Internship Title : How AI can advances the building of Domain Specific Languages ?

IRIT - Toulouse INP
Candidates' number : 5-6

Contacts : Meriem Ouederni (meriem.ouederni@irit.fr), Lotfi Chaari (lotfi.chaari@irit.fr), Jean Baptist Raclet (raclet@irit.fr)

Keywords: AI, Software Engineering, MDE, IoT, Signals, Distributed System.

Topic Abstract: Both Software Engineering and Artificial Intelligence (AI) could be used side-by-side for better dealing with modelling, checking and validating IoT-based systems. Our aim is to suggest a rigorous domain specific language (DSL) applied to, yet not exhaustively, healthcare systems. In a such context, we apply our approach to real-world case studies where, particularly, two medical sensors, namely, EEG and ECG are dealt with.

This topic follows data-driven approaches to provide models based on the observed data. We aim at using AI concepts such as Machine or Deep Learning for modelling (including syntax and semantics levels) of a target IoT Domain Specific Language (DSL). The use of AI enables us to create more precise and efficient models, and this eventually implies better data analysis (control) applications. Models would be regularly updated and refined, e.g. once in a week or once in a month, etc. w.r.t. the historical data accumulated from the domain environment, and which can be gathered from e.g. a big data warehouse, etc.

This work aims at gathering together skills from Software Engineering and Signal communities. Here, we are interested in, among other issues, signal synchronisation as the main feature handled in this topic. The students will develop a framework taking into consideration several parameters at different levels such as behavioural (interoperability, opacity or security), signals, deployment (connexion throughout blue-tooth, wifi, cloud, etc.).

The intern-ship will proceed following several steps. A very first step will study the state of the art AI4MDE and MDE4AI. Then, several AI techniques should be experimented (surveyed) and adapted for MDE. A prior DSL version should be extended with AI techniques. Then, several parsers will be be encoded to generate java or python executable codes to be deployed on real devices. The prototype will be done using Eclipse Modelling Framework as supporting tool.

References

[1] H. Al-Hamadi, A. Gawanmeh and M. Al-Qutayri, Formalizing electrocardiogram (ECG) signal behavior in event-B, 2014 IEEE 16th International Conference on e-Health Networking, Applications and Services (Healthcom), 2014, pp. 55-60, doi: 10.1109/HealthCom.2014.7001813.

[2] Huang G., Meng J., Zhang D., Zhu X, Window Function for EEG Power Density Estimation and Its Application in SSVEP Based BCIs, In: Jeschke S., Liu H., Schilberg D. (eds) Intelligent Robotics and Applications. ICIRA 2011. Lecture Notes in Computer Science, vol 7102. Springer, Berlin, Heidelberg, doi:10.1007/978364225489514.

[3] Covantes-Osuna C., Paredes O., Vlez-Prez H., Romo-Vzquez R, Window Functions Analysis in Filters for EEG Movement Intention Signals, In: Gonzlez Daz C. et al. (eds) VIII Latin American Conference on Biomedical Engineering and XLII National Conference on Biomedical Engineering. CLAIB 2019. IFMBE Proceedings, vol 75. Springer, Cham, doi:10.1007/978-3-030-30648-925.

[4] Ciccozzi F., Spalazzese R, MDE4IoT: Supporting the Internet of Things with Model-Driven Engineering, In: Badica C. et al. (eds) Intelligent Distributed Computing X. IDC 2016. Studies in Computational Intelligence, vol 678. Springer, Cham, doi:10.1007/978-3-319-48829-57.

[5] S, Jrn Guy, Pop A, Fritzson P, et al. Towards integrated model-driven testing of scada systems using the eclipse modeling framework and modelica, 19th Australian Conference on Software Engineering (aswec 2008). IEEE, 2008.

[6] B. Ramachandran and S. Bashyam, Development of real-time ECG signal monitoring system for telemedicine application, 2017 Third International Conference on Biosignals, Images and Instrumentation (ICBSII), 2017, pp. 1-4, doi: 10.1109/ICBSII.2017.8082285.

[7] Nepomuceno, Thiago, et al. AutoIoT: a framework based on user-driven MDE for generating IoT applications. Proceedings of the 35th Annual ACM Symposium on Applied Computing. 2020.

[8] Rouse, Margaret (2019). internet of things (IoT). IOT Agenda. Retrieved 14 August 2019.

[9] Laplante, Phillip A.; Kassab, Mohamad; Laplante, Nancy L.; Voas, Jeffrey M. Building Caring Healthcare Systems in the Internet of Things. IEEE Systems Journal. 12 (3): 30303037. Bibcode:2018ISysJ..12.3030L. doi:10.1109/JSYST.2017.2662602

[10] Harrand N, Fleurey F, Morin B, et al. ThingML: a language and code generation framework for heterogeneous targets, Proceedings of the ACM/IEEE 19th International Conference on Model Driven Engineering Languages and Systems. 2016: 125-135.