NEWSLETTER

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Ramanujaniana (part 2)

BNAIC 2010

Fractals and AI

News from the Benelux Association for Artificial Intelligence

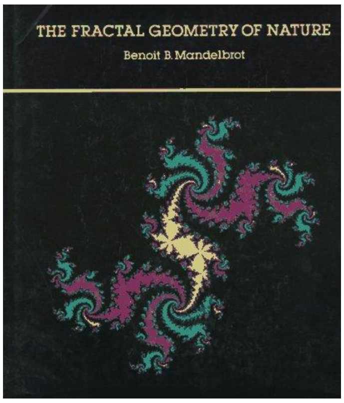
Fractals and AI

Editor-in-chief

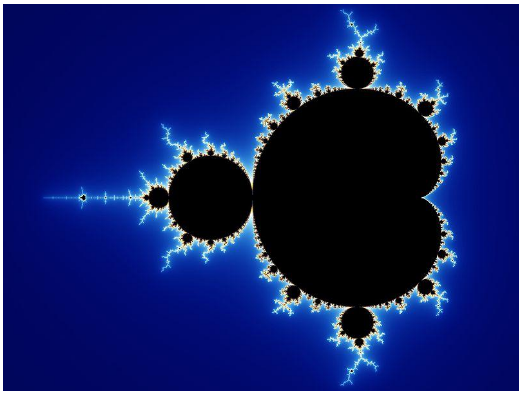
On October 14, 2010, Benoit Mandelbrot died at the age of 85. Mandelbrot worked on a wide range of mathematical problems, including mathematical physics and quantitative finance, but is best known as the father of fractal geometry. Mandelbrot spent most of his career at IBM's Thomas J. Watson Research Center, and was appointed as an IBM Fellow.

From 1951 onward, Mandelbrot worked on problems and published papers not only in mathematics but in applied fields such as information theory, economics, and fluid dynamics. He became convinced that two key themes, fat tails and self-similar structures, ran through a multitude of problems encountered in those fields. In 1975, he coined the term *fractal* to describe these structures and then began studying the fractal set now being called after him. In 1982, Mandelbrot expanded and updated his ideas in *The Fractal Geometry of Nature*. This influential work brought fractals into the mainstream of professional and popular mathematics, the latter especially by the inclusion of many beautiful pictures of fractals. (By the way, when I received the article *Mathematical Beauty* by Henk Visser for publication, see Vol. 27(4), pp. 80-86, I initially thought that it surely would be related to fractals.)

Benoit B. Mandelbrot (1924 – 2010).



Cover of *The Fractal Geometry of Nature*.



The Mandelbrot set.

Looking for applications of fractal geometry in AI, we easily encounter several instances. Probably the most well-known is fractal compression of signals or images. The method relies on the fact that parts of an image often resemble other parts of the same image. Fractal algorithms convert these parts into mathematical data called "fractal codes" which are used to recreate the encoded image. Fractal compression differs from pixel-based compression schemes, since no pixels are saved. Once an image has been converted into fractal code, the image can be recreated to fill any screen size without the loss of sharpness that occurs in conventional compression schemes. As a result, fractal compression is also a popular method in video-game design, especially regarding the computer-graphics part. Another application area of fractals is the automatic generation of music. Here, chaotic models create compositions from the harmonic and inharmonic phenomena of nature. Since the 1970s also fractals have been studied as models for algorithmic composition. Besides, many other applications exist, such as (without going into detail) the simulation of bacteria growth, DNA sequence feature recognition, optimizing the architecture of neural networks, the construction of models for financial time series, and many, many more. As a coincidence, this issue contains the announcement for the 2011 European Conference on Artificial Life, where fractal geometry (without explicitly being mentioned) surely will be a topic of interest. I will be happy to receive the mentioning of other interesting applications of fractal geometry in AI, or even better, to obtain a report on such an application.

Wikipedia's page on fractals:	**http://en.wikipedia.org/wiki/Fractal**
Wikipedia's page on Mandelbrot:	**http://en.wikipedia.org/wiki/Benoit_Mandelbrot**

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The photographs on pp. 150-151 are by courtesy of the BNAIC 2010 organizers.

Front cover: A beautiful fractal (see the editorial).

The deadline for the next issue is: **March 1, 2011**.

BNVKI-Board News

Antal van den Bosch

Best wishes for 2011! It seems that AI is as alive as it ever was; let's hope 2011 brings lots of novel developments as the last years have done. And let's not shy away from setting new goals, modest ones included. To the public, we as a field are making gains in highly visible large-scale areas, such as online recommendations for books or music. In fields like recommender systems, the algorithms were already there, but the real-world scale of the internet and thousands to millions of users and items has driven a lot of interesting new work: applied and fundamental at the same time.

The board is looking forward to meeting you again this year at one of the AI events in the Benelux or abroad, including our own BNAIC-2011, in Ghent.

Ramanujaniana
Part 2

Henk Visser
Haarlem

[**Continued**]

(When Log returns to the Institute after the holiday, the first thing she does is going to Math.)

LOG. Happy new year, Math! Did you make any progress in the mean time?

MATH. I am still thinking about our extraordinary discovery of the generation of the natural numbers in the representations as a sum of two squares of the $n(5^k{\cdot}13)$'s.

LOG. I see you didn't wipe it out. Did you find a proof? (*She points at the blackboard.)*

$n(5^0{\cdot}13) = 1$
$n(5^1{\cdot}13) = 2$
$n(5^2{\cdot}13) = 3$
$n(5^3{\cdot}13) = 4$
$n(5^4{\cdot}13) = 5$
$n(5^5{\cdot}13) = 6$
$n(5^6{\cdot}13) = 7$
$n(5^7{\cdot}13) = 8$
$n(5^8{\cdot}13) = 9$
$n(5^9{\cdot}13) = 10$
$n(5^{10}{\cdot}13) = 11$

MATH. What bothers me is that I'm writing a book on productive problem solving in mathematics, and yet don't know how to handle the problem of proving the underlying theorem.

LOG. Did you consider writing 13, and powers of 5, as a sum of two irreducible squares?

MATH. Of course I did:

$13 = 2^2 + 3^2$

$5^1 = 1^2 + 2^2$
$5^2 = 3^2 + 4^2$
$5^3 = 2^2 + 11^2$
$5^4 = 7^2 + 24^2$
$5^5 = 38^2 + 41^2$
$5^6 = 44^2 + 117^2$
$5^7 = 29^2 + 278^2$
$5^8 = 336^2 + 527^2$
$5^9 = 718^2 + 1199^2$
$5^{10} = 237^2 + 3116^2$

Thereby a subproblem arose: finding a formula for 5^n as the sum of two irreducible squares. With the help of that formula we can redescribe $5^n{\cdot}13$ in a possibly promising way.

LOG. What did you have in mind with these redescriptions?

MATH. That I will show you with 325, in other words, $5^2{\cdot}13$.

$$\begin{aligned}5^2{\cdot}13 &= (3^2 + 4^2)(2^2 + 3^2)\\ &= 6^2 + 8^2 + 12^2 + 9^2\\ &= 6^2 + 8^2 + 2{\cdot}8{\cdot}9 + 9^2\\ &= 6^2 + (8 + 9)^2\end{aligned}$$

Similarly,

$$\begin{aligned}&= 6^2 + 12^2 + 9^2 + 8^2\\ &= 6^2 + 2{\cdot}6{\cdot}12 + 12^2 + 9^2 - 2{\cdot}9{\cdot}8 + 8^2\\ &= (6 + 12)^2 + (9 - 8)^2\end{aligned}$$

LOG. And how about the formula?

MATH. I couldn't find a formula for 5^n as the sum of two irreducible squares, but instead I found a connection between two successive sums. First I saw

$$5^7 = 29^2 + 278^2 \text{ and } 5^8 = 336^2 + 527^2$$

$$2{\cdot}278 - 29 = 527$$

Then I checked it with

$$5^8 = 336^2 + 527^2 \text{ and } 5^9 = 718^2 + 1199^2$$

Or perhaps can you do it?

LOG.

$$2{\cdot}527 = 1054 \text{ and } 1054 - 336 = 718$$

Remarkable!

MATH. But now look again at 5^7 and 5^8:

$$5^7 = 29^2 + 278^2 \text{ and } 5^8 = 336^2 + 527^2$$

$$2{\cdot}29 + 278 = 336$$
$$2{\cdot}278 - 29 = 527$$

LOG. I see, it's hardly necessary any longer to check it for 5^8 and 5^9:

$$5^8 = 336^2 + 527^2 \text{ and } 5^9 = 718^2 + 1199^2$$

$$2{\cdot}336 + 527 = 1199$$
$$2{\cdot}527 - 336 = 718$$

MATH. It's also possible to begin with the second part of 5^8:

$$2{\cdot}527 + 336 = 1390$$
$$2{\cdot}336 - 527 = 145$$

Only, this gives reducible squares. In general we have:

If
$$5^n = p^2 + q^2,$$
then
$$5^{n+1} = (2p + q)^2 + (2q - p)^2$$
and
$$5^{n+1} = (2q + p)^2 + (2p - q)^2$$

LOG. After all, this is almost trivial, but nevertheless it had still to be noticed. How now?

MATH. The trick with 325 didn't succeed for $n(5^k{\cdot}13)$ with this result. Therefore I stopped.

LOG. Why not go straight to the sums of two squares of the $n(5^k{\cdot}13)$'s themselves, starting with $5^1{\cdot}13$, in other words, 65:

$65 = 1^2 + 8^2$
$65 = 4^2 + 7^2$

I will apply the procedure that you derived for the powers of 5 on these outcomes, look:

$(2{\cdot}1 + 8)^2 + (2{\cdot}8 - 1)^2 = 10^2 + 15^2$
$(2{\cdot}1 - 8)^2 + (2{\cdot}8 + 1)^2 = 6^2 + 17^2$

$(2{\cdot}4 + 7)^2 + (2{\cdot}7 - 4)^2 = 15^2 + 10^2$
$(2{\cdot}4 - 7)^2 + (2{\cdot}7 + 4)^2 = 1^2 + 18^2$

MATH. It works! And we get one more representation for 325, or $5^2{\cdot}13$, than for $5^1{\cdot}13$, a reducible one, which can also be derived from $5^0{\cdot}13$. Let me see how it goes with the three representations of 325:

$(2{\cdot}10 + 15)^2 + (2{\cdot}15 - 10)^2 = 35^2 + 20^2$
$(2{\cdot}10 - 15)^2 + (2{\cdot}15 + 10)^2 = 5^2 + 40^2$

$(2{\cdot}6 + 17)^2 + (2{\cdot}17 - 6)^2 = 29^2 + 28^2$
$(2{\cdot}6 - 17)^2 + (2{\cdot}17 + 6)^2 = 5^2 + 40^2$

$(2{\cdot}1 + 18)^2 + (2{\cdot}18 - 1)^2 = 20^2 + 35^2$
$(2{\cdot}1 - 18)^2 + (2{\cdot}18 + 1)^2 = 16^2 + 37^2$

LOG. On balance, four representations of $5^3{\cdot}13$! Two irreducible, but also two reducible equations which we could have immediately derived from the representations of 65. They can be called 'reducible representations'.

MATH. OK. It's also clear that $10^2 + 15^2$, the reducible representation of $5^2{\cdot}13$, gives two reducible representations of $5^3{\cdot}13$. The irreducible representations give them too, but each of them gives an irreducible one, as well, or at least a representation that is not divisible by 5, and these two representations are different. It seems that the proof of the general theorem must follow on the same lines.

If
$$5^n{\cdot}13 = p^2 + q^2,$$
then
$$5^{n+1}{\cdot}13 = (2p + q)^2 + (2q - p)^2$$
and
$$5^{n+1}{\cdot}13 = (2q + p)^2 + (2p - q)^2$$

LOG. Apparently, either $2p + q$ and $2q - p$ are both divisible by 5, or this holds for $2p - q$ and $2q + p$. How do you prove that?

MATH. Straightforward:

$p^2 + q^2 \equiv 0 (\mathrm{mod}\ 5)$
$p^2 + 5pq + 6q^2 \equiv 0 (\mathrm{mod}\ 5)$
$(p + 2q)(p + 3q) \equiv 0 (\mathrm{mod}\ 5)$

Of course, either $p + 2q \equiv 0 (\mathrm{mod}\ 5)$ or $p + 3q \equiv 0 (\mathrm{mod}\ 5)$.

The rest is child's play:

if $p + 2q \equiv 0 (\mathrm{mod}\ 5)$, then also
$-4p + 2q \equiv 0 (\mathrm{mod}\ 5)$ and $-2p + q \equiv 0 (\mathrm{mod}\ 5)$;
then the second representation is reducible;

if $p + 3q \equiv 0 (\text{mod } 5)$, then also
$6p + 3q \equiv 0 (\text{mod } 5)$, and $2p + q \equiv 0 (\text{mod } 5)$

if $2p + q \equiv 0 (\text{mod } 5)$, then also
$2p - 4q \equiv 0 (\text{mod } 5)$, and $p - 2q \equiv 0 (\text{mod } 5)$;
then the first representation is reducible.

So it seems that the $n(5^k \cdot 13)$'s are no mystery any more.

LOG. A rigorous proof requires more.

MATH. I'm content with what we did. What I appreciate most, is that we found a method of construing more and more representations. It's a pity that Comp isn't with us, because he could easily write a program for it, whereas we must do it with paper and pencil, or chalk and blackboard!

LOG. I want to see just one more application. What do you think of $5^4 \cdot 13$?

MATH. We already have the four representations of $5^3 \cdot 13$:

$5^2 + 40^2$, $16^2 + 37^2$, $20^2 + 35^2$, $28^2 + 29^2$

$5^4 \cdot 13 = 50^2 + 75^2$ and $85^2 + 30^2$
$5^4 \cdot 13 = 69^2 + 58^2$ and $90^2 + 5^2$
$5^4 \cdot 13 = 75^2 + 50^2$ and $90^2 + 5^2$
$5^4 \cdot 13 = 85^2 + 30^2$ and $86^2 + 27^2$

Now we also have the five representations of $5^4 \cdot 13$:

$5^2 + 90^2$, $27^2 + 86^2$, $30^2 + 85^2$, $50^2 + 75^2$, $58^2 + 69^2$

LOG. And we know that $5^4 \cdot 13$ is the smallest number with exactly five representations as a sum of two squares. Well done! But now I'm going to work, see you Math.

MATH. Thanks a lot for your cooperation! Bye bye!

(Math is still working on the subject when Comp enters the room.)

COMP. Good morning, Math, and best wishes!

MATH. Thank you, the year began well, I found the following theorems:

If
$$5^n = p^2 + q^2,$$
then
$$5^{n+1} = (2p + q)^2 + (2q - p)^2$$
and
$$5^{n+1} = (2q + p)^2 + (2p - q)^2$$

and, with Log's help,

If
$$5^n \cdot 13 = p^2 + q^2,$$
then
$$5^{n+1} \cdot 13 = (2p + q)^2 + (2q - p)^2$$
and
$$5^{n+1} \cdot 13 = (2q + p)^2 + (2p - q)^2$$

COMP. I see, and this gave you the possibility to successively derive representations as a sum of two squares.

MATH. And now I try to generalize these results. I begin with bare powers:

If
$$c^n = p^2 + q^2 \text{ and } a^2 + b^2 = c,$$
then
$$c^{n+1} = (ap + bq)^2 + (aq - bp)^2$$
and
$$c^{n+1} = (aq + bp)^2 + (ap - bq)^2$$

COMP. Let me see how it works for 13.

$13 = 2^2 + 3^2$ and $2^2 + 3^2 = 13$
$13^2 = 13^2 + 0^2$
$13^2 = 12^2 + 5^2$

I continue with $13^2 = 12^2 + 5^2$
$13^3 = 39^2 + 26^2$
$13^3 = 46^2 + 9^2$, not bad!

$13^4 = 156^2 + 65^2$
$13^4 = 169^2 + 0^2$
$13^4 = 119^2 + 120^2$, nice!
$13^4 = 156^2 + 65^2$

It's better to work out the irreducible sums only:

$13^5 = (3 \cdot 119 + 2 \cdot 120)^2 + (3 \cdot 120 - 2 \cdot 119)^2$
$= 597^2 + 122^2$ irreducible
$13^5 = (3 \cdot 120 + 2 \cdot 119)^2 + (3 \cdot 119 - 2 \cdot 120)^2$
$= 598^2 + 117^2$, reducible

$13^6 = (3 \cdot 597 + 2 \cdot 122)^2 + (3 \cdot 122 - 2 \cdot 597)^2$
$= 2035^2 + 828^2$

Interesting, but how do you want to proceed, when you successively hit upon 5, 13, 17, 29, 37, 41, that is, prime numbers of the form $4n + 1$?

MATH. Well, in that case the values of p and q change along with the next number of the row. For 5, they are 1 and 2, for 13, 2 and 3, for 17, 1 and 4, and so on.

COMP. Can you demonstrate it?

MATH. I take your list which begins with 325.

$m(3) = 5^2{\cdot}13$
$m(6) = 5^2{\cdot}13{\cdot}17$
$m(12) = 5^2{\cdot}13{\cdot}17{\cdot}29$
$m(24) = 5^2{\cdot}13{\cdot}17{\cdot}29{\cdot}37$
$m(48) = 5^2{\cdot}13{\cdot}17{\cdot}29{\cdot}37{\cdot}41$

We already know:

$5^2{\cdot}13 = 1^2 + 18^2$
$5^2{\cdot}13 = 6^2 + 17^2$
$5^2{\cdot}13 = 10^2 + 15^2$

Then we have the well-known decomposition of 17:

$17 = 4^2 + 1^2$

This determines the rule:

$5^2{\cdot}13{\cdot}17 = (4p + q)^2 + (4q - p)^2$

$5^2{\cdot}13{\cdot}17 = (4q + p)^2 + (4p - q)^2$

The application is very easy:

$5^2{\cdot}13{\cdot}17 = 22^2 + 71^2$
$5^2{\cdot}13{\cdot}17 = 73^2 + 14^2$
$5^2{\cdot}13{\cdot}17 = 22^2 + 71^2$
$5^2{\cdot}13{\cdot}17 = 41^2 + 62^2$
$5^2{\cdot}13{\cdot}17 = 64^2 + 7^2$
$5^2{\cdot}13{\cdot}17 = 55^2 + 50^2$
$5^2{\cdot}13{\cdot}17 = 70^2 + 25^2$

Do you want me to continue?

COMP. No, I'm convinced! The number of representations has been doubled, and I trust that the story is repeated when we compute the representations of $5^2{\cdot}13{\cdot}17{\cdot}29$. But I will show you that I understand your procedure, by calculating the first two sums, starting from $22^2 + 71^2$:

$(5{\cdot}22 + 2{\cdot}71)^2 + (5{\cdot}71 - 2{\cdot}22)^2 = 252^2 + 311^2$
$(5{\cdot}71 + 2{\cdot}22)^2 + (5{\cdot}22 - 2{\cdot}71)^2 = 399^2 + 32^2$

MATH. I think this will do for the moment.

COMP. I agree. Have a good day! *(He leaves the room, whereas Math is still thinking about the whole business.)*

MATH. *(talking to himself)* Why do we have to confine ourselves to different squares? Let me expand Log's example of 50. *(He goes to the blackboard.)*

$2{\cdot}5^2 = 5^2 + 5^2$
$50 = 7^2 + 1^2$

$2{\cdot}13^2 = 13^2 + 13^2$
$338 = 17^2 + 7^2$

$2{\cdot}17^2 = 17^2 + 17^2$
$578 = 23^2 + 7^2$

$2{\cdot}29^2 = 29^2 + 29^2$
$1682 = 41^2 + 1^2$

We need a procedure for deriving representations of numbers with higher exponents, so it seems that we must modify my rule.

If
$$mc^n = p^2 + q^2 \text{ and } a^2 + b^2 = c,$$
then
$$mc^{n+1} = (ap + bq)^2 + (aq - bp)^2$$
and
$$mc^{n+1} = (aq + bp)^2 + (ap - bq)^2$$

Or else

If
$$mc^n = p_n^2 + q_n^2 \text{ and } a^2 + b^2 = c,$$
then
$$mc^{n+1} = (ap_n + bq_n)^2 + (aq_n - bp_n)^2$$
and
$$mc^{n+1} = (aq_n + bp_n)^2 + (ap_n - bq_n)^2$$

I start with the representation of $2{\cdot}5^0$.

$5 = 1^2 + 2^2$ $\quad a = 1$ and $b = 2$

$2{\cdot}5^0 = 1^2 + 1^2$ $\quad p_0 = 1$ and $q_0 = 1$

$2{\cdot}5^1 = 3^2 + 1^2$ $\quad p_1 = 3$ and $q_1 = 1$
$= 3^2 + 1^2$

$2{\cdot}5^2 = 5^2 + 5^2$ $\quad p_2 = 5$ and $q_2 = 5$
$= 7^2 + 1^2$ $\quad p_2 = 7$ and $q_2 = 1$

$2{\cdot}5^3 = 15^2 + 5^2$ $\quad p_3 = 15$ and $q_3 = 5$
$= 15^2 + 5^2$
$= 9^2 + 13^2$ $\quad p_3 = 9$ and $q_3 = 13$
$= 15^2 + 5^2$

$2{\cdot}5^4 = 25^2 + 25^2$
$= 35^2 + 5^2$
$= 35^2 + 5^2$
$= 31^2 + 17^2$ $\quad p_4 = 31$ and $q_4 = 17$

Humph, I am only interested in irreducible squares.

$2{\cdot}5^5 = 79^2 + 3^2$
$2{\cdot}5^6 = 161^2 + 73^2$
$2{\cdot}5^7 = 307^2 + 249^2$

The other way around?

$29^2 + 31^2 = 1802$

$$1802 = 2{\cdot}17{\cdot}53$$

$1802 = 34{\cdot}53$	$1802 = 106{\cdot}17$
$53 = 2^2 + 7^2$	$17 = 1^2 + 4^2$
$34{\cdot}53^0 = 3^2 + 5^2$	$106{\cdot}17^0 = 5^2 + 9^2$
$34{\cdot}53^1 = 41^2 + 11^2$	$106{\cdot}17^1 = 41^2 + 11^2$
$= 31^2 + 29^2$	$= 29^2 + 31^2$
$34{\cdot}53^2 = 159^2 + 265^2$	$106{\cdot}17^2 = 85^2 + 153^2$
$= \mathbf{5^2 + 309^2}$	$= \mathbf{175^2 + 3^2}$
$= 265^2 + 159^2$	$= 153^2 + 85^2$
$= \mathbf{141^2 + 275^2}$	$= \mathbf{147^2 + 95^2}$

Enough.

(Math stops his investigations and turns to the preparation of a lecture. After a while Log enters the room.)

LOG. I was thinking about 325, the smallest number that is three times the sum of two squares. You found it by trial and error, so to say. But why does it have that property? Without an answer to this question, we don't really understand what's going on!

MATH. I remember that Hans Hahn, the famous mathematician of the Vienna Circle, said something similar about mathematical proofs. We only understand a mathematical proof when we know why it goes as it goes and not otherwise. Well, I can reassure you. When we apply my theorem to the smallest incommensurable sums of two different squares, 5, as the sum of 1^2 and 2^2, and 13 as the sum of 2^2 and 3^2, then we get 5 as the smallest number that is the sum of two different squares, $5{\cdot}13$ as the smallest number that is twice the sum of two different squares, and one more with $5^2{\cdot}13$.

LOG. That is clear, but one is inclined to think that $5^3{\cdot}13$ is the smallest number that is the sum of four different squares. However, Wolfram gives $5{\cdot}13{\cdot}17$, as we know. I mention this example on purpose, because we missed $m(4)$ in our tables.

MATH. We can derive the sums from the representation of 17 and the two representations of 65 with my procedure:

$$a = 1 \text{ and } b = 4$$

$p = 1$ and $q = 8$	$p = 4$ and $q = 7$
$5{\cdot}13{\cdot}17 = 33^2 + 4^2$	$5{\cdot}13{\cdot}17 = 32^2 + 9^2$
$5{\cdot}13{\cdot}17 = 12^2 + 31^2$	$5{\cdot}13{\cdot}17 = 23^2 + 24^2$

LOG. It follows that we can make the following mini-table:

$m(2) = 5{\cdot}13$
$m(4) = 5{\cdot}13{\cdot}17$

MATH. But $m(8) = 5^3{\cdot}13{\cdot}17$ according to Wolfram.

LOG. Look (*consulting Wolfram*):

27625 is the smallest number with 8 representations as a sum of 2 squares:
$27625 = 20^2 + 165^2 = 27^2 + 164^2 = 45^2 + 160^2 = 60^2 + 155^2 =$
$83^2 + 144^2 = 88^2 + 141^2 = 101^2 + 132^2 = 115^2 + 120^2$

There are only four irreducible representations, whereas all representations of $m(4)$ are irreducible. Let me see how it is with $5{\cdot}13{\cdot}17{\cdot}29$. *(She consults Wolfram again.)*

32045 has 8 representations as a sum of 2 squares:
$32045 = 2^2 + 179^2 = 19^2 + 178^2 = 46^2 + 173^2 = 67^2 + 166^2 =$
$74^2 + 163^2 = 86^2 + 157^2 = 109^2 + 142^2 = 122^2 + 131^2$

MATH. All are irreducible! That is the significance of my procedure! As a matter of fact, I am more interested in minimal irreducible representations than in minimal representations *tout court.*

LOG. Does this mean that we must start all over again?

MATH. Why not? We must make new tables:

$M(2) = 5{\cdot}13$
$M(4) = 5{\cdot}13{\cdot}17$
$M(8) = 5{\cdot}13{\cdot}17{\cdot}29$

Even my 325, $m(3)$ with small letter m, must be replaced.

LOG. This is too much for me! Who says that there is any solution at all for three irreducible representations, let alone for higher odd numbers? I quit. Have a good day! *(She leaves the room, whereas Math remains absorbed in thought.)*

(However, after a while, Log returns.)

MATH. You here again Log, what bothers you?

LOG. When I thought about your last problem, I tried some even numbers that are one larger than a square, because I considered your restriction to products of powers of prime numbers of the form $4n + 1$ too narrow. After all, my example of 50 was not that bad! See what I found:

$7^2 + 1^2 = 5^2 + 5^2$
$17^2 + 1^2 = 13^2 + 11^2$

$27^2 + 1^2 = 21^2 + 17^2$

$13^2 + 1^2 = 11^2 + 7^2$
$23^2 + 1^2 = 19^2 + 13^2$
$33^2 + 1^2 = 27^2 + 19^2$

Do you notice something?

MATH. Of course:

$(10n - 3)^2 + 1^2 = (8n - 3)^2 + (6n - 1)^2$

$(10n + 3)^2 + 1^2 = (8n + 3)^2 + (6n + 1)^2$

Very elementary equations, how could I have missed them! But I recognize good old Pythagoras in the coefficients! This makes a simplification possible:

$(5n - 3)^2 + 1^2 = (4n - 3)^2 + (3n - 1)^2$
$(5n + 3)^2 + 1^2 = (4n + 3)^2 + (3n + 1)^2$

LOG. Then we can also try other Pythagorean triples, for example (5, 12, 13). Let me try:

$(13n - x)^2 + 1^2 = (12n - y)^2 + (5n - z)^2$
$26x = 24y + 10z$

$13x = 12y + 5z$
$x^2 + 1 = y^2 + z^2$

$x^2 = y^2 + z^2 - 1$

$169x^2 = 169y^2 + 169z^2 - 169$
$144y^2 + 120yz + 25z^2 = 169y^2 + 169z^2 - 169$
$169 = 25y^2 - 120yz + 144z^2$
$(5y - 12z)^2 = 13^2$

$5y - 12z = 13$

$z = 1$
$y = 5$
$x = 5$

$(13n - 5)^2 + 1^2 = (12n - 5)^2 + (5n - 1)^2$

Another suitable sum-producing equation!

MATH. And also

$(13n + 5)^2 + 1^2 = (12n + 5)^2 + (5n + 1)^2$

It's easy to generalize such equations for all Pythagorean triples. Let $a^2 + b^2 = c^2$, then your formula $13x = 12y + 5z$ becomes $cx = by + az$ and $5y - 12z = 13$ becomes $ay - bz = c$. Take $z = 1$, then $y = (c + b)/a$ and $x = (c + b)/a$. Therefore the generalization is obvious:

If

$$a^2 + b^2 = c^2$$

then

$$(cn - (c + b)/a)^2 + 1^2 = (bn - (c + b)/a)^2 + (an - 1)^2$$
$$(cn + (c + b)/a)^2 + 1^2 = (bn + (c + b)/a)^2 + (an + 1)^2$$

LOG. It's a pity that the formulas still contain a constant. Can't we replace the 1's by expressions such as $(c + b)/a$?

MATH. I am afraid that then $(c + b)/a$ must also be replaced.

LOG. This means that we have to find new regularities, for example by looking at other numbers than my even multiples of 1. What do you think of 85?

MATH. It is twice the sum of two squares: $2^2 + 9^2 = 6^2 + 7^2$. But then it's interesting to consider more multiples of 5.

LOG. 125 for example? $2^2 + 11^2 = 5^2 + 10^2$.

MATH. Not very impressive, but now look at 130! $3^2 + 11^2 = 7^2 + 9^2$. Do you notice something?

LOG. Now we have

$2^2 + 9^2 = 6^2 + 7^2$
$3^2 + 11^2 = 7^2 + 9^2$

The first bases of the sums increase by 1, the second by 2. It would be nice if

$4^2 + 13^2 = 8^2 + 11^2$

MATH. It is: 185! And preceding $2^2 + 9^2 = 6^2 + 7^2$ we have your favorite 50:

$1^2 + 7^2 = 5^2 + 5^2$

LOG. The generalization is trivial:

$n^2 + (2n + 5)^2 = (n + 4)^2 + (2n + 3)^2$

MATH. Yes, but there is good old Pythagoras again!

LOG. This means that the formula for the next Pythagorean triple can be found by solving the following equation:

$n^2 + (xn + 13)^2 = (n + 5)^2 + (xn + 12)^2$

(after some scribbling on the blackboard) That's easy:

$n^2 + (5n + 13)^2 = (n + 5)^2 + (5n + 12)^2$

MATH. But what if we think of the general case, $a^2 + b^2 = c^2$?

LOG. Again solving an equation:

$n^2 + (xn + c)^2 = (n + a)^2 + (xn + b)^2$

(Scribbling ...)

$n^2 + (an/(c – b) + c)^2 = (n + a)^2 + (an/(c – b) + b)^2$

Here you are! No constants any more! I am happy! *(She embraces Math.)*

MATH. This deserves a drink!

(They leave the L.E.J. Brouwer Institute and go to an Amsterdam pub. Here the subject of their discussion is the problem of finding a general formula for numbers which are twice the sum of two cubic numbers, such as 4104 and Ramanujan's 1729. Blood is thicker than water!)

BNAIC 2010 REPORT

Richard Booth, Grégoire Danoy,
Benjamin Gâteau, Isabelle Jars,
Marcin Seredynski, Djamel Khadraoui
(program co-chairs, BNAIC 2010)

The 22nd edition of the Benelux Conference on Artificial Intelligence took place in Luxembourg on October 25-26, 2010. This was the first time that BNAIC had been held in the Grand Duchy, which only recently was welcomed into the BNVKI fold. The conference was hosted jointly by the University of Luxembourg and the Centre de Recherche Public Henri Tudor. Despite increased travel costs for participants, the turnout was good, and the atmosphere was convivial. A total of 99 participants registered for the conference, with the biggest contingent (50 people) coming from institutes in the Netherlands. As might be expected, this year there was also a sizeable contingent (22) affiliated to institutes in the host country of Luxembourg, while 18 participants made the journey from Belgium. The remaining 9 attendees came from France, Italy, Germany, Sweden and the United States.

Two of the BNAIC 2010 General Chairs, Leon van der Torre (l) and Thibaud Latour (r) open the conference.

PROGRAM

This year the BNAIC conference was lucky to welcome a couple of outstanding invited speakers, in Jérôme Lang (CNRS and Université Paris-Dauphine) and Michael Mateas (University of Southern California, Santa Cruz, USA). The title of Jérôme's talk was *Voting, Incomplete Knowledge and Communication*, which was mainly about one of the key problems in the area of Computational Social Choice, namely the determination of a winning alternative in an election when knowledge about voters' preferences is incomplete.

Jérôme Lang beginning his invited talk.

Michael is one of the best-known researchers in the area of AI in Videogames. In his talk, titled *The Algorithm is the Message: AI as an Expressive Medium*, he explored the possibility of using game AI to enable new forms of interactive experiences, describing the research and design challenges that arise from a focus on AI as an expressive medium.

Michael Mateas during his talk.

Regarding the contributed papers, as in previous years, submissions were invited for papers in three categories: original papers (category A), "compressed contributions" (category B), which were papers which had already been accepted or published in other AI-related conferences or journals after June 1, 2009, and demonstrations (category C). A total of 76 submitted papers were received, breaking down into 36 category A, 34 category B and 6 category C. Out of these, a total number of 67 papers were accepted: 30 from category A, 31 from category B and all 6 demonstration papers from category C. 50 of the accepted category A and B papers were accepted for oral presentation, with the remaining 11 accepted for poster presentation.

Awards

There were two awards at this year's BNAIC. An award for Best Original Paper (open to all category A papers) and Best Demonstration. For Best Original Paper, the Program Co-chairs drew up a shortlist of 5 papers, based on the received reviews. They were:

- *On the existence of semi-stable extensions*, by Martin Caminada and Bart Verheij
- *Fast Bayesian people detection*, by Gwenn Englebienne and Ben J.A. Kröse
- *Probability assessments from multiple experts: Qualitative information is more robust*, by Linda van der Gaag, Silja Renooij, Hermi J.M. Schijf, Armin R. Elbers and Willie L. Loeffen
- *Sparse orthonormalized partial least squares* by Marcel van Gerven and Tom Heskes
- *Human-agent team formation: An empirical study* by Arlette van Wissen, Kobi Gal, Bart Kamphorst and Virginia Dignum

These 5 were further evaluated by the appointed award jury consisting of Hendrik Blockeel, Nico Roos and Katja Verbeeck, and the winner, announced at the BNAIC closing ceremony was

- *Fast Bayesian people detection*, by Gwenn Englebienne and Ben J.A. Kröse (Universiteit van Amsterdam)

The Best Demonstration award was, as usual, organised by Prof Jaap van den Herik and the Stichting Knowledge Based Systems, with additional sponsoring by Strukton. The prize was awarded to:

- *Bonaparte accident victim identification system*, by Willem Burgers, Wim Wiegerinck and Bert Kappen.


The winners of the Best Demo award receive their prize.

BNAIC 2010: Session Reports

AI for Games and Entertainment

Jos Uiterwijk
DKE, Maastricht University

The first paper in this session, *Unreal GOAL Bots*, by Koen Hindriks, M. Birna van Riemsdijk, Tristan Behrens, Rien Korstanje, Nick Kraayenbrink, Wouter Pasman and Lennard de Rijk, was presented by Birna. She reported on the difficulty of connecting cognitive or rational agents to an interactive, real-time computer game. This is a far-from-trivial exercise, especially for logic-based agents. Birna reported on the effort to connect bots using the GOAL agent programming language to the real-time game Unreal Tournament 2004, focussing in particular on the design of a suitable interface. For this purpose, they used a recently introduced toolkit called EIS (the Environment Interface Standard). The results show that the availability of EIS indeed facilitates connecting arbitrary agent platforms with relatively little effort to such environments. Future research will concentrate on the very interesting research question whether it is possible to develop agent-controlled bots that are able to compete with experienced human players using the same information the human players possess. Even more challenging is the question whether they can develop agent-controlled bots that cannot be distinguished by experienced human players from human game players. We look forward.

The second paper in the session was titled *APOPCALEAPS: Automatic Music Generation with CHRiSM*, by Jon Sneyers and Danny De Schreye. Jon presented the APOPCALEAPS system (Automatic POP Composer And LEArner of ParameterS) for generating and learning pop music based on chance rules, implemented in CHRiSM, a high-level rule-based probabilistic logic programming language. The presentation was not only visual, but included a nice audio demonstration. As such I think this presentation would have scored well as a demo presentation. The probability distributions are currently tuned manually. However, the APOPCALEAPS system allows in principle parameter learning from previously generated pieces. In order to make learning computationally feasible, the underlying CHRiSM system has to be sufficiently efficient. This is the subject of ongoing work.

In the third presentation, *Enhancements for Multi-Player Monte-Carlo Tree Search*, by Pim Nijssen and Mark Winands, Pim reported on his ongoing work on multi-player search algorithms. In particular, he proposed two new enhancements for Monte-Carlo Tree Search (MCTS) in multi-player games. The first one is Progressive History, a combination of Progressive Bias and the widely-used History Heuristic. Experiments in two different multi-player games, Focus and Chinese Checkers, reveal that Progressive History is a considerable improvement in Focus, and works even better in Chinese Checkers. The second improvement concerns a multi-player variant of Monte-Carlo Tree Search Solver (MP-MCTS-Solver). Update rules are non-trivial in multi-player games, and Pim reported on several variants. Experiments were done in Focus only and show that the best results are obtained when only game-theoretic scores are used when all moves from a position lead to the same winner, otherwise using the simulation score. This work clearly still is in progress.

The final presentation in this session was *Tennis Patterns: Player, Match and Beyond*, by Jonathan Vis, Walter Kosters and Antonio Terroba. Jonathan described the application of pattern-mining techniques to the game of tennis. Experiments show that the approach works in practice, though the results are not always easy to interpret. Further research includes the search for more general patterns. For specific players strengths and weaknesses could be explored, and patterns for matches and more general ones should be further examined. Finally, the general structure of the (groups of) interesting patterns needs further analysis.

All in all this was a very interesting session and I am eager to see results of future research for all four research groups involved. So, hopefully to be continued next year.

Bayesian Networks

Emil Weydert
University of Luxembourg

The session on Bayesian Networks took place in a small, cramped room, which however did not keep away the aficionados. Inspired by cognitive science, Johan Kwisthout introduced two abduction concepts for Bayesian networks aimed at finding the most simple, respectively the most informative, explanation. Although these problems were shown to be intractable in general, they become tractable under some more or less reasonable constraints.

Barbara Pieters and Linda van der Gaag presented work on the danger of lurking dependencies for naive Bayesian classifiers, i.e., of those dependencies able to reverse the sign of influence of a feature on the class variable. This was illustrated by the counterintuitive handling of examples in the context of qualitative probabilistic considerations. A desirable property for practical Bayesian networks is monotonicity, which requires that higher values for the observable variables should tend to produce higher values for the target variables.

Merel Rietbergen and Linda van der Gaag proposed a method on how to achieve monotonicity by changing a single parameter probability. Although the complexity here was shown to be high, a local application to suitable parts of a network might still be useful.

The talks roused a number of questions and comments, and the struggle of the chair to pronounce Dutch names ensured additional entertainment.

- *Two New Notions of Abduction in Bayesian networks*, by Johan Kwisthout.

- *On Lurking Dependencies and Naive Bayesian Classifiers*, by Barbara F.I. Pieters and Linda C. van der Gaag.
- *Attaining Monotonicity for Bayesian* Networks, by Merel T. Rietbergen and Linda C. van der Gaag.

Business and Industrial Applications

Virginia Dignum
Delft University of Technology

Three papers were presented in the Business and Industrial Applications session on Monday afternoon.

The first paper on *Enhanced Hospital Resource Management using Anticipatory Policies in Online Dynamic Multi-objective Optimization*, was presented by Peter Bosman of RUN and focused on the design of EAs for solving dynamic MO optimization problems. The results illustrate, for the first time, that time-dependency can be detected and dealt with successfully for dynamic optimization problems with multiple objectives using anticipatory policies.

The second paper entitled *A Bayesian Petrophysical Decision Support System for Estimation of Reservoir Compositions*, presented by Willem Burgers, described work done in cooperation with Shell to obtain compositional estimates of drilling locations. The Bayesian approach taken combines expert knowledge with information obtained from measurements. The ability of the system to estimate compositions is tested using synthetic data resulting on estimates that are within one error bar (uncertainty bound) from the actual value for unimodal distributions. Tests also confirmed the consistency of the model.

Finally, Niek Wijngaards presented work done at D-CIS lab on an intelligent system facilitating better informed decision making under severe uncertainty, as often found in emergency management. This work proposes a framework to facilitate medium and longer term decision making under severe uncertainty using Multi-Criteria Decision Analysis and considering scenarios: descriptions of a situation and its possible future developments. The theoretical framework was demonstrated within the Diadem project in a distributed decision-support system by orchestrating both automated systems and human experts into workflows tailored to each specific problem.

Evolutionary Algorithms

Walter Kosters
Universiteit Leiden

In the first presentation Peter Bosman (from CWI in Amsterdam) discussed *The Anticipated Mean Shift and Cluster Registration in Mixture-based EDAs for Multi-Objective Optimization.* The long title covers the contents well. Estimation-of-Distribution Algorithms (EDAs) are evolutionary algorithms that use probabilistic modelling to get a better grip on the problem structure. They can in particular be used for Multi-Objective Optimization problems, where the Pareto front (consisting of solutions that do not beat one another, but do beat the rest of the solutions found so far) must be thoroughly examined. Special clusterings can be used to guide the search along this set, i.e., population of solutions. Several schemes are proposed and evaluated. The full paper was published in the Proceedings of the 2010 Genetic and Evolutionary Computation Conference (GECCO).

The second talk, entitled *An Intermediate Form of Behavioral Control in 'Reactive' Robots*, was given by Sjoerd Lagarde (paper co-authored by Ida Sprinkhuizen-Kuyper, Guido de Croon and Pim Haselager, all from the Radboud University at Nijmegen). The idea of control as a form of traffic regulation is explored by means of a simulation in the context of a relatively simple environment with a day-and-night rhythm. Several types of agents are tested. Control system agents (based on neural networks) seem to outperform reactive agents: they effectively adapt to their environment by "resting at night". The higher control structures assist in the inhibition of appropriate layers.

The third and last paper was *Identifying and Exploiting Commonalities for the Job-shop Scheduling Problem*, presented by Han Hoogeveen (with co-authors Marnix Kammer and Marjan van den Akker, all from Utrecht University). Good solutions to combinatorial optimization problems often have many building elements in common, and their number increases with the quality of the solution. These elements, referred to as commonalities, and their application within the job-shop scheduling problem (JSSP), are the subject of the presentation. As an example: so-called all-pairs communalities correspond with operations executed on the same machine (in a JSSP) in the given order. Though commonalities do not seem to flourish in the JSSP application, their usage improves the results of a simulated-annealing approach. The paper also mentions some negative experiments.

Game Theory and Strategic Reasoning

Mathijs de Weerdt
Delft University of Technology

The session on Game Theory and Strategic Reasoning contained interesting talks providing inspiring examples of situations where computer science and artificial intelligence techniques can be used in situations with multiple, often self-interested, actors.

In the first talk, Tim van Heugten presented a proof for an upper bound on the Price of Anarchy (PoA) in congestion games he found with two other Master's students from the Delft University of Technology. The PoA is the ratio of the costs of the worst-case Nash equilibrium to the optimal routing of all agents. They provided a theoretical bound on the PoA of series-parallel congestion networks, which was conjectured based on experimental data in a paper by Christodoulou et al. (2009) they studied for a seminar course.

A related worst-case analysis was given in the talk on a multiplayer (complete-information) board game called Rolit. Mark Winands presented a method developed with Jahn-Takeshi Saito to compute the minimal score a “paranoid” player can obtain. The paranoid assumption expresses that other players at every point in the game choose the action that minimizes this player’s score when they themselves are indifferent between the possible outcomes. This assumption significantly reduces the search tree. By combining this idea with a technique called proof-number search they succeeded in computing the “paranoid” scores of games of size up to 8×8 and four players.

Also for the talk by Tomas Klos several days of CPU cycles were burnt. He presented the Master’s thesis research of Bart de Keizer on finding a weighted voting game that matches a given power distribution as closely as possible. A naive algorithm for computing this inverse voting power problem is doubly exponential, but Bart came up with a more efficient method to systematically analyze all possible weight vectors, arriving at the first known exact approach to this problem.

When it was Wojciech Jamroga’s turn to present his joint work with İnanç Seylan, he focused not so much on their (tableau) algorithm for (burning CPU cycles and) deciding satisfiability of formulas in their Coalition Description Logic, but more on the expressivity of this language. He explained that although the technical change of introducing the concept of individuals is only minor, the expressivity (in a non-formal sense) and applicability are increased significantly. This extension of their earlier work thus allows for (the verification of) statements about what certain (groups of) individuals can achieve in a specific multi-agent environment or game.

Given the plans for future work presented by the authors, more high-quality work can soon be expected. So hopefully we will have at least two game theory sessions at next year’s BNAIC.

Machine Learning

Antal van den Bosch
TiCC, UvT, Tilburg

Although not the only session to feature machine learning papers, the “machine learning” session offered a good set of advanced machine learning work. The first paper, *Split Variational Inference* by Guillaume Bouchard and Onno Zoeter, Xerox Research Centre Europe, presented a method to ease the approximation of the integral of a positive function, by smoothly cutting the integral in smaller integrals. The approach is based on soft binning, and is related to the mixture mean field approach, which was shown to be a special case of the authors’ approach when soft-max functions are used for the binning. Using very intuitive graphics, a convincing case was made for the proposed method.

Both the first and the second paper were previously published (“B”) papers. The Bouchard and Zoeter paper was published in the Proceedings of the 26th Annual International Conference on Machine Learning (ICML). The second paper, *Risk Sensitive Path Integral Control* by Bart van den Broek, Wim Wiegerinck and Bert Kappen (Radboud University, Nijmegen), was presented at the 26th Conference on Uncertainty in Artificial Intelligence (UAI 2010). It describes work in risk sensitive control as emergent behaviour of agents who need to reach a target, or need to avoid a threat. In both cases, an agent can have an optimistic or pessimistic attitude. As presenter Bart van den Broek explained, risk-sensitive optimal control generalizes the objective of normal stochastic optimal control by minimizing an expected exponentiated cost-to-go. The well-illustrated presentation explained how the present work had made use of recent advances in solving a type of nonlinear partial differential equation, using a path integral formalism.

The third paper, in the “A” category of full and previously unpublished papers, was *Fast Bayesian People Detection* by Gwenn Englebienne and Ben Krose (University of Amsterdam). With even more illuminating illustrations than the first two presentations (moving images can tell a long story in a few seconds), Gwenn Englebierre gave an intuitive account of their solutions to some vexing problems in people detection, in their case using a ceiling-mounted camera looking down onto people, and able to detect the number of people at a particular time slice, with robustness to partial occlusions and under different (difficult) light conditions in different locations. While all of this can be performed by state-of-the-art approaches, they cannot run in real time, and are inefficient in their optimization (e.g., to generalize to different locations. The novel method presented at BNAIC relies on prior knowledge of the average size of people, and can incorporate similar types of domain knowledge such as typical walking behaviour (e.g., the distance that people keep to other people).

Multi-Agent Systems

Benjamin Gâteau
CRP Henri Tudor, Luxembourg

Multi-Agent Systems (MAS) could be seen as a way to distribute AI. MAS allow the modelling of heterogeneous, complex and evolving systems and bring a different and superior global intelligence compared to one of each belonging agents. This intelligence comes from the coexistence of autonomous entities (agents) with a multitude of interactions in a dynamic environment.

The first initial paper titled *Deceit and Trust in Intercultural Trade* was replaced by *Optimal Temporal Decoupling in Multi-agent Systems*. In this paper, temporal decoupling is used for multi-agent coordination problems. The temporal decoupling enables agents to plan independent of each other, while the combination of the individual solutions is guaranteed to be a valid solution for the multi-agent coordination problem.

The second paper titled *Governance of Services: A Natural Function for Agents* was presented by Virginia Dignum. She proposed tracks and insights for a dynamically evolving service-oriented software architecture, using agents. In order to meet the requests of future electronic service provision, four challenges are identified: dynamic behaviour, formalization of business roles and rules, response to change, and formalization of agreements.

The third paper *Human-Agent Team Formation: An Empirical Study* was also presented by Virginia Dignum. The presentation dealt with an experimental study with 18 subjects in which interactions between parties are explored during team formation. Parties may be human or perceived as being a computer agent. The study explores differences in human behaviour if a party is perceived to be a computer agent.

The last paper of the session was presented by M. Birna van Riemsdijk (*Formalizing Organizational Constraints: A Semantic Approach*). She presented a model for normative multi-agent systems that integrates hard (or non-violable) with soft (or violable) constraints.

Natural Language Processing

Matthieu Geist
Supélec Metz

Four papers have been presented during the session 'Natural Language Processing' chaired by Matthieu Geist, namely *Using Suffixarrays as Language Models: Scaling the n-gram* by Herman Stehouwer and Menno Van Zaanen, *Answering Complex Questions in Natural Language using Probabilistic Logic Programming and the Web* by José Oramas M. and Luc De Raedt, *Language Modeling with Dynamic Bayesian Networks Using Conversation Types and Part of Speech Information* by Yangyang Shi, Pascal Wiggers and Catholijn M. Jonker, and *Paraphrase Generation as Monolingual Translation: Data and Evaluation* by Sander Wubben, Antal van den Bosch and Emiel Krahmer.

All presentations were of high quality and sparked off an interesting and constructive debate among the audience.

Pattern Discovery

Wim Wiegerinck
SNN, Nijmegen

Sparse Orthonormalized Partial Least Squares, by Marcel van Gerven and Tom Heskes. The first paper of this session was presented by Tom Heskes. The presentation started with a short tutorial on partial least squares as two-layer linear models and how these models can be optimized in an iterative scheme. Then it was proposed to enforce sparseness of the parameters from input to hiddens by adding an L1 penalty term to the sum-squared error cost function. It was argued that this hardly affected the complexity of optimization. The method was applied to optimize a model for the reconstruction of presented images from BOLD responses in primary visual cortex ("Brain reading"). The method was able to find sparse solutions with small reconstruction error.

Bayesian Monte Carlo for the Global Optimization of Expensive Functions, by Perry Groot, Adriana Birlutiut and Tom Heskes. The second paper of this session was presented by Perry Groot. In this paper, the goal was to develop a generic method to find the optimum of a function that is expensive to evaluate. An additional complication is the assumption of stochastic environmental variables. The running example was the optimization of cake-mix ingredients. Which cake ingredients yield, on average, the best cakes under the uncertainty of different oven characteristics? In this example, a function evaluation is an actual baking of a cake. The generic mathematical problem is addressed using an elegant Bayesian approach, using Gaussian processes to model the function class and exploiting Gaussian integration for inference.

Attempting to Increase the Performance of Petri Net based Situation Recognition, by Anders Dahlbom, Lars Niklasson and Göran Falkman. The third speaker, Anders Dahlbom, came all the way from Sweden. His presentation was on an application of Petri Nets. The application was about detecting suspicious movements of people in a shopping mall in relation to pick-pocketing. The paper presented an attempt to increase the performance of the model, an attempt which was not yet very successful. So, in contrast to the first two presentations, this presentation could be more viewed as a discussion of work in process. I was happy to hear from Anders that he found the BNAIC and in particular the reviewer's feedback very useful.

Semantic Web / Intelligent Systems

Jaap van den Herik
TiCC, UvT, Tilburg

The session consisted of four diverse, but very interesting topics. They triggered four lively discussions after the last words of the presenter. The discussions were open, difficult but to the point, and had a prospective component. For organisatorial reasons there was a change in the program (the presenter was also session chair). Time management was strict by the speakers, the moderator, and the audience. If this session would be leading for the conference's opinion then it would be good, very good.

The first presentation was *Semantic Web-based Knowledge Acquisitions Using Key Events from News* by Frederik Hogenboom, Flavius Frasincar, and Uzay Kaymank. The presenter was Frederik Hogenboom. He started with the "open door": News messages impact on stock prices". Then he continued to explain that news may have a double function, viz. (1) update, and (2) rephrasing of a person's ideas on the context. For a proper understanding of his message Frederik introduced the Hermes Framework. It consists of four phases: (1) news classification, (2) knowledge update, (3) news querying, and (4) presenting the News. All four phases were extensively discussed. To provide some ideas on the contents we mention a list of attention points for phase 1: (a) ontology, (b) multiple lexical representations, (c) semantic lexicon synonyms. These points of attention were achieved by the following steps: (1) tokenisation, (2) sentence splitting, (3) determination of the stem of the words, (4) morphological analysis, and (5) the help of google.

The other four phases were discussed analogously. The full Hermes Framework was then complemented by a Hermes News Portal. Finally, a positive evaluation on the work performed was given. In the open discussion Antal van den Bosch brought up the news item: "Yahoo is bought by Google, or maybe the buy is just prevented". What is the reaction/update/context of the Hermes Framework after such a statement? Almost everybody in the audience had an opinion, and voiced suggestions. The end was that Hermes' belief system should be made more robust.

The second presentation was *Approximations and Self-Organisation or the Web of Data* by Christophe Gueret, Kathrin Dentler, and Stefan Schlobach. The presenter was Kathirn Dentler. She started to define the essence of the semantic web: *linked data*. For a proper understanding and suitable results her advice was: (1) use your eyes well, (2) use https, (3) use RDF, and (4) use URLs. Moreover, invoke the help of Computational Intelligence. It provides adaptiveness, robustness, and scalability; three properties that are needed for changing data. Subsequently, the essence of the semantic web was described by (1) adaptivity, (2) simplicity, (3) interactivity (any time and being in the loop), and (4) scalability and robustness. All four points were discussed at length. The emphasis was an ontology mapping and swarm optimization. Then, the attention went to the progress of science: to what extent do we achieve *swarm intelligence*? And also *collective intelligence* (such as ants and bees)? Obviously, the presenter kept the audience. In particular her next topic did people think about the future: what about semantic gossiping? There she referred to her M.Sc. thesis with the main topic "Semantic Web reasoning by Swarm Intelligence", Kathrin completed her presentation by the intriguing question: What can CI gain from SW? The audience reacted instantaneously. The first reaction was: "Please, remark, Computational Intelligence is more than triples." After Kathrin had agreed with this statement, again Antal van den Bosch came in with a kind of "conclusion". "Having heard this lecture then SW (semantic web) is nothing, at least nothing more than linked data, which implies that CI can gain nothing from SW." This was not the last word, but a full account of pros and cons is too abundant for this report. A provisional conclusion might be that the overclaim of the Semantic Web is over. It is linked data and nothing more.

The third presentation was *Simulating Peer Support for Victims of Cyberbullying* by Janneke van der Zwaan, Virginia Dignum, and Catholijn Jonker. The presenter was Janneke van der Zwaan. Cyberbullying is a hot topic and has already many large surveys. It leads in 20 to 40 per cent to victimization (estimation). Anyway it is so frustrating that 23-33 per cent does not want to talk on the negative experiences. Janneke looked at it from the technical side by developing a design of a program that could be involved in the fight against cyberbullying by focusing on the emotional utterances of the sender. When detecting the person as a cypberbullying person measures should be taken. Many obstacles that will occur in this project (that just has been started) were discussed. In particular the OCC Model (by researchers from Carnegie Mellon) was mentioned as reference point. The countermeasures could be: support, advice, and training of the victim. This could be done by a pedagogical agent or an empathic agent. Janneke agreed that a full-fledged application was far in the future, but it was best to start now. The discussion was not on the technical points, but on the legal issues and the psychological matters.

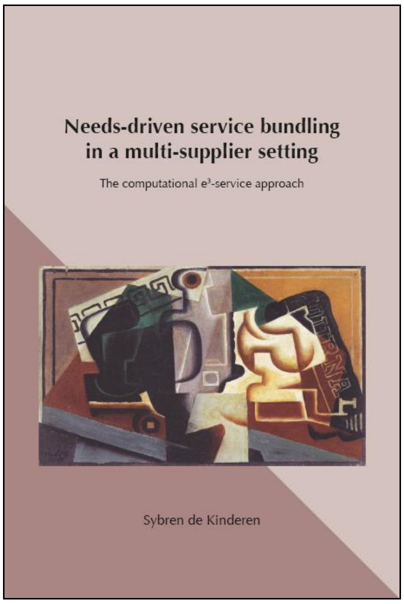
The fourth presentation was *Deceit and Trust in Intercultural Trade* by Gert Jan Hofstede, Catholijn Jonker, and Tim Verwaart. The presenter was Tim Verwaart. Originally this lecture was scheduled in the session Multi-agent Systems. Tim Verwaart had an excellent lecture – the best of the BNAIC in my opinion. It was challenging and entertaining. He started to inform us on the following. "Most people do not deceive, even if they have a motive and opportunity to do so (only Macchiavelli followers do)". Then the models were discussed: models of deceit, trust, and culture. "The role of trust is found in supply chains with asymmetric information." This is a nice statement which gave the audience some food for pondering. Examples of a Fish Market and other experiments were given to underline the value of the statement. The main topic for an agent are its decisions on deceit and on trust. How should a model on these topics look like? Of course, ethics play a role, and maybe being not rational, or follow the rules, but rules depend on culture. So, a model of deceit could well follow a rational strategy. The audience was whispering and busy with updating their own beliefs. At that moment we were pushed into thinking on the conditions for deceit: opportunities, motives, thresholds, personal relations, the other's behavior, personal traits, cultural background. In summary, it looks like a Ph.D. project without no end. For the presenter there was a fantastic end by big hands from the audience after he had answered many questions satisfactorily. It was the end of a very, very good BNAIC session.

PH.D. THESIS ABSTRACTS

Needs-Driven Service Bundling in a Multi-Supplier Setting: The computational e^3-service approach

Ph.D. thesis abstract
Sybren de Kinderen

Promotor: Prof.dr. J.M. Akkermans
Co-promotor: Dr. J. Gordijn
Date of defense: October 25, 2010



We propose a methodology to create, in a semi-automated manner, (possibly multi-supplier) bundles of commercial services that together satisfy a complex customer need.

Services are often offered as a bundle, a package of elementary services that is sold at a single price. First and foremost, such bundles are required because elementary services often satisfy a customer need only partially, but together satisfy this need completely. For example: an e-mail service is often supplemented by a spam filter service, to avoid that the customer is flooded by unwanted e-mails.

Currently, service bundles are more and more unbundled into their constituent parts, which are subsequently re-bundled to fit with specific customer needs. Consider for example that many ISPs now modularize their service offerings, such as by offering internet access only (without web hosting or an e-mail box). At the same time, we see that IT often plays an important role in realizing such services. If IT plays an important part in realizing a service, then it should also be possible to sell services via IT.

In this thesis we propose a methodology that, in a *semi-automated manner*, creates bundles of *commercial services* in line with *specific customer needs*. As suggested by the italicized words, multi-disciplinarity is key to the theory development of our methodology: We use theories from service marketing to enable analysis of commercial services and customer needs, and combine these with theories from computer science to formalize the analyses to the extent that the computer can do something with it.

From a computer-science perspective, an important contribution of this thesis lies in the development of a computational reasoning method called PCM^2. With PCM^2, we describe a reasoning method that gradually considers new requirements and that, based upon service constraints, adjusts existing ones, or may even remove requirements altogether.

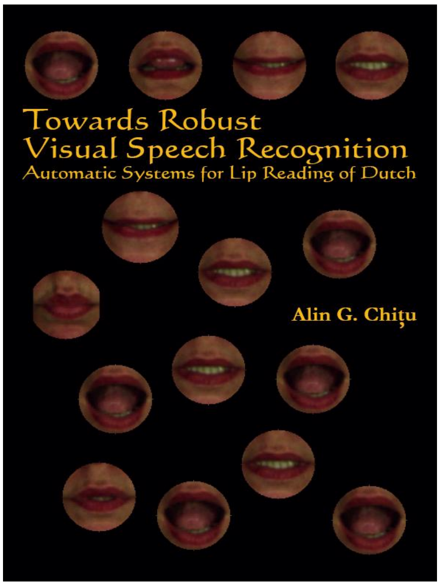
Thus, with our reasoning method, we perceive the space of user requirements to be a problem space in its own right. This is an interesting addition to existing versions of the Problem Solving Method Propose Critique Modify (PCM), whereby requirements and constraints are often perceived as given, and whereby the gradual generation of solutions is the focus. Hence PCM^2: we perform gradual creation of a solution (a service bundle in our case), as well as gradual consideration of requirements and constraints.

For practical validation, we applied our methodology to four substantial, real-life, practical cases. In addition, we implemented the methodology in software to show that the needs-driven bundling reasoning process can indeed be carried out in a semi-automated manner.

Towards Robust Visual Speech Recognition: Automatic systems for lip reading of Dutch

Ph.D. thesis abstract
Alin Gavril Chițu

Promotores: Prof.dr. C.M. Jonker, Prof.dr.drs. L.J.M. Rothkrantz
Date of defense: November 2, 2010



In the last two decades we witnessed a rapid increase of the computational power governed by Moore's Law. As a side effect, the affordability of cheaper and faster CPUs increased as well. Therefore, many new "smart" devices flooded the market and made informational systems widely spread. The number of users of information systems has also increased many folds, and the user's characteristics have changed to include not only a small number of initiates but also a majority of non-technical people. To make this transition possible systems' developers had to change the computer user interfaces in order to make it simpler and more intuitive. However, the interaction was still based on rather artificial devices such as "mouse" and "key-board". Since the Moore's Law continues to work over and over again we came to a critical moment when the current systems can easily cope with other input streams such as video and audio, to name the most important, and others. We can, therefore, envision systems with which we can communicate through speech and body movements and that can automatically and transparently adapt to the environment and user. This can be done for instance by recognizing the user affective state, by understanding the task of the user and recognizing the context of the interaction.

Automatic speech recognition by capturing and processing the audio signal is one development in this direction. Even though in controlled settings automatic speech recognition has achieved spectacular results, its performance is still dependent on the context (for instance on the level of the background noise). Automatic lip reading has appeared in this context as a way to enhance automatic speech recognition in noisy environments. Even though it is still a relatively novel research domain, other applications were found which employ lip reading as stand alone: interfaces for hearing-impaired persons, security applications, speech recovery from mute or deteriorated films, silence interfaces.

With the advances in visual signal processing the research in lip reading was also revitalized. However, at the moment of writing of this thesis lip reading was still waiting for its great leap. This thesis investigates several techniques for directing lip reading towards more robust performances.

The thesis starts by introducing the relevant methodologies that govern automatic lip reading. Next it introduces all the concepts needed to understand the technologies, experiments, results and discussions presented later on. It is, therefore, one of the most important parts of the thesis. The presentation of the state-of-the-art in lip reading is setting the starting point of the research presented. Before continuing to follow the lip reading process the thesis introduces the mathematical foundations that give the theoretical support for the analysis.

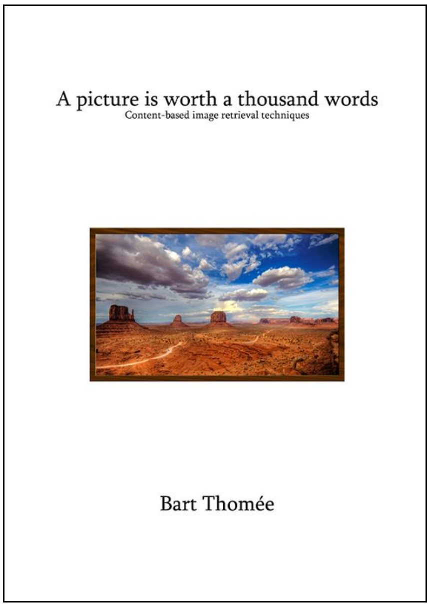
All our systems are based on the Hidden Markov Models approach. This paradigm has proved to be very useful in similar problems and we successfully employed it for lip reading. The main idea behind it is the Bayesian rule which says that starting from some a-priori knowledge we can always improve our understanding of a system through observation. Observation translates into processing the video stream in a set of features that describe what is being said by the speaker. However, in order to appropriately train a lip-reading system, a large amount of data is needed. The first important contribution of our research is a large data corpus for the Dutch language. This corpus, named “New Delft University of Technology Audio Visual Speech Corpus”, is at the date of writing this thesis one of the largest corpus for lip reading in Dutch. The corpus contains dual-view high-speed recordings (i.e., 100 Hz) of continuous speech in Dutch. During the building of the corpus, we also produced an incipient set of guidelines for building a data corpus for lip reading which we hope to be useful for other researchers.

However, the core of this thesis consists in the data parameterization. Data parameterization is the process that transforms the input video data in a set of features that are used later on for training and testing the resulting recognizer. The parameterization should reduce the size of the input data while preserving the most important information related with what the speaker says. We investigated three data-parameterization techniques each coming from a different category of algorithms. We used Active Appearance Models which generate a combined geometric- and appearance-based set of features, we used optical-flow analysis which is an appearance-based approach that directly accounts for the apparent movement on the speaker’s face and we used a statistical approach which generates the geometry of lips without starting from an a-priori fixed model. During the research presented in this thesis we investigated the performances of these data-parameterization techniques and we pointed out their strengths and weaknesses. We also analysed the performance of lip reading starting from other points of view. We analysed the influence of the sampling rate of the video data, the performance of the lip readers as a function of the recognition task, but also the performance as a function of the size of the corpus used. Answering to all these questions improved our understanding of the limitations and the possible improvements of lip reading.

A Picture is Worth a Thousand Words: Content-based image retrieval techniques

Ph.D. thesis abstract
Bart Thomée

Promotor: Prof.dr. J.N. Kok
Date of defense: November 4, 2010



With the current trend of transferring more and more information to personal computers and the internet, different approaches are required in order to find back the desired information. Search engines like Google and Yahoo! are quite capable of retrieving documents based on their textual contents. However, the quality of the results is often far from optimal when it comes down to finding imagery. The well-known saying "a picture is worth a thousand words" highlights one of the main reasons it is so difficult to track down the images someone is looking for, in particular because the words assigned to an image can also differ from person to person. What one person may describe as a "holiday picture showing a mountain" can be considered by another as "scenery of Iceland", whereas a third person may perceive the photo as "the Eyjafjallajökull volcano on the verge of eruption". A search engine thus has to accommodate for all kinds of image interpretations.

Computers are not yet able to see the world like we do. The field of computer vision aims to translate the knowledge on the human vision system into algorithms to give computers similar capability. In this thesis many different computer-vision techniques are discussed, ranging from techniques that focus on the colours of images to techniques that analyze images from the point of view of the way cones in the human retina are distributed. However, in my work computer vision is the means to an end, and I use it in the context of content-based image retrieval. My main research objectives are to design techniques that (i) assist the user in finding images of interest quicker than before, and (ii) provide the user with a better search experience than before.

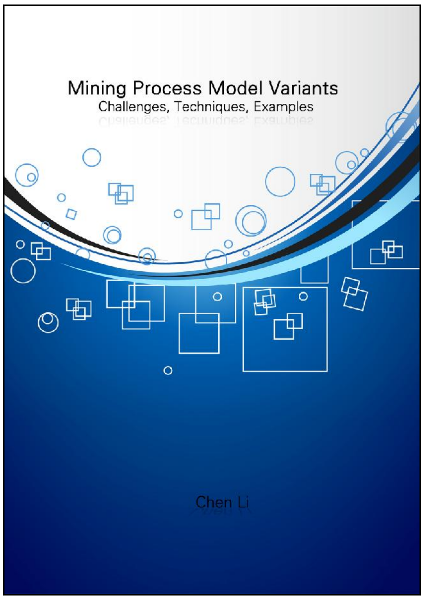
Interactive image retrieval is an approach that is not very widely used by internet-based search engines, but which nonetheless shows good potential for returning relevant images to the queries of users. Interactive image retrieval keeps the user actively involved, by asking her for feedback on the current set of results, with the aim of finding out more accurately what she is and isn't looking for. In my thesis, I first review over 200 representative articles from the recent research literature to discover the current trends in which the field is heading, and the current challenges that the research community is facing. This survey also serves to place my own work into context. I then proceed with presenting two interactive approaches for content-based image retrieval, of which the first is a novel paradigm our research group has called Artificial Imagination (AIm). This paradigm can be considered as the digital analogy of our own visual imagination. While the user is searching, the search engine forms mental images of what the user may be looking for. By presenting these mental images to the user for verification, the system can figure out quicker what the user has in mind, in contrast with when the system is not able to include these artificially imagined pictures. The second interactive approach I present in my thesis involves a new browsing mechanism for intuitive visual exploration of image collections. The interface enables the user to quickly get a feeling of what the collection has to offer, and to effortlessly locate many images of interest.

In my thesis I have also focused on the topic of near-duplicate image detection, which is particularly useful for increasing the diversity in image that web-based image search engines return. For instance, if one would search for "mona lisa" on Google Image Search, then many of the returned images are variations of the original painting of Leonardo da Vinci. By employing duplicate image detection, the results could be cleaned up by condensing all originals and copies, therefore allowing other images to become more prominent in the image ranking. I have therefore evaluated the performance of several duplicate-detection techniques. I focused in particular on the amount of memory the techniques required for their internal representation of the images, the time required for detecting copies that were embedded in a collection of several million images, and finally how accurate the techniques were in detecting the copies. A wonderful discovery was that to obtain high detection accuracy it is not necessary to use a memory intensive nor computationally intensive duplicate detector. This discovery paints a bright outlook for attempting to perform copy detection on a truly large scale, such as on the billions of images that are presently available on the internet.

Mining Process Model Variants: Challenges, Techniques, Examples

Ph.D. thesis abstract
Chen Li

Promotor: Prof.dr. R.J. Wieringa
Co-promotor: Dr. A. Wombacher
Date of defense: November 11, 2010



During the last years a new generation of process-aware information systems has emerged, which enables process model configurations at buildtime as well as process instance changes during runtime. Respective model adaptations result in large collections of process model variants that are derived from same process models, but slightly differ in structure. Generally, such model variants are expensive to maintain and configure. In this thesis, we present challenges, scenarios and algorithms for representing, comparing and mining such process model variants.

We first introduce the notion of process distance, which corresponds to the minimal number of high-level change operations needed for transforming one process model into another. In general, we presume that the shorter the average distance between a reference process model and related process variants is, the less changes are required for adapting the variants and the less efforts are needed for (future) process configuration. In this context, we present a method based on boolean algebra to compute the distance between two process models.

Starting with a collection of related process model variants, the major goal of this thesis is to discover a reference process model out of which these variants can be easily configured; i.e., a reference process model with minimal average distance to the variants. To achieve this goal we present two advanced algorithms which have their pros & cons, and that are applicable in different scenarios. Our clustering algorithm does not presume any knowledge about the original reference process model out of which the process model variants were configured. By only looking at the process model variants, this algorithm can quickly discover a reference process model in polynomial time, which allows us to scale up when solving real-world problems. The clustering algorithm further provides information on how well each part of the discovered reference model fits to the variants. Our heuristic algorithm, in turn, can take the original reference model into account as well. In particular, the user can control to what degree the discovered model differs from the original one. This way we can avoid spaghetti-like process models and additionally control how many changes we want to perform on the original reference model.

We systematically evaluate and compare the two algorithms based on simulations that comprise more than 7000 process models. Simulation results indicate good performance and make the differences between the two algorithms explicit. For example, the simulation results indicate that our clustering algorithm runs significantly faster than our heuristic algorithm. However, our heuristic algorithm can identify important changes at the beginning of the search and can discover better results than the clustering algorithm.

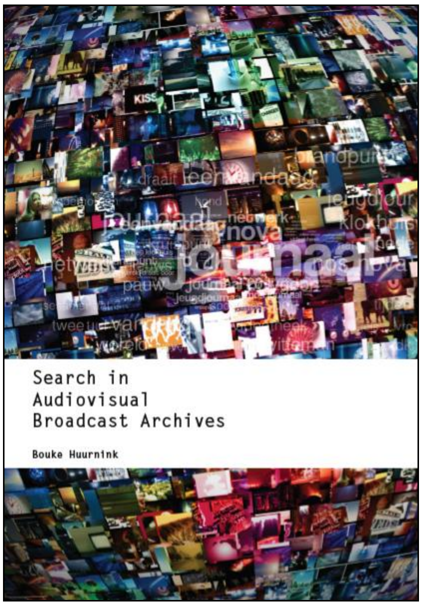
We successfully applied the two algorithms to cases from the automotive and the healthcare domain. During these case studies, the practical relevance and benefit of our work has become evident once more.

Overall, this Ph.D thesis will contribute to more intelligent information systems by learning from past adaptations and to an improved management of the variants by continuously evolving related reference process models.

Search in Audiovisual Broadcast Archives

Ph.D. thesis abstract
Bouke Huurnink

Promotores: Prof.dr. M. de Rijke, Prof.dr.ir A.W.M. Smeulders
Date of defense: November 26, 2010



Documentary makers, journalists, news editors, and other media professionals routinely require previously recorded audiovisual material for new productions. For example, a news editor might wish to reuse footage shots by overseas services for the evening news, or a documentary maker describing the history of the Christmas tradition might desire shots of Christmas trees recorded over the decades. Important sources for reusable broadcasts are audiovisual broadcast archives, which preserve and manage audiovisual material.

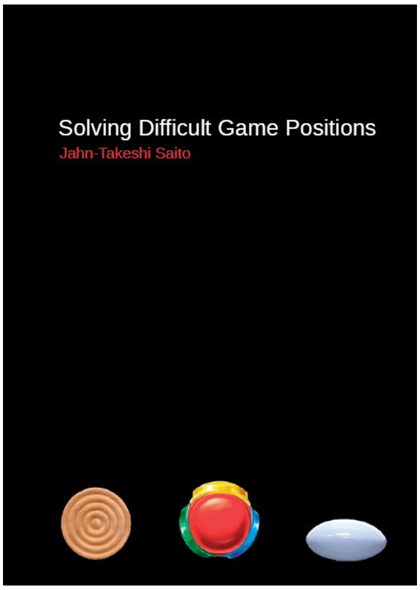
In this thesis we study search in audiovisual broadcast archives. Our approach is twofold, and accordingly the thesis is structured in two parts. Part I is dedicated to studying the *searcher*, and includes an analysis of the actions of media professionals on the online search interface of a national broadcast archive. We characterize their actions both in terms of their searches and in terms of their purchases. In order to model the behaviour of media professionals we follow this analysis with a simulation experiment. Here we investigate different methods for modelling the searches and purchases recorded in the archive.

Having gained a better understanding of the searcher, in Part II we move on to study search. In particular, we investigate how state-of-art methods for automatically generating content metadata from video may be used to improve the search for audiovisual fragments, in the context of the audiovisual broadcast archive. We use data from the searchers that we studied in Part I to help define new test collections for retrieval evaluation. These are used as the basis for experiments aimed at solving specific problems that are faced when searching with automatically generated descriptions of video content. Finally, we combine multiple sources of retrieval information, both automatically generated and manually created, and investigate their potential impact on search in the archive.

Solving Difficult Game Positions

Ph.D. thesis abstract
Jahn-Takeshi Saito

Promotor: Prof.dr. G. Weiss
Co-promotores: Dr. M.H.M. Winands, Dr.ir. J.W.H.M. Uiterwijk
Date of defense: December 15, 2010



Humans enjoy playing games not only to satisfy their desire for entertainment but also because they seek an intellectual challenge. One obvious challenge in games is defeating an opponent. The AI equivalent to this challenge is the design of strong game-playing programs. Another challenge in games is finding the result of a game position, for instance whether a Chess position is a win or a loss. The AI equivalent to this challenge is the design of algorithms that solve positions. While game-playing programs have become much stronger over the years, solving games still remains a difficult task today and has therefore been receiving attention continuously.

The topic of the thesis is the difficult task of solving game positions. Our research utilizes current developments in the rapidly developing field of Monte-Carlo methods for game-tree search and the continuously evolving field of Proof-Number Search to develop new solving algorithms. To that end, the here described research contributes and tests new forward-search algorithms, i.e., algorithms that explore a search space by starting from a game position and developing a search tree from top to bottom. The new algorithms are empirically evaluated on three games, (1) Go, (2) Lines of Action (LOA), and (3) Rolit.

Chapter 1 provides an introduction. It describes the place of games in the domain of AI and provides the notion of solving games and solving game positions. The chapter introduces the problem statement:

> **PS** How can we improve forward search for solving game positions?

Moreover, Chapter 1 provides four research questions that address four aspects of the problem statement that are central to solving game positions with forward search. The four questions deal with the following topics, which are part of the recent progress in the research on game-tree search: (1) search with Monte-Carlo evaluation, (2) Monte-Carlo Tree Search, (3) parallelized search, and (4) search for multi-player games.

The aim of Chapter 2 is to provide an overview of search techniques related and relevant to the solving algorithms presented in later chapters. It introduces basic concepts and gives notational conventions. It devotes particular detail to two topics: proof-number algorithms and Monte-Carlo techniques. Proof-number algorithms are stressed because they are well-studied standard techniques for solving. The reason for paying particular attention to Monte-Carlo techniques is that they have recently contributed substantially to the field of games and AI.

Chapter 3 introduces a new algorithm, MC-PNS, that combines Monte-Carlo evaluation (MCE) with Proof-Number Search (PNS). Thereby the first research question is addressed.

> **RQ 1** How can we use Monte-Carlo evaluation to improve Proof-Number Search for solving game positions?

An application of the new algorithm and several of its variants to the life-and-death sub-problem of Go is described. It is demonstrated experimentally that given the right setting of parameters MC-PNS outperforms simple PNS. Moreover, MC-PNS is compared with a pattern-based heuristic for initialization leaf nodes in the search tree of PNS. The result is that MC-PNS outperforms the purely pattern-based initialization. We conclude that the reason for the superior performance of MC-PNS is the flexibility of the MCE.

Chapter 4 introduces a novel Monte-Carlo Tree Search (MCTS) variant, called MCTS-Solver, addressing the second research question.

> **RQ 2** How can the Monte-Carlo Tree Search framework contribute to solving game positions?

The chapter adapts the recently developed MCTS framework for solving game positions. MCTS-Solver differs from traditional MCTS in that it can solve positions by propagating game-theoretic values. As a result it converges faster to the best move in narrow tactical lines. Experiments in the game of Lines of Action (LOA) show that MCTS-Solver with a particular selection strategy solves LOA positions three times faster than MCTS-Solver using the standard selection strategy UCT. When comparing MCTS-Solver to αβ search, MCTS-Solver requires about the same effort as αβ to solve positions. Moreover, we observe that PN^2 (a two-level Proof-Number Search algorithm) is still five times faster than MCTS-Solver. Additionally, we show that tree parallelization for MCTS-Solver has a scaling factor of 4 with 8 threads, easily outperforming root parallelization. We conclude that at least during game-play (online) MCTS-Solver is comparable with a standard αβ search in solving positions. However, for off-line solving positions, PNS is still a better choice.

Chapter 5 introduces a parallel Proof-Number Search algorithm for shared memory, called RP{PNS. Thereby, we answer the third research question.

> **RQ 3** How can Proof-Number Search be parallelized?

The parallelization is achieved by threads that select moves close to the principal variation based on a probability distribution. Furthermore, we adapted RP-PNS for PN^2, resulting in an algorithm called RP-PN^2. The algorithms are evaluated on LOA positions. For eight threads, the scaling factor found for RP-PN^2 (4.7) is even better than that of RP-PNS (3.5) but mainly achieved because the size of the second-level (i.e., PN_2) tree depends on the number of threads used. Based on these results the chapter concludes that RP-PNS and RP-PN^2 are viable for parallelizing PNS and PN^2, respectively.

Chapter 6 focuses on solving multi-player games. The chapter gives an answer to the fourth research question.

> **RQ 4** How can Proof-Number Search be applied to multi-player games?

The starting point of Chapter 6 is the observation that many two-player games have been solved but virtually no research has been devoted to solving multi-player games. We identify as a reason for this observation that multi-player games generally do not have a unique game-theoretic value or strategy because their search trees have multiple equilibrium points. Therefore, the straightforward way of solving a game by finding the outcome under optimal play (that is applied in two-player games) cannot be applied to multi-player games directly. We therefore propose solving multi-player games under the paranoid condition. This is equivalent to finding the optimal score that a player can achieve independently of the other players' strategies. We then propose Paranoid Proof-Number Search (PPNS) for solving multi-player games under the paranoid condition.

The chapter describes the multi-player variant of the game of Reversi, Rolit, and discusses how to apply PPNS to solve various multi-player variants of 4×4 and 6×6 Rolit, and four-player 8×8 Rolit. The outcome is that in 4×4 Rolit under the paranoid condition some players can achieve more than the minimum score while in 6×6 Rolit and in four-player 8×8 Rolit no player can achieve more than the minimum score. However, we observe that for 6×6 Rolit and four-player 8×8 Rolit PPNS performs better than we would expect from standard paranoid search. The chapter concludes by stating that PPNS is able to exploit the non-uniformity of the game tree in multi-player games.

Chapter 7 concludes the thesis and gives an outlook to open questions and directions for future research. While the thesis provides PPNS addressing the class of deterministic multi-player games with perfect information, we end by pointing out that solving deterministic multi-player games with imperfect information still remains a challenge and we briefly speculate how this problem can be tackled.

Happy Hour

H. Jaap van den Herik
TiCC, UvT, Tilburg

Our scientific research also has its happy hour. It takes place annually, in the December issue of the *BNVKI newsletter*, when we provide an overview of the results of the year involved. Obviously, AI has broadened its scope. A telling instance is that all activities concerning Web 2.0, originally called the semantic web, are essential to AI research. Even though we have nowadays arrived at the opinion that Web 2.0 should be characterised as “linked data”, we still consider all research work in this field as belonging to AI. Analogous arguments can be applied to other fields of research within the AI domain. For instance, Monte Carlo sampling and Monte Carlo Tree Search (MCTS) nowadays clearly belong to the area of game playing and as such to one of the oldest applications of AI research. MCTS is mainly known through its successful application in Go. For your memory, I recall that after DEEP BLUE’S victory against Kasparov (1997), Go research received full attention. The research progress on Web 2.0 and on Go in themselves already deserves a happy hour. However, there is much more. After the enormous jump of last year (from 55 (2008) to 76 (2009)), we see again a jump in the production of Ph.D. theses. Admittedly, the increase is many times smaller. Yet, an increase of 4 shows that we did not only hold our productive position, but that we managed to improve it. The happy hour for the general number of AI theses also holds for the SIKS theses. There the increase was 6, considered to be a success since we passed the number of 50.

As usual we honour all our promoti/promotae and besides we reproduce the 2010 SIKS list of Ph.D. defences. An overview of the scores and grand total of both are given in Figure 1.

Year	# of Theses	# of SIKS Theses
1994	22	-
1995	23	-
1996	21	-
1997	30	-
1998	21	5
1999	28	8
2000	19	11
2001	25	11
2002	33	17
2003	37	18
2004	45	20
2005	45	21
2006	54	28
2007	46	25
2008	55	35
2009	76	46
2010	**80**	**52**
Grand Total		

Figure 1: Scores and grand total.

The 80 Ph.D. thesis announcements are related to the following domains: (1) Artificial Intelligence, (2) AI and Law, (3) AI and Medicine, (4) AI and Economy, (5) AI and Civil Engineering, (6) AI and Computer Science, (7) AI and Information Sciences, (8) AI and Logic, (9) AI and NBIC, (10) AI and Humanities, and (11) AI and the Web.

In comparison to 2009 we may note that (10) AI and Humanities and (11) AI and the Web have been added to the list. The contributions by ToKeN and CATCH are significant. In particular, the Cultural Heritage domain has strengthened in 2010 again its relations to AI and Exact Sciences, resulting in a number of Ph.D. theses.

From figure 1, we may derive two prevailing conclusions on the increase of numbers over 2010. First, we may observe, in the case of general AI and that of SIKS, that the increase is 4 and 6, respectively. For SIKS we noticed a jump in 2008 (in comparison to 2007) of ten theses, bringing the total number from 25 to 35. Then we overstepped the increase of ten by 1 and arrive at 46 theses in total over 2009, and now in 2010 we passed the number of 50 theses in this year by two. A compliment to all SIKS professors is fully deserved. The compliment also holds for (a) the Co-promotors and daily advisors, as well as (b) the SIKS course managers and (c) the SIKS director, SIKS manager, and SIKS board. Congratulations to all of you. Second, analogous to last year I would like to repeat that the scientific field related to AI has again widened and deepened. This means that the impact of AI on the society is growing. There are many, many distinct research topics and we see that the incorporation of AI techniques in the research of these topics continues to find its way.

PREDICTIONS

The title of this section should be: "Predictions confirmed and outclassed". At a happy hour, it is advisable not to show too much happiness, since improving an improvement is always difficult, and one has to be careful for the concept of "verschlimverbesserung" (i.e., continue to polish all arguments so that the final results is nuisance). However, with the current results we do not need many interpretations to find a good explanation and a good reason for our happy hour. AI is flourishing and so is its Ph.D. thesis production over the last four years. Below I would like to repeat briefly some of my predictions over the last four years.

In 2006, I predicted for 2012 the following numbers: for the general announcements 100 Ph.D. theses, and for SIKS 50 Ph.D. theses. Having seen the current result, I am very pleased with SIKS and would like to encourage them to keep up the good work.

In 2007, I stated to expect 80 general announcements for 2009. With the number of 76 I showed my approval in last year's contribution. The result was within the 5 per cent error interval, which made me confident. Moreover, in the same year 2007 I then stated for SIKS for 2009: "I would optimistically like to go for 40 Ph.D. students, since SIKS is growing and the number of Ph.D. students per chair is growing". As the reader may understand, I am outclassed. So, I continue with 2009.

In 2009, I stated that reaching a sub goal does not necessarily imply that the main goal will be reached successfully. So, I reiterate my prediction for 2012, namely arriving at (2012: 100, 50), I foresee the following path: (2009: 76, 46), (2010: 86, 48), (2011: 96, 49) and (2012: 100, 50). We know that the correct numbers for 2010 are 80 (instead of 86) and 52 (instead of 48).

Below we honour our 80 successful Ph.D. defenders who completed their theses in 2010. We list them together with the date of promotion. Thereafter we reproduce the SIKS promovendi 2010 list, followed by a list of new announcements. For the SIKS promovendi list I would like to have your attention on the fact that number 53 has to be lowered by one since 48 has been withdrawn. Finally, we provide you with the date of one inaugural address and we wish professor Babuska much success with his work at Delft University of Technology.

Olga Kulyk (UT) (January 14, 2010), **Ingo Wassink** (UT) (January 14, 2010), **P. van der Putten** (UL) (January 19, 2010), **E.M.W. Lameijer** (UL) (January 28, 2010), **Claudia Hauff** (UT) (January 29, 2010), **Joost Geurts** (CWI) (February 3, 2010), **Matthijs van Leeuwen** (UU) (February 9, 2010), **Frans Oliehoek** (UvA) (February 12, 2010), **A.W. Keizer** (UL) (February 18, 2010), **Sicco Verwer** (TUD) (March 2, 2010), **Sander Bakkes** (UvT) (March 3, 2010), **Wim Fikkert** (UT) (March 11, 2010), **Susan van den Braak** (UU) (March 15, 2010), **Adriaan Ter Mors** (TUD) (March 15, 2010), **Antonie Vincent van Leijen** (UvA) (March 18, 2010), **Gianluigi Folino** (RUN) (March 22, 2010), **Spyros Kotoulas** (VU) (March 24, 2010), **Sander van Splunter** (VU) (March 29, 2010), **Charlotte Gerritsen** (VU) (April 12, 2010), **Hugo Kielman** (UL) (April 14, 2010), **Michiel Hildebrand** (VU) (April 20, 2010), **Krzysztof Siewicz** (UL) (April 20, 2010), **Rebecca Ong** (UL) (April 22, 2010), **Henriette Cramer** (UvA) (April 23, 2010), **Martin Oti** (RUN) (April 23, 2010), **Bas Steunebrink** (UU) (April 27, 2010), **Koen Deschacht** (KUL) (May, 3, 2010), **Arjan de Jong** (TUD) (May 3, 2010), **Maria Mos** (UvT) (May 12, 2010), **Gert Kootstra** (RUG) (May 17, 2010), **Ivo Swartjes** (UT) (May 19, 2010), **Zulfiqar Ali Memon** (VU) (May 25, 2010), **Arne Koopman** (UU) (May 31, 2010), **Marten Voulon** (UL) (June 3, 2010), **Harold van Heerde** (UT) (June 4, 2010), **Dmytro Tykhonov** (TUD) (June 7, 2010), **John Borking** (UL) (June 9, 2010), **Lianne Bodenstaff**

(UT) (June 17, 2010), **Lineke Sneller** (Nyenrode Business Universiteit) (June 18, 2010), **Stratos Idreos** (UvA) (June 18, 2010), **Marieke van Erp** (UvT) (June 30, 2010), **Edwin Commandeur** (UvT) (June 30, 2010), **Robin Aly** (UT) (July 2, 2010), **Ying Zhang** (CWI) (July 8, 2010), **Dolf Trieschnigg** (UT) (September 1, 2010), **Marcel Hiel** (UvT) (September 7, 2010), **Teduh Dirgahayu** (UT) (September 10, 2010), **Jelmer van Ast** (TUD) (September 14, 2010), **Jose Janssen** (OU) (September 17, 2010), **C.M. van der Zant** (RUG) (September 24, 2010), **Dirk Fahland** (TU/e) (September 27, 2010), **Niels Lohmann** (TUE) (September 27, 2010), **Ghazanfar Farooq Siddiqui** (VU) (September 28, 2010), **Victor de Boer** (UvA) (September 30, 2010), **Guillaume Chaslot** (UM) (September 30, 2010), **Mark van Assem** (VU) (October 1, 2010), **Vasilios Andrikopoulos** (UvT) (October 1, 2010), **Peter van Kranenburg** (UU) (October 4, 2010), **Ralph Niels** (RUG) (October 4, 2010), **Mark van Staalduinen** (TUD) (October 7, 2010), **Pieter Bellekens** (TU/e) (October 7, 2010), **Matthijs Amelink** (TUD) (October 18, 2010), **Maria Niessen** (RUG) (October 22, 2010), **Sybren de Kinderen** (VUA) (October 25, 2010), **Alin Gavril Chitu** (TUD) (November 2, 2010), **Marcel Heerink** (UvA) (November 3, 2010), **B. Thomee** (UL) (November 4, 20101), **Milan Lovric** (EUR) (November 5, 2010), **Siska Fitrianie** (TUD) (November 8, 2010), **Chen Li** (UT) (November 11, 2010), **J.S. de Bruin** (UL) (November 23, 20101), **Riham Abdel Kader** (November 25, 2010), **Bouke Huurnink** (UvA) (November 26, 2010), **Alia Khairia Amin** (CWI) (December 8, 2010), **Peter-Paul van Maanen** (VU) (December 9, 2010), **Edgar Meij** (UvA) (December 10, 2010), **Jahn-Takeshi Saito** (UM) (December 15, 2010), **Vincent Pijpers** (VU) (December 17, 2010), **R. Beukelaar** (LU) (December 21, 2010).

SIKS PROMOVENDI 2010

2010-01. **Matthijs van Leeuwen** (UU) February 9, 2010. *Patterns that Matter*. Promotor: Prof.dr. A.P.J.M. Siebes (UU).

2010-02. **Ingo Wassink** (UT) January 14, 2010. *Work Flows in Life Science.* Promotor: Prof.dr. ir. A. Nijholt (UT), Prof.dr. G.C. van der Veer (OU). Co-promotor: Dr. P. van der Vet (UT).

2010-03. **Joost Geurts** (CWI) February 3, 2010. *A Document Engineering Model and Processing Framework for Multimedia Documents*. Promotor: Prof.dr. L. Hardman (CWI/TU/e). Co-promotor: Dr. J. van Ossenbruggen (CWI).

2010-04. **Olga Kulyk** (UT) January 14, 2010. *Do You Know What I Know? Situational awareness of co-located teams in multidisplay environments.* Promotores: Prof.dr.ir. A. Nijholt (UT), Prof.dr. G.C. van der Veer (OU). Co-promotor: Dr. E.M.A.G. van Dijk (UT).

2010-05. **Claudia Hauff** (UT) January 29, 2010. *Predicting the Effectiveness of Queries and Retrieval Systems*. Promotor: Prof.dr. F.M.G. de Jong (UT). Co-promotor: Dr.ir. D. Hiemstra (UT).

2010-06. **Sander Bakkes** (UvT) March 3, 2010. *Rapid Adaptation of Video Game AI*. Promotor: Prof.dr. H.J. van den Herik (UvT). Co-promotor: Dr.ir. P.H.M. Spronck (UvT).

2010-07. **Wim Fikkert** (UT) March 11, 2010. *Gesture Interaction at a Distance.* Promotores: Prof.dr.ir. A. Nijholt (UT), Prof.dr. G.C. van der Veer (OU). Co-promotor: Dr. P. van der Vet (UT).

2010-08. **Krzysztof Siewicz** (UL) April 20, 2010. *Towards an Improved Regulatory Framework of Free Software. Protecting user freedoms in a world of software communities and eGovernments.* Promotores: Prof.dr. H.J. van den Herik (UvT/UL), Prof.mr. A.H.J. Schmidt (UL).

2010-09. **Hugo Kielman** (UL) April 14, 2010. *Politiële Gegevensverwerking en Privacy, Naar een effectieve waarborging.* Promotores: Prof.dr. H.J. van den Herik (UvT/UL), Prof.mr. A.H.J. Schmidt (UL). Co-promotor: Mr.dr. L. Mommers (UL).

2010-10. **Rebecca Ong** (UL) April 22, 2010. *Mobile Communication and Protection of Children.* Promotor: Prof.dr. H.J. van den Herik (UvT/UL). Co-promotor: Mr.dr. B. Schermer.

2010-11. **Adriaan Ter Mors** (TUD) March 15, 2010. *The World according to MARP: Multi-agent route planning.* Promotor: Prof.dr. C. Witteveen (TUD). Co-promotor: Dr.ir. F.A. Kuipers (TUD).

2010-12. **Susan van den Braak** (UU) March 15, 2010. *Sensemaking Software for Crime Analysis.* Promotores: Prof.dr. J.-J.Ch. Meyer (UU), Prof.dr.mr. H. Prakken (UU/RUG). Co-promotores: Dr. H. van Oostendorp (UU), Dr. G.A.W. Vreeswijk (UU).

2010-13. **Gianluigi Folino** (RUN) March 22, 2010. *High Performance Data Mining using Bio-inspired Techniques.* Promotor: Prof.dr. T.M. Heskes (RUN). Co-promotor: Dr. E. Marchiori (RUN).

2010-14. **Sander van Splunter** (VU) March 29, 2010. *Automated Web Service Reconfiguration.* Promotor: Prof.dr. F.M.T. Brazier (TUD). Co-promotor: Dr. P.H.G. van Langen (TUD).

2010-15. **Lianne Bodenstaff** (UT) June 17, 2010. *Managing Dependency Relations in Inter-Organizational Models*. Promotores: Prof.dr. R.J. Wieringa (UT), Prof.dr. M. Reichert (University of Ulm).

2010-16. **Sicco Verwer** (TUD) March 2, 2010. *Efficient Identification of Timed Automata: theory and practice*. Promotor: Prof.dr. C. Witteveen (TUD). Co-promotor: Dr. M. de Weerdt (TUD).

2010-17. **Spyros Kotoulas** (VU) March 24, 2010. *Scalable Discovery of Networked Resources: Algorithms, infrastructure, applications*. Promotor: Prof.dr. F. van Harmelen (VU). Co-promotor: Dr. R. Siebes (VU).

2010-18. **Charlotte Gerritsen** (VU) April 12, 2010. *Caught in the Act: Investigating crime by agent-based simulation.* Promotor: Prof.dr. J. Treur (VU). Co-promotor: Dr. M.C.A. Klein (VU).

2010-19. **Henriette Cramer** (UvA) April 23, 2010. *People's Responses to Autonomous and Adaptive Systems.* Promotor: Prof.dr. B.J. Wielinga (UvA). Co-promotor: Dr. V. Evers (UvA).

2010-20. **Ivo Swartjes** (UT) May 19, 2010. *Whose Story Is It Anyway? How Improv Informs Agency and Authorship of Emergent Narrative*. Promotor: Prof.dr.ir. A. Nijholt (UT). Co-promotor: Dr. M. Theune (UT).

2010-21. **Harold van Heerde** (UT) June 4, 2010. *Privacy-aware Data Management by means of Data Degradation.* Promotores: Prof.dr. P.G.M. Apers (UT), Prof.dr. P. Pucheral (University of Versailles Saint-Quentin). Co-promotor: Dr. M. Fokkinga (UT).

2010-22. **Michiel Hildebrand** (UvA) April 20, 2010. *End-user Support for Access to Heterogeneous Linked Data*. Promotores: Prof. dr. L. Hardman (CWI/UvA), Prof.dr. A.Th. Schreiber (VU). Co-promotor: dr. J.R. van Ossenbruggen (CWI).

2010-23. **Bas Steunebrink** (UU) April 27, 2010. *The Logical Structure of Emotions*. Promotor: Prof.dr. J.-J.Ch. Meyer (UU). Co-promotor: Dr. M.M. Dastani (UU).

2010-24. **Dmytro Tykhonov** (TUD) June 7, 2010. *Designing Generic and Efficient Negotiation Strategies*. Promotor: Prof.dr. C.M. Jonker (TUD). Co-promotor: Dr. K. Hindriks (TUD).

2010-25. **Zulfiqar Ali Memon** (VU) May 25, 2010. *Modelling Human-Awareness for Ambient Agents: A human mindreading perspective*. Promotor: Prof.dr. J. Treur (VU). Co-promotor: Dr. T. Bosse (VU).

2010-26. **Ying Zhang** (UvA) July 8, 2010. *XRPC: Efficient Distributed Query Processing on Heterogeneous XQuery Engines.* Promotores: Prof.dr. M.L. Kersten (CWI/UvA). Co-promotor: Dr. P. Boncz (CWI).

2010-27. **Marten Voulon** (UL) June 3, 2010. *Automatisch Contracteren*. Promotores: Prof. mr. H. Franken (UL), Prof.dr. H.J. van den Herik (UvT/UL).

2010-28. **Arne Koopman** (UU) May 31, 2010. *Characteristic Relational Patterns.* Promotor: Prof.dr. A.P.J.M. Siebes (UU).

2010-29. **Stratos Idreos** (UvA) June 24, 2010. *Database Cracking: Towards auto-tuning database kernels.* Promotor: Prof.dr. M.L. Kersten (CWI/UvA). Co-promotor: Dr. S. Manegold (CWI).

2010-30. **Marieke van Erp** (UvT) June 30, 2010. *Accessing Natural History – Discoveries in data cleaning, structuring, and retrieval.* Promotor: Prof.dr. A.P.J. van den Bosch (UvT). Co-promotor: Dr. P. K. Lendvai (UvT).

2010-31. **Victor de Boer** (UvA) September 30, 2010. *Ontology Enrichment from Heterogeneous Sources on the Web.* Promotor: Prof.dr. B.J. Wielinga (UvA). Co-promotor: Dr. M. van Someren (UVA).

2010-32. **Marcel Hiel** (UvT) September 7, 2010. *An Adaptive Service Oriented Architecture: Automatically solving interoperability problems.* Promotor: Prof.dr. W.J.A.M van den Heuvel (UvT). Co-promotor: Dr. H. Weigand (UvT).

2010-33. **Robin Aly** (UT) July 2. 2010. *Modeling Representation Uncertainty in Concept-Based Multimedia Retrieval.* Promotores: Prof.dr. P.G.M. Apers (UT), Prof.dr. F.M.G. de Jong (UT). Co-promotor: Dr.ir. D. Hiemstra (UT).

2010-34. **Teduh Dirgahayu** (UT) September 10, 2010. *Interaction Design in Service Compositions*. Promotor: Prof.dr.ir. C.A. Vissers (UT). Co-promotor: Dr. M. van Sinderen (UT).

2010-35. **Dolf Trieschnigg** (UT) September 1, 2010. *Proof of Concept: Concept-based biomedical information retrieval.* Promotores: Prof.dr. F.M.G. de Jong (UT), Prof.dr.ir. W. Kraaij (RUN).

2010-36. **Jose Janssen** (OU) September 17, 2010. *Paving the Way for Lifelong Learning; Facilitating competence development through a learning path specification*. Promotor: Prof.dr. E.J.R. Koper (OU). Co-promotor: Dr. A. Berlanga (OU).

2010-37. **Niels Lohmann** (TU/e) September 27, 2010. *Correctness of Services and their Composition.* Promotores: Prof.dr. W.M.P. van der Aalst (TU/e), Prof.dr. K. Wolf (University of Rostock). Co-promotor: Dr. N. Sidorova (TU/e).

2010-38. **Dirk Fahland** (TU/e) September 27, 2010. *From Scenarios to Components*. Promotores: Prof.dr. W.M.P. van der Aalst (TU/e), Prof.dr. W. Reisig (Humboldt University Berlin). Co-promotor: Prof.dr. K. Wolf (University of Rostock).

2010-39. **Ghazanfar Farooq Siddiqui** (VU) September 28, 2010. *Integrative Modeling of Emotions in Virtual Agents.* Promotor: Prof.dr. J. Treur (VU). Co-promotores: Dr. T. Bosse (VU), Dr. J.F. Hoorn (VU).

2010-40. **Mark van Assem** (VU) October 1, 2010. *Converting and Integrating Vocabularies for the Semantic Web*. Promotor: prof.dr. A.Th. Schreiber (VU). Co-promotor: dr. J.R. van Ossenbruggen (CWI/VU).

2010-41. **Guillaume Chaslot** (UM) September 30, 2010. *Monte-Carlo Tree Search*. Promotor: Prof.dr. G. Weiss (UM). Co-promotores: Dr.ir. J.W.H.M. Uiterwijk (UM), Dr. M.H.M. Winands (UM), Dr. B. Bouzy (Univ Paris Descartes).

2010-42. **Sybren de Kinderen** (VU) October 25, 2010. *Needs-driven Service Bundling in a Multi-supplier Setting - the computational e3-service approach*. Promotor: Prof.dr. J.M Akkermans (VU). Co-promotor: Dr. J. Gordijn (VU).

2010-43. **Peter van Kranenburg** (UU) October 4, 2010. *A Computational Approach to Content-Based Retrieval of Folk Song Melodies*. Promotores: Prof.dr. R.C. Veltkamp (UU), Prof.dr. L.P. Grijp (UU, Meertens Instituut). Co-promotor: Dr. F. Wiering (UU).

2010-44. **Pieter Bellekens** (TU/e) October 7, 2010. *An Approach towards Context-sensitive and User-adapted Access to Heterogeneous Data Sources, Illustrated in the Television Domain*. Promotores: Prof.dr. P.M.E. De Bra (TUE), Prof.dr.ir. G.J.P.M Houben (TUD). Co-promotor: Dr. L.M. Aroyo (VU).

2010-45. **Vasilios Andrikopoulos** (UvT) October 1, 2010. *A Theory and Model for the Evolution of Software Services*. Promotor: Prof.dr. M. Papazoglou (UvT).

2010-46. **Vincent Pijpers** (VU) December 17, 2010. *e3alignment: Exploring Inter-Organizational Business-ICT Alignment*. Promotor: Prof.dr. J.M. Akkermans (VU). Co-promotor: Dr. J. Gordijn (VU).

2010-47. **Chen Li** (UT) November 11, 2010. *Mining Process Model Variants: Challenges, Techniques, Examples*. Promotor: Prof.dr. R.J. Wieringa (UT). Co-promotor: Dr. A. Wombacher (UT).

2010-48. Withdrawn

2010-49. **Jahn-Takeshi Saito** (UM) December 15, 2010. *Solving Difficult Game Positions*. Promotor: Prof.dr. G. Weiss (UM). Co-promotores: Dr.ir. J.W.H.M. Uiterwijk (UM), Dr. M.H.M. Winands (UM).

2010-50. **Bouke Huurnink** (UVA) November 26, 2010. *Search in Audiovisual Broadcast Archives.* Promotores: Prof.dr. M. de Rijke (UvA), Prof.dr.ir A.W.M. Smeulders (UvA).

2010-51. **Alia Khairia Amin** (CWI) December 8, 2010. *Understanding and Supporting Information Seeking Tasks in Multiple Sources*. Promotor: Prof.dr. L. Hardman (CWI/UvA). Co-promotor: Dr. J. van Ossenbruggen (VU/CWI).

2010-52. **Peter-Paul van Maanen** (VU) December 9, 2010. *Adaptive Support for Human-Computer Teams: Exploring the use of cognitive models of trust and attention.* Promotor: Prof.dr. J. Treur (VU). Co-promotor: Dr. T. Bosse (VU).

2010-53. **Edgar Meij** (UVA) December 10, 2010. *Combining Concepts and Language Models for Information Access*. Promotor: Prof.dr. M. de Rijke (UvA)

NEW ANNOUNCEMENTS 2010

Below we add one announcement to our list of new announcements 2010. The first one is a SIKS Ph.D. defence. This escaped our attention. The actual list starts at November 25 and continues to December 21 (7 defences). The list of new announcements for 2011 will be published next year.

Riham Abdel Kader (UT) (November 25, 2010). *ROX: Run-Tome Optimization of XQueries.* University of Twente. Promotor: Prof.dr. P.M.G. Apers. Co-promotor: Dr.ir. M. van Keulen.

Alia Khairia Amin (UvA) (December 8, 2010). *Understanding and Supporting Information Seeking Tasks in Multiple Sources***.** University of Amsterdam. Promotor: Prof.dr. L. Hardman (CWI/UvA). Co-promotor: Dr. J.R. van Ossenbruggen (VU/CWI).

Peter-Paul van Maanen (VU) (December 9, 2010). *Adaptive Support for Human-Computer Teams: Exploring the use of cognitive models of trust and attention.* Vrije Universiteit Amsterdam. Promotor: Prof.dr. J. Treur (VU). Co-promotor: Dr. T. Bosse (VU).

Edgar Meij (UvA) (December 10, 2010). *Combining Concepts and Language Models for Information Access.* University of Amsterdam. Promotor: Prof.dr. M. de Rijke (UvA).

Jahn-Takeshi Saito (UM) (December 15, 2010). *Solving Difficult Game Positions.* Maastricht University. Promotor: Prof.dr. G. Weiss (UM). Co-promotores: Dr.ir. J.W.H.M. Uiterwijk (UM), Dr. M.H.M. Winands (UM).

Vincent Pijpers (VU) (December 17, 2010). *e3alignment: Exploring Inter-Organizational Business-ICT Alignment.* Vrije Universiteit

Amsterdam. Promotor: Prof.dr. J.M. Akkermans (VU). Co-promotor: Dr. J. Gordijn (VU).

R. Beukelaar (LU) (December 21, 2010). *Interaction and Evolutionary Algorithms*. Leiden University. Promotores: Prof.dr. T.H.W. Bäck (UL), Prof.dr. J.N. Kok (UL).

THE NBIC LIST

As a sequel to last year's contribution, we again have the pleasure to offer you the NBIC Ph.D. thesis list. Owing to organisational matters, the list is not complete. Yet, as a service to our readers, we offer you an incomplete list. Here we see the integration of the NBIC theses since all three theses are also listed in the successful Ph.D. defenders list 2010.

THE NBIC LIST 2010

Ingo Wassink (January 14, 2010), **Olga Kulyk** (January 14, 2010), **Martin Oti** (April 23, 2010).

INAUGURAL ADDRESS

With much pleasure we announce the following inaugural address.

Dr. R. Babuska (January 14, 2011). *Title to be announced.* Delft University of Technology.

Section Editor
Richard Starmans

Advanced SIKS-Course on "Agent-Based Simulation"

INTRODUCTION

On February 21 and 22, 2011, the School for Information and Knowledge Systems (SIKS) will organize an advanced course on "Agent-Based Simulation". 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.

Agent-Based Modelling and Simulation (ABMS) focuses on the study of the actions and interactions of autonomous agents (both individual or collective entities such as organizations or groups) with a view to assessing their effects on the system as a whole. It combines elements of game theory, complex systems, emergence, computational sociology, multi-agent systems, and evolutionary programming.

The models simulate the simultaneous operations and interactions of multiple agents, in an attempt to re-create and predict the appearance of complex phenomena. The process is one of emergence from the lower (micro) level of systems to a higher (macro) level. Central to ABM is the idea that (simple) behavioural rules generate complex behaviour, but also that the whole is greater than the sum of the parts. Most agent-based models are composed of:

(1) numerous agents;
(2) decision-making heuristics;
(3) learning rules or adaptive processes;
(4) an interaction topology; and
(5) a non-agent environment.

Individual agents are typically characterized as bounded rational, presumed to be acting in what they perceive as their own interests, such as reproduction, economic benefit, or social status using their own decision-making rules. The environment specifies constraints and rules for interaction, at physical, social and cultural-normative level.

Social simulation is a research field that applies agent-based computational models to the study of social phenomena, such as the emergence of social norms, the segregation of ethnic groups in urban cities and the formation of collective opinion. It aims to help (social) scientists to understand and explain complex social phenomena by looking at agent interaction in given social structures.

This course is appropriate for researchers who would like to apply ABMS for their research into complex social systems.

Location: Conference Center Woudschoten, Zeist
Date: February 21-22, 2011
Scientific directors: Dr. Virginia Dignum (TUD), Dr. Frank Dignum (UU)

PROVISIONARY PROGRAM

February 21

9:00 – 9:30	Coffee and introduction
9:30 – 11:30	Introduction in social simulation
11:30 – 13:00	Introduction in agent-based social simulation
13:00 – 14:00	Lunch
14:00 – 15:00	Exercises
15:00 – 15:30	Coffee/tea
15:30 – 17:00	Agents for social simulation

February 22

9:00 – 9:30	Introduction to applications
9:30 – 10:30	Firefighting teams
10:30 – 11:00	Coffee
11:00 – 12:00	STRO
12:00 – 13:00	Policy making
13:00 – 14:00	Lunch
14:00 – 15:00	Large simulations
15:00 – 16:00	Economics
16:00 – 17:00	Future directions

More details on the program will be provided shortly.

REGISTRATION

More details on registration will be made available soon.

ANNOUNCEMENTS

Call for Papers

ECAL 2011

Back to the origins of Alife

ECAL 2011, European Conference on Artificial Life, an international conference on the simulation and synthesis of living systems

August 8-12, 2011, Paris, France
www.ecal11.org

Artificial Life is an interdisciplinary undertaking that investigates the fundamental properties of living systems through the simulation and synthesis of biological entities and processes. It also attempts to design and build artificial systems that display properties of organisms, or societies of organisms, out of abiotic or virtual parts.

ECAL, the European Conference on Artificial Life, is a biennial event that alternates with the US-based Alife conference series.

In the early 1990's, the first two ECAL conferences in Paris and Brussels were mainly centred on theoretical biology and the physics of complex systems. Today, we feel that Alife can look back on these origins and take more inspiration from new developments at the intersection between computer science and theoretical biology – thus it is our wish to refocus the conference on complex biological systems. Closing a loop, this ECAL will mark the 20th anniversary of the 1st ECAL and will be framed as a tribute to the late Francisco Varela, co-organizer in 1991 with two of this year's committee members (Paul Bourgine and Hugues Bersini).

You are invited to submit papers to this exciting event! (Please forward this call responsibly.)

IMPORTANT DATES

- Paper and abstract submission: April 6, 2011
- Paper and abstract notification: June 10, 2011
- Camera ready papers: July 1, 2011
- Early registration: June 10, 2011
- End of registration: July 31, 2011

THEMES

A new body of disciplines: Over the past two decades, biological knowledge has grown at an unprecedented rate, giving rise to new disciplines such as systems biology – testimony of the striking progress of modelling and quantitative methods across the field. During the same period, highly speculative ideas have matured, and entire conferences and journals are now devoted to them. Synthesizing artificial cells, simulating large-scale biological networks, storing and making intelligent use of an exponentially growing amount of data (e.g., microarrays), exploiting biological substrates for computation and control, and deploying bio-inspired engineering are all cutting-edge topics today.

ECAL 2011 will leverage the remarkable development of biological modelling and extend the topics of Artificial Life to the fundamental properties of living organisms: their multiscale pattern-forming morphodynamics, their autopoiesis, robustness, capacity to self-repair, cognitive capacities, and co-adaptation at all levels, including ecological ones. ECAL 2011 will bring together a large interdisciplinary community of biologists, computer scientists, physicists, and mathematicians. It will invite them to reflect on how traditional boundaries between disciplines have become blurred, and to revisit in depth what constitutes "life".

Papers are welcome in all areas of the field, including:

- Artificial Chemistries
- Biological & Chemical Information Processing and Production
- Complex Networks
- Emergent Engineering
- Evolutionary and Learning Dynamics
- Minimal Cognition and Physical Intelligence
- Minimal (Bottom up) Synthetic Cells
- Mixed Living (Technology) Systems
- Modular Robotics
- Multilevel Ecologies
- Organizations & Collective Intelligence
- Origins of Life
- Protocellular Energetics & Metabolic Networks
- Philosophy of Artificial Life & Living Technology
- Robotic Energy Autonomy
- Robotic Self-Assembly
- (Chemical) Self-Assembly & Complexity
- Socio-Technical Systems
- Systems Biology
- Swarm Intelligence
- Theoretical and Computational Frameworks
- Top Down Artificial Cells

All authors are encouraged to explain how their work sheds light on the fundamental properties of living systems and makes progress on the important open questions identified during previous meetings.

PAPER/ABSTRACT FORMAT

There are two options for submission: either full-paper format or abstract format.

1. Full papers have an 8-page maximum length, which should report on new, unpublished work.
2. Abstracts are limited to 2 pages and should discuss work previously published in a journal. It is therefore essential that a reference to the previously published article is cited.

All submissions will be subject to peer review, and all accepted submissions will be allocated either an oral presentation slot or a poster slot with no distinction being made between the two submission formats.

All formatting guidelines (including Word and LaTeX style files) and submission instructions will be available on the conference website within the next few weeks at http://www.ecal11.org/call-for-papers.

PUBLICATION

Every accepted full-paper and abstract submission will be published by MIT Press in a single online open-access proceedings volume.

The top 10 accepted publications will have the opportunity to publish a revised and expanded version of their conference paper in the *Artificial Life* journal.

LOCATION

The conference will be held at the Cité Internationale Universitaire de Paris (CIUP), located on a wooded park at the southern edge of the French capital. See more information at http://www.ecal11.org/venue. Registration information will be posted soon at http://www.ecal11.org/registration.

ORGANIZATION

- René Doursat, Chair
- Hugues Bersini
- Paul Bourgine
- Mario Giacobini & Tom Lenaerts, Program Chairs
- Marco Dorigo

CONTACT

For further information about the conference program and travel arrangements, please see the website, http://www.ecal11.org. For questions about the submission, reviewing process and other issues, email to: contact@ecal11.org.

HOW TO SUBSCRIBE

The BNVKI-AIABN Newsletter is a direct benefit of membership of the BNVKI-AIABN: Benelux Association for Artificial Intelligence. Membership dues are € 40 for regular members; € 25 for doctoral students (AIO's); and € 20 for students. In addition, members will receive access to the electronic version of the European journal *AI Communications*. The Newsletter appears bimonthly and contains information about conferences, research projects, job opportunities, funding opportunities, etc., provided enough information is supplied. Therefore, all members are encouraged to send news and items they consider worthwhile to the editorial office of the BNVKI/AIABN Newsletter. Subscription is done by payment of the membership due to Postbank no. 3102697 in The Netherlands (IBAN: NL 74 PSTB 0003 1026 97; BIC: PSTBNL21). Specify *BNVKI/AIABN* as the recipient, and please do not forget to mention your name and address. Sending of the BNVKI/AIABN Newsletter will only commence after your payment has been received. If you wish to conclude your membership, please send a written notification to the editorial office before December 1, 2011.

COPY

The editorial board welcomes product announcements, book reviews, product reviews, overviews of AI education, AI research in business, and interviews. Contributions stating controversial opinions or otherwise stimulating discussions are highly encouraged. Please send your submission by E-mail (MS Word or text) to newsletter@maastrichtuniversity.nl.

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