IC–Beispielprogramm: Fakultätsberechnung

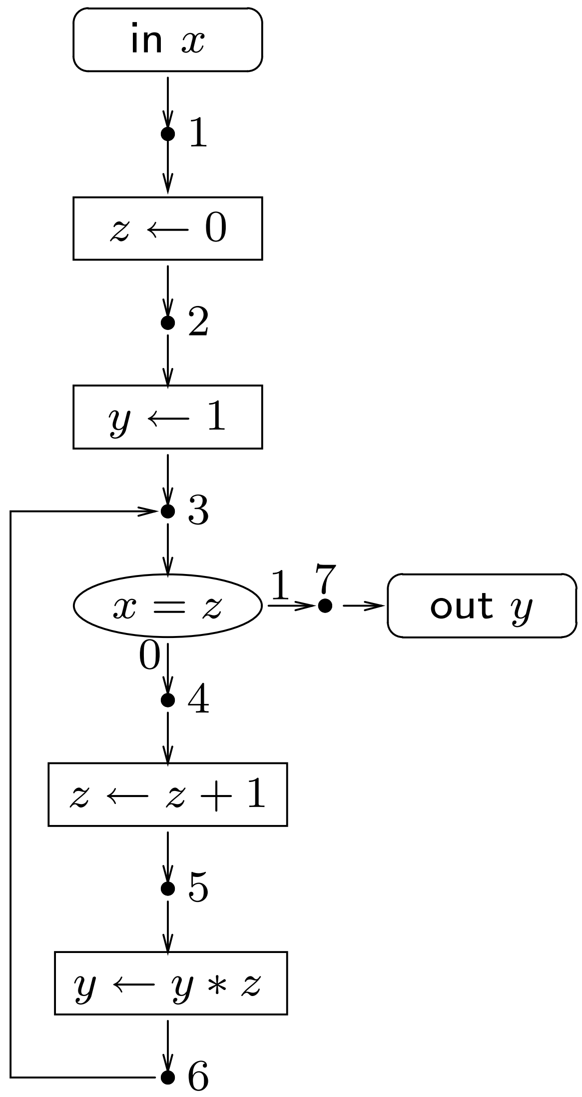
$\pi_f \in IC$:

$$
\begin{aligned}
& \mathsf{in}\ x; \mathsf{out}\ y; \mathsf{loc}\ z; \\
& z \leftarrow 0; \\
& y \leftarrow 1; \\
l :\ & \mathsf{if}\ x = z\ \mathsf{goto}\ l'; \\
& z \leftarrow z + 1; \\
& y \leftarrow y * z; \\
& \mathsf{goto}\ l
\end{aligned}
$$

mit Standardmarken:

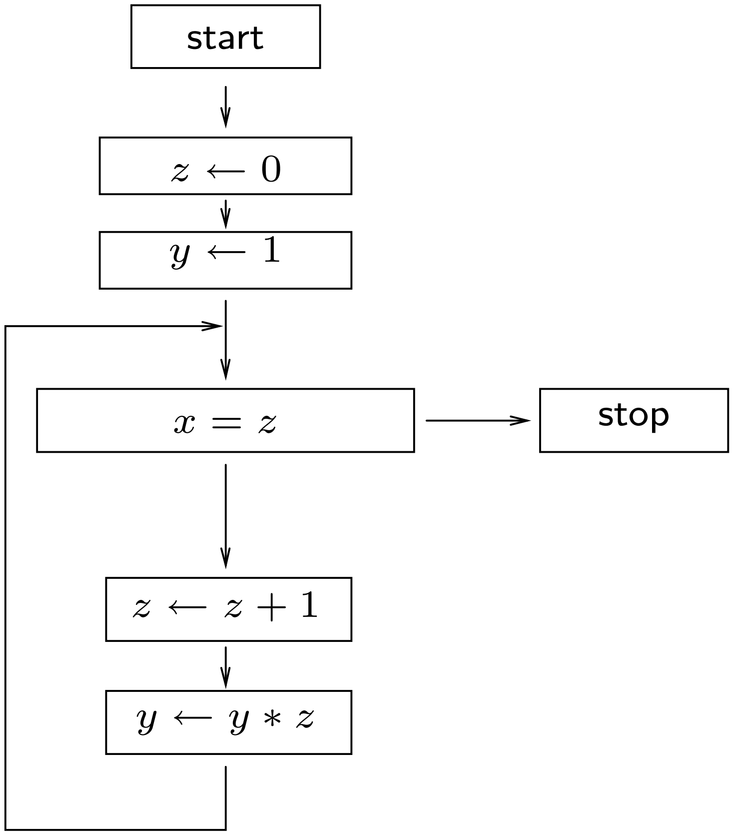
$$
\begin{aligned}
& \mathsf{in}\ x; \mathsf{out}\ y; \mathsf{loc}\ z; \\
1 :\ & z \leftarrow 0; \\
2 :\ & y \leftarrow 1; \\
3 :\ & \mathsf{if}\ x = z\ \mathsf{goto}\ 7; \\
4 :\ & z \leftarrow z + 1; \\
5 :\ & y \leftarrow y * z; \\
6 :\ & \mathsf{goto}\ 3
\end{aligned}
$$

Beispiel: Flussdiagramm von π_f

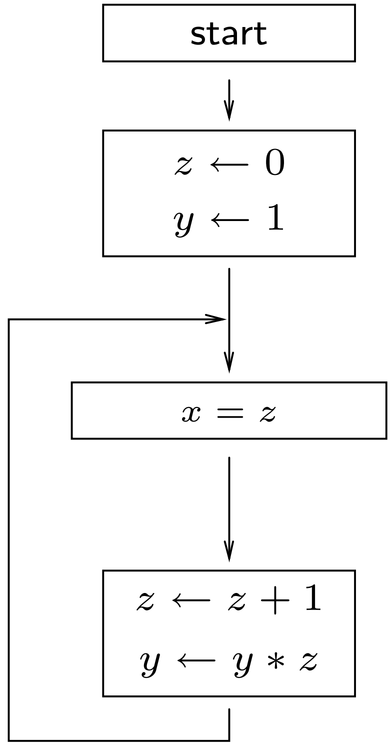


Beispiel: BB- und SI-Graph

SI-Graph zu π_f:

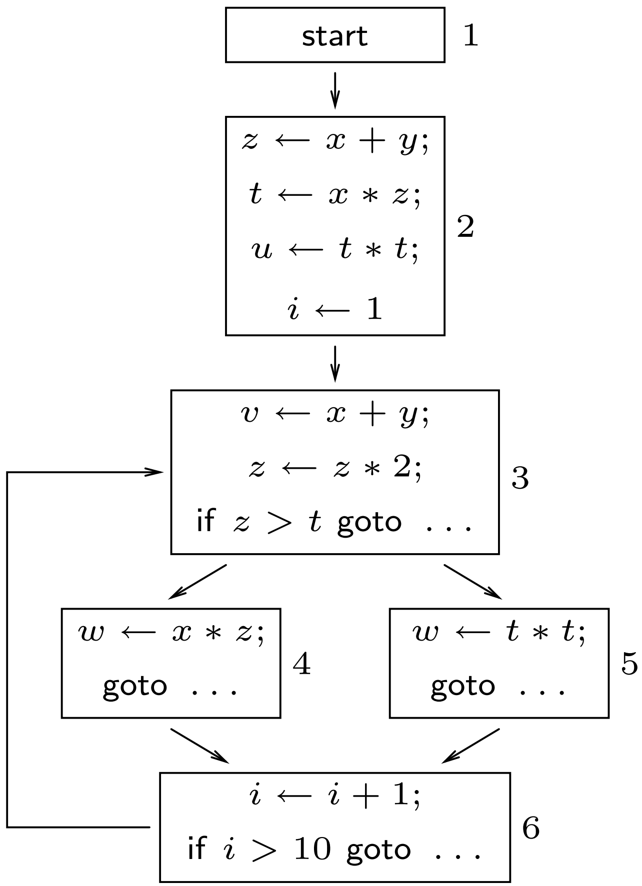


BB-Graph zu π_f:

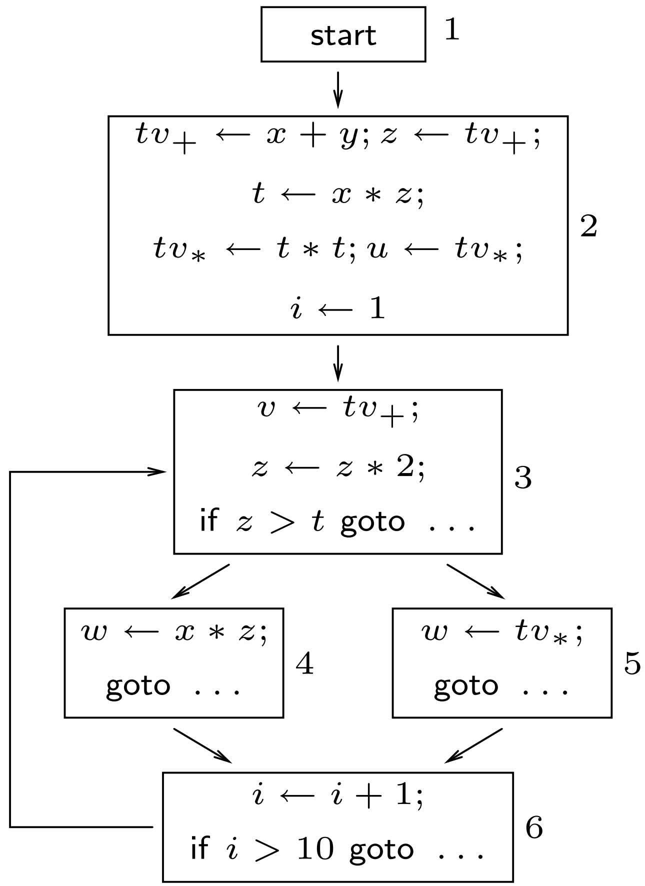


Beispiel: Common Subexpression Elimination

Ausgangsprogramm:



Nach Common Subexpression Elimination:
(ohne überflüssige Kopieranweisungen)



Gleichungssystem *Available Expressions* Analyse

$$
\begin{aligned}
X_1 &= (1,1,1,1,1,1,1) = d_s \\
X_2 &= X_1 \\
X_3 &= \varphi_2(X_2) \sqcup \varphi_6(X_6) \\
X_4 &= \varphi_3(X_3) \\
X_5 &= \varphi_3(X_3) \\
X_6 &= \varphi_4(X_4) \sqcup \varphi_5(X_5)
\end{aligned}
$$

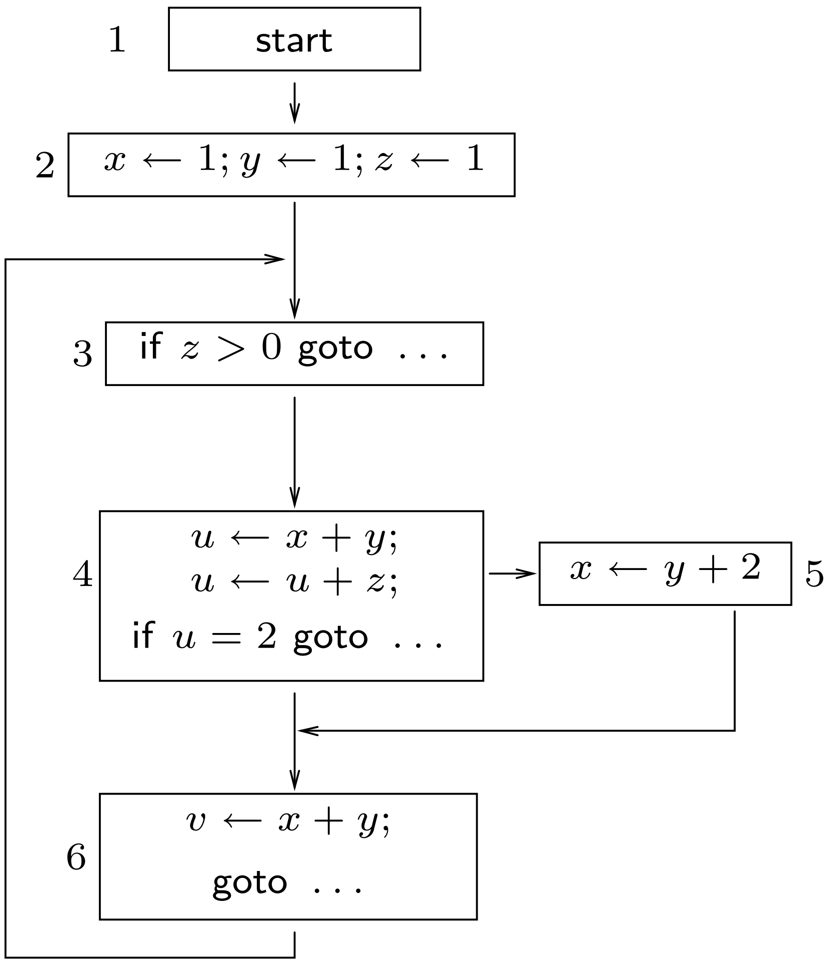
Vereinfachung von E_Δ:

$$
\begin{aligned}
X_1 &= X_2 = (1,1,1,1,1,1,1) \\
X_3 &= (0,0,0,1,1,1,1) \sqcup \varphi_6(X_6) \\
&= (0,0,0,1,1,1,1) \sqcup \varphi_6((\varphi_4 \sqcup \varphi_5)(\varphi_3(X_3))) \qquad (*) \\
X_4 &= X_5 = \varphi_3(X_3) \\
X_6 &= (\varphi_4 \sqcup \varphi_5)(X_4)
\end{aligned}
$$

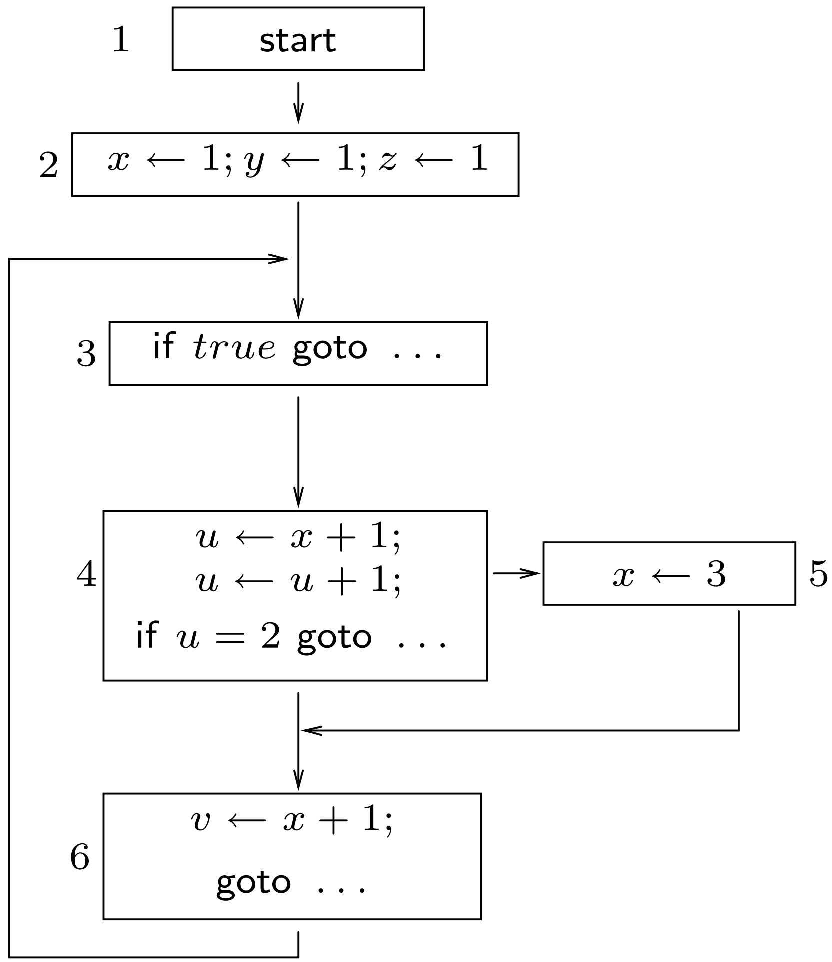
mit $\varphi_6((\varphi_4 \sqcup \varphi_5)(\varphi_3(b_1, \ldots, b_7))) = (0, 1, b_3, 1, 1, 0, 0)$

Reaching Definitions Analyse und Konstantenfaltung

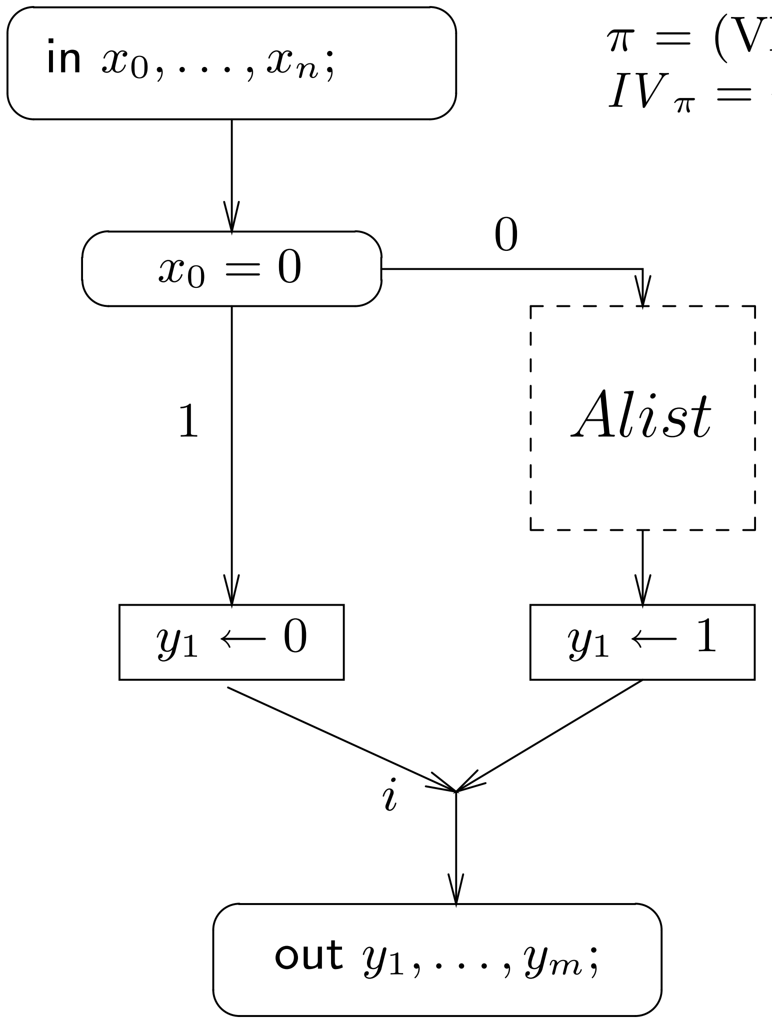
Ursprünglicher Flussgraph:



Nach Konstantenfaltung:



Nicht-Entscheidbarkeit der Konstanzeigenschaft



$\pi = (\text{Vlist},\text{Alist})$
$IV_\pi = \{x_1, \ldots, x_n\}$

RD^{MFP}: Transferfunktionen und Gleichungssystem

$$
\begin{aligned}
\varphi_4(d_1, d_2, d_3, d_4, d_5) &= (d_3 + d_4 + d_5, d_2, d_3, d_4, d_5) \\
\varphi_5(d_1, d_2, d_3, d_4, d_5) &= (d_1, d_2, d_4 + 2, d_4, d_5) \\
\varphi_6(d_1, d_2, d_3, d_4, d_5) &= (d_1, d_3 + d_4, d_3, d_4, d_5)
\end{aligned}
$$

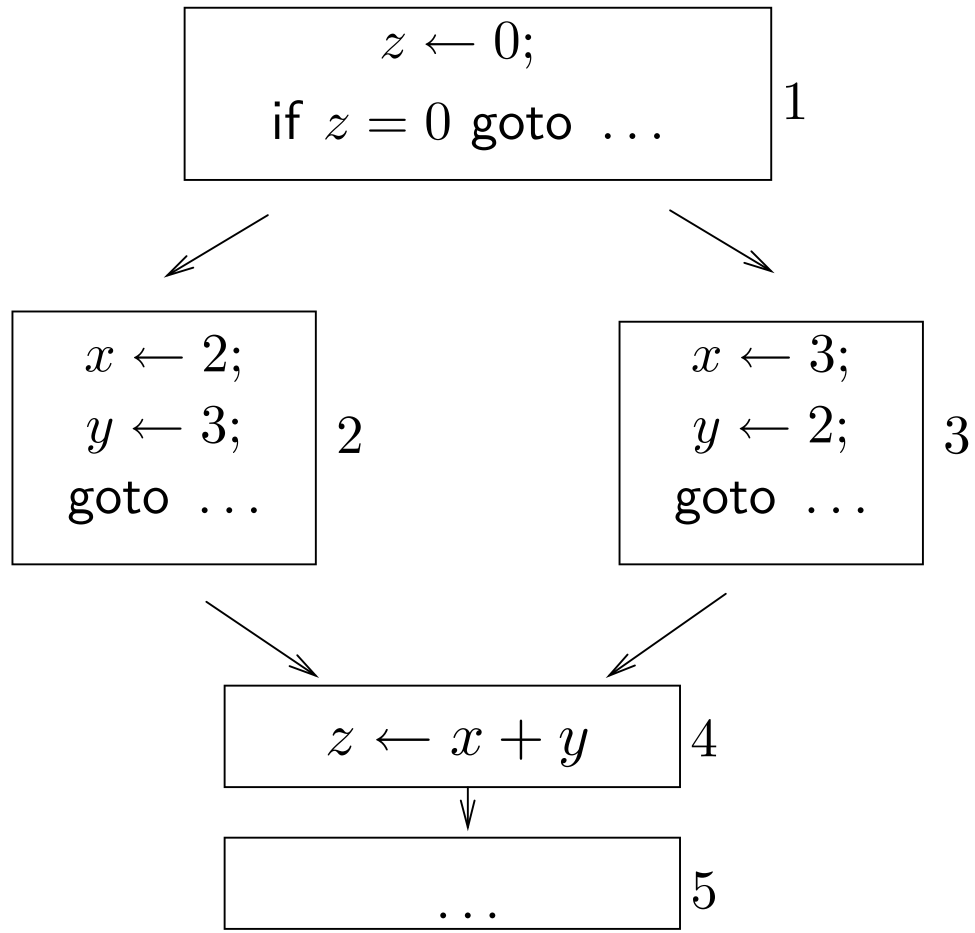
Vereinfachtes Gleichungssystem von (E_Δ):

$$
\begin{aligned}
& X_1 = && X_2 = (\top, \ldots, \top) \\
(*) \quad & X_3 = && (\top, \top, 1, 1, 1) \sqcup \varphi_6([\varphi_4 \sqcup \varphi_5 \circ \varphi_4](X_3)) \\
& X_4 = && X_3 \\
& X_5 = && \varphi_4(X_3) \\
& X_6 = && [\varphi_4 \sqcup \varphi_5 \circ \varphi_4](X_3)
\end{aligned}
$$

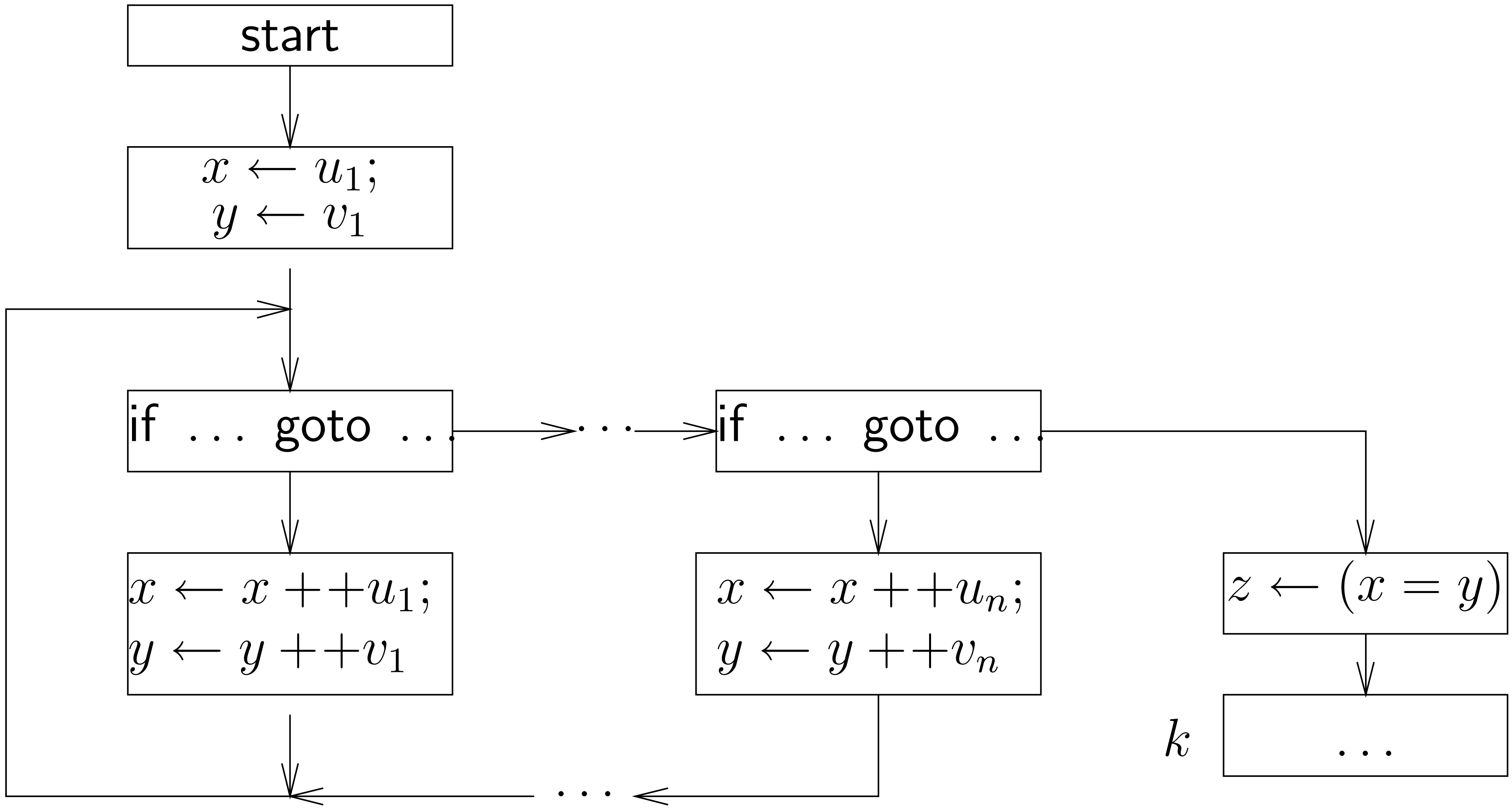
Dabei gilt:

$$
\begin{aligned}
[\varphi_4 \sqcup \varphi_5 \circ \varphi_4](d_1, \ldots, d_5) &= (d_3 + d_4 + d_5, d_2, d_3 \sqcup (d_4 + 2), d_4, d_5) \\
\varphi_6([\varphi_4 \sqcup \varphi_5 \circ \varphi_4])(d_1, \ldots, d_5) &= (d_3 + d_4 + d_5, (d_3 \sqcup (d_4 + 2)) + d_4, \\
&\qquad d_3 \sqcup (d_4 + 2), d_4, d_5)
\end{aligned}
$$

$RD^{MOP} \neq RD^{MFP}$

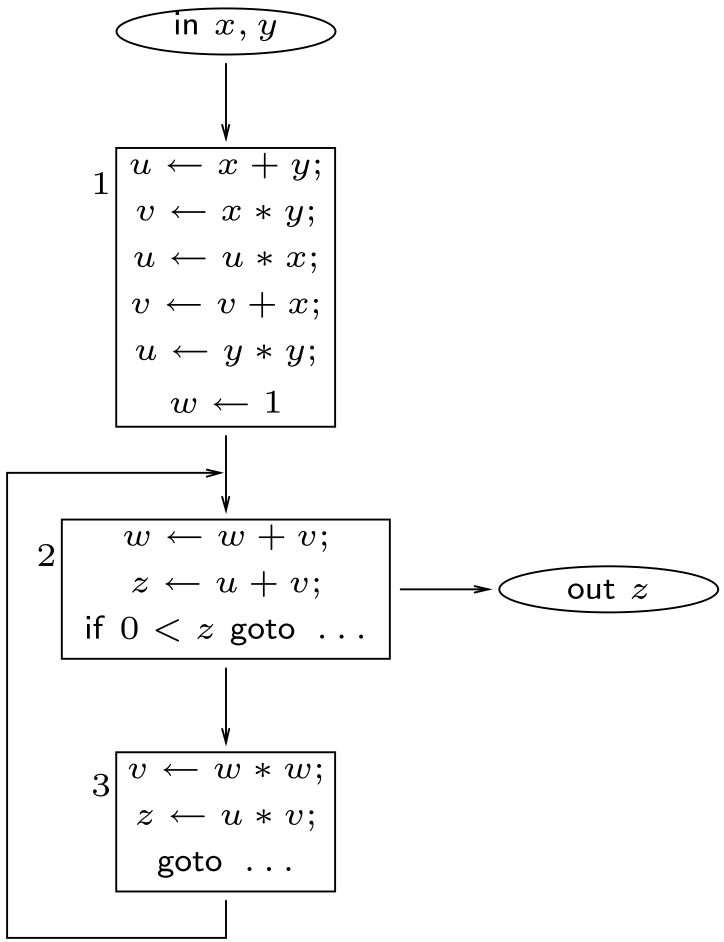


Nicht-Entscheidbarkeit der Konstanteninformationen RD_i^{MOP}



Beispiel: Dead Code Elimination

Ausgangsprogramm:



Nach Dead Code Elimination: