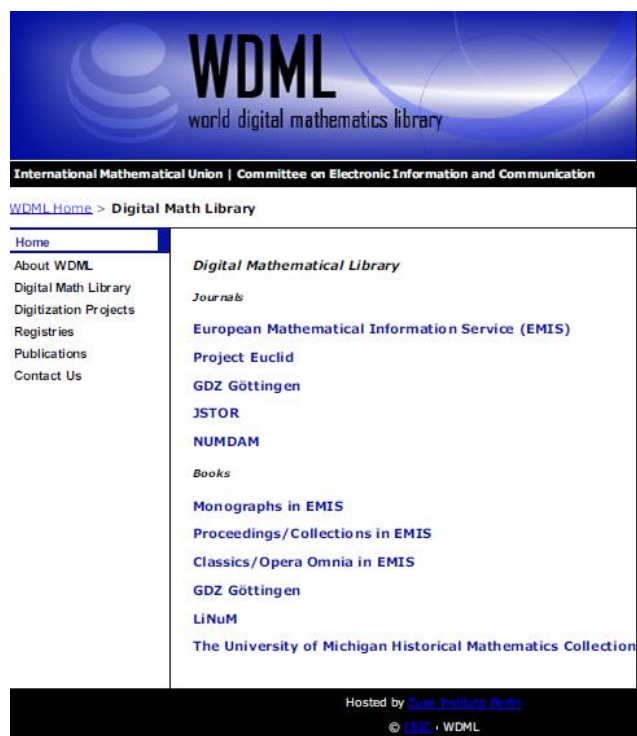


## The Challenges of the Pt-DML

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Everyone agrees that the world is now more digital than ever. Information technology is profoundly transforming the ways in which scholars consume research and disseminate their outputs. Content may still be used in different formats (e.g., people find articles online and print them locally) and on different devices (e.g., iPods, Kindles, handheld readers), but increasingly it must be at least discoverable online to reach readers. For that reason, literature in non-digital format is losing its audience. In many disciplines, people are aware of such problems and are developing initiatives to transform the relevant non-digital resources (e.g., books, journals, maps) to digital formats, organizing them in coherent collections (e.g., see the World Digital Library by UNESCO at [1]).



The mathematicians have contemplated an effort to digitize the past mathematical literature (estimated in 75 million pages) in order to make it available online,

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this effort is commonly designated by the World Digital Mathematics Library (WDML) [2]. This IMU (International Mathematical Union) virtual project has stimulated several other concrete projects and workshops, such as the European Science Foundation Workshop on the European Virtual Library in Mathematics held at the University of Santiago de Compostela, Spain, 13 – 14<sup>th</sup> March 2009 [3].

The aim is to make as much of the past literature available as possible, linked to the present literature in suitable ways, pushed by the principle that mathematics is an accumulative science (so the past is very relevant) with a remarkable importance to other disciplines. Common examples of such importance are: (a) *Medical Imaging (tomography)* is possible because of early 20<sup>th</sup> century measure theory; (b) *Secure Transactions* between banks or over the internet are possible because of cryptography results in number theory from the last two centuries; and (c) *Modern String Theory* depends on algebraic geometry from 19<sup>th</sup> century, besides many others. Hence it is expectable that present and future scientific development will use decisively past mathematical literature.

In the end, the key point of WDML is to preserve knowledge and to make it worldwide and effectively available to whoever need it.

### The present situation

The WDML effort is still under active development and, so far, it has been materialized in a set of projects and initiatives, for which we list a few (including comments from their own homepages):

- mini-DML [4]: *a French project with the goal to col- late in one place basic bibliographical data for any kind of mathematical digital article and make them acces- sible to the users through simple search or metadata retrieval. It is based at NUMDAM and provides a simple search interface for the collected data;*
- European Mathematical Information Service (EMIS) [5]: *The first electronic mathematical library;*

- JSTOR [6]: is a general digitization project for the cultural heritage of the USA. It includes a large collection of mathematical journals, but has some interface limitations as single page view only;
- “Göttinger Digitalisierungs-Zentrum” (GDZ) [7]: the digitization center of the State and University Library Göttingen, with more than 4 Million pages of digitized content available (including the digitized Gutenberg Bible). This encompasses more than 1.2 Million pages of mathematics, accessible through the Mathematica collection;
- “Jahrbuch Project” or Electronic Research Archive for Mathematics (ERAM) [8]: provides an electronic database containing the reviews from the “Jahrbuch über die Fortschritte der Mathematik” as well as digitized versions of the most relevant publication of the time;
- “Numérisation de documents anciens mathématiques” (NUMDAM) [9]: a French digitization project, providing access to the digitized versions of the French major mathematical journals, extending the collection continuously. The articles are available in PDF and DjVu format. Descriptions of the articles are provided, including the identifying numbers of the reference journals *Mathematical Reviews* and *Zentralblatt der Mathematik* (not the MSC classification, though), an abstract and the complete bibliography, with each item linked to a digitized version if available, *MR* and *Zbl*;
- Project Euclid [10]: a user-centered initiative to create an environment for the effective and affordable distribution of serial literature in mathematics and statis-

tics. Project Euclid is designed to address the unique needs of independent and society journals through a collaborative partnership with scholarly publishers, professional societies, and academic libraries. In particular, Project Euclid has digitized back-files of the given journals and provides free access for many issues. Metadata come with abstract, keywords and classifications (no links to review journals);

- “Biblioteka Wirtualna Matematyki” [11]: a Polish project that is based at the ICM of Warsaw University, with the goal of digitizing Polish mathematical journals;
- Czech DML [12]: one of the European pilot projects having both a repository and a search engine;
- “Biblioteca Digital Española de Matemáticas” [13]: a project for the Spanish journals promoted by the Spanish Committee of Mathematics;
- Ulf Rehmann’s Collection [14]: sited at the Bielefeld University, gives links and information regarding digitization projects and a fairly comprehensive list of digitized mathematics available.

The above projects and initiatives are generally funded by national foundations or academic resources (with some exceptions as JSTOR which is a private enterprise). These (retro-)digitalized materials are (and more will be made) available online, at a reasonable cost or free of charges, in the form of an authoritative and enduring digital collection, developed and curated by a network of institutions. For the WDMML goal to happen, many issues and challenges need to be addressed, and this is being done through a number of committees, sub-committees and projects.

In Portugal, in spite of the organization of the 2006 International Workshop held at the University of Aveiro that produced a collective book [15], we are somehow delayed, e.g. when compared to France or USA, but it seems that now things are starting to roll on. The inertia not only is due to financial issues but it is also related with the general unawareness of scholars to this

topic. There are two main initiatives that are OAI aggregators of some of the Portuguese digital resources available (mainly preprints and thesis; without digitalization concerns), namely, the *Repositório Científico de Acesso Aberto de Portugal* (RCAAP) at [16] and the *Portuguese Archive of Mathematics* (PAM) at [17].

Another aspect which is crucial to build the Portuguese DML (PtDML) is the identification and catalog of portuguese relevant resources to be digitized or transformed in order to be available in an aggregator web portal. In particular, the journal *Portugaliae Mathematica*, up to 1993, is retrodigitized and available at the site of the National Digital Library [18]. The journal is now published by the European Mathematical Society Publishing House. For instance, a search at mini-DML for “von Neumann” will yield now eight results, five from Project Euclid, one from the Czech DML, one from Numdam and one from *Portugaliae Mathematica*:

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00238014. von Neumann, John

**A Further Remark Concerning the Distribution of the Ratio of the Mean Square Successive Difference to the Variance**

Ann. Math. Statist. 13, no. 1 (1942), 86-88

[Article \(Euclid\)](#)

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00120986. von Neumann, John

**Approximative properties of matrices of high finite order**

Portugaliae mathematica 3(1), 1-62 (1942)

[Article \(Portugaliae Mathematica\)](#)

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00238024. von Neumann, John

**Distribution of the Ratio of the Mean Square Successive Difference to the Variance**

Ann. Math. Statist. 12, no. 4 (1941), 367-395

[Article \(Euclid\)](#)

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00310345. von Neumann, John

**Miscellaneous. On the position of mathematics. The mathematician**

Applications of Mathematics, Volume 10, number 5 (1965), 444-451

[Article \(Czech-DML\)](#)

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00223444. von Neumann, John; Goldstine, H. H.

**Numerical inverting of matrices of high order**

Bull. Amer. Math. Soc. (N.S.) 53, no. 11 (1947), 1021-1099

[Article \(Euclid\)](#)

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00104938. von Neumann, J.

**On infinite direct products**

Compos. Math. 6, 1-77 (1939)

[Article \(Numdam\)](#)

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00238001. Hart, B. I.; von Neumann, John

**Tabulation of the Probabilities for the Ratio of the Mean Square Successive Difference to the Variance**

Ann. Math. Statist. 13, no. 2 (1942), 207-214

[Article \(Euclid\)](#)

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00238053. von Neumann, J.; Kent, R. H.; Bellinson, H. R.; Hart, B. I.

**The Mean Square Successive Difference**

Ann. Math. Statist. 12, no. 2 (1941), 153-162

[Article \(Euclid\)](#)

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But the journal *Portugaliae Mathematica* is not the only mathematical portuguese heritage. In fact, other periodical publications from several institutions exist and need to be addressed in order to be in the PtDML, e.g. from the Portuguese Mathematical Society, there

are the *Bulletin* at [19] and *Gazeta* at [20]; among other publications from other institutions which are currently being surveyed [16, 17].

## The EuDML project

EuDML, European Digital Mathematical Library, is a project that will build a new service for search and browsing to serve as a proxy to existing European portals of mathematical content. That will be achieved by implementing, on top of a rich metadata repository, a single access portal for heterogeneous and multilingual collections of digitized and born digital contents (papers, books, manuscripts, etc.). The service will be constructed by merging and augmenting the information available about each document from each collection, and matching documents and references across the entire combined library. Relevant elements such as authors, bibliographic references and mathematical concepts will be singled out and linked to matching items in the collections; similar mechanisms will be provided as public web-services so that end-users or other external mathematical resources will be able to discover and link to EuDML items. This way, EuDML will be a new major player in the European (and, in general, international) emerging landscape of scientific information discovery services, enabled for reuse in new added-value chains (such as in mashups). EuDML also will be aligned with the purposes of Europeana, The European Digital Library at [21], an initiative willing to reach the same objectives but considering the overall scientific and cultural European heritage. In that sense, it is expected EuDML will interoperate with Europeana for the area of mathematics! The EuDML consortium will comprise 14 international partners (including the Zentralblatt Math, based in Germany and the actual European larger database in mathematics, plus also partners from Portugal, Spain, France, UK, Poland, Czech Republic, Hungary, Bulgaria and Greece) and will be coordinated by a Computer Science research team from the IST/Tecnical University of Lisbon with a large scientific and technical experience on design and development of digital libraries. The EuDML project will be co-funded by the ICT Policy Support Programme (ICT PSP) of the European Commission. It will start the 1<sup>st</sup> February 2010, and will last for 3 years.

It is expected that the participation of the IST in this initiative will result in a strong incentive to the Portuguese mathematics community, to boost new activities towards the development of the PtDML - Portuguese Digital Mathematical Library, in an effort to be lead by the CIM in close collaboration with its associates including the mathematical societies SPM and SPE and the mathematical libraries of Portuguese universities.



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- [2] World Digital Mathematics Library: <http://www.mathunion.org/WDMML/>
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- [4] The mini-DML: <http://www.numdam.org/minidml/>
- [5] The European Mathematical Information Service (EMIS): <http://www.emis.de/>
- [6] JSTOR: <http://www.jstor.org/>
- [7] Göttinger Digitalisierungs-Zentrum: <http://gdz.sub.uni-goettingen.de/dms/colbrowse/?DC=mathematica>
- [8] Jahrbuch Project: <http://www.emis.de/projects/JFM/>
- [9] NUMDAM: <http://www.numdam.org>
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- [13] “Biblioteca Digital Española de Matemáticas”: <http://dmle.cindoc.csic.es/>
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- [18] Portugaliae Mathematica at the Portuguese National Library: <http://purl.pt/index/pmath/vol/PT/index.html>
- [19] Bulletin of the Portuguese Mathematical Society: <http://nautilus.fis.uc.pt/bspm/>
- [20] Gazeta of the Portuguese Mathematical Society: <http://www.mat.uc.pt/~gazeta/GazetaOnline/online.php>
- [21] Europeana - The European Digital Library (Eu-DML): <http://www.europeana.eu>