



OpenLabNotes

An Electronic Laboratory Notebook Extension for

OpenLabFramework



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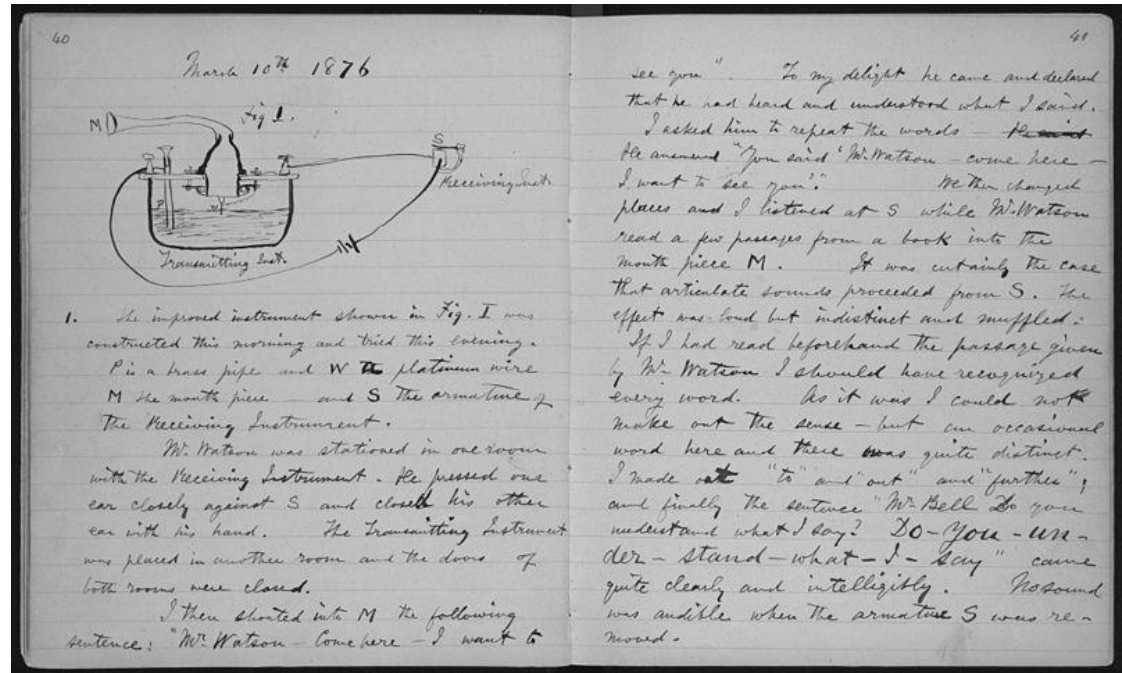


mpii max planck institut
informatik



Paper Laboratory Notebooks

- Documentation of experimental work:
 - Setup
 - Results
 - Notes
- Reproducibility
- Legal proof for an invention



Page from a laboratory notebook of Alexander Graham Bell, 1876.

- Notebooks can get destroyed, lost, or stolen.
- Difficult to locate specific information, especially in case of staff changes.
- Difficult to incorporate already digitalized results.
- Difficult to share specific information.

Electronic Laboratory Notebooks (ELNs)

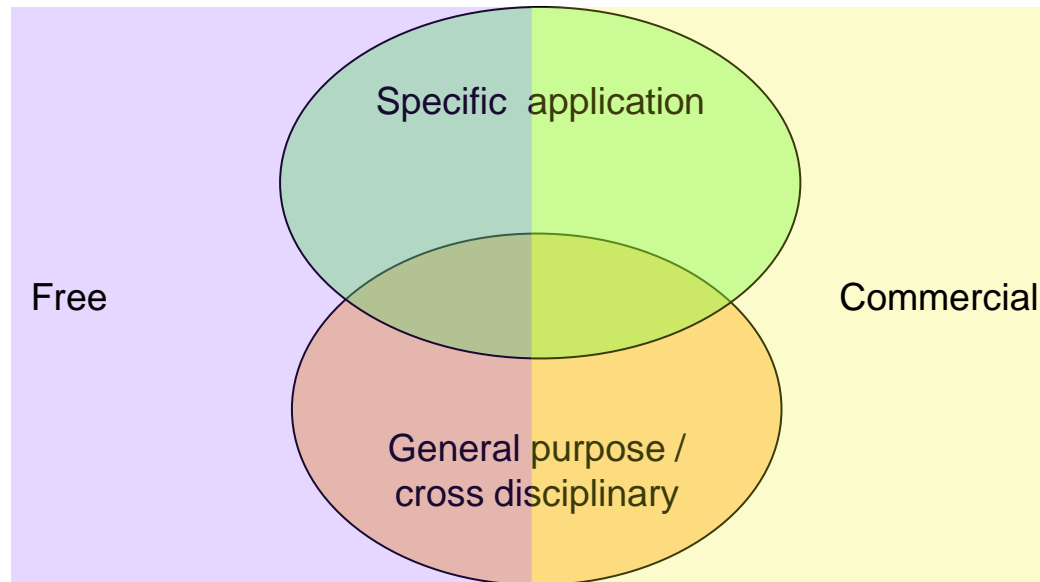
- Documentation of experimental work
- Reproducibility
- Rich text editor
- Full text search
- Document sharing
- Collaborative editing
- Automated backup
- Timestamps



- **For many years not considered a legal document**
- Commercial solutions quite expensive
- Difficult to set up and maintain
- Data migration issues

Types of ELNs

International Agency for Research on Cancer ELN



CFR21 part 11

U.S. Food and Drug Administration

Applies to all FDA-regulated industries

Provides guidelines for

Electronic records

Electronic signatures

Primary intent is to make sure that any recorded information can not be falsified at a later point (e.g. scientific fraud)

How can this be achieved?

Guidance for Industry Part 11, Electronic Records; Electronic Signatures — Scope and Application

U.S. Department of Health and Human Services
Food and Drug Administration
Center for Drug Evaluation and Research (CDER)
Center for Biologics Evaluation and Research (CBER)
Center for Devices and Radiological Health (CDRH)
Center for Food Safety and Applied Nutrition (CFSAN)
Center for Veterinary Medicine (CVM)
Office of Regulatory Affairs (ORA)

August 2003
Pharmaceutical CGMPs

How to protect the data

Backend:

- Firewall

- Access limited to system administrators

Frontend:

Identity:

- User authentication

- Access rules

- Trusted authority, i.e. LDAP etc.

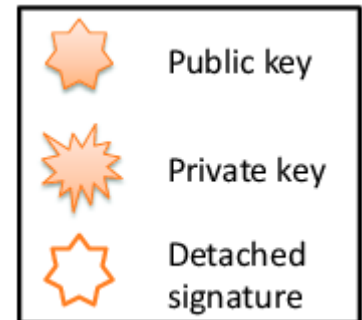
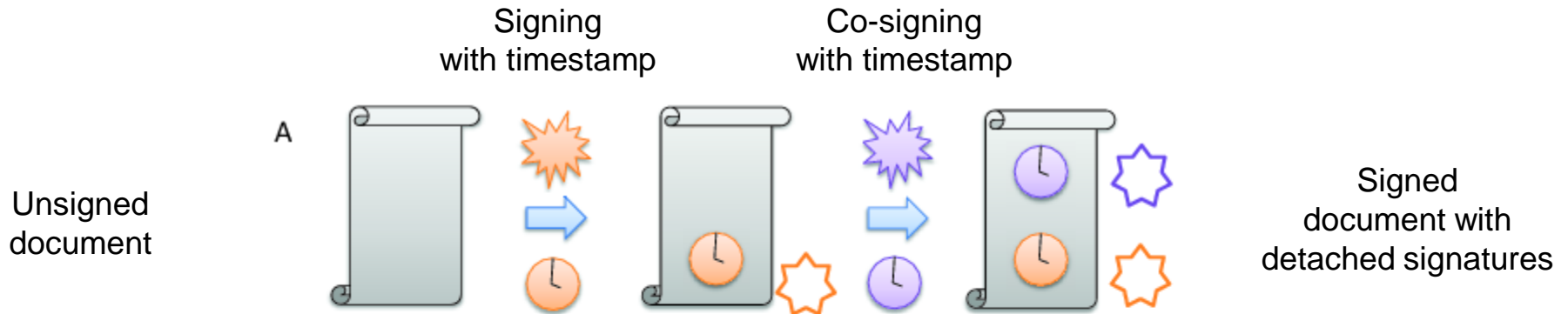
Content:

- Digital signature

- Co-signing for patenting



Digital signature scheme





OpenLabFramework

Laboratory Information Management System

Web application based on Grails web application framework

Development started in 2010

Published in 2014

Developed for the functional genomics community, but

Generally usable as a sample management and tracking solution due to its modular structure

OpenLabFramework

Gene Cell Line Data Attachments Projects Storage Master Data

Project Tree

- Test
- Top Secret

Show CellLineData MCF7 - pAcpt - [PTEN]p

Cell Line MCF7

Acceptor pAcpt

First Recombinant [PTEN]

Second Recombinant

Culture Media DMEM

Medium Additives None a

FCS

Plasmid Number

Colony Number

Notes

Projects None a

Test

Attachments Passage Cell Line Data Storage Antibiotics

Please select a passage: Refresh

Showing all passages for this CellLineData. Please select a s

There are 2 units left.

You are here: BigFreezer >> Gateway-1 >> Box1 (Change)

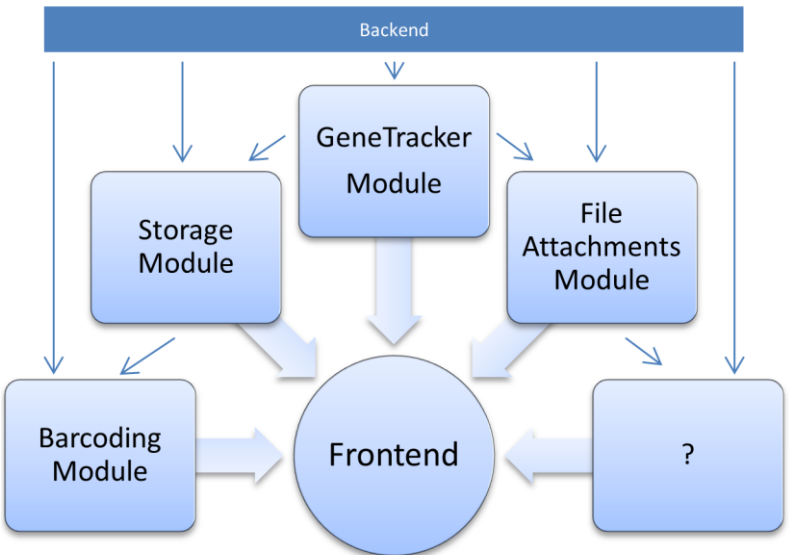
	1	2	3
A	MCF7 - pAcpt - [PTEN]pDestA - DMEM	MCF7 - pAcpt - [PTEN]pDestA - DMEM - 19/02/13	MCF7 - [PTEN]
B	MCF7 - pAcpt - [MyTestGene-M1]pDestA - DMEM - xx/xx/xx	Click to add	Click to
C	Click to add	Click to add	Click to
D	Click to add	Click to add	Click to

Version 1.2 on Grails 2.2.2

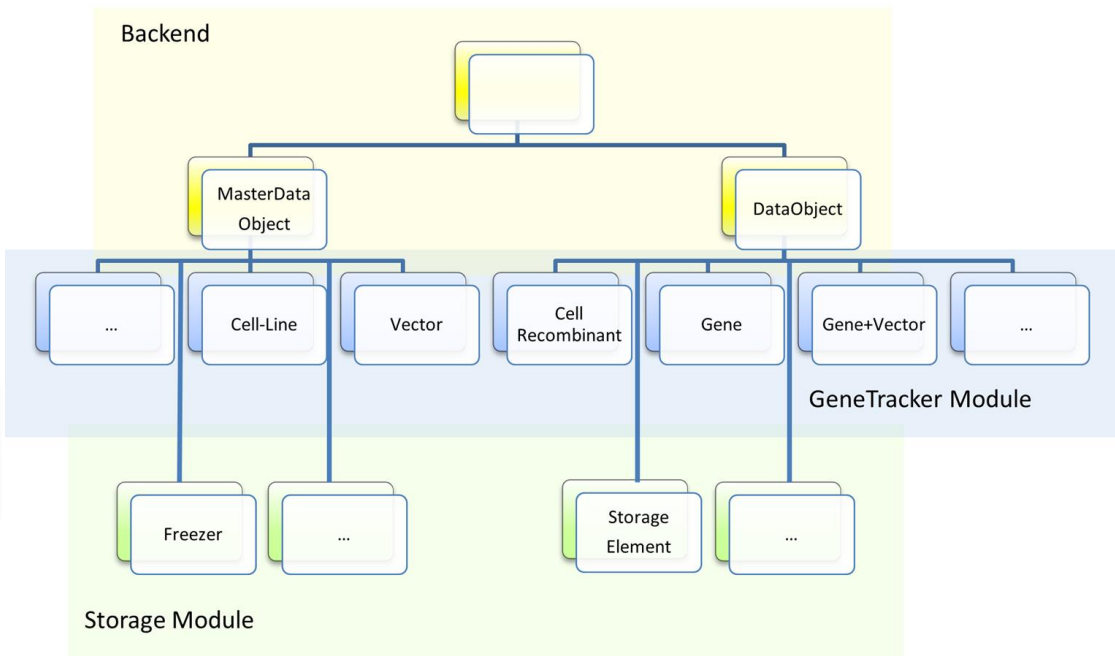


OpenLabFramework

Modular structure



Class Hierarchy





Project Tree

Test
Top Secret



Home Recombinant List New Recombinant Delete

Show Recombinant [My test gene-M1]pDestA

Genes: My test gene-M1 PTEN

Notes:

Projects: None added

Vector: pDestA

1



History

Creator	admin
Date Created	2013-05-21 11:48:43 UTC
Last Modifier	admin
Last Update	2013-05-21 11:48:43 UTC

2



Addins

Print Barcode Label

Site: Label:

Description:

Text:

Attachments

3

Attachments Storage

There are 0 units left.

You are here: BigFreezer >> Gateway-1 >> Box1 [\(Change\)](#)

4

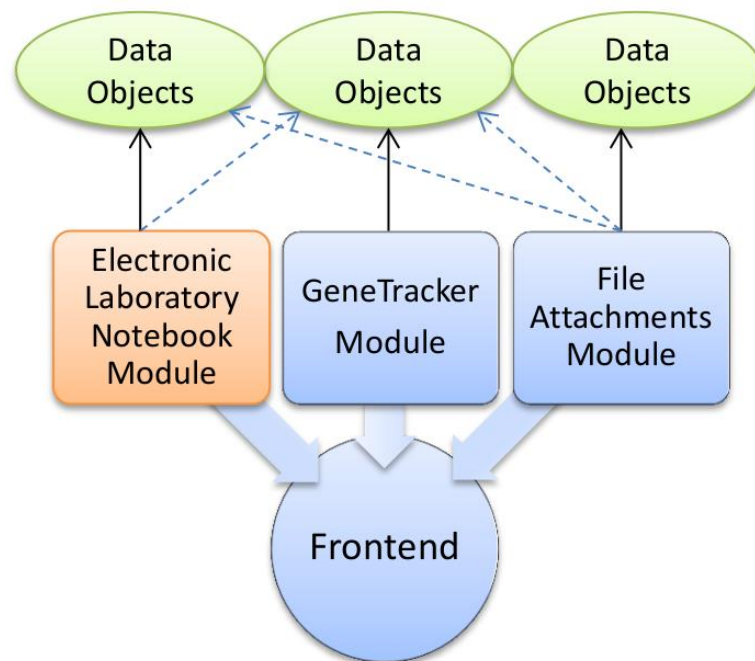
	1	2	3	4	5	6	7
A	MCF7 - pAccpt - [PTEN]pDestA - DMEM	MCF7 - pAccpt - [PTEN]pDestA - DMEM - 19/02/13	MCF7 - pAccpt - [PTEN]pDestA - DMEM - 2	MCF7 - pAccpt - [ABCD]pDestA - [ABCD]pDestB - DMEM	MCF7 - pAccpt - [ABCD]pDestA - [ABCD]pDestB - DMEM	MCF7 - pAccpt - [ABCD]pDestA - [ABCD]pDestB - DMEM - xx/xx/xx	MCF7 - pAccpt - [ABCD]pDestA - [ABCD]pDestB - DMEM - xx/xx
B	MCF7 - pAccpt - [MyTestGene-	Click to add	Click to add	Click to add	Click to add	Click to add	Click to add

LEGEND

- W: Wildtype
- M: Mutant
- P: Promotor
- C: cDNA derived
- F: Gene Fragment
- K: Knockdown (Silenced)

OpenLabNotes as an ELN module for OpenLabFramework

Documents in OpenLabNotes can interact with existing modules and their DataObjects out of the box.



Create Note



Create new Note

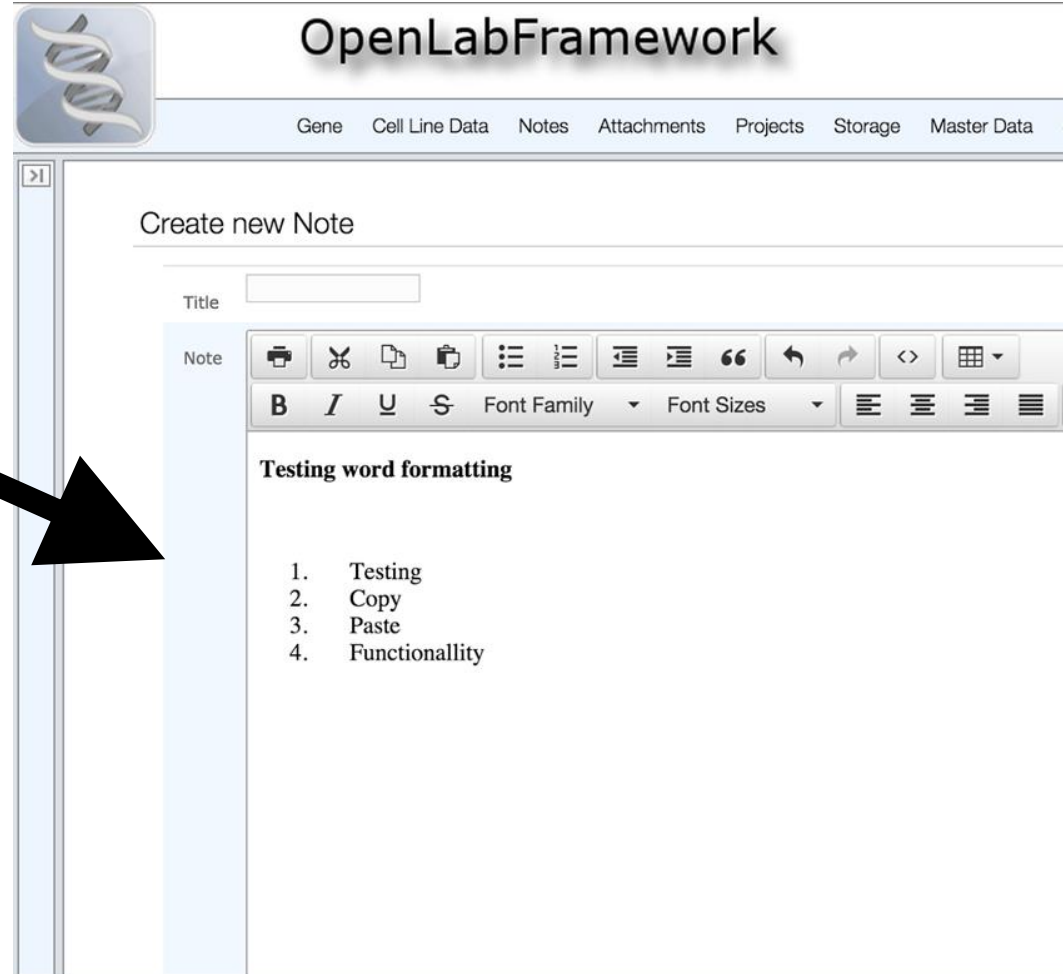
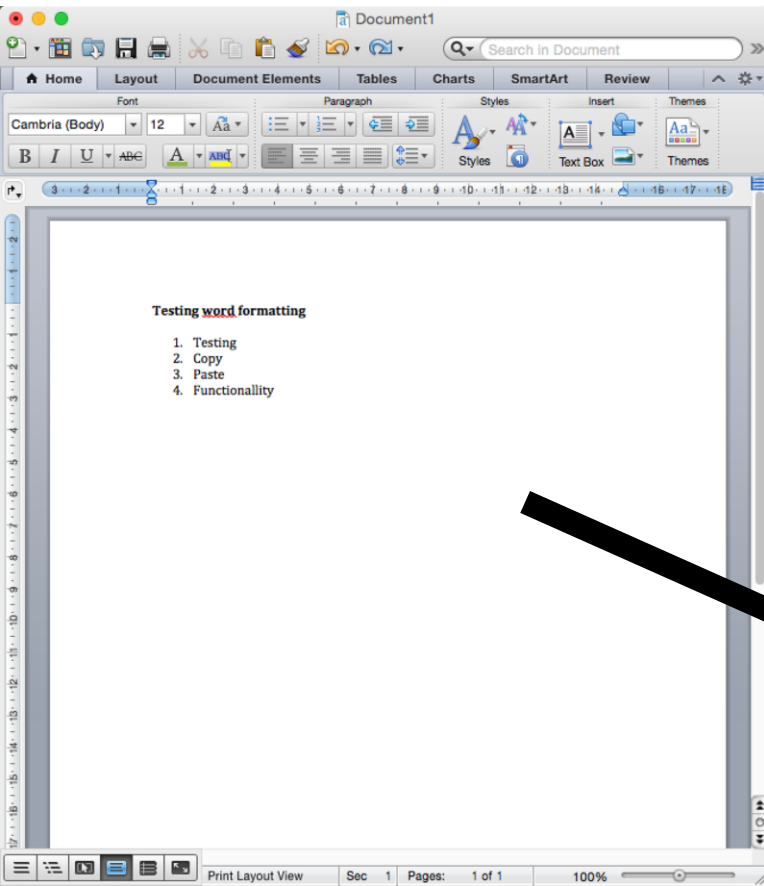
Title

Note

Rich text editor toolbar with icons for print, cut, copy, paste, bulleted list, numbered list, indent, outdent, quote, undo, redo, source code, and table. Below the icons are text formatting options: Bold (B), Italic (I), Underline (U), Strikethrough (ABC), Font Family, Font Sizes, alignment (left, center, right, justified), and text color (A).

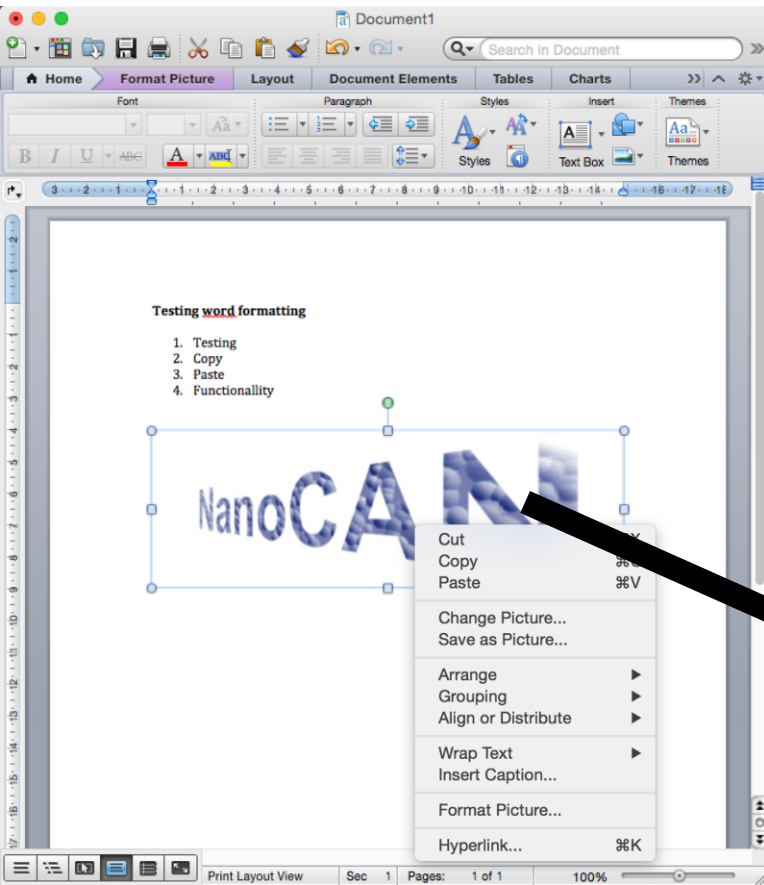
ELN Note 1 content goes here|

Copy and Paste

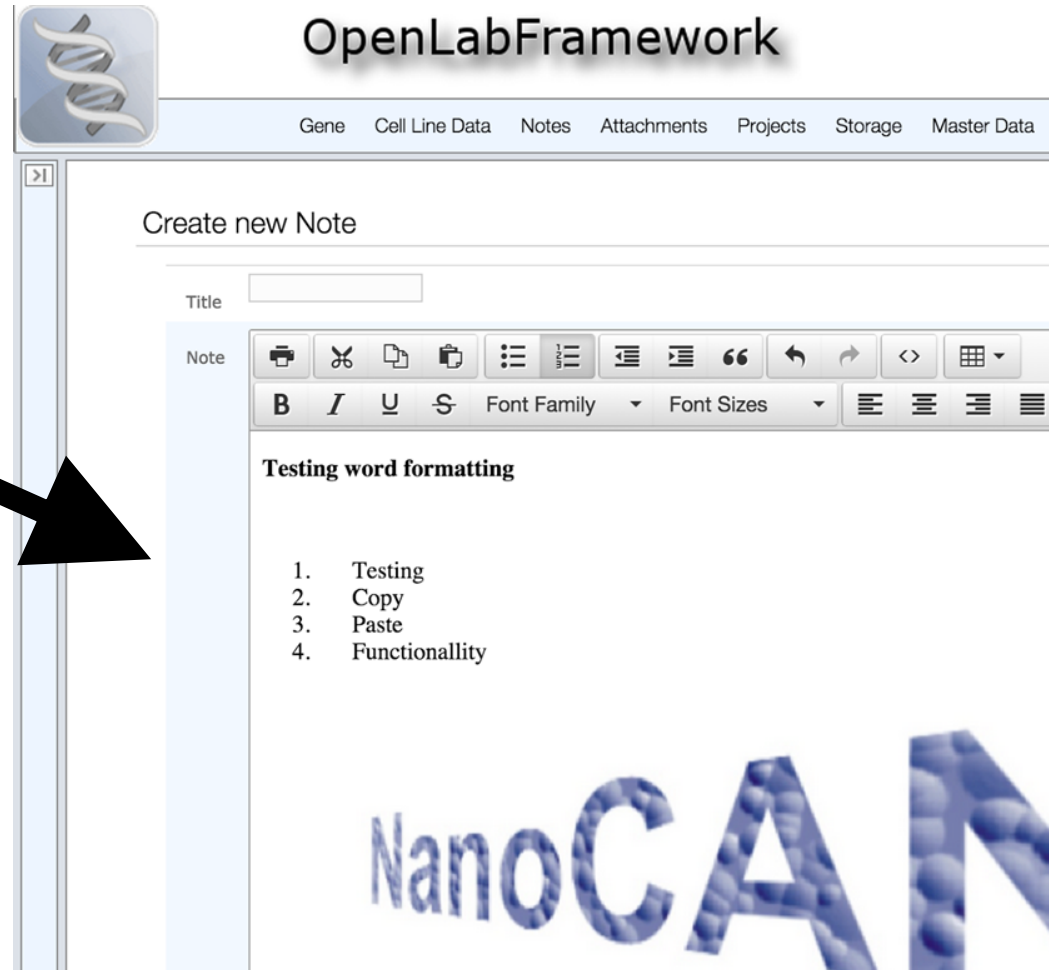


MS Office, Editor, Evernote, Web, ...

Copy and Paste Images



MS Office, Editor, Evernote, Web, ...



List Notes



OpenLabFramework

Search

Hello ELNuserA [Logout]

Gene Cell Line Data Notes Attachments Projects Storage Master Data Settings

Home New Noteltem

Noteltem List

Filter options:

Results per page: 10 Creator: Last Modifier: Project: Filter

Creator	Last Update	Date Created	Finalized Date	Supervisor	Supervisor Signed Date	Title	Note Preview
ELNuserA	4/23/15	4/23/15				ELN Note 1 show	ELN Note 1 content goes here.

CSV EXCEL ODS PDF RTF XML

Show Note



Show Note ELN Note 1

Edit Finalize Delete Download note as docx Download note as PDF

Title: ELN Note 1

Samples: *None added*
esyhh

Upload attachment:
 Previously attached files are shown in a tab below the note.

Shared with: *None added*
admin

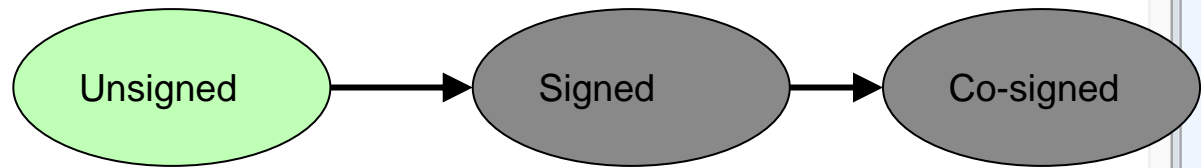
Projects: *None added*
amspro1

Notebook: *None added*
test

Note:

History

Date created:	2015-04-23 10:57:24 CEST
Author:	ELNuserA
Note status:	draft



Signing a Document

The screenshot shows the OpenLabFramework interface for editing a note. The 'Finalize' button is highlighted with a red circle. The note details include:

- Title: ELN Note 1
- Samples: None added (dropdown: esyhh, Add to)
- Upload attachment: Previously attached files are shown in a tab below the note. (Upload a file, Submit)
- Shared with: None added (dropdown: admin, Add to)
- Projects: None added (dropdown: amspro1, Add to)
- Notebook: None added (dropdown: test, Add to)

The History window shows:

Date created:	2015-04-23 12:34:21 CEST
Author:	ELNuserA
Note status:	draft

The flow diagram below the interface illustrates the document signing process:

```
graph LR; A([Unsigned]) -- Finalize --> B([Signed]); B --> C([Co-signed]);
```

Generate Public/Private Keys



OpenLabFramework

Search

Hello ELNuserA [\[Logout\]](#)

[Gene](#) [Cell Line Data](#) [Notes](#) [Attachments](#) [Projects](#) [Storage](#) [Master Data](#) [Settings](#)

Generate keys

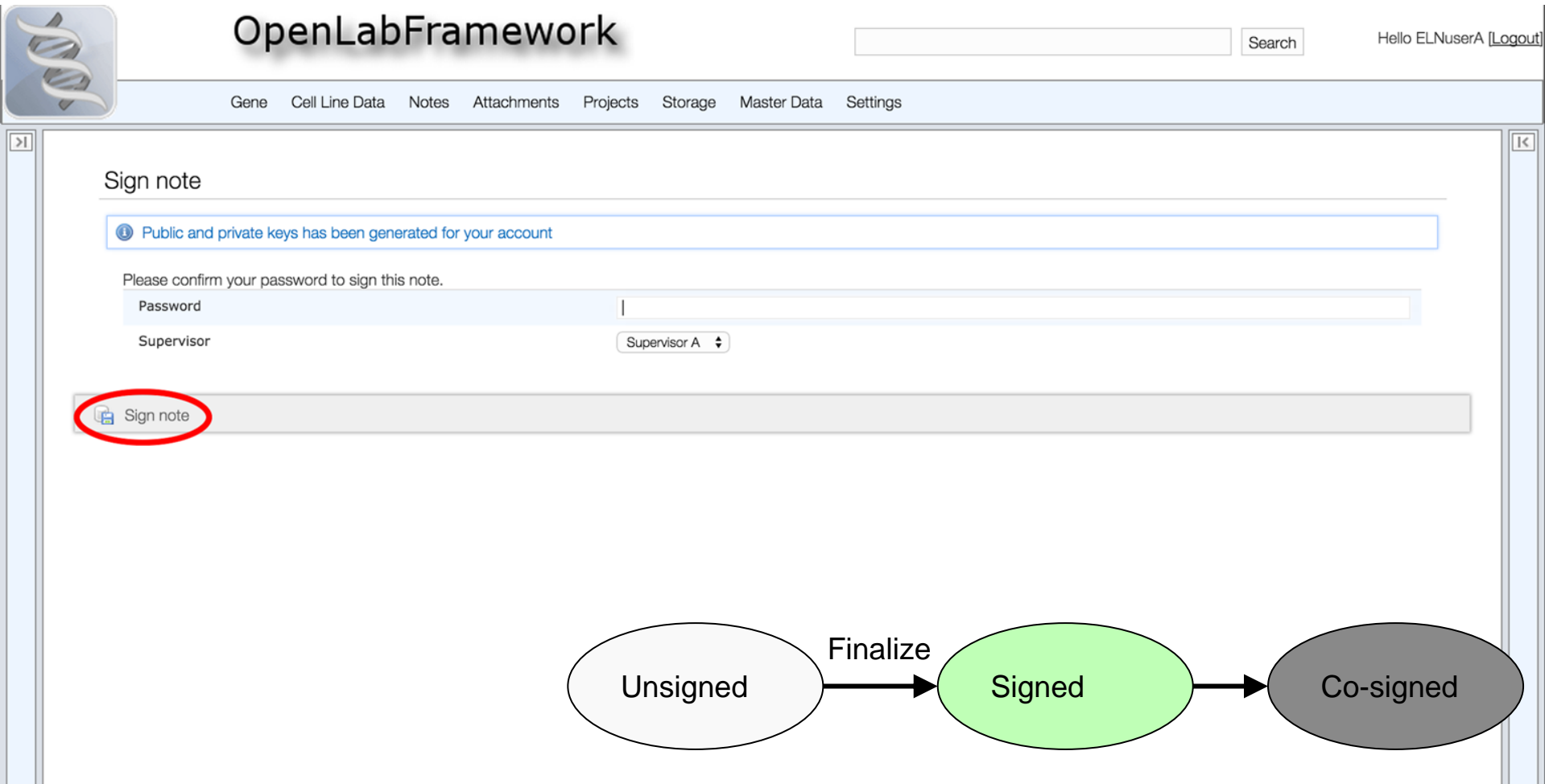
 User ELNuserA does not have any keys!

For security reasons we need to generate keys for encryption of notes. Please confirm your password.

Password

 Generate keys

Sign Note & Select Supervisor



OpenLabFramework

Gene Cell Line Data Notes Attachments Projects Storage Master Data Settings

Search Hello ELNuserA [Logout]

Sign note

Public and private keys has been generated for your account

Please confirm your password to sign this note.


Password

Supervisor Supervisor A

Sign note

```
graph LR; Unsigned([Unsigned]) -- Finalize --> Signed([Signed]); Signed --> CoSigned([Co-signed]);
```

Signature Checks



OpenLabFramework Search Hello ELNuserA [Logout]

Gene Cell Line Data Notes Attachments Projects Storage Master Data Settings

Show Note ELN Note 1

Note was signed

Download note as docx Download note as PDF

Pending supervisor signature, note can not be edited or deleted.

Title: ELN Note 1

Samples: None added
esyhh Add to

Upload attachment: Previously attached files are shown in a tab below the note.

Upload a file

Submit

Shared with: None added
admin Add to

Projects: None added
amspro1 Add to

Notebook: None added

History

Date created:	2015-04-23 12:34:21 CEST
Date finalized:	2015-04-23 12:55:01 CEST
Author:	ELNuserA
Author signature:	✓
Supervisor:	ELNsupervisorA
Supervisor signature:	✗
Note status:	final

Supervisor Signature

The screenshot displays the OpenLabFramework web application. At the top, there is a search bar and a user greeting: "Hello ELNsupervisorA [Logout]". The main navigation bar includes "Gene", "Cell Line Data", "Notes", "Attachments", "Projects", "Storage", "Master Data", and "Settings". The "Notes" menu is open, showing options: "List notebooks", "Create new note", "List own notes", "List notes shared with me", "List notes signed as supervisor", and "List notes I need to sign". The last option is circled in red. Below the menu, the "Noteltem List" section is visible, with filter options for "Results per page" (set to 10), "Creator", "Last Modifier", and "Project". A table of notes is shown with columns: "Creator", "Last Update", "Date Created", "Finalized Date", "Supervisor", "Supervisor Signed Date", "Title", and "Note Preview". The first row contains: "ELNuserA", "4/23/15", "4/23/15", "4/23/15", "ELNsupervisorA", "ELN Note 1", and "show". The "show" link is circled in red. A preview window for "Testing word formatting" is open next to the "show" link. At the bottom, there are icons for file exports: CSV, EXCEL, ODS, PDF, RTF, and XML.

OpenLabFramework

Search Hello ELNsupervisorA [Logout]

Gene Cell Line Data Notes Attachments Projects Storage Master Data Settings

Home New Noteltem

Noteltem List

Filter options:

Results per page: 10 Creator: Last Modifier: Project: Filter

Creator	Last Update	Date Created	Finalized Date	Supervisor	Supervisor Signed Date	Title	Note Preview
ELNuserA	4/23/15	4/23/15	4/23/15	ELNsupervisorA		ELN Note 1 show	Testing word formatting

CSV EXCEL ODS PDF RTF XML

Co-signed Document

The screenshot displays the OpenLabFramework interface for an ELN Note titled "ELN Note 1". The interface includes a navigation menu with options like Gene, Cell Line Data, Notes, Attachments, Projects, Storage, Master Data, and Settings. A search bar and user information "Hello ELNsupervisorA [Logout]" are visible in the top right. The main content area shows the note details, including a "Note was signed" notification and a "This note is signed by you and the author" message. The "Samples" section shows "None added" with a dropdown menu containing "esyhh" and an "Add to" button. The "Upload attachment" section has a message "Previously attached files are shown in a tab below the note." and an "Upload a file" button. The "Shared with" section shows "None added" with a dropdown menu containing "admin" and an "Add to" button. The "Projects" section shows "None added" with a dropdown menu containing "amspro1" and an "Add to" button. The "Notebook" section shows "None added". A "History" window is open on the right, displaying the following information:

History	
Date created:	2015-04-23 12:34:21 CEST
Date finalized:	2015-04-23 12:55:01 CEST
Author:	ELNuserA
Author signature:	✓
Date signed by supervisor:	2015-04-23 13:26:24 CEST
Supervisor:	ELNsupervisorA
Supervisor signature:	✓
Note status:	signed



Link Documents to Samples



Show Note ELN Note 1

Download note as docx Download note as PDF

Signed by you and the supervisor, note can not be edited or deleted.

Title: ELN Note 1

Samples:

- CHO-K1 - RPMI 1640

Upload attachment:

Previously attached files are shown in a tab below the note.

Shared with:

None added

Projects:

- ELN Project A

Notebook:

None added

History

Date created:	2015-04-23 12:34:21 CEST
Date finalized:	2015-04-23 12:55:01 CEST
Author:	ELNuserA
Author signature:	
Date signed by supervisor:	2015-04-23 13:26:24 CEST
Supervisor:	ELNsupervisorA
Supervisor signature:	
Note status:	signed

Share Documents



Show Note ELN Note 2

Edit Finalize Delete Download note as docx Download note as PDF

Title: ELN Note 2

Samples: *None added*
esyhh

Upload attachment: Previously attached files are shown in a tab below the note.

Shared with:

- User B (ELNuserB)
- ELNsupervisorA

Projects: *None added*
amspro1

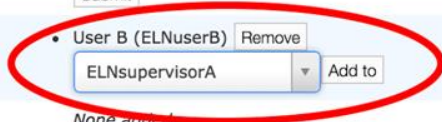
Notebook: *None added*
test

Note:



History

Date created:	2015-04-23 14:12:06 CEST
Author:	ELNuserA
Note status:	draft



Add to Projects



Show Note ELN Note 1

Download note as docx Download note as PDF

Signed by you and the supervisor, note can not be edited or deleted.

Title: ELN Note 1
Samples: *None added*
esyhh

Upload attachment: Previously attached files are shown in a tab below the note.

Shared with: *None added*
admin

Projects: *None added*
ELN Project A

Notebook: *None added*
test

Note:

History	
Date created:	2015-04-23 12:34:21 CEST
Date finalized:	2015-04-23 12:55:01 CEST
Author:	ELNuserA
Author signature:	
Date signed by supervisor:	2015-04-23 13:26:24 CEST
Supervisor:	ELNsupervisorA
Supervisor signature:	
Note status:	signed

Filter Options



Noteltem List

Filter options:

Results per page: 10 Creator (Author): Supervisor: Last Modifier:

Project: Date: Created 5 May 2015 - 5 May 2015

Creator	Last Update	Date Created	Finalized Date	Supervisor	Supervisor Signed Date	Title	Note Preview
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Summary

Electronic Laboratory Notebooks will soon be standard for experimental research

Commercial solutions: Too expensive?

Free solutions: Data protection?

OpenLabNotes:

- Rich text editor

- Full text search and filter options

- Shareability and Export

- Digital signatures (co-signing)

- Documents organized in notebooks and projects

Integrated with OpenLabFramework:

- Direct reference to samples

- Uploading additional documents

- Single solution

Open Challenges

Lack of integration with trusted authorities

ELN data format standard needed

More features:

- Editable copies of finalized documents

- Extend digital signature protection to attached documents

- User groups

Deployment challenging

Community adaptation



Requirements & Availability

>= Java 6 with Java Cryptography Extension

Java web application server: Tomcat (6 or 7)

GitHub

<https://github.com/NanoCAN/OpenLabFramework>
<https://github.com/NanoCAN/OpenLabNotes>



<https://hub.docker.com/r/nanocan/openlabframework/>

```
docker pull nanocan/openlabframework
```



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Fond til almene Formaal*



Thank you for your attention