

UČNI NAČRT PREDMETA / COURSE SYLLABUS (leto / year 2016/17)						
<b>Predmet:</b>		Numerična linearna algebra				
<b>Course title:</b>		Numerical linear algebra				
<b>Študijski program in stopnja</b> Study programme and level		<b>Študijska smer</b> Study field		<b>Letnik</b> Academic year	<b>Semester</b> Semester	
Univerzitetni študijski program Matematika		ni smeri		3	drugi	
First cycle academic study programme Mathematics		none		3	second	
<b>Vrsta predmeta / Course type</b>				izbirni / elective		
<b>Univerzitetna koda predmeta / University course code:</b>				M0231		
<b>Predavanja</b> Lectures	<b>Seminar</b> Seminar	<b>Vaje</b> Tutorial	<b>Klinične vaje</b> work	<b>Druge oblike</b> študija	<b>Samost. delo</b> Individ. work	<b>ECTS</b>
30		30			90	5
<b>Nosilec predmeta / Lecturer:</b>		prof. dr. Bor Plestenjak, prof. dr. Emil Žagar				
<b>Jeziki / Languages:</b>		<b>Predavanja / Lectures:</b>		slovenski / Slovene		
		<b>Vaje / Tutorial:</b>		slovenski / Slovene		
<b>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</b>				<b>Prerequisites:</b>		
Vpis v letnik študija.				Enrolment in the programme.		
Opravljen predmet Uvod v numerične metode.				Completed course Introduction to numerical methods.		
<b>Vsebina:</b>				<b>Content (Syllabus outline):</b>		

<p>Nesimetrični problem lastnih vrednosti. Teorija perturbacij. Implicitna QR metoda z enojnim in dvojnim premikom.</p>	<p>Nonsymmetric eigenvalue problem. Perturbation theory. Implicit QR iteration with single and double shifts.</p>
<p>Simetrični problem lastnih vrednosti. Izrek o minimaksu. Tridiagonalna QR iteracija. Rayleighov kvocient. Pristop »deli in vladaj«. Bisekcija in inverzna iteracija. Jacobijeva metoda, relativno robustne reprezentacije.</p>	<p>Symmetric eigenvalue problem. Min-max theorem. Tridiagonal QR iteration. Rayleigh quotient. Divide-and-conquer method. Bisection and inverse iteration. Relatively robust representations.</p>
<p>Posplošeni problem lastnih vrednosti. Polinomski problem lastnih vrednosti.</p>	<p>Generalized eigenvalue problem. Polynomial eigenvalue problem.</p>
<p>Singularni razcep. Pseudoinverz. Uporaba pri linearnih problemih najmanjših kvadratov. Računanje singularnega razcepa: QR algoritem, dqds algoritem, Jacobijeva metoda.</p>	<p>Singular value decomposition. Pseudoinverse. Application in linear least squares problems. Numerical methods for singular value decomposition: QR iteration, dqds algorithm, the Jacobi method.</p>

#### **Temeljni literatura in viri / Readings:**

<p>J. W. Demmel: Uporabna numerična linearna algebra, DMFA-založništvo, Ljubljana, 2000.  G. H. Golub, C. F. Van Loan: Matrix Computations, 3rd edition, Johns Hopkins Univ. Press, Baltimore, 1996.  B. N. Datta: Numerical Linear Algebra and Applications, Brooks/Cole, Pacific Grove, 1995.  L. N. Trefethen, D. Bau: Numerical Linear Algebra, SIAM, Philadelphia, 1997.</p>
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#### **Cilji in kompetence:**

<p>Slušatelj spozna numerično reševanje problemov lastnih vrednosti in vektorjev. S tem konstruktivno ter vsebinsko dopolni vsebine, ki jih sreča pri Algebri 1 in Uvodu v numerične metode. Pridobljeno znanje praktično utrdi z domačimi nalogami in reševanjem problemov s pomočjo programov Matlab in Mathematica.</p>
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#### **Objectives and competences:**

<p>Students learn numerical methods for the computation of eigenvalues and eigenvectors. New knowledge constructively complements the content of courses Algebra 1 and Introduction to numerical methods. The acquired knowledge is consolidated by homework assignments and solving problems using programs Matlab and Mathematica.</p>
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#### **Predvideni študijski rezultati:**

#### **Intended learning outcomes:**

Znanje in razumevanje: Poznavanje numeričnih algoritmov za računanje lastnih vrednosti in vektorjev. Sposobnost izbire ustreznega algoritma. Znanje programiranja in uporabe programskega paketa Matlab oziroma drugih sorodnih orodij za reševanje tovrstnih problemov. Uporaba: Ekonomično in natančno numerično računanje lastnih vrednosti in vektorjev  
Refleksija: Razumevanje teorije na podlagi uporabe.

Prenosljive spretnosti – niso vezane le na en predmet: Spretnost uporabe računalnika pri reševanju matematičnih problemov. Razumevanje razlik med eksaktnim in numeričnim računanjem. Predmet konstruktivno nadgrajuje znanja linearne algebre.

Knowledge and understanding: Understanding of numerical algorithms for the computation of eigenvalues and eigenvectors. The ability to choose an appropriate algorithm. Knowledge of computer programming package Matlab or other similar software for solving such problems.

Applications: Economical and accurate numerical computation of eigenvalues and eigenvectors.

Reflection: Understanding of the theory from the applications.

Transferable skills: The ability to solve mathematical problems using a computer. Understanding the differences between the exact and the numerical computation. The subject enriches constructively the knowledge of linear algebra.

**Metode poučevanja in učenja:**

Predavanja, vaje, domače naloge, konzultacije

**Learning and teaching methods:**

Lectures, exercises, homework, consultations

**Načini ocenjevanja:**

Delež (v %) /  
Weight (in %)

**Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):

Sprotno preverjanje (domače naloge, kolokviji in projektno delo)

Končno preverjanje (pisni in ustni izpit)

Ocene: 6-10 pozitivno, 1-5 negativno

(v skladu s Statutom UL)

50%

50%

Type (examination, oral, coursework, project):

Continuing (homework, midterm exams, project work) Final (written and oral exam)

Grading: 6-10 pass, 1-5 fail (according to the Statute of UL)

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**Reference nosilca / Lecturer's references:**

Bor Plestenjak:

GHEORGHIU, C. I., HOCHSTENBACH, Michiel E., PLESTENJAK, Bor, ROMMES, Joost. Spectral collocation solutions to multiparameter Mathieu's system. Applied mathematics and computation, ISSN 0096-3003. [Print ed.], 2012, vol. 218, iss. 24, str. 11990-12000. [COBISS.SI-ID 16484185]

PLESTENJAK, Bor, BAREL, Marc van, CAMP, Ellen van. A Cholesky LR algorithm for the positive definite symmetric diagonal-plus-semiseparable eigenproblem. V: CHING, Wai-Ki (ur.). Second international conference on structured matrices : Hong Kong Baptist University, 08-11 June 2006, (Linear algebra and its applications, ISSN 0024-3795, Vol. 428, Issues 2-3, 2008). New York: North Holland, 2008, vol. 428, iss. 2-3, str. 586-599. [COBISS.SI-ID 14475097]

PLESTENJAK, Bor. Numerical methods for the tridiagonal hyperbolic quadratic eigenvalue problem. V: Fifth international workshop on accurate solution in eigenvalue problems : hagen, Germany from June 29 to July 1, 2004. Philadelphia: SIAM, 2006, vol. 28, no. 4, str. 1157-1172. [COBISS.SI-ID 14367833]

Emil Žagar:

JAKLIČ, Gašper, ŽAGAR, Emil. Curvature variation minimizing cubic Hermite interpolants. Applied mathematics and computation, ISSN 0096-3003. [Print ed.], 2011, vol. 218, iss. 7, str. 3918-3924. [COBISS.SI-ID 16049241]

JAKLIČ, Gašper, KOZAK, Jernej, KRAJNC, Marjetka, VITRIH, Vito, ŽAGAR, Emil. Hermite geometric interpolation by rational Bézier spatial curves. SIAM journal on numerical analysis, ISSN 0036-1429, 2012, vol. 50, no. 5, str. 2695-2715. [COBISS.SI-ID 16449369]

KOZAK, Jernej, ŽAGAR, Emil. On geometric interpolation by polynomial curves. SIAM journal on numerical analysis, ISSN 0036-1429, 2004, vol. 42, no. 3, str. 953-967. [COBISS.SI-ID 13398617]