

# The European Digital Mathematics Library

*Radoslav Pavlov and Jiří Rákosník*

*DiPP 2013, Veliko Tarnovo*

Mathematics is beautiful:  
What was true yesterday  
is still true today.

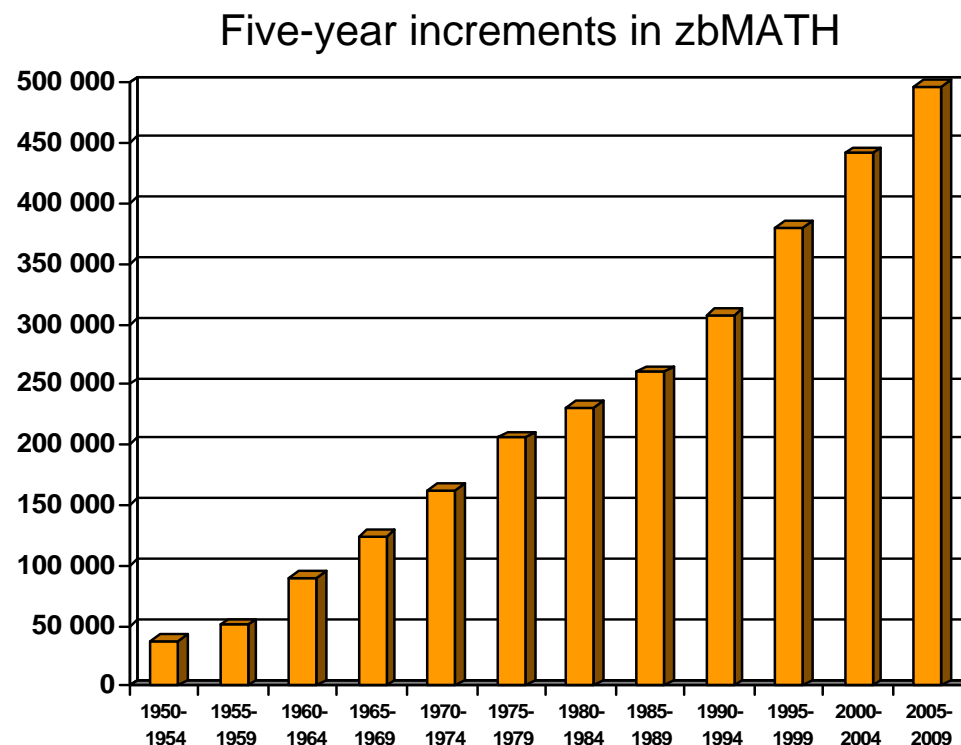
*Jaroslav Kurzweil*

## Why

- Mathematical validated literature
  - forms an edifice whose individual building blocks remain in the construction for ever
  - does not get obsolete, new results do not supersede older ones
  - remains valid only in its entirety, building a wide network of references
  - provides timeless utility to other fields

## Mathematical literature is ever growing

- Mathematical validated literature is an edifice whose individual building blocks remain in the construction for ever
- Permanently accelerating growth
  - < 10 % before 1900
  - > 70 % after 1950
- > 100 000 new publications a year
- Interdependence
  - 1/2 of citations aim more than 10 years back
  - 1/4 of citations aim more than 20 years back



- We need a reference library
  - exhaustive
  - up-to-date
  - well organized
  - widely open
  - easy to use for non-mathematicians
- Electronic approach offers a solution:
  - new publications are prepared in electronic form
  - the old ones are being digitized in numerous projects
- However:
  - efforts are not well coordinated and do not systematically cover the literature
  - digital documents are often duplicated among various providers
  - serials are often split across providers
  - good access requires numerous subscriptions and complicated search
  - permanent reliable access is not guaranteed

## What

- The European Digital Mathematics Library as a complex solution with the aims
  - to create a **common infrastructure** for seamless navigation, searching and interacting within the deeply interlinked network of **distributed validated** multilingual digital mathematical content available throughout Europe, which will make mathematics readily available for all users
  - to provide a **safe archival back-end** so that publishers do not have to maintain their back catalogues indefinitely, and thus agree to transfer their content and to license **eventual open access** to it according to their moving wall policy
  - to satisfy the demand for **reliable and long-term availability** of mathematical research output

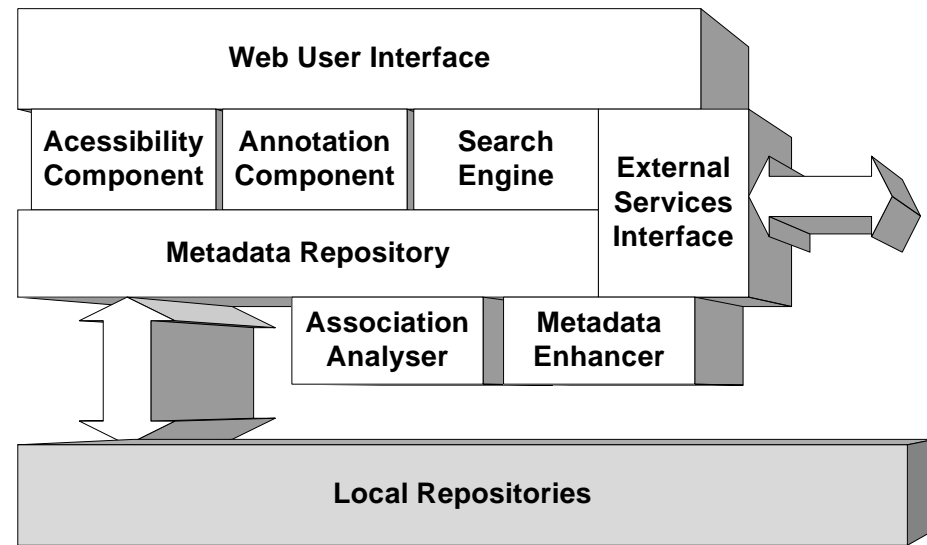
## The project

- Project partly financed by the EC Competitiveness and Innovation Framework Programme
  - Information and Communications Technologies Policy Support Programme / Open Access to Scientific Information
- 3,2 M€ (1,6 M€ from the EC)
- February 2010 – January 2013



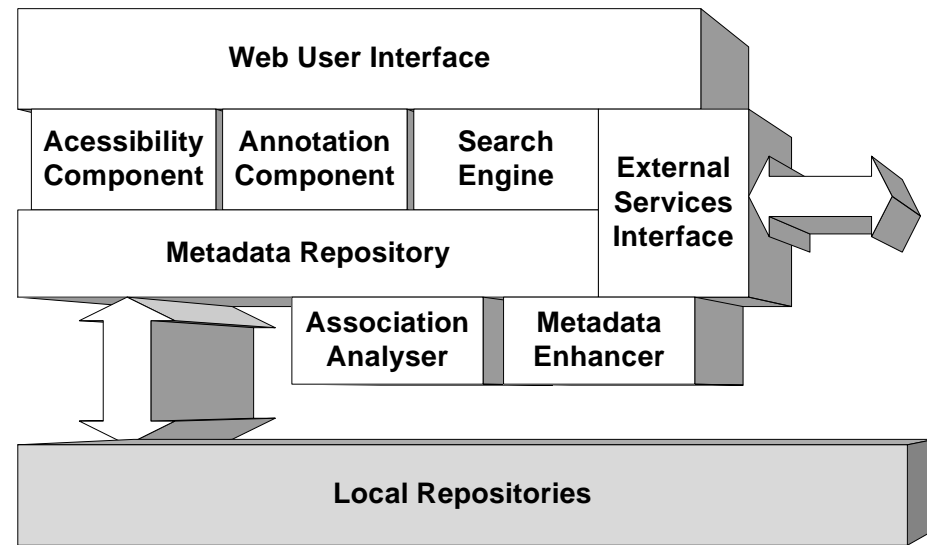
## System architecture

- **Metadata Repository** – the central point of reference managing a replica of all metadata for all items in the different local repositories
- **Search Engine** – to search and item identifier resolution facilities
- **Metadata Enhancer** – collection of tools to expand or complete the metadata existing by content providers (OCR over full texts, multilingual metadata, generating MathML, etc.)
- **Association Analyser** – to detect, analyse and record relations between individual items



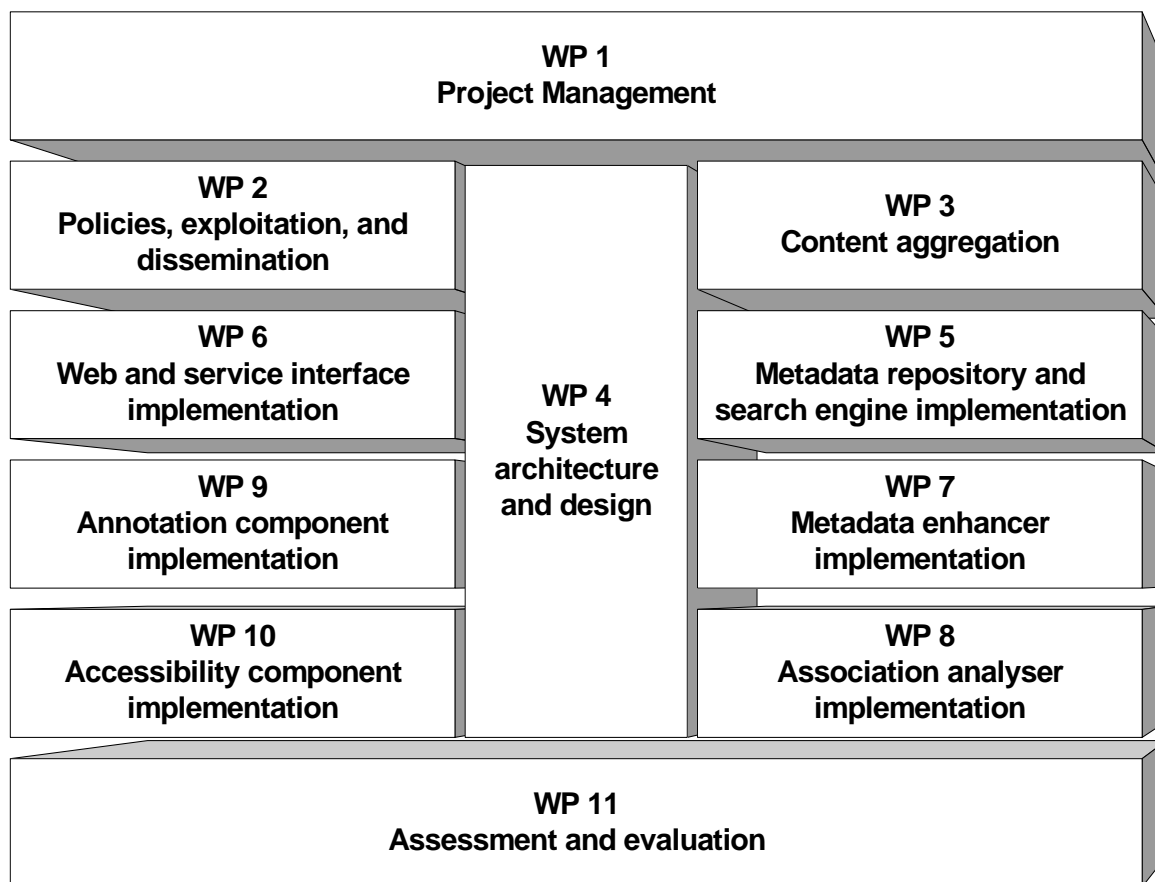
## System architecture

- **Annotation Component** – mechanisms to attach new material to individual items in the repositories and maintain this new material
- **Accessibility Component** – support for enhancing accessibility of items, if required, before presentation to end users
- **Web User Interface** and **External Services Interface** – to provide access to the collected resources system to human and machine users and interfaces for integration of third party services



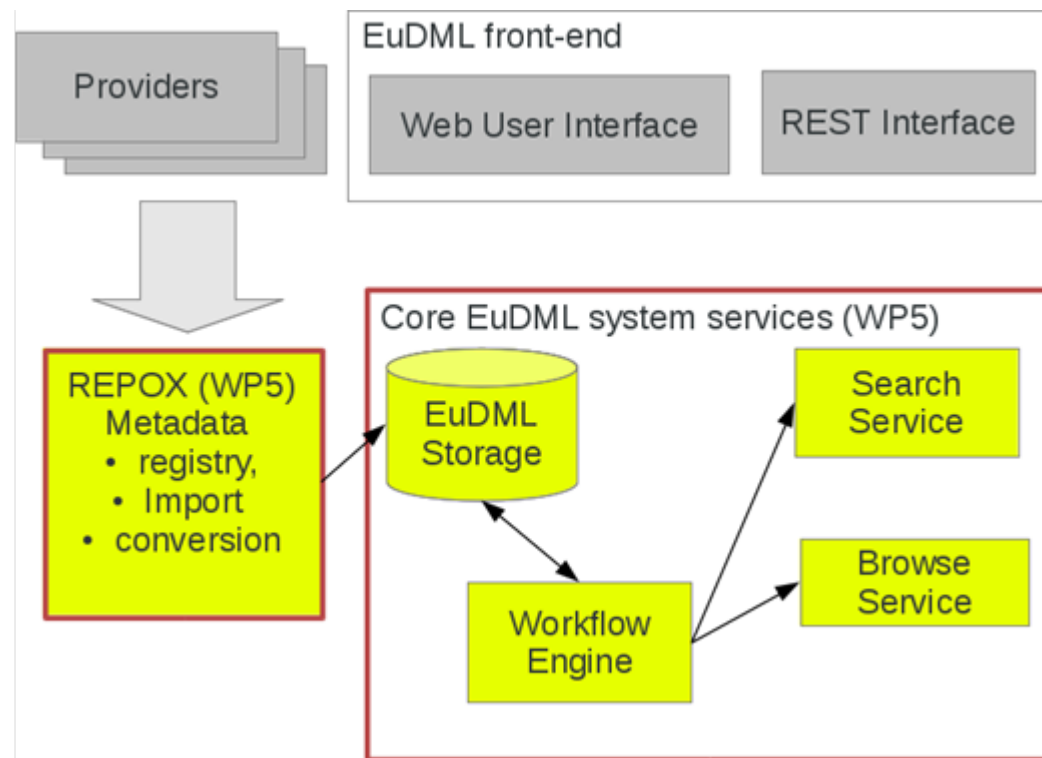


## Project structure

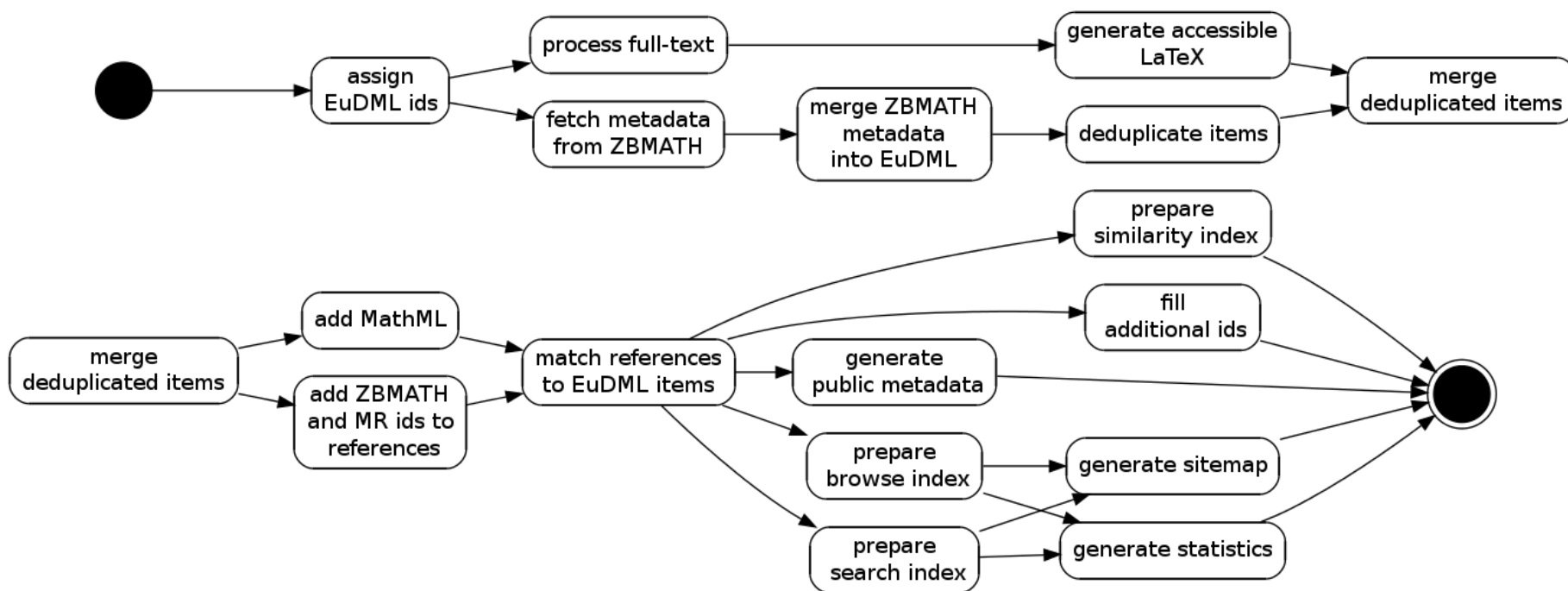


## Core services overview

- REPOX – framework for managing metadata spaces
- YADDA – main data repository



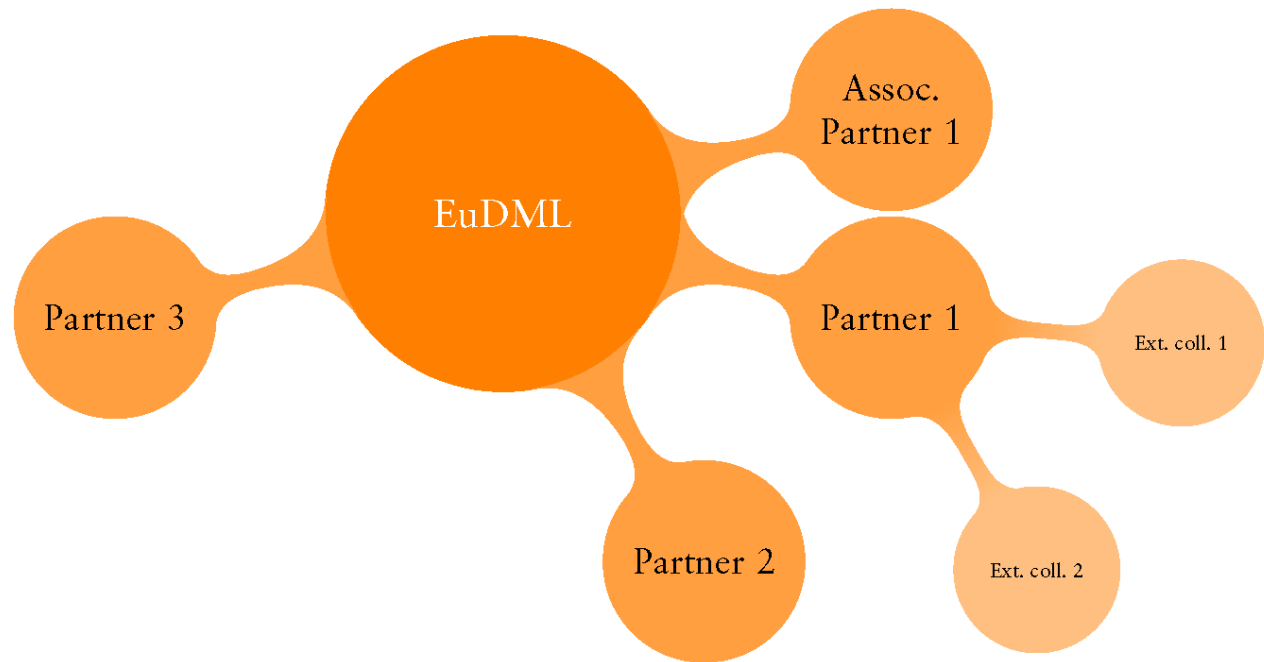
## Processing workflow



fulltext-processing (~7d), eudml-indexing (~33h), zbl-match-ref (~18h), gensim-training (~17h), gensim-indexing (~14h) ....

## Content aggregation

To aggregate all the metadata contributed to the project in a single repository and format



## Metadata schema

- Content analysis
- Providers feedback
- Common EuDML metadata schema – JAT Suite (Journal archiving and interchange tag, U.S. National Library of Medicine)
- Metadata harvest
- Final version of EuDML metadata schema, JATS NISO 1.0

- ⌘ [EuDML Network](#)
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    - ⌘ [EuDML metadata schema specification](#)
  - ⌘ [API](#)
- ⌘ [Links](#)

## *EuDML metadata schema specification (v2.0 - final)*

The EuDML metadata schema version 2.0 as defined by deliverable D3.6 is implemented in two XML schemas providing the 2 root elements holding XML metadata for two major types of items, namely **journal articles** and **books**.

A consequence of this choice is that:

- ⌘ There is no separate schema for book parts (typically individual articles in a proceedings volume); these are described and exchanged within the whole book record they belong to.
- ⌘ There is no separate schema for multi-volume works. Instead a book record may carry the description of the multi-volume work it belongs to, if any.




**Journal articles** are described with unmodified **Journal Archiving and Interchange Tag Set, NISO version 1.0** XML schema structure with root element <article>. However, as the NISO schema lacks a namespace declaration, the formal specification of the journal article schema, located at <http://eudml.org/schema/2.0/eudml-article-2.0.xsd> adds the definition of the target namespace "http://jats.nlm.nih.gov" to the standard XML schema definition. There are no other modifications to the standard.


Structured documentation for this schema is available at

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Search term  Search

Find out more at <http://eudml.org/>

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We will *deliver* a truly open, sustainable and *innovative* framework for *access* and exploitation of Europe's rich

## Content aggregation

Item type	Number of items
Journal article	221 293
Proceedings contribution	2 962
Book chapter	42 520
Book: monograph	1 724
Book: conference	66
Book: volume	1 179
Multiple volume book	296
Total	270 040

Projects	Contributed
GDZ, ElibM	100 000
Gallica, NUMDAM, CEDRAM	57 000
DML-CZ	28 000
RusDML	17 000
DML-PL	14 000
DML-E	6 400
HDML	3 000
BDIM	2 000
BuIDML	1 700
SPM/BNP	1 300

## EuDML policies

- The texts in EuDML must have been **scientifically validated and formally published**.
- EuDML items must be **open access after a finite embargo period**. Once documents contributed to the library are made open access due to this policy, they **cannot revert to close access** later on.
- The **digital full text** of each item contributed to EuDML must be **archived physically at one of the EuDML member institutions**.



## Sustainability – EuDML Initiative

- Association without legal personality
  - The European Mathematical Society
  - Fachinformationszentrum Karlsruhe (Zentralblatt MATH Berlin)
  - Interdisciplinary Centre for Math. and Computational Modelling, Univ. of Warsaw
  - Cellule MathDoc, Université Joseph Fourier, Grenoble
  - Institute of Mathematics of the ASCR, v. v. i., Praha
  - University of Birmingham
  - Institute of Mathematics and Informatics BAS, Sofia
  - Ionian University, Corfu
  - Società Italiana per la Matematica Applicata e Industriale
  - Unione Matematica Italiana
  - Niedersächsische Staats- und Universitätsbibliothek Göttingen

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Enter your search terms to get started

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### Search Tips

- search is case and diacritics insensitive (Bézout = bezout)
- search is performed on exact words as typed (theorem ≠ theorems)
- phrases are supported with quote notation ("Uniformization theorem" ≠ Uniformization theorem = uniformization AND theorem)
- wildcards \* and ? can be used (except in phrases)

EuDML is currently indexing **227991** items across **13** collections [more statistics](#)

### What is EuDML?

*EuDML makes the mathematics literature available online in the form of an enduring digital collection, developed and maintained by a network of institutions.*

**REGISTER FOR EuDML  
FIND OUT THE BENEFITS**

### Features

1. Search and explore the collection
2. Find related items and journals
3. Save and share your findings

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### Recent Notes

This paper has a serious problem. Unfortunately, it seems the editorial statement by the editors of the journal didn't make it into EuDML. Click on the Zentralblatt link below to read it!

[See more](#)

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This topic has recently become quite popular. A lot of information can be found on the web site of the Research group on variable exponent spaces and image processing

<http://www.helsinki.fi/~pharjule/varsob/index.shtml>

[See more](#)

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A very readable set of Hilbert's lecture notes in English that covers this material is available as:

<http://www.cambridge.org/gb/knowledge/isbn/item144333>

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kur

- Kuramoto-Sivashinsky
- Kuramoto-Sivashinsky equation
- Kuratow ski
- Kuratow ski graph
- Kuratow ski polyhedron
- Kuratow ski set
- Kuratow ski-Knaster
- Kuratow ski-Knaster fan
- Kurzwil-Henstock
- Kurzwil-Henstock integral

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2. Find related items and journals

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## Advanced Search

Match  of the following rules

Any field contains (math terms translated to English)

**Item**  
 Any field contains  
**Any field contains (math terms translated to English)**

**Title**  
 Item title contains

**Author**  
 Author's name contains

**Publication Year**  
 Is published  
 Is published before  
 Is published after

**Journal**  
 Journal title contains

**Language**  
 Language is

Search

## Subjects

The main purpose of the classification of items in the mathematical literature using the Mathematics Subject Classification scheme is to help users find the items of present or potential interest to them as readily as possible. The MSC is a hierarchical scheme, with three levels of structure. A classification can be two, three or five digits long, depending on how many levels of the classification scheme are used. The first level representing the main mathematical disciplines is labeled by a two digit number, the second representing specific areas is labeled by a letter (or a hyphen), and the third level for specific kind of mathematical object or a well-known problem or research area is labeled by another two digit number.

- |  |  |
|--|--|
| 00-XX <a href="#">General</a>  | 45-XX <a href="#">Integral equations</a>                                       |
| 01-XX <a href="#">History and biography</a>  | 46-XX <a href="#">Functional analysis</a>                                      |
| 03-XX <a href="#">Mathematical logic and foundations</a>                                       | 47-XX <a href="#">Operator theory</a>  |
| 05-XX <a href="#">Combinatorics</a>  | 49-XX <a href="#">Calculus of variations and optimal control; optimization</a> |
| 06-XX <a href="#">Order, lattices, ordered algebraic structures</a>                            | 51-XX <a href="#">Geometry</a>   |
| 08-XX <a href="#">General algebraic systems</a>  | 52-XX <a href="#">Convex and discrete geometry</a>                             |
| 11-XX <a href="#">Number theory</a>  | 53-XX <a href="#">Differential geometry</a>                                    |
| 12-XX <a href="#">Field theory and polynomials</a>   | 54-XX <a href="#">General topology</a>   |
| 13-XX <a href="#">Commutative algebra</a>  | 55-XX <a href="#">Algebraic topology</a>                                       |
| 14-XX <a href="#">Algebraic geometry</a>   | 57-XX <a href="#">Manifolds and cell complexes</a>                             |
| 15-XX <a href="#">Linear and multilinear algebra; matrix theory</a>                            | 58-XX <a href="#">Global analysis, analysis on manifolds</a>                   |
| 16-XX <a href="#">Associative rings and algebras</a>   | 60-XX <a href="#">Probability theory and stochastic processes</a>              |
| 17-XX <a href="#">Nonassociative rings and algebras</a>  | 62-XX <a href="#">Statistics</a>   |
| 18-XX <a href="#">Category theory; homological algebra</a>                                     | 65-XX <a href="#">Numerical analysis</a>                                       |
| 19-XX <a href="#">K-theory</a>   | 68-XX <a href="#">Computer science</a>   |
| 20-XX <a href="#">Group theory and generalizations</a>   | 70-XX <a href="#">Mechanics of particles and systems</a>                       |
| 22-XX <a href="#">Topological groups, Lie groups</a>   | 74-XX <a href="#">Mechanics of deformable solids</a>                           |
| 26-XX <a href="#">Real functions</a>   | 76-XX <a href="#">Fluid mechanics</a>  |
| 28-XX <a href="#">Measure and integration</a>  | 78-XX <a href="#">Optics, electromagnetic theory</a>                           |
| 30-XX <a href="#">Functions of a complex variable</a>  | 80-XX <a href="#">Classical thermodynamics; heat transfer</a>                  |
| 31-XX <a href="#">Potential theory</a>   | 81-XX <a href="#">Quantum theory</a>   |
| 32-XX <a href="#">Several complex variables and analytic spaces</a>                            | 82-XX <a href="#">Statistical mechanics, structure of matter</a>               |
| 33-XX <a href="#">Special functions ( deals with the properties of functions as functions)</a> | 83-XX <a href="#">Relativity and gravitational theory</a>                      |
| 34-XX <a href="#">Ordinary differential equations</a>  | 85-XX <a href="#">Astronomy and astrophysics</a>                               |
| 35-XX <a href="#">Partial differential equations</a>   | 86-XX <a href="#">Geophysics</a>   |
| 37-XX <a href="#">Dynamical systems and ergodic theory</a>                                     | 90-XX <a href="#">Operations research, mathematical programming</a>            |
| 39-XX <a href="#">Difference and functional equations</a>                                      | 91-XX <a href="#">Game theory, economics, social and behavioral sciences</a>   |
| 40-XX <a href="#">Sequences, series, summability</a>   | 92-XX <a href="#">Biology and other natural sciences</a>                       |
| 41-XX <a href="#">Approximations and expansions</a>  | 93-XX <a href="#">Systems theory; control</a>                                  |
| 42-XX <a href="#">Harmonic analysis on Euclidean spaces</a>                                    | 94-XX <a href="#">Information and communication, circuits</a>                  |
| 43-XX <a href="#">Abstract harmonic analysis</a>   | 97-XX <a href="#">Mathematics education</a>                                    |
| 44-XX <a href="#">Integral transforms, operational calculus</a>                                |  |

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[Aequationes mathematicae](#)

ISSN: 0001-9054, 1420-8903

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The screenshot shows the EuDML website search interface. At the top left is the EuDML logo and the text "The EUROPEAN DIGITAL MATHEMATICS LIBRARY". In the top right corner, the user name "Jiří Rákosník" and a "Log Out" link are visible. A language selection dropdown menu is open, showing a list of languages: English (en), български (bg), čeština (cs), Deutsch (de), ελληνικά (el), English (en), español (es), français (fr), italiano (it), lietuvių kalba (lt), polski (pl), português (pt), română (ro), русский (ru), and slovenčina (sk). The "English (en)" option is currently selected. Below the language menu is a search input field with the placeholder text "Title, Author, Keyword, Citation, Date..." and a "Search" button. A navigation bar contains links for "Home", "Advanced Search", "Browse by Subject", and "Browse by Journal". Below the search bar, there is a "Search" section with the heading "Search" and the instruction "Enter your search terms to get started". An "Advanced Search" link is also present. At the bottom of the search section, there is a button that says "Embed EuDML Search on Your Website". An orange callout box on the right side of the search bar contains search tips, including a list of search operators and a note about uniformization theorems.

English (en) | Jiří Rákosník | Log Out

български (bg)

čeština (cs)

Deutsch (de)

ελληνικά (el)

English (en)

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Enter your search terms to get started

Title, Author, Keyword, Citation, Date... Search

Advanced Search

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Search tips:

- accents insensitive
- search on exact words as typed
- use parentheses ( )
- use AND with quote notation
- ("Uniformization theorem" ≠ Uniformization theorem = uniformization AND theorem)
- wildcards \* and ? can be used (except in phrases)

[Начална страница](#) | [Разширено търсене](#) | [Преглед по теми](#) | [Преглед по списания](#)

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## Търсене

Въведете Вашите условия и критерии за търсене

Заглавие, Автор, Ключова дума, цитиране, дата ... Търсене

[Разширено търсене](#) ▶

<> Embed EuDML Search on Your Website

### Съвети за търсене

- Търсенето е без разлика за главни и малки букви и диакритични знаци, например: (Bézout=bezout)
- Търсенето на думи се извършва според точното изписване, например думите (theorem ≠ theorems) се приемат за различни
- Фрази се поддържат с цитат нотация - ("Uniformization theorem" ≠ Uniformization theorem=uniformization AND theorem)
- Заместващите символи \* и ? могат да се използват (с изключение на фрази)

EuDML е индексирал съдържание от **227991** публикации в **13** колекции [повече статистики](#)

### Какво е EuDML?

EuDML прави достъпна онлайн математическата литература публикувана в Европа. EuDML осигурява дългосрочно съхранение и достъп до дигитални колекции, разработени и поддържани от мрежа от институции.

**REGISTER FOR EuDML**

### Характеристики

1. Търсене и преглед на колекции
2. Откриване на релевантни публикации и списания
3. Запазете и споделете Вашите резултати от търсене

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### Последни новини

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A very readable set of Hilbert's lecture notes in English that covers this material is available as:

## Advanced Search

Match  of the following rulesAnyfield contains [Add Sub-clause](#)[Add Another Rule](#)

Contains the following math formula (red border means the formula is incomplete)

Formula preview

$$\int_{\Omega} f(x)dx$$

 Only documents with accessible full-text

Search

formula is incomplete)

$\int_{\Omega} f(x) dx$

Formula preview

$\int_{\Omega} f(x) dx$

Only documents with accessible full-text

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### [Explicit estimates for some mixed integral inequalities.](#)

[Pachpatte, Baburao G.](#) — 2010

Electronic Journal of Differential Equations (EJDE) [electronic only]

### [Application of Pettis integration to differential inclusions with three-point boundary conditions in Banach spaces.](#)

[Dalila Azzam-Laouir, Boutana, Imen](#) — 2007

Electronic Journal of Differential Equations (EJDE) [electronic only]

### [Some non-homogeneous Hardy spaces on locally compact Vilenkin groups](#)

[Shanzhen Lu, Dachun Yang](#) — 1996

Colloquium Mathematicae

### [Semi-classical analysis and vanishing properties of solutions to quasilinear equations.](#)

[Belaud, Yves](#) — 2002

Electronic Journal of Differential Equations (EJDE) [electronic only]

### [New bounds for \$A\_{\infty}\$ weights.](#)

[Radice, Teresa](#) — 2008

Annales Academiae Scientiarum Fennicae. Mathematica

### [Typical faces of best approximating three-polytopes.](#)

[Böröczky, Károly J.; Tick, Péter; Wintsche, Gergely](#) — 2007

Beiträge zur Algebra und Geometrie

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Beiträge zur Algebra und Geometrie 1

Colloquium Mathematicae 1

## Authors

Azzam-Laouir, D 1

Belaud, Y 1

Boutana, I 1

Böröczky, KJ 1

Lu, S 1

More... ➔

## Years

2010 1

2008 1

2007 2



## New bounds for $A_\infty$ weights.

[Radice, Teresa](#)

[Annales Academiæ Scientiarum Fennicæ. Mathematica \(2008\)](#)

Volume: 33, Issue: 1, page 111-119  
ISSN 1239-629X

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Radice, Teresa. "New bounds for  $w$  weights." *Annales Academiæ Scientiarum Fennicæ. Mathematica* 33.1 (2008): 111-119. <<http://eudml.org/doc/129285>>

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#### Harmonic analysis in several variables

42B25 [Maximal functions](#), [Littlewood-Paley theory](#)

#### Linear function spaces and their duals

46E30 [Spaces of measurable functions](#), [L<sup>p</sup>-spaces](#), [Orlicz spaces](#), [Köthe function spaces](#), [Lorentz spaces](#), [rearrangement invariant spaces](#), [ideal spaces](#), etc.)


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26D15 [Inequalities for sums, series and integrals](#)

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## New bounds for $A_\infty$ weights.

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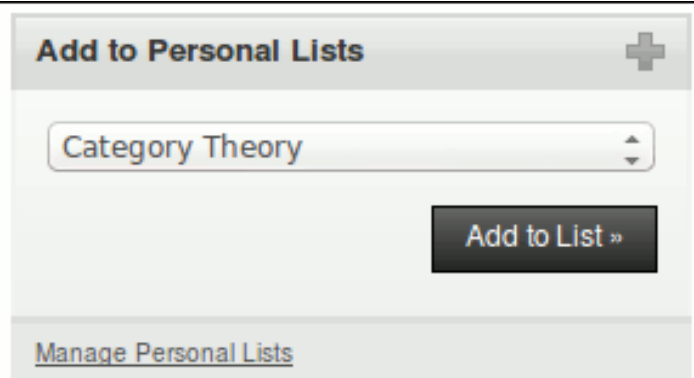
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A very readable set of Hilbert's lecture notes in English that covers this material is available as:  
<http://www.cambridge.org/gb/knowledge/isbn/item1144333>

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## Category Theory

Quasi-abelian categories and sheaves

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## Conclusion

- EuDML is a successful pilot project
- Substantial core content
- Wide range of services
- Continuously growing
- Possible basis for a future World Digital Mathematics Library