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Benefit and Risks of AI

AM-B SoSe 2022

Benefits and Risks of AI
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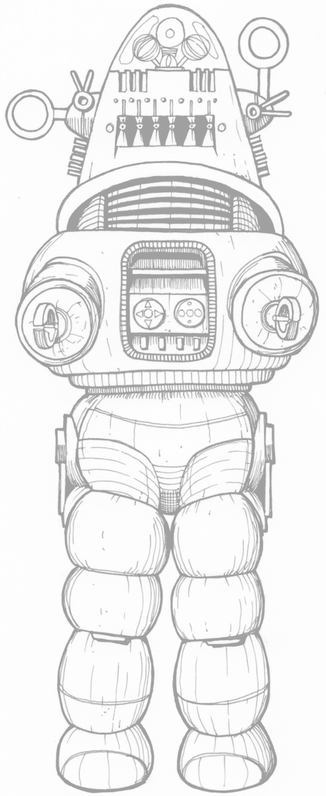


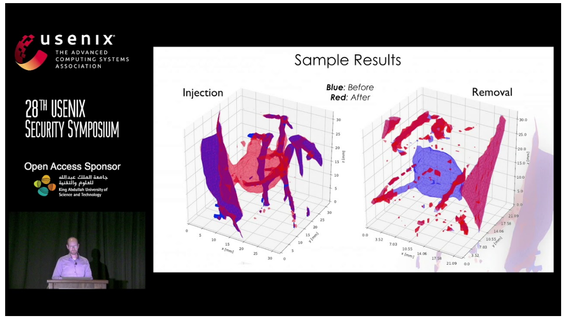
Benefits and Risks of AI
Deepfake - Examples

Image- and video-material but also audio-data in which parts have been modified. Among the methods most prominent in creating deepfakes is **G**enerative **A**dversarial **N**etworks (GAN) and **V**ariational **A**uto**E**ncoder

- Synthesizing mouth shapes from audio

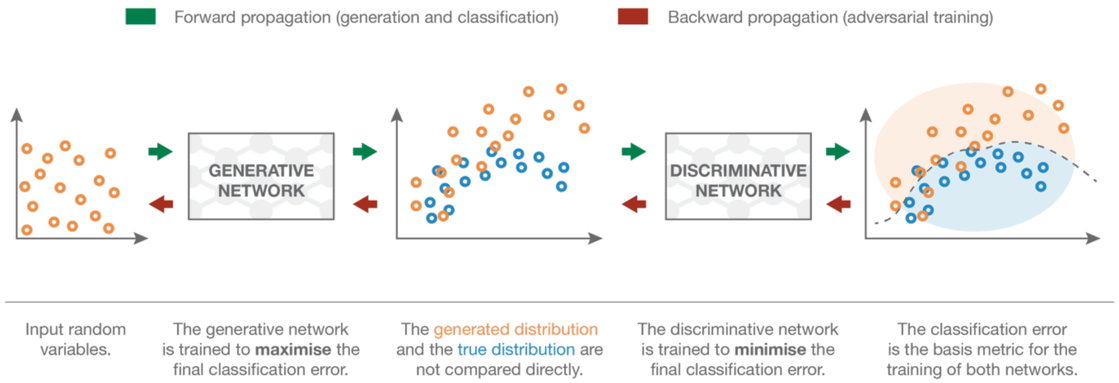
- Facial reenactment

- Tampering of 3D Medical Imagery



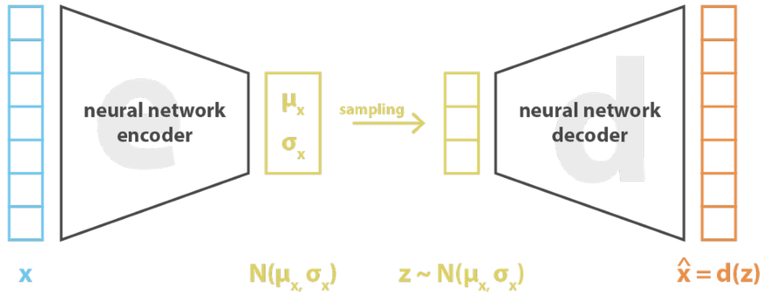
Benefits and Risks of AI
Deepfake - GAN & VAE

GAN



Source: website

VAE



$$\text{loss} = \|x - \hat{x}\|^2 + KL[N(\mu_x, \sigma_x), N(0, I)] = \|x - d(z)\|^2 + KL[N(\mu_x, \sigma_x), N(0, I)]$$

Source: website

What do you think ???

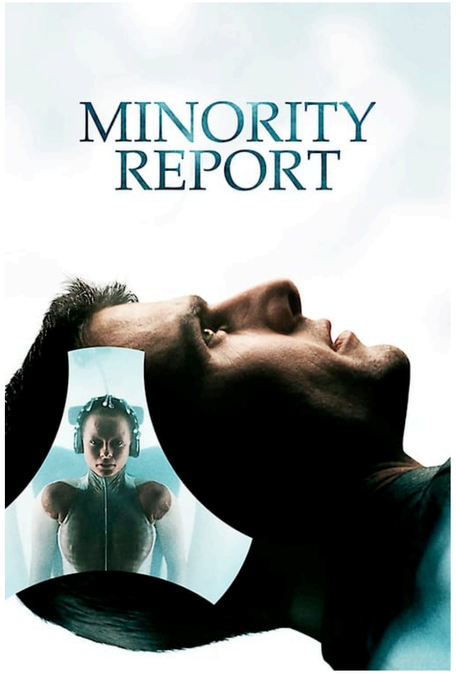
Benefits and Risks of AI
Predictive Policing

Usage of mathematical and analytical techniques for predicting criminal activities

According to RAND corporation there are four general categories:

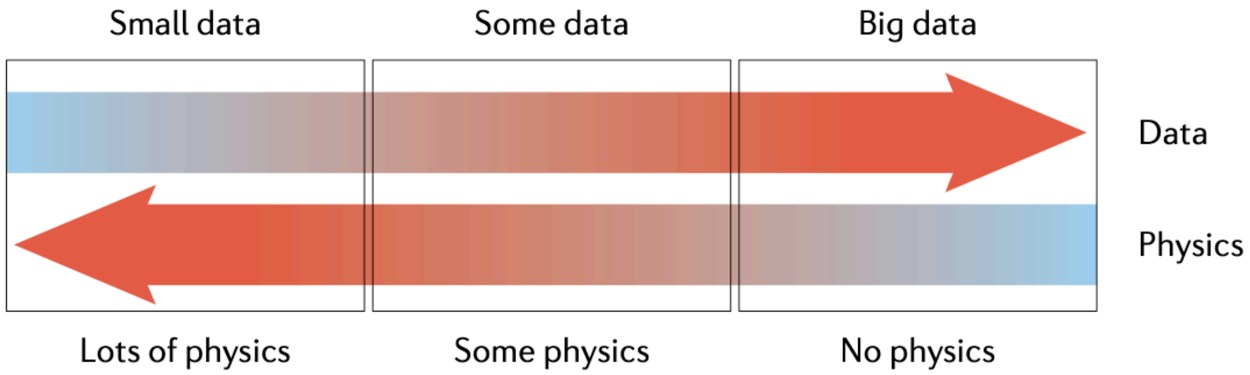
- Methods for predicting crimes
- Methods for predicting offenders
- Methods for predicting perpetrators' identities

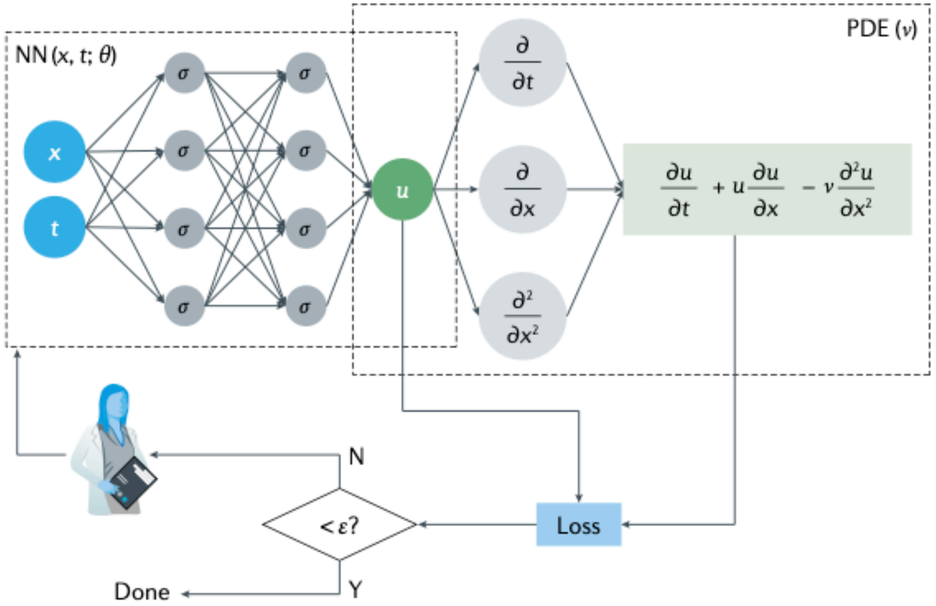
Some Statistics



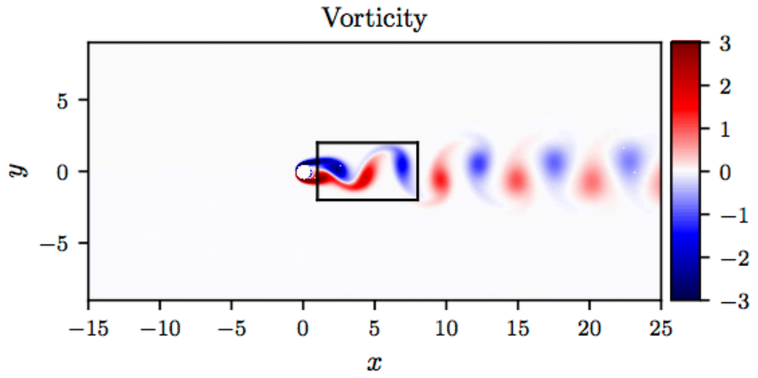
What do you think ???

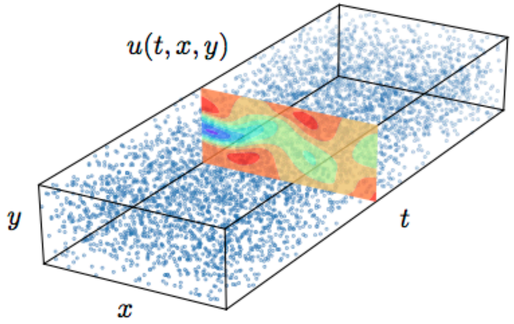
Applications of machine learning methods in general and deep learning methods in particular are becoming increasingly important for the natural sciences (physics, chemistry, biology). In a broader sense this does also tackle questions related to the combination of „classical“ simulation and data driven machine learning.

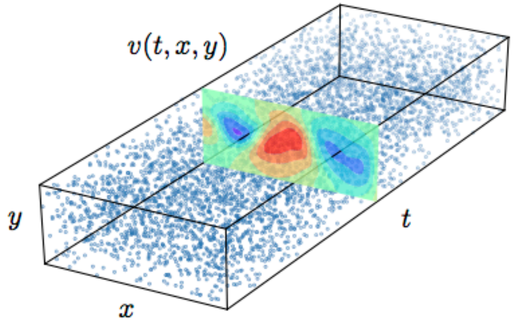




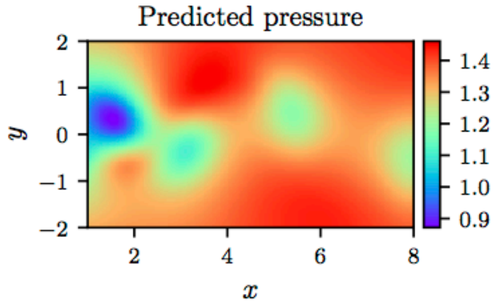
Source: „Physics informed machine learning“, Nature Reviews Physics, 2021

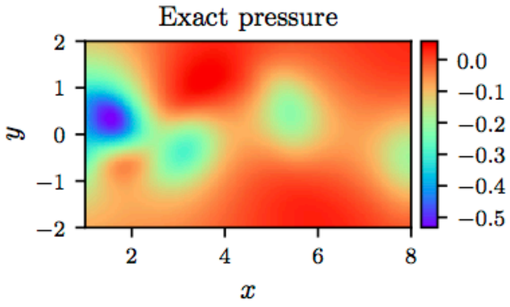






$$u_t + \lambda_1(uu_x + vu_y) = -p_x + \lambda_2(u_{xx} + u_{yy}),$$
$$v_t + \lambda_1(uv_x + vv_y) = -p_y + \lambda_2(v_{xx} + v_{yy}),$$





Correct PDE	$u_t + (uu_x + vu_y) = -p_x + 0.01(u_{xx} + u_{yy})$ $v_t + (uv_x + vv_y) = -p_y + 0.01(v_{xx} + v_{yy})$
Identified PDE (clean data)	$u_t + 0.999(uu_x + vu_y) = -p_x + 0.01047(u_{xx} + u_{yy})$ $v_t + 0.999(uv_x + vv_y) = -p_y + 0.01047(v_{xx} + v_{yy})$
Identified PDE (1% noise)	$u_t + 0.998(uu_x + vu_y) = -p_x + 0.01057(u_{xx} + u_{yy})$ $v_t + 0.998(uv_x + vv_y) = -p_y + 0.01057(v_{xx} + v_{yy})$

Source: „Physics Informed Deep Learning (Part II): Data-driven Discovery of Nonlinear Partial Differential Equations“
https://doi.org/10.48550/arXiv.1711.10566

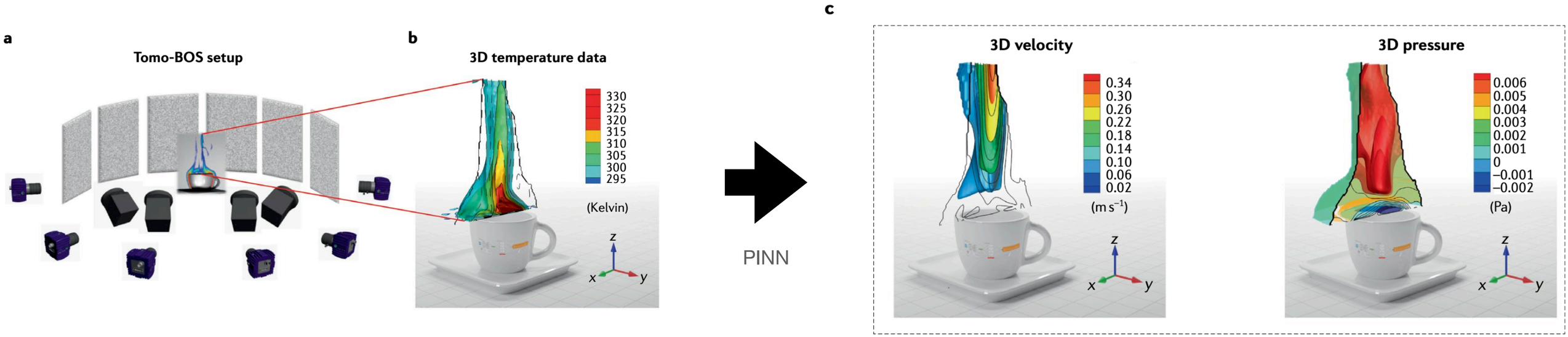


Fig. 2 | **Inferring the 3D flow over an espresso cup based using the Tomo-BOS imaging system and physics-informed neural networks (PINNs). a** | Six cameras are aligned around an espresso cup, recording the distortion of the dot-patterns in the panels placed in the background, where the distortion is caused by the density variation of the airflow above the espresso cup. The image data are acquired and processed with LaVision's Tomographic BOS software (DaVis 10.1.1). **b** | 3D temperature field derived from the refractive index field and reconstructed based on the 2D images from all six cameras. **c** | Physics-informed neural network (PINN) inference of the 3D velocity field (left) and pressure field (right) from the temperature data. The Tomo-BOS experiment was performed by F. Fuest, Y. J. Jeon and C. Gray from LaVision. The PINN inference and visualization were performed by S. Cai and C. Li at Brown University. Image courtesy of S. Cai and C. Li, Brown University.

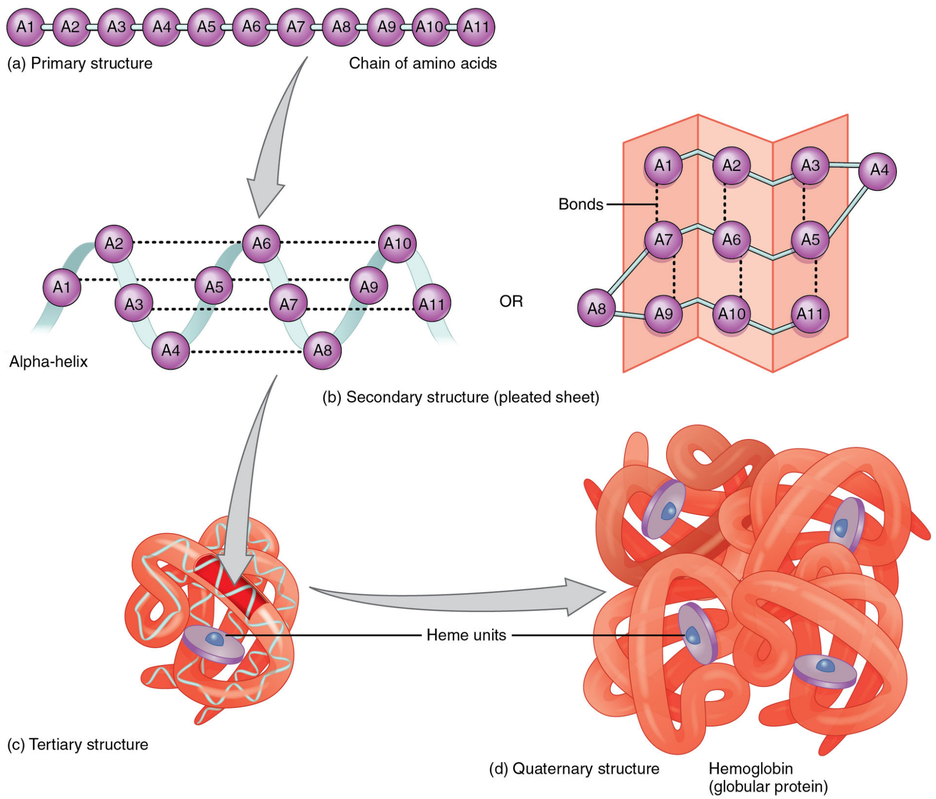
Source: „Physics informed machine learning", Nature Reviews Physics, 2021
See also Paper for more details

Benefits and Risks of AI
AI meets Natural Sciences - Examples

Protein folding describes the process that transforms a chain of amino acids into its native three-dimensional structure. The protein's biological function does highly depend on its **conformation**. Structurally abnormal proteins can cause severe diseases which are summarized as proteinopathy

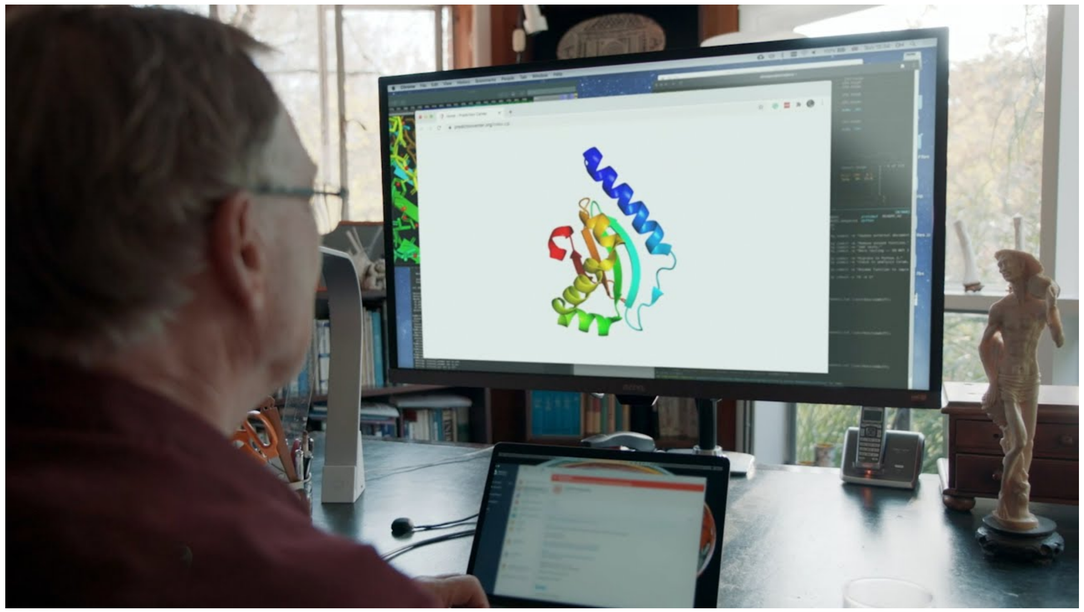
Source: „Physics Informed Deep Learning (Part II): Data-driven Discovery of Nonlinear Partial Differential Equations“ https://doi.org/10.48550/arXiv.1711.10566

Benefits and Risks of AI
AI meets Natural Sciences - Pros & Cons



Source: Wikipedia

Predicting a protein's three-dimensional structure is a challenging and time consuming task. The CASP (*Critical Assessment of Protein Structure Prediction*) is a worldwide experiment that is taking place every two years in order to evaluate the best methods for protein structure prediction. CASP13 (in 2018) and CASP14 (in 2020) was won by AlphaFold and AlphaFold 2. AlphaFold is a deep learning system created by DeepMind



What do you think ???