UČNI NAČRT PREDMETA / COURSE SYLLABUS			
Predmet:	Teorija programskih jezikov		
Course title:	Theory of programming languages		

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
Univerzitetna koda predmeta / University course code:	M2820

Predavanja **Lectures**	**Seminar** **Seminar**	**Vaje** **Tutorial**	**Klinične vaje** **work**	**Druge oblike študija**	**Samost. delo** **Individ. work**	**ECTS**
45		**30**			**105**	**6**

Nosilec predmeta / Lecturer:	doc. Matija Pretnar, prof. Alexander Keith Simpson, prof. Andrej Bauer

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:**

Vsebina:	**Content (Syllabus outline):**
Pri predmetu se obravnava teorija programskih jezikov s poudarkom na uporabi matematičnih	The course covers the theory of programming languages with empahsis on mathematical

metod pri podajanju jezikov in analizi njihovih lastnosti. Obravnavajo se naslednje teme: - konkretna in abstraktna sintaksa, - induktivne definicije, definicije - dokazovanje s strukturno indukcijo - induktivni podatkovni tipi kot - operacijska semantika kot - funkcijski programski jeziki: - polimorfizem, parametrični - ukazni programski jeziki, - denotacijska semantika: domene in - izbirne vsebine: objektni leksična in gramatična analiza kot prevajanje konkretne v abstraktno sintakso podane z sodbami in pravili sklepanja po abstraktni sintaksi ali po strukturi izpeljave primer uporabe strukturnih definicij in strukturne indukcije induktivno definirana relacija, semantika malih in velikih korakov	methods for specification of programming languages and analysis of their properties. The following topics are covered: - concrete and abstract syntax, lexical analysis and parsing as translation of concrete syntax to abstract syntax - inductive definitions, definitions given in terms of judgements and rules of inference - proofs by structural induction on abstract syntax and on the structure of a derivation - inductive datatypes as an example of use of structural definitions and structural induction - operational semantics as an inductively specified relation, small-step and big-step semantics - functional programming languages: recursive definitions, eager and lazy languages, static analysis, type checking, safety as a consequence of progress and termination lemmas, significance of

rekurzivne definicije, neučakani in leni jeziki, statična analiza, preverjanje tipov, varnost kot posledica leme o napredku in leme o ohranitvi, pomen varnosti v praksi polimorfizem in Hindley-Milnerjeva izpeljava tipov specifikacije in dokazovanje pravilnosti programov zvezne funkcije, izrek o obstoju negibnih točk, denotacijska semantika funkcijskega programskega jezika, interpretacija rekurzije z negibnimi točkami programski jeziki, paralelno računanje, logično programiranje	safety in practice - polymorphism, parametric polymorphism and Hindley-Milner type inference - imperative programming languages, specification and proofs of correctness - denotational semantics: domains and continuous maps, existence of fixed points, denotational semantics of a functional language, interpretation of recursion as fixed points - optional topics: object-oriented programming languages, parallel computing, logic programming

Temeljni literatura in viri / Readings:

- B.C. Pierce: “Types and Programming Languages”. The MIT Press 2002.
- J.C. Reynolds: “Theories of Programming Languages”. Cambridge University Press 1998.
- R.M. Amadio & P.-L. Currien: “Domains and λ-calculi”. Cambridge Tracts in Theoretical Computer Science 46. Cambridge University Press, 1998.

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je predstavitev modernega, matematičnega pristopa, k teoriji programskih	The objective of the course is to present modern, mathematical approach to theory of

jezikov. Študenti pridobijo sposobnost analize programskih jezikov ter osnovnih konceptov povezanih z njimi.	programming languages. Students will attain the ability to analyze programming languages and the basic concepts related to them.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Slušatelji se naučijo, kako načrtujemo in analiziramo programske jezike s formalnimi matematičnimi metodami.	Knowledge and understanding: Students learn how to design and analyze programming languages with formal mathematical methods.

Metode poučevanja in učenja:	**Learning and teaching methods:**
predavanja, vaje, domače naloge	lectures, tutorials, homeworks

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
domače naloge, kolokviji, projekti, pisni izpit, ustni izpit ocene: 5 (negativno), 6-10 (pozitivno) (po Statutu UL)	100%	homework, midterm exams, projects, written exam, oral exam grading: 5 (fail), 6-10 (pass) (according to the Statute of UL)

Reference nosilca / Lecturer's references:

Andrej Bauer:

– LUKŠIČ, Primož, HORVAT, Boris, BAUER, Andrej, PISANSKI, Tomaž. Practical E-Learning for the Faculty of Mathematics and Physics at the University of Ljubljana. Interdisciplinary journal of knowledge & learning objects, ISSN 1552-2210, 2007, vol. 3, str. 73-83 [COBISS.SI-ID 14269529]

– BAUER, Andrej, STONE, Christopher A. RZ: a tool for bringing constructive and computable

mathematics closer to programming practice. V: Computation and logic in the real world : Third Conference on Computability in Europe, CiE 2007, Siena, Italy, June 18-23, 2007 : proceedings, (Lecture notes in computer science, ISSN 0302-9743, 4497). Berlin, Heidelberg: Springer, cop. 2007, str. 28-42 [COBISS.SI-ID 14631769]

Matija Pretnar:

– PLOTKIN, Gordon, PRETNAR, Matija. Handling algebraic effects. Logical methods in computer science, ISSN 1860-5974, 2013, vol. 9, iss. 4, paper 23 (str. 1-36) [COBISS.SI-ID 16816729]

– PRETNAR, Matija. Inferring algebraic effects. Logical methods in computer science, ISSN 1860-5974, 2014, vol. 10, iss. 3, paper 21 (str. 1-43) [COBISS.SI-ID 17190745]

– BAUER, Andrej, PRETNAR, Matija. An effect system for algebraic effects and handlers. Logical methods in computer science, ISSN 1860-5974, 2014, vol. 10, iss. 4, paper 9 (str. 1-29). http://arxiv.org/pdf/1306.6316 [COBISS.SI-ID 17191001]

Alexander Keith Simpson:

– AWODEY, Steve, BUTZ, Carsten, SIMPSON, Alex, STREICHER, Thomas. Relating first-order set theories and elementary toposes. Bulletin of symbolic logic, ISSN 1079-8986, 2007, vol. 13, no. 3, str. 340-358 [COBISS.SI-ID 17096537]

– SIMPSON, Alex. Computational adequacy for recursive types in models of intuitionistic set theory. Annals of pure and applied Logic, ISSN 0168-0072. [Print ed.], 2004, vol. 130, iss. 1-3, str. 207-275 [COBISS.SI-ID 17117017]

– SIMPSON, Alex. A characterization of the least-fixed-point operator by dinaturality. Theoretical computer science, ISSN 0304-3975, 1993, vol. 118, iss. 2, str. 301-314 [COBISS.SI-ID 17181017]