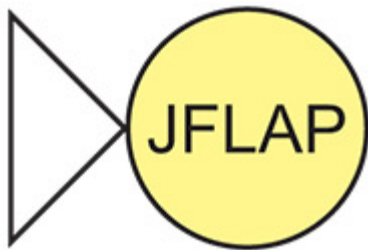
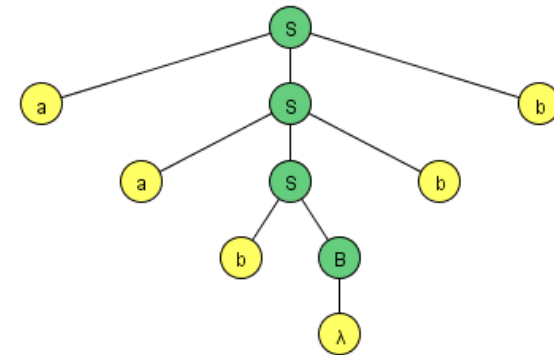


# Changes to JFLAP to Increase Its Use in Courses



Susan H. Rodger  
Duke University  
rodger@cs.duke.edu



ITiCSE 2011  
Darmstadt, Germany  
June 29, 2011



NSF Grants CCLI-0442513 and TUES-1044191

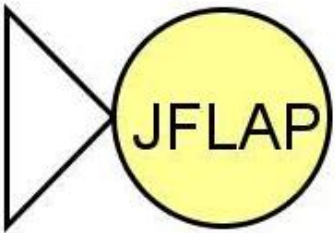
# Co-Authors



Henry Qin



Jonathan Su

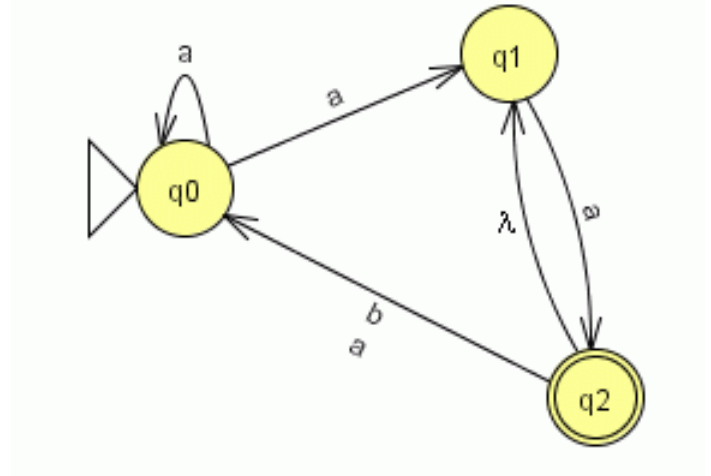


# Overview of JFLAP

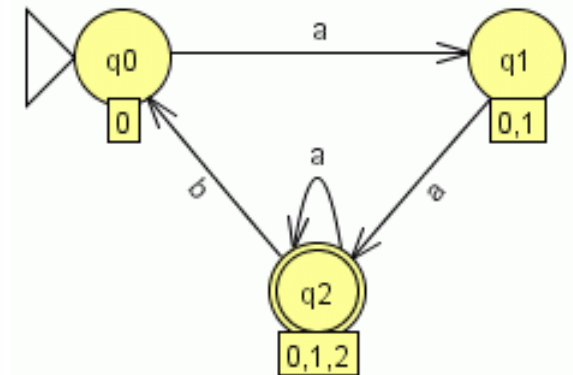
- **Java Formal Languages and Automata Package**
- Instructional tool to learn concepts of Formal Languages and Automata Theory
- Topics:
  - Regular Languages
  - Context-Free Languages
  - Recursively Enumerable Languages
  - Lsystems
- **With JFLAP your creations come to life!**

# JFLAP – Regular Languages

- Create
  - DFA and NFA
  - Moore and Mealy
  - regular grammar
  - regular expression

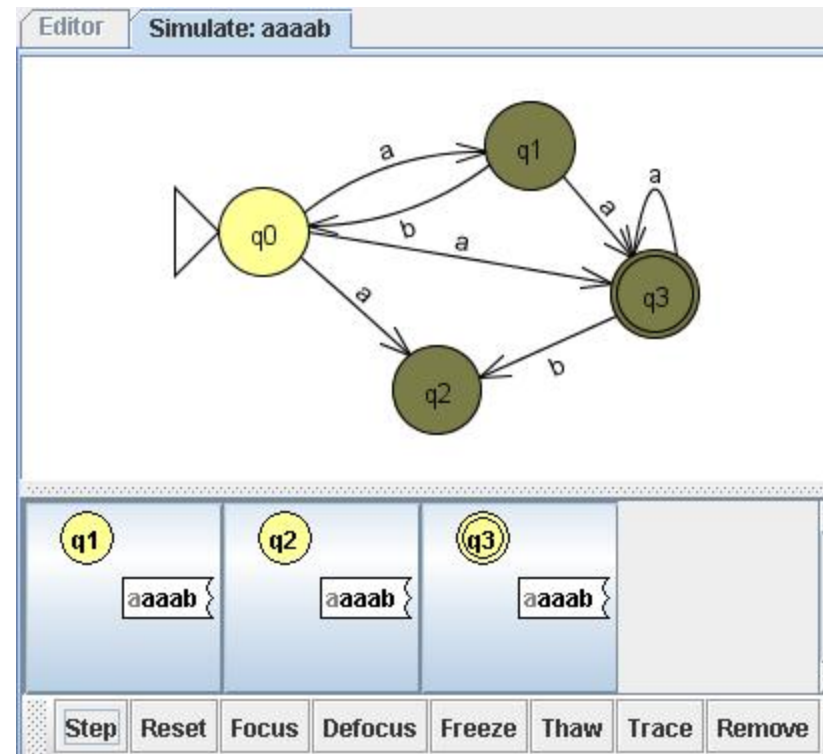


- Conversions
  - NFA to DFA to minimal DFA
  - NFA  $\leftrightarrow$  regular expression
  - NFA  $\leftrightarrow$  regular grammar



# JFLAP – Regular languages (more)

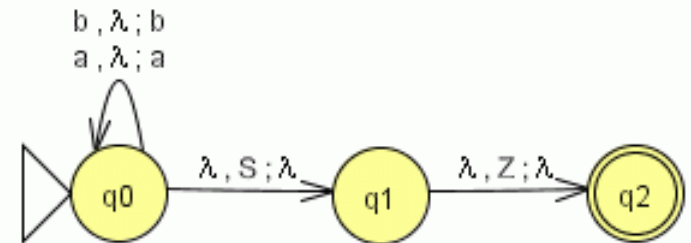
- Simulate DFA and NFA
  - Step with Closure or Step by State
  - Fast Run
  - Multiple Run
- Combine two DFA
- Compare Equivalence
- Brute Force Parser
- Pumping Lemma



# JFLAP – Context-free Languages

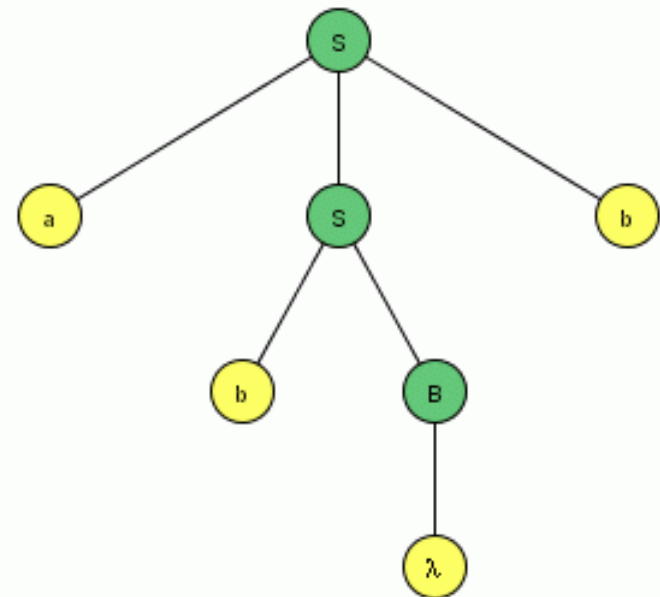
- Create

- Nondeterministic PDA
- Context-free grammar
- Pumping Lemma



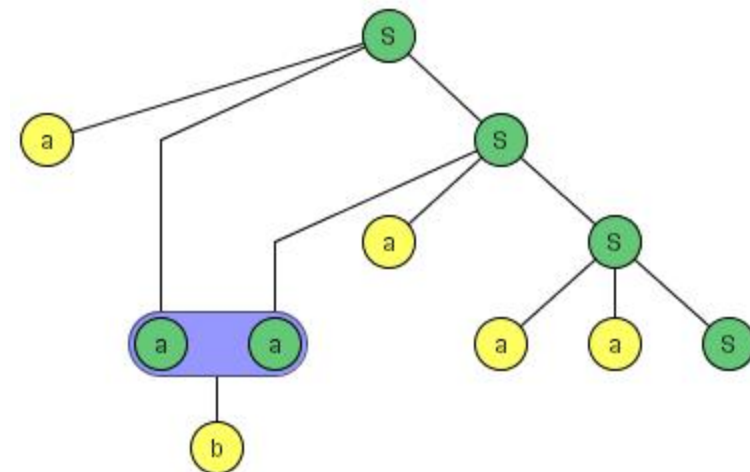
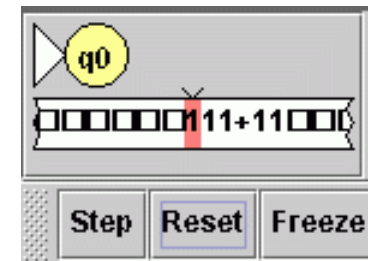
- Transform

- PDA  $\rightarrow$  CFG
- CFG  $\rightarrow$  PDA (LL & SLR parser)
- CFG  $\rightarrow$  CNF
- CFG  $\rightarrow$  Parse table (LL and SLR)
- CFG  $\rightarrow$  Brute Force Parser

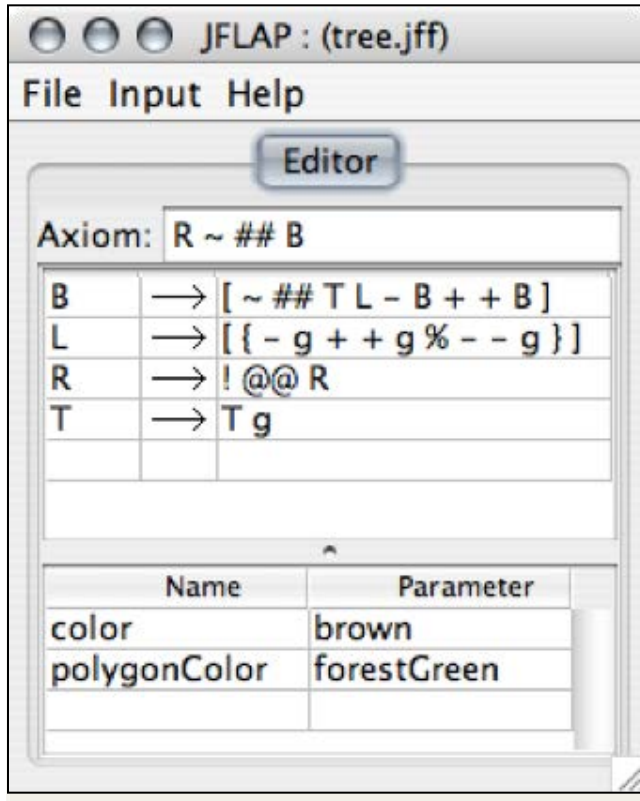


# JFLAP – Recursively Enumerable Languages

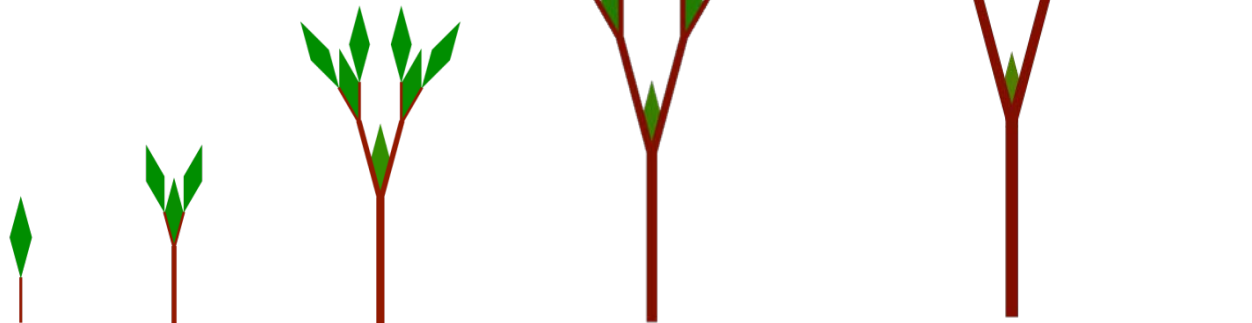
- Create
  - Turing Machine (1-Tape)
  - Turing Machine (multi-tape)
  - Building Blocks
  - Unrestricted grammar
- Parsing
  - Unrestricted grammar with brute force parser



# JFLAP - L-Systems



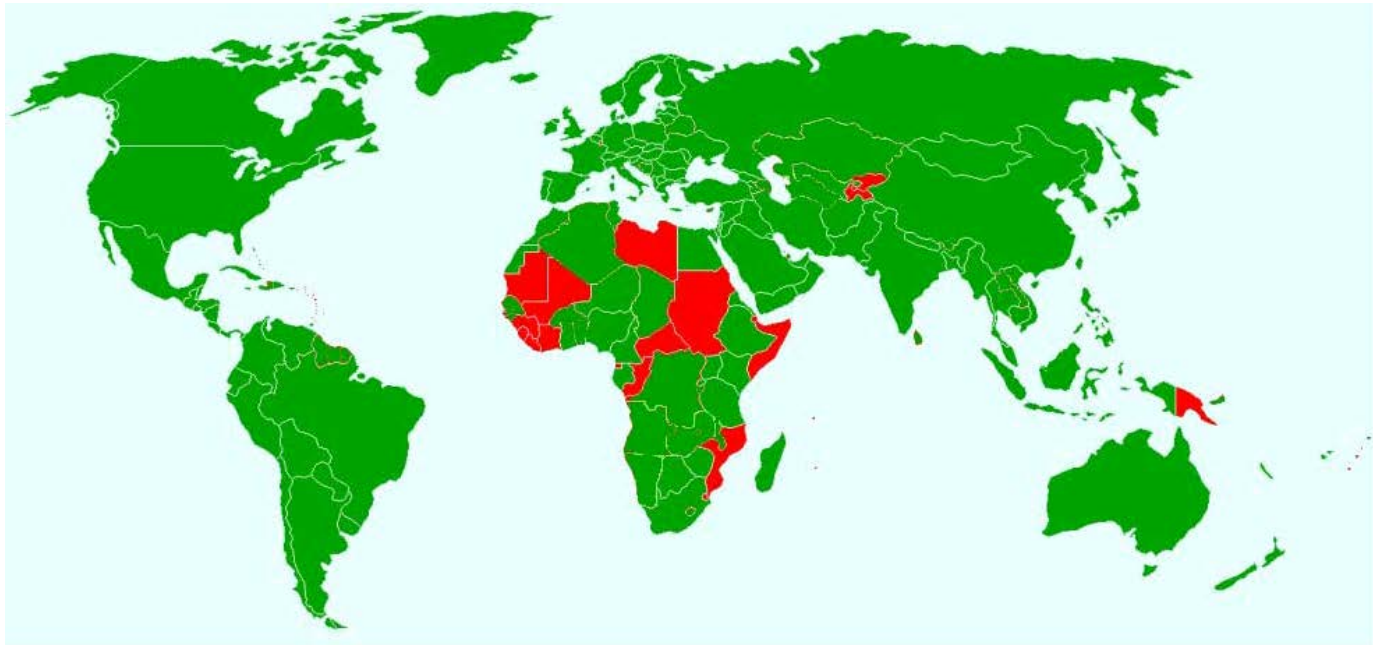
- This L-System renders as a tree that grows larger with each successive derivation step.





# JFLAP's Use Around the World

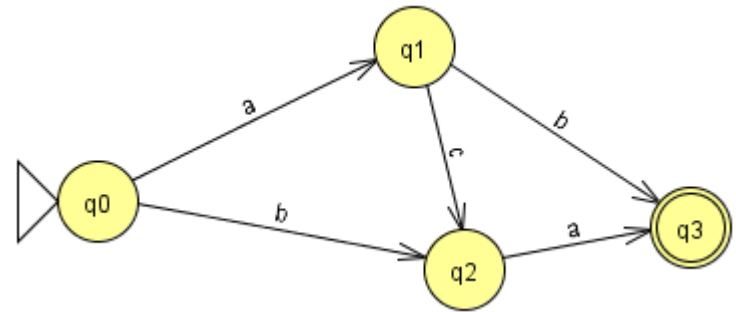
- JFLAP web page has over 300,000 hits since 1996
- Google Search
  - JFLAP appears on over 9830 web pages
  - Note: search only public web pages
- JFLAP been downloaded in over 160 countries



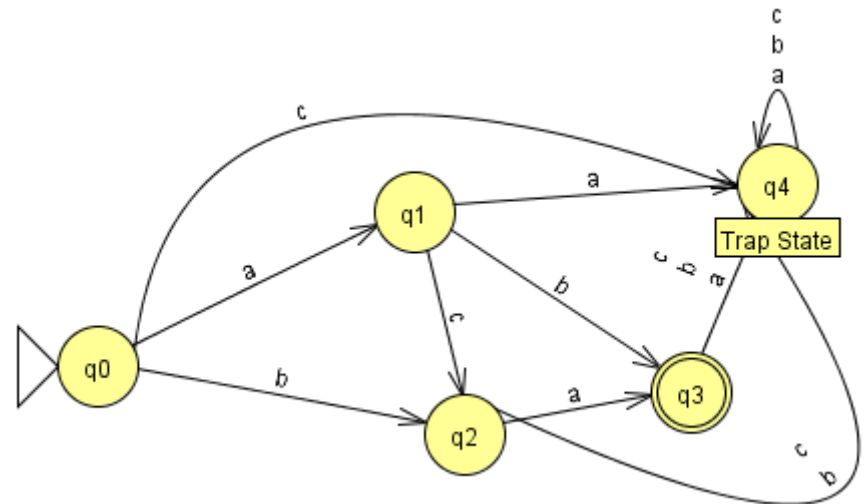
# JFLAP Demos

# DFA new features

- Here is a simple DFA



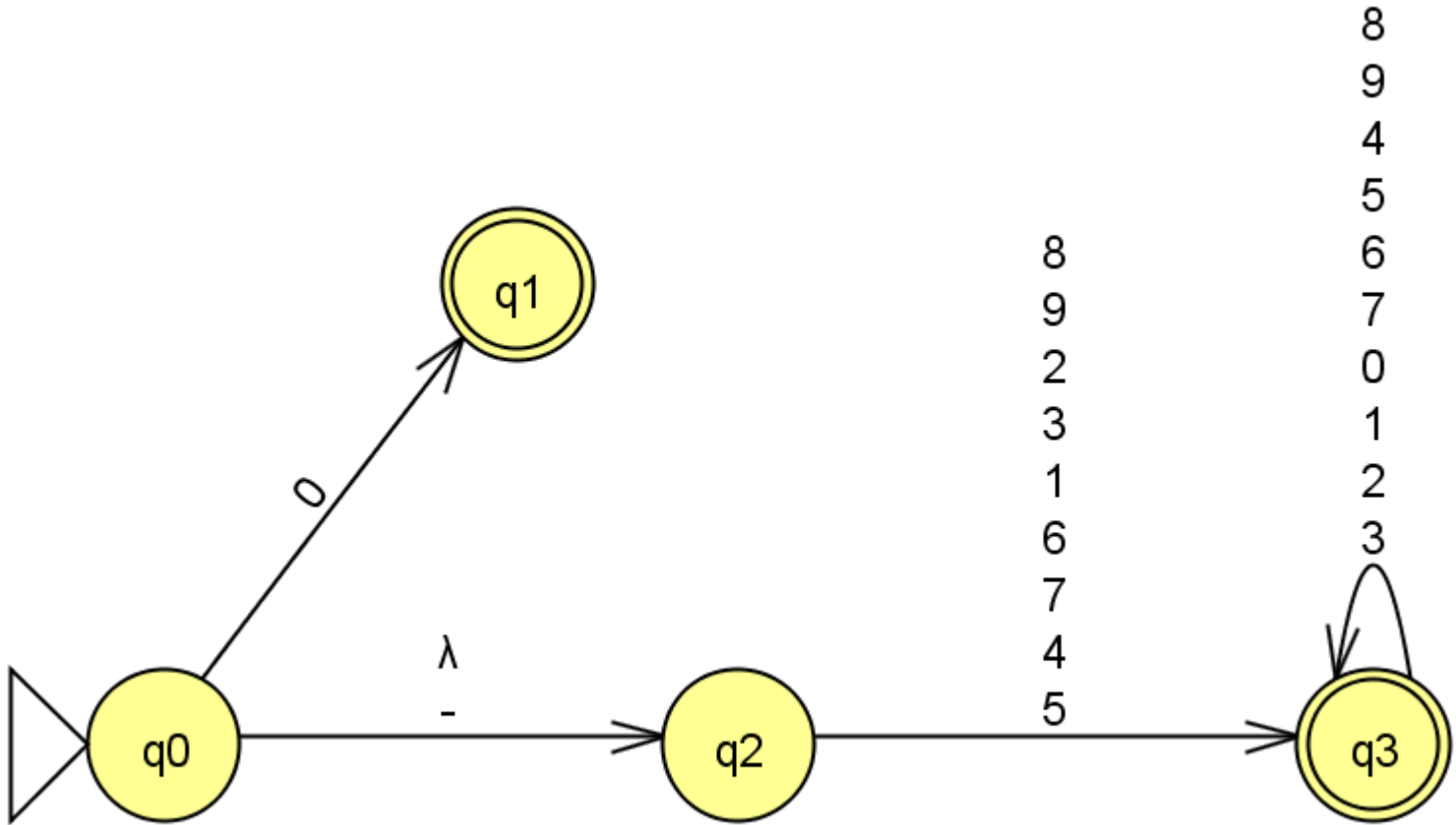
- New features:
  - Added trap state
  - Curved two of the transitions



# Example: Build an NFA for valid integers

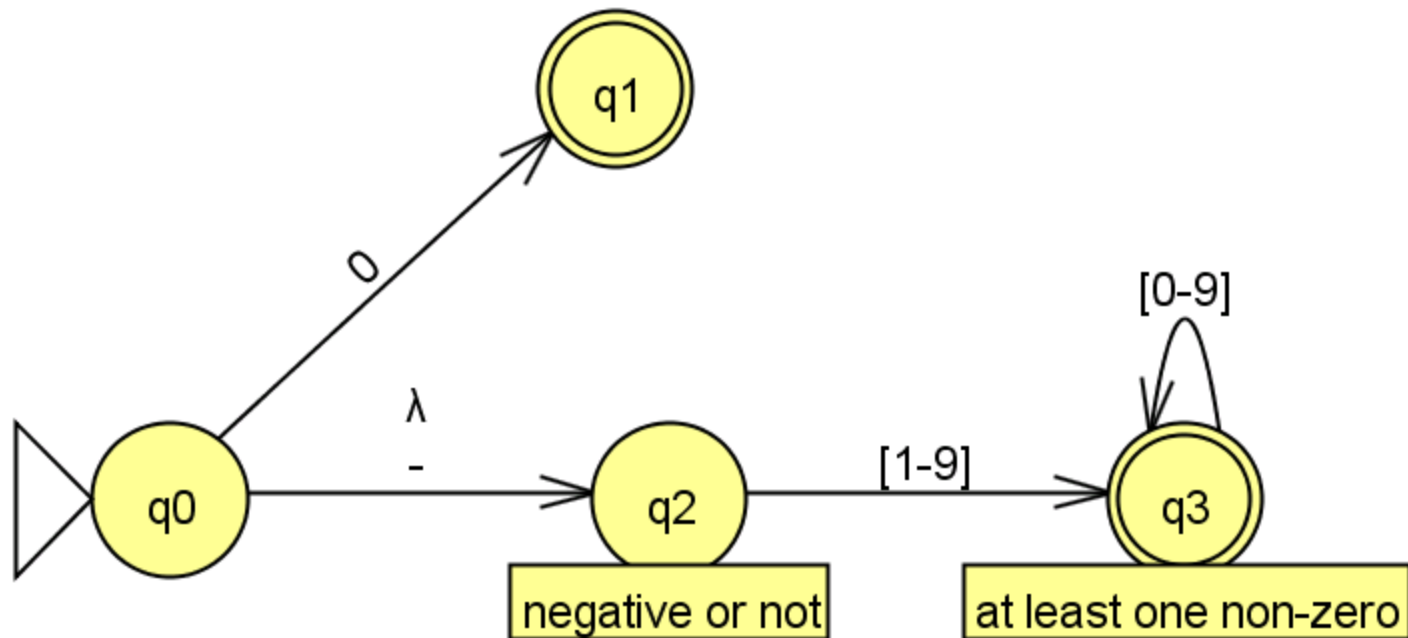
- Example:
  - Valid integers  $\{-3, 8, 0, 456, 13, 500, \dots\}$
  - Not valid:  $\{006, 3-6, 4.5, \dots\}$

# Example: NFA for all valid integers



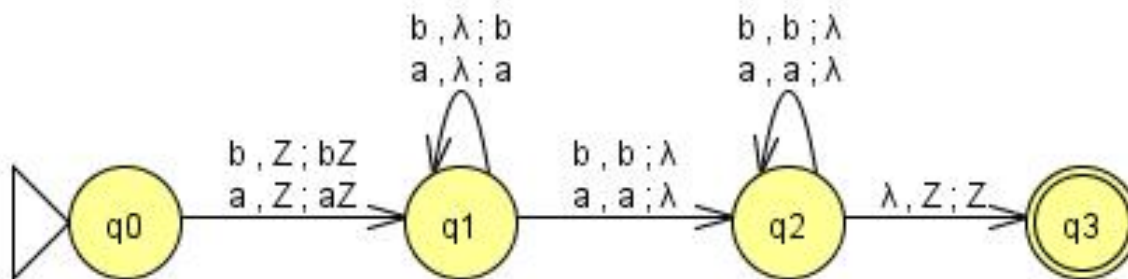
# NFA annotated and shortcut

- New feature: [1-9] on labels



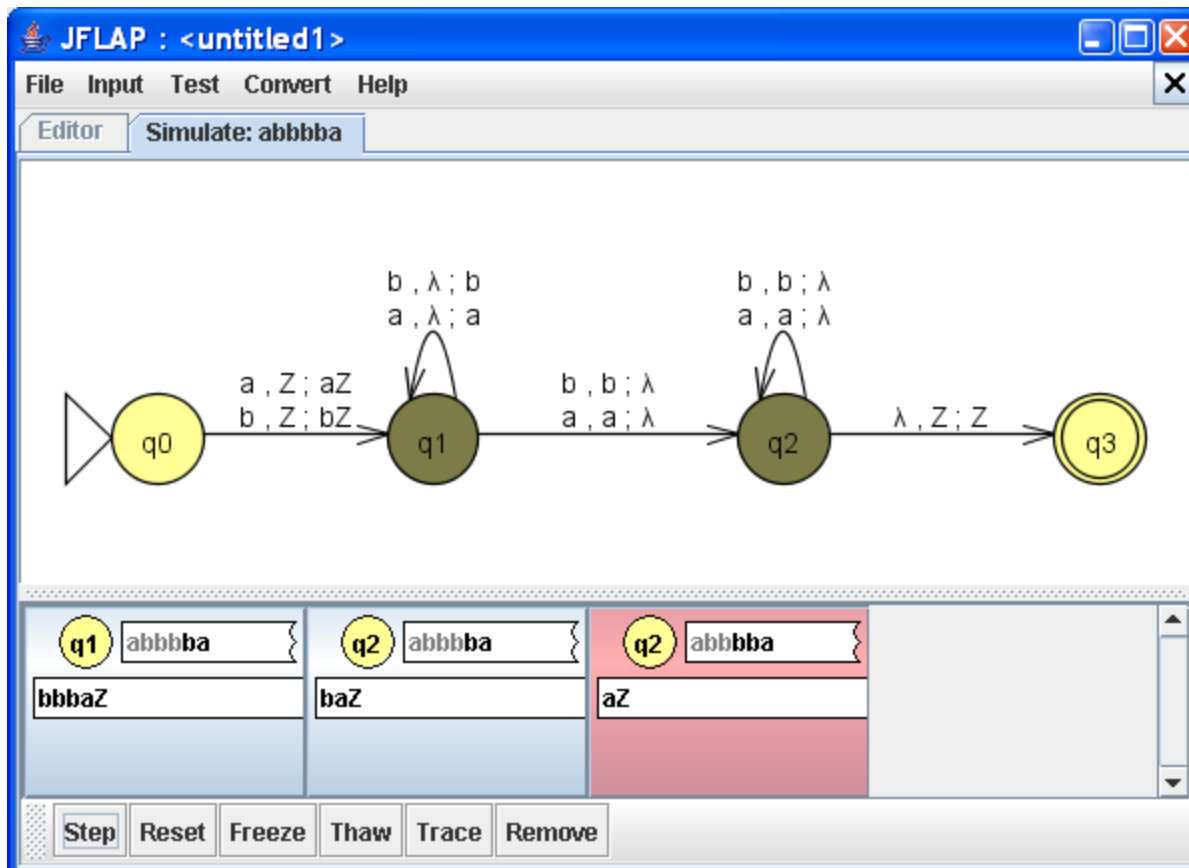
# Example : NPDA

- NPDA for palindromes of even length
- New feature: asks for multi-char or single char for labels



# Example (cont)

- Run input strings on the NPDA
  - Shows the nondeterminism



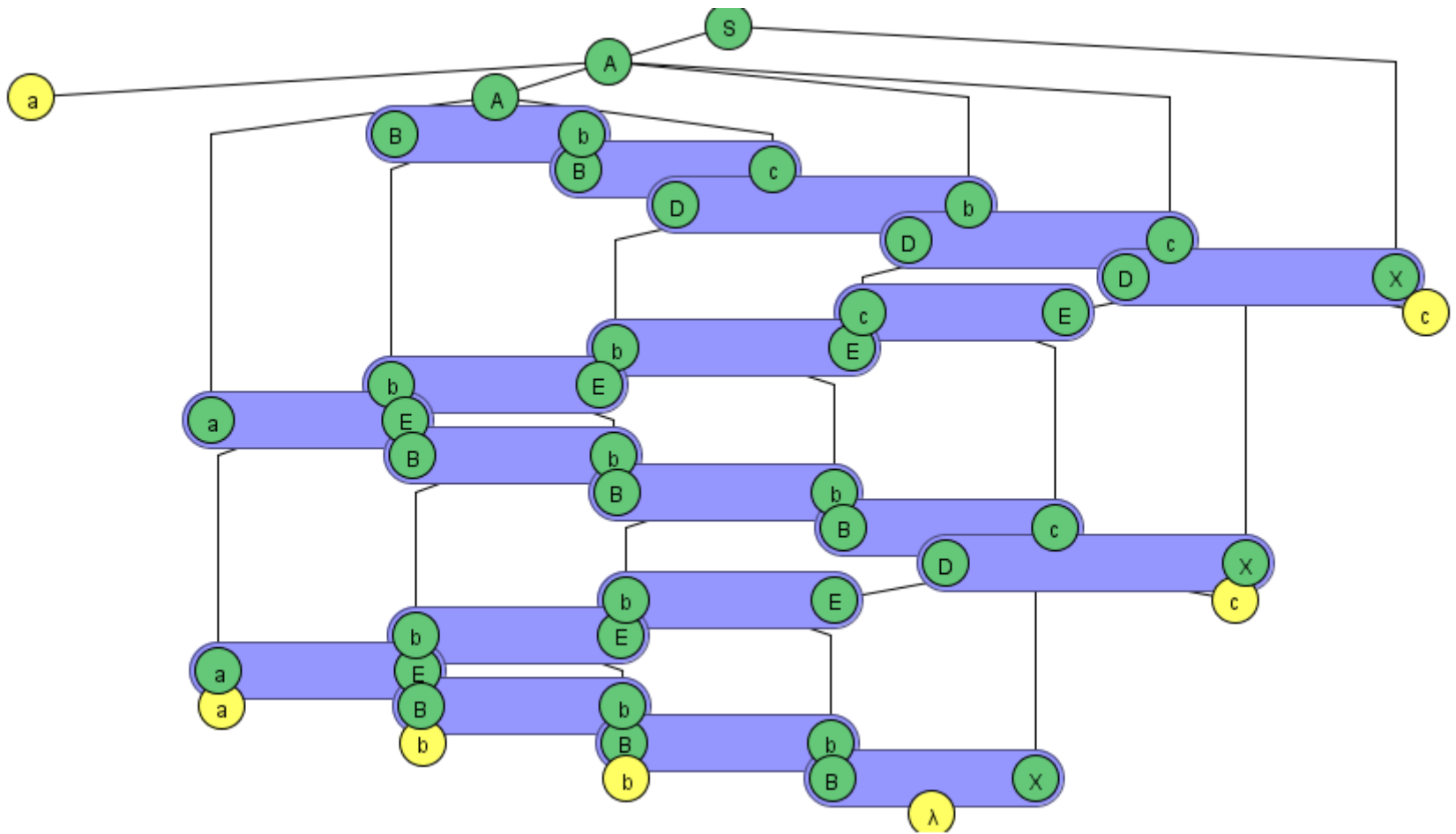


# Example

## Unrestricted Grammar - anbncn

S	→	AX
A	→	aAbc
A	→	aBbc
Bb	→	bB
Bc	→	D
Dc	→	cD
Db	→	bD
DX	→	EXc
BX	→	$\lambda$
cE	→	Ec
bE	→	Eb
aE	→	aB

# Trace aabbcc

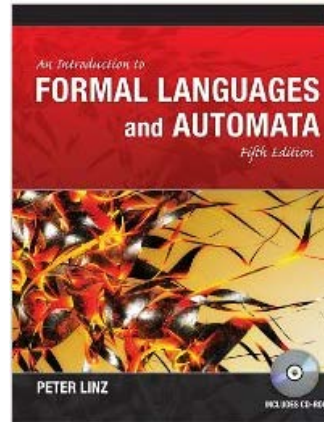


# JFLAP Materials

JFLAP book  
Use with automata  
theory textbook



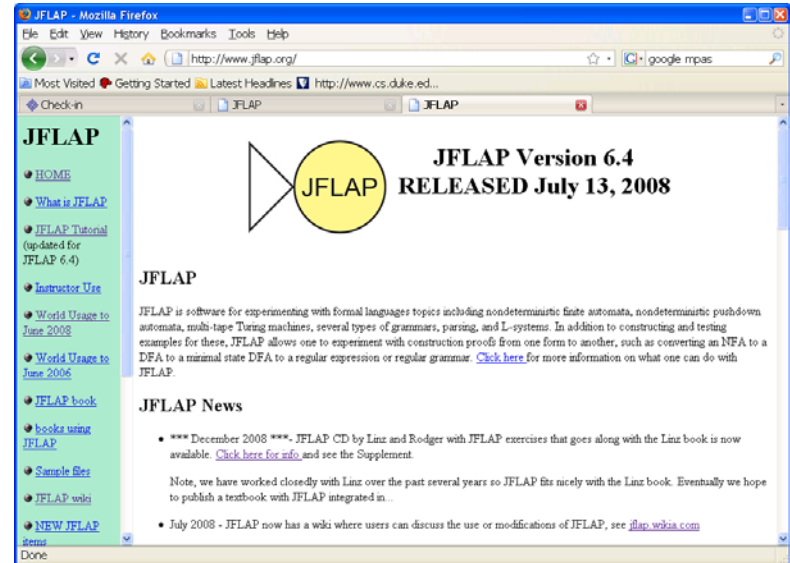
JFLAP works well  
with Linz book



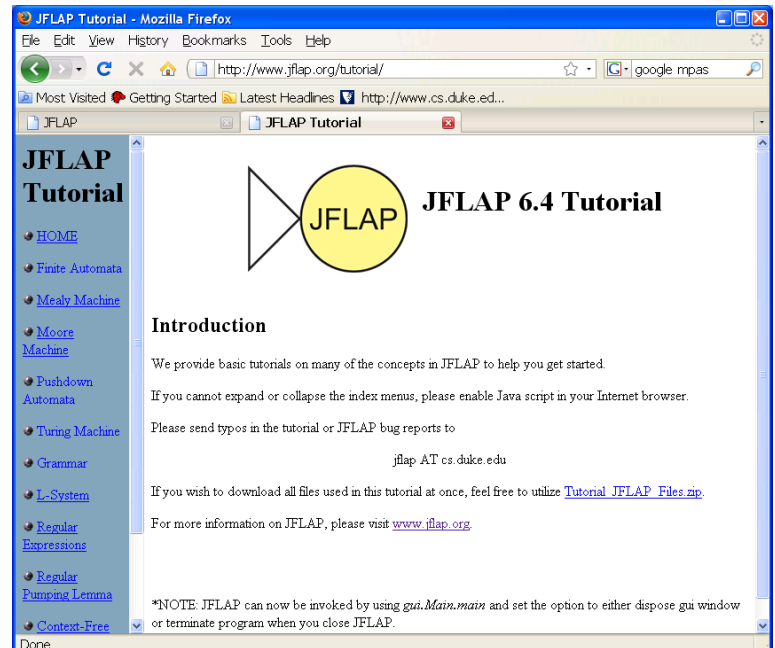
CD supplement with  
JFLAP exercises to  
go with this book

JFLAP is FREE

[www.jflap.org](http://www.jflap.org)



## JFLAP online tutorial



# Questions?

