FACS FACTS

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Editor Jawed Siddiqi

From now on we shall ensure that FACS FACTS like its sister publication the FACS journal will appear quarterly. Our target dispatch dates are the last days of the months of May, August, November and February.

We are still having difficulty in obtaining "copy" for FACS FACTS, this might be because you are not sure what and when to send.

FACS FACTS is an "open-newsletter" _ it welcomes contributions. The newsletter provides an excellent forum to get your early thoughts circulated and reviewed. So why not send us your draft research reports. You can also send notices of events like workshops and conferences. The submission dates are end of April, July, October and January.

Jawed Siddiqi

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BCS-FACS Meeting on LOTOS
11 September 1990

A meeting on LOTOS, organised by the BCS-FACS group and sponsored by British Telecom, was held at Imperial College on 11 September 1990. LOTOS, Language Of Temporal Ordering Specification, has been adopted as an International Standard for the specification of the behaviour of distributed, concurrent information processing systems; this meeting was put on with the intention of disseminating information about the nature of the language itself, the availability of support tools and the experience of some of those who are now using LOTOS in earnest.

The day began with a tutorial on the language, presented by Ken Turner of Stirling University; no previous knowledge of the language was assumed, and the speaker gave a very comprehensible and gently humorous introduction to all aspects of the notation.

The other talk before lunch was given by Paul Tilanus of Netherlands PTT Research. His topic was **Tools for LOTOS**, and he gave us an overwiew of the current state of play. Much of the work reported here was partly sponsored by the Esprit project LOTOSPHERE, currently the largest project working on LOTOS development; it was noted that the work on tools within LOTOSPHERE took as input tools created within the earlier SEDOS project. The speaker identified various phases in the specification life cycle and discussed the tools which would usefully support those phases.
He mentioned text editors and syntax-directed editors for specification preparation, tools for syntax and static semantic analysis, simulators which allow the specifier to step through possible behaviours of the system to be specified, tools to perform correctness-preserving transformations or alternatively to check that proposed transformations are indeed correctness-preserving, "compilers" which can produce executable prototypes from a specification by taking note of additional comments which resolve non-deterministic aspects of the specification, and tools for automatic test generation and selection.
At present, tools exist in each of the categories described here, but they are research products rather than production quality tools and in general are not yet able to handle specifications of the size encountered in industrial environments.

The proceedings resumed after lunch with a talk by Robert Booth of British Telecom entitled **Experience of using LOTOS for OSI**. Again the speaker was describing work done as part of the LOTOSPHERE project, specifically on the OSI Specification and Implementation Task. The aims of this Task are to use LOTOS in practice together with the methodology and tools developed in LOTOSPHERE; the application area is OSI

Transaction Processing, chosen because this is a service which could be exploited widely for data processing, whilst being a complex standard not yet fully developed.
The work has a definitely industrial focus, aiming to employ technologies which can be used immediately in industry. Experience of such use should lead to refinement of the LOTOSPHERE methodology. Technology transfer and the building of confidence in the new techniques are important aims. Some facets of the LOTOSPHERE method are: LOTOS as a wide-spectrum language used to describe systems at many different levels of abstraction, identification and description of specification structuring styles such as constraint-oriented and state-oriented, transformation methods for moving from one style to another, simulation and testing, compilation and prototyping, the creation of a library of compiled LOTOS fragments..
Experience gained suggests that the notation has good expressive power within its intended field of application, though the inability to express timing constraints is felt to be a potential problem area. The ACT ONE component is found to be cumbersome for describing the kinds of data strucures needed in this Task. Testing is given a high profile by industrial users, but the speaker felt that simulation was a soft option, and in some cases had encouraged specifiers to modify their specifications in order to be executable. Tool performance is felt to be inadequate at present, that is to say, too slow on life-size specifications. The need is felt for some kind of module mechanism to be introduced into the language.

Clazien Wezeman, also of British Telecom, then gave a talk on **Conformance Testing and LOTOS**. She discussed the idea of conformance, a concept which is inherently more complex than the notion of correct implementation for sequential systems since it has to take account of the possible reduction of non-determinism in an implementation. She contrasted the informal specification/informal conformance scenario with its formal counterpart. She stressed the need for testing even when formal specification and formal development techniques were used, and the main part of her talk was concerned with a method, known as CO-OP, which derives a formal description of a tester for a given system.
The derivation is compositional, which is to say that given a system described as a composition of two simpler behaviours, then the tester for the composed system is itself composed from testers for the simpler behaviours. Further research will investigate the relation between this work and the ISO conformance testing Standard, will address the problem of test selection (even though we may be able to derive a formal description of a suitable tester we cannot in general exercise all possible behaviours), and will apply the method to life-size examples. Again the work reported here has taken place under the LOTOSPHERE umbrella, though it derives from earlier work in the Alvey FORMAP project.

Tommaso Bolognesi, of CNR-CNUCE Pisa, then spoke about **Timed LOTOS: which way to go?**. As mentioned earlier, there is a felt need for the ability to express timing constraints. Many proposals for new features in LOTOS to satisfy this need have been put forward, but none has been universally welcomed as the definitive answer to the problem. The motivation behind these efforts is to provide realistic specification of time-dependent behaviour, and some formal basis for performance analysis. Any new features to be introduced must be sufficiently expressive and perspicuous; for example, specifiying explicitly the passing of time, represented by `tick' events, is very tedious. An undesirable but predictable side effect of new timing features would be a more complex underlying theory, and consequent loss of analytic power.

The day ended with a talk by Stewart Black of Hewlett-Packard Labs, whose topic was **Object-Oriented LOTOS**. He began by explaining the notion of `object-orientedness' (which we can take as read for FACS group members) and went on to justify the need for an object-oriented LOTOS. The main point here is to to be able to describe distributed systems using the object model. It is felt that such descriptions could profit from the experience of object-oriented modelling (as described by Grady Booch, for example, in his recent book ``Object-Oriented Design''). The parallels were drawn between process definitions in LOTOS and class templates in the object-oriented world, between process instantiations and objects, between value parameters and object states, between behaviour expressions and methods.
It was intended that some minimal extensions to LOTOS should be introduced, for example, to support inheritance; it should be possible to translate down to standard LOTOS. Some misgivings were expressed by members of the audience about the feasibility of this.

The meeting was interesting and instructive, bringing us up to date with current activity centred on LOTOS. On behalf of all those who attended, our thanks to the speakers and the organisers. Also in this issue of the Newsletter we include some of the papers presented at the meeting.

David Till, 25th February 1991

Formal Methods in Computing - Their relevance to the Engineering Community: Investment and Benefit

A report of a one day meeting, 5 November 1990, Overseas House, London.

As a rite Northerner I was intrigued to attend a meeting organised by the London Mathematical Society and the British Computer Society. What maths can London get up to that the rest of us don't need? Has anyone told the M1 corridor folk? The brief of the meeting was to popularise the Formal Methods theme with speakers and presentations aiming to describe current good practice to engineers rather than advance the limits of the subject itself.

John Wadsworth (IBM Hursley) gave a talk familiar to seasoned Formal Methoders in which he outlined the maintenance and development nightmare that IBM faced with its transaction processing package CICS by 1981. It was already 12 years, and was successful enough to have thousands of users worldwide, to be running on a wide range of IBM mainframes and suffering from the "rot" of many many changes to its specification. In a move now acknowledged as critical to the continued success of the product IBM respecified the core of the system in Z, with consultancy from a prime mover of Z, Oxford University. The new specification style was found to fit after the Program Function Specification (IBM-speak for a very high level, low precision document subject to approval by review techniques only) and before the Component Level Design and Coding Stages. John Wadsworth commented "For a product due to be delivered to thousands of sites it only needs the new Product Level Design Stage (the Z level) to trap a few errors for a great deal of money to be saved." Unfortunately - and as was true for the other presentations - no way was found to quantify these savings.

Internally IBM seem well pleased with their experiences, thought hey have not found the approach infectious. The vast army of CICS application programmers outside IBM do not make direct use of the interface specifications, for example.

Bernie Cohen is always a joy to listen to. If these notes are incomplete it is because I was reflecting upon his thoughts rather than scratching on paper. He could well have subtitled his talk on the Identification and Discharge of Proof Obligations as "Everybody is talking about it but few are willing to do it."

His uncontroversial starting point is that it is fruitless to develop software in an ad hoc way, try to measure its quality at the end, and then either keep it or throw it away. Indeed the Engineers in the audience quickly recognised the "must assess the method of production at every stage" philosophy of the B5 5750 or ISO 9000 Quality Assurance standards.

In engineering environments it is the duty - or obligation - of the designer to present a convincing argument for the adequacy of the work and the responsibility of the reviewers to avow that they were convinced by these arguments. The level of proof should be appropriate to the risk: testing, compliance, analysis or formal verification as needed. This is culturally different from the from the product-orientated "walkthrough" technique in widespread use at present within the software industry. Walkthroughs mix fault finding with approval. ("If I don't find any more faults there aren't any.")

Bernie's trademark is making comparisons with other disciplines. He set the brain cells fusing when he made a claim that mature engineering disciplines have so abstracted from the raw physics that the engineers can manipulate the icons - can conduct rigorous proofs - without even understanding the basic physics. For example, electronic engineering, where the formalism of electronic symbols is sufficient to think about designs. Could software engineers divorce themselves from the basics of their machines and think exclusively at an abstract level? If so, Formal Methods have a chance! Just to stop us getting too excited, Bernie reminded us of the proof obligations. Tools could assist in administrative tidiness and the proofs are assisted by skilful designs in the first place, but the proofs still remain to be done.

And then he didn't do any, but I refer you back to (my) subtitle of his talk!

Paul Robinson echoed some of Bernie Cohen's ideas but set them into a commercial context. Rolls-Royce and Associates Ltd have an obvious safety need, but also need to observe real-world constraints on development times and costs. One of their major findings was that a Formal Methods approach does fit in to their existing document-driven/change-controlled approach (Lifespan).

For Rolls-Royce and Associates Ltd much of the problem rests with relying on the trustability of the compiler's output (see the comments about symbolic abstractions above). Their approach was to use the SPADE (Southampton Program Analysis and Development Environment) system which allows the formal specification - statements in the form of boolean statements - to be embedded into the code. Static analysis (some machine based, guided by an expert) and much dynamic testing provide evidence to external assessors that the software does do as specified. Of course, this still doesn't check that the product as specified will be one that the user actually wants.

The talk highlighted two other bonuses. Static analysis identified and prevented the error of other bonuses. Coincidental coupling when a module was to be reused in another place. In its first location it could presume variables had been previously been initialisation to zero but in the second place this was not so. The second was that the formal specification could be used to generate example test cases and answers, to be checked against the actual results. This helped change the dynamic testing into a confirmatory rather than debugging exercise.

David Brownbridge then described how Praxis Systems plc had fared when using Z in the development of an air traffic control display system. This was a medium scale development, involving four to seven people over eighteen months. The workers started with a basic familiarity of Formal Methods, and had access to a sophisticated Z editor and version control/distribution facilities.

As at IBM the formal specification was written to take a systems view, then component-oriented software specifications were extracted. The

systems view turned out to be a two hundred page mix of Z and narrative, structured over ten chapters going from the abstract to the concrete, aiming to provide a traceable record of design decisions for the benefit of the users and also the implementers. This specification was agreed by the client. The software specifications were developed by taking slices of the relevant functional specifications from each chapter.

Praxis found that the coding stage still raised the questions about the specifications, particularly to do with omission/lack of coverage faults. The original specifications had to be changed, and the normal change control procedures instigated. Animated tools proved useful for highlighting missing requirements and for exploring the consequences of chosing between interpretations, but were not found effective in coming to terms with detailed logic. An important lesson was that getting the level of abstraction right over the various levels of specification was very important, but was difficult with their level of experience at that time. Even trivial computer based support, such as the machine enforcing sequential presentation of the specification (as opposed to its serial development) and type-checking facilities, was found to be invaluable. Also, despite spending cash on training the clients in reading Z. Praxis still reported a tendency of the users to rely on the most concrete specifications of all - the program listings.

So, I concluded, it isn't a case of London telling the rest of us something new. Indeed, with the speakers employed at Hursley, Derby and Bath, perhaps they were telling London!

The examples cited, are not particularly new or large. They do, though, show the (unquantified) use of formal techniques to everyday problems in engineering applications. The talks were aimed at Engineers rather than Formal Methods experts and eschewed too many $\forall x.T \Leftrightarrow \neg F$, so on. I commend other talks in the series to Engineering folk.

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FORMAL ASPECTS OF COMPUTING

Contents of recent and forthcoming issues.

Vol. 3, No. 1 (January - March '91)

Vol. 3, No. 2 (April - June '91)

C. Morgan and J.C.P. Woodcock, Oxford University Computing Laboratory, UK (Eds.)

3rd Refinement Workshop

Proceedings of the 3rd Refinement Workshop (organised by BCS-FACS, and sponsored by IBM UK Laboratories, Hursley Park and the Programming Research Group, University of Oxford), 9-11 January 1990, Hursley Park

Publication: end February 1991
208pp. (approx.), with 25 figures
Soft cover
£20.00 (BCS and FACS members £16.00)
ISBN 3-540-19624-2

The papers contained in this volume were presented at the 3rd Refinement Workshop which was held at IBM's Hursley Park Laboratory, from 9-11 January 1990. In January 1988, Professor John McDermid, of the University of York, organised a two-day workshop on the "Theory and Practice of Refinement". In his foreword to the workshop proceedings, Professor McDermid stated that the two main obstacles to the application of formal methods were the lack of an adequate technique for modularising specifications and the limitations of refinement techniques. The purpose of this first workshop was to focus attention on refinement and expedite work in the area. Since then, the 2nd and 3rd Refinement Workshops have been held and the 4th Refinement Workshop is planned for January 1991.

Refinement, in its most general sense, is the extraction of programs from specifications. The objective of work in the refinement area is the systematic and verified development of implementations from specifications, be they hardware or software developments.

Contents: Deriving an Occam implementation of action systems - Refinement algebra proves correctness of compiling specifications - On the usability of logics which handle partial functions - Designing and refining specifications with modules - Formal program development in extended ML for the working programmer - Relations and refinement in circuit design - Specifying and refining concurrent systems: an example from the RAISE project - Using refinement to convince: lessons learned from a case study.

Proc. 3rd Refinement Workshop
9 - 11 January 1990, Hursley Park.

Contents

Tools for LOTOS

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August 1990

Abstract
In this paper an overview is given of potential tools for LOTOS. These tools are presented from a user's point of view (which user requirements are satisfied). Most attention will go to those tools that have no counterpart in, or differ significantly from, tools for programming languages, thus stressing the properties of LOTOS as *specification* language.

1 Introduction

Formal Description Techniques (FDTs) are techniques for the definition of the behaviour of (information processing) systems in a language with a formal syntax and semantics. FDTs are important tools for the specification, design, and analysis of information processing systems. It is by means of FDTs that system descriptions can be used that are *complete, consistent, concise, unambiguous* and *precise.* An important aspect of formally specified system is that it allows analysis by mathematical methods. (Cited from [IS8807].)

LOTOS is an FDT for which the above holds. The application area for LOTOS are distributed, concurrent information processing systems. In this area, where the complexity of systems behaviour is often too large for human comprehension, LOTOS provides support. This sounds promising.

Though LOTOS as a mental tool in the description of a system should not be underestimated, the real power and support (of any FDT) can only be exploited fully when tools are used. Due to the sound mathematical basis of LOTOS (process algebra and abstract data types), quite a number of tools can be envisaged for various phases in the specification life cycle.

[1]The work is partly sponsored by LOTOSPHERE (Esprit Ref. 2304). The opinions expressed in this paper, though influenced by this project, are the author's opinions; not necessarily those of LOTOSPHERE.

It should be noted that the life cycle of a specification differs significantly from a program life cycle. Normally one produces a high level specification first (e.g. a *service* in OSI context). This high level specification is refined: detail is added without (significant) changes of the overall behaviour (e.g. the service can be refined into a *protocol*). A detailed specification, possibly annotated with implementation decisions, might be 'compiled' to produce a prototype.

FDTs and programming languages have in common that the syntax, and for well-defined languages, the semantics are unambigously defined, making some analysis posssible. They also have in common that tools (a compiler for a programming language) are needed to make them useful.

For programs the refinement steps, recording the design/implementation decisions explicitely, are missing.

Some tools for FDTs look, due to the commonalities, a lot like tools for programming languages. In the sequel these tools will be mentioned, but most attention will be paid to tools that are specific for LOTOS (FDTs).

2 Specification Creation

Specifications for LOTOS can be created with

- any ASCII editor,
- a structure editor
  - textual,
  - graphical.

A structure editor, also called template editor or syntax driven editor, allows the user to indicate some nonterminal and replace it by one out of several templates. For instance, when a <*behaviour – expression*> is indicated, this can be replaced by the template of a <*hide – expression*>: **hide** <*gate – identifier – list*> **in** <*behaviour – expression*>.

The advantage of a structure editor is that one does not need to remember the details of Lots Of Terribly Obscure Symbols[2]: nonterminals are replaced by something that is syntactically correct at that place. A further advantage is that the lay-out is taken care of automatically.

Structure editing can become frustrating when used at low levels. E.g. it might be easier to type a <*gate – identifier – list*> (identifiers and commas), than to do this with template

[2]I first heard this alternative explanation of the acronym LOTOS from Peter van Eijk, but it is probably of a much older origin.

replacement (which takes care of the commas). It is therefore a user requirement that a structure editor allows to escape to plain text editing.

3 Static Checking

Once the specification is created (or modified), it has to be checked for syntactical and static semantical correctness. The static semantics of LOTOS are rather complex as a result of the LOTOS design decision *not* to constrain the specifier unnecessary. Nevertheless, tools for syntax and static semantics checking are feasible (of course).

One interesting possibility is to create a tool that integrates the tool functions of a structure editor and an interactive static semantics checker. Fortunately, meta-tools that help in generating such a tool exist [ReTe88, DiKo89].

The syntax and static semantics error report is in fact not something a user really wants to do (user requirement), but it is a prerequisite for other tools (for verification, simulation, code generation) to work correctly. In general, the preparation for validation (see section 4) is rather time consuming, and once an error is found it is hard to continue analysis. For this reason one wants to eliminate as many errors as possible using static checks.

A more interesting report could be a cross reference report. In particular an interactive version is helpful for LOTOS in helping to resolve overloading: for an operator the correct definition and the relevant equations are indicated, even if there are several operators with the same name.

The dependency report provides the user with a report on the logical dependency order among process definitions and among type definitions. In a sense the dependency report is a complexity measure, and based on this report one might decide to change the structure of the specification in order to lower the complexity and improve understandability.

When the interactions of the two operands (behaviour expressions) of a parallel operator do not match, no interaction will take place. E.g.

```
g ! 0 ? b : Bool ;          and          g ! true ? n : Nat ;
```

do not match, but that is hard to discover when there are many offers or when there are 20 pages in between[3]. From the static semantics point of view there is nothing wrong with specifying deadlock or dead specification code. However, in most cases the intention is *not* to specify deadlock or dead code, and a gate-sortlist report reports on this kind of 'suspicious mismatches'.

[3]It has been reported that in an 'industrial size' specification, the ISDN D channel Layer 3 protocol specification, most errors found with a simulator are errors in the data types and mismatches in events due to different orders of offers [TiYa88].

4 Validation of the Specification

Simulation is a good means to get confidence in the specification: is the specified behaviour indeed the desired behaviour?

A simple simulator takes the user through the behaviour in a step by step fashion. The tool shows the list of possible events, the user selects one of these events, provides values for variables, and the tool computes the list of subsequent events [Eijk88, Tre89]. In these computations the equations of the abstract data types are treated as rewrite rules.

Such a simulator can be equiped with features to log a simulation session, replay such a session, step or jump back in the trace to follow another branch, etc.

A more advanced simulator could offer a number of additional functionalities.

- **symbolic simulation**
  When no values are specified for variables, the simulation computes the behaviour with open expressions (expressions with variables). That means that not all guards and selection predicates can be evaluated to True or False, and instead they are collected. The simulated behaviour is valid for those values of the variables that make all guards and selection predicates found on the simulated trace true.

- **narrowing**
  Narrowing is a technique that tries to evaluate one or more expressions (a so-called 'goal') in the presence of variables. This technique is therefore a very powerful addition to symbolic simulation, e.g. to inform the user about the infeasibility of a trace when the goal for that trace always evaluates to False.

  Example: a simulation trace with a goal that contains $x\ IsIn\ emptySet$ or $Is\_Setup(y) \wedge Is\_Release(y)$ is not feasible for any x or y.

- **multi-step directed simulation**
  Instead of indicating exactly what event should be done next, a user might indicate a pattern of events, and the simulator should establish all possible traces that satisfy that pattern (simulation directed by a pattern). Without symbolic simulation the power of multi-step simulation is rather limited (because in non-symbolic simulation the user might need to provide values half way the pattern).

5 Transformations of the Specification

Once a high level specification is available, transformations towards more implementation oriented specifications are possible. For this purpose the weak bisimulation congruence and equivalence, and the testing congruence and equivalence as defined in [IS8807, Annex B] can be used for the process part of LOTOS. Each of these transformations preserves most properties of the specification while changing some property in a controlled

way. These transformations are therefore called *Correctness Preserving Transformations* (CPTs).

Two more CPTs on the process part have been defined recently ([LOT90a], publications in preparation).

The *regrouping of parallel processes* [LOT90b] is a transformation that takes an expression consisting of a number of processes composed with parallel operators and transforms these into an expression, with strong bisimulation equivalent behaviour, in which the processes are grouped differently. The original configuration of processes might be a good presentation of the logical structure (architecture) of the system, and the regrouping might reflect the intended partitioning of processes over processors.

The *bipartition of functionality* [LOT90c] is a transformation that splits a single process into two processes communicating in a prescribed configuration. The original and the pair of communicating processes are weak bisimulation equivalent.

CPTs like the ones described above are best supported by a tool that checks the conditions for transformation and, if the conditions are satisfied, takes care of the replacement. In a sense these transformations are a special kind of edit operation.

Correctness preserving transformation of the data type part of LOTOS also exist.

The equations of the abstract data types are handled as rewrite rules by e.g. the simulator. A desirable property of this rewrite system is that rewriting terminates and leads to unique normal forms (this is called 'complete'). With limited user interaction a so-called completion tool can transform a set of conditional equations into a complete conditional rewrite system. This transformation preserves the initial semantics of the algebraic specification.

6 Verification of Transformations

Despite the nice transformations described in the previous section there are occasion where refinement of the specification has to follow other, less-controled ways. To get some confidence in these 'hop, skip and jump transformations' one wants to check afterwards that e.g.

- a temporal formula expressing some property that holds for the original specification also holds for the transformed one,
- an abstraction of the original specification is equivalent or congruent in some sense to the same abstraction of the transformed specification.

Several properties of a LOTOS specification can be expressed in temporal logics. The temporal logics formula for a certain property can be derived from the original LOTOS

specification and from the transformed specification. Then it should be verified that the formula for the transformed specification can be proved from the formula of the original specification. A tool that assists in this proof (or proves it automatically) would be helpful.

If the full specification and its transformation are large, then an abstraction of the specification might be used. Examples of abstractions are

- projection of LOTOS on basic LOTOS (no data),
- combining several interactions into 'abstract actions'.

When the abstractions of the specification and its transformation are of manageable size, tools for automatic proof of weak/strong bisimulation/testing equivalence/congruence can be applied. What new abstractions can be invented that provide valuable information on the original specification remains a research topic.

7 Compilation

When a formal language can be compiled, then it is, one might say 'by definition', a programming language. The term 'compilation of LOTOS' is used to address two approaches to prototyping:

- The implementation decisions that cannot be represented in LOTOS are added in the specification in special comments. These special comments address topics like e.g.
  - association of abstract data types with machine data types, in particular for integers, booleans, characters, ...
  - resolving value generation,
  - association of a delay to an internal event that represents a timer.

  LOTOS extended with these special comments can then be compiled [MMT89].
- The specification is transformed (using CPTs and creativity) until all 'difficult' constructs are eliminated. LOTOS restricted to 'easy' constructs can then be compiled. Currently it is expected that this approach will produce more efficient code.

Of course these approaches can be combined, but in that case one comes dangerously close to the 'extended subset' phenomenon.

8 Test Derivation from the Specification

No matter how many precautions have been taken, the final implementation needs to be tested. There are ways to generate tests from a LOTOS specification, but in many cases the set of generated tests is not finite or too large to be practical.

One of the test generation tools currently available for basic LOTOS is based on the CO-OP method[Wez89] (where CO-OP stands for Compulsory and Optional events). This method is currently being extended to full LOTOS.

9 Concluding Remarks

For formal languages like LOTOS and programming languages some similar tools can be produced. However, due to the different objectives of a specification and a programming language, quite a number of specification specific tools are possible. The tools being available are available as research products, and in most cases not yet able to handle specifications of the size that can be expected in an industrial environment. One of the objectives of the Esprit project LOTOSPHERE is to show the feasibility of a tool environment that would be servicable to the information technology industry.

A language like LOTOS requires support. Tools provide part of that support, but equally important is the support of the user by a good (set of) method(s). It is for this reason that LOTOS methodology receives a lot of attention in the LOTOSPHERE project[4].

LOTOS is not a dead language, and that means that use of the language results in proposals to extend the language. One of the (conservative) extensions currently under study is the introduction of modules [Bri89]. The acceptance of this extension has a significant impact on the tools, as shown by an earlier, and more primitive, attempt [Hul89]. New tools that would be needed, like version and configuration management, will probably be very similar to existing ones for programming languages.

References

[Bri89] E. Brinksma, *Specification Modules in LOTOS*, in [Vuo90].

[DiKo89] M.H.H. van Dijk, J.W.C. Koorn, *Generic Syntax-Directed Editor*, The CENTAUR User's Guide Version 0.9, 1989.

[Eijk88] P.H.J. van Eijk, Software tools for the specification language LOTOS, Ph.D. thesis, University Twente, The Netherlands, 1988.

[4]The fact that LOTOSPHERE is mentioned several times is *not* because I'm involved in this project, but because it currently is simply the largest reseach project devoted to LOTOS only.

[EVD89] P.H.J. van Eijk, C.A. Vissers and M. Diaz (editors), *The Formal Description Technique LOTOS – Results of the ESPRIT/SEDOS Project*, North-Holland, Amsterdam, 1989.

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[LOT90a] LOTOSPHERE Task 1.2, *Correctness Preserving Transformations*, First Year Deliverable of Task 1.2, April 1990.

[LOT90b] A paper on the solution of the *Regrouping of Parallel Processes* problem has been accepted at ICDCS X, 1990.

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[TiYa88] P.A.J. Tilanus, Y. Yang, *Experience with LOTOS and environment LOTTE on an ISDN protocol*, in the proceedings of the BSC FACS conference 'Specification and Verification of Concurrent Sytems', Stirling, July 1988. (Recently published: C. Rattray (editor), Springer-Verlag, Berlin, 1990.)

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[Wez89] C.D. Wezeman, The CO-OP method for compositional derivation of conformance testers, in the proceedings of the 'Ninth IFIP WG 6.1 International Symposium on Protocol Specification, Testing, and Verification', edited by E. Brinksma, G. Scollo and C.A. Vissers, June 1989.

British Telecom - British Computer Society / FACS Group
Meeting on LOTOS - London, September 11, 1990

Timed LOTOS: which way to go ?

T. Bolognesi

C.N.R. - CNUCE - Pisa

Contents

1. Motivations and requirements for a timed extension of LOTOS

Motivations

- *Realistic* specification of concurrent systems exhibiting *time-dependent behaviour*

  (where time parameters such as **data processing times, communication channel delays, timeouts** influence system's behaviour, e.g. by pruning branches).

- *Performance analysis*

Requirements

- *User-friendly*

  specifying explicitly the passing of time (tick-events) is tedious...

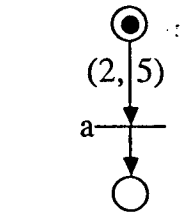
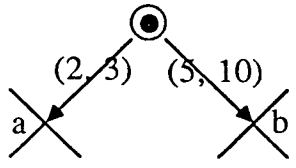
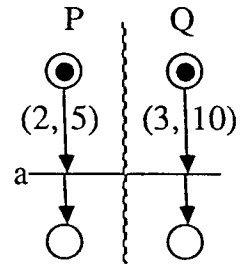
- *Upward-compatible*
  - a LOTOS spec should be a legal Timed LOTOS spec, and
  - its new (timed) interpretation should be the same as, or *very close* to the old (standard) interpretation.

Expected side-effect

More complex underlying theory,
loss of analytical power.

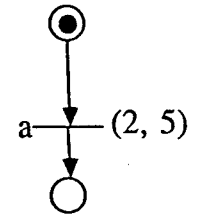
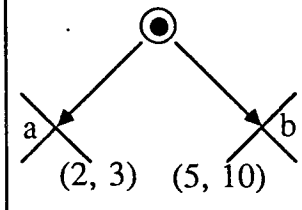
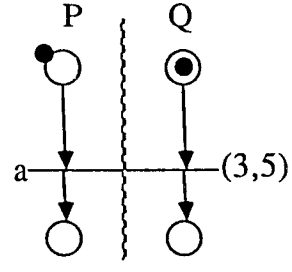
2. A lesson from timed Petri Nets

Timed-Arc Petri Nets ≈[W83]

Example	Behaviour	General feature
	**a** *may* occur; **if** it happens **then** 2 ≤time(a)≤ 5	passive (reactive) system; *"declarative" timing*
	**b** may occur in place of **a**	(as above)
	if **a** occurs, then 3 ≤time(a)≤ 5	*local* significance of time intervals (timers) mismatch of time intervals may lead to deadlock

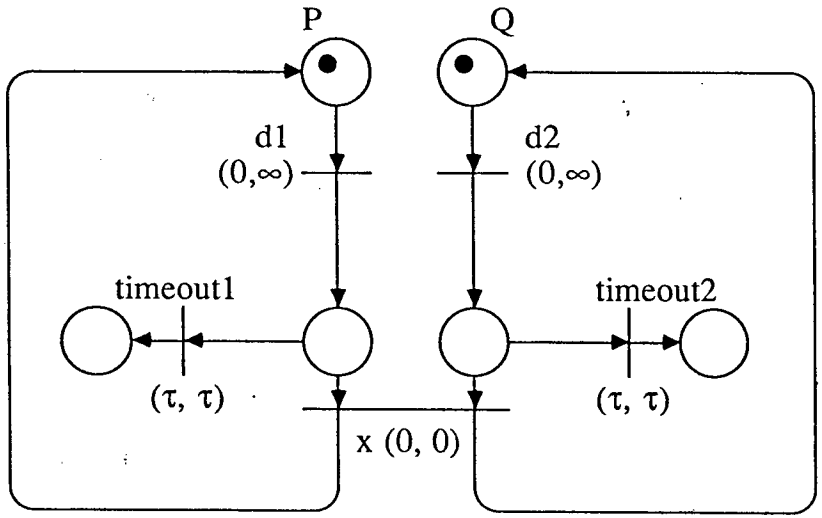
Declarative and local timing

Timed-Transition Petri Nets [MF76]

Example	Behaviour	General feature
	**a** *must* occur, and 2 ≤time(a)≤ 5	active system; *"imperative" timing*
	**b** will never occur, because at time t > 3 **a** must have occurred	(as above)
	**as soon as** **a** is enabled, a timer for **a** is started; **a** must then happen in due time	*non-local* significance of time intervals (timers) no deadlocks from time interval mismatch

Imperative and non-local timing

Timed-Interaction Petri Net for a Symmetric Timeout System



- *non-local timing:*

  x occurs ASAP, that is, as soon as P *and* Q are ready for it.

- *imperative timing:*

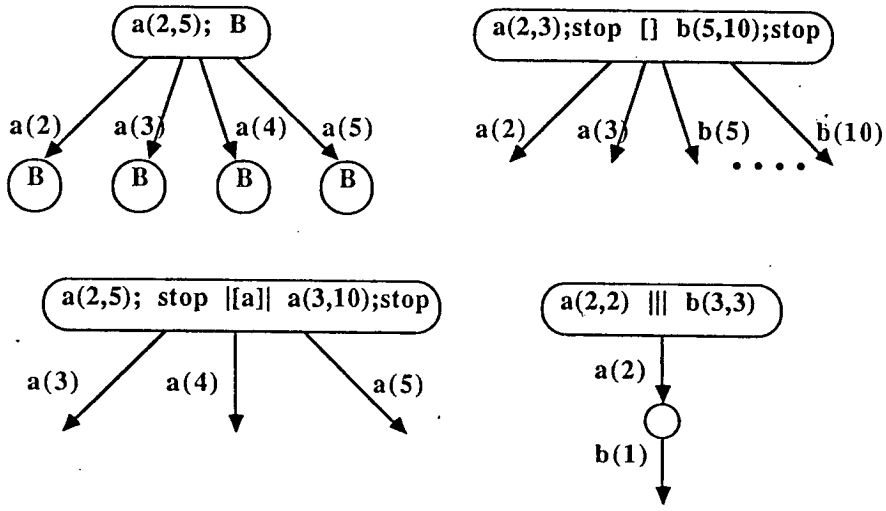
  a timeout *must* occur if the partner for interaction x is not ready in time.

Comparing Timed-Arc and Timed-Transition Petri Nets

	Expressive power	*Analytical power*
Timed-Arc Petri Nets	- Cannot adequately model symmetric timeout - Are not more expressive than untimed Petri Nets [BC89]	+ Polynomial time algorithm for checking the feasibility of a given timed behaviour [BR85]
Timed-Transition Petri Nets	+ Can adequately model symmetric timeout + Can simulate Turing machines [JLL77]	- *Boundedness* (of circulating tokens) and *Reachability* (of a given marking) become undecidable [JLL77]

3. A Timed-Action-LOTOS ≈ [QAF89]

Examples



- Time is *global* and *discrete*; events are instantaneous.
- (Implicit) timers are *local* to processes:
  the specifier may indicate, in *action prefix*, the time interval during which the action is offered.
- The semantics is a minimal and most direct extension of the Structured Operational Semantics of LOTOS:
  it yields *Timed Transition Systems*.
- Timed transition B--a(t)-->B' means that B may transform into B' by performing action a at time t, *relative* to the previous global event.

Action prefix

a(t1, t2); B--a(t)-->B (t1 ≤ t ≤ t2)

Choice

B1--a(t)-->B1' *implies* B1 [] B2--a(t)-->B1'

Synchronization

B1--a(t)-->B1' *and* B2--a(t)-->B2'
implies B1 [] B2--a(t)-->B1'

Interleaving

B1--a(t)-->B1' *and* (B2--a(t')-->B2, at t'≥t, *or* *not*(B2--->))

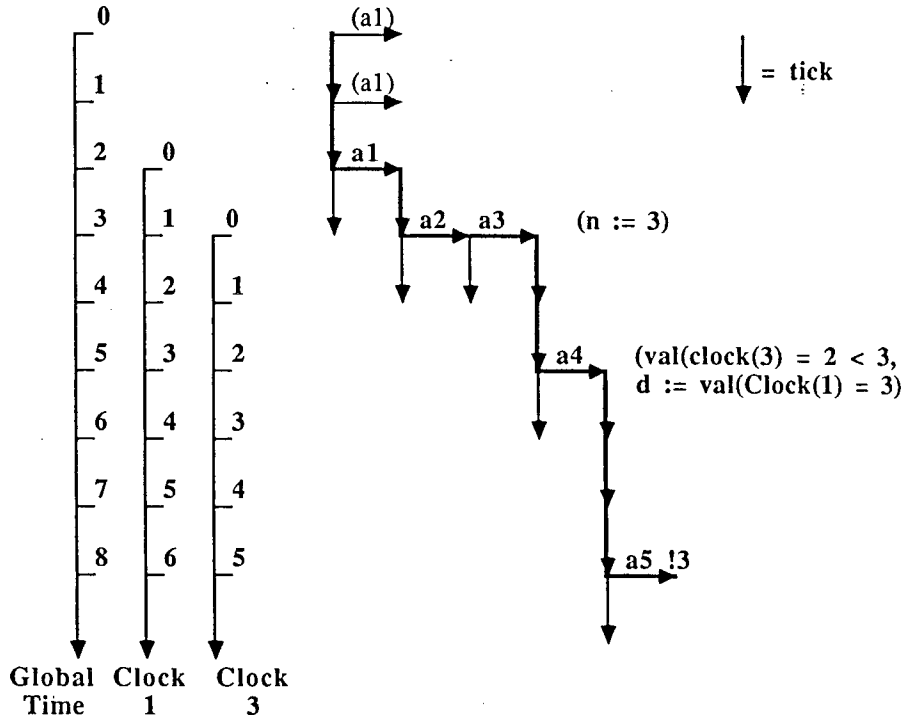
implies B1 ||| B2 --a(t)-->B1' ||| Old(t, B2)

- Analogy with Timed-Arc Petri Nets
  - Local (implicit) timers.
  - "Declarative" timing (see choice operator "[]")
  - Difficulty in adequately modelling the Symmetric Timeout system (no ASAP capability).
- Use of negative preemises (in semantics of "|||")

4. Clock-Extended-LOTOS ≈ [vHTZ89]

Example

```
        a1              [start(Clock(1))];
        a2 ?n : nat     [start(Clock(n))];
        a3;
    choice d : duration []
        a4              [(value(Clock(n)) < 3)
                        and (d = value(Clock(1)))];
        a5 !d; ...
```



- Time is *global* and *discrete*; events are instantaneous.
- Clocks *local* to processes are manipulated explicitly: every process may *start*, *read*, *reset* its clocks, on the occurrence of a given event.
- Time values (and clock id's) are normal data values. In particular they may appear in *selection predicates*.
- Given a sequence of events (in a single process), control over the time interval between non adjacient events is straightforward.
- An implicit *tick event* (pure passing of time) is ***always*** possible for every process, in any state.
- Parallel processes may not share the same clock.

- Analogy with Timed-Arc Petri Nets.
  - Local clocks
  - "Declarative" timing: no action is forced to occur (*tick* alternatives).
  - Difficulty in modelling the Symmetric Timeout system:

    with a trick we may express that, if synchronization x occurs, it is indeed ASAP; however, we cannot avoid the *tick-syndrome*: x is enabled in time, and NOT executed, or *tick* occurs in place of a *timeout*.

5. Towards a Timed-Interaction-LOTOS

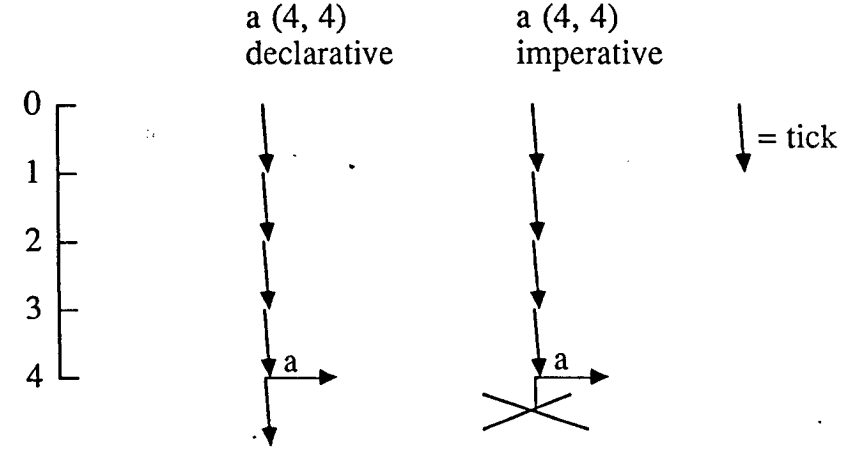
- **Non-local** timers (of Timed-Trans. PNs) ---> Timed **inter**-action (by a *timer* operator)

The Symmetric Timeout System (see Timed-Trans. PN of p. 5) could be described as follows:

```
process Sym-Timeout-System :=

        timer x(0, 0) in                (* x ASAP *)
                (P   |[x]|   Q)
where
process P:= d1;
        (    x; P
        []   timer timeout1(τ, τ) in
                        (timeout1; stop)
        )
endproc

process Q:=     <similar to P>     endproc

endproc (* Sym-Timeout-System *)
```

(for semantics of timer op., see [BLT90], under revision)

- **Imperative** timing (for eliminating the *tick syndrome*) ---> priorities



A priority operator **"prior(a > tick) in ..."** could make tick-events possible only in the *absence* of an alternative a-event:

B--tick-->B' and *not* B--a-->

---

prior(a > tick) in (B) --tick--> **prior(a > tick) in** (B')

(see [G89] for a discussion on negative premises and priority)

6. Conclusions

- No proposal for timed LOTOS has been so far recognized as the definite solution.

- Further approaches to timed process algebras have been investigated (Milner, Roscoe-Reed, Nicollin et al., Groote, Brinksma...);

  their potential benefits for the definition of an adequate Timed LOTOS should be investigated.

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[BC89] T . Bolognesi, P. Cremonese, "The Weakness of Some Timed Models for Concurrent Systems", Technical Report CNUCE C89-29, CNUCE - C.N.R., Pisa, October 1989.

[BR85] T. Bolognesi, H. Rudin, "On the Analysis of Time-Dependent Protocols by Network Flow Algorithms", Proceedings of the IFIP WG6.1 Fourth International Workshop on Protocol Specification, Testing, and Verification, Y. Yemini, R. Strom, S. Yemini editors, North-Holland 1985, pp.491-514.

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[QF87] J. Quemada, A. Fernandez, "Introduction of Quantitative Relative Time into LOTOS", Proceedings of IFIP WG 6.1 Seventh International Conference on Protocol Specification, Testing, and Verification, H.Rudin, C. H. West Editors, North-Holland, 1987, pp. 105-121.

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[W83] B. Walter, "Timed Petri-Nets for Modelling and Analyzing Protocols with Real-Time Characteristics", Proceedings of 3rd IFIP Workshop on Protocol Specification, Testing, and Verification, (H.Rudin, C. H. West Editors), North-Holland, 1983, pp. 149-159.

LOTOS and Conformance Testing.

Presentation for BCS Meeting on LOTOS, September 1990.
By Clazien Wezeman of the Formal Methods in OSI Group of British Telecom Research and Technology.

Abstract of the presentation.

Conformance testing is the art of establishing through testing whether an implementation conforms to a specification. The presentation will introduce the objectives of conformance testing and show its importance in the area of communicating systems. It will show how conformance tests are currently produced, and why the use of formal methods (including formal specification languages) would improve the process of producing conformance tests.

The presentation will proceed by introducing a formal method for deriving conformance tests from LOTOS specifications. This method is based on a formal notion of conformance and allows for formal reasoning on the correctness of its products. The method is the CO-OP method, named after its main attributes the sets Compulsory and Options.

The presentation is based on research work carried out in the Alvey project FORMAP (Formal Methods applied to Protocols), the Esprit 2 project Lotosphere and an internal BT research project.

Literature:

C.D. Wezeman, The CO-OP Method, a method for compositional derivation of canonical testers, M.Sc. Thesis, memorandum INF-88, University of Twente, NL, 1988.

C.D. Wezeman, The CO-OP method for compositional derivation of conformance tests, in Proc. IFIP WG 6.1 International Symposium on Protocol Specification, Testing and Verification, Enschede, NL, June 1989.

R. Alderden, COOPER the compositional construction of a canonical tester, in Proc. FORTE '89 Second International Conference on Formal Description Techniques for Distributed Systems and Communication Protocols, December 1989, Vancouver B.C., Canada, 1989.

C.D. Wezeman, S.Batley, J.A.Lynch, Formal Methods to assist Conformance Testing - A Case Study, to appear.

CONTENTS

BCS-FACS

British Computer Society - Formal Aspects of Computing Science Special Interest Group

presents:

A one-day workshop on Formal Aspects of Measurement

Friday, 3rd May, 1991

Council Room
South Bank Polytechnic
103 Borough Road
LONDON SE1 0AA

Programme:

09:30-10:00:	Registration
Morning session	(Robin Whitty, chair)
10:00-10:05:	Introductory remarks
10:05-10:30:	Norman Fenton, City University Software metrics: why a formal approach?
10:30-11:00:	Jim Bieman, Colorado State University Deriving measures of software reuse in object-oriented systems
11:00-11:15:	Coffee
11:15-11:45:	Norbert Fuchs, Alcatel Austria-ELIN Language independent definition of axiomatic metrics
11:45-12:15:	Austin Melton, Kansas State University Constructive software measurement
12:15-12:45:	Horst Zuse, Technical University of Berlin Measurement theory applied to software metrics
12:45-14:00:	Lunch
Afternoon session	(Horst Zuse, chair)
14:00-14:30:	Martin Shepperd, Bournemouth Polytechnic Algebraic models, OBJ and metrics validation
14:30-15:00:	Dave Gustafson, Kansas State University Properties of software measures
15:00-15:30:	Tea

15:30-16:00: Barbara Kitchenham, National Computing Centre
Never mind the metrics - what about the numbers?

16:00-16:30: Panel discussion with:
Jim Bieman, Tim Denvir, Norman Fenton, Norbert Fuchs, Barbara Kitchenham

Software measurement: a mathematical or an empirical science?

16:30-16:45: Closing remarks

FURTHER DETAILS

The meeting will be held in the Council Room of the South Bank Polytechnic at 103 Borough Road, London SE1 0AA. The registration fee for this meeting is £50 for BCS-FACS members, and £70 for non-BCS-FACS members. This will include a buffet lunch.

If you would like to attend, please fill in the registration form below, and return it to:

Research Administrator,
Centre for Systems and Software Engineering,
103 Borough Road,
London SE1 0AA.

Please enclose a cheque for the correct amount made out to BCS-FACS.

The places available for this meeting are limited, so please register early and don't forget to enclose your cheque. Registration will be strictly on a first-paid, first served basis.

REGISTRATION FORM

BCS FACS -- Formal Aspects of Measurement - Friday 3rd May.

Name(s): _____

Institution: _____

Address: _____

_____

Fee enclosed (£50 for FACS members, £70 for others): _____

Special dietary request: _____

Mark here if receipt required: ☐

CALL FOR PAPERS
FORTE'91

Fourth International Conference on FORMAL DESCRIPTION TECHNIQUES

Sydney, AUSTRALIA, 19-22 November, 1991

FORTE'91 is expected to be sponsored[1] by IFIP WG 6.1, other professional organisations such as IEEE (Australian Branch), and by the Overseas Telecommunications Corporation of Australia (OTC) and the Australian Telecommunications Corporation (Telecom Australia). The Conference will focus principally on standarized **FDTs** (Estelle, **LOTOS**, **SDL**, ...) and will include industrial applicability. The Conference will be a forum for presentation of the state of the art in theory, application, tools and industrialization of FDTs and will provide an excellent orientation for newcomers. The above FDTs have been designed for Distributed Systems and Protocols, but are applicable to other areas.

Research papers, industrial usage reports, tutorial proposals and tool demonstrations on FDTs are solicited, particularly in the following areas:

- Examples and analyses of formal descriptions
- Verification, validation, and testing
- Practical usage experience and case studies
- Industrial transfer and usage
- Design and implementation
- Methodology and architecture
- FDT-based software engineering
- Tools and tool support

North-Holland will publish the Conference Proceedings as a hardbound volume, titled 'Formal Description Techniques IV'. The Conference will start with one-day of tutorials on November 19.

1st June 91: Submission of full research papers (5 copies, 12 pt single spaced, max 16 pages). Send to Gordon Rose.

14th June 91: Submission of industrial usage reports (5 copies, 12 pt single spaced, max 8 pages), tutorial proposals and tool demonstrations. Send to Ken Parker.

1st Sept 91: Notification of acceptance.

30th Sept 91: Camera-ready version for participants' proceedings.
(Camera-ready version for hardbound volume to be handed in at the Conference.)

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Local Arrangements: D. Charrett (OTC - Australia).

ANNOUNCEMENT AND CALL FOR PAPERS

TWELFTH INTERNATIONAL CONFERENCE ON APPLICATION AND THEORY OF PETRI NETS

Wednesday 26 - Friday 28, June 1991

and

PETRI NETS TUTORIAL

Monday 24 - Tuesday 25, June 1991

Aarhus, Denmark

The Twelfth Annual International Petri Net Conference will be organized by Aarhus University, Aarhus, Denmark. Papers presenting original contributions in any area of application and theory of Petri nets are sought. The language of the conference is English.

TOPICS

System design and verification using nets
Causality/partial order theory of concurrency
Analysis and synthesis, structure and behaviour of nets
Net-based semantical, logical and algebraic calculi
Higher-level net models
Timed and stochastic nets
Relationships between net theory and other approaches
Symbolics net representation (graphical, textual, ...)
Computer tools for nets
Experience with using nets, case studies
Educational issues related to nets

Applications of nets to:
- office automation
- flexible manufacturing
- programming languages
- protocols and interfaces
- hardware structures
- real-time systems
- performance evaluation
- operations research
- embedded systems

The conference takes place under the auspices of: AFCET SIG "Systèmes Parallèles et Distribués" and CNRS-C^3, AICA, BCS SIG "Formal Aspects of Computing Science", EATCS and GI SIG "Petri Nets and Related System Models".

PAPERS

Authors are invited to submit an *extended abstract* (approx. 10 pages) or a *full draft paper* (at most 30 pages) for the conference. The title page must contain a short abstract and a classification of the topics covered, preferably using the list of topics above. The paper or extended abstract must clearly state the problem being addressed, the goal of the work, the results achieved and the relation to other work.

TOOLS, POSTERS, PROJECTS, MEETINGS AND COURSES

The conference will also comprise:

- An *exhibition of posters* describing theoretical and practical results. Posters are displayed throughout the conference.

- An *exhibition of computer tools* for Petri nets. Tuesday will be the main day of the tool exhibition and each tool will have its own scheduled time for a coherent presentation for a large audience. The length of each presentation will be approx. 60 min. Moreover, periods are set aside during the conference in which tools can be demonstrated for small groups. The organizers will provide Macintosh, IBM PC and SUN equipment. Moreover, there will be an overhead projection system for Macintosh and IBM PC. It may, upon request, be possible to supply other kinds of computer equipment.

- Short *presentations of projects* where nets are put into practice. This section of the conference allows the presentation of experiences of using nets in on-going or completed projects. The presentations will take place in a special session during the conference and each of them may be supplemented by a brief report in the proceedings.

- *Meetings and courses* with relation to Petri Nets. Monday and Tuesday will be the days for this activity. It is possible to arrange meetings for different groups, e.g. participants in international Petri Net projects. It is also possible to arrange small educational courses, e.g. with respect to some of the demonstrated Petri net tools. All activities are free of charge for the participants.

It is possible to combine different kinds of activities, e.g. a poster exhibition with a tool exhibition or a project presentation. For all four kinds of activities a brief description (2-10 pages) should be submitted to the program committee. The form of the intended activity must be clearly indicated, and the contents and purpose must be thoroughly described.

SUBMISSIONS

All kinds of submissions must be *received* by the chairman of the program committee no later than January 15, 1991 in *10 copies*. It is recommended to use express or courier mail. Submissions received too late will not be accepted. Authors will be notified of acceptance/rejection by March 31, 1991. Final papers are due by May 15, 1991. The page limit will be 20 pages for papers and 10 pages for project presentations.

TUTORIAL

The tutorial will concentrate on the basic notions and fundamental concepts of Petri nets. There will be talks on Elementary Net Systems, Place/Transition Systems, High Level Nets, Coloured Petri Nets, Timed and Stochastic Nets and Performance Evaluation.

HISTORY OF THE CONFERENCE

The conference was formerly called the European Workshop on Applications and Theory of Petri Nets and the meetings have taken place annually since 1980:

1980	Strasbourg, France	1986	Oxford, UK
1981	Bad Honnef, Germany	1987	Zaragoza, Spain
1982	Varenna, Italy	1988	Venice, Italy
1983	Toulouse, France	1989	Bonn, Germany
1984	Aarhus, Denmark	1990	Paris, France
1985	Espoo, Finland		

The aim of the conferences is to create a forum for discussing progress in the application and theory of Petri nets. Typically, the conferences have 100-150 participants - one third of these coming from industry while the rest are from universities and research institutions. The conference takes place in the last week of June.

PROGRAM COMMITTEE CHAIRMAN

Manuel Silva
Departamento Ingeniería
Eléctrica e Informática
C/María de Luna, 3 (Actur)
E-50015 Zaragoza
Spain

Phone: +34 76 51 72 74
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ORGANIZING COMMITTEE CHAIRMAN

Kurt Jensen
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PROGRAM COMMITTEE

G.F. Balbo, Italy
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L. Cherkasova, USSR
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G. Cutts, UK
P. Degano, Italy
C. Girault, France
T. Hildebrand, France
S. Kodama, Japan
P. Lauer, Canada
A. Mazurkiewicz, Poland
T. Murata, USA
S. Natkin, France
M. Nielsen, Denmark
W. Reisig, Germany
R.M. Shapiro, USA
M. Silva, Spain (chairman)
P. Starke, Germany
P.S. Thiagarajan, India
R. Valk, Germany
A. Valmari, Finland

Other major activities of the Petri net community include:

THE PETRI NET NEWSLETTER

The newsletter is published by the Special Interest Group on Petri Nets and Related System Models of the Gesellschaft für Informatik, three times a year. The newsletter contains short research articles, announcements of meetings, abstracts of recent publications, etc. The newsletter is edited by O. Herzog, W. Reisig and R. Valk and can be ordered from the following address:

Prof. W. Reisig
Institut für Informatik, TU München
Postfach 202420
D-8000 München 2
Germany

Phone: +49 89 2105 2405
Telefax: +49 89 2105 8207
E-mail: reisig@lan.informatik.tu-muenchen.dbp.de

ADVANCES IN PETRI NETS

This series is published by the Springer-Verlag (within the Lecture Notes in Computer Science series). The volumes are edited by G. Rozenberg. The intention of this series is to present the most significant recent results in the application and theory of Petri Nets to the broad computer science community. The majority of papers appearing in the Advances of Petri Nets are selected from those presented at the conferences. These papers appear in the Advances in a revised and improved form. Research papers and survey articles for the Advances can also be submitted directly to:

Prof. G. Rozenberg
Dep. of Mathematics & Computer Science
University of Leiden, Niels Bohr Weg 1
P.O. Box 9512, NL-2300 CA Leiden
The Netherlands

Phone: +31 71 27 70 55
Telefax: +31 71 27 58 19
E-mail: rozenber@hlerul5.bitnet

ADVANCED COURSES ON PETRI NETS

They are organized periodically, in order to present the progress in Petri nets in a systematic way. Until now there have been two such courses: Hamburg 1979 and Bad Honnef 1986. The material from these courses has also been published by Springer-Verlag (within the Lecture Notes in Computer Science series).

The activities of the Petri net community are coordinated by the following steering committee:

STEERING COMMITTEE

H.J. Genrich, Germany
K. Jensen, Denmark
G. De Michelis, Italy
C.A. Petri, Germany (honorary member)
G. Roucairol, France
G. Rozenberg, The Netherlands (chairman)
M. Silva, Spain

CATEGORY THEORY AND COMPUTER SCIENCE

(second announcement and call for papers)

3-6 September 1991
Ecole Normale Supérieure, Paris

The Fourth of the biennial Summer Conferences on Category Theory and Computer Science will be held in Paris. The main purpose of these conferences is to link research in category theory with computer science. The importance of categories in understanding basic issues in computer science is now well established. Other structures in logic, algebra and topology are also seen as fundamental and the scope of the conference is to cover applications of these structures as well. Papers are welcome in any of the following, non-exhaustive, list of topics :

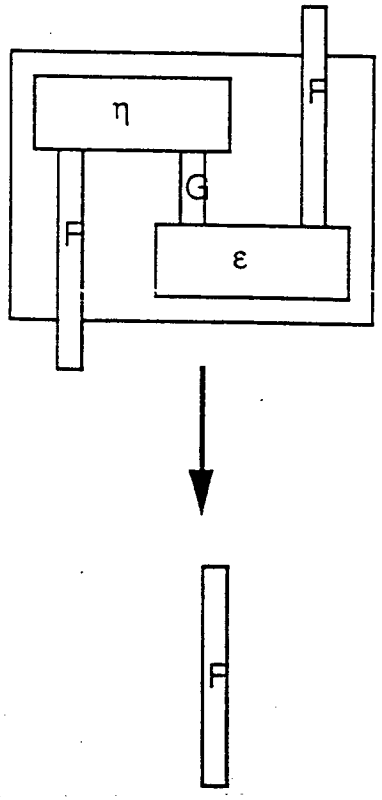
- Semantics of Programming Languages
- Program Logics and Specification
- Type Theory
- Categorical Logic
- Semantics of Concurrency
- Linear Logic

It is intended to publish the proceedings as Springer Lecture Notes.

Organizing and Program Committee:
Samson Abramsky, Pierre-Louis Curien, Peter Dybjer, Giuseppe Longo, John Mitchell,David Pitt, Andrew Pitts, Axel Poigné, David Rydeheard, Don Sannella, Eric Wagner.

Important Dates

Deadline for submission of papers: March 1, 1991
Notification of acceptance: May 15, 1991
Final paper due: July 1, 1991



Authors should send 5 copies of a draft paper (length of the papers should not exceed 10 dense pages, or 20 loose pages, the ideal being 15 "normally filled" pages, as usual not including references nor possible (short) appendices; no double submissions) to:

David Pitt, Department of Mathematics, University of Surrey, Guildford, Surrey, GU2 XH, U.K.
e-mail: dhp@cs.surrey.ac.uk

Pierre-Louis Curien is responsible for **local arrangements** :

LIENS, 45 rue d'Ulm, 75230 Paris Cedex 05, France
e-mail: curien@dmi.ens.fr

Fourth International Workshop on Petri Nets and Performance Models PNPM91

CALL FOR PAPERS

Melbourne, Australia

Tutorial Day: 2 December 1991
Conference: 3-5 December 1991

Sponsor: Telecom Australia

Co-operation requested with Association for Computing Machinery, IEEE Computer Society, IEEE Victorian Section, IFIP

General Chairman:	Fred Symons (Monash University, Melbourne)
International Committee Chairman:	Tharam Dillon (LaTrobe University, Melbourne)
Programme Co-Chairmen:	Jonathan Billington (TRL, Melbourne) Bill Henderson (Adelaide University)
Organising Committee Chairman:	Jim Park (TRL, Melbourne)

International Committee:

G. Balbo (Italy)	S. Natkin (France)
H. Beilner (Germany)	L. Ojala (Finland)
K. Jensen (Denmark)	K. Onaga (Japan)
M. Kim (Korea)	M. Silva (Spain)
W. Lu (China)	D. Simpson (UK)
J.F. Meyer (USA)	K. Trivedi (USA)

Programme Committee:

M. Ajmone Marsan	M.K. Molloy
G. Chiola	M. Murata
G. Ciardo	T. Murata
J.M. Colom	S. Nishio
J. Dugan	W.H. Sanders
G. Florin	H. Takagi
P. Haas	P. Taylor
S. Haddad	M. Vernon
G. Juanole	W.M. Zuberek
J. Magott	

Scope of Workshop

The workshop provides a forum for the presentation of original contributions in the area of Petri net based models and tools for performance evaluation and systems design. During the Workshop, facilities will be provided for the exhibition of computer-aided Petri net tools. The day before the workshop, Monday 2 December 1991, a day of tutorials will be presented. The language of the workshop is English.

Topics

* New developments in timed and stochastic Petri nets, including high-level stochastic nets
* Analysis methods for timed and stochastic nets
* Advances in incorporating time into nets, while retaining the results of General Net Theory
* Relationships with other formal systems where timed extensions are being developed (e.g. process algebras)
* Application of nets to the design and performance evaluation of systems including computing, communications, information, office automation and flexible manufacturing systems
* Computer aids for the analysis of Petri net models
* Educational issues, including the role of Petri nets in teaching concurrency

Information for Authors

Submissions

Authors are invited to submit five copies of a full paper (in English and no longer than 20 A4 pages) to Jonathan Billington by 1 May 1991. The name and address of the author(s), and a short abstract are to be included on a separate title page. Descriptions of work in progress, particularly related to industrial applications (2 to 4 pages), and indications of interest in exhibiting a tool (1 page description) are also invited.

Address for Correspondence

Jonathan Billington
Telecom Australia Research Laboratories
P.O. Box 249
Clayton, Vic., 3168
AUSTRALIA
Tel: +61-3-5416416
Fax: +61-3-5442362
Email: j.billington@trl.oz.au

Important Dates

1 May 1991: Submission Deadline
1 August 1991: Notification of acceptance/rejection
5 September 1991: Final version due

Proceedings

Accepted papers will be published in the proceedings by the IEEE Computer Society.

Tutorial Day

On Monday 2 December 1991 a set of tutorials will be presented. The purpose of the tutorials will be to provide introductory information on Petri net fundamentals and their extensions for performance evaluation. The tutorials will be presented by leading international experts. The tutorials will provide an ideal opportunity for students, academics and industry personnel interested in learning the basics of new techniques that will be of increasing importance in the design of concurrent, distributed or real time systems.

Tools Exhibition

It is intended to provide facilities for the demonstration of computer aided tools for the creation, manipulation and analysis of Petri net based models. Please send details of computing requirements to Jonathan Billington. (See REPLY FORM below).

REPLY FORM

PNPM91, Melbourne Australia

Please complete and return by email, fax or post to:

Jonathan Billington
Telecom Australia Research Laboratories
P.O. Box 249
Clayton, Vic., 3168
AUSTRALIA
Tel: +61-3-5416416
Fax: +61-3-5442362
Email: j.billington@trl.oz.au

Name:
Title:
Address:

Postcode:
Telephone:
Fax:
Email:

❑ I intend to attend PNPM91
❑ I wish to attend the Tutorial Day
❑ I shall submit a paper

Title:

Co-authors:

❑ I intend to exhibit a tool
Name of Tool:
Machine:
Operating System:
Memory required:

❑ Please send me the next circular.

FORTHCOMING EVENTS - 6 March 1991

1991

Date: **March 18 - 19**
Title: **3rd Annual Oregon Workshop on Software Metrics**
Location: Silverton, Oregon, USA.
Sponsor: Portland State Univ. and Oregon Centre for Advanced Technology Education.
Contact: Warren Harrison, Dept. of Comp. Sci., Portland State Univ., Portland, OR 97207-0751, USA.

Date: **March 25 - 28**
Title: **Mathematical Foundations of Programming Semantics**
Location: Carnegie Mellon University, Pittsburgh, Pennsylvania, USA.
Acronym: MFPS91
Contact: Stephen Brookes, School of Computer Science, Carnegie Mellon University, Pittsburgh, PA 15213, Tel. 412-268-8820.
Email: brookes@cs.cmu.edu.

Date: **March 26 - 28**
Title: **7th British Colloquium for Theoretical Computer Science**
Location: Liverpool, England.
Acronym: BCTCS 7
Contact: Paul E Dunne (BCTCS 7), Department of Computer Science, University of Liverpool, Liverpool L69 3BX, Great Britain.
Email: ped@uk.ac.liv.cs.and

Date: **April 8 - 12**
Title: **TAPSOFT'91 Fourth International Joint Conference on the Theory and Practice of Software Development**
Location: Brighton, UK
Acronym: TAPSOFT'91
Contact: TAPSOFT'91, PPL Conference Services, 2 Savoy Hill, London WC2R 0BL. Tel. 071 240 1871, Fax. 071 497 3633.

Date: **April 10 - 12**
Title: **Fourth International Conference on Rewriting Techniques and Applications**
Acronym: RTA 91
Location: Como, Italy.
Sponsors: University of Milan, EATCS, IEEE, TC on MFCS, ACM, SIGACT, SIGART.
Contact: Professor G Degli Antoni, Dipartimento di Scienze dell'Informazione, Università degli Studi di Milano, Via Moretto da Brescia, 9, I-20133 Milano, Italy. Telephone: Tel. (+39)-02-7575-201/209.
Email: gdantoni@imisiam.bitnet.

Date: **April 21 - 24**
Title: **ACM SIGPLAN Symposium on Principles and Practices of Parallel Programming**
Acronym: PPoPP 91.
Location: Hilton Hotel, Williamsburg, Virginia, USA.
Sponsor: SIGPLAN.
Contact: Dennis Gannon, Dept. of Computer Science, Indiana Univ., 101 Lindley Hall, Bloomington, IN, 47401. Tel. (812) 855-5184.
Email: gannon@iuvax.cs.indiana.edu.

Date: **April 22 - 24**
Title: **10th Int'l Symposium on Computer Hardware Description Languages and their Applications**
Acronym: CHDL 91
Location: Marseille, France.
Cosponsors: Int'l Federation for Information Processing et al.
Contact: Dominique Borrione, Imag/Artemis, BP 53X, 38041 Grenoble Cedex, France, phone (33) 7651-4604, ext. 5240, fax (33) 7651-9637.
Email: borrione@imag.imag.fr.

Date: **April 22 - 25**
Title: **2nd International Conference on Systems Integration**
Location: Morristown, N.J.
Acronym: ICSI '91
Sponsor: INIS, New Jersey Inst. of Technology (Dept. of CS and IS) in coop. with SIGSOFT, AT&T Syscorp, Inc., IEEE-CS and ACM.
Contact: C V Ramamoorthy, UC Berkeley, 1117 Sierra Vista Way, Lafayette, CA 94549; 'phone (415) 642-4751.

Date: **May 2 - 4**
Title: **Formal Power Series and Algebraic Combinatorics**
Location: Bordeaux, France.
Contact: M. Delest, Department d'Informatique, Universite de Bordeaux I, 351 Cours de la Liberation, 33405 Talence Cedex, France.
Email: maylis@geocub.greco-prog.fr.

Date: **May 5 - 10**
Title: **Mathematical Fundamentals of Database and Knowledge Base Systems**
Acronym: **MFDBS-91**
Location: Goehren, Germany.
Contact: Bernhard Thalheim, Rostock Univ., Computer Science Dept., 2500 Rostock, GDR. Tel. (37) (81) 45430.

Date: **May 6 - 8**
Title: **ACM Symposium on Theory of Computing**
Acronym: STOC '91
Location: New Orleans, Louisiana, USA.
Contact: Cris Koutsougeras, Computer Science Dept., Tulane University, New Orleans, LA 70118.
Email: cris@rex.cs.tulane.edu.
Or Contact: Jeff Vitter, Department of Computer Science, Brown University, Providence, Rhode Island, 02912-1910.
Email: jsv@cs.brown.edu.

Date: **May 7 - 10**
Title: **International Workshop on Logic Synthesis**
Location: Research Triangle Park, N.C., USA.
Sponsor: SIGDA and MCNC.
Contact: Franc Brglez, BNR/MCNC, P.O. Box 12889, Research Triangle Park, NC; (919) 248-1925.
Email: brglez@mcnc.org.

Date: **May 13 - 17**
Title: **13th Int'l Conference on Software Engineering**
Acronym: ICSE 13
Location: Austin, Texas, USA.
Cosponsor: ACM.
Contact: ICSE 13, Bryan Fugate, MCC, 3500 W. Balcones Center Dr., Austin, TX 78759- 6509, phone (512) 338-3330; MCC, PO BOX 200015, Austin, TX 78720-0015; or ICSE 13, IEEE Computer Soc., 1730 Massachusetts Ave. NW, Washington, DC 20036-1903, phone (202) 371-1013.
Email: belady@mcc.com.

Date: **May 17 - 18**
Title: **International Symposium on Software Reliability Engineering**
Location: Austin, Texas, USA.
Sponsors: IEEE CS Technical Committee on Software Engineering and National Aeronautics and Space Administration.
Contact: John C. Munson, Division of Comp. Sci., Univ. of West Florida, Pensacola, FL 32514; (904) 474-2989.
Email: jmunson@dcsnet.uwf.edu.

Date: **May 21 - 23**
Title: **4th Software Engineering Standards Application Workshop**
Location: San Diego, Calif., USA.
Sponsor: IEEE-CS.
Contact: Vera Edelstein, NYNEX Corp., 500 Westchester Ave., White Plains, NY 10604; Tel. (914) 683-2888.

Date: **May 21 - 24**
Title: **ACM SIGMETRICS Conference on Measurement & Modelling Computer Systems**
Location: San Diego, California, USA.
Acronym: SIGMETRICS '91
Sponsor: SIGMETRICS.
Contact: Michael Molloy, Hewlett-Packard Corp., 3404 East Harmony Rd., Fort Collins, CO 80525; 'phone (303) 229-6367.
Email: molloy%hpfcda@hp.com.

Date: **May 22 - 24**
Title: **Second International Conference on Algebraic Methodology and Software Technology**
Acronym: **AMAST**
Location: Iowa City, Iowa, USA.
Contact: Professor Eugene Madison, University of Iowa, Iowa City, IA, USA.

Date: **May 28 - 29**
Title: **The 5th Israel Conference on Computer Systems and Software Engineering**
Location: Herzelia, Israel.
Sponsor: IEEE CS., Israeli Chapter et al.
Contact: Conference Secretariat, c/o OFTRA Ltd., P.O. Box 50432, Tel Aviv, 61500, Israel. Tel. 972-3-664825. Fax. 972-3-660952.

Date: **June 10 - 13**
Title: **Conference on Parallel Architectures and Languages Europe**
Location: Congress and Meeting Centre "De Koningshof", PO BOX 140, 5500 AC Veldhoven, The Netherlands.
Acronym: PARLE '91.
Contact: Mr F Stoots, Philips Research Laboratries, PO BOX 80.000, 5600 JA Eindhoven, The Netherlands. Fax. +31 40 744748.
Email: stoots@dooma.prl.philips.nl

Date: **June 12 - 14**
Title: **3rd International Software Configuration Management Workshop**
Location: Norwegian Inst. of Tech., Trondheim, Norway.
Sponsor: SIGSOFT and IEEE Computer Society.
Contact: Reidar Conradi, Division of Computer Systems and Telematics (DCST) Norwegian Inst. of Tech., N-7034. Tel. 47 7 593444.
Email: conradi@idt.unit.no.

Date: **June 17 - 19**
Title: **17th International Workshop on Graph-Theoretic Concepts in Computer Science**
Location: Fischbachau, West Germany.
Contact: Gunther Schmidt, Fakulat fur Informatik, UniBw Munchen, Werener-Heisenberg-Weg 39, D-8014 Neubiberg, West Germany; 'phone ++49 89 6004 2261.

Date: **June 17 - 19**
Title: **ACM Symposium on Partial Evaluation Semantics-Based Program Manipulation**
Location: Yale Univ., New Haven, Conn., USA.
Sponsor: SIGPLAN.
Contact: Charles Consel, Yale Univ., Comp. Sci. Dept., 51 Prospect St., New Haven, CT 06520; phone (203) 432-1274.
Email: consel@yale.edu.

Date: **June 24 - 28**
Title: **SIGPLAN Conference on Programming Languages Design and Implementation**
Acronym: **ACM SIGPLAN '91**
Location: Toronto, Ontario, Canada.
Sponsor: SIGPLAN.
Contact: Brent Hailpern, IBM Old Orchard Rd., Armonk, NY 10504; 'phone (914) 765-6481.
Email: bth@ibm.com.

Date: **June 25 - 27**
Title: **The Twenty-First Annual International Symposium on Fault-Tolerant Computing**
Acronym: FTCS 21
Location: Montreal, Canada.
Sponsor: IEEE Computer Soc. Technical Committee on Fault-Tolerant Computing.
Contact: Vinod K. Agarwal, McGill Univ., Electrical Eng., Dept., 3480 University St., Montreal, Que., Canada H3A 2A7, 'phone (514) 398-7136, fax (514) 398-4470.
Email: agarwal@spock.ee.mcgill.ca.

Date: **June 25 - 28**
Title: **Eighth International Conference on Logic Programming**
Acronym: ICLP'91
Location: Paris, France.
Contact: Koichi Furukawa, ICOT, Mita Kokusai Building, 21 F4 - 28 Mita 1, Chome, Minato-ku, Japan 108, Japan.
Email: furukawa@icot.or.jp.
Paper Submission Details:
6 copies of the full contribution which must not exceed 5000 words (approximately 20 pages double space). The front page should include name(s) of the author(s), affiliation, complete address, telephone, telex, fax, e-mail.

Date: **June 26 - 28**
Title: **Twelfth International Conference on Application and Theory of Petri Nets**
Location: Aarhus, Denmark.
Contact: (Programme Committee Chairman) Manuel Silva, Departamento Ingeniería, Eléctrica e Informática, C/María de Luna, 3 (Actur) E-50015 Zaragoza, Spain. Tel. +34 76 51 72 74. (Organizing Committee Chairman) Kurt Jensen, Computer Science Department, Aarhus University, Ny Munkegade, Bldg. 540, DK-8000 Aarhus C, Denmark. Tel. +45 86 12 71 88.
Email: icpn@daimi.aau.dk.

Date: **June 27 - 29**
Title: **3rd International Conference on Software Engineering and Knowledge Engineering**
Location: Skokie, Ill., USA.
Sponsor: Knowledge System Inst., Inst. for Information Industry, SWIFT, and Univ. of Pittsburgh.
Contact: W.D. Hurley, Dept. of Comp. Sci., Alumni Hall, Univ. of Pittsburgh, Pittsburgh, PA 15260; (412) 624-8843.
Email: hurley@cs.pitt.edu.

Date: **June 30 - July 3**
Title: **Structure in Complexity Theory Sixth Annual Conference**
Location: University of Chicago, Chicago, Illinois, USA.
Sponsors: IEEE, ACM SIGACT, EATCS.
Contact: Stuart Kurtz, Department of Computer Science, University of Chicago, Chicago, IL 85721, USA.
Email: stuart@cs.uchicago.edu.

Date: **July 1 - 3**
Title: **International Conference on Computing 1991**
Acronym: **COMP 1991**
Location: Imperial College of Science and Technology, London, United Kingdom.
Sponsors: IEEE in coop. with SIGSOFT, Charles Babbage Institute (Minneapolis), IFAC, British Computer Society, IEEE-CS, British Association for the Advancement of Science, British Society for the History of Science. The Royal Society, Institution of Electronic and Radio Engineers.
Contact: General Chair, E. Ash CBE FRS, Imperial College of London, Exhibition Road, London SW7 2AZ, United Kingdom. Tel. +44 1 589 5111.

Date: **July 1 - 4**
Title: **Workshop on Computer-Aided Verification**
Location: Aalborg University, Denmark.
Contact: E.M. Clarke, Carnegie-Mellon Univ., Comp. Sc. Dept., Pittsburgh, PA 15213, USA.

Date: **July 8 - 12**
Title: **18th International Colloquium on Automata, Languages, and Programming**
Acronym: **ICALP '91**
Location: Departamento de Informática y Automática, Facultad de Matemáticas, Universidad Complutense, Av. Complutense s/n, 28040 Madrid, Spain.
Contact: Prof. Mario Rodrîguez Artalejo.
Email: W450@EMDUCM11.BITNET.

Date: **July 14 - 19**
Title: **6th Annual IEEE Logic in Computer Science Symposium**
Location: Amsterdam, Netherlands.
Sponsors: IEEE, EATCS, ASL in cooperation with ACM SIGACT.
Contact: Albert Meyer, MIT Lab for Computer Science, ME43-315, 545 Technology Square, Cambridge, MA 02139. Tel. (617) 253-6024.
Email: meyer@lcs.mit.ecu.
Paper Submission Details:
Submit eight copies of detailed abstract to Gilles Kahn, Prog. Chair, INRIA Sophia Antipolis, 06565 Valbonne Cedex, France. Fax: (33) 93 65 77 66.
Email: kahn@mirsa.inria.fr.

Date: **July 15 - 17**
Title: **International Symposium on Symbolic and Algebraic Computation**
Location: Hotel Maritim, Bonn, West Germany.
Sponsor: SIGSAM, GI, GAD.
Contact: Fritz Schwartz, GMD, Institut FI, Postfach, 1240, 5205 St. Augustin, W. Germany 2241-142782.
Email: gf;002@dbngmd4.

Date: **July 15 - 19**
Title: **6th Annual IEEE Logic in Computer Science Symposium**
Location: Amsterdam, Netherlands.
Sponsor: IEEE, EATCS, ASL in coop. SIGACT.
Contact: D. Leivant, School for Comp. Sci., Carnegie-Mellon, Univ., Pittsburgh, PA 15213, USA.

Date: **July 15 - 19**
Title: **5th European Conference on Object-Oriented Programming**
Location: Univ. of Geneva, Switzerland.
Acronym: ECOOP '91
Contact: Karl Lieberherr, Center for Software Sciences, Northeastern University, College of Comp. Sci., Cullinane Hall, Boston, MA 02115; 'phone: (617) 437-2077; fax: (617) 437-5121.
Email: lieber@corwin.ccs.northeastern.edu.

Date: **August 14 - 16**
Title: **Workshop on Algorithms and Data Structures**
Acronym: WADS '91.
Location: Ottawa, Canada.
Sponsor: Carleton Univ.
Contact: WADS '91, School of Comp. Sci., Carleton Univ., Ottawa, Canada K15 5B6; phone (613) 788-4333.
Email: wads@scs.carleton.ca.

Date: **August 19 - 21**
Title: **10th Annual ACM Symposium in Principles of Distributed Computing**
Location: Hotel Chateau Champlain, Montreal, Canada.
Acronym: PODC '91.
Sponsor: SIGOPS and SIGACT.
Contact: Luigi Logrippo, Univ. of Ottawa, Dept. of Comp. Sci., Ottawa, Ontario K1N 6N5, Canada; 'phone (613) 564-5450.
Email: lmlsa@uottawa.

Date: **August 26 - 28**
Title: **Third International Symposium on Programming Language Implementation and Logic Programming**
Location: Passau, Federal Republic of Germany.
Acronym: PLILP 91.

Date: **August 28 - 30**
Title: **Conference on Functional Programming Languages and Computer Architecture**
Location: Cambridge, Mass.
Sponsor: IFIP WG 2.8. SIGPLAN, SIGARCH, and Harvard Univ.
Contact: Robert Muller, Aiken Computation Lab., Harvard Univ., Cambridge, MA 02138; 'phone (617) 495-8427.
Email: muller@harvard.edu.

Date: **September 3 - 6**
Title: **Category Theory and Computer Science**
Location: Ecole Normale Supérieure, Paris, France.
Contact: David Pitt, Department of Mathematics, University of Surrey, Guildford, Surrey GU2 XH, UK.
Email: dhp@cs.surrey.ac.uk.
Local arrangements:
Pierre-Louis Curien, LIENS, 45 rue d'Ulm, 75230 Paris Cedex 05, France.
Email: curien@dmi.ens.fr.

Date: **September 9 - 13**
Title: **16th International Symposium on Mathematical Foundations of Computer Science**
Acronym: MFCS'91
Location: Warsaw, Poland.
Sponsors: Institute of Computer Science of the Polish Academy of Sciences and the Institute of Informatics of Warsaw University.
Contact: P. Chrzastwoski-Wachtel and A. Tarlecki, MFCS'91, Institute of Computer Science, Polish Academy of Sciences, PKiN, P.O. Box 22, 00-901 Warsaw, Poland.

Date: **September 16 - 18**
Title: **Software Engineering for Real Time Systems**
Location: Royal Agricultural College, Cirencester, UK.
Sponsor: IEE.
Organisers: Institution of Electrical Engineers.
Contact: Conference Services, The Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, UK. Tel. 071 240 1871 Ext. 222. Telex. 261176 IEE LDN G. Fax. 071 240 7735.

Date: **September 18 - 20**
Title: **Working Conf. on Security and Reliability in Distributed Systems**
Location: Prince Edward County, Ont., Canada.
Sponsor: IFIP.
Contact: Stewart Lee, Computer Systems Research Inst., D.L. Pratt Bldg., Univ. of Toronto, 6 King's College Rd., Toronto, Ont., Canada M5S 1A4, 'phone (416) 878-5035, fax (416) 978-4765.
Email: stew@hub.toronto.edu.

Date: **September 23 - 27**
Title: **Computational Intelligence '91**
Location: Milano, Italy.
Sponsor: PC and VG in coop. with SIGART.
Contact: Mr. Giorgio Valle, Univ. Degli Studi di Milano, via Moretto, 00 Brecia 9, Milano 20133, Diparto, Italy; 'phone 0039 2 2772278.
Email: valle@imiucca.

Date: **September 24 - 27**
Title: **Theoretical Aspects of Computer Software**
Location: Tohoku University, Sendai, Japan.
Sponsors: Tohoku University, Information Processing Society of Japan, IEEE, ACM SIGACT, Association for Symbolic Logic.
Contact: Prof. Takayasu Ito, Department of Information Engineering, Tohoku University, Sendai, Japan 980.
Email: ito@ito.ecei.tohoku.ac.jp.
Fax: 81 22 267 4404.

Date: **October 2 - 4**
Title: **Foundations of Computer Science**
Location: San Juan, Puerto Rico.
Sponsor: IEEE
Contact: Local Arrangements Chairs: Tom Leighton, Laboratory for Computer Science, M.I.T., Cambridge, MA 02139, USA.
Or: Alok Aggarwal, T.J. Watson Research Center, P.O. Box 218, Yorktown Heights, NY 10598, USA.
Paper Submission Details:
Send 16 copies of an extended abstract by April 3, 1991 to:
Michael Sipser, Laboratory for Computer Science, M.I.T., Cambridge, MA 02139, USA.

Date: **October 6 - 11**
Title: **OOPSLA 91**
Location: Phoenix Convention Senter, Phoenix, Ariz., USA.
Sponsor: SIGPLAN.
Contact: John Richards, IBM TJ Watson Research Ctr., PO BOX 704, Yorktown Heights, NY 10598; (914) 784-7731.
Email: jtr@ibm.com.

Date: **October 7 - 8**
Title: **Fifth SEI Conference on Software Engineering Education**
Acronym: CSEE 91
Location: Pittsburgh, USA.
Contact: James E. Tomayko, Software Engineering Inst., Carnegie Mellon Univ., 4500 Fifth Ave., Pittsburgh, PA 1521303890, phone (412) 268-6806, fax (412) 268-5758.
Email: jet@sei.cmu.edu.

Date: **October 8 - 10**
Title: **4th Symposium on Testing Analysis and Verification**
Acronym: TAV-4.
Location: Victoria, British Columbia, Canada.
Sponsor: SIGSOFT.
Contact: William E. Howden, CSE, UCSD, La Jolla, CA 92093; phone (619) 534-2723.
Email: howden@cs.ucsd.edu.

Date: **October 14 - 17**
Title: **Conference on Software Maintenance**
Location: Sorrento, Italy
Sponsors: IEEE Computer Society - Technical Committee on Software Engineering, The Institute of Electrical and Electronics Engineers, Inc.
Contact: John Munson, Division of Computer Science, University of West Florida, Pensacola, FL 32514, 'phone: (904) 474-2989.
Email: jmunson@uwf.bitnet.
Or: Roberto Ciampoli, Olivetti Information Services, Vie Croce 19, 00142 Rome, Italy, 'phone: +39 (6) 5411552, fax: +39 (6) 5415239.

Date: **October 16 - 19**
Title: **5th International Symposium on Methodologies**
Location: Charlotte, N.C., U.S.A.
Acronym: ISMIS-91.
Sponsor: Univ. of North Carolina.
Contact: Bill Chu, Dept. of Comp. Sci., Univ. of North Carolina, Charlotte, NC 28223; 'phone (704) 547-4568.
Email: billchu@unccvax.uncc.edu.

Date: **October 21 - 24**
Title: **Third European Software Engineering Conference**
Contact: Alfonso Fugetta, CEFRIEI, c/o AICA-ESEC '91, P.le Rodolfo Morandi 2, 1.2021 Milan, Italy.
Email: alfonso@imicefr.bitnet.
Acronym: ESEC 91
Location: Milano, Italy.
Sponsors: AFCET et al.

Date: **October 21 - 25**
Title: **VDM'91**
Location: Leeuwenhorst Congress Center, The Netherlands.
Contact: Hans Toetenel, OC-chair, Delft University of Technology, PO BOX 356, 2600 AJ Delft, The Netherlands.
Email: toet@dutiaa.tudelft.nl.
Or: PC-chair - Soren Prehn at sp@cpe.csd.cri.dk.

Date: **October 25 - 26**
Title: **Sixth Int'l Workshop on Software Specification and Design**
Location: Como, Italy.
Sponsor: SIGSOFT and IEEE-CS.
Contact: Jean-Pierre Finance, CRIN Univ. de Nancy 1, Campus Scientifique, BP 239, 54506 Vandoeuvre les,; 33 83 91 21.
Email: finance@loria.crin.fr.

Date: **19 - 22 November**
Title: **Fourth International Conference on Formal Description Techniques**
Location: Sydney, Australia.
Acronym: FORTE '91
Sponsors: IFIP WG 6.1, IEEE, OTC and Telecom Australia.
Contact: Dr Ken Parker, Telecom Research Laboratories, PO Box 249, Clayton, Victoria 3168, Australia, Tel. +61 3 541 6797, Fax. +61 3 544 2362.
Email: k.parker@trl.oz.au.
Paper Submission Details:
Submission of full research papers (5 copies, 12 pt single spaced, max 16 pages) sent to: Prof Gordon Rose, Computer Science Dept., University of Queensland, Queensland 4072, Australia, Tel. +61 7 377 2766, Fax. +61 7 371 0783.
Email: rose@uqcspe.cs.uq.oz.au.

Date: **December 3 - 5**
Title: **The Fourth International Workshop on Petri Nets and Performance Models**
Acronym: PNPM 91.
Location: Melbourne, Australia.
Sponsor: Telecom Australia.
Contact: Jonathan Billington, Telecom Australia Research Laboratories, PO BOX 249, Clayton, Vic., 3168, Australia. Tel. +61-3-5416416, Fax. +61-3-5442362.
Email: j.billington@trl.oz.au.
Paper Submission Details:
Authors are invited to submit five copies of a full paper (in English and no longer than 20 A4 pages) to Jonathan Billington by 1 May 1991.

Date: **December 4 - 6**
Title: **Software for Critical Systems**
Location: Fairmount Hotel, New Orleans, La, USA.
Acronym: SIGSOFT '91.
Sponsor: SIGSOFT.
Contact: Mark Moriconi, SRI International, 333 Ravenwood Ave., Menlo Park, CA 94025; 'phone (415) 859-5924.
Email: Moriconi@csl.sri.com.
Paper Submission Details:
Submit six copies of the full paper to Peter G. Neumann, Computer Science Laboratory, SRI International, 333 Ravenswood Avenue, Menlo Park, CA 94025 before 3 May 1991.
Email: neumann@csl.sri.com.

Date: **December 4 - 6**
Title: **Int'l Conf. on Parallel and Distributed Information Systems**
Location: Miami Beach, Southern Florida.
Sponsor: SIGARCH, SIGMOD, IEEE, CS, Florida International Univ.
Contact: Amit Sheth, Bellcore, 1J-210, 444 Hoes La., Piscataway, NJ 08854; 'phone: (908) 699-3300; fax: (908) 699-9011.
Email: amit@ctt.bellcore.com.
Paper Submission Details:
Submit seven copies of full paper by **May 10, 1991,** and abstract by electronic mail to H.V. Jagadish, 3C414A, AT&T Bell Labs, 600 Mountain Ave., Murray Hill, NJ 07974.
Email: jag@research.att.com.

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Date: **January 20 - 24**
Title: **19th ACM Symposium on Principles of Programming Languages**
Acronym: POPL '92
Location: Albequerque, N. Mex., USA.
Sponsor: SIGACT, SIGPLAN.
Contact: Stuart Feldman, Bell Commun. Research, 445 South St., Rm. 2E-386, Morristown, NJ 07960-1910. Tel. (201) 829-4305.
Email: sif@bellcore.com.

Date: **May 11 - 15**
Title: **14th Int'l Conf. on Software Eng.**
Acronym: ICSE 92
Location: Melbourne, Australia.
Cosponsors: IEEE Computer Soc. et al.
Paper Submission Details:
Submit six copies of full paper or experience report by **Sept. 6, 1991,** to A.Y. Montgomery, Computer Science Dept., Royal Melbourne Inst. of Tech., PO Box 2476V, Melbourne 3001, Victoria, Australia, 'phone 61 (3) 660-2943, fax 61 (3) 662-1617.
Email: aym@goanna.cs.rmit.oz.au.

Date: **July 12 - 17**
Title: **19th International Colloquium on Automata, Languages, and Programming**
Acronym: ICALP 92
Location: Technische Universität Wien, Austria.
Contact: Prof. Werner Kuich, Institut für Algebra und Diskrete Mathematik, Technische Universität Wien, Wiedner Haupstraße 8-10, A-1040 Wien, Tel.: +43 1 58801 5450.
Email: kuich@btx.UUCP.
Paper Submission Details:
Submit seven copies of an extended abstract to the Chairman of the Programme Committee, Prof. Werner Kuich before 15 November 1991.