Time	Group	Submission in Moodle; Mails with subject: [SMD2022]
Th.12:15–13:00	A	leonora.kardum@udo.edu and karolin.hymon@udo.edu
Fr. 10:15–11:00	B	lukas.nickel@udo.edu and noah.biederbeck@udo.edu
Fr. 12:15–13:00	C	rune.dominik@udo.edu and felix.geyer@udo.edu

Exercise 3 *Dice* **4 p.**

For this task, use the notation for probabilities from the lecture (e.g., $P(W_{\text{red}} + W_{\text{blue}} = 42) = \ldots$, $P(W_{\text{red}} + W_{\text{blue}} = 42 \mid W_{\text{red}} = 4) = \ldots$).
You roll two dice, one red and one blue. What is the probability that

(a) the sum of pips is 9,

(b) the sum of pips is 9 or larger,

(c) one die shows 4 and the other 5 pips,

(d) the red die shows 4 and the blue die 5 pips?

You roll the dice so that the blue die rolls behind an object so that you can't see it at first. The red die shows a 4. After you have seen this, what is the probability that

(e) the sum of pips is 9,

(f) the sum of pips is 9 or larger,

(g) the red die shows 4 and the blue die 5 pips?

Exercise 4 *Maxwell velocity distribution* **6 p.**

The probability density of the magnitude of the velocity v of the molecules in an ideal gas at the absolute temperature T is given by

$$f(v) = N \cdot \exp\left(-\frac{mv^2}{2k_{\text{B}}T}\right) \cdot 4\pi v^2,$$

where m is the molecular mass, k_{B} is the Boltzmann constant, and N is the normalization constant.

To answer the following questions, you must first determine N and the solution to a) each as a function of m and T. Express the results of questions b) trough e) as functions of v_m.

Note to c) and d): An analytical solution is not possible here, use a numerical method instead. For this purpose use the library `scipy`: `https://docs.scipy.org/doc/scipy/reference/optimize.html#root-finding`.

How big are

(a) the most probable velocity v_m,

(b) the mean of the velocity $\langle v \rangle$,

(c) the median of the velocity $v_{0.5}$,

(d) the full width at half height of the distribution (v_{FWHM}) and

(e) the standard deviation of the velocity σ_v.