

# CADE-21 Workshop Proposal

## Workshop on Disproving: Non-Theorems, Non-Validity, Non-Provability

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### 1 Motivation

Automated Reasoning (AR) has traditionally focused on automatically proving theorems which *were already known to be valid*. If, however, a formula is wrong, i.e. it is a *non-theorem*, then most traditional AR methods and tools cannot handle this properly (That means that they will fail, run out of resources, or simply not terminate).

The opposite of proving, which we call *disproving*, aims at designing automated reasoning strategies and tools that are able to deal with *non-theorems* in a meaningful fashion. This means not only that they should terminate, but also that they provide informative output upon termination, like for example a proof of non-validity, a counter model, a falsifying instantiation, or suggestions on how the formula can be repaired.

In practical applications of AR, automated reasoning is mostly used for proving intermediate lemmas. Many of these lemmas are simply guesses that will turn out to be false. Therefore, in order to be useful as assistant, the AR system must be able to deal with non-validity. Moreover, the system should be able to provide hints to the user that might help him/her to find out why the lemma is incorrect, or to suggest reparations.

Beside mathematics, a growing area of AR applications now is concerned with verifying the correctness of *systems*. Because most system designs are initially incorrect, the corresponding correctness statements are often non-valid. For this reason, tools used in verification need to give meaningful output on non-theorems as well.

### 2 Goals of the Workshop

The disproving workshops are intended as a platform for the exchange of ideas among researchers that are concerned with disproving in the broad sense. By collecting, presenting, discussing and relating the different approaches across the different AR sub-communities, the workshop can identify problems and solutions that they have in common.

Our long term goal is that the workshop series contributes to forming a *disproving community* within AR, gives the work on disproving a greater visibility, and motivates researchers to further follow this direction of research.

### 3 Workshop Scope and Topics

In the scope of the workshop is every method that is able to discover non-theorems and provide explanation why the formula is not a theorem. Possible topics are decision procedures, model

generation methods, reduction to SAT, formula simplification methods, abstraction based methods, and failed-proof analysis. The main topics of the workshop can be summarized as:

- disproving conjectures in general,
- extending standard proving methods with disproving capabilities,
- approximative methods for identifying non-theorems,
- generation of counter examples,
- (finite) model generation,
- decision procedures for fragments of undecidable logics,
- failure analysis,
- reparation of non-theorems,
- heuristics that help in identifying non-theorems,
- applications and system descriptions.

## 4 Previous Workshops and Cooperations

The proposed workshop is the successor of three DISPROVING workshops, which were organized by the same authors as this proposal and which were held in conjunction with the following conferences:

- IJCAR 2004 in Cork, Ireland  
<http://www.cs.chalmers.se/~ahrendt/ijcar-ws-disproving>
- CADE 2005 in Tallinn, Estonia  
<http://www.cs.chalmers.se/~ahrendt/cade20-ws-disproving>
- IJCAR 2006 in Seattle, USA  
<http://www.easychair.org/FLoC-06/DISPROVING.html>

The number of participants has varied between 10 and 20, with a tendency towards increase-ment.

The Disproving Workshop is related to the workshop series “Model Computation – Principles, Algorithms, Applications” which was held several times at CADE, the last two times (2000 and 2003) with Peter Baumgartner as a co-organizer.

At CADE 2005, we have cooperated with the ESCAR<sup>4</sup> workshop by sharing an invited speaker. At IJCAR 2004, we cooperated with the PDPAR<sup>5</sup> workshop by sharing an invited speaker and publishing selected papers from both workshops in a common ENTCS volume.

## 5 Organization

We expect to be able to accept sufficiently many papers to be able to fill a complete day and hence propose a one-day workshop.

Submission will be electronic (through EasyChair) and papers will be reviewed by a program committee of approximately ten members. Based on experience with the previous workshops, we expect to be successful in attracting well-known researchers to serve on the program committee. Authors of accepted papers are required to present their work at the workshop. Beside mature work, we will also accept preliminary work or work in progress. We plan to have at least one invited talk by a well-recognized researcher.

We expect about 20 participants. The calls for papers and participation will be widely posted.

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<sup>4</sup> Empirically Successful Classical Automated Reasoning

<sup>5</sup> Pragmatics of Decision Procedures in Automated Reasoning

## 6 Organizers

The organizers of the workshop are:

- Wolfgang Ahrendt,  
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*Wolfgang Ahrendt* worked on the deductive identification of non-theorems in the frame of loose inductive data type specifications having more than one model. He wrote his Ph.D thesis about this subject, presented the work at the CADE-17 Workshop on Model Computation and published an according paper at CADE-18. Other works and publications were devoted to tableaux style theorem proving ( $\epsilon$ -terms in free variable tableaux, proof transformations between rich and simple analytic calculi), and software verification (Prolog compiler verification with KIV, Java source code verification with KeY). He collected tutorials on object-oriented software verification at CADE 2005 and FMCO 2006.

*Hans de Nivelle* has worked on various aspects of resolution based theorem proving. From 1995 to 2000, he worked mainly on resolution decision procedures. He developed resolution decision procedures for the guarded fragment and for the two-variable fragment. His current research interests include: Optimized translations of modal logics into the guarded fragment, with the purpose of obtaining decision procedures, and the use of finite model generation as proof search procedure. He was co-chair of the second international workshop on the implementation of logics, held in Havana, Cuba in 2001.

*Peter Baumgartner* works on the advancement and applications of automated deduction systems, in particular calculi and implementations of both first-order and non-classical logics. He is currently working in a NICTA project that develops a new constraint programming platform. His main interest here is to contribute first-order logic theorem proving technology for the analysis and transformation of constraint specifications.

Most publications are from the area of automated deduction, including theory and applications of model building deduction systems, which is a topic of “disproving”. Besides the

DISPROVING series, he (co-)organized various workshops on automated deduction in the past. Among them FTP 2000 (First-Order Theorem Proving, Scotland, together with Hantao Zhang), an IJCAI workshop 2003 on knowledge representation techniques for E-learning systems, and the following CADE workshops:

1. CADE-19 workshop *Model Computation – Principles, Algorithms, Applications*, July 2003. Organizers: P. Baumgartner, C. Fermüller. See [www.uni-koblenz.de/~peter/models03](http://www.uni-koblenz.de/~peter/models03)
2. CADE-17 workshop *Model Computation – Principles, Algorithms, Applications*, June 2000. Organizers: P. Baumgartner, C. Fermüller, N. Peltier, H. Zhang. See [www.uni-koblenz.de/~peter/CADE17-WS-MODELS](http://www.uni-koblenz.de/~peter/CADE17-WS-MODELS)
3. CADE-15 workshop *Problem-solving Methodologies with Automated Deduction*, July 1998. Organizers: Peter Baumgartner, Ulrich Furbach, Michael Kohlhase, William McCune, Wolfgang Reif, Mark Stickel and Tomas Uribe.
4. CADE-12 workshop *Theory Reasoning in Automated Deduction*, July 1994. Organizers: Peter Baumgartner, Ulrich Furbach