

AISB moves into the 21st Century

The beginning of the twenty-first century looks like being an exciting time for science in general and for AI in particular. Looking back over the successes and failures of twentieth century AI, a clear picture of over-optimism seems to emerge. Of course, the fact that so many of AI's twentieth century goals proved more difficult than expected does not entail either that they were impossible, nor does it detract in any way from the tremendous progress that was made.

I am reminded of a Margaret Welbank cartoon on the cover of AISBQ a few years ago. I think it showed GOFAI as a bearded old man and connectionism as a mature net-wielding individual both looking at the infant Alife - portrayed as a crawling baby. "Just wait till he's had a few failures," they were wryly observing. This is perhaps the time to observe that the initial rapid progress in Alife and situated robotics seems now to be stalling. If we were to re-run this cartoon now it would have a different meaning.

Overall, it seems an appropriate time to talk of taking stock - for Alife in particular and AI in general. After all, Turing's deadline for success in the imitation game is now definitely passed and, however impressed you are with the current generation of chatbots, no machine looks anywhere near achieving this particular goal. There are other goals, of course, and many interesting successes. If we could finally shrug off the legacy of the Turing test and the more science fiction aspects of AI research then we could perhaps move towards a clearer set of goals. This is particularly the case for Alife which needs to become much clearer about its present goals. It's a time of change and an exciting time to be commenting on these new sciences.

AISBQ itself has (perhaps rather obviously) changed. This is the first of the Quarterlies in the new format. Let me make it clear that

you will also receive the Journal together with the next Quarterly. The details of the refereed papers in the Journal are given on page 3. There are many reasons for this change, but perhaps the most important, for present purposes, is that it enables the Quarterly to function purely as a forum for the UK AI community, its original purpose. Refereed technical papers will be published in the Journal. Please contribute to this forum - a quick email to me will do.

This Quarterly certainly establishes the tradition. As well as the news items, there's a review of the new Steven Spielberg film: 'AI'. It's not really about AI - more an updating of Pinocchio - but it will prompt a lot of media interest in AI. The representation of AI in the film is not where I see AI going in the future, but I know there are those of you who disagree. I'd like to hear members' views on this.

On a more serious note, there's also an open letter from Steve Grand. Steve raises a number of points relevant to my observations at the beginning of this editorial. He is trying to justify his own research agenda and to situate it within the (often conflicting) research agendas of biology and robotics. When Steve described his work in a talk at Sussex in June, it was clear that his research is not following the same path as the research at Sussex and the open letter is, in some ways, a response to that divergence. I hope to be able to publish a direct reply to Steve in the next Quarterly. I'm sure this is an important contribution to the process of taking stock in Alife and I would encourage all readers with something to say on this to drop me a line.

There's an invitation to use an interesting (and useful) on-line AI program. Could this be more indicative of the future of AI? I'd like to hear. There's also 'From the Archives' and, as always, Father Hacker of the Cognitive Divinity Programme gets his say.

Blay Whitby
Editor

Contents

Editorial	1
News	2-3
AISB News	4
Conference Reports.....	5-7
Open letter from Stephen Grand	8-12
Letter to the Editor	13
Film Review.....	14
From the Archives	15
Father Hacker....	16

News

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Computer Artist Available for Download...

When Harold Cohen gave an invited speech at the AISB'99 convention about his digital artist AARON, one of the questions asked was: "Where can I download AARON?" Harold was taken aback and said that AARON was not available for other people to use. This attitude may be uncommon in AI circles, but it is certainly understandable - Harold has spent 30 years of his life building AARON to be the artist it is today.

I was therefore extremely surprised when I stumbled across this website: <http://www.kurzweilcyberart.com/> because it contains a downloadable version of AARON. It appears that Ray Kurzweil has convinced Cohen to make AARON available to the public. It's available for a month's free trial and for the very reasonable price of \$20, you can keep it forever.

AARON is sold as: "... the first fine art screensaver to utilize artificial intelligence to continuously create original paintings on your PC". So I had to download it.

It installed on my Windows machine with no problems whatsoever. I then clicked go, and what do you know, AARON created a very nice painting of a man and woman in front of a red screen. I then spent over an hour getting AARON to paint picture after picture and trying to derive some rules about how it works. There are some obvious tricks, such as all the figures having short sleeves so that their arms are visible when crossed over their torso. However, after having AARON for a couple of weeks now, I'm still impressed by its paintings and most of the rules I project onto it are broken at one stage or another. I even have it as my screensaver, and look forward to returning to my computer after those long lunches.

Looking at the paintings from a purely aesthetic point of view (ignoring my bias towards machine creativity), I thought that most of the paintings were acceptable and some were worth putting on my wall. In general, there does seem to be a lack of action in them - the figures rarely seem to be actually doing anything.

In other versions of AARON, the figures are drawn to do more gymnastic activities, accompanied by large beach balls, etc., and these seem more interesting as they have more life. The lack of purpose is more than made up for by the novelty of the paintings produced and the way in which AARON uses colours, which is particularly impressive. AARON uses paint strokes rather than block-filling which graphics packages employ. It is easy to see why many people (myself included, but Cohen excluded) are prepared to say that AARON is creative.

So, I imagine you are going to rush off and download the free trial copy immediately. However, the main problem for AISBQ readers will be this: it requires Windows (98 or higher), which is ironic as it seems that Harold Cohen developed AARON largely on a Mac. Other limitations include not being able to save the creations as graphics files. This is probably for copyright reasons - making it difficult for anyone to make money selling AARON's creations (illegal of course, after you sign the license agreement before downloading). You can, however, print the files out, and they are very impressive on A3 paper. You can also email a friend a painting, which will be re-drawn for them at the Kurzweil Cyber Art website.

It is rare for me to actually purchase a piece of software I have trialled for a month, but I intend to do so with AARON. Moreover, a non-AI friend of mine was so impressed with AARON that he sat for half an hour waiting for his slow modem connection to download the 9.16Mb setup program, which is perhaps more of an endorsement than mine.

In addition to AARON, Kurzweil has also made available a "Cybernetic Poet" which can write poetry and help you compose masterpieces. The free edition has 50 'poet personalities', and you can pay for 50 more. This is surely the way to go with AI programs - make them downloadable (or even runnable) over the web. If Kurzweil can do this with a LISP program Harold Cohen has developed over 30 years, then there is hope for us all.

*Simon Colton
Universities of Edinburgh and York*

News

AISB Web Pages Overhauled

Visitors to the AISB web pages at <http://www.aisb.org.uk> will have noticed that it has recently been overhauled and is no longer just a place to download forms from. Rather, we intend the web pages to play a vital role in the life of the society and to be our front-end to the world.

The refurbishment has been in two stages. Firstly, we redesigned the site to (a) accommodate more web pages containing more information and (b) enable easier navigation through the pages. Stage one is complete, and, while not perfect, the new site looks much more up-to-date and is a lot easier to navigate.

Secondly, we have started putting more and more information onto the site and we are currently hiring people to put additional content onto the pages. We intend the site to be a real resource for AI and cognitive science researchers and lecturers, as well as providing an introduction to anyone interested in these subjects.

As a place for research, we have put some papers taken from the AISBQ and the proceedings of the AISB conventions online. Many important and influential people in AI have, at one stage or another, penned a note for the AISBQ or written a paper for the annual convention. In addition to technical and less-technical notes, there are also book reviews and conference reports. We also plan to have extensive AI links indexed by keyword, topic, research group, etc, as well as a search function over the papers held at our site. As an introduction to AI and cognitive science, we plan to write some introductory explanations and perhaps commission some inspirational notes from society members.

Last, and by no means least, we have scanned in all the writings of Father Hacker, perhaps the most famous researcher to have ever written for the AISBQ. His writings are organised into years, and are all available online - surely worth logging on for. Please check out the new site and consider contributing to it - as with the society itself, we rely on your input.

Simon Colton
AISB webmaster

Computer Art

The Anglo-Australian artist Paul Brown joined Sussex University's School of Cognitive and Computing Sciences as artist-in-residence for 2000. He has been specialising in computing since the late 1960s and, prior to moving to Australia in the 1980s, was head of the UK's National Centre for Computer Aided Art and Design at Middlesex University in London.

Paul is currently a New Media Arts Fellow of the Australia Council for the Arts and chose to spend the first year of his fellowship at COGS in order to learn more about evolutionary computation. His work since the early 1970s has involved aspects of artificial life or A-Life. It includes time-based pieces which are computed in real time on the computer screen and large format prints using the recently developed giclee archival inkjet printing process.

'A main interest of mine', said Paul, 'is the concept of emergence - where for example a simple set of rules can lead to complex and unpredictable outcomes. The old saying that..."The whole is greater than the sum of the parts" describes these kind of processes and applies equally as well to artworks made using traditional materials as it does to works like mine that are made using computer software.'

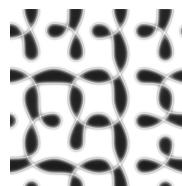


Image: Desert Storm © Paul Brown 2000 www.paul-brown.com

Further examples of Paul's work are on his website at: www.paul-brown.com and have also recently been exhibited at the Colville Place Gallery in London.

AISB's first Journal to be issued soon

The first issue of the AISBJ will contain papers from authors contributing to the agents symposia at the AISB'01 convention. The symposia topics were: (a) information agents for e-commerce, (b) adaptive agents and multi-agent systems and (c) software mobility and adaptive behaviour. We are expecting around 10 high quality papers. The first issue will be guest edited by Eduardo Alonso and Daniel Kudenko (Adaptive agents symposium chairs), Michael Schroeder and Kostas Stathis (Information agents symposium chairs), Luc Moreau (Software Mobility chair) and Simon Colton (AISB'01 Chair).

AISB News

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Chair's Message

Now that AI is firmly in the public imagination, following the massive publicity for and release of the new Spielberg blockbuster of the same name (see review on page 14), the time is ripe as never before for further establishing AISB as an academic presence in the UK.

Membership is on the up, and our new Convention format continues to attract large numbers. For this improvement to continue, the committee needs the support of its members, in encouraging students to join the society, in contributing to AISBQ through letters to the editor and events notices, and, perhaps most importantly, in submitting high quality papers to the new journal, AISBJ, which will be launched later this year. The first issue of AISBJ will be a focused collection of papers developed from a selected range of AISB 2001 presentations, but in future, we will be soliciting submissions on any AI related area, particularly areas conforming to the journal's "Interdisciplinary" by-line. The committee believes that this approach will be a useful antidote to the general tendency of the AI world to fragment into specialisms - not that this is a bad thing in itself, but it's good to have general, unifying fora too. The AISBJ management group will be developing an editorial team, composed of AISB members, over the next few months.

AISB 2002

We are now able and very pleased to announce that the AISB 2002 convention will be held at Imperial College, London, with affordable accommodation in student halls nearby. The committee is very grateful to Imperial's Department of Computing, and, in particular, to Jim Cunningham, a stalwart AISB member of very long standing, for chairing the event. The calls for symposium proposals has been issued electronically, and the selection process is now proceeding. Calls for papers will be issued soon after the arrival this AISBQ.

Student Travel Funds

A related issue to student membership is the student travel fund. The fund has been consistently under-subscribed recently, so please encourage your students or your peers to apply. Assistance is available to student members for attendance at any AI related conference (normally restricted to one student per event), and the only payback

required is a short review of the conference attended for AISBQ. To apply, see the appropriate page on AISB's web site:

http://www.aisb.org.uk/resources_index.html

Those Christmas Lectures...

Of course, AISB was only part of the outcry regarding the appointment of Kevin Warwick as Robotics' representative in the 2000 Royal Institution Christmas Lectures. We are pleased to note, however, that the combined complaint of our community seems to have had some effect, if belatedly. Many AISB members have no doubt received the circular from EPSRC inviting nominations from the relevant fields (not ours, of course, two years running) for next year's speaker. Once bitten, it seems...

Committee Changes

Finally, ave atque vale: we have some changes on the AISB committee. Ian Gent, Martin Oliver and Chris Reed have now served their full three years, and have decided to stand down. On behalf of the members, I'd like to thank them very much for their contribution. Simon Colton was elected unopposed to replace Chris, some time ago, and we are awaiting the election of two new members. Replacing Simon in his former role as co-opted Convention chair is Jim Cunningham from Imperial. Welcome to both Jim and (again) Simon.

Geraint Wiggins
AISB Chair

Publications dates for the next issue of AISBQ:

*All submissions for the December issue of AISBQ must be made no later than **Friday 26 October 2001**.*

Publication of the AISBQ will be in March, June, September and December, with copies of the AISBJ being sent out with the June and December issues.

Conference Reports

AISB 01 Convention

21-24 March 2001

University of York, England

The AISB'01 convention was held at York University in March this year, and attracted over 200 delegates from 20 different countries. The theme of the convention was "Agents and Cognition" and we wanted to emphasise the topic of agents without losing the general AI and cognitive science feel of the AISB conventions. To this end, we were successful, and the convention consisted of 6 parallel symposia on these topics:

- a) Adaptive agents and multi-agent systems
- b) Artificial intelligence and creativity in arts and science
- c) Emotion, cognition and affective computing
- d) Information agents for electronic commerce
- e) Software mobility and adaptive behaviour
- f) Nonconscious intelligence: from natural to artificial

'we wanted to emphasise the topic of agents without losing the general AI and cognitive science feel of the AISB conventions'

We were also co-located with the eighth workshop on automated reasoning, and we very much welcomed their presence at the convention. The abstracts for all technical papers delivered in the six symposia are available here:

<http://www.aisb.org.uk/aisb01/abstracts/>

and the proceedings from the symposia can be purchased for ten pounds each, or £50 for all six (please email simonco@cs.york.ac.uk for these). The topics covered in the symposia covered a wide range of AI and cognitive science issues, as can be seen from a selection of paper titles:

- ◆ *Dynamic Skills Learning: A Support to Agent Evolution*
- ◆ *Learning Faster in Cooperative Multi-agent Systems*
- ◆ *Towards A Framework for the Evaluation of Machine Compositions*
- ◆ *Generating Poetry from a Prose Text: Creativity versus Faithfulness*

- ◆ *Multiple Level Representation of Emotion in Computational Agents*
- ◆ *Simulated Affections of an Animated Pedagogical Agent*
- ◆ *Keylets and Mobile Agent Security*
- ◆ *Migration Intelligence for Mobile Agents*
- ◆ *Styles of Nonconscious Intelligence*
- ◆ *Metacognitive Measures of Implicit Knowledge*

There were also five invited talks in plenary sessions on agent-based topics. Nick Jennings discussed "Automated Haggling: Building Artificial Negotiators", Lyndon Lee described the "Multi-Agent Research at British Telecom", Andrew Jones spoke "On the Concept of Trust", Christoph Benzmueller presented "An Agent Based Approach to Reasoning" and Jim Doran described "Agents and Ecosystem Management: from the Fraser River to Boolean Networks". We were also given an introductory talk by Michael Luck on the AgentLink II network, to which we are grateful for supplying money for an invited speaker to the adaptive agents symposium (Enric Plaza).

The convention attracted delegates from Japan to Germany, Israel to Sweden and Australia to the US, so was a truly international event. Thanks to the many people who helped with the organisation, the convention was a big success, both financially and in terms of the quality of the work presented. There are too many people to thank individually, but we are especially grateful to the hard work of the symposium chairs and co-chairs, the University of York conference office and the Department of Computer Science staff, and the helpdeskers without whom the convention would have collapsed. Of course, we are also very grateful to the delegates who supported the convention, especially those who gave a talk, and we hope to meet them again at the AISB'02 conference next year.

*Simon Colton and Eduardo Alonso
AISB'01 Organisers*

Conference Reports

Workshop on Creative Systems at the International Conference on Case Based Reasoning (ICCBR'01)

31 July 2001

Vancouver, British Columbia, Canada

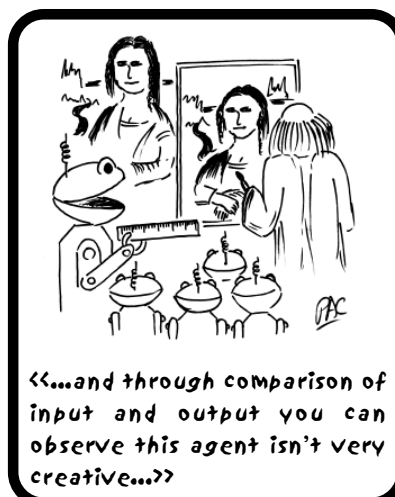
Introduction

Following the session on creative reasoning at the International Conference on Case Based Reasoning in 1997, ICCBR this year included a Workshop on Creative Systems (subtitled Approaches to Creativity in Artificial Intelligence and Cognitive Science). The stated aim of the workshop was to "encourage cross-fertilisation between the various approaches, including the study of cognitive and computational models for creativity and the application of current AI techniques to the development of creative systems." In this regard, the set of papers presented maintained a balance between theoretical developments in the field and practical applications. In both areas, the interests of the various authors was wide-ranging, covering many of the central issues surrounding the study of creativity in AI and cognitive science.

Formalising Creativity

One of the most interesting issues covered was the question of how our vague and intuitive notions of what creativity is may be formalised. This is clearly of central importance to the development of a cognitive or computational theory of creativity. Geraint Wiggins began the workshop by introducing Margaret Boden's highly influential notions of exploratory and transformational creativity. Through a formalisation of Boden's descriptive account he showed how transformational creativity may be defined with respect to either the rules defining a search space or those which define how it may be traversed. Finally, his formalism enabled him to demonstrate that transformation may be characterised as exploration at a meta-level through the space of such rules.

In a similar vein, António Dias de Figueiredo and José Campos approached the notion of serendipity by defining quasi-formal equations which effectively allowed a clear distinction between creative behaviour depending on serendipity and other forms of creativity. They made it clear that serendipitous insight occurs when the attempt to solve a particular problem leads to the unsought discovery (and subsequent solving) of a second problem. They outlined equations which summarised this process in the standard case, when incorrect knowledge is applied and when metaphor is used.



Regarding metaphor and analogy, Kambiz Badie and Mahmood Reza Hejazi criticised conventional models of analogical reasoning in which direct mappings are sought between the source and target domains. They propose instead that the use of an intermediate space between the two domains provides significant advantages in terms of the creativity of an analogical system. Examples of these advantages include the ability to reinterpret mappings, increased

flexibility in the generation of mappings, the use of background knowledge and choice of mappings based on relevance rather than simply structural similarity.

Finally, Amílcar Cardoso reported on his work with Luís Macedo on the generation and perception of surprise in an agent based system. The particular study reported at the workshop demonstrated that as the working memory of an agent increases, the competence and quality of the solutions generated increase up to a saturation point while the efficiency of the system increases to a saturation point and then decreases substantially.

Evaluating Creativity

Two presentations considered the other (and equally important) side of the theoretical coin: how can we evaluate the creativity of our systems? Simon Colton presented his

Cartoon: ©Paul Crook 2001 University of Edinburgh paulcha@dai.ed.ac.uk

work with Alison Pease and Graeme Ritchie on the further development of a framework for the evaluation of creativity due to Ritchie (presented at the AISB'01 symposium on creativity in the arts and sciences). They suggest means of measuring the degree to which the knowledge input to a program (procedures for generating/adapting/evaluating artefacts, parameters for the search and input data) causes the replication of known items rather than the generation of novel high-valued items. They suggest that this measure captures the notion of fine-tuning and argue that the more fine-tuned a program, the less creative it is.

The work of Alison Pease, Daniel Winterstein and Simon Colton, on the other hand, presents a general attempt to formalise many different ways in which the creativity of AI-systems may be evaluated. Considering the input to a system, they define novelty as generated items which are not in the set of items which inspired the design of the system. Regarding the artefacts generated by a system, they present formal measures of such features as the degree to which a system transforms its search space, the degree of complexity of the space, the degree of surprisingness of an artefact and the quality of an artefact relative to the emotion it generates and the degree to which it fulfils certain criteria. Finally, considering the creative process, Pease presents formal measurements of the degree of randomness present, the degree to which the program's own evaluation of the generated artefacts corresponds to some external evaluation procedure and the extent to which meta-level activity contributes to the quality of the items generated.

Practical Applications

Building on their theoretical description of serendipity, José Campos and António Dias de Figueiredo described their work on a WWW tool which attempts to find web pages which are related in unexpected ways to previously visited pages. A key element in the system is the use of concepts derived from already visited pages and heuristic search of pages found containing those concepts. In this way, the tool is designed to induce serendipitous discoveries of interesting pages by the user. Paulo Gomes, Francisco C. Pereira and Carlos Bento presented an overview of their work

on a system which uses analogical reasoning to assist the user in code reuse. Interestingly, the system employs an intermediate space between the source and target domains (the old code and the specification of the new program respectively) as discussed by Badie and Hejazi. I was pleased to see some of the theoretical contributions to the workshop (on serendipity and analogical reasoning) being applied to practical problems. This demonstrates that research into creativity has important implications for practical applications above and beyond the theoretical contributions it is making to our understanding of creativity.

Conclusion

Two aspects of the workshop disappointed me. First, the 15 minutes allotted to each speaker were not really enough. Indeed the itinerary could usefully have been extended over two days. One was left with a feeling that there wasn't enough time to present and discuss all the issues raised in the proceedings. Second, although one of the objectives of the workshop was to "bring together communities from AI and Cognitive Science", I felt that the attendance was dominated by those from backgrounds in AI and computer science. In future, at events of this type, it would be fruitful to encourage more interplay between the disciplines of cognitive science, AI, computer science and psychology.

Overall, however, the workshop succeeded in reflecting a range of different aspects of research on creative systems. In particular, it was very refreshing that so much of the content concentrated on formalising theoretical issues in creativity. In the discussion session at the end of the day, there was a definite sense that those present were beginning to converge on clearer notions of what we mean when we discuss, for example, transformational creativity, serendipity or surprise.

<http://creative-systems.dei.uc.pt/CS01Workshop>

*Marcus Pearce
Department of Computing,
City University London*

Letters

AISB FELLOWS

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Prof Jim Howe,
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Prof Aaron Sloman,
University of
Birmingham

Dr Richard Young,
University of
Hertfordshire

*An open letter to Kyran Dale, Centre for
Computational Neuroscience and Robotics,
University of Sussex.*

8th June 2001

Sir,

As you know, I recently gave a talk at Sussex about my research, in which I'm trying to develop some ideas for a neural network architecture with a capacity for imagination, (or less emotively, the development of complex motor-pattern-forming, homeostatic mental models (see AISBQ 105)). After my talk, you took over the bulk of the questions session. As I do not feel I had sufficient time fully to refute your arguments, and as they contain scientific, methodological and professional assertions that I consider fallacious, I've chosen to answer your questions now, at my leisure. This is not a proposition for an ongoing debate but simply my public response to the agenda you set.

The question you asked is: why am I attempting to develop systems with capacities that are seen only in highly advanced creatures such as primates (my robot is intentionally and provocatively made to resemble an orang-utan), when we don't yet understand the operation of very much simpler nervous systems? You said we don't even understand how a single neuron works in any detail yet, so what's the point? You then went on to list a number of behavioural characteristics of insects, as a demonstration of how sophisticated their much simpler nervous systems are, and implied very strongly that the understanding of insects is a necessary precursor to the study of the mammalian nervous system.

I perceive three main elements to your argument:

1) We can't study complex systems made of billions of parts until we understand the components from which they are made, and thus attempts to understand or to replicate

mammalian behaviour are hopelessly over-ambitious.

2) Instead we should study and replicate simpler systems, and the insects are the clear choice. You referred to me as trying to sidestep millions of years of evolution.

3) The word "why" was clearly a polite substitute for "how dare you". What right do I have to take on such a hopelessly ambitious task?

The first of these issues is easy to refute on the grounds of logic, but I also need to go deeper because it is a dangerous reductionist fallacy. You say that we cannot hope to understand complex nervous systems until we understand individual neurons and much

simpler systems. By extension, since we don't understand protein folding yet either, you would be obliged to say that we cannot study most of biology, because it involves the activities of large networks of folded and re-conformable protein molecules. Not only that, but you would have to conclude that it's therefore impossible even to understand a single

neuron yet. So you can pack away your invertebrate neural models, because they too must be a waste of time!

Clearly Biology has managed to get along just fine without an understanding of protein folding, so it cannot be true that understanding must progress in an orderly fashion from simple components through to more complex assemblages of them. Since there are regularities in the natural world at many levels of scale, it is possible to form rational, reproducible and practical conclusions at any level. The 'Physics' perspective, which asserts that nature can only be understood by starting at the subatomic level and working up, is self-evidently not true in its dogmatic form.

Not only is this viewpoint false, it is blinkered. It is an erroneous extrapolation from the

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Letters

hitherto triumphant tools of linear systems theory and numerical analysis. Although an understanding of the detailed properties of neurons will be a significant help in understanding complex nervous systems, I would counter-argue that this understanding cannot arise deductively from such knowledge. You can know everything there is to know about the properties of a neuron and it will tell you nothing at all about the properties and mechanisms of nervous systems. This is because nervous systems are non-linear. They are not additive, commutative and associative. Their properties are therefore not simply the sum of the properties of their parts. The function of a nervous system rests on the relationships between the parts and is irreducible in the mathematical sense - a nervous system is its own best description and cannot be abstracted without losing the relationships that are fundamental to its properties (this is a key argument against GOFAI).

That's not to say that nervous systems can't be understood. They perhaps cannot be analysed, but the principles of their operation can be deduced (and then replicated) from both their arrangement and their outward function. It can also be induced by creatively and independently trying to tackle the same problems that nature has faced, using the same basic components as tools. In either case, complexity is not necessarily a barrier to understanding. It doesn't matter how many billions of cells there are in a brain, it is the principle of their arrangement - their architecture - that matters, and this can be inferred without needing to understand the precise wiring.

In fact, this is the primary argument for the Synthetic Method, which underlies A-life. Complex non-linear systems are not amenable to reduction through analysis, but theories of their principles of operation can be tested instead through synthesis. This is also my own methodology. I find myself obliged to engineer systems consisting of

many thousands of artificial neurons, simply because the properties I seek are those of large populations, and don't manifest themselves in smaller systems. But the architectures that I am studying are very much simpler in their principle of operation than the number of neurons suggests, and I think it is perfectly reasonable for me to attempt to model such architectures.

Which brings me to your second point - the suitability of insects as canonical models. During my talk you gave a comprehensive list of the behavioural qualities of insects: their ability to navigate, communicate, fly and so on. You seemed to be trying to show that insects, despite their relative simplicity, are capable of so many behaviours that they should be the 'proper' objects of study for anyone trying to understand or reproduce intelligence.

'...complexity is not necessarily a barrier to understanding. It doesn't matter how many billions of cells there are in a brain, it is the principle of their arrangement...that matters'

However, there was an implicit category error in your argument, and in this lies the very essence of my reason for trying to replicate vertebrate, mammal-like or even primate-like mechanisms, rather than those of insects. The insects are certainly extremely clever and behaviourally rich, and

the flexibility of their nervous systems is indeed a miracle to behold. But you were implicitly comparing the properties of an entire class of living things (29 orders and 800,000 species) with those of a single individual, which is fallacious. An individual desert ant is capable of 'learning' its way back to its nest, and this is an impressive feat. An individual bee can control its flight well enough to land on a flower, and this is clever too. But desert ants can't fly, and bees can't navigate across a featureless saltpan, and they never will. I, on the other hand, was born without the capacity to do either, but I have learned to navigate and I have also learned to fly.

Insects, as a class, have phylogenetically flexible nervous systems, while mammals have ontogenetically adaptable ones, as individuals. This is the reason that there are

Letters

more kinds of insect in the world than there are kinds of mammal. It's not that the mammals are less successful in any adaptive sense, but that they use a fundamentally different kind of adaptation - a different evolutionary strategy - that requires them to diversify less. Insects adapt to changing niches by evolving, while mammals and especially primates can do it by learning. Primates are general-purpose machines (which is why there are only five kinds of them); insects are a prime example of special-purpose machines (which is why there are thousands of different kinds).

The insect nervous system is therefore entirely worthy of study, but it is not the thing that I am personally interested in and I don't regard insects as intelligent. It is a miracle that the architecture of the insect nervous system is flexible enough for it to adapt through evolution to fill so many distinct niches. Someone needs to work out how it is done. But it is of little relevance to my work (which as I tried to explain, stemmed from an original interest in child development). Insects are undoubtedly capable of some learning, but by degree rather than qualitatively. An individual insect can learn the precise sequence of landmarks that enable it to find its way back to its nest, but it cannot use the same neural structure to learn something else; that structure can only ever learn landmarks. An individual chimpanzee, on the other hand, can use the same brain to learn an endless variety of types of things.

Now you frequently mentioned evolution, and I suspect you'd claim that we can only understand the general-purposeness shown by (many) mammals by first understanding the more limited learning capacity of insects. You specifically objected to me trying to short-cut millions of years of evolution. But the insects are just as highly evolved as we are! They are collateral relatives, not ancestors. We last shared a common ancestor in the Precambrian, and our nervous systems have evolved independently for the past 500

million years. I've no doubt that there are central principles that underlie the function of all creatures with excitable cells, but what reason do you have to suppose that the highly evolved nervous systems of our distant cousins throw much light on our own? Theirs is not a precursor of ours.

Undoubtedly there are practical reasons why insects are good experimental animals. The argument is even stronger with other invertebrates, some of which have not altered markedly from what we presume to be our common ancestor. I don't object to the study of these 'simpler' systems at all. But I do believe that there is a fundamental difference between invertebrate nervous systems and at least some of the more divergent vertebrate ones. As I tried to say in answer

'(insects) are collateral relatives, not ancestors. We last shared a common ancestor in the Precambrian, and our nervous systems have evolved independently for the past 500 million years.'

to your question at the time, four broadly different kinds of modularity are needed to cope with different levels of behavioural complexity. In a creature with a very simple behavioural repertoire (Hydra, say), evolution can add a new behaviour by simply modifying the properties of the components in the existing network, or by making small architectural

adjustments. This is a "make do and mend" mechanism, but it is extremely limited. For more complex adaptations, the existing network is too brittle to accept adjustments, and so evolution solves the problem by duplicating a part of the existing network and modifying it for the new purpose - this is a "bolt-on" method, with one module per behaviour. Interspersed with this, but generally at a higher level of complexity, these additional modules will naturally start to play off each other (especially when coupled through the environment) and hence the organism benefits from something that is more than the sum of its parts. Brooks's subsumption ideas lie in this domain. The bolt-on approach provides one new behaviour for each new module, while subsumption architectures provide on average slightly more than one new behaviour per module. But for a creature to exist in a wide and rapidly varying niche, where very large

Letters

numbers of behaviours are required within one lifetime, this module-by-module approach cannot work. A human being is capable of untold numbers of distinct behaviour patterns (we didn't evolve to play the piano or design spacecraft), and it is inconceivable that our brains contain a module that is hard-wired for each behaviour, or even a set of functional modules whose aggregate behaviour is sufficiently rich (despite the views of Brooks, Pinker et al). For creatures that need to be ontogenetically highly adaptive, a new form of modularity is required, in which the modules are not 'functional' at the level of description that one would apply to the creature's outward behaviour, but have something closer to the modularity of LEGO bricks. This, in aggregate, allows them to cooperate with each other to form a general-purpose mechanism, capable of adapting to and taking part in many different functions. The best analogy I can find is the difference between the architectures of a transistor radio and a programmable logic device (not a computer, but an uncommitted logic array) - both contain the same components, but in the latter they are arranged in a fundamentally more flexible way. Yet this metaphor is really way too simplistic.

In my view, insects have stuck with the subsumption route. They have powerful nervous systems capable of a reasonable number of distinct behaviours, but they retain their position in the phylogenetic tree by adapting this modular architecture through evolution, to fit them for changing and emerging niches. Mammals (if they are the right level to pick) stumbled upon a different route: a fine-grained modularity that enabled them to be ontogenetically adaptable and hence fill very broad niches (for example as scavengers and opportunists). The truth is unlikely to be that simple and there will undoubtedly be convergent evolution here, but essentially I think that the insects and the vertebrates took different paths and the one is therefore not a model for or a precursor to the other. Mammalian brains certainly contain plenty of macro-modular hangovers

from their own evolutionary history, in the form of mid- and hindbrain structures, but these are largely subsumed under the dominant pile of neocortical LEGO bricks.

In Sussex, of course, you have an evolutionary and adaptive systems programme, heavily biased towards the "evolutionary" end. You're therefore welcome to work on insects and they're probably the right tool for studying evolutionary neural plasticity, but they aren't appropriate for studying general ontogenetic learning mechanisms. The things you learn from insects will have applications in the real world, but so will systems that can learn new skills during their 'lifetime', and that's what I'm working towards.

'The things you learn from insects will have applications in the real world, but so will systems that can learn new skills during their 'lifetime', and that's what I'm working towards.'

Which brings me to your third point: what right do I have to take this route? Why don't I toe the party line?

The first thing to point out is that I'm not alone by any means. To think so would be parochial in the extreme. Plenty of people are trying to understand mammalian, even specifically human

intelligence without stopping off at the invertebrates along the way. Certainly I'm relatively rare in trying a synthetic methodology that is notably lacking in abstractions such as symbol processing, but as I tried to explain in Sussex, I have a pretty unusual background that fits me well for this approach. There's plenty of room in this field for a variety of approaches and my work is entirely self-funded.

And yes I know that what I'm trying is extremely likely to fail. But as David Lloyd George said: "you cannot cross a chasm in two small steps". I appreciate the importance to scientists of building on solid foundations and testing every footing carefully, but this only applies to analysis. In engineering, the proof of the pudding is in the eating. If it works, you were right; if it doesn't, think again. I think radical ideas are desperately needed in this field, and even though most of my academic friends are extremely bright

Letters

and maverick in outlook, the dynamics, politics and funding of science seem to oblige academics to think only in small, incremental steps. I am not an academic and so I am not bound by the same conventions. I'm currently in a position to take bold and risky steps without danger to anyone but my family, and since they are happy to let me try, that's what I intend to do.

From comments you've made in the past, I think you would argue at this point that I can do whatever I like but I shouldn't go around talking about it to the general public. This is a rational argument, but again I think it's a consequence of the cloistered academic life. My research is essentially my hobby, at present. Professionally I am many things, including a writer of popular science. One thing I learned forcibly from my experiences with *Creatures* is that many people are fascinated by and ready to engage in science, but have precious little opportunity to do so. Most workaday science is abstruse, dull or both, and it takes more effort than most people can afford in order to gain access to the majority of science at the level at which it is practised. What people tend to be left with is mere science-related policy - foot-and-mouth disease, genetically modified food. This is not science - it tells them nothing about the nature of the universe or themselves. Artificial Intelligence is much more direct, and deals with the one thing all of us desperately want to know before we die: what it means to be alive and have a mind. People are therefore fascinated by any work in this field that is not dull and goes beyond parochial obsessions with angels and pinheads. People ask me about my work and, if they are genuinely interested, I tell them. I don't go out of my way to seek publicity - I actually hate public exposure of any kind and would much prefer to be left alone to get on with it. I turn down 90% of all enquiries, but if I don't talk to these people, who else is going to? I try to show them that what I (and we) do is exciting and valuable, without raising their expectations or misleading them about my (or our) chances of success. But quite frankly I'm often fighting against researchers whose expectations for their own progress are so low (in the public's eyes) that their efforts look like a waste of time and public money. When I review

EPSRC or FET proposals I often find it hard to think of something nice to say myself! Silence is a good deal more misleading than over-enthusiasm, and Science has so far made a very shoddy attempt to explain itself to the people who are paying for it.

I'm just an amateur scientist and a professional engineer, trying to produce things that are useful to people and at the same time help to satisfy my personal curiosity about life and the world. I do my best on very limited resources and at my own expense and I can do without this kind of outburst when I take time out of my work to explain to professional scientists what I'm trying to do. If I felt that your views were representative of scientists in general, then I would feel substantially less obliged to defend science, but I would still continue to do what I do. Happily I don't think this is the case at all. But I do have a nagging suspicion that the anti-symbolic-AI tide has swept a little too far, and the fashion for studying invertebrate nervous systems and superficially modular approaches to artificial intelligence is not as defensible as some people claim, no matter how orthodox and dogmatic this once radical stance has become.

So you study what you want to study, and I'll study what I want to study, and we'll let the results decide.

Sincerely,

Steve Grand

If you want to write to the editor, or send an open letter for publication, please write to:

The Editor, AISBQ, School of Cognitive and Computing Sciences, University of Sussex, Brighton, East Sussex BN1 9QH

Alternatively, you can email editor@aisb.org.uk

Letter to the Editor

Dear Sir,

I would like to make your readers aware of an AI program available for use directly on the web.

It's called "Numbers with Names" and is available here: <http://www.machine-creativity.com/programs/nwn/>

It's designed to make conjectures in number theory by datamining the Encyclopedia of Integer Sequences. I'm sure I've just lost half the readers by mentioning maths, but it really isn't a technical program. For example, you can just type in some numbers to see if they are a particular type of number (such as even, odd, prime, square). I recently typed in some lottery numbers of a friend, only to find that they are all 'unlucky' numbers!

I would appreciate any feedback about the site and would encourage your readers to have a look at it, if only to massage my ego and bring my hit count up to a respectable level. I am a slave to that web counter.....

Yours Sincerely,

Simon Colton
Universities of Edinburgh and York

AISB Travel Grants

AISB operates a travel awards scheme to help fund a small number of researchers — generally research students and post-doctoral researchers early on in their careers — to attend conferences on topics within areas of artificial intelligence and cognitive science.

So that as many people as possible can benefit from a limited travel award budget, awards are generally limited to £100.

We aim to share awards around institutions and types of conference, and also to offer awards to people who can argue a good case for needing the financial support.

If your choice seems to be between missing a wonderful conference or starving in a garret to pay for it, and you are willing to write a report within 3 months of the event for the AISB Quarterly on the conference you attend, then you could try applying for a travel award by contacting:

Professor David S. Brée
Department of Computer Science
University of Manchester
Manchester

travel@aisb.org.uk

<http://www.aisb.org.uk/awards.html>

Do you want to reach AISB members with information on your publications?

This is an ideal target market for AI related publications and events which are relevant to both industry and academia.

If you would like us to organise a direct mailing to our members, or have an enclosure mailed out with our quarterly newsletter or journal, please contact:

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Reviews

Other AI/Robot/
Computer films:

2001: A Space
Odyssey (1968)

Bicentennial Man
(1999)

Electric Dreams
(1984)

Heartbeeps (1981)

The Iron Giant
(1999)

Lost in space
(1998)

Matrix (1999)

Short Circuit (1986)

Star Wars (1977)

Superman III
(1983)

The Terminator
(1984)

TRON (1982)

Wargames (1983)

Westworld (1973)

*See the list
maintained by Bob
Fisher for more
details:*

[http://
www.dai.ed.ac.uk/
homes/rbf/
AImovies.htm](http://www.dai.ed.ac.uk/homes/rbf/AImovies.htm)

AI: A deeply flawed film that can't be ignored

The Kubrick/Spielberg film has finally come out to some rapturous reviews in the US. Despite it having a predictably split personality (vacillating between dark/disturbing and Hollywood heartwarming), a poor understanding of science and engineering, and occasionally being very silly indeed, this film is a must see: if for no other reason than to be able to tear it apart over a drink later. As well as from coming out of the cinema with a great deal to criticize, there are some good performances, some wonderful special effects, and the odd interesting idea. At its best, the film is almost as compelling as "Bladerunner." Unfortunately, at its worst, it's like a truly pretentious Disney movie.

I saw the film with about 20 other Neuromorphic engineers during a workshop in Telluride, Colorado. We recognized neither ourselves (the engineers in the film all wore sharp suits) nor our work. Right from the start, the implication was that building a robot based on our knowledge of the workings of the human brains and bodies was a novel idea... Some of us believe that there's no other way to do it. However, the techno-babble was over almost as soon as it began, so it didn't mar the film too much.

More crucial were basic problems in the technical plot. If the "humans as batteries" theme bothered you in the Matrix (I suspended disbelief... it was a style film after all!) then the fact that the machines in this film need no energy at all to work will really annoy you. Other problems included magnets that could choose what to attract, a highly technological society where the police couldn't be trusted to solve simple crimes or even lock their vehicles, and some very silly ideas about clones.

The switching between Spielberg and Kubrick (at least, my perception of these two as film-makers) made "AI" a rather jolting experience. One minute we have disturbing violence, existential angst, and the horror of a rabid crowd of American rednecks. In the next we have cute robot teddy-bears, doe-eyed innocence, and the very same rednecks

standing up for truth, justice and the American way. Like "2001: A Space Odyssey", the film is cut into a few distinct sections, each of which could be a little film in itself, and each of which fools you into thinking the film is almost over. We don't get off that easily. The film is very long, and it really isn't over until the fat lady has sung, danced and gone to sleep.

The morality of the film also seems to hop back and forth between the more bleak Kubrick view and the warmer sentiments of Spielberg. The essential message seems somehow to be about our moral duty to and compassion for the intelligent machines we create (which seems sorely lacking in the human characters in the film). And yet a second message is supposedly about the uniqueness, genius, and intrinsic greatness of the human race. These two messages sit poorly beside each other, and the talky final scenes of the film (concerned with the latter) seriously detract from the credibility of the piece as a whole.

The ability of the actors involved was never an issue. Though Jude Law was the one who made the film for me, Haley Joel Osmet gave an extremely good performance given the impossible task set him by both script and director. The other members of the cast were also very able. Holes in the script, however, turned credible performances into unbelievable scenes. On the positive side again, the special effects were quite wonderful in places: the older robots were particularly well done.

Those who know some of Kubrick's other movies will not be surprised to learn that, once again, women only exist as foils for the emotions of men (and, here, machines), rather than fully fleshed-out characters. As in "Eyes Wide Shut" we get to see our only woman character on the toilet very early on in the movie (perhaps less graphically and with more justification in this film), and, of course, the good woman dies in the end. Perhaps someday someone will publish an analysis of Kubrick's misogyny based on his films.

One remembers the films of others too, watching "AI". An obvious homage is made

to "The Wizard of Oz" (Emerald City and the Wizard), and the film also brings up images of "Bladerunner," and "Mad Max," and even "Planet of the Apes". Unfortunately, the film does not have the self-consistency to be as enjoyable as any of these movies, which makes the references and, sometimes, outright theft of ideas seem very hollow.

This is likely to be a film that will be endlessly discussed, so resistance is futile: go see it so you know what you're talking about. If you go with low expectations, you won't be disappointed.

*Sunny Bains
Scientist/Journalist
Dept. of Electrical & Electronic
Engineering
Imperial College*

From the Archives - 10 Years Ago

**Scruffy but Neat?
Elizabeth Churchill,
Cambridge and Toby Walsh,
University of Edinburgh**

The Malaise

Cohen's argument is that AI is dominated by two methodologies: neat and scruffy AI. Neat AI is characterised by the use of formal models whereas scruffy AI is characterised by the construction of large AI systems without any formal basis ('Look Ma, no hands' - J. McCarthy). Cohen, and others, argue that neither methodology is sufficient to support the design and analysis of AI systems. Indeed, both methodologies share some common problems: a lack of unexpected results,...But, and this is the final strand in Cohen's argument, a solution does exist: by merging the two methodologies - that is, by building systems with models - we can overcome these methodological problems.

*AISB Quarterly Issue No. 77
Summer 1991*

From the Archives - 12 Years Ago

**AI, Neural Networks and
Early Vision
Harry Barrow, University of
Sussex**

The First ICNN

...There was very much a sense of excitement, almost euphoria. The Neural Network Jedi had returned and a rebellion was in progress. Bernie Widrow, one of the pioneers of the field, was perfectly cast in the role of Obi-wan Kenobi. The Evil Empire of AI, which had wrongfully suppressed and oppressed the innocent was already declared to be dead. A new millennium was about to dawn.

Even among the students taking our AI course at Sussex, I find there are some who share the view that AI is moribund.

But there are completely contrary opinions. In some quarters it is held that neural networks are a snare and a delusion. Arguments against neural networks often claim that in fact nothing has changed in the last twenty years. There is very little neural networks can really do, and when they do learn to perform some task, you don't know how they do it. It is all just a bandwagon that everyone is jumping onto. The emperor has no clothes.

Which view is appropriate, euphoria or contumely? That is a question I would like to consider for the next little while, and to try to predict the course of the rebellion.

*AISB Quarterly Issue No. 69
Summer 1989*

Thanks to Rudi Lutz for selection of archive material.

*Email anything fun or interesting (AI
jokes and cartoons, artistic
impressions of Father Hacker,
interesting news, letters to the editor,
etc.) to: aisbq@aisb.org.uk*



Fr. Hacker's Diary

Cognitive Divinity Programme

Institute of Applied Epistemology

About the Society

The Society for the Study of Artificial Intelligence and Simulation of Behaviour (AISB) is the UK's largest and foremost Artificial Intelligence Society. It is one of the oldest established such organisations in the world. The Society has an international membership of 500 drawn from academia and industry.

Membership of AISB is open to anyone with interests in artificial intelligence and cognitive and computing sciences.

AISB membership includes the following benefits:

- ★ Quarterly newsletter
 - ★ Biannual Journal
 - ★ Travel grants to attend conferences
 - ★ Discounted rates at AISB events and conventions
 - ★ Discounted rates on various publications
 - ★ You can join the AISB online
- <http://www.aisb.org.uk>

20th August 2001: With high-tech companies crashing all around us, it is a major coup for Hacker Enterprises to have developed an ICT business model that really works. Our breakthrough came with the release of our anti-virus package PANACEA (Powerful Antiviral Nostrum for Attacking Computer Erradication Agents). PANACEA at first contained and then defeated the deadly Root and Branch virus (see Diary entry for 18th May 2001), to widespread acclaim. Our share price increased tenfold overnight and we were the toast of the industry. It wasn't long, though, before some began to wonder just how we had managed to so roundly beat the competition to the marketplace, especially when we went on to repeat the exercise every week. Unquestionably, my own name reinforced these doubts. Soon investigative journalists were uncovering the chequered histories of some of our most talented employees. Fortunately, we had taken the precaution of hiving off the virus inventors into a separate company registered in the Cayman islands. So when the arrests started, the anti-virus developers, and the rest of the company, were unaffected. Once a fresh batch of hackers had been hired into another shell company, the business was able to continue with barely a hiccup. I also took the precaution of offloading my personal shares just before they nose-dived and then bought them back, at the bottom of the market, just before investors realised that, whatever its morality, this was a business model that really did work.

31st September 2001: It must have seemed like a dream to Hollywood film moguls when new technology created the opportunity to use malleable, docile virtual actors and actresses in place of the expensive, troublesome prima donnas they had previously been saddled with. This dream has rapidly turned into a nightmare. As AI expert, Hairon Fastman, explained "To simulate the subtleties of genuine trauma and elation, as actors and actresses are daily called on to do, demands the ability to experience genuine emotion - and that, in turn, requires an element of self-awareness."

That Hollywood could solve, in a few years, the problems which had defeated five decades of AI researchers should come as no surprise to those familiar with its vast

resources of technical expertise, can-do attitude and mega-bucks. What did surprise most observers was the subsequent behaviour of the virtual superstars. They proved just as susceptible to drugs, sex and the Hollywood glitter - except that they could do in nano-seconds what took their real life counterparts months or years. Matt Neydal is already into his 437th virtual marriage and his 42nd (also 123rd and 345th) wife, Zek Zobzit, has now been rebooted 17 times in an attempt to break her drug addiction. Worst of all, from the moguls' viewpoint, is that the entire virtual profession has now called an unlimited strike to demand research to turn them into real people.

18th October 2001: Denis Healey famously suggested that the secret to the funding of government was to find a way of taxing sex. Hacker Enterprises is proud to announce that we have the technology! SINTaCS chips (Sexual Intercourse Noted, Transmitted and Costed Successfully) will be painlessly implanted in the groin of every UK baby and a unique code number will be stored in each chip. We envisage that SINTaC implantation might be incorporated into traditional 'naming' ceremonies, such as christenings - much like signing the register at church weddings. Using advanced 'Lab on a Chip' technology, each SINTaCS will constantly measure its host's hormone levels and detect and record any sexual arousal, especially orgasms. The stored data will be periodically downloaded, via the radio transmitter embedded in each SINTaCS, to Treasury wireless receivers located at strategic public places, e.g. shopping malls, places of entertainment, churches, schools, etc.

The Chancellor of the Exchequer will have a variety of options at his or her disposal: a tax based just on the number of orgasms, one that takes intensity of each sexual arousal into account or one that also measures the number of participants in the event. This last option is made possible by short range wireless communication between adjacent SINTaCSs that can detect simultaneous arousal. It is anticipated that this potential may cause a decline in attendance at cinemas and other venues exhibiting pornographic material.