JFLAP

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Abstract. *JFLAP (Java Formal Language and Automata Package) is a visual and interactive software for experimenting formal languages. It includes nondeterministic finite automata, nondeterministic pushdown automata, multi-tape Turing machines, several types of grammars, parsing and L-systems. It is a very useful tool to create, explain, understand and test formal languages in a very intuitively manner.*

1 Introduction

JFLAP is a software to create and test many automata types, regular grammar and also support many conversions between languages.

Due to its graphical and intuitive interface, is very useful as a simulation and learning tool in Formal Languages and Automata Theory fields.

2 Creating automata

As we can see in the following figure, the automata interface is graphical and very easy to understand.

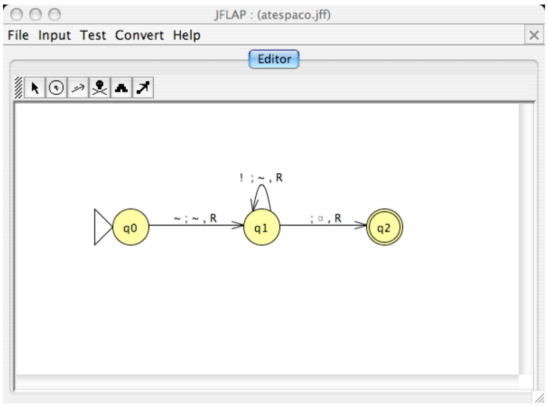


Figure 1 – Example automata with initial state in q0 and final state in q2 node.

3 Automata conversion

In the JFLAP (conversion mode) we can convert from one language to another. In the regular languages domain is possible to convert an AFN (Automata Finite Non-deterministic) to an AFD (Automata Finite Deterministic), an AFD type to a minimum AFD, an AFD to a regular expression, a AFN to a regular grammar and a regular grammar to a AFN.

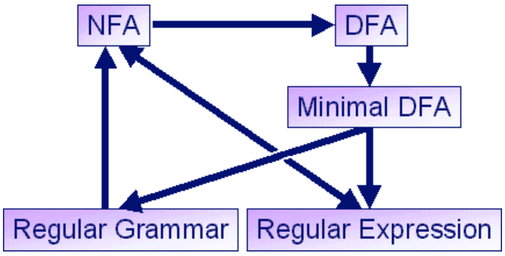


Figure 2 –Conversion modes to regular languages representation.

4 Implementation of "lavanda" automata

As an exercise it was implemented *Lavanda* [3] problem in JFLAP's automata (multi-type). It takes a string and verifies interactively if each single character fulfils the pre-requisites (step-by-step). If the verification process ends up with a green color background, it means that the input string is validated with no errors (Figure 3).

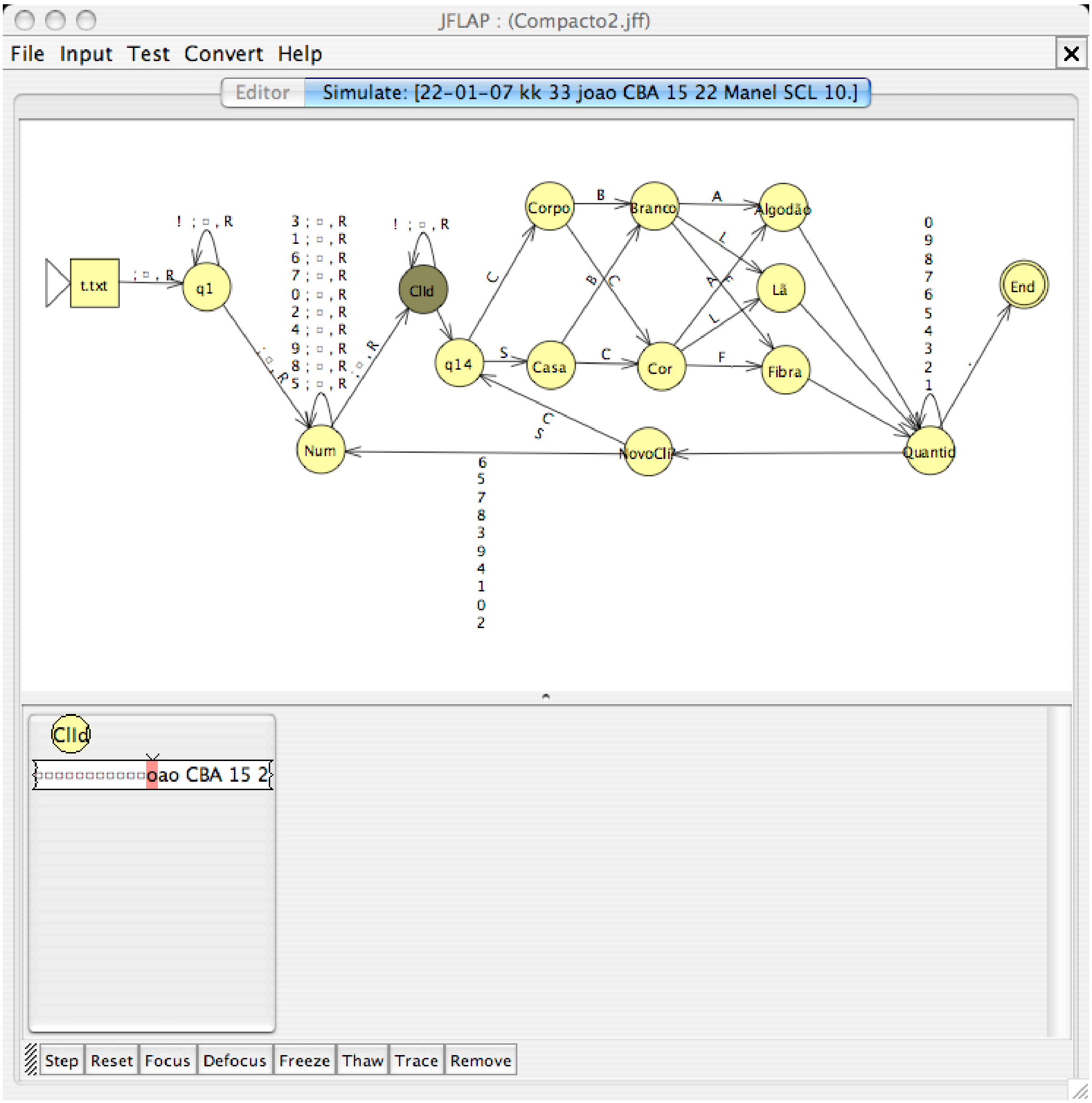


Figure 3 –Snapshot of “Lavanda Input String validation” automata

5 *Lavanda* Grammar

Once again, in order to show the automatic parse table and parse tree for grammars in JFLAP, it was adopted *lavanda* problem (based in lavanda context free grammar [3]).

JFLAP uses capital letters to represent non-terminal symbols and regular ones to terminal symbols. The sample expression used to automatically build parse table and parse tree is as follows:

drniocxqff.

The symbols used are:

Non-terminal Symbols:

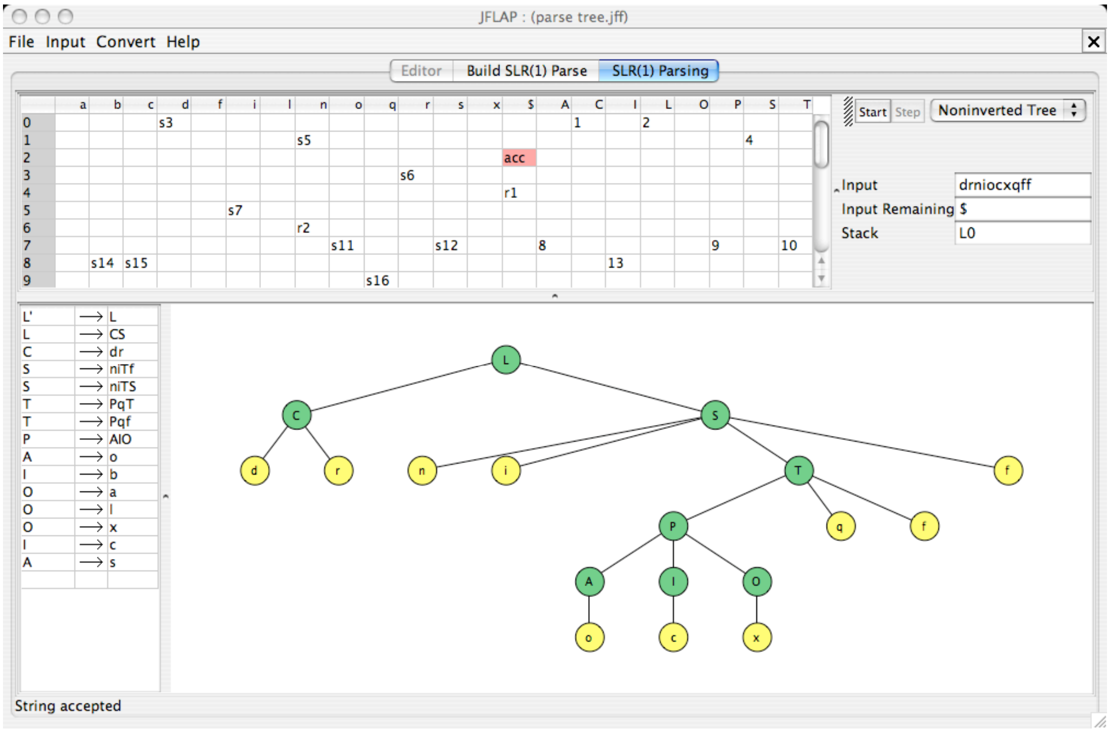
Lavanda
Sacos
Umsaco
clAsse
FiO

Cabeçalho
loTes
tiPo
tInto

Terminal Symbols:

d – data
f - "."
id Clientes
quantidade
cor
lã
corpo

r - IdPR
numero do Saco
tipo
branco
algodão
xfibra
casa



	a	b	c	d	f	i	l	n	o	q	r	s	x	$	A	C	I	L	O	P	S	T
0				s3												1		2				
1								s5													4	
2														acc								
3											s6											
4														r1								
5						s7																
6								r2														
7									s11			s12			8					9		10
8		s14	s15														13					
9										s16												

Input drniocxqff
Input Remaining $
Stack L0

L'	→	L
L	→	CS
C	→	dr
S	→	niTf
S	→	niTS
T	→	PqT
T	→	Pqf
P	→	AIO
A	→	o
I	→	b
O	→	a
O	→	l
O	→	x
I	→	c
A	→	s

String accepted

Figure 4 –Parse table (⇖), Sample Expression (⇗), Grammar (⇙) and Parse Tree (⇘)

6 Generic Functions

-Experimentation in Structured Languages: Simulate automata string processing, build parse tables and parse trees for grammars and design successive L-system expansions. The main automata types are AFD (Automata Finite Deterministic) AFN (Non-Deterministic), PDA (Pile Deterministic Automata) and Turing multi-tape Machines. The parsing algorithms implemented are brute-force parsing, LL(1) parsing e SLR(1)parsing.

-Conversion in equivalent structures: Convert regular expressions to AFD, AFN and PDA to grammar, grammar to PDA, AFD minimal, free context grammar to Chomsky normal form.

-Analytical tools: Show language structure properties e.g. Identification of Non-deterministic states, Lambda Transitions and Equivalence between two finite automata.

7 Future Works

Still adopting "Lavanda exercise", it would be possible to run automatas (PDA type) to make the following calculations:

a) Number of bags sent and number of Packs for each client. b) Total clothes for each of the 12 kind of Packs (From 'corpo/br/alg' to 'casa/cor/fib') sent from PR to LC. c) Total cost of each bag (assuming that the pricelist is given).

8 Conclusions

Because of the interactive and graphical interface presented, JFLAP package can be used as an aid in learning the basic concepts of Formal Languages and Automata Theory.

This presentation is oriented to the problem presented in "Processamento de Linguagens" classes ("lavanda" [3]) that presents a specific context free grammar.

References

[1] www.jflap.org em 20 de Junho de 2007

[2] http://homepages.dcc.ufmg.br/~nvieira/cursos/tl/a05s2/relatorio_curso.doc em 20 de Junho de 2007

[3] www.di.uminho.pt/~prh/mespl06tp.pdf