

(1.) Course Title: INFPHD046 Verification of Functional Programs	Credits: 6
Course Classification: Optional	
Theoretical or Practical Nature of the Course, 'training character'¹³: Theoretical (credit%)	
Type of Class: lecture number of hours: 2/week in the given semester, <i>(If the course is not (only) taught in Hungarian, then the language: English)</i> Additional (specific) methods and characteristics² used in delivering the knowledge <i>(if any)</i> : literature research, evaluation and application of prototype provers	
Assessment Method (Exam / Midterm Grade / Other³): Exam Additional (specific) methods⁴ applied in knowledge assessment <i>(if any)</i> : -	
Course Placement in Curriculum (Semester Number): 1.,3.	
Prerequisites <i>(if any)</i> : -	
Course Description: A concise yet informative description of the knowledge to be acquired.	
- Basic concepts of correctness of functional programs: referential transparency, equational reasoning. - Structural induction. - ML-based theorem proving systems. Proof tactics. - Isabelle. Isabelle HOL. PVS, Coq., Sparkle. - Temporal logic-based inference systems. - HOL-UNITY. - Correctness of Erlang programs. ErlVer. - Type invariants. - Examining the safety and progress properties of interactive Clean processes. - Correctness of refactoring functional programs.	
2-5 Most Important Required and Recommended Literature List of required and recommended literature (notes, textbooks) with bibliographic data (author, title, publication details, (possibly pages), ISBN).	
• Tobias Nipkow, Lawrence C. Paulson, Markus Wenzel, in: Isabelle/HOL: A Proof Assistant for Higher-Order Logic, LNCS Tutorial, vol. 2283, Springer, Berlin, 2002. • Tejfel M., Horváth Z., Kozsik T.: Extending the Sparkle Core Language with object abstraction. Acta Cybernetica (ISSN 0324-721 X), 17 (2005), pp. 419-445. (The ACM Digital Library: http://portal.acm.org/citation.cfm?id=1133461.1133467#) • Péter Berczky, Dániel Horpácsi, and Simon Thompson: A proof assistant based formalisation of a subset of sequential Core Erlang. In Trends in Functional Programming, Aleksander Byrski and John Hughes (Eds.). Springer, Cham, Germany. 139–158. isbn:978-3-030-57761-2 https://doi.org/10.1007/978-3-030-57761-2_7 (2020). • Arsenii Fomin, Péter Berczky, Dániel Horpácsi, and Gergő Lajos Turán: Mechanised Proofs of Atom Exhaustion in Erlang. In Proceedings of the 24th ACM SIGPLAN International Workshop on	

Erlang (Erlang '25). Association for Computing Machinery, New York, NY, USA, 14–25. <https://doi.org/10.1145/3759161.3763045> (2025)

- de Mol, M., van Eekelen, M., Plasmeijer, R.: Theorem Proving for Functional Programmers, Sparkle: A Functional Theorem Prover, Springer Verlag, LNCS 2312, p. 55 ff., 2001
- Mads Dam, Lars-Íke Fredlund, and Dilian Gurov: Toward Parametric Verification of Open Distributed Systems. In: Compositionality: The Significant Difference. Lecture Notes in Computer Science, vol. 1536, pp. 150-185, 1998.
- Markus Kaltenbach: Unity Verifier. PhD Thesis. University of Texas, Austin, 1996. <http://www.cs.utexas.edu/users/psp/markus/diss.html>

List of Prescribed Professional Competencies and Competency Elements

(knowledge, skills, etc., KKK Section 8) that the course significantly contributes to developing (highlight the most important ones).

a) Knowledge

- Has a research-level understanding of the general and specific characteristics, major directions, and precisely developed boundaries of the subject area within the discipline, as well as the agreed and debated interrelations.
- Creatively comprehends the interrelations, theories, and conceptual frameworks and terminologies of the given field of study.¹
- Possesses research methodology knowledge necessary for independent research in the given discipline/field.

b) Skills

- Capable of creative analysis of the field, synthesizing comprehensive and specific interrelations with a new perspective, and conducting appropriate evaluative and critical activities.
- Able to apply and further develop the specialized learning and problem-solving methods of the field.
- Can creatively elaborate on the novel, previously unknown practical implications of theoretical issues.
- Capable of planning and executing new projects, conducting research in the field, and developing new techniques and approaches.
- Able to identify unforeseen professional problems and uncover the detailed theoretical and practical background necessary for their resolution at a research level.
- Can construct and communicate new relations relevant to the field, as well as comprehensive interrelations significant for personal and communal existence.

¹**Section 108**, Article 37 of the National Curriculum Act (Nftv.) 37. lesson: a session (lecture, seminar, exercise, consultation) requiring the personal involvement of the instructor to fulfil the academic requirements specified in the curriculum, the duration of which is at least forty-five minutes and not more than sixty minutes.

² e.g. case studies, role play, thematic presentations, etc.

³ e.g. continuous debriefing, mid-year report

⁴ e.g. request for case studies, thematic papers, essays, business, organisational plans, etc.

c) Attitudes

- Represents and further develops the relations that contribute to the process of human self-creation based on the field's characteristics.
- Possesses an interest and learning ability that enable identifying and solving currently unpredictable research problems in the field.
- Demonstrates a firm professional commitment, a continuous dedication to exploring new approaches, and an acceptance of the necessity for persistent effort.

d) Autonomy and Responsibility

- Builds and initiates new knowledge areas with creative independence and proposes new practical solutions.
- Participates in formulating theoretical and practical questions with a leadership role and high-level cooperation.
- Engages as an equal discussion partner with professionals in the field.
- Takes responsibility for raising and addressing new ethical questions concerning theoretical and practical aspects of the profession.

Course responsible (name, position, academic degree): **Dr. Zoltán Horváth, professor, PhD**

Instructor(s) involved in teaching the course (if any) (name, position, academic degree):
Dr. Máté Tejfel, associate professor, PhD, Dr. Dániel Horpácsi, assistant professor, PhD