(1.) Course Title: INFPHD045 Distributed functional programming	**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, *(If the course is not (only) taught in Hungarian, then **the language**: **English**)* **Additional** (specific**) methods and characteristics**[2] used in delivering the knowledge *(if any)*: literature research, evaluation of available prototype solutions	
Assessment Method (Exam / Midterm Grade / **Other**[3]): Exam **Additional** (specific) **methods**[4] applied in knowledge assessment *(if any)*: -	
Course Placement in Curriculum (Semester Number): 2., 4.	
Prerequisites (*if any*): -	

Course Description: **A concise yet informative description of the knowledge** to be acquired.

- Parallel and distributed programming possibilities in functional languages.
- Evaluation strategies: speculative evaluation, parallel evaluation, explicit parallelism, threads.
- Using annotations in Concurrent Clean, par, seq, with primitives, GpH, Distributed Clean.
- Communication, using channels (Clean) and ports (Distributed Haskell).
- Elements of Eden, concurrent ML, Facile language supporting parallel and distributed programming.
- Mobile functional code: JoCaml, Mobile Haskell, Clean dynamics.
- Distributed functional systems in telecommunications, Erlang.
- Design patterns of functional programs for parallel and distributed evaluation.
- Refactoring of functional programs for distributed, parallel and multi-core systems.

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).

- István, Bozó ; Melinda, Tóth ; Balázs, Varga: Refactoring concurrent Erlang applications for distribution, ANNALES UNIVERSITATIS SCIENTIARUM BUDAPESTINENSIS DE ROLANDO EOTVOS NOMINATAE SECTIO COMPUTATORICA 57 : x pp. 245-270. , 26 p. (2024)
- Kozsik T., Tóth M., Bozó I., Horváth Z.: Static Analysis for Divide-and-Conquer Pattern Discovery, COMPUTING AND INFORMATICS 35 : 4 pp. 764-791. , 28 p. (2016)
- Bozó I., Fördős V., Horváth Z., Tóth M., Horpácsi D., Kozsik T., Kőszegi J., Barwell, A., Brown, C. and Hammond, K.: Discovering parallel pattern candidates in Erlang. In Proceedings of the Thirteenth ACM SIGPLAN workshop on Erlang (Erlang '14). Association for Computing Machinery, New York, NY, USA, 13–23. https://doi.org/10.1145/2633448.2633453 (2014)
- Fournet, C., Le Fessant, F., Maranget, L., Schmitt, A.: JoCaml: A Language for Concurrent Distri buted and Mobile Programming, In: Advanced Functional Programming, 4th International School, AFP 2002, Oxford, Revised Lectures, Springer, LNCS 2638, pp. 129-158, 2003.
- Serrarens, P.R.: Communication Issues in Distributed Functional Computing, Ph.D. Thesis, University of Nijmegen, January 2001.

- Horváth Z., Hernyák Z., Zsók V: Coordination Language for Distributed Clean, Acta Cybernetica (ISSN 0324-721 X), 17 (2005) pp. 247-271. (The ACM Digital Library: http://portal.acm.org/citation.cfm?id=1133461.1133476#)
- Loidl, H-W., et al.: Comparing Parallel Functional Languages: Programming and Performance, Higher-Order and Symbolic Computation 16 (3), pp. 203-251, Kluwer Academic Publisher, September 2003.
- K. Hammond, G. Michaelson (eds): Research Directions in Parallel Functional Programming. Springer, 1999.
- Armstrong, J., Virding, R., Wikström, C., Williams, M.: Concurrent Programming in Erlang, Prentice Hall, 1996.
- P. Trinder et al: Algorithm + Strategy = Parallelism. J. of Functional Programming, 8(1):23{60, 1998.
- Trinder et al: Parallel and Distributed Haskells. J. of Functional Programming, 12(4+5):469{510, 2003.

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.

[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.

- 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.

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. Melinda Tóth, associate professor, PhD, Dr. Viktória Zsók, assistant professor, PhD.**