European Science Foundation

Standing Committee for the European Medical Research Councils (EMRC)

ESF/EMRC EXPLORATORY WORKSHOP

FUNDAMENTALS OF MEDICAL INFORMATICS

Elspeet, Netherlands

27-29 October 2002

Convened by: Peter Lucas[1], Ameen Abu-Hanna[2] and Nada Lavrac[3]

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European Science Foundation

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European Science Foundation - EMRC Exploratory Workshop

Fundamentals of medical informatics

Elspeet, Netherlands, 27-29 October 2002

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Rationale:

As the use of computers in healthcare has evolved rapidly the last decade, medical-informatics researchers are increasingly involved in practical work, often initiated by the medical community. This intensified involvement with the medical field has offered interesting opportunities for researchers to evaluate ideas in a real-world setting. However, this trend has also resulted in a gradual shift away from fundamental research in Medical Informatics. The process has been ongoing at least since the beginning of the 1990s. In the 1970s en 1980s, medical-informatics research stood at the for-front of fundamental research in computer science, contributing to important achievements. Methods and techniques, originally developed for dealing with medical problems, were successfully applied by computer scientists to other fields. Examples include semantic databases, rule-based expert systems, conceptual modelling, machine learning, decision-theoretic planning, neural networks, Bayesian networks, computer simulation, and signal and image processing. Medical Informatics also offers a natural context for performing Bioinformatics research.

Due to the repositioning of medical-informatics research as a result of the abundance of practical IT opportunities, the influence of Medical Informatics on computer science and equally on other fields has diminished considerably. Many medical computer scientists also seem to neglect the opportunities offered by the progress in the Life Sciences, and remain far removed from basic research. This trend may be regarded as indicative for the current state of research in Medical Informatics, and may contribute to undermining fundamentally oriented research which has proved itself in the past, and which is necessary for the scientific future of Medical Informatics research. The goal of the proposed Exploratory Workshop is to consolidate and revitalise fundamental research in Medical Informatics by bringing together key researchers in Medical Informatics and related fields, such as Bioinformatics, Biomedical Engineering, and Statistics. **Without a good solid scientific foundation, that is constantly being added and deepened, Medical Informatics may not be able to contribute to the scientific basis of medicine in a substantial way in the near future.**

Timeliness:

Until recently, clinical patient data have been stored in almost inaccessible paper form, hampering scientific use of this information. Furthermore, the IT infrastructure of hospitals consisted for more than 25 years only of a hospital-wide information system, storing administrative data and laboratory data. However, this infrastructure is currently being revolutionised by the introduction of electronic communication and clinical information systems in the wards. Similar developments are taking place in primary care. From a scientific point of view, these developments are extremely interesting, since it will create an environment that is better suited to medical-informatics research than ever before. Given the fact that Bioinformatics has given a major impetus to fundamental research in the Life Sciences, Medical Informatics can also profit from this by carrying out complementary research within the context of medicine. This will provide new opportunities for testing fundamental principles of Medical Informatics. Hence, it now appears to be the appropriate time to **reconsider the research directions in Medical Informatics, as the infrastructure to carry out that research will soon expand in university hospitals, and clinical applications of basic research in the Life Sciences are expected soon**.

Format and Expected Outcome:

- The workshop lasts 2 days. There are some extra activities planned one day before the start of the workshop which are meant to learn knowing each other. The workshop will be different from a traditional workshop; e.g. it will not be fully filled with presentations (although there will be some). It will take place in an informal atmosphere.
- The ultimate aim of the workshop is to produce and publish a volume titled **Fundamentals of Biomedical Informatics** based on previous and current research of the participants. The workshop acts as a **kick-off meeting** for this undertaking.
- During the Exploratory Workshop much time will be devoted to deciding about what should be included in this volume. Editorial and writing teams will also be put together.
- It is expected that much can in be based on existing papers of the participants. Before the start of the workshop, every participant will be asked to submit relevant work. The papers will be distributed at the workshop.
- In order to make sure that the workshop is effective, three to four working groups will be formed.
- The workshop participants have significant influence on the actual content and structure of the workshop; the organisers will come up with initial suggestions.

Workshop Themes and Topics:

The list below is neither meant to be exhaustive nor are themes and topics meant to be mutually exclusive.

Modelling in Biomedicine

- Causal modelling (qualitative models of cause-effect relationships)
- Logical formalisation of biomedical knowledge, clinical guidelines, and so on
- Formalisation of biomedical terminology
- Model-based reasoning (in particular model-based diagnosis using abduction or consistency checking)
- Bayesian modelling (development of Bayesian networks based on biomedical expert knowledge)
- Mathematical modelling and simulation (development of mathematical simulation models of cells, e.g. nerve cells, and organs, e.g. the heart and vessels)

Data-mining, machine learning in Biomedicine

- Learning of causal knowledge
- Use of genetic algorithms in model and feature selection
- Subgroup discovery
- Learning temporal knowledge from data
- Bayesian classifiers
- Inductive logic programming
- Classification structure learning

Bioinformatics in Medicine

- Machine learning and Bioinformatics
- Statistics and Bioinformatics
- Mathematical models of Biomolecules
- Information retrieval in Bioinformatics
- Bayesian models and Bioinformatics
- Neural networks and pattern recognition and Bioinformatics
- Rough set theory and Bioinformatics

PRELIMINARY PROGRAMME:

Sunday 27th October 2002

18.30-20.00	*Dinner*

Monday 28th October 2002

09.20 - 09.30	**Welcome** Peter Lucas, Nada Lavrac, Ameen Abu-Hanna
09.30 - 10.30	**Modelling biological systems and clinical problems using machine learning** Jan Komorowski and Ameen Abu-Hanna
10.30 - 11.00	*Coffee break*
11.00 - 12.00	**Representation, formalisation and verification of medical guidelines** Mar Marcos and Lucila Ohno-Machado
12.00 - 12.10	**Introduction to the European Science Foundation** Hui Wang
12.30 - 14.00	*Lunch*
14.00 - 15.00	**Bayesian networks - causality, modeling, learning and evaluation** Gregory Cooper and Linda van der Gaag
15.00 - 16.00	**Modelling of biological and medical features and problem solving** Peter Hammond and Peter Lucas
16.00 - 17.00	*Refreshments and Walking*
17.00 - 18.00	**Constraint-based data-mining and subgroup discovery** Luc de Raedt and Nada Lavrac
18.00 - 20.00	*Dinner*

Tuesday 29th October 2002

09.30 - 10.30	**Machine learning methods in bioinformatics** Luc Dehaspe and Lucila Ohno Machado
10.30 - 11.00	*Coffee*
11.00 - 12.00	**Bayesian-network structure learning, evolutionary algorithms, cluster analysis** Pedro Larranaga and José Pena
12.00 - 12.30	**Formation of 3 Working-Groups**
12.30 - 14.00	*Lunch*
14.00 - 15.00	**Representation and reasoning with temporal knowledge** Riccardo Bellazzi and Marie-Odile Cordier
15.00 - 16.00	**Working Session I** (possibly peripatetic)
16.00 - 16.30	*Refreshments*
16.30 - 17.30	**Working Session II** (possibly peripatetic)
17.30 - 18.30	**Plenary Session : discussion of outcome of working sessions and production of book proposal**

Wednesday 30th October 2002

Morning	*Departure*

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Notes on Preliminary Programme

1. A 'talk' could consists of 45 min. presentation and 15 min. discussion, and is not expected to be very formal in nature. The talks are meant to explain how your work fits in with the aim of the workshop, which is to produce a book about fundamental (formal-methods oriented) research in Biomedicine. For example, you could start focussing on your own research, and at the end of your talk you answer questions such as:

   - what is the role and place of this work in the context of the book

   - relationships with other work, possibly of other participants

2. It is thus not necessarily true that your talk consists of a fancy PP presentation; just writing on the flip-over or using hand-written slides is also fine. As we try to achieve a common goal, a standard workshop or conference presentation may be less suitable.

3. Two people are involved in each 'talk'. The order of the names is alphabetic. Note that we have not always formed pairs based on your primary expertise or on the paper(s) you submitted. The joint talks are meant as a first step to collaboration. This implies that sometimes, your role during a talk will be mainly supportive, whereas in other cases you will be the main speaker. You should contact your fellow presenter to discuss in what way to distribute the work.

4. There is much time available during the workshop for discussion, both during the presentations and during working sessions

Peter Lucas

European Science Foundation

Objectives of the ESF Standing Committee for European Medical Research Councils (EMRC)

The **ESF Standing Committee for the European Medical Research Councils (EMRC)** has overall responsibility for initiating and coordinating ESF's scientific activities in medical sciences and for providing expert advice on issues of science policy. It covers a broad range of disciplines and the Committee's main objectives range from promoting interactions between the biomedical and clinical research communities, through providing policy advice, to stimulating collaboration in emerging research areas.

The EMRC covers fields such as:

- Diagnostic and therapeutic medicine
- Neurology
- Immunology
- Psychology
- Clinical studies
- Toxicology
- Human genetics
- Medicinal biotechnology

EMRC supports a limited number of **Exploratory Workshops** each year. These workshops allow leading European scientists to explore novel ideas at the European level with the challenging aim of "spearheading" new and preferably inter-disciplinary areas of research.

One outcome of an ESF Exploratory Workshop may be that participants decide to submit a proposal for an ESF scientific **Programme, Network** or **Euroconference**, possibly to be financed by, and coordinated through, the European Science Foundation. If this is the case, it is expected that participants of the workshop follow the relevant procedures.

In the case of **Programmes** ("à la carte" or eurocores), a draft proposal should be submitted to the EMRC Secretariat for advice, to then subsequently undergo further external refereeing. If successful in obtaining EMRC's scientific recommendation, the proposal will be submitted to ESF Member Organisations for funding on a voluntary basis. More details are available at **www.esf.org/emrc**.

In the case of a **Network** the proposal is submitted to the ESF Network Secretariat. The results of the refereeing process and EMRC's scientific recommendations are provided to the Network Group. This is the body that decides whether or not to recommend a proposal for launching. More details are available at **www.esf.org/networks**.

In the case of **Euroconferences**, the proposal is submitted to the ESF Euresco Secretariat. A Committee (assisted by Advisory Panels) takes full responsibility for the selection of conference subjects and chairmen.
More details are available at **www.esf.org/euresco**.

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Fundamentals of Medical Informatics

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