ICT for EU-India Cross Cultural Dissemination

Summary of UPV activities and results

UNIVERSIDAD POLITECNICA DE VALENCIA - Spain -

University of Udine - Italy -

B.M. Birla Science Centre - India -

University of Genoa - Italy -

María Alpuente

OUTLINE

- General profile of our node:
  ELP and RFIA
- Overview of ELP activities
- Summary of ELP results in 2005

General profile of the node

UPV - Public University

35,000 Students
2,500 Academic Staff
1,700 PhD Students
55 Degree Programs
50 PhD Programs

15 Schools, all Eng. areas
45 Departments

300 Research Groups at UPV

35 Informatics groups

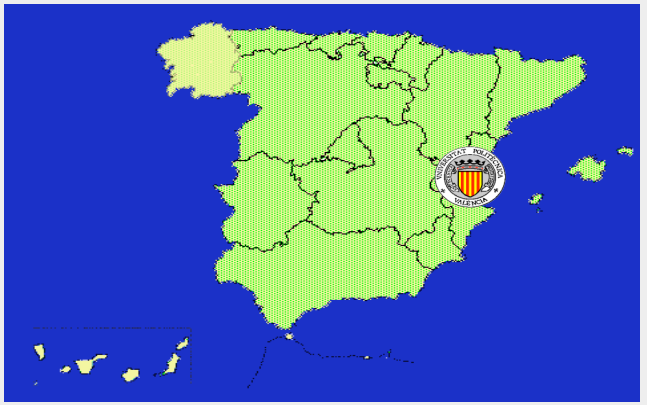
The UPV partnership

DSIC
DEPARTAMENTO DE SISTEMAS INFORMÁTICOS Y COMPUTACIÓN

In this project, UPV is represented by two groups ⊆
Dept. of Information Systems and Computation (DSIC)

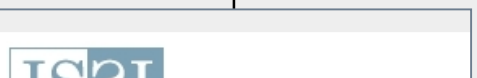
- ELP:
  Extensions of Logic Programming &
  Programming Languages

- RFIA:
  Pattern Recognition &
  Artificial Intelligence



ELP ⊆ GPLIS Group (1986)
70 Researchers (25 PhDs)

GPLIS
LOGIC PROGRAMMING & SOFTWARE ENGINEERING GROUP



ISSI

Isidro Ramos

INFORMATION SYSTEMS
& SOFTWARE ENGINEERING

Model-driven Software Develop.
Software Architectures
Legacy Systems
DBs and Information Systems
E-contents
Digital Libraries
Home Automation

ELP

María Alpuente

EXTENSIONS OF
LOGIC PROGRAMMING
& PROGRAMMING LANGUAGES

Software Quality
Multiparadigm Software Technology
Lightweight Formal Methods
Automated Software Engineering
Term Rewriting Systems
Communication and Concurrency
Data mining and Inductive Progr.
Semantics of Progr. Languages

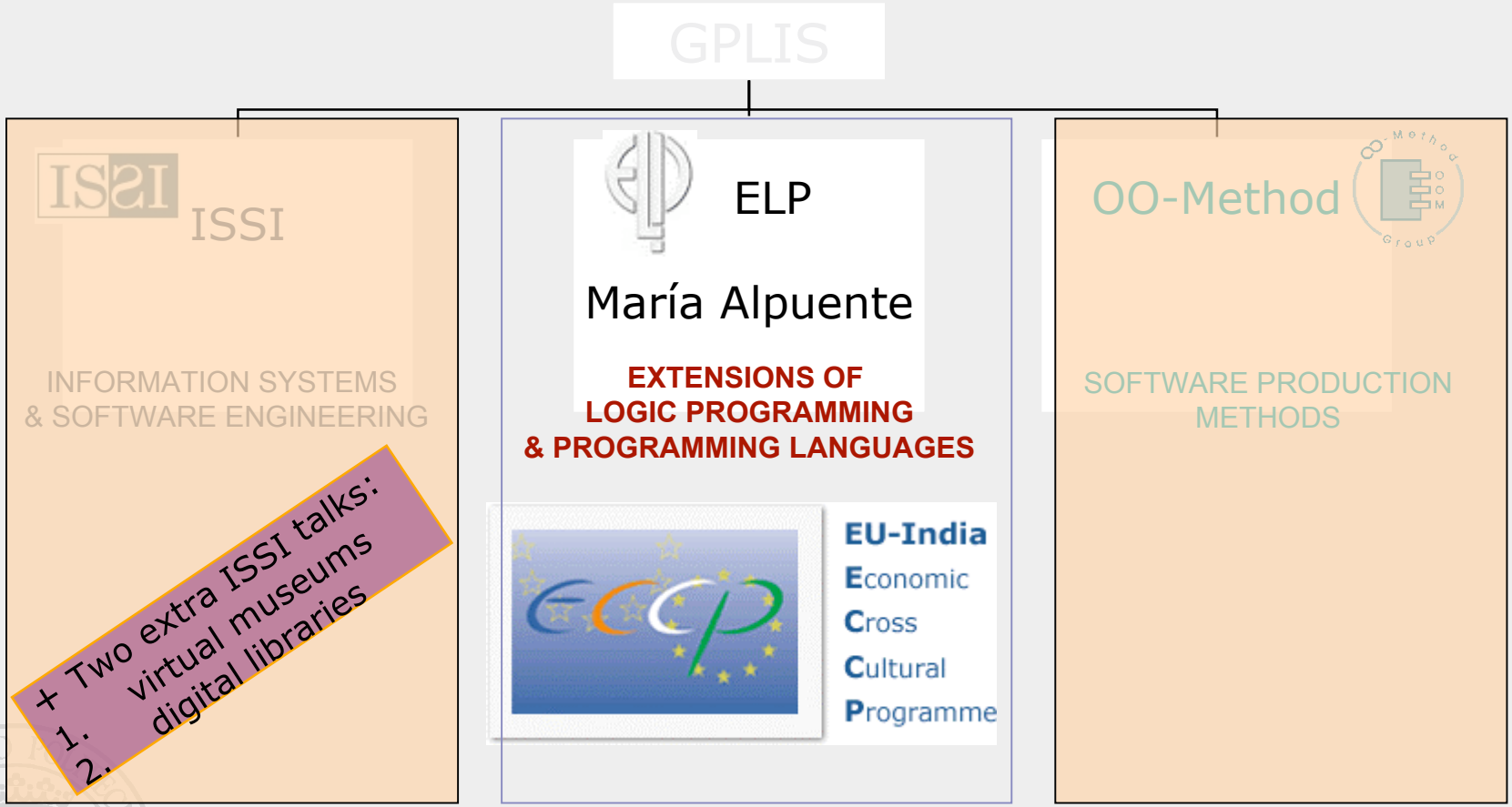
OO-Method

Oscar Pastor

SOFTWARE PRODUCTION
METHODS

Automatic Programming
Web Engineering
Business Modeling
Pervasive Systems
Software Quality
Empirical SE

The ELP Group



The ELP Group
25 Researchers (12 PhDs)

María Alpuente
Germán Vidal
Jose Hernández
Salvador Lucas
Javier Oliver
M. José Ramírez
Santiago Escobar
Francisco Correa
Cesar Ferri
Marisa Llorens
Alicia Villanueva

10 PhD Students

Beatriz Alarcon, Gustavo Arroyo, Antonio Bella, Ricardo Blanco, Vicent Estruch, Javier Garcia-Vivó, Raul Gutierrez, Guadalupe Ramos, Josep Silva

The RFIA Group (14 researchers, 9 PhDs)

Pattern Recognition
Speech Technology

Natural Language Engineering

Information Extraction
Question Answering

Emilio Sanchis *- group coordinator -*
Paolo Rosso *- project coordinator -*
Lidia Moreno
Antonio Molina
Ferrán Pla
Encarna Segarra

5 PhD Students:
Jose Manuel Gomez
Rafael Guzmán
David Pinto
Davide Buscaldi
Yassine Benajiba

The UPV partnership

RFIA participates in two WGs:
(coordinated by Genoa)

WG4 Clustering techniques for document organisation & **retrieval**

WG8 Semantic Information Retrieval:
A **Natural Language** Processing Task

(Stefano Rovetta- Paolo Rosso)

ELP coordinates two WGs:

(cooperation with Udine)

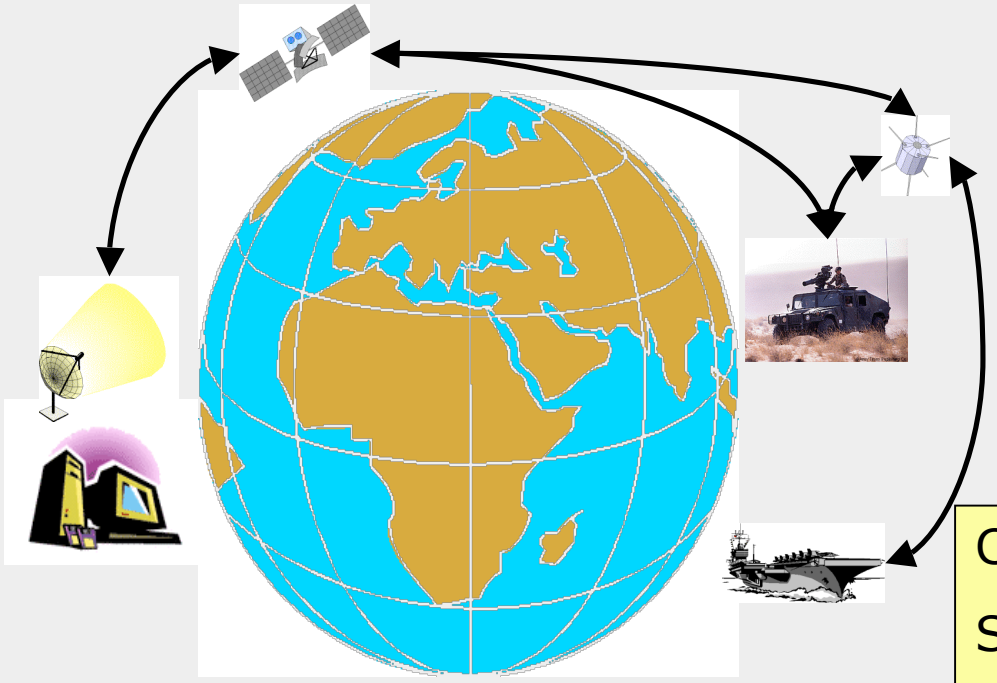
WG3 Specification and Verification of Web Sites

WG7 Intelligent Tutoring Systems

OUTLINE

- General profile of our node:
  ELP and RFIA
- Overview of ELP activities
- Summary of ELP results in 2005

Research Motivation: IS



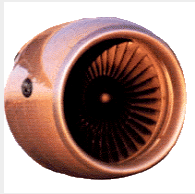
Communication

Security

Commerce

The ever-growing demand
for *quality, safety, efficiency*, …

Strong Requirements

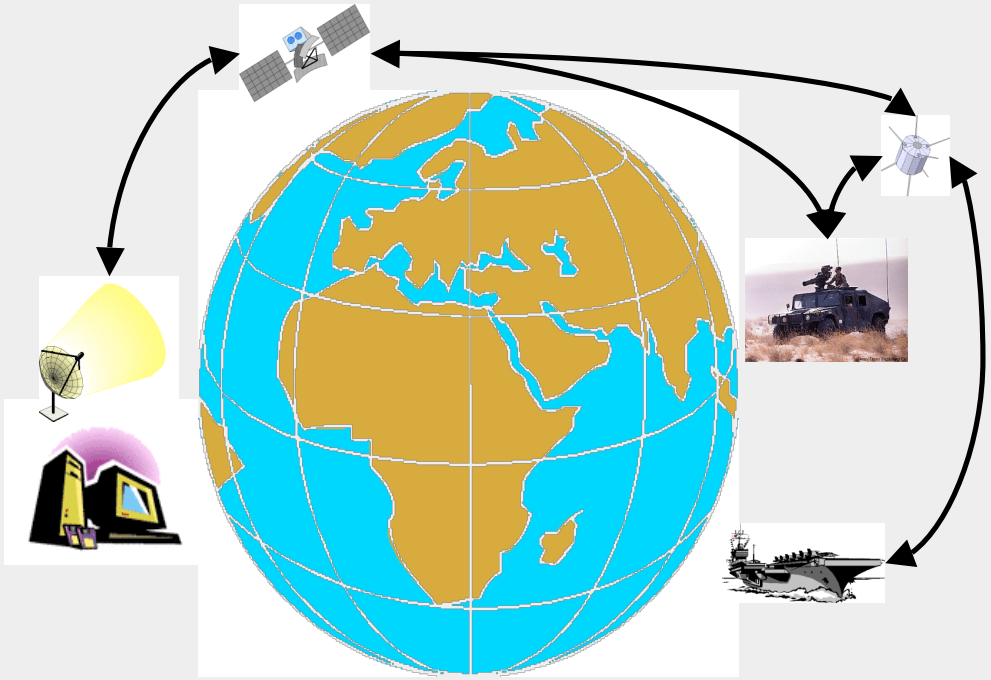


Systems that must *never crash* and must *always meet their deadlines*.

Systems that must be *robust, secure, trustworthy,* and *extensible*.

Performance-critical open networking systems that are costly to shut down.

Research Motivation: IS



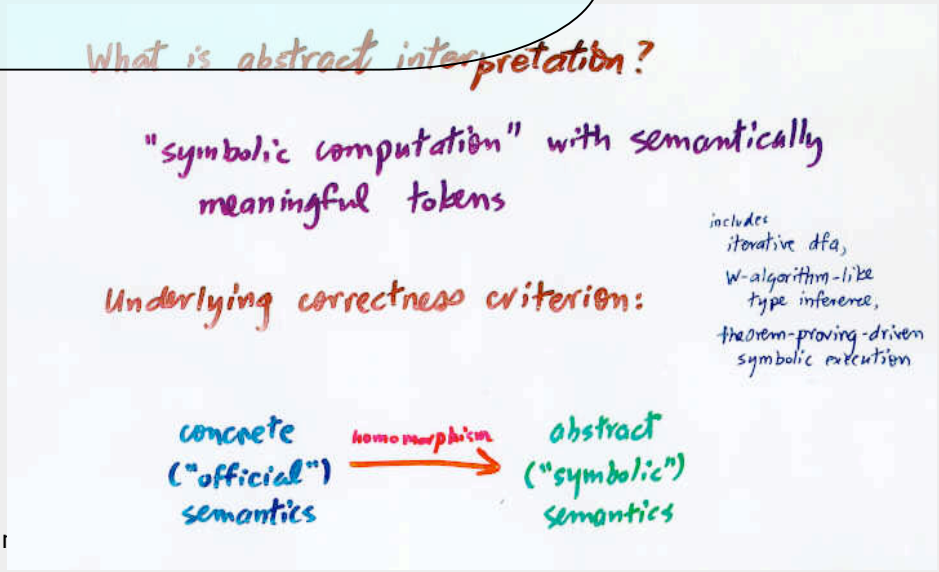
The ever-growing demand
for *quality, safety, efficiency*, …

Lack of adequate S&T:
fragility, unreliability, …

The **high costs and high failure rates** of current software systems call for **better Software Technologies**

… An **opportunity for Formal Methods** to provide a suitable scientific and technological framework needed for achieving the desired **qualitative leap**

Formal Methods & Tools



The ELP Work Themes: "Quality" leit motiv

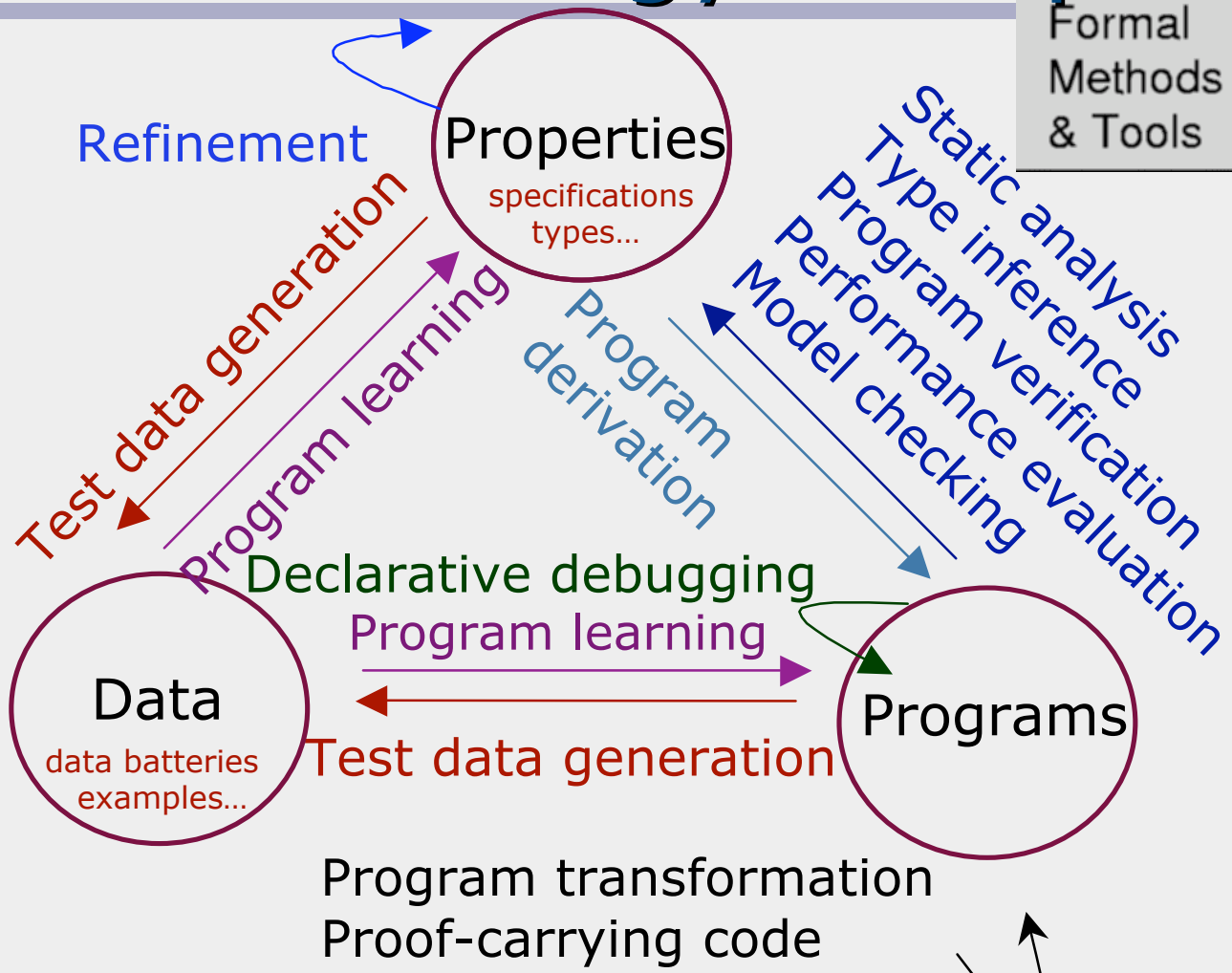
GENERAL PURPOSE: Formal methods, Tools and Techniques
for developing
high-quality software
-reliable, evolvable, cost-effective-

The ELP Work Themes : "Quality" leit motiv

GENERAL PURPOSE: Formal methods, Tools and Techniques for developing high-quality software *-reliable, evolvable, cost-effective-*

KEY TECHNOLOGY: Lightweight approach based on Multi-paradigm Declarative Programming

Overall view: Software Trilogy metaphor



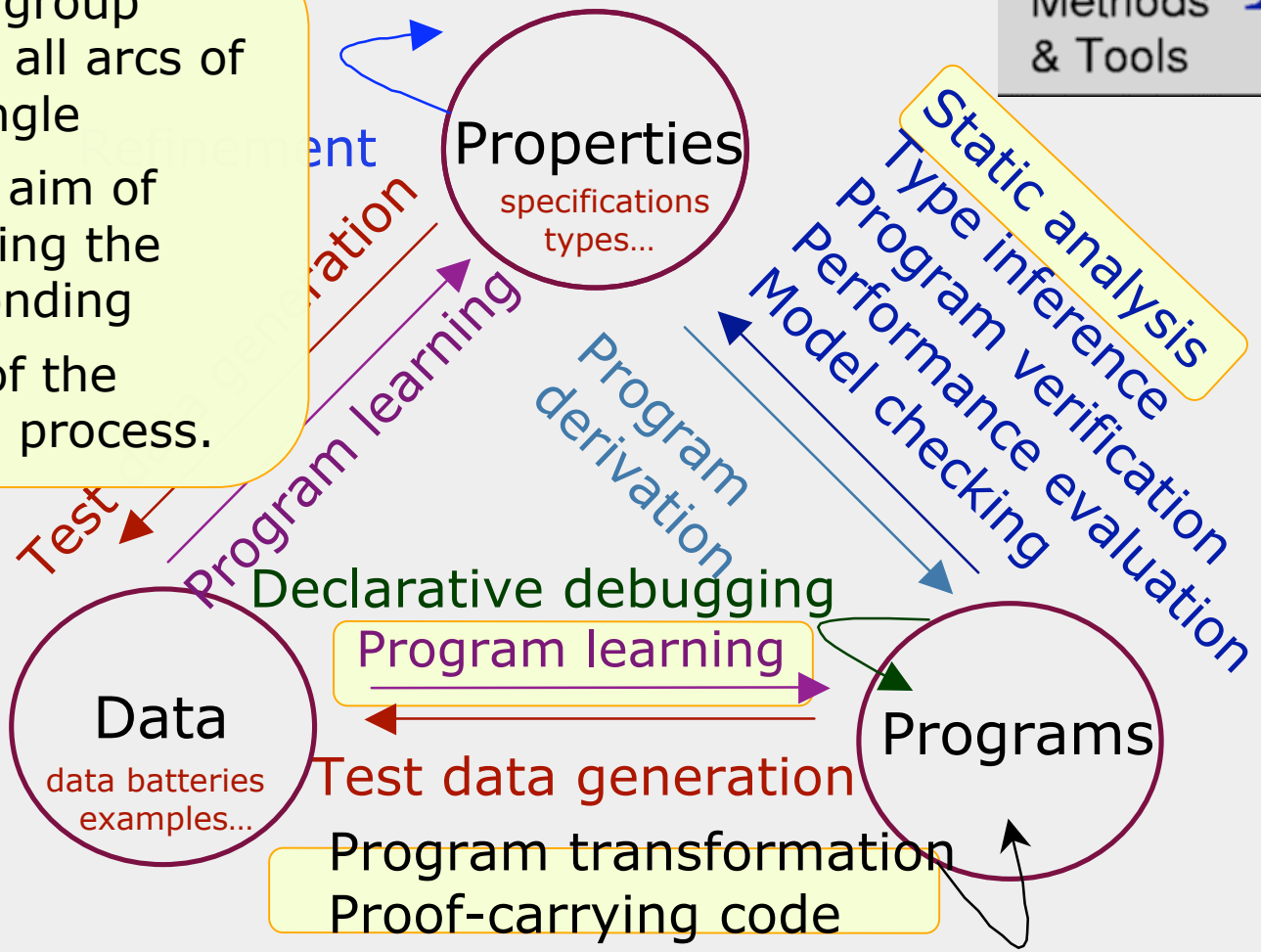
Overall view: Software Trilogy

Formal Methods & Tools

The ELP group explores all arcs of this triangle

with the aim of automating the corresponding

phases of the software process.



The ELP Work Themes :

Key lines: Software quality, formal methods, multi-paradigm (declarative) programming, automated software engineering, semantics

Topics:

i) Theories, languages, methods and tools to support automated *analysis, specification, verification, modeling, debugging, learning, optimization, certification, and transformation of software (components)*

ii) Techniques for assembling provably reliable components into predictably reliable systems

Focus of the project

ELP coordinates two WGs:
(cooperation with Udine)

WG3 Specification and Verification of Web Sites

WG7 Intelligent Tutoring Systems

WG3 Specification and Verification of Web Sites (1)

Starting Date: Year 1, Month 5 (May 2004)
Duration: 9 months
Partner responsible: Valencia
Other partners: Udine, Hyderabad

Exchanges related to WG3:

Udine-to-VLC:	D. Ballis	(10 days, March 05)
VLC–to-Udine:	J. García-Vivó -8 m. contract-	(10 days, Nov 05)
	M. Alpuente	(10 days, Oct 04 & Feb 05)
VLC-to-Hyd:	M. Alpuente & S. Escobar	(15 days, Jan 05)
	M.J. Ramírez & L. Moreno	(10 days, Nov 04)
Hyd–to-VLC:	S. Babu	(5 days, March 05)

Workshop: Valencia – Year 2, Month 3

People involved: M. Alpuente, M. Falaschi, S. Escobar, S. Lucas, G. Vidal, M.J. Ramirez, J. Orallo, C. Ferri, V. Estruch, J. Silva, D. Ballis, J. García-Vivó, B. Alarcón, J.D. Llopis

WG3 Specification and Verification of Web Sites (2)

KEY IDEA: “Term rewriting and machine learning machinery for developing and mantaining complex Web sites”

Objectives of WG3:

1. To develop a declarative specification language (as well as a methodology) for the verification of the semantic properties of a Web site, related to **both the structure and the contents** (that is, to verify the data available in each page and determine how information can be browsed by following hyperlinks).

2. To define a correction methodology for repairing faulty web sites semi-automatically.
   This can help the user learn to fix any detected inconsistency.

Our medium-term goal is to repair Web sites automatically

As we understand 2, it is half-way between WG3 and WG7

WG3 Specification and Verification of Web Sites (3)

We have provided a rule-based specification language to

specify integrity conditions for a given Web site

and a verification technique to

- automatically check whether those conditions are fulfilled
- help to repair faulty Web sites

Our framework is based on a rewriting-like technique (partial rewriting), which is more suitable for dealing with semistructured data (eg. XML/XHTML documents)

Web Specification Language

In our proposal, **Web pages are seen as ground (terms)** and **Web specifications are sets of rules** that allow us to specify conditions in order to

- detect forbidden or incorrect information
- detect missing or incomplete Web pages

A Web specification is made up of

- a set of correctness rules I_N
- a set of completeness rules I_M
- a set of rewrite rules (i.e. a Term Rewriting System) R

A Web Specification Example

Consider a Web site containing some information about a research group (e.g. member group affiliation, personal data, publications,…)

Correctness Rules I_N

```
hpage(X) → error | X in [: TextTag :] * sex [: TextTag :]*
blink(X) → error
```

Completeness Rules I_M

```
hpage(status(professor)) → #hpage(#status(#professor),
                                   teaching))
member(name(X), surname(Y)) → #hpage(fullname(append(X,Y)),
                                     status)
```

Rewrite Rules R = Definition of function `append`

WG3 Specification and Verification of Web Sites (4)

In addition, we have developed 4 extra lines:

1. Produced and evaluated a graphical implementation of the tool GVerdi for the automatic verification of Web sites
M. Alpuente, D. Ballis, J. Garcia-Vivo, M. Falaschi

2. Explored rewriting logic as a basis for specifying and verifying dynamic properties of Web sites
S. Escobar, S. Lucas

3. Program slicing for web documents
J. Silva and G. Vidal

4. Web categorization by program learning (distance-based DTs)
V. Estruch, M.J. Ramirez, J. Hernandez-Orallo, C. Ferri

WWV 2005, the 1st Int'l Workshop on Automated Specification and Verification of Web Sites
March 14-15, 2005, Valencia

- Attended by 42 participants, from 11 countries

  - Austria, Canada, France, Germany, India, Italy, Japan, Mexico, Spain, UK, and USA -

- WWV'05 provided a common forum for researchers from the communities of:

  Rule-based programming
  Automated Software Engineering
  Web-oriented research

to facilitate the cross-fertilization and the advancement of hybrid methods that combine the three areas.

WWV 2005, the 1st Int'l Workshop on Automated Specification and Verification of Web Sites
March 14-15, 2005, Valencia

PROGRAM COMMITTEE

Maria Alpuente	Technical U. of Valencia, Spain
Sarat Babu	CDAC, India
Demis Ballis	U. of Udine, Italy
Gilles Barthe	INRIA Sophia-Antipolis, France
Thierry Despeyroux	INRIA Sophia-Antipolis, France
Wolfgang Emmerich	U. College London, UK
Santiago Escobar	Technical U. of Valencia, Spain
Moreno Falaschi	U. of Siena, Italy
Maria del Mar Gallardo	Technical U. of Malaga, Spain
Furio Honsell	U. of Udine, Italy
Giorgio Levi	U. of Pisa, Italy
Jan Maluszynski	Linköping U., Sweden
Massimo Marchiori	MIT CS Lab, USA
Tiziana Margaria	U. of Göttingen, Germany

WWV 2005, the 1st Int'l Workshop on Automated Specification and Verification of Web Sites
March 14-15, 2005, Valencia

- **TECHNICAL PROGRAM**

  2 invited talks:
  - A. Finkelstein – U. College, London
  - S. Khrishnamurthi – U. Brown, USA

  10 regular papers
  2 position papers
  6 system descriptions/work in progress

6 SESSIONS:

(1) Formal Models for describing and reasoning about Web Sites
(2) Testing, Validation and Categorization of Web Sites
(3) Accessibility Evaluation
(4) XML transformation and optimization
(5) Rule-based approaches to Web site analysis and verification
(6) Model-checking and Static Analysis applied to the Web

- **POST-PROCEEDINGS** in the series Elsevier ENTCS

WG7 Intelligent Tutoring Systems

Starting Date: Year 2, Month 8 (Aug 2005)
Duration: 9 months
Partner responsible: Valencia
Other partners: Udine, Hyderabad

Exchanges:
Udine-to-VLC:
1 expert (2 months, Sept 2005, funded by UPV) - Marco Comini
1 expert (3 months, Apr 2006, funded by Spanish MEC) - Marco Comini

Workshop: Valencia – Year 3, Month 5

People involved: M. Alpuente, M. Falaschi, S. Escobar, S. Lucas, G. Vidal , G. Ramos, G. Arroyo, R. Blanco, J. Oliver, M.J. Ramirez, J. Orallo, A. Villanueva, M. Comini, D. Ballis, J. García-Vivó, B. Alarcón, A. Bella, J.D. Llopis, V. Estruch

WG7 Intelligent Tutoring Systems

("Integrating new communication technologies in education")

Objective of WG7

To develop tools and techniques to support the learning of declarative programming languages.

The key idea is to help the students learn to recognize and fix program errors, by providing meaningful explanations and by suggesting possible ways to repair the bugs

Intelligent Tutoring Systems

Activities are organized in several lines:

- Modelling, analysis, and verification tools and techniques
- Diagnosis, tracing, and optimization of multiparadigm programs
- Declarative debugging and program learning

We have been working on preparatory methodologies to support the learning of declarative languages

Our medium-term goal is to develop educational tools as an outcome of some these works

OUTLINE

- General profile of our node:
  ELP and RFIA
- Overview of ELP activities
- Summary of ELP results in 2005

The ELP achievements (i)

1. Modelling, analysis, and verification tools and techniques

- Analysis tools for Maude (termination, strategy annotations, Maude.Net)
- A tool for the modeling and validation of concurrent systems subject to structural dynamic changes
- A symbolic (abstract) model checker for tccp
- A formal specification of popular security protocol analizers

The ELP achievements (ii)

2. Diagnosis, tracing, and optimization of multiparadigm programs:

- Off-line partial evaluator for Curry programs and for the specification language Rose
- A PE-based, program slicing framework that is useful for debugging and code reuse
- A methodology for slicing XML documents
- A tool for removing redundant arguments

The ELP achievements (iii)

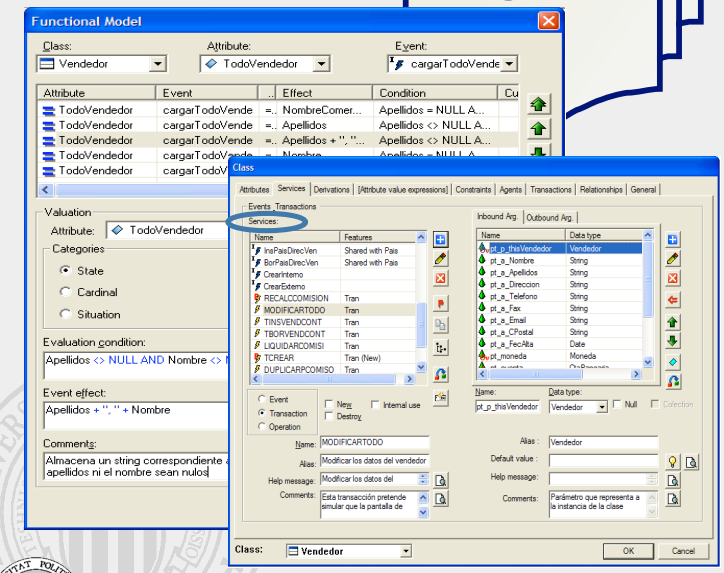
3. Declarative debugging and program learning:

- A generic bottom-up declarative debugging scheme
- Abstract debugger and program corrector for Maude
- An inductive system for the learning of decision multi-trees and application to Web categorization
- A term-rewriting framework for repairing Web sites

… on the practical side…

FORMALLY-BASED,
PRACTICAL TOOLS
Maude, Haskell, tccp, Curry & XHTML

Multi-Paradigm Declarative Programs



- program analyzers
- program transformers
- declarative debuggers
- model checkers
- web verifiers (filtering + categorization)
- inductive learning capabilities

The GVERDI System

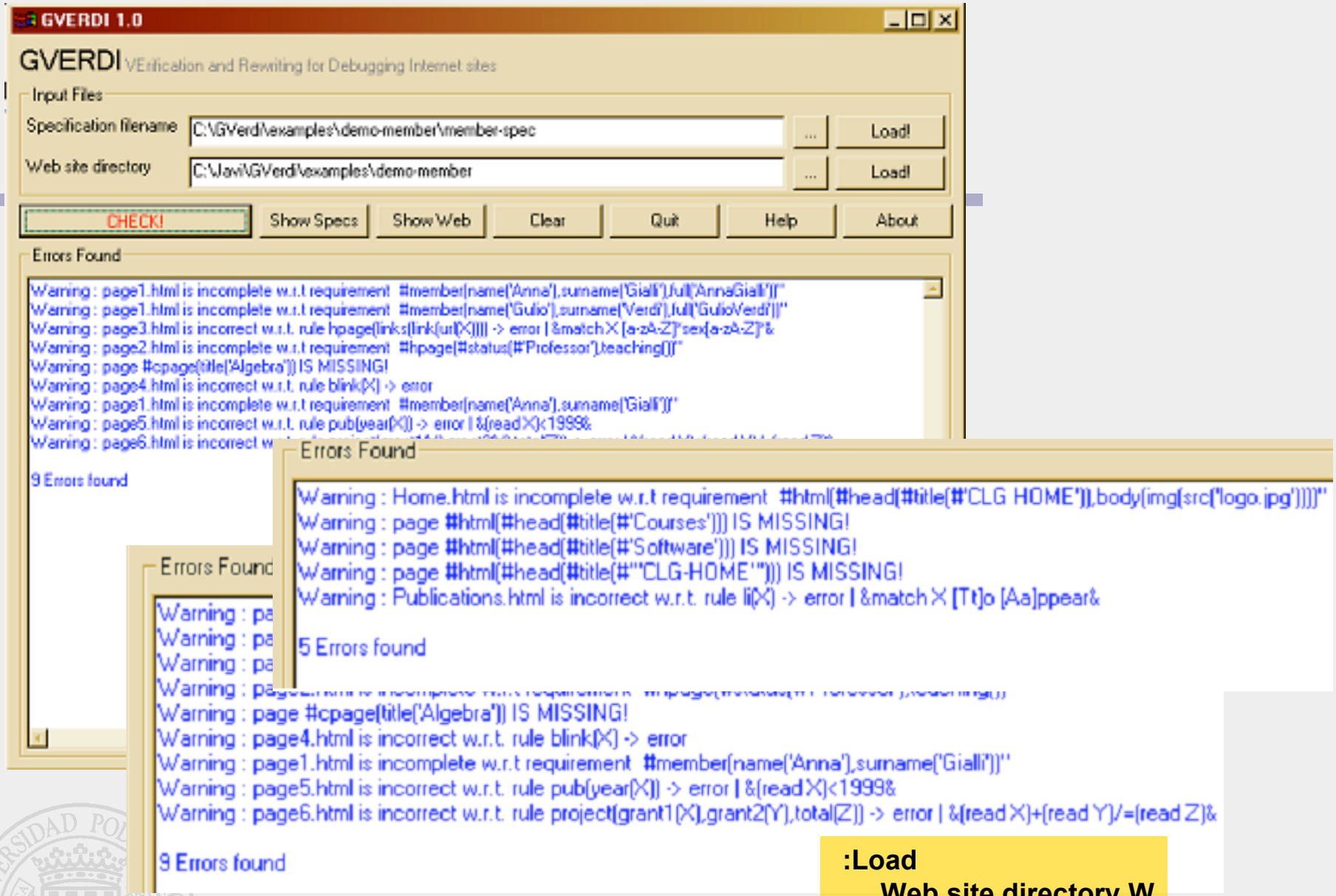
The prototype GVERDI implements the rewriting-based language for the specification and the verification of integrity conditions of Web sites.

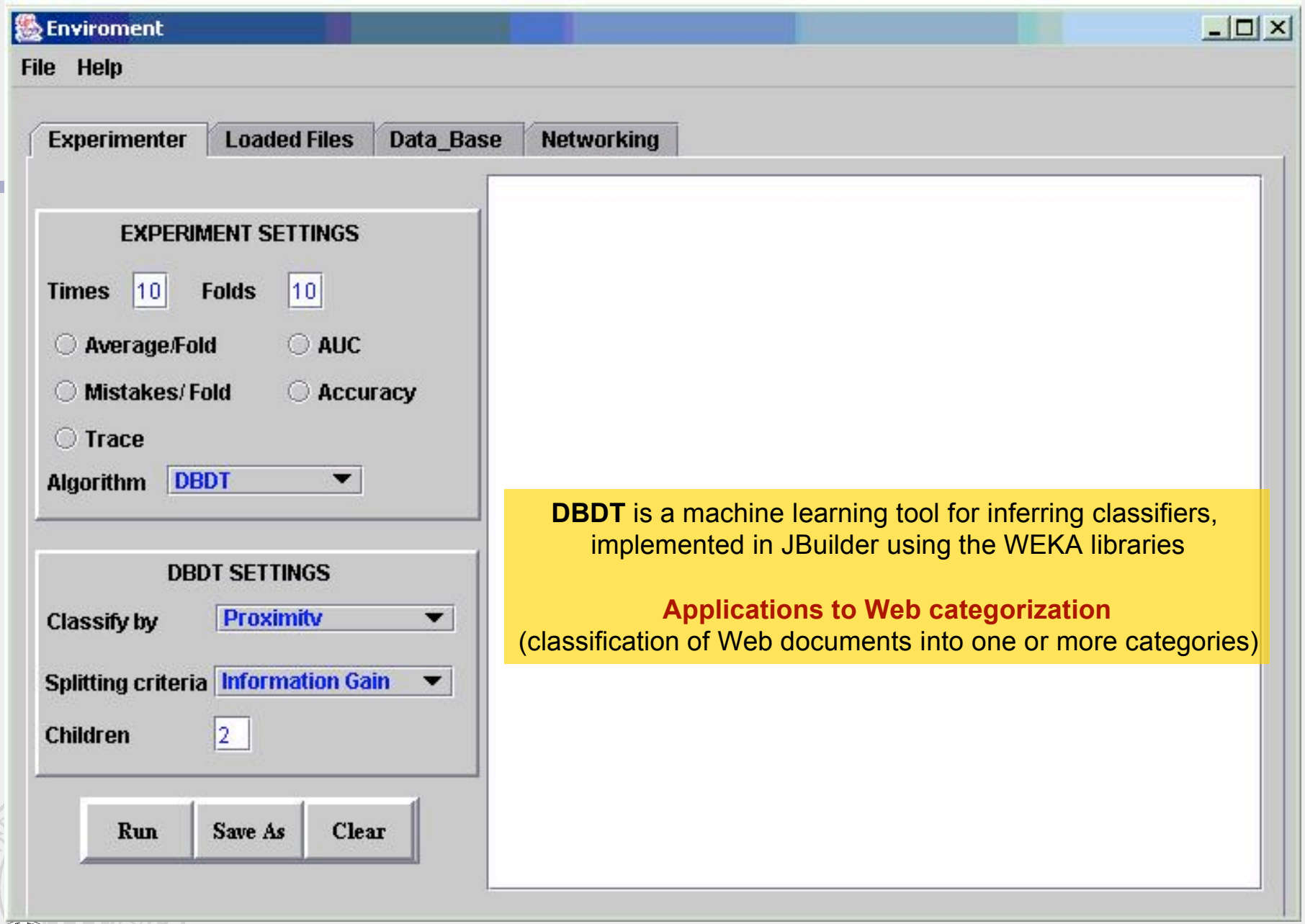
- Written in Haskell
- Intuitive Graphical User Interface
- Publicly available at

  `http://www.dsic.upv.es/users/elp/GVerdi/`

- We tested the system on real Web sites, e.g.

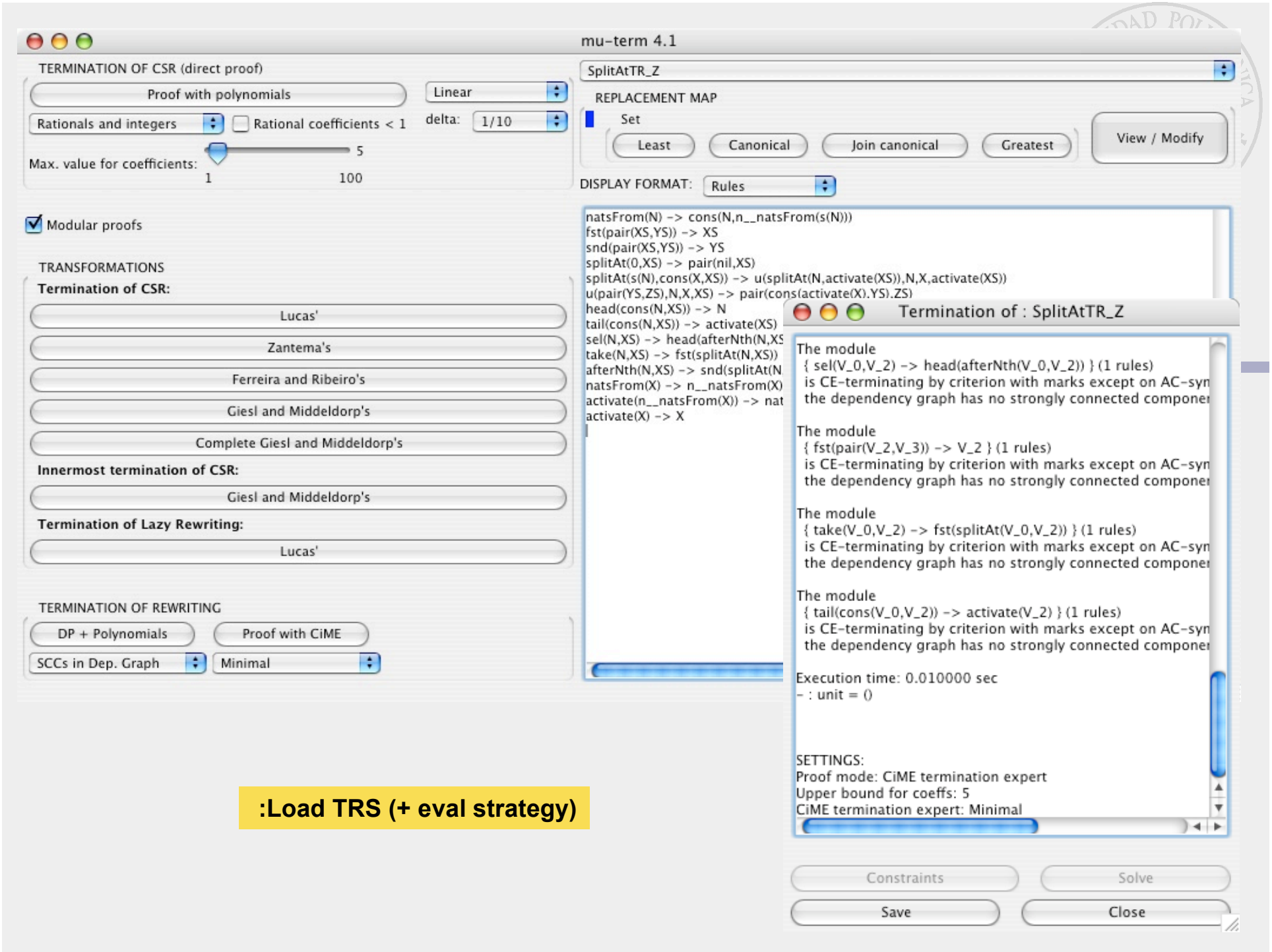
  `http://www.dimi.uniud.it/clg`


GVERDI 1.0
GVERDI VErification and Rewriting for Debugging Internet sites
Input Files
Specification filename
C:\GVerdi\examples\demo-member\member-spec
Load!
Web site directory
C:\Java\GVerdi\examples\demo-member
Load!
CHECK!
Show Specs
Show Web
Clear
Quit
Help
About
Errors Found
Warning : page1.html is incomplete w.r.t requirement #member(name('Anna'),surname('Gialli'),full('AnnaGialli'))"
Warning : page1.html is incomplete w.r.t requirement #member(name('Gulio'),surname('Verdi'),full('GulioVerdi'))"
Warning : page3.html is incorrect w.r.t. rule hpage(links(link(url(X)))) -> error | &match X [a-zA-Z]*sex[a-zA-Z]*&
Warning : page2.html is incomplete w.r.t requirement #hpage(#status(#'Professor'),teaching())"
Warning : page #cpage(title('Algebra')) IS MISSING!
Warning : page4.html is incorrect w.r.t. rule blink(X) -> error
Warning : page1.html is incomplete w.r.t requirement #member(name('Anna'),surname('Gialli'))"
Warning : page5.html is incorrect w.r.t. rule pub(year(X)) -> error | &(read X)<1999&
9 Errors found
Errors Found
Warning : Home.html is incomplete w.r.t requirement #html(#head(#title(#'CLG HOME')),body(img(src('logo.jpg')))))"
Warning : page #html(#head(#title(#'Courses'))) IS MISSING!
Warning : page #html(#head(#title(#'Software'))) IS MISSING!
Warning : page #html(#head(#title(#'"CLG-HOME"'))) IS MISSING!
Warning : Publications.html is incorrect w.r.t. rule li(X) -> error | &match X [Tt]o [Aa]ppear&
5 Errors found
Errors Found
Warning : page #cpage(title('Algebra')) IS MISSING!
Warning : page4.html is incorrect w.r.t. rule blink(X) -> error
Warning : page1.html is incomplete w.r.t requirement #member(name('Anna'),surname('Gialli'))"
Warning : page5.html is incorrect w.r.t. rule pub(year(X)) -> error | &(read X)<1999&
Warning : page6.html is incorrect w.r.t. rule project(grant1(X),grant2(Y),total(Z)) -> error | &(read X)+(read Y)/=(read Z)&
9 Errors found
:Load
Web site directory W
Web Specification S



DBDT is a machine learning tool for inferring classifiers, implemented in JBuilder using the WEKA libraries

Applications to Web categorization
(classification of Web documents into one or more categories)

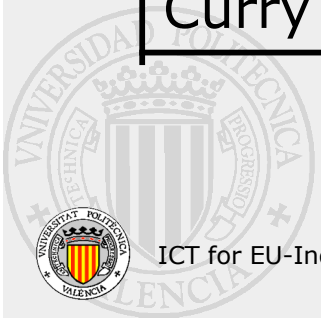

mu-term 4.1
TERMINATION OF CSR (direct proof)
Proof with polynomials
Linear
Rationals and integers
Rational coefficients < 1
delta:
1/10
Max. value for coefficients:
5
1
100
Modular proofs
TRANSFORMATIONS
Termination of CSR:
Lucas'
Zantema's
Ferreira and Ribeiro's
Giesl and Middeldorp's
Complete Giesl and Middeldorp's
Innermost termination of CSR:
Giesl and Middeldorp's
Termination of Lazy Rewriting:
Lucas'
TERMINATION OF REWRITING
DP + Polynomials
Proof with CiME
SCCs in Dep. Graph
Minimal
SplitAtTR_Z
REPLACEMENT MAP
Set
Least
Canonical
Join canonical
Greatest
View / Modify
DISPLAY FORMAT:
Rules
natsFrom(N) -> cons(N,n__natsFrom(s(N)))
fst(pair(XS,YS)) -> XS
snd(pair(XS,YS)) -> YS
splitAt(0,XS) -> pair(nil,XS)
splitAt(s(N),cons(X,XS)) -> u(splitAt(N,activate(XS)),N,X,activate(XS))
u(pair(YS,ZS),N,X,XS) -> pair(cons(activate(X),YS),ZS)
head(cons(N,XS)) -> N
tail(cons(N,XS)) -> activate(XS)
sel(N,XS) -> head(afterNth(N,XS
take(N,XS) -> fst(splitAt(N,XS))
afterNth(N,XS) -> snd(splitAt(N
natsFrom(X) -> n__natsFrom(X)
activate(n__natsFrom(X)) -> nat
activate(X) -> X
Termination of : SplitAtTR_Z
The module
{ sel(V_0,V_2) -> head(afterNth(V_0,V_2)) } (1 rules)
is CE-terminating by criterion with marks except on AC-syn
the dependency graph has no strongly connected compone
The module
{ fst(pair(V_2,V_3)) -> V_2 } (1 rules)
is CE-terminating by criterion with marks except on AC-syn
the dependency graph has no strongly connected compone
The module
{ take(V_0,V_2) -> fst(splitAt(V_0,V_2)) } (1 rules)
is CE-terminating by criterion with marks except on AC-syn
the dependency graph has no strongly connected compone
The module
{ tail(cons(V_0,V_2)) -> activate(V_2) } (1 rules)
is CE-terminating by criterion with marks except on AC-syn
the dependency graph has no strongly connected compone
Execution time: 0.010000 sec
- : unit = ()
SETTINGS:
Proof mode: CiME termination expert
Upper bound for coeffs: 5
CiME termination expert: Minimal
Constraints
Solve
Save
Close
:Load TRS (+ eval strategy)

Implementation Status

Maude, Haskell, tccp, Curry, HTML/XML

	Done	Ongoing
Web sites verifier (GVerdi) and repair tool	√	√
termination analyzer, strategies (MuTerm)		√
machine learner (DBDT)	√	
reconfig. nets verifier (MCReNet)	√	
model checker for tccp		√
declarative debuggers (Debussy)		√
offline program specializer (OffPeVal)	√	
Curry and XML slicers	√	

available at the ELP website



13 Journal Articles (2004-2005)

Theoretical Computer Science (3)	Elsevier Science
Information Processing Letters (2)	"
Theory and Practice of Logic Programming (3)	Oxford U. Press
J. Symbolic Computation (2)	Academic Press
RAIRO Theoretical Informatics and Applications	EDP Sciences
Software Tools for Technology Transfer	Springer-Verlag
Applicable Algebra in Engineering, Communication and Computing	"
Higher-Order and Symbolic Computation	Kluwer

>30 Conference Papers (2004-2005)

RTA	FLOPS	LOPSTR
ICFP	PPDP	ILP
ESOP	PEPM	WRLA
ICML	MCS	WST
QAPL	WFLP	ISOLA
JELIA	WRS	RULE
RISE	FOSSAC	NLP
NLDB	CiCling	…

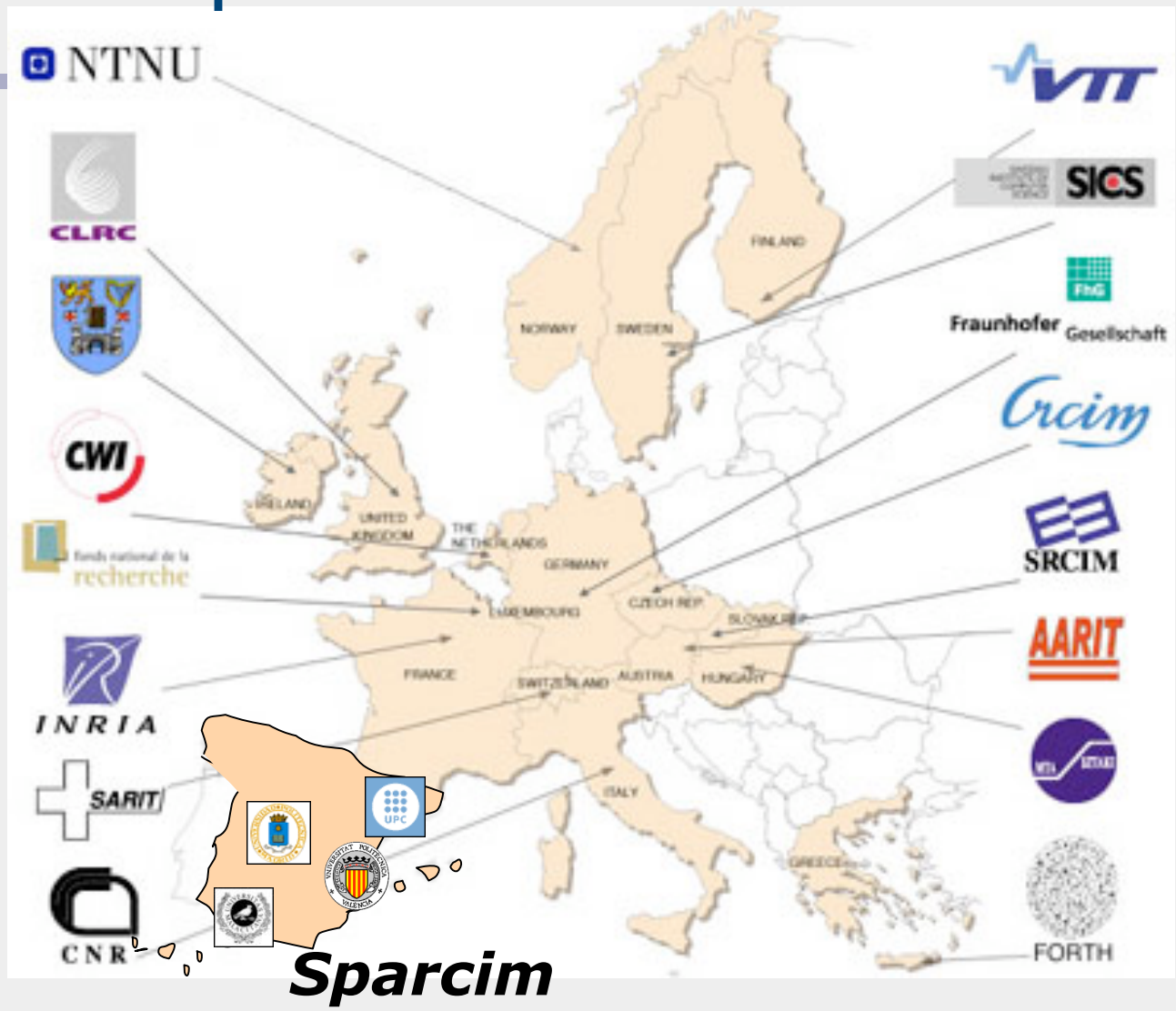
ACM Press
IEEE Press
Elsevier
Springer LNCS/LNAI
ENTCS
Thomson Ed.

ELP Int'l Cooperation

C.A.U Kiel	Germany	M. Hanus
RWTH Aachen	"	J. Giesl
U. Bristol	UK	P. Flach
U. Kent	"	O. Chitil
U. Southampon	"	M. Leuschel
U. Illinois	USA	J. Meseguer
U. Portland	"	S. Antoy
T.U. Wien	Austria	B. Gramlich
U. Monash	Australia	D. Dowe
LIX Paris	France	R. Cousot
IRISA Rennes	"	E. Badouel
IMAG Grenoble	"	R. Echahed
U. Orsay	"	C. Marché

JOINT PROJECTS
JOINT PUBLICATIONS
WORKSHOPS
  CO-ORGANIZATION
STAYS

Sparcim: Spanish arm of ERCIM



ELP Int'l Cooperation

- Approval of the Joint **PhD programme** with:
  - Udine
  - Siena
  - Hyderabad
  - Sophia-Antipolis

- WWV'06 is planned as a satellite event of ISOLA'06:

  2nd Intl Symposium on Leveraging Applications of Formal Methods
  Phapos, Chipre, Sep 2006






3. Other ELP activities

PC members of:

2006: ICLP, ESOP, WRS, AISC, WRLA
2005: LOPSTR, LPAR, WRS, IFL, IJCAI, RULE, WCFLP, PKDD, PPDP, ECML
2004: LOPSTR, WRS, IFL, WRLA, WFLP, WLPE, ROCAI, COLOPS, STAIRS

Organization of:

ROCAI 2004 (1st Workshop on ROC Analysis in AI)
STAIRS 2004 (2nd European Starting AI Researcher Symp.)

WWV is planned for 2006 as a satellite event of ISOLA'06:
2nd Intl Symposium on Leveraging Applications of Formal Methods,
Phapos, Chipre, Sep 2006

Applied for a **joint PhD programme** with Udine, Siena, Hyderabad and Sophia-Antipolis