Artificial Neural Networks and Deep Learning Summer 2018
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Organisational Rules for Exam Admission

The lecture is accompanied by exercise sheets. At the beginning of each exercise lesson, the exercises are *voted for*. By voting for an exercise, one expresses one's willingness to present something about it. (Suggestions for a solution will be discussed, they need not be correct right away.) To the exam will be admitted who

1. voted for *at least* half of the exercises *and*
2. presented something for *at least* two exercises.

Exercise Sheet 1 — Reminder: Vector Computations and Geometry

Exercise 1 Vector Computations

Let the two vectors $\vec{x} = (3, 1, 2)^\top$ and $\vec{y} = (2, 3, 4)^\top$ be given. Compute

a) the difference vector pointing from $\vec{x}$ to $\vec{y}$,

b) the scalar (or inner) product $\vec{x}^\top \cdot \vec{y}$,

c) the vector product $\vec{x} \times \vec{y}$.

d) the matrix (or outer) product $\vec{x} \cdot \vec{y}^\top$,

e) the angle between the two vectors.

Exercise 2 Hessian Normal Form

Transform the following line equations into Hessian normal form $\vec{r}^\top \cdot \vec{n}_0 - d = 0$:

a) $3x - 4y - 20 = 0$,

b) $x + y + 3 = 0$,

c) $y = bx + c$ mit $c < 0$.

Exercise 3 Distances to Straight Lines

a) What distance does the origin have from the line $12x - 5y + 39 = 0$?

b) What distance does $P_1 \mathrel{\widehat{=}} (4, 3)^\top$ have from the line that intersects the coordinate axes at $x = \frac{10}{3}$ and $y = \frac{5}{2}$?

c) What distance do the parallels $2x - 3y = 6$ and $4x - 6y = 25$ have?

Exercise 4 Plane Equations

Which plane through the point $\vec{p} = (-3, 0, 2)^\top$ is perpendicular to the line $\vec{x} = (-1, -2, 0)^\top + k \cdot (1, 1, -1)^\top$ for $k \in \mathbb{R}$?

Exercise 5 Points on a Plane

A plane through the point with location vector $\vec{p}$ that is perpendicular to the vector $\vec{n}$ has the equation $(\vec{x} - \vec{p})^\top \vec{n} = 0$. Let $\vec{p} = (1, -1, 2)^\top$ and $\vec{n} = (1, 2, -3)^\top$.
Which of the following points lie in the plane?
$P_1 \mathrel{\widehat{=}} (-2, -1, 1)^\top$, $P_2 \mathrel{\widehat{=}} (1, -1, 2)^\top$, $P_3 \mathrel{\widehat{=}} (2, -2, 1)^\top$.

Exercise 6 Distance of a Point from a Plane

Find a formula to compute the distance of a given point $\vec{y} = (y_1, y_2, y_3)^\top$ to a plane $(\vec{x} - \vec{p})^\top \vec{n} = 0$. Use this formula to compute the distance for $\vec{p} = (-1, -1, -1)^\top$, $\vec{n} = (4, -2, 3)^\top$ and $\vec{y} = (3, 14, -6)^\top$.