Quiz:

Which of the following statement(s) is/are correct?

(a) Interpretation methods are mainly needed to better explain real world phenomena.

(b) Model-agnostic methods need access to gradients to explain a model.

(c) If a model-agnostic and a model-specific method are applied on the same ML model, the output of the two methods will be the same.

(d) While feature effects methods show the influence of a feature on the target, feature importance methods focus on a feature's impact on the model fit.

(e) In IML we distinguish between global IML methods, which explain the behavior of the model over the entire feature space, and local IML methods, which only explain the prediction of individual observations.

(f) Technically, correlation is a measure of *linear* statistical dependence.

(g) All in the lecture mentioned measures for correlation and dependencies are limited to continuous random variables.

(h) Features that have an equal feature effect are correlated.

(i) A feature interaction between two features x_j and x_k is apparent if a change in x_j influences the impact of x_k on the target.

Exercise 1:

You received a dataset with 11 observations and two features:

	1	2	3	4	5	6	7	8	9	$\sum_{i=1}^n$
y	-7.79	-5.37	-4.08	-1.97	0.02	2.05	1.93	2.16	2.13	-10.92
x1	-1.00	-0.75	-0.50	-0.25	0.00	0.25	0.50	0.75	1.00	0
x2	0.95	0.57	0.29	-0.03	0.02	0.08	0.23	0.54	0.98	3.63

The last column corresponds to the sum of values of each row.

a) Compute the Pearson correlation of x_1 and x_2. The formula is:

$$\rho(x_1, x_2) = \frac{\sum_{i=1}^n (x_1^{(i)} - \overline{x}_1)(x_2^{(i)} - \overline{x}_2)}{\sqrt{\sum_{i=1}^n (x_1^{(i)} - \overline{x}_1)^2}\sqrt{\sum_{i=1}^n (x_2^{(i)} - \overline{x}_2)^2}}$$

To speed up things, the individual differences to the means $(x_1^{(i)} - \overline{x_1}, x_2^{(i)} - \overline{x_2})$, are given in the table above.

	1	2	3	4	5	6	7	8	9
$x_1^{(i)} - \overline{x_1}$	-1.00	-0.75	-0.50	-0.25	0.00	0.25	0.50	0.75	1.00
$x_2^{(i)} - \overline{x_2}$	0.55	0.17	-0.11	-0.43	-0.38	-0.32	-0.17	0.14	0.58

Interpret the results. Based on $\rho(x_1, x_2)$, are x_1 and x_2 correlated?

b) Add points (x_1, x_2) to the following figure:
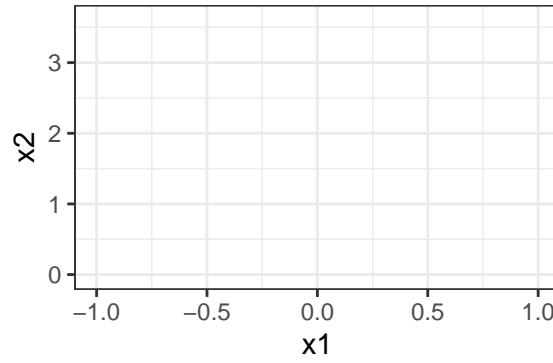
Based on your drawing, do you consider the Pearson correlation coefficient a reliable measure to detect dependencies for the above use case?

Exercise 2:

Show, that the following holds:

$$R^2 = \rho^2.$$

Recap:

$$\rho = \frac{\sum_{i=1}^{n} \left(x^{(i)} - \bar{x}\right) \cdot \left(y^{(i)} - \bar{y}\right)}{\sqrt{\sum_{i=1}^{n}(x^{(i)} - \bar{x})^2}\sqrt{\sum_{i=1}^{n} \left(y^{(i)} - \bar{y}\right)^2}},$$

$$R^2 = 1 - \frac{SSE_{LM}}{SSE_c},$$

where

$$SSE_{LM} = \sum_{i=1}^{n}(y^{(i)} - \hat{f}_{LM}(x^{(i)}))^2,$$

$$SSE_c = \sum_{i=1}^{n}(y^{(i)} - \bar{y})^2$$

are the sum of squares due to regression and the total sum of squares, respectively.

Exercise 3:

Consider the following function:

$$f(\mathbf{x}) = 2x_1 + 3x_2 - x_1|x_2|.$$

Mathematically check whether interactions are present.