Syntax vs. Semantics

Syntax is the form of a program structure.

Semantics is the meaning of the structure.

Example: int x = 5;

Syntax 🡪 <type> <variable> = <value>

Semantics 🡪 stores vavlue 5 in a memory location referred to as x

Syntax is described using Backus Naur Form (BNF)

<non-terminal symbols>

Terminal symbols

<program> 🡪 <statement list>

<statement list> 🡪 <statement>

<statement list> 🡪 <statement>; <statement list>

<statement> 🡪 <assignment>

<assignment> 🡪 <variable> = <value>

<variable> 🡪 x

<value> 🡪 5

<program>  
 |  
<statement list>  
 |  
<statement>; <statement list>  
 |  
<assignment>  
 |  
<variable> = <value>  
 | |  
 x 5

<integer> 🡪 <digit> | <leading digit><more digits>

<more digits> 🡪 <digit> | <leading digit><more digits>

<digit> 🡪 0 | <leading digit>

<leading digit> 🡪 1|2|3|4|5|6|7|8|9

<s> 🡪 <s> + <s> | <s> - <s> | <s> \* <s> | <s> / <s>

<s> -> a | b | c

a \* b + c  
| | |  
 <s> |  
 | |  
 <s>

ambiguous language / ambiguous grammar – 2 or more valid parse trees for the same program sentence. This is bad because when we turn this parse tree into actual code, order of operations determined from the parse tree may affect the outcome.

Precedence: which operator should be performed first? Can create a new non terminal and move the higher precedence operation lower on the BNF.

<s> 🡪 <s> + <s> | <s> - <s> | <s> \* <s> | <s> / <s> | <A>

<A> 🡪 <A> \* <A> | <A> / <A> | <B>

<B> 🡪 a|b|c

This is still ambiguous, for instance a + b + c still has two different parse trees.

Associatvity: Which is the order that operators are evaluated? (left to right and right to left)  
+ - \* / are called left dissociative. Create a new non terminal that is for the next level of BNF and put in on right operand.

<s> 🡪 <s> + <s> | <s> - <s> | <s> \* <s> | <s> / <s> | <A>

<A> 🡪 <A> \* <B> | <A> / <B> | <B>

<B> 🡪 a|b|c

<if> 🡪 if <condition> then <statement> | if <condition> then <statement> else <statement> endif

This is ambiguous unless we make it much more complicated.

<if> 🡪 <matching if> | <unmatching if>

<matching if> 🡪 if <condition> then <matching if> else <matching if>

<nonmatching if> 🡪 if <condition> then <statement>   
 | if <condition> then <matching if> else <nonmatching if>