Exercise 1:

Let the 2D feature vectors in the following figure be with two different numeric target values (2 and 4). Predict the point (7,6) - represented by the grey point in the picture - with the k-nearest neighbor method. Distance function should be the L_1 norm (Manhattan distance):

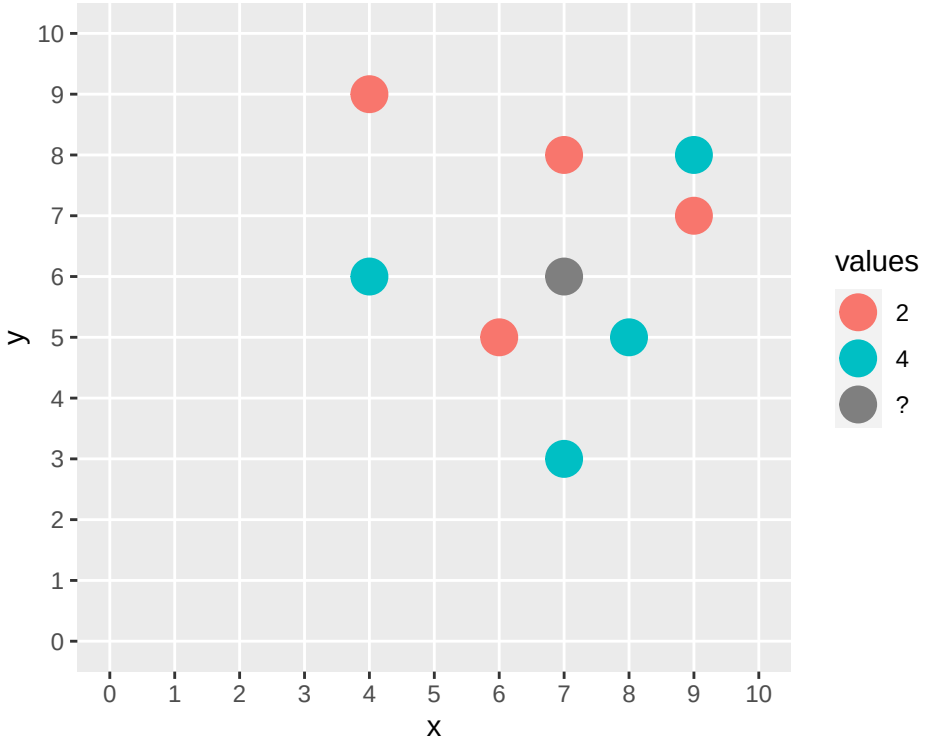
$$d_{\text{manhattan}}(x, \tilde{x}) = \sum_{j=1}^{p} |x_j - \tilde{x}_j|$$

State as the prediction the unweighted and the weighted (according to the Manhattan distance) mean of the values of the k-nearest neighbors.

a) $k = 3$

b) $k = 5$

c) $k = 7$



Exercise 2:

The `mlr3` ecosystem, which we will use heavily to do machine learning in R, mirrors the HRO principle we have encountered in the lecture. Have a look at `https://mlr3book.mlr-org.com/learners.html` for a quick introduction.

a) Familiarize yourself with `tasks`, `learners` and the `train` method. How do these components compare to what you have learned in the lecture?

b) Have a closer look at the learner associated with the hypothesis space of linear models (hint: you can access the learner object's fields and methods with the dollar sign):

```
learner_lm <- mlr3learners::LearnerRegrLM$new()
learner_lm
```

c) We now train a linear regression learner on the `mtcars` data. Describe the task (features, target, number of observations). What does the last line tell you? Lastly, inspect the learner object to get the estimated regression coefficients (hint: you will only find something here after the training method has been called).

```
task_mtcars <- mlr3::tsk("mtcars")
learner_lm$train(task_mtcars)
predictions <- learner_lm$predict(task_mtcars)
predictions$score()
```

Exercise 3:

We want to predict the age of an abalone using its longest shell measurement and its weight.

See: `http://archive.ics.uci.edu/ml/datasets/Abalone` for more details.

a) Plot `LongestShell`, `WholeWeight` on the x- and y-axis and color points with `Rings`

Using the mlr3-package:

b) Fit a linear model

c) Fit a k-nearest-neighbors model

d) Compare the fitted and observed targets for lm and knn, respectively (Hint: Use `autoplot()`)

Hint: See the official book manual of the mlr3 package for usage:

`https://mlr3book.mlr-org.com/index.html`