Machine Learning

CS-433

Martin Jaggi & Nicolas Flammarion

EPFL

19th Sept 2023

Alternatives

Master

- CS-552 Modern Natural Language Processing
- CS-502 Deep learning in biomedicine
- EE-559 – Deep Learning *(UniGe)*
- CIVIL-459 – Deep learn. for autonomous vehicles
- EE-411 – Fundamentals of inference and learning
- MGT-418 – Convex optimization
- MATH-403 – Low-rank approximation techniques
- MATH-412 – Statistical ML
- MATH-520 – Mathematics of machine learning
- MICRO-455 – Applied ML
- MICRO-401 – ML Programming
- MICRO-570 – Advanced ML
- DH-406 – ML for Digital Humanities
- CS-430 – Intelligent Agents
- CS-439 – Optimization for ML
- CS-401 – Applied Data Analysis
- CS-503 – Visual intelligence: machines and minds
- EE-556 – Mathematics of data
- CS-526 – Learning theory

Bachelor

- CS-233 – Intro to ML
- CS-330 – Artificial Intelligence
- EE-311 - Fundamentals of machine learning
- CIVIL-226 – Introduction to ML for engineers
- BIO-322 – Intro to ML for bioengineers
- ME-390 - Foundations of artificial intelligence

Seminars, Doctoral Courses and continued education

- ENG-704 – EECS Seminar: Advanced Topics in ML
- CS-723 – Topics in ML Systems
- CS-612 – Topics in Natural Language Processing
- EE-608 – Deep Learn. for Natural Language Proc.
- EE-618 – Theory and M. for Reinforcement Learning
- EE-613 – ML for engineers
- EPFL Extension School – Applied Data Science: ML

Research talks: join mailing list:
ml@groupes.epfl.ch on groups.epfl.ch

EPFL

Course Logistics

Assessment

- **Project 1 (10%)**, due Oct 30th
- **Project 2 (30%)**, due Dec 21st
- **Final exam (60%)**

Course Logistics

Lectures

tentative
schedule

MJ	19/9	Introduction, Linear Regression	01a,01b 01c,01d		
	20/9	Cost functions		Lab 1	
	26/9	Optimization			
	27/9	Optimization		Lab 2	Project 1 start
	03/10	Least Squares, Overfitting			
	04/10	Max Likelihood, Ridge Regression, Lasso		Lab 3	
NF	10/10	Generalization, Model Selection, and Validation			
	11/10	Bias-Variance decomposition		Lab 4	
	17/10	Classification			
	18/10	Logistic Regression		Lab 5	
	24/10	K-Nearest Neighbor			
	25/10	Support Vector Machines		Lab 6	
	31/10	Kernel Regression			Proj. 1 due 30.10.
	01/11	Neural Networks – Basics, Representation Power		Lab 7	
	07/11	Neural Networks – Backpropagation, Activation Functions			Project 2 start
	08/11	Neural Networks – CNNs, Regularization, Data Augmentation, Dropout		Lab 8	
	14/11	Neural Networks – Transformers			
	15/11	Adversarial ML		Lab 9	
	21/11	Ethics and Fairness in ML			
MJ	22/11	Unsupervised Learning, K-Means		Lab 10	
	28/11	Gaussian Mixture Models			
	29/12	EM algorithm		Lab 11	
	05/12	Matrix Factorizations			
	06/12	Text Representation Learning		Lab 12 & Project Q&A	
	12/12	Self-supervised learning			
	13/12	Generative models		Lab 13	
	19/12	*Guest Lecture, t.b.d.*			
	20/12	*Projects pitch session (optional)*			Proj. 2 due 21.12.

Course Logistics

Lectures

Tuesday 2x45mins, Room: Rolex learning center
Thursday 2x45mins, Room: Rolex learning centre

We provide PDF lecture notes on our webpage and GitHub, and streaming&recordings of all lectures available

Course Logistics

Exercises

Thursday 14:15 - 16:00 - **live interaction!**
Rooms: INF1, INF119, INJ218, INM202, INR219
assignment by lastname, see course info sheet PDF

All labs and projects are in **Python**.
See the first lab to get started.

Code Repository for Labs: github.com/epfml/ML_course

Course Logistics

Team of assistants

contact us: online forum!

Lara Orlandic (Organizing TA)
Maksym Andriushchenko
Francesco D'Angelo
Corentin Dumery
Dongyang Fan
Simin Fan
Hojjat Karami
Atli Kosson
Skander Moalla
Hristo Papazov
Aditya Varre
Oguz Yüksel

Erwan Emlil
Vinko Sabolcec
Mikhail Seliugin
Guanyu Zhang
Yauheniya Karelskaya
Alejandro Hernandez Cano
Naisong Zhou
Aybars Yazici

Philippe Servant
Yiyang Feng
Leonardo Trentini
Simon Halstensen
Mathis Randl
Mohamed Hadhri
Dong Chu

Course Logistics

Projects

- **Project 1 (10%)**, due Oct 30th
- **Project 2 (30%)**, due Dec 21st

Real-world problems, Python, Groups of **3** Students

What to expect?

- **overview** over ML
- basic **understanding** of most important ML **methods** and **fundamental concepts**
- experience how ML is done on a **practical** problem

Your colleagues here

EPFL sections

What is Machine Learning?

What is Machine Learning?

algorithms that can

learn from data

traditions…

data
rules
traditional programming
output
data
desired output
ML
rules
ML model
weights w

traditions…

test
data
ML
testing
output

training
data
desired
output
ML
training
rules
ML model
weights w

Learning Functions from Data

	input	output	
pixels		hussar monkey	**image classification**
text	"Bonjour! Comment allez-vous?"	"Hello! how are you?"	**translation**
audio		"Hello! how are you?"	**speech to text**
pixels		"a dog is sitting at the beach next to another dog"	**image captioning**
text	wha…t?		**writing assistant**

input	output	
“moon landing conspiracy”	webpage 1 webpage 2 webpage 3	**web search**
browsing history on fashion website		**recommender system**
pixels	melanoma	**medical image processing**
video	“look at whether it works for the UK or not”	**lip reading**
“moon landing conspiracy…”	The bot must be trained in a language capable of decoding Python's strings and displaying it on a high quality display, in order to be able to produce what they have learned in English, and indeed, these images, have been uploaded to the web for quite some time. If this type of thing is indeed present in the wild, then what sort of wild bot should I be worried about? Thanks to this one specific experiment performed on the same day - as described by the author: Using some kind of neural network to learn speech, and being able to decode it in order to communicate with others (including yourself)	**text generation**
professional dancer + photo of myself	https://youtu.be	**dance transfer**

image source

Classification

The Learning Algorithm

$\boldsymbol{x}_i \in \mathbb{R}^d$

(Stochastic Gradient Descent)

$$\boldsymbol{w} := \boldsymbol{w} + \lambda \cdot \boldsymbol{x}$$

iteration cost: O(d)

Perceptron

(Rosenblatt 1957)

Support-Vector-Machine

(Cortes & Vapnik 1995)

towards…

understanding intelligence

?

if-then-else

$\neq$

intelligence

towards…

understanding intelligence

?

Machine Learning

vs

Neuroscience / HBP

What is the difference between Artificial Intelligence, Data Mining, Statistics, Machine Learning?

AI
Computer Science
Statistics
Machine Learning
Application domain

Job Skills

Machine Learning
Coding Skills
Math & Statistics
Data Scientist
Software Engineer
Traditional Scientist
Application domain

Cycles of popularity

source

why ML?

Applications

Industry Applications

- majority of industries, originally not ‘digital’:
  - agriculture, NGOs, ‘sharing economy', logistics, delivery, services, manufacturing, sports, personalized health, call centers, entertainment, …
- **not only** the ‘usual suspects’

facebook

amazon.com

Google

Applications in Other Sciences

- increasingly data driven
  - … Psychology, Economics, Medicine, Social sciences
  - science of X ➔ *digital* science of X

en.wikipedia.org/wiki/Index_of_branches_of_science

ML is only a small part!

History

- ML is **not new!**

London 1854
cholera outbreak

History

- ML is **not new!**
- the early days - 1950ies and 1960ies
  - Neural networks
  - Turing

What has changed?

1950s: 10^3 FLOP

2023: 10^{24} FLOP*

"the embryo of an electronic computer that … will be able to walk, talk, see, write, reproduce itself and be conscious of its existence." 1958

The New York Times

SECTIONS

TECHNOLOGY

How Many Computers to Identify a Cat? 16,000

By JOHN MARKOFF JUNE 25, 2012

Email

Share

Tweet

*chatGPT training estimate

Challenges

- Hype
  - cycles of AI popularity
- Data Ethics, Privacy, Fairness

amazon.de

Hallo! Melden Sie sich an, um persönliche Empfehlungen zu erhalten. Neukunde? Bitte hier starten.

Mein Amazon | Sonderangebote | Wunschzettel | Gutscheine | Geschenke

Alle Kategorien ansehen | Suche | Sport & Freizeit

Sport & Freizeit | Erweiterte Suche | Camping & Outdoor | Fitness | Fußball | Golf | Pulsuhren & GPS | R

Größeres Bild

Für Kunden: Stellen Sie Ihre eigenen Bilder ein.

Baseballschläger Aluminium "32" von Tysonz

von Unbekannt

Noch keine Kundenrezensionen vorhanden: Schreiben Sie die erste!

Preis: EUR 21,90

Alle Preisangaben inkl. MwSt.

Auf Lager.

Verkauf und Versand durch **knockout24**. Für weitere Informationen klic
Verkäufernamen.

Noch 4 Stück auf Lager.

2 neu ab EUR 21,90

Kunden, die diesen Artikel gekauft haben, kauften auch

Pfeffer 2442 KO Verteidigungsspray JET 40 ml von Pfeffer KO

(12)

EUR 5,22

Sturmhaube 3-loch Acryl schwarz von Unbekannt

(13)

EUR 1,38

Pfefferspray KO-FOG 40ML von Pfeffer KO

(17)

EUR 5,19

KO-CS Verteidigungsspray 40 ml von KO-CS

(33)

EUR 4,22

Challenges

- Hype
  - cycles of AI popularity
- Data Ethics, Privacy, Fairness
- Lack of Interpretability
  - example: medical applications of deep learning
- Social Implications of AI
  - impact and potential unsafe use *(today's models)*
    - e.g. impact on labor market, education, abuse, misinformation,…
  - threats from Super-human AI *(tomorrow's models)*
    - see Nick Bostrom, Yuval Harari

need: Scientific Method, Reproducible Research, Open Source and Open Data

ML Applications
by CS-433 Master Students

ML4science projects by your colleagues 2020

Machine Learning-based Estimation of Cardiac Contractility from Peripheral Pressure Waveform
Deep learning techniques for geometric matching of C. Elegans brain microscopy images
Benchmarking Machine Learning Methods for Eukaryote/Prokaryote Contigs Classification
Machine Learning for Science: Classification of Skin Samples Using Mass Spectrometry Analysis
Application of Deep Knockoffs for fMRI to Generate Surrogate Data
Automatic detection of weak cipher usage in aircraft communications
Predicting Topic Change and Emoji Usage from Twitter Data
Cell Nuclei Segmentation in 2D Fluorescence Microscopy Images
Unsupervised cell classification in flow cytometry data
Predicting chemicals concentration in water streams using Gradient Boosting Regressor
Extracting Masonry Building Facades through Polygon Image Segmentation
Sequence-dependent clustering of DNA in Protein-DNA Xray crystal data and in cgDNA+ model
Applying the VoxelMorph Framework to C.Elegans Brain Data
Using forearm sEMG to control individual fingers of a robotic hand
Music beyond Major and Minor
Avalanche Forecasting: An Ordinal Regression Approach
Machine Learning for Side-Channel Disassembly
Multi-object Detection and Tracking
Motion-based Similarity Search in Videos of Confucian Rituals
Detecting the Degree of Cavitation In Situ in Young Trees
Machine Learning in Chemistry
Personalized Federated Image classification using Weight Erosion
In-crystal Gamma-interaction localization for positron emission tomography (PET) from Cherenkov photons
Classification of zebrafish embryo using various ML methods
Resource-Efficient Machine Learning Algorithm Design for On-Implant Neurological Symptom Detection
Ebola Virus Disease Diagnosis for West African Ebola Virus epidemic
Supervised classification of fly behaviors from posetracking data
Cell-type classification from microscope imaging
COVID-19 Predictions using Machine Learning
Unsupervised time series analysis of country wise COVID data
Voxelmorph
Unsupervised classification of video games styles
Can the Style and Wording in Critical Reviews of Video Games Predict its PEGI Labelling?
Ensemble Methods for Dynamic Portfolio Valuation
Vector embeddings of harmonies in music with deep learning
Robustness of U-Net based models to common image artefacts
Recognizing Humor and Predicting Humor Ratings in Short Texts
Segmentation of cell nuclei in 2D microscopy images with CNNs
Mechanism of Action (MoA) Prediction – Kaggle Competition
Diagnostic and Prognostic models for Ebola
Automatic Grading of Handwritten Student Essays
Stroke Level Prediction through Pacman Game Data
Among Us Project 2 – Market states prediction
Regularized maximum likelihood estimation – TRANSP-OR
Stroke Level Estimation through pac-man game data played by acute stroke patients
STLM: Steganography in Text using Language Models
Eastern Rituals Search Engine (ERSE)
Cough Classifier
Extracting high value lung ultrasound images from video for the diagnosis and prognosis of COVID-19
Detecting rooftop available surface for installing PV modules in aerial images using Deep Learning
Dimensionality reduction and clustering of energy consumption time series in supermarket buildings
Protein-Protein Interactions
Predicting gene-gene relationship with CNNC model
PneumoNet: Neural networks for the detection of pneumonia from digital lung auscultation audio
Predicting errors during Pacman for stroke patients
Galaxy Detection Machine Learning Project
Automatic detection of available area for rooftop solar panel installations
Prediction of myocardial infection risk after stenosis diagnosis
LC3 compressive strength analysis
Adapting Attention Guided Camera Localization for the Geodetic Engineering Laboratory
Machine learning models to predict the diagnosis and risk of COVID-19 from clinical data in Switzerland
Facades and Openings Detection Based on Different Deep Learning Models
Variational Inference compared to Markov Chain Monte Carlo for modelling gene expression
3D Spatiotemporal clustering of mixed-type medical data in Tanzania
Classification and Clustering on Schizophrenic Patient's Data
TRANSP-OR – Prediction of mode of transportation
Learned cross-domain descriptors (LCD) for drone navigation
What if Interactive GlobalCOVID Policy Simulator
Image Segmentation of Adenovirus Particles in Food Vacuoles of Eukaryotic Organisms
Music Beyond Major and Minor
Determining the important features for estimating the reproduction number in the COVID-19 pandemic
Exploring chord embedding spaces between musical composers and eras
Vector Embeddings of Musical Chords
Word embeddings and transformer models for optimal learning
Identification of fire periods from air quality monitoring network measurements
Drone and pigeon detection
Characterization of turbulent structures in tokamaks
Improving Deep Learning models for EMG decoding used for prosthesis control enhancement
Pneumonia Diagnosis based on CNN-LSTM-BERT Model
L-form bacteria segmentation
Machine Learning for Spaced Repetition in Human Learning
COVID-19 risk stratification on Chest X-Rays: performance on a small cohort of patients in Switzerland
Dry vs Wet Cough Automatic Classification using the COUGHVID Dataset
Improving Freshwater Quality Measurements through Machine Learning
Lesion detection on cardiology images using Deep Learning
3D to 2D feature matching for next generation 3D mapping algorithms
Calibrate a model of OTC markets

ML4science projects by your colleagues 2021

Probing EEG Signals with Neural-Network Classifiers
Learning from Re-Structured Knowledge in Pretrained Transformer Feed-Forward Layers
A System for Automating the Detection and Counting of Frogs in Small Passages
Efficient CNN defect detection in sewer pipes with application of active learning
Convolutional graph neural networks for tracking yeast cells
U-Net for segmenting fascicles in vagus nerve histologies
The Best Location for You to Live
Severe vs Mild Cough Classification
Improving Chord Prediction in Jazz Music using Melody Information
Identifying recrystallization in stainless steel using machine learning on accoustic data
Socio-epidemiological insights from a yearlong COVID-19 Twitter stream
Complete Sentence Detection for Speech Recognition Systems
Deformation of images using Generative Adversarial Networks: a study on neural activity data of the worm C. elegans
Predicting emotions from brain data using various machine learning models.
Optimization of a memory gene selection for annotating cell-families in scRNAseq data, a machine learning approach
Wolf Howling Detection
Machine Learning for Energy Expenditure Prediction
Identifying Green Jobs
Surrogate modelling of nerve electrical stimulation using deep learning
Improving Chord Prediction in Jazz Music
Learning-based Correspondences for Ophthalmic Image Registration
Machine Learning replaces Radiative Transfer
Deep Learning-based Discomfort Glare Detection
Network Architecture Search and Expert Designed CNNs for Multi-target Concrete Defect Detection
SKA Source finding
Classification of ordinal outcomes for the analysis of injury severity using machine learning methods
Developing a ML pipeline to detect centrioles in human cells
If You Are Happy And You Know It, Your Speech Will Surely Show It: A CNN Based Speech Emotion Detector
SELFIES or SMILES? A case study in chemical reaction prediction
Machine learning for flir temperature extraction
Posture Detection for Healthy Desk Work
Tuberculosis Classification Survey using Computer Vision models
Phosphorylation Site Prediction Using Deep Learning
Unsupervised Topic Modeling
Disambiguating Voynich Manuscript transliterations with word embeddings
Transformer network for the Dial-a-Ride problem
Covert speech decoding from EEG signals
Stock Prediction using Sentiment Analysis
Studying Lobbying Influence in the European Parliament using Twitter data
Oscillation Classifier for a 2 dimension trajectory
Automation of tuft detachment detection for flow detachment analysis
Predicting lobbying influence in the European parliament through retweet graphs
Predict mouse behaviour from LFP recordings
Predicting the Coordination Environment of Zn metalloproteins
Approaches to DFT Parameter Learning
Effect of Loss Function on Supervised Learning of Quantum Many-Body States
ModalPINN - Reconstruction of airflow around a cylinder using limited number of sensors
Unsteady parametrized Stokes equations in a 2D arterial bifurcation with stenosis: design of an Autoencoder for data compression
The future of data storage: "Digital Polymers"
Droplet Classification & Cell Counting
Discrete traffic data generation using ML methods
Detecting TB from chest X-Rays in a population of patients living with HIV and diabetes in West Africa
Machine learning for predicting stimuli response in mice
Modular Clinical Decision Support Networks for Data-Driven Diagnostic Predictions
Evaluating the performance of GANs on C. Elegans neural network images deformation
Exploring and Visualising Patterns in 300’000 Consultations Collected with a Clinical Decision Support Algorithm
Mouse Action Segmentation
Music Super-resolution with Spectral Flatness Loss and HiFi-GAN discriminators
Lego Project
The LEGO Detection Project
Using GANs to deform 3D bodies
Semantic Segmentation of Centrioles in Human Cells and Assigning Them to Nuclei
Finding meaning in autogenerated text
Droplet Counter
Reconstruction of cell lineage with deep learning and cell state transition dynamic inference
Automatic detection of natural slicks in Lake Geneva from a ground-based optical imagery package
Delineating Solar Panels using Aerial Imagery
Psychology takes on ML
EcoML
Exploring the feasibility of DNN models for the quantitative discrimination between different conformational species of α-synuclein
Complex Valued Neural Networks
Neuron and axon image detection
A regression based approach of exploring the glare metrics using real world experiments data
Ophthalmology Image Registration
Move sequence detection on bouldering problems
Understanding Bouldering using ML Methods
Generalizability of dysarthric speech detection models across languages and pathologies
Retinal image registration
Improving chord prediction in Jazz music using melody information
Protein domain classification
DNA Binding Sites Prediction
Unsupervised Learning to Prescribe Medication to Schizophrenic Patients
Plasma Mode Classification using 2D-Convolutional Neural Networks
Predicting Ions Concentration in Water Streams
Unsupervised Non-Deformable Retina Images Registration Using Neural Network
Detecting novelty in USPTO patent applications with neural networks
Digitizing patents
Fear Decoding in Rodents
Combining Unsupervised and Supervised Learning Techniques for Prediction and Analysis of Rhône's Plume Shape
Racing team - detection of cones
Lung Ultrasound Covid Classification
Hydrometeor Classification and riming degree estimation from Multi-Angle Snowflake Camera images.
Single amino acid prediction at protein-protein interaction interfaces
Reproduce test-time training algorithm on iWildCam dataset
Towards Accurate Prediction of Donor-acceptor Copolymer Properties
Word Embeddings for the Morphosyntactic Analysis of the Voynich Manuscript

ML4science projects by your colleagues 2022

Estimating the robustness of deep learning fraud detection on the ethereum blockchain against attackers with a leaked model
ML4 Science Physics Informed Neural Networks
CERN Zenodo - Adaptable Spam Filter Modelling
Grokking - Reproducibility Report
Solving Road Segmentation using UNet
Wildfire Susceptibility Mapping
Modelling Energetic Particles in Matter
HOPE-Generator
Crack Segmentation on FRP CT Images Using Residual Multi-scale Dilated Convolution and Reversed Cross Entropy Loss
Epilepsy Detection
Rhe force applied by a standing wave acoustic levitator on small objects
Predicting the Intelligence of a Person From a Video: A Deep Learning Approach
Using Machine Learning for the Prediction of Motor Impairment and Recovery in Stroke
Firing rate prediction in optic nerve fibers
Optimal U-Net for Image Segmentation
Option B - Text classification
Satellite Images Classification - Project 2
Solubility classification of molecules
Modelisation of electron diffusion in water for radiation therapy using Generative Adversarial Networks
Sentiment Analysis on Tweets
Brain Fingerprinting and Task Decoding via Graph Structure Learning
Aerospace Bearing
Fear classification from physiological information using knowledge distillation
Predicting apartment demand using Machine Learning models
Cells and Pili Detection on ISCAT images
Brain Fingerprinting: Identifying Individuals via learned brain graphs
Doping detection using athlete's biological passports
Autonomous Lane Changing using Deep Reinforcement Learning with Graph Neural Networks
Sea ice coverage
Reproducibility Study of ”Scaled-YOLOv4: Scaling Cross Stage Partial Network”
Centriole elimination program in C. elegans
Image Road Segmentation
Towards Commonsense Causal Reasoning with Large Language Models
Probe Posture Prediction
Reproducibility Study of ``Assessing Generalization via Disagreement''
ML project with the Laboratory of the Physics of Biological Systems
Optimization of Biological Age Prediction from Brain Anatomical Volume Measurements using Subgrouping Models
Do CNNs and Vision Transformers learn visual representations similar to those of the monkey brain?
Fine-tuning DeepLabv3 as a Road Segmentor for Satellite Images
Evaluating the Performance of the U-Net CNN for Road Segmentation in Satellite Images
A convolutional neural network segmenting fission yeast microscopy images
Bias Slayer: AI4Health - Spotting biased applications
Prognostic models on an international data set of 800'000 patients suspected of COVID-19
Language Proficiency and Authorship Classification Strength
Predicting Housing Demand
Segmentation of fission yeast microscopy images
On the Limits of Human-centered Commonsense in Large Language Models
Cell segmentation using time-sequence data
Automated Forensic Ink Recognition via MSP Analysis
Predicting if two frames are part of the same video
Natural Language processing: Twitter sentiment analysis
Reproducibility Study of ”Amortized Tree Generation for Bottom-up Synthesis Planning and Synthesizable Molecular Design”
Improving 3D cell segmentation in whole-brain imaging
Label-free identification of neurodegenerative aggregates using Deep Learning
Detection of protein aggregates in neural cells in Parkinson's disease
Worm tracking for personality detection
Decoding Brain States Triggered via Video Game with fMRI Based MVPA Approach

Building an ML model to determine tweet sentiment
Tweets Sentiment Analysis
Hit The Road Jack
Fine-tuning a neural language model to address text constraints
Automated Inpaintings of Humans in Images
Characteristics of different transcription factors
Fine-tuning and Prompt-learning on Commonsense Causal Reasoning
Mandatory Lane Change Prediction
Magical Mandrills
Reproducibility Study of Behavior Transformers
Predicting Social Media Sentiment: A Text Classification Approach
Machine learning in finance: forecasting and trading
Deep Learning-Based Clustering of Images of Damaged Buildings
GFP classification project
Team DTJ - Tweet sentimental analysis
Neural Network Architectures for Road Segmentation
Tracking worms for reading minds by Andromeda
ML4Science - Training an LCD model on the KITTI dataset
ML4Science: Mining Effective Words For Climate Change Communication
Automatic segmentation of nerve histological section - TNE lab
Prediction of fractional flow reserve based on CT scan images and lesion masks of coronary arteries
Composer Classifier on MuseScore Sheet Music
Adaptive Quantization for 6DoF Pose Estimation
Deep hedging (reproducibility challenge)
Exchange Rate Forecasting with Neural Networks
Physics-informed neural networks for a system of discrete masses and springs
Semantic Road Segmentation using combination of high spatial resolution Neural Network model
Road segmentation
Multitask learning for harmodynamics
Reproducibility Challenge of the paper: Numerical influence of ReLU’(0) on backpropagation
Text Sentiment Classification Project
Deep Learning-Based Dysarthric Speech Classification In Adverse Acoustic Environments
Report For Text Sentiment Classification
Vote Prediction Algorithm - Valais Constituante
Modular Decision Support Networks (MoDN) to predict respiratory disease from lung sounds
Predicting poverty through time with publicly available data
Censorship of Twitter - Unsupervised Topic Modeling
A New 1D CNN Method to detect Sleep Apnea using a single-lead ECG signal
Combinatorial optimization with Autoregressive Neural Networks
Classification of Tweets based on Censorship
Patent Classification into Sustainable Development Goals defined by the United Nations.
Intrusion Detection System for Blockchain Transactions
latecommers Finding relevant gene for centriol assembly and desasembly in C.Elegans
Modelling of the neutral hydrogen in galaxies with a Fully-Connected Neural Network
Budding and Fission Yeast Segmentation
Predicting Depression From Passive Phone Data - NoCommonPoint -SMSL
Multimodal Deep Learning for a Global data set of COVID-19 Patients
Explaining the Valais Constituent Assembly Votes
Andasi Project 2: Predicting Myocardial Infarction from In Silico Data Using Transfer Learning
Machine Learning in Quantitative Finance - Fast Derivatives Pricing and Hedging
Improving Causality Understanding of Trajectory Prediction Models Using Contrastive Learning
Sleep Stage Classification through Non-Invasive Sensors
MultiModal Modular Network (MoMoNet) for predicting COVID diagnosis from mixed image and tabular data
Novelty Detection and Revenue Estimation
Deep Learning for Edge-AI Respiratory Disorder Monitoring
Novelty Detection in the Dotcom Bubble
Reproducing results for Adaptive Stochastic Variance Reduction for Non-convex Finite-Sum Minimization method
Federated learning for semantic segmentation of cracks in images

Reproducibility Challenge

reproduce (parts of) the experiments in a machine learning research paper:
https://paperswithcode.com/rc2022 (To be confirmed for 2023)
(the papers can be from any conference such as
NeurIPS, ICML, ICLR, ACL-IJCNLP, EMNLP, CVPR, ICCV, AAAI and IJCAI

Reproducibility Challenge recent examples:
On Warm-Starting Neural Network Training
Can gradient clipping mitigate label noise?
Sanity-Checking Pruning Methods: Random Tickets can win the Jackpot
Learning to Play Sequential Games versus Unknown Opponents
Distributed Distillation for On-Device Learning
AdaAttN: Revisit Attention Mechanism in Arbitrary Neural Style Transfer
Reproducing Empirical Results and Assessing Theoretical Guarantees of PAGE
Contrastive Learning of Musical Representation
Invariance Principle Meets Information Bottleneck for Out-of-Distribution Generalization
Learning by Turning: Neural Architecture Aware Optimisation

Applications, cont.

Image Data

- Astronomy
- Face recognition
- 2D + 3D medical imaging
- OCR
- self-driving cars

how-old.net (deactivated)

How-Old.net
HOW OLD DO I LOOK? #HowOldRobot

Text Data

- Text Understanding & Text Generation
- Spam Detection
- User Content
- Medical Text
- Machine Translation

negative	*neutral*	But i wanna wear my Concords tomorrow though but i don't feel like it
positive	*neutral*	Gonna watch Grey's Anatomy all day today and tomorrow(:
negative	*neutral*	@CoachVac heey do you know anything about UVA's fallll fest loll they invited me
neutral	*neutral*	@DustyEf when that sun is high in that Texas sky, I'll be buckin it to county fair. A
neutral	*positive*	Up 20 points in my money league with Vernon Davis and L. Fitz still to go tomorro
neutral	*positive*	DEEJAYING this FRIDAY in THE FIRST CHOP it's CHRIS actual SMITH with a smash

signing that was scheduled for tomorrow at the Books A Million
oks like it! Was after El Clasico on Sunday. I didn't like her lol
ent for the 2nd time today!
asketball Game tomorrow at 6:00 pm Then Football Senior nigh
@Young__Assassin VS @jamievarner set for TUF 16 Finale on t
lide thru sometime this weekend ill have somethin yu can sip c
absolutely-- I meant out of the Bachmann, Perry, Santorum, H
re Levein discussion on Wed. Can't keep changing boss, but he
vember 02, 1958 Elvis gave a party at his hotel before going o
t to then kick back n party everyday like its Fri
o exited about Vancouver tomorrow! I'm like a kid at Christma

Medical: Genetic Data

ref

Audio & Multimodal Data

- Hearing aids
- Voice Recognition

- Automatic Translation
- Lip Reading
- Video Analysis

LYREBIRD

Numerical / Sensor Data

- Cern
- Astronomy / Telescopes
- Fitness Trackers
- Weather Forecast
- Robotics
- Kinect

Games & Simulations

- Immediate Feedback
- Chess, Go
- Physical World

Internet Data: Part 1

$\approx UV^\top$

Recommender systems, Ads

Internet Data Part 2 / Large Language Models

ChatGPT

Virtual assistants

Generative AI

generation of
image, video,
audio, text
modalities

New Opportunities?

Your turn

up next:

- Regression
- Linear Regression
- Classification
- … **fundamental concepts of ML**