For reference students must follow APA format.

**6. Evaluation :**

|  |  |  |  |
| --- | --- | --- | --- |
| **Proposal** | **Mid-Term Defense** | **Final Defense** | **Total Marks** |
| 10 Points | 30 Points | 60 Points | 100 Points |

**6.1 Evaluators:**

Project Supervisor (Mentor of the project) -40%

Internal (HOD/Program Coordinator or decided by Coordinator) -20%

External Supervisor -40%

**6.2 Duration (for 1 group)**

• Presentation 20 minutes

• Viva 15 minutes

• Demonstration 15 minutes

• Report checking 10 minutes

**7. References**

Marchewka, J. T. *Information Technology Project Management*. Leyh Publishing LLC, USA

Schwalbe, K 2019*, Information technology project management* Ninth Edition., Cengage, Australia

Course Title: **Digital Pedagogy**

Course No.: ICT Ed 538 Nature of course: Theoretical + Practical

Level: M.Ed. Credit Hour: 3 (2+1)

Semester: Third Teaching Hour: 64 (32+32)

1. **Course Description**

This course aims to provide educators with the knowledge and skills to effectively integrate technology into their teaching and learning practices. This course will also acquire the knowledge and skills required to design, implement and evaluate digital pedagogical practices in online and blended learning digital platforms and environments using Moodle based LMS.

1. **General Objective of the Course**:

The general objectives of this course are as follows:

* To synthesis and evaluate different approaches to the use of digital technology in education
* To develop the knowledge and skills required to design, implement, and evaluate digital pedagogical practices in educational.
* To gain the skills to create online and blended learning environments.
* To address ethical and societal issues in relation to the use of digital pedagogy

1. **Course Outlines:**

|  |  |  |
| --- | --- | --- |
| **Specific Objectives** | **Contents** | **Hrs.** |
| * Discuss concept of digital pedagogy * Compare Digital literacy and Digital Pedagogy * Explore the elements of Digital literacy * Discuss the different generation and learning style. * Map pedagogy into TPACK framework | **Unit 1: Introduction to Digital Pedagogy**   * 1. Definition of Digital Pedagogy   2. Concept of Digital Literacy and Digital Pedagogy   3. Elements of Digital Literacy   4. Gen Z and Gen Alpha and learning styles   5. Digital pedagogy in TPACK framework   6. Online and Blended learning best practices | **10T** |
| * Discuss LMS and MOOC for online and blended learning. * Determine elements of LMS and MOOC. * Demonstrate configuration of LMS system * Demonstrate Course configuration in LMS * Demonstrate the different mode of student enrollment process in LMS | **Unit 2: Configuration of LMS/MOOC platform**   * 1. Learning Management System and MOOC Practices   2. Elements of Learning Management System   3. Elements of MOOC   4. Setup LMS platform for teaching learning   5. Course configure in LMS   6. Student enroll in LMS   **Practical Work/Case study**   * Design self-learning instruction student for Course * Configure Moodle or Similar platform * Course configure in Moodle or Similar platform * Student Enroll in manual and self-mode | **4T+8P** |
| * Develop learning resources plan for defined curriculum to LMS * Demonstrate text-based, audio-visual and interactive learning resources design develop process for LMS * Audit developed learning resources with course objective. | **Unit 3: Design Learning Resources (LR) for LMS**   * 1. Concept of different types of LR   2. Design and develop a text-based LR   3. Design and develop an audio-visual LR   4. Design and develop interactive LR   5. Auditing the LR with course objective.   **Practical Work/Case study**   * Design self-learning instruction student on LR * Develop Student Instruction * Work on LMS with text-based LR. * Work on LMS with audio-visual LR. * Work on LMS with interactive LR. | **2T+9P** |
| * Develop learning activities plan for defined curriculum to LMS * Demonstrate assignments, quizzes and collaborative learning assessment design develop process for LMS * Audit developed learning activities with course objective. | **Unit 4: Design Learning Activities (LA) for LMS**   * 1. Concept of Learning Activities (LA)   2. Design and develop assignments   3. Design and develop quizzes   4. Design and develop collaborative assessment   5. Auditing the LA with course objective   **Practical Work/Case study**   * Design self-learning instruction student on LA * Work on LMS with assignments LA. * Work on LMS with quizzes LA. * Work on LMS with collaborative LA. | **2T+9P** |
| * Discuss different types assessment methods in digital pedagogy perspectives. * Discuss the elements of learning analytics * Demonstrate student feedback process and track logs. * Explain the LMS and other collaborative tools | **Unit 5: Learning Assessment and Evaluation in LMS**   * 1. Concept of Assessment and evaluation   2. Learning analytics   3. Student feedback and log track   4. Collaboration work   5. Integration with other tools   **Practical Work/Case study**   * Work on LMS with Grade configuration, course completion criteria. * Demonstrate Collaborative Work * Demonstrate collaboration on LMS and another tools | **4T+6P** |
| * Define concept of digital citizens and netiquette * Discuss privacy and copy right issues in digital pedagogy * Explain the issues of accessibility and equity ensure * Discuss the digital safety on learning platform and learner end devices | **Unit 6: Legal, Ethical and Social Issues in LMS**   * 1. Concept of Digital Citizen and Netiquette   2. Privacy and copyright issues   3. Accessibility and equity issues   4. Digital safety in virtual space   **Practical Work/Case study**   * Case study on accessibility, equity and safety issues on leading MOOC platform: Coursera, edX, Futurelearn, Swayam | **10T** |

1. **Instructional Techniques**

The instructional techniques for this course are divided into two groups. First group consists of general instructional techniques applicable to most of the units. The second group consists of specific instructional techniques applicable to specific units.

**4.1 General Techniques**

* Providing the reading materials to the students to familiarize the units.
* Lecture, question-answer, discussion, brainstorming, practical, and buzz session.

**4.2 Specific Instructional Techniques**

|  |  |  |
| --- | --- | --- |
| **Unit** | **Activity and instructional techniques** | **Teaching Hours (32)** |
| **II-V** | Use Open sources based LMS tools like Moodle, prepare complete learning site with LR, LA and assessment. |  |

**Note: *Specific Instructional Techniques may or may not require for each of the units mentioned in course outline.***

1. **Evaluation**
   1. **Evaluation (Internal Assessment and External Assessment):**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Nature of course** | **Internal Assessment** | **External Practical Exam/Viva** | **Semester Examination** | **Total Marks** |
| Theory | 40% | 20% | 40% | 100% |

***Note****: Students must pass separately in internal assessment, external practical exam / viva and or semester examination.*

* 1. **Evaluation for Part I ( Theory)**
     1. **Internal Evaluation 40%**

Internal evaluation will be conducted by course teacher based on following activities:

1. Attendance 5 points
2. Participation in learning activities 5 points
3. First assessment ( written assignment) 10 points
4. Second assessment ( Term examination ) 10 points
5. Third assessment ( Internal Practical Exam/Case Study) 10 points

|  |
| --- |
| Total 40 points |

* 1. **External Evaluation (Final Examination) 40%**

|  |
| --- |
| Examination Division, office of the Dean, Faculty of Education will conduct final examination at the end of semester.   1. Objective type question (Multiple choice 10questionsx1mark) 10 marks 2. Short answer questions (6 questions x 5 marks) 30 marks |
| Total 40 marks |

* 1. **Evaluation for part II (practical) 20%**

|  |  |  |
| --- | --- | --- |
| Nature of the course | Semester final examination by External Examiner | Total percent |
| Practical | 100% |  |

**6.3.1 Practical Examination Evaluation Scheme**

1. External assessment …………………………100%
2. Record book ………………………. 20%
3. Laboratory work exam/Case………..40%
4. VIVA………………………………..40%
5. **Recommended books and reading materials (including relevant published articles in national and international journals)**
6. **Reference materials**

Nash S. S. & Rice W. (2022). *Moodle 4 e-learning course development the definitive guide to creating great courses in Moodle 4. 0 using instructional design principles* 5th edition (5th ed.). Packet Publishing Limited.

Course Title: **Data Science and Statistics**

Course No. ICT Ed. 517 Nature of course: Theoretical + Practical

Level: M.Ed. Credit hours: 3 (1T+2P)

Semester: First Teaching hours: 64

1. **Course Description**

The aim of the course is to impart knowledge of data science along with data visualization, linear algebra, statistics, probability, data manipulation, data cleansing, rescaling, machine learning, neural network, network analysis along with python to implement all the concepts.

1. **General Objectives of the Course**

Following are the general objective of this course:

* To familiarize the students with data science basics
* To enhance the skill of students in analyzing, manipulating and cleaning data
* To make the students competent in using statistical tools
* To enable the students to make use of API’s
* To make the students knowledgeable about natural language processing, machine learning and recommender system
* To make the students able to write python programs to do different task in the field of data science

1. **Specific Objectives and Contents**

|  |  |
| --- | --- |
| **Specific Objectives** | **Contents** |
| * Give an introduction of data science * Describe its dominance * Make use of matplotlib * Generate Bar Charts, Line Charts and Scatterplots | **Unit 1: Introduction to Data Science and Data Visualization (5)**   * 1. The Ascendance of Data   2. What Is Data Science?   3. matplotlib Library   4. Bar Charts   5. Line Charts   6. Scatterplots |
| * Explore Vectors and Matrices * Analyze data using methods of central tendencies, dispersion and correlation * State and Identify Simpson’s paradox * Define random variable * Identify and make use of probability distributions | **Unit 2: Linear Algebra, Statistics and Probability (9)**   * 1. Vectors and Matrices   2. Describing a Single Set of Data   3. Central Tendencies, Dispersion and Correlation   4. Simpson’s Paradox   5. Dependence and Independence   6. Conditional Probability and Bayes’s Theorem   7. Random Variables and Continuous Distributions   8. The Normal Distribution   9. The Central Limit Theorem |
| * Understand the concept of data IO * Read data from different source: flat file, web * Make use of API along with JSON and XML too | **Unit 3: Getting Data (8)**   * 1. stdin and stdout   2. Reading Files      1. The Basics of Text Files      2. Delimited Files      3. Scraping the Web   3. Using APIs   4. JSON (and XML)   5. Using an Unauthenticated API   6. Finding APIs      1. Example: Using the Twitter APIs      2. Getting Credentials |
| * Explore 1D, 2D and Multi-Dimensional Data * Illustrate data cleaning, munging, manipulating, rescaling and dimension reduction | **Unit 4: Working with Data (4)**   * 1. Exploring Data      1. Exploring One-Dimensional Data      2. Two Dimensions      3. Many Dimensions   2. Cleaning and Munging   3. Manipulating Data   4. Rescaling   5. Dimensionality Reduction |
| * Define Machine Learning * Identify overfitting, under-fitting and correctness * Describe neural network * Implement feed forward NN, Backpropagation, defeating a CAPTCHA * Deploy Recommender System | **Unit 5: Machine Learning, Neural Network and Recommender System (14)**   * 1. What Is Machine Learning?   2. Overfitting and Underfitting   3. Correctness   4. The Bias-Variance Trade-off   5. Feature Extraction and Selection   6. Perceptrons   7. Feed-Forward Neural Networks   8. Backpropagation   9. Example: Defeating a CAPTCHA   10. Manual Curation   11. Recommending What’s Popular   12. User-Based Collaborative Filtering   13. Item-Based Collaborative Filtering |
| * Describe Natural Language Processing * Understand Word clouds, n-gram models and Grammars * Apply Gibbs Sampling * Develop Network Analysis tools * Deploy betweenness centrality, eigenvector centrality and page rank | **Unit 6: Natural Language Processing and Network Analysis (10)**   * 1. Word Clouds   2. n-gram Models   3. Grammars   4. An Aside: Gibbs Sampling   5. Topic Modeling   6. Betweenness Centrality   7. Eigenvector Centrality      1. Matrix Multiplication      2. Centrality   8. Directed Graphs and PageRank |
|  | **Unit 7: Crash Course in Python (14)**   * 1. Getting Python   2. The Zen of Python   3. Whitespace Formatting, Modules and Arithmetic   4. Functions, Strings and Exceptions   5. Lists, Tuples, Dictionaries and Sets   6. Control Flow and Truthiness   7. Sorting, List Comprehensions, Generators and Iterators   8. Randomness and Regular Expressions   9. Object-Oriented Programming   10. Functional Tools   11. Enumerate   12. zip and Argument Unpacking   13. args and kwargs |

**Recommended Books**

Joel Grus (2015). Data Science from Scratch\_ First Principles with Python, 1st Ed., O'Reilly Media

Jake VanderPlas (2016). Python Data Science Handbook. Essential Tools for Working with Data, 1st Ed., O'Reilly Media

Jesús Rogel & Salazar (2020). Advanced Data Science and Analytics with Python, 1st Ed., CRC Press