The competition Series in the NoE EUNITE 2001 to 2003

1 Introduction

The following summary is not intended to describe the contents of competitions within the EUNITE Network (NoE); instead, a few essential conclusions from this series of competitions are presented.

Scientific competitions are well-known instruments which have motivated scientists to develop new ideas for several centuries. Today too, large sums of money are sometimes offered as prizes for solutions to unsolved problems in various fields of natural science. The Clay Mathematics Institute has singled out seven so-called Millennium Problems, for which prizes totalling seven million dollars have been offered. These problems include the task of deriving a more fundamental understanding of the Navier-Stokes differential equation on the basis of concrete mathematical proofs, for instance. Since this equation constitutes the basis for the entire field of fluid mechanics, this competition problem is of special scientific as well as technical interest.

Traditionally, the competitions in EUNITE are organised by the committee which is responsible for technology transfer within the network. However, can competitions of this kind also contribute to technology transfer? In my opinion, they can certainly serve as a useful instrument, if problems currently encountered in industry are considered by a large number of scientists from different fields of specialisation, and if the solutions are then applied at the company concerned in the event of success. I wish to briefly justify this standpoint in the following.

2 Tasks and essential facts

The EUNITE international open competition focuses on bench-marking competitive techniques like fuzzy logic, neural networks and advanced mathematical statistics and on demonstrating the efficiency of these disciplines in addressing real-world issues. In total three competitions with different tasks were organised from 2001 to 2003.

Competition 2001:

The first competition in the framework of EUNITE was announced with the title: 'Intelligent technologies for load forecast in Eastern-Slovakia'. The problem to be solved is the forecasting of maximum daily electrical load based on electrical load values and additional data. We had in total 56 registrations from 21 countries. During the competition the web page has been visited 2500 times. Finally 15 participants submitted 18 solutions based on a wide variety of creative approaches.

Winners 2001:
1. Chih-Jen LIN, Dept. of Computer Science, National Taiwan Univ. TW
2. David ESP, National Grid UK
3. Werner BROCKMANN, Institute of Computer Engineering, Med. Univ. Lübeck, Germany

Competition 2002:

The second competition in the framework of EUNITE has the topic Modelling the Bank's Client behaviour using Intelligent Technologies'. In total 143 people from 33 countries registered and downloaded the data and at least 15 participants sent there results and a report.

Winners 2002:
1. Marcin Wojnarski , Institute of Informatics, University of Warsaw (Poland)
2. Gama University of Porto (Portugal)
3. Davis Esp National Grid (UK).

Competition 2003:

The problem posed in 2003 involved modelling of the temperature variation in the melting tank (Schott Glas, Germany) of a glass furnace on the basis of process variables. The special challenge presented by this problem involves the long delay times between the change in a control variable and the change in temperature at the outlet from the melting tank. In total 56 people registered and downloaded the data. A total of twenty proposed solutions were received, some of them from the United States and Brazil, among other countries

Winners 2003
1. Marcin Wojnarski, University of Warsaw, Poland
2. Bernhard Pfahringer, Waikato University in New Zealand
3. Dumitru-Iulian Nastac and Adrain Costea, Computer Science Centre in Turku, Finland

As an expression of its gratitude, Schott Glas awarded prizes in the amounts of 5000 € (1st place), 3000 € (2nd place), and 1000 € (3rd place). "

Competition Working Team 2003/4:

EUNITE is a Network of Excellence. Consequently, those who actively co-operate in such a network, and of course the EC as the source of financial support, have a special interest in quantifying excellence in particular fields. The solution of this problem is not easy, but it should be borne in mind in the course of activities within the network. Of course, the solutions presented by the winners of a competition are certainly good, or at least better than those offered by the other participants. However, does this suffice for being considered as excellent? After all, it is often difficult to classify a solution. Scientific developments in the field of intelligent technology occur so fast that an individual person is hardly capable of achieving excellence as an expert in all areas. Hence, what could be more logical than the attempt to combine good detail solutions in such a way that an improvement can finally be achieved? For this purpose, we have established a competition team in which about eight participants have continued their intensive work with the data of the 2003 competition. Each member of the team has to contribute ideas, deliver new results or share parts of his algorithms or methods to improve the results which has been obtained in June 2003.

3 Concluding appraisal of competitions on data analysis in EUNITE

Competitions on data analysis had already been organised on the ERUDIT I and II networks. With the start of EUNITE, it was clear that an adjustment in the focus of attention was also necessary for the competitions. The aspect of adaptivity required special emphasis. A particularly difficult problem in conceiving such competitions is the definition of an unambiguous and useful measure of error, since ranking of the submitted solutions is not possible without such a definition. In this context, two different types of problems must be distinguished.

1. Classification problems

In 2002, the credit risk had to be analysed on the basis of customer profile data. For this purpose, unknown transactions had to be appraised, and the correct results were known only to the organisers. With problems of this kind, the definition of the error criterion is simple, since the winner is the participant who predicts the most transactions correctly. As a rule, such a criterion also approximates the real problem very closely. In this case, however, it is not easy to find problems with adaptive character. The problem posed in 2002 corresponded to a classical classification task without the necessity of applying adaptive methods. In a strict sense, therefore, this problem was not really appropriate for EUNITE.

2. Prediction problems

For prediction tasks such as the problems posed in 2001 and 2003, the definition of a criterion is considerably more complicated. Before the start of the competition, a formula which takes the deviation between prediction and real data into account was defined as error criterion. In 2003, provision was also made for weighting with respect to the time elapsed since the last known input and output values. The fact that the accuracy of prediction decreases with time is self-evident, and predictions in the far-distant future should therefore not be weighted so heavily in the calculation of the overall error. For the glass-tank problem of 2003, it was clear from the beginning that a prediction was difficult even for a period of only two weeks, whereas predictions within a period of a few hours are technically meaningless in view of the delay times usually involved.

For modelling with the desired adaptive character in 2001 as well as 2003, a serious problem was the impossibility of adapting the model to match the prediction period, since no output data were available for feed-back over the entire prediction period. For a practical application, of course, such an adaptation of the model on the basis of a continuous comparison between the predicted output data and those actually measured is both feasible and useful. For instance, a competition could be organised in such a way that the participants receive the input values for two days without the output to be predicted and then submit their prediction to the organiser within a reasonable processing period. All participants could then receive the real output data and the input data for the next two weeks. For such a sequential procedure, of course, the organisational effort and expense would be considerably greater. Furthermore, a serious disadvantage is the fact that a participant cannot afford not to remain "on the ball" for two or three weeks.

In 2003, the solution which best corresponded to the error criterion was the approach for which the last-given value is maintained constant over the entire prediction period. Although this solution does not provide any useful support whatsoever for process modelling, it was declared to be the winning solution, since it was formally superior to all other solutions submitted. If the competition had been discontinued at this point, the result would have proved unsatisfactory for all concerned. Because of the continuation as a team, however, other good solutions remained competitive, for example, those which predicted a trend in behaviour with acceptable accuracy.

The effort necessary for participating in the competition was certainly quite substantial. Some participants invested only a few hours' work and, as a rule, applied existing software for the purpose. Nonetheless, several days' work, including the preparation of the report, is necessary even in this case. On the other hand, we know that other participants have worked intensively on the problem for two to four weeks. For university personnel, this is certainly easier to organise than for employees in industry.
What are the reasons for the motivation to participate in such a competition?

The order in which the following factors are listed reflects my own personal opinion and makes no claim to general validity.

1. Usefulness for one's own career
For one thing, a successful score in a competition can positively accentuate one's personal curriculum vitae. This feature is especially important for participants from universities. On the other hand, it may also prove to be beneficial for one's own career in business and industry. In the first two competitions, one representative from industry was also among the prize winners. He also reported having become better known within the company as a result of the award. Above all, however, it thus became evident that the company's own R&D personnel perform at a high level, and that they need not be afraid of comparisons with specialists elsewhere. This aspect is of particular interest, since very few opportunities for "benchmarking" otherwise exist for such positions in a company.

2. Personal benchmarking / contacts with other specialists
Participants in a competition have no chance of achieving a winning position unless they have already been concerned with the associated questions for quite a long time. A competition offers a possibility of appraising the status of one's own algorithms, that is, how good one's own approach is in comparison with those of other specialists. Every serious scientist must have an interest in comparisons of this kind, since continuing development is feasible only on the basis of such position determinations.
In the team competition, special emphasis has been placed on contact among the participants. The resulting possibility of exchanging a wide variety of information thus provides ideas and incentives for potential improvements in one's own methods.

3. Attendance at international conferences
The incentive offered by an opportunity to publish one's own results at a conference should not be underestimated either. For employees in industry, attendance at international conferences is by no means self-evident, and the assumption of the total travel expenses provides an additional incentive to dedicate one's efforts to the topic.

4. Contacts with industry
Whenever the task involves a real problem encountered in industry, a valuable contact with the associated industrial partner can result from participation in the competition. In many cases, this aspect is not yet evident to the participants during the tendering phase of the competition. With the introduction of the team competition in July 2003, however, every participant was made aware of this fact. Schott in Mainz did not have any solution to its own problem; consequently, the company was and still is prepared to continue working with appropriate solution proposals in a paid project after conclusion of the competition. This constitutes a vital aspect of technology transfer.

5 Prize money
For the last two competitions held in 2002 and 2003, monetary prizes were offered. Sums of money ranging from 3000 to 5000 € represent a considerable incentive for participants. For a university employee from the Eastern European countries, this amount is several times as high as his normal monthly salary. On the other hand, the participants were no less numerous during the initial years of the competitions despite the fact that monetary prizes had never been offered at that time. Hence, I do not think that this aspect is all that important for the decision to participate in a competition.

So much for the motivation of participants. However, what can a company expect if it participates in a competition and furnishes data for the purpose?
The answer can be summarised in a very simple way. Whoever is willing to invest time in the preparation and evaluation can profit immensely from such a competition. Without active cooperation of this kind, the result will not be satisfactory, and especially the assessment of the significance for one's own company will be difficult. In 2003 and 2004, the cooperation between Schott and the organisers was extremely close. Consequently, I have assigned a decidedly higher rating to the results of the competition in 2003 and to the possibilities for utilising these results, in comparison with those from the other two competitions (2001 and

2002). From the results of the team competition, Schott will select solutions and prepare an online prediction of the melting-tank process on this basis, since these solutions are better than those previously applied by the company itself. If no company-internal results are available for comparison, however, an appraisal of the solutions from the competition presents a problem.

All companies which have participated in the EUNITE competitions have received 15 to 20 solutions. It is difficult to imagine that these companies could have obtained such a large number of different trial solutions within the scope of the usual cooperative projects with universities or other research institutions. Since most participants work actively in their respective fields of research, the state of the art can be described with these solutions. The transfer of up-to-date methods and algorithms to an industrial company can thus take place.

Besides the participants and industrial companies, the third partner must also be mentioned: the network itself, as well as the sponsor of the network activity. To which extent do these competitions correspond with the support concept of NoE?

1. Networking / internal technology transfer
First of all, a platform is created by processing an identical problem; such a platform can facilitate the exchange of methods and algorithms among the participants. In particular, the instrument of the competition team has considerably enhanced this exchange. The competitions have resulted in increased cooperation, which can be designated as genuine networking.

2. External technology transfer
If the competition results in a real application at a company, the objective of technology transfer has been achieved within the network. To our great joy, the present results of the competition series thus represent a successful technology transfer contribution. Since this aspect is an important criterion for awarding with NoE, the interests of the European Community have also been realised.

3. Improvement in the external presence of the network
The competitions have been continuously observed even by those members of the network who did not participate actively. Advertising for the competition by e-mails and the Internet have positively affected the publicity of the network.

In conclusion, the competition series in EUNITE can be regarded as a success. Especially the competition in 2003 and the subsequent competition team have resulted in a genuine and successful technology transfer. In order to ensure this success, however,

- the selection of problems,
- the integration of industrial partners,
- the preparation of data,
- the attention paid to participants, and
- the subsequent publication of results

must be implemented with great vigour and engagement. The continuing receipt of enquiries and requests for data and solutions from the 1998 to 2000 competitions even today is highly encouraging. If scientists employ the EUNITE data as a benchmark, this is a reliable indication that we have made a correct selection of problems.