

Laudatory Remarks Regarding Ray Reiter  
Presented at IJCAI93  
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## 1 Introduction

I am honored to introduce the recipient of the *Fourth International Joint Conference on Artificial Intelligence (IJCAI) Award for Research Excellence*, Ray Reiter. I nominated Ray for the award, together with distinguished seconds by John McCarthy and Alan Mackworth. I believe that Ray deserves to be in the company of the past awardees: John McCarthy, Alan Newell and Marvin Minsky. In these short remarks I will talk about Ray as a person and as a scientist, and why I believe he is eminently worthy of the award.

## 2 Ray Reiter - The Person

I came to know Ray almost exactly 20 years ago to the day. He was at the University of British Columbia at the time. I was on vacation with my family, passing through Vancouver on my way to IJCAI, held at Stanford that year. I took time out from my vacation to meet Ray since I had read some of his papers and he was working in an area of interest to me. It was an enjoyable visit and, over the years, we have become close friends. I have come to value our friendship and to be influenced by his research.

To gain a better perspective of Ray on the personal side I have solicited comments from some of his students: Dave Etherington, Randy Goebel and Brian Funt, and from his colleagues: John Seely Brown, Johan de Kleer, Hector Levesque, John Mylopoulos and Richard Rosenberg.

Although he is an interesting conversationalist, Ray is basically a modest person who neither talks much about himself nor boasts about his research. I believe that Ray understands that his research is good, but he does not seem to value his research as highly as others, such as I, do. This mistake

to undervalue his research has cost him dearly. When I sent Ray a message to tell him that I was nominating him for the IJCAI award and wanted a copy of his vitae, he demurred and said that I was wasting my time since he would never receive the award. I responded that I did not ask for his opinion, but for his vitae and that I was going to nominate him with or without his cooperation. He was so confident that he would not win that he made a fatal mistake – he offered to take me to the best restaurant in France if he won. The reason I look so well fed today is because we went to Paul Bocuse’s three star restaurant in Lyons a few days ago to celebrate the award. Ray is a man who keeps his word –well, almost – I won’t talk about the Singapore Sling he still owes me at Raffles in Singapore.

One of the surprising things about Ray is that he is a Lepidopterist - he chases after butterflies in the tropical rain forests. We shall also find out that he chases after other things as well. He also goes ‘ape’ every now and then. He has gone to Malaysia and to Indonesia to be in the tropical rain forests to frolic with orangutangs and to meet primitive cultures. Preceding *IJCAI-91* he was in Borneo. Heavy rains and sodden landing strips forced the cancellation of a missionary flight that was to pick him up for the trip back down river and then to Australia (where he was program co-chair). At great expense he ended up having to charter a helicopter to bring him back to civilization to be in time for the opening of *IJCAI*. Ah, the things he goes through to serve our community.

His boyhood friend Rich Rosenberg says that Ray was a typical young boy. Rich states,

Both Ray and I belonged to a religious Zionist youth group for a couple of years when we were about 15. But the primary reasons were neither religion nor Israel — but girls. Against the understood rules of the organization we held dances and actually did slow dancing. After a while the religious stuff became too oppressive and he quit.

Ray’s behavior in graduate school became more interesting. At the University of Michigan, Ray became fascinated with motorcycles; he and his fellow students John Seely Brown and Abbe Mowshowitz bought large BMW touring bikes. He made trips in Europe and in the U.S. wearing leather but, according to our sources, somehow looking somewhat out of place. Can you envision one of the gurus of nonmonotonic reasoning running around as if he were one of the Hells Angels gang?

Ray spent his first year in undergraduate school at the University of Toronto in engineering physics before transferring to the Arts faculty in mathematics, physics, and chemistry with a strong interest in applied mathematics. Rich Rosenberg believes that this is an early indication of his resistance to hacks and his strong commitment to formal approaches.

Ray is fundamentally a night person. His graduate students know not to look for him until some time after 2:00PM. He prowls around at night and prefers New York and Toronto to Vancouver since he can get a cup of coffee anywhere at 4:00AM in the big cities. Alan Mackworth speculates that

Ray is a machine for turning caffeine and nicotine into theorems. To be cut off from this feed stock during the height of his productive hours would be distressing.

### 3 Ray Reiter - The Scientist

I will now turn to Ray's scientific work. Ray's research is concerned with the formal foundations of knowledge representation and reasoning in AI. His work is motivated by specific practical problems in AI which, in turn, drive the theoretical results. He isolates problems and techniques that arise in different application areas in AI, formalizes and, where possible, generalizes them, then explores what these theories have to say about the applications that motivated them, and about knowledge representation in general. It is clear that his overall objective is to determine unifying reasoning patterns that cut across application domains. From conversations with him, this reflects his belief that a science of AI is possible, and that one way to achieve it is by isolating these patterns, and studying their formal properties. He is fundamentally looking to break new ground rather than to prove a result, just because it can be proven. It is this probing of what do things mean, why do they seem to work when we do things in a certain way, and how can we explain a phenomenon in a coherent fashion, that distinguishes his work. It appears to me that he brings a Talmudic approach to his work.<sup>1</sup>

He studies the literature of a subject, understands it thoroughly and tries to explain why things follow from our readings. He is not interested in *any problem*, but in ones that will shed light on a class of problems. Dave Etherington states that Reiter's Maxim is:

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<sup>1</sup>This is not surprising since, when Ray was in his teens, his rabbi tried to convince him to attend rabbinical school. He was so impressed with Ray's talmudic abilities that he offered to pay for his studies if he went to rabbinical school.

Just because you can prove it, that doesn't mean that it is interesting.

His research covers a wide range of areas in AI: nonmonotonic reasoning, AI and databases, logic programming, truth maintenance systems, diagnostic reasoning, computational vision, and representation and reasoning for dynamic worlds.

*Nonmonotonic Reasoning.* Ray is one of the founders of the field of nonmonotonic reasoning. I believe that this is a major accomplishment that computer scientists have made to the field of mathematical logic. His 1978 papers on closed world reasoning [Rei78b] and on reasoning by default [Rei78c] are among the first to deal with a formal treatment of nonmonotonic reasoning. The work derives from his observations about AI Programming languages (Planner and Prolog), databases, the frame problem and natural language processing that all deal with default situations. In his 1978 paper on default he argues that the underlying notion is "...in the absence of evidence to the contrary, assume ...". His work on *default reasoning* was finalized for his article [Rei80] in the seminal 1980 issue of the AI Journal. This work was supplemented with papers with Etherington, [ER83], which initiated a large body of research on nonmonotonic formalisms for inheritance; with Criscuolo, [RC83], which described a variety of problematic settings for default reasoning and provided a number of standard benchmark examples for the field; and with Bertossi, [BR92], which provides a circumscriptive characterization of generic objects in geometry. The paper with Bertossi promises a general theory of genericity in mathematics based on circumscription, and is the first example of an AI theory with a non-trivial application to mathematics and to mathematical logic.

On the negative side, I believe that Ray is the cause of our having been plagued by the ubiquitous "tweety" example in nonmonotonic reasoning.

*AI and Databases.* A significant part of his research has been to generalize databases and to develop a theory of deductive databases that includes reasoning capabilities. He was the first to have provided an axiomatization for relational databases and their deductive generalizations [Rei84]. This has now become the standard specification for the research community in deductive databases. His most important contributions in AI and databases are as follows. In 1978 he formulated the Closed World Assumption (CWA) [Rei78b]. This was the first formalization of the concept of negation in deductive databases. He investigated some of the formal properties of the CWA. This paper was very influential and has led to a considerable body

of research involving generalizations of the CWA, and its implications for nonmonotonic reasoning and logic programming. Indeed, my work on the Generalized Closed World Assumption (GCWA) [Min82], was influenced by Reiter's paper. In 1978 he also provided the first proposal for compiling the deductive rules of a database [Rei78a], in order to obtain an efficient implementation of a deductive system. In 1984 he provided the first formal account of the concept of an integrity constraint [Rei84], and more recently he has proposed a more radical approach which appeals to an autoepistemic interpretation of constraints. In 1992 he developed a theory of database updates based on the situation calculus [Rei92a]. This work borrows from a variety of AI planning ideas in the situation calculus to yield an approach to the formalization of database updates. This is a very nice example where problems and their solutions from "classical" AI - in this case the frame problem - have applications to problems outside the field.

*Logic Programming.* He has made three important contributions to the field of logic programming. In 1971 he independently formulated, and proved the completeness of the SL resolution procedure, which he called the clause-ordered linear resolution strategy, which forms the procedural basis for logic programming interpreters [Rei71]. His work on the CWA provided an early semantics for Prolog's negation-as-failure operator. His papers on nonmonotonic reasoning [Rei87a] both emphasized the nonmonotonic character of the negation-as-failure operators of Planner and Prolog, and the potential uses of such programming languages for implementing nonmonotonic reasoning systems. This insight provided the motivation for a large body of current research on nonmonotonicity and logic programming including a bi-annual conference, *Nonmonotonic Reasoning and Logic Programming*.

*Truth Maintenance Systems.* Together with de Kleer he gave the first theoretical foundations for assumption based truth maintenance systems [dKR87]. This revealed their intimate relationship to abductive reasoning, which explains why these systems have enjoyed such widespread applications.

*Diagnostic Reasoning.* Ray provided the first formalization, in an extremely general setting, of the task of diagnosing faulty systems [Rei87b]. This formalism has now become the standard theory of the diagnostic reasoning community.

*Computational Vision.* Together with Alan Mackworth, he provided the first formal account of high level image interpretation for computational vision [RM89]. This allows, for the first time, the integration of background knowledge about the scene domain into the image interpretation process,

and provides an account of how this knowledge conditions the interpretations computed.

*Representation and Reasoning for Dynamic Worlds.* Ray's current work focuses on problems of representation and reasoning for dynamic worlds. He believes that while AI does have various theories of time and change, none of these is sufficiently rich to express everything one wants to say about changing worlds. His current research revolves around the situation calculus as a formal framework in which to explore these issues. I believe that this is a very promising direction of research. He already has some results: providing a foundational axiomatization for the situation calculus, including mathematical induction for proving properties of world states [Rei92b] and addressing the frame problem for determinate events [Rei91]. He is exploring a novel logic programming language based on these ideas tailored to discrete event simulation and robot control. He is also exploring many applications in computer science of a rich theory of change, specifically, applications of the above ideas to program verification, database updates, software specification languages and concurrency control.

## 4 Summary

It is clear that Ray has made major contributions over a period of more than 20 years to the field of AI. He has led the way in the formalization of default and nonmonotonic reasoning, artificial intelligence and deductive databases, diagnostic reasoning, and computational vision. He is in the forefront of those who are making AI a science. In closing I would like to quote his former student David Etherington:

There seem to be two sides to Ray, one that his peers see and another that he reveals only to his friends. ... At first they seem incongruous – like the juxtaposition of the logician and the jungle trekker; reflection shows that his sense of adventure, his desire to explore ahead of the pack and to push on the frontiers, reconcile them. We should expect to continue to be surprised by where he goes next, in either realm.

I am proud to introduce to you the recipient of the *IJCAI Award for Research Excellence* - Ray Reiter.

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