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270202 - ALG - Algebra

Coordinating unit: 270 - FIB - Barcelona School of Informatics
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN DATA SCIENCE AND ENGINEERING (Syllabus 2017). (Teaching unit Compulsory)
ECTS credits: 7,5 Teaching languages: Catalan

Degree competences to which the subject contributes

Basic:

CB1. That students have demonstrated to possess and understand knowledge in an area of ??study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply Knowledge from the vanguard of their field of study.

Specific:

CE1. Skillfully use mathematical concepts and methods that underlie the problems of science and data engineering.

Generical:

CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.

Transversal:

CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.

CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

Teaching methodology

Different methodologies will be considered for lectures, exercises and laboratory classes.
The lectures will consist mainly of master classes, based on presentations and explanations on the slate; The problem classes will be to solve exercises and practice concepts learned in the theory sessions and in the laboratory classes, short projects will be solved using python.

Learning objectives of the subject

1.Acquisition of the basic knowledge of linear algebra (vector spaces, matrices, linear systems)
2.Recognize concepts of linear algebra within interdisciplinary problems.
3.Learn how to use linear algebra in solving problems of data analysis and modeling.
4.Using linear algebra tools in mathematical problems
5.Using software to solve exercises related to linear algebra
6.Understanding of the notions of matrix decomposition, its geometric interpretation and its application in exercise solving

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Study load

Total learning time: 187h 30m	Theory classes:	45h	24.00%
	Laboratory classes:	30h	16.00%
	Guided activities:	0h	0.00%
	Self study:	112h 30m	60.00%

Content

Matrices

Degree competences to which the content contributes:

Description:
Definition and operations with metrices, rank, elementary transformations.

Linear systems

Degree competences to which the content contributes:

Description:
Gaussian elimination, discussion of solutions of linear systems, numerical methods for linear system solving. Linear systems in data modelization.

Vector spaces

Degree competences to which the content contributes:

Description:
Vector space definition. Vectors, linear combinations, dependency, generators, bases, coordinates. Vector subspaces, intersection and sum.

Linear maps

Degree competences to which the content contributes:

Description:
Linear maps, kernel and range, rank; matrix of a linear map in a basis; change of basis

Diagonalization

Degree competences to which the content contributes:

Description:
Eigenvalues and eigenvectors; characteristic polynomial; algebraic and geometric multiplicity, diagonalization criteria, application to the computation of power of matrices and functions of matrices. Special case of Markov matrices and symmetric matrices.

Linear discrete dynamical systems

Degree competences to which the content contributes:

Description:
Madelling of problems via linear discrete dynamical systems, resolution and analysis of particular and generic solutions; long.term behaviour of hte solutions; numerical methods for the computation of eigenvalues and eigenvectors; recurrencies and homogeneous linear difference equations, resolution and study of the solutions.

Orthogonality

Degree competences to which the content contributes:

Description:
Inner product, norm, distance, angle; orthogonal complement and orthogonal projection; orthonormal basis and orthogonalization methods; orthogonal matrices and isometries; matrix norm; singular value decomposition, application to rank approximation and dimensional reduction in data and image analysis; bilinear and quadratic forms; spectral theorem and inertia indices.

Planning of activities

Development of topic 1	Hours: 17h Theory classes: 3h Practical classes: 3h Laboratory classes: 1h Guided activities: 0h Self study: 10h
Specific objectives: 1, 2, 5	

Development of topic 2	Hours: 17h Theory classes: 3h Practical classes: 3h Laboratory classes: 1h Guided activities: 0h Self study: 10h
Specific objectives: 1, 2, 3, 4, 5	

Development of topic 3	Hours: 33h Theory classes: 8h Practical classes: 6h Laboratory classes: 1h Guided activities: 0h Self study: 18h
Specific objectives: 1, 2, 3, 4, 5	

Development of topic 4	Hours: 17h Theory classes: 3h Practical classes: 3h Laboratory classes: 1h Guided activities: 0h Self study: 10h
Specific objectives: 1, 2, 3, 4, 5	

Development of topic 5	Hours: 32h Theory classes: 8h Practical classes: 6h Laboratory classes: 1h Guided activities: 0h Self study: 17h
Specific objectives: 1, 2, 3, 4, 5, 6	

Development of topic 6	Hours: 20h Theory classes: 4h Practical classes: 3h Laboratory classes: 1h Guided activities: 2h Self study: 10h
Specific objectives: 1, 2, 3, 4, 5, 6	

Development of topic 7	Hours: 33h 30m Theory classes: 8h 30m Practical classes: 6h Laboratory classes: 1h 30m Guided activities: 0h Self study: 17h 30m
Specific objectives: 1, 2, 3, 4, 5, 6	

Final exam	Hours: 8h Guided activities: 3h Self study: 5h
Description: Final exam Specific objectives: 1, 2, 3, 4, 6	

Partial exam	Hours: 6h 30m Guided activities: 1h 30m Self study: 5h

Description: Partial exam Specific objectives: 1, 2, 3, 4, 6	

Lab exam	Hours: 3h 30m Guided activities: 1h Self study: 2h 30m
Description: Lab exam Specific objectives: 1, 2, 3, 4, 5, 6	

Qualification system

The assessment of the subject will consist of the marks: P, F, L
The mark P will be obtained from the partial exam.
The mark F will be obtained from the final exam.
The mark L will be obtained by an examination at the computer classroom where the resolution of exercises using python will be evaluated.
The final mark will be computed as follows:

Note = maximum (60% F + 30% P + 10% L, F)

The re-evaluation grade will be the mark of the reavaluation exam.

Bibliography

Basic:

Friedberg, S.H.; Insel, A.J.; Spence, L.E. Linear algebra. New int. ed., fourth edition. Pearson Education, 2014. ISBN 9781292026503.

Poole, D. Linear algebra: a modern introduction. 3rd ed. Brooks/Cole/Cengage Learning, 2011. ISBN 9780538735445.

Strang, G. Introduction to linear algebra. 5th ed. Cambridge Press, 2016. ISBN 9780980232776.

Complementary:

Meyer, C.D. Matrix analysis and applied linear algebra. SIAM, Society for Industrial and Applied Mathematics, 2000. ISBN 0898714540.

Aubanell, A.; Benseny, A.; Delshams, A. Eines bàsiques de càlcul numèric: amb 87 problemes resolts. Universitat Autònoma de Barcelona, 1991. ISBN 8479292318.