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**COMSATS University Islamabad (CUI)**

**Lab Terminal**

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**Course: Topics in Computer Science**

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**Question 5:**

**Semantic Analysis Overview**

1. Type Checking: Verifying that operations are performed on compatible types.
2. Scope Resolution: Ensuring that variables, methods, and classes are declared before use.
3. Symbol Table Management: Building and utilizing a symbol table to track declarations and usage.
4. Inheritance Checks: Validating correct usage of inheritance and method overriding.
5. Control Flow Validation: Ensuring proper return statements and reachable code.

**Key Components:**

1. **Parser and Lexer Definitions:**
   * The project utilizes Bison and Flex for parsing and lexical analysis, respectively.
   * The Bison file (.y extension) defines the grammar and parsing rules, while the Flex file (.l extension) specifies the lexical tokens.
2. **Semantic Analysis Functions:**
   * Within the parser definitions, semantic analysis functions are integrated to perform tasks such as:
     + Type Checking: Ensuring that operations are performed on compatible data types.
     + Scope Resolution: Verifying that variables and functions are declared before use and are accessible within the current scope.
     + Symbol Table Management: Maintaining a symbol table to track identifiers, their types, and other relevant information.
     + Inheritance and Overriding Checks: Validating correct usage of inheritance hierarchies and method overriding.
3. **Integration in the Compilation Process:**
   * The main.cpp file serves as the entry point for the compiler, orchestrating the compilation process, including semantic analysis.
   * The CMakeLists.txt file contains build configurations, ensuring that all components are correctly compiled and linked.

**Understanding the Workflow:**

* The lexer (Flex) processes the input source code to generate tokens.
* The parser (Bison) analyzes the token stream according to the defined grammar, constructing a parse tree.
* During parsing, semantic analysis functions are invoked to check for semantic errors, utilizing the symbol table and enforcing language rules.