

## Matrix Calculator

### Problem description

Be similar to a simple calculator. In the problem, you're asked to write a syntax and semantic checker for a matrix expression compiler. The objective of this problem contains two parts. The first part is to build an AST for the input expression. The second part is to check if the dimension on both sides of each operator is valid. For example of multiplication:  $A_{1 \times 2} B_{2 \times 1}$  is valid which will generate a matrix with  $1 \times 1$  dimension. But  $A_{2 \times 3} B_{2 \times 4}$  is invalid. But if we take transpose of A in expression:  $A_{2 \times 3}^T B_{2 \times 4}$  which equals to  $A_{3 \times 2} B_{2 \times 4}$  the whole expression can be valid. The following are supported operators in this compiler:

addition '+', subtraction '-', multiplication '\*', transpose '^T', parenthesis '()'. All matrices are 2-dimensional matrices which are represented as [column number, row number] e.g. [2, 3] is a  $2 \times 3$  matrix and [5, 1] is a  $5 \times 1$  matrix. Your output should show "Syntax Error" if the input expression does not follow the grammar. If it follows the grammar, then apply semantic check to see if the dimension on both sides of each operator is correct. Print "Semantic error on col" followed by the location of the first operator which makes the semantic error occur in post order of AST. If no syntax error or semantic error, print "Accepted".

#### Sample Input 1:

[2, 1]^T \* [2, 1]

#### Sample Output 1:

Accepted

#### Sample Input 2:

([2, 3] \* [2, 3]^T)^T + [4, 1]

#### Sample Output 2:

Semantic error on col 19

#### Sample Input 3:

([1, 2] + [2, 1]^T) \* [1, 3] \* [1, 3]^T \* [3, 3]

#### Sample Output 3:

Semantic error on col 16