Volume One
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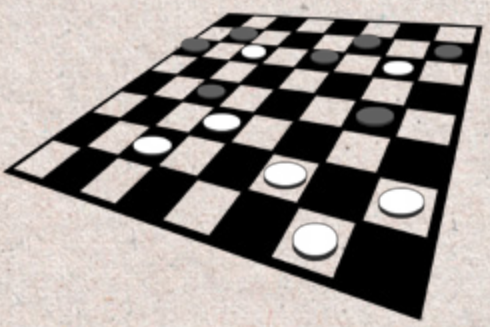
Newsletter

ON THE COLLABORATION OF IIIM & CADIA

INTERVIEW WITH YNGVI BJÖRNSSON

Dr. Yngvi Björnsson is the co-director of Reykjavik University's artificial intelligence lab; the Center for Analysis & Design of Intelligent Agents. A world renowned expert in artificial intelligence techniques for search algorithms, machine learning and AI applied to computer games. His general-game playing (GGP) AI system won the GGP World Championship two consecutive years and recently led to the creation of a startup company. He was a member of the University of Alberta, Canada team that solved the game of checkers in 2007, an achievement that was listed as one of the Year's Top 10 Most Important Scientific Achievements by Science Magazine.

Website link:
ru.is/faculty/yngvi



As a leading figure in the collaboration of IIIM & CADIA, we were curious to hear his thoughts on the partnership's most important aspects.

What do you consider the most important role of IIIM?

The most important role of IIIM is to bridge the industry-academia gap. Too often academic research ends in dusty drawers, despite its great potential to improve the competitiveness of the industry. There are several reasons for this, such as funding running out prematurely, discontinuity because students come and go, or simply limited interest in or knowledge of practical applications on the academic side. The successful commercialization of technology resulting from research takes a lot of work and requires additional skills. IIIM provides a channel, or bridge, that can enrich both academia and industry by arranging collaboration that will strengthen both parties' capacity to innovate and excel.

What of the importance of CADIA's collaboration with IIIM?

Again, bridging the gap between industry and academia. We already have a concrete example of an ongoing project that fits this profile. Research done at CADIA in collaboration with a world-leading game-development company was passed on to IIIM for further development and commercialization. This channel's availability was invaluable for CADIA. I am hopeful that this project will become a showcase example of the difference an institute like IIIM can make, both for academia and industry.

Your research in AI has led to the creation of a startup company. What can you tell us about that?

We are at the forefront of research when it comes to general game-playing systems. That is, software that skillfully learns to play different kind of board games without any human supervision. This technology opens up many new possibilities in the fast-growing casual games market; for example, it can assist technically unskilled people to effortlessly design and develop their own games. But because of the game market's highly dynamic, complex and fast moving nature, it is too early to say how this will eventually develop. I have also worked with non-gaming start-up companies to successfully enhance their products and services using state-of-the-art artificial-intelligence technology.

IIIM COSPONSORS INTERNATIONAL CONFERENCE ON INTELLIGENT VIRTUAL AGENTS

After attending many international events, IIIM got a chance to take part in the 2011 International Conference on Intelligent Virtual Agents (IVA), which featured the special topic *"Language and culture"*, at Reykjavik University from September 15 – 17. IIIM was an official sponsor of the conference with Managing Director Kristinn R. Thórisson and Associate Director Stacy Marcella taking the lead as conference chairs.

IVA is an annual interdisciplinary conference widely recognized as the main forum for presenting research on modeling, developing, and evaluating intelligent virtual agents with a focus on communicative abilities and social behavior. Presentations focus on theoretical issues, while participants are offered a venue to showcase practical working applications. Researchers from the fields of human-human and human-robot interaction are encouraged to share work relevant to intelligent virtual agents, giving a broader perspective on current applications.

Website link:
iva2011.ru.is

SIMULATING MODERN BANKING SYSTEMS & ECONOMIC THEORY

Dr. Jacky Mallett graduated from MIT in 2005. She has over 2 decades of industry experience, designing, building and troubleshooting Distributed Systems, with extensive experience in real-time critical systems, high performance computing, signal processing, and wide area networking. She returned to University and completed her Ph.D. at the MIT Media Lab in 2005 with work on the problem of coordinating large groups of autonomous cameras in real time. She became interested in the banking system during the 2007 credit crisis, and is currently working on building simulations of Basel Regulated Banking frameworks, with the goal of integrating an Economic and Distributed Systems understanding of their behavior, and their influence on macro-economic stability.

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Economics has always faced the problem that it is an observational activity, and that it is difficult if not impossible to run practical large scale experiments to support its theories. We cannot simply raise US interest rates from 5 - 10% to test what would happen to industrial output. But if we can't run this kind of experiment, what basis do we have for claims that low interest rates stimulate the economy? After all, in the USA low interest rates only stimulate the demand for new loans, if the loan supply is already at its maximum, then there may not be any affect at all on the number of loans being made.

Experimental models provide the answer to this question, and a number of complicated economic models exist. However, the models currently used in economics are strictly mathematical representations built from existing economic theories. These theoretical models do not even attempt to imitate real conditions in the way that engineers build scaled down copies of bridge or engine designs seek to explore the behavior of a larger system. Rather, today's economic models are complex mathematical representations of economic theory, theory never tested or proven correct in the real world.

Our approach is to try and build simulations of part or all of the real economy, and see how the result compares both with economic theory and statistics from the real world. Last year we built a simulation of the textbook banking system, which immediately demonstrated that the description of the banking system found in Economic Textbooks couldn't work as described. It also demonstrated some interesting features, including cyclical behavior in the money and loan supply that was purely a result of the mechanical operation of the system.

Building on that we are now working on a simulation that should be much closer to the mechanisms used by today's banks. The design of this simulation is currently under peer review from within the banking and accounting professions to ensure that it is correct. The next step is to start building a very simple economic system that we're calling the *"village economy"*. This will allow us to explore how the money supply interacts with the price level in a world without bank lending, and eventually introduce a banking system to see what difference it makes. We're particularly interested in testing the fundamental monetary theorems used in macro-economics, and a set of models widely used by the Central Banks called *"General Equilibrium Theory"*. The kind of feedback systems we see in the economy very rarely demonstrate 'equilibrium' when they're used in other areas of science and engineering, so we're curious to see why economic theory makes this claim.

NEW MEMBERS JOIN BOARD OF DIRECTORS

IIIM's Annual Board meeting in Spring 2011 anticipated a shift in members, ushering in fresh faces to the Board of Directors to begin a new three-year term (2011-2013). Each highly qualified member will provide valuable input to guide the organization's direction, using their knowledge and experience to further the goals of IIIM.

Current Board of Directors: From the left - Bala Kamallakharan (reserve board member), Thórunn Sigfúsdóttir, Sigrídur Ólafsdóttir, Hlynur Halldórsson, Gísli Hjálmtýsson, Kristinn R. Thorisson

ON FOUR FUNDAMENTAL QUESTIONS ABOUT AI: AN EXPERT'S THOUGHTS

Dr. Pei Wang is an Associate Professor at Temple University. He received his Ph.D. in Computer Science and Cognitive Science from Indiana University, and his M.S. and B.S. in Computer Science from Peking University. His main research project is NARS (Non-Axiomatic Reasoning System), a general-purpose reasoning system. Dr. Wang is the Co-Chair of the Program Committee of the First Conference on Artificial General Intelligence, and the Chief Executive Editor of the Journal of Artificial General Intelligence.

Website link:
cis.temple.edu/~wangp

IIIM's Featured Article section, reserved for distinguished associates or affiliates of the Institute, presents Dr. Wang's thoughts on four key questions regarding artificial intelligence (AI):

1. **What is AI?**
2. **Can AI be built?**
3. **How do we build AI?**
4. **Should AI be built?**

When answering these questions, Dr. Wang thinks the order they are put in must be answered first:

> *"These four questions will be discussed in the given order, because the answer to the "What" question strongly influences the answers of the other questions. So, this must be addressed first. After that, if the answer to the "Can" question is negative, it makes little sense to talk about the "How" and "Should" questions. Finally, if nobody knows how to achieve this goal, we do not need to worry about whether it is a good idea to actually create AI."*

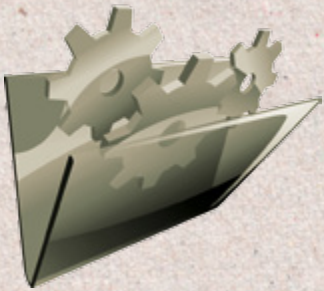
Once put in order, Dr. Wang can express his ideas, concerns, criticism, and personal thoughts regarding these diverse issues.

What is AI?

> *"AI is computer systems that can adapt to the environment and work with insufficient knowledge and resources."*

Building upon the general idea that artificial intelligence aims to mimic human intelligence as precisely as possible, he notes that it is impossible for a computer to be identical to a human being in all aspects. This means that an intelligent system must focus on certain aspects, while treating others as secondary or irrelevant.

Dr. Wang likes to think of what intelligence means in terms of replicating its function; "To me "intelligence" refers to the ability of adapting to the environment while working with insufficient knowledge and resources, which means that an intelligent system should rely on finite processing capacity, work in real time, remain open to unexpected tasks, and learn from experience."



Can AI be built?

> *"Yes, since the above definition does not require anything impossible. The previous failures are mainly due to misconceptions."*

Various proofs have proposed the impossibility of building systems that rival human intelligence. One of the more prominent ones, Turning's "Lady Lovelace's Objection", is summed up by Dr. Wang: "Intelligence requires originality, creativity, and autonomy, but computers can only act according to predetermined programs, therefore computers cannot have intelligence."

However, this relies entirely on the assumption that computer programs can only provide answers that are explicitly provided by the programmer. While computer systems often work this way, providing only a single, pre-programmed answer to any stimulus or problem, we know for a fact that they do not have to be confined to this function. This fact is made more obvious by Dr. Wang's counterpoint:

> *"[…] When saying that computer's actions are "programmed", it is about the low-level activities of the system. The fact that the system's low-level activities are predetermined by various programs does not necessarily mean that its behaviors when solving a problem always follow a fixed procedure."*

How do we build AI?

> *"The most likely way is to design a reasoning system in a non-axiomatic manner, in which validity means adaptation under knowledge-resource restriction."*

In Dr. Wang's opinion, human-level AIs can, and should, be built using a unified approach: "To start with a core system built with a single technique, and then to add optional tools built with auxiliary techniques." He continues, noting that a unified AI system should also be a reasoning system, by mentioning his own system as proof-of-concept-the Non-Axiomatic Reasoning System (NARS). Here he explains some of the reasons for this:

> *"The major difficulty in building an intelligent reasoning system is that the study of reasoning systems is dominated by mathematical logic, where the systems are designed to be axiomatic, meaning that they start with a set of axioms that are supposed to be true, then use truth-preserving rules to derive true conclusions, without considering the resource expense."*

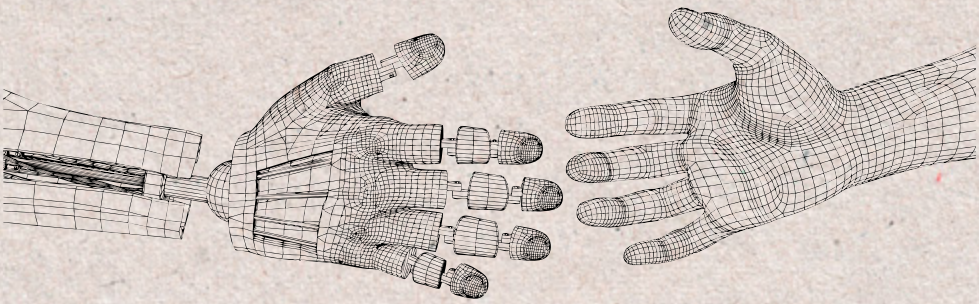
Should AI be built?

Many arguments against building AI exist; a popular one is the fear of such systems becoming too powerful and/or turning against the human race. Dr. Wang remains conservative in his answers to this argument because he considers confining systems' abilities to certain rules or laws is essentially impossible:

> *"Here the difficulty comes from the fact that for a sufficiently complicated intelligent system, it is practically impossible to fully control its experience. Or, put in another way, if a system's experience can be fully controlled, its behavior will be fully predictable, however, such a system cannot be fully intelligent.*
> *Due to insufficient knowledge and resources, the derived goals of an intelligent system are not always consistent with their origins. Similarly, the system cannot fully anticipate all consequences of its actions, so even if its goal is benign, the actual consequence may still turn out to be harmful, to the surprise of the system itself."*

Dr. Wang concludes with a concise answer to the question of whether AI should be built:

> *"Yes, since AI has great potential in many applications, though we need to be careful all the time to avoid its misuse or abuse."*



Find full article at:
iiim.is/2010/05/questions-about-artificial-intelligence

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RESEARCHERS GATHER AT HUMANOBS WORKSHOP

Reykjavik University continued hosting events in the fall of 2011 with the *"HUMANOBS Constructivist Workshop"*, an important event jointly supported by IIIM along with the STReP research grant within the 6th European Community Framework Programme and Reykjavik University. This workshop was a detailed exploration of some of the most important questions related to the impending paradigm shift from constructionist to constructive methodologies, using short presentations and targeted teamwork to cooperatively address this issue.

The development of artificial intelligence systems to date has been largely one of manual labor. This Constructionist approach to AI has resulted in a diverse set of isolated solutions to small pieces of a much larger question: how to artificially replicate the fundamental principles of intelligence.

Small success stories of how these pieces were put together in robotics, for example, has made people optimistic that continuing on this path will lead to artificial general intelligence. Unfortunately, this is unlikely. Standard software development methods, with their top-down design approach, put serious limitations on scaling. This results in systems with limited domain application and severe performance brittleness. Genuine integration, as required for general intelligence, is both practically and theoretically prevented.

Going beyond current AI systems requires significantly more complex integration than currently attempted, especially regarding transversal functions such as attention and learning. The only way to address the challenge is by replacing top-down architectural design with methods focusing on self-

generated code and self-organizing architectures. We call this Constructivist AI, in reference to the self-constructive principles on which it must be based. We face a myriad of questions in the pursuit of this approach: How different will the methodologies employed for Constructivist AI be from today's software development methods? What role can logic and reasoning play in this? How do we construct highly distributed architectures for these purposes? Do we need new programming languages?

This first open HUMANOBS workshop gathered several renowned researchers within AI community — including Pei Wang, Jörg Siekman & Ricardo Sanz — to search for answers. The most interesting presentations from this workshop, such as *"Requirements for AGI", "Predictable Constructivism", "From Constructionist to Constructivist AI"*, and "*Automated Reasoning"*, showed progress towards solutions and can be found on youtube.com:

youtube.com/user/IIIMvideos/videos

The HUMANOBS project started in January 2009 and will run until mid-2012. The goal of the project is to create an artificial intelligence that can learn how to socially interact by observing and imitating people. The three main objectives of this project are to build auto-reconfiguring architecture, behavior observation mechanisms and behavior generation, and coordination mechanisms. The intended result is the creation of a virtual humanoid television host capable of taking interviews and conducting a 30-minute TV program.

INTRODUCING THE LATEST SCIENCE TO THE PUBLIC: EUROPE-WIDE RESEARCHERS' NIGHT

The Europe-wide Researchers' Night Event (Icel. „*Vísindavaka*") brought together the public at large with researchers, held on September 23, 2011 at over 800 venues in 320 European cities across 32 countries. This was the second year that IIIM took part in this international event.

Researchers' Night is one of the EU's most popular initiatives for the general public - aimed especially at families, young people, and those who might not see themselves as science fans. The idea is for the public to experience science in an entertaining way. During Researchers' Night people can discover different research facilities, use the latest technologies and instruments, watch demonstrations and simulations, and meet scientists to exchange ideas or learn more about a specific field.

During this year's event the attendees got a chance to meet several of our scientists and learn about their work. **Dr. J. Deon Garrett** presented research on *Augmenting Spatial Navigation Structures with Semantic Information*. The goal of this project is to develop a mechanism which allows a robot to increase its behavior repertoire and capabilities by annotating the physical environment. **Dr. Jacky Mallett** presented her recent work on *Banking System Modeling and Simulation*, raising timely questions about the accuracy of the current monetary and economy theory. Our Senior Programmer **Guðný R. Jónsdóttir** presented the project *Conversation with Polite Computers*, which attempts to create autonomous computer characters that can interact with people in a human-like manner.

IIIM AWARDED QUALITY LABEL FOR CLUSTER MANAGEMENT EXCELLENCE

After less than two years of operation, the Icelandic Institute for Intelligent Machines (IIIM) is proud to have been awarded the **European Bronze Label of Cluster Management Excellence**.

The method of benchmarking was developed by the European Cluster Excellence Initiative (ECEI), which recruits experienced persons and organizations in Europe to identify quality indicators for cluster management and procedures in peer-assessment.

Find full article at:
www.iiim.is/2011/10/iiim-award-for-quality-excellence

The Quality Label signifies first and foremost that the holder of the title has been carefully evaluated and has been found to excel in quality of management and development, in comparison to nearly 150 other businesses. In the words of the ECEI:
"The benchmarking was conducted in the context of the project NGPExcellence – Cluster Excellence in the Nordic Countries, Germany and Poland. The project, which benchmarked 143 clusters in seven European Countries, […] focuses on cluster management, not on the framework conditions or a cluster as such. It is based on a modular set of quality indicators and a transparent process how to benchmark them. The Quality Label is voluntary and enables cluster managers to receive proof of their cluster management excellence by an independent third body according to clear indicators."

At IIIM we strive for the highest quality in our work–in methodologies, services, and research innovation. In light of the Institute's short history, this important acknowledgement came as a pleasant surprise.

We are grateful for this high level of interest from individuals and clusters around Europe; we appreciate the honor and thank everyone involved.

CONTACT

IIIM is located on the 2nd floor of Reykjavik University's new-millennium building in Nauthólsvik, within unique outdoors areas and near the country's only artificial beach.

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