

CS5218 Assignment1 Report

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1 Task 1

The data flow equations should like below:

$$I_{entry}(l) = \begin{cases} \emptyset, & \text{if } l = init(S_F) \\ \cup \{I_{exit}(l') \mid (l', l) \in flow(S_F)\}, & \text{otherwise} \end{cases}$$

$$I_{exit}(l) = (I_{entry}(l) \setminus kill_I(B^l)) \cup gen_I(B^l), \text{ where } B^l \in block(S_F)$$

kill and gen functions are show below:

$$gen_I([z := a]^l) = \{z\}$$

$$gen_I([skip]^l) = \emptyset$$

$$gen_I([b]^l) = \emptyset$$

$$kill_I([z := a]^l) = \emptyset$$

$$kill_I([skip]^l) = \emptyset$$

$$kill_I([b]^l) = \emptyset$$

Combine above formula, the monotone framework is defined as:

$$L = P(Var_*)$$

$$\subseteq = \subseteq$$

$$\cup = \cup$$

$$\perp = \emptyset$$

$$l = \emptyset$$

$$E = \{init(S_*)\}$$

$$F = flow(S_*)$$

$$\mathcal{F} = \{f : L \rightarrow L \mid \exists l_k, l_g : f(l) = (l \setminus l_k) \cup l_g\}$$

$$f_\ell(l) = (l \setminus kill(B^\ell)) \cup gen(B^\ell), \text{ where } B^\ell \in blocks(S_*)$$

2 Task 2

We use a direct way to calculate the initialized variables analysis for non-loop program. As we know, when reach a block, the initialized variables in previous reached block is already exist. The program is loop-free, so the possible execute path's number is limited, we can go through all possible execute paths, the block initialized variable is the union of all block's variables which reach before the target block.

Implementation detail:

- 1) We go through all the blocks, record the variables initialized within each block.
- 2) Use stack to implement the depth-first-search algorithm. Once find a path, then go through the node from start to the end, make sure the node in the back contains all the variables that the previous node have.

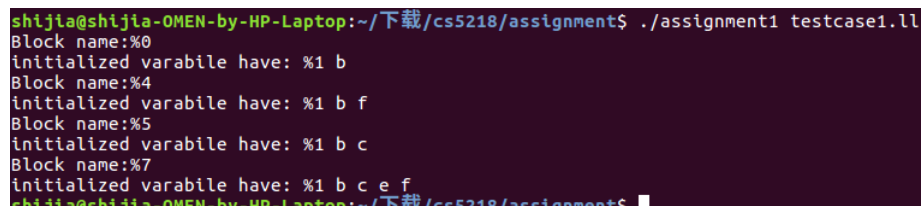
the compile command:

```
clang++-3.5 -o assignment1 Assignment1.cpp 'llvm-config-3.5 -cxxflags' 'llvm-config-3.5 -ldflags' 'llvm-config-3.5 -libs' -lpthread -lcurses -ldl
```

the execute command:

```
./assignment1 testcase1.ll
```

the result show below:



```
shijia@shijia-OMEN-by-HP-Laptop:~/下载/cs5218/assignment$ ./assignment1 testcase1.ll
Block name:%0
initialized variable have: %1 b
Block name:%4
initialized variable have: %1 b f
Block name:%5
initialized variable have: %1 b c
Block name:%7
initialized variable have: %1 b c e f
shijia@shijia-OMEN-by-HP-Laptop:~/下载/cs5218/assignment$
```

Figure 1: testcase1 execute output