Quo Vadis Center for Intelligent Technologies??? (Discussion about Research Interest of CIT)

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Abstract: The paper deals with selected ideas and concepts of determination of the most important task in the IT of 21-st century. It referes to questions like: Will Artificial Intelligence play an important part of the current and future IT in our everyday life? What can change our IT approaches and what can influence our necessity for pieces of knowledge what we need for everyday life? Will be a technology Human-Centered? Is Humatronics idea the way the mankind should progress? Will the Humanoid robots and non-human companions reality of just science fiction?

1 Introduction

Artificial Intelligence plays an important part of the concept of the higher degree of information society so called Ambient Intelligence concept which has been promoted in the EU – ISTAG (Information Technology Advisory Group) workgroup outcome. The report called **"Ambient Intelligence"** proves the importance of Machine Intelligence in the overall framework of new generation of complex information systems. According to these facts the new generation of experts related to these challenges is very important and needed for advance new understanding of information society with full Machine Intelligence concept. More information can be found in internet sources.

2 What is the Most Important in IT and AI?

The most important problem of AI in current days is a problem of "LEARNING" and creating "LEARNING TECHNOLOGIES". Notions like "LEARNING" and "INCREMENTAL LEARNING", multiply source LEARNING, knowledge fusion

and some others are very important issues of the current research. The most important problem for AI and for knowledge fusion is a very simple but very complicated strategy of multi-agent learning which is a very hot topic in research (see figure). The solution and implementation of such an approach would have a tremendous application potential and IF some prototypes of such an approach will come in particular applications it will be very inspirative and encouraging for other applications. Nowadays there are only few really learning systems in technology.

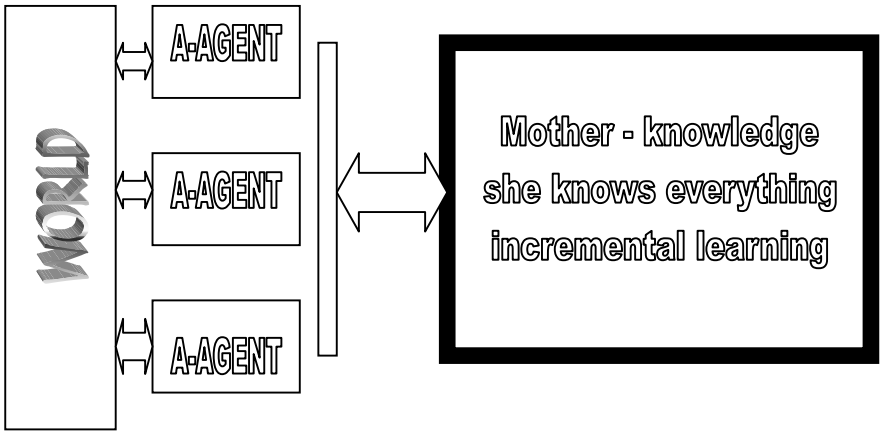


Figure 1

Elementary principles of multisource incremental learning – basic challenge of AI in 21st century

The above principle hides number of non-elementary problems from which can be selected e.g. as follows:

1 Learning approaches to get any form of knowledge by AGENTS,

2 using the pieces of knowledge and provide it for MOTHER for fussion procedure with other pieces of knowledges,

3 utilization of all the MOTHER knowledge by AGENTS for getting more knowledge.

This principle shows that to accomplish and build such systems is a great engineering challenge. There are 2 basic issues in this “dream” and are as follows:

1 How to learn?

2 How to represent the knowledge – which would be good and suitable for fusion and replication?

The learning is very important issue and what is clear that learning should have a great adaptability and such contribute to knowledge acquisition. Learning should be “life-like” means we should learn on mistakes and we should use such a framework which would be able to learn instantly and incrementally. The basic approach for this is a framework of “REINFORCEMENT LEARNING”. This is a framework ho to learn and how to get more knowledge. There are number of problems inside reinforcement learning and what is important to create a framework to be able to learn.

3 Learning Technology – Demonstrations Using Mobile Robots

We want to focus our demonstration activities and presentation using mobile robotics domain. Therefore we have established 2 new sub/entities within a Center for Intelligent technologies as follows:

- **Laboratory for Autonomous Systems (LAS-CIT)**
- **Laboratory for Humanoid Systems (LHS-CIT).**

The common challenge for all CIT is to push a research in creating “learnable Systems” in basic research and also in application domain mainly in mobile robotics. What is VERY important that we want to think about BUILDING such a concept for learning which could be used for e.g. AIBO and after minor modification also in Banking information system or Medical Expert System.

3.1 Autonomous Systems Using Incremental Learning

For research in our center we start very intensively use systems LEGO MINDSTORM (6 pieces) and AIBO SONY robotic Dog (2 pieces CIT). Basically we want to test the idea of incremental learning when the first and elementary accomplishment will be a test for Intelligent Parking problem. We are working on the problem that while Agent A is having knowledge about parking robot to Garage A and Agent B is having the pieces of the knowledge to park robot in Garage B – we want to create a Agent C which will be able park in Garage A or B. This elementary idea can be extended to number of garages and then it is not so elementary problem. The crucial problem is knowledge representation and fusion for creating the resulting Agent C.

Figure 2
Lego Mindstorm and Aibo the newest version

3.2 Humanoid Robots as Technological Systems

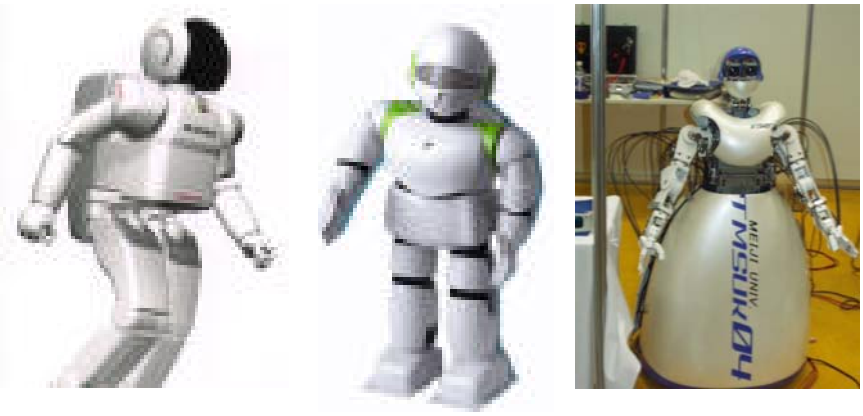
Humanoid robots are complex cybernetic systems which are remaining humans and they are divided into 2 different groups

- Domain oriented – they have ambition to serve a special domain for services and defined number of tasks
- Universal Humanoid robots which are oriented to be able to “live” like GPS – universal General Problem Solvers

Many labs and companies have already developed number of humanoid robots and these robots are able to solve number of interesting tasks including walking procedure which is very well solved with ASIMO – Honda Robot which is developed under strong support of Honda. Also number of other robots was developed including SONY AIBO robot dog which is not a humanoid robot but technologically is very interesting solution and will contribute to the humanoid robots.

The State of the Art of Humanoid robots are in controlling robots using:

- Teleoperation – which is not so easy and number of implementation problems are beeing solved there including softness and precissnes of trajectories and so on.
- Self-organized operations – these are based on learnable technologie and these are mainly done using artificial and computational Intelligence.



Asimo Robot Pino Robot Meiji University Robot

Figure 3
Various Humanoid Robot Platforms

Our challenge is to “play” with Robosapiens V2 – Robosapien is packed with an awesome number of features made possible by advanced technologies:

1) Fluid motions and gestures: fast dynamic 2-speed walking and turning; full-function arms with two types of grippers.

2) 67 pre-programmed functions: pick-up, throw, kick, dance, kung-fu, fart, belch, rap and more; 3 demonstration modes.

3) Fully programmable by remote control: Up to 84 program steps with 4 program modes for advanced operations; programmable “reflexes” to sound and touch stimuli.

4) Fluent international “caveman” speech.

Figure 4
Robosapiens V2 Platform

4 Artificial Intelligence, Learnable Technologies and Applications – Industry

The following idea is very urgent and critical in development and involvement of AI into industry -

If there will not be a practical (economical) need of embedding new technologies into real-world applications it will be a big problem for AI support.

Lets rise a question about willingness of companies to promote new technologies – again if it **will not generate money** – there is a **little chance** that AI will be dominant in information domain. Is AI and Intelligent technologies **well known** among professional IT sales people? Answer is definitely **"NO"** or "very little" and it is a big mistake – but mistake of whom??? Industry or Academia???? **Academia should force industry to use AI based technologies or Industry should ask Academia to promote AI based approaches.** Answer is very difficult and depends on personalities and activities of companies and AI communities in various countries.

If we do a research in Ai applications in last years – maybe we found not so many or we even do not able to specify them because of commercial aspects or some other reasons. So in spite of the above not so optimistic lines we should rise a question:

Should we (research community) make some effort to support AI applications in real-world problems?

Lets analyze the option of **"no or we do not care"** and option **"yes"**. The risk analysis is important for realizing the future of students and engineering students in the official branch of AI. Currently there is a big interest for AI among students e.g. on TU Kosice this year finish 29 students and next and coming years even more around 50/60 students per year. So here are some consideration for the risk analysis of both options:

- What if we do **"not care" or "not make any effort"** in AI application?

If we **will not make any effort** we do risk the following situation

a) Interest of companies will be decreasing if AI will not "make money"; AI is a not "Handy effect technology".

b) Interest of students will be huge after some years of stagnation it will decrease and will be lost among other technologies.

c) Funding of AI project in experimental and application research will have decreasing trends.

d) The "black box" effect of AI for managers, sales people will be continuing.

e) No interest for biologically motivated systems from industry.

f) No interest for learnable systems because it is not profitable when e.g. a labor values is low.

g) There will be no willingness to formalize the expert knowledge into software systems because the expert does not want!!!

- What if we **do "care"** and we will do something and what we should do?

Lets point out that "do something" is just a general framework with very open options mainly with activities in preparation of next generation of AI people which will be able to focus on real world applications. Some implication of potentially successful activity could be as follows:

a) Industry and application world will ask for pilot project and more proof about usefulness of AI technologies.

b) More consulting activities will be needed for companies.

c) Interest for people able to adapt, embed and develop Intelligent technologies will grow.

d) Intelligent technologies will be applied differently in different countries and not always only economical aspects will be playing the motivation factor but also desire for new and more user-friendly technologies for humans.

e) More support for Intelligent technologies research could be expected.

f) Interest for Biologically motivated systems from companies should have increasing trends.

g) Sales managers and companies should be more "educated" in Intelligent technologies domain.

There must be underline that there are number of activities within EU research area are focused to applications of Intelligent technologies. Based on extensive experience during implementing AI technologies are the following selected problems for relation between company and potential customers:

a) Customer should not believe that Intelligent Technologies cannot collaborate with experts and the only data source of knowledge is the only solution - experts with long experience should not be neglected. The goal is the creation of intelligent system.

b) The problem of financial covering of pilot project is the main issue. Simple question "Who will pay the pilot project" is not so easy. Big companies have big expenses for this pilot project and it could be a significant obstacle for application of AI in real problems.

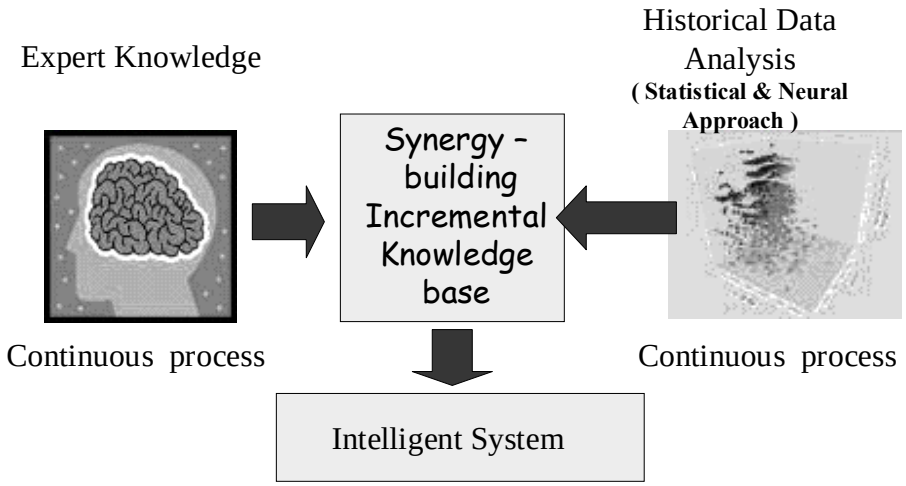


Figure 5
General Concept of creating Intelligent Systems

c) Transparency of the solution – customer must understand the basic principles of the solution – there should be elimination of black box effect. The examples of such a functional transparency can be seen on the following figure.

d) The phase of embedding the intelligent technology into over all workflow is very important. To underline the basic features of Machine Intelligence and Intelligent technology – learn-ability and self-improving ability should be visible.

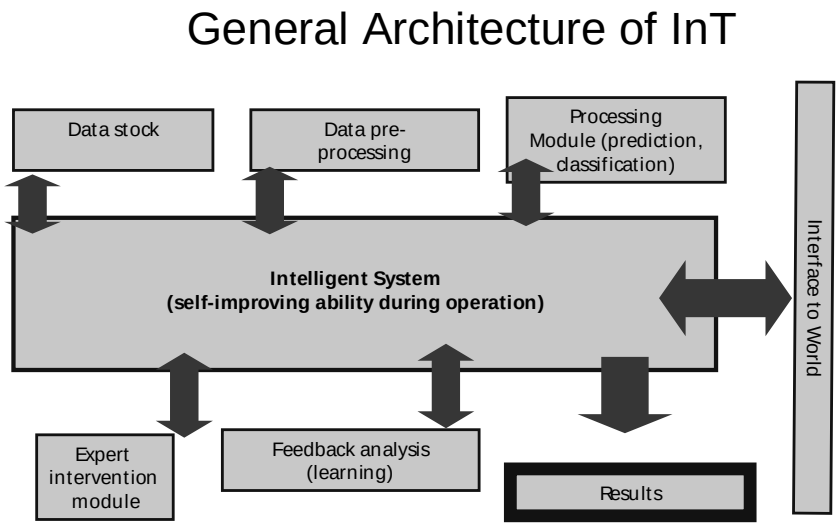


Figure 6
General Architecture of Intelligent Systems

5 Relation between Basic AI Research and Application of AI in Real-world Problems

This relation invokes the following questions:

- Should people from basic research promote applications of AI and support all possible activities for bringing AI in real world problems?
- IF there is a community of AI people working in applications should they support basic AI research?
- What kind of students should be “produce”? Students for basic research (as until now) or students ready to implement AI technologies in any possible domains?

Regarding the first question is must be clear that applications should give a new level of information society. The main area where application should be prevailing is a large data sets and large database handling in sense of data mining and knowledge discovery. The main role of basic research community is to underline and focus companies to the main advantages and disadvantages of AI technologies including learn-ability, function approximation, knowledge acquisition and many others.

The second question is valid if we do assume that such communities exist. We have to point out that there are number of companies oriented towards to the application e.g. HNC, ELITE and so on. The support of these companies for basic research seems to be a bit weak and not really supportive. Basic research is rather supported by agencies and research supported by governmental agencies as well.

We should focus mainly to students willing to apply AI in real world problems. We should teach students to promote the basic principles of AI and be able to analyze the problem and able to design a solution which should bring the new technologies into everyday use for benefit of mankind. We should be in contact with companies and create an intensive atmosphere of objective evaluation of the projects to decide where **AI should be useful or non-useful for particular problem**.

6 Teaching Computational Intelligence – Example of Do-something Approach

Computational intelligence is a comprehensive subject which has some of the goals in the concept of overall AI branch teaching in the Faculty of EE and Informatics. The goals are as follows:

a) Attract students to the importance and the future of Machine Intelligence in next generation of information systems.

b) Reveal the application potential of Machine Intelligence by students and support the students creativity in finding useful applications in local industry.

c) Contact the local companies made by students and promotion of machine intelligence tools among the industry.

d) Understanding the usefulness of machine intelligence by students and encourage the machine intelligence in next generation of information systems.

Students after introductory lessons are recommended to gather into **virtual companies.** These virtual companies must have pre-defined structure as follows:

a) **President** of the company

b) Promote manager

c) Sales manager

d) Case-study analytic

e) Programmer in C++ language

f) System Programmer.

Students are **asked to contact the local companies** to get real-world data and make pilot experiments with data to make pre-project information for possible application of machine intelligence in the companies. In schools year 2001-2002, 2003, 2005 we have had many virtual companies e.g.

a) Intelligent traffic systems – students contacted the local traffic police department in Košice to get info how to improve the handling the traffic related problems in Košice.

b) Money note recognition systems – students contacted the leading Bank in Košice to develop the note recognition counter for banking personals. Students have developed the pilot project with fast and full recognition of EURO notes. Students have designed the neural based system for note recognition of EURO notes. System was very reliable and fast.

c) Intelligent prediction systems for betting companies – students have contacted the local betting company with aim to study the possibility of using the machine intelligence in prediction of rated in British football league and World Championship in Ice Hockey in Sweden 2002. The pilot prediction system was made by neural approach and students have used the data provided to them by companies. One of the particular results was the prediction of the ice-hockey match between Slovakia and Russia in the Championship final. The prediction was 75% for Slovak team which was a very good prediction.

d) Intelligent Hot House systems – students have contacted the local Botanical Garden with the aim to design the theoretical project of intelligent system for fresh air control for selected fauna based on experience of experts.

Students were led to approach the problem using the basic concept of building intelligent system as is on the Figures #5 and #6. The above principles lead students to think about the **application potential of Machine Intelligence**. The response of the students is very positive and students are asked to make their company presentation which is recorded and ported on the internet to inform the Cyberspace about these activities. In fact we can state that the teaching can be done by 2 ways of approach as follows (from students perspective – it is learning):

1 learning by being told

2 learning by Exploration

It is obvious that this approach using virtual companies is “Learning by exploration” and even more because students are being missionaries of AI and new technologies in general and that is a position what we do need to have them. The following figure is presenting a solution for motor control using NN approach designed by students with virtual company ITS (Intelligent Technological Systems).

Conclusion

The paper deals with selected problems of applying AI in real world problems and point out some problems of relation between basic research and applications of AI.

The lack of applications could lead to many problems including decreasing the support of research and education of AI oriented branches. The author point out that this topic should be a **matter of discussion in Slovak and Hungarian AI communities**.

The concept of teaching Machine Intelligence related subject is based in project oriented approach. Students are lead to work in teams (virtual companies) and are recommended to contact local companies to find an interesting application for machine intelligence technologies. The presentation of these "companies" is very inspiring and creative. We do strongly believe that this approach in teaching connected with demonstration with **autonomous and humanoid systems** can bring more attractivity to the Machine Intelligence technologies among the students.

Literature

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