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## GREENSTONE: ACTUAL USE IN ARGENTINA

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GREENSTONE: USO ATUAL NA ARGENTINA

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**RESUMO:** Este artigo apresenta as características e a história do software para criar e gerenciar bibliotecas digitais Greenstone, desenvolvidas inicialmente pela Universidade de Waikato, Nova Zelândia, em 1997. Primeiro, a comunidade de usuários é descrita a nível global, com foco no uso atual que o software conseguiu na Argentina: o número de implementações disponíveis, sua evolução, o tipo, tamanho e variedade dos desenvolvimentos existentes, bem como a sua aplicação à gestão de repositórios digitais de ciência e tecnologia no campo das instituições científicas, tecnológicas e de ensino superior na Argentina. Em segundo lugar, são detalhadas as ações realizadas após a criação do Centro Nacional para a Promoção da Greenstone na Argentina em 2009. Os dados coletados das pesquisas permitiram observar que os motivos predominantes para a escolha desta plataforma foram, entre outros, a facilidade de instalação e configuração, seu baixo nível de requisitos tecnológicos, a escassez geral de recursos humanos dedicados a essa atividade e a complexidade do software alternativo existente naquele momento. Ao longo destes 8 anos, tanto os repositórios digitais quanto os sistemas que os suportam evoluíram drasticamente, modificando o cenário atual. Paralelamente, em 2016, a nova versão principal da Greenstone implementou uma reengenharia completa do software para adaptá-la às tecnologias em uso: XML, XSLT, serviços Web e Java. Como consequência disso, a comunidade de desenvolvimento local apresenta novos desafios para a migração de bibliotecas digitais e repositórios implementados com versões anteriores.

**PALAVRAS-CHAVE:** Biblioteca universitária. Software livre. Biblioteca digital. Base de dados de texto completo. Repositórios digitais. Sistema de gestão de bases de dados. Cooperação online

**ABSTRACT:** This paper presents the characteristics and history of the software Greenstone to create and manage digital libraries, initially developed by the University of Waikato, New Zealand in 1997. First, the user community is described at a global level, focusing on the current use that the software has achieved in Argentina: the number of implementations available, their evolution, the type, size and variety of the existing developments, as well as their application to the management of digital repositories of science and technology in the field of scientific, technological and higher education institutions in Argentina. Secondly, the actions carried out after the creation of the National Center for the Promotion of Greenstone in Argentina in 2009 are detailed. Data collected from surveys made it possible to observe that the predominant reasons for choosing this platform were, among others, its ease of installation and configuration, its low level of technological requirements, the general scarcity of human resources dedicated to this activity, and the complexity of the alternative software existing at that time. Throughout these 8 years, both the digital repositories and the systems that support them evolved drastically, modifying the current scenario. In parallel, in 2016 the new major version of Greenstone implemented a complete re-engineering of the software to adapt it to the technologies in use: XML, XSLT, Web-services and Java. As a consequence of this, the local development community poses new challenges for the migration of digital libraries and repositories implemented with previous versions.

**KEYWORDS:** Academic libraries . Open source software. Digital libraries. Capacity building. Institutional repositories. Argentina

**RESUMEN:** Este trabajo presenta las características e historia del software para crear y gestionar bibliotecas digitales Greenstone, desarrollado inicialmente por la Universidad de Waikato, Nueva Zelandia en 1997.

En primer lugar, se describe la comunidad de usuarios a nivel global, focalizando en el uso actual que el software ha alcanzado en Argentina: la cantidad de implementaciones disponibles, su evolución, el tipo, tamaño y variedad de los desarrollos existentes, así como su aplicación a la gestión de repositórios digitales de ciencia y tecnología en el ámbito de las instituciones científicas, tecnológicas y de educación superior en Argentina.

En segundo lugar, se detallan las acciones llevadas a cabo a partir de la creación del Centro Nacional de Promoción de Greenstone en Argentina en 2009. Datos recabados en encuestas realizadas permitieron observar que las razones predominantes para elegir esta plataforma fueron, entre otras, su facilidad de instalación y configuración, su bajo nivel de requerimiento tecnológico, la generalizada escasez de recursos humanos dedicados a esta actividad, y la complejidad que presentaban los softwares alternativos existentes en ese momento. A lo largo de estos 8 años, tanto los repositórios digitales como los sistemas que los soportan evolucionaron drásticamente, modificando el escenario actual. Paralelamente, en 2016 la nueva versión mayor de Greenstone implementó una reingeniería completa del software para su adaptación a las tecnologías en uso: XML, XSLT, Web-services y Java. Como consecuencia de esto, la comunidad de desarrollo local se plantea nuevos desafíos para la migración de las bibliotecas digitales y repositórios implementados con versiones anteriores.

**PALABRAS CLAVE:** Biblioteca digital. Biblioteca universitária. Software de código abierto. Desarrollo de la capacidad. Repositórios institucionales. Argentina

## 1 INTRODUCTION AND METHODOLOGY

This paper introduces the features and history of the software to create and manage digital libraries Greenstone, developed by the University of Waikato in New Zealand and distributed under the General Public License (GNU) since 1997.

The first part presents a historical record that reconstructs, from documentary sources and testimonies of the protagonists, the way in which the software was introduced in the countries of Latin America and especially in Argentina, thanks to the support of Unesco. Then, actions carried out after the creation in 2009 of the National Center for the Promotion of Greenstone (CNG) in Argentina are detailed.

In the second part of the article, based on an specific survey made from the observation and analysis of websites built with Greenstone in Argentina, the current use that the software has achieved is described: the number of existing implementations, its evolution, the type, size and variety of the collections developed, as well as its application to the management of digital repositories of science and technology in the field of scientific, technological and higher education institutions in Argentina.

In the third part the characteristics of the major version launched in 2016 are exposed, which implied a complete reengineering of the software to incorporate new technologies of the web, and two cases of digital libraries implemented with the new version are described below.

Finally, general considerations are made based on the observed uses and the possibilities offered by version 3, in light of the changes and advances occurred both in the digital repositories and in the systems that support them.

## 2 CHARACTERISTIC AND HISTORY OF GREENSTONE

Greenstone is a set of programs designed to create and distribute digital collections, which allows organizing and publishing information through the Internet or in CD-ROM format. It was originated in the New Zealand Digital Library Project located in the University of Waikato and was developed in collaboration with UNESCO and the NGO for Human Development with headquarters in Antwerp, Belgium. It is free software, open source, multilingual and multiplatform, issued under the terms of the GNU General Public License since 1997 (GREENSTONE DIGITAL LIBRARY SOFTWARE).

The initial objective of the developers was to offer a simple and complete tool that would allow institutions of all types and sizes to organize their digital collections and offer them to their readers. All this without the need to have a powerful infrastructure and equipment –initially, having a desktop PC was enough - nor expert computer knowledge to

install and configure the program. Anyone with basic computer skills and the desire to get involved in the subject was able to create and manage a digital library in a few steps. This caused the program to be widely disseminated.

Greenstone accepts documents in a wide range of proprietary and standard formats, and is compatible with numerous standards for the exchange of documents and metadata, including compliance with the OAI-PMH protocol and the Z39.50 standards for information retrieval. It rapidly converts bibliographic databases into digital libraries, including full texts of reference documents if available.

Some of its main premises have been to ensure that the software puts minimal demands of resources on the system and be easy to install, as well as maintaining compatibility with previous versions. Its flexibility, robustness, ease of use and free availability converted it in a useful and powerful resource for developing countries.

The core of the system (up to and including version 2) is programmed in C ++ and the general operation uses scripts developed in Perl. It has its own search engine (MGPP), although it also works with Lucene from Apache. It has three interfaces: a graphical interface for the administration, configuration and updating of the digital library, a command-line interface for internal maintenance and the web interface for publishing the digital library on the Internet.

Parallel to the maintenance and updating of version 2, in 2002 the team of the University of Waikato began the development of version 3, which included a complete reengineering of the software with migration of technologies and new functionalities (GREENSTONE WIKI).

Between 2000 and 2006 the University of Waikato worked on developing documentation, delivering training workshops in several countries, generating tutorials and using examples to promote the implementation of the new version. As it is common in all open source projects, the Greenstone user base is unknown, as it is distributed through the SourceForge site. However, it is possible to measure it through some specific data, such as:

- a) The distribution from SourceForge started in November 2000.
- b) The average downloads per month since then has been 5,000, while the total of downloads registered until June 2015 was close to a million.
- c) The software was downloaded from 170 different countries and the list of registered users is 770.

Concerning its dissemination in our region, 2005 marked an important milestone since the completion of the "Mercosur Seminar for the construction of digital libraries" (UNESCO, 2005), which had been supported by the UNESCO Regional Science Office for Latin America and the Caribbean, the National Library of Uruguay, and sponsored by the

University of the Republic of Uruguay. The course was held in Montevideo, Unesco financed the fees and stays of the teachers, and each country selected the participants who received scholarships from their institutions.

The teachers of that course were Jesús Tramullas, professor at the University of Zaragoza, Spain; Ana María Sanllorenti, at that time member of the Argentine National Library; Ximena Cruzat, from the National Library of Chile; Ana Pavani, from the PUC University of Brazil, and professors Fernando Da Rosa and Rodolfo Pilas, from the University of the Republic of Uruguay and the Linux Users Group from Uruguay respectively. Thanks to this seminar, the software began to be known in the countries of Latin America since it was attended by 62 librarians and professionals from Argentina, Brazil, Chile, Colombia, Peru, Paraguay and Venezuela.

In December 2008, Greenstone was awarded by the US-based Andrew Mellon Foundation due to its contribution to the field of education, culture and human promotion. According to the Unesco representative for Latin America and the Caribbean:

"This award has allowed Greenstone, for the first time, to have its own discretionary resources to help launch initiatives in developing countries and to complement the support of international donors" (CYRANEK, G., 2010, p.9).

The University of Waikato received the award and allocated part of the money for the dissemination and strengthening of Greenstone users and developers communities, particularly in developing countries in Latin America. Based on the list of users in Spanish, a call was published for the creation of national centers that would be responsible for the local promotion of the software.

These centers had to be formed by non-profit institutions that would have as objectives: to promote the software in their country or associated region, to make a survey to know the use in their country, its scope of application, its degree of acceptance and the possible requirements, to create a directory of local specialists and define a calendar of training workshops, collaborate with the process of translating the documentation into Spanish and, finally, to develop a free access site to house the National Center and encourage regional collaboration.

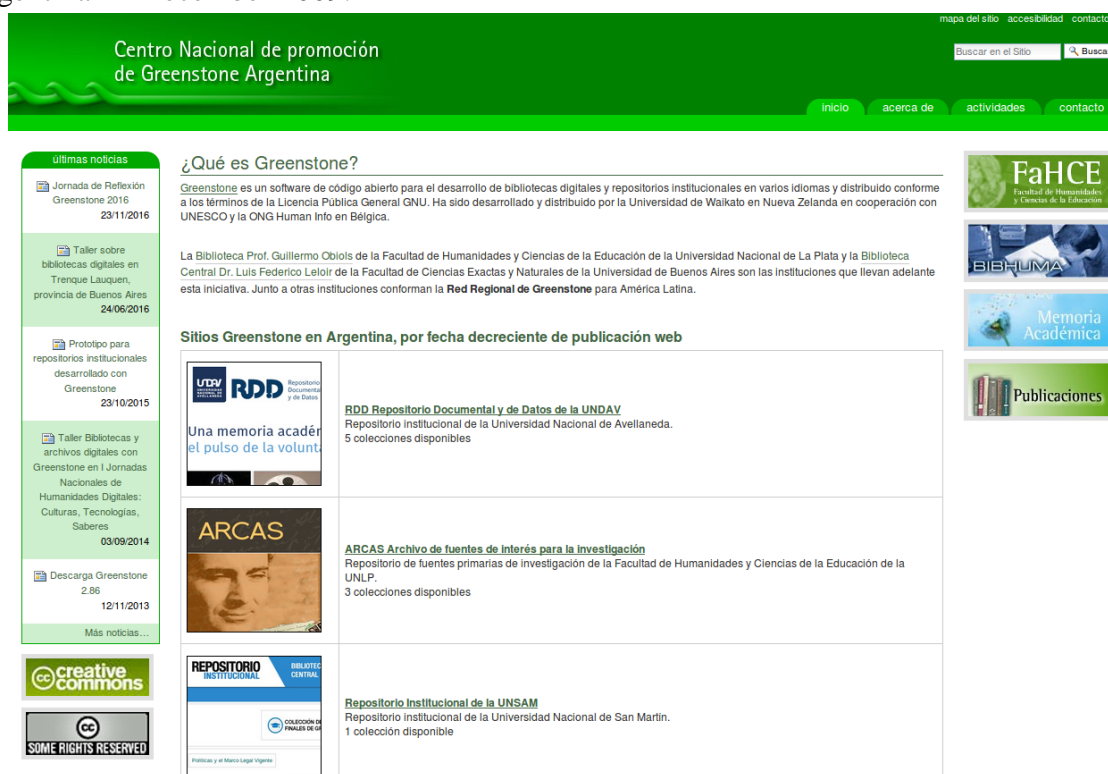
Based on this call, 4 National Centers were created in the region: two in Chile (Cardenal Silva Henríquez University UCSH and Foundation for Agrarian Innovation (FIA), one in Cuba (Center for Cybernetics Applied to Medicine CECAM) and another in Argentina, National Center for the Promotion of Greenstone Argentina (CNG).

In Argentina, the joint initiative of the Prof. Guillermo Obiols Library of the Faculty of Humanities and Education Sciences of the National University of La Plata and the Central Library Dr. Luis Federico Leloir of the Faculty of Exact and Natural Sciences of the

University of Buenos Aires, constituted the National Center of Promotion of Greenstone Argentina (CNG) in December of 2009.

### 3 NATIONAL CENTER FOR THE PROMOTION OF GREENSTONE ARGENTINA (CNG)

In Argentina, the joint initiative of the Prof. Guillermo Obiols Library of the Faculty of Humanities and Education Sciences of the National University of La Plata and the Dr. Luis Federico Leloir Central Library of the Faculty of Exact and Natural Sciences of the University of Buenos Aires constituted the National Center for the Promotion of Greenstone Argentina in December 2009.



**Figure 1.** HCNG’s Homepage

Source: Retrieved from <http://cng.fahce.unlp.edu.ar/> on 25-2-2018.

Among the activities carried out in the period 2010-2016, the following stand out: the holding of two national meetings of software users (2009 and 2011), three surveys on the development of digital libraries and the use of Greenstone in Argentina (2009, 2011 and 2016), a large number of courses, workshops and dissemination talks were dictated, the creation and continuous updating of the National Center website (<http://cng.fahce.unlp.edu.ar/>), the development of a prototype for the creation of institutional repositories, and the service of advice and specialized technical support to institutions and users that required it.

The CNG offered 8 training courses and workshops for introductory, intermediate and advanced level between 2009 and 2014, all of them free of charge and under the auspices of the host institutions that provided the space. In 2016, it also organized a Reflection Workshop for the institutions that are currently using the software, where the actual situation of each one and the future perspectives were discussed.

Within the framework of the participation in a Project called "Research and Development in Institutional Repositories of the National Universities of the Buenos Aires Region" (PICTO-CIN 149 2011/2012), a prototype for the creation of institutional repositories was developed from the CNG using Greenstone, as a way to provide resources for participating institutions (PICHININI, M., 2012). Taking into account that Greenstone is generic software for digital libraries, the objective of the prototype was to reduce the cost of adaptation and configuration of the software for the management of a typical institutional repository, with the provision of three basic collections already developed (theses, articles and papers). The three collections include a specific metadata schema for each documentary type and the generic metadata schema for the entire repository. The prototype also contemplates the configuration of the OAI-PMH protocol in accordance with the provisions of the National Digital Repository System (SNRD) Guidelines. The idea of the prototype was to allow institutions with scarce resources, both human and technological, to have a model already designed to create their own institutional repository, based on previous developments in other institutions. To this end, an installation tutorial was written. It includes a complete description of the product, a data dictionary describing the metadata used and a basic use and digitization tutorial. The prototype was published on the CNG website in open access, so potential interested parties could download it.

In relation to the surveys conducted, an average of 50 responses was received in each one (2009, 2011 and 2016). The level of user training was increasing at each opportunity in accordance with the requirements of the features available in the software, the specificity of the difficulties encountered and the requirements for solutions in the developer community.

Some of the reasons that determined the choice of software over other available are the ease of installation and use, its low level of technological requirement, the lack of human resources available in quantity and quality to address the task of creation and maintenance of the digital libraries and institutional repositories, and the evident complexity of installation and configuration of other existing systems.

Finally, among the difficulties and weaknesses with Greenstone detected in the surveys, we can mention the small community of developers, limited to the University of Waikato and associated consultants, the limited amount of documentation available on the software Wiki (<http://wiki.greenstone.org>) and a limited supply of specialized consultants in the country.

## 4 CURRENT STATE IN ARGENTINA: CHARACTERIZATION OF IMPLEMENTATIONS

In order to know the current use of Greenstone in Argentina, a specific research was made from the sites developed with this technology. The information available at the CNG, which has a chronological list of existing digital libraries, was taken as a basis. To these digital libraries, sites not included were added and others that were no longer active were eliminated. It should be noted that the list includes Greenstone digital libraries available through the web and with public access to their contents. Internal use developments that some institutions have were not included.

In total, 25 active and production implementations were located in different types of institutions in Argentina. They can be seen in a table in the Annex.

If we look at the type of application developed, the total list shows that 16 cases are digital institutional repositories, 8 are digital libraries dedicated to a particular subject (eg surveying) or a documentary type (eg photographs), and 1 case is a digital repository of research sources:

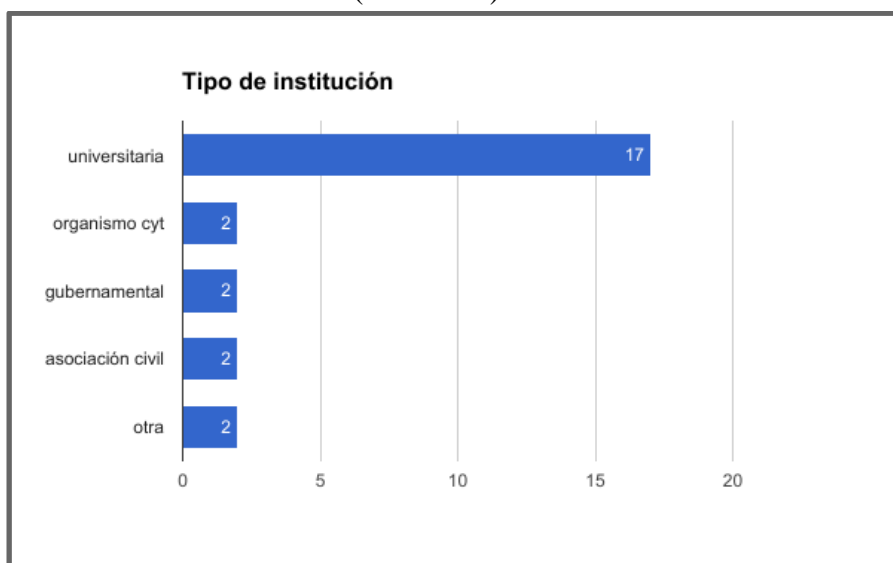


**Graph 1.** Type of application developed with Greenstone  
**Source:** Survey conducted ad-hoc for this work

Considering that Greenstone is not specific software for the development of institutional digital repositories, the number and the variety of institutions that chose it for this purpose is striking. Although university institutions -both public and private-predominate, science and technology organizations (CNEA and INTA), government agencies (Information and Documentation Center of the Ministry of Economy and Mariano Moreno National Library), civil associations (Epimeleia and Stock Market of cereals), a professional



association (Professional Association of Surveying) and a network of libraries of research institutes in the area of social sciences (CLACSO) also use it.



**Graph 2.** Type of institution that uses Greenstone  
Source: Survey conducted ad-hoc for this work

In order to measure the size of the existing developments, the amount of both collections and digital objects included in them was recorded.

Regarding the collections, each site organizes them according to different criteria and objectives. A great diversity of collections was observed, although they include mostly text in different formats, there are also important collections of photographs, medals, manuscripts and historical documents, newspaper clippings, audios and audiovisual material. In total 112 collections were registered in all the sites.

Regarding textual collections, the inclusion of scientific and technological production (theses, articles, books and chapters, technical reports, journals, conferences and conference proceedings, among others) predominates in the case of institutions that use Greenstone as an institutional repository. However, in many cases, an inclusion of textual documents of institutional type was observed such as subject programs, courses and seminars that are dictated, curricula, projects and institutional reports, archival documents, minutes of meetings and others.

To estimate the amount of digital objects included, searches were performed with the command "site" and "filetype" in the Google search engine. There were around 480,000 files in total and 81,200 were files in pdf format.

The two tables that follow show the size of the existing developments according to the number of digital objects contained. The table of pdf files refers mainly to textual documents, since it is the most used format. Although it is known that other formats are also used (doc, docx, ppt, pptx, txt, etc.) they were not included in this account. On the other hand, the table

of total files shows the totality of documents, although the final amounts could be a little overvalued since all the typology of files was considered:

**Table 1.** Number of files registered by development (pdf y totals)

<b>Pdf files</b>	<b>Total</b>	<b>%</b>		<b>Total files</b>	<b>Total</b>	<b>%</b>
Between 0 and 99	5	20%		Between 0 and 99	1	4%
Between 100 and 999	9	36%		Between 100 and 999	4	16%
Between 1000 and 9999	9	36%		Between 1000 and 9999	8	32%
Between 10000 and 99999	2	8%		Between 10000 and 99999	12	48%
<b>Total</b>	<b>25</b>			<b>Total</b>	<b>25</b>	

Source: Survey conducted ad-hoc for this work

Then, to size these quantities, the total amount of digital objects gathered in the Portal of the National System of Digital Repositories (SNRD) under the Ministry of Science, Technology and Productive Innovation (Mincyt) was registered, with a total of 97,360 records to the date. This portal collects, through the OAI-PMH protocol, the scientific and technological production of the institutions attached to the SNRD, which to date are around 40. It should be noted that to integrate this portal, in addition to having an institutional repository in production and having joined the system, it is necessary to comply with the SNRD Guidelines and expose the metadata of the digital objects in the format required.

The following table shows the contribution of records of the institutions that are part of the SNRD according to the type of software used by each of them:

**Table 2.** Number of repositories and documents contributed to the SNRD according to the software used

Software	Number of repositories	Number of documents	% documents contributed
DSpace	12	64626	66%
Greenstone	5	22802	23%
OJS	1	6068	6%
Eprints	1	2153	2%
Others <sup>1</sup>	3	1711	2%
<b>Total</b>	<b>22</b>	<b>97360</b>	

**Source:** Survey conducted ad-hoc for this work

As can be seen above, although most of the participant repositories (12) use the well-known software DSpace, contributing 66% of the records, the five repositories that use Greenstone contribute 23% of the total, representing the second place of the order shown in the board.

## 5 GREENSTONE VERSIÓN 3: FEATURES, IMPLEMENTATIONS AND AND DIFFERENCES WITH VERSION 2

Greenstone 3 is a complete redesign of the old version of Greenstone 2 that was programmed in C ++. However, Greenstone3 retains many aspects of its management, configuration and services. The librarian interface (GLI), which is the tool that allows creating, parameterizing and building collections, continues to work the same and even commands to perform tasks by console that are still similar in both versions. The profound changes are about internal technology and new services, and not about the management and configuration tools. This new development retains all the advantages of Greenstone 2: multiplatform, highly configurable and multilingual (SPANNO, 2013).

Written in Java, the new software is structured as a network of independent modules that communicate through XML. Then the XML documents are converted to HTML using XSL technology and presented with the servlet container TOMCAT. The interchangeable

1 In Others we included 2 repositories with self development software and 1 made with the SIGB PMB (<http://www.sigb.net/>)

collections by the SOAP protocol make the information contained in them not only readable by humans but also by machines through the use of web services. The technologies used are explained in further detail in the following table:

**Table 3.** Technologies applied in GS3

Technology	Characteristics
JAVA	Oracle, Java Research License (JRL) One of the most popular programming languages in the use of client-server web applications. It only requires a Java virtual machine (JVM) for its execution.
XML	Developed and Recommended by W3C. Machine-readable document marking language. Very used for the exchange of structured information between platforms.
XSL	Standard of the W3C For the transformation of XML documents using rules. The union of XML and XSLT allows separating content and presentation.
SOAP	Standard of the W3C Simple Object Access Protocol. Protocol for the exchange of structured information through XML data exchange.
SOLR	Apache Software Foundation. Open source under Apache 2.0 license Search engine developed in Java. Includes full text search, highlighting of terms, faceting of results, real-time indexing, scalability and fault tolerance.
TOMCAT	Apache Software Foundation. Open source under Apache 2.0 license Servlet container.

**Source:** Prepared for this work

The improvements and new services incorporated in Greenstone 3 can be summarized in the following points:

- Clean URLs: Greenstone 3 uses simpler urls consisting of terms separated by slashes in hierarchical order and the cumbersome parameters of version 2 are no longer incorporated
- Greater customization of the interface: The program generates the data of the page in XML that is converted into HTML through XSLT. This offers complete freedom when defining the visualization for each page of the digital library
- Cross search between collections: The search between different collections is automatic now and includes the possibility of ordering the results by different criteria such as in the search of each collection
- Faceting of search results: With the implementation of the Solr search engine, the results of a search can be faceted (filtered) with different customizable criteria at the collection level

- In the same installation several digital libraries with different interfaces: A single installation of Greenstone 3 can form several Digital Libraries or sets of collections and each of them can be displayed with an unlimited number of interfaces (eg interface for mobile and tablets, for printing etc)
- RSS: The RSS service is automatically activated in each collection
- Collection of documents: Each collection has the possibility to activate the "Basket" tool which consists of being able to select documents from collections for the export of their records
- Search fragments: In the search results you can display the text fragments that contain the search term that was found in the document

## 6 ONLINE DIGITAL LIBRARIES DEVELOPED WITH GREENSTONE 3

Although version 3 began to be programmed in 2002, it was not until 2016 that the official software set it as the main download version, also announcing that version 2 would remain in effect, but would no longer be upgraded.

Despite the recent change, at the local level some incipient and promising developments have started at the same time, two of them are discussed below.

The first one is ARCAS, the repository of research sources inaugurated in 2014 which combines the use of Greenstone version 3 together with a content management system (Plone) for user management and updating of contents of the site through a web form. In this case, and since it is a relatively new development, it was developed with version 3 from the very beginning, so there was no work of migration or adaptation of pre-existing collections.



**Figur2 2.** ARCAS Homepage

Source: Retrieved from <http://arcas.fahce.unlp.edu.ar> on 28-4-2017.

Each collection has an academic coordinator in charge that administers the contents, the exhibitions and the academic work group. One of the premises of the development was to minimize the dependence of the library staff on the maintenance of the portal and the sources. To solve this point, a metadata edition form was implemented, accessible internally from the Plone content manager or from the visualization of the documents in Greenstone after authentication verification. In this way the researchers edit the description of existing documents or add new ones to the collection.

The form in Plone uses the Greenstone web service technology to obtain the Collection, Series, Subseries and Work data, in the case of editing the metadata of an existing document. Once the work is chosen, the current description is loaded and the researcher modifies the record. The new version will be reviewed by the technical staff of the library and updated in the public portal.

Formulario para edición de datos descriptivos de las fuentes prim

Los datos que usted va a editar se actualizarán una vez hayan sido revisados y aceptados para su inclusión/modificación por el equipo técnico. Recibirá un mail con la modificación por Usted realizada y cuando haya sido actualizado en el Portal público. En todos los casos, el formulario mostrará para editar la versión pública. Si necesita modificar una versión generada por usted aún no publicada, recibirá información recibida por mail para recuperar los datos de las versiones intermedias.

Descripción del Item  Elija una serie para editar

**Colección**  
Elija una colección para editar  
puig

**Serie**  
Elija una obra para editar  
Maldición eterna a quien lea estas páginas

**Sub Serie**  
Elija una sub serie para editar  
Para-textos

**Obra**  
Elija una obra para editar  
Sin valor

Formulario de Plone que levanta los metadatos del documento a editar mediante el web service de Greenstone3

**Figure 3.** Form for metadata editing in ARCAS  
Source: Retrieved from <http://arcas.fahce.unlp.edu.ar> on 28-4-2017.

The collection of manuscripts by Manuel Puig<sup>2</sup>, in particular, gathers digitized images that have been organized and described by the research team in charge. In this case, the implementation of the asynchronous visualization of the images that make up each manuscript was used and also included in Greenstone3 for the representation of paged images.

The screenshot shows the ARCAS website interface. At the top, there is a navigation menu with links for 'Novidades', 'Acerca de Arcas', 'Colecciones', 'Exhibiciones', 'Contacto', and 'Entrar'. Below the menu is a search bar with the text 'todos los campos' and a 'Buscar' button. The main content area features a header for 'Maldición eterna a quien lea estas páginas - Pre-textos redaccionales. Español'. Below this, there is a section titled 'Pre-textos redaccionales. Español. Bloque 09'. The left sidebar contains metadata for the document, including the author (Puig, Manuel), creation date (1979-1980), and a description of the physical document. The main content area displays a vertical gallery of thumbnails on the left, with an orange box highlighting the 'Paginado de imágenes' feature. To the right, a larger image shows a page of handwritten text with corrections and annotations, labeled 'Hoja 4, Recto (ID puig.NMeqlep.N.F.19.0114R\_(47))'. An 'Ampliar' button is visible in the top right corner of the image view.

**Figure 4.** Paging images in ARCAS  
Source: Retrieved from <http://arcas.fahce.unlp.edu.ar> on 28-4-2017.

The second is the new version of the Digital Library of the Faculty of Exact and Natural Sciences of the UBA, which left the pre-existing site and made the migration of all its collections to version 3.

**2 Juan Manuel Puig Delledonne** (December 28, 1932 – July 22, 1990) was a famous Argentine writer. His best-known novels are *La traición de Rita Hayworth* (*Betrayed by Rita Hayworth*, 1968), *Boquitas pintadas* (*Heartbreak Tango*, 1969) and *El beso de la mujer araña* (*Kiss of the Spider Woman*, 1976).

This involved generating a new configuration file for each collection, since the file that configures the collections in Greenstone 2 was not applicable to Greenstone 3, which includes XSLT technology.

On the other hand, a new visualization of the interface was generated, including the Bootstrap styles that produce rendered sites.

The screenshot displays the article visualization interface on the FCEN-UBA Digital Library. At the top, there is a blue header with 'Biblioteca Digital' and 'Colecciones'. Below this, a breadcrumb trail reads 'Biblioteca Digital / Articulos / Documento'. The main content area features the 'JOUR' logo and the article title: 'Marchi, M.C.; Bilmes, S.A.; Ribeiro, C.T.M.; Ochoa, E.A.; Kleinke, M.; Alvarez, F. "A comprehensive study of the influence of the stoichiometry on the physical properties of TiOx films prepared by ion beam deposition" (2010). Journal of Applied Physics. 108(6)'. Below the title are two green boxes: one with a download icon stating 'El editor permite incluir el artículo en su versión final en nuestro repositorio' and another with a refresh icon stating 'Consulte el artículo en la página del editor'. To the right of these boxes is a Creative Commons license icon with the text 'Consulte la política relativa al Acceso Abierto del editor'. Below the boxes are navigation tabs for 'Abstract', 'Registro', 'Referencias', and 'Citación'. The 'Abstract' tab is selected, showing the text: 'A comprehensive study of nonstoichiometry titanium oxide thin films (TiOx, 0.3<math>x</math>≤2) prepared by ion beam deposition technique is reported. The physical properties of the material are studied by ultraviolet and x-ray photoelectron, Raman, and Fourier transform infrared spectroscopies, and atomic force microscopy. An abrupt transition from metallic characteristics to a wide gap semiconductor is observed in a very narrow range of oxygen variation. Concomitantly with this change the crystal structure and morphology suffer remarkable physical properties modifications. This transformation is ascribed to surface-volume energy minimization due to the influence of oxygen determining the size of the TiO2 particles during coalescence. © 2010 American Institute of Physics.' On the right side of the page, there is a search bar labeled 'Buscar en:' and a list of search options: 'Documento', 'Ultimos Documentos', 'Autor FCEN - Año', 'Autor FCEN - Revista', 'Año - Revista', and 'Revista - Año'. A mouse cursor is visible over the search options.

**Figure 5.** Article visualization on the FCEN-UBA Digital Library  
Source: Retrieved from <http://digital-beta.bl.fcen.uba.ar/> on 28-4-2017.

This implementation incorporates the new services of Greenstone 3: Cross-search among all the collections, the faceting of the search results and the visualization of the fragments of the text with the highlighted search term.



The screenshot displays the search results interface of the FCEN-UBA Digital Library. At the top, it shows the search query 'cell' and the total number of results, 821. A list of related terms is provided, such as 'cell (18103)', 'cella (3)', 'celladhesive (1)', etc. The search results are listed below, with the first three entries visible. The first entry is by Bermúdez Moretti, M., et al. (1995) about GABA uptake in a yeast strain. The second entry is by Bildner, A.G., et al. (2013) about galectins at the fetomaternal interface. The third entry is by Perone, M.J., et al. (2009) about suppression of autoimmune diabetes. Annotations with green boxes and arrows point to specific elements: 'Indicador de frecuencia de términos' points to the list of related terms; 'Filtrar los resultados' points to the filter sidebar on the right; and 'Segmento de texto con término de búsqueda destacado' points to a snippet where the word 'cell' is highlighted in yellow.

**Figure 6.** Search results screen of FCEN-UBA Digital Library  
 Source: Retrieved from <http://digital-beta.bl.fcen.uba.ar/> on 28-4-2017.

## 7 FINAL COMMENTS AND FUTURE PERSPECTIVES

To finish, in this section we expose some thoughts that arise from the evidenced development and the current situation.

First of all, we would like to emphasize that the original purposes and characteristics of the software -which are maintained in the new version- allowed institutions with scarce resources, both human and technological, to develop digital libraries of all kinds from a simple product which is easy to install and use and highly configurable and adaptable to the greatest variety of possible requirements. This was the initial reason why the software spread so widely in our region and in our country, and the reason why there is an important number of libraries and digital repositories in full production that use it today.

In the field of institutional repositories, both at a global level and in our country there was initially a period of testing and experimentation that was characterized by the implementation of repositories using diverse software. In a second stage, the experimentation

of this software was displaced by the adoption of the program that became of majority use. Currently, institutions rarely perform an experimentation phase and, instead, they choose that platform already consolidated and more widespread, in a context given by the greater diffusion capacity of the majority-use software and the institutions that support it, although the product could not cover all the needs or fit their characteristics. Today, DSpace is presented as a solution that contemplates all the possible functionalities required for repositories. As it is common in all open source software, it is always possible to introduce adaptations and improvements, but clearly is a product that requires advanced knowledge in programming for its eventual modification. This restricts the possibilities of those institutions that do not have dedicated IT personnel to use it: they should keep the standard version, resigning the possibility of adapting the final design to specific needs, or, if they can, should opt for outsourcing the technical service.

An aspect of no small importance is Greenstone's ductility to represent in the user interface very diverse organizational forms of institutions and their intellectual production. Greenstone does not impose a metaphor for the representation of information, but it is freely designed by those responsible for repositories or digital libraries. On the contrary, we find in the repositories created with DSpace, the same and repeated organization of the information that is grouped under the term "Communities". Sometimes this term refers to collections or to dependencies of an institution and other possibilities. The result is the concealment of organizational forms that cannot be fully represented in their variety. The institutions thus force a way to show their production that is not faithful to the elements or to the ways in which the cycle of intellectual production takes place.

In this sense, we claim for the importance of maintaining certain level of diversity in the use and development of software that allows meeting the specific requirements and situations that arise in different areas without trying to homogenize or impose a technology as the only possible choice with the exception of compliance with the necessary protocols and standards. Frequently, this pretension of uniformity and standardization leads to the imposition of certain technologies that ultimately promote the predominance of a particular product over the rest, eliminating the alleged competitors, and with it, also the possibility that other groups and initiatives grow and develop, generating a productive circle of knowledge creation in return.

On the other hand, when observing in detail the existing developments made with Greenstone, we see an important wealth and variety, both in the type of collections and objects included, as well as in their design. The reuse and use of resources and previous databases can also be observed. All this was possible thanks to the ease of the software that allowed many librarians to be encouraged to develop and manage their own collections. In the institutions in which Greenstone was used, the personnel involved made a strong learning and acquired new skills in the use of information technologies that allowed them to lead their own developments.

One of the biggest challenges that Greenstone faces now is the development of a community with greater participation of developers. Currently, the predominant profile of the community is composed of members of libraries, archives and memory institutions that are self-taught in the use of computer tools that allow them to meet the needs of the institutions to which they belong and their users. The ease of implementation of the software and the scarce resources necessary for its use gave rise to a community of diverse professional profiles with different levels of technical knowledge that were the strong point of the beginning of its history. The development of new functions and the correction of the code were almost totally in charge of the original development group, with few interventions from developers from the rest of the world. Many of the needs were assisted and implemented in each new version, but it is not enough in the face of the growing progress of new technologies.

From the CNG we call for reflection on these issues and invite the institutions of the region and the country that lead the digital repositories networks to accompany and sustain the existing developments, support and strengthen the community of Greenstone users and maintain a minimum interoperability base that allows diversity and integration according to the possibilities of each one.

And finally, we also invite you to join us to know and explore the potential that Greenstone version 3 offers for the development of new applications and the migration of existing sites.

## ANNEX: LIST OF GREENSTONE IMPLEMENTATIONS IN ARGENTINA

TI=kind of institution / TS=kind of site / COL=total collections

#	Site name	Institution	TI	URL	TS	COL	pdf	total files
1	Repositorio institucional	Instituto Universitario de Ciencias de la Salud Fundación H. A. Barceló	UN	<a href="http://www.barcelo.edu.ar/greenstone/cgi-bin/library.cgi">http://www.barcelo.edu.ar/greenstone/cgi-bin/library.cgi</a>	RI	4	458	3360
2	Repositorio institucional	Instituto Universitario y Hospital Italiano de Buenos Aires	UN	<a href="http://trovare.hospitalitaliano.org.ar/">http://trovare.hospitalitaliano.org.ar/</a>	RI	5	406	2990
3	Fauba digital	UBA. Facultad de Agronomía	UN	<a href="http://ri.agro.uba.ar/">http://ri.agro.uba.ar/</a>	RI	2	2030	19300
4	Repositorio	UBA. Facultad de Ciencias Económicas	UN	<a href="http://bibliotecadigital.econ.uba.ar/">http://bibliotecadigital.econ.uba.ar/</a>	RI	7	3560	17400

5	Biblioteca Digital	UBA. Facultad de Ciencias Exactas y Naturales	UN	<a href="http://digital.bl.fcen.uba.ar/">http://digital.bl.fcen.uba.ar/</a>	RI	4	7620	18700
6	Memoria institucional	UBA. Facultad de Medicina	UN	<a href="http://www.bibliomedicinadigital.fmed.uba.ar/medicina/cgi-bin/library.cgi">http://www.bibliomedicinadigital.fmed.uba.ar/medicina/cgi-bin/library.cgi</a>	RI	2	383	94500
7	Biblioteca Digital	Universidad Católica Argentina	UN	<a href="http://bibliotecadigital.uca.edu.ar/">http://bibliotecadigital.uca.edu.ar/</a>	RI	6	6050	38300
8	Archivo fotográfico	Universidad Católica de Córdoba	UN	<a href="http://bibdigital.uccor.edu.ar/gsd/cgi-bin/library.cgi">http://bibdigital.uccor.edu.ar/gsd/cgi-bin/library.cgi</a>	BD	1		15500
9	Repositorio Digital Institucional	Universidad de Buenos Aires	UN	<a href="http://repositorioubas.sisbi.uba.ar/">http://repositorioubas.sisbi.uba.ar/</a>	RI	5	1320	25300
10	RDD Repositorio Documental y de Datos	Universidad Nacional de Avellaneda	UN	<a href="http://rdd.undav.edu.ar/">http://rdd.undav.edu.ar/</a>	RI	5	30	458
11	Repositorio digital de acceso abierto	Universidad Nacional de La Pampa	UN	<a href="http://www.biblioteca.unlpam.edu.ar/greenstone/cgi-bin/inicio.htm/">http://www.biblioteca.unlpam.edu.ar/greenstone/cgi-bin/inicio.htm/</a>	RI	5	4750	26800
12	Repositorio Digital Institucional José María Rosa	Universidad Nacional de Lanús.	UN	<a href="http://www.repositoriojmr.unla.edu.ar/">http://www.repositoriojmr.unla.edu.ar/</a>	RI	1	307	2230
13	Archivo periodístico del exilio argentino en México y Recursos digitales externos	Universidad Nacional de Lanús.	UN	<a href="http://www.unla.edu.ar/greenstone/cgi-bin/library.cgi?site=localhost&amp;a=p&amp;p=about&amp;c=archived&amp;l=es&amp;w=utf-8">http://www.unla.edu.ar/greenstone/cgi-bin/library.cgi?site=localhost&amp;a=p&amp;p=about&amp;c=archived&amp;l=es&amp;w=utf-8</a>	BD	2	9140	27000
14	Repositorio institucional	Universidad Nacional de San Martín	UN	<a href="http://ri.unsam.edu.ar/">http://ri.unsam.edu.ar/</a>	RI	1	151	7760
15	Biblioteca Digital Arq. Hilario Zalba	UNLP. Facultad de Arquitectura y Urbanismo	UN	<a href="http://bdzalba.fau.unlp.edu.ar/greenstone/cgi-bin/library.cgi">http://bdzalba.fau.unlp.edu.ar/greenstone/cgi-bin/library.cgi</a>	RI	6	179	1330
16	Memoria académica	UNLP. Facultad de Humanidades	UN	<a href="http://www.memoria.fahce.unlp.edu.ar/">http://www.memoria.fahce.unlp.edu.ar/</a>	RI	10	19800	89400

17	Arcas	UNLP. Facultad de Humanidades	UN	<a href="http://arcas.fahce.unlp.edu.ar/">http://arcas.fahce.unlp.edu.ar/</a>	RF	3	2	269
18	Red de bibliotecas virtuales de ciencias sociales	CLACSO	otra	<a href="http://www.biblioteca.clacso.edu.ar/">http://www.biblioteca.clacso.edu.ar/</a>	RI	3	19300	39100
19	Biblioteca digital de agrimensura	Consejo Profesional de Agrimensura de la Provincia de Buenos Aires	otra	<a href="http://www.bibliotecacpa.org.ar/greenstone/cgi-bin/library.cgi">http://www.bibliotecacpa.org.ar/greenstone/cgi-bin/library.cgi</a>	BD	6	1280	8730
20	Biblioteca digital histórica	CNEA. Centro de información Eduardo Savino	OCyT	<a href="http://bdcies.cnea.gov.ar/">http://bdcies.cnea.gov.ar/</a>	BD	3	551	1260
21	Biblioteca Digital Prohuerta	Instituto Nacional de Tecnología Industrial	OCyT	<a href="http://prohuerta.inta.gov.ar/biblioteca/">http://prohuerta.inta.gov.ar/biblioteca/</a>	BD	6		294
22	Acervo digital anotado de literatura argentina	Biblioteca Nacional Mariano Moreno	GOB	<a href="http://adala.fahce.unlp.edu.ar/">http://adala.fahce.unlp.edu.ar/</a>	BD	1		42
23	Biblioteca digital	Ministerio de Economía. Centro de documentación informativa	GOB	<a href="http://cdi.mecon.gov.ar/greenstone/cgi-bin/library.cgi">http://cdi.mecon.gov.ar/greenstone/cgi-bin/library.cgi</a>	BD	14	287	404
24	Epimeleia Biblioteca para la persona	Asociación civil Epimeleia	AC	<a href="http://bibliotecaparalapersona-epimeleia.com/greenstone/cgi-bin/library.cgi">http://bibliotecaparalapersona-epimeleia.com/greenstone/cgi-bin/library.cgi</a>	BD	6	431	30300
25	Biblioteca Digital	Bolsa de cereales	AC	<a href="http://bolsadecereales.com.ar/greenstone/cgi-bin/library.cgi">http://bolsadecereales.com.ar/greenstone/cgi-bin/library.cgi</a>	RI	4	3090	8050
Total de colecciones y objetos digitales						112	81125	478777

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