Homework 3
Due in class on Wed, Mar 28, 2012

This short homework assignment will help you review your understanding of data flow analysis.

1. Translate the following program into three-address code and draw the control-flow graph for the program. For this problem, the nodes of the control-flow graph should be (maximally large) basic blocks.

\[
\begin{align*}
\text{dx} &= x_1 - x_0 \\
\text{dy} &= y_1 - y_0 \\
\text{d} &= 2 \times \text{dy} - \text{dx} \\
y &= y_0 \\
\text{for} \ (x = x_0 + 1; x < x_1; x++) & \{ \\
\quad \text{if} \ (d > 0) \ & \{ \\
\quad \quad y++ \\
\quad \quad d += 2 \times \text{dy} - 2 \times \text{dx} \\
\quad \} \\
\quad \text{else} & \\
\quad d += 2 \times \text{dy} \\
\}\}
\end{align*}
\]

2. Consider the following control-flow graph:

\[
\begin{align*}
(1) \ a &:= 1 \\
(2) \ b &:= 2 \\
(3) \ c &:= a + b \\
(4) \ d &:= c - a \\
(5) \ b &:= a + b \\
(6) \ e &:= c - a \\
(7) \ a &:= b \times d \\
(8) \ b &:= a - d \\
(9) \ d &:= b \times d \\
(10) \ d &:= a + b \\
(11) \ e &:= e + 1
\end{align*}
\]

Write down the following:
(a) For each statement, the set of definitions that reach the end of the statement.
(b) For each statement, the set of expressions that are available at the end of the statement.
(c) For each statement, the set of variables that are live at the beginning of the statement.
(d) For each statement, the set of expressions that are very busy at the beginning of the statement.