Cheat Sheet

Dataflow Analysis:

for($v \in V$) {

$\text{out}(v) \coloneqq \bigcup s\colon s \in \text{successor}(v) :: \text{in}(s)$

$\text{in}(v) \coloneqq \text{use}(v) \cup \left(\text{out}(v) \setminus def(v)\right)$

}

Invariants:

I0 ≡ $\text{use}(v) \subseteq \text{in}(v)$

I1 ≡ $\text{out}(v) \setminus \text{def}(v) \subseteq \text{in}(v)$

I2 ≡ $\forall\, s : s \in \text{successor}(v) :: \text{in}(s) \subseteq \text{out}(v)$

Notation:

Followers(A) ≡ FL(A)

Starters(A) ≡ ST(A)

Nullable(A) ≡ N(A)

Capitals are non-terminals, lowercase are terminals.

Greek letters are sequences.

Nullable Induction:

Observed	***Rule***
1. $\alpha = \varepsilon$	Nullable(α) = true
2. $\alpha = t$	Nullable(α) = false
3. $\alpha = A$	Nullable(α) = Nullable(A)
4. $\alpha = \alpha_1\alpha_2 \dots \alpha_n$	Nullable(α) = Nullable(α_1) $\wedge \dots \wedge$ Nullable(α_n)
5. $\alpha = \alpha_1 \vert \alpha_2 \vert \dots \vert \alpha_n$	Nullable(α) = Nullable(α_1) $\vee \dots \vee$ Nullable(α_n)
6. $\alpha = \beta^*$	Nullable(α) = true

Starters Induction:

Observed	***Rule***
1. $\alpha = \varepsilon$	Starters(α) = { ε }
2. $\alpha = t$	Starters(α) = { t }
3. $\alpha = A$	Starters(α) = Starters(A)
4. $\alpha = \alpha_1\alpha_2 \ldots \alpha_n$	Starters(α) = Starters(α_1)$\bigoplus$Starters($\alpha_2 \ldots \alpha_n$)
5. $\alpha = \alpha_1 \vert \alpha_2 \vert \ldots \vert \alpha_n$	Starters(α) = Starters(α_1) ∪ … ∪ Starters(α_n)
6. $\alpha = \beta^*$	Starters(α) = Starters(β) ∪ { ε }

$$\mathrm{A} \bigoplus \mathrm{B} = \begin{cases} \mathrm{A} & \text{if } \varepsilon \notin \mathrm{A} \\ (\mathrm{A}\backslash\{\varepsilon\}) \cup \mathrm{B} & \text{otherwise} \end{cases}$$

Followers First Step:

$$\mathrm{FL}_0(\mathrm{A}) = \left(\bigcup_{\mathrm{C}::=\alpha\mathrm{A}\beta} \mathrm{ST}(\beta) \right) \backslash\{\varepsilon\}$$

Followers Inductive Step:

$$\mathrm{FL}_{i+1}(A) = \mathrm{FL}_i(A) \cup \bigcup_{\mathrm{C}::=\alpha\mathrm{A}\beta \text{ and } \mathrm{Nullable}(\beta)} \mathrm{FL}_i(\mathrm{C})$$

Followers Final Step:

$$\mathrm{FL}(\mathrm{A}) = \mathrm{FL}_n(\mathrm{A}) \cup \begin{cases} \{\varepsilon\} & \text{if } \mathrm{S} \Rightarrow^* \alpha\mathrm{A} \\ \{\} & \text{otherwise} \end{cases}$$

For each choice in A ::= $\beta(\alpha_1| \ldots |a_m)\gamma$ define:

Predict(α_i) = Starters($\alpha_i\gamma$) $\oplus$ Followers(A)

For repetitions in A ::= $\beta(\alpha)^*\gamma$

Predict(α) = Starters(α)

Predict(γ) = Starters(γ) $\oplus$ Followers(A)

For sequences A ::= $\alpha\beta\gamma$

Predict(A) = ST(α) $\oplus$ ST(β) $\oplus$ ST(γ)

x64:

pop rm: Stores data at [rsp] into rm, and rsp += 8

push rm: Does rsp -= 8, then stores rm at [rsp]

mov rm,r: Takes r, stores it in rm

mov rm,imm32: Stores imm32 in rm

RM examples:

Form	Example
r	# rdx
[rdisp + disp]	# [rbp-10]
[ridx*mult + disp]	# [rcx*8+11223344]
[rdisp + ridx*mult + disp]	# [rbx+rsi*4-8]
[disp]	# [11223344]

Useful Registers:

rax, rcx, rdx, rbx, rsp, rbp, rsi, rdi

r8, r9, r10, r11, r12, r13, r14, r15