

# Neural Networks Hello World + Assignments 2, 3

(Neural Networks Implementation and Application Tutorial)

Vilém Zouhar, Noon Pokaratsiri Goldstein

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# Overview

- Assignment 2
- Gradient
- PyTorch's Autograd
- NN Hello World
- Assignment 3

# Assignment 2

- *Tutor cue:* go through the assignment
- What were the biggest issues? Coding or theory?
- Do you feel they are too easy/hard?
- Do you feel they are unrelated to the lecture content?

# Optimization

## Gradient 🤔

- What is it?
- How do we denote it?
  - ▶  $\nabla f(p) = [\frac{\delta f}{\delta x_1}(p), \dots, \frac{\delta f}{\delta x_k}(p)]$
- Why is it important?
  - ▶ Optimization

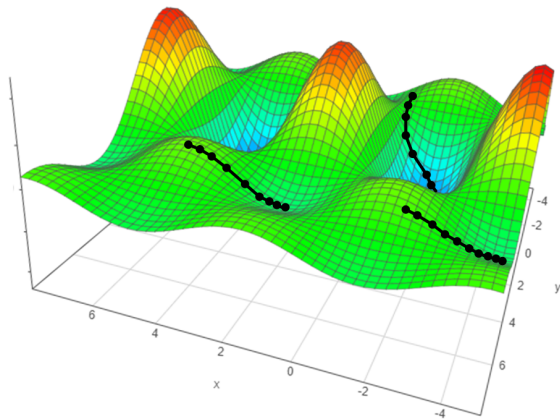


Figure 1: Function parameter landscape from [1]

# Optimization

## Few questions 🤔

- How does step/gradient-based optimization work?
- How is the step size determined?
- Why do we subtract the gradient and not add it?
- If we start in different places will we always find the same spot?
- Will we always find the global minimum?

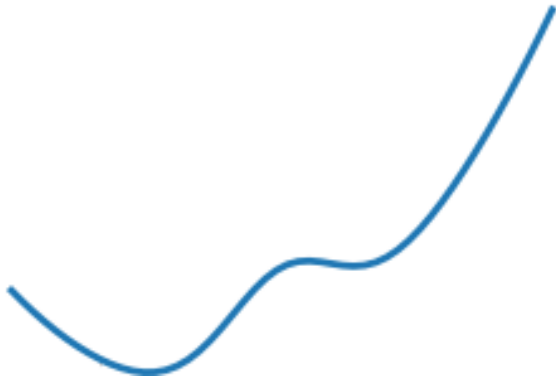


Figure 2: Function parameter landscape from [2]

# Autograd & PyTorch

How to get the gradient at  $(x, y) = (2, 3)$  of  $x \cdot y + \sin(\pi \cdot x)$ ?

- By hand 🤔
- Autograd 🌟😊

## By hand

$$\frac{\delta}{\delta x} = y + \pi \cdot \cos(\pi \cdot x) \rightarrow 3 + \pi$$

$$\frac{\delta}{\delta y} = x \rightarrow 2$$

$$\nabla f(2, 3) \rightarrow (3 + \pi, 2)$$

## Autograd

```
import torch
import numpy as np
x = torch.tensor(2.0, requires_grad=True)
y = torch.tensor(3.0, requires_grad=True)
out = x*y + torch.sin(np.pi*x)
out.backward() # trigger gradient computation
assert np.isclose(x.grad, 3+np.pi)
assert np.isclose(y.grad, 2)
```

# Assignment 3

- Any questions?

# Resources

- [1] Optimization & landscapes [offconvex.org/2018/11/07/optimization-beyond-landscape/](https://offconvex.org/2018/11/07/optimization-beyond-landscape/)
- [2] Optimization Introduction by Scipy  
[scipy-lectures.org/advanced/mathematical\\_optimization/](https://scipy-lectures.org/advanced/mathematical_optimization/)