

# Homework 12

PB17000297 罗晏宸

November 18 2019

## Exercise 1

针对第十二讲代码优化 (2) P55 上流图, 计算活跃变量数据流方程。

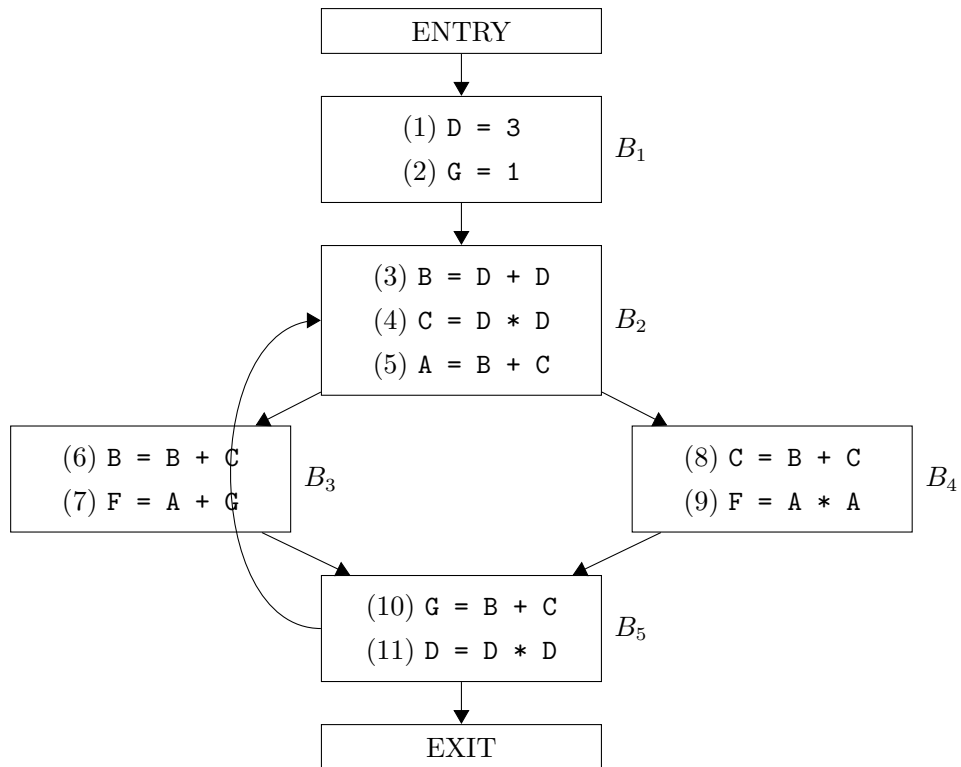


图 1: 第十二讲代码优化 (2) P55 上流图

解 首先给出每个基本块的 *use* 和 *def* 集合

基本块	$use$	$def$
$B_1$	$use_1 = \{\}$	$def_1 = \{D, G\}$
$B_2$	$use_2 = \{D\}$	$def_2 = \{A, B, C\}$
$B_3$	$use_3 = \{A, B, C, G\}$	$def_3 = \{F\}$
$B_4$	$use_4 = \{A, B, C\}$	$def_4 = \{F\}$
$B_5$	$use_5 = \{B, C, D\}$	$def_5 = \{G\}$

初始值

$$IN[B_1] = IN[B_2] = IN[B_3] = IN[B_4] = IN[B_5] = \emptyset$$

$$OUT[B_5] = \emptyset$$

第一次迭代

$$\begin{aligned}
OUT[B_5] &= OUT[B_5] \cup IN[B_2] &&= \{\} \cup \{\} &&= \{\} \\
IN[B_5] &= use_5 \cup (OUT[B_5] - def_5) &&= \{B, C, D\} \cup (\{\} - \{G\}) &&= \{B, C, D\} \\
OUT[B_4] &= OUT[B_4] \cup IN[B_5] &&= \{\} \cup \{B, C, D\} &&= \{B, C, D\} \\
IN[B_4] &= use_4 \cup (OUT[B_4] - def_4) &&= \{A, B, C\} \cup (\{B, C, D\} - \{F\}) &&= \{A, B, C, D\} \\
OUT[B_3] &= OUT[B_3] \cup IN[B_5] &&= \{\} \cup \{B, C, D\} &&= \{B, C, D\} \\
IN[B_3] &= use_3 \cup (OUT[B_3] - def_3) &&= \{A, B, C, G\} \cup (\{B, C, D\} - \{F\}) &&= \{A, B, C, D, G\} \\
OUT[B_2] &= OUT[B_2] \cup IN[B_3] \cup IN[B_4] &&= \{\} \cup \{A, B, C, D, G\} \cup \{A, B, C, D\} &&= \{A, B, C, D, G\} \\
IN[B_2] &= use_2 \cup (OUT[B_2] - def_2) &&= \{D\} \cup (\{A, B, C, D, G\} - \{A, B, C\}) &&= \{D, G\} \\
OUT[B_1] &= OUT[B_1] \cup IN[B_2] &&= \{\} \cup \{A, D, G\} &&= \{D, G\} \\
IN[B_1] &= use_1 \cup (OUT[B_1] - def_1) &&= \{\} \cup (\{D, G\} - \{D, G\}) &&= \{\}
\end{aligned}$$

第二次迭代

$$\begin{array}{llll}
\text{OUT}[B_5] & = \text{OUT}[B_5] \cup \text{IN}[B_2] & = \{\} \cup \{\text{D}, \text{G}\} & = \{\text{D}, \text{G}\} \\
\text{IN}[B_5] & = \text{use}_5 \cup (\text{OUT}[B_5] - \text{def}_5) & = \{\text{B}, \text{C}, \text{D}\} \cup (\{\text{D}, \text{G}\} - \{\text{G}\}) & = \{\text{B}, \text{C}, \text{D}\} \\
\text{OUT}[B_4] & = \text{OUT}[B_4] \cup \text{IN}[B_5] & = \{\text{B}, \text{C}, \text{D}\} \cup \{\text{B}, \text{C}, \text{D}\} & = \{\text{B}, \text{C}, \text{D}\} \\
\text{IN}[B_4] & = \text{use}_4 \cup (\text{OUT}[B_4] - \text{def}_4) & = \{\text{A}, \text{B}, \text{C}\} \cup (\{\text{B}, \text{C}, \text{D}\} - \{\text{F}\}) & = \{\text{A}, \text{B}, \text{C}, \text{D}\} \\
\text{OUT}[B_3] & = \text{OUT}[B_3] \cup \text{IN}[B_5] & = \{\text{B}, \text{C}, \text{D}\} \cup \{\text{B}, \text{C}, \text{D}\} & = \{\text{B}, \text{C}, \text{D}\} \\
\text{IN}[B_3] & = \text{use}_3 \cup (\text{OUT}[B_3] - \text{def}_3) & = \{\text{A}, \text{B}, \text{C}, \text{G}\} \cup (\{\text{B}, \text{C}, \text{D}\} - \{\text{F}\}) & = \{\text{A}, \text{B}, \text{C}, \text{D}, \text{G}\} \\
\text{OUT}[B_2] & = \text{OUT}[B_2] \cup \text{IN}[B_3] \cup \text{IN}[B_4] & = \{\text{A}, \text{B}, \text{C}, \text{D}, \text{G}\} \cup \{\text{A}, \text{B}, \text{C}, \text{D}, \text{G}\} \cup \{\text{A}, \text{B}, \text{C}, \text{D}\} & = \{\text{A}, \text{B}, \text{C}, \text{D}, \text{G}\} \\
\text{IN}[B_2] & = \text{use}_2 \cup (\text{OUT}[B_2] - \text{def}_2) & = \{\text{D}\} \cup (\{\text{A}, \text{B}, \text{C}, \text{D}, \text{G}\} - \{\text{A}, \text{B}, \text{C}\}) & = \{\text{D}, \text{G}\} \\
\text{OUT}[B_1] & = \text{OUT}[B_1] \cup \text{IN}[B_2] & = \{\text{D}, \text{G}\} \cup \{\text{D}, \text{G}\} & = \{\text{D}, \text{G}\} \\
\text{IN}[B_1] & = \text{use}_1 \cup (\text{OUT}[B_1] - \text{def}_1) & = \{\} \cup (\{\text{D}, \text{G}\} - \{\text{D}, \text{G}\}) & = \{\}
\end{array}$$

第三次迭代

$$\begin{array}{llll}
\text{OUT}[B_5] & = \text{OUT}[B_5] \cup \text{IN}[B_2] & = \{\text{D}, \text{G}\} \cup \{\text{D}, \text{G}\} & = \{\text{D}, \text{G}\} \\
\text{IN}[B_5] & = \text{use}_5 \cup (\text{OUT}[B_5] - \text{def}_5) & = \{\text{B}, \text{C}, \text{D}\} \cup (\{\text{D}, \text{G}\} - \{\text{G}\}) & = \{\text{B}, \text{C}, \text{D}\} \\
\text{OUT}[B_4] & = \text{OUT}[B_4] \cup \text{IN}[B_5] & = \{\text{B}, \text{C}, \text{D}\} \cup \{\text{B}, \text{C}, \text{D}\} & = \{\text{B}, \text{C}, \text{D}\} \\
\text{IN}[B_4] & = \text{use}_4 \cup (\text{OUT}[B_4] - \text{def}_4) & = \{\text{A}, \text{B}, \text{C}\} \cup (\{\text{B}, \text{C}, \text{D}\} - \{\text{F}\}) & = \{\text{A}, \text{B}, \text{C}, \text{D}\} \\
\text{OUT}[B_3] & = \text{OUT}[B_3] \cup \text{IN}[B_5] & = \{\text{B}, \text{C}, \text{D}\} \cup \{\text{B}, \text{C}, \text{D}\} & = \{\text{B}, \text{C}, \text{D}\} \\
\text{IN}[B_3] & = \text{use}_3 \cup (\text{OUT}[B_3] - \text{def}_3) & = \{\text{A}, \text{B}, \text{C}, \text{G}\} \cup (\{\text{B}, \text{C}, \text{D}\} - \{\text{F}\}) & = \{\text{A}, \text{B}, \text{C}, \text{D}, \text{G}\} \\
\text{OUT}[B_2] & = \text{OUT}[B_2] \cup \text{IN}[B_3] \cup \text{IN}[B_4] & = \{\text{A}, \text{B}, \text{C}, \text{D}, \text{G}\} \cup \{\text{A}, \text{B}, \text{C}, \text{D}, \text{G}\} \cup \{\text{A}, \text{B}, \text{C}, \text{D}\} & = \{\text{A}, \text{B}, \text{C}, \text{D}, \text{G}\} \\
\text{IN}[B_2] & = \text{use}_2 \cup (\text{OUT}[B_2] - \text{def}_2) & = \{\text{D}\} \cup (\{\text{A}, \text{B}, \text{C}, \text{D}, \text{G}\} - \{\text{A}, \text{B}, \text{C}\}) & = \{\text{D}, \text{G}\} \\
\text{OUT}[B_1] & = \text{OUT}[B_1] \cup \text{IN}[B_2] & = \{\text{D}, \text{G}\} \cup \{\text{D}, \text{G}\} & = \{\text{D}, \text{G}\} \\
\text{IN}[B_1] & = \text{use}_1 \cup (\text{OUT}[B_1] - \text{def}_1) & = \{\} \cup (\{\text{D}, \text{G}\} - \{\text{D}, \text{G}\}) & = \{\}
\end{array}$$

不再有 IN 值发生改变，迭代终止。