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| **Chapter**  | **Topics** |
| Chapter one | **Introduction to The Process of Conducting Research** |
| Chapter two | **Research Design Introduction*** Steps in the Process of Research
* Identifying a hypothesis and/or research problem,
* specifying a purpose and creating research questions
* Reviewing literature
* Ethics of research and informed consent
 |
| Chapter three  | **Introduction to Qualitative Research*** Essence of Qualitative Data
* Sampling
* Collection Techniques
* Biography
* Phenomenology
* Grounded Theory
* Ethnography
* Case Study
 |
| Chapter four  | **Interpreting Qualitative Data*** Qualitative Data Analysis Procedures
* Coding
* Thematic development
 |
| Chapter five  | **Introduction to Quantitative Research*** Essence of Quantitative Data
* Collection and Analysis Techniques
* Sampling methods
 |
| Chapter six  | **Introduction to Mixed Research Methods** * Advantages
* Design Components
* Explanatory Mixed Methods Framework
* Exploratory Mixed Methods Framework
 |
| Chapter seven | **Research proposal and report writing** * Components of Research proposal writing
* Components of final research report writing
* Design science research
 |
| Reference  | 1. John Creswell Research Design: Qualitative, Quantitative, and Mixed Methods Approaches: SAGE Publications, Inc; Fourth Edition (March 14, 2013)
 |
| Methodology :( Lecture, discussions, article reviewing, seminar presentation etc.) Method of Evaluation:Evaluation will be conducted based on continuous assessment and final exam.* Continuous Assessments (50%)
* Attendance, lab activity, project, Quizzes, Assignment, Test
* Final written exam (50%)
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| Institution  | University of Gondar  |
| Faculty | Informatics  |
| Department | Information Science  |
| Course Title | **Foundation of Information &Data Science** |
| Course Code:  | ISDS1101 |
| Instructor | TBA |
| Weight  | 3 chrs. equivalent to 6 ECTS |
| Target Group:  | Master’s Students  |
| Year /Semester | Year: I, Semester: I |
| Pre-requisites  | none  |
| Course Status | General course |
| Course Description | This course is focused on examining the evolution of information science; information representation, organization and management; information in social organizations; information search and retrieval; human information seeking behaviors and interaction; information policy, ethics and scholarly communications. Additionally,This course also provides a comprehensive overview of modern data science: the practice of obtaining, exploring, modeling, and interpreting data. In addition. These course provides techniques about how to obtain data from legitimate open-source repositories using web APIs and page scraping, and introduces specific technologies (R, Python, and SQL) and techniques (support vector machines and random forests) for analysis. |
| Course Objectives | **At the end of this course the students will be able to:*** Describe and discuss the philosophical bases, conceptual structure, methodologies, and technologies related to information science
* Describe and analyze information science in a variety of contexts.
* Understanding the history, concepts, techniques and terminology used in information science.
* Understand the various problem areas of information science.
* Understand and able to identify information seeking behaviors.
* Understand the contemporary nature of data science
* Understand how to analyze, interpret and visualize data used for decision making
* Understand about data analysis tools
* Understand data science's role in making meaningful insights from the complex and large sets of data all around us.
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| Institution  | University of Gondar  |
| Faculty | Informatics  |
| Department | Information Science  |
| Course Title | **Introduction to Data Analytics** |
| Course Code:  | ISDS1113 |
| Instructor | TBA |
| Weight  | 3 chrs equivalent to 6 ECTS |
| Target Group:  | Master’s Students  |
| Year /Semester | Year: I, Semester: I |
| Pre-requisites  | none  |
| Course Status | Core course |
| Course Description | Introduction to data analytics introduces you to the basics of data science and data analytics for handling of massive databases. The course covers concepts data mining for big data analytics, and introduces you to the practicalities of map-reduce while adopting the big data management life cycle |
|  Course Objectives | * This course is designed to provide you the basic techniques of data science, that included prominent algorithms used to mine data (e.g., clustering and association rule mining), and basic statistical modeling (e.g., linear and non-linear regression). The course is targeted towards individuals who would like to know the practices used and the potential use of large scale data analytics. The objective of this course is to ascertain that the students know the fundamental techniques and tools used to design and analyze large volumes of data.
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| **Chapter**  | **Topics** |
| Chapter one | * Introduction to data analytics (DA),
* Data preparation, and
* Data cleaning.
* Data types and measures of similarity
 |
| Chapter two | * Data Preprocessing and numerosity reduction
* Data Governance
* Weka a walkthrough
 |
| Chapter three  | * Model building (Supervised Learning)
* Hands on with IBM Modeler
* Model evaluation in supervised learning
 |
| Chapter four  | * Frequent pattern mining and Hands on with IBM Modeler.
* Unsupervised learning and evaluation
 |
| Reference  | 1. Data Mining: Concepts and Techniques, Third Edition by Jiawei Han, MichelineKamber, Jian Pei, ISBN-10: 0123814790
 |
| Methodology (Lecture, discussions, article reviewing, seminar presentation etc.) Method of Evaluation:Evaluation will be conducted based on continuous assessment and final exam.* Continuous Assessments (50%)
* Attendance, lab activity, project, Quizzes, Assignment, Test

Final written exam (50%) |

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| **Institution**  | University of Gondar  |
| **Faculty** | Informatics  |
| **Department** | Information Science  |
| Course Title | **Exploratory Data Analysis and Visualization**  |
| Course Code:  | ISDS1114 |
| Instructor | TBA |
| Weight  | 3 chrs equivalent to 6 ECTS |
| Target Group:  | Master’s students  |
| Year /Semester | Year:I, Semester: I |
| Pre-requisites  | none  |
| Course status | Core course |
| Course Description | This course covers Exploratory Data Analysis and Visualization characteristics, explore, visualize, analyze, repeat and selective data collective and data exploration techniques and tools required for exploratory data analysis and visualization. The course focuses on concepts, principles and techniques of exploratory data analysis and visualization. It also covers exploratory data analysis and visualization tools such as R Programming for data analysis and Tableau for data visualization..  |
| Course Objectives | **On completion of this course, students will be able to:*** Understand the process of exploratory data analysis
* Identify data exploration, analysis, and visualization
* train industry standard tools for data analysis and visualization
* Understand R Programming , Tableau and their application
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| **Chapter**  | **Topics** |
| Chapter One | **Introduction to Exploratory Data Analysis*** Explore
* Visualize
* Analyze
* Repeat
 |
| Chapter Two | * Selective data collective and data exploration
* Data Science, Data Analysis, Cleansing & Transformation
* Methods of Exploratory Data Analysis
* Applications Exploratory Data Analysis for Dimension Reduction & Clustering
 |
| Chapter Three  |  **Data Visualization*** Story telling through Data
* Communicating using Data Visualization
* Dashboards and Automation, Visualization Product
 |
| Chapter Four  | * Exploratory Data Analysis and Visualization tools
* Data analysis (using R)
* Data visualization (using Tableau)
 |
| Reference  | 1. JoneTukey,Exploring Data Tables, Trends, and Shapes,1998
2. Julie Steele and Noah Iliinsky “ Beautiful Visualization ”, 2010
3. Julie Steele and Noah Iliinsky, “Designing Data Visualizations: Representing Informational Relationships , 2011.
4. Dylan Z. Childs ,”Introduction to Exploratory Data Analysis with R”,2017
5. Steve Wexler , Jeffrey Shaffer and Andy Cotgreave,“The Big Book of Dashboards: Visualizing Your Data Using Real-World Business Scenarios”, June,2017
 |
| Methodology ( Lecture and Laboratory)* + In the laboratory session of this course, students are predictable to practice in the lab.

 Method of Evaluation:* Evaluation will be carried out based on continuous assessment and final exam.
* Continuous Assessments (50%)
* Attendance, lab activity, project, Quizzes, Assignment, Test
* Final exam (50%)
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| Institution  | **University of Gondar** |
| Faculty | Informatics |
| Department | Information Science |
| Course Title | **Advanced Database Systems and Semantic web Analysis** |
| Course Code | ISDS1211 |
| Course Status | Core Course |
| Credit | 3credit hours equivalent to 6 ECTS  |
| Target Group | Masters Students |
| Class Room | TBA |  |  |
| Year | I | Semester  | II |
| Course Instructor(s) | TBA |
| Course Description | This course provides various principles of database management system (DBMS) as well as its advanced features will be discussed. This course also considers distributed databases and emerging trends in database system. It allows exploring various ways of designing and implementing database systems, features and distributed databases. In structuring this course, we commence with the basic design and implementation of relational databases. The course covers the modern data warehousing techniques with OLAP and emerging Database Models Technologies and Applications. The course also provides various principles and features about semantic web analytics.This course is also investigating the next generation of the Web whose key distinguishing characteristics will be the support for and use of semantics in new, more effective, more intelligent, ways of managing information and supporting applications.The Web, as it exists today, primarily supports human understanding and the interpretation of the vast information space it encompasses. However the Web was originally designed with a goal to support not only human-human communication but also as one that would enable automated machine processing of data with minimal human intervention.The Semantic Web is Tim Berners-Lee’s vision of a machine understandable and unambiguously computer interpretable Web. |
| Course Objectives | At the end of this course students will be able to:* Describe the basic concepts of Relational Database Design
* Explain Database implementation and tools
* Describe SQL and Database System catalog.
* Describe the process of DB Query processing and evaluation.
* Discuss the concepts of transaction management.
* Explain the Database Security and Authorization.
* Describe the design of Distributed Databases.
* Know how to design with DB and XML.
* Describe the basic concept of Data warehousing and OLAP
* Discuss the emerging Database Models Technologies and Applications
* Understand the rationale behind Semantic Web.
* Understand how to Model ontologies using Resource Description Framework (RDF).
* Understand how to design RDF Schemas for ontologies.
* Model and design ontologies using Web Ontology Language (OWL).
* Query ontologies using SPARQL.
* Understand and reflect on the principles of Ontology Engineering.
* Make an association between Semantic web and Web 2.0.
* Apply Semantic web technologies to real world applications.
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| Chapter one  | **Contents /Topics** |
| **Introduction** |
| * Relational Database Design
* Database Implementation & Tools
* Advanced SQL
* Database System Catalog
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| Chapter two | **DBMS Advance Features** |
| * Query Processing & Evaluation
* Transaction Management and Recovery
* Database Security & Authorizations
 |
| Chapter three | **Distributed Databases** |
| * Enhanced Database Models
* Object Oriented Database
* Database and XML
* Introduction To Data Warehousing and OLAP
* Data Modeling for Data Warehouses
* Building a Data Warehouse
* Typical Functionality of a Data Warehouse
 |
| Chapter four | **Emerging Trends and Example of DBMS Architecture** |
| * Emerging Database Models
* Technologies and Applications
* Mobile Databases
* Multimedia Databases
* PostgreSQL& Oracle
 |
| Chapter five | **Introduction to Semantic web** |
| * Semantic web layer
* Linked Data
* Ontology Languages for the Semantic Web
* Resource Description Framework (RDF)
* Lightweight ontologies: RDF Schema
* Web Ontology Language (OWL)
* A query language for RDF: SPARQL
* RDF serialization languages
 |
| Chapter six | * Inference over RDFS, OWL
* Ontology Engineering
* Ontology building
* Ontology mapping
* Semantic web Application
 |
| Teaching Strategy | The course will be offered through: lectures, laboratory classes, discussions, individual assignments and projects, group project works |
| Assessment Criteria | Achievements of learners are assessed10%: Article Review (Individual Work)10%: Article Review (Group Work)10%: Seminar Presentation20%: Project Work50%: Final Examination |
| Learners’ assignments/activities | Assignments/activities will be displayed along with lecture slides or they will be sent through hard copy, email or they will be posted on the server shared folder. |
| Required software  | DBMS Tools: ORACLE and PostgreSQL |
| References | Bancilhon, E, and Buneman, P., eds. [1990] Advances in Database Programming Languages, ACM Press, 1990.Bancilhon, E, Delobel, c., and Kanellakis, P., eds. [1992] Building an Object-OrientedDatabase System: The Story of 02, Morgan Kaufmann, 1992.Bischoff, ]., and T. Alexander, eds., Data Warehouse: Practical Advice from theExperts, Prentice-Hall, 1997.McFadden, F. R., and Hoffer, J. A. [1994] Modern Database Management, 4th ed., Benjamin Cummings, 1994.Melton, J., and Simon, A. R. [1993] Understanding the New SQL: A Complete Guide,Morgan Kaufmann.Kim, W., Reiner, D., and Batory, D., eds. [1985] Query Processing in Database Systems,Springer-Verlag, 1985.Ozsu, M. T., and Valduriez, P. [1999] Principles of Distributed Database Systems, 2nded., Prentice-Hall, 1999.Subramanian V. S., and [ajodia, S., eds. [1996] Multimedia Database Systems: Issuesand Research Directions, Springer Verlag. 1996.Yao, S., ed. [1985] Principles of Database Design, vol. 1: Logical Organizations, Prentice-Hall, 1985.Pascal Hitzler, Markus Krotzsch, Sebastian Rudolph, Foundations of Semantic Web Technologies, CRCPress, 2009.Dean Allemang, James Hendler, and Semantic Web for the Working Ontologist: Effective Modeling in RDFS andOWL, Morgan Kauffmann, ISBN-10: 0-12-373556-4.Michael C. Daconta, Leo J. Obrst, Kevin T. Smith, The Semantic Web: A Guide to the Future of XML,Web Services, and Knowledge Management:S Powers, Practical RDF (Paperback) ,OReilly (1 Aug 2003).Thomas B. Passin, Explorer’s Guide to the Semantic Web (Paperback), Manning Publications (8 Jul 2004). |

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| Institution  | University of Gondar |
| Faculty | Informatics |
| Department | Information Science |
| Course Title | **Data Science and Analytics workshop** |
| Course Code | ISDS1212 |
| Course Status | Core Course |
| Credit | 3credit hours equivalent to 6 ECTS  |
| Target Group | Masters Students |
| Class Room | TBA |  |  |
| Year | I | Semester  | II |
| Course Instructor(s) | TBA |
| Course Description | Introduction to data analytics introduces you to the basics of data science and data analytics for handling of massive databases. The course covers concepts data mining for big data analytics, and introduces you to the practicalities of map-reduce while adopting the big data management life cycle |
| Course Objectives | This course is designed to provide you the basic techniques of data science, that included data science and analytics toolsThe course is targeted towards individuals who would like to know the practices used and the potential use of large scale data analytics. The objective of this course is to ascertain that the students know the fundamental techniques and tools used to design and analyze large volumes of data. |
| Chapters  | **Topics**  |
| Chapter one | **Data analytics lifecycle:*** Discovery
* Data preparation
* Model planning
* Model building
* Communicating results
* Operationalizing
 |
| Chapter two | **Data analytics methods using R*** Introduction to R
* Analyzing and exploring the data
* Statistics for model building and evaluation
 |
| Chapter three | **Advanced analytics technologies and tools*** **Map Reduce** and **Hadoop**- analytics for unstructured data,  **Tableau data visualization**
 |
| Chapter four | **Introduction to data science using Python** |
| Software requirements  | R, Python, Map Reduce, Hadoop, Tableau data visualization |
| Teaching Strategy | The course will be offered through: lectures, laboratory classes, discussions, individual assignments and projects, group project works |
| Assessment Criteria | Achievements of learners are assessed50%: Project Work (using data science and analytics tools)50%: Final Examination |
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| **Institution**  | University of Gondar  |
| **Faculty** | Informatics  |
| **Department** | Information Science  |
| Course Title | **Advanced Machine Learning & Data Mining** |
| Course Code:  | ISDS1213 |
| Instructor | TBA |
| Weight  | 3 chrs equivalent to 6 ECTS |
| Target Group:  | Master’s Students  |
| Year /Semester | Year I, Semester: II |
| Pre-requisites  | none  |
| Course Status | Core  |
| Course Description | Nowadays, With the rapid rise of the interdisciplinary data science and big data fields, there has been a push for increased extraction of knowledge and insight from all types, forms, and shapes of dataThis course focuses on understanding how the primary machine learning algorithms work. So the students will be able to select and adapt the methods to solve specific problems. This can provide a competitive advantage professionally for practitioners, and also for the companies/research domains to which the methods are applied. |
| Course Objectives | At the end of the course, students will be able to:* + Have a solid understanding of what the various algorithms do and when to use them
	+ Have the ability to adapt the approaches to meet different needs specific to a project goal
	+ Get a research skills to locate and utilize the literature of the field
	+ correctly interpret and present results--a key skill set for practitioners of machine learning and data mining
	+ select and define a representation for data to be used as input to a machine learning algorithm
	+ select and define a representation for the model to be output by machine learning algorithm
	+ compare different algorithms according to the properties of their inputs and outputs
 |
| **Software requirements**  | * Rapid Miner machine learning toolkit in Java ,
* Python, will be used for conducting the lab session
 |

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| **Chapter**  | **TOPICS** |
| Chapter one | * Fundamentals of machine learning and data mining
* Introduction to machine learning and data mining.
* Concept learning, Decision tree learning, Rule learning, learning for numerical prediction, Instance-based learning and Genetic algorithms.
* Data Cleaning, imputation, cross-validation, and interpreting results
 |
| Chapter two | * Data Preparation
* Data reduction
* Attribute subset selection
* Forward selection
* Backward elimination
* Combination
* Transformation
* Normalization
* Discretization
* Dimensionality Reduction
* PCA, SVD
* Tensor Decomposition
* Supervised and Unsupervised Methods
* Segmentation
* Classification
* Association rule mining
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| Chapter three  | Advanced Machine Learning Concepts and Techniques* SVMs and Ensemble methods
* Bayesian learning
* Unsupervised learning and Clustering
* Neural Network
* Logistic regression
* Expectation maximization algorithms
* Genetic algorithms
 |
| Chapter four  | * Application Areas of machine learning and data mining
* Information retrieval and text mining, and n-grams
* Recommendation systems
* Outlier detection
* Frequent Pattern mining and APRIORI
 |
| Chapter five  | **Segmentation** * Partitioning
* Hierarchical
* Density based
* Grid based
 |
|  **Reference**  | 1. Machine Learning, Mitchell, (1997), McGraw-Hill
2. Data Mining: Concepts and Techniques, Third Edition by Han, Kamber, and Pei, 2011.
3. Pattern Recognition and Machine Learning by Christopher Bishop; 2007.
4. Applied Predictive Modeling by Max Kuhn and Kjell Johnson; 2013.
5. Python for Data Analysis by Wes McKinney; 2013.
6. Introduction to Machine Learning, Alpaydin, (2004), MIT Press
7. Data Mining (2nd ed.), Han and Kamber, (2006), Morgan Kaufmann
8. Pattern Classification (2nd ed.), Duda, Hart and Stork, (2001), WileySpringer
9. Pattern Recognition and Neural Networks, Ripley, (1996), Cambridge
10. Classification and Regression Trees, Breiman, Friedman, Olshen and Stone(1984), Kluwer
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| **Institution**  | University of Gondar  |
| **Faculty** | Informatics  |
| **Department** | Information Science  |
| Course Title | **Big Data Analytics**  |
| Course Code:  | ISDS1214 |
| Instructor | TBA |
| Weight  | 4 Chrs equivalent to 7 ECTS |
| Target Group:  |  Master’s students  |
| Year /Semester | Year I, Semester: II |
| Pre-requisites  | none  |
| Course status | Core  |
| Course Description | This course covers big data characteristics, big data components, big data challenges, techniques and tools required for big data analytics. The course focuses on concepts, principles and techniques of big data analytics. It also covers big data analytics tools such as Hadoop and Spark.  |
| Course Objectives | On completion of this course, students will be able to:* Understand big data basics
* Identify big data characteristics and challenges
* Comprehend analytical tools and techniques of big data
* Understand Apache Hadoop, spark and their application
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| **Chapter**  | **TOPICS** |
| Chapter one | * Introduction to Big Data
* Big Data definition
* Four V’s in Big Data
* Big data sources
* Big Data Ecosystem
* Big Data as an Industry outlook
* Big Data Applications
* Big Data Components
* Big Data Characteristics
* Key Components in Big Data Analytics Environment
 |
| Chapter two | * **Big Data Application**
* Text Analytics
* Analytics of data Streams
* Graph analytics
* Location analytics
* Etc.
 |
| Chapter three | **Big data analytics philosophy*** Map reduce
* Parallel computing
 |
| Chapter four  | **Big data analytics tools** * comparison of big data analytics tools
* Introduction to Hadoop
* Hadoop Architecture
* Hadoop Applications & HDFS
* Hadoop MapReduce Framework
* Apache Mahout
* Spark and its application
 |
| Reference  | 1. V.mayerschonberger and k.cukier, “Big data: a revolution that will transform how we live, work and think
2. Eric Sammer “ Hadoop Operations”, May 2012, ISBN: 9781449337
3. Maheshwari , “Big data analytics made accessible , 2017.
4. Jeffrey Stanton Introduction to data science, Syracuse university,2012
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| **Institution**  | University of Gondar  |
| **Faculty** | Informatics  |
| **Department** | Information Science  |
| Course Title | **Graduate Seminar in Information and Data Science** |
| Course Code:  | ISDS2111 |
| Instructor | TBA |
| Weight  | 2 chrs equivalent to 5 ECTS |
| Target Group:  | Master’s Students  |
| Year /Semester | Year II, Semester: I |
| Pre-requisites  | none  |
| Course Status | Core  |
| * **Seminar contents**
 | List of Seminar Topics

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| * Current issues of Information Science
* Current issues of Data Science
* Business intelligence predictive analytics
* Web Analytics Solution
* Big Data and Business Intelligence (BI)
* Data mining in Search Engine Analytics
* Application of Hadoop for big data analysis
* Educational data mining
* Data mining marketing
* Health data mining
* Open source data mining
* Data mining trends
* Digital visual interface.
* Application of python for data science
* Information Needs & Behaviors
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