

ELN

an Electronic Lab Notebook

By Daniel A. Wagenaar

version 1.2.16

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Chapter 1

Introduction

This document describes the installation and usage of ELN, an electronic lab notebook written by Daniel Wagenaar. This introduction will not cover why you should keep a lab notebook, nor why an electronic lab notebook may be desirable. You already know that. It will however, cover some of the ideas behind this particular implementation.

1.1 Why use ELN?

There are any number of software packages available that implement electronic notebooks. So why should you choose ELN? ELN is for you if:

- You want your notes to be stored in a human-readable format.
- You want your notes to be stored in a format that will be easy to parse electronically even 500 years from now.
- You want your notes to be protected against accidental deletion.
- You want your notes to be automatically dated.
- You want to concentrate on entering text and not on formatting.
- You want to be able to include images and simple graphics with your notes and you want that to be easy.
- You want your notebook software to be fast, even with thousands of pages of notes.
- You like your software to be open-source so that you can make your own improvements to it, and be confident that you can still run it 20 years from now.

However, ELN may not be for you if:

- You want complete control over the formatting of your notes. (ELN will allow you some coarse control.)

- You need to typeset complex equations in your notes. (ELN will allow you to set basic equations.)
- You need to typeset music in your notes.
- You need to import formatted documents into your notes. (ELN can archive web pages and pdf files for you, but they cannot be rendered onto the notebook pages.)
- You need a fully polished graphical user interface.
- You need a help desk on-call.

Lastly, a note on development. ELN is being developed by an active research scientist. Practically, that means two things: On the positive side, it means that I have a vested interest in fixing bugs and improving ELN, because I use it daily. On the negative side, that means that, by and large, new features are added only when I need them and bugs are fixed when I have time. I certainly do welcome feature requests, but I cannot guarantee that they will get implemented quickly or at all. (If you are in a hurry, I will consider (paid) consultancy related to ELN.) Finally, I definitely welcome contributions to either the code or the documentation. I would be very happy if ELN turned into a community-supported open source project.

1.2 Features

ELN notebooks consist of “entries” that fill one or more pages. Each entry has a title and consists of paragraphs of text, tables, and/or graphics canvases. Typesetting is deliberately simple: you can create italics and bold face text as well as super- and subscripts, but you cannot choose typefaces or font sizes (except as a global option). These limits were a conscious design choice: the hope is that this will force the user to concentrate on content rather than form, just as you would in a paper notebook.

Graphic manipulation is similarly rudimentary: you can drag-and-drop or cut-and-paste images and (svg) vector graphics into a notebook entry, and these graphics can be cropped and resized, but they cannot, e.g., be rotated or recolored. You can add simple symbols in a limited set of colors to the graphics as well as draw freehand lines. It is also possible to attach text notes to the graphics. You cannot, however, create arbitrarily complex graphics in ELN; for that, the author recommends using the GIMP* or Inkscape†. It is easy to cut-and-paste from these programs into ELN, and even easier to simply grab screenshots and paste them into ELN.

ELN supports footnotes and references to other pages within the same notebook, and automatically downloads and archives web pages if you type their URL into a notebook entry. This, for instance, facilitates keeping data sheets, MSDSs, and journal articles with your notes.

*<http://www.gimp.org>.

†<http://www.inkscape.org>.

A key feature of ELN is that each entry is stored in a separate file. (A notebook is a folder on your hard disk with these files in a subfolder.) This approach has numerous advantages:

- It makes for fast editing regardless of the size of the notebook;
- It limits the damage potential of hard disk corruption;
- It makes it convenient to use external version control software to archive your notebooks (Git* and Bazaar† and explicitly supported);
- It facilitates electronically verifying when an entry was created; and
- It makes it much easier to manually correct broken files if somehow data does get compromised.‡

Another important design feature is that entries automatically get locked (i.e., become immune to editing) after 24 hours.§ This design choice might be controversial, but it is an important feature for a lab notebook: it encourages (in fact, enforces), chronological note taking and discourages manipulating data post-hoc.¶

ELN does not, at present, offer any facilities for multi-user collaboration. However, if used in conjunction with version control software, it is not hard to automatically maintain a central library of many lab members' notebooks. Lab members can then readily browse each others' notebooks. In addition, ELN can export anything from an individual page to an entire notebook to pdf.

1.3 Contacting the author

If you like ELN or find fault with it, if you discover a bug or have a suggestion for a new feature, if you are interested in improving this documentation or have a patch to contribute to the code, I want to hear from you. My contact information is at <http://www.danielwagenaar.net>. I very much look forward to hearing from you. I realize that this guide is extremely terse, and I really do welcome questions, particularly if they help me to improve ELN or its documentation.

*<http://git-scm.com> (free and open source despite the “.com” domain).

†<http://bazaar.canonical.com> (ditto).

‡Of course that's not supposed to happen, but ELN, like all software, does have bugs, so it is good to know that failure can never be catastrophic.

§See below under “Editing old entries” for a minor exception.

¶ELN on its own cannot be relied on to fully guarantee that entries aren't modified post-hoc, because it is certainly possible to modify entries using an external text editor. However, judicious use of version control software can be used to document that such abuse has not occurred.

Chapter 2

Installation

The latest version of the software can always be downloaded from either of the following places:

- <https://github.com/wagenadl/elN/releases>
- <http://www.danielwagenaar.net/elN>

2.1 Installing precompiled binaries

Installation on Windows should be easy using the “.msi” installation package. Installation on Mac OS X should be straightforward by unpacking the “.dmg” archive and placing “elN.app” anywhere on your hard disk. Installation on Debian, Ubuntu, or Mint Linux should be equally easy using the “.deb” installation package. At present, installation on other flavors of Linux will require compiling the sources yourself, but this should be straightforward (see below).

At present, neither Android devices nor iPads are currently supported, simply because the author doesn’t own any. If you are interested in porting ELN to either of these platforms or would like to commission me to do so, please contact me by email.

Please note that development occurs primarily on Linux, so the Windows and Mac OS versions may lag behind.

2.2 Compiling the source

To compile the source, download the source at <https://github.com/wagenadl/elN>. You will need “Qt” version 5.6 or later.

2.2.1 Compiling on Linux or Mac OS

You will need a C++ compiler and “make”. On Ubuntu Linux, this is as simple as `sudo apt-get install g++ make`. On Mac OS, you need the “Command Line tools for

XCode” from the Apple Developers’ web site*.

Open a terminal and “cd” to the root of the unpacked source archive. Then type `make` and fetch a cup of tea. Then, either manually copy the files “build/el`n`” and “build-webgrab/webgrab” to a location on your PATH, or type `sudo make install` to install into “/usr/local/bin”. On Mac, `make macdmg` creates a `dmg` package that can easily be carried to other machines.

2.2.2 Compiling on Windows

You will need a C++ compiler. I have successfully used both MinGW and Microsoft Visual Studio.

First, run “updatesources.sh” in the “tools” subfolder in a Cygwin shell. Then open, one by one, “src/el`n`.pro” and “webgrab/webgrab.pro” in Qt Creator and follow the standard build steps.

*<https://developer.apple.com/xcode>.

Chapter 3

Using ELN

ELN has a deliberately sparse user interface that may take a little getting used to. It is the author's hope, however, that users will quickly get to appreciate the simplicity of the system.

3.1 Some general notes

ELN is intended to be fully usable either with traditional laptop or desktop computers or with tablets. To facilitate that, it only uses the left mouse button and hardly any keyboard modifiers (shift, control, alt, etc.) It can also be operated exclusively from the keyboard.

3.2 Creating a new notebook

When ELN starts, it displays a list of recent notebooks and also offers the choice of opening a notebook that is not on the list or to create a new notebook. When you click "Create new notebook," it will immediately ask you where you want to store that notebook. It will then open the front page of your notebook, where you can change its title and add your name as the author as well as your affiliation or other relevant information. It is highly recommended that you give your notebook a meaningful title, as that title will show up in ELN's opening screen in the future.

Other options on the opening screen are "Open other existing notebook," which speaks for itself, and "Clone hosted notebook for local use," which is explained under "Archiving (version control)," below.

To leave the front page and go to the first actual page of your new notebook, press [Page Down] or [Ctrl][Shift][+] on your keyboard, or use the navigation buttons in the tool bar.

3.3 Creating new entries

To create a new entry, press **[Ctrl][Shift][+]** or click the **+** icon in the tool bar. To encourage you to give your entries meaningful titles, the cursor is positioned in the title field so you can start typing right away. (The title you give to your entry here is automatically copied to the table of contents.) To move from the title to the first paragraph of your entry, simply press **[Enter]** or **[Tab]**.

3.4 Adding text


Text mode is ELN's default mode, so you should be able to start typing right away. If not, click the **A** mode icon (or press **[F2]**) to enter text mode. Click below existing contents or inside an existing paragraph to start editing. Note that it is not possible to edit an entry that is older than 24 hours.

Navigating between text paragraphs is done using the arrow keys as you would expect, and you can split and join paragraphs with **[Enter]** and **[Delete]** or **[Backspace]** as you would expect.* Text may be cut-and-pasted as you would expect using **[Ctrl][X]**, **[Ctrl][C]**, and **[Ctrl][V]** as in other programs.

3.5 Adding graphics

Graphics can be added by dragging an image file onto the page or by pressing **[Ctrl][V]** to paste an image from the system clipboard.


Various plot symbols as well as freehand lines can be added using the **•** and **/** icons (**[F4]** and **[F5]**). Straight line segments can be added by double clicking the **/** icon (or by pressing **[Shift][F5]**) which turns the squiggly line into a straight line: **/**. Several choices for symbol size, line width, and color are available. (These options are not extendible. By limiting the options, ELN hopes to encourage you to not spend too much time thinking about the perfect color for your annotation.)

Text annotations can be added to the graphics canvas using the  icon (**[F6]**) and either clicking to place text or dragging to place text with a connector line. Type faces and font sizes cannot be changed (again, on purpose).

Images, plot symbols, freehand and straight lines, and text annotations can be moved around, cropped, and resized by selecting the **+** icon (by clicking it or pressing **[F3]**). As a convenience, a mouse drag with **[Control]** held performs the same manipulations without selecting the **+** icon.

Also with the **+** icon selected, you can change the wrap width of text annotations by dragging the right edge of your annotation. The end of a connector line can be moved by holding **[Shift]** while dragging the annotation. (A note without a connector line can be given a connector line by Shift-dragging; connector lines automatically vanish if their ends are dragged into the text of the note.)

*It is, however, not possible to join paragraphs across a graphics canvas.

Graphics objects can be deleted with the  icon selected by hovering the cursor over them and pressing [Delete]. They can be restored by pressing [Insert]. An empty graphics canvas can be deleted by pressing [Delete]. [Ctrl][Delete] works in any mode, provided there is no active text cursor.








3.6 Adding tables

Tables can be inserted as their own paragraphs. Simply start typing the contents of the first table cell, then hit [Tab] to create a second cell. Navigation within a table is with [Tab] and [Shift][Tab] for left and right, [Enter] and [Shift][Enter] for next and previous line, and of course the arrow keys. New columns or rows can be inserted by holding [Control] while navigating. Columns or rows can be deleted by selecting the entire column or row and pressing [Delete].



3.7 Saving your work

You don't have to! ELN automatically saves your work every 10 seconds (if you have made any changes) and when you navigate to a different entry (ditto). If you have configured version control (see below), your changes are automatically committed and pushed to the server every 5 minutes and when you close the notebook.

3.8 Navigation

Navigation between pages and entries is done using [Page Up] and [Page Down], using the scroll wheel of your mouse, or with the navigation buttons overlaid on the bottom left of the notebook:  and  move up and down by one page;  and  move by 10 pages. To go to the table of contents, press [Ctrl][Home] or click , and to go to the latest entry, press [Ctrl][End] or click . Clicking on a page link (hold [Control] if the link is on an editable page) activates the link. Press [Ctrl][Shift][+] (or click the  icon) to start a new entry. (Pressing [Page Up] on an untitled and empty entry abandons that entry.)

3.9 Editing old entries

Cannot be done. Except that you can use the  icon ([F6]) to create so-called “late notes.” These are automatically set in a distinct color and decorated with a date stamp. They may be manipulated just like text annotations on a graphics canvas. To indicate that an entry cannot be edited, ELN switches to “browse” mode, indicated by the  icon being automatically selected.

a — emdash	d α alpha	e A Alpha	f μ A uA	g \times times	h ∞ inf
- endash	β beta	B Beta	μ C uC	\times cross	' prime
- figuredash	γ gamma	Γ Gamma	μ g ug	\times x	" dprime
... dots	δ delta	Δ Delta	μ J uJ	\div div	\exists E
	ϵ epsilon	E Epsilon	μ L uL	\cdot cdot	\forall A
b \downarrow v	ζ zeta	Z Zeta	μ l ul	\cdots cdots	\in inset
\Downarrow V	η eta	H Eta	μ M uM	$\sqrt{}$ sqrt	\notin notinset
\nearrow arrownw	θ theta	Θ Theta	μ m um	\sum sum	\propto prop
\nearrow arrowne	ι iota	I Iota	μ S uS	\int int	\mathbb{N} N
\swarrow arrowsw	κ kappa	K Kappa	μ s us	∂ partial	\mathbb{R} R
\searrow arrowse	λ lambda	Λ Lambda	μ V uV	∂ d	\mathbb{Q} Q
	μ mu	M Mu	Ω Ohm	∇ nabla	\mathbb{Z} Z
c $^\circ$ deg	ν nu	N Nu	$k\Omega$ kOhm	\star star	\mathbb{C} C
\oslash diam	ξ xi	Ξ Xi	$M\Omega$ MOhm	\perp perp	
\flat flat	\omicron omicron	O Omicron	$G\Omega$ GOhm		i \vec{x} vec
\sharp sharp	π pi	Π Pi	$m\Omega$ mOhm		\hat{x} hat
\natural natural	ρ rho	P Rho	\hbar hbar		\tilde{x} tilde
\dagger dagger	σ sigma	Σ Sigma			\dot{x} dot
\ddagger ddagger	τ tau	T Tau			\ddot{x} ddot
\P pilcrow	υ upsilon	Υ Upsilon			\bar{x} bar
\P par	φ phi	Φ Phi			\bar{x} sbar
\S sec	χ chi	X Chi			
\circ circ	ψ psi	Ψ Psi			
\square sqr	ω omega	Ω Omega			

Figure 3.2: Symbols that may be obtained by a TeX-like command. To get the symbols on the left, type the character sequence on the right and press `[Ctrl][\]`. **a.** General punctuation. **b.** Arrows. **c.** Other symbols. **d, e.** Lowercase and uppercase Greek letters. **f.** Scientific units. **g.** Mathematical operators. **h.** Other mathematical symbols. **i.** Mathematical accents. (The codes in *i* are different from the others, in that the accent is placed over the preceding character rather than as a separate entity.)

3.12 Footnotes

Press `[Ctrl][N]` to create a footnote. Footnotes are connected to the main text by arbitrary tags: the word at the cursor becomes the tag. If you prefer to use symbols to tag footnotes, the symbols \ast , \dagger , \ddagger , \S , \P , and \sharp can be created by typing \ast , \dagger , \ddagger , \S , \P , and \sharp before pressing `[Ctrl][N]`. Footnotes are deleted by deleting the tag in the main text or by pressing `[Ctrl][Shift][N]` while the tag is highlighted.

If your tag is a big integer, it is interpreted as a PubMed ID. In that case, ELN will insert the corresponding citation in the note for you automatically. (If you have suggestions for other kinds of automatically created note contents, I want to hear from you.)

3.13 Hyperlinks

Press `[Ctrl][L]` to create a hyperlink. (If your hyperlink contains spaces, you will have to select the text first, otherwise, ELN figures out the boundaries of the link text automatically.)

Hovering over a link displays a thumbnail of the page*, and double clicking opens a pdf of the downloaded page. Double clicking with [Shift] held opens the original web page. Hyperlinks are typeset with a pale blue background once download is complete and with a pink background if download fails. (A yellow background indicates that download is in progress.)

3.14 Magic links

ELN recognizes not just URL-style hyperlinks, but also a number of other “magic” links:

- A small number (at most 4 digits), upon pressing [Ctrl][L] becomes a hyperlink to another page in the notebook.
- A large number (more than 4 digits) will be interpreted as a PubMed ID and will link to PubMed. When possible, the corresponding article will be automatically downloaded and archived with the notebook.

3.15 Typesetting quotations, computer code, and other imported materials

Occasionally it is useful to typeset “imported” materials such as quotations differently from the rest of your notes. In a small concession to typographic nicety, ELN does this for you if you press [Ctrl][Tab]. The paragraph will be typeset in a slightly different color, a slightly smaller point size, and with slightly larger margins. To undo, simply press [Ctrl][Tab] again. Similarly, indentation can be cycled between indented paragraphs (the default), non-indented paragraphs, and “dedented” paragraphs, which is useful for typing bullet lists. This is done by pressing [Shift][Tab].

3.16 Typesetting mathematics

When typing mathematical equations, having to frequently press [Ctrl][\] for special characters and [Ctrl][/] for italics can get tiresome. To avoid this annoyance, press [Ctrl][`] (that’s the key to the left of the [1] on many qwerty keyboards) to enter (and exit) “math” mode, which turns the A icon into \int . (Math code can also be entered by double-clicking the A icon or pressing [Shift][F2].)



In math mode, special characters can be entered simply by typing their name and single-character words are typeset in italics.[†] Additionally, simple subscripts and su-

*Currently, the Mac and Windows versions merely show the title of a web page while hovering. I hope to restore thumbnailing when Qt’s QWebEngine technology further matures.


[†]A few exceptions apply: “x” does not generate \times , “d” does not generate ∂ , and ELN tries to guess whether you mean the variables *a* and *I* or the words “a” and “I.” A few other subtle cases are handled semi-intelligently as well.

perscripts can be typeset by just typing underscore or hat followed by the text of the sub- or superscript. As a result, a basic equation like $\int_1^\infty 1/x^2 dx = 1$ can be typeset simple by typing “`int_1^inf 1/x^2 dx = 1`”.


3.17 Typesetting computer code

When typing computer code, the automatic substitutions in Figure 3.1 can be a hindrance. To disable all automatic substitutions, press `[Ctrl][F2]` (or click the  icon with `[Ctrl]` held). The icon will change to , which signifies “Code” mode. Press `[F2]` to return to normal text mode.

3.18 Exporting and printing

ELN can export your entire notebook or portions of it to pdf or print them directly. Simply press `[Ctrl][P]` or click the  icon to open the print dialog and select either “Print to pdf” or an actual printer.

3.19 Searching your notebook

ELN incorporates a simple but very useful full-text search facility. Press `[Ctrl][F]` or click the  icon to open the search dialog, type any word or phrase, and press `[Enter]` or click “OK.” A list with search results from the entire notebook will open; click on a result to navigate to the relevant entry.

3.20 Customization

At present, you cannot graphically change the looks of a notebook. However, inside each notebook folder, ELN creates a file called “style.json” that defines many of the style parameters of the notebook. I don’t have the time right now to document all of them (feel free to contribute). Particularly important ones are “page-width” and “page-height” which specify the width and height of a notebook page in points (1/72”) and the various “...-font-family” variables.

3.21 Archiving (version control)

If you have Git installed on your computer, you can choose to have your notebooks archived locally or to another computer using Git. Simple enable the “Archiving” option and specify the place where you want the archive to be stored.

Archiving locally is extremely easy, but of limited utility. Archiving remotely is somewhat more involved. If you have no experience with Git, it is probably best to remedy that first. Some of the following is likely to be hard to understand otherwise.

Caution: Black diamond contents ahead. For remote archiving, you need to have a host computer that you can access by ssh without a password. Typically, that involves setting up a public/private RSA key pair using `ssh-keygen` or similar and appending the public key to the file `~/.ssh/authorized_keys` on the server. Further details can be found elsewhere. In my experience, doing this from a Windows computer is much more tricky than from either Linux or Mac OS; the only Windows solution I have found is “Pageant,” which is part of the “PuTTY” package.* If you use Git to store your notebook on a remote host, you can also access it from other computers. To do that, you would select “Clone hosted notebook for local use” from the ELN opening screen. Conveniently, once you have cloned the notebook, you can treat it just like any other local notebook, with one caveat: you must never open a notebook simultaneously on two computers, and always allow Git to “commit and push” any changes back to the host. (Otherwise, your notebook can get into a messy state from which recovery will require typing Git commands in a terminal window. Note that it is always completely safe to only use one client computer with Git.)

Warning: Double black diamond contents ahead. It is also possible to turn an existing notebook into a Git repository. There are two steps:

1. you should replace the line in your notebook’s “style.json” file that says “vc”: ””” to “vc”: ”git””;
2. you should locate the “.nb” folder, type `git init` to turn your notebook into a Git repository, then type some variant of

```
ssh user@host git init --bare somewhere/nice/notebook.nb
git push -u user@host:somewhere/nice/notebook.nb
```

to set up the archive host.

Again, if this section doesn’t make sense to you, please first learn about Git version control, then read it again before contacting me. (And yes, I will be happy to assist.)

3.22 Conclusion

I hope that ELN will be useful to you, and that it will encourage you to take more—and more usable—notes. I love to hear happy users’ stories. I also welcome bug reports of all kinds. And in the unlikely event that ELN appears to have chewed up your notes, please do not just throw away the broken notebook. Although I cannot make any guarantees (see the GPL license text!), it almost certainly can be fixed. And I would be happy to try and help.

Pasadena, May 2013;

Cincinnati, February 2014;

Woods Hole, June 2015;

Pasadena, January 2016, January 2017, April 2019.

*At <http://www.putty.org>. See <http://the.earth.li/~sgtatham/putty/0.58/htmldoc/Chapter9.html> for an introduction to Pageant.