NEWSLETTER

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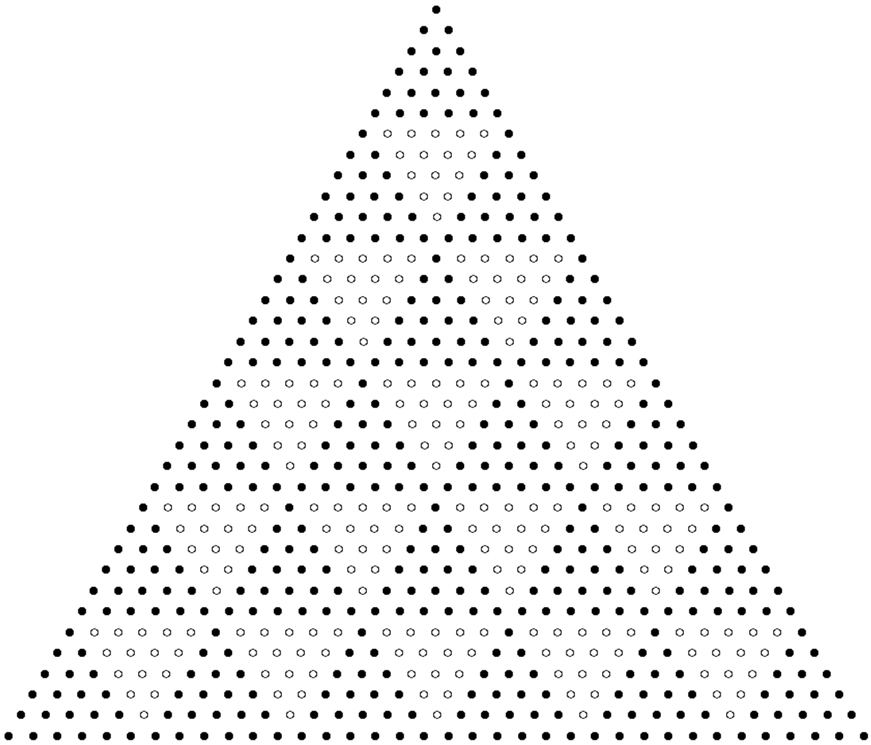

Polygonal numbers adrift

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Legal KBS in practice

News from the Belgium-Netherlands Association for Artificial Intelligence

Into the Depths of Space by Self-Replication

Editor-in-chief

The space shuttle disaster of February 1 again stirred the debate over the necessity of manned spacecrafts. Advocates of manned space missions say that humans are indispensable, e.g., for carrying out experiments. Opponents fear that manned spacecrafts are too expensive and too dangerous for their crews. Can AI contribute to the conquest of space without putting lives at risk? Yes, implied Michael A. Arbib and Chris Boyce in the late 1970s, when they introduced the concept of the *von Neumann probe:* an interstellar robot rocket that can build another von Neumann probe from raw materials. (The probe is of course named after John von Neumann, who in 1948 envisioned a self-replicating automaton.) The von Neumann probe starts conquering the depths of space by visiting a neighbouring stellar system. Using the raw materials from an asteroid or planet, the von Neumann probe produces copies of itself, which are sent to neighbouring stellar systems. Because of its reproductive capability, the number of active probes increases exponentially with time, and the entire Milky Way can be explored in a fraction of the time it would take with a non-replicating probe.

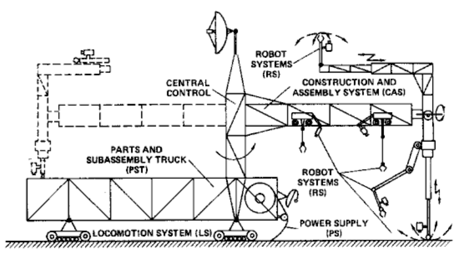
Do von Neumann probes sound farfetched to you? Already in 1980 NASA conducted a study titled *Advanced automation for space missions*. In the study detailed plans were developed for constructing self-replicating systems (SRS) on the moon. An SRS is an autonomous system that can produce copies of itself solely by using materials it collects from the environment. The main requirement for an SRS is that it must be able to obtain sufficient material for self-construction. The NASA study claims that this requirement can be met. The moon soil can be used as raw material and, by applying techniques such as electrophoresis, minerals can be isolated and synthesized into the basic materials allowing SRS to replicate.

Are we any closer to the realization of von Neumann probes than in 1980? Somewhat. Improvements in robotics and computer-aided manufacturing have made a major step towards the realization of SRS. In the Golem project, Jordan Pollack and colleagues employ evolutionary techniques to generate simple virtual robots based on elementary parts. Using computer-aided manufacturing the virtual robots are transformed into physical robots almost automatically. At present, the manufacturing equipment is far more complex than the physical robots, so we cannot speak of *replication* yet.

In 1980, the NASA study estimated that realization of an SRS on the moon would take twenty years. That seems quite optimistic; even with the current state of the art it may very well take another twenty years to achieve this goal. Moreover, a real von Neumann probe is even more complex, because it also involves an autonomous interstellar spacecraft. Pessimists say that since we have not yet observed alien von Neumann probes in our solar system, extra-terrestrial intelligence does not exist. The idea of von Neumann probes is so straightforward and effective that if extra-terrestrial intelligence exists they must have visited us already.

Just as the duplication of von Neumann probes may lead to duplication of work, occasionally duplication of work can happen when reporting on a workshop or conference. The double report of the Benelearn 2002 conference in this issue of the BNVKI Newsletter is a case in point. On page 14 Martijn van Otterlo and Edwin de Jong describe Benelearn 2002 from a Dutch viewpoint, and on page 16 Joke Reumers reports on the same event from a Belgian viewpoint. Luckily, the different viewpoints yield an enjoyable stereoscopic “in depth” view of the Benelearn.

Von Neumann probes: http://www.angelfire.com/on2/daviddarling/vonNeumannprobe.htm
Advanced automation for space missions: http://www.islandone.org/MMSG/aasm/
Golem project: http://demo.cs.brandeis.edu/golem/



A mobile SRS constructor as envisioned in the NASA study.

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Photo by Martijn van Otterlo (page 15)

BNVKI-Board News

Han La Poutré

In the midst of February, the "ICES/KIS" epoch was concluded, in which many senior researchers have been involved by putting together large project proposals for "Bsik" funding. To describe this shortly, the ICES/KIS funding is a governemental initiative to enhance the knowledge infrastructure of the Netherlands. It seeks for substantial projects carried out by solid consortia of both academic institutes and companies, which address activities going from fundamental research into applied research, and, subsequently, into commercial exploitation. For this initiative, a large amount of funding is available for the projects to be carried out in the next four years, viz. 800 million euro.

Many researchers have participated in these activities in one way or another, including myself. In total, a lot of effort has been put into these, in the hope that funding for research will be returned. At the moment, it turns out that about 20 proposals have been submitted in the ICT area. For all (five) areas together, in total 1,700 million euro has been asked. So, the budget asked is twice as much as the available budged. Let's hope that our research community gets some "return on investment", and that the research in artificial intelligence can earn a good share via several projects.

Now that we all have gone back to the "normal" operational mode, we face our daily activities again. At the BNVKI, the monetary issues have been paid attention to extensively. The tentative idea of a close cooperation between the BNVKI Newsletter and a SIKS newsforum appeared with a more limited (but positive) perspective than assessed last year. Therefore, new and additional ways to address the funding of the BNVKI are being explored. The Board takes here into account the discussion that took place at the BNVKI Plenary Meeting at the BNAIC in Leuven as well as the outcomes of the enquiry performed during this BNAIC. It aims at the support of the BNVKI Newsletter in the upcoming years, by some way of funding or cooperation, while keeping the independence of the Newsletter.

In the meanwhile, NWO/EW and IPN (Informaticaonderzoek Platform Nederland, which will represent almost all computer science researchers in the Netherlands) have offered (thanks to Jaap van den Herik) a grant for the BNVKI Newsletter for this year, anticipating on a possible, future cooperation between the Newsletter and a new IPN Magazine.

In the upcoming period, longer-term approaches will be considered and investigated by the Board. We will keep you informed!

Monetary Survey over 2001

Cees Witteveen

Due to a change in the board of the BNVKI, the financial records over the year 2001 still had to be approved by the auditing committee of the BNVKI. Last January, the auditing committee consisting of Cor Bioch (EUR) and Maarten van Someren (UvA) approved the monetary survey over the year 2001.

Due to the loss of sponsors, compared to 2000 and before, this year shows a growing deficit: In 2001, we spent € 1670 more than we received.

An overview of the monetary survey over this year together with surveys of the years before can be found at http://www.cs.unimaas.nl/~bnvki/monetary/

The New Generations

Jaap van den Herik
IKAT, Universiteit Maastricht

Science is life. For some dedicated persons life is science. These dedicated persons are the researchers who devote their whole life to their hobby, science. Currently, the world of science is best characterized as being in a state of flux. This means: never a dull moment, in particular since good research produces always some progress. Now and then it even makes a big leap forward. Below we see five announcements of scientific reports, i.e., Ph.D. theses that substantiate the advance of the research undertaken, and the progress made. They are proofs of promises once given to the supervisors. Hence, we may welcome a new slate of doctores who will find their way in science or in society. With much pleasure the BNVKI-Newsletter Board congratulates the new doctores with their new status.

H. Stuckenschmidt (January 23, 2003). *Ontology-Based Information Sharing in Weakly Structured Environments*. VU Amsterdam. Promotor: Prof.dr. F.A.H. van Harmelen. Co-promotor: Prof.dr. O. Herzog.

Jan Broersen (February 25, 2003). *Modal Action Logics for Reasoning About Reactive Systems*. VU Amsterdam. Promotores: Prof.dr. J.-J.Ch. Meyer, Prof.dr. R.J. Wieringa, and Prof.dr. R.P. van de Riet.

M. Petkovic (February 28, 2003). *Content-Based Video Retrieval Supported by Database Technology*. Universiteit Utrecht. Promotor: Prof.dr. W. Jonker.

M. Schuemie (March 3, 2003). *Human-Computer Interaction and Presence in Virtual Reality Exposure Therapy*. TU Delft. Promotor: Prof.dr.ir. F.W. Jansen. Co-promotor: Dr.ir. C.A.P.G. van der Mast.

J. Lehmann (March 11, 2003). *Causation in Artificial Intelligence and Law - A modelling approach*. Universiteit van Amsterdam. Promotores: Prof.dr. J.A.P.G. Breuker and Prof.mr. P.W. Brouwer.

The five newborn doctores do not constitute the only new generation to be mentioned in this column. In the past, I have infrequently reported on professors who changed status (e.g., farewell speeches or taking up a task in the University Board). A few times I had the opportunity to welcome a new colleague. Seeing the recent developments at the Dutch Universities, the AI discipline is producing a new generation that is knocking at the door. The old generation (not disappeared yet), was in some respect the first generation of AI professors. Most of them are now in their last ten years, we mention: Wielinga, Breuker, Koppelaar, Scha, Groen, and Van den Herik. They are appointed some 15 years ago. Others appointed some ten years ago are: Treur, Meyer, and De Bra. At this moment (2003) it is my pleasure to congratulate the following three new persons with their appointment and their inaugural addresses. The new professors are: Lambert Schomaker (RU Groningen), Frank van Harmelen (VU Amsterdam), and Eric Postma (Universiteit Maastricht). Below we announce their inaugural addresses, of which the one by Lambert Schomaker took place in December last year.

INAUGUARAL ADDRESSES

Prof.dr. L.R.B. Schomaker (December 10, 2002). *Patronen en symbolen: een wereld door het oog van de machine.* Rijksuniversiteit Groningen.

Prof.dr. F.A.H. van Harmelen (February 13, 2003). *Het Eerste Oordeel*. VU Amsterdam.

Prof.dr. E.O Postma (June 13, 2003). Universiteit Maastricht (no title available).

Polygonal Numbers Adrift

Henk Visser
IKAT, Universiteit Maastricht

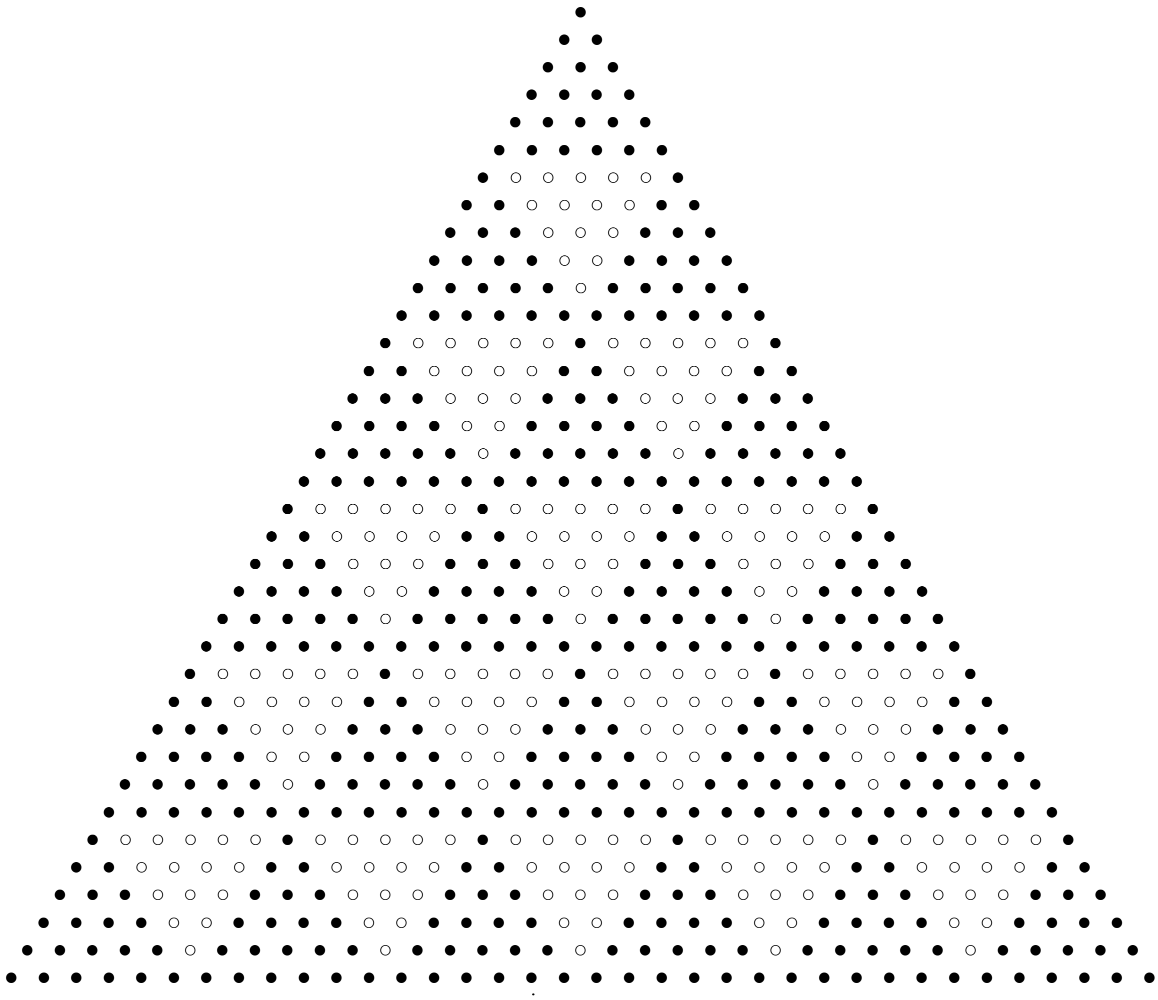
LOG. (*standing in the doorway of Math's room*) Hallo Math, are you busy?
MATH. As always, but that does not mean that I have no time for you. Did you find something interesting?
LOG. (*entering the room*) Yes, I found a generalization of your favourite formula that says that the triangular number of a square is equal to the sum of the squares of two successive triangular numbers. Look (*she goes to the blackboard*):

$$\mathrm{t}(\mathrm{s}(n)) = \mathrm{s}(\mathrm{t}(n)) + \mathrm{s}(\mathrm{t}(n-1))$$

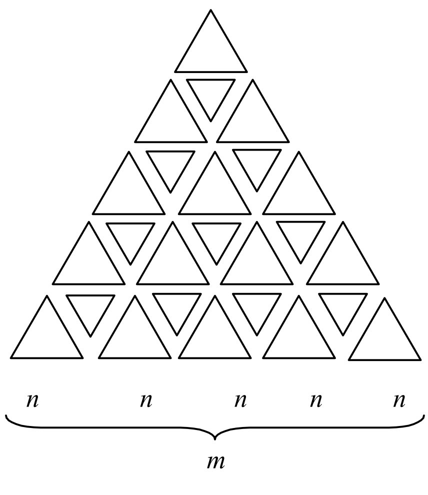
MATH. Do you mean that… (*he is interrupted by LOG*)
LOG. Yes, a square is nothing but the product of two equal factors. The only thing we have to do is to take the product of two triangular numbers:

$$\mathrm{t}(mn) = \mathrm{t}(m)\mathrm{t}(n) + \mathrm{t}(m-1)\mathrm{t}(n-1)$$

MATH. How did you find it?
LOG. Well, when I looked at your representation of the equation 666 = 441 + 225 (*she points at the picture on the wall*),



then I realized that it is not necessary to take six triangles on its base, we can take any number of triangles we want (*she makes the sketch shown below)*.



MATH. I see. There is no need to explain it to me any further. But how is it possible that I did not see it when I found my formula? It is amazing! I am much obliged to you. It also seems that you just demonstrated that perspicuous representations may have a heuristic use. Moreover, your new figure is also convincing in the sense that it makes a formal algebraical proof superfluous. Or do you still want to show that

$$\tfrac{1}{2}mn(mn + 1) = \tfrac{1}{2}m(m + 1)\,\tfrac{1}{2}n(n + 1) + \tfrac{1}{2}(m - 1)m\,\tfrac{1}{2}(n - 1)n$$

LOG. Not at all, although I think that this would be a nice exercise for high school students. By the way, do you know the formula for the triangular number of a sum?
MATH. Do you mean

$$t(m+n) = t(m) + mn + t(n)$$

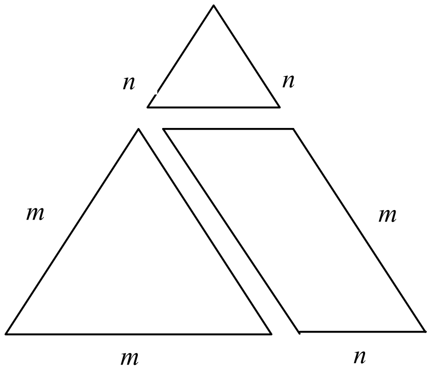
LOG. Yes, and I found also a generalization of this formula. My idea was simple; I first considered the formula for squares, in your notation:

$$s(m+n) = s(m) + 2mn + s(n)$$

MATH. Aha, then the general formula for a polygonal number of a sum becomes:

$$p_k(m+n) = p_k(m) + (k-2)mn + p_k(n)$$

I do not need to see the algebraical proof; I will leave that to my nephew Arit, whom I am helping with his algebra. But do you perhaps have a perspicuous representation of this formula?
LOG. Yes, I do. I started with the formula for $t(m+n)$, or, as you now call it, $p_3(m+n)$, and drew the following picture:



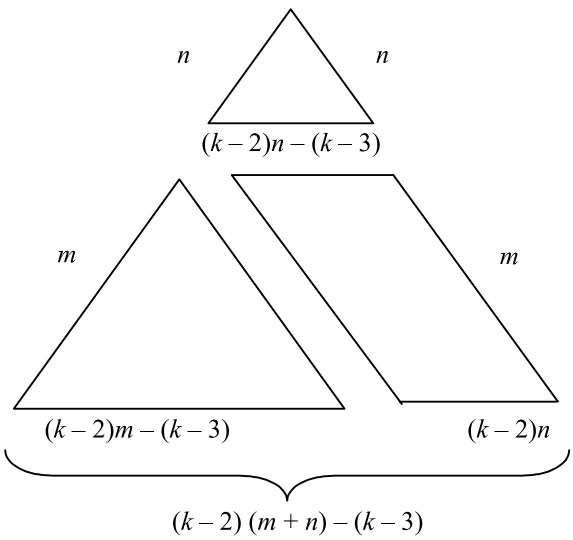
MATH. That is easy, but do the standard representations of higher polygonal numbers also allow such simple configurations?
LOG. No, but I discovered that they can get triangular representations as well. This goes as follows. Consider the formula for a polygonal number in general:

$$p_k(n) = \tfrac{1}{2}n((k-2)n - (k-4))$$

This can be seen as the formula for the sum of an arithmetical series of n terms, with first term 1 and last term

$$(k-2)n - (k-3)$$

But now that we know the last term, we can represent $p_k(m+n)$ as a figure consisting of two triangles and a parallelogram too:



You see, $(k-2)n$ is the difference of $(k-2)(m+n)-(k-3)$ and $(k-2)m-(k-3)$ and this explains, in a sense, that $(k-2)mn$ occurs in the formula for $p_k(m+n)$.
MATH. Very nice! I am impressed! Especially your redescription of the formula for $p_k(n)$ is important as an example of a productive problem solving procedure, if I may say so. I do not believe that a computer could do this.
COMP. (*appearing in the door opening*) Speak of the devil and his imp appears. Were you speaking ill of me?
MATH. (*laughing*) I am surprised that you used a quotation from *Intuitionism*. Are you reading it?
COMP: Yes, I have been told that some computer scientists pretend to be intuitionists in matters of philosophy of mathematics, so I decided to study Heyting's book and I just arrived at page 5, you see. But what does that figure on the blackboard mean? Can you explain it to me? A computer programmer should at least know what the problem solution is, before he starts thinking about how a computer could find it.
LOG. Go ahead, Math. After all you are a trained mathematics teacher!
MATH. Oh please! Comp, this time we were discussing polygonal numbers in general, and that is why there are formulas in the picture. But I can give you a concrete example, to begin with. You know how triangular numbers appear as sums, for example

$$t(5) = 1 + 2 + 3 + 4 + 5$$

Now we do not use the letter 't' anymore, but replace it by 'p_3', for obvious reasons. I trust that you now understand the following formula:

$$p_3(n) = 1 + 2 + 3 + 4 + \ldots + n$$

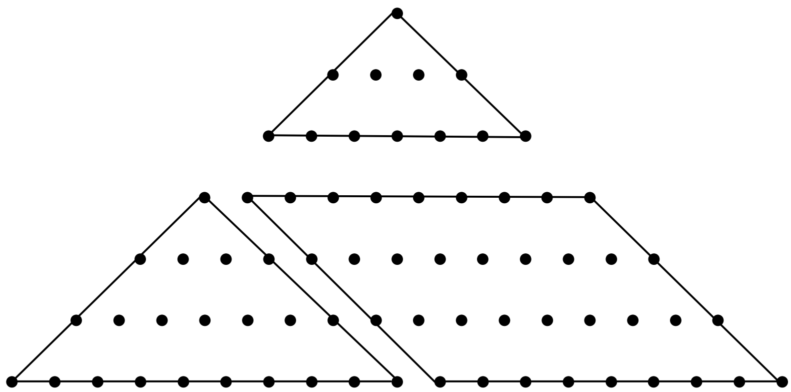
COMP. No problem.
MATH. The next formula concerns squares. Look:

$$p_4(n) = 1 + 3 + 5 + 7 + ... + n$$

COMP. I see. May I write down the formula for pentagonal numbers?
MATH. Go ahead!
COMP.

$$p_5(n) = 1 + 4 + 7 + 10 + ... + n$$

MATH. Let me now draw a picture of $p_5(7)$ and locate three groups in it:



What do you notice?
COMP. $p_5(7)$ consists of $p_5(3)$ and $p_5(4)$ and, eh … 36 other points arranged in a parallelogram, just as in the picture above.
MATH. The problem was to find a formula for the other points. What do you think?

COMP. I see. Every pentagonal number is the sum of an arithmetical progression. We need the formula for the last term if we want to compute the length of the parallelogram.
MATH. Just do it!
COMP.

$$p_5(n) = 1 + (1 + 3) + (1 + 3 + 3) + (1 + 3 + 3 + 3) + ... + (1 + \underbrace{3 + 3 + 3 + ... + 3}_{n-1})$$

The formula for the last term is $1 + 3(n - 1)$. The length of the parallelogram is in general

$$1 + 3(m + n - 1) - (1 + 3(m - 1)) = 3n$$

Now I know at least that (*looking at the figure that Math drew*):

$$p_5(m + n) = p_5(m) + p_5(n) + 3mn$$

This fits in with your figure; 36 is equal to 3 times 3 times 4. Oh, for $p_k(m + n)$ the coefficient of mn must be $k - 2$, so (*with a certain triumph*):

$$p_k(m + n) = p_k(m) + p_k(n) + (k - 2)mn$$

MATH. Excellent!
LOG. I agree, but in fact this is only *Spielerei* without scientific significance; or did you have some interesting novelty, Math?
MATH. Only something that supports my ideas about intuitive insights. But maybe it is interesting for Comp too, for I wonder whether a computer program could find a certain formula.
COMP. That was just the reason that I came to see you. I was anxious to hear if you had some work for me. You know; I still believe that computers can do more than you are inclined to think.
LOG. Well, Math, that is a challenge!
MATH. All right. I was also interested in generalizations of earlier results and I found a formula for triangular numbers of polygonal numbers in general. However, later on I gave up my fixation on triangular numbers and then I found a simple formula for

$$p_\lambda(p_\mu(n)) - p_\mu(p_\lambda(n))$$

It is on this point that I thought of Comp. Would his computer find my formula? But I will first sketch how I found a special formula for

$$p_3(p_k(n))$$

It is again a question of intuitive insights which mathematicians are good at, although it is still an unsettled problem why our spontaneous solutions are oftener right than wrong as Russell said. Yet I will give a suggestion in which direction this problem might be solved.
LOG. I assume that you did not work out your last expression with the help of the general formula for a polygonal number?
MATH. No, I started with a table. Here it is:

N	$P_3(N)$	$P_4(N)$	$P_5(N)$	$P_4(P_3(N))$	$P_3(P_4(N))$	$P_5(P_3(N))$	$P_3(P_5(N))$
0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1
2	3	4	5	9	10	12	15
3	6	9	12	36	45	51	78
4	10	16	22	100	136	145	253
5	15	25	35	225	325	330	630

I already knew that each number of the sixth column is equal to the sum of the last two numbers of the preceding column, but I saw that this rule does not hold for 630, the last number of the last column. So I tried a new rule and took 330 and two times 145. That gave 620 and that is almost 630. It is only 10 less. Then I applied the new rule to 253 and took 145 and two times 51. That gave 247 and that is only 6 less than 253. Well, 10 and 6 are very familiar to us, so I did not hesitate to write down the following formula:

$$p_3(p_5(n)) = p_5(p_3(n)) + 2p_5(p_3(n-1)) + p_3(n-1)$$

In order to generalize this formula I enlarged the table with columns for $p_6(p_3(n))$ and $p_3(p_6(n))$ as follows:

$P_7(P_3(N))$	$P_3(P_7(N))$
0	0
1	1
15	21
66	120
190	406
435	1035

Well, to make a long story short, I found

$$p_3(p_6(n)) = p_6(p_3(n)) + 3p_6(p_3(n-1)) + 3p_3(n-1)$$

and then I listed the four formulas that I now had:

$$\begin{aligned} p_3(p_3(n)) &= p_3(p_3(n)) \\ p_3(p_4(n)) &= p_4(p_3(n)) + 1p_4(p_3(n-1)) \\ p_3(p_5(n)) &= p_5(p_3(n)) + 2p_5(p_3(n-1)) + 1p_3(n-1) \\ p_3(p_6(n)) &= p_6(p_3(n)) + 3p_6(p_3(n-1)) + 3p_3(n-1) \end{aligned}$$

What do you think?
LOG. That the coefficients of $p_3(n-1)$ are again triangular numbers?
MATH. Indeed. The result is clear:

$$p_3(p_k(n)) = p_k(p_3(n)) + (k-3)p_k(p_3(n-1)) + p_3(k-4)p_3(n-1)$$

COMP. Did you check this formula?
MATH. As a matter of fact, yes. I made two more columns:

$P_7(P_3(N))$	$P_3(P_7(N))$
0	0
1	1
18	28
81	171
235	595
540	1540

COMP. Let me see, 540 plus four times 235 makes 1480. $p_3(3) = 6$ and $p_3(4) = 10$, that gives 60, 1480 plus 60 gives 1540. It seems that you are right!
LOG. Did you prove your formula?
MATH. Yes, I did, but the strange thing was that at first it did not come out. However, I never doubted that my formula would be correct, and I sought the mistake in my algebraical derivation. And I was right.
LOG. Last week you quoted Russell, who wrote in his book *Human Knowledge* that he did not know how to make explicit what guides mathematical intuition in such cases as you dealt with. A few moments ago you promised to give a hint for an answer to Russell's question.
MATH. All my examples made use of polygonal numbers. They gave rise to simple functions. When I solved my problems about these functions, I found equally simple relationships; more precisely, I only made use of polygonal functions themselves. Look at the coefficients of $p_3(n-1)$ in the list above. They were 1 and 3. Now

someone might think that they should be seen as the first two odd numbers instead of the first two triangular numbers. But as soon as it was found that the third coefficient was 6, this possibility was ruled out. Yet it remains the case that mathematical intuition is also guided by the discovery of conspicuous connections.
LOG. It is only a pity that your last example is so unimportant. Moreover, the resulting formula is not interesting.
MATH. I agree. However, I would not have found my next attractive formula without it! That is to say, we will soon be able to overturn the ladder, to quote Sextus Empiricus. But before doing that, I will derive a new table from the tables that we already have. The reason for it will become clear afterwards. What I would like you to do for me Comp, is to let your computer find a formula, without further information. In the mean time, I will tell LOG my solution.
COMP. That's agreed!
MATH: Here is the derived table:

$f(3,3) = 0$	$f(4,4) = 0$	$f(5,5) = 0$	$f(6,6) = 0$
$f(3,4) = 1$	$f(4,5) = 3$	$f(5,6) = 6$	$f(6,7) = 10$
$f\,3,5) = 3$	$f(4,6) = 8$	$f(5,7) = 15$	$f(6,8) = 24$
$f(3,6) = 6$	$f(4,7) = 15$	$f(5,8) = 27$	$f(6,9) = 42$

COMP. I understand that you want to know whether a computer can find an algebraical expression for this function. I will do my best. But please give me also a sheet of paper with the original table. I want to see whether my computer can find a relationship between the values in the last column and preceding ones.
(*Math looks in his pamk pers and takes out two sheets of paper and gives one to Comp. Comp leaves the room*)
MATH. (*shows the other piece of paper to Log*) Look, Log:

N	$P_4(P_3(N))$	$P_3(P_4(N))$	$P_5(P_3(N))$	$P_3(P_5(N))$	$P_6(P_3(N))$	$P_3(P_6(N))$	$P_7(P_3(N))$	$P_3(P_7(N))$
0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1
2	9	10	12	15	15	21	18	28
3	36	45	51	78	66	120	81	171
4	100	136	145	253	190	406	235	595
5	225	325	330	630	435	1035	540	1540

When I arrived at this table, I noticed that the differences between the pairs in the last line are always a multitude of 100. I also saw that the differences in the last line but one are a multitude of 36. This suggested a formula of the following form:

$$p_\lambda(p_\mu(n)) - p_\mu(p_\lambda(n)) = f(\lambda,\mu)p_4(p_3(n-1))$$

The problem was now, to determine the function f. That is why I asked Comp to find this function too, although I drew up the derived table only after I had found it myself. I did this as follows. I noticed that

$$f(\lambda,\mu) = p_\lambda(p_\mu(2)) - p_\mu(p_\lambda(2))$$

The values of $p_\mu(2)$ and $p_\lambda(2)$ are, of course, easy to compute with the formula for $p_k(n)$:

$$p_k(n) = \tfrac{1}{2}n((k-2)n - (k-4))$$

LOG. Let me see:

$$p_\mu(2) = \tfrac{1}{2}\,2((\mu-2)2 - (\mu-4)) = \mu$$

That is nice! Then $p_\lambda(2)$ must be λ. We are almost ready; we have only to apply the formula for $p_k(n)$:

$$\begin{aligned}
f(\lambda,\mu) &= p_\lambda(p_\mu(2)) - p_\mu(p_\lambda(2))\\
&= p_\lambda(\mu) - p_\mu(\lambda)\\
&= \tfrac{1}{2}\,\mu((\lambda-2)\mu - (\lambda-4)) - \tfrac{1}{2}\,\lambda((\mu-2)\,\lambda - (\mu-4))\\
&= \tfrac{1}{2}(\mu^2\lambda - 2\mu^2 - \mu\lambda + 4\mu - \lambda^2\mu + 2\lambda^2 + \lambda\mu - 4\lambda)\\
&= \tfrac{1}{2}(\mu^2\lambda - 2\mu^2 + 4\mu - \lambda^2\mu + 2\lambda^2 - 4\lambda)\\
&= \tfrac{1}{2}(\mu\lambda(\mu-\lambda) - 2(\mu^2-\lambda^2) + 4(\mu-\lambda\\
&= \tfrac{1}{2}(\mu-\lambda)(\mu\lambda - (\mu+\lambda) + 4)\\
&= \tfrac{1}{2}(\mu-\lambda)(\mu-2)(\lambda-2)
\end{aligned}$$

That is an amazingly simple formula! Now we can also rewrite $p_4(p_3(n-1))$ as $(\frac{1}{2}n(n-1))^2$, and your general formula becomes:

$$p_\lambda(p_\mu(n)) - p_\mu(p_\lambda(n)) = \tfrac{1}{2}(\mu-\lambda)(\mu-2)(\lambda-2)(\tfrac{1}{2}n(n-1))^2$$

or something like that.

MATH. Excellent! But I wonder whether the algebraical derivation of the formula for $f(\lambda,\mu)$ cannot also be found intuitively from the derived table:

$f(3,3) = 0$	$f(4,4) = 0$	$f(5,5) = 0$	$f(6,6) = 0$
$f(3,4) = 1$	$f(4,5) = 3$	$f(5,6) = 6$	$f(6,7) = 10$
$f(3,5) = 3$	$f(4,6) = 8$	$f(5,7) = 15$	$f(6,8) = 24$
$f(3,6) = 6$	$f(4,7) = 15$	$f(5,8) = 27$	$f(6,9) = 42$

Let me show you what such an intuitive derivation could look like!

LOG. Do you mean that you yourself did not find the formula in that way?

MATH. You are right, and it is easy to present such a derivation with hindsight. This does not imply that it is far-fetched. Look, because the value of $f(\lambda,\mu)$ is 0 if λ and μ are equal, it is divisible by $\mu - \lambda$. Notice that I assume that μ is greater than λ. It follows that $f(\lambda,\mu)$ has the form

$$(\mu-\lambda)g(\lambda,\mu)$$

Now we can make the corresponding table for $g(\lambda,\mu)$ as follows:

$g(3,3) = 0$	$g(4,4) = 0$	$g(5,5) = 0$	$g(6,6) = 0$
$g(3,4) = 1$	$g(4,5) = 3$	$g(5,6) = 6$	$g(6,7) = 10$
$g(3,5) = \frac{1}{2}\cdot 3$	$g(4,6) = 4$	$g(5,7) = \frac{1}{2}\cdot 15$	$g(6,8) = 12$
$g(3,6) = 2$	$g(4,7) = 5$	$g(5,8) = 9$	$g(6,9) = 14$

Or, if we make it more uniform,

$g(3,3) = 0$	$g(4,4) = 0$	$g(5,5) = 0$	$g(6,6) = 0$
$g(3,4) = \frac{1}{2}\cdot 2$	$g(4,5) = \frac{1}{2}\cdot 6$	$g(5,6) = \frac{1}{2}\cdot 12$	$g(6,7) = \frac{1}{2}\cdot 20$
$g(3,5) = \frac{1}{2}\cdot 3$	$g(4,6) = \frac{1}{2}\cdot 8$	$g(5,7) = \frac{1}{2}\cdot 15$	$g(6,8) = \frac{1}{2}\cdot 24$
$g(3,6) = \frac{1}{2}\cdot 4$	$g(4,7) = \frac{1}{2}\cdot 10$	$g(5,8) = \frac{1}{2}\cdot 18$	$g(6,9) = \frac{1}{2}\cdot 28$

As soon as someone discovers that the numbers in the second column are all divisible by 2, and those in the third column by 3, and the numbers in the fourth column by 4, he can rewrite this table with the following result:

$g(3,3) = 0$	$g(4,4) = 0$	$g(5,5) = 0$	$g(6,6) = 0$
$g(3,4) = \frac{1}{2}\cdot 2$	$g(4,5) = \frac{1}{2}\cdot 2\cdot 3$	$g(5,6) = \frac{1}{2}\cdot 3\cdot 4$	$g(6,7) = \frac{1}{2}\cdot 4\cdot 5$
$g(3,5) = \frac{1}{2}\cdot 3$	$g(4,6) = \frac{1}{2}\cdot 2\cdot 4$	$g(5,7) = \frac{1}{2}\cdot 3\cdot 5$	$g(6,8) = \frac{1}{2}\cdot 4\cdot 6$
$g(3,6) = \frac{1}{2}\cdot 4$	$g(4,7) = \frac{1}{2}\cdot 2\cdot 5$	$g(5,8) = \frac{1}{2}\cdot 3\cdot 6$	$g(6,9) = \frac{1}{2}\cdot 4\cdot 7$

Then the rest is child's play. Yet I must confess that I gave the derived table as an exercise to several mathematicians. All of them succeeded in finding the solution, but none of them did it in the intuitive way. I am anxious to hear if Comp, or rather his computer found it.

COMP. (*entering the room*) Here is the imp again! His devilish powers have overcome!

MATH. Welcome Comp. What did you find?

COMP. First of all, I wrote a program for your original table. In order to find a connection between the numbers in the last column and preceding values, I considered only numbers in the same row. Moreover, I restricted the absolute value of the coefficients to a maximum of 3.

Nevertheless the computer found 48 solutions within the total number of combinations that was eh… (*Comp shows the list with the solutions to Math*)

MATH. Ah, there are two solutions with only three values, in your notation:

[0, -1, 0, 0, 0, 3, -1]

and

[0, 0, 0, 0, -3, 3, 1]

This means that

$$p_3(p_5(n)) = 3p_3(p_4(n)) - p_5(p_3(n)) - p_3(n)$$

and

$$p_3(p_5(n)) = p_5(p_3(n)) + 3p_3(p_4(n)) - 3p_4(p_3(n))$$

The second formula can be rewritten as

$$p_3(p_5(n)) - p_5(p_3(n)) = 3(p_3(p_4(n)) - p_4(p_3(n)))$$

and that is interesting, because it is a consequence of our general formula.
COMP. I understand that your general formula has something to do with the function of two variables – in my notation X and Y – that you asked me to find. Well, I also wrote a program for that problem. I tried evolutionary algorithms on expression trees, with operations +, –, and *, plus constants from -5 to 5. And indeed my computer came up with a solution, after hours of searching. Here it is (*Comp shows Math a piece of paper with the following formula*):

(((5 * (((X * ((((0 * Y) * (Y + Y)) + (Y * (X – -4))) + X)) * X) + (Y – (((Y + X) – ((X * Y) – ((5 * Y) + 4))) + (((3 + (Y + X)) – ((-3 – -2) * (-2 + X))) + (((X – Y) * X)))))) – (1 * (Y – Y))) + (Y – ((((4 * 5) * Y) – Y) * (X * (Y + ((Y + X) * ((3 * (-4 – 2)) + (((X – X) + (Y + X)) * Y))))))))

This did not look not very elegant to me, so I simplified it to (*Comp writes on the blackboard*):

(19Y^2 + 5Y + 5)X^3 + (38Y^3 – 322Y – 5)X^2 + (19Y^4 – 361Y^2 + 5Y – 15)X –29Y – 25

Is this what you mean?
LOG. (*laughing*) Do say yes Math!
MATH. With pleasure, but I cannot believe that the last formula is correct. Did you check your solution, Comp?
COMP. No, I did not, but I am not content with it anyway. The formula is too complicated. But what else can I do?
MATH. Maybe you can add the division by 2, and also restrict the other coefficients and constants to -2, -1, 1 and 2. I am curious…
COMP. OK. (*leaves the room*)

(*While Comp is working on his task, Log and Math begin to check Comp's first formula. First of all they give X and Y the values 4 and 5, but they do not get the corresponding function value 3. Then they try again with the arguments 3 and 4, with the same negative result. They conclude that the formula must be wrong. Comp returns almost an hour later.*)

COMP. My computer triumphed! After adding your restrictions, some debugging and some tuning, my computer found the following formula:

(((Y – 2) * ((X – Y) * (Y – (X + (Y – 2))))) / 2)

I simplified it to:

(Y – X) * (X – 2) * (Y – 2) / 2

Seems correct to me.
LOG. Did you expect that, Math?
MATH. Yes, in a way. Nevertheless, I admire your achievement, Comp. With hindsight I think that computers can be of great heuristic help, provided that they are instructed in advance with constraints such as a limitation of the coefficients to small numbers. Take your second formula after I had rewritten it:

$$p_3(p_5(n)) - p_5(p_3(n)) = 3(p_3(p_4(n)) - p_4(p_3(n)))$$

It is possible that my investigation had taken a different course if I had known this formula. On the other hand, your first formula appeared to be incorrect. It seems that you made a mistake when you copied it.
COMP. That is possible. Errare humanum est.

LOG. Quite right. How often do we not make mistakes, not only when we are guessing, but even when we are applying formulas in a mechanical way.
MATH. I agree. The question is: which do you trust more, your formal skills or my intuitive abilities?
COMP. Or my computer power?
(*The discussion ends in laughter*)

This is the third and last paper on “intuitive insights”. The other two are “Squangles” and “Pentries and heptries”. The author is very grateful to the computer scientists Marjan Dragt and Jeroen Donkers, who wrote the computer programs alluded to in – respectively – the first two papers and the third paper. Moreover, their comments during the problem solving process were of great value for the wording of the – not always fictitious! – discussions in the papers.

BeNeLearn'02

Report by
Martijn van Otterlo and Edwin de Jong

Some forty-five people had come to Utrecht on a very cold, but beautiful winter day to participate in the twelfth Belgium-Dutch Conference on Machine Learning (BeNeLearn'02) on the 4th of December 2002. The conference gathers researchers from the Netherlands and Belgium that are active in the field of Machine Learning, although some participants from outside these countries broaden this horizon slightly. The conference was organized by Marco Wiering and Walter de Back, and it was held at the Universiteit Utrecht.

From the 15 presented papers, 10 came from the Netherlands and 4 from Belgium. The remaining one came from Portugal. Furthermore, the co-authors of some of the papers came from the United States, Finland, Slovenia and France. The Dutch contributions were spread over 5 universities while the Belgian contributions originated from Gent and Leuven. Some of the participants coming from Leuven experienced traffic problems in and around their city, but fortunately the schedule was flexible and could be adapted online. The conference consisted of one track, so the participants had the chance to see all presentations.

The day started with an invited talk by Professor Helge Ritter, from the "Arbeitsgruppe Neuroinformatik" of the University of Bielefeld, Germany. Ritter's interest is in robots that learn to imitate actions, and impressive demonstrations accompanying the talk showed that this interest is the basis of a substantial research programme. One demo for instance showed a simulated 3-dimensional hand imitating a human hand. A striking aspect was that this research does not consist of developing one or a few techniques for imitation learning, but rather combines a large number of distinct techniques into a single robotic setup. These techniques ranged from speech recognition, tactile matrix sensors (combined with techniques from vision) and gesture recognition to high level symbolic approaches. Thus, the work sketched an image of AI as a place where many specific engineering techniques come together, rather than as a quest for a single ultimate search algorithm.

The morning session addressed diverse directions in machine learning. The first talk, presented by Edwin de Jong, discussed an approach to multi-agent learning where agents can reuse part of their controller while relearning other, problem-specific parts. Marco Wiering discussed a generalization of feedforward neural networks, so-called causal neural networks, in which input features and target outputs can be represented as input or output units. In this way the common feedforward structure of neural networks can be generalized towards more generally applicable architectures. The last talk in this session, presented by Rui Camacho, discussed a general method for providing language bias in inductive logic programming. The basic idea is to define language levels that can be searched in a sequential order, from simple hypotheses to complex ones.

The lunch was organized by the organizers of BeNeLearn and fortunately, given the fact that it was a really cold, Dutch winter day, it was in the same building. The long table gave much room for discussions about the morning and upcoming sessions.

The first afternoon session opened with a talk on 'locally linear generative topographic mapping' presented by Sjaak Verbeek. This was the only work in the conference dealing with unsupervised learning. Verbeek discussed an interesting idea for non-linear data projection. Although the mathematical machinery is quite sophisticated, the visualizations of the projections immediately showed their advantages over existing mappings.

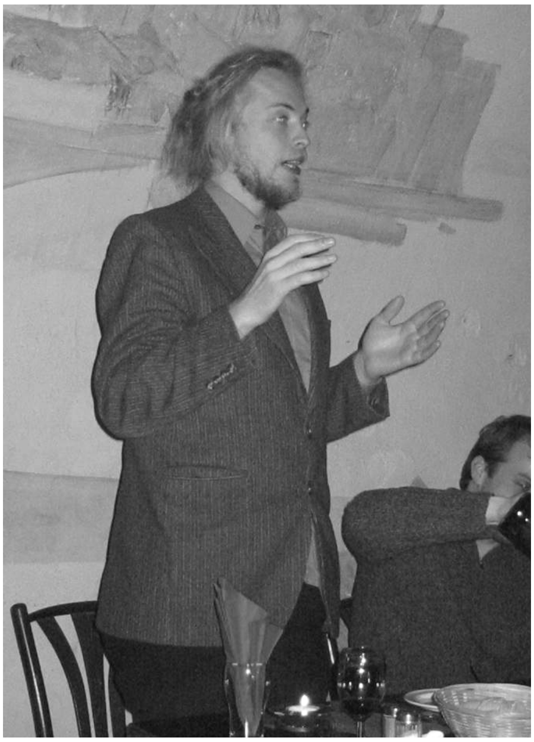
Because the people from Leuven had meanwhile arrived, Sophie Verbaeten was able to give her talk in the afternoon session. Verbaeten gave an interesting talk about the general problem of outliers. Although her talk was mainly about experiments with a specific relational learning algorithm, the topic was general enough to trigger a discussion on the important concept of 'outliers'. How can we decide that some data point has been 'mislabeled'? The third talk in this session was about the very fundamentals of learning. Jeroen van Maanen discussed algorithmic information theory and his approach to universal learning agents. He mixed notions of minimum description length and algorithm statistics, contrasted his work with an existing universal learning algorithm by Marcus Hutter and tried to remove the need for external utility functions while preserving universality.

Unfortunately, 15 minutes are very short for such fundamental concepts, although the author had some very informative sheets. The next talk could be called an 'outlier' for this conference, in the sense that the main contribution of the paper did not involve machine learning. The main part of the talk dealt with dynamically assigning roles to agents in a multi-agent system. Jelle Kok presented very interesting research based on recent work on coordination graphs by Carlos Guestrin. The talk discussed mechanisms using role graphs to reduce the amount of coordination and to loosen the dependency on communication for coordination. While the results were preliminary, the performance increase in a simulated soccer system was promising. Federico Divina closed the session with a talk about maintaining diversity in evolutionary concept learning. In evolutionary learning diversity is an important issue, and Divina considers this issue in a system where concepts are represented by means of a relational language.

The second afternoon session started with a highly interesting talk by Hendrik Blockeel about 'supermodels'. This has nothing to do with electing 'Miss BeNeLearn', but rather deals with inducing a kind of metamodels from which multiple concrete models can be efficiently generated in order to avoid executing computationally heavy induction processes many times in very similar contexts. Blockeel triggers a new research direction which could prove very fruitful in machine learning.

Because Yvan Saeys was absent, this part of the session could be filled in by the talk of Kurt Driessens that was originally scheduled for the morning session. Driessens talked about his fairly well-known relational reinforcement learning (RRL) system. In this talk he presented extended results from his ICML'02 paper on the same topic of using guidance in RRL. In his own words 'it was a natural thing to present preliminary results at ICML and the extended, better, results at BeNeLearn'. Results were presented on how to give 'expert advice' as guidance to the learner, and especially when and how to give advice. The next speaker, Floor Verdenius, presented very interesting work on the use of continuous wavelet transforms to derive features from a dataset in order to choose between techniques using different representations.

After that, Teemu Roos presented work on efficient supervised learning of Bayesian networks. He showed that for a large class of Bayesian network models, a general condition can be given so that the supervised learning problem is equivalent with logistic regression. Wojtek Jamroga then, presented recent results on the use of multiple (user) models and how to combine them. He proposed that a model's importance may be weighted with the confidence the agent has in the model and that this confidence can be (partly) based on the amount of available data. Viara Popova then closed the conference with a talk about monotone decision trees. Different labeling techniques and splitting criteria were discussed in the context of decision trees for ordinal classification.



Marco Wiering.

Half of the participants joined the conference dinner. The dinner was a safe choice: no Dutch food, no Belgian food, but instead delicious food from the Balkan restaurant 'Boro'. The restaurant is situated in the center of the city and provided some excellent three course meals. Especially the 'burning' dessert with pancakes was spectacular. During diner, many Belgium-Dutch issues were raised but only some of them settled...

The various contributions to the conference showed that the two small Dutch-speaking countries are active in all corners of the large field of machine learning. Paradigms such as supervised, unsupervised and reinforcement learning were covered as well as various methodologies such as neural and Bayesian networks, genetic algorithms and decision trees. Many contributions also show interest and expertise in relational representations to strengthen the expressive power of representational tools for machine learning. Also, some contributions attribute to theoretical foundations, data understanding and supermodels. Furthermore it is worth noticing, as Marco Wiering did in his editor's introduction to the proceedings, that no work on support vector machines was presented at the conference, although these receive much attention in other, international conferences. To round up, we can say that this conference was a success and showed an active community. We are looking forward to another interesting conference next year.... See you in Brussels!

URL for Ritter's Neuroinformatics group:
http://www.TechFak.Uni-Bielefeld.DE/ags/ni/

BENELEARN'02

Report by Joke Reumers
COMO, VU Brussel

The twelfth Belgian-Dutch Conference on Machine Learning (Benelearn '02) was held at the Universteit Utrecht on December 4, 2002. About 50 researchers, mostly from Belgian and Dutch universities, gathered to attend talks on various topics related to machine learning. Genetic algorithms, decision tree learning, inductive logic programming, reinforcement learning, are a selection of the techniques used by the authors. Also the applications wee various: although most authors used standard data sets or artificially generated data sets, there was also an application in bioinformatics (Saeys et al.) and the Tetris game (Driessens & Dzeroski).

Benelearn was officially opened with an invited talk by Prof. Helge Ritter from the University of Bielefeld, Germany. His talk *Towards Robots that Learn to Imitate Actions* covered three different subjects concerning robot imitation. The first dealt with the focus point in images: on which part of an image does a human concentrate to analyze a picture and how can this knowledge be transferred to robot vision? The second subject dealt with visual recognition of human hand postures, and the final subject concentrated on the actual implementation of a robot hand which lifted up objects that were pointed out by a human. The talk was concluded with an impressive video that showed the human hand in action.

The order of the presentations was somewhat disturbed by traffic problems. All Belgian participants were late, resulting in a shuffle of the presentations. The description of the presentations is given in the order that was noted in the conference program.

On Using Guidance in Relational Reinforcement Learning
Kurt Driessens and Saso Dzeroski

Kurt Driessens talked about his current research in Relational Reinforcement Learning (RRL). When dealing with large state spaces, RRL encounters two major problems: first, it may be infeasible to learn the Q-function in a tabular form, and second, the rewards in state space may be so sparse that discovery with random exploration will be too slow. The authors tackled the first problem with a RRL approach, and the second with a use of "reasonable policies" to provide guidance.

Context-Based Policy Search: Transfer of Experience Across Problems
Leonid Peshkin and Edwin De Jong

Edwin de Jong's talk addressed the problem of generalisation in reinforcement learning. Their solution consisted of finding a bias in a learning problem and then applying this bias in subsequent problems. This made it possible to address problems that could not be solved otherwise.

Identifying Mislabeled Training Examples in ILP Classification Problems
Sofie Verbaeten

In her presentation, Sofie Verbaeten introduced a technique to identify mislabeled training examples in ILP classification problems. The (noisy) training set is preprocessed, i.e. outliers are identified and then removed. Different filtering techniques were applied and evaluated on a Bongard data set that was corrupted with noise.

Improving the Efficiency of ILP Systems Using an Incremental Language Level Search
Rui Camacho

In the last talk of the morning session Rui Camacho elaborated on "Improving the Efficiency of ILP Systems". The technique used to accomplish this goal avoids the generation of useless hypotheses, and is called Incremental Language Level Search (ILLS). ILLS defines a language bias coupled with a search strategy. Substantial efficiency improvements were accomplished on several ILP data sets.

Locally Linear Generative Topographic Mapping
Jakob Verbeek, Nikos Vlassis, and Ben Kröse

In his presentation, Jakob Verbeek proposed a model for non-linear data projection that combines Generative Topographic Mapping and Coordinated Principal Component Analysis. The first approach is extended by using more complex nodes in the network, and using a piece-wise linear mapping between data and latent space, as opposed to the point-wise coupling of the GTM.

Evolving Causal Neural Networks
Marco Wiering

Marco Wiering introduced causal neural networks, a generalisation of feed-forward neural networks. In causal neural networks, input features and target outputs can be represented as input or output units. A forward-backward propagation algorithm is proposed for inferring the values of the target outputs, which are represented as input units. Genetic algorithms are used to deal with the large number of possible structures and feature selection. The results show that this approach can outperform the usual feed-forward architectures for particular problems.

Model Growth
Jeroen Van Maanen

A more theoretical approach is used in Jeroen van Maanen's research. He discussed the possibility of a framework that adds interactivity to inductive inference, based on a utility function that is internal to the learning subject and independent of the environment. A minimum description length (MDL) approach is used in this utility function.

Non-communicative Multi-agent Coordination in Continuous Domains
Jelle Kok, Mathhijs Spaan, and Nikos Vlassis

Jelle Kok and his colleagues extended coordination graphs to cope with continuous domains and/or unavailability of communication. Coordination graphs offer tractable approximations for action coordination in a group of agents. The previous ideas have been applied in a simulation robot soccer team with promising results.

Non-universal Suffrage Selection Operators Favor Population Diversity in Genetic Algorithms
Federico Divina, Maarten Keijzer, and Elena Marchiori

In his talk, Federico Divina showed a Genetic Algorithm approach to concept learning. In such an approach, an individual represents a partial solution that covers some instances of the learning set. The Universal Suffrage (US) selection operator makes sure that both the population is diverse and that as many instances as possible are covered. In their research, two variants and the original version of the US operator are experimentally compared. The variants incorporate information on the hardness of the instances to be covered during the evolutionary process.

Induction of Supermodels
Hendrik Blockeel

With a somewhat ambiguous title, Hendrik Blockeel immediately got the attention of the audience. Starting from the observation that ML experiments are often performed with a number of different algorithms, different settings, etc., the intention is not to focus on algorithms that induce a single model, but on algorithms that induce a kind of model generator or supermodel, from which concrete models can be efficiently generated.

Selecting Relevant Features of Splice Site Prediction by Estimation of Distribution Algorithms
Yvan Saeys, Sven Degroeve, Dirk Aeyels, Yves van de Peer, and Pierre Rouze

The research presented in this talk is the result of a collaboration of biology and computer science researchers. The problem of splice site prediction was tackled with a genetic algorithm approach. Estimation of Distribution Algorithms is a more general framework for genetic algorithms. This estimation is successfully applied to feature selection for splice site prediction.

Detecting Orthogonol Class Boundaries in Entropy Behavior
Floor Verdenius and Maarten Van Someren

One of the key problems in machine learning is technique selection, and finding an appropriate model class for a domain is an important step in this problem. The presentation focused on a specific problem, a model class of nested hyper-rectangles with numerical values, and a specific feature of this model class: the distribution of information gain over the variables show cusps. Experiments show that the cuspiness of information gain can be used to choose between methods for nested hyper-rectangles and methods for linear hyperplanes.

Supervised Learning of Bayesian Network Parameters
Hannes Wettig, Peter Grunwald, Teemu Roos, Petri Myllymaki, and Henry Tirri

In Bayesian Networks, the supervised learning problem means that it is not clear how to find the parameters maximising the supervised (conditional) likelihood. This paper proposed an efficient solution to this problem for a large class of Naive Bayes and Tree-augmented Naive Bayes classifiers. This was done by showing that under certain conditions the supervised learning problem is equivalent to logistic regression. The global maximum can then be easily found by local optimisation methods.

Datasize Based Confidence Measure for a Learning Agent
Wojciech Jamroga

In the last but one presentation, Wojciech Jamroga presented a confidence measure for learning agents. The agent keeps a probabilistic model of environment of action. The confidence measure reflects only the fact whether the agent has collected sufficient observations. This is related to trust that can be put in the model. Two different measures are proposed, both based on aggregate variance of the estimator provided by the learning process.

Labelling and Splitting Criteria for Monotone Decision Trees
Jan Bioch and Viara Popova

Viara Popova addressed the question how to label the leaves of a decision tree in a way that guarantees the monotonicity of the resulting tree. Dynamic and static labelling were experimentally compared. Furthermore, two splitting criteria were compared in the context of monotone decision trees: the entropy criterion and the number of conflicts criterion.

Lunch was served in the student restaurant of the university. Several Dutch specialities, such as peanut butter and 'meat croquettes' were highly appreciated by the participants.

After an interesting day at the Universiteit Utrecht, a drink was offered for everyone who felt a need to continue ongoing discussions or start new ones. To the joy of many, next to several fine wines, even a selection of Belgian beers was present!

Benelearn was concluded with an excellent meal in a pleasant environment. The Hungarian restaurant BORO, is situated close to one of Utrecht's many canals.

Farewell Reind

Jaap van den Herik
IKAT, Universiteit Maastricht

On November 1, 2002, Professor Reind van de Riet officially stepped down as the chairman of the Board of Governers of the Graduate School SIKS. He was involved in SIKS from the very beginning.

His enthusiasm brought many researchers from the Netherlands together for constitutional meetings all over the country and even in Belgium. Van de Riet has considererably contributed to SIKS with many new ideas, for instance on the Ph.D. education, the AiO guidance, the scientific committees, a SIKS newsletter called SIKSTANT, the SIKS days, and the SIKS master classes.

On December 6, 2002, the board of SIKS had the pleasure to say goodbye to Professor van de Riet in the warm environment of the Universiteit Utrecht. In the auditorium where in 1579 the “Unie van Utrecht” was agreed, Van den Riet played the organ.

Reind van de Riet playing the organ.

The members of the SIKS board.

The board members listened devotedly (see photograph below). As a courtesy to all BNVKI members who know Van de Riet we are able to provide them with some of the selected personal feelings of Van de Riet. Since Van de Riet is an open-minded and very friendly person, I feel no objection to quote from his 2002 letter to his many good friends interested in the well-being of the Van de Riet family.

"Finally, one of my duties for the University was filling the chair of the board of the graduate School SIKS. This is a cooperation of some ten universities in the Netherlands to organize teaching for Ph.D. students and cooperating in research. This year was a special year as we had to prepare for a next accreditation of the School by the Dutch Academy of Sciences. A report had to be written, an international committee of peers had to be chosen, and presentations for this committee had to be arranged, in short a very interesting but also challenging task. Although we still don't know what the final result will be, we are quite confident about it as the committee was very content, and also very critical with positive criticism. In any event, my successor as chairman can enjoy the re-accreditation and I could say goodbye to my fellow members of the SIKS Board. There was a nice dinner celebrating my departure and it was in a nice place: the faculty club of the Universiteit Utrecht, connected to the Aula of that University, a place of Dutch historical interest as it is the place where the "Unie van Utrecht" was held in 1579, just at the start of the freedom fight (against the Spanish occupation). More importantly there is an historic organ and I could present to the dinner guests a small organ concert of half an hour as a musical hors d'oeuvre/introduction. The dinner was fine, the speeches were warm and excellent and the present which was given to me was appropriate: a DVD player (my colleagues are thinking that I have now plenty of time); I am still busy with my DKE work, I still have two Ph.D. students and give lectures all over Europe, which is very rewarding indeed."

Reind, we thank you for all you did for SIKS, and we wish your successor Hans Akkermans a very good time too.

Report on the 3rd Dutch-Belgian Information Retrieval Workshop (DIR-2002)

Rik De Busser
ICLI, KU Leuven

In the Low Countries, interest in information retrieval, the discipline that is mainly concerned with identifying information in document or multimedia collections, has been modest but steady throughout the years. In 2000, this led to the first Dutch-Belgian Information Retrieval Workshop (DIR) at the Universiteit Maastricht (the Netherlands). Two years later, the third edition of DIR shows that the IR community in Belgium and the Netherlands is more alive than ever. Organized by ICRI/LIIR (the research group Legal Informatics and IR of the Interdisciplinary Centre for Law and IT, KU Leuven, Belgium) in cooperation with SIKS (Dutch Research School for Information and Knowledge Systems) and the IWT Flanders, DIR-2002 received considerable attention from researchers and students from the

Netherlands, Belgium, and – notwithstanding the local focus – various other countries. Altogether, more than 80 participants registered for the workshop. The local organizers were Marie-Francine Moens (KU Leuven, Belgium), Djoerd Hiemstra (TU Twente, the Netherlands) and Wessel Kraaij (TNO Delft, the Netherlands).

Unlike DIR-2001, which focussed on user interaction and adaptive methods in IR, the organizers of the 2002 workshop had opted for keeping the subject matter as diverse as possible. Fourteen presentations and a keynote speech were crammed into a tight one-day schedule, covering an array of IR subjects as diverse as XML, video retrieval, cross-language IR, and IR from historical corpora. Candidate speakers were invited to submit an extended abstract, which was checked by an international committee of reviewers. We were very happy that all speakers later also submitted a full paper, although this was by no means a prerequisite for the workshop. All papers and an abstract of the keynote speech are bundled into an electronic volume, which is available at http://www.law.kuleuven.ac.be/icri/proceedings_dir.php.

The Presentations

The morning started off with the keynote lecture of Karen Sparck Jones (Cambridge, UK). Unfortunately, some grave circumstances prevented Prof. Sparck Jones to attend the meeting, but she managed to record a vivid speech on videotape – *Language and information: old ideas revisited and new ones considered* – in which she discussed the pros and cons of statistical techniques for language information processing (LIP) in a historical context [10]. She argued that, although some radical progress has been made in the field of statistical language processing during the previous decade, these developments were to a considerable extent a continuation of ideas that had already been developed in the 1950s and 1960s and that there was still considerable room for innovation, both in purely statistical LIP and for hybrid techniques.

Apart from the keynote speech, the five talks in the forenoon focused on IR from semi-structured documents and multimedia information retrieval, both of which are issues that currently seem to be very much in the spotlight in the IR world. The first three talks [9, 7 6] covered the former subject and affirmed the increasing importance of XML for information retrieval; the latter two [2, 12] dealt with content-based image retrieval. During the second session of five talks in the afternoon – after a copious though rather hasty lunch in a historical farmstead – the theme shifted towards the use of natural language processing in IR [5, 11, 1, 13, 8]. Roughly, presentations either dealt with evaluating the effectiveness of complementing traditional IR techniques with NLP or with issues concerning lexical cohesion. The last session of the day started off with three talks in the field of cross-lingual IR [4, 14, 15] and the day closed with a highly interesting presentation on information retrieval from historical corpora [3].

Conclusion

All in all, the Third Dutch-Belgian Information Retrieval Workshop was a success. Attendance (more than 80 participants) was a lot higher than was expected, as was the quality of the submissions. Maybe the large number of presentations demanded some perseverance of the attendants, but it also ensured a diverse view on the Dutch and Belgian IR scene. We can only advise all that are interested to keep an eye on the next DIR, which will be organized by the Universiteit van Amsterdam (the Netherlands). Further information on DIR-2002 can be found on http://www.law.kuleuven.ac.be/icri/seminars.php?id=7&where=.

Acknowledgements

The organisers would like to thank the sponsors – the Dutch Research School for Information and Knowledge Systems (SIKS) and IWT Flanders – for their kind support. They would also like to express their thanks to the team of reviewers for the effort they put into correcting the submissions.

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SECTION KNOWLEDGE SYSTEMS IN LAW AND COMPUTER SCIENCE

Section Editor
Marie-Francine Moens

Legal Knowledge Based Systems: An inventory of possible (causes of) errors

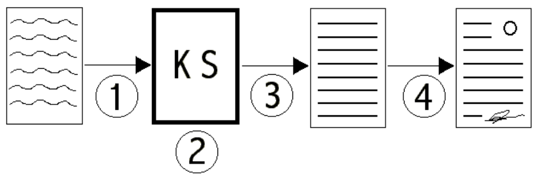
Report by Martin Apistola
CLI, VU Amsterdam

This article is a brief description of a paper and presentation by Hugo De Bruin et al. (2002).

The application of legal knowledge based systems (LKBSs) in practice has increased and many of these systems function satisfactorily (De Bruin et al., 2002). But despite this optimism, De Bruin shows us that some LKBSs do produce incorrect results. At first sight we may blame the LKBS for its technical and legal shortcomings, but we can also take a look at ourselves as users who make mistakes when interacting with the system. When we try to understand both shortcomings, we may increase the quality of LKBSs. The study of Hugo de Bruin was limited to the 'human based' source of errors. First, I will briefly describe De Bruin's view on how users interact with LKBSs, what can go wrong during this interaction and how LKBSs usually support users. After this I will describe De Bruin's categorisation of possible reasons why users cause errors in working with LKBSs. Next I will briefly describe De Bruin's case study in which he looked how this categorisation relates to practice. De Bruin's study is meant as a first investigation for future study after LKBSs. The focus of his study is on LKBSs deployed in a municipality that support public administration in taking legislation based decisions in citizen's cases such as social welfare permits, building permits and tax assessment.

INCORRECT DECISIONS AND LKBS SUPPORT

In using LKBSs, two types of legal incorrect decisions may occur according to Dutch Law: material and formal incorrect decisions. An example of a material incorrect decision is granting too much money to a citizen. An example of a formal incorrect decision is that a certain deadline is violated. Incorrect results can be caused by errors made at various stages in interaction with LKBSs. The stages are shown in the figure below.



Interaction with a knowledge based system.

First of all, raw data is entered into the LKBS by a user (**1**). This data is processed by the LKBS (**2**). The result of the processed data is a draft decision (**3**). The user may decide to adjust this draft decision (**4**). The process results in a final decision.

During interaction with the LKBS, the following errors can be made: because of incorrect input a wrong decision is made (**1**); a wrong decision is made because of an error in the system (**2**); the draft decision is not adjusted when necessary (**3** & **4**); a right decision is made, but is processed or copied wrongly (**4**); a wrong decision is copied (**4**).

Usually, LKBSs offer only partial, or incomplete, support to their users. Partial support means that the LKBS leaves room for its users to interpret output of the system. A reason for this is that the legal system is not always unambiguous. In some cases the user needs to interpret the output of the system because it is not specific enough. In other cases the LKBS can only provide legal explanations or precedents and the final decision is left to its user. The fact that legal systems do not always provide clear answers can cause the borderline between incomplete and incorrect support by LKBSs to be vague. This makes it for example difficult to decide whether the user transformed (too) general remarks of the LKBS into a wrong decision or whether the LKBS produced a wrong decision in the first place.

POSSIBLE CAUSES OF HUMAN BASED ERRORS

De Bruin's study is limited to the errors caused by humans working with LKBSs and he assumes that LKBSs themselves function properly. Based on human-computer interaction and legal knowledge based systems research, De Bruin et al. (2002) found a number of possible causes of human based errors:

1. *Insufficient awareness to which extent the LKBS is meant to support the user's task*: Users are not informed about the completeness of support and do not know how much trust to put in the system.
2. *Insufficient domain knowledge to verify and adjust LKBS outcomes*: Not every user has sufficient experience and knowledge to verify and adjust the outcome of LKBSs.
3. *Strategic behaviour*: There are two types of users: users that complement the system without thinking of a desired outcome, and users who already have expectations and want the system to produce the results they desire.
4. *Usability problems*: Is the system easy in use and is the system comfortable for the user? How easy is the system to learn for a user? Is the user able to "feel how the system thinks?" How easy is it to reset/recover the system?
5. *External pressure*: More errors can be made if the workload of users is too high.

CASE STUDY

To find out whether municipality consultants deal with the same errors, De Bruin performed a case study. In the case study he investigated a LKBS named MRE-Abw that supports the 'General Assistance Act' (Algemene Bijstandswet, Abw). De Bruin interviewed six consultants and three staff members of a municipality. As a result of his case study, De Bruin describes a number of causes for errors in using LKBSs based on the error classification of the previous section.

1. *Insufficient awareness to which extent the LKBS is meant to support the user's task:* Almost all consultants were generally aware that the LKBS provides only partial support and they often adjusted the output of the system by themselves. The system was seen more as a checklist than as an 'expert' helping them to form a decision. An annual quality review and research by Groothuis & Svensson (2000; see De Bruin et al. 2002) of the same municipality and the same LKBS that De Bruin investigated, shows that a considerable number of errors were made by the consultants in using the MRE-Abw LKBS, especially when incomplete systems were used. Despite of this evidence of errors made, all users in De Bruin's case study believed that they made no mistake in adjusting the system's output.
2. *Insufficient domain knowledge to verify and adjust LKBS outcomes:* This was no cause for errors. The consultants had a relatively high level of domain knowledge. They have been working at the municipality for between one and six years. Five of them followed a course on legal administration.
3. *Strategic behaviour:* Decision making and checking those decisions was done by the same person; this provoked strategic behaviour. Often, users wanted to come up with a certain decision and provided information in such a way that the system arrived at the same decision.
4. *Usability problems:* The system scored well on the subject of usability; most consultants knew how to work with the system, despite lack of training. One risk factor was that the system might encourage careless processing because of frequent use of default values and quick ways of navigating.
5. *External pressure:* Consultants said that they are under no pressure.

CONCLUSION

It is difficult to draw general conclusions from the study by De Bruin. First of all, legal systems are not always unambiguous and so evaluation of LKBSs becomes a difficult task. Secondly, only a small number of users in one municipality working in the same field with the same system, were interviewed. The study has mostly provided subjective data on how users look at the system, which may be different from how they actually use the system. Consultants use the MRE system mainly as a checklist and as a tool for drafting a decision. De Bruin suggests that, although the users say that they have only few problems with the system, they still make a considerable number of errors with it. A reason for this is, that the system provides only partial support, and the user has not enough knowledge about the aspects of the cases that are insufficiently supported and that need user interference. The study leads to an important result: Designers and users of LKBSs have to pay more attention to the problem of partial support in order to improve the quality of LKBS based decisions.

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AI EDUCATION

Section Editor
Evert van de Vrie

Professional Tools in Education by CA's Academic Partner Program

Evert van de Vrie
Open Universiteit Nederland

Computer Associates, one of the biggest world wide operating IT-enterprises, has a clear view on knowledge management and tooling in business applications. At a meeting related to the LOKweb-project (see earlier issues of the BNVKI Newsletter), they presented their view and policies. A set of portal services offers a variety of solutions, ranging from enterprise management and security to portal and business intelligence.

The portal and business intelligence solutions are offered in the CleverPath suite. One of the well known products in this suite is Aion, nowadays named as 'Cleverpath Aion BRE'. Aion's kernel is a business rule engine for expert systems applications. Over the past years many professional applications have been developed with Aion, for example for insurance companies or harbour traffic agencies.

Some of the universities in the Netherlands already have a long tradition in using Aion as an example tool for knowledge system development. Various educational tasks of the mentioned LOKweb also use Aion as a development tool for expert systems.

Recently Aion 9.1 was released, featuring a Java interface layer, dynamic rule management and Valens for rule verification.

CA offers an Academic Partner Program to public educational institutes. Within the context of the program, institutes can use CA-tools, as examples or tools for training in AI or knowledge systems. More details can be found on http://www3.ca.com/partners/academic/

Of course CA has its reasons for offering the program. On the other hand, it gives possibilities for students to work with professional tools as applied in business circumstances.

M.Sc. Theses in Section AI Education

Supervisors of remarkable M.Sc. work are invited to ask their student for a short article, to be submitted to the editor of the Section AI Education.

SIKS

Section Editor
Richard Starmans

Advanced Course: Intelligent Data Analysis

February 27-28, 2003, Zeist

On February 27 and 28, 2003, the School for Information and Knowledge Systems (SIKS) will organize an Advanced Course on Intelligent Data Analysis. The course takes two days, will be given in English and is part of the so called Advanced Components Stage of the Educational Program for SIKS Ph.D. Students. Although these courses are primarily intended for SIKS Ph.D. Students, other participants are not excluded. However, their number of passes will be restricted and depends on the number of students taking the course. The course is given by experienced lecturers actively involved in the research areas related to the topics of the course.

Location: Conference center Woudschoten in Zeist.

Scientific directors: dr. J.C. Bioch (EUR) and prof.dr. A.P.J.M. Siebes (UU)

PRELIMINARY PROGRAM

Thursday February 27, 2003:

- Dr. R. Potharst (EUR) - *Intelligent Decisions in Direct Mailing*
- Drs. V. Popova (EUR) - *Ordinal classification (ordinal datasets, ordinal decision trees, ordinal classification with noise)*
- Dr. M.C. van Wezel (EUR) - *Ensembles of Neural Networks*
- Dr. J.C. Bioch (EUR) - *Learning Conceptual Hierarchies by Functional Decomposition (functional decompositions of datasets)*

Friday February 28, 2003:

- Dr. A.J. Feelders (UU) - *Graphical Modelling for Discrete Data*
- Dr.ir. D. Thierens (UU) - *Principles of competent genetic algorithms*
- Prof.dr.ir. P.M.B. Vitanyi (CWI) - *The Similarity Metric*
- Prof.dr. J.N. Kok (UL) - *Natural Computing: from Computer Science to Molecular Informatics*

For more information on SIKS activities, please contact the SIKS office: office@siks.nl

Free Subscription to the BNVKI Newsletter for SIKS Ph.D. Students

SIKS has decided to offer all its Ph.D. students a **free subscription** to the BNVKI Newsletter/**free membership** of the BNVKI, the Association of Dutch and Belgian AI-researchers. Normally, membership dues are € 25,- for doctoral students (AIO's).

For those not entirely familiar with the activities of BNVKI, more information can be found on: http://www.cs.unimaas.nl/~bnvki/

Among other things, members of BNVKI receive 6 issues of the BNVKI Newsletter (in English) yearly, as well as access to the electronic version of the European journal *AI Communications*. The BNVKI Newsletter appears bimonthly and contains information on conferences, courses, workshops, job opportunities and applications in the field of Artificial Intelligence. Special sections are devoted to such topics as "AI and Law" and "Computer Linguistics". The BNVKI Newsletter also contains a section with announcements of SIKS-activities and information on the educational program.

HOW TO SUBSCRIBE?

In cooperation with BNVKI, we made the following arrangement. In order to subscribe, SIKS Ph.D. students should contact the Editorial Office of BNVKI by sending an email to **newsletter@cs.unimaas.nl** and provide the BNVKI with the following information:

Name:
University:
Postal address:
Please add "SIKS Ph.D. student" to your message (to make sure that you will not be billed !)

Some of our Ph.D. students may have a *personal* subscription/*personal* membership for 2003 already (personal means: not financed by some faculty or university) We have agreed with BNVKI that the new arrangement applies to them as well. If they contact the Editorial Office of BNVKI and identify themselves as a SIKS Ph.D. student, they will not be billed c.q. they will receive their money back. This arrangement does not apply to Ph.D. students who are a member of BNVKI already because they visited last year's BNAIC.

ANNOUNCEMENTS

Call For Papers BNAIC'03

October 23-24, 2003, Nijmegen

The 15th Belgian-Dutch Conference on Artificial Intelligence (BNAIC'03) is organised by SNN and the Katholieke Universiteit Nijmegen, under the auspices of BNVKI/AIABN (the Belgian-Dutch Association for Artificial Intelligence), and of

SIKS (School for Information and Knowledge Systems).

BNAIC'03 will be held on Thursday October 23 and Friday October 24, 2003 in the Radboud Auditorium and Kasteel Heijendaal in Nijmegen. It will be collocated with the workshop *Learning Solutions* to be held on Wednesday October 22, 2003. This collocation aims to promote interaction between researchers in AI and industry. BNAIC papers and demonstrations addressing industrial applications will be offered a poster at the workshop.

SUBMISSION INFORMATION

The conference aims at presenting an overview of state-of-the art research in artificial intelligence in Belgium and The Netherlands. Submissions of the following three types are invited.

TYPE A: REGULAR PAPERS

Papers presenting new original work. Submitted papers should not exceed a length of 8 pages. These papers will be reviewed on overall quality and relevance. A-papers will be accepted for either oral or poster presentation. All accepted papers will be fully published in the proceedings.

TYPE B: COMPRESSED CONTRIBUTIONS

AI papers that have been accepted after June 1, 2002 for other refereed conferences or journals can be resubmitted and will be accepted as compressed contributions. Authors are invited to submit the officially published version (without page restriction) together with a one or two-page abstract. B-papers will be accepted for either oral or poster presentation. The abstract of the paper will be published in the proceedings. Note that, in departure from previous years, a separate author registration is required for each B-type contribution.

TYPE C: DEMONSTRATIONS AND APPLICATIONS

Proposals for demonstrations will be evaluated based on submitted demonstration summaries (in English) stating the following: the purpose of the system to be demonstrated, its user groups, the organisation or project for which it is developed, the developers, and the technology used. In addition, the system requirements and the duration (not exceeding 30 minutes) should be mentioned. Especially researchers from industry are encouraged to submit papers presenting their applications and experiences. The maximum size of demonstration summaries is 2 pages.

For all submission types possible topics of submissions include, but are not limited to

- multi-agent systems
- neural networks
- knowledge-based systems
- natural language processing
- games
- search
- machine learning
- robotics
- knowledge representation
- knowledge management
- knowledge discovery and data mining
- verification and validation
- ontologies
- logic programming
- optimization
- intelligent agents
- evolutionary algorithms

Papers and demonstration summaries should be submitted electronically according to the instructions that will be posted at the BNAIC'03 conference website. Format information and style files will be posted at this website as well. Submissions should be accompanied by a message stating the submission type (A, B, or C) and an abstract of the paper in plain text. Proper receipt of submissions will be acknowledged by e-mail. The deadline for submissions is June 2, 2003. Submission implies willingness of at least one author to register for BNAIC and present the paper. For each B-type paper, a separate author registration is required. Authors keep the copyright of their submissions.

IMPORTANT DATES

Deadline for submissions: June 2, 2003
Notification of acceptance: July 21, 2003
Deadline for camera-ready papers: September 1, 2003

Organizing committee:
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Peter Lucas (KUN)
Tom Heskes (SNN, KUN)

More information can be found on the conference website: http://www.snn.kun.nl/bnaic/. For further inquiries, please send an e-mail to bnaic@snn.kun.nl.

Call for Papers
The 10th Advances in Computer Games Conference

November 24-27, 2003, Graz

The 10th Conference on Advances in Computer Games (ACG10) will be held in Graz, Austria, in the Casineum of the Casino in the centre of Graz. The conference is sponsored by IFIP and organized by the ICGA. It commences on Monday November 24 and will take place on four consecutive days. The conference aims in the first place at providing an international forum for computer-games researchers presenting new results on ongoing work. The recent successes of the three International Conferences on Computers and Games have encouraged the organizers to widen their scope and therefore we also invite contributors on all aspects of research related to computers and games.

Relevant topics include, but are not limited to:
- the current state of game-playing programs,
- new theoretical developments in game-related research,
- general scientific contributions produced by the study of games.

Also researchers on topics such as
- social aspects of computer games,
- cognitive research of how humans play games, and
- issues related to networked games

are invited to submit their contribution.

IMPORTANT DATES

- Deadline for paper submission: May 2, 2003
- Accept/Reject notifications: June 16, 2003
- Deadline for final papers (camera-ready copy): August 1, 2003

PAPER SUBMISSION REQUIREMENTS

The proceedings of ACG10 will be published by Kluwer. Use the Kluwer style files found at: http://www.wkap.com/ifip/. The maximum length of papers in this format is 20 pages. The preferred format for submission is PDF, but Postscript is also acceptable. The final version for the proceedings is to be submitted in LaTeX2e source form. Microsoft Word documents will be accepted but are not encouraged.

All papers will be refereed. Accepted papers will be presented at the conference and printed in the proceedings.

To submit a paper, please send an email to acg-paper@icga.org with the paper attached as a PDF or a Postscript file. Other requirements are:
- The paper must be in English language, not exceeding 20 pages. (The receipt of a paper will be acknowledged).
- Notice of acceptance of papers will be sent by June 16, 2003 to the principal author.

REFEREEING PROCESS

All submissions will be refereed, and those accepted will be scheduled for presentation. Authors of accepted papers, or their representatives, are expected to present their papers at the conference.

http://www.cs.unimaas.nl/ICGA/acg10/

CONFERENCES, SYMPOSIA WORKSHOPS

Below, the reader finds a list of conferences and websites or addresses for further information.

MARCH 21-23, 2003
The Fourth International Conference on Intelligent Data Engineering and Automated Learning (IDEAL'03). Hong Kong, P.R. China.
http://www.comp.hkbu.edu.hk/IDEAL2003/

MARCH 24-26, 2003
AAAI Spring Symposium on Agent-mediated Knowledge Management. Stanford University, USA.
http://www.dfki.uni-kl.de/~elst/AMKM/index.html

APRIL 12, 2003
Formal Approaches to Multi-agent Systems (FAMAS'03). Warsaw, Poland.
http://www.ai.rug.nl/conf/famas

MAY 1-3, 2003
Third SIAM International Conference on Data Mining (2003). San Francisco, USA.
http://www.siam.org/meetings/sdm03/

MAY 5-7, 2003
Atlantic Web Intelligence Conference (AWIC'03). Madrid, Spain,
http://nova.ls.fi.upm.es/AWIC03

MAY 11-15, 2003
The 16th International Florida AI Research Society Conference (FLAIRS-03). St Augustine, USA.
http://www.flairs.com/flairs2003/

JUNE 2-5, 2003
Intelligent Information Systems 2003 (IIS'03). Zakopane, Poland.
http://iipwm.ipipan.waw.pl

JUNE 9-11, 2003
16th Bled Electronic Commerce Conference. Conference theme: e-Transformation. Bled, Slovenia.
http://ecom.fov.uni-mb.si/

JUNE 18-20, 2003
The 10th Colloquium on Structural Information and Communication Complexity (SIROCCO 2003). Umea, Sweden
http://www.informatik.uni-halle.de/sirocco2003/

JUNE 23-26, 2003
The 2003 International Multiconference in Computer Science and Computer Engineering (14 Joint Int'l Conferences). Las Vegas, Nevada, USA.
http://www.ashland.edu/~iajwa/conferences/

JUNE 23-26, 2003
Fifth International Conference on Case-Based Reasoning. Trondheim, Norway.
http://www.iccbr.org/iccbr03

JUNE 29, 2003
A workshop on Logic and Communication in Multi-Agent Systems (LCMAS). Eindhoven, the Netherlands.
http://www.win.tue.nl/~evink/lcmas03.html

JUNE 30-JULY 4, 2003
30th International Colloquium on Automata, Languages and Programming (ICALP 2003). Eindhoven, The Netherlands.
http://www.win.tue.nl/icalp2003

JULY 2-4, 2003
International 12. Turkish Symposium on Artificial Intelligence and Neural Networks (TAINN' 2003). Çanakkale, Turkey.
http://cs.comu.edu.tr/tainn03/

JULY 14-17, 2003
3rd International Symposium on Imprecise Probabilities and Their Applications (ISIPTA '03). Lugano, Switzerland.
http://www.sipta.org/~isipta03

JULY 21-25, 2003
11th International Conference on Conceptual Structures (ICCS 2003). Dresden, Germany.

JULY 28-AUGUST 2, 2003
The 19th International Conference on Automated Deduction (CADE-19). Miami, USA.
http://www.CADE-19.info

AUGUST 18-29, 2003
The Student Session of the 15th European Summer School in Logic, Language and Information (ESSLLI-2003). Vienna, Austria.
http://www.science.uva.nl/~bcate/esslli03

SEPTEMBER 3-5, 2003
7th International Conference on Knowledge-Based Intelligent Information & Engineering Systems (KES'2003). Oxford, United Kingdom.
http://www.brighton.ac.uk/kes/kes2003/

SEPTEMBER 9-12, 2003
International Conference TABLEAUX 2003. Automated Reasoning with Analytic Tableaux and Related Methods. Roma, Italy.
http://pop.dia.uniroma3.it/mailman/listinfo.cgi/tab03

SEPTEMBER 15-17, 2003
Fourth International Working Conference on Intelligent Virtual Agents (IVA2003). Kloster Irsee, Germany.
http://www.sigmedia.org/iva03

SEPTEMBER 15-18, 2003
The 26th German Conference on Artificial Intelligence (KI-2003). Hamburg, Germany.
http://www.ki2003.de

OCTOBER 13-17, 2003
IEEE/WIC International Conference on Web Intelligence (WI 2003). Beijing, China.
http://www.comp.hkbu.edu.hk/WI03/

OCTOBER 13-17, 2003
IEEE/WIC International Conference on Intelligent Agent Technology (IAT 2003). Beijing, China.
http://www.comp.hkbu.edu.hk/IAT03

OCTOBER 23-24, 2003
15th Belgian-Dutch Conference on Artificial Intelligence (BNAIC 2003). Nijmegen, The Netherlands.

OCTOBER 28-31, 2003
The 2003 IEEE Symposium on Visual Languages and Formal Methods (VLFM '03). Auckland, New Zealand.
http://www.cs.dal.ca/HCC03/VLFM/

NOVEMBER 3-5, 2003
Eighteenth International Symposium on Computer and Information Sciences (ISCIS'03). Antalya, Turkey.
http://www.iscis03.metu.edu.tr/

NOVEMBER 22-30, 2003
The 11th World Computer Chess Championship 2003 (WCCC). Graz, Austria.
http://www.graz03.at/servlet/sls/Tornado/web/2003/content/6A8AE675BEC0AF00C1256B0E00478EC6

NOVEMBER 23-27, 2003
The 8th Computer Olympiad. Graz, Austria. Information: J. Hellemons, info@icga.org.
http://www.cs.unimaas.nl/olympiad2003/

NOVEMBER 24-27, 2003
The 10th Advances in Computer Games Conference (ACG10). Graz, Austria.
http://www.cs.unimaas.nl/ICGA/acg10/

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