



# Chapter 0

## Exercises

Course "Compiler Construction"

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# Section

## Exercises 02

- 2.1 First and follow set
- 2.2 Nullability
- 2.3 Associativity and precedence
- 2.4 Tiny language

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## 2.1: First and follow for this


$$\begin{aligned} \textit{exp} &\rightarrow \textit{term exp}' \\ \textit{exp}' &\rightarrow \textit{addop term exp}' \mid \epsilon \\ \textit{addop} &\rightarrow + \mid - \\ \textit{term} &\rightarrow \textit{factor term}' \\ \textit{term}' &\rightarrow \textit{mulop factor term}' \mid \epsilon \\ \textit{mulop} &\rightarrow * \\ \textit{factor} &\rightarrow (\textit{exp}) \mid \mathbf{number} \end{aligned}$$

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## 2.1: Follow set: fill out this



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production	init	pass 1	pass 2
$exp \rightarrow term\ exp'$			
$exp' \rightarrow addop\ term\ exp'$			
$exp' \rightarrow \epsilon$			
$addop \rightarrow +$			
$addop \rightarrow -$			
$term \rightarrow factor\ term'$			
$term' \rightarrow mulop\ factor\ term'$			
$term' \rightarrow \epsilon$			
$mulop \rightarrow *$			
$factor \rightarrow (exp)$			
$factor \rightarrow \mathbf{number}$			

## 2.2: Nullable algo?

Describe an algo for checking nullability.



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## 2.3: Associativity and precedence



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op	precedence	associativity
+, -	low	left assoc.
*, /	higher	left. assoc.
↑	highest	right. assoc



# Flat (simple, but highly ambiguous)



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$$\begin{aligned} \textit{exp} &\rightarrow \mathbf{number} \mid (\textit{exp}) \mid \textit{exp op exp} \\ \textit{op} &\rightarrow + \mid - \mid * \mid \uparrow \end{aligned}$$

# Grammar from the lecture as inspiration



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$$\begin{aligned} \textit{exp} &\rightarrow \textit{exp addop term} \mid \textit{term} \\ \textit{addop} &\rightarrow + \mid - \\ \textit{term} &\rightarrow \textit{term mulop factor} \mid \textit{factor} \\ \textit{mulop} &\rightarrow * \\ \textit{factor} &\rightarrow (\textit{exp}) \mid \mathbf{number} \end{aligned}$$

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## 2.4: TINY grammar

<i>program</i>	→	<i>stmts</i>
<i>stmts</i>	→	<i>stmts</i> ; <i>stmt</i>   <i>stmt</i>
<i>stmt</i>	→	<i>if-stmt</i>   <i>repeat-stmt</i>   <i>assign-stmt</i>   <i>read-stmt</i>   <i>write-stmt</i>
<i>if-stmt</i>	→	<b>if</b> <i>expr</i> <b>then</b> <i>stmt</i> <b>end</b>   <b>if</b> <i>expr</i> <b>then</b> <i>stmt</i> <b>else</b> <i>stmt</i> <b>end</b>
<i>repeat-stmt</i>	→	<b>repeat</b> <i>stmts</i> <b>until</b> <i>expr</i>
<i>assign-stmt</i>	→	<b>identifier</b> := <i>expr</i>
<i>read-stmt</i>	→	<b>read</b> <i>identifier</i>
<i>write-stmt</i>	→	<b>write</b> <i>expr</i>
<i>expr</i>	→	<i>simple-expr</i> <i>comparison-op</i> <i>simple-expr</i>   <i>simple-expr</i>
<i>comparison-op</i>	→	<   =
<i>simple-expr</i>	→	<i>simple-expr</i> <i>addop</i> <i>term</i>   <i>term</i>
<i>addop</i>	→	+   -
<i>term</i>	→	<i>term</i> <i>mulop</i> <i>factor</i>   <i>factor</i>
<i>mulop</i>	→	*   /
<i>factor</i>	→	( <i>expr</i> )   <b>number</b>   <b>identifier</b>