



**FLORIDA INTERNATIONAL UNIVERSITY
UNIVERSITY CURRICULUM COMMITTEE**
Proposal for a New Course

DO NOT TYPE IN THIS BOX

Bulletin # : 3

Academic Year : 2018-19

1. School/College Engineering and Computing
Div./Dept. in Which Taught School of Computing and Information Sciences

2. CAP 2 3
Alpha Prefix 1st Last 3 "C"-lec-lab "L"-Lab Cr. Hrs.
Digit Digits

CIP Code (Leave this blank): _____

CAP 2752

3. Grading Method (select one): Graded Pass/Fail

4a. Course Title Fundamentals of Data Science

b. Abbreviated course Title (for computer class schedules, transcripts) Fundamentals of Data Sci.

LIMITED TO 25 Characters (including spaces)

5. Statewide Course Numbering Subject Matter Area CIS (Computing and Information Sciences)

6. Catalog Description/Major Topics (not to exceed 200 characters including spaces)
College of Medicine and College of Law: Attach description not exceeding 1,000 characters including spaces.

This course will teach data science fundamentals to undergraduate non-CS majors. The focus will be on real-world applications and use of associated analysis, visualization tools, Python programming.

7. Attach detailed syllabus course outline and course justification on separate page(s).

8. Prerequisite(s): B.S. or B.S. standing or permission of the instructor

9. Corequisite(s): None

10. Objective(s) of Course:

Understand the principles and approaches of data science, including the pre-processing, data-representation, data analysis and visualization

11. Does this course duplicate/overlap other courses at FIU? No Yes

If yes, please explain: _____

12. What other closely related department(s) have been consulted about this course?

None

PROPOSAL REQUESTED BY:

Faculty Contact Fahad Saeed 11 / 28 / 2018

(Type name) (Signature)
fsaheed@fiu.edu (305) 348-3131
(Email address) (Phone number)

Chairperson (Dept./Div.) S.S. Iyengar 11 / 28 / 2018
(Type name) (Signature)

Chairperson (Curr. Comm.) Cesar Levy 11 / 29 / 2018
(Type name) (Signature)

College/School Dean John Volakis 12 / 3 / 2018
(Type name) (Signature)

Submit one original form. Attach one copy of the course syllabus containing: course description, objectives, learning outcomes, major topics and textbooks.

Fundamentals of Data Science

Course Justification

Massive volumes of data sets are being generated in all forms from disparate sources including the social media, multimedia content, scientific experiments, tourism and financial systems. With these large data sets there is an inherent need to automate and process the data in a scalable and meaningful fashion. Since the amount of data accessible is large and is produced in different formats and contexts traditional methods of processing will not work. Therefore, new methods are needed to process these heterogeneous large data sets with varying quality and semantics. Further, high-performance computing is needed to process this data in a scalable fashion.

There is no undergraduate course in data science at FIU that focuses on students with non-CS majors. Such data-science skills are in high-demand and are essential in today's industry. The course will cover the fundamentals of the relevant data-science techniques on how to efficiently process, clean and compute in an intelligent and meaningful manner with available tools.

In particular, the covered topics will include: Introduction to data analysis techniques and associated computing concepts for non-CS majors. Topics include foundations for data analysis, visualization, parallel processing, metadata, provenance, and data stewardship.

This new course will give non-CS major students data science skills along with sound computational thinking to better prepare them for today's marketplace.

CAP 2xxx: Fundamentals of Data Science

Taught by:

Fahad Saeed
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Catalog Description:

This course will teach data science fundamentals to undergraduate non-CS majors. The focus will be on real-world applications and use of associated analysis, visualization tools, Python programming.

Summary:

This course will teach non-programmers to think in computing terms about modern topics, and to approach real-world applications through data science. The course will enable students to:

- Acquire computational thinking skills that will enable students to represent and reason about complex problems in the digital arena
- Understand different kinds of data in terms of their possibilities and limitations to approach complex problems cast in terms of the emerging field of data science
- Become data science scholars through best practices in data documentation and dissemination

The course is intended for students in disciplines outside of computer science and no prior programming experience is assumed. The course topics will be particularly relevant to students interested in physical sciences and social sciences.

Pre-requisites

None for B.S. or B.A. standing or permission of the instructor.

Textbook:

TBD

Times & Locations:

Lecture will be held twice a week for 1 hour, 15 minutes;
Office hours will be held once a week.

Grading

Homework	20%
Midterm Exam	30%
Presentations	10%
Final Exam	40%

Reading

Reading assignments will be distributed via the website. Readings will be associated with each lecture, and these should be completed in order to completely understand the material.

Homework

There will be at least 4 homework assignments. Homeworks will be available on the website by the beginning of the first class of the week. Homeworks must be submitted electronically as a single pdf file via the website. Late homeworks will be penalized 50%, and not accepted after the start of the first class of the week.

Exams and Evaluation

- a) There will be presentation on advanced topics by each individual student which will be evaluated by the instructors
- b) There will be two exams: a midterm and a final.

Schedule of Topics

Lecture #	Topic
1	Computational thinking and data science <ul style="list-style-type: none"> •What is computational thinking •Computational thinking for reasoning and analysis •What is data science •Data scientists •The context of data science
2	Data <ul style="list-style-type: none"> •What is data •What is not (yet) data •Time series data •Networked data •Geospatial data •Text data •Labeled and annotated data •Big data
3	Data Representation (structured) <ul style="list-style-type: none"> • Interrelations • Spreadsheets • Databases • Matrices • Graphs • Other perspectives
3	Data analysis software <ul style="list-style-type: none"> •Programs for data analysis •Inputs and Outputs •Program Parameters

	<ul style="list-style-type: none"> •Programming Languages •Programs as Black Boxes •Algorithms versus software •Data Structures and why they are important for data sciences
4	Multi-step data analysis as workflows <ul style="list-style-type: none"> •Building workflows by composing software •Pre---processing and post---processing data •Workflows for data analysis •Workflow inputs and parameters •Executing workflows •Exploring data through workflows •Workflows in practice
5	Workflow Jupyter notebook practicum <ul style="list-style-type: none"> • The Jupyter notebook workflow system • Jupyter notebook in practice
6	Data pre-processing <ul style="list-style-type: none"> •Data cleaning •Quality control •Data integration •Feature selection •Feature construction
7	Data lifecycle <ul style="list-style-type: none"> •Data collection •Data storage •Data extraction and querying •Data integration •Data presentation
8	Data visualization <ul style="list-style-type: none"> •Quality of visualizations •Major types of visualizations •Time series visualizations •Geospatial visualizations •Multi---dimensional spaces •Network visualizations
9, 10	Data analysis tasks (I) <ul style="list-style-type: none"> • Data analysis tasks in data mining, statistics, and machine learning • Supervised learning <ul style="list-style-type: none"> o Classification tasks o Classification algorithms o Evaluation of classifiers
11,12	Data analysis tasks (II)

	<ul style="list-style-type: none"> • Unsupervised learning <ul style="list-style-type: none"> ◦ Clustering • Pattern detection • Anomaly detection
13	Data analysis tasks (III) <ul style="list-style-type: none"> • Causality • Probabilistic graphical models • Bayesian networks • Causal models
14,15	Parallel and Distributed Computing for Big data <ul style="list-style-type: none"> • Cost of Computation • Divide and Conquer • Speedup with Parallel Processing • Limits of speedups: Critical Path • Amdahl's law • When problems are not parallelizable • Introduction to Parallel Graph Algorithms
16	Semantic metadata <ul style="list-style-type: none"> • What is metadata • Basic metadata versus semantic metadata • Metadata about data collection • Metadata about data processing • Metadata for search and retrieval • Metadata standards • Domain metadata and ontologies
17	Ontologies (I) <ul style="list-style-type: none"> • What is an ontology • Taxonomies and class inheritance • Properties • Logical constraints
18	Data formats and standards <ul style="list-style-type: none"> • Data formats • Data standards • Data repositories • Data services • The Semantic Web and linked open data
19	Data stewardship <ul style="list-style-type: none"> • Data sharing • Data identifiers • Licenses for data • Data citation and attribution • Software and other work products
20	Advanced Topics (I)

	Privacy and Ethics in Data Science
21	Advanced Topics (I) Introduction to Databases
22	Advanced Topics (I) Multidisciplinary Collaborations between data scientists and domain specialists (best practices)
23,24,25	Presentation by students on advanced topics