**Formal Methods in Software Engineering** - Informatică, an 3, sem 2

An univ. 2022-2023

Curs: Florentin Ipate

Laborator: Mihail Pleșa

Invited speakers: Marian Gheorghe (University of Bradford), Adrian Țurcanu (Heriot-Watt University), Sorina Preduț.

1. **Obiective**: Asimilarea principalelor concepte si tehnici de formal modelling and verification, model-based testing, membrane computing și quantum computing.
2. **Cerinte**

Notarea se va face pe baza de proiect. Proiectele se vor efectua in echipe (dimensiunea echipei pentru fiecare tema este specificata mai jos) si vor fi prezentate la curs sau la laborator, in functie de tema aleasa (conform informațiilor de mai jos), in saptamanile 7-10 conform programarii stabilite cu cadrul didactic de curs/laborator, astfel incat numarul maxim de studenti care prezinta in cadrul unui curs/laborator sa fie 10. Tema proiectului de curs va fi aleasa din lista de mai jos. Fiecare tema din lista poate fi aleasa de cel mult 2 echipe.

Fiecare tema consta in prezentarea unui articol (exceptie fac temele din secțiunea E – pentru clarificari asupra acestora va veti adresa cadrului didactic de laborator). Prezentarea va fi sub forma de slide-uri, insotite de demo-uri. Slide-urile vor descrie succint conceptele si metodele abordate in articol. Demo-ul va prezenta exemple/ studii de caz care ilustreaza conceptele si metodele prezentate; aceste exemple nu vor fi insa cele din articol si vor fi create de catre echipa.

La prezentare este necesara prezenta intregii echipe, fiecare student descriind principala sa contributie la proiect. Timpul alocat fiecarui student este de 10 minute. Atunci cand echipa considera ca nu toti membrii echipei au avut o contributie egala la realizarea proiectului, se va indica, in procente, contributia estimata a fiecaruia.

1. **Teme proiecte**
2. **Formal Modelling and Verification** – prezentarea acestor teme se va face la curs
3. Turcanu A, Shaikh T, Mazilu CN (2020) On Model Checking of a Robotic Mechanism. J Robotics Autom 4(1):158-. (Marime echipa: 3)
4. S. Predut, F. Ipate, M. Gheorghe, F. Campean: Formal Modelling of Cruise Control System Using Event-B and Rodin Platform, IHPCC/SmartCity/DSS, 1541-1546, 2018. (Marime echipa: 3)
5. Sebastian Wieczorek, Vitaly Kozyura, Andreas Roth, Michael Leuschel, Jens Bendisposto, Daniel Plagge, Ina Schieferdecker: Applying Model Checking to Generate Model-Based Integration Tests from Choreography Models. TestCom/FATES 2009: 179-194 (Marime echipa: 4)
6. Bakir ME, Gheorghe M, Konur S, Stannett M (2016) Comparative Analysis of Statistical Model Checking Tools, Int Conf on Membrane Computing, 119-135. (Marime echipa: 3)
7. **Model-based Testing** – prezentarea acestor teme se va face la curs
8. D. Dranidis, K. Bratanis, F. Ipate: JSXM: a tool for automated test generation, in SEFM 2012 (International Conference on Software Engineering and Formal Methods), Lecture Notes in Computer Science 7504 Springer, 352-366, 2012. (Marime echipa: 3)
9. R. Lefticaru, F. Ipate: Automatic State-Based Test Generation Using Genetic Algorithms, in 9th International Symposium on Symbolic and Numeric Algorithms for Scientific Computing (SYNASC 2007) September 26-29, 2007, Timisoara, Romania, Proceedings. IEEE Computer Society, 188-195, 2007. (Marime echipa: 2)
10. Pelin Akpinar et al. Web Application Testing With Model Based Testing Method: Case Study. 2020 International Conference on Electrical, Communication, and Computer Engineering (ICECCE) (Marime echipa: 2)
11. Muhammad Nouman Zafar, Wasif Afzal, Eduard Enoiu, Athanasios Stratis, Aitor Arrieta, Goiuria Sagardui: Model-Based Testing in Practice: An Industrial Case Study using GraphWalker. ISEC 2021: 5:1-5:11 (Marime echipa: 2)
12. **Membrane Computing Applications** - prezentarea acestor teme se va face la curs
13. Raluca Lefticaru, Marian Gheorghe, Florentin Ipate: An empirical evaluation of P system testing techniques. Nat. Comput. 10(1): 151-165 (2011) (Marime echipa: 3)
14. R. Lefticaru, F. Ipate, M. Gheorghe: Model Checking Based Test Generation from P Systems Using P-Lingua, Romanian Journal of Information Science and Technology, 13(2), 153-168, 2010. (Marime echipa: 3)
15. S. Konur, L. Mierla, F. Ipate, M. Gheorghe: kpworkbench: A software suit for membrane systems, SoftwareX, 11: 100407, 2020. (Marime echipa: 3)
16. F. Ipate, A. Turcanu: Modeling, Verification and Testing of P Systems Using Rodin and ProB, in Ninth Brainstorming Week on Membrane Computing, 209-220, Fenix Editora, Sevilla, 2011. (Marime echipa: 3)
17. R. Lefticaru, M. E. Bakir, S. Konur, M. Stannett, F. Ipate: Modelling and Validating an Engineering Application in Kernel P Systems, Int. Conf. on Membrane Computing 2017, LNCS, 183-195, 2017. (Marime echipa: 3)
18. M. Gheorghe, R. Ceterchi, F. Ipate, S. Konur, R. Lefticaru: Kernel P Systems: From Modelling to Verification and Testing, Theoretical Computer Science, 724:45-60, 2018. (Marime echipa: 3)
19. M. Gheorghe, R. Lefticaru, S. Konur, I. M. Niculescu, H. N. Adorna: Spiking Neural P Systems: Matrix Representation and Formal Verification, Journal of Membrane Computing, 3:133-148, 2021. (Marime echipa: 3)
20. K Jensen, L.M. Kristensen, L. Wells: Coloured Petri Nets and CPN Tools for Modelling and Validation of Concurrent Systems, International Journal on Software Tools for Technology Transfer, 9 (2007), 213-254. (Marime echipa: 3)
21. **Membrane Computing Applications** - prezentarea acestor teme se va face la laborator
22. G. Zhang, C. Liu, M. Gheorghe, F. Ipate: Solving Satisfiability Problems with Membrane Algorithms, in The Fourth International Conference on Bio-Inspired Computing: Theories and Applications (BIC-TA), Beijing, China, 16-19 October 29-36, 2009. (Marime echipa: 3)
23. Nishida, T.Y., 2007. Membrane algorithm with Brownian subalgorithm and genetic subalgorithm. International Journal of Foundations of Computer Science, 18(06), pp.1353-1360.(Marime echipa: 3)
24. Song, T., Pan, L., Wu, T., Zheng, P., Wong, M.D. and Rodríguez-Patón, A., 2019. Spiking neural P systems with learning functions. IEEE transactions on nanobioscience, 18(2), pp.176-190. (Marime echipa: 3)
25. Wang, J., Hu, J., Peng, H., Pérez Jiménez, M.D.J. and Riscos Núñez, A., 2015. Decision tree models induced by membrane systems. Romanian Journal of Information Science and Technology (ROMJIST), 18 (3), 228-239. (Marime echipa: 3)
26. Ganbaatar, G., Nyamdorj, D., Cichon, G. and Ishdorj, T.O., 2021. Implementation of RSA cryptographic algorithm using SN P systems based on HP/LP neurons. Journal of Membrane Computing, pp.1-13. (Marime echipa: 3)
27. Ma, T., Hao, S., Wang, X., Rodríguez-Patón, A.A., Wang, S. and Song, T., 2019. Double Layers Self-Organized Spiking Neural P Systems With Anti-Spikes for Fingerprint Recognition. IEEE Access, 7, pp.177562-177570. (Marime echipa: 3)
28. Carandang, J.P., Villaflores, J.M.B., Cabarle, F.G.C., Adorna, H.N. and Martínez del Amor, M.Á., 2016. CuSNP: Spiking neural P systems simulators in CUDA. In ACMC 2016: The 5th Asian Conference on Membrane Computing (2016), pp. 451-468.. IMCS: International Membrane Computing Society. (Marime echipa: 3)
29. Abadi, M. and Andersen, D.G., 2016. Learning to protect communications with adversarial neural cryptography. arXiv preprint arXiv:1610.06918. (Marime echipa: 3)
30. Diehl, P.U. and Cook, M., 2015. Unsupervised learning of digit recognition using spike-timing-dependent plasticity. Frontiers in computational neuroscience, 9, p.99. (Marime echipa: 3)
31. Zhang, G., Zhang, X., Rong, H., Paul, P., Zhu, M., Neri, F. and Ong, Y.S., 2022. A layered spiking neural system for classification problems. International journal of neural systems, 32(08), p.2250023. (Marime echipa: 3)
32. Plesa, M.I., Gheoghe, M., Ipate, F. and Zhang, G., 2022. A key agreement protocol based on spiking neural P systems with anti-spikes. Journal of Membrane Computing, pp.1-11. (Marime echipa: 3)
33. **Quantum computing applications -** prezentarea acestor teme se va face la laborator
34. Grover’s algorithm (Marime echipa: 3)
35. Shor’s algorithm (Marime echipa: 3)
36. Quantum Machine Learning (Marime echipa: 5)

**Resurse:**

<https://qiskit.org/textbook-beta/course/introduction-course>

[💻 Qiskit Foundations - Coding with Qiskit Season 1](https://www.youtube.com/playlist?list=PLOFEBzvs-Vvp2xg9-POLJhQwtVktlYGbY)

<https://medium.com/qiskit/qiskit-and-its-fundamental-elements-bcd7ead80492>

<https://qiskit.org/documentation/tutorials/circuits/1_getting_started_with_qiskit.html>