

# NNexus Glasses

## *A Drop-in Showcase for Wikification*

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**Abstract.** This paper describes a general drop-in approach for showcasing web services and web user interfaces, provided they are accessible through or realized via JavaScript and CSS. The author utilizes the Greasemonkey extension for Firefox to invade the client with user scripts, which load the desired new functionality, as if looking at the web through an enhanced pair of glasses. Such demos have so far typically required access and modifications to the production server of the target website. The approach is particularly valuable for mock-integration with closed, proprietary platforms and/or sites serving content under restrictive copyright licenses. A potential use case is to aid an “elevator pitch” to a company interested in MKM technologies, by supplementing it with a drop-in demo on their live system.

To exemplify, the paper presents a case study of using the recent rewrite of the NNexus auto-linker for mathematical concepts to invade the closed web platforms of Zentralblat Math and DLMF with wikification links.

## 1 Introduction

Upon the creation of a new software suite, both in a research or industry setting, come the challenges of marketing and adoption (or sales). It is common for applications related to Mathematical Knowledge Management (MKM) to require sophisticated software components (e.g. a variety of databases, web servers, programming language environments and library dependencies), as well as a steep learning curve to becoming an expert with the deployment and maintenance of such systems. While user interfaces are commonly light-weight, in comparison to backend code, they are just as commonly bundled together with said code.

A very helpful exception to that rule are web user interfaces, which communicate with their respective backends through HTTP, using e.g. the RESTful or SOAP paradigms, achieving a loose coupling between the components. A modern example of realizing loose coupling is using JavaScript to perform asynchronous requests to the backend, following the AJAX paradigm [Gar05]. Ideally, this class of interfaces allows a simple mechanism for inclusion, via adding a small number of JavaScript “script” tags to the host website requesting the interface.

However, while the high convenience of embedding such interfaces is a strong point to promote adoption, it is not directly translatable in marketing the interface. The chief problem is that most potential adopters are themselves large and elaborate software platforms, running on mission-critical live servers, where

the risk of downtime and lack of stability outweighs the promise of adding experimental features. This paper addresses how to invade such platforms with “drop-in showcases” of web interfaces and/or web services, backed by a successful case study of demonstrating the NNexus [Gin13b; Gin13a] system on the Zentralblatt Math [Kar13] and DLMF [Nat13] platforms.

## 1.1 NNexus

As a minimal introduction, NNexus [GKX09] is an auto-linking (or “wikification”) application for the PlanetMath.org [Pla13] online mathematics encyclopedia. NNexus automates three problems related to the automatic wikification of mathematical concepts. First, it crawls mathematical web resources, currently PlanetMath.org, Wolfram MathWorld [Wei13], Wikipedia.org [Wik13] and DLMF [Nat13], and automatically assembles an index of mathematical terms defined within. At the time of writing, the NNexus index contains over 50,000 concepts, each a unique triple of natural language phrase, the definition’s URL and a mathematical category (e.g. MSC [Msc] class). The second task is on-demand “concept discovery”, whereby a longest-token matching algorithm mines for previously indexed concepts inside a newly requested HTML source, followed by a disambiguation algorithm that performs clustering and similarity analyses in order to return a relevant subset of the discovered concepts. Finally, the third task is one of annotation, e.g. embedding the discovered concepts as HTML links (with optional RDFa), or providing a stand-off JSON annotation.

As part of a comprehensive modernization effort, the NNexus 2.0 release [Gin13a] underwent a full rewrite and redesign, as a production-ready, stand-alone application. It is free, open source software, hosted on Github. In that context, it was time to address both testing and showcasing on the main potential adopter web sites – and while the author has direct access to deploy on PlanetMath.org, that is not the case for any other site. Named NNexus Glasses [Gin13b], the showcase was realized via creating a minimal user script, executed by Firefox’s Greasemonkey [Gre] extension.

## 1.2 Greasemonkey and User scripts

User scripts are an internet phenomenon. Their most popular archive, User-Script.org [Use] contains over 100,000 contributed scripts. From micro snippets to elaborate frameworks, all written in JavaScript, they are a great way to use the web programming paradigm in order to create, what can be seen as, domain-specific web page plug-ins. All widespread browsers have native add-ons that enable the inclusion of user scripts. The author used Firefox’s Greasemonkey, while also available are Tampermonkey [Jan13] for Chrome, IE7Pro [Inn13] for Internet Explorer, GreaseKit [KAT13] for Safari and other Webkit browsers. As good guidelines for writing browser-independent JavaScript code now exist, it is possible to write interoperable user scripts and execute them from one’s browser of choice, with possibly minimal modifications.

The main advantage over browser plug-ins, is that the JavaScript nature of user scripts positions them on the same level as the web page, rather than on the level of the browser’s menu and native code. Indeed some of the common uses of user scripts is to extend or modify existing interfaces of web games, social networking and video streaming sites, to name a few. One can imagine MKM use cases for user scripts as well – e.g. modifying a page with including MathJaX [Mat] to render its MathML on a legacy browser, or restyling its math content using the STIX fonts [STI]. For our purpose, the result was a user script to invoke the NNexus web service and style the returned results on *any* web address of our choosing.

## 2 NNexus Glasses

NNexus Glasses [Gin13b] is a tiny user script. Fifty lines of JavaScript white-list the domains on which to enable the script; on page load, connect to the NNexus showcase server [Gin13c], hosted at Jacobs University; and finally style the results. What is even more impressive is the 3-click installation (load, confirm, enable), once Greasemonkey is activated.

### 2.1 Installation

1. Install and enable Greasemonkey [Gre] in Firefox
2. Click on the link to the NNexus Glasses user script [Gin13b]<sup>1</sup>.
3. Confirm installation, enable script.
4. Done! <sup>2</sup>

To enjoy a demo, navigate to a page in the supported list of domains, notably pages on Zentralblatt Math and DLMF.

### 2.2 Demonstration

To reiterate, if one was to market a product such as NNexus in a situation where there were just a few minutes to convince an executive of its value, using a user script could achieve an operational demo on their live system in a matter of a couple of minutes.

We present two such showcases of NNexus, invading the web sites of Zentralblatt Math, from Fig. 1 to Fig. 2, and the Digital Library of Mathematical Functions (DLMF), from Fig. 3 to Fig. 4. These screenshots were created with the author’s local machine, without the knowledge or assistance of the two organizations, as the effect was achieved by simply enabling the NNexus Glasses user script and refreshing the web page.

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<sup>1</sup> In case Firefox is not the default browser, “click” is a shorthand for “open in Firefox” here.

<sup>2</sup> One should always double-check both Greasemonkey and NNexus Glasses are enabled.

### 2.3 A Primer on Linking

In Fig. 2 and Fig. 4, one can notice an array of additional links superimposed on top of the original Fig. 1 and Fig. 3. Each link points to one or more definitions of the mathematical concept identified by NNexus. The NNexus web service has two flavors of links it can embed in HTML pages – classic single links (shown in light brown) and “multi-links” (shown in orange). It distinguishes between the two via HTML class attributes, which applications can style and adapt to their needs. In this showcase, the CSS styling is specified within the NNexus Glasses user script.

### 2.4 Multi-links

An interesting annotation case is the embedding and presentation of concepts that have multiple definitions – a situation that we encounter when the same concept is defined in several domains (e.g. both PlanetMath.org and DLMF). Our current solution for presenting such “multi-links” to the user is to show a differently styled HTML anchor, with a simple onclick event that expands it into a number of concrete links. To make serving several links visually appealing, NNexus uses the icon image of the domain in which a concept is defined as an anchor for each specific link. An example of a multi-link can be seen in Listing 1.1. It is worth mentioning that this interface is very openly experimental, as the author is still collecting user feedback – multi-links have become available only with the current reimplementation of NNexus, and they are a young feature that is still in development. The solution presented in this paper is an early approximation, which so far seems sufficiently acceptable for the drop-in showcases.

**Listing 1.1.** A NNexus Multi-link

```
<a class="nnexus_concepts" href="javascript:void(0)"  
    onclick="this.nextSibling.style.display='inline'>  
    Bessel functions  
</a>  
<sup style="display:none;">  
    <a class="nnexus_concept"  
        href="http://dlmf.nist.gov/10.1">  
          
    </a>  
    <a class="nnexus_concept"  
        href="http://planetmath.org/besselsequation">  
          
    </a>  
</sup>
```

[Zbl 1244.35002](#)

[Cohl, Howard S.](#)

**Fundamental solution of Laplace's equation in hyperspherical geometry.** (English)

[J] [SIGMA, Symmetry Integrability Geom. Methods Appl.](#) 7, Paper 108, 14 p., electronic only (2011). ISSN 1815-0659/e

**Summary:** Due to the isotropy of  $d$ -dimensional hyperspherical space, one expects there to exist a spherically symmetric fundamental solution for its corresponding Laplace-Beltrami operator. The  $R$ -radius hypersphere  $S_{\{R\}}^{\{d\}}$  with  $R > 0$ , represents a Riemannian manifold with positive-constant sectional curvature. We obtain a spherically symmetric fundamental solution of Laplace's equation on this manifold in terms of its geodesic radius. We give several matching expressions for this fundamental solution including a definite integral over reciprocal powers of the trigonometric sine, finite summation expressions over trigonometric functions, Gauss hypergeometric functions, and in terms of the associated Legendre function of the second kind on the cut (Ferrers function of the second kind) with degree and order given by  $d/2 - 1$  and  $1 - d/2$  respectively, with real argument between plus and minus one.

**MSC 2000:**

[\\*35A08](#) Fundamental solutions of PDE

[35J05](#) Laplace equation, etc.

[32Q10](#) Positive curvature manifolds

[31C12](#) Potential theory on Riemannian manifolds

[33C05](#) Classical hypergeometric functions

**Keywords:** hyperspherical geometry; fundamental solution; Laplace's equation; separation of variables; Ferrers functions

**Fig. 1.** Original: Zentralblatt MATH

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**Fig. 2.** NNexus Glasses: Zentralblatt MATH

### §33.20(iv) Uniform Asymptotic Expansions

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For a comprehensive collection of asymptotic expansions that cover  $f(\epsilon, \ell; r)$  and  $h(\epsilon, \ell; r)$  as  $\epsilon \rightarrow 0 \pm$  and are uniform in  $r$ , including unbounded values, see Curtis (1964a, §7). These expansions are in terms of elementary functions, Airy functions, and Bessel functions of orders  $2\ell + 1$  and  $2\ell + 2$ .

**Fig. 3.** Original: Digital Library of Mathematical Functions

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**Fig. 4.** NNexus Glasses: Digital Library of Mathematical Functions

## 3 Conclusion

This paper presented a purely client-side approach for creating “drop-in showcases” on potentially proprietary, live web systems, for the purposes of pitching a demo of a web service or web user interface. The method is applicable for any application which is accessible through, or implemented in, JavaScript and CSS, as it leverages the power of user scripts and potentially the AJAX [Gar05] communication paradigm.

The presented use case invades two live systems with wikification, or auto-linking, of mathematical concepts, realized via a user script communicating with a NNexus web service. An experimental interface for presenting and interacting with NNexus “multi-links” is also described.

While NNexus Glasses is considered a complete solution to the showcasing problem, interesting future work remains to be done for the NNexus user interface. There are plans to make the degree of linking customizable by the user – once the algorithm has “concept relevance” quantified in terms of probabilities, one can adjust a cut-off threshold for displaying or hiding a concept link. This is useful, as expert users would be interested in only the most relevant links, while novices could benefit from having as many links as possible in order to easily jump to supporting definitions.

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