Dataflow Analysis
- Feb 19
y := x
z := 1

while [y > 1] do (  
  z := z * y
  y := y - 1  
)

y := 0
Reaching Definitions.

An assignment $[x := a]_l^e$ reaches entry or exit of $e'$ if there is an execution where $[x := a]_l^e$ occurs and after that there is no assignment to $x$ till $e'$ is reached. $[x := a]_l^e$ no assignments to $x$ till $e'$.
RD is undecidable.

\[ [x := a]^l ; S ; [y := x]^l' \]
Programming Language

\[ a := x | n | a_1 \circ_{a} a_2 \]
\[ b := \text{true} | \text{false} | a_1 \circ_{r} a_2 | b_1 \circ_{b} b_2 \]

Ex.
\[ \circ_{a} = \{+, -, \ldots, \} \]
\[ \circ_{r} = \{<, =, >, \leq, \geq \} \]
\[ \circ_{b} = \{\land, \lor, \oplus\} \]
Statements

\[ S ::= [x := a] \mid [\text{skip}] \mid \]
\[ \text{if} \ [b] \ \text{then} \ S_1 \ \text{else} \ S_2 \]
\[ \text{while} \ [b] \ \text{do} \ S \]
\[ S_1 ; S_2 \]
In general, if \( f : T \rightarrow T \)

RD analysis

\[ f : T \rightarrow T \]

\[ T = \langle DF_{\text{entry}}^{1}, DF_{\text{exit}}^{1}, \ldots \rangle \]
\[ T = \langle DF_{\text{entry}}^i, DF_{\text{exit}}^i \rangle_{i=1,...,6} \]

Lattice:
\[ \langle DF_{\text{entry}}^i, DF_{\text{exit}}^i \rangle \leq \langle DF_{\text{entry}}^{i'}, DF_{\text{exit}}^{i'} \rangle \]
iff \[ \forall i. \ DF_{\text{entry}}^i \leq DF_{\text{entry}}^{i'} \]
\[ DF_{\text{exit}}^i \leq DF_{\text{exit}}^{i'} \]

\[ f : T \rightarrow T \text{ computing RD} \]

So there is a \textit{monotonic}. 

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Hence $RD : \operatorname{lfp} f$

Monotonic does not say\[X \subseteq f(X).
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but says that\[X \subseteq Y \implies f(X) \subseteq f(Y).
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