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Compositional Approach for Program Specification and Verification

This course is devoted to compositional methods in program construction and program verification. The aim of the course is to present semantically-based methods of program description, construct program algebras of various abstraction types, investigate their properties, develop logics of partial predicates, oriented on such algebras, and use the developed formalisms for proving correctness of sample programs.

Syllabus

1. Methodological principles of program formalization. Main program aspects: external and internal aspects. Levels of abstractions. Main notions of programming. Intensional and extensional aspects of notions. Formalization of data, functions, and compositions.

2. Data and program algebras. Subalgebras, homomorphisms of algebras, properties of algebras. Algebras of quasiary predicates and functions. Compositional semantics of programming languages.

3. Algebra-based logics of partial predicates. Levels of abstraction in logic construction. Compositional logics. Logics of quasiary predicates. First-order neoclassical logics. Program logics.

4. Floyd-Hoare logics for partial predicates. Correctness and completeness of Floyd-Hoare logic. Proving correctness of sample programs using their compositional semantics.

5. Exercises

As a result of the course students should learn

- compositional methods of programs formalization;
- properties of data and program algebras;
- algebra-based logics, their properties;
- methods of program verification based on their compositional semantics.

Students should be also able to prove correctness of relatively simple programs.