

Workshop on Constraints in Software Testing, Verification, and Analysis (CSTVA'14)

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1. MAIN CONTACT

Vijay Ganesh (see above for contact details).

2. WORKSHOP LENGTH

One day

3. WORKSHOP DATES

Preferably before the start of the ICSE conference.

4. WORKSHOP OPEN OR CLOSED

Open.

5. MIN/MAX NUMBER OF PARTICIPANTS

Minimum: 15, and Maximum: 50. We may not organize the workshop if there are fewer than 15 participants.

ABSTRACT

The last decade has seen a revolutionary improvement in the efficiency and expressive power of Boolean SAT, SMT and Constraint Programming (CSP/CP) solvers, with a consequent impact on all manner of software engineering (SE) applications and research programs. A prime example of this is the rapid development and adoption of solver-based symbolic-execution techniques in myriad applications such as test generation, security, and analysis. Despite this increasing use of solvers, there are few venues that are solely dedicated to bringing together the broader SE and solver communities in one place. This workshop at the flagship SE conference is designed precisely to fill this gap. The aim of the workshop is to highlight use of solvers in novel applications, new solver features, and encourage their use in fresh solutions to long-standing SE problems. Furthermore, as current users become more sophisticated they demand richer solver interfaces that are extensible, tunable and programmable. Designing such interfaces requires deeper interaction between solver developers and users. Hence, this workshop will also act as a venue for feedback from users to developers.

6. WORKSHOP THEME AND GOALS

Recent years have seen an increasing interest in the application of constraint solving techniques to testing, verification and analysis of software systems. The reason for this interest is the dramatic improvement in efficiency and expressive power of Boolean SAT, SMT and CP solvers, thus making it considerably easier to build and maintain software engineering (SE) applications. Significant number of constraint-based techniques have been proposed and investigated in model-based testing, code-based testing, property-oriented testing, statistical testing, equivalence checking, model checking, fault localization, verification, and program analysis. What is even more interesting is that as solvers become more efficient and expressive, newer applications are being developed in diverse areas such as security, synthesis, type systems and software product lines. In the past, solvers were largely used as black boxes. However, more recently a central idea in solver-based SE applications is a deep integration of solver and application. The benefits of deep integration over a black box approach are many. An example benefit of deeper integration is that it can enable applications to better utilize the adaptive features of modern solvers. Often the resulting SE techniques are far more powerful and effective than before.

It is within this context of increasing use of solvers in SE, especially through deep integration of extensible solvers with applications, that we propose a new workshop on solvers and software engineering at ICSE, the flagship SE conference. The goal of the workshop is to bring together in one place the largely distinct communities of solver and broader SE researchers. We expect a very intense and positive cross-community interaction between the members of the two communities. Such interaction could lead to completely new approaches to long-standing SE problems, and current users of solvers can discuss their experience and provide rapid feedback to solver developers. The workshop could also influence new research directions into easily extensible, tunable and programmable solvers. Finally, the workshop can help showcase the breadth and depth of the influence of solvers in SE research.

A prime example of how interaction between solver researchers and the SE community can lead to impactful research is “symbolic execution and its application to testing, verification and analysis”. Symbolic execution for software testing was proposed by Lori Clarke and J.C. King in

the 1970's. However, it didn't really pick up until nearly thirty years later in the mid-2000's, in large measure due to dramatic improvement in solver technology. Thanks to SAT solvers like MiniSAT, Lingeling, ManySAT, and SMT solvers like Z3, Yices, CVC4, MathSAT, STP, and HAMPI, a variety of symbolic-execution engines have been developed. Examples of the most successful such tools include SAGE, PathCrawler, KLEE (and its predecessor EXE), BitBlaze, WebBlaze, S2E, Java PathFinder and KINT.

Another example of deep integration of solver and application is the recently proposed model-checking algorithm IC3. In this approach, not only is a solver used by the model-checker, but also the design of the IC3 algorithm itself is influenced by ideas from SAT solving.

A third example comes from the development of specialised CP techniques for constraints on floating-point numbers which could not be accurately resolved using the mathematical tools developed for real numbers. This is a significant recent advance in solver technology with huge potential for impact in automated testing and verification of numerical software.

We believe that the success we have seen of the combination of solvers and above-mentioned SE fields can be replicated in other areas of SE. It is with this goal of increasing the awareness of solvers in the broader SE community, and increasing interaction between solver and SE researchers that the workshop is being proposed.

The workshop will focus on a broad range of topics where solvers have already made an impact, e.g., symbolic-execution based testing, as well as newer ones where their use is still nascent, e.g., synthesis and software product lines.

Topics for the Workshop

The topics for the workshop include, but are not limited to, the following:

- Constraint-based analysis of programs and models
- Constraint-based test input generation
- SMT solvers for testing, verification, analysis, and synthesis
- SMT solvers and their applications in computer security
- Programmable SMT solvers
- Combinations of constraint solvers
- Constraint programming and software engineering
- Solvers and software product lines
- Solvers and fault localization

7. RELEVANCE TO THE FIELD OF SE

The idea of capturing software behavior through logic constraints is an old but very important idea that has always played a role in SE. However, in the past SE researchers didn't have access to efficient solvers, and instead had to

develop their own solutions to process the constraints generated by their applications. All that changed in the last 15 years. Armed with increasingly powerful SAT/SMT solvers, researchers tackled many hard SE problems. As mentioned above, many areas of SE have been transformed thanks to solvers and we expect that the broader SE community will benefit greatly from continued improvement in solver technology, and deeper integration of solver and application.

In addition to the above-mentioned applications that have been impacted by solvers, new and emerging areas where solvers are used heavily include software product lines, constraint-based program analysis and fault localization. These application domains are quite distinct from each other, and yet they all rely on powerful solvers. For example, in software product lines (SPL) research the goal is to show that the user-selected features and configuration can lead to a valid product, that does not violate important safety and security properties. On the surface, the SPL research area seems very different from the problem of fault localization, where the problem is to isolate the root cause(s) of an error given a program and an error-revealing input. In the constraint-based program analysis field, the paradigm is to express the program analysis problem as constraints in declarative languages such as Prolog. These constraints are then interpreted by powerful solvers to perform analysis on input programs. In the past, researchers in each of these application areas had to develop individual specialised solutions to address their problems. As already highlighted in the above Section, thanks to the advent of efficient and expressive solvers, a new class of systematic methods is being explored to solve these knotty problems.

8. GENERATING DISCUSSION

We expect a very robust attendance at the workshop. We plan to organize a panel discussion on the future of solvers in SE that will bring together 2 leading solver developers and 2 leading users to present their views on how we can build solvers that better serve SE research needs. We expect to hold the panel towards the end of the workshop. We also hope to invite a leading SE researcher to give a keynote address on his/her experience in using solvers.

We are also considering the possibility of presentation-only papers (e.g., tool papers) that can generate a lot of interest. Such papers can be shorter, say, 6 pages and will not be included in any proceedings.

9. PRELIMINARY WEB SITE

<https://ece.uwaterloo.ca/~vganesh/cstva14.html>

10. PROGRAM COMMITTEE

We are fortunate that many of the leading researchers in the field of SAT/SMT solvers, CP and SE applications have agreed to be part of the program committee of the proposed workshop. We believe that this reflects the increasing recognition of the fact that the broader community needs a workshop or conference where developers of different constraint solving techniques and their users can meet and exchange ideas.

The following people have all already agreed to be on the Program Committee.

1. Vijay Ganesh, University of Waterloo, Canada
2. Nicky Williams, CEA LIST, France
3. Kapil Vaswani, Microsoft Research, India
4. Aditya Nori, Microsoft Research, India
5. Rupak Majumdar, Max Planck Institute for Software Systems, Germany
6. Koushik Sen, University of California, Berkeley, USA
7. Frank Tip, University of Waterloo, Canada
8. Joxan Jaffar, National University of Singapore, Singapore
9. Nikolaj Bjorner, Microsoft Research, USA
10. Leonardo DeMoura, Microsoft Research, USA
11. Cristian Cadar, Imperial College London, UK
12. Arnaud Gotlieb, Simula, Norway and INRIA, France
13. Frederic Dadeau, FEMTO-ST/INRIA, France
14. Krzysztof Czarnecki, University of Waterloo, USA
15. Julian Dolby, IBM TJ Watson Center, USA
16. Ofer Strichman, Technion, Israel
17. François Bobot, CEA LIST, France
18. Sébastien Bardin, CEA LIST, France
19. Sylvain Conchon, Université Paris Sud, France
20. Emina Torlak, University of California, Berkeley, USA
21. Daniel LeBerre, Université d'Artois, France
22. Cesare Tinelli, University of Iowa, USA
23. Chris Wintersteiger, Microsoft Research, UK
24. Patrick Heymans, University of Namur, Belgium
25. Marsha Chechik, University of Toronto, Canada
26. Xiangyu Zhang, Purdue University, USA

11. PARTICIPANT SOLICITATION

Participants will be solicited through a mailshot of the Call For Papers and a poster. This should reach a wide audience thanks to the diversity of the program committee. The workshop will be open to all participants until the maximum number of participants is reached.

12. PROCEEDINGS

Accepted papers (except presentation-only papers) will be published in the workshop proceedings. The ideal number of papers is around 12 and expected length is 10 pages with 1-2 additional pages for references in standard ICSE format.

13. EXPECTED ATTENDANCE

This proposed workshop will be the 6th of the CSTVA (Constraints in Software Testing, Verification and Analysis) workshop series, held for the last few years alongside ICST (IEEE International Conference on Software Testing).

The first CSTVA meeting was held alongside the CP conference (Principles and Practice of Constraint Programming) in Nantes, France, in 2006 and attracted more than 25 participants. It also featured an invited presentation by Andy King (University of Kent). See <http://www.irisa.fr/manifestations/2006/CSTVA06/> for more details.

The second edition took place in conjunction with the ICST 2010 in Paris, France, attracting more than 30 participants. It also featured an invited presentation by Peli de Halleux (senior researcher at Microsoft Research). See <http://www.st.cs.uni-saarland.de/cstva10> for more details.

A third meeting at ICST 2011 in Berlin, Germany, also attracted a similar number of attendees, and featured an invited presentation of Patrice Godefroid (principal researcher at Microsoft Research). See <http://www.st.cs.uni-saarland.de/cstva11> for more details.

A fourth edition was held at ICST 2012 in Montreal, Canada which attracted close to 40 participants. It also featured a keynote presentation by Vijay Ganesh (an assistant professor at the University of Waterloo, and a co-organizer of the proposed workshop.) See <http://srg.doc.ic.ac.uk/cstva12/> for more details.

A fifth edition was held at ICST 2013 in Luxembourg which attracted more than 40 participants. It featured a keynote address by Sarfraz Kurshid (University of Texas, Austin). See <http://cstva2013.univ-fcomte.fr/index.php?aim> for more details.

Given the success of the previous editions of this workshop we believe that the current version we are proposing will also be successful. We believe that by co-locating with ICSE and broadening the scope of the workshop to go beyond testing, verification and analysis, and include synthesis, security and software product lines etc., will increase the chances of success of the workshop dramatically. We are hopeful that we will attract more than 40 participants.

As mentioned before, we informally discussed the idea of organizing such an ICSE workshop with many leading SE researchers, and found that most were very enthusiastic about it. Most of the researchers we contacted gladly accepted our invitation to join the program committee.

14. LOGISTIC CONSTRAINTS

The room should be covered by wifi if possible, in case of videos or on-line demonstrations.

15. ORGANIZER BACKGROUND

1. **Vijay Ganesh** is an assistant professor at the University of Waterloo, Ontario, Canada. His primary research interests are SAT/SMT solvers and their applications to testing, formal methods and SE in gen-

eral. He has developed leading SMT solvers, and also worked on their application to testing and formal verification. His award-winning solvers STP and HAMPI are currently being used in more than 100 research projects.

On the organizational front, Vijay organized one of the first summer schools on SAT/SMT solvers in 2011 at the Massachusetts Institute of Technology. The summer school featured 36 lectures by leading solver developers and their users over a period of 6 days. The total number of participants exceeded 230, and included participants from all over the world. The profile of the participants ranged from theoreticians interested in understanding why SAT solvers work so well, to hackers who wanted to use solvers for a variety of security applications. This summer school has started trend, and now it is held every year alongside the SAT or CAV conferences. More details can be found at: <http://people.csail.mit.edu/vganesh/summerschool/index.html>. Vijay has also served on the program committee of many conferences and workshops including FroCos, IEEE NCA, and SMT (usually co-held with CAV).

2. **Nicky Williams** is a leading researcher in symbolic execution based methods for testing and verification. She is a research engineer in the CEA LIST Software Reliability Lab, which works closely with industry on the application of new techniques to the verification and validation of software systems. Nicky initiated the development of the CLP-based PathCrawler test generation tool and has worked for several years on its extension and application to different industrial problems.

Nicky has been a member of the program committee for several conferences and workshops in the domain, such as ICTSS, QSIC, AFADL and several previous editions of the CSTVA workshop and this year decided to participate for the first time in the organisation of this workshop.

CALL FOR PAPERS

CSTVA'14

International workshop on Constraints in Software Testing, Verification and Analysis 2014

<https://ece.uwaterloo.ca/~vganesh/cstva14.html>

A workshop of ICSE'14, the 36th International Conference on Software Engineering,
Hyderabad, India, 31st May - 7th June 2014

Important Dates:

- Workshop paper submissions due January 14, 2014
- Notification to authors February 17, 2014
- Camera-ready copies of authors' papers March 14, 2014

Submission Details:

Research papers: Authors are invited to submit original contributions, presenting novel ideas, results or systems in constraint-based software engineering. Papers should not be published or submitted elsewhere during the time of evaluation.

Tool demo papers or fast abstract papers: Authors are invited to propose tool demonstrations or fast abstract, presenting new tools, new challenges or breaking results in constraint-based software engineering.

Submitted papers must be in PDF format, formatted according to the ACM Formatting Guidelines. (Please see <http://www.acm.org/sigs/publications/proceedings-templates>. LaTeX users, please use the "Option 2" style), and must not exceed the following size limits:

- Research papers: max 10 pages for the main text, including figures, tables, appendices, references may be included on up to 2 additional pages
- Tool demo/presentation-only papers: max 6 pages

All accepted papers (except presentation-only papers) will be published in the workshop proceedings.

Topics:

Recent years have seen an increasing usage and consequent impact of Boolean SAT, SMT and Constraint Programming (CP or CSP) solvers in testing, verification and analysis of software systems. The primary reason for this is the dramatic improvement in the efficiency and expressive power of solvers. As newer and more powerful solvers are built, software engineering researchers dramatically scale existing applications such as symbolic-execution methods, or find unexpected applications for them, e.g., software product lines or fault localization methods.

This workshop will bring together researchers in solvers and software engineering applications in order to raise the awareness of constraint solving in the broader software engineering research community, and encourage development of new applications based on tunable, extensible, and programmable solvers. The workshop will focus on a broad range of topics where solvers have already made an impact, e.g., symbolic-execution based testing, verification and analysis, as well as newer applications

where their use is still nascent, e.g., synthesis, software product lines and fault localization. Submission topics include, but are not limited to, the following:

- Constraint-based analysis of programs and models
- Constraint-based test input generation and fault localization
- Solvers and computer security
- SMT solvers for testing, verification, analysis, and synthesis
- Programmable SMT solvers
- Combinations of constraint solvers
- Solvers for software product lines

Following the 5 previous editions of this workshop, held first at the CP and then the ICST conferences, this year's CSTVA workshop will be held at ICSE with the goal of strengthening the links between the solver and software engineering research communities. The workshop aims to encourage newer applications of solvers, showcase their rich extensible APIs, and act as a forum for feedback from users to solver developers.

Organizers:

Vijay Ganesh, Univ. Waterloo, Canada, vganesh@uwaterloo.ca
Nicky Williams, CEA LIST, France, nicky.williams@cea.fr

Program committee:

Kapil Vaswani, Microsoft Research, India
Aditya Nori, Microsoft Research, India
Rupak Majumdar, MPI Software Systems, Germany
Joxan Jaffar, National University of Singapore, Singapore
Frank Tip, University of Waterloo, Canada
Koushik Sen, University of California, Berkeley, USA
Cristian Cadar, Imperial College London, UK
Arnaud Gotlieb, SIMULA, Norway and INRIA, France
Frederic Dadeau, FEMTO-ST/INRIA, France
Krzysztof Czarnecki, University of Waterloo, USA
Julian Dolby, IBM TJ Watson Center, USA
Ofer Strichman, Technion, Israel
Nikolaj Bjorner, Microsoft Research, USA
Leonardo DeMoura, Microsoft Research, USA
Francois Bobot, CEA LIST, France
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Cesare Tinelli, University of Iowa, USA
Chris Wintersteiger, Microsoft Research, UK
Patrick Heymans, University of Namur, Belgium
Marsha Chechik, University of Toronto, Canada
Xiangyu Zhang, Purdue University