1]

ex ::= ex + ex (1) | ex * ex (2) | ex ex (3) | ex / ex (4) | (ex) (5) | ID (6) | INT (7)

	ID	INT	+	*	/	(	)
ex	(1,2)						

LL(1)

first(ex) = { (, ID, INT }

first(ex + ex) = { (, ID, INT }

∩

first(ex * ex) = { (, ID, INT }

≠

∅

⇒ NOT LL(1)

term ::= factor factors

factors ::= ε | * factor factors
| / factor factors
| factor factors

factor ::= ID | INT | (ex)

What are priorities?

*, /, ␣ - bind stronger

\+ - binds weaker

nullable(ex) ?

ex ::= term (+ term)*

≡ term terms

terms ::= ε | + term terms

ID * ID + ID + ID * ID

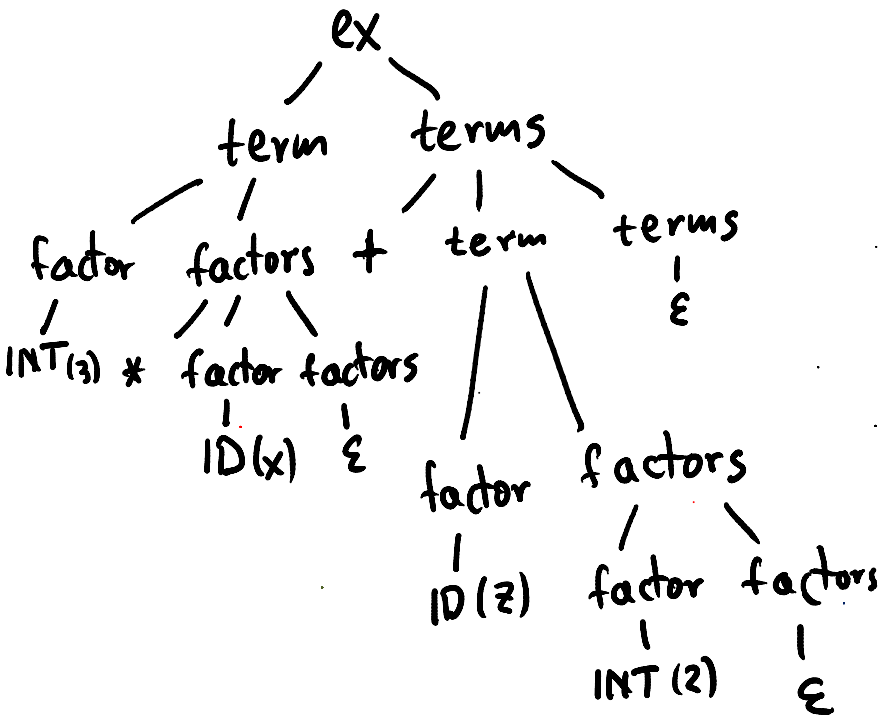
(ID * ID) + (ID) + (ID * ID)

term

1] ex ::= ex + ex | ex * ex | ex ex | ex / ex | (ex) | ID | INT

ex → termterms → factor factors terms
→ factor * factor factors terms

3 * X + Z 2 ← "strange"



term ::= factor factors
factors ::= ε | * factor factors
| / factor factors
| factor factors ←
factor ::= ID | INT | (ex)

ex ::= term (+ term)*
≡ term terms terms ::= ε | + term terms

ID * ID + ID + ID * ID
term

1

nullable (factors)

⇓

follow (term) ⊆ follow (factor)

nullable : terms, factors

FIRST:

term	factors	factor	ex	terms
	*, /	ID, INT, (		+
ID, INT, (	ID, INT, (		ID, INT, (	

FOLLOW:

+,)	+,)	*, /, ID, INT, (, +, +,)	)	)

term ::= factor factors

factors ::= ε | * factor factors
| / factor factors
| factor factors

factor ::= ID | INT | (ex)

ex ::= term (+ term)*

≡ term terms

terms ::= ε | + term terms

ID * ID + ID + ID * ID

term

1	ID	INT	(	)	*	/	+
term	1	1	1	∅	∅	∅	∅
factors	4	4	4	1	2	3	1
factor	1	2	3	∅	∅	∅	∅
ex	1	1	1	∅	∅	∅	∅
terms	∅	∅	∅	1	∅	∅	2

nullable: terms, factors

FIRST:

term	factors	factor	ex	terms
	*, /	ID, INT, (		+
ID, INT, (	ID, INT, (		ID, INT, (	

FOLLOW:

term	factors	factor	ex	terms
+,)	+,)	*, /, ID, INT, (, +, +,)	)	)

term ::= factor factors

factors ::= ε (1) | * factor factors (2) | / factor factors (3) | factor factors (4)

factor ::= ID (1) | INT (2) | (ex) (3)

ID ID ID ⌐ +

ex ::= term (+ term)*

≡ term terms

terms ::= ε (1) | + term terms (2)

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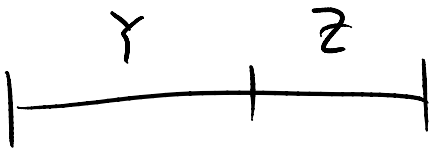
$X \to a$

$X \to YZ$

--- $S \to \varepsilon$

CYK



$$\frac{Y \overset{*}{\Rightarrow} a_1 \dots a_n \qquad Z \overset{*}{\Rightarrow} b_1 \dots b_m}{X \to a_1 \dots a_n b_1 \dots b_m}$$

$B \to SB \mid Y$

$S \Rightarrow AS_1 \Rightarrow AOS_2 \Rightarrow AOSS_3$
$\Rightarrow AOSCB \Rightarrow A(S)B$

$A \to \varepsilon$

$S \to S_1$

$A \to S$

$S \to A(S)B$

$S \to AS_1$

$S_1 \to OS_2$

$S_2 \to SS_3$

$S_3 \to CB$

$S \to SS_1$

$O \to ($

$C \to)$

$(S_2 \to S_3)$

$S_1 \to OS_3$

$S_2 \to S_1 S_3$

9

! #

$S \to \#A \mid !\# \mid !$

$A \to ! \mid \#B \mid \varepsilon$

$B \to \#B \mid !$

###!

a)

$S \Rightarrow \#A \Rightarrow \#\#B$

$\Rightarrow \#\#\#B \Rightarrow \#\#\#!$

b)

A: ! | # #*! | ε

B: #*!

S: # (! | # #*! | ε)

| !#

| !

c)

reg → simple (regular) grammars