CENTRO DE INVESTIGACIÓN Y DE ESTUDIOS AVANZADOS DEL IPN
UNIDAD TAMAULIPAS

Project #1

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Polynomial Calculator

TALK A bit about lex and yacc
The program is divided into 4 types:

1. Tokenization
2. Especificacion de tokens
3. Funciones de especificacion de tokens if apply
4. Reglas de precedencia
5. Funcion de produccion

Tokenization

Most restrictive of the set, they generate regular languages. They must have a single non-terminal on the left-hand-side and a right-hand-side consisting of a single terminal or single terminal followed by a single non-terminal.

Example:

Regex to define tokens such as identifiers, language keywords in programming languages. A coin vending machine that accepts only 1-Rupee, 2-Rupee and 5-Rupee coins has a regular language with only three words – 1, 2, 5.

Especificacion de tokens

Generate context-free languages, a category of immense interest to NLP practitioners. Here all rules take the form $A \implies \beta$, where A is a single non-terminal symbol and β is a string of symbols.

Example:

Statement blocks in programming languages such as functions in parentheses, If-Else, for loops. In natural language, nouns and their plurals can be recognized through one Non Deterministic Finite Automaton (NFA), verbs and their different forms can be recognized through another NFA, and then combined.
Singular (The girl runs home $\implies$ Girl + Runs).
Plural (The girls run home $\implies$ Girls + Run)

Funciones de especificacion de tokens

The highest programmable level, they generate context-sensitive languages. They have rules of the form $\alpha A \beta \implies \alpha \gamma \beta$ with A as a non-terminal and α, β, γ as strings of terminals and non-terminals. Strings α, β may be empty, but γ must be nonempty.

Example:

Though most language constructs in natural language are context-free, in some situations linear matching of tokens has to be done, such as - The square roots of 16, 9 and 4 are 4, 3 and 2, respectively. Here 16 is to be matched with 4, 9 is matched with 3, and 4 is matched with 2.

Reglas de precedencia

Are too generic and unrestricted to describe the syntax of either programming or natural languages

Example:

A language with no restrictions is not conducive to communication or automation. Hence there are no common examples for this type. However, some mathematical seemingly unsolvable equations are expressed in this form.

Función de producción

Exercise: Create a regular expression to accept vehicle registration plates of Mexico State. There are three-letter series assigned **LGA-PEZ**


```
/^[L-P]{1}[G-ZA-E]{1}[A-Z]{1}-\d{2}-\d{2}$/
```

Explanation:

```python
import numpy as np

def incmatrix(genl1,genl2):
    m = len(genl1)
    n = len(genl2)
    M = None #to become the incidence matrix
    VT = np.zeros((n*m,1), int)  #dummy variable

    #compute the bitwise xor matrix
    M1 = bitxormatrix(genl1)
    M2 = np.triu(bitxormatrix(genl2),1)

    for i in range(m-1):
        for j in range(i+1, m):
            [r,c] = np.where(M2 == M1[i,j])
            for k in range(len(r)):
                VT[(i)*n + r[k]] = 1;
                VT[(i)*n + c[k]] = 1;
                VT[(j)*n + r[k]] = 1;
                VT[(j)*n + c[k]] = 1;

                if M is None:
                    M = np.copy(VT)
                else:
                    M = np.concatenate((M, VT), 1)

                VT = np.zeros((n*m,1), int)

    return M
```

Listing 1: Python example