Cover Sheet: Request 14137

MAS4XXX Linear Algebra for Data Science

Info

Process	Course|New|Ugrad/Pro
Status	Pending at PV - University Curriculum Committee (UCC)
Submitter	Philip Boyland boyland@ufl.edu
Created	8/20/2019 4:12:40 PM
Updated	11/20/2019 1:59:12 PM
Description of request	Proposed course is named "Linear Algebra for Data Science"

Actions

Step	Status	Group	User	Comment	Updated
Department	Approved	CLAS - Mathematics 011613000	Kevin Knudson	No external consultation completed. The only departments which would possibly have overlapping content would be CISE and Statistics, neither of which have such courses.	8/31/2019
No document changes					
College	Recycled	CLAS - College of Liberal Arts and Sciences	Joseph Spillane	The College Curriculum Committee recycles this request, with the following changes needed: 1) Please revise course objectives to meet UCC standards (see https://gov.clas.ufl.edu/files/Cor Problems-Checklist.pdf); 2) please provide more detail on assignments in grading scheme.	10/14/2019
No document changes					
Department	Approved	CLAS - Mathematics 011613000	Kevin Knudson		10/23/2019
No document changes					
College	Conditionall Approved	CLAS - College of Liberal Arts and Sciences	Joseph Spillane	The College Curriculum Committee conditionally approves this request, with the following: 1) please fix the overlap on the grade ranges; 2) on the course syllabus, please separate move the Matlab text in the prerequisites section to its own section.	11/19/2019
No document changes					
Department	Approved	CLAS - Mathematics 011613000	Kevin Knudson		11/20/2019
syllabus-linalgdata.pdf					11/19/2019
College	Approved	CLAS - College of Liberal Arts and Sciences	Joseph Spillane		11/20/2019
No document changes					

Original file: Cover sheet.pdf

Step	Status	Group	User	Comment	Updated
University Curriculum Committee	Pending	PV - University Curriculum Committee (UCC)			11/20/2019
No document changes					
Statewide Course Numbering System					
No document changes					
Office of the Registrar					
No document changes					
Student Academic Support System					
No document changes					
Catalog					
No document changes					
College Notified					
No document changes					

Course|New for request 14137

Info

Request: MAS4XXX Linear Algebra for Data Science
Description of request: Proposed course is named "Linear Algebra for Data Science"
Submitter: Philip Boyland boyland@ufl.edu
Created: 11/19/2019 8:55:51 PM
Form version: 4

Responses

Recommended Prefix MAS
Course Level 4
Course Number XXX
Category of Instruction Advanced
Lab Code None
Course Title Linear Algebra for Data Science
Transcript Title Lin Alg-Data Science
Degree Type Baccalaureate

Delivery Method(s) On-Campus
Co-Listing No

Effective Term Earliest Available
Effective Year Earliest Available
Rotating Topic? No
Repeatable Credit? No

Amount of Credit 3

S/U Only? No
Contact Type Regularly Scheduled
Weekly Contact Hours 3
Course Description A second course in linear algebra, focusing on topics that are the most essential for data science. Introduces theory and numerical methods required for large data-sets and machine learning. Topics include LU, QR, and singular-value decompositions; conditioning and stability; the DFT and filters; deep learning; fully connected and convolutional nets
Prerequisites (MAS 3114 or MAS4105) & MAC2313
Co-requisites N/A
Rationale and Placement in Curriculum This is a second course in linear algebra focusing on the theory and
computational methods necessary in data science.
These advanced topics are critical skills for students planning to work
in industry, and also serve as a foundation for further study in related
areas of mathematics, statistics, science and engineering. Several courses
connected to the proposed data science major will have this course as a
prerequisite, and this course will also be useful to majors in other
disciplines that require the solution of large scale linear problems.
Course Objectives A student who successfully completes this course will be able to:

* Perform basic linear algebra computations by hand and in Matlab.

* Prove the existence of the various standard matrix decompositions and
use their numerical implementation for data analysis and solving linear problems.

* Construct routines which avoid the common sources of error
based on an appreciation of conditioning and stability in numerical linear algebra computations.

* Derive the basic properties and write Matlab code implementations of the Discrete Fourier

Transform, convolution, filtering and one step convolutional nets

* Construct simple feedforward neural networks using learning functions, loss functions and stochastic gradient descent

Course Textbook(s) and/or Other Assigned Reading Linear Algebra and Learning from Data, by Gilbert Strang, Wellesley-Cambridge Press; First edition (2019)

Weekly Schedule of Topics Week 1: Review of basic Linear Algebra: linear independence, basis, dimension,
Week 2: Matrices, linear transformations, associated subspaces
Week 3: Systems of equations, LU decomposition
Week 4: Inner products, orthogonality, QR decomposition, Eigenvalues, eigenvectors
Week 5: EXAM 1, Jordan normal form, linear differential equations
Week 6: Spectral theorem, norms, spectral radius, introduction to least squares
Week 7: Singular value decomposition, principal component analysis, best low rank approximation
Week 8: Basic numerical linear algebra, conditioning, stability, iterative methods
Week 9: Fourier Series and Discrete Fourier Transform, convolution,
Week 10: EXAM 2, Toeplitz matrices and shift invariant linear filters
Week 11: Optimization, Levenberg-Marquardt, Gradient Descent
Week 12: Deep learning, layers, learning and loss functions
Week 13: Fully connected and convolutional nets
Week 14: Back propagation and chain rule, stochastic descent
Finals week: EXAM 3

Grading Scheme Homework will be assigned every two weeks on a Friday and due the next Friday, so there will be about 7 total assignments. The homework will foster mastery over the material covered in class in the previous two weeks. It will include hand computations, proofs and Matlab computations. All problems will be graded and the graded homework will be returned by the following Friday.

There will be three 50 minute exams.

The three exams constitute 80% of the grade and the homework is 20%.

The grade ranges for the total scores are 93-100% A, 90-92% A-, 88-89% B+,83-87% B, 80-82% B-, 78-79% C+,73-77% C, 70-72% C-, 60-69% D, <60% F.

Instructor(s) Philip Boyland

Attendance & Make-up Yes

Accomodations Yes

UF Grading Policies for assigning Grade Points Yes

Course Evaluation Policy Yes

University of Florida (http://ufl.edu/)

Philip Boyland (https://people.clas.ufl.edu/boyland/)
Department of Mathematics

College *of* Liberal Arts *and* Sciences (http://clas.ufl.edu/)

Preliminary Syllabus: Linear Algebra for Data Science

Course Numbers: MAT4930 (section 24192)

Time and Location: Spring 2020, MWF 7

Office Hours : MWF period 8 and by appointment made 24 hours in advance.

Required Text: *Linear Algebra and Learning from Data,* by Gilbert Strang, Wellesley-Cambridge Press; First edition (2019)

Course Description: A second course in linear algebra, focusing on topics that are the most essential for data science. Introduces theory and numerical methods required for linear problems associated with large data-sets and machine learning. Topics include LU, QR, and singular-value decompositions of matrices; conditioning and stability; the DFT and linear filters; deep learning; fully connected and convolutional nets; and stochastic descent.

Prerequisites: A course in linear algebra (MAS 3114, MAS4105 or equivalent course) is required.

Programming Prerequisite: Class assignments will require Matlab or comparable platform, and so if you don't know one of these you will need to have enough experience with a programming language to pick up Matlab reasonably quickly.

Homework: Homework will be assigned every two weeks on a Friday and due the next Friday, so there will be about 7 total assignments. The homework will foster mastery over the material covered in class in the previous two weeks. It will include hand computations, proofs and Matlab computations. All problems will be graded and the graded homework will be returned by the following Friday.

Exams: There will be three 50 minute exams. The first two will take place in class on Wednesday during week 5 and week 10. The third exam will take place during the class's final exam slot as designated by the University which is **.

Grades: The three exams are weighted equally and are not cumulative. The three exams constitute 80% of the

grade and the homework is 20%. The grade ranges for the total scores are 93-100% A, 90-92% A-, 88-89% B+,83-87% B, 80-82% B-, 78-79% C+,73-77% C, 70-72% C-, 60-69% D, <60% F.

Weekly Schedule:

Week 1: Review of basic Linear Algebra: linear independence, basis, dimension,

Week 2: Matrices, linear transformations, associated subspaces

Week 3: Systems of equations, LU decomposition

Week 4: Inner products, orthogonality, QR decomposition, Eigenvalues, eigenvectors

Week 5: EXAM 1, Jordan normal form, linear differential equations

Week 6: Spectral theorem, norms, spectral radius, introduction to least squares

Week 7: Singular value decomposition, principal component analysis, best low rank approximation

Week 8: Basic numerical linear algebra, conditioning, stability, iterative methods

Week 9: Fourier Series and Discrete Fourier Transform, convolution,

Week 10: EXAM 2, Toeplitz matrices and shift invariant linear filters

Week 11: Optimization, Levenberg-Marquardt, Gradient Descent

Week 12: Deep learning, layers, learning and loss functions

Week 13: Fully connected and convolutional nets

Week 14: Back propagation and chain rule, stochastic descent

Finals week: EXAM 3

Announcements: You are responsible for all announcements made in class which could include changes in exam dates and material covered.

Class Attendance: Most students benefit a great deal from attending class regularly. Arriving late and/or leaving early, reading the newspaper, looking at your cell phone, etc. disrupts the class and is rude and unprofessional.

Excused Absences: In certain circumstances a student will be able to make up a missed exam. These circumstances could include medical situations, family emergencies, travel for University activities (eg. band, debating club, etc), and religious observances. In these cases the student must inform me before or within one week after the missed work and **provide written documentation**.

Grading Disputes: Any issues or questions about the grading of exams must be brought to my attention within one week after the exams are returned to the class

Additional Information:

Grades: Grading will be in accord with the UF policy stated at https://catalog.ufl.edu/ugrad/current/regulations /info/grades.aspx. (https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx)

Honor Code: "UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following

pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.”

Class Attendance: “Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx. (https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx)”

Accommodations for Students with Disabilities: “Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, https://www.dso.ufl.edu/drc/ (https://www.dso.ufl.edu/drc/)) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.”

Online Evaluations: “Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/ (https://gatorevals.aa.ufl.edu/students/). Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/ (https://ufl.bluera.com/ufl/). Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/ (https://gatorevals.aa.ufl.edu/public-results/).”

Contact information for the Counseling and Wellness Center: https://counseling.ufl.edu/ (https://counseling.ufl.edu/), 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Edit (https://people.clas.ufl.edu/boyland/wp-admin/post.php?post=1791&action=edit)