from PROOF to COMPUTATION through LINEAR LOGIC

Simona Ronchi Della Rocca

national coordinator

SITES

1. ROMA
Abrusci, Guerrini, Maieli, Mascari, Pedicini, Piazza, Re David, Tortora de Falco

2. VERONA
Bellin, Masini, Solitro, Fleury

3. UDINE, BOLOGNA
Alessi, Coppola, Dal Lago, DiGianantonio, Honsell, Lenisa, Martini

4. TORINO
De Liguoro, Ronchi Della Rocca, Roversi

AIM

 ….the aim of our project is twofold. Firstly, we want to use Linear Logic as federating theme, very suitable for gathering the expertise and experience of all those Italian researchers who have encountered it in their scientific practice.
In this context, we want to collaborate each other in order to further explore the structure of Linear Logic and to use the methodologies from it for solving particular problems in Computer Science.

Secondly, we want to reason on the relationships between Linear Logic and Theoretical Computer Science, through an analysis of the obtained results. We aim to define new developments. Almost all the Italian researches working in Linear Logic are present in this project, and they already collaborated in Italian and international research projects. What we expect from such a synergy is a deeper understanding of several fundamental problems of Computer Science, a clearer and more unified organization of our fields of research, and a new critical view of the relationships between Linear Logic and Theoretical Computer Science.

RESEARCH PROJECT

The project will be organized into three lines:

1) Structural proof theory

.. we want both to study problems related to the proof theory of LL, and to export proof theory techniques from LL to other systems (for example, classical logic).

2) Study of computations of fixed complexity

...we want in particular to study logics derived from LL, with the property of characterizing computations of given complexity, and to explore their possible applications to programming languages

3) Semantics of both proofs and programming languages.

...we want both to model the meaning of logical systems (in particular of proof-nets) and to use tools from LL (e.g. game theory or coherence spaces) for studying the formal semantics of programming languages.

OUR EXPERTISE

1) Structural proof theory

proof-nets and optimal lambda-reduction (Bologna, Roma, Udine, Verona)
non commutative linear logic (Roma)
models of "unusual" logical connectives (Torino)

2) Study of computations of fixed complexity

L.A.L (Bologna, Torino, Udine)
E.A.L. (Bologna, Torino, Udine)

3) Semantics of both proofs and programming languages

semantics of proof-nets (Roma)
coherent semantics of programming languages (Torino, Udine)
game semantics of programming languages (Torino, Udine)

THE EVALUATION

4 evaluations: 67/80

item:
- Originalità del progetto e suo contributo al progresso delle conoscenze scientifiche (OR)
- Chiarezza e verificabilità degli obiettivi (CV)
- Appropriatezza dei metodi e delle tecniche da utilizzare (MT)
- Adeguatezza delle risorse (RIS)
- Congruità del finanziamento richiesto (FIN)
- Competenza del coordinatore scientifico (COMC)
- Competenza dei gruppi proponenti (COMG)
- Complementarità dei gruppi proponenti (CO   MP)

FIRST EVALUATION: 67/80

OR (9):
Generally this is a state of the art proposal on the extension of modern proof theory and its applications to computation. Hard to assess as there seem to be 4 units involved.

CV (7):
There are three main lines to this proposal, well-focused in themselves. However it is not straightforward to integrate the second (Complexity) with the other two; and links between the first and third component are not brought out in the proposal.

MT (9):
All current techniques seem to be represented in the proposal; there is perhaps an over-emphasis on Linear Logic itself, but the proposers are clearly aware of (and have perhaps been responsible for) a number of recent novelties.

RIS (7):
The four contributing research programmes seem well thought through in themselves, and reasonable numbers of people are involved. (Of course their ability to carry things through depends on their quality which I do not know).

FIRST EVALUATION: 67/80

FIN (7):
The four contributing research programmes seem adequately funded, though I would be inclined to put more stress on those which are asking for less funds!
COMG (9):
All four units are really excellent. And the proposed researchers at Torino and Verona are known to me and are very strong.
COMG (9):
It is much easier to see how this fits together when you know who the people are. The members complement each other nicely.

Overall evaluation:
Assuming there is adequate integration (both spatial and personal) between the various groups I would go ahead with this. It is clearly serious stuff. I feel very positive about this project, the more so now I see the quality of those involved.

SECOND EVALUATION: 75/80

OR (9):

The application clearly shows a good knowledge of the current state of the art. The research programme which is set out should lead to significant developments along several existing lines of research, e.g. the study of complexity via systems of Linear Logic, the theory of proof-nets, and various forms of semantics. However, I did not find any radically original ideas, opening up new lines of investigation, in the proposal.

CV (9):

The research objectives are generally plausible and entirely feasible. The research undertaken in the project should lead to publications in high-quality journals and conferences, and hence can be monitored on an ex post basis. I found the statement of research goals a little vague. It mostly took the form of listing a number of possible areas for investigation. I would have liked to see crisper hypotheses based on more sharply formulated ideas and proposals for how to proceed. One of the better examples which approximated to this was the discussion of L(C) and requirements for a complexity logic in the Unit 4 document. Even here, though, I would have appreciated a sharper analysis and more definite ideas of how to go forward.

SECOND EVALUATION: 75/80

MT (9):
The invesrtigators clearly have a good knowledge of the state of the art techniques and methods.
Whether these will be sufficient for real new insights in the topics of the programme is hard to predict.
Most of the researchers are coming from a lambda-calculus and proof theory background. It might turn out to be the case that a broader perspective, e.g. using tools from concurrency as well, might be valuable in achieving their objectives.
RIS (9):
Clearly these are well-qualified teams of researchers, with a good level of critical mass.
COMPG (10):
The standard of scientific competence in these groups is generally very good. Each of the four groups has a good critical mass.
The weakest group is clearly that at Verona. Nevertheless, this group still makes a worthwhile contribution to the overall project. Their participation in this project should help to strengthen the research base at Verona. I would therefore view it as a mistake to exclude them from the project.

SECOND EVALUATION: 75/80

COM (10):
There is a good blend of distinctive and over-lapping contributions between the four sites. I would expct the inter-site cooperation to work very well.

OVERALL EVALUATION:
In some ways, I would have liked the proposers to be a bit bolder, and more prepared to `think outside the box'. It would be better if they set their own intellectual agenda more distinctively, rather than tending to follow the current trends from elsewhere. Nevertheless, I believe that this is a very worth-while project, which would both enhance the international state of the art in its field, and give a major boost to research in theoretical computer science in Italy. I strongly support funding this proposal.

The scientific quality of the personnel in this proposal is very good. I would also expect the inter-site collaboration to add value. The consortium as a whole is a coherent group with over-lapping but complementary strengths. For example, the Udine group is strong in semantics and optimal reduction, the Torino group in types and complexity, the Roma group in proof nets and non-commutative logic. These topics feed into each other so that there should naturally be some productive synergy between these groups.

THIRD EVALUATION: 76/80

OR (10):
Tematiche nuove ed importanti. Idee originali di circa 15-18 anni fa, radicate in strutture logico-matematiche non-banali, hanno trovato applicazioni in Informatica ed aperto una nuova via alla Teoria della Prova.
CV (9):
Alcuni obbiettivi sono ormai classici, nell'ambito proposto, e sara' facile raffrontarli a risultati gia' ottenuti o prospettati da altri, a livello internazionale.
Altri, piu' specifici del progetto, sono anche molto chiari.
MT (10):
I proponenti sembrano sapere bene quel che possono ottenere con i metodi proposti, matematici ed informatici.
OVERALL EVALUATION:
Proposta preparata con competenza, sulla base di risultati gia' ottenuti, con molti sviluppi possibili, sia teorici sia pratici. L'originalita' (anche se ormai "matura") della tematica fa parte di trends nuovi del pensare la teoria della prova e le sue applicazioni informatiche, che stano aprendo quadri concettuali radicalmente innovatori. Le ricadute, dirette ed indirette (forse le piu' importanti: di metodo), in parte gia' sotto gli occhi di tutti, non potranno che essere di grande rilievo. E' possibile che alcune di queste saranno ottenute nell'ambito di questo programma. Un gruppo di ricercatori di alto livello che conoscono i contributi rispettivi (ampiamente citati) e sapranno, penso, utilizzare la sinergia

FORTH EVALUATION: 80/80

O (10):

Il carattero innovativo delle ricerche è certo. Il progetto è aggiornato sugli ultimi sviluppi della Logica Lineare (LL) : la logica non commutativa, la Logica Lineare Leggera, la Ludica…. Lo scopo di un tale progetto è un progresso significativo nella conoscenza profonda degli vari problemi fondamentali dell'Informatica e dei rapporti tra Logica Lineare e Informatica Teorica.

CV(10):

La seconda fase del progetto è detta "fase consuntiva", dedicata alla riflessione sul lavoro svolto e più generalmente sul ruolo di LL e Ludica in Informatica. Un workshop internazionale sarà organizzato su questo tema e darà la possibilità di verificare ex-post i risultati dell' attività di ricerca.

OVERALL EVALUATION:

Il progetto riunisce quasi tutti i ricercatori che lavorano in Italia nell'ambito della Logica Lineare. Questi ricercatori hanno già collaborato nel progetto europeo TMR "Linear Logic in Computer Science" e in diversi progetti di ricerca nazionali. Il programma e gli obiettivi del progetto sono eccellenti ; il loro successo mi pare molto credibile e conforterà il posto della ricerca italiana su scala internazionale. Dunque raccomando assolutamente il suO finanziamento.

Eccellente progetto. Sono molto favorabile al suo finanziamento.

RESEARCH ORGANIZATION

LINE LEADERS:

1) Structural proof theory: STEFANO GUERRINI

2) Study of computations of fixed complexity:
LUCA ROVERSI

3) Semantics of both proofs and programming languages:
MARINA LENISA

FINAL EVALUATION

The evaluation criteria for a project like this one, characterized by the fact that the results will be theoretical, are the following:

- The publications developed during the project can be evaluated with respect to the impact factor and pertinence of either the journal or the conference proceedings, when they will appear.
- We will invite, at every workshop of the project, external referees, which will be asked to write reports on the quality of our scientific research. Such reports will be attached to the final one.
- The software developed inside the project will be put in the web, for be freely used by the scientific community. To all users a report on their experience will be asked.
- The proceedings of the final meeting will be published.
  The modalities of the publication and the success of the volume will be a measure of the result of the project.