Parsing with Lex & Yacc

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Discrete Math Bridging Course, HSE University

HW # 1: Practice in Boolean Logic

For the 1st home assignment, choose one of the following tasks:

1. Given a Boolean formula, translate it into Conjunctive Normal Form and into Disjunctive Normal Form.
2. Given a Boolean formula in 2-CNF (in which clauses could also be of the form `(p->q)`), use the resolution method to determine whether it is satisfiable.

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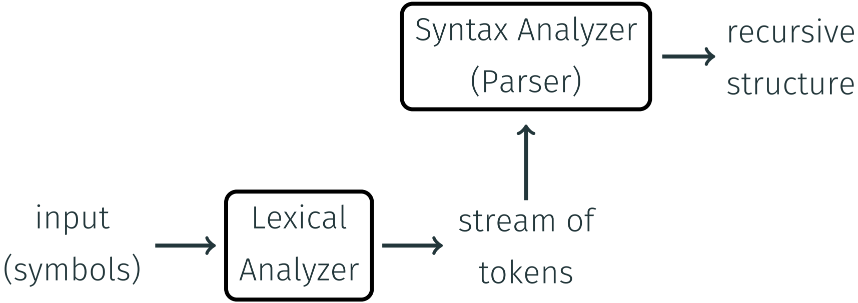
The Parsing Workflow



Lexical Analysis

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- Tokens are much more convenient to work with (in the grammar).

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Int_opt ::= INT | ε
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- Input example:

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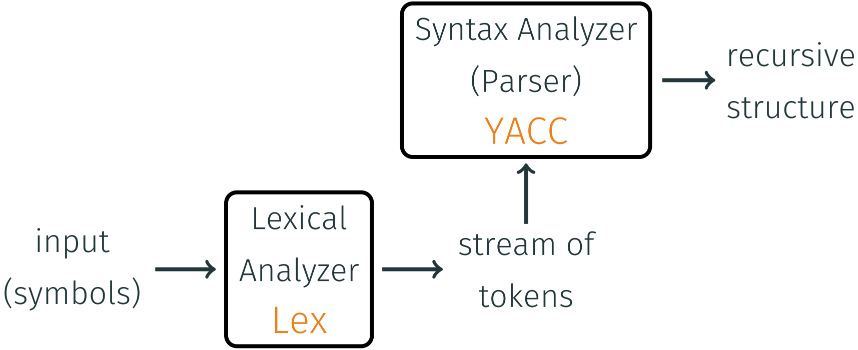
Implementation: Lex & Yacc



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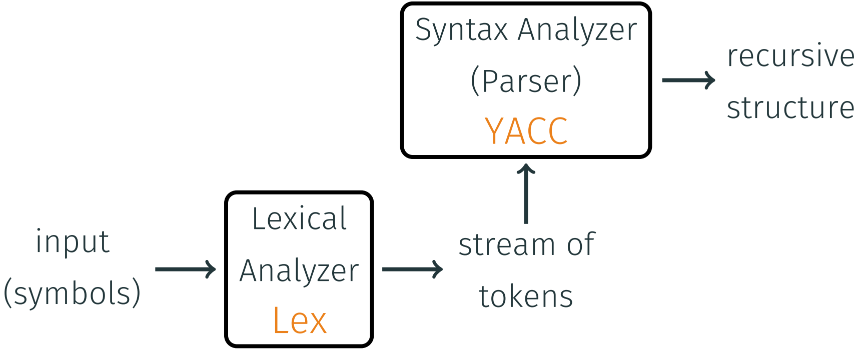

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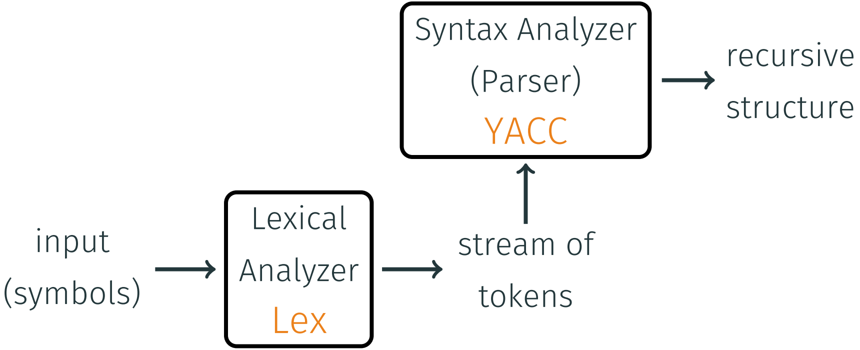

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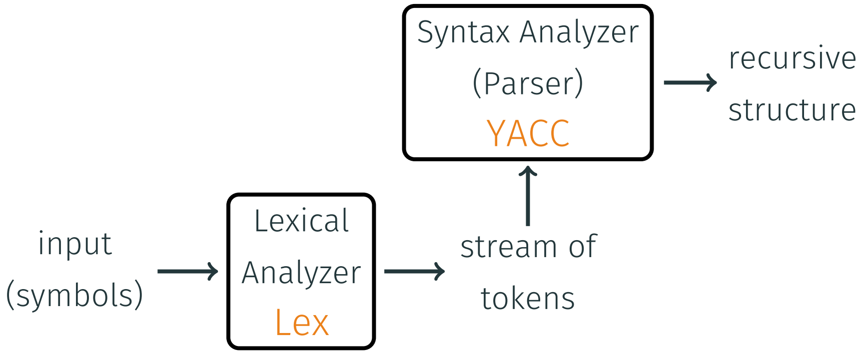

- YACC = Yet Another Compiler Compiler
- In Python, we use PLY (Python Lex & Yacc).

PLY Code for Lexical Analysis

- Declare tokens and literals (one-symbol tokens):

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tokens = [ 'INT' ]
literals = ['+','-','(',')','^','x']
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- For each token, declare a “`t_`”-function:

```
def t_INT(t):
    r'\d+'
    try:
        t.value = int(t.value)
    except ValueError:
        print "Too large!", t.value
        t.value = 0
    return t
```

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t_NAME     = r'[a-zA-Z_][a-zA-Z0-9_]*'
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- `r'\d+'` is a **regular expression** for sequences of decimal numbers.
- Another example: regular expression for **names** (identifiers)

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t_NAME     = r'[a-zA-Z_][a-zA-Z0-9_]*'
```

- Finally, build the lexer:

```
import ply.lex as lex
lex.lex()
```

PLY Code for Parsing

- Each rule of the grammar is implemented as a "`p_`"-function:

```
def polymult(p,q) :
    r = []
    for i in xrange(len(p)) :
        for j in xrange(len(q)) :
            safeadd(r,i+j,p[i]*q[j])
    return r
```

...

```
def p_tm_mult(p):
    "tm : tm '(' expr ')'"
    p[0] = polymult(p[1],p[3])
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- A "`p_`"-function generates an object `p[0]`, using `p[1]`, `p[2]`, ..., which are obtained from the lexer or recursively from parsing.

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- The code of PLY examples is available on the course’s webpage:

  http://www.mi-ras.ru/~sk/lehre/dm_hse2019/

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- For priorities, see another example available on the webpage: calculator.

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Choose one:

1. Given a Boolean formula, constructed from variables using `/\` (conjunction), `\/` (disjunction), `->` (implication), and `~` (negation), translate it into Conjunctive Normal Form and into Disjunctive Normal Form.

2. Given a Boolean formula in 2-CNF, use the resolution method to determine whether it is satisfiable. Clauses of the 2-CNF can be of one of the two forms: α `\/` β or α `->` β, where α and β are literals (`p` or `~p`, where `p` is a variable). The CNF is presented in the usual notation, for example:
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   `(p -> q) /\ (~r \/ s) /\ (~q -> p)`

Tasks available at the course's webpage.

Good luck!