SEG2106 - Assignment 3

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Exercise 1:

We start with the following grammar:

```
<program> ::={<statement_list>}
<statement_list> ::=<statement>;<statement_list>
    | <statement>;
<statement> ::=call: <procedure_call>
    | compute: <expression>
<procedure_call>::=id(<parameters>)
<parameters>::=<factor>,<parameters>
    | <factor>
<expression> ::=id=<factor>+<factor>
    | id=<factor>-<factor>
    |id=<factor>
<factor> ::=id|num
```

We need to convert this into an LL1 grammar by removing left recursion and performing left factoring.

Left Factoring

This is where we have one non terminal that can derive multiple other non terminals, both with the same `FIRST()`.

Here, `<statement_list>` has 2 derivations starting with `<statement>`, `<parameters>` has 2 derivations starting with `<factor>`, and `<expression>` has 3 derivations starting with `<factor>`

This can be fixed by removing the common part and putting it in a seperate nonterminal.

For `<statement_list>`:

```
<statement_list> ::= <statement>;<statement_list'>
<statement_list'> ::= <statement_list>
    | Epsilon
```

For `<parameters>`:

```
<parameters> ::= <factor><parameters'>
<parameters'> ::= ,<parameters>
    | Epsilon
```

For `<expression>`:

```
<expression> ::= id=<factor><expression'>
<expression'> ::= +<factor>
    | -<factor>
    | Epsilon
```

Now the overall code becomes:

```
<program> ::={<statement_list>}
<statement_list> ::= <statement>;<statement_list'>
<statement_list'> ::= <statement_list>
    | Epsilon
<statement> ::=call: <procedure_call>
    | compute: <expression>
<procedure_call>::=id(<parameters>)
<parameters> ::= <factor><parameters'>
<parameters'> ::= ,<parameters>
    | Epsilon
<expression> ::= id=<factor><expression'>
<expression'> ::= +<factor>
    | -<factor>
    | Epsilon
<factor> ::=id|num
```

Left Recursion

Left factoring is where some non terminal A can derive another expression where the leftmost non terminal is A. So something like:

$A \implies A\alpha$

So if we had something like `<statement> :: <statement> <other non-terminal>` we would have to fix this by adding something like `<statement'>`.

Luckily we do not have any left recursion in this situation.

Excersise 3

First Sets:

```
FIRST(program) = {
FIRST(statement_list) = call compute
FIRST(statement_list') = call compute ϵ
FIRST(statement) = call compute
FIRST(procedure_call) = id
FIRST(parameters) = id num
FIRST(parameters') = , ϵ
FIRST(expression) = id
FIRST(expression') = + - ϵ
FIRST(factor) = id num
```

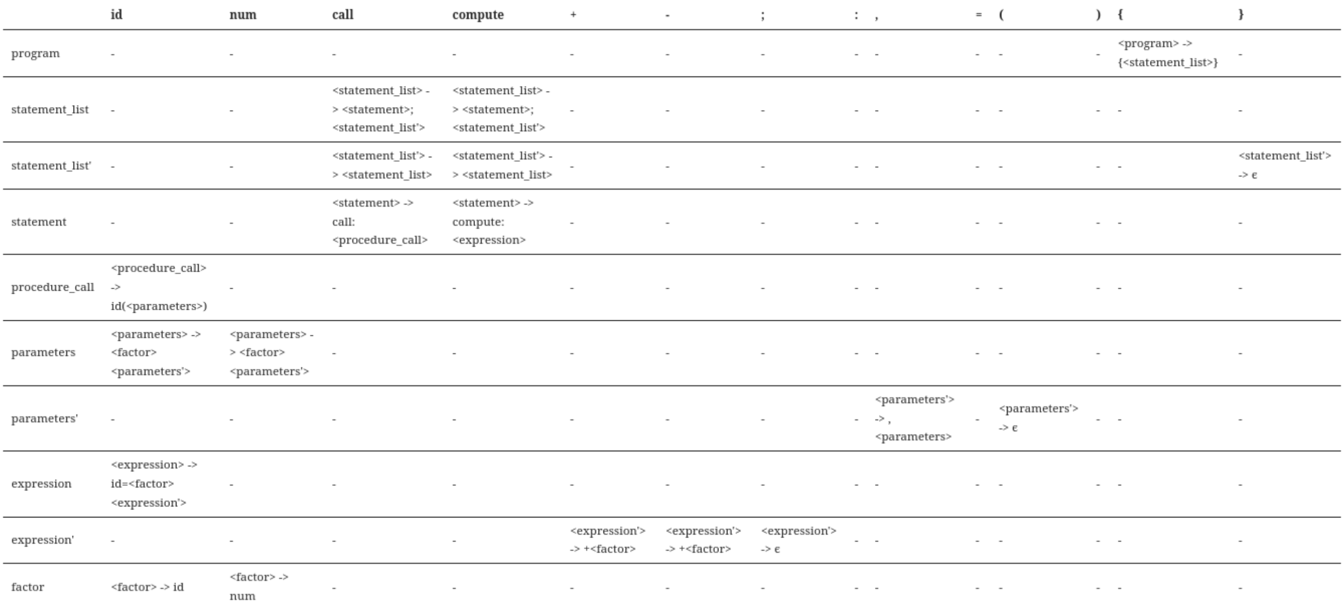
Follow Sets:

```
FOLLOW(program) = $
FOLLOW(statement_list) = }
FOLLOW(statement_list') = }
FOLLOW(statement) = ;
FOLLOW(procedure_call) = ;
FOLLOW(parameters) = )
FOLLOW(parameters') = )
FOLLOW(expression) = ;
FOLLOW(expression') = ;
FOLLOW(factor) = ; , + - )
```

To make the parse table, I put as columns all the terminals, and as the rows all the non terminals.

For each terminal I go though its **first** set and use that to populate that row. If I come across an ϵ, I then *also add* that nonterminals **follow** set.

Parse Table:



	id	num	call	compute	+	-	;	:	,	=	(	)	{	}
program	-	-	-	-	-	-	-	-	-	-	-	-	<program> -> {<statement_list>}	-
statement_list	-	-	<statement_list> -> <statement>; <statement_list'>	<statement_list> -> <statement>; <statement_list'>	-	-	-	-	-	-	-	-	-	-
statement_list'	-	-	<statement_list'> -> <statement_list>	<statement_list'> -> <statement_list>	-	-	-	-	-	-	-	-	-	<statement_list'> -> ϵ
statement	-	-	<statement> -> call: <procedure_call>	<statement> -> compute: <expression>	-	-	-	-	-	-	-	-	-	-
procedure_call	<procedure_call> -> id(<parameters>)	-	-	-	-	-	-	-	-	-	-	-	-	-
parameters	<parameters> -> <factor> <parameters'>	<parameters> -> <factor> <parameters'>	-	-	-	-	-	-	-	-	-	-	-	-
parameters'	-	-	-	-	-	-	-	-	<parameters'> -> , <parameters>	-	<parameters'> -> ϵ	-	-	-
expression	<expression> -> id=<factor> <expression'>	-	-	-	-	-	-	-	-	-	-	-	-	-
expression'	-	-	-	-	<expression'> -> +<factor>	<expression'> -> +<factor>	<expression'> -> ϵ	-	-	-	-	-	-	-
factor	<factor> -> id	<factor> -> num	-	-	-	-	-	-	-	-	-	-	-	-