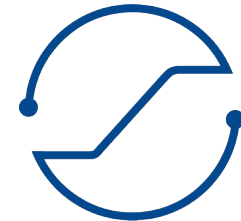


Distributed Deep Learning by Horovod

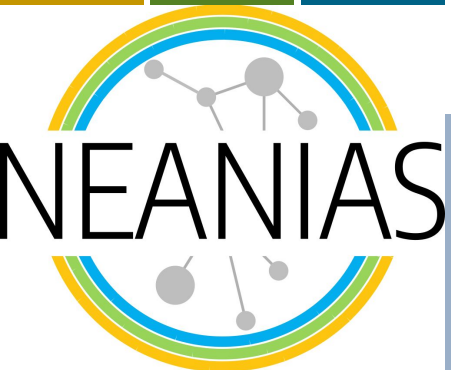
Jozsef Kovacs, SZTAKI
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ELKH
Eötvös Loránd
Kutatási Hálózat



SZTAKI

www.neanias.eu



Novel EOSC Services for
Emerging Atmosphere,
Underwater & Space
Challenges

NEANIAS receives funding from
European Union under Horizon 2020
Research and Innovation
Programme under grant agreement
No. 863448



NEANIAS: Services, Infrastructures, Communities & Business

NEANIAS - Novel EOSC Services for Emerging Atmosphere, Underwater & Space Challenges

Call: INFRAEOSC-02-2019

Project ID: 863448

Duration: 36 months

Finish: 31.10.2022

- › Address community-specific needs for underwater, atmosphere and space research sectors
- › Onboard communities to the Open Science, EOSC and interdisciplinary research era
- › Nurture new business opportunities
- › Power-up EOSC

NEANIAS

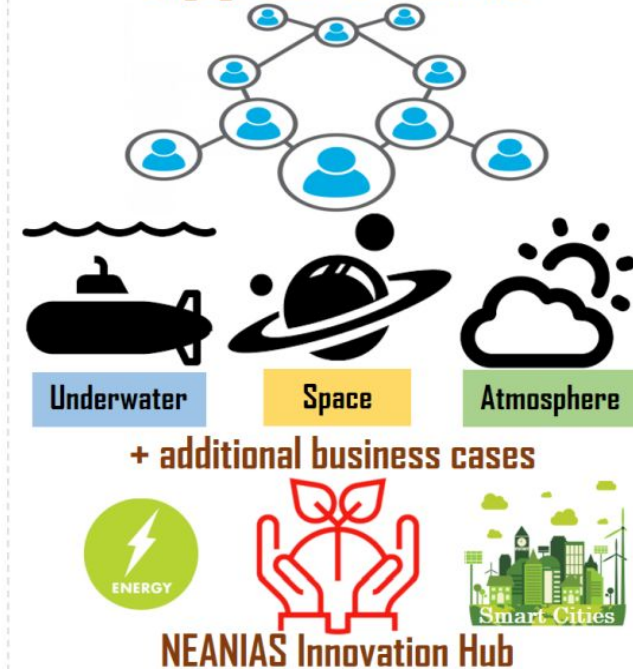


Co-design, Innovative Thematic Services Tailored to Specific Data Cycle Processes

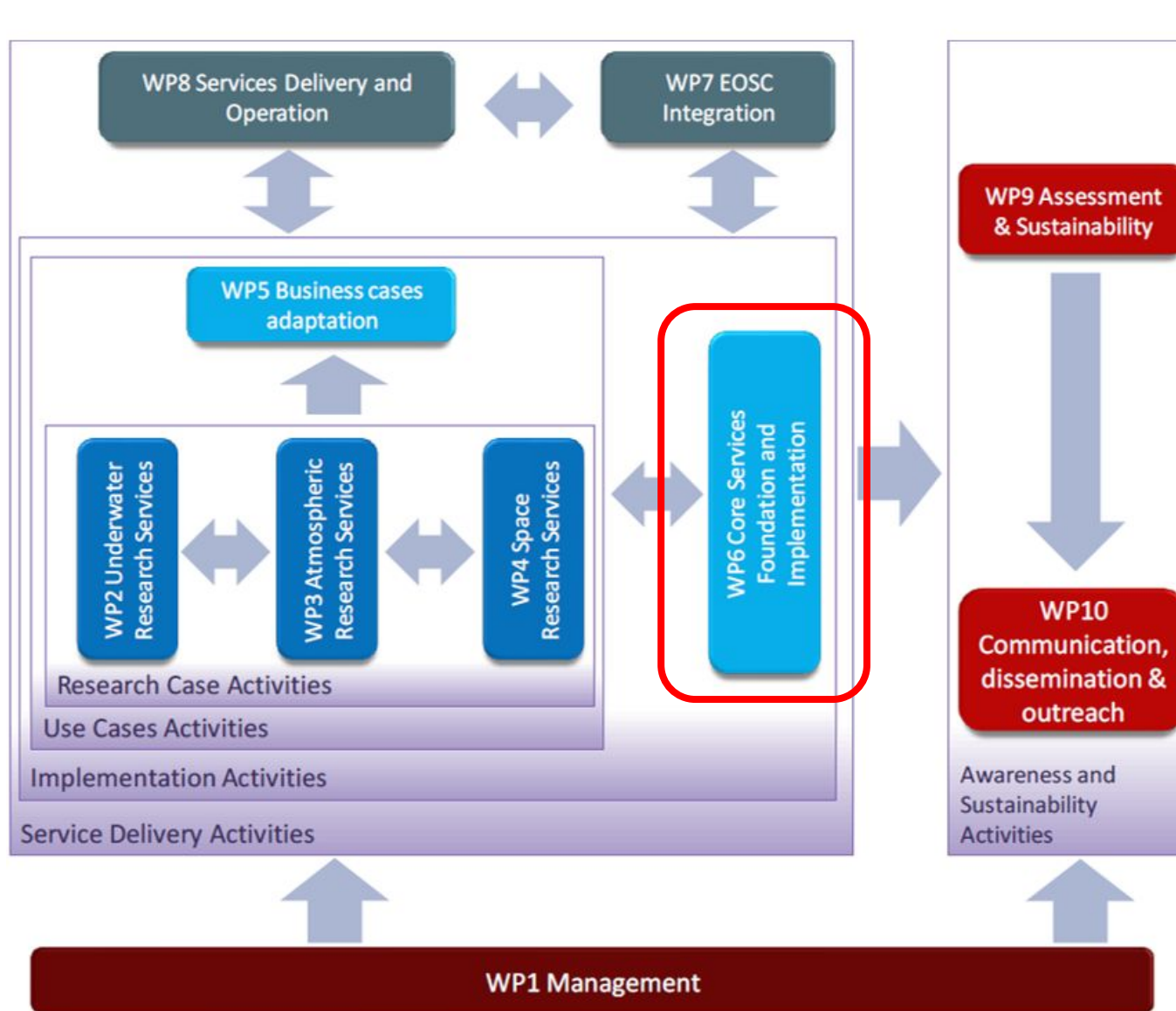
Develop/ Integrate Cross-Cutting Core & Thematic Services at EOSC



Engage User Communities



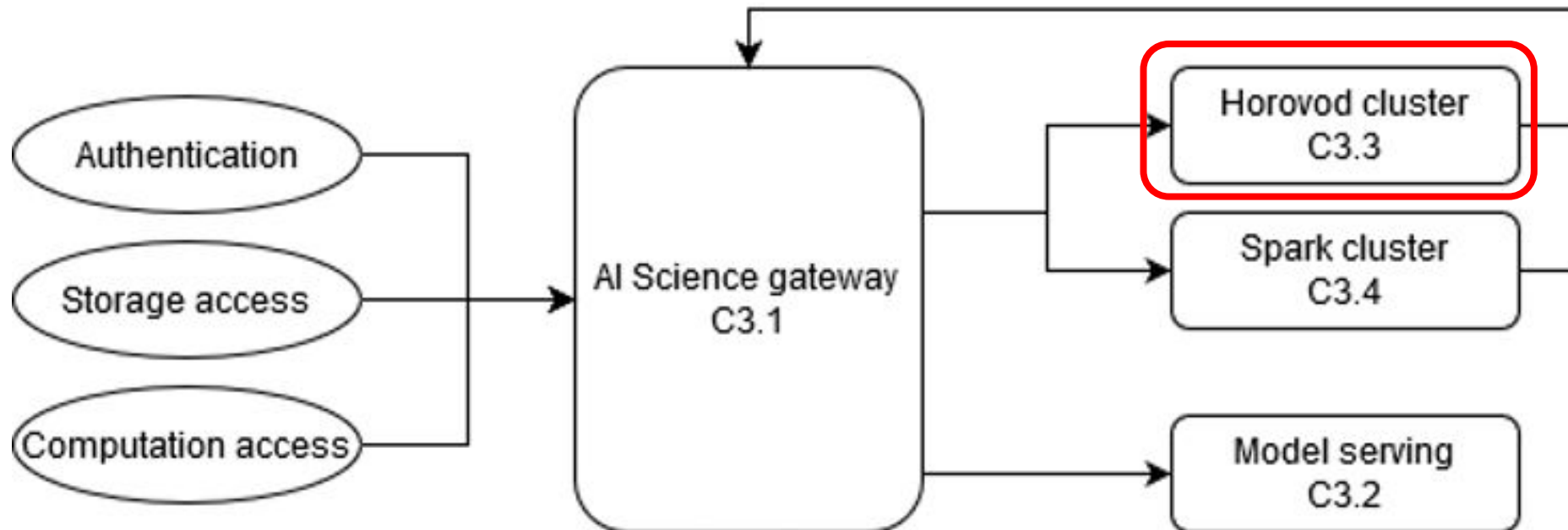
Neantias project structure – Core services



WP6 services

- › C1 Open-science lifecycle support services
- › C2 EOSC, RI and cloud integration enabling service
- › C3 Artificial Intelligence service
- › C4 Visualisation services

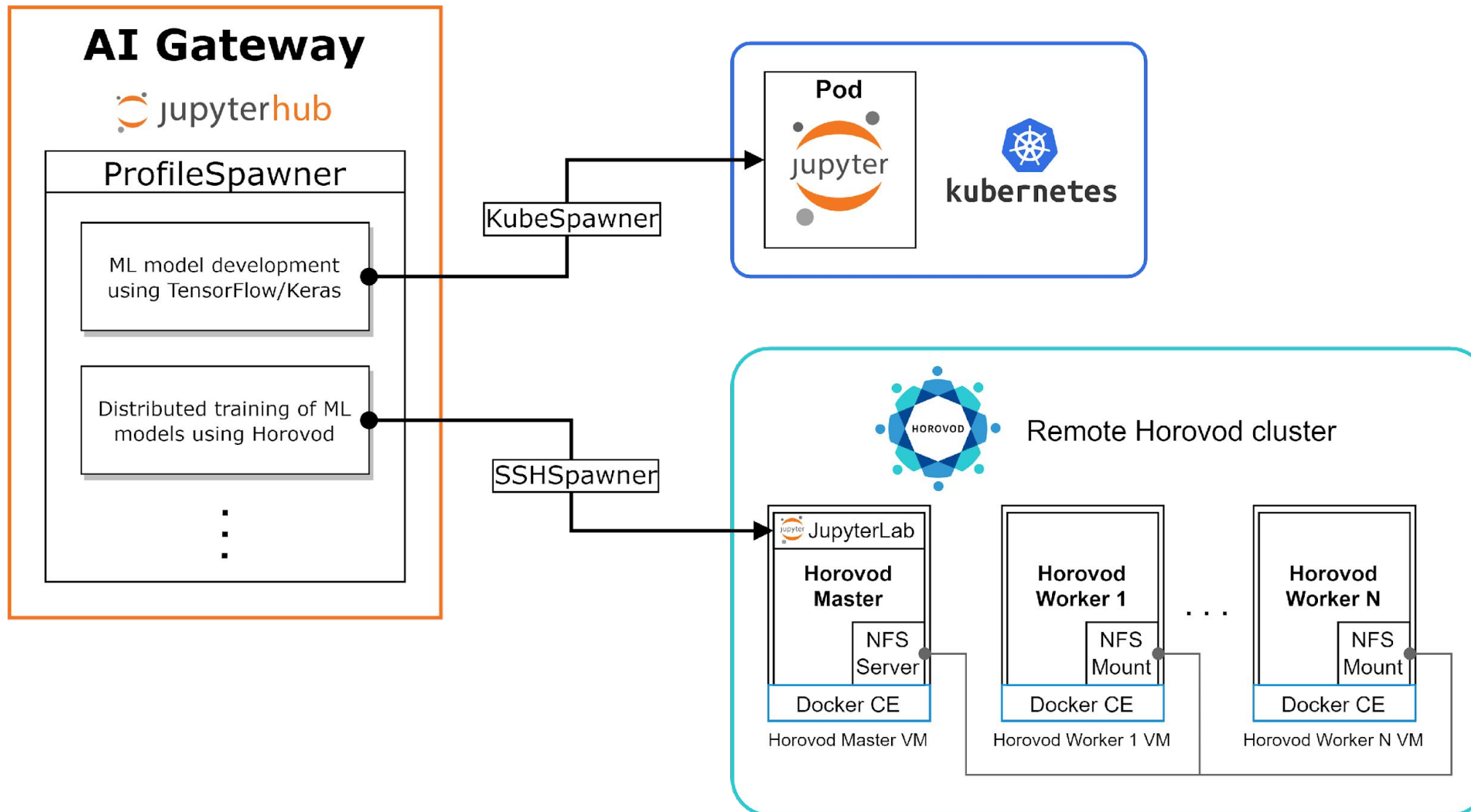
- › Basic core services
- › Development and training of ML models
- › Model serving of ML models



- › Open-source distributed deep learning framework from Uber
- › Supports TensorFlow, Keras, PyTorch, Apache MXNet and Spark
- › Provide an easy-to-use framework for distributed training
 - Execute on hundreds of GPUs with just a few lines of additional code
 - Great scaling efficiency
- › Data parallel execution
 - Training data is divided into subsets
 - Train the same replicated model on each node
 - Model parameters are synchronised between the workers
- › Ring-Allreduce strategy
 - Horovod utilizes Message-Passing Interface (MPI)
 - Each node communicates with two of its peers $2*(N-1)$ times
 - NVIDIA NCCL 2.0 for intra-node communication



Workflow Overview





Server Options

- ML model development using Tensorflow/Keras**
Environment for ML model development supported by Tensorflow and Keras Python ML libraries
- Distributed training of ML models using Horovod**
Environment for Distributed Deep Learning by Horovod. IMPORTANT: You need to request a personal cluster before choosing this environment at eosc-horovod@sztaki.hu
- Serving ML models using BentoML**
Environment for establishing a service by BentoML with a ML model behind
- ADAM API**
Environment for using ADAM API
- ASTRO ML**
Environment for using MRCNN
- TIRAMISU**
Environment for using Tiramisu modeling

▼ Options for mounting remote storage

Start

ai-gateway.neanias.eu

Sign in with keycloak

Server Options

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Environment for using Tiramisu modeling

▼ Options for mounting remote storage

Start

Starting the single-user server using SSHSpawner

jupyterhub Home Token kpora@sztaki.hu Logout

Your server is starting up.
You will be redirected automatically when it's ready for you.

Spawning server...

Event log

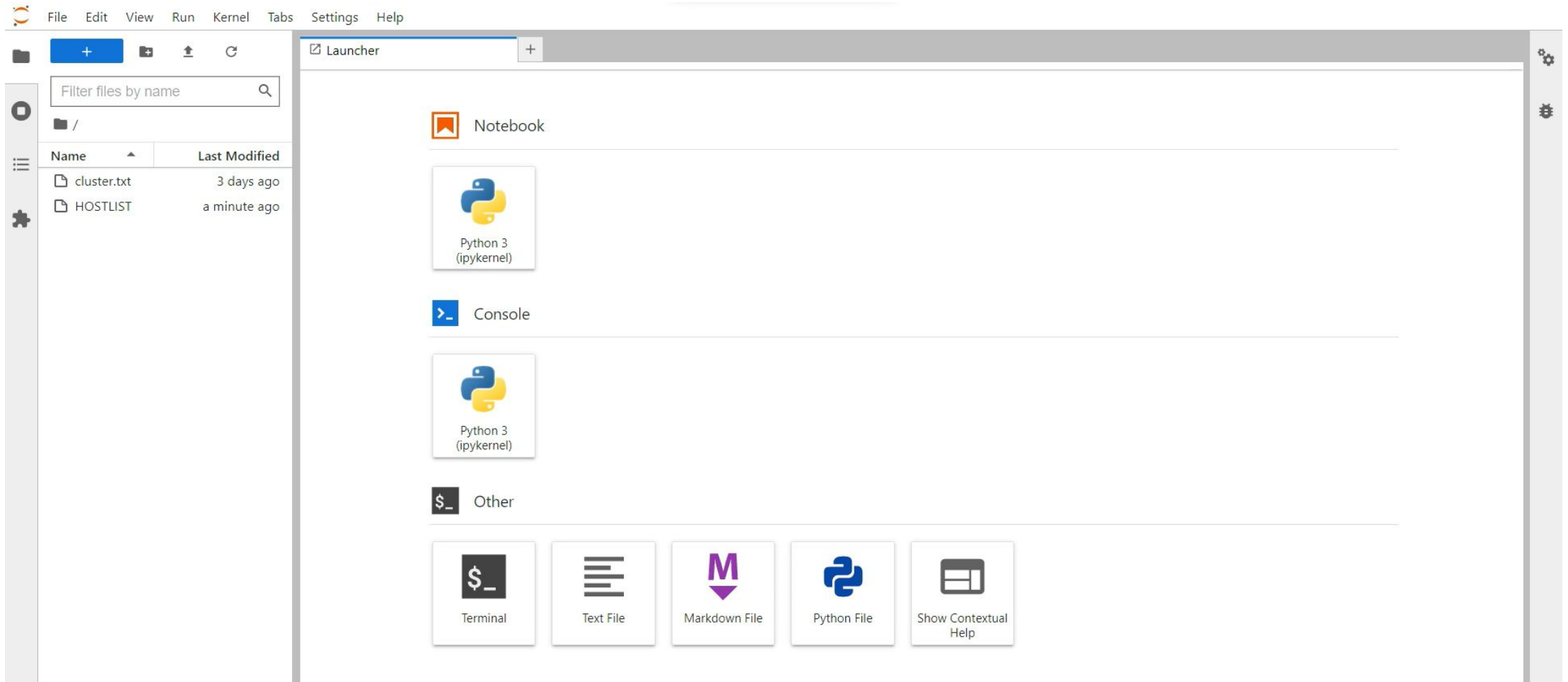
jupyterhub Home Token kpora@sztaki.hu Logout

Your server is starting up.
You will be redirected automatically when it's ready for you.

Server ready at /user/kpora@sztaki.hu/

Event log

JupyterLab Environment

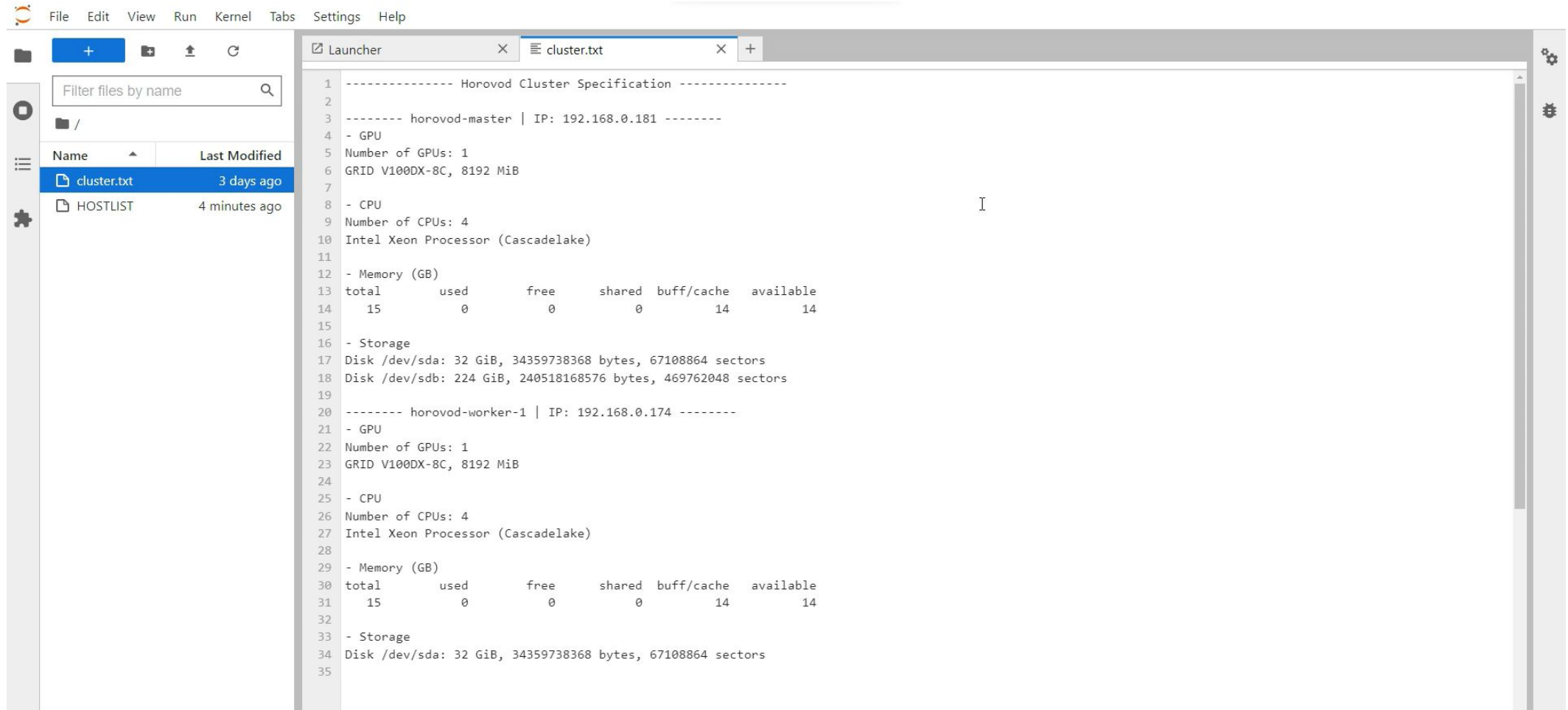


The screenshot shows the JupyterLab Launcher interface. At the top, there is a menu bar with options: File, Edit, View, Run, Kernel, Tabs, Settings, and Help. Below the menu bar is a toolbar with icons for creating a new notebook, opening a recent notebook, and refreshing the view. On the left side, there is a sidebar with a search bar labeled "Filter files by name" and a file browser showing a directory structure with files "cluster.txt" (modified 3 days ago) and "HOSTLIST" (modified a minute ago). The main area is titled "Launcher" and contains three sections: "Notebook" with a Python 3 (ipykernel) icon, "Console" with a Python 3 (ipykernel) icon, and "Other" with five icons: Terminal, Text File, Markdown File, Python File, and Show Contextual Help.

File Browser - /horovod directory



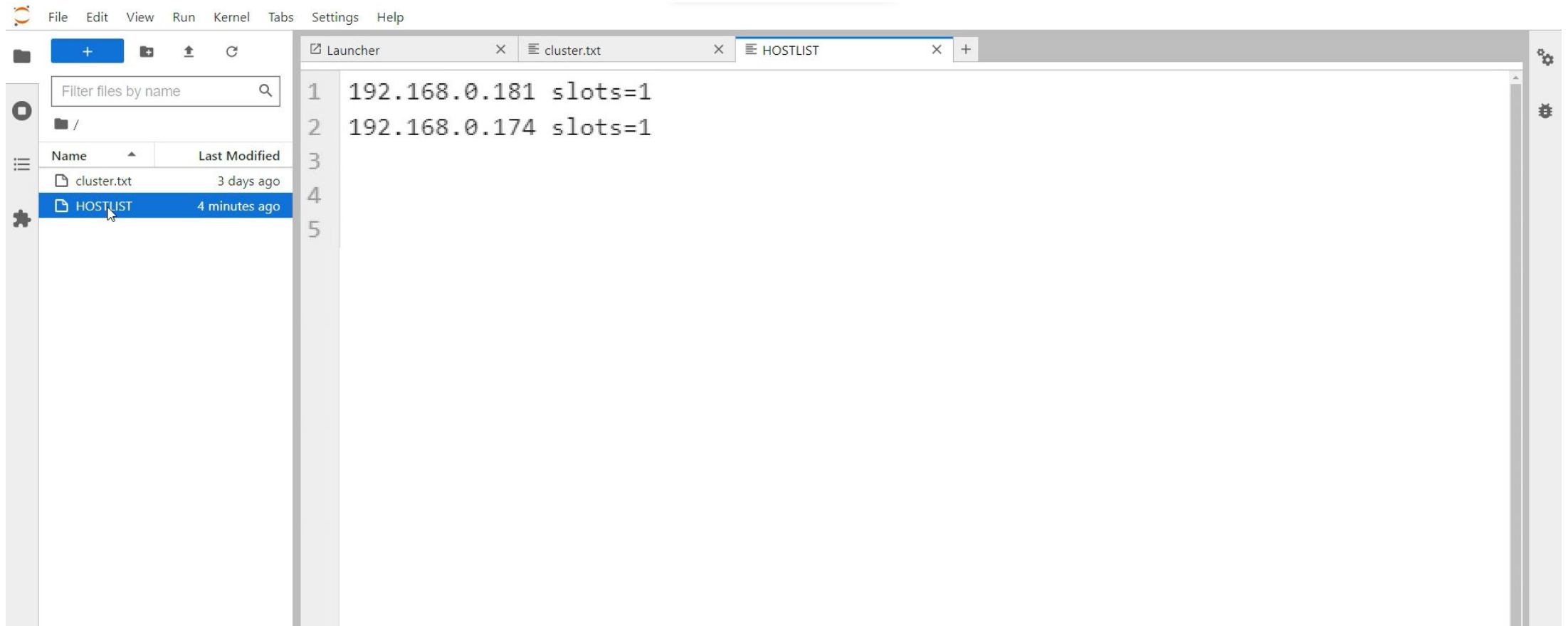
Cluster Summary



```

1 ----- Horovod Cluster Specification -----
2
3 ----- horovod-master | IP: 192.168.0.181 -----
4 - GPU
5 Number of GPUs: 1
6 GRID V100DX-8C, 8192 MiB
7
8 - CPU
9 Number of CPUs: 4
10 Intel Xeon Processor (Cascadelake)
11
12 - Memory (GB)
13 total      used      free      shared  buff/cache  available
14 15          0          0          0        14          14
15
16 - Storage
17 Disk /dev/sda: 32 GiB, 34359738368 bytes, 67108864 sectors
18 Disk /dev/sdb: 224 GiB, 240518168576 bytes, 469762048 sectors
19
20 ----- horovod-worker-1 | IP: 192.168.0.174 -----
21 - GPU
22 Number of GPUs: 1
23 GRID V100DX-8C, 8192 MiB
24
25 - CPU
26 Number of CPUs: 4
27 Intel Xeon Processor (Cascadelake)
28
29 - Memory (GB)
30 total      used      free      shared  buff/cache  available
31 15          0          0          0        14          14
32
33 - Storage
34 Disk /dev/sda: 32 GiB, 34359738368 bytes, 67108864 sectors
35
  
```

Host list for training



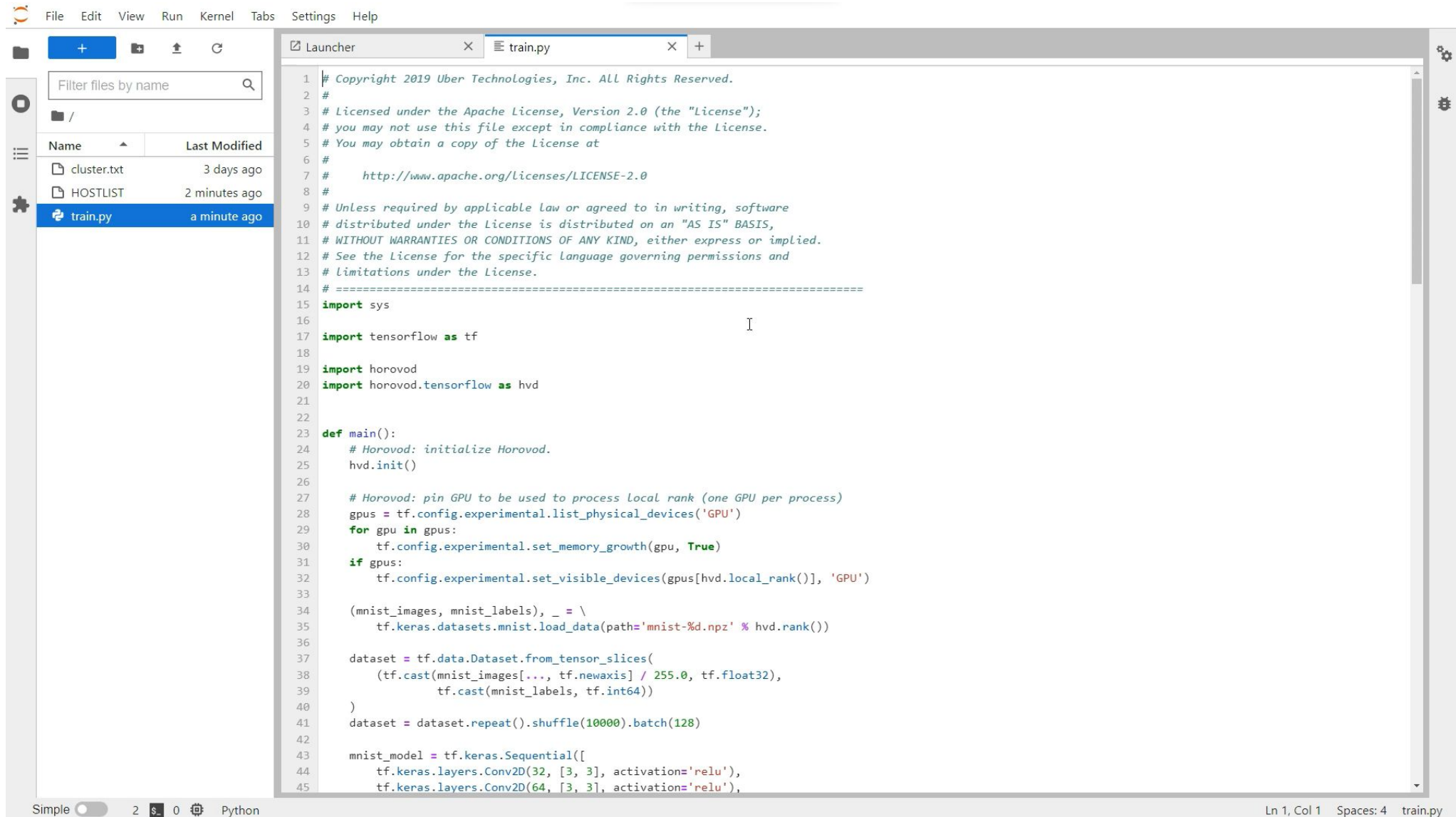
The screenshot shows a code editor window with three tabs: "Launcher", "cluster.txt", and "HOSTLIST". The "HOSTLIST" tab is active and displays the following content:

```
1 192.168.0.181 slots=1
2 192.168.0.174 slots=1
3
4
5
```

The left sidebar shows a file explorer with a search bar and a list of files:

Name	Last Modified
cluster.txt	3 days ago
HOSTLIST	4 minutes ago

Example training script

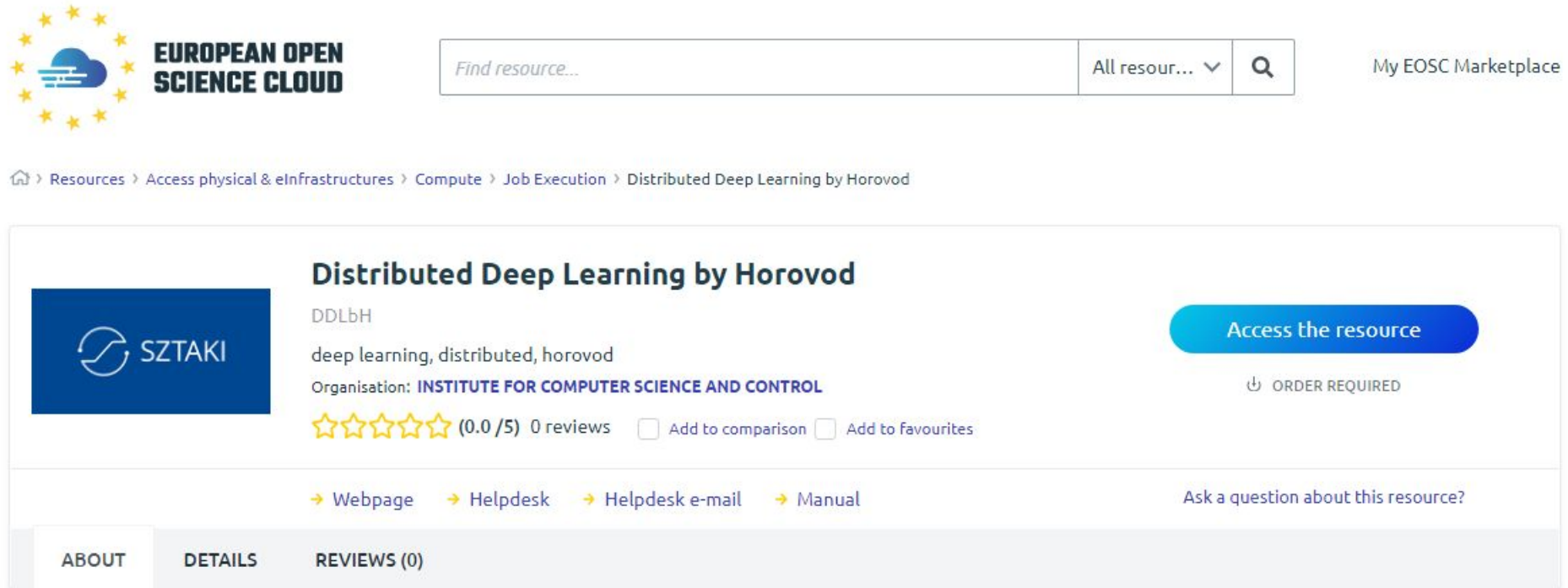


```

1  # Copyright 2019 Uber Technologies, Inc. All Rights Reserved.
2  #
3  # Licensed under the Apache License, Version 2.0 (the "License");
4  # you may not use this file except in compliance with the License.
5  # You may obtain a copy of the License at
6  #
7  #   http://www.apache.org/licenses/LICENSE-2.0
8  #
9  # Unless required by applicable law or agreed to in writing, software
10 # distributed under the License is distributed on an "AS IS" BASIS,
11 # WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
12 # See the license for the specific language governing permissions and
13 # limitations under the License.
14 # =====
15 import sys
16
17 import tensorflow as tf
18
19 import horovod
20 import horovod.tensorflow as hvd
21
22
23 def main():
24     # Horovod: initialize Horovod.
25     hvd.init()
26
27     # Horovod: pin GPU to be used to process Local rank (one GPU per process)
28     gpus = tf.config.experimental.list_physical_devices('GPU')
29     for gpu in gpus:
30         tf.config.experimental.set_memory_growth(gpu, True)
31     if gpus:
32         tf.config.experimental.set_visible_devices(gpus[hvd.local_rank()], 'GPU')
33
34     (mnist_images, mnist_labels), _ = \
35         tf.keras.datasets.mnist.load_data(path='mnist-%d.npz' % hvd.rank())
36
37     dataset = tf.data.Dataset.from_tensor_slices(
38         (tf.cast(mnist_images[...], tf.float32) / 255.0, tf.cast(mnist_labels, tf.int64))
39     )
40
41     dataset = dataset.repeat().shuffle(10000).batch(128)
42
43     mnist_model = tf.keras.Sequential([
44         tf.keras.layers.Conv2D(32, [3, 3], activation='relu'),
45         tf.keras.layers.Conv2D(64, [3, 3], activation='relu'),

```


Simple 2 0 Python Ln 1, Col 1 Spaces: 4 train.py



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Distributed Deep Learning by Horovod

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deep learning, distributed, horovod
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ABOUT DETAILS REVIEWS (0)

Distributed Deep Learning by Horovod

Providing researchers a reliable platform designed for performing distributed deep learning operations with great scaling efficiency

The Distributed Deep Learning by Horovod service aims to provide the infrastructure, resources and libraries to its users in order to perform effective distributed training of deep neural networks.

Horovod is a distributed training framework with the main goal of enabling the simple and effective distribution of deep learning operations. While requiring just a few lines of additional code (compared to sequential version), Horovod enables training to be performed across possibly hundreds of GPUs, with great efficiency.

SCIENTIFIC CATEGORISATION



- Engineering & Technology
- Electrical, Electronic & Information Engineering

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New issue

Tracker *  PrivateSubject *

Description

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Preview

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H1

H2

H3



pre

Status * Start date Priority * Due date Assignee Request type * Critical Files Nincs fájl...választva (Maximum size: 10 MB)Watchers  [Search for watchers to add](#)

Create

Create and add another

Limited-time demo

- Gain short term access to a demo cluster
- Hosted on ELKH Cloud
- 4 GPU enabled nodes



Request deployment on EOSC resources

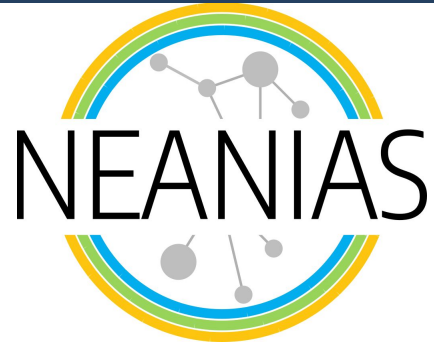
- Long term access
- Exact period length and node count is up to negotiation



Self-hosted

- User manual
- Technical consultation





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NEANIAS receives funding from European Union under Horizon 2020 Research and Innovation Programme under grant agreement No. 863448

Thank you for your attention!

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