

# SAT *Live!*

## First Birthday

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### Abstract

One year ago a web site collecting SAT related links was launched: SAT *Live!* was born. After 6 first months with few activity, SAT *Live!* is becoming more and more popular. This paper explains why I decided to create such a site, presents the site itself and then concludes with some ideas to improve it.

## 1 SAT and the web

Let us first consider why the web is important for SAT research. The first great thing about the web is the ability to access *electronic documents*. It is now possible to find the most recent papers in an electronic format from the personal web pages authors. Note that this has been possible because major conferences (such as IJCAI for instance) give permission to authors of papers published in their proceedings. But this is not particular to SAT research area. Another good reason to use the web is to access *SAT solvers*. Most SAT solvers are available free of charge for research purposes. Access to these solvers is important for further evaluation. Lastly, the availability of *SAT benchmark problems* is certainly another illustration of the importance of the web for the SAT community.

So there are useful SAT related materials available on the web. But how to access them? One solution is to bookmark the personal web pages of all researchers working on SAT, and take a look every now and then to see if some new information is available. Another way is to construct a web page (a site) dedicated to SAT, that will concentrate the information about that subject. But still, someone needs to go through all the SAT related pages every now and then to maintain and keep up-to-date that page.

This could be a solution if you know who is working on the subject. Now suppose that a new community is getting interested in SAT (model checking community, for instance). People from that community can begin to publish new results about SAT but you won't notice them because you may not be aware of that pool of web pages from that community. Suppose also that some

people are mainly interested in SAT as users: they typically want to know what the recent SAT solvers are, the most recent techniques, etc. They may not be aware of who is working in that area.

What does it mean? A “portal” for SAT related research should be open, that is should allow anybody from any community to point out a particular work or tool related to SAT. If anybody can contribute to the site, it is unlikely that the information will be clustered in only one community. Furthermore, by sharing the update with other people, the effort to do it is minimized. These are the ideas I had in mind when I conceived of SAT *Live!*.

But some web sites about SAT already exist. Let us briefly mention two of them.

## 1.1 SATLIB

SATLIB<sup>1</sup> is the first web site to be dedicated to SAT. It was created by Holger Hoos and Thomas Stützle in 1998 [HS00]. From the web site: “*SATLIB is a collection of benchmark problems, solvers, and tools we are using for our own SAT related research. One strong motivation for creating SATLIB is to provide a uniform test-bed for SAT solvers as well as a site for collecting SAT problem instances, algorithms, and empirical characterizations of the algorithms performance.*”.

SATLIB contains collections of benchmarks, solvers, an annotated bibliography, a list of people, links and conferences related to SAT.

The collection of benchmarks is certainly the origin of the success of SATLIB: benchmarks do not evolve, and there are usually not a profusion of new ones every year, so it is easy to maintain an up-to-date collection of benchmarks. By centralizing the access to some benchmarks and providing a detailed information about them, SATLIB certainly did (and still do) a great job for the SAT community.

The collection of SAT solvers is somewhat more difficult to maintain: new versions of the solvers can appear (which add new features or correct bugs), and new solvers will appear. Usually, the best way to obtain up-to-date information about these solvers is to take a look to the author’s web page (which means that you must be aware of their existence). However, by keeping older versions of the solvers online, one can use exactly the version of a solver described in a paper. SATLIB SAT solvers collection is also very useful in that regard.

The annotated bibliography is a pretty good idea. It contains a lot of SAT related papers published in major conferences or journals. All the references

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<sup>1</sup><http://www.satlib.org/>

have a link to an electronic version of the paper. So it is easy to get the ones you do not know about. Lastly, the keywords help to situate each paper.

If there is one criticism that can be made about SATLIB, it is the infrequent updates of the site: 14 updates in 3 years is not a lot! One reason the update is infrequent is related to the design of the site. The site is based on static web pages that must be updated by their webmaster.

## 1.2 SAT-Ex

One of the still under construction part of SATLIB is the *SAT solvers evaluation*. The idea here is to provide a clear picture of the efficiency of various SAT solvers (typically the ones in the solvers collection) and various benchmarks (the ones from the benchmarks collection). This idea was ambitious and appeared difficult to implement.

Laurent Simon [SC01] dedicated one entire site to that subject more than one year ago with SAT-Ex<sup>2</sup>. It uses dynamic HTML to display experimental results from various complete SAT solvers stored in a database. The great thing with SAT-Ex is the way you manage the information. One can display the results of solvers from a group of benchmarks to a single instance. Furthermore, new solvers and benchmarks can be added to the database. (Chaff[MMZ<sup>+</sup>01] have been added on SAT-Ex a few days after its availability for instance). It is a great tool to compare complete SAT solvers. SAT-Ex currently contains 23 SAT solvers and 1303 benchmarks. It allows to point out challenging instances, namely the benchmarks not solved by any solver, or the ones solved by only one or two solvers (which also emphasizes these solvers). Furthermore, all the information displayed on the site can be freely downloaded and processed for customized needs. (Note that the last version of the site, 2.0, allows a lot of customization online).

## 2 SAT Live!

After seeing SAT-Ex, I decided to create a dynamic version of the SAT web page I was maintaining. Laurent Simon is using php3 for SAT-Ex, I decided to use JavaServer pages for mine (as a Java programmer, this looked as an obvious choice). The idea was that anybody could add a link to the site, in a pure anarchical way. Furthermore, the site should be “autonomous” in the sense that it should evolve without anybody monitoring it. The 13th of July 2000, SAT *Live!* was online. It was first only one dynamic web page, that is one page that can be updated by anybody. After a while, it took its actual form. The 8th of September, SAT *Live!* got its own domain name ([www.satlive.org](http://www.satlive.org)).

<sup>2</sup><http://www.lri.fr/~simon/satex/satex.php3>

## 2.1 A collection of links

SAT *Live!* is managing URLs (links). Anybody can add a link to SAT *Live!*. You must register to the site if you want your name to be associated with the link, else you can submit anonymously. There is no moderator, so the new link appears immediately. It is possible to associate some keywords to each link, and the links are classified as:

- *papers*: any link to proceedings or journal papers, technical reports, books, etc.
- *software*: any link to SAT solvers or tools
- *benchmarks*
- *events*: mainly links to upcoming conferences or workshops.
- *announcement*: for other information (web sites, mailing-lists, etc.).

SAT *Live!* currently contains more than 80 links, among them 14 software, 4 benchmarks and 8 events. Most of the papers are very recent, and some of them were even available in SAT *Live!* before their presentation at the conference. (Because their authors did make them available on the web early).

It is interesting to take a look to the most visited links through SAT *Live!*. The first one is the web page of the new Chaff solver (more than 200 hits in 3 months), the second a paper concerning SAT-based software verification (almost 200 hits in 10 months) and the last one is a link to SAT20001 workshop online proceedings (almost 150 hits in more than one month).

### How to contribute?

You can either post a link anonymously, in which case there is no particular requirement, or not, in which case you must subscribe to SAT *Live!* first. (Please note that subscribing does not mean you will appear on the people page or receive email notifications: you can set your preferences.) In the first case, just type **anonymous** instead of your email. Then you need to classify your link, and provide a title, a URL and a comment about the link. You must check that the information you provided displays correctly using the preview button. When everything is fine, you can go to the next step to choose some keywords for your link. It should appear on the home page automatically after that.

## 2.2 The users

Who are the users of SAT *Live!* ? One can take a look to the people section to answer that question. People willing to be kept aware of new links added to SAT *Live!* can subscribe to the site and provide their name, email, affiliation, country and personal web page. This information is displayed in a “people interested in SAT” web page if they want to. There are currently 67 persons visible on

that page, some academics from Artificial Intelligence or Theoretical Computer Science background, but also some from Model Checking. Interestingly, one can also find some people from the industry, for instance from one of the two companies selling SAT solvers, and more generally from companies involved in hardware verification.

Another way to get an idea of who is using *SAT Live!* is to take a look at the statistics of the site (freely available to anybody). One can check that the number of hits is growing since the beginning of the year (the stats for January and February are no longer appearing because I lost the logs due to a misconfiguration of the server logs rotation). One can recognize among the organizations accessing to the site some well known from the Electronic Design Automation community.

One can also take a look at the referrer pages to see where people are coming from. A lot of people are coming from search engine results on queries such as “SAT” or “Chaff”, which means that *SAT Live!* is well known from these search engines. Else people are mainly coming from web pages of SAT researchers referring the site.

### **2.3 The forum**

The discussion forum is a feature that was added in November 2000. There are currently four distinct forums: one for SAT general topics, one to provide some feedback about *SAT Live!*, another for the forum feature itself and a brand new one dedicated to SAT-Ex. This last one should help Laurent Simon to gather information about the different SAT solvers and benchmarks used in SAT-Ex.

Few discussions ran on the forums: I tried twice to launch a thread about a common API for SAT solvers but only a few people participated and nothing really happened. However, this thread was reopened shortly after SAT2001 by someone from Compaq, providing useful information about the expectation of people working with SAT solvers in hardware verification.

I hope that the new features that will be available soon on the forum will encourage people to use it.

### **2.4 The SATBIB project**

I already said that I found the annotated bibliography of SATLIB very useful. But something annoying with bibliography is to maintain it. One of the format commonly used to share bibliographic information is the bibtex format. It is very convenient for latex users and most bibliographic tools can import bibtex files. Some other nice features are that it is possible to specify URLs for the references and to automatically generate an HTML file taking into account that information. (The result is then similar to the SATLIB annotated bibliography,

but with the additional feature of providing for each reference a bibtex entry.) I would have liked to maintain such a kind of bibliographic database were everybody can add and correct references. Ideally, people entering a link to a paper in *SAT Live!* should fill this database. The problem is that references evolve. When the paper is accepted for publication, an electronic version may appear on the web but the reference is not complete: there is no page number, etc. Then when the proceedings or journal are published, the full reference is known. But maybe the person that proposed the link will take a long time before being aware of the right reference. So sharing a bibliographic database should allow anybody to correct, update the references in a convenient way. It does not seem easy to use a database driven approach for that case.

One day, I got the idea to share the bibtex file using Concurrent Version System (CVS), a tool widely used for distributed programming projects. It means that you need a CVS client to participate to that project. It is therefore a bit more technical than filling a form in a web page but some tools (like emacs) can help.

#### **How does it work?**

There are two bibtex files maintained in the SATBIB project: `confs.bib` and `satbib.bib`. The first one groups proceedings references of major conferences not dedicated to SAT (IJCAI, AAI, etc.). The second one contains SAT related references using crossreferences to the conference proceedings appearing in `confs.bib`. You can download the latest version of these files from the SATBIB web page. If you want to contribute references to these files, you need to setup a CVS client as described in the SATBIB web page.

### **3 Promote your work on *SAT Live!***

One of the site that also inspired me when I decided to create *SAT Live!* is UMBC AgentWeb<sup>3</sup>. This web site simply is the reference about what's going on in the Agent community. The AgentNews newsletter summarize every week the new additions to the site. It works because people are now used to promote their work in that way.

The SAT community is certainly smaller than the Agent one, but I think that the same kind of result could be obtain if people working around SAT were promoting their work through *SAT Live!*.

Why *SAT Live!* ? Well, the main reason is that it exists and can be used for that purpose ;-). Another one is that you are sure that at least the people subscribed to the site will be aware of your work, plus all the visitors not subscribed. As already pointed out, search engines are pretty aware of *SAT Live!*

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<sup>3</sup><http://agents.umbc.edu/>

existence so your work is also likely to be caught by the search engines.

For people still not convinced by the importance of the web to spread scientific information, a study from ResearchIndex<sup>4</sup> shows that papers available on the web are more highly cited<sup>5</sup>. *Another good reason to use SAT Live! to promote your work is that both ResearchIndex and BDLP<sup>6</sup> are using it as a source of new documents (you can check that on the stats).*

## 4 Future improvements

One of the main issue with SAT *Live!* is the response time of the site. Because the current implementation gather the information requested for each page from a database, the response time is poor. This will be a major issue if the site continues to grow at the current rate. So I need to work on caching techniques to reduce the access to the database. I will focus on that soon.

I use an open source forum tool called Jive<sup>7</sup> for the forum feature. One of the annoying thing with the current forum is that people cannot have an email notification of the discussions running on the forums. This feature will be available in the version 2.0 of the tool. I will update the SAT *Live!* forum when it will be available.

Another thing is the design of the site. I tried to do my possible to make the site looking attractive and user friendly, but I think it can be much better. One student from the Design department of the University of Newcastle kindly proposed to help me to improve SAT *Live!* in that way.

## 5 Conclusion

The SATisfiability problem (SAT) currently receives a growing interest due to the practical solutions available to solve it. It is now possible to use SAT solvers as engines for industrial strength applications. This is illustrated for instance by SAT-based model checking [BCCZ99] or SAT-based planning [KS96]. As a consequence, more and more people not directly working on SAT are interested by new developments in that area.

SAT *Live!* is a web site dedicated to SAT that can be updated by anybody in a pure anarchical way. It's main aim is to be a portal to SAT related research, where both *users* and *researchers* can meet. It is open to anybody: academics as well as industrials or hobbyists, from any background. It should be considered

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<sup>4</sup><http://www.researchindex.com>

<sup>5</sup><http://www.neci.nec.com/lawrence/papers/online-nature01/>

<sup>6</sup><http://dblp.uni-trier.de/>

<sup>7</sup><http://www.jivesoftware.com/>

as a tool to promote SAT related work.

SAT *Live!* is currently more used as a source of information than as a mean to share information. It looks like a site cannot belong to a community but to someone. For instance, a few people still ask me to add a link to their site or paper, or to add them on the people page: they can do that by themselves! I take the responsibility to maintain this site online, to provide a tool. The content of the site itself mainly depends on SAT *Live!* users.

Because I am currently the main contributor of the site (67 persons are currently subscribed to the site, but few of them are contributing links), the current picture of SAT research drawn by SAT *Live!* is a bit biased: it denotes much more my own interests concerning that problem than what's really going on. For instance, I think that the work in Theoretical Computer Science and most of the work concerning incomplete methods for SAT are not currently well represented in SAT *Live!*. A few people from various background contributing links related to their own interests could fix that.

I think that the major contribution of SAT *Live!* so far is to reach researchers from both SAT and Model Checking background. I am pretty happy of the recent link concerning the special issue on SAT at the Microprocessor Test and Verification (MTV'02) conference. It shows that SAT-based tools are currently considered seriously.

Finally, I mentioned that a few companies from EDA are currently looking at SAT *Live!*. They are welcome to participate to the site, by providing more information about the type of problem they want to solve, providing some benchmarks, or participating to standardization efforts.

I tried to explain in this paper the main reasons that pushed me to create this site. I would be happy to have your feedback about it on SAT *Live!*forum.

## References

- [BCCZ99] Armin Biere, Alessandro Cimatti, Edmund M. Clarke, and Y. Zhu. Symbolic Model Checking without BDDs. In *Proceedings of Tools and Algorithms for the Analysis and Construction of Systems (TACAS'99)*, number 1579 in LNCS, 1999.
- [HS00] Holger H. Hoos and Thomas Stützle. SATLIB: An Online Resource for Research on SAT. In Ian Gent, Hans van Maaren, and Toby Walsh, editors, *SAT2000: Highlights of Satisfiability Research in the year 2000*, Frontiers in Artificial Intelligence and Applications, pages 283–292. Kluwer Academic, 2000.

- [KS96] Henry A. Kautz and Bart Selman. Pushing the envelope : Planning, propositional logic, and stochastic search. In *Proceedings of the Twelfth National Conference on Artificial Intelligence (AAAI'96)*, pages 1194–1201, 1996.
- [MMZ<sup>+</sup>01] Matthew W. Moskewicz, Conor F. Madigan, Ying Zhao, Lintao Zhang, and Sharad Malik. Chaff: Engineering an Efficient SAT Solver. In *Proceedings of the 38th Design Automation Conference (DAC'01)*, June 2001.
- [SC01] Laurent Simon and Philippe Chatalic. SATEx: a web-based framework for SAT experimentation. In Henry Kautz and Bart Selman, editors, *Electronic Notes in Discrete Mathematics*, volume 9. Elsevier Science Publishers, June 2001. <http://www.lri.fr/~simon/satex/satex.php3>.