First and Follow Sets

When I learn't about first and follow sets at university I found them difficult to follow, so I have tried to rewrite the rules I was taught for creating them so that they would be easier to understand. I hope it helps :)

If you are worried if these rules are actually correct, I have had a lecturer ask if he can use them in his class so I am assuming they are correct...

Please feel free to contact me if you have any queries about or suggestions for this page. My email address is james@jambe.cjb.net.

Rules for First Sets

1. If X is a terminal then First(X) is just X!
2. If there is a Production X → ε then add ε to first(X)
3. If there is a Production X → Y1Y2..Yk then add first(Y1Y2..Yk) to first(X)
4. First(Y1Y2..Yk) is either
    1. First(Y1) (if First(Y1) doesn't contain ε)
    2. OR (if First(Y1) does contain ε) then First (Y1Y2..Yk) is everything in First(Y1) <except for ε > as well as everything in First(Y2..Yk)
    3. If First(Y1) First(Y2)..First(Yk) all contain ε then add ε to First(Y1Y2..Yk) as well.

Rules for Follow Sets

1. First put $ (the end of input marker) in Follow(S) (S is the start symbol)
2. If there is a production A → aBb, (where a can be a whole string) then everything in FIRST(b) except for ε is placed in FOLLOW(B).
3. If there is a production A → aB, then everything in FOLLOW(A) is in FOLLOW(B)
4. If there is a production A → aBb, where FIRST(b) contains ε , then everything in FOLLOW(A) is in FOLLOW(B)

Here an example for you to follow through.

The Grammar

E → TE'

E' → +TE'

$E' \rightarrow \varepsilon$

$T \rightarrow FT'$

$T' \rightarrow *FT'$

$T' \rightarrow \varepsilon$

$F \rightarrow (E)$

$F \rightarrow id$

First Sets	Follow Sets
We Want to make First sets so first we list the sets we need FIRST(E) = {} FIRST(E') = {} FIRST(T) = {} FIRST(T') = {} FIRST(F) = {} First We apply rule 2 to $T' \rightarrow \varepsilon$ and $E' \rightarrow \varepsilon$ FIRST(E) = {} FIRST(E') = { ε } FIRST(T) = {} FIRST(T') = { ε } FIRST(F) = {} First We apply rule 3 to $T' \rightarrow *FT'$ this rule tells us that we can add everything in First(*FT') into First(T')	We want to make Follow sets so first we list the sets we need FOLLOW(E) = {} FOLLOW(E') = {} FOLLOW(T) ={} FOLLOW(T') = {} FOLLOW(F) = {} The First thing we do is Add $ to the start Symbol 'E' FOLLOW(E) = {$} FOLLOW(E') = {} FOLLOW(T) ={} FOLLOW(T') = {} FOLLOW(F) = {} Next we apply rule 2 to $E' \rightarrow +TE'$ This says that

Since First(*) useing rule 1 is * we can add * to First(T')

FIRST(E) = {}

FIRST(E') = {+, ε }

FIRST(T) = {}

FIRST(T') = {*, ε }

FIRST(F) = {}

First We apply rule 3 to T' → *FT' this rule tells us that we can add everything in First(*FT') into First(T')

Since First(*) useing rule 1 is * we can add * to First(T')

FIRST(E) = {}

FIRST(E') = {+, ε }

FIRST(T) = {}

FIRST(T') = {*, ε }

FIRST(F) = {}

Two more productions begin with terminals F → (E) and F → id If we apply rule 3 to these we get...

FIRST(E) = {}

FIRST(E') = {+, ε }

FIRST(T) = {}

FIRST(T') = {*, ε }

FIRST(F) = {'(',id}

Next we apply rule 3 to T → FT' once again this tells us everything in First(E') except for ε should be in Follow(T)

FOLLOW(E) = {$}

FOLLOW(E') = {}

FOLLOW(T) ={+}

FOLLOW(T') = {}

FOLLOW(F) = {}

Next we apply rule 3 to E →TE' This says that we should add everything in Follow(E) into Follow (E')

FOLLOW(E) = {$}

FOLLOW(E') = {$}

FOLLOW(T) ={+}

FOLLOW(T') = {}

FOLLOW(F) = {}

Next we apply rule 3 to T → FT' This says that we should add everything in Follow(T) into Follow(T')

FOLLOW(E) = {$}

FOLLOW(E') = {$}

FOLLOW(T) ={+}

FOLLOW(T') = {+}

FOLLOW(F) = {}

that we can add First(FT') to First(T)

Since First(F) doesn't contain ε that means that First (FT') is just First(F)

FIRST(E) = {}

FIRST(E') = {+, ε }

FIRST(T) = {'(',id}

FIRST(T') = {*, ε }

FIRST(F) = {'(',id}

Lastly we apply rule 3 to E → TE' once again this tells us that we can add First(TE') to First(E)

Since First(T) doesn't contain ε that means that First (TE') is just First(T)

FIRST(E) = {'(',id}

FIRST(E') = {+, ε }

FIRST(T) = {'(',id}

FIRST(T') = {*, ε }

FIRST(F) = {'(',id}

Doing anything else doesn't change the sets so we are done!

Now we apply rule 2 to T' →*FT' This says that everything in First(T') except for ε should be in Follow(F)

FOLLOW(E) = {$}

FOLLOW(E') = {$}

FOLLOW(T) ={+}

FOLLOW(T') = {+}

FOLLOW(F) = {*}

Now we apply rule 2 to F → (E) This says that everything in First(')') should be in Follow(E)

FOLLOW(E) = {$,)}

FOLLOW(E') = {$}

FOLLOW(T) ={+}

FOLLOW(T') = {+}

FOLLOW(F) = {*}

Next we apply rule 3 to E → TE' This says that we should add everything in Follow(E) into Follow(E')

FOLLOW(E) = {$,)}

FOLLOW(E') = {$,)}

FOLLOW(T) = {+}

FOLLOW(T') = {+}

FOLLOW(F) = {*}

Next we apply rule 4 to E' → +TE' This says that we should add everything in Follow(E') into Follow(T) (because First(E') contains ε)

FOLLOW(E) = {$,)}

FOLLOW(E') = {$,)}

FOLLOW(T) = {+,$,)}

FOLLOW(T') = {+}

FOLLOW(F) = {*}

Next we apply rule 3 to T → FT' This says that we should add everything in Follow(T) into Follow(T')

FOLLOW(E) = {$,)}

FOLLOW(E') = {$,)}

FOLLOW(T) = {+,$,)}

FOLLOW(T') = {+,$,)}

FOLLOW(F) = {*}

Finaly we apply rule 4 to T' → *FT' This says that we should add everything in Follow(T') into Follow(F)

FOLLOW(E) = {$,)}

FOLLOW(E') = {$,)}

FOLLOW(T) = {+,$,)}

FOLLOW(T') = {+,$,)}

FOLLOW(F) = {*,+,$,)}

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