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Publication Methods

The Electronic News Journals (ENJ) are a medium for exchange of scientific information and debate. In particular, they serve as the forum where articles received by the ETAI (Electronic Transactions on Artificial Intelligence) are discussed publicly for review.

ENJ's are primarily published as WWW pages in HTML encoding, since they are intended for on-line use. In particular, they contain considerable numbers of links to other pages and structures on the net: articles that are available on-line, home pages of conferences and of individual researchers, links to other part of the ETAI structure, and so on. However, they also contain parts that can be read without clicking the hot links, for example, the debate contributions.

The present version of the News Journal is a derivative, formatted representation and is intended to be printed out on paper and read off-line. Due to the limitations of the paper medium, only some of the WWW links have been retained as footnotes. There are also some other differences of minor importance between the HTML version and the present one. – In order to make practical use of the WWW links, as well as to see and use other links in the structure, please retrieve the on-line ENJ from the following URL:

`http://www.ida.liu.se/ext/etai/actions/njl/`

which contains a table of back issues of ENJ's and Newsletters on Reasoning about Actions and Change.

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Dates of Publication

Since the date of publication may be understood either as the date of first public appearance, or as the day of reproduction on paper in many copies, and since both of these definitions may be difficult to apply in the case of electronic publication, we make the following clarifying statement.

The contents of the present issue were put on-line in their original, HTML version during the month of July, 1997. Then the contents were edited and formatted, resulting in the present, formatted version which was published on February 12, 1998, in two concurrent editions: an on-line edition and a paper edition. The on-line edition was timestamped electronically and put on-line by Linköping University Electronic Press at the URL specified on page (i). The paper edition was obtained by printing the on-line edition on a standard computer printer. It was reproduced in 200 copies, legally archived, and made available for distribution.

Vol. 1: *19-24*, 31.7.1997
http://www.ida.liu.se/ext/etai/actions/nj/9707/

July Issue Selected News

Erik Sandewall
Linköping University, Sweden

From the editor

The purpose of this News Journal

The main purpose of this News Journal is to serve as a vehicle for review discussion about recently published articles in the area of **Reasoning about Actions and Change**. The character of these review discussions can now be demonstrated in concrete terms. Earlier this month, our ETAI area received Paolo Liberatore's article "The Complexity of the Language $\mathcal{A}$", and the period of questions, answers, and review discussion about this contribution has already started. Please take a look, therefore, at the discussion page for that article. You will notice how the discussion page contains the same kinds of questions and answers about the article as you would expect to hear at a conference. Here, however, the ETAI discussions are accessible to the whole community, and not only those who happen to attend the conference, and they are retained for future reference. And, maybe the most important of all, the written format provides time to think before writing the questions and the answers.

I hope you will agree that this mode of scientific communication is a significant step ahead from older systems - it's interactive, unlike a conventional journal, it's preserved for future use, unlike a discussion at a conference, and it's available to everyone, unlike an exchange of E-mails.

The top news in the monthly issues of the present News Journal will be a list of recently received articles, which allows you to see what articles have appeared, and what is being said about them. (The list of received articles for our area will be updated continuously, so please check it if you want these news more often than once a month).

Welcome to participate in the discussions

The main components of ETAI are now operational, in particular for the present research area: the structure of WWW pages has been set up, the News Journal has started to appear, and the review discussion for the first contribution has started. You are of course welcome to participate in this scheme yourself, both by submitting questions or comments to current articles, and by submitting your own articles. Each article discussion page contains a handle for submitting questions/comments, and the main ETAI structure contains instructions for authors. If you have any questions, please send me a note.

Have you seen an article recently where you think a similar discussion ought to be opened, for example, because you have a question to the authors which you think may be of general interest? No problems: send me a note with the reference to the article and the first question, and I'll contact the author and set up the discussion page.

And then: formal peer review in ETAI

Besides the discussion facility, ETAI also includes a **formal review facility** leading to **acceptance**. The ETAI publication scheme is different from the usual one, and works in two steps:

- First, an article is opened to discussion, as is now the case for Liberatore's article.
- Then, after a discussion period of three months, and after the author(s) have had a chance to revise it, the article is **refereed** for **acceptance**, using confidential referees and journal level criteria of quality.

We expect that the decision on acceptance can be done rapidly because when the papers have arrived that far, it will already be quite clear how it is received. However, notice that the author doesn't have to wait for publication before the paper becomes visible: it "exists" all the time through this discussion and review period.

The scope of ETAI is defined by the participating research areas (see the ETAI home page for a menue of the currently participating areas). Refereeing for acceptance is done, within each area, by an editorial committee consisting of about ten leading researchers *in that particular area.* See, for example, the editorial committee for actions and change. The combination of an open discussion period and subsequent formal refereeing by specialists in the area of the contribution guarantee the best possible "quality control". In fact, we foresee that the quality of articles accepted by ETAI will be distinctly higher than for articles in **any** conventional journal.

So, if you have a research contribution on Reasoning about Actions and Change which is ready for being submitted to a journal - consider the advantages of submitting it to the ETAI!

Other services

In addition to advertising received articles, the News Journal will contain calendarium information (forthcoming conferences, etc), links to current research software, discussion on general topics within our area, and lists of articles in our area which appear in other journals and at conferences. A [1][demonstration issue] of the News Journal was issued in May, and gives examples of how these other kinds of news items will be presented.

The members of the subscriber list for the present News Journal will receive a reminder by E-mail each time a new issue is out. In order to subscribe or unsubscribe, please [2][send me a note].

ETAI recent developments

The ETAI is a "federation" of research areas, each with its own area editor, news journal, and reviewing mechanism, just like ours. The area of Intelligent User Interfaces (area editor: Elisabeth André) issued its first News Journal earlier during this month (July), and the area of Planning and Scheduling (area editor: Susanne Biundo) will see the issue of its first News Journal within shortly. Additional areas are starting up or being considered.

In a broader perspective, electronic publishing is now developing rapidly. A committee within the ACM, chaired by Joe Halpern is presently working on a new ACM strategy for electronic publishing. Things go at very different speed in different disciplines, but it has reportedly reached far e.g. in astronomy. The ETAI initiative has been reported at several conferences on scientific publication, and has been received with a lot of interest.

Therefore, submitting your article to ETAI achieves two important purposes: obtaining qualified feedback, and giving it the highest possible visibility both now and in the future.

ETAI Publications

Received research articles

The following article has been received by the present News Journal. Clicking the ACRES code of the article leads to its abstract and full text, via a cover page. Clicking the title of the article itself leads to a page containing the on-going question-answer debate about the

[1] Ref: http://www.ida.liu.se/ext/etai/actions/nj/9705/noframe.html
[2] E-mail address: erisa@ida.liu.se

article, with options for submitting a question or comment, and of course for seeing the full text of the article.

[3]**f-cis.linep.se-97-006** Paolo Liberatore:

[4]The Complexity of the Language A.

There is also [5][a plain web page containing a list of all received articles], and similarly [6][a page using frames]. (On the date of issue of this first issue of the News Journal, the list only contains Liberatore's article. Additional contributions will be added to the list successively).

Accepted research articles

This heading will be used in future issues of the present News Journal for reporting on articles which have been **accepted by the ETAI** after confidential review, thereby achieving proof of high journal quality. At the present time, of course, no article has reached to that point.

Software

Announcements of research software systems

This News Journal invites announcements of research software systems pertaining to the area of actions and change. We believe that the development and diffusion of software systems representing the state of the art in research is now very important in this research area. Also, the electronic communication medium is particularly appropriate for this purpose.

The demo issue contained announcements of two software systems for actions and change: the VITAL system and the DLS algorithm.

Debates

General debate on approaches to reasoning about actions and change

The demo issue also contained the beginning of a debate on general approaches to reasoning about actions and change. Additional contributions to that debate are invited, and will be organized in a fashion similar to the discussions about received articles.

[3]Ref: http://www.ep.liu.se/ea/cis/1997/006/
[4]Ref: http://www.ida.liu.se/ext/etai/received/actions/001/aipf.html
[5]Ref. http://www.ida.liu.se/ext/etai/received/actions/received.html
[6]Ref. http://www.ida.liu.se/ext/etai/received/actions/recframe.html

Calendar

Forthcoming conferences and workshops

FCR-98: Formalization of Commonsense Reasoning.
London, U.K., 7.1-9.1, 1998. Papers due: 10.10 1997.
CFP: http://www.dcs.qmw.ac.uk/ rsm/CS98/CS98cfp.html
INFO: http://www.dcs.qmw.ac.uk/ rsm/CS98/index.html

The organizers of this conference have set up a Common Sense Problem Page, containing (quote) *a collection of problems or descriptions of domains which individual contributors have found of interest from the point of view of logical formalizations of common sense reasoning. Additions to this collection are welcome...* (end quote).

TIME-98: International Workshop on Temporal Representation and Reasoning.
Sanibel Island, Florida, USA, 15.5-16.5, 1998. Papers due: 8.12 1997.
CFP: http://www.cs.fit.edu/ lina/time/cfp.txt
INFO: http://www.cs.fit.edu/ lina/time/time98.html
MSG: http://www.ida.liu.se/ext/brs/confi/cfp/TIME-98.txt

KR-98: International Conference on Knowledge Representation and Reasoning.
Trento, Italy, 2.6-5.6, 1998. Papers due: 1.12 1997.
CFP: http://www.kr.org/kr/kr98/cfp.html
INFO: http://www.kr.org/kr/kr98/
MSG: http://www.ida.liu.se/ext/brs/confi/cfp/KR-98.txt

Special journal issues and other events

None at this point.

Other publications

In journals

The present heading will list journal articles on Reasoning about Actions and Change, with special priority on articles in high quality journals containing only a small proportion of AI and KR contributions - articles which may otherwise easily be overlooked by researchers in our field.

We begin with the following articles. We are happy to receive suggestions for what journals and what articles ought to be covered.

jr-fi-30-109 Yan Zhang and Norman Y. Foo:
Deriving Invariants and Constraints from Action Theories.

jr-aij-92-91 B. Shults and B.J. Kuipers:
Proving properties of continuous systems: qualitative simulation and temporal logic.

jr-aij-92-131 Fangzhen Lin and Ray Reiter:
How to progress a database.

jr-aij-92-301 A.D. Kshemkalyani:
Reasoning about causality between distributed nonatomic events.

In conferences

The News Journal will regularly list references to articles on reasoning about Actions and Change which appear in other journals or conferences.

Lists of articles on Reasoning about Actions and Change at AAAI-97, NRAC-97, and IJCAI-97 can be found in the [7][corresponding section] of the previous (demo) issue of this News Journal.

Similar lists of relevant articles at some other recent conferences will follow.

[7]Ref: http://www.ida.liu.se/ext/etai/actions/nj/9705/noframe.html#fapr

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http://www.ida.liu.se/ext/etai/received/actions/001/

Paolo Liberatore:

The Complexity of the Language $\mathcal{A}$

Summary of the article

The original version of the full article has been published by Linköping University Electronic Press, and is permanently available at
`http://www.ep.liu.se/ea/cis/1997/006/`

The language $\mathcal{A}$ has been proposed in 1993 by Gelfond and Lifschitz to formalize properties of actions. $\mathcal{A}$ is an high-level language, and its syntax and semantics are similar to those of logic programming languages (with negation). For example, stating that a fact P holds after a sequence of actions $A_1, ..., A_m$ is denoted by P **after** $A_1; ...; A_m$

The main contribution of this paper is the analysis of the computational properties of $\mathcal{A}$. Namely, we prove that deciding the consistency of a set of statements in $\mathcal{A}$ is NP-complete. We also prove that entailment (deciding what is implied by a set of statements) is coNP-complete. These two results are strictly related.

The practical implications of these results are not necessarily negative. While it is strongly believed that NP-complete problems cannot, in general, be solved efficiently, they are easier than other problems in higher classes of the polynomial hierarchy. Many heuristics for solving NP problems (e.g. the problem of satisfiability of a propositional formula) have been developed. We explicitly reformulate the problem of consistency in $\mathcal{A}$ as the problem of satisfiability of a propositional formula. This is done by translating the set of statements of $\mathcal{A}$ into a set of clauses whose Clark's completion is satisfiable if and only if the original set of statements in $\mathcal{A}$ is consistent. Since Clark's completion of a set of clauses can be expressed as a propositional formula, this is indeed a translation of consistency in $\mathcal{A}$ into propositional satisfiability. Heuristics for SAT can thus be applied to the resulting propositional formula.

We analyze the computational properties of $\mathcal{A}$ when the language is restricted. The main result obtained is that an exponential number of initial states is a necessary condition to obtain the NP hardness. The number of actions and the number of effect of actions seemed at a

first look to cause intractability. Indeed they do not, since restricting these numbers to be small does not lead to tractability. The two most significant tractable sublanguages of $\mathcal{A}$ are the one in which the initial state is fully known, and the one in which cause-effect rules have only one positive precondition and one positive effect.

The last problem analyzed in this paper is the effect of states that are not reachable from the initial state. In the original semantics of $\mathcal{A}$, unreachable states can affect the consistency of a set of statements, while intuitively they should not. We propose an alternative semantics that does not suffer from this drawback.

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http://www.ida.liu.se/ext/etai/received/actions/001/

Protocol of on-line discussion during July, 1997 about the following research article:

Paolo Liberatore:

The Complexity of the Language A

Q1. **Erik Sandewall** (11.7)

Paolo,
What is the relationship (or is there any) between your results and the results by Nebel and Bäckström on the complexity of plan validation and temporal projection? Since basic cal-A characterizes updates to the current state, it is at least related to the STRIPS-based framework of classical planning, and deciding the consistency of a set of statements in cal-A would seem to be related to plan validation? For a reference to Nebel/Bäckström, see

Bernhard Nebel and Christer Bäckström:
On the Computational Complexity of Temporal Projection, Planning and Plan Validation.
j-aij-66-125([8]): Artificial Intelligence 66(1):125-160, 1994.

A1. **Paolo Liberatore** (14.7)

This is an interesting question. In general, entailment in reasoning about actions languages such $\mathcal{A}$ is strictly related to (deductive) plan validation. Indeed, a plan is a sequence of actions, and it achieves a goal G iff the goal is true after the execution of the sequence (regardless of the initial state).

As for the specific problems of consistency (or entailment) in $\mathcal{A}$ and plan validation as defined by Bäckström and Nebel, I think there are substantial differences. Let me explain in short what is the source of intractability of these problems. In $\mathcal{A}$ the NP-hardness is due to the

[8] All info:
http://www.ida.liu.se/%7Echrba/publications/article-full.html
Postscript:
ftp://ftp.ida.liu.se/pub/labs/tosca/people/chrba/aij94-v66.ps.gz

incomplete specification of the initial state: one has in general to consider an exponential number of possible initial states. The problems of temporal projection and plan validation analyzed by Bäckström and Nebel are intractable because the possible sequences of actions can be exponentially many. The initial state is fixed (and fully specified), but, in order to verify if a fact is true after an event (or to verify whether a goal is achieved), one has to consider all the possible sequences of actions that respect a given ordering.

Of course both problems (entailment and plan validation) are coNP complete, so one can be reduced to each other, but I do not think there is a "simple" and intuitive way to do that for entailment in $\mathcal{A}$ and plan validation as defined by Bäckström and Nebel.

Q2. **Michael Thielscher** (22.7)

Paolo, I have two questions/comments. First, Your proof of intractability of general $\mathcal{A}$ relies on the construction of effect propositions all of whose conditions are unspecified in the initial state. It therefore seems that even if the initial state is incomplete, if only the number of (relevant) unspecified fluents is small then both consistency checking and entailment is still polynomial, am I right?

A2. **Paolo Liberatore** (24.7)

Yes. Indeed, NP completeness is due to the fact that the possible initial states are exponentially many. If there is only a constant (small) number of unspecified fluents in the initial state, then the number of initial states is constant (in complexity theory, if c is a constant, then 2^c is also a constant). The same holds also when there is a non-constant number of unspecified fluents in the initial state, but no effect proposition have them as preconditions.

Q3. **Michael Thielscher** (22.7)

My other question is, Did you have a look at extensions of $\mathcal{A}$ which support nondeterministic actions? Does tractablity in case of complete initial states still hold?

A3. **Paolo Liberatore** (24.7)

I have not studied the complexity of the extensions of $\mathcal{A}$ in details. At a first look, it seems easy to prove that the dialects that include concurrent actions (the proposals by Baral&Gelfond and Li&Pereira) are more complex than basic $\mathcal{A}$, namely Σ_2 for consistency and Π_2 for entailment. The complete knowledge of the initial state should reduce the complexity to NP and coNP, respectively. The proposal by Bornscheuer&Thielscher should be as easy as basic $\mathcal{A}$ (NP and coNP complete). About non-deterministic actions: I had a look to $\mathcal{AR}_0$ (proposed by Kartha&Lifschitz), and it seems to me that it should be Σ_2 also. A complete knowledge of the inital state does not help, since the domain description can always contain propositions such `A releases F`. There are other formalizations of non-deterministic actions, but I have not analyzed them yet.

Q4. **Erik Sandewall** (28.7)

Paolo,
Your construction in section 4 seems to be similar but not identical to PMON; let me ask you about what the relation may be. In your case, if the action A_k goes from node i to node j, you introduce for each fluent F_o the clauses

$$x_o^j \leftarrow c_o^j, \neg x_o^i$$

$$x_o^j \leftarrow \neg c_o^j, x_o^i$$

Furthermore, each effect proposition, for example

$$A_k \text{ causes } F_0 \text{ if } F_1, F_2$$

is mapped into a clause

$$c_0^j \leftarrow x_1^i, x_2^i, \neg x_0^i$$

The last literal is needed because c_0^j expresses that F_0 has to change from node i to node j, whereas the effect proposition merely assigns its new value, regardless of whether it had it before or not. (I hope I got this right).

Now, this is similar to how occlusion is used in PMON, except that occlusion only states a "permission" to change. (Occlusion is the same as the "release" operator later adopted by Lifschitz). Therefore, the counterpart of the first two clauses above are the "nochange" axioms, which in your notation would be

$$c_o^j \leftarrow x_o^i, \neg x_o^j$$

$$c_o^j \leftarrow \neg x_o^i, x_o^j$$

which together say "if $x_o^i \neq x_o^j$ then c_o^j". For things to come out right, in PMON one has to minimize occlusion before applying the nochange axioms. In your case there does not seem to be any corresponding partitioning of the axioms for the purpose of completion.

My question is whether the difference between your clause pair and the nochange axioms is crucial for the construction, and in particular, whether that is the reason why partitioning of the axioms does not seem to be necessary.

PMON was introduced in "Features and Fluents" (my book at Oxford University Press, 1994) and in Doherty's article at ETAI 1994.

A4. **Paolo Liberatore** (30.7)

I will answer to the last question first. From a computational point of view, entailment under completion is "only" coNP compete, since the completion of a set of clauses is a propositional formula of polynomial size. On the other hand, circumscriptive entailment is Π_2 complete, thus harder.

Since PMON requires a minimization of the occlusion predicate, it should be harder than the completion formulation of $\mathcal{A}$. On the other hand, PMON allows a correct formulation of non-deterministic actions, while completion does not. Right now, I do not see an easy way of extending the translation of section 4 without introducing an explicit minimization, thus increasing the complexity. Of course, this increase of complexity should not be considered bad, since languages with non-deterministic actions are surely harder (in the general case) than simple languages. I agree with you that extending the translation in the sense you pointed out should allow the identification of subclasses of the problem for which the computational complexity is only coNP, since it should be easier to find classes for which the minimazation policy can be replaced by a simpler completion.