All-Termination($T$)

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Panagiotis Manolios, Aaron Turon. All-Termination($T$). TACAS 2009
Life with a theorem prover:

Define functions

Make conjectures

Known functions

Rewriting

Induction

Proving engine

Known facts

User

Theorem prover
Life with a theorem prover:

Define functions

Prove termination

Make conjectures

Known functions

Rewriting

Induction

Proving engine

Known facts

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Theorem prover
Life with a theorem prover:

User

Define functions → Termination analysis → Known functions → Proving engine

Make conjectures

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Induction

Theorem prover
(defun replace-ith (i v list)
  (if (consp list)
      (if (zp i) (cons v (cdr list))
        (cons (car list)
              (replace-ith (1- i) v (cdr list))))
    nil))
(defun replace-ith (i v list)
  (if (consp list)
      (if (zp i) (cons v (cdr list))
         (cons (car list)
            (replace-ith (1- i) v (cdr list)))))
    nil))

• Measures: (acl2-count i), (acl2-count list)
(defun replace-ith (i v list)
  (if (consp list)
      (if (zp i) (cons v (cdr list))
          (cons (car list)
              (replace-ith (1- i) v (cdr list)))
      nil))

• Measured subsets: \{i\}, \{list\}
  – Guide rewriting heuristics:
    (replace-ith 3 v list)
    vs (replace-ith i 3 list)
  – Yield induction schemes
A better life with ACL2s:

Define functions → All-Termination analysis → Known functions

Make conjectures → Proving engine → Known facts

Rewriting

Induction

Theorem prover

User
CCG analysis in the ACL2 Sedan

• Push-button
  – avoid teaching ordinals to freshmen

• Powerful
  – shows ~98% regression suite terminating
  – c.f. Legato's recent challenge

• Based on size-change termination (SCT)

• Does static analysis, including thm proving
  – Want to extract more information from this analysis!
Theoretical results:

All-Termination(SCT) is no harder than SCT

- Both are PSPACE-complete
- PSPACE algorithm for All-Termination is impractical

Practical algorithm:
Experimental results

CCG + All-Termination(SCT) on the regression suite

Number of functions: >11,000
Proved terminating: 98%  (note: same as CCG+SCT)

Multiargument functions:
  Proved terminating 1728
  With “nontrivial” m-sets 90%
  With multiple m-sets 7%
  Maximum m-set count 3

Running time (not including CCG): 30 seconds
Thank you

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