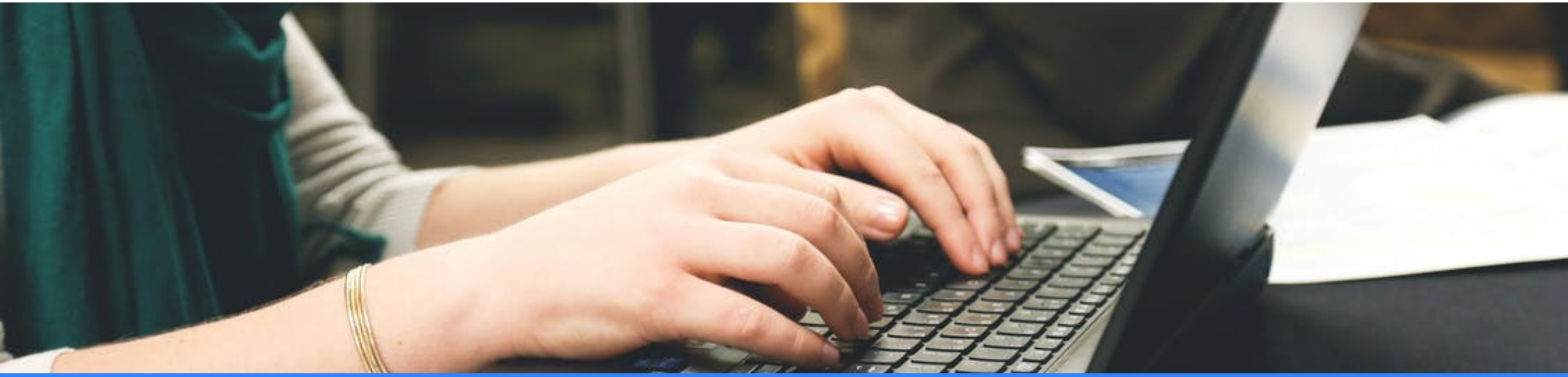
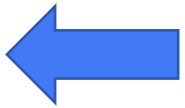


Practical Machine Learning

Introduction

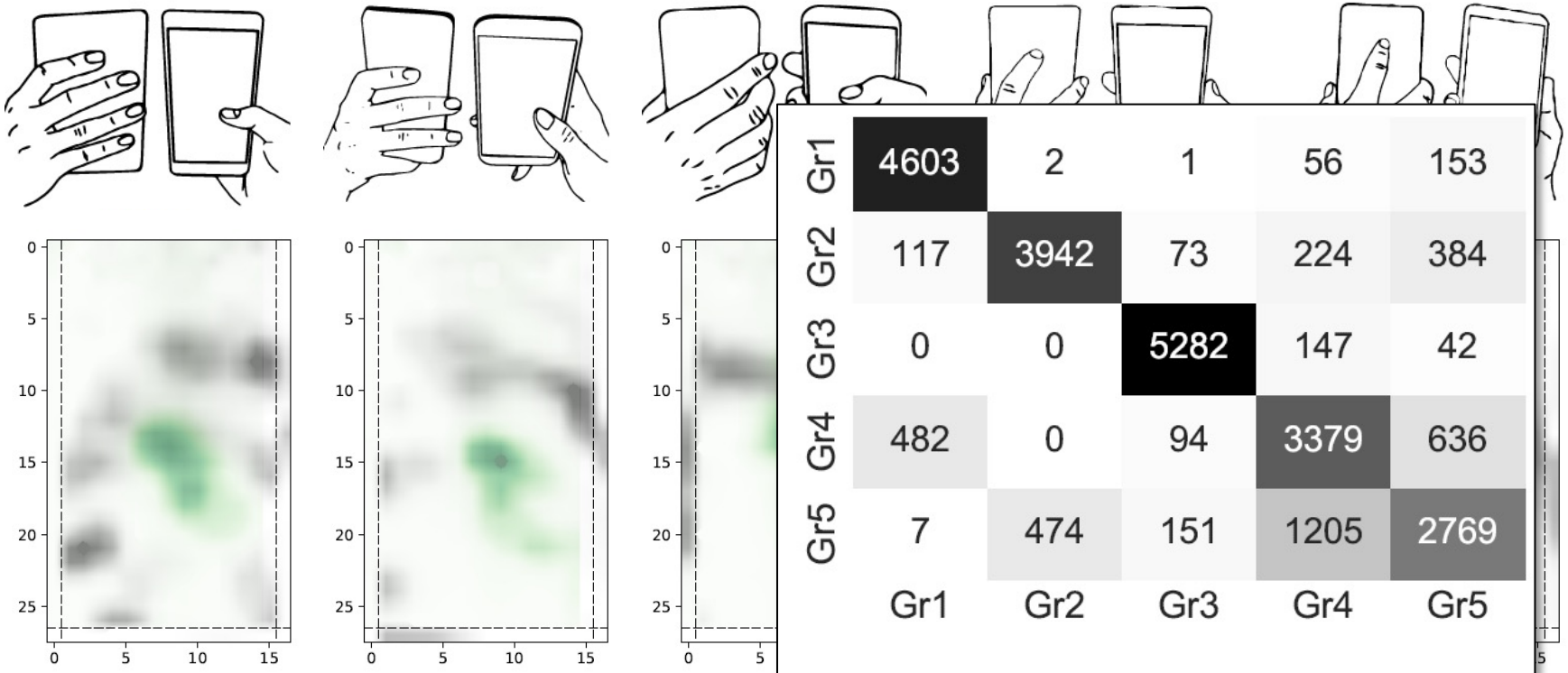
Sven Mayer

Where can we find ML used?

- Self driving cars (Tesla)
- Voice interfaces (Alexa, Siri)
- Face recogntion (Google Photos)
- Recomender systems (Netflix, Amazon)
- Games (AlphaGo)
- Character recognition (Post offices)
- Banking systems
- Medical diagnosis
- ML for Human-Computer Interaction  **Focus**

Introduction into Machine Learning

Examples



(a) Grip 1 (b) Grip 2 (c)

	Gr1	Gr2	Gr3	Gr4	Gr5
Gr1	4603	2	1	56	153
Gr2	117	3942	73	224	384
Gr3	0	0	5282	147	42
Gr4	482	0	94	3379	636
Gr5	7	474	151	1205	2769

Figure 7: Confusion matrix showing the classification results for the exemplary grip classifier.

Huy Viet Le, Sven Mayer, Patrick Bader, and Niels He
the whole device surface. In Proceedings of MobileHCI

Introduction into Machine Learning

Examples

Huy Viet Le, Sven Mayer, Maximilian Weiß, Jonas Vogelsang, Henrike Weingärtner, and Niels Henze. 2020. Shortcut Gestures for Mobile Text Editing on Fully Touch Sensitive Smartphones. ACM ToCHI. DOI: https://doi.org/10.1145/3396233

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Examples

Huy Viet Le, Thomas Kosch, Patrick Bader, Sven Mayer, and Niels Henze. 2018. PalmTouch: Using the Palm as an Additional Input Modality on Commodity Smartphones. In Proceedings of CHI '18. Association for Computing Machinery, New York, NY, USA, Paper 360, 1–13. DOI: https://doi.org/10.1145/3173574.3173934

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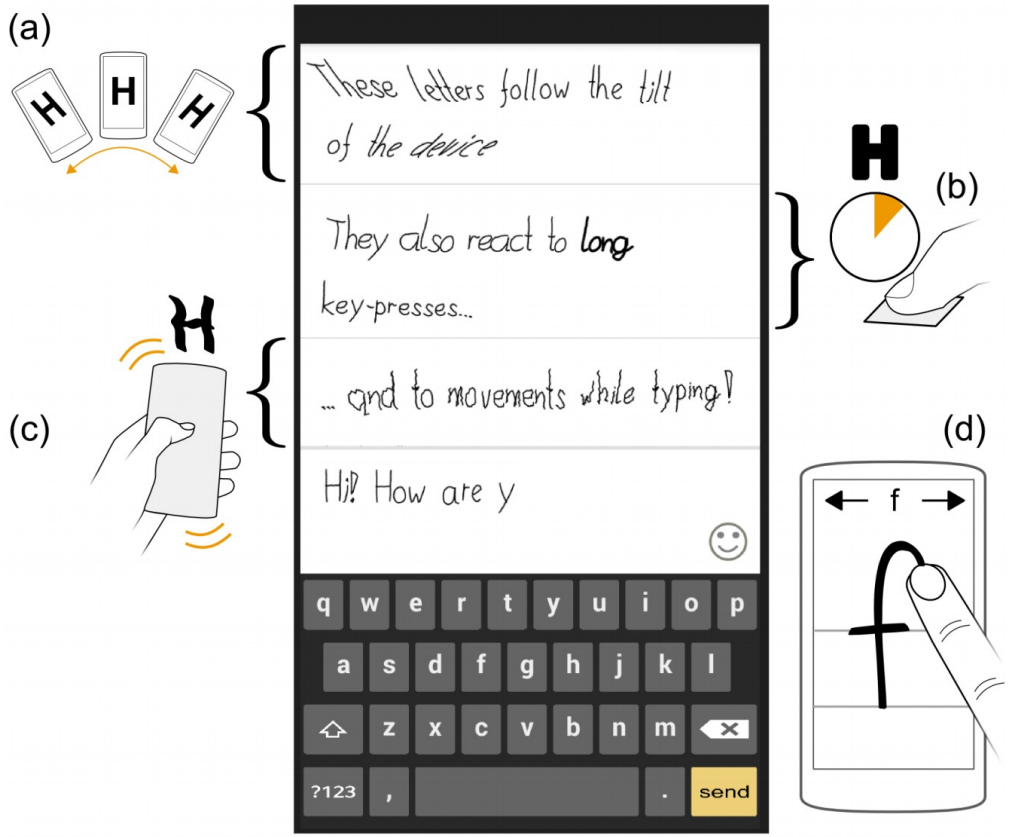
Adaptive Keyboards



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Examples

Xucong Zhang, Yusuke Sugano, and Andreas Bulling. 2019. Evaluation of Appearance-Based Methods and Implications for Gaze-Based Applications. In Proc. Of CHI '19. ACM. DOI: https://doi.org/10.1145/3290605.3300646

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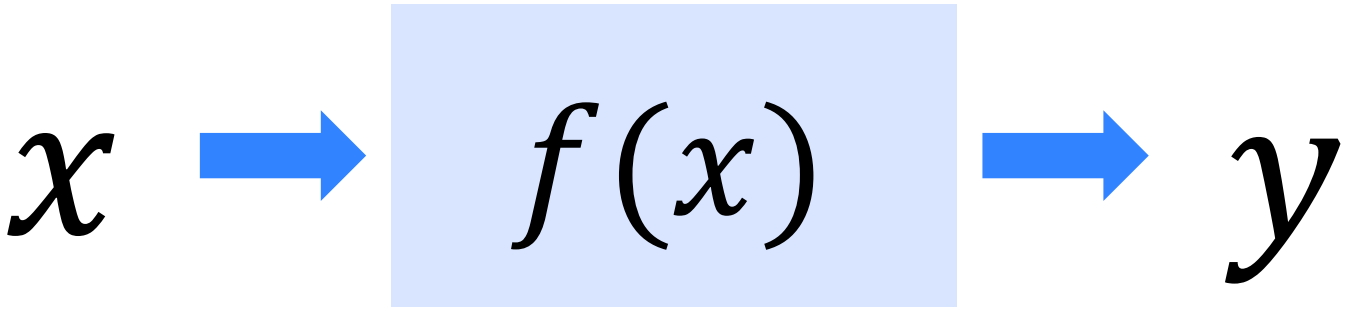

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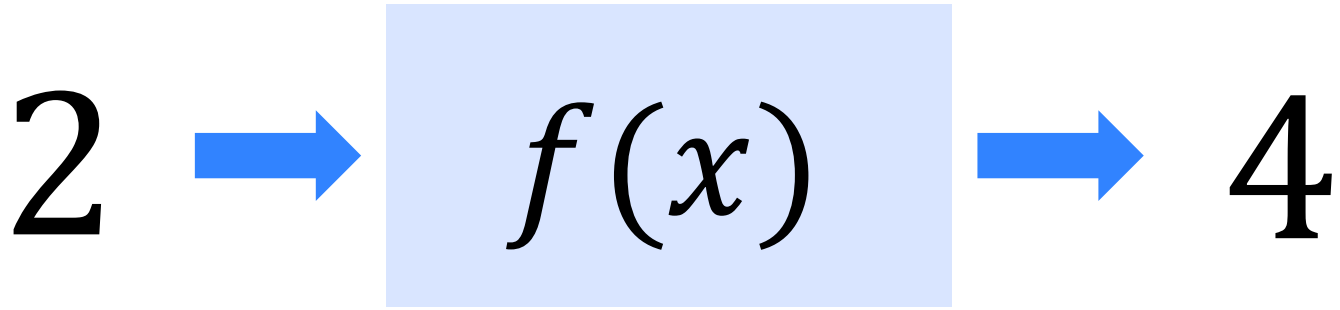
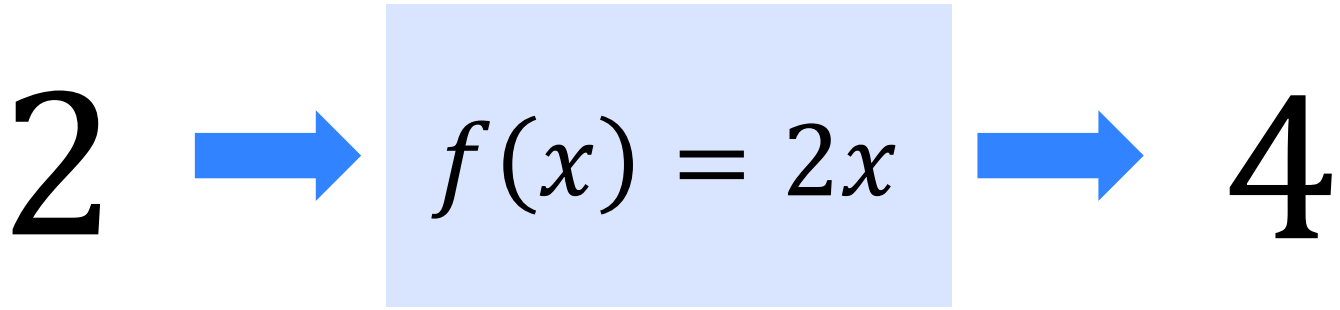
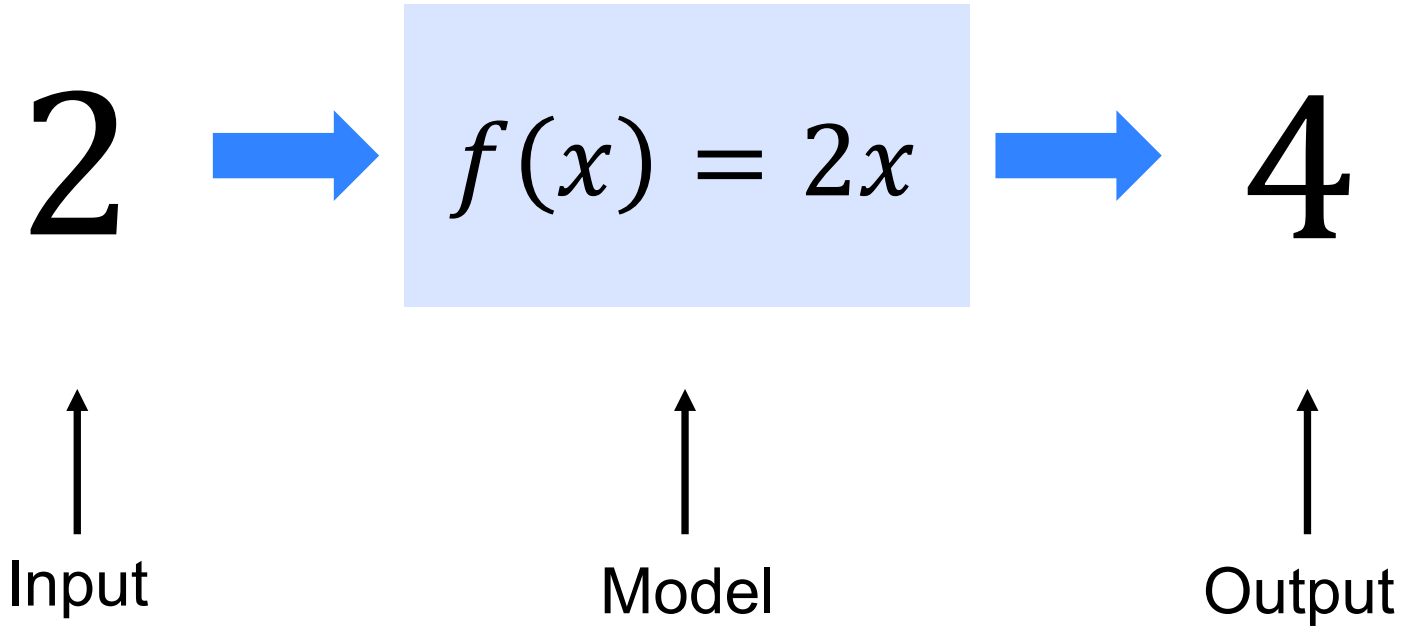


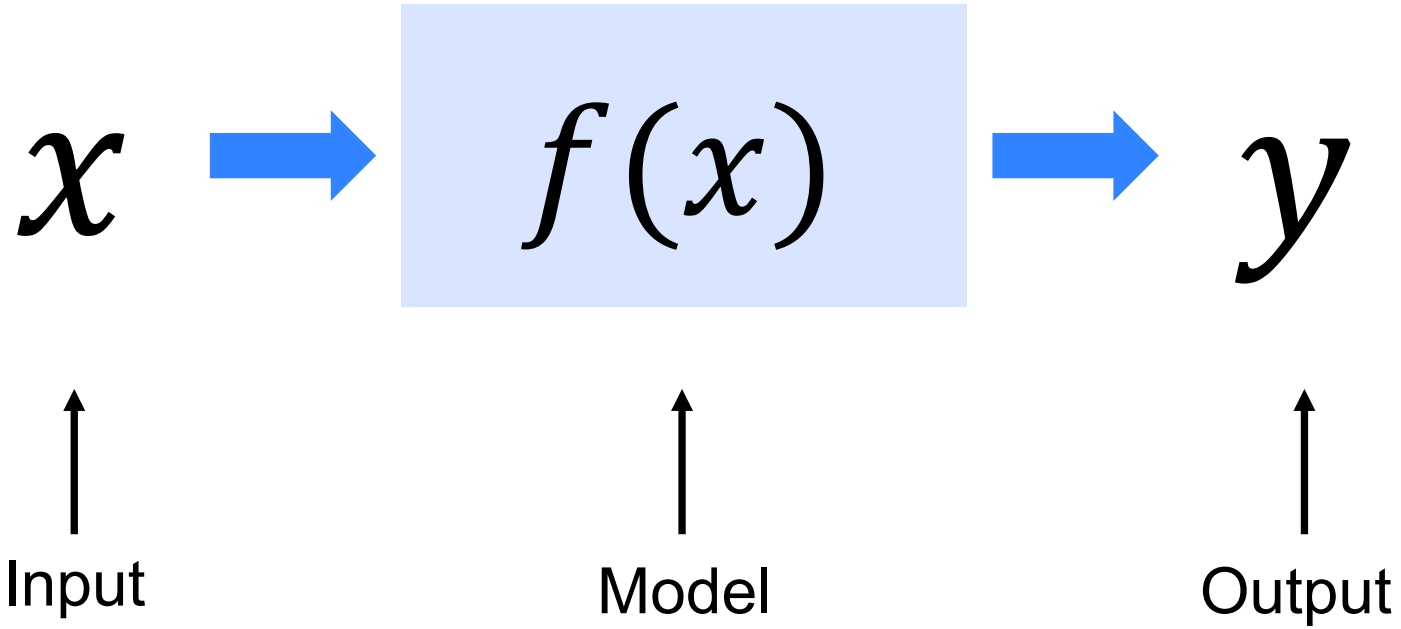
Introduction into Machine Learning



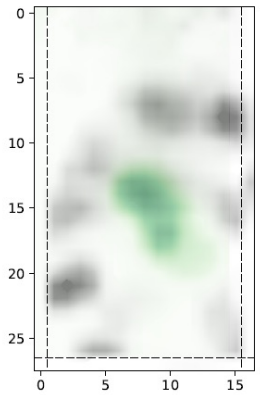
Introduction into Machine Learning



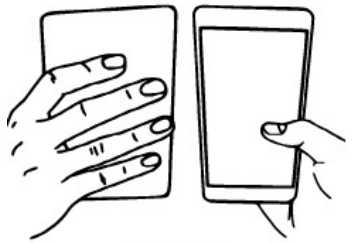
Introduction into Machine Learning



Introduction into Machine Learning



$f(x)$



Input

Model?

Output

Introduction into Machine Learning

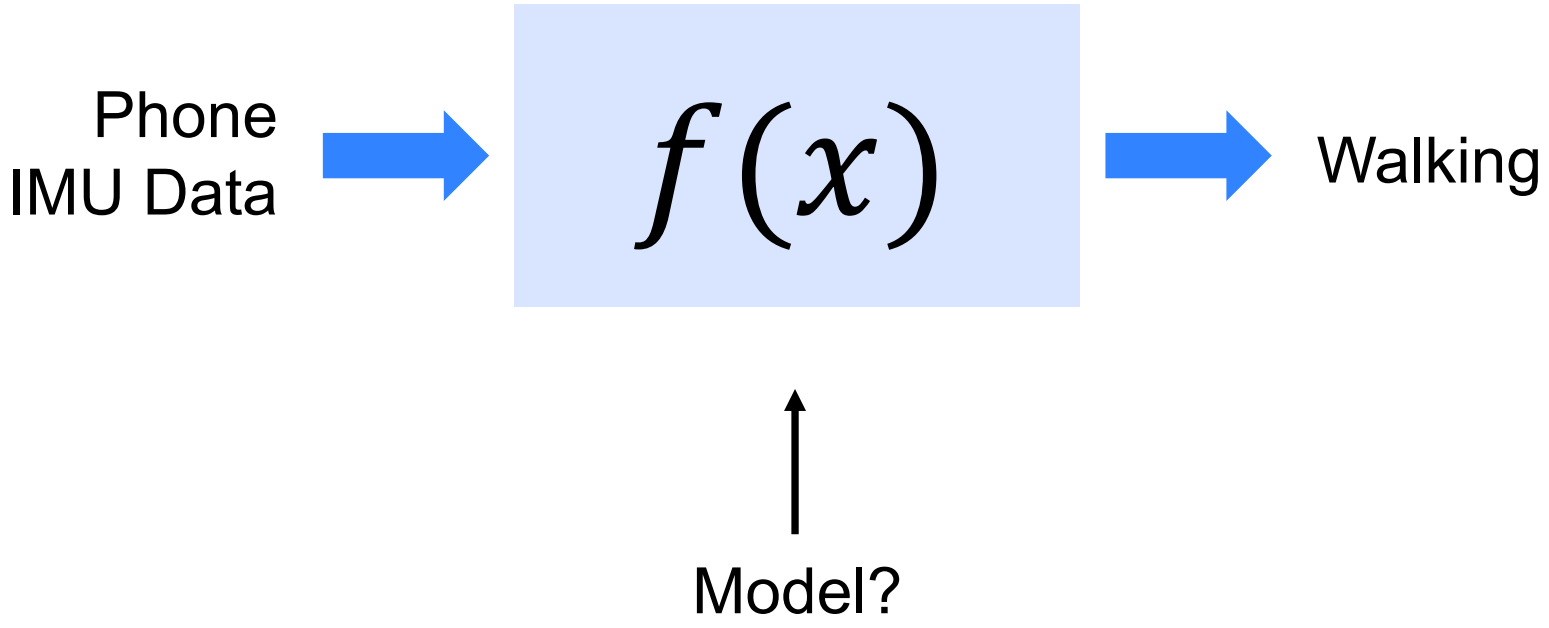
$f(x)$

Walking

Model?

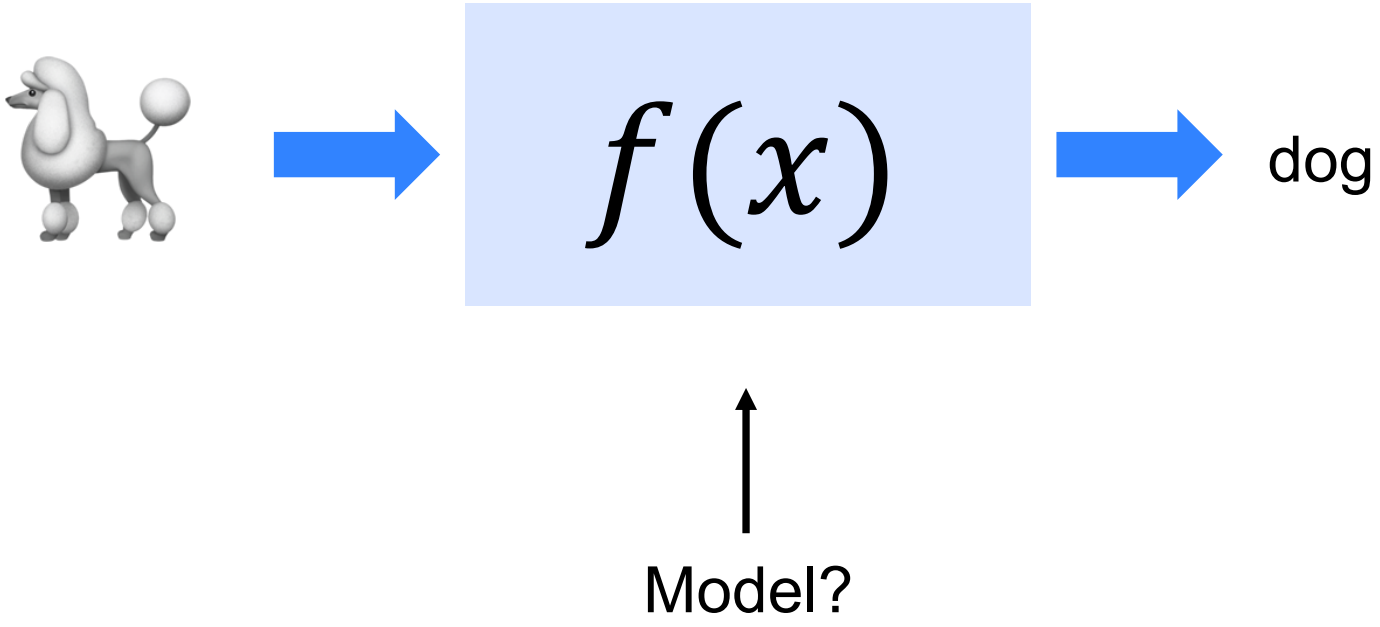
*human activity recognition

Introduction into Machine Learning



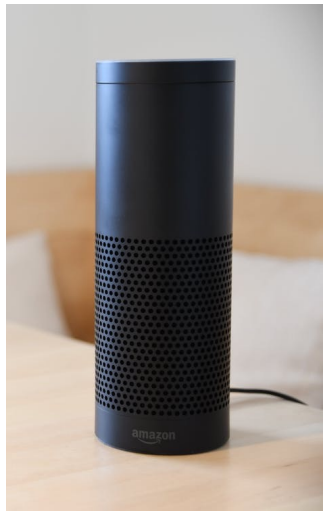
*human activity recognition

Introduction into Machine Learning



*object recognition

Introduction into Machine Learning



$f(x)$

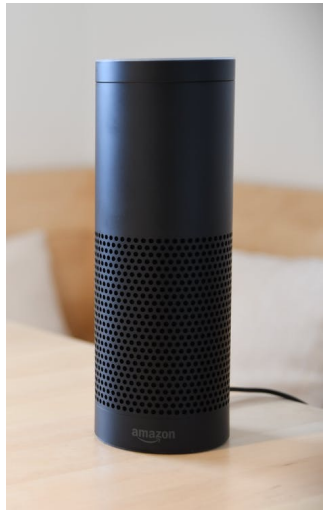
speaker

Model?

*object recognition

Introduction into Machine Learning

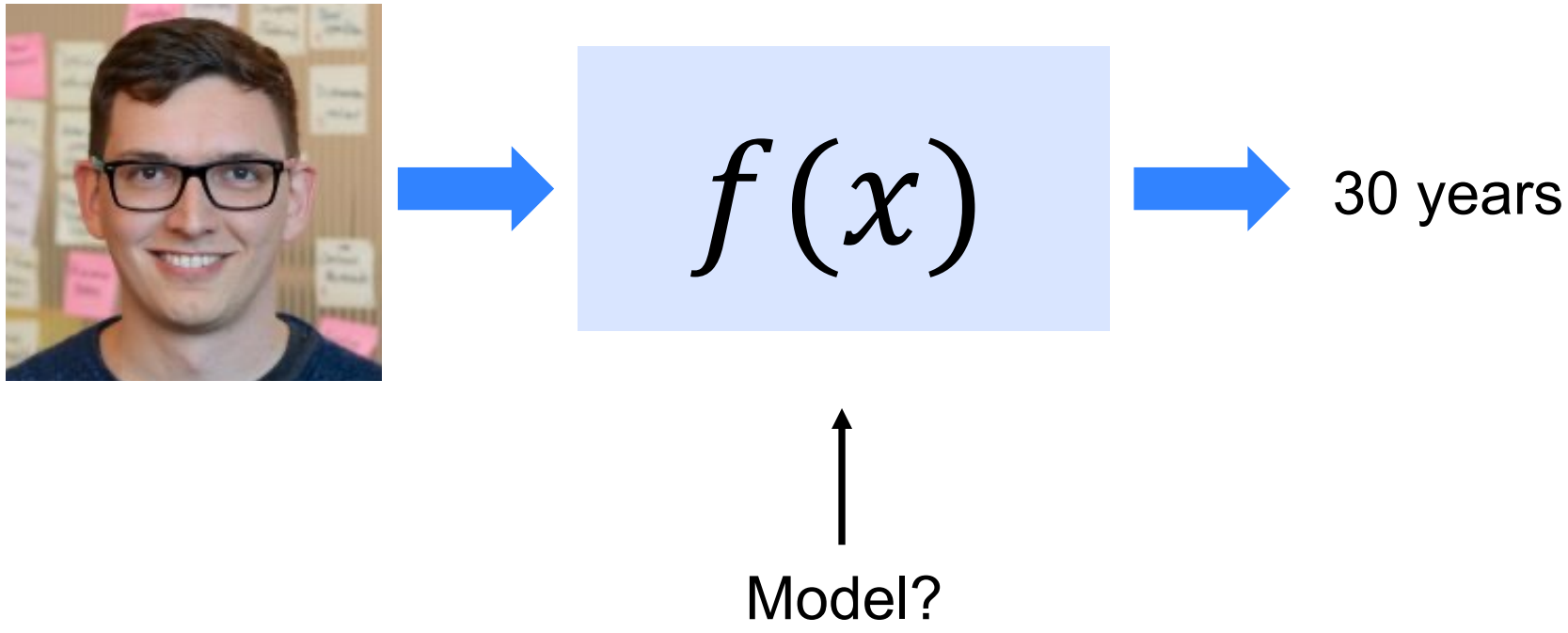
speaker → $f(x)$ →



Model?

*Generative Adversarial Network (GAN)

Introduction into Machine Learning



Gil Levi, and Tal Hassner. "Age and gender classification using convolutional neural networks." In Proceedings of the CVPR workshops. 2015. IEEE: https://doi.org/10.1109/CVPRW.2015.7301352

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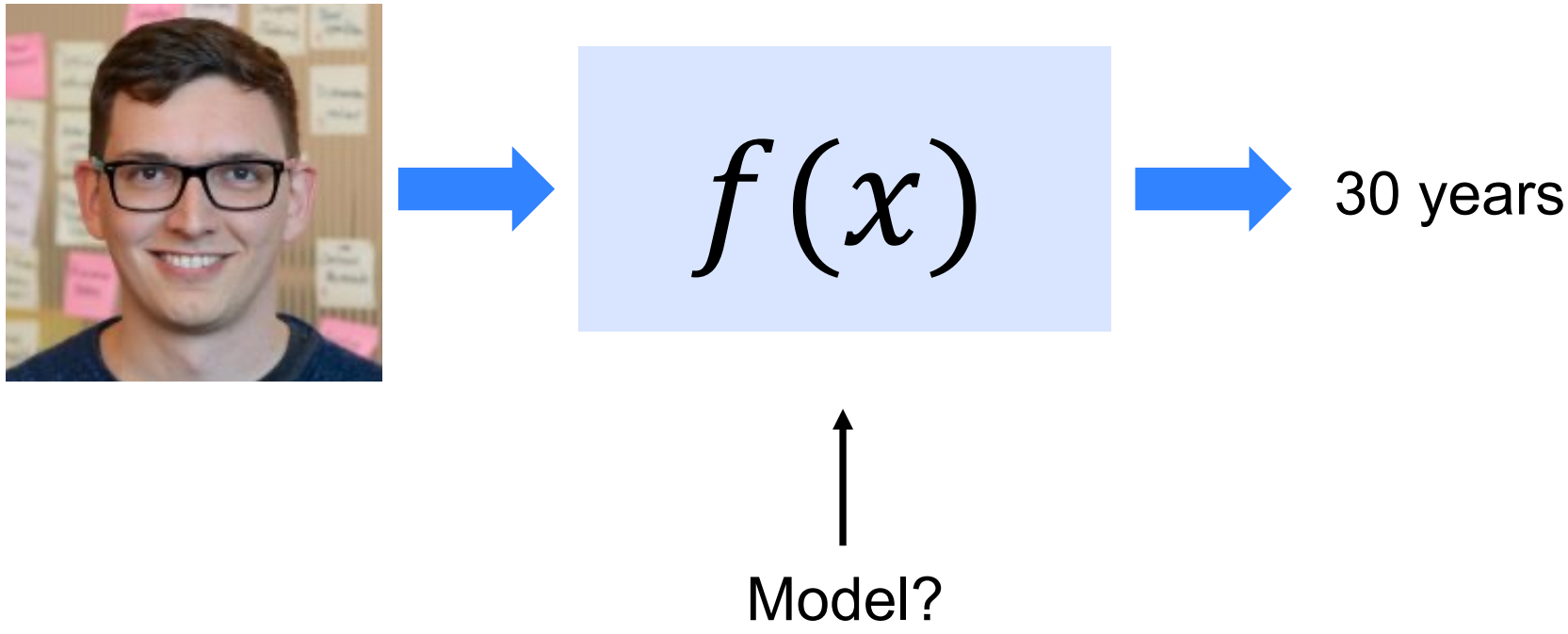

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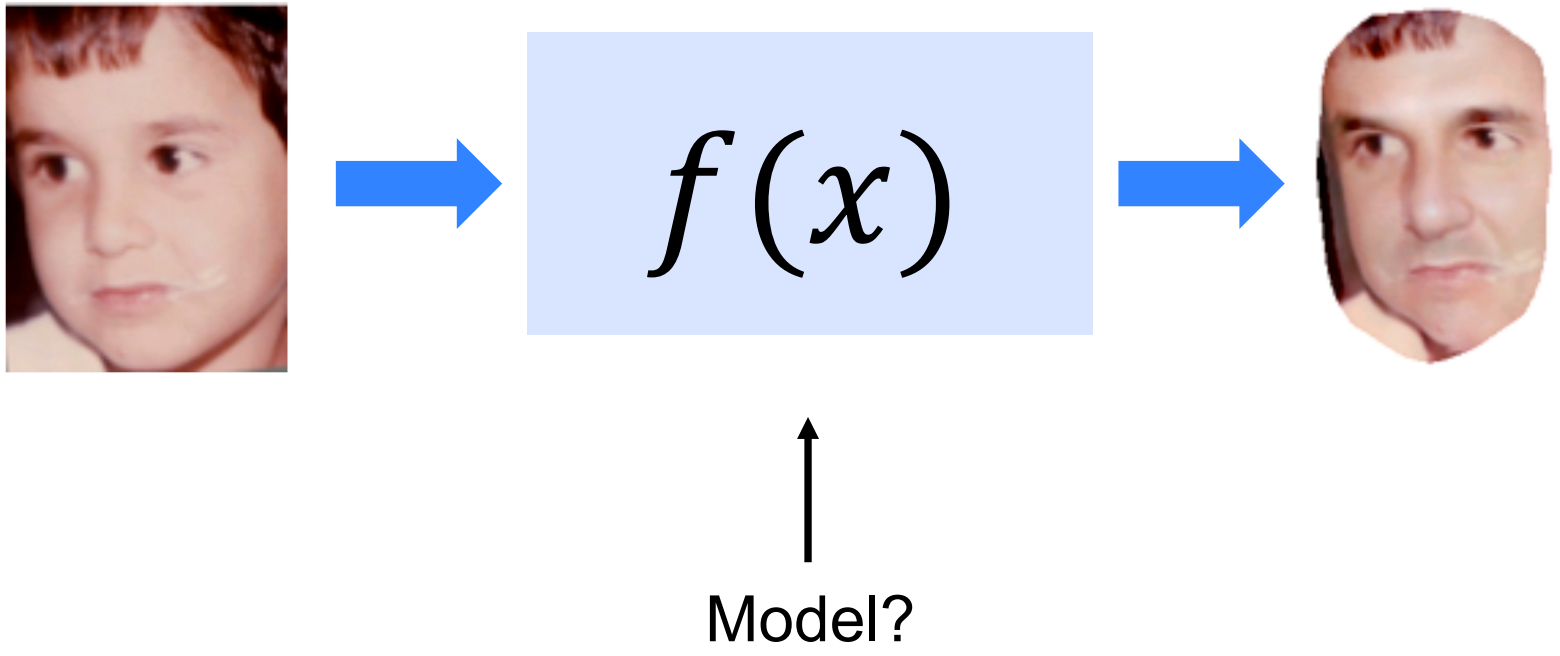

Ira Kemelmacher-Shlizerman, Supasorn Suwajanakorn, and Steven M. Seitz. 2014. Illumination-aware age progression. In Proceedings of the CVPR 2024. IEEE. DOI: https://doi.org/10.1109/CVPR.2014.426

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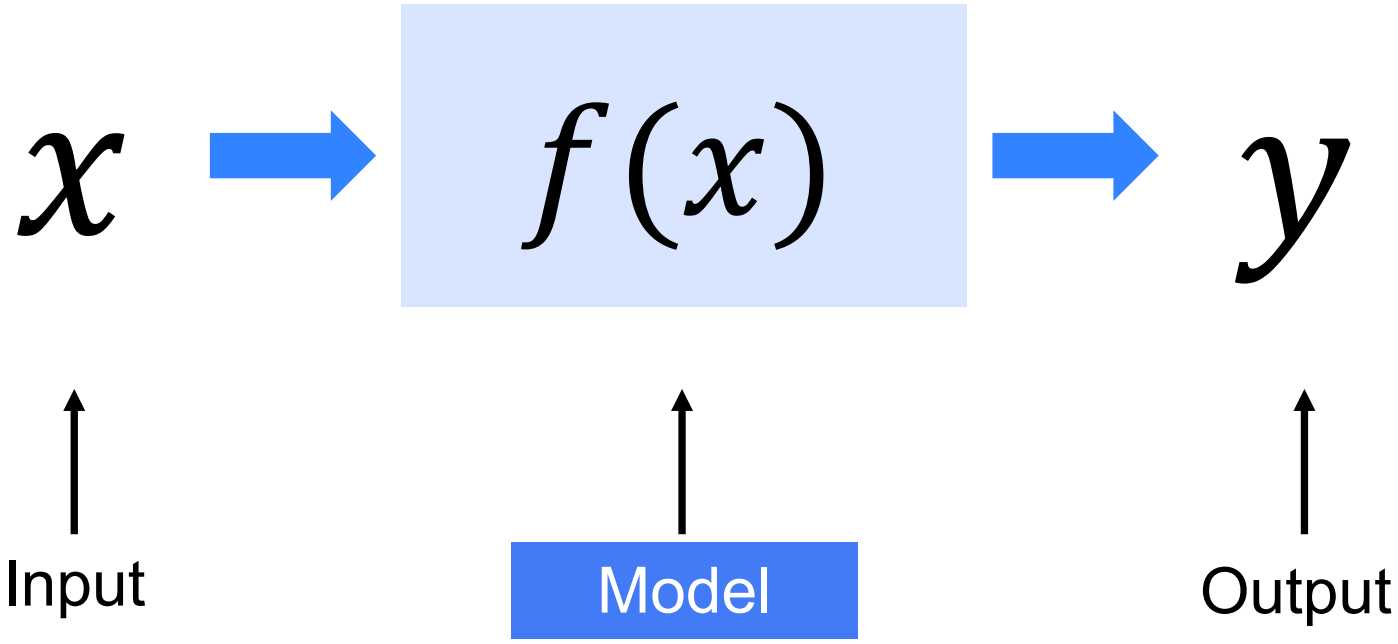

Models

- “Traditional” Machine Learning
  - Support Vector Machines
  - Decision Trees
  - Random Forest
  - …
- “Deep” Learning Methods
  - Neuronal Networks
  - Convolutional Neuronal Networks
  - Recurrent Neural Network (RNN)
  - Generative Adversarial Network (GAN)
  - …

Models

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- “Deep” Learning Methods
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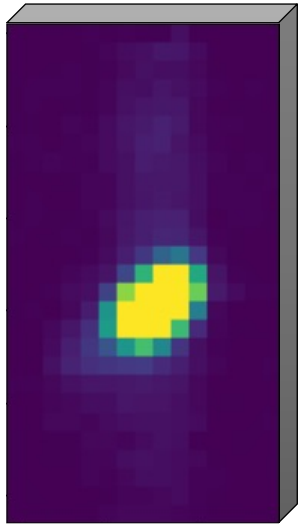
  - Convolutional Neuronal Networks
  - Recurrent Neural Network (RNN)
  - Generative Adversarial Network (GAN)
  - …

We will look at some of them in this lecture.

We will focus mainly on Deep Learning Methods.

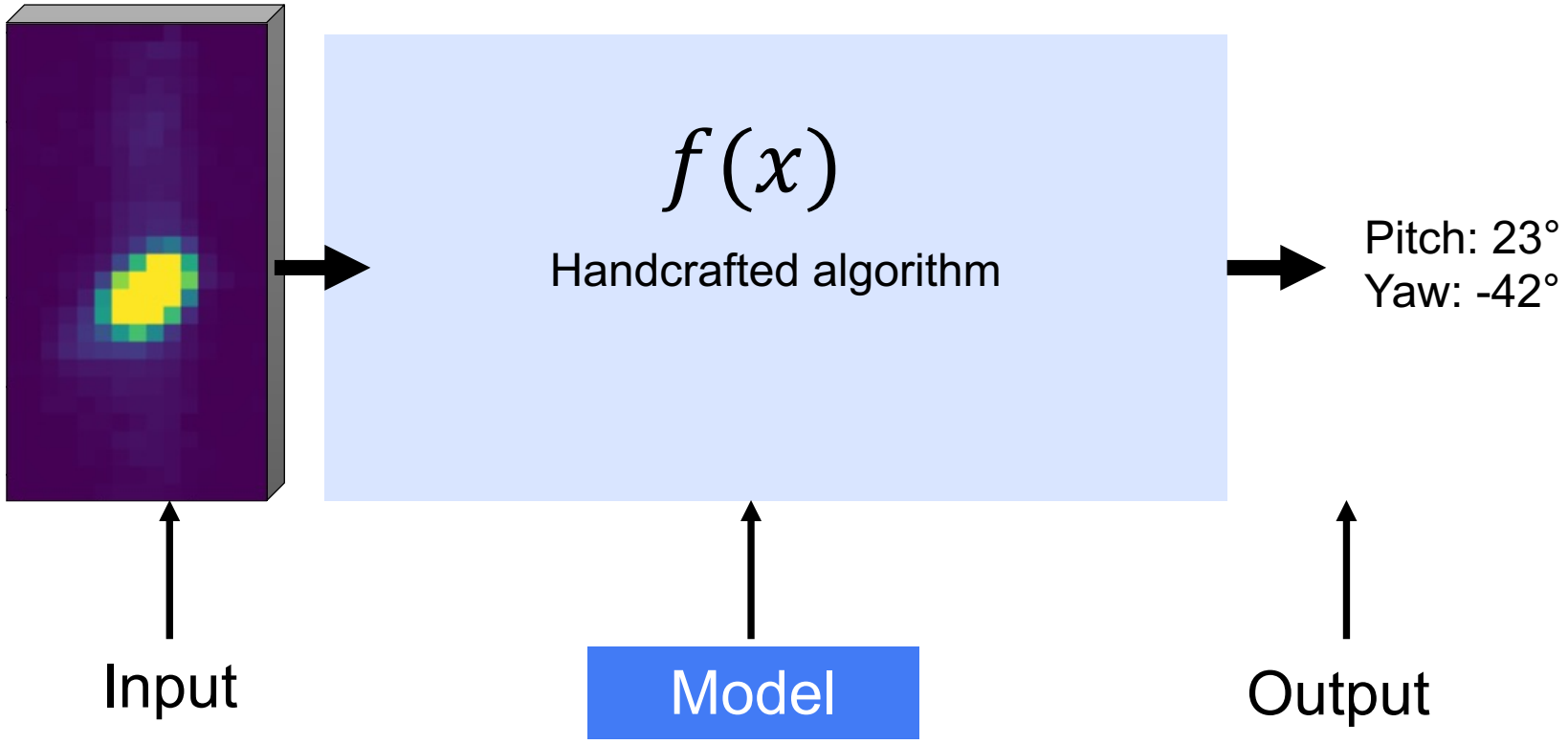
Example

Human-Computer Interaction



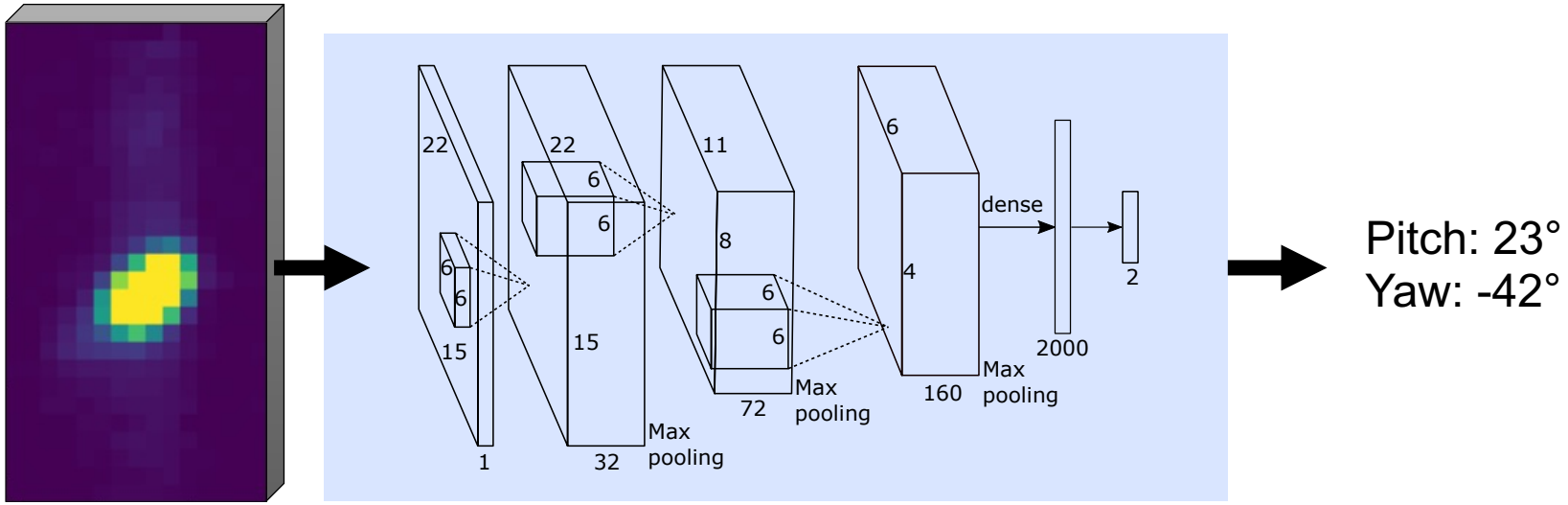
Example

Human-Computer Interaction



Example

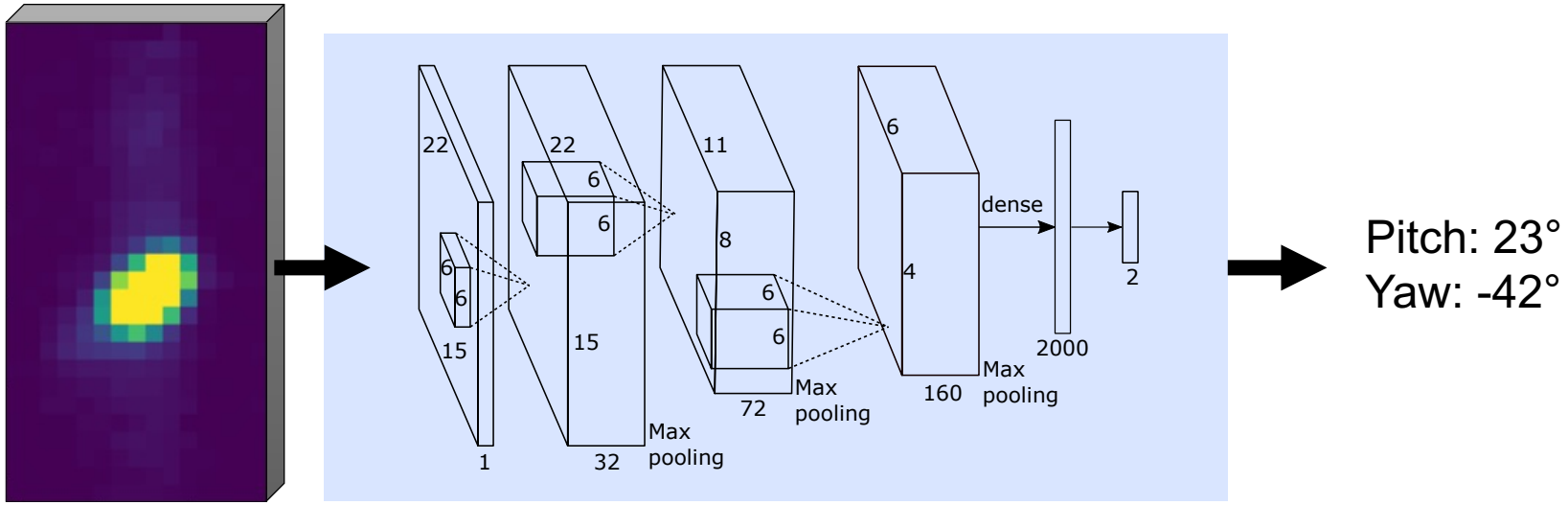
Human-Computer Interaction



Pitch: 23°
Yaw: -42°

Example

Human-Computer Interaction



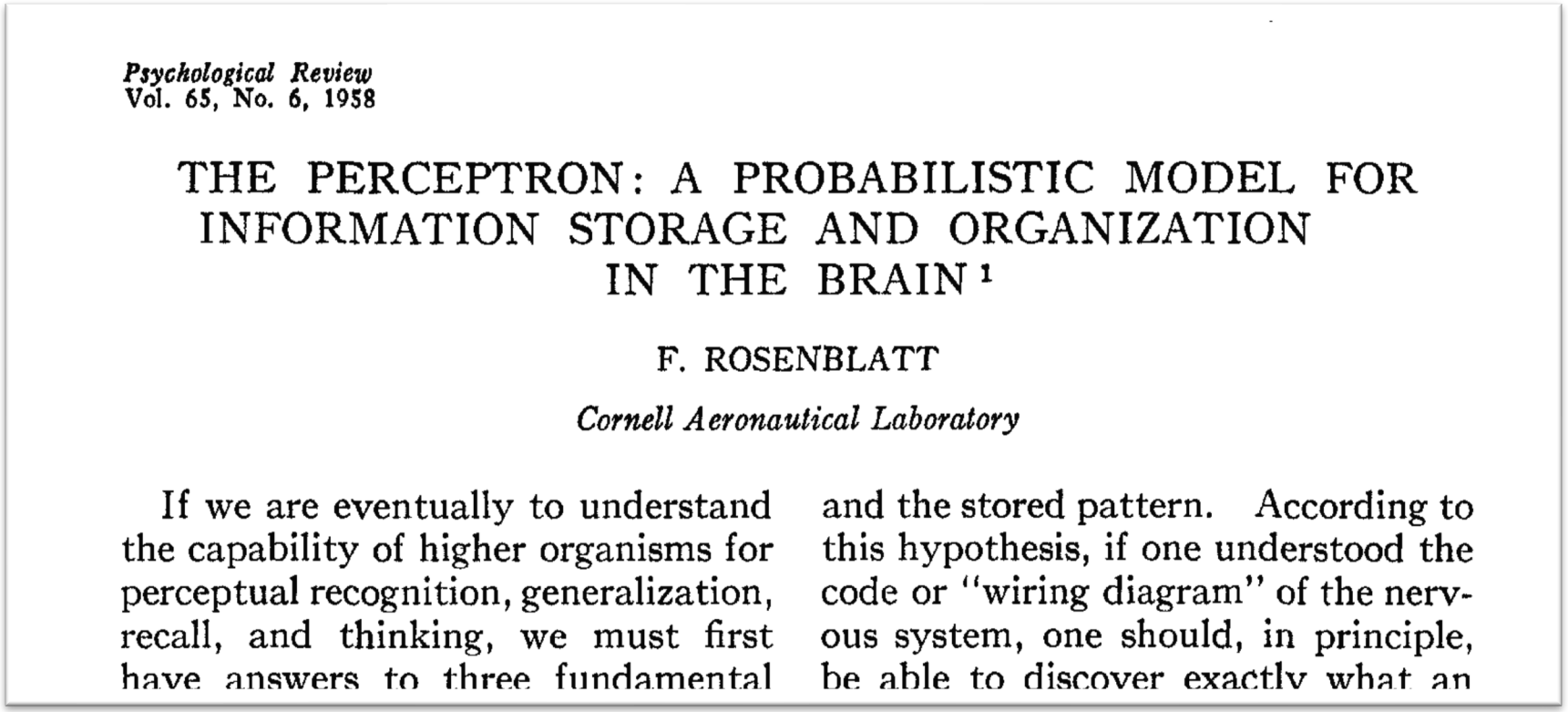
Method	Pitch			Yaw		
	RMSE	MAE	SD	RMSE	MAE	SD
GP reimplementation of Xiao et al. [41]*	14.74	11.78	14.38	56.58	40.51	39.51
pseudo implementation of Xiao et al. [41]**	14.19	11.58	8.21	44.53	33.39	29.46
CNN + L2	12.8	10.09	7.88	24.19	17.62	16.58

8.9%

45.7%

Neuronal Networks

What can be trained?



Psychological Review
Vol. 65, No. 6, 1958

THE PERCEPTRON: A PROBABILISTIC MODEL FOR INFORMATION STORAGE AND ORGANIZATION IN THE BRAIN[1]

F. ROSENBLATT

Cornell Aeronautical Laboratory

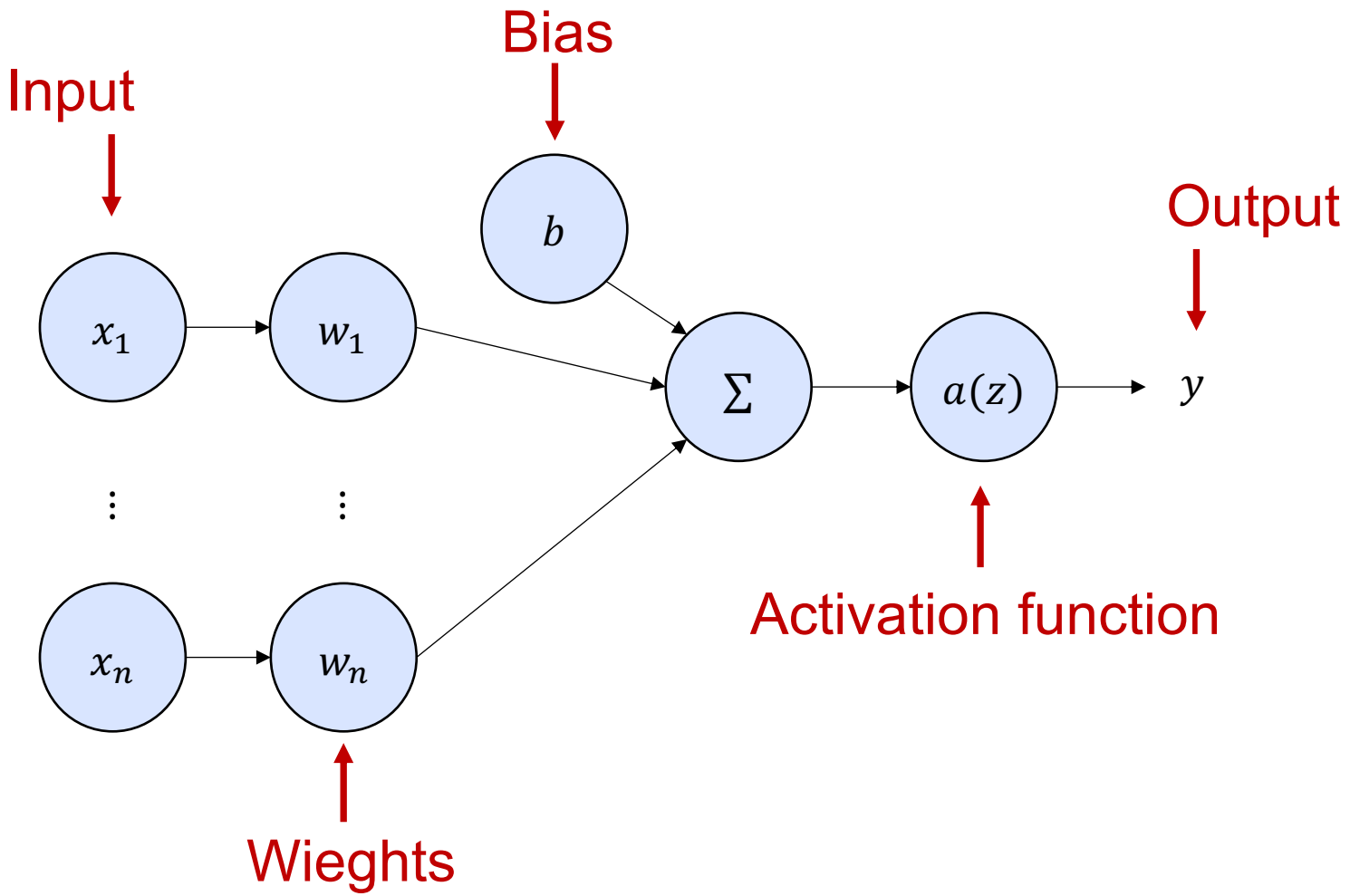
If we are eventually to understand the capability of higher organisms for perceptual recognition, generalization, recall, and thinking, we must first have answers to three fundamental

and the stored pattern. According to this hypothesis, if one understood the code or "wiring diagram" of the nervous system, one should, in principle, be able to discover exactly what an

Frank Rosenblatt. "The perceptron: a probabilistic model for information storage and organization in the brain." *Psychological review* 65, no. 6 (1958): 386. DOI: https://psycnet.apa.org/doi/10.1037/h0042519

What is a Perceptron?

Single-Layer Perceptron



Conclusion

Introduction to Machine Learning

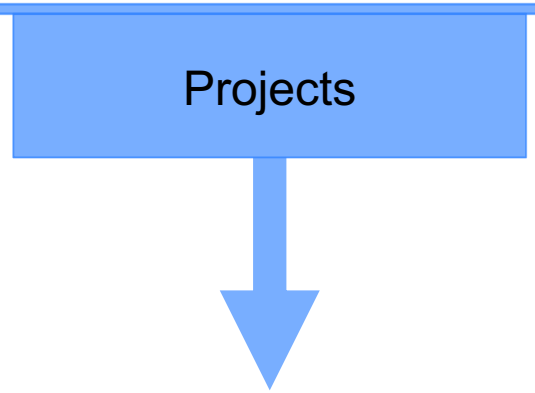
- Practical Examples
- General understanding of the model f(x)
- Deep Learning Approaches
  - Perceptron
  - Weights & biases can be trained
  - Activation function

Questions?

Tutorials

Tutorials

- 06.05.2022 Organization & Exercise 01: Recording your own data (2 weeks)
- 13.05.2022 Live Coding Session: Getting Started with Neuronal Networks
- 20.05.2022 Live Coding Session: Deploying Models to Mobile Devices (Android) & Exercise 02: Clearing your data and training the first model (2 weeks)
- 27.05.2022 canceled
- 03.06.2022 Project Ideation & Exercise 03: Training an improved model based on a large dataset (1 weeks)
- 10.06.2022 Project Pitches: Show Current Project Status
- 17.06.2022 Individual Help for Projects
- 24.06.2022 Individual Help for Projects
- 01.07.2022 Individual Help for Projects
- 08.07.2022 Individual Help for Projects
- 15.07.2022 canceled
- 22.07.2022 How to give a great project presentation & Q'n'A: Exam preparation &Individual Help for Projects
- 29.07.2022 Final Presentation

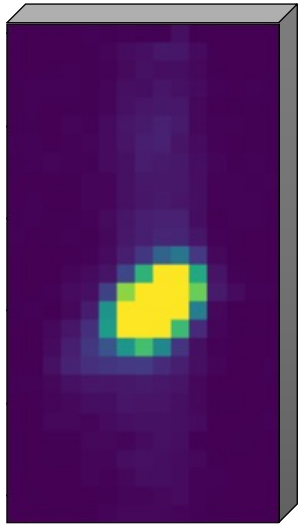


Tutorials

- Exercise 01: Recording your own data
  - 2 weeks
- Exercise 02: Clearing your data and training the first model
  - 2 weeks
- Exercise 03: Training an improved model based on a large dataset
  - 1 week

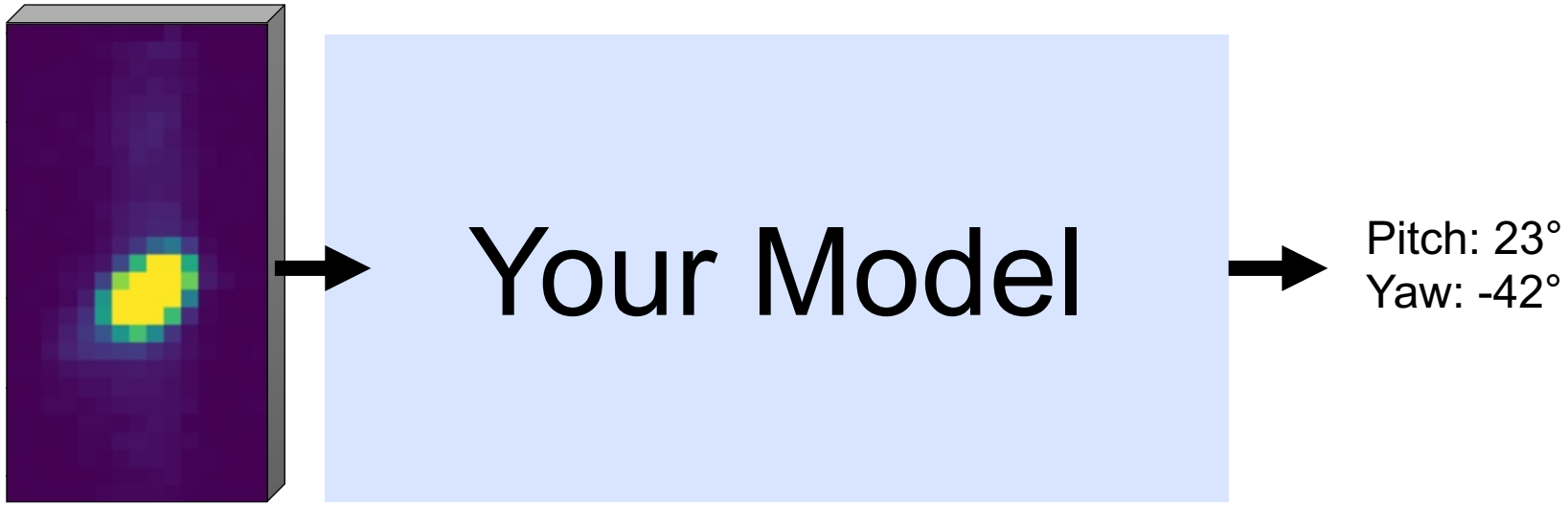
Example

Human-Computer Interaction



Example

Human-Computer Interaction



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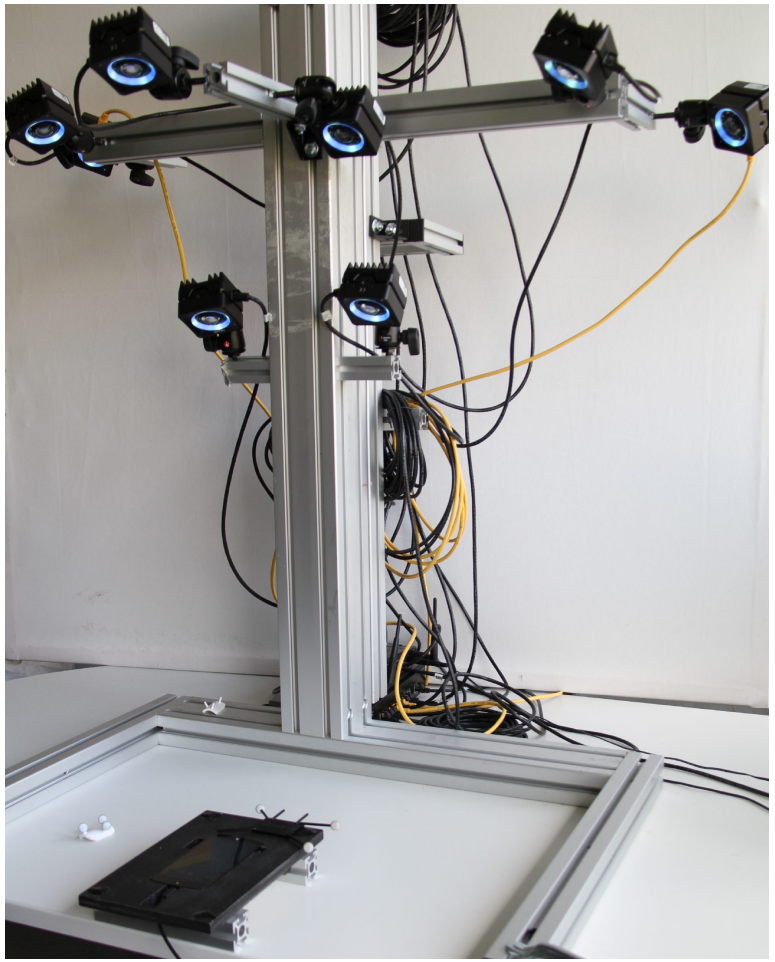
Exercise 01: Recording Your Own Data



Exercise 01: Recording Your Own Data

- You are required to record your own dataset
- Location:
  - Frauenlobstraße 7A
    80337 München

Detailed Information will flow by Monday

Exercise 02: Data and Training

- **Step 1:** Clean your data
  - Start here: https://github.com/interactionlab/Capacitive-Finger-Orientation-Estimation/blob/master/Step1_Preprocessing.ipynb
  - A) This is not enough for data cleaning
    - Hints: clock sync, data augmentation, normalization
  - B) You can be better
- **Step 2:** Train your first model
  - Start here: https://github.com/interactionlab/Capacitive-Finger-Orientation-Estimation/blob/master/Step4_Training_unsing_Keras.ipynb
  - Goal: outperform Pitch RMSE = 24.19° and Yaw RMSE = 12.80°
  - Note: due to the not diverse dataset this should be easily possible.

Exercise 03: Improve your Model

- We will collect all of your data, preprocess it, and merge it.
- => 50 datasets
- => 50 times the diversity
- => 50 times more robust – but way harder to train

- **Goal:** Outperform Pitch RMSE = 24.19° and Yaw RMSE = 12.80°

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