

# *A grammar-based approach to multilingual mathematics*

Jordi Saludes, Olga Caprotti, Sebastian Xambó-Descamps  
UPC, Barcelona



# MOLTO-EEU

## a larger Consortium

- ❖ approved on 7/12/2011
- ❖ 2 new countries/  
languages:
  - ❖ Be Informed (NL)
  - ❖ Uni Zürich (CH)
- ❖ 2 new use cases:
  - ❖ decision making system
  - ❖ multilingual semantic wikis

FP7-CT-2007

MOLTO Enlarged EU

### SEVENTH FRAMEWORK PROGRAMME Information and Communication Technologies

Grant agreement for: Small or medium-scale focused research project

#### *Annex I - "Description of Work"*

Project acronym: *MOLTO Enlarged EU*  
Project full title: Multilingual On-Line Translation  
Grant agreement no.: 288317

Beneficiary Number	Beneficiary name	Beneficiary short name	Country	Project Entry month	Project Exit Month
1	Göteborgs universitet (coordinator)	UCOT	Sweden	1	30
2	Helsingin yliopisto	UIEL	Finland	1	30
3	Universidad Politécnica de Catalunya	UPC	Spain	1	30
4	Onroep AD	Onroep	Belgium	1	30
5	Motuswiss-GmbH	MCCW	Austria	1	13/04/2010
6	Be Informed	BI	The Netherlands	21	30
7	University of Zurich	UISE	Switzerland	21	30

Annex I - "Description of Work" - Part B Page 1 of 8  
Version 3.7.3 agreed with the EC services

# All deliverables (not updated)

## Quick list

Number	Title	Attached files	Date Published
D 7.1	D7.1 Patent MT and Retrieval Prototype Beta	D71_final.pdf	01/2012
D 2.1	GF Grammar Compiler API	D2.1.pdf	03/2011
D 1.3A	D1.3A Advisory Board Report	D1.3A.pdf	03/2011
D 8.2	Multilingual grammar for museum object descriptions	WP8-D2.pdf, d8.2-grammars.tar.gz, WP8-D2.pdf, WP8-D2.pdf, WP8-D2.pdf	03/2012
D 6.2	Prototype of comanding CAS	<a href="http://www.molto-project.eu/print:book:export:html:1487.pdf">http://www.molto-project.eu/print:book:export:html:1487.pdf</a>	03/2012
D X.2	Annual Public Report M24	DX.2.pdf	03/2012
D 5.2	Description and evaluation of the combination prototypes	D52.pdf	03/2012
D 4.2	D4.2. Data models and alignments	D4.2.pdf	05/2011
D 10.1	Dissemination Plan with Monitoring and Assessment	D10.1.pdf	06/2010
D 10.2	MOLTO web service, first version	D10.2.pdf	06/2010
D 8.1	D8.1 Ontology and corpus study of the cultural heritage domain	D8-1.pdf	09/2011
D 5.1	Description of the final collection of corpora	D51c.pdf	09/2011
D 3.1	D 3.1. The Translation Tools API	The MOLTO Translation Tools API.pdf, d31.zip	09/2011
D 1.4	Periodic Management Report T18	<a href="http://www.molto-project.eu/print:book:export:html:1324.pdf">http://www.molto-project.eu/print:book:export:html:1324.pdf</a>	10/2011
D 2.2	D2.2 Grammar IDE	<a href="http://www.molto-project.eu/print:book:export:html:1379.pdf">http://www.molto-project.eu/print:book:export:html:1379.pdf</a>	10/2011
D 6.1	Simple drill grammar library	d61.pdf	10/2011
D 4.3	D4.3 Grammar ontology interoperability	D4.3.pdf, D4.3_edited.pdf	10/2011
D 4.1	D 4.1. Knowledge Representation Infrastructure	D4.1.pdf, D4.1_reviewed.pdf	11/2010
D 1.2	Progress Report	D1.2.pdf	11/2010
D 9.1	D9.1 MOLTO test criteria, methods and schedule	D9.1-final.pdf, d91-final_w_cover.odt	12/2010

<http://www.molto-project.eu/view/biblio/deliverables>

# Use case: Mathematics

Multilingual, natural, mathematical language

Any language, whether formal or natural, is the basic tool for reasoning and communicating (with a fellow or a machine) along time and across space

Along time: archival publications

Across space: crossing borders (mental borders too :), disciplines or mental frameworks)



# Education

from the point of view of language learning

Thinking, speaking and writing  
are core competencies

A professional thinks, speaks, and writes in a specialized language, the level of expertise is often noticed by the kind of language employed.

# A QUESTION TO THE EDUCATORS

Lately we seem to pay no effort to translating:  
foreign jargon abounds.

WHY?

global market

what about

local communities of practice?

new areas of research and development?

# Mathematicians are lexicographers, too

## Symbolic lexicographers

Naming abstract objects and proving statements about them is the job of a mathematician.

A mathematician compiles a dictionary in his/her area of research.

lex•i•cog•ra•pher | ,leksə'kägɹəfər |  
noun  
a person who compiles dictionaries.



# Inklings of translations

## Common math notation

CLAIM:

Some notation we commonly use is often remnant  
of the original definition

Let  $K$  be a field - where  $K$  is short for Körper

$Q$ , the set of Rationals -  $Q$  for "quoziante" (Peano)

$Z$ , the set of Integers - for Zahlen

(<http://jeff560.tripod.com/nth.html>)

# Die Menge der Brücke Q

The set of fractions Q

## Die Menge der Brüche Q

The amount of breaks Q  
Die Menge der Brüche Q

Search "Die Menge der B..." at:

- Google
- Google Images
- The Free Dictionary
- Urban Dictionary
- Lingoes
- Wikipedia
- IMDb
- Youtube

jeier Elemente einer Menge M. Für jedes solches

der nich

au dann wenn  $a \sim a$  für alle  $a \in M$

```
MathTalk> parse "select a set of the rational numbers Z such that for all numbers $ x $ , x divides y ." | lin
select a set of the rational numbers Z such that for all numbers $ x $ , x divides y .
seleziona un insieme dei numeri razionali Z tale che per tutti numeri $ x $ , x divida ad y .
selecciona un conjunto de los números racionales Z tal que para todos números $ x $ , x divida a y .
```

# Mathematics is universal

Yet it is multilingual

WebALT - Web Advanced Learning Technologies (EDC-22253, 2005-2008)

The screenshot shows the 'WebALT Online Practice Question Bank Editor' interface. On the left, there is a 'Topics in this Question Bank' sidebar with a tree view. The main area displays a question titled 'Question Name: Integration' with the text 'Transpose  $\begin{bmatrix} 1 & 2 \\ 3 & -3 \end{bmatrix}$ ' and an input field. A language dropdown menu is open on the right, showing options: English, English, French, Italian, Spanish, and Swedish. The MapleSoft logo is visible in the top right corner.

The screenshot shows the 'Demo Course' interface. At the top, it says 'You are logged in as user - (Logout)'. Below that, there is a breadcrumb trail: 'TLM > DC1 > SCORM/AICOs > Mathdx SCORM Exercise'. A 'Course structure' sidebar on the left shows 'Mathdx Demo' with two exercises. The main content area displays a message: 'Hello user Lesson Status: incomplete (incomplete means you have attempted the exercise but did not submit the result.) You need 70 score to pass this exercise.' Below this, there is a question in Catalan: '¿Què és el divisor comú de  $x^2 - 1$  y  $x^2 + 2 * x + 1$  ?'. A language dropdown menu is open, showing options: Spanish, English, French, Italian, Spanish, and Swedish. A mathematical toolbar is visible below the question, containing various symbols and operators.

First release of a Mathematical Grammar Library based on GF

# Mathematical Grammar Library

Demo

Jordi Saludes will demonstrate

- \* online mathematical translator
- \* word problem tutor