Project 3: Liveness Analysis

Points:

- 20 out of 35 (total of project)

Due:

- March 9th (Tue) 23:59

Objectives:

- review the ideas of liveness analysis
- learn how to implement a basic data-flow analysis pass

Tasks:

- **Step-0 (optional)**: Find (at most) one classmate to form a team.

- **Step-1**: Read the instructions in the **HelloDataFlow-LLVM** repo (see below) and understand how it works. use the LLVM documents for more references about the APIs.

- **Step-2**: Implement the basic liveness analysis as an LLVM pass, with the following specifications:
  - given a C function, your implementation finds the **LiveOut** sets for basic blocks in its CFG;
  - your implementation should be able to **handle back edges**, that is, an iterative algorithm or a worklist-based one should be used.
  - your implementation only needs to handle a **basic scenario**, where
    - all the variables are *local* variables;
    - all the variables are of *primitive* data types;
    - the operators in assignments only include `+, -, *, /`
    - the IR may include comparing and branching instructions, like `icmp` and `br`, which may also ``use'' variables (and ``define'' variables)

- **Step-3**: Test your implementation to make sure it works correctly. Test cases will be provided.

Delivery:

- A PDF report:
  - first summarizes the algorithm and major data structures
  - then explains the implementation details: source code pieces + clear explanation
- A source code package (following the same structure as in **HelloDataFlow-LLVM**)
- A video demo with voice (3-5 mins, you may use Zoom for recording) showing:
  - your source code and its compilation;
  - loading the implemented pass and running it on test cases;
  - successfully pass all the test cases.

Reference:

- **HelloPass-LLVM**: https://github.com/ufarooq/HelloDataFlow-LLVM
- The LLVM Compiler Infrastructure
- Writing an LLVM Pass

Grading Criteria:

- Correctness of the implementation (your implementation may be tested with more test cases);
- The clarity of the report and video (details matter).
- The grades of the two students in a team will be the same, unless the contributions are highly biased.