Keynote
Linear Software Models: An Algebraic Theory of Software Composition

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Abstract: The central goal of our software theory is to solve the composition problem of a software system of any size from sub-systems down to indivisible components either produced in house, or purchased from other manufacturers. The theory guides the gradual or agile design of the system by means of quantitative criteria for the current design quality, and by highlighting problematic coupling spots to be resolved in order to improve the software design. The theory is based upon solid results of linear algebra, and the broadly accepted wisdom that modularity is essential for understandable and maintainable software design. The main algebraic structure of the theory is the Modularity Matrix. It links structors – a generalization of classes – in the matrix columns, to their provided functionals – a generalization of methods – in the matrix rows. The theory predicts that neat modules for any given system are the blocks of a block-diagonal standard matrix. The matrix itself is the source of quantitative criteria for design quality. Module sizes are determined by the matrix eigenvectors. The theory formalizes intuitive concepts widely used in software engineering, providing precise definitions for coupling, cohesion, modules, single responsibility and canonical systems such as design patterns. This talk also touches recent research results showing that apparently different alternative theories, such as the Modularity Lattice from FCA (Formal Concept Analysis) and approaches using the Laplacian Matrix are equivalent to the Modularity Matrix. Therefore, Linear Software Models are proposed as a coherent unified algebraic theory of software composition.

About the Speaker

Iaakov Exman is a faculty member of The Jerusalem College of Engineering (JCE – Azrieli), Department of Software Engineering. He received his Ph.D. from The Hebrew University of Jerusalem, Israel (HUJI) and performed post-doctoral research at Stanford University, California, USA. He had extensive industrial experience both with very large R&D teams within IAI (Israel Aerospace Industries) and small agile groups in start-ups, and has been a research associate at HUJI, before joining JCE in 2001. His research interests are in the area of software theory, including algebraic software theory, automated software generation from ontological conceptual structures and software aspects of quantum computation. He has authored and co-authored about 100 papers in these fields. Dr. Exman has organized together with Spanish colleagues from UC3M (University Carlos III of Madrid) the SKY International Workshop on Software Knowledge, since 2010, which has been held annually in various European locations. He is actively associated with the GTSE Workshop on General Theory of Software Engineering from its first 2012 edition at the KTH in Stockholm, and since then annually co-located with the ICSE International Conference on Software Engineering.