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Shared modelling and simulation environment (SMSE)

CPNU proposal

1st Training School for tutors
September 8, 2021

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Background

- **CybPhys project commitments**
- **BSU SMSE suggestions and their discussions**
- **CPNU ICT Infrastructure**
- **Time and budget limitation**

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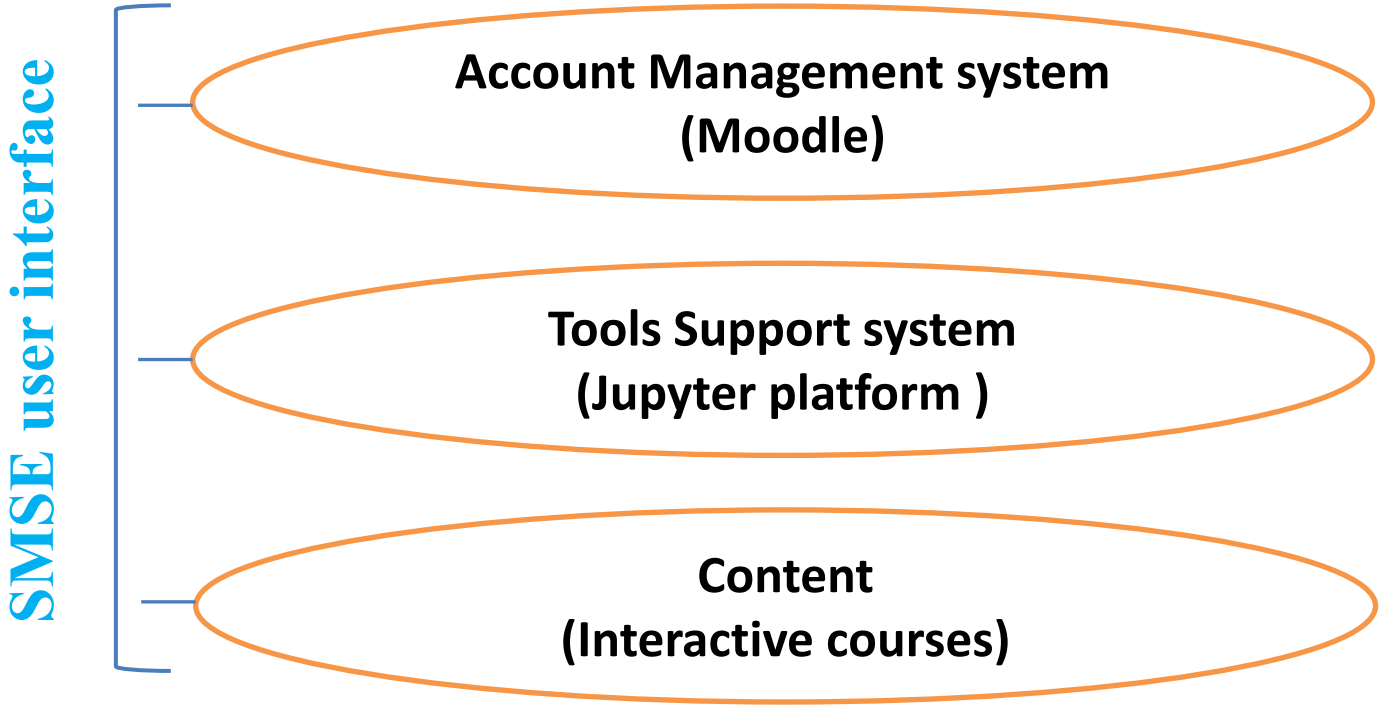
SMSE architecture

Main idea and task – embedding Jupyter platform to Moodle



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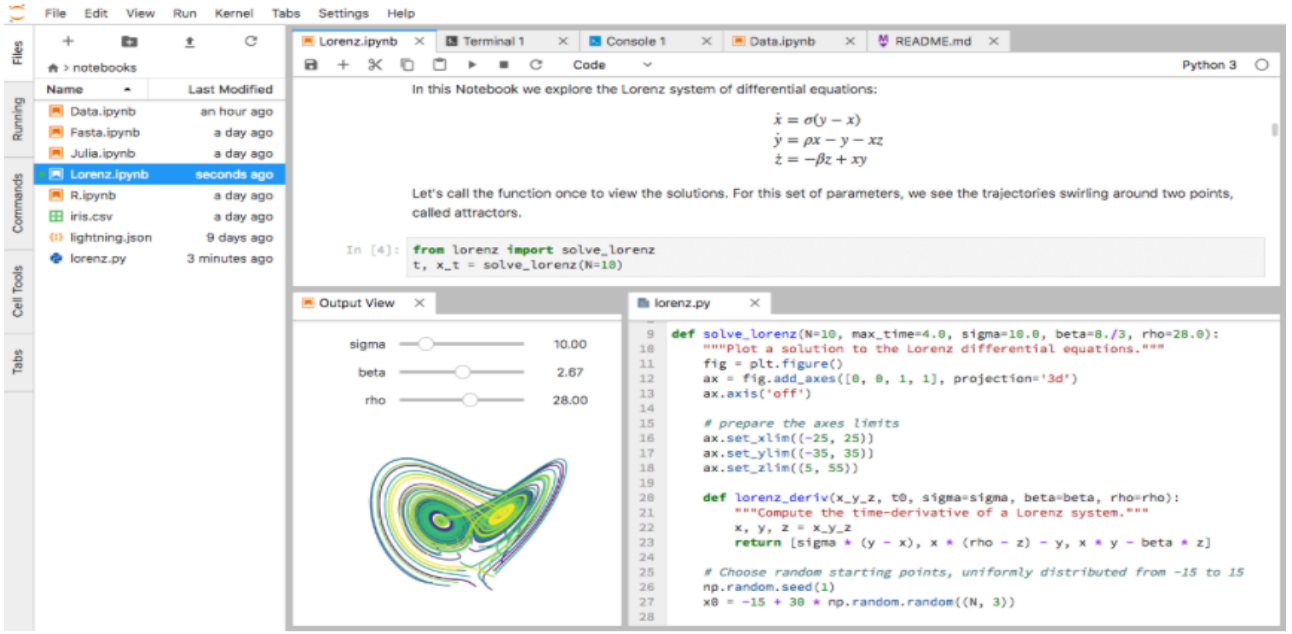
SMSE development goal

To provide users with the ability to create and use interactive courses in the form of Jupyter Notebook documents:

Multi-frame view with inserts of :

- **Structured text**
- **Executed code parts**
- **Drawings and charters**
- **Results of modeling with plotting**



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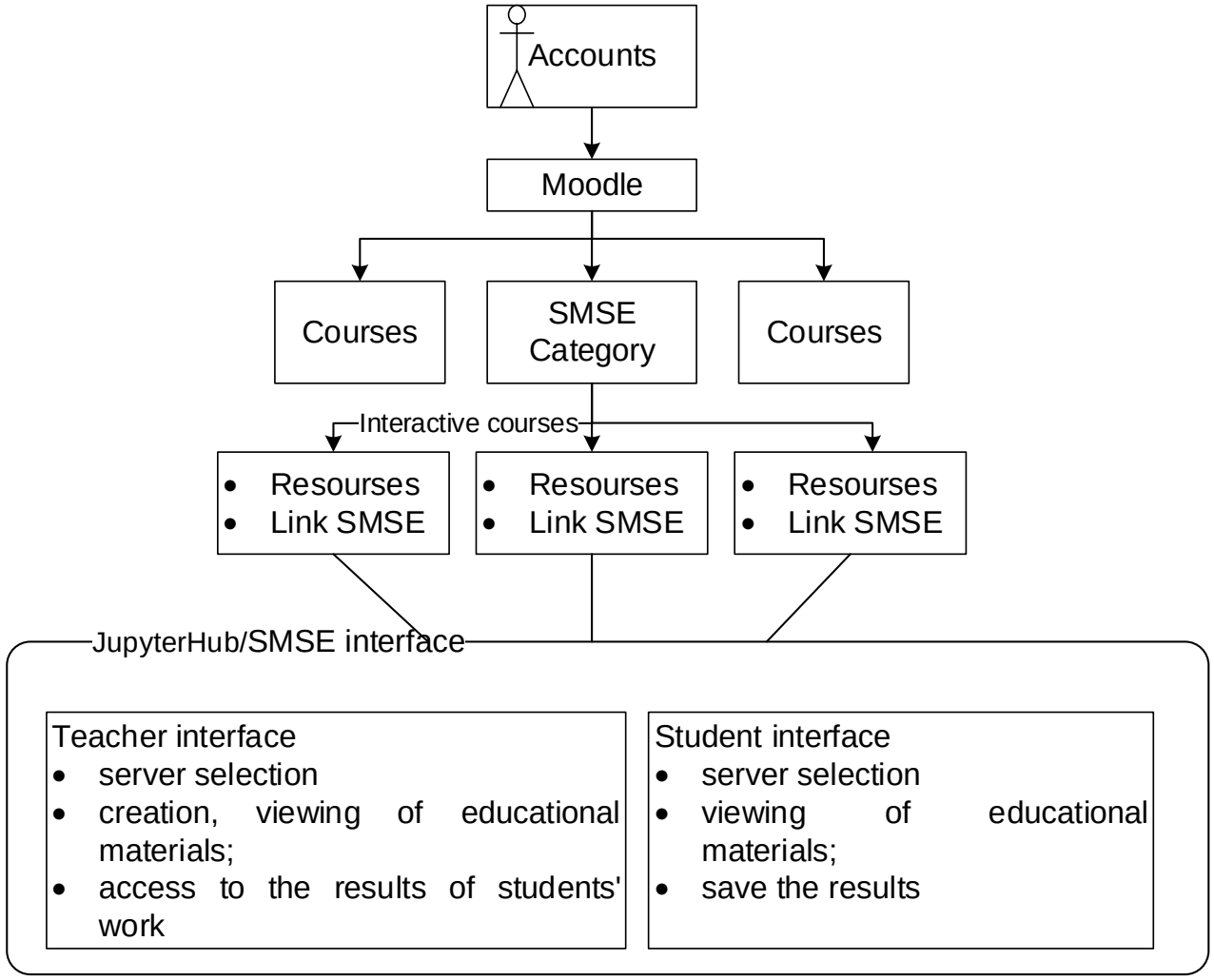
SMSE use case diagram



SMSE structure components

LMS Moodle :

- registration of SMSE users and control of them accounts
- integration of SMSE courses with another teaching materials and courses
- collection and visualization of test results and etc.

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SMSE structure components

Jupyter platform:

- **JupyterHub -** to serve Jupyter notebooks for multiple users
- **JupyterLab** enables to work with Jupyter notebooks documents and its kernels (program languages, modelling tools etc.)
- **Jupyter Notebook –** final teaching document with possibility to run simple simulations and advanced analytical tools right from the browser

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SMSE structure components

LTI (Learning Tools Interoperability) authentication:

- Pass-through authentication with LMS Moodle
- Integration Moodle with Jupyter platform

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SMSE structure components

Additional (optional) components:

- **DockerSpawner (JupyterHub Docker Spawner)** enables JupyterHub to spawn single user notebook servers in Docker containers. Containers isolate software from its environment. It allows to develop a set of servers with various services for students.

- **Conda -** for installing Jupyter notebook kernelsand switching easily between them

- **nbgrader** allows to easily create assignments for students that include both coding exercises, written responses and quickly grading completed assignments.

SMSE interface functional requirements

1. **Access to SMSE with Moodle account**
2. **Creation a SMSE environment with default kernels**
3. **Linking Jupyter notebook server with Moodle account**
4. **Adding kernels to Jupyter notebook server**
5. **Distributed access to Jupyter notebook documents and SMSE tools**
6. **Integration SMSE with Doker and nbgrade (optional)**
7. **Integration nbgrade with Moodle as for collection of completed assignments.(optional)**

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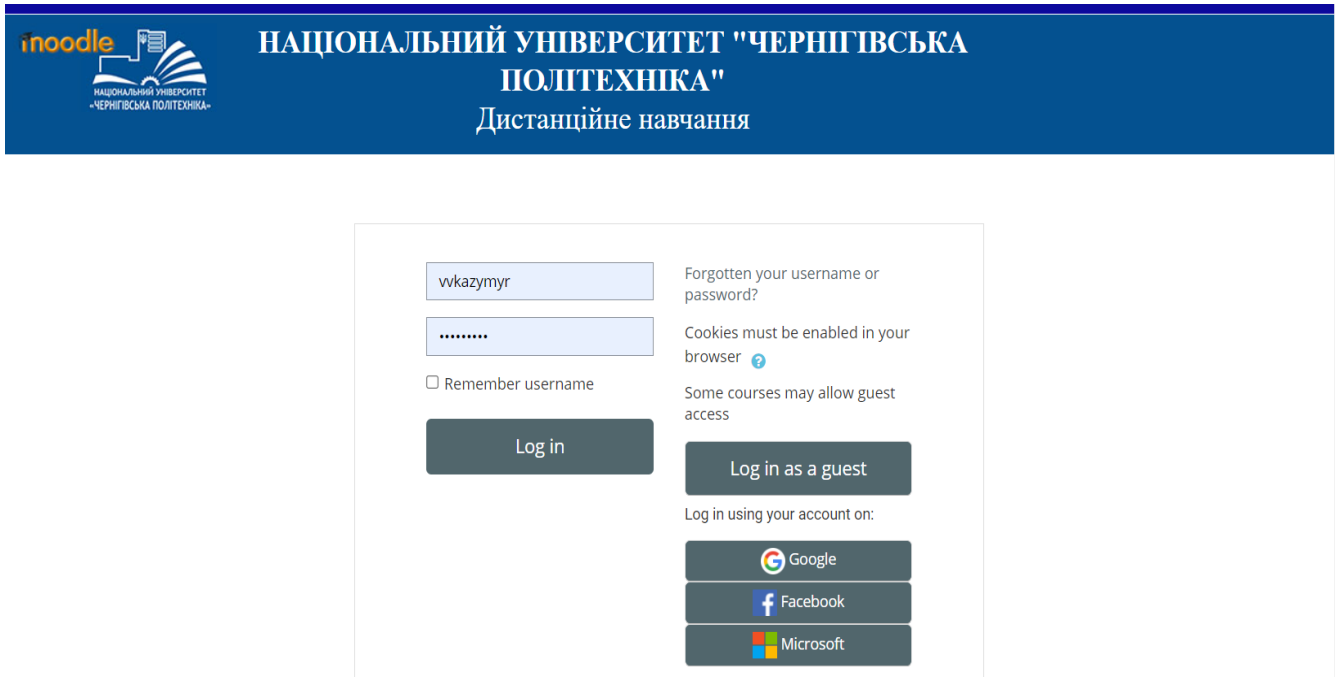
Prototype of SMSE user interface

1. Login to Moodle of CPNU



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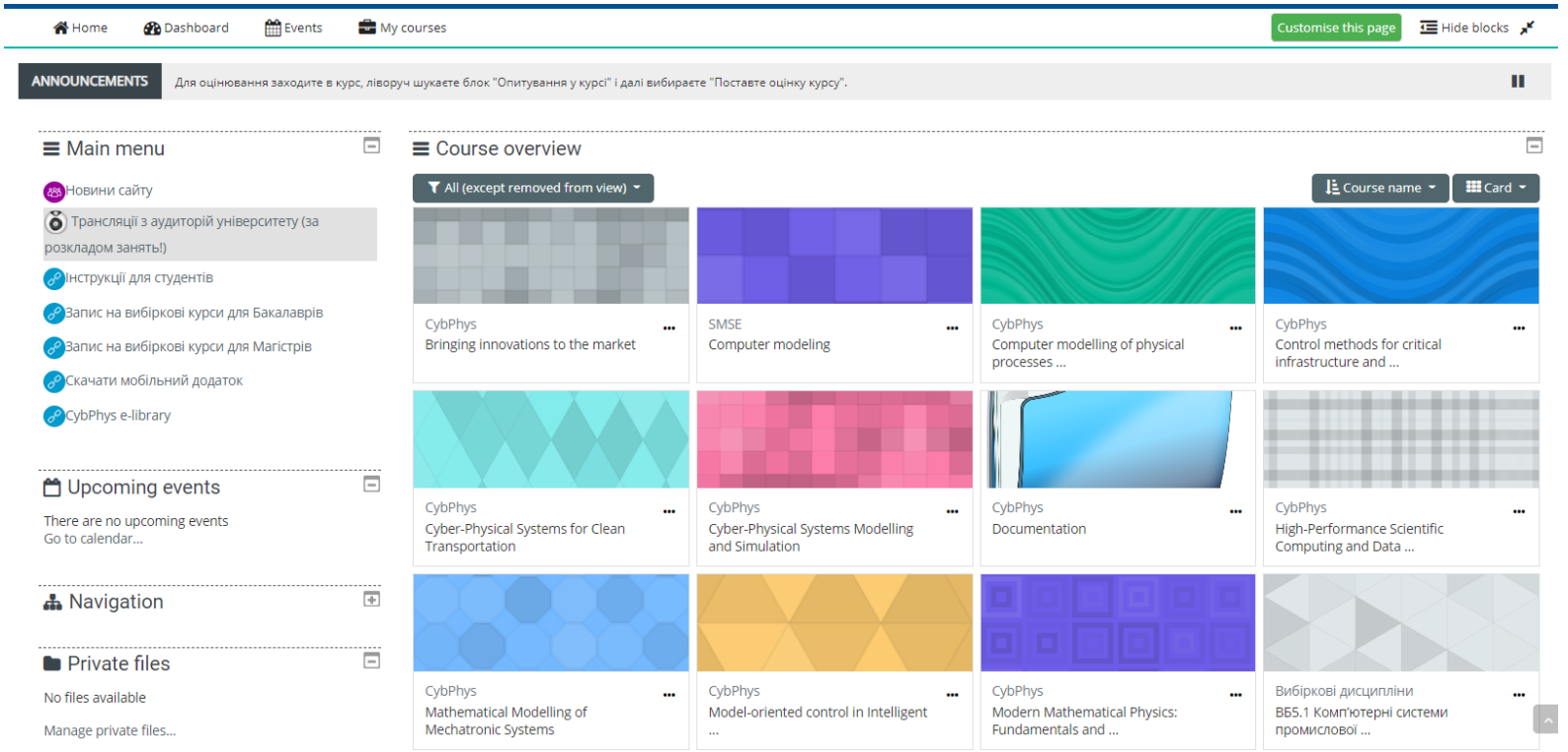
Prototype of SMSE user interface

2. Select SMSE category on Moodle dashboard



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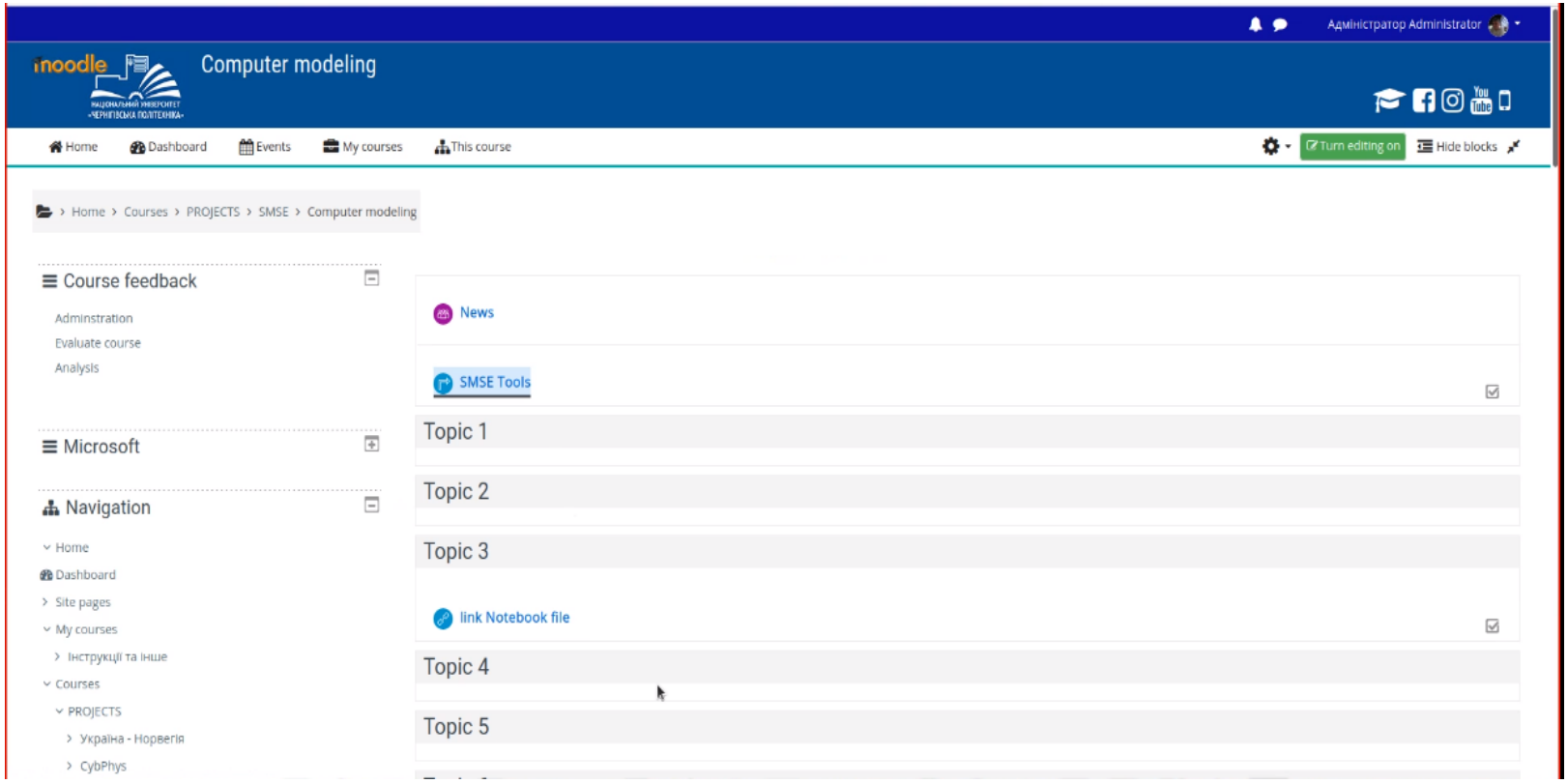
Prototype of SMSE user interface

3. Start JupyterHub for SMSE - click on SMSE tools.



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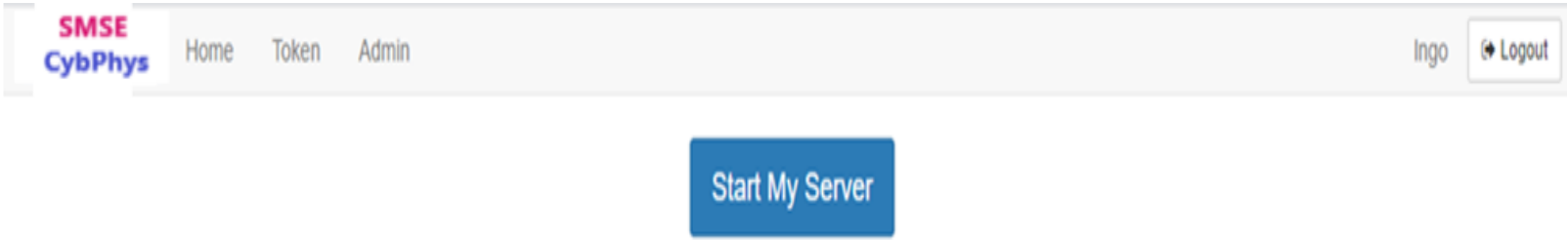
Prototype of SMSE user interface

4. Start JupyterLab



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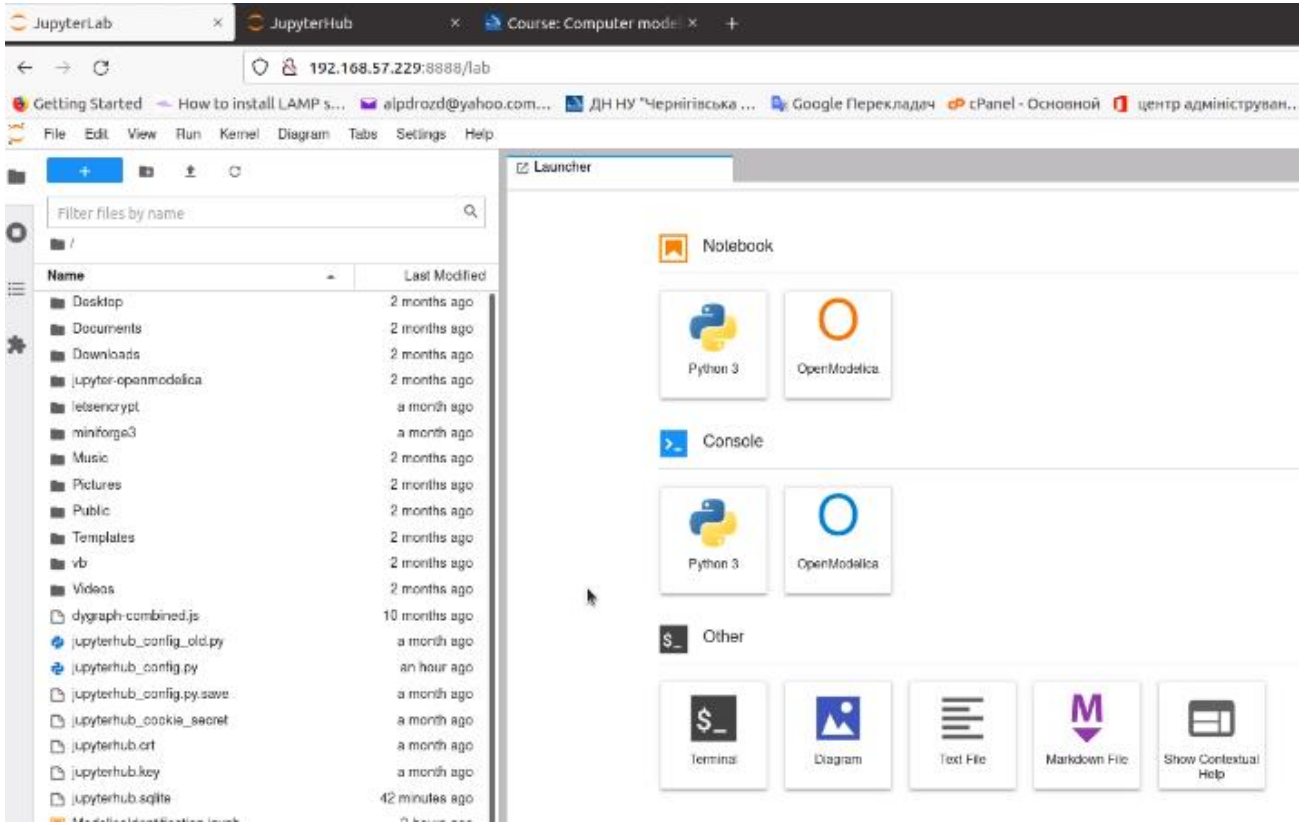
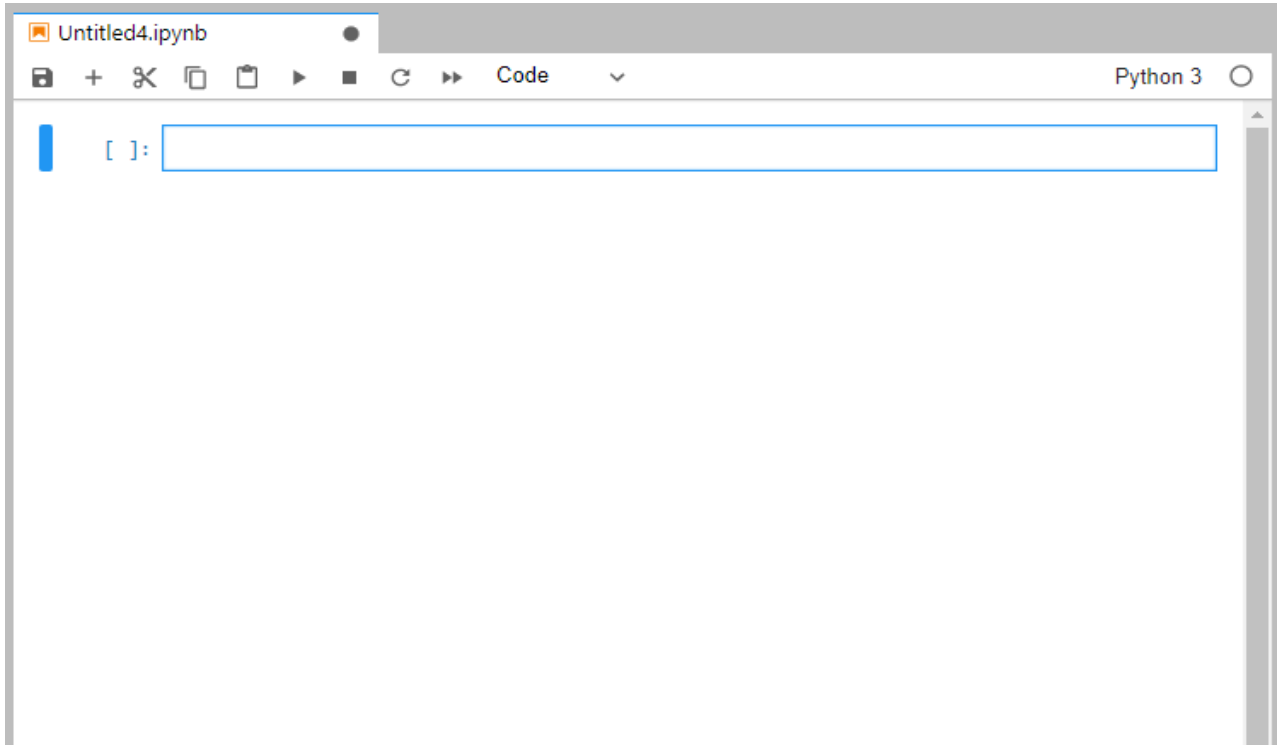
Prototype of SMSE user interface

5. Select document with Jupyter notebook kernel



Prototype of SMSE user interface

6. Select document will be opened (or created)



Hardware questions to be solved

1. Purchase of new more power Moodle server
2. Purchase of SMSE server (for deployment of Jupyter platform and SMSE user interface)
3. Upgrade of network

Software questions to be clarified

1. Creation the Jupyter notebook documents supported by several kernels
2. Integration nbgrade with Moodle
3. Using of clients kernels

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Project plan

N	Activity	Term
1	Purchase of equipment (hardware and software)	October, 2021
2	Installation of the software on the servers of CPNU	November, 2021
	Configuring all software including account creation	December, 2021
	Implementation of the necessary functions	February, 2022
	Development of SMSE interface	March, 2022
	Development of SMSE course examples	May, 2022
	Testing of SMSE	June, 2022
	Development of documentation	July, 2022
	Delivery-acceptance of SMSE	August, 2022

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Project team

1. **Project manager**
2. **Programmer**
3. **System administrator**
4. **Tester**

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Contact information:

Chernihiv National University of Technology
14035, Ukraine, Chernihiv, Shevchenko Str., 95

site: www.stu.cn.ua

CybPhys project contacts:

Volodymyr Kazymyr

tel. +38 050 344 43 77

e-mail: vvkazymyr@gmail.com