

UČNI NAČRT PREDMETA / COURSE SYLLABUS (leto / year 2017/18)						
Predmet:		Numerična aproksimacija in interpolacija				
Course title:		Numerical approximation and interpolation				
Študijski program in stopnja Study programme and level		Študijska smer Study field		Letnik Academic year	Semester Semester	
Magistrski študijski program Matematika		ni smeri		1 ali 2	prvi ali drugi	
Master's study programme Mathematics		none		1 or 2	first or second	
Vrsta predmeta / Course type				izbirni temeljni / core elective		
Univerzitetna koda predmeta / University course code:				M2406		
Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
45		30			105	6
Nosilec predmeta / Lecturer:		prof. dr. Marjeta Krajnc, prof. dr. Emil Žagar				
Jeziki / Languages:		Predavanja / Lectures: slovenski / Slovene, angleški / English				
		Vaje / Tutorial: slovenski / Slovene, angleški / English				
Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:				Prerequisites:		
Vpis v letnik študija.				Enrolment in the programme.		
Vsebina:				Content (Syllabus outline):		

<p>Aproksimacija funkcij: Izbira prostorov aproksimativnih funkcij. Polinomi. Trigonometrijski polinomi. Odsekoma polinomske funkcije. Stabilnost baz. Weierstrassov izrek. Pozitivni operatorji. Optimalni aproksimativni problem. Eksistenca in enoličnost elementa najboljše aproksimacije. Enakomerna konveksnost, stroga normiranost.</p> <p>Enakomerna aproksimacija s polinomi: Enoličnost za diskretni in zvezni primer. Alternacija residuala. Konstrukcija. Prvi in drugi Remesov postopek. Konvergenca. Polinomi Čebiševa. Posplošitve: Čebiševi sistemi funkcij, generalizirani polinomi.</p> <p>Metoda najmanjših kvadratov v zveznem in diskretnem primeru: Ortogonalni polinomi. Tričlenska rekurzivna formula. Gram-Schmidtova ortogonalizacija in numerično stabilnejše izvedbe. Reortogonalizacija. Navezava diskretnega in zveznega primera. Enakomerna konvergenca L2-aproksimacij.</p> <p>Interpolacija: Interpolacija s polinomi. Lagrangeva oblika interpolacijskega polinoma in ostanek. Baricentrična Lagrangeova interpolacija. Deljene diference. Newtonova oblika interpolacijskega polinoma, posplošena Hornerjeva shema. Divergenca interpolacijskih polinomov.</p> <p>Odsekoma polinomske funkcije, zlepki: Eulerjevi poligoni, interpolacija in aproksimacija v drugi normi. Kubični zlepki. B-zlepki kot baza prostora odsekoma polinomskih funkcij. Bézierove krivulje. Zlepki v dveh dimenzijah.</p>	<p>Approximation of functions: Spaces of approximation functions. Polynomials. Trigonometric polynomials. Piecewise polynomial functions. Stability of bases. Weierstrass' Theorem. Positive operators.</p> <p>Optimal approximation. Existence and uniqueness of the best approximation. Uniform convexity and strong normed spaces.</p> <p>Uniform approximation by polynomials:</p> <p>Uniqueness in the discrete and continuous case. Iteration of residuals. Construction. The first and the second Remes algorithm. Convergence. Chebyshev polynomials. Generalizations: Chebyshev systems, generalized polynomials.</p> <p>Continuous and discrete least squares:</p> <p>Orthogonal polynomials. Three-term recurrence. Gram-Schmidt orthogonalization, basic and stable version. Reorthogonalization.</p> <p>Connection between discrete and continuous case. Uniform convergence of L2-approximants.</p> <p>Interpolation: Polynomial interpolation. Lagrange form. Barycentric Lagrange interpolation. Divided differences. Newton form and generalized Horner scheme. Divergence of interpolating polynomials.</p> <p>Piecewise polynomial functions, splines: Euler polygons, interpolation and approximation in the second norm. Cubic splines. B-spline bases of piecewise polynomial functions. Bézier curves. Splines in two dimensions.</p>
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Temeljni literatura in viri / Readings:

J. Kozak: Numerična analiza, DMFA-založništvo, Ljubljana, 2008.

R. L. Burden, J. D. Faires: Numerical Analysis, 8th edition, Brooks/Cole, Pacific Grove, 2005.

E. K. Blum: Numerical Analysis and Computation : Theory and Practice, Addison-Wesley, Reading, 1998.

Z. Bohte: Numerične metode, DMFA-založništvo, Ljubljana, 1991.

S. D. Conte, C. de Boor: Elementary Numerical Analysis : An Algorithmic Approach, 3rd edition, McGraw-Hill, Auckland, 1986.

C. de Boor: A Practical Guide to Splines, Springer, New York, 2001.

E. Isaacson, H. B. Keller: Analysis of Numerical Methods, John Wiley & Sons, New York-London-Sydney, 1994.

D. R. Kincaid, E. W. Cheney: Numerical Analysis : Mathematics of Scientific Computing, 3rd edition, Brooks/Cole, Pacific Grove, 2002.

Cilji in kompetence:

Slušatelj dopolni poznavanje analitičnih metod aproksimacije in interpolacije z numeričnimi. Ob domačih nalogah pridobljeno znanje praktično utrdi.

Objectives and competences:

Student supplements knowledge of analytical methods in approximation and interpolation by numerical aspects. By solving homeworks the obtained theoretical knowledge is consolidated.

Predvideni študijski rezultati:

Znanje in razumevanje: Razumevanje pojmov interpolacije in aproksimacije. Praktično obvladanje numeričnih postopkov za konstrukcijo interpolacijskih oziroma aproksimacijskih funkcij.

Uporaba: Numerična konstrukcija interpolacijskih ali aproksimacijskih funkcij s pomočjo računalnika in ocenjevanje napak na podlagi teorije. Interpolacija in aproksimacija se uporabljata na mnogih področjih, še posebej pri računalniško podprtem grafičnem modeliranju.

Refleksija: Razumevanje teorije na podlagi

Intended learning outcomes:

Knowledge and understanding: Understanding of interpolation and approximation. Ability of numerical algorithms for construction of interpolating or approximating functions.

Application: Numerical construction of interpolating and approximating functions using a computer and error estimation based on theory. Interpolation and approximation are used in several fields, in particular in computer aided graphical modelling.

Reflection: Understanding of theory based through applications.

uporabe.

Prenosljive spretnosti – niso vezane le na en predmet: Spretnost uporabe računalnika pri reševanju matematičnih problemov. Razumevje razlik med eksaktnim in numeričnim računanjem.

Transferable skills: Skill of using computer for solving numerical problems. Understanding differences between exact and numerical computing.

Metode poučevanja in učenja:

Predavanja, vaje, domače naloge, konzultacije.

Learning and teaching methods:

Lectures, exercises, homeworks, consultations.

Načini ocenjevanja:

Delež (v %) /

Weight (in %)

Assessment:

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

domače naloge ali project

pisni izpit

ustni izpit

Ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)

20%

40%

40%

Type (homeworks, examination, oral, coursework, project):

homeworks or project

written exam

oral exam

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

Reference nosilca / Lecturer's references:

Marjetka Krajnc:

JAKLIČ, Gašper, KOZAK, Jernej, KRAJNC, Marjetka, VITRIH, Vito, ŽAGAR, Emil. High order parametric polynomial approximation of conic sections. Constructive approximation, ISSN 0176-4276, 2013, vol. 38, iss. 1, str. 1-18. [COBISS.SI-ID 16716121]

KRAJNC, Marjetka. Interpolation scheme for planar cubic G [sup] 2 spline curves. Acta applicandae mathematicae, ISSN 0167-8019, 2011, vol. 113, no. 2, str. 129-143. [COBISS.SI-ID 16215385]

KRAJNC, Marjetka. Geometric Hermite interpolation by cubic G[sup]1 splines. Nonlinear Analysis,

Theory, Methods and Applications, ISSN 0362-546X. [Print ed.], 2009, vol. 70, iss. 7, str. 2614-2626. [COBISS.SI-ID 15508569]

Emil Žagar:

JAKLIČ, Gašper, KOZAK, Jernej, VITRIH, Vito, ŽAGAR, Emil. Lagrange geometric interpolation by rational spatial cubic Bézier curves. Computer Aided Geometric Design, ISSN 0167-8396, 2012, vol. 29, iss. 3-4, str. 175-188. [COBISS.SI-ID 16207449]

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]

ŽAGAR, Emil. On G^2 continuous spline interpolation of curves in R^d . BIT, ISSN 0006-3835, 2002, vol. 42, no. 3, str. 670-688. [COBISS.SI-ID 12027993]