

Experimenting with finite state automata in GAP

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600
YEARS

1988 GAP is published in Aachen

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1997 GAP HQ moves to St Andrews

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- 2013 Most recent version (4.6.4) is released

- ▶ C Kernel

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- ▶ Algebraic Library

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- ▶ Interactive Environment
- ▶ Programming Language
- ▶ Packages

Authors Manuel Delgado, Steve Linton, José João Morais

Dates Started – 1998;
Official package acceptance – 2004;
Most recent version (1.13) – 2011

Automata

Some notation, expressions, reminders

Automaton $A = (Q, \Sigma, \delta, Q_0, F)$

Types of automata:

Deterministic Exactly one transition per letter per state

Nondeterministic Allowing for no or multiple transitions per letter per state

Epsilon Allowing for ε transitions

Automata

Some notation, expressions, reminders

Transition function forms:

- ▶ Function
- ▶ Diagram
- ▶ Table

Automata

Some notation, expressions, reminders

- ▶ Regular Expression = Rational Expression
- ▶ Permutation Automaton
- ▶ Reversible Automaton

Lets see what we can do with this package.

Demonstration

Investigation of a given automaton and its reverse

- ▶ What is the reverse?
- ▶ How does the diagram look?
- ▶ What regular language is accepted?
- ▶ Are the languages equal?
- ▶ What is a permutation of the given automaton?
- ▶ Does the permutation really have the same language?
- ▶ Is the language of the given automaton finite?

Demonstration

Investigation of a random non-deterministic automaton

- ▶ How big is the non-deterministic equivalent automaton?
- ▶ Can the NDA be reduced?
- ▶ What is the deterministic equivalent?
- ▶ Can the DA be reduced?
- ▶ What properties does the DA have?
- ▶ What is the diagram of the DA?

Demonstration

Creating new automata from existing ones

- ▶ What is the union of two automata?
- ▶ What is the product of two automata?

Demonstration

Investigation of a rational expression

- ▶ How can new expressions be created?
- ▶ Which automaton accepts this expression?

Demonstration

Investigation of a random rational expression

- ▶ How long is the expression?
- ▶ Which automaton accepts the expression?
- ▶ Is the word *abc* in the language?

Demonstration

Investigating two rational expressions

- ▶ Is the concatenation finite?
- ▶ What are all the words of the language?
- ▶ Which automaton accepts all these words?
- ▶ Which automaton accepts the expression?

Thank you

Thank you!

GAP Webpage

`www.gap-system.org`

Automata Webpage

`cmup.fc.up.pt/cmup/mdelgado/automata/`

Forum Email

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