Thinking about grammars

- Consider an expression language involving integers 1, 2 and 3 and the + operator
- These rules make the + operator left associative

  <e> ::= <int> | <e> + <int>

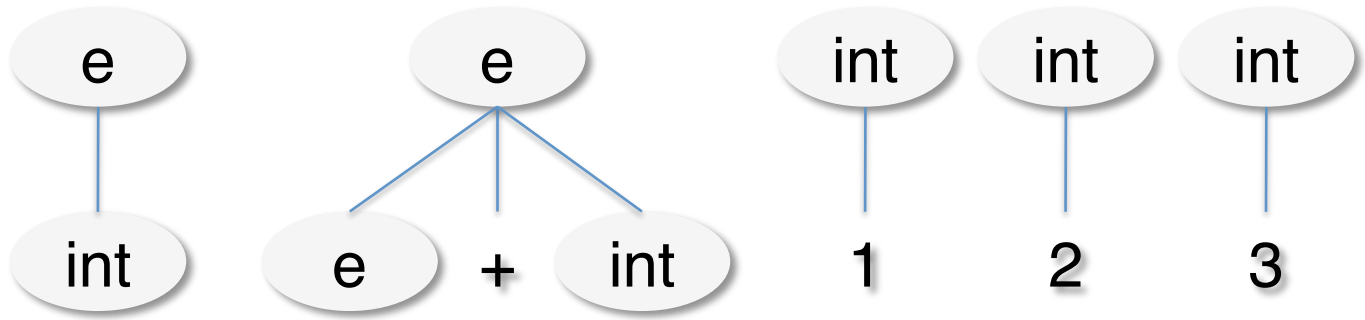
  <int> ::= 1 | 2 | 3
- Note that using the "|" notation obscures the fact that there are really five rules

<e> ::= <int>	<int> ::= 1
<e> ::= <e> + <int>	<int> ::= 2
	<int> ::= 3

A graphical view

- Each rule is a little tree with a non-terminal as its root and children which are non-terminals or terminals
- Here's how we we might visualize the grammar using ovals for non-terminals and strings as terminals

<e> ::= <int>
<e> ::= <e>+<int>
<int> ::= 1
<int> ::= 2
<int> ::= 3



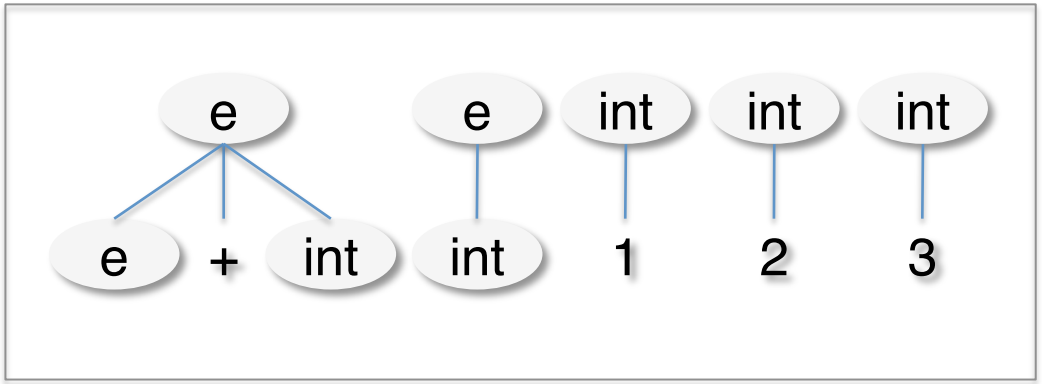
Generating a string & parse tree

- Create a parse tree P consisting of the node

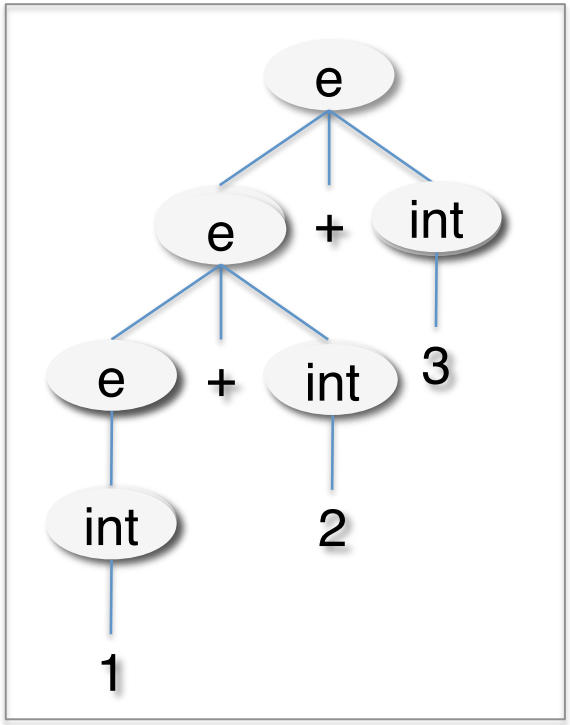
- Repeat until P has no non-terminals leaf nodes
  - Select a leaf node L that is a non-terminal
  - Select a grammar tree T that has the same non-terminal as its root and make a copy of it
  - Replace the leaf L in P with the copy of T

1 + 2 + 3

Here's an example showing the parse tree for 1+2+3



the grammar rules



the parse tree

1 + 2 + 3

Here's an example showing the derivation of 1+2+3