

# Machine Learning

FYS-2021  
Autumn 2024

# Course goal

- Introduction to the most important concepts in Machine Learning.
- Perfect level for starting:
  - Pattern Recognition FYS-3012 (advanced ML, more theory)
  - Deep Learning FYS-3033 (deep neural networks)
  - Kaggle competitions <https://www.kaggle.com/>
- A good balance between theory and practice
  - Plenty of ML blogs and tutorials online, but often weak on the theory side. This course give you the theory behind.

# Organization

- Lectures: Tuesdays and Thursdays 14:15-16:00
- Exercises: once a week but several groups - you may change group
- 2 sites: Tromsø and Bodø

[https://timeplan.uit.no/emne\\_timeplan.php?sem=24h&module=FYS-2021-1](https://timeplan.uit.no/emne_timeplan.php?sem=24h&module=FYS-2021-1)

Uke 34	Mandag 19.08.2024	Tirsdag 20.08.2024	Onsdag 21.08.2024	Torsdag 22.08.2024
08:00	08:15-10:00 FYS-2021-1 C. Choi	TEKNOBYGGET 1.026 Gruppe 4 Andre ...		08:15-10:00 FYS-2021-1 C. Choi
09:00				TEKNOBYGGET 1.026 Gruppe 2 Siv ing Informatikk master informatikk ...
10:00		10:15-12:00 FYS-2021-1 C. Choi	TEKNOBYGGET 1.026 Gruppe 1 Siv ing Anvendt fysikk og matematikk FYS-2021-1 ...	10:15-12:00 PHG 139 Gruppe 5 Bode FYS-2021-1 C. Choi
11:00				TEKNOBYGGET 1.026 Gruppe 3 Kuntig Intelligens ...
12:00				
13:00				
14:00		14:15-16:00 FYS-2021-1 B. Ricaud E. Wetzler	PHG 139 TEKNOBYGGET 1.022AUD Forelesning Opptak+live ...	14:15-16:00 FYS-2021-1 B. Ricaud E. Wetzler
15:00				PHG 139 TEKNOBYGGET 1.022AUD Forelesning Opptak+live ...
16:00				

# Course plan

Course plan on Canvas <https://uit.instructure.com/courses/34698>

- Lectures and exercises every week
- 2 Assignments: pass/fail
- 1 take-home exam (focused on code and practice) 50% of the final grade
- 1 final exam (focused on the theory) 50% of the final grade

# Tools for the course

- Online resources
  - See the list on Canvas
- Communication
  - Canvas
  - Discord
  - Questions in lectures / exercises
- Programming
  - Python
  - Jupyter notebooks
  - Python modules for ML: numpy, matplotlib, pandas, scikit-learn
  - Github

# Plan for August

**ML  
HISTORY**

**LINEAR  
REGRESSION**

**LOGISTIC  
REGRESSION  
(1 NEURON)**

**OPTIMIZATION  
&  
GRADIENT DESCENT**

imgflip.com



← Ready for assignment 1:  
Make something that learns!

# First exercise session

## Programming for Machine Learning

- Python and Python tricks
- Github

# Matrices and Machine learning

Forget about for loops: use matrix-vector multiplications

- More concise maths
- Faster computations in Python (calls routines coded in C, process chunks of memory)
- Can be processed in parallel with GPUs





# Matrices and Machine learning

Forget about for loops: use matrix vector multiplications

$$Ay = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1N} \\ a_{21} & a_{22} & & \\ \vdots & & \ddots & \\ a_{M1} & & & a_{MN} \end{pmatrix} \begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{pmatrix} = \begin{pmatrix} a_{11}y_1 + \cdots + a_{1N}y_N \\ a_{21}y_1 + \cdots + a_{2N}y_N \\ \vdots \\ \sum_j a_{Mj}y_j \end{pmatrix}$$

```
1 B = numpy.array((M,1))
2 for i in range(M):
3     B[i] = 0
4     for j in range(N):
5         B[i] = B[i] + a[i,j]*y[j]
```

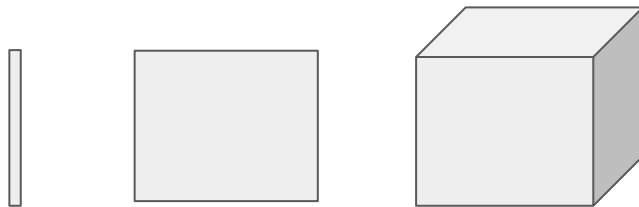
```
1 B=A@y
```

# Tensors

A tensor is a n-dimensional array.

Example: a vector (1), a matrix (2), a data cube (3), ...

- Deep learning is heavily using tensors and matrix multiplications.
- One framework for designing deep learning model is called “Tensorflow”



*Make sure you know your linear algebra!*

# Git and version control



Git documentation:

<https://git-scm.com/doc>

Popular platform: Github <https://github.com/about>

- Track changes in code, allow many people to work on the same code.
- Save the incremental difference in code
- Heavily used in Machine Learning

<https://en.wikipedia.org/wiki/Git>

<https://docs.github.com/en/get-started/using-git/about-git>

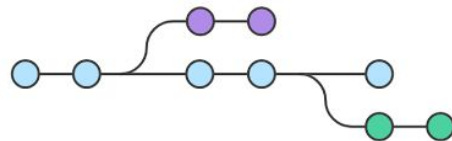
<https://docs.github.com/en/get-started/start-your-journey/hello-world>

<https://sillevl.gitbooks.io/git/>

Example: <https://github.com/pytorch/pytorch> or

<https://github.com/microsoft/ML-For-Beginners>

Practice during the first exercise session



# Git

Git for the ML course

- you will have to use Git for the mandatory assignments

Before or during exercise session:

- install Git
- create a Github account