Deep learning for medical imaging school

Hands-on session

Autoencoders

By

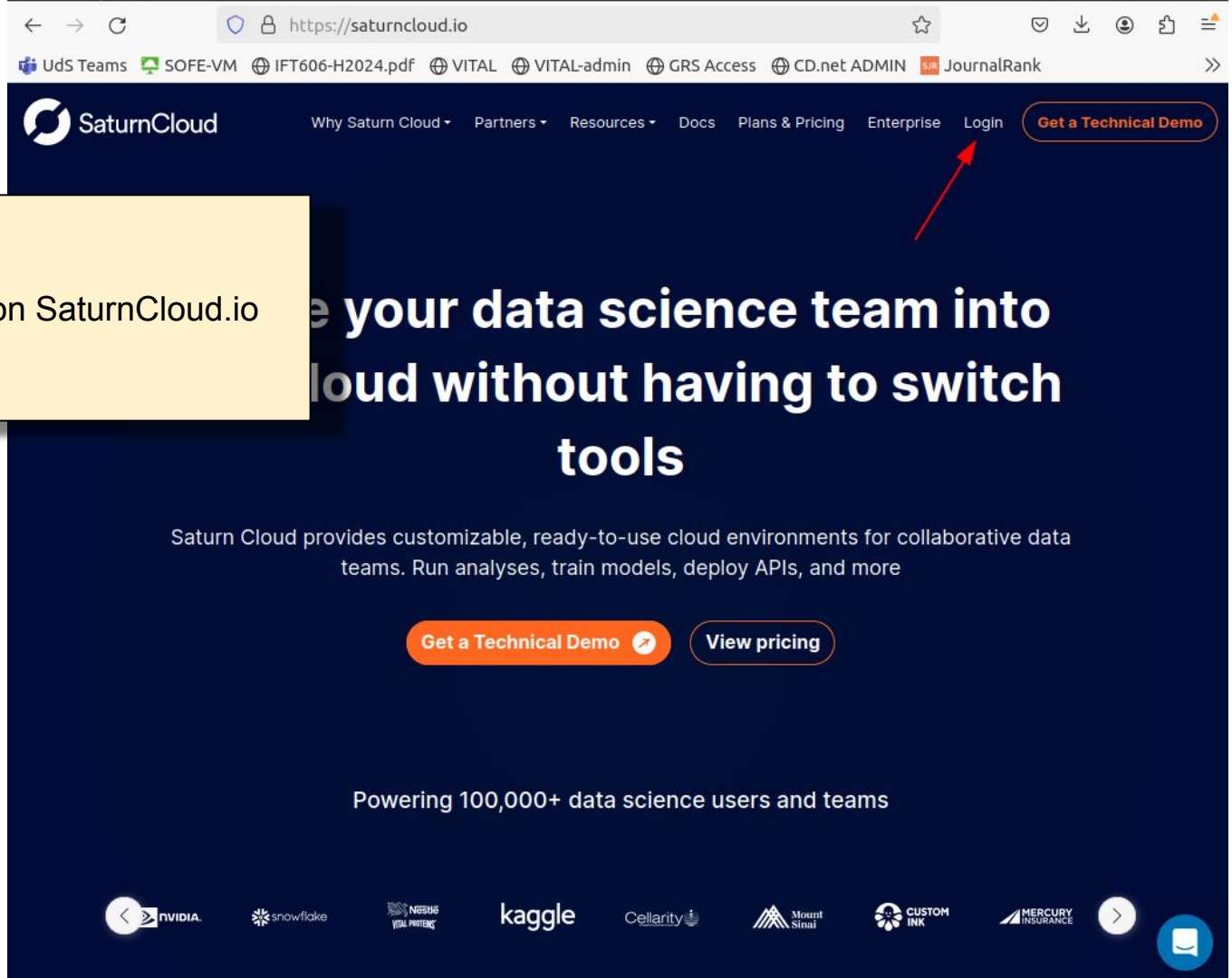
Pierre-Marc Jodoin, Nathan Painchaud

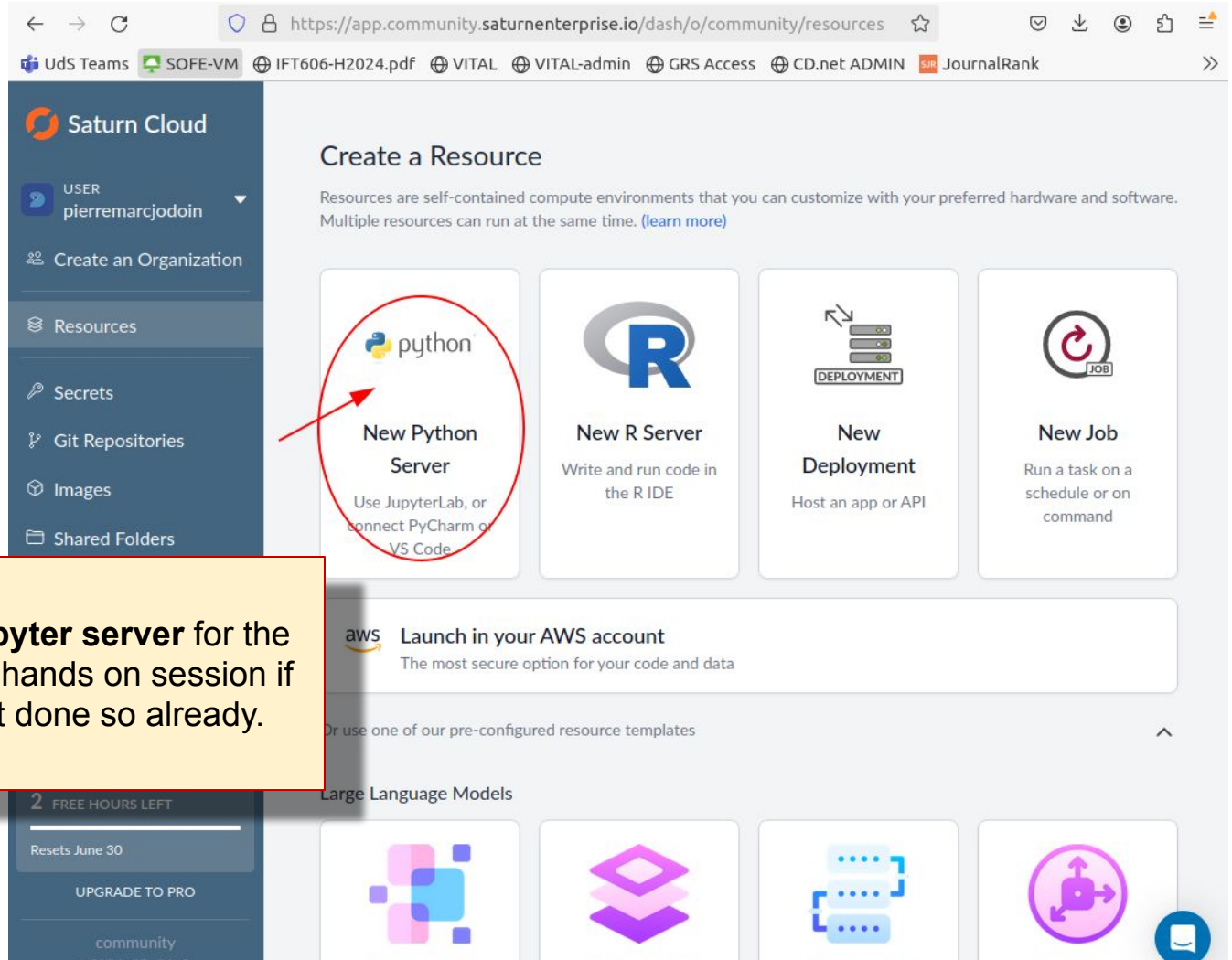
With the support of

Thomas Grenier

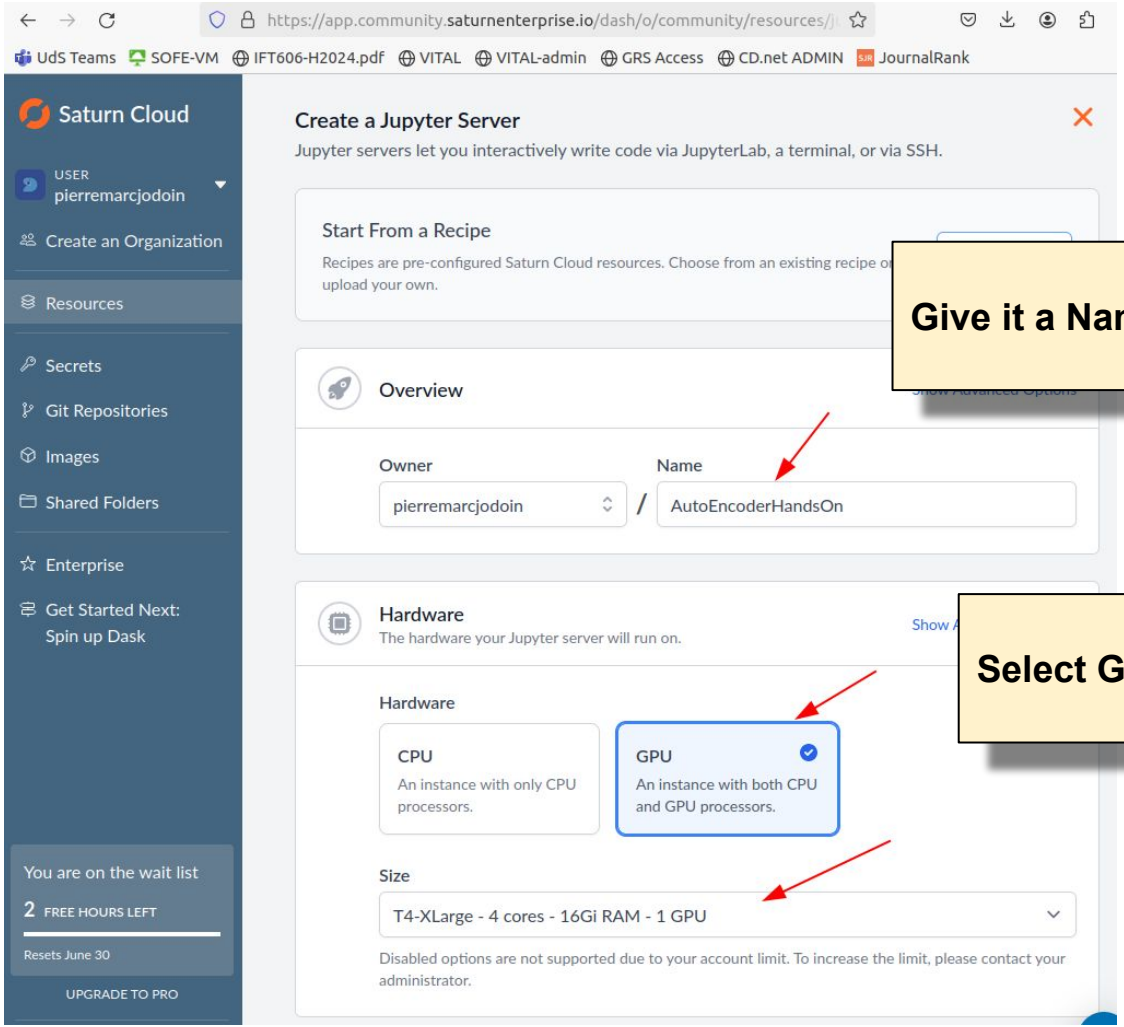
Setup your
SaturnCloud
environment

First, login on SaturnCloud.io





Create a Jupyter server for the autoencoder hands on session if you haven't done so already.


https://app.community.saturnenterprise.io/dash/o/community/resources/
UdS Teams
SOFE-VM
IFT606-H2024.pdf
VITAL
VITAL-admin
GRS Access
CD.net ADMIN
JournalRank
Saturn Cloud
USER
pierremarcjodoin
Create an Organization
Resources
Secrets
Git Repositories
Images
Shared Folders
Enterprise
Get Started Next:
Spin up Dask
You are on the wait list
2 FREE HOURS LEFT
Resets June 30
UPGRADE TO PRO
Create a Jupyter Server
Jupyter servers let you interactively write code via JupyterLab, a terminal, or via SSH.
Start From a Recipe
Recipes are pre-configured Saturn Cloud resources. Choose from an existing recipe or
upload your own.
Overview
Owner
pierremarcjodoin
/
Name
AutoEncoderHandsOn
Hardware
The hardware your Jupyter server will run on.
Hardware
CPU
An instance with only CPU processors.
GPU
An instance with both CPU and GPU processors.
Size
T4-XLarge - 4 cores - 16Gi RAM - 1 GPU
Disabled options are not supported due to your account limit. To increase the limit, please contact your administrator.
Give it a Name
Select GPU

https://app.community.saturnenterprise.io/dash/o/community/resources/j

UdS Teams | SOFE-VM | IFT606-H2024.pdf | VITAL | VITAL-admin | GRS Access | CD.net ADMIN | JournalRank

Saturn Cloud

USER
pierremarcjodoin

Create an Organization

Resources

Secrets

Git Repositories

Images

Shared Folders

Enterprise

Get Started Next:
Spin up Dask

Environment

The software your Jupyter server will use. This includes libraries, packages, environment variables, and other attributes.

Show Advanced Options

Write [torchvision] for pip install

Extra Packages

Extra packages are installed every time the resource starts up - right before the start script. Use spaces to separate packages.
If you find yourself adding the same packages to lots of resources, you may want to permanently add packages to a custom image instead. (?)

Conda | Pip | Apt

```
torchvision
```

This is a requirements.txt

If enabled, this should be valid requirements file describing all packages to be installed by `pip`, such as the content produced by `pip freeze`. See the `pip` documentation for details.

The packages together will run the following script:

```
apt-get install htop zip unzip
pip install torchvision
```

Saturn Cloud

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Create an Organization

Resources

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Git Repositories

Images

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Get Started Next:
Spin up Dask

Environment

The software your Jupyter server will use. This includes libraries, packages, environment variables, and other attributes.

Show Advanced Options

Image

saturncloud/saturn-python-pytorch

Version

2023.09.01

Extra Packages

Extra packages are installed every time the resource starts up - right before the start script. Use spaces to separate packages.
If you find yourself adding the same packages to lots of resources, you may want to permanently add packages to a custom image instead. (?)

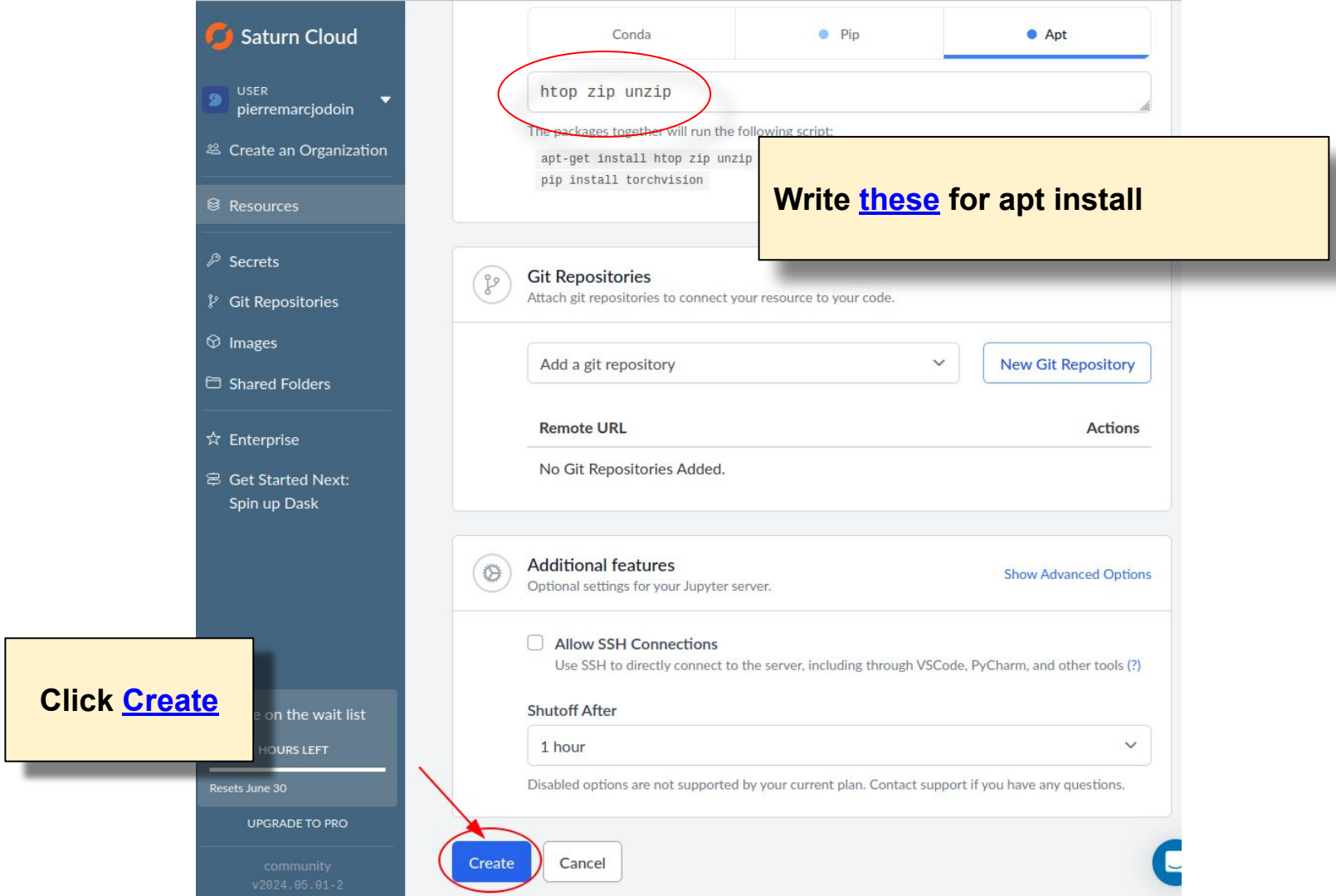
Conda | Pip | Apt

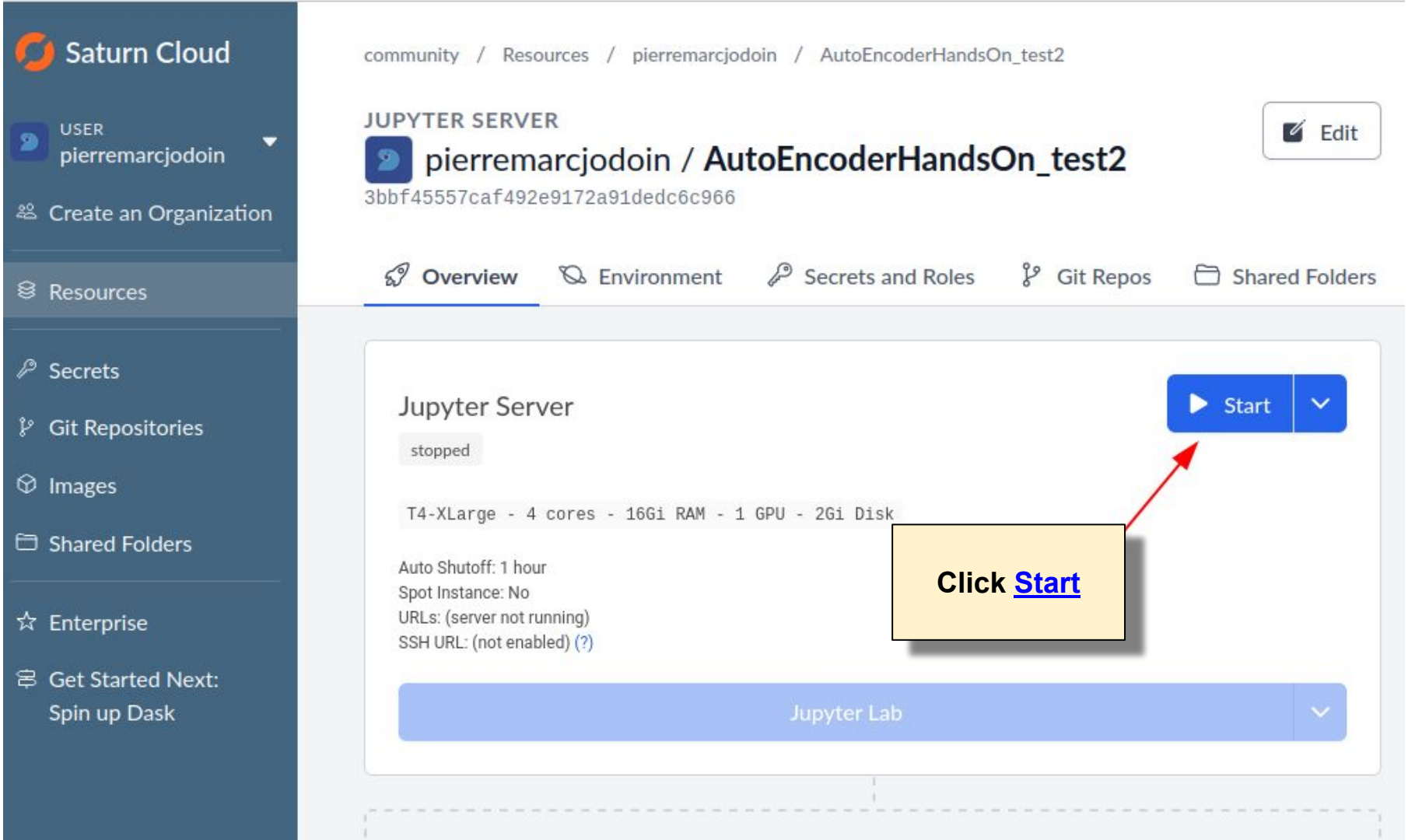
```
htop zip unzip
```

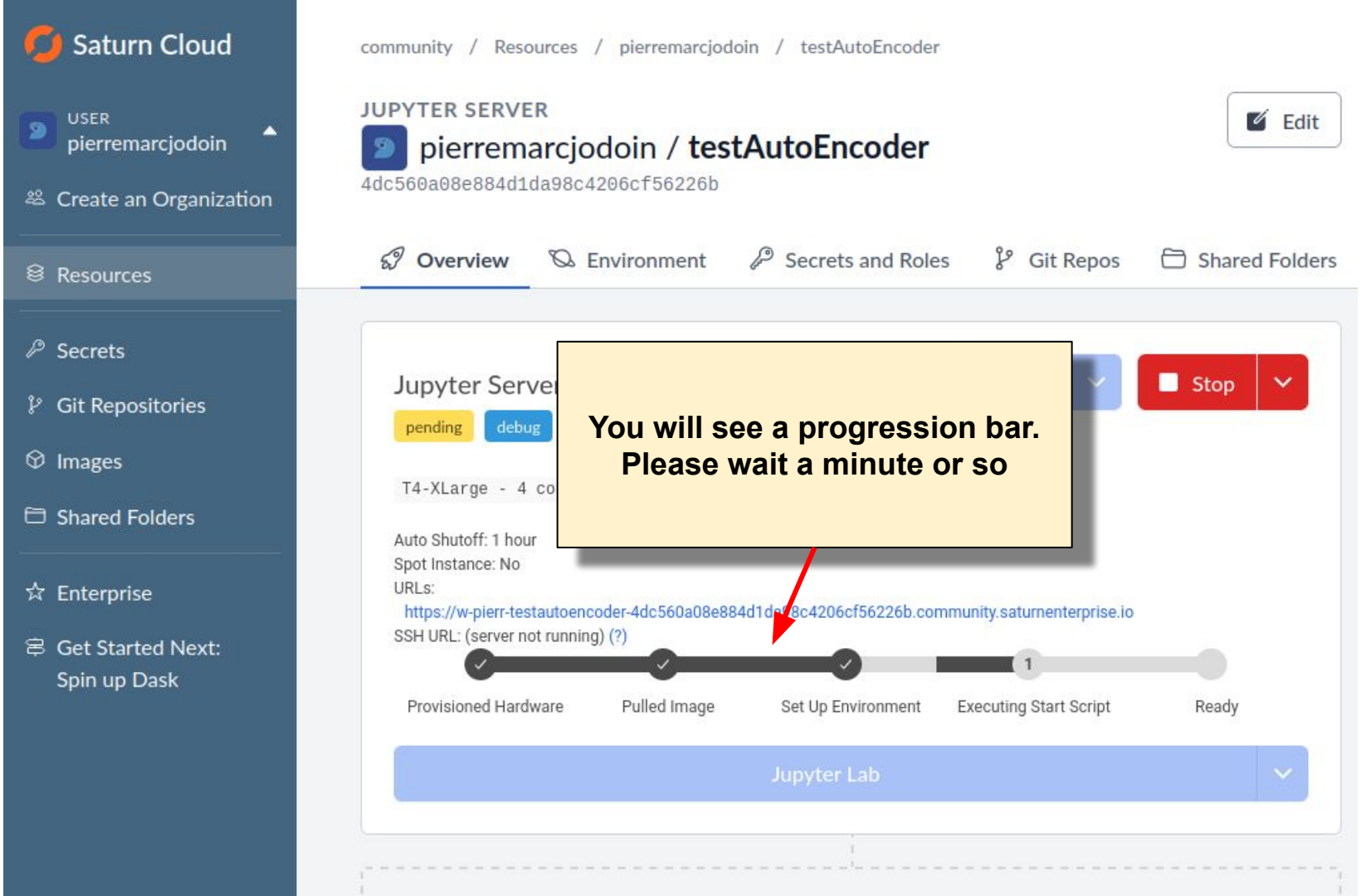
The packages together will run the follow

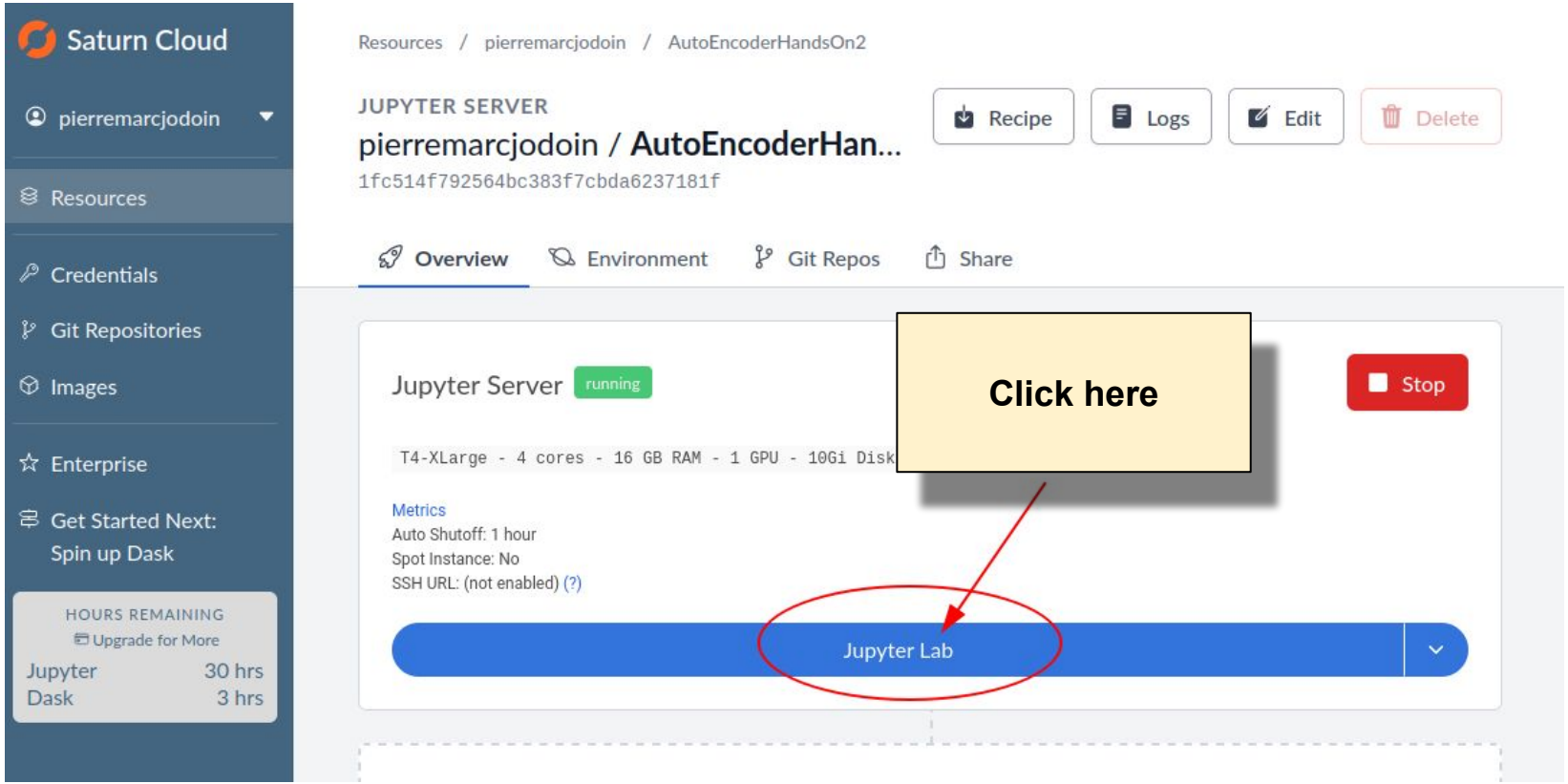
```
apt-get install htop zip unzip
pip install torchvision
```

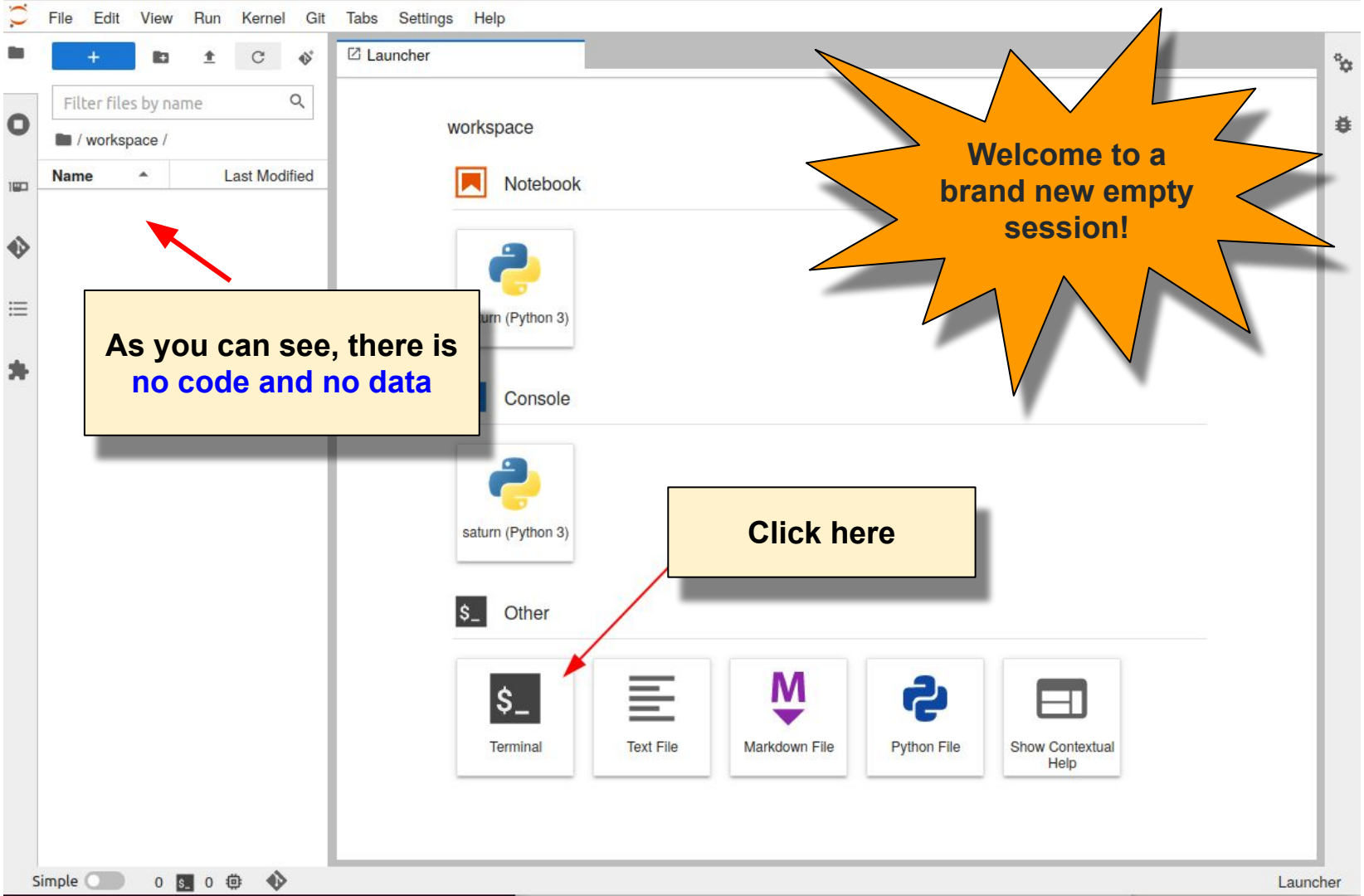
Write these for apt install


Saturn Cloud
USER
pierremarcjodoin
Create an Organization
Resources
Secrets
Git Repositories
Images
Shared Folders
Enterprise
Get Started Next:
Spin up Dask
on the wait list
HOURS LEFT
Resets June 30
UPGRADE TO PRO
community
v2024.05.01-2
Conda
Pip
Apt
htop zip unzip
The packages together will run the following script:
apt-get install htop zip unzip
pip install torchvision
Write these for apt install
Git Repositories
Attach git repositories to connect your resource to your code.
Add a git repository
New Git Repository
Remote URL
Actions
No Git Repositories Added.
Additional features
Optional settings for your Jupyter server.
Show Advanced Options
Allow SSH Connections
Use SSH to directly connect to the server, including through VSCode, PyCharm, and other tools (?)
Shutoff After
1 hour
Disabled options are not supported by your current plan. Contact support if you have any questions.
Create
Cancel
Click Create

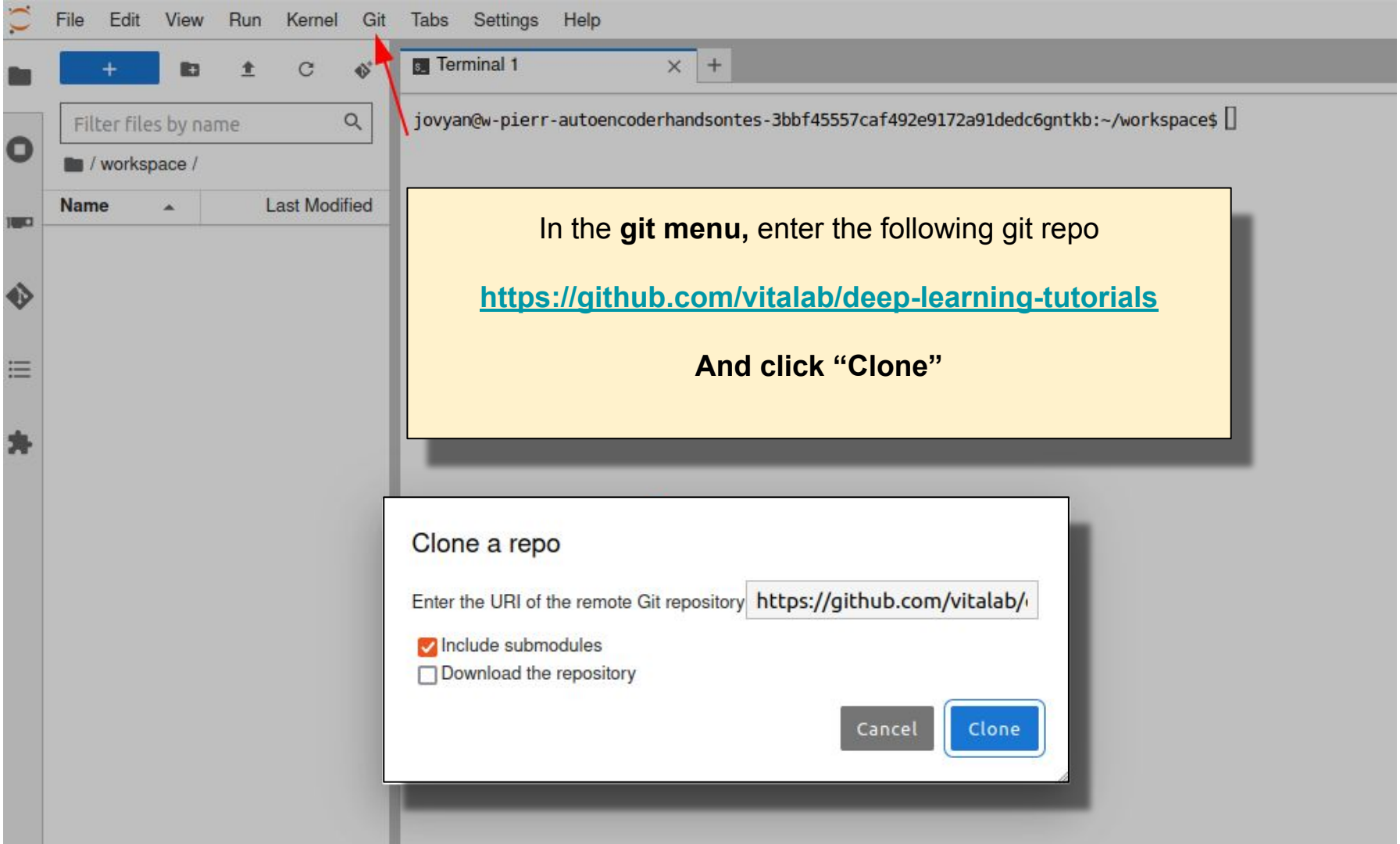

Saturn Cloud
USER
pierremarcjodoin
Create an Organization
Resources
Secrets
Git Repositories
Images
Shared Folders
Enterprise
Get Started Next:
Spin up Dask
community / Resources / pierremarcjodoin / AutoEncoderHandsOn_test2
JUPYTER SERVER
pierremarcjodoin / AutoEncoderHandsOn_test2
3bbf45557caf492e9172a91dedc6c966
Edit
Overview
Environment
Secrets and Roles
Git Repos
Shared Folders
Jupyter Server
stopped
Start
T4-XLarge - 4 cores - 16Gi RAM - 1 GPU - 2Gi Disk
Auto Shutoff: 1 hour
Spot Instance: No
URLs: (server not running)
SSH URL: (not enabled) (?)
Click Start
Jupyter Lab

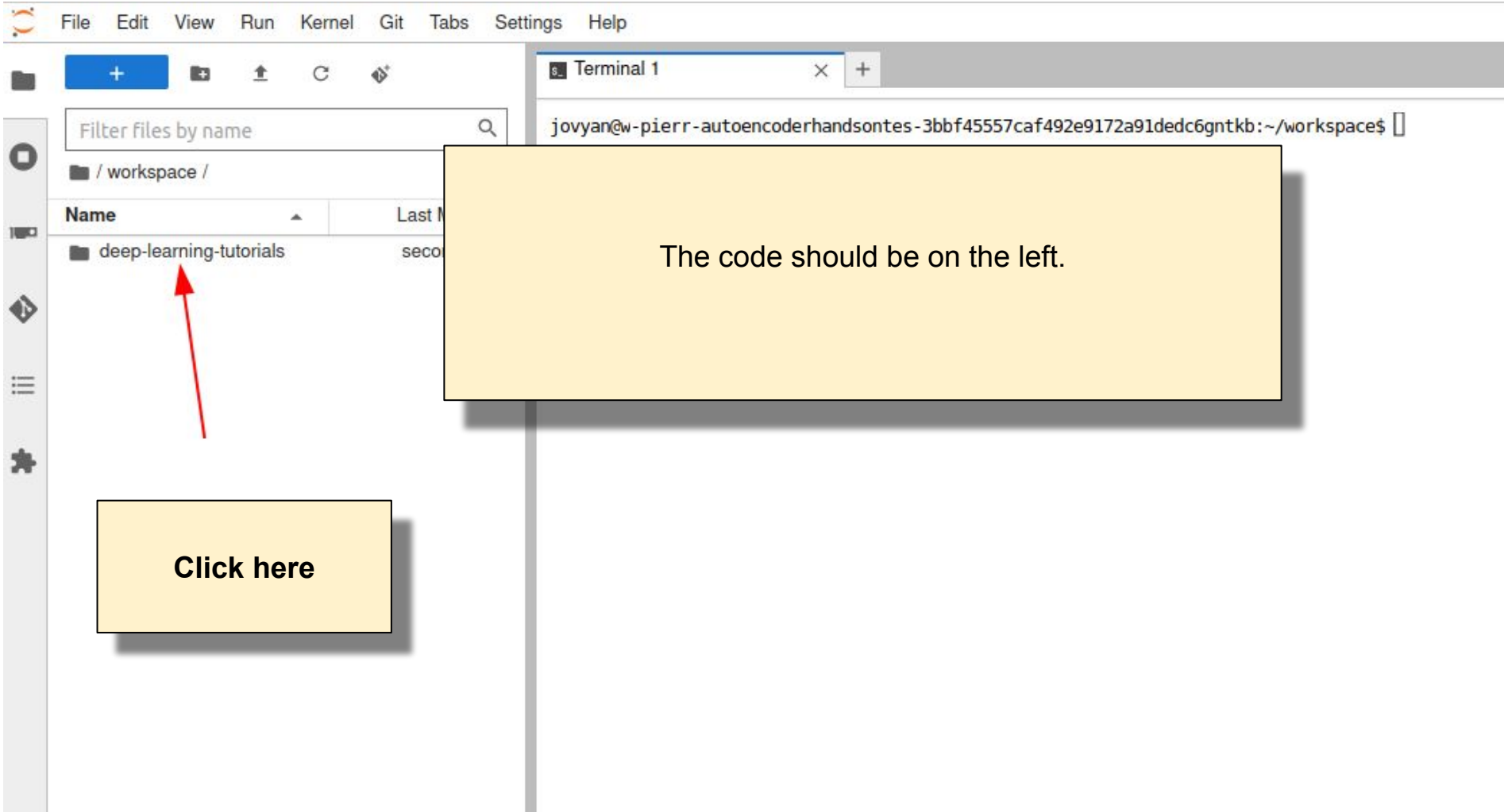

Saturn Cloud
USER
pierremarcjodoin
Create an Organization
Resources
Secrets
Git Repositories
Images
Shared Folders
Enterprise
Get Started Next:
Spin up Dask
community / Resources / pierremarcjodoin / testAutoEncoder
JUPYTER SERVER
pierremarcjodoin / testAutoEncoder
4dc560a08e884d1da98c4206cf56226b
Edit
Overview
Environment
Secrets and Roles
Git Repos
Shared Folders
Jupyter Serve
pending
debug
Stop
T4-XLarge - 4 co
Auto Shutoff: 1 hour
Spot Instance: No
URLs:
https://w-pierr-testautoencoder-4dc560a08e884d1da98c4206cf56226b.community.saturnenterprise.io
SSH URL: (server not running) (?)
1
Provisioned Hardware
Pulled Image
Set Up Environment
Executing Start Script
Ready
Jupyter Lab
You will see a progression bar.
Please wait a minute or so


Saturn Cloud
pierremarcjodoin
Resources
Credentials
Git Repositories
Images
Enterprise
Get Started Next:
Spin up Dask
HOURS REMAINING
Upgrade for More
Jupyter 30 hrs
Dask 3 hrs
Resources / pierremarcjodoin / AutoEncoderHandsOn2
JUPYTER SERVER
pierremarcjodoin / AutoEncoderHan...
1fc514f792564bc383f7cbda6237181f
Recipe
Logs
Edit
Delete
Overview
Environment
Git Repos
Share
Jupyter Server
running
Stop
T4-XLarge - 4 cores - 16 GB RAM - 1 GPU - 10Gi Disk
Metrics
Auto Shutoff: 1 hour
Spot Instance: No
SSH URL: (not enabled) (?)
Click here
Jupyter Lab

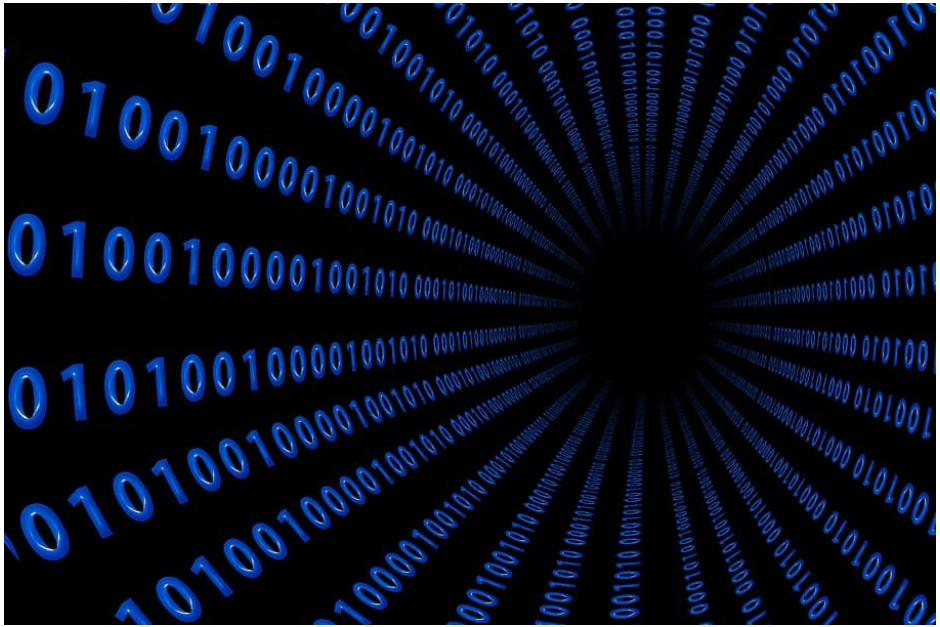

File Edit View Run Kernel Git Tabs Settings Help
Launcher
Filter files by name
/ workspace /
Name
Last Modified
workspace
Notebook
urn (Python 3)
Console
saturn (Python 3)
Other
Terminal
Text File
Markdown File
Python File
Show Contextual Help
Welcome to a brand new empty session!
As you can see, there is no code and no data
Click here
Simple
Launcher

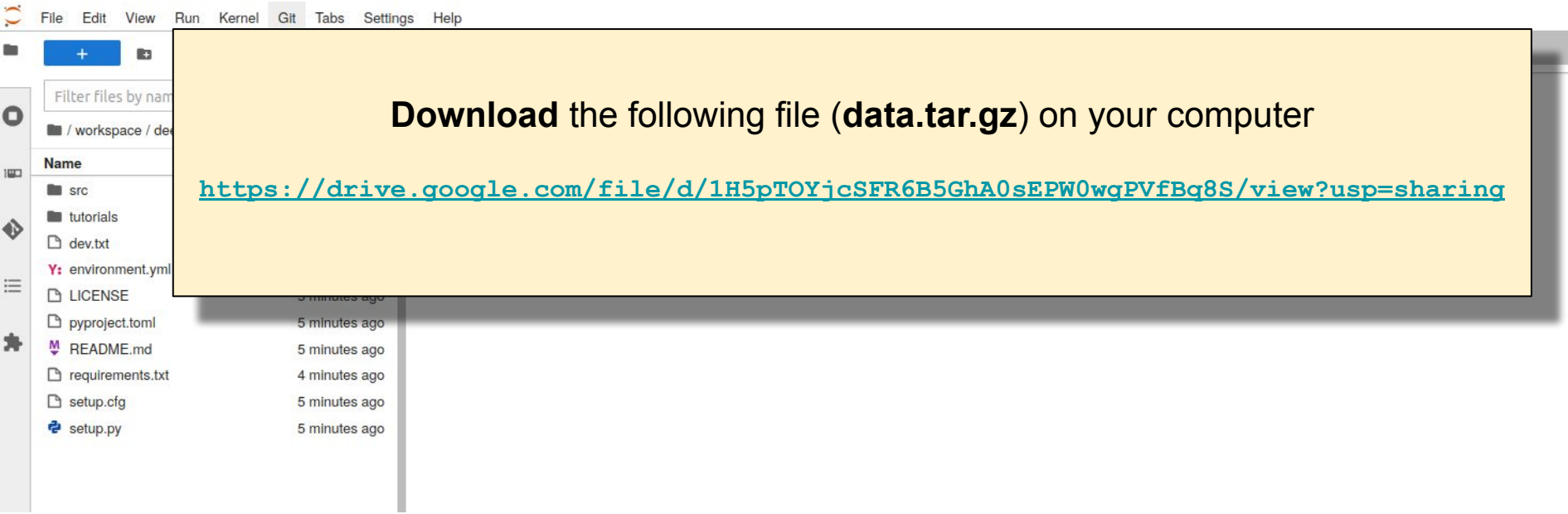
Lets download the code

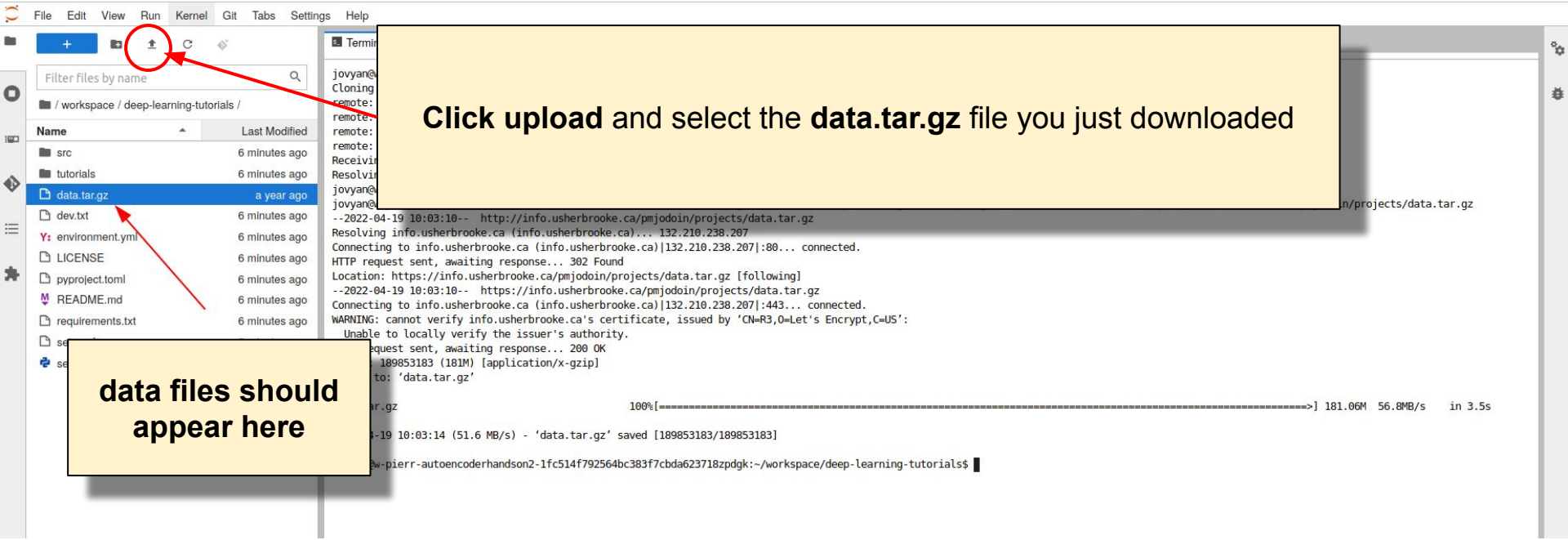

File Edit View Run Kernel Git Tabs Settings Help
Terminal 1
jovyan@w-pierr-autoencoderhandsontes-3bbf45557caf492e9172a91dedc6gntkb:~/workspace$
Filter files by name
/ workspace /
Name
Last Modified
In the **git menu,** enter the following git repo
https://github.com/vitalab/deep-learning-tutorials
And click “Clone”
Clone a repo
Enter the URI of the remote Git repository
https://github.com/vitalab/
Include submodules
Download the repository
Cancel
Clone

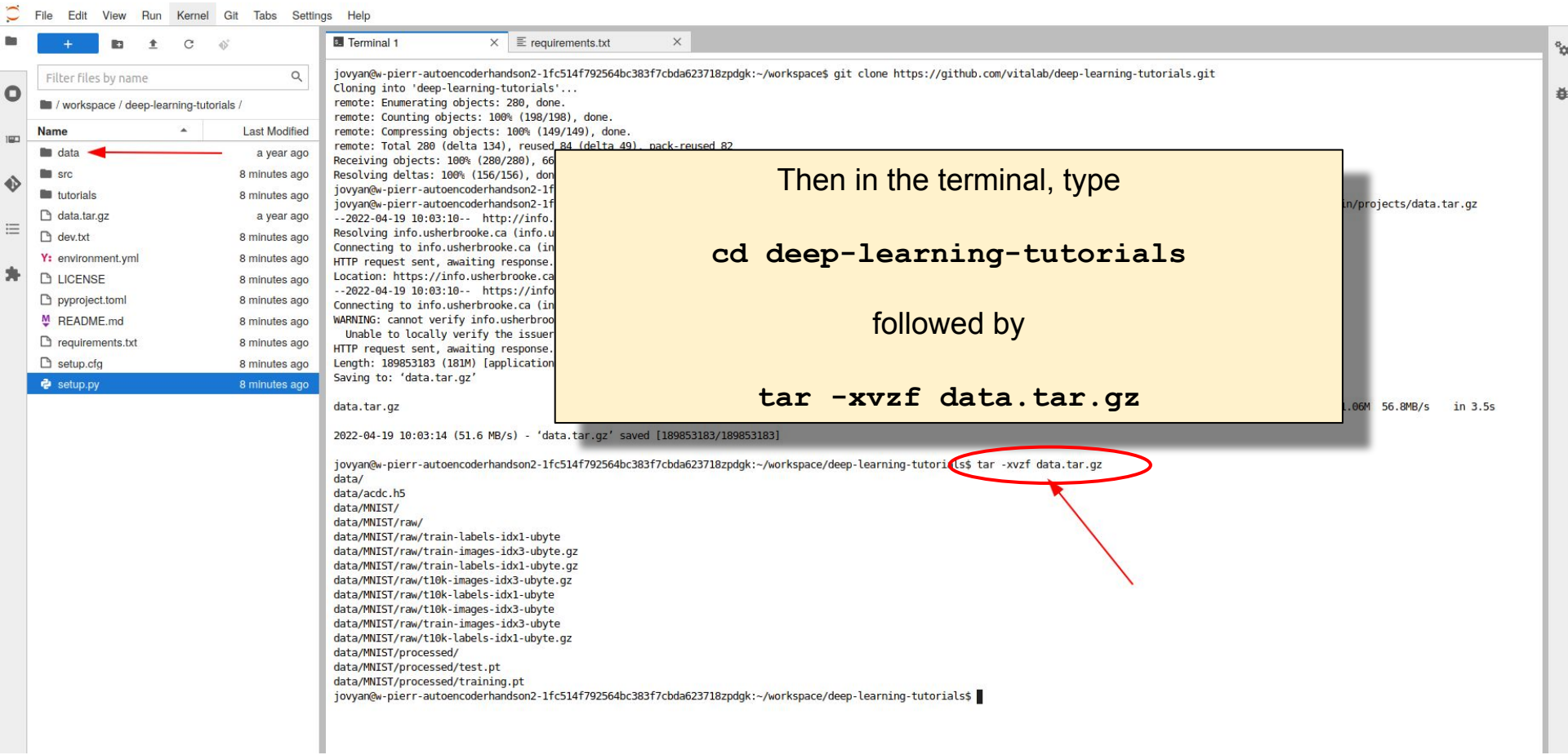

File Edit View Run Kernel Git Tabs Settings Help
Filter files by name
/ workspace /
Name
deep-learning-tutorials
Terminal 1
jovyan@w-pierr-autoencoderhandsontes-3bbf45557caf492e9172a91dedc6gntkb:~/workspace$
The code should be on the left.
Click here

Lets download the data




File Edit View Run Kernel Git Tabs Settings Help
Filter files by nam
/ workspace / de
Name
src
tutorials
dev.txt
environment.yml
LICENSE
pyproject.toml 5 minutes ago
README.md 5 minutes ago
requirements.txt 4 minutes ago
setup.cfg 5 minutes ago
setup.py 5 minutes ago
Download the following file (**data.tar.gz**) on your computer
https://drive.google.com/file/d/1H5pTOYjcSFR6B5GhA0sEPW0wqPVfBq8S/view?usp=sharing


File Edit View Run Kernel Git Tabs Settings Help
Filter files by name
/ workspace / deep-learning-tutorials /
Name
Last Modified
src 6 minutes ago
tutorials 6 minutes ago
data.tar.gz a year ago
dev.txt 6 minutes ago
environment.yml 6 minutes ago
LICENSE 6 minutes ago
pyproject.toml 6 minutes ago
README.md 6 minutes ago
requirements.txt 6 minutes ago
Click upload and select the data.tar.gz file you just downloaded
data files should appear here
--2022-04-19 10:03:10-- http://info.usherbrooke.ca/pmjodoin/projects/data.tar.gz
Resolving info.usherbrooke.ca (info.usherbrooke.ca)... 132.210.238.207
Connecting to info.usherbrooke.ca (info.usherbrooke.ca)|132.210.238.207|:80... connected.
HTTP request sent, awaiting response... 302 Found
Location: https://info.usherbrooke.ca/pmjodoin/projects/data.tar.gz [following]
--2022-04-19 10:03:10-- https://info.usherbrooke.ca/pmjodoin/projects/data.tar.gz
Connecting to info.usherbrooke.ca (info.usherbrooke.ca)|132.210.238.207|:443... connected.
WARNING: cannot verify info.usherbrooke.ca's certificate, issued by 'CN=R3,O=Let's Encrypt,C=US':
Unable to locally verify the issuer's authority.
189853183 (181M) [application/x-gzip]
to: 'data.tar.gz'
100%[>] 181.06M 56.8MB/s in 3.5s
-19 10:03:14 (51.6 MB/s) - 'data.tar.gz' saved [189853183/189853183]


File Edit View Run Kernel Git Tabs Settings Help
Filter files by name
/ workspace / deep-learning-tutorials /
Name
Last Modified
data a year ago
src 8 minutes ago
tutorials 8 minutes ago
data.tar.gz a year ago
dev.txt 8 minutes ago
environment.yml 8 minutes ago
LICENSE 8 minutes ago
pyproject.toml 8 minutes ago
README.md 8 minutes ago
requirements.txt 8 minutes ago
setup.cfg 8 minutes ago
setup.py 8 minutes ago
Terminal 1
requirements.txt
jovyan@w-pierr-autoencoderhandson2-1fc514f792564bc383f7cbda623718zpdgk:~/workspace$ git clone https://github.com/vitalab/deep-learning-tutorials.git
Cloning into 'deep-learning-tutorials'...
remote: Enumerating objects: 280, done.
remote: Counting objects: 100% (198/198), done.
remote: Compressing objects: 100% (149/149), done.
remote: Total 280 (delta 134), reused 84 (delta 49), pack-reused 82
Receiving objects: 100% (280/280), 66
Resolving deltas: 100% (156/156), don
jovyan@w-pierr-autoencoderhandson2-1f
jovyan@w-pierr-autoencoderhandson2-1f
--2022-04-19 10:03:10-- http://info.
Resolving info.usherbrooke.ca (info.u
Connecting to info.usherbrooke.ca (in
HTTP request sent, awaiting response.
Location: https://info.usherbrooke.ca
--2022-04-19 10:03:10-- https://info
Connecting to info.usherbrooke.ca (in
WARNING: cannot verify info.usherbroo
Unable to locally verify the issuer
HTTP request sent, awaiting response.
Length: 189853183 (181M) [application
Saving to: 'data.tar.gz'
data.tar.gz
2022-04-19 10:03:14 (51.6 MB/s) - 'data.tar.gz' saved [189853183/189853183]
jovyan@w-pierr-autoencoderhandson2-1fc514f792564bc383f7cbda623718zpdgk:~/workspace/deep-learning-tutorials$ tar -xvzf data.tar.gz
data/
data/acdc.h5
data/MNIST/
data/MNIST/raw/
data/MNIST/raw/train-labels-idx1-ubyte
data/MNIST/raw/train-images-idx3-ubyte.gz
data/MNIST/raw/train-labels-idx1-ubyte.gz
data/MNIST/raw/t10k-images-idx3-ubyte.gz
data/MNIST/raw/t10k-labels-idx1-ubyte
data/MNIST/raw/t10k-images-idx3-ubyte
data/MNIST/raw/train-images-idx3-ubyte
data/MNIST/raw/t10k-labels-idx1-ubyte.gz
data/MNIST/processed/
data/MNIST/processed/test.pt
data/MNIST/processed/training.pt
jovyan@w-pierr-autoencoderhandson2-1fc514f792564bc383f7cbda623718zpdgk:~/workspace/deep-learning-tutorials$
Then in the terminal, type
cd deep-learning-tutorials
followed by
tar -xvzf data.tar.gz

Autoencoders’ Hands on

File Edit View Run Kernel Git Tabs Settings Help

Filter files by name

/ ... / deep-learning-tutorials / tutorials /

Name	Last Modified
cardiac-mri-autoencoder...	12 minutes ago
mnist-autoencoders.ipynb	2 minutes ago

Terminal 1 | mnist-autoencoders.ipynb

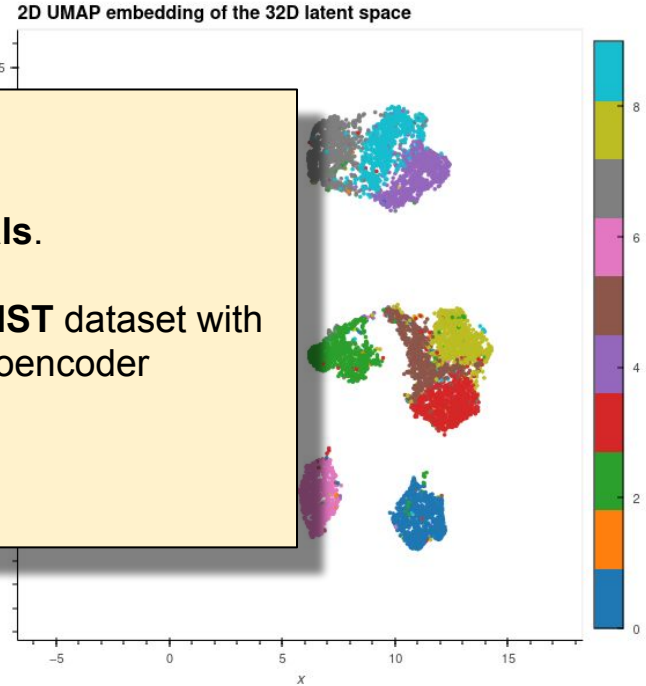
Markdown git

)

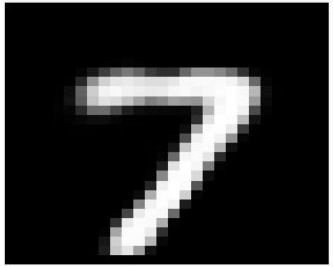
Last executed at 2024-06-18 14:44:54 in 49.64s

Encoding the dataset items in the latent space...
Learning UMAP embedding for latent space vectors...

[12]:

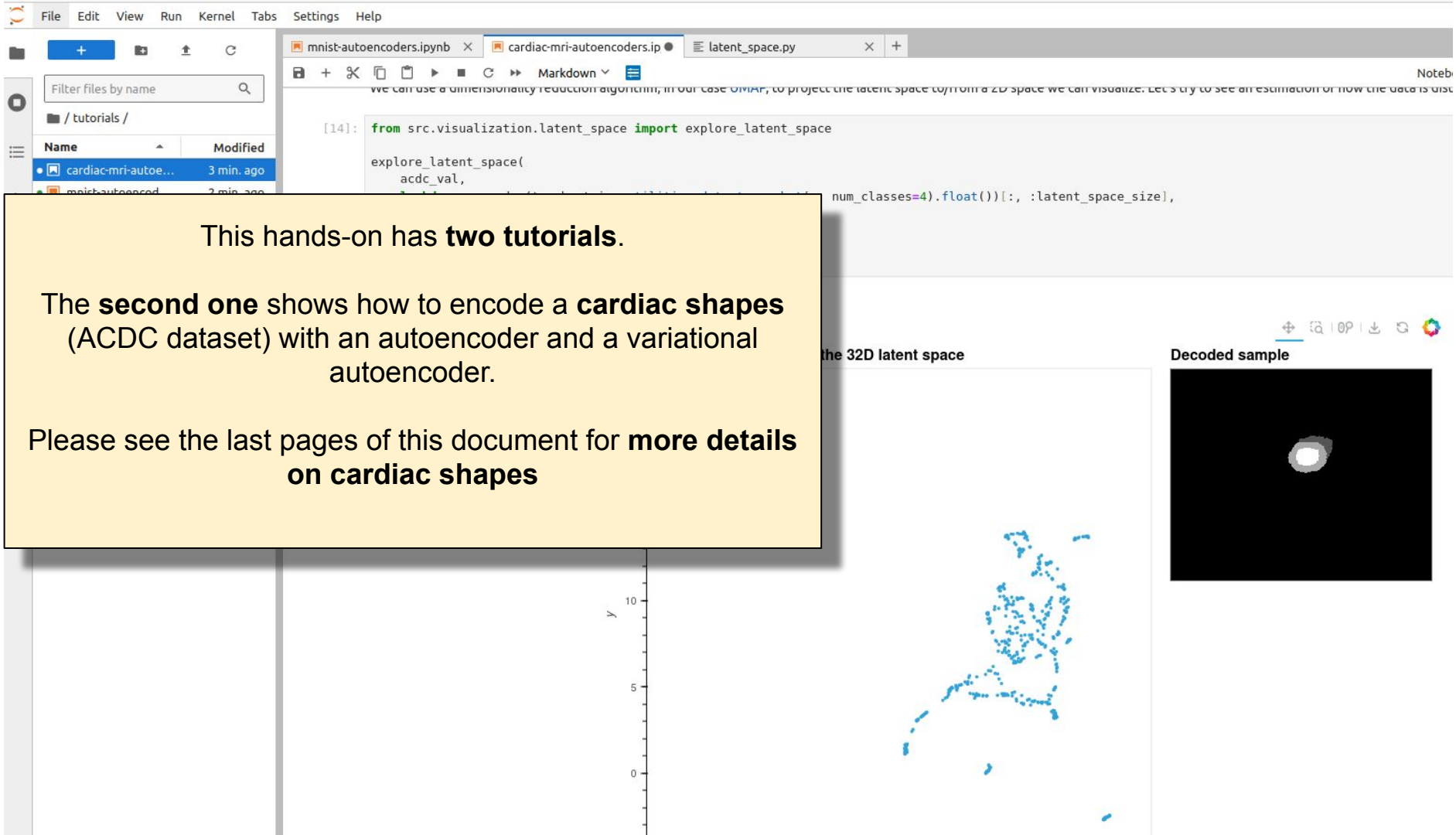


Decoded sample



This hands-on has **two tutorials**.

The **first one** shows how to encode the **MNIST** dataset with an autoencoder and a variational autoencoder

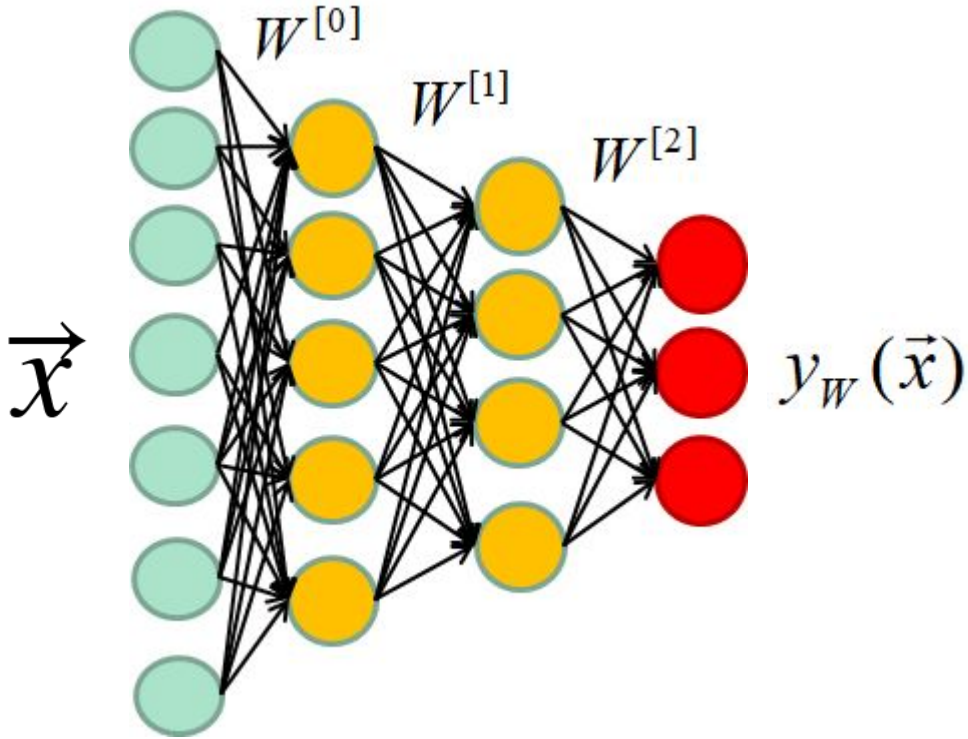


This hands-on has **two tutorials**.

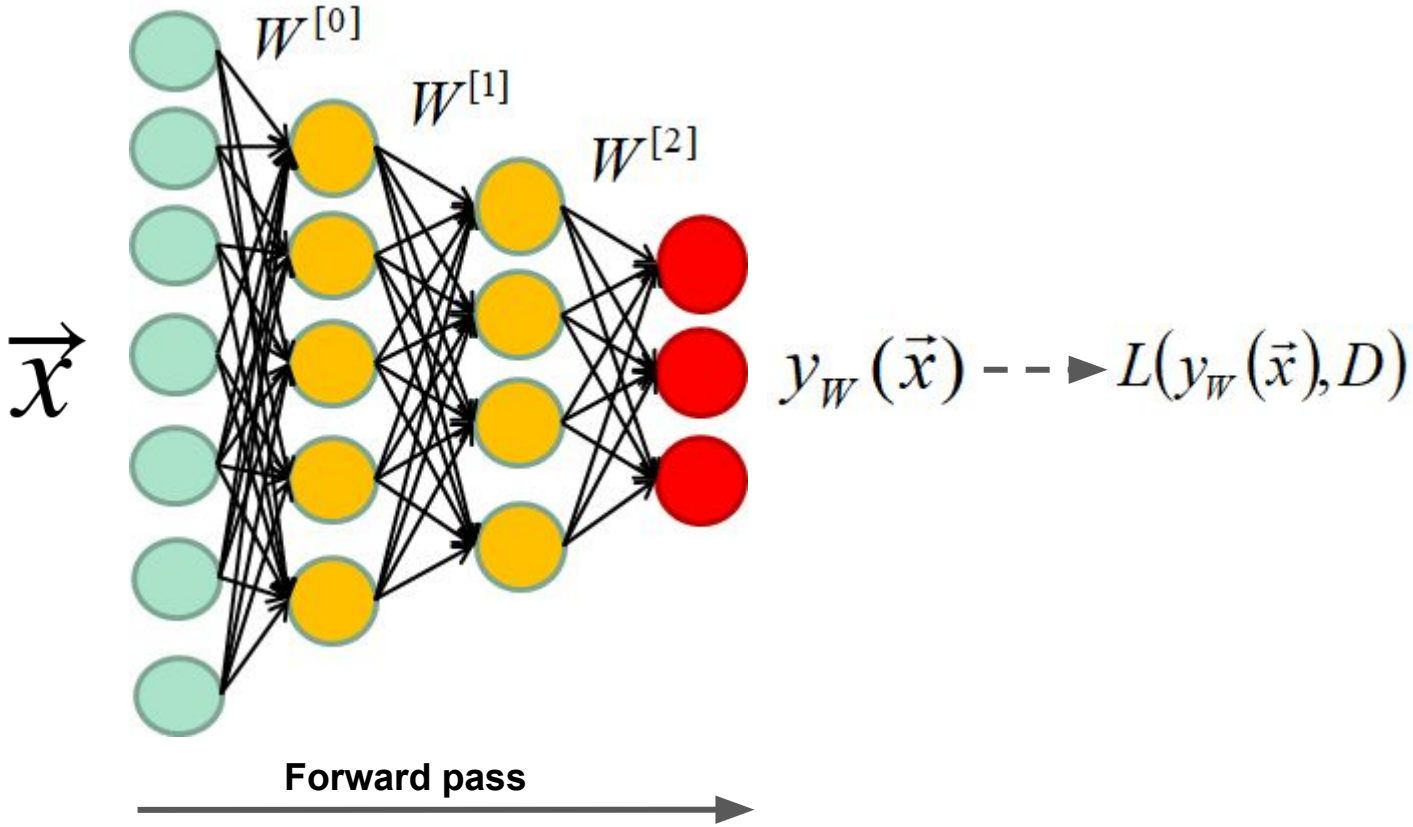
The **second one** shows how to encode a **cardiac shapes** (ACDC dataset) with an autoencoder and a variational autoencoder.

Please see the last pages of this document for **more details on cardiac shapes**

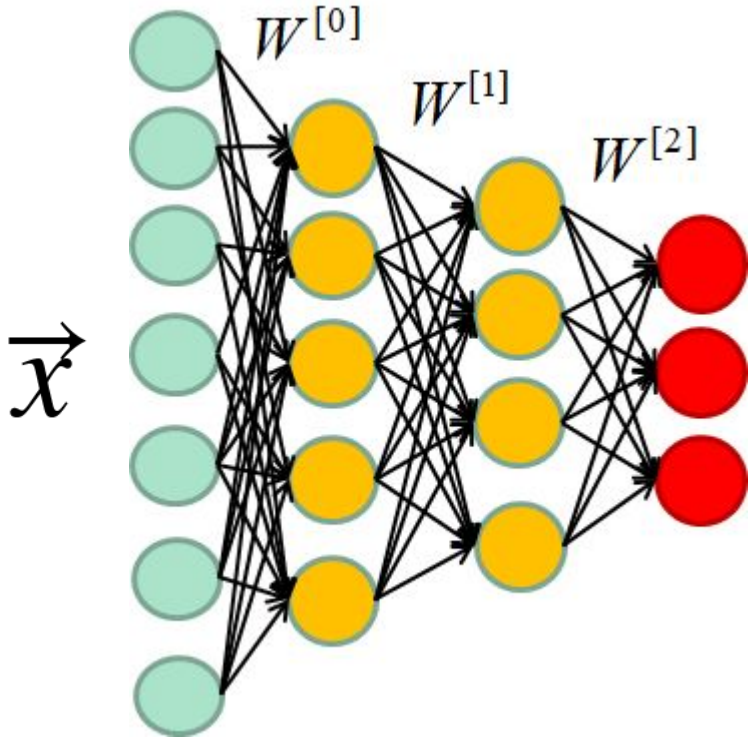
Autoencoders (recap)


$W^{[0]}$
$W^{[1]}$
$W^{[2]}$
$\vec{x}$
$y_W(\vec{x})$

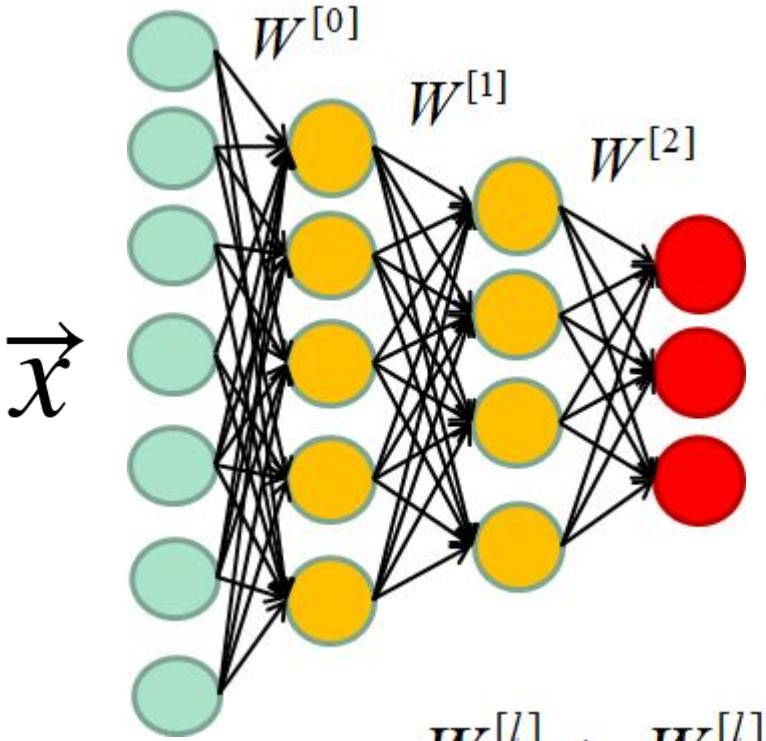
Annotated dataset: $D = \{(\vec{x}_1, t_1), (\vec{x}_2, t_2), \ldots, (\vec{x}_N, t_N)\}$



Annotated dataset: $D = \{(\vec{x}_1, t_1), (\vec{x}_2, t_2), \ldots, (\vec{x}_N, t_N)\}$

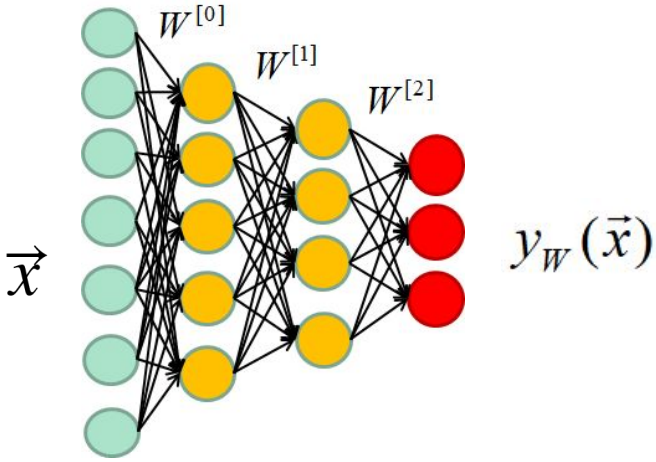


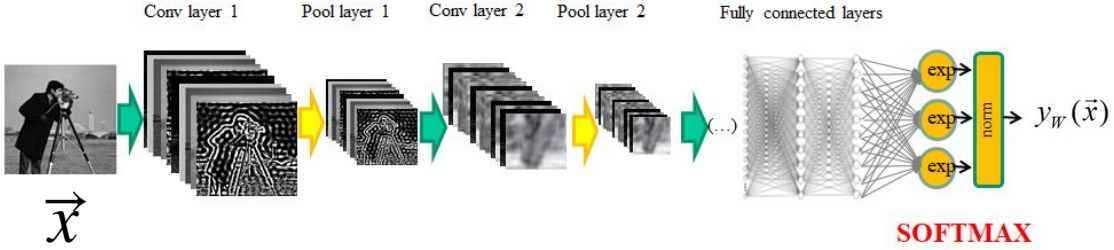
Annotated dataset: $D = \{(\vec{x}_1, t_1), (\vec{x}_2, t_2), \ldots, (\vec{x}_N, t_N)\}$

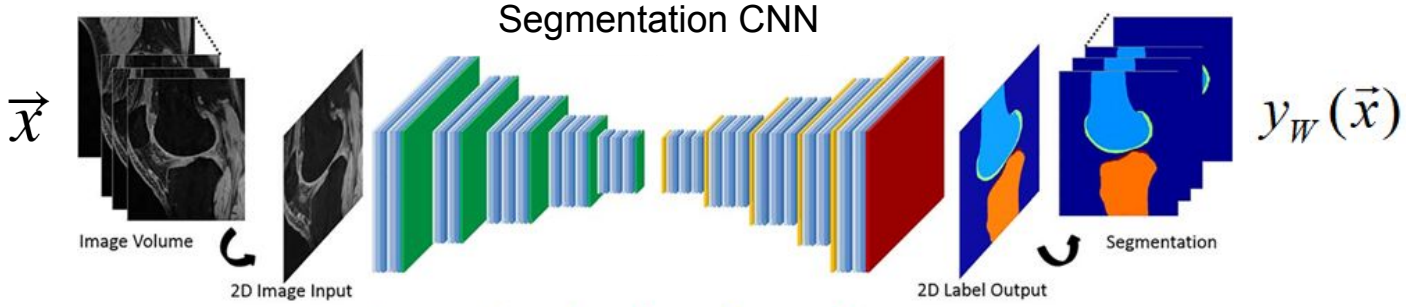


Gradient descent

$$W_j^{[l]} \leftarrow W_j^{[l]} - \eta \frac{\partial\left(L\left(y_W(\vec{x})\right)\right)}{\partial W_j^{[l]}}$$



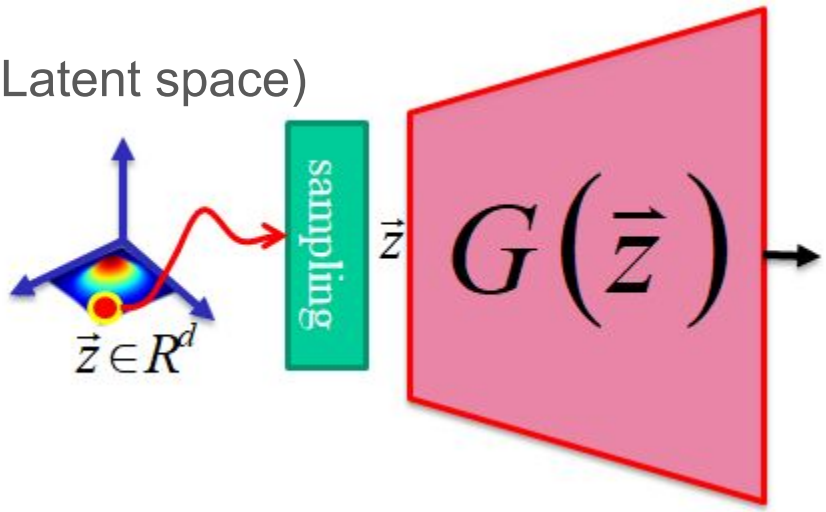




Fang Liu, etal., Deep convolutional neural network and 3D deformable approach for tissue segmentation in musculoskeletal magnetic resonance imaging. in Magnetic resonance in medicine 2018 DOI:10.1002/mrm.26841

GAN

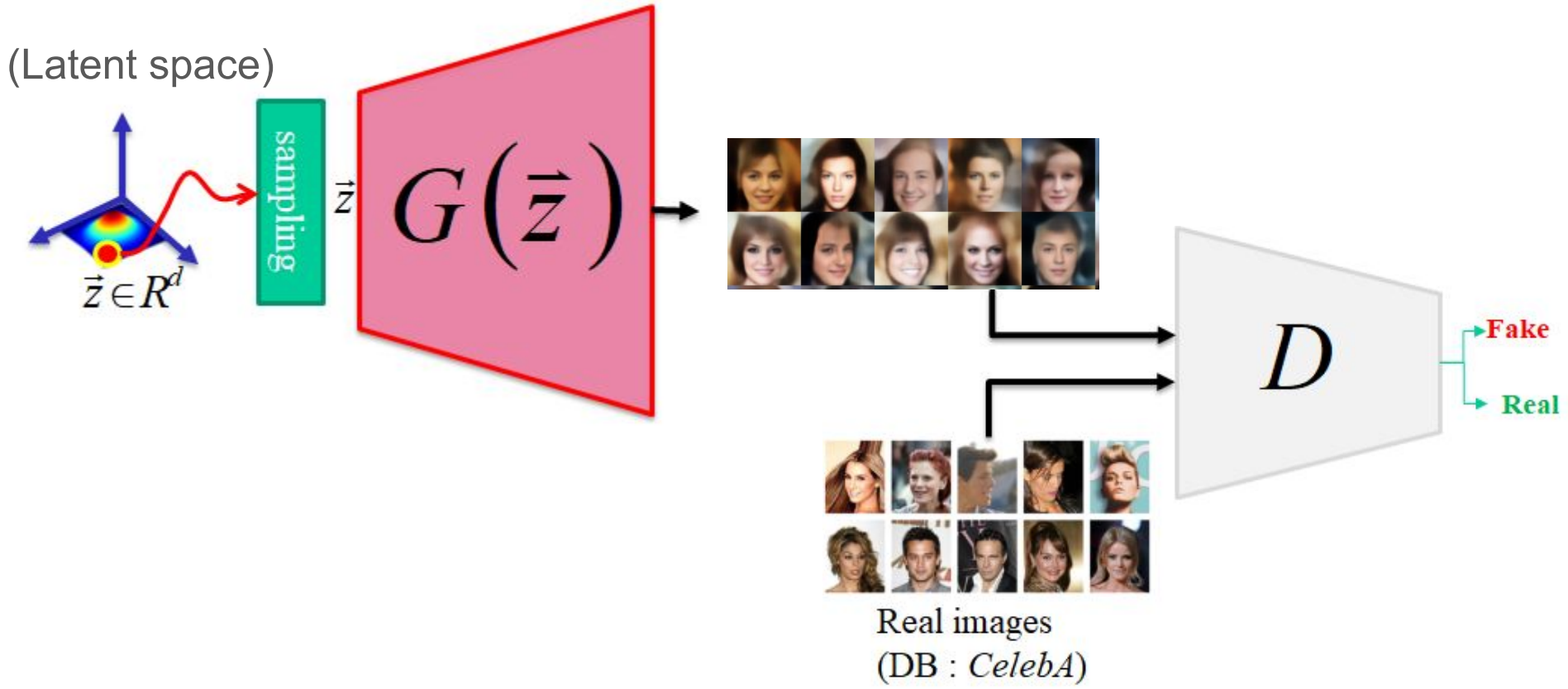
(Latent space)



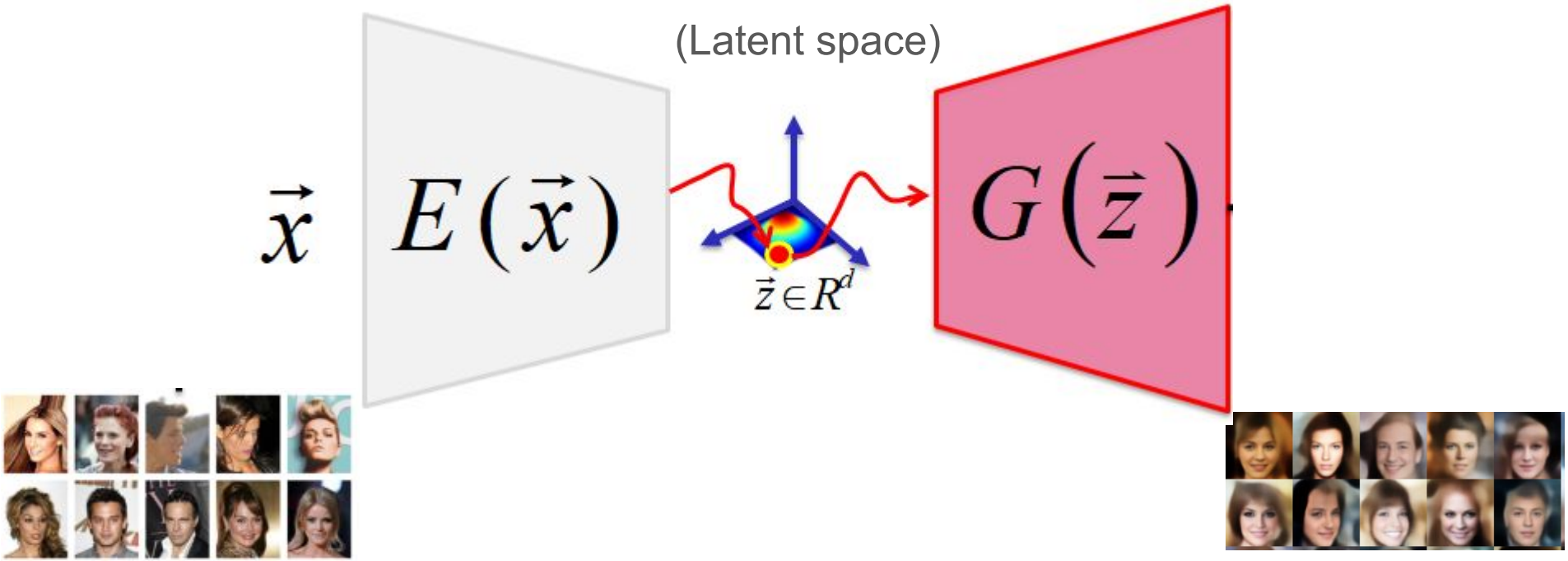
Loss?

Annotated dataset?

GAN

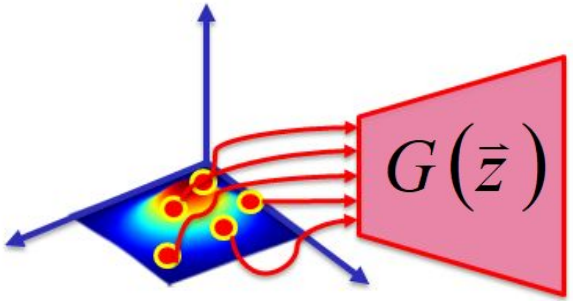

(Latent space)
$\vec{z} \in R^d$
sampling
$\vec{z}$
$G(\vec{z})$
D
Fake
Real
Real images
(DB : *CelebA*)

Autoencoders



Autoencoders (once training is over)

(Latent space)



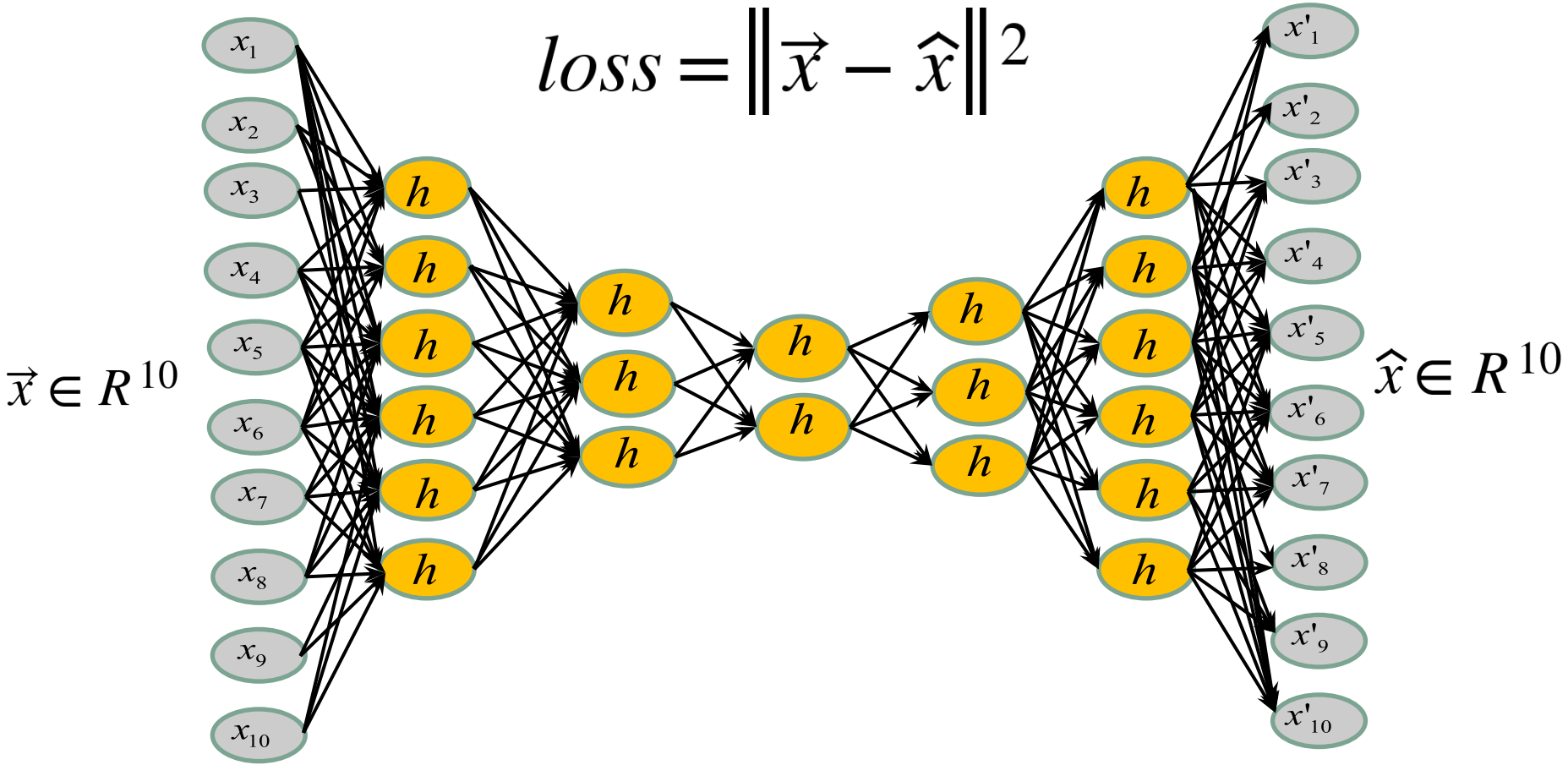
Summary

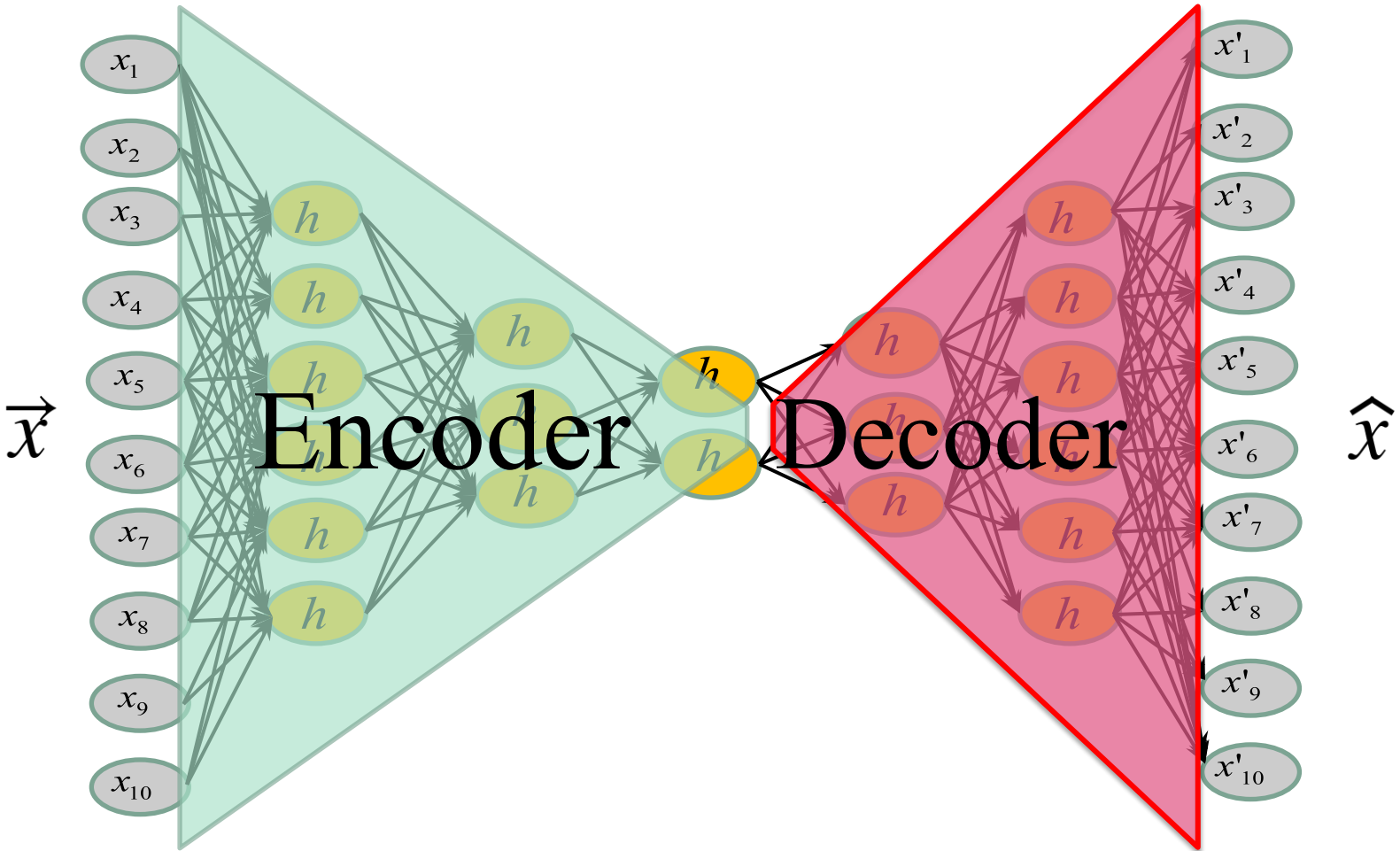
1. What are autoencoders and variational autoencoders?
2. How do they apply to MNIST (grayscale images)?
3. How do they apply to segmentation maps (ACDC cardiac labels)?

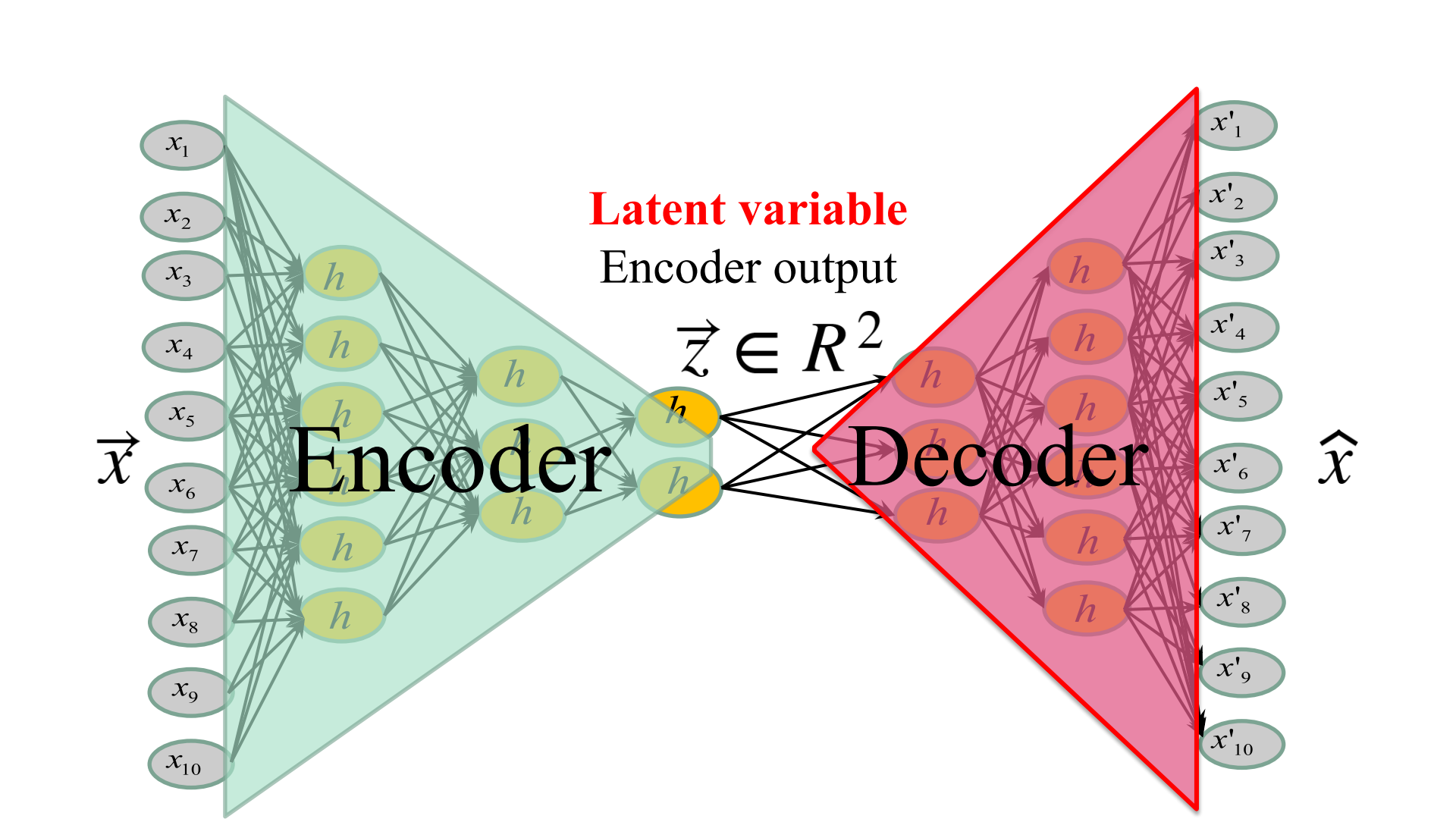
Goal : learn the latent representation of a set of data

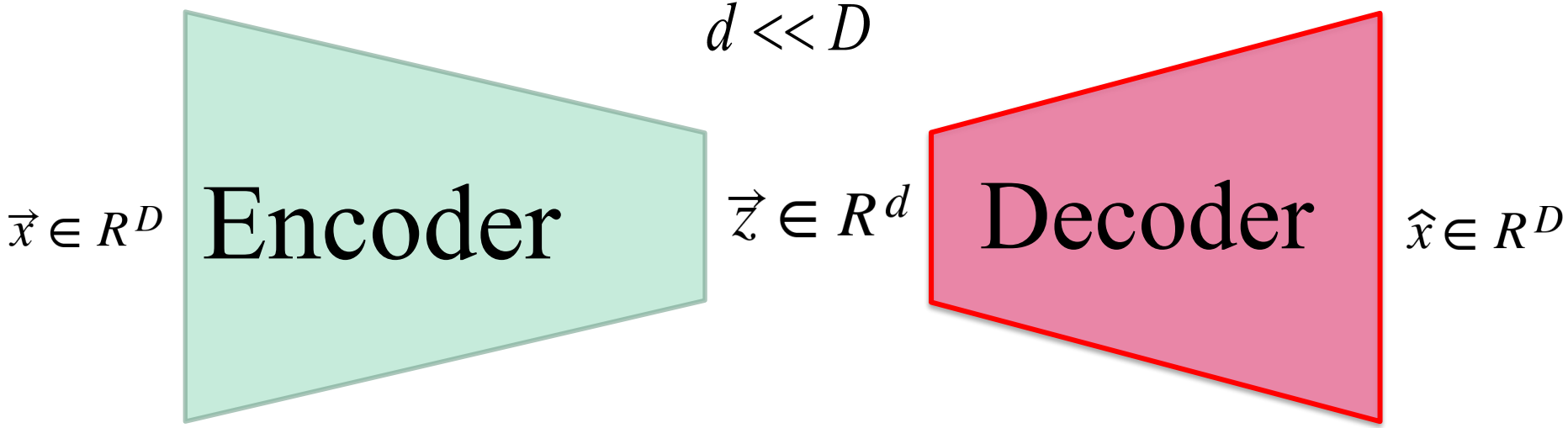
How : by training a Neural Net to output its own … input!

Note : if you are familiar with AE and VAE, you may skip the next couple of slides.


$loss = \|\vec{x} - \hat{x}\|^2$
$\vec{x} \in R^{10}$
$\hat{x} \in R^{10}$
x_1
x_2
x_3
x_4
x_5
x_6
x_7
x_8
x_9
x_{10}
x'_1
x'_2
x'_3
x'_4
x'_5
x'_6
x'_7
x'_8
x'_9
x'_{10}
h

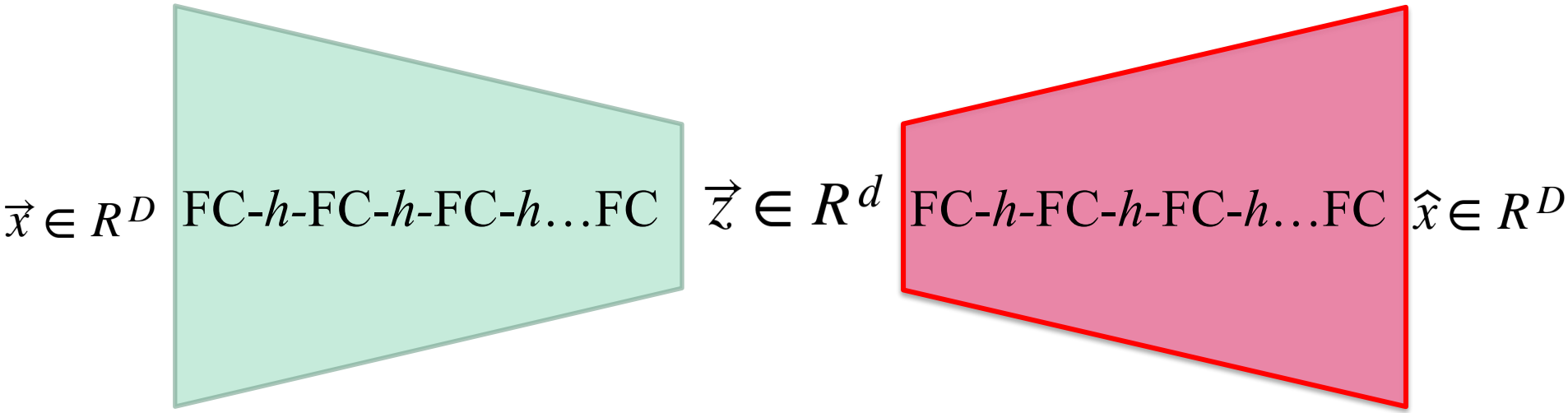

$\vec{x}$
x_1
x_2
x_3
x_4
x_5
x_6
x_7
x_8
x_9
x_{10}
Encoder
Decoder
$\hat{x}$
x'_1
x'_2
x'_3
x'_4
x'_5
x'_6
x'_7
x'_8
x'_9
x'_{10}


Latent variable
Encoder output
$\vec{z} \in R^2$
$\vec{x}$
Encoder
Decoder
$\hat{x}$
x_1
x_2
x_3
x_4
x_5
x_6
x_7
x_8
x_9
x_{10}
x'_1
x'_2
x'_3
x'_4
x'_5
x'_6
x'_7
x'_8
x'_9
x'_{10}
h

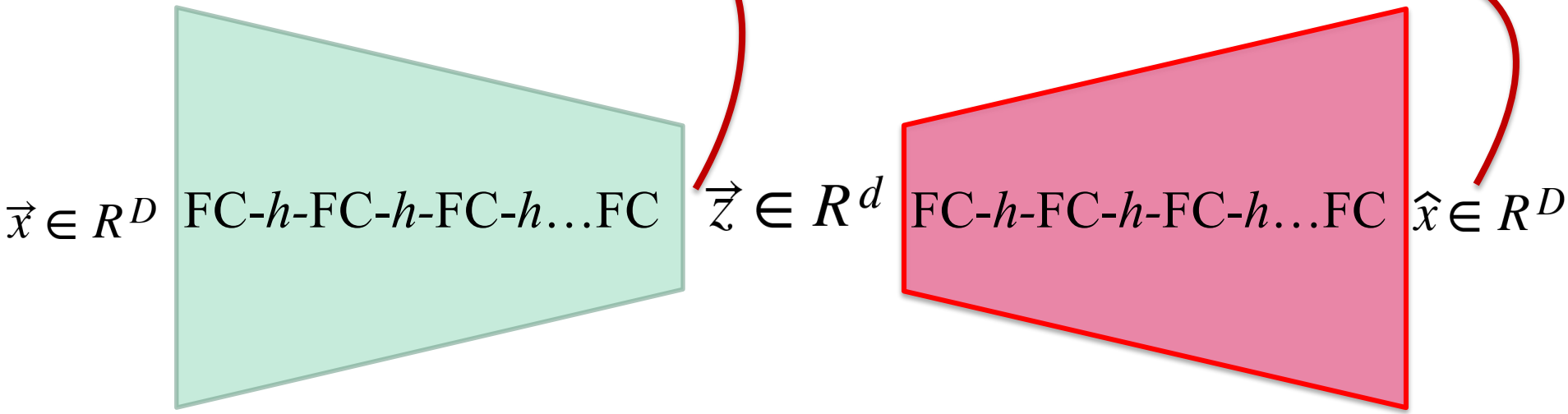

$d << D$
$\vec{x} \in R^D$
Encoder
$\vec{z} \in R^d$
Decoder
$\hat{x} \in R^D$

Fully-Connected Layers

h : activation function

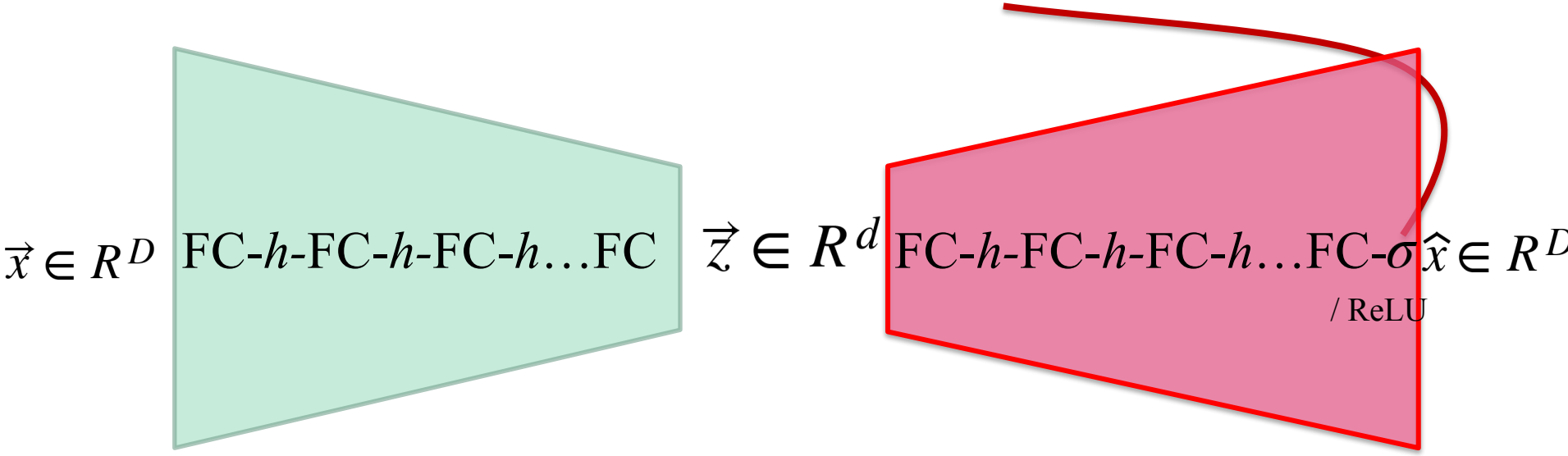


Very often...
No activation function at the output
of the encoder and the decoder



See **why?**

Sometimes **sigmoid** to predict pixel values between 0 and 1 or **ReLU** when the pixel values can be large but never negative.



The number of neurons

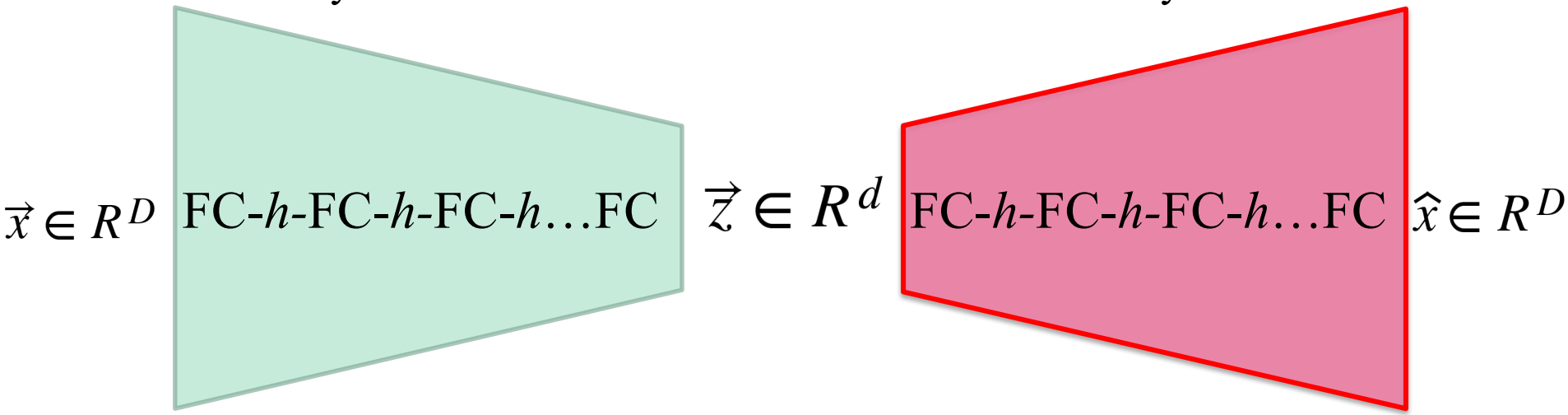
Decrease (or stay the same)

from a layer to another

The number of neurons

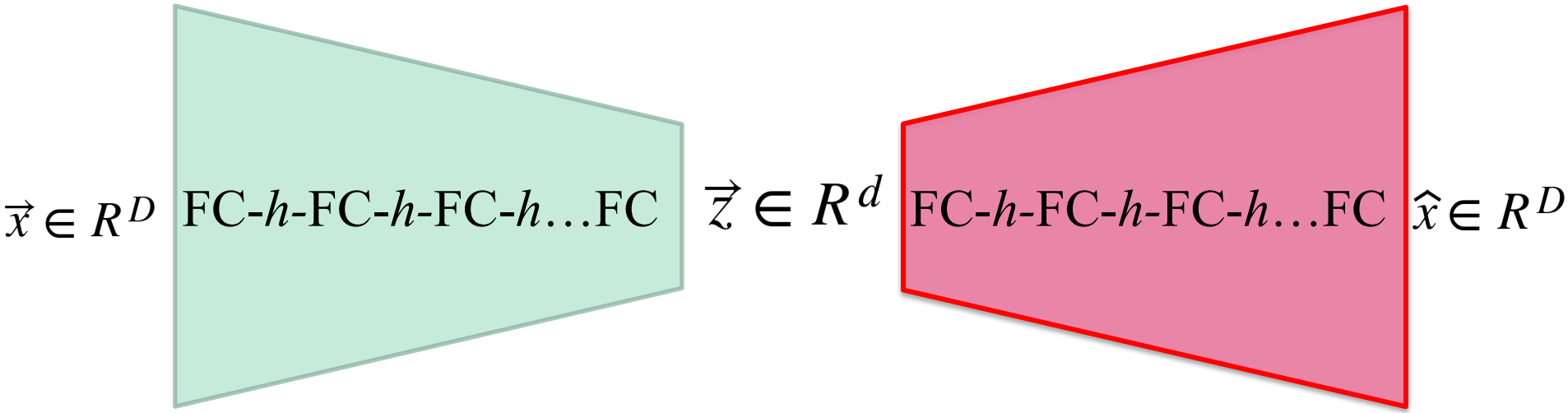
Increase (or stay the same)

from a layer to another



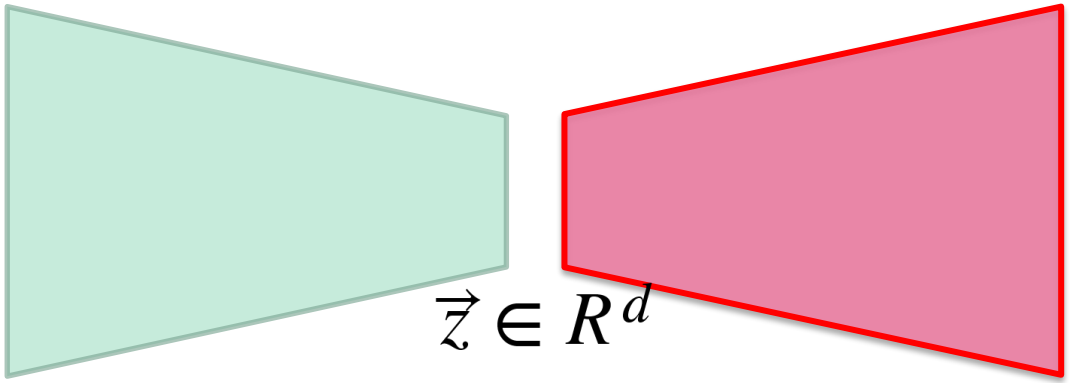
Very often...

The structure of the encoder is the **dual** of that of the decoder



Basic image-based autoencoder

$\vec{x}$



$\vec{z} \in R^d$

$\hat{x}$

Simple MNIST Autoencoder

```
class autoencoder(nn.Module):

    def __init__(self):

        super(autoencoder, self).__init__()

        self.encoder = nn.Sequential(

            nn.Linear(28 * 28, 128), nn.ReLU(True),

            nn.Linear(128, 64), nn.ReLU(True),

            nn.Linear(64, 12), nn.ReLU(True),

            nn.Linear(12, 2))

        self.decoder = nn.Sequential(

            nn.Linear(2, 12), nn.ReLU(True),

            nn.Linear(12, 64), nn.ReLU(True),

            nn.Linear(64, 128), nn.ReLU(True),

            nn.Linear(128, 28 * 28))


    def forward(self, x):

        z = self.encoder(x)

        x_prime = self.decoder(z)

        return x_prime
```

Latent space 2D

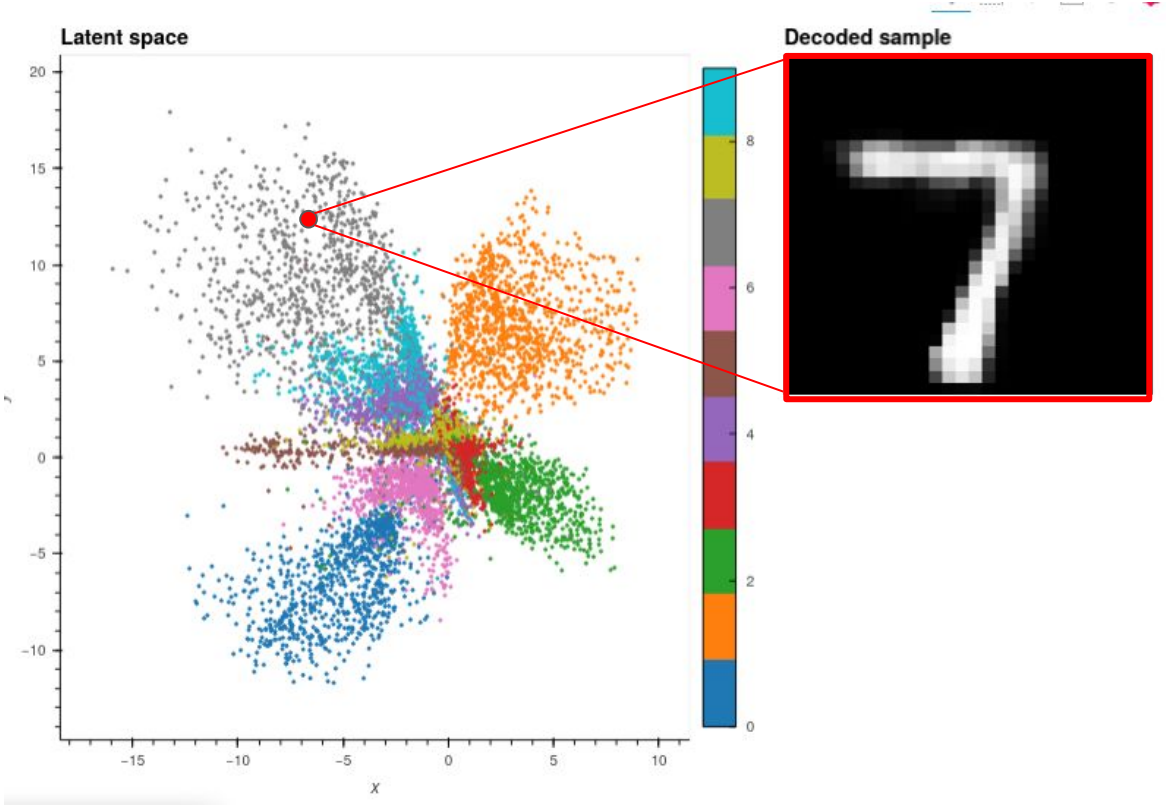
Simple MNIST Autoencoder

symmetry

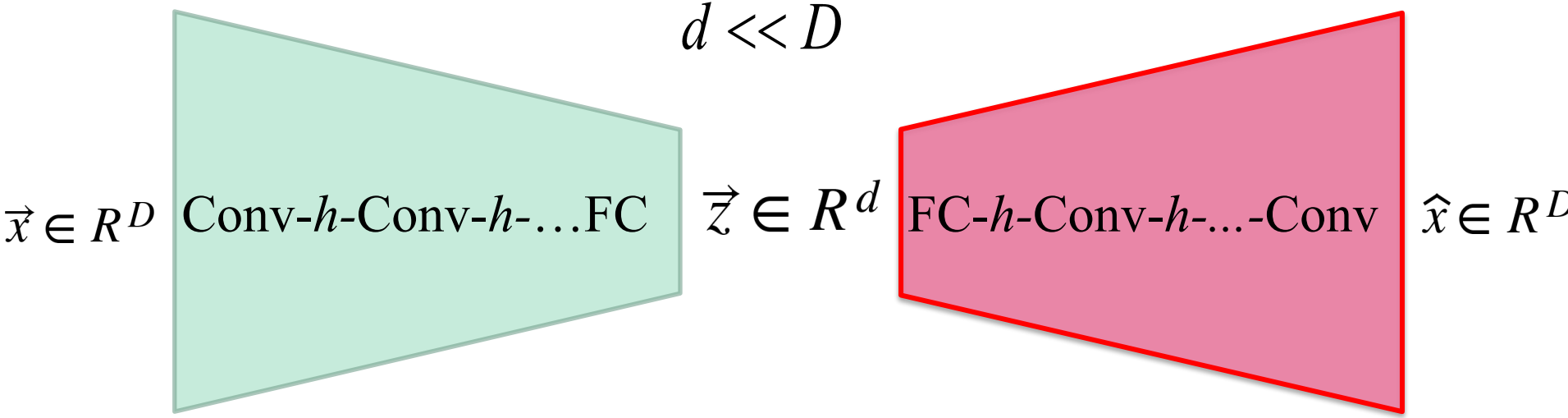
```
class autoencoder(nn.Module):

    def __init__(self):

        super(autoencoder, self).__init__()

        self.encoder = nn.Sequential(

            nn.Linear(28 * 28, 128), nn.ReLU(True),

            nn.Linear(128, 64), nn.ReLU(True),

            nn.Linear(64, 12), nn.ReLU(True),

            nn.Linear(12, 2))

        self.decoder = nn.Sequential(

            nn.Linear(2, 12), nn.ReLU(True),

            nn.Linear(12, 64), nn.ReLU(True),

            nn.Linear(64, 128), nn.ReLU(True),

            nn.Linear(128, 28 * 28))


    def forward(self, x):

        z = self.encoder(x)

        x_prime = self.decoder(z)

        return x_prime
```

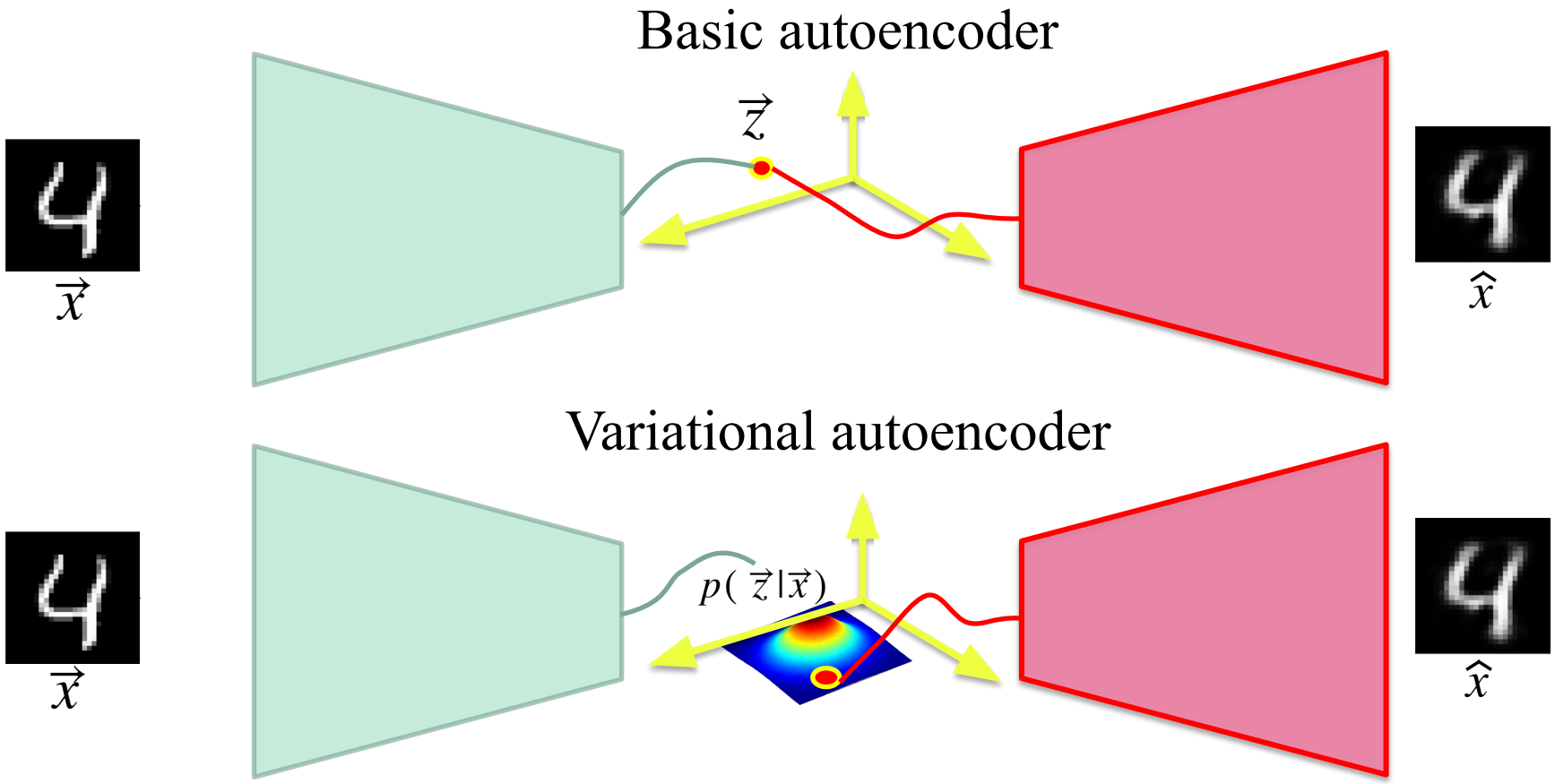
MNIST latent space (for 1000 images)

Each 2D point corresponds to an image

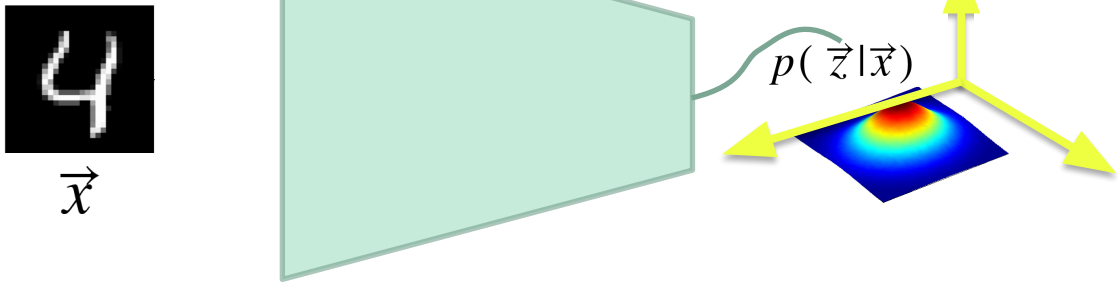


Conv layers


$d << D$
$\vec{x} \in R^D$
Conv-h-Conv-h-…FC
$\vec{z} \in R^d$
FC-h-Conv-h-...-Conv
$\hat{x} \in R^D$

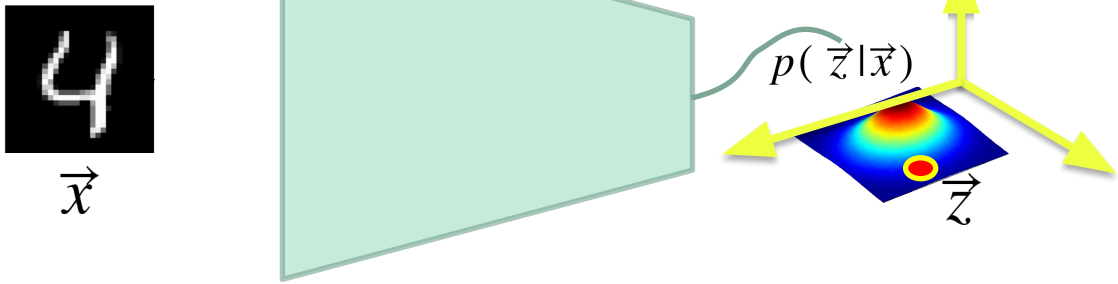

Basic autoencoder
$\vec{z}$
$\vec{x}$
$\hat{x}$
Variational autoencoder
$p(\vec{z}|\vec{x})$
$\vec{x}$
$\hat{x}$

Variational autoencoder



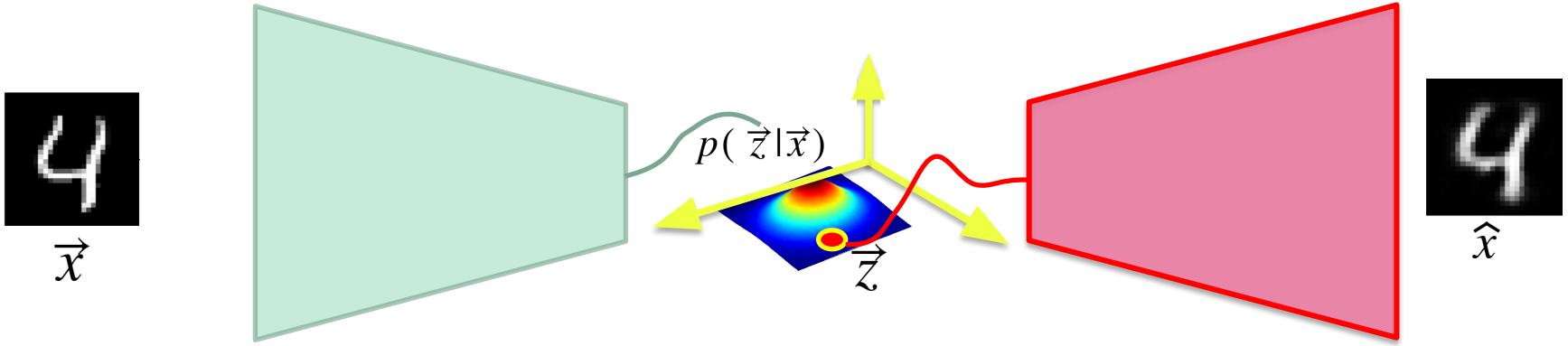
The encoder outputs a **distribution** $p(\vec{z}|\vec{x})$ and not just a **vector** $\vec{z}$

Variational autoencoder



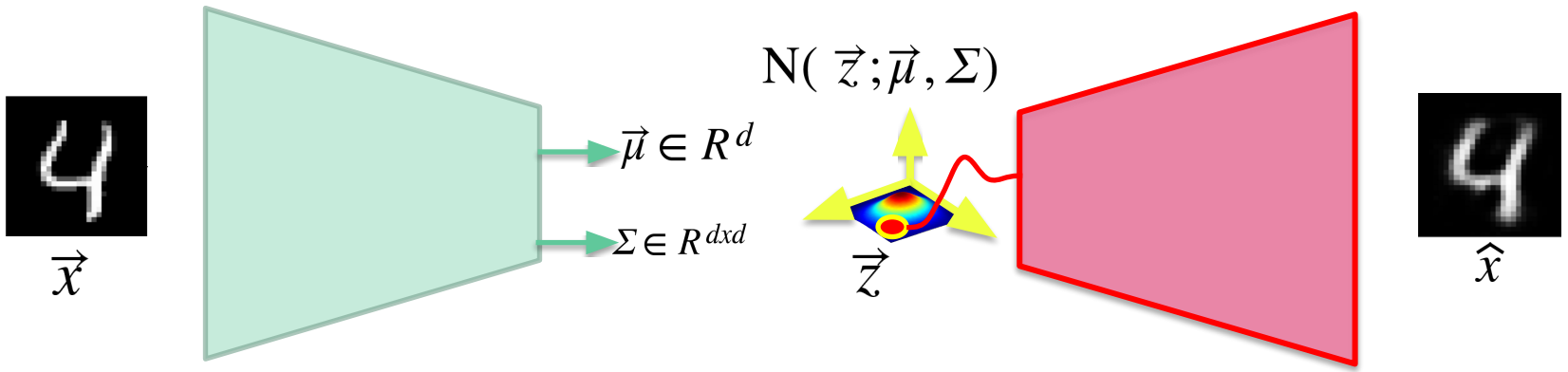
Random sample $\vec{z} \sim P(\vec{z}|\vec{x})$

Variational autoencoder

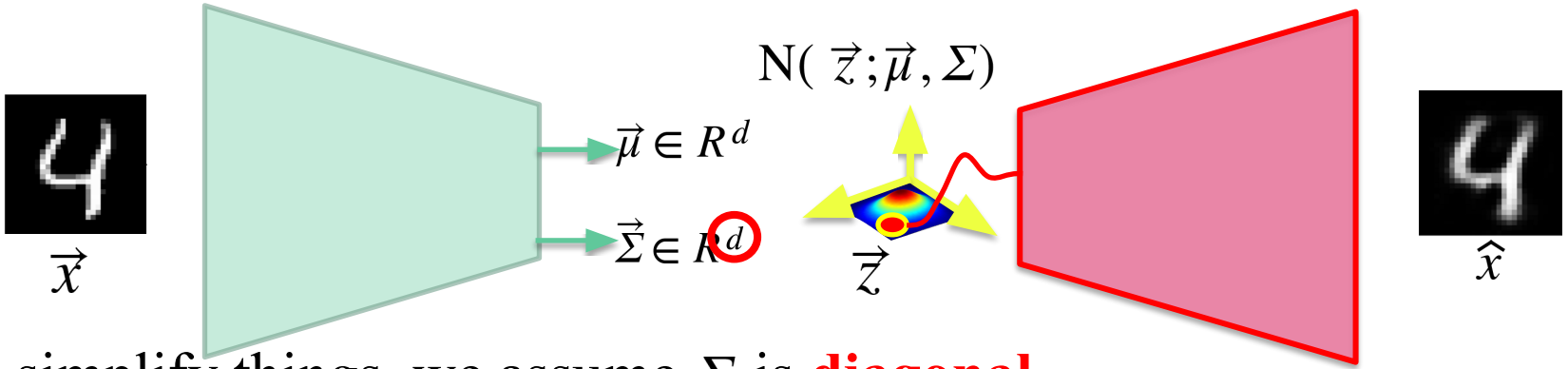


...and rebuild $\hat{x}$

$$p(\vec{z}|\vec{x}) \sim Gaussian$$



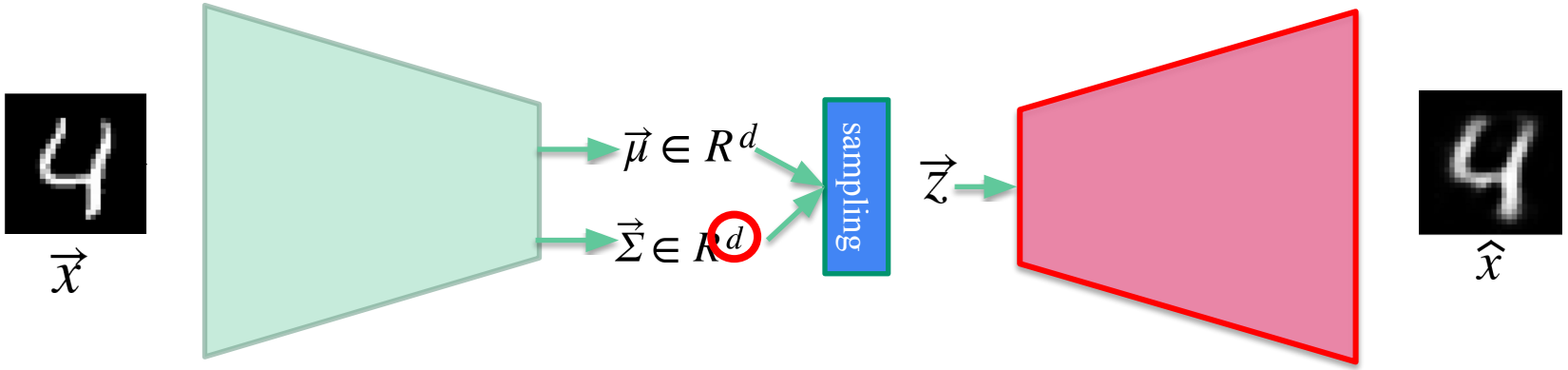
$$p(\vec{z}|\vec{x}) \sim Gaussian$$



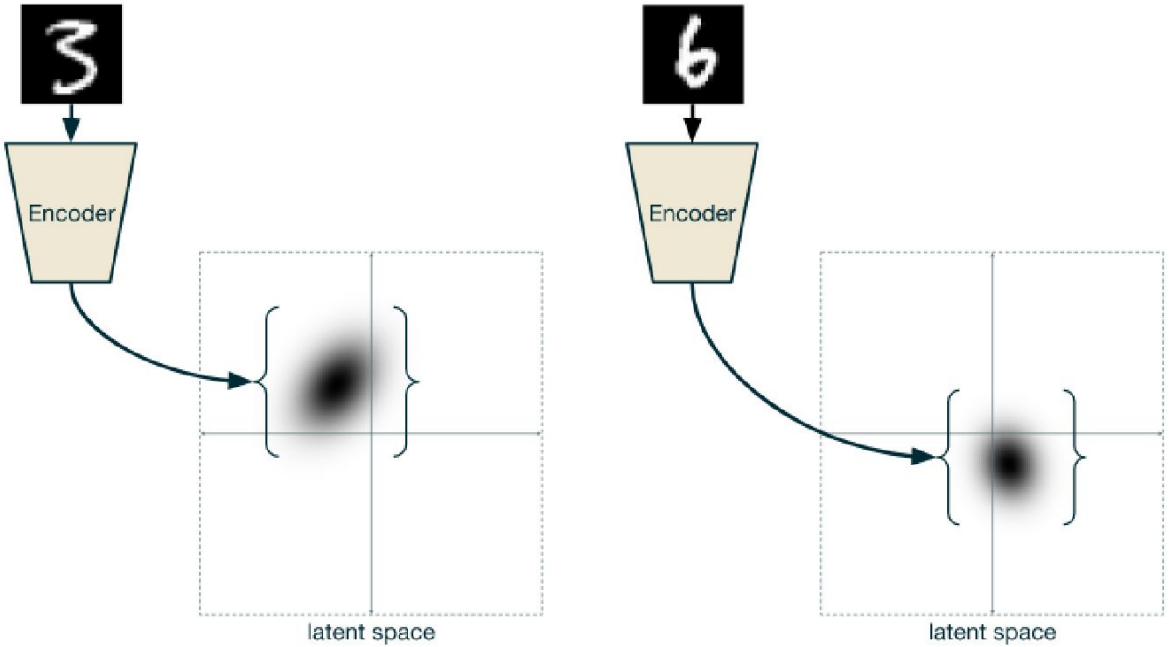
To simplify things, we assume Σ is **diagonal**

$$\Sigma = \begin{pmatrix} \sigma_1^2 & 0 & 0 & 0 \\ 0 & \sigma_1^2 & 0 & 0 \\ 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & \sigma_d^2 \end{pmatrix}$$

Variational autoencoder

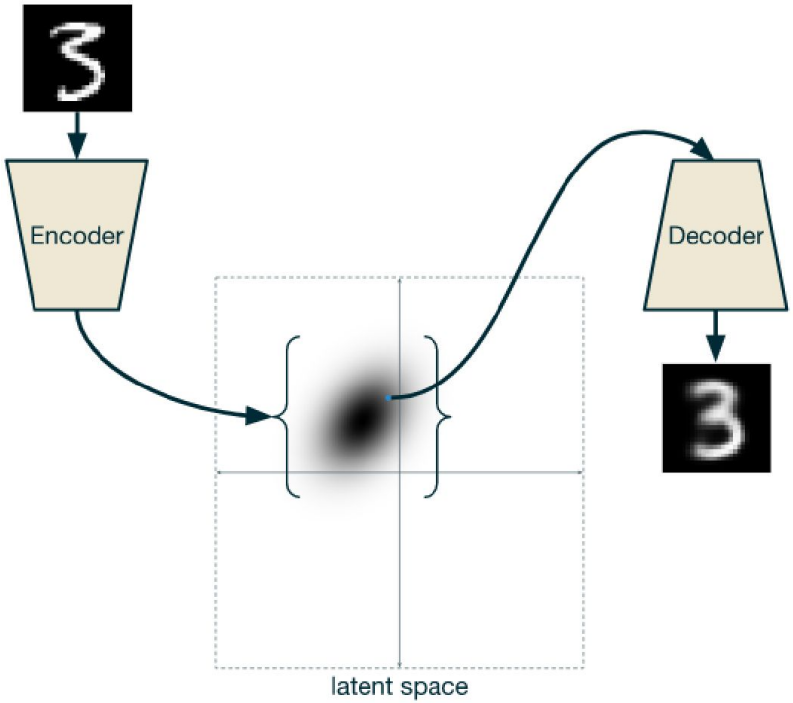


Another way of seeing things…



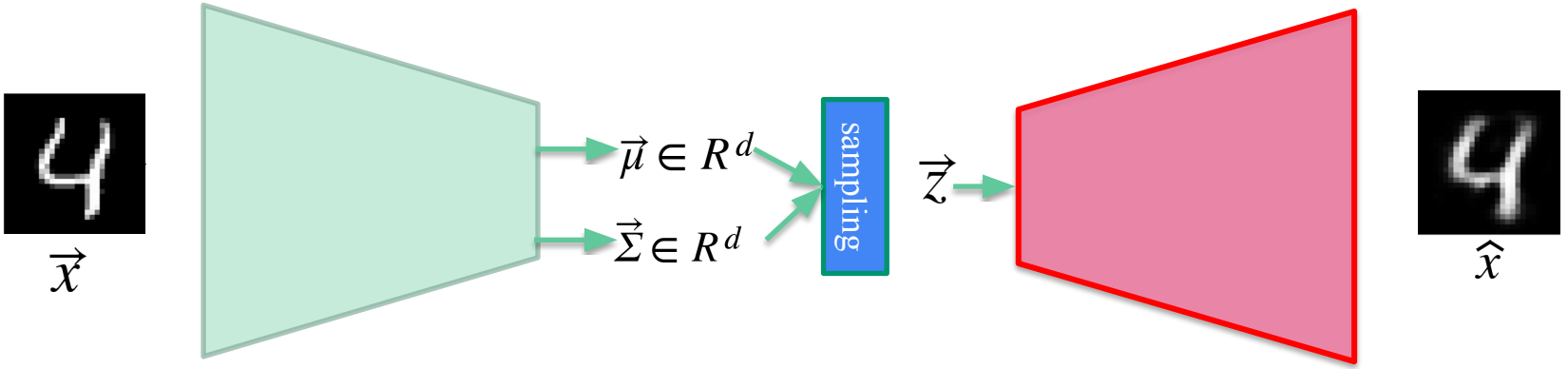
https://ijdykeman.github.io/ml/2016/12/21/cvae.html

Another way of seeing things…



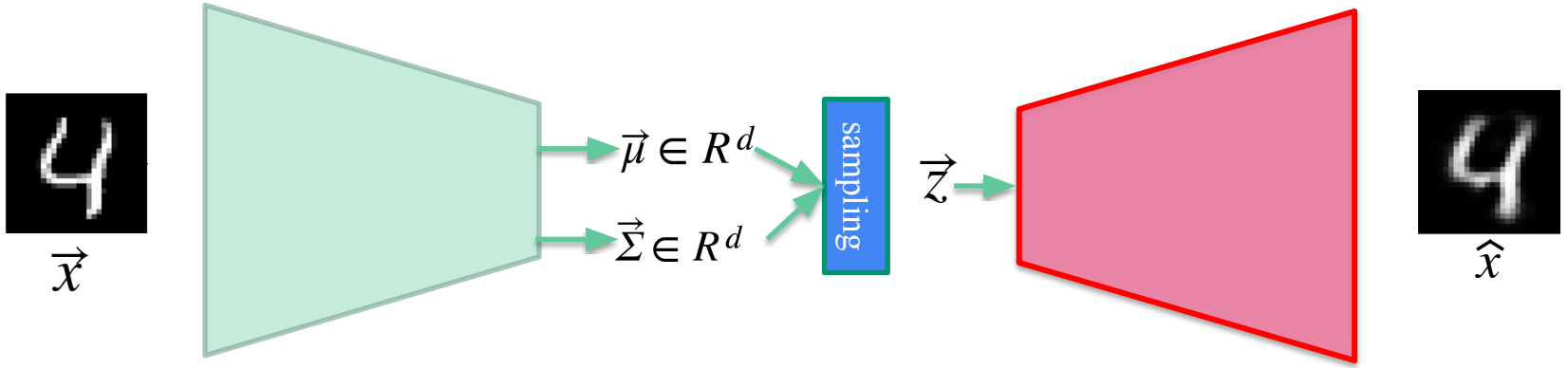
https://ijdykeman.github.io/ml/2016/12/21/cvae.html

ELBO loss : Evidence Lower Bound loss



$$Loss = \underbrace{(\vec{x} - \hat{x})^2}_{\text{Loss decoder}} + \underbrace{\lambda KL(N(\vec{z}; \vec{0}, \vec{1}), N(\vec{z}; \vec{\mu}, \vec{\Sigma}))}_{\text{Loss encoder}}$$

Other loss (in case the output is binary)

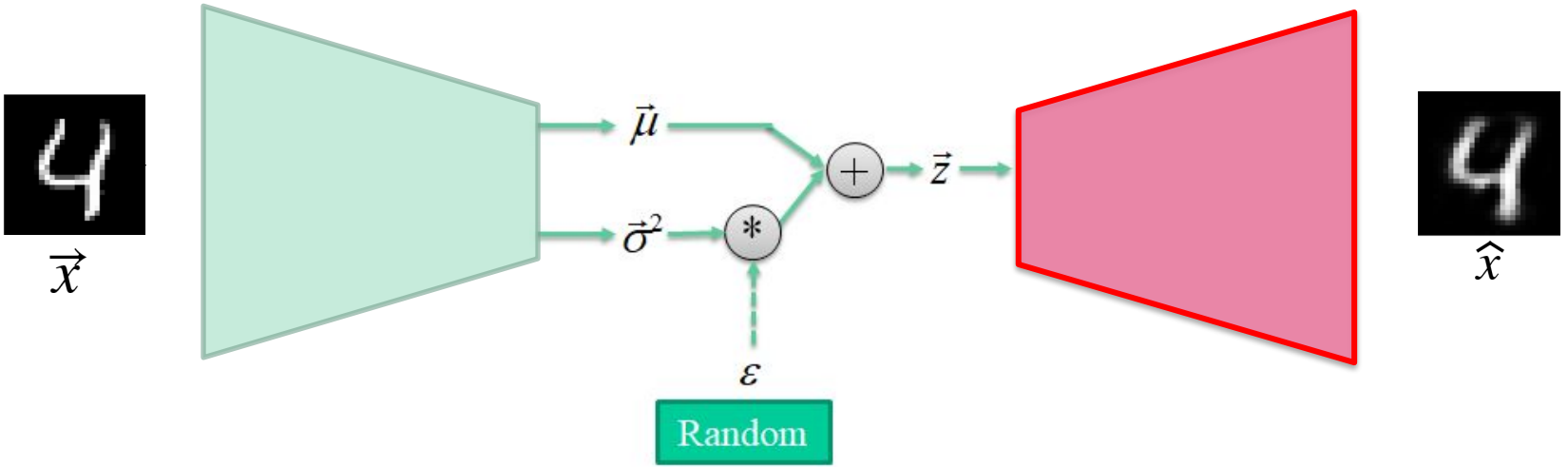


$$Loss = CrossEntropy(\vec{x}, \hat{x}) + \lambda KL\left(N(\vec{z}; \vec{0}, \vec{1}), N(\vec{z}; \vec{\mu}, \vec{\Sigma})\right)$$

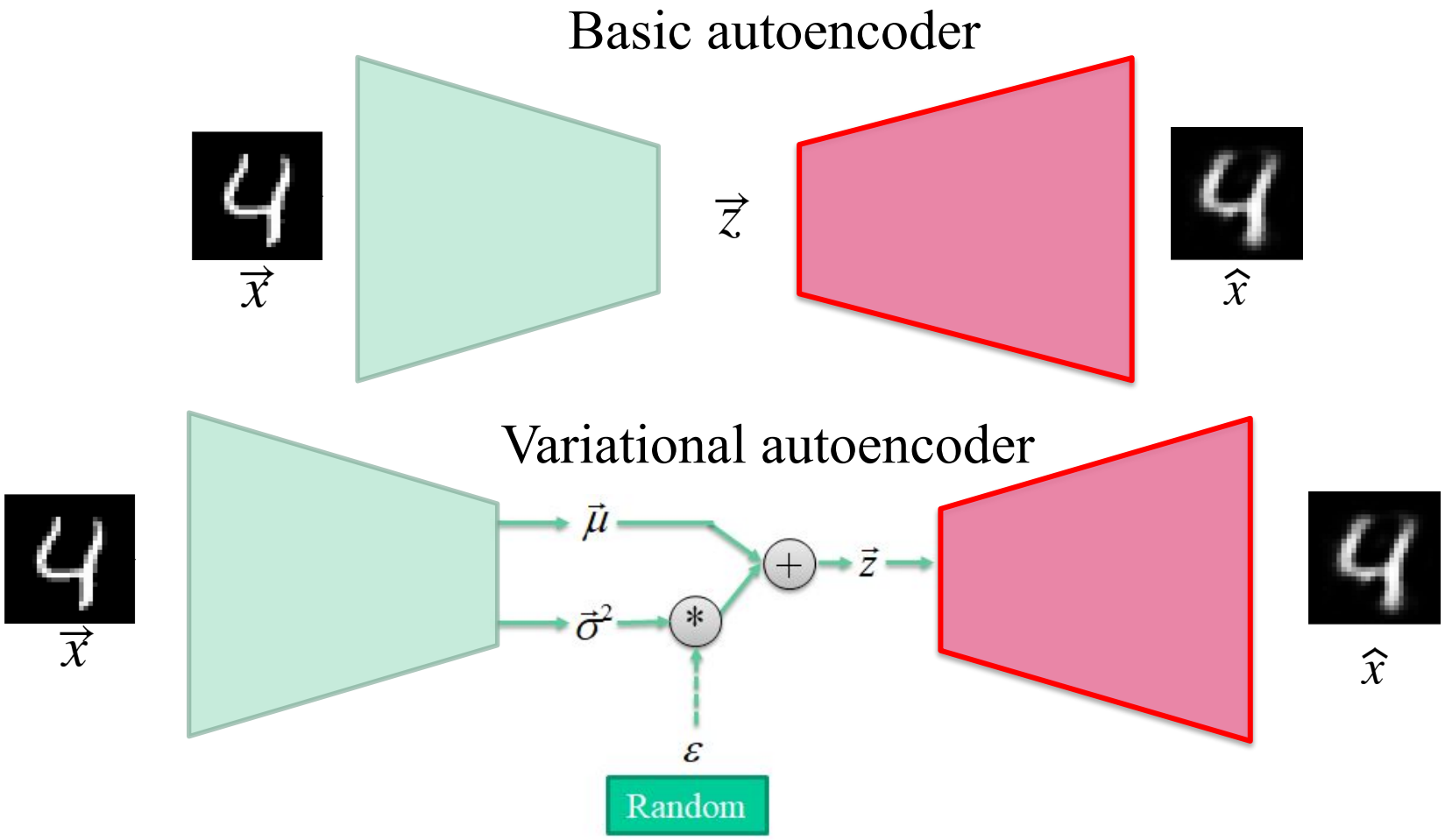
Loss decoder

Loss encoder

Reparametrization trick instead of sampling

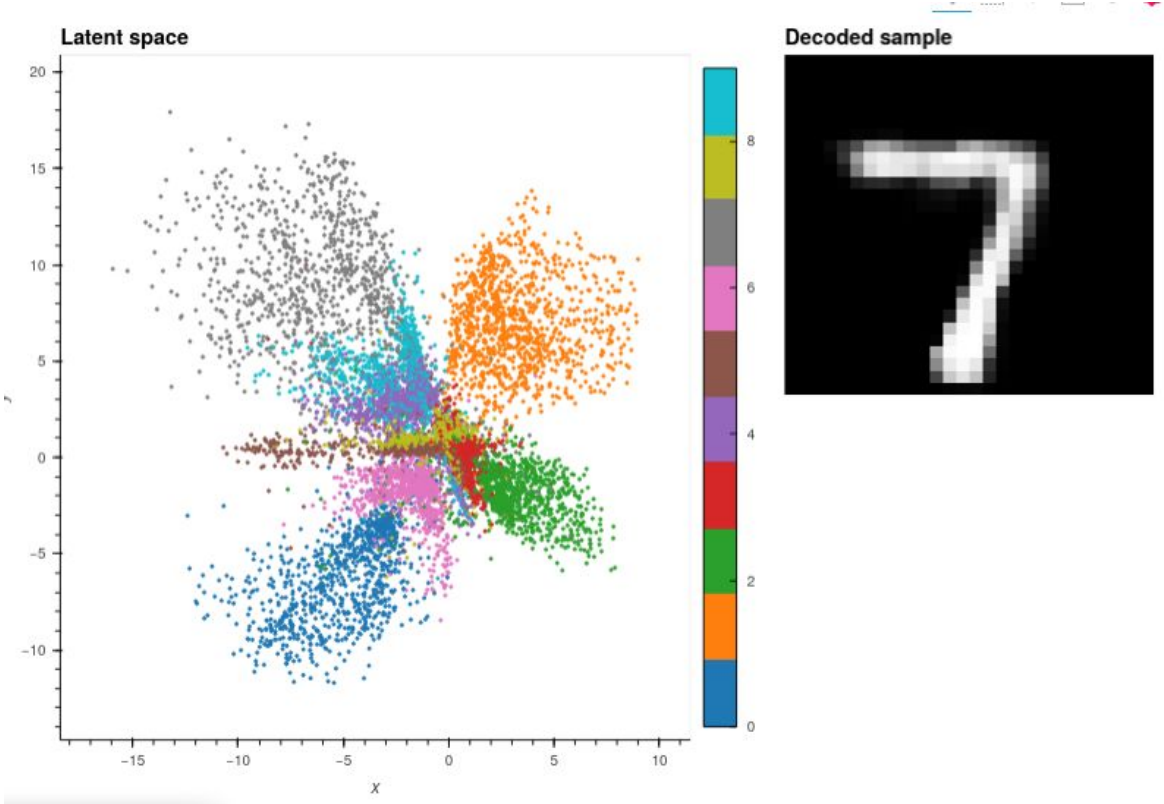


MNIST


Basic autoencoder
$\vec{x}$
$\vec{z}$
$\hat{x}$
Variational autoencoder
$\vec{x}$
$\vec{\mu}$
$\vec{\sigma}^2$
*
+
$\vec{z}$
$\hat{x}$
ε
Random

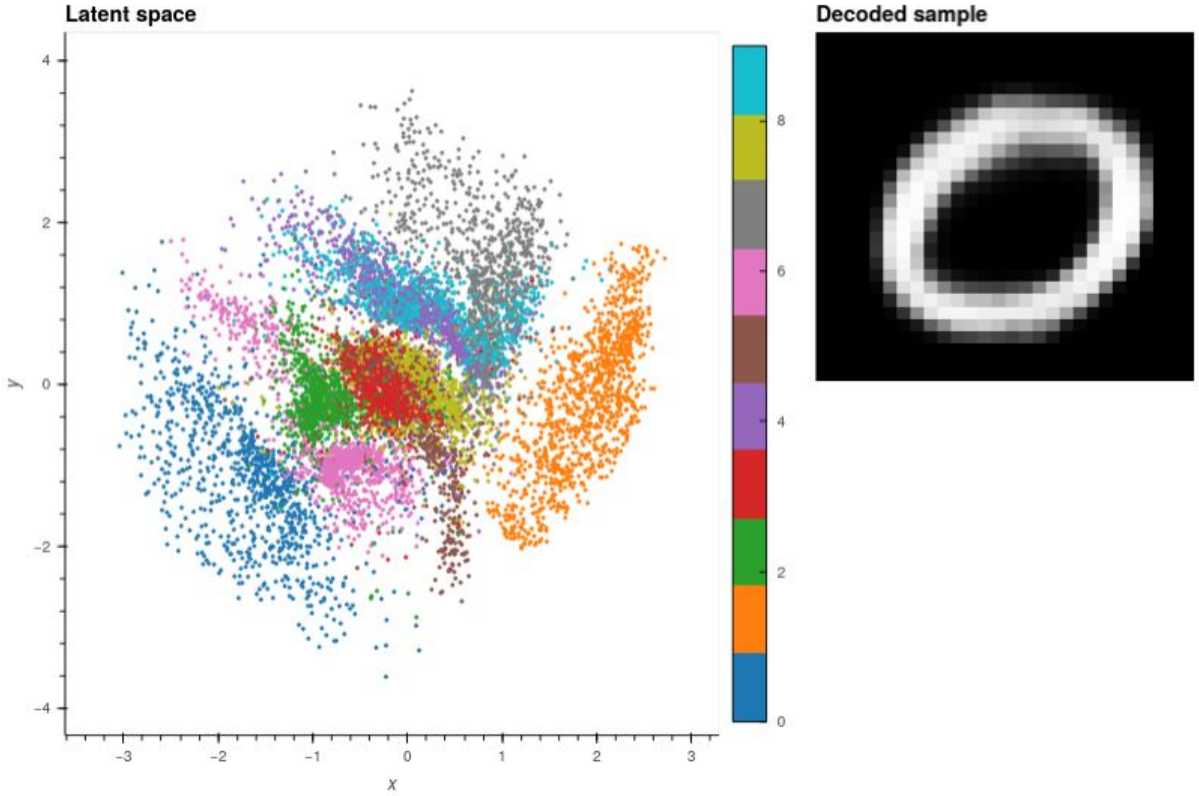
MNIST

Visualize the latent space (autoencoder)



MNIST

Visualize the latent space (variational autoencoder)



MNIST

Code is in the file:

`mnist-autoencoders.ipynb`

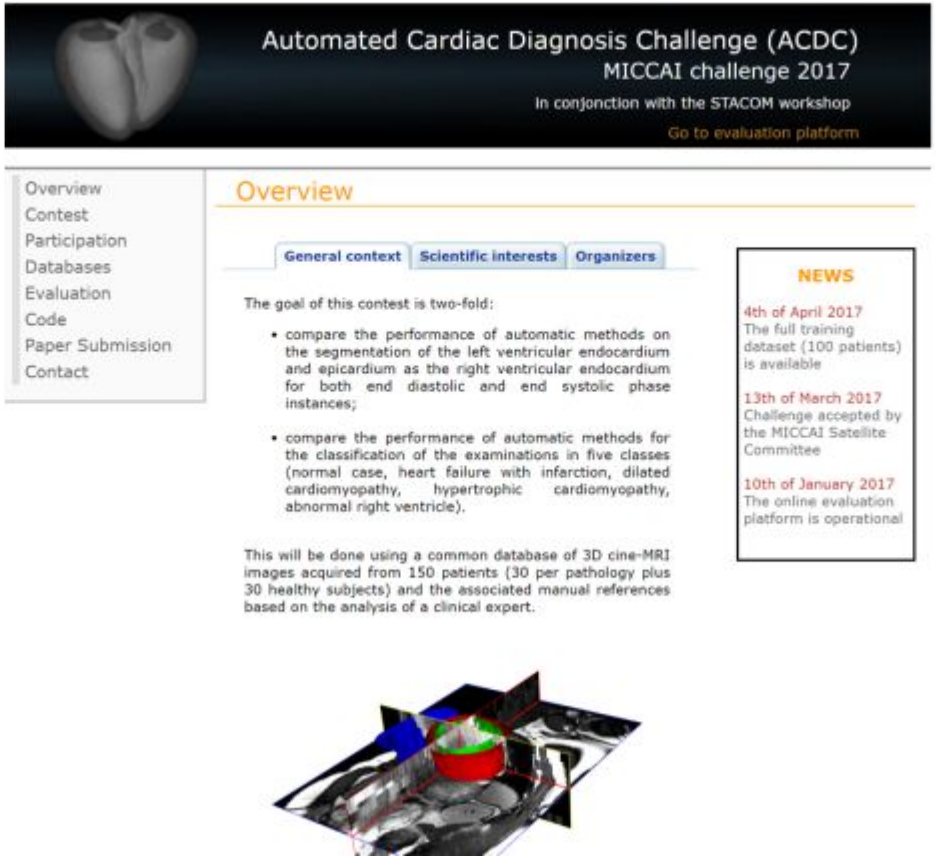
MICCAI 2017

Automated Cardiac Diagnosis Challenge

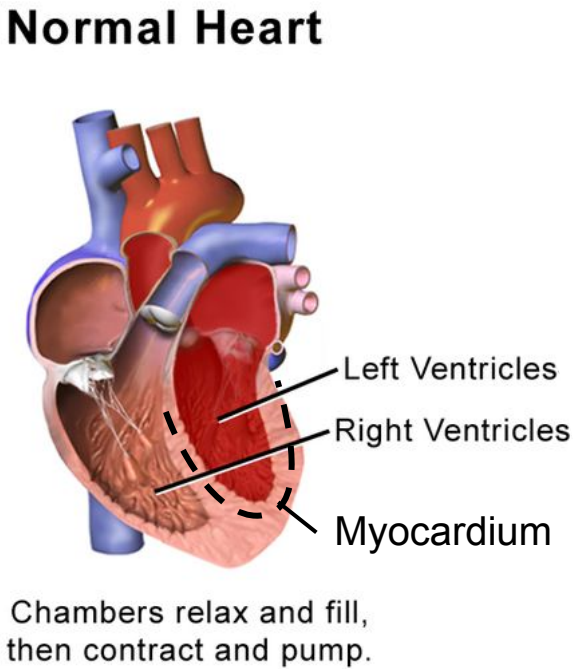
150 exams (all from different patients) divided into 5 groups:

- dilated cardiomyopathy (DCM),
- hypertrophic cardiomyopathy (HCM),
- myocardial infarction (MINF),
- abnormal right ventricle (RV)
- patients without cardiac disease (NOR).

website: ***creatis.insa-lyon.fr/Challenge/acdc***

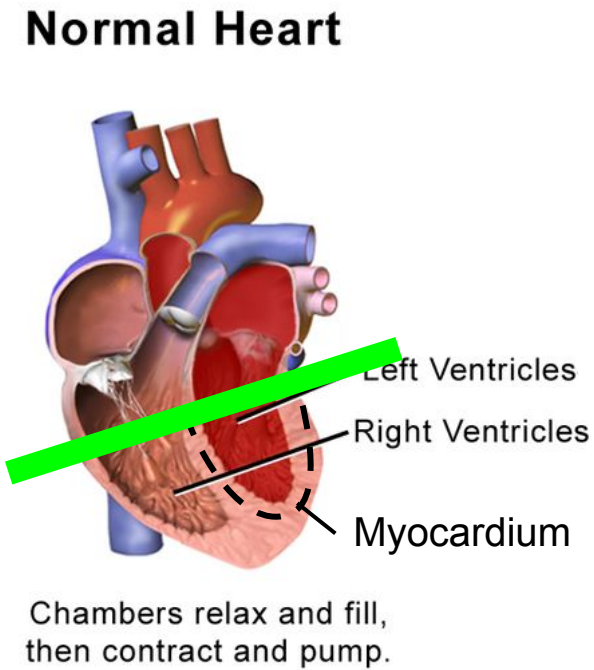


Cardiac anatomy

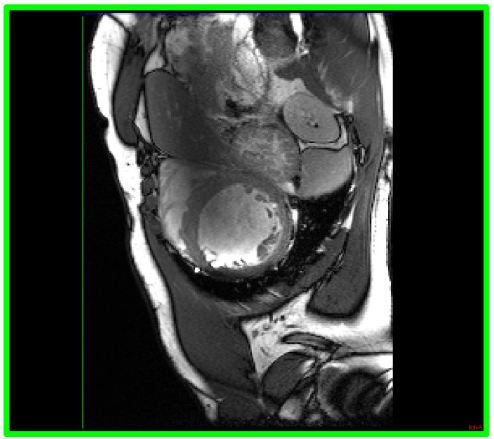


https://commons.wikimedia.org/

Cardiac anatomy

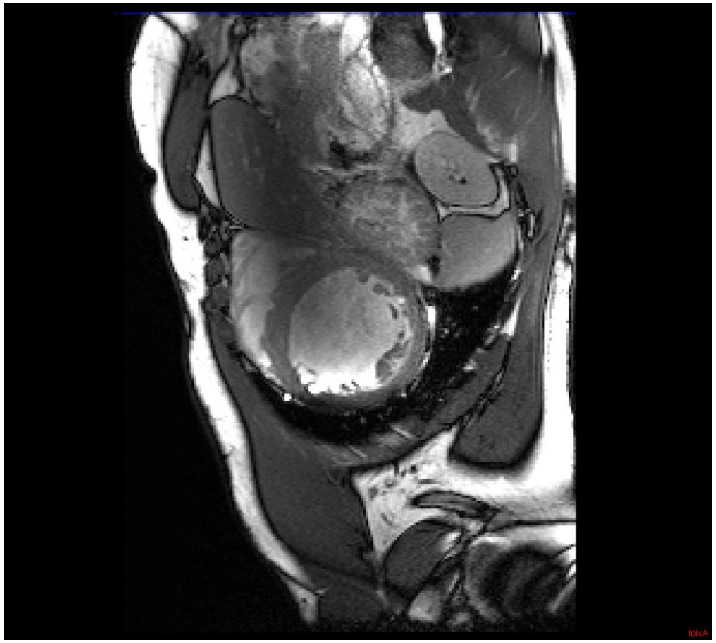


Cross-section : **short axis view**

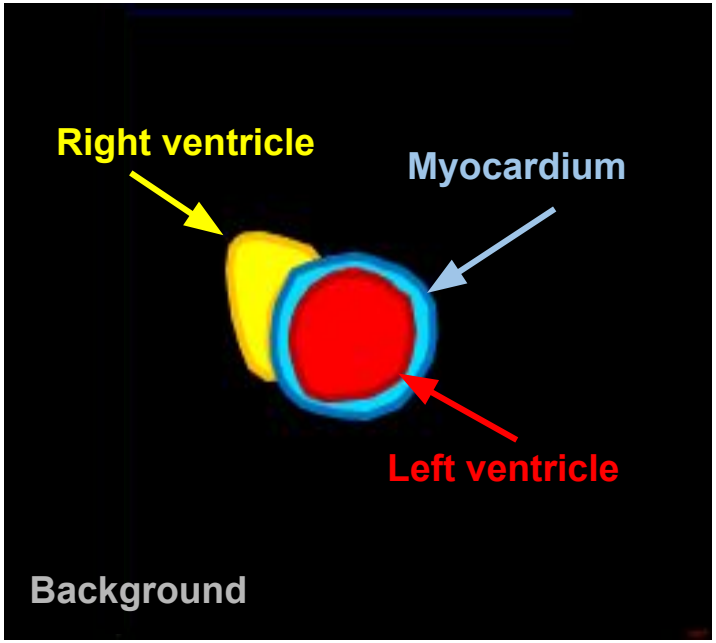


https://commons.wikimedia.org/

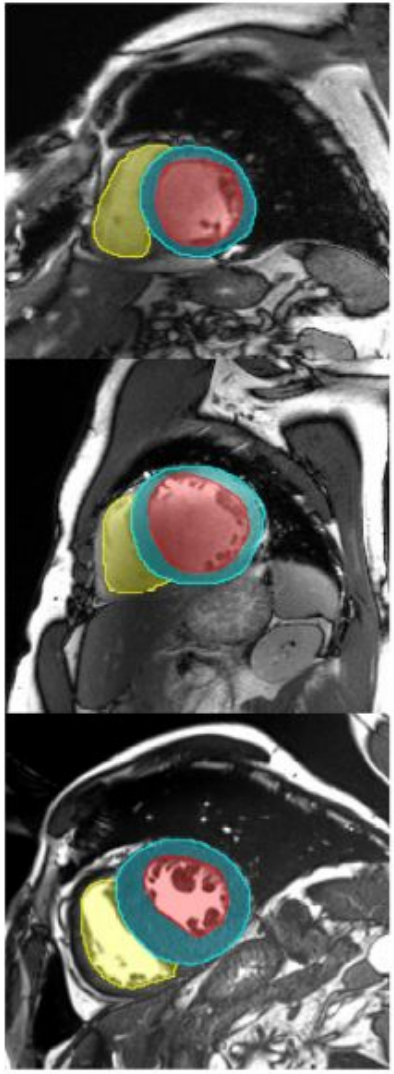
Short axis cardiac MRI



Short axis segmentation map

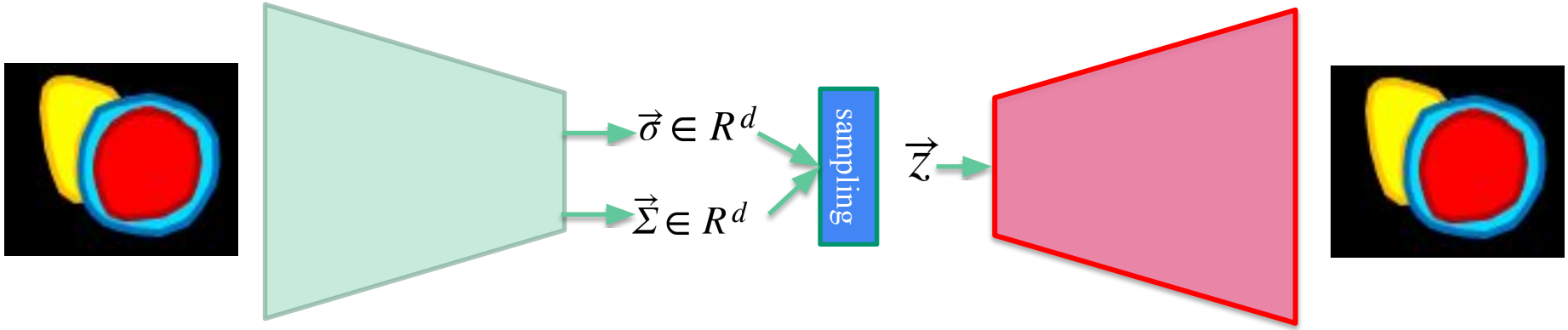


Other examples:



ACDC

Convolutional Variational autoencoder



ACDC

Code is in the file:

`cardiac-mri-autoencoders.ipynb`

Thank you

Image

saturncloud/saturn-pytorch : Version 2022.03.01

Spot Instance

This requests the server of specified size as Spot Instance. Spot Instances are less expensive, but may be shut down at any time (with a two-minute warning). (?)

Working Directory

/home/jovyan/workspace

~~Write opencv-python torchvision==0.11.2 for pip install~~

Write opencv-python torchvision==0.18.1 for pip install

Extra Packages

Extra packages are installed every tim

If you find yourself adding the same packages to lots of resources, you may want to permanently add packages to a custom image instead. (?)

~~Conda Install~~ | Pip Install | Apt Packages

```
opencv-python torchvision==0.11.2
```

The packages together will run the following script:

```
apt-get install htop zip unzip python3-opencv
pip install opencv-python torchvision==0.11.2
```

Shutoff After

1 hour

Disabled options are not supported in the Free plan. Upgrade to Pro for unlimited resources.

Advanced Settings (optional)

Save Cancel

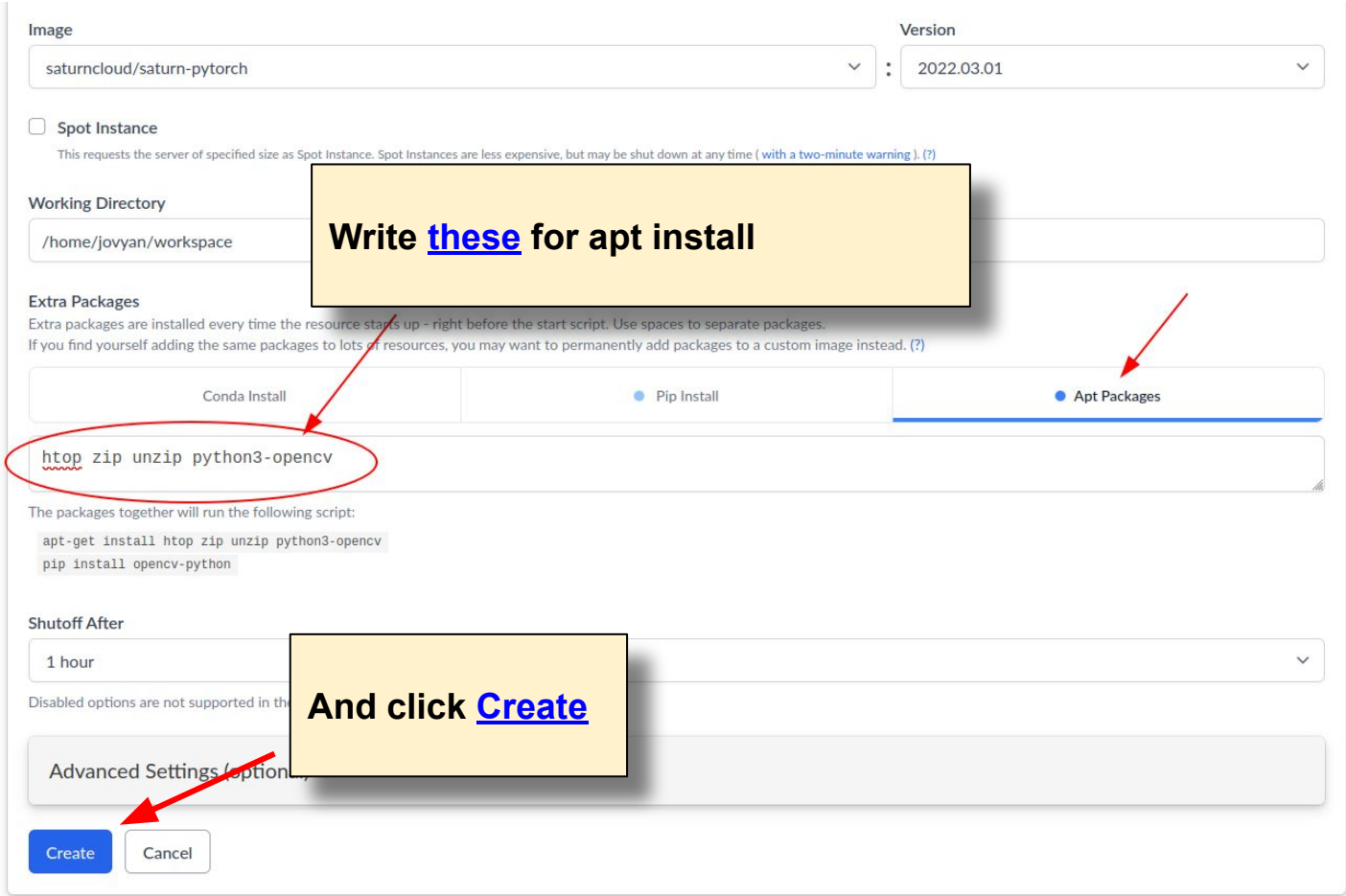
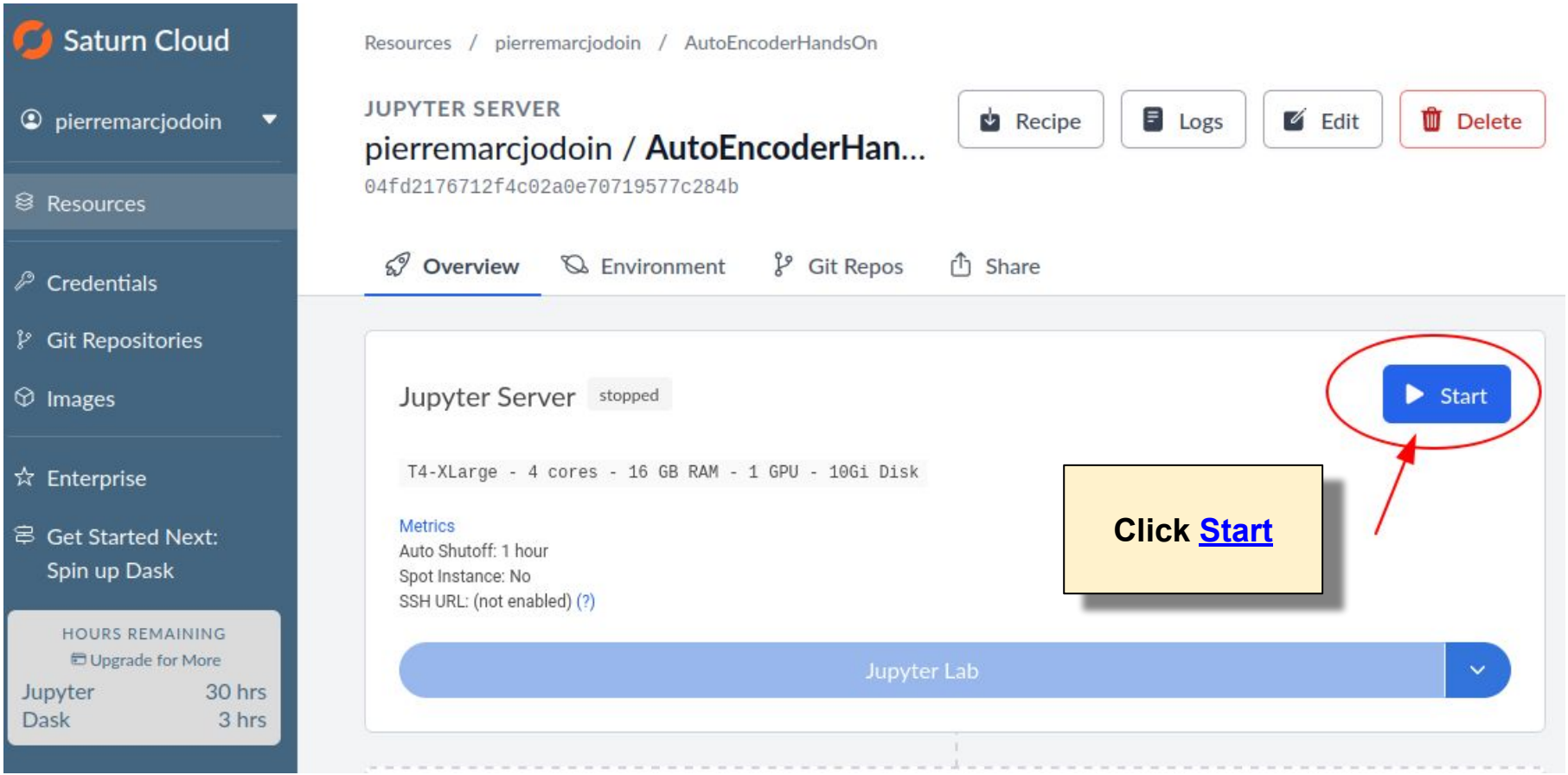
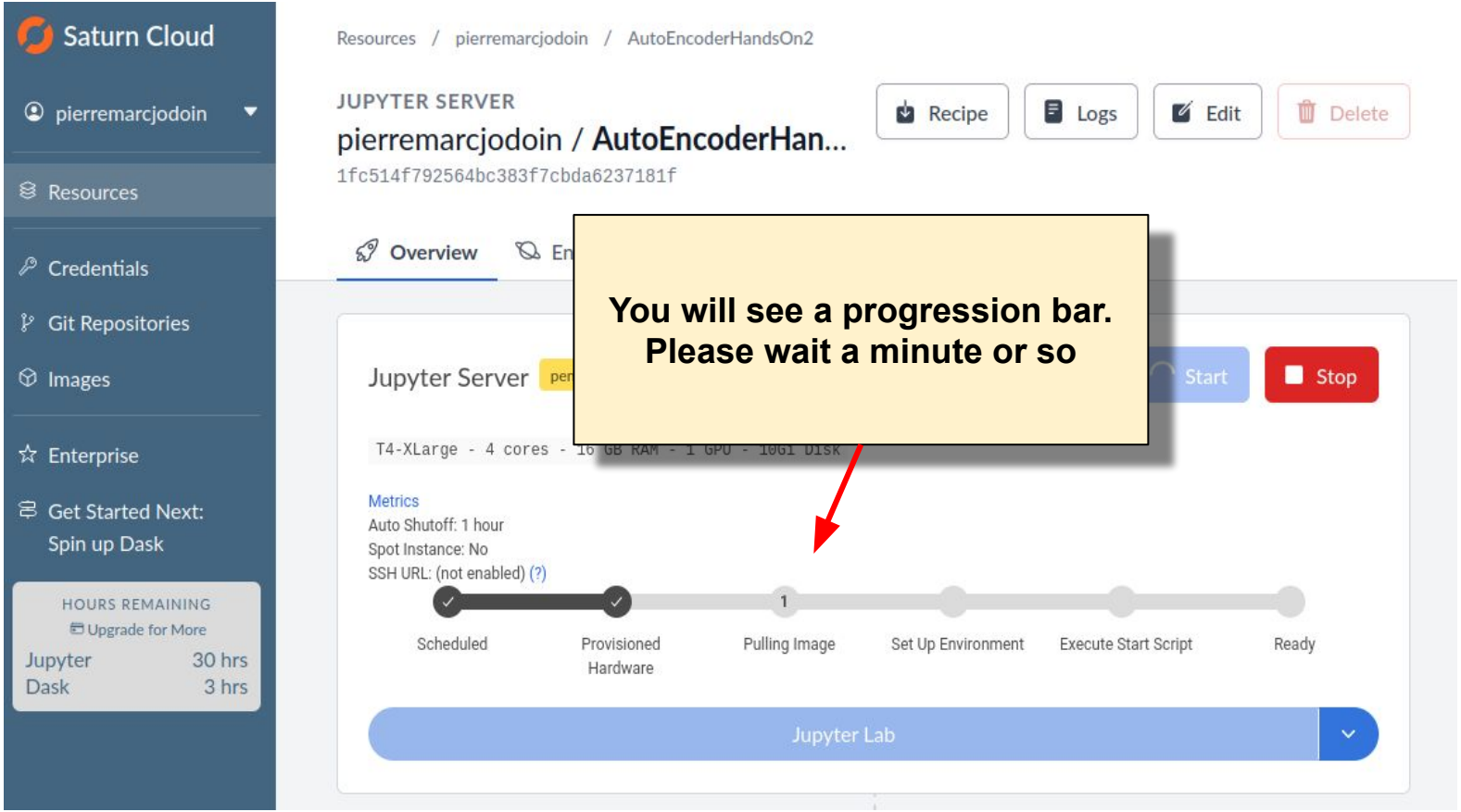
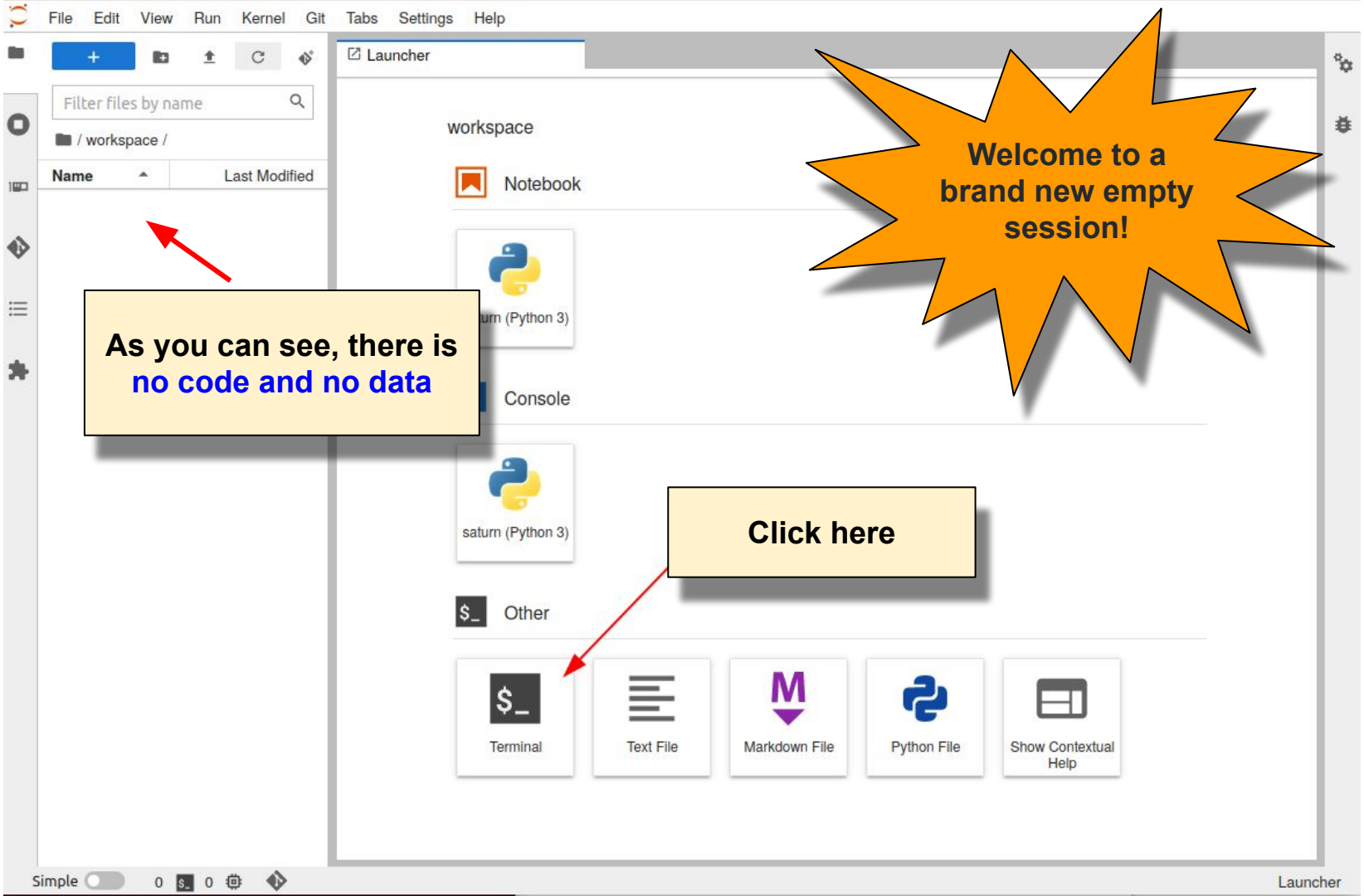


Image
saturncloud/saturn-pytorch
Version
2022.03.01
Spot Instance
This requests the server of specified size as Spot Instance. Spot Instances are less expensive, but may be shut down at any time (with a two-minute warning). (?)
Working Directory
/home/jovyan/workspace
Write these for apt install
Extra Packages
Extra packages are installed every time the resource starts up - right before the start script. Use spaces to separate packages.
If you find yourself adding the same packages to lots of resources, you may want to permanently add packages to a custom image instead. (?)
Conda Install
Pip Install
Apt Packages
htop zip unzip python3-opencv
The packages together will run the following script:
apt-get install htop zip unzip python3-opencv
pip install opencv-python
Shutoff After
1 hour
Disabled options are not supported in th
And click Create
Advanced Settings (option
Create
Cancel


Saturn Cloud
pierremarcjodoin
Resources
Credentials
Git Repositories
Images
Enterprise
Get Started Next:
Spin up Dask
HOURS REMAINING
Upgrade for More
Jupyter 30 hrs
Dask 3 hrs
Resources / pierremarcjodoin / AutoEncoderHandsOn
JUPYTER SERVER
pierremarcjodoin / AutoEncoderHan...
04fd2176712f4c02a0e70719577c284b
Recipe
Logs
Edit
Delete
Overview
Environment
Git Repos
Share
Jupyter Server
stopped
Start
T4-XLarge - 4 cores - 16 GB RAM - 1 GPU - 10Gi Disk
Metrics
Auto Shutoff: 1 hour
Spot Instance: No
SSH URL: (not enabled) (?)
Click Start
Jupyter Lab

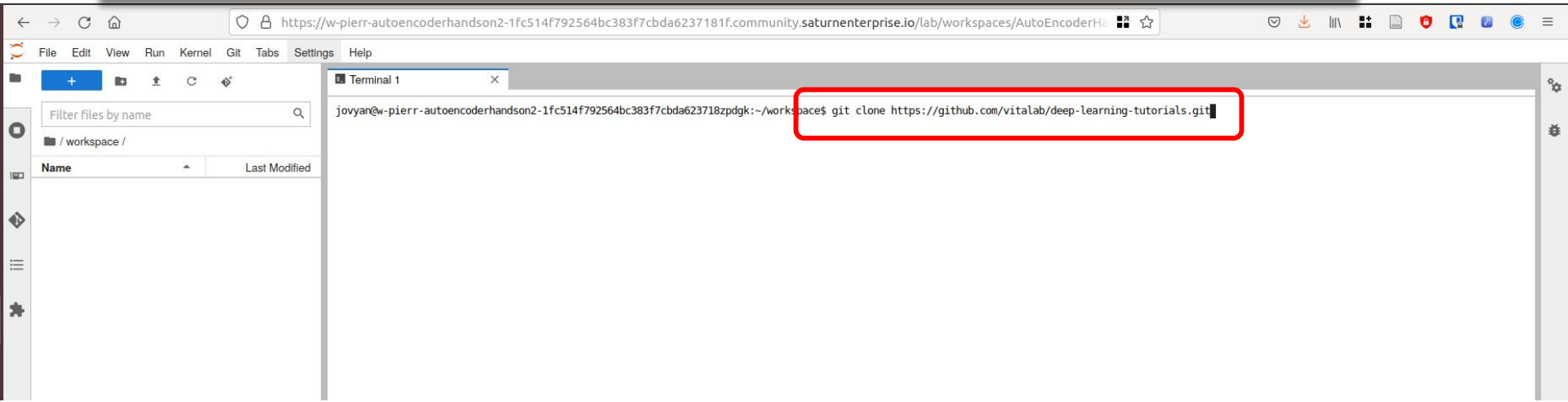

Saturn Cloud
pierremarcjodoin
Resources
Credentials
Git Repositories
Images
Enterprise
Get Started Next:
Spin up Dask
HOURS REMAINING
Upgrade for More
Jupyter 30 hrs
Dask 3 hrs
Resources / pierremarcjodoin / AutoEncoderHandsOn2
JUPYTER SERVER
pierremarcjodoin / AutoEncoderHan...
1fc514f792564bc383f7cbda6237181f
Recipe
Logs
Edit
Delete
Overview
You will see a progression bar.
Please wait a minute or so
Jupyter Server
Start
Stop
T4-XLarge - 4 cores - 16 GB RAM - 1 GPU - 10Gi Disk
Metrics
Auto Shutoff: 1 hour
Spot Instance: No
SSH URL: (not enabled) (?)
Scheduled
Provisioned Hardware
Pulling Image
Set Up Environment
Execute Start Script
Ready
Jupyter Lab


File Edit View Run Kernel Git Tabs Settings Help
Launcher
Filter files by name
/ workspace /
Name
Last Modified
workspace
Notebook
urn (Python 3)
Console
saturn (Python 3)
Other
Terminal
Text File
Markdown File
Python File
Show Contextual Help
Welcome to a brand new empty session!
As you can see, there is no code and no data
Click here
Simple
Launcher

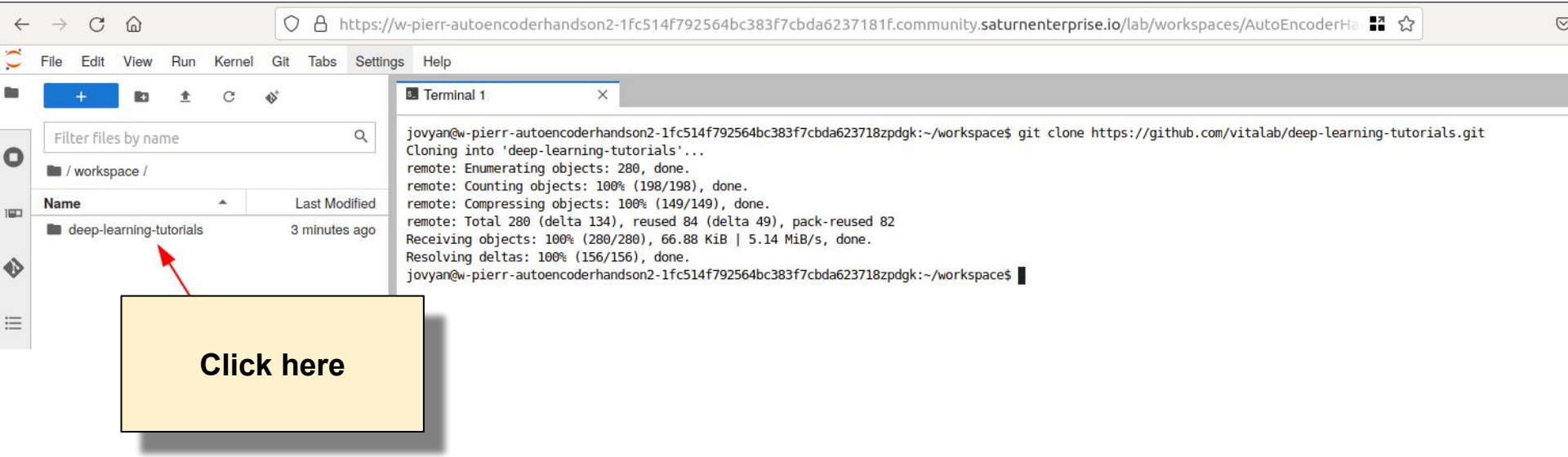
Lets download the code

In the terminal, type

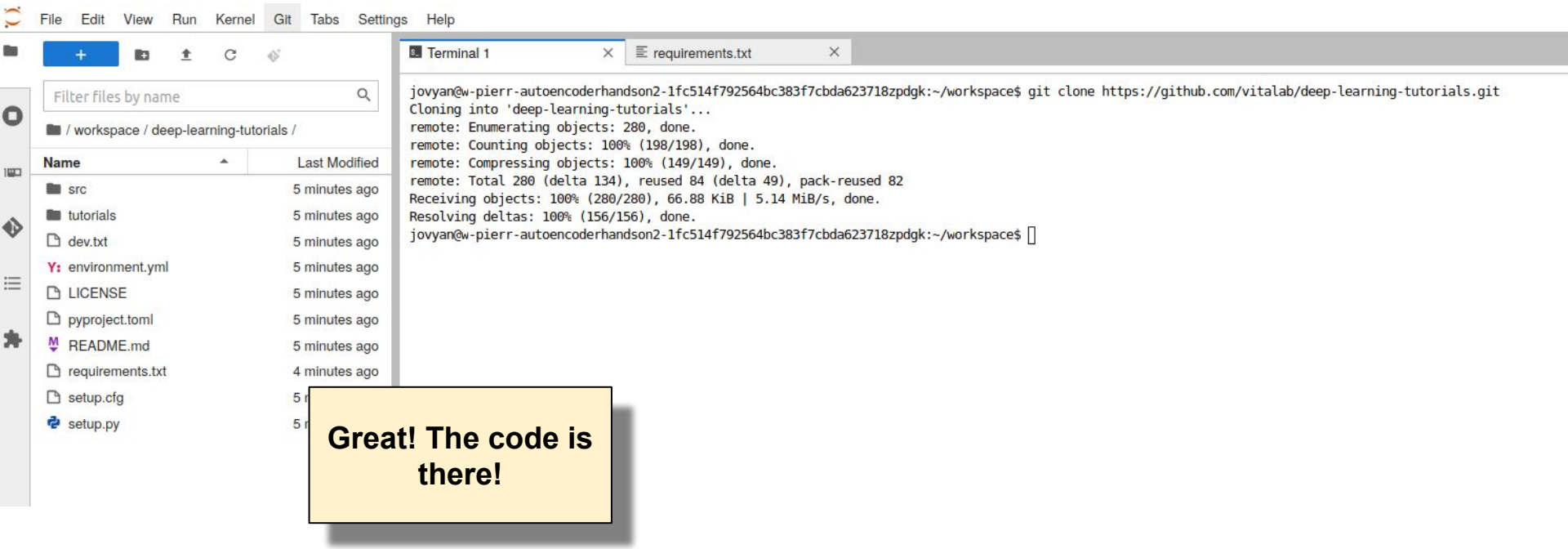
```
git clone https://github.com/vitalab/deep-learning-tutorials.git
```



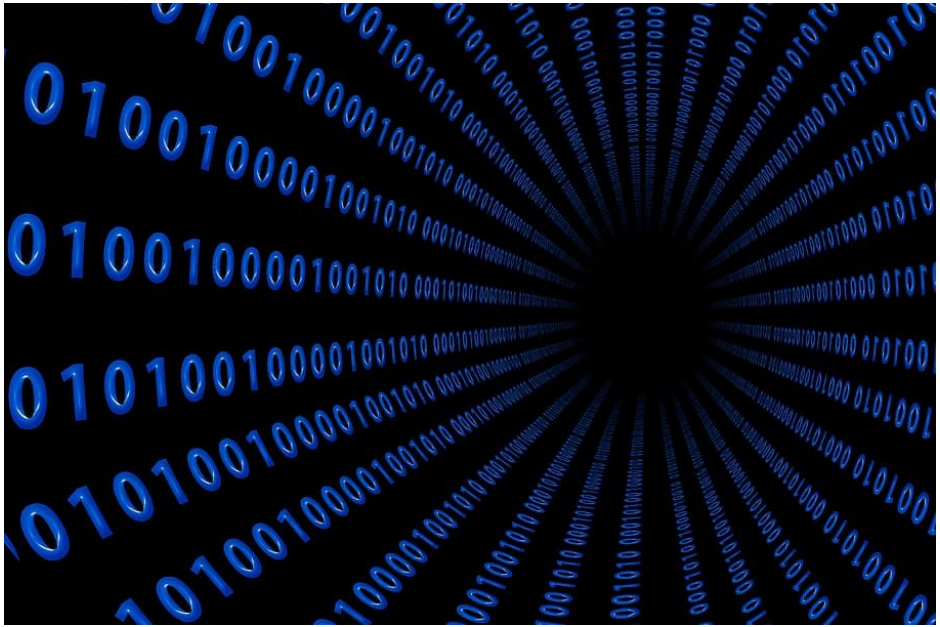
This command allows to **download the code** from a public **gitHub repository**

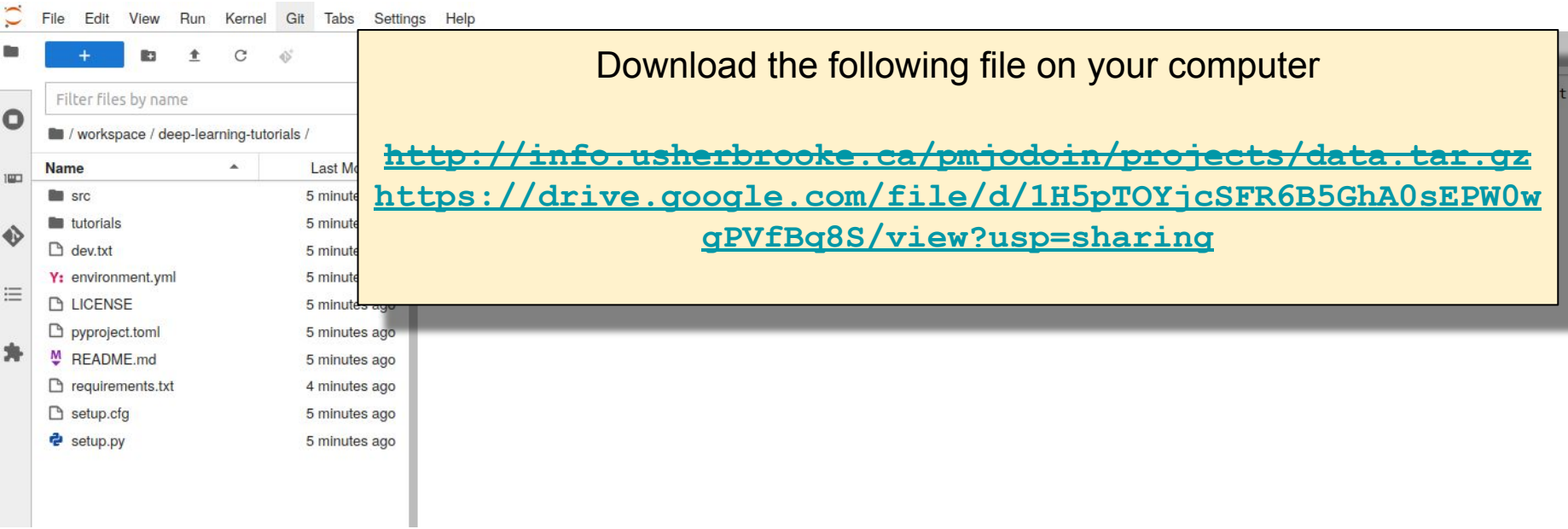


Click here


File Edit View Run Kernel Git Tabs Settings Help
Filter files by name
/ workspace / deep-learning-tutorials /
Name
Last Modified
src 5 minutes ago
tutorials 5 minutes ago
dev.txt 5 minutes ago
environment.yml 5 minutes ago
LICENSE 5 minutes ago
pyproject.toml 5 minutes ago
README.md 5 minutes ago
requirements.txt 4 minutes ago
setup.cfg
setup.py
Terminal 1
requirements.txt
jovyan@w-pierr-autoencoderhandson2-1fc514f792564bc383f7cbda623718zpdgk:~/workspace$ git clone https://github.com/vitalab/deep-learning-tutorials.git
Cloning into 'deep-learning-tutorials'...
remote: Enumerating objects: 280, done.
remote: Counting objects: 100% (198/198), done.
remote: Compressing objects: 100% (149/149), done.
remote: Total 280 (delta 134), reused 84 (delta 49), pack-reused 82
Receiving objects: 100% (280/280), 66.88 KiB | 5.14 MiB/s, done.
Resolving deltas: 100% (156/156), done.
jovyan@w-pierr-autoencoderhandson2-1fc514f792564bc383f7cbda623718zpdgk:~/workspace$
Great! The code is there!

Lets download the data

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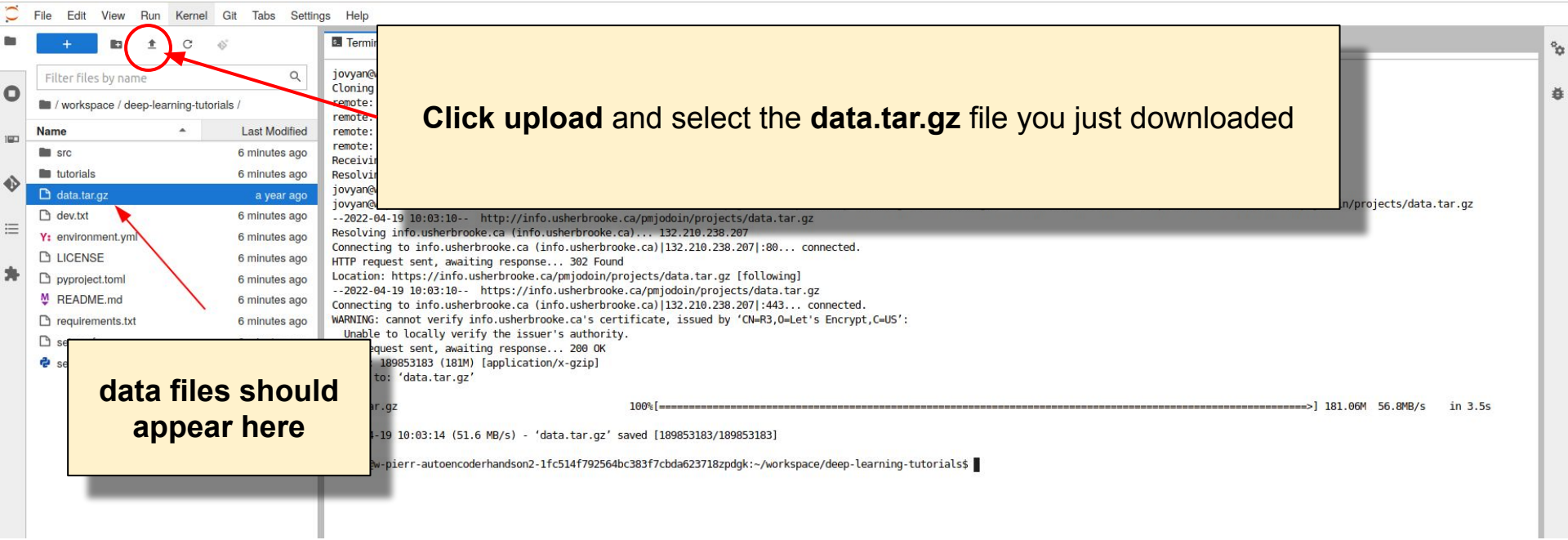
tutorials 5 minute
dev.txt 5 minute
environment.yml 5 minute
LICENSE 5 minutes ago
pyproject.toml 5 minutes ago
README.md 5 minutes ago
requirements.txt 4 minutes ago
setup.cfg 5 minutes ago
setup.py 5 minutes ago
Download the following file on your computer
http://info.usherbrooke.ca/pmjodoin/projects/data.tar.gz
https://drive.google.com/file/d/1H5pTOYjcSFR6B5GhA0sEPW0wgPVfBq8S/view?usp=sharing


File Edit View Run Kernel Git Tabs Settings Help
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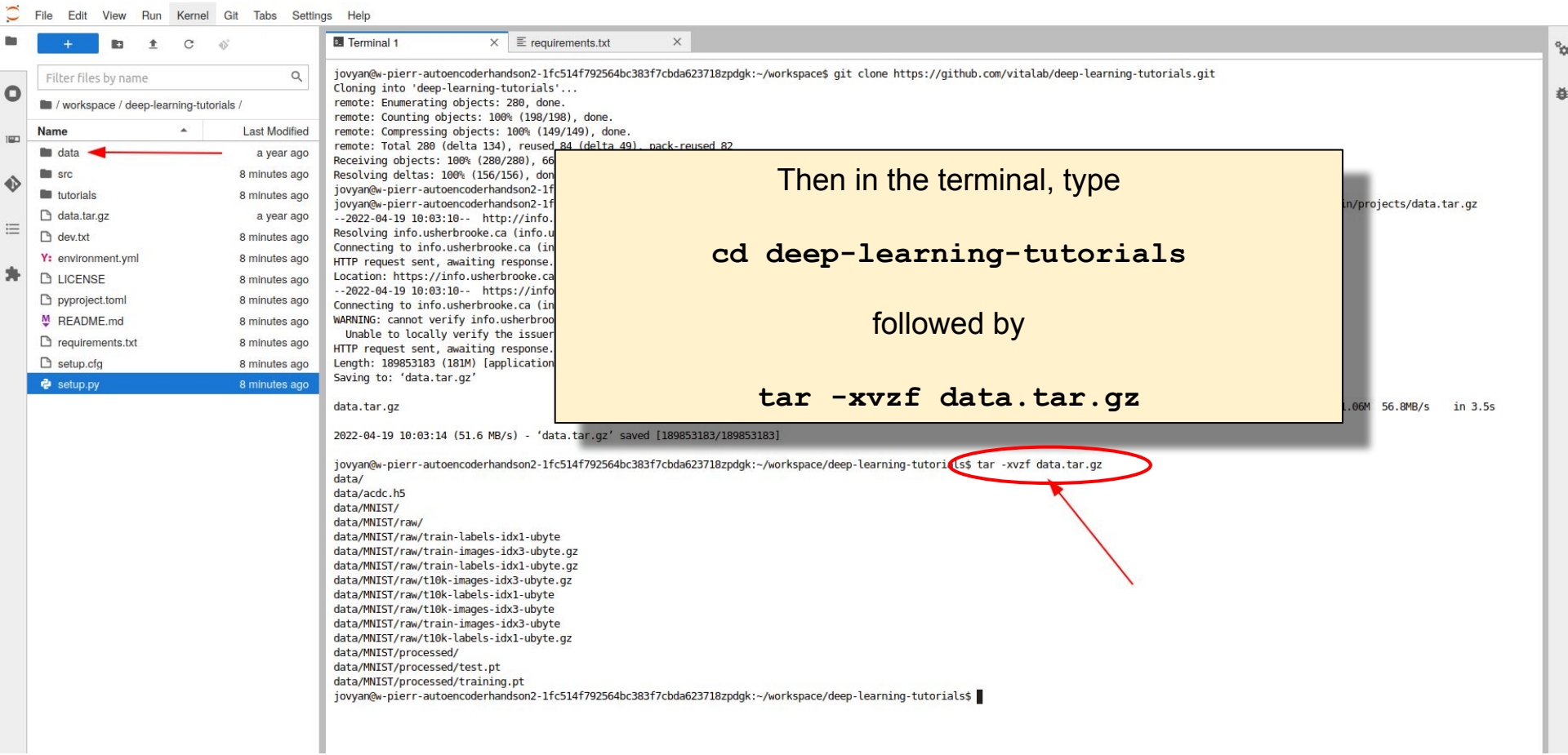
tutorials 6 minutes ago
data.tar.gz a year ago
dev.txt 6 minutes ago
environment.yml 6 minutes ago
LICENSE 6 minutes ago
pyproject.toml 6 minutes ago
README.md 6 minutes ago
requirements.txt 6 minutes ago
Click upload and select the data.tar.gz file you just downloaded
data files should appear here
--2022-04-19 10:03:10-- http://info.usherbrooke.ca/pmjodoin/projects/data.tar.gz
Resolving info.usherbrooke.ca (info.usherbrooke.ca)... 132.210.238.207
Connecting to info.usherbrooke.ca (info.usherbrooke.ca)|132.210.238.207|:80... connected.
HTTP request sent, awaiting response... 302 Found
Location: https://info.usherbrooke.ca/pmjodoin/projects/data.tar.gz [following]
--2022-04-19 10:03:10-- https://info.usherbrooke.ca/pmjodoin/projects/data.tar.gz
Connecting to info.usherbrooke.ca (info.usherbrooke.ca)|132.210.238.207|:443... connected.
WARNING: cannot verify info.usherbrooke.ca's certificate, issued by 'CN=R3,O=Let's Encrypt,C=US':
Unable to locally verify the issuer's authority.
189853183 (181M) [application/x-gzip]
to: 'data.tar.gz'
100%[>] 181.06M 56.8MB/s in 3.5s
-19 10:03:14 (51.6 MB/s) - 'data.tar.gz' saved [189853183/189853183]


File Edit View Run Kernel Git Tabs Settings Help
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tutorials 8 minutes ago
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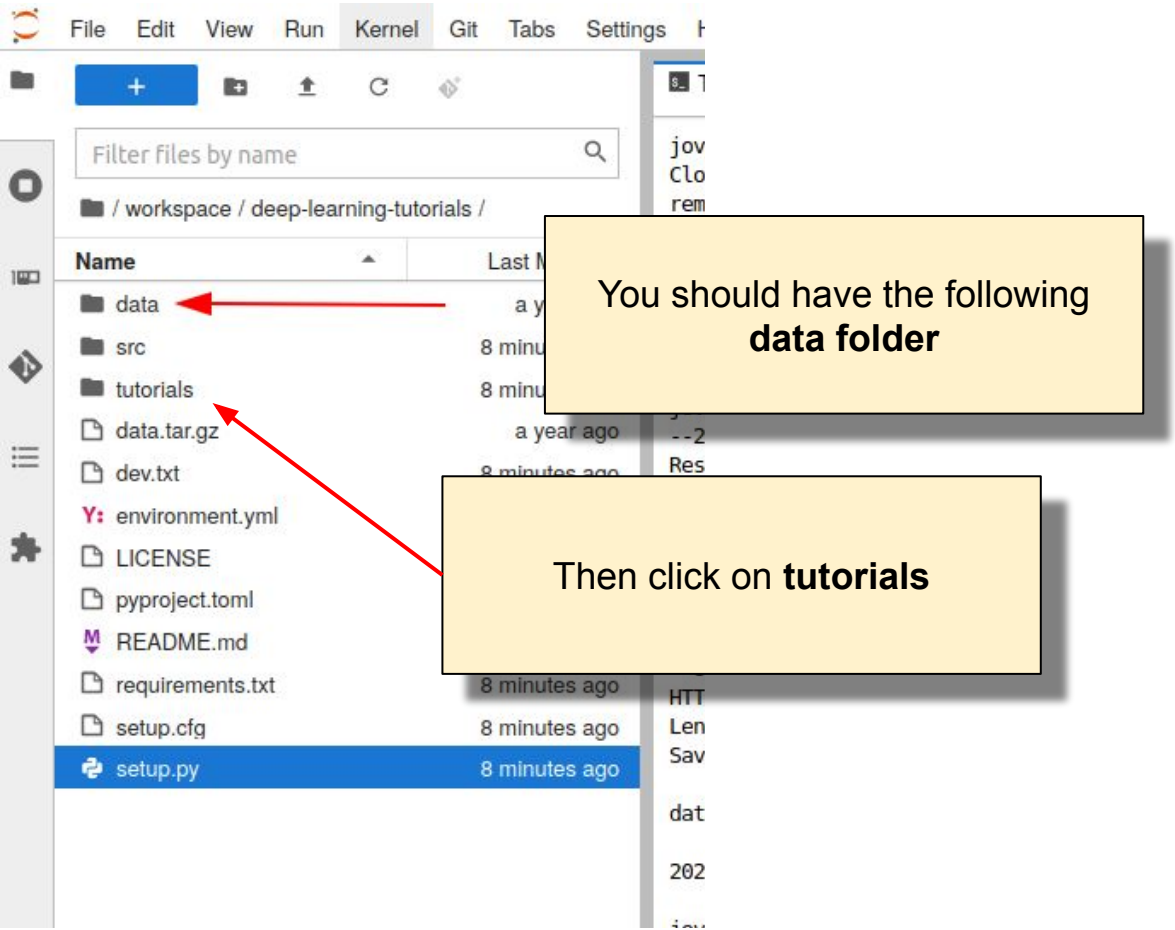
environment.yml 8 minutes ago
LICENSE 8 minutes ago
pyproject.toml 8 minutes ago
README.md 8 minutes ago
requirements.txt 8 minutes ago
setup.cfg 8 minutes ago
setup.py 8 minutes ago
Terminal 1
requirements.txt
jovyan@w-pierr-autoencoderhandson2-1fc514f792564bc383f7cbda623718zpdgk:~/workspace$ git clone https://github.com/vitalab/deep-learning-tutorials.git
Cloning into 'deep-learning-tutorials'...
remote: Enumerating objects: 280, done.
remote: Counting objects: 100% (198/198), done.
remote: Compressing objects: 100% (149/149), done.
remote: Total 280 (delta 134), reused 84 (delta 49), pack-reused 82
Receiving objects: 100% (280/280), 66
Resolving deltas: 100% (156/156), don
jovyan@w-pierr-autoencoderhandson2-1f
jovyan@w-pierr-autoencoderhandson2-1f
--2022-04-19 10:03:10-- http://info.
Resolving info.usherbrooke.ca (info.u
Connecting to info.usherbrooke.ca (in
HTTP request sent, awaiting response.
Location: https://info.usherbrooke.ca
--2022-04-19 10:03:10-- https://info
Connecting to info.usherbrooke.ca (in
WARNING: cannot verify info.usherbroo
Unable to locally verify the issuer
HTTP request sent, awaiting response.
Length: 189853183 (181M) [application
Saving to: 'data.tar.gz'
data.tar.gz
2022-04-19 10:03:14 (51.6 MB/s) - 'data.tar.gz' saved [189853183/189853183]
jovyan@w-pierr-autoencoderhandson2-1fc514f792564bc383f7cbda623718zpdgk:~/workspace/deep-learning-tutorials$ tar -xvzf data.tar.gz
data/
data/acdc.h5
data/MNIST/
data/MNIST/raw/
data/MNIST/raw/train-labels-idx1-ubyte
data/MNIST/raw/train-images-idx3-ubyte.gz
data/MNIST/raw/train-labels-idx1-ubyte.gz
data/MNIST/raw/t10k-images-idx3-ubyte.gz
data/MNIST/raw/t10k-labels-idx1-ubyte
data/MNIST/raw/t10k-images-idx3-ubyte
data/MNIST/raw/train-images-idx3-ubyte
data/MNIST/raw/t10k-labels-idx1-ubyte.gz
data/MNIST/processed/
data/MNIST/processed/test.pt
data/MNIST/processed/training.pt
jovyan@w-pierr-autoencoderhandson2-1fc514f792564bc383f7cbda623718zpdgk:~/workspace/deep-learning-tutorials$
Then in the terminal, type
cd deep-learning-tutorials
followed by
tar -xvzf data.tar.gz


File Edit View Run Kernel Git Tabs Settings
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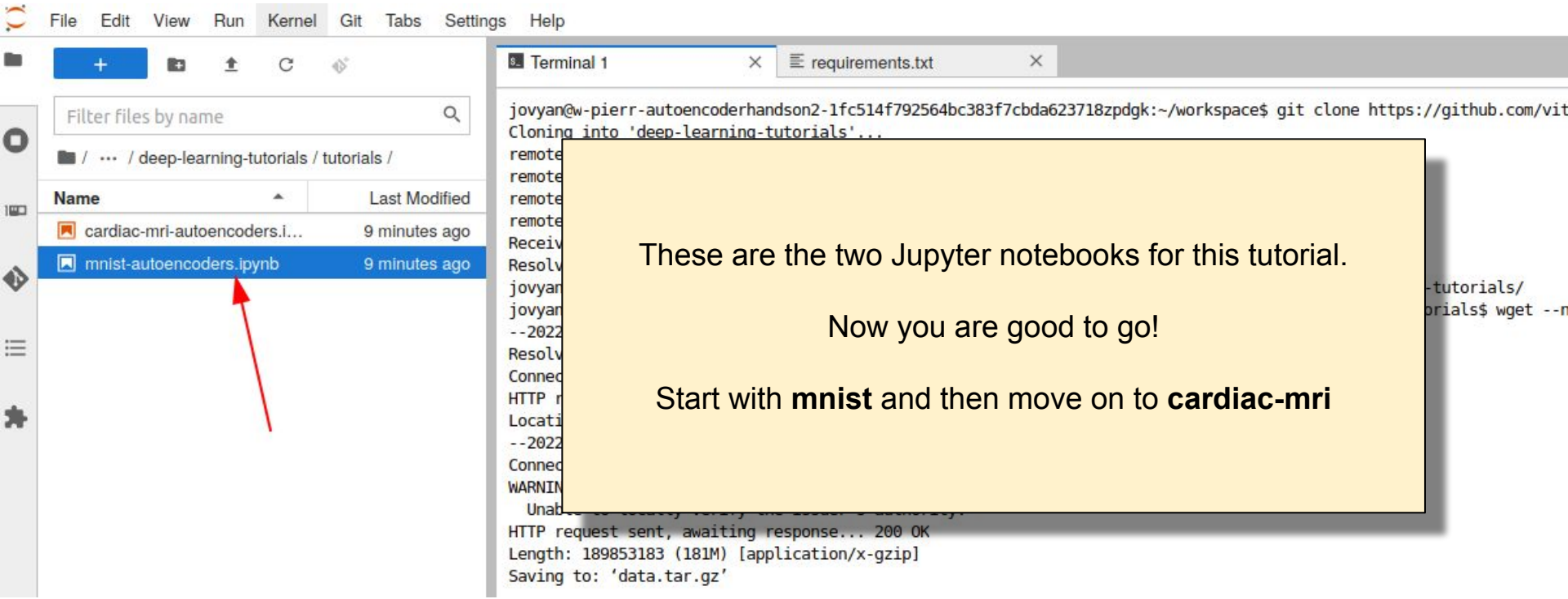
dev.txt
environment.yml
LICENSE
pyproject.toml
README.md
requirements.txt
8 minutes ago
setup.cfg
8 minutes ago
setup.py
8 minutes ago
You should have the following
data folder
Then click on tutorials


File Edit View Run Kernel Git Tabs Settings Help
Filter files by name
/ ··· / deep-learning-tutorials / tutorials /
Name
Last Modified
cardiac-mri-autoencoders.i...
9 minutes ago
mnist-autoencoders.ipynb
9 minutes ago
Terminal 1
requirements.txt
jovyan@w-pierr-autoencoderhandson2-1fc514f792564bc383f7cbda623718zpdgk:~/workspace$ git clone https://github.com/vit
Cloning into 'deep-learning-tutorials'...
HTTP request sent, awaiting response... 200 OK
Length: 189853183 (181M) [application/x-gzip]
Saving to: 'data.tar.gz'
These are the two Jupyter notebooks for this tutorial.
Now you are good to go!
Start with mnist and then move on to cardiac-mri