# HOMEWORK 2:
## WRITTEN EXERCISE PART

## 1 Information Theory [25/4 pts]

Suppose $X, Y$ are two random variables taking values in a discrete finite set $V$. Let $H(Y)$ denote the entropy of $Y$, and let $H(Y|X)$ denote the conditional entropy of $Y$ conditioned on $X$. Prove that if $X, Y$ are independent, then $H(Y) = H(Y|X)$.
Solution goes here.

## 2 Standardizing Numeric Features [25/4 pts]

Standardize the data set with four points in 2 dimension: $(7, 7), (3, 7), (3, 3), (7, 3)$.
Solution goes here.

## 3 $k$-Nearest Neighbors [25/4 pts]

Consider the training data set $x_1 = (7, 7), y_1 = 0; x_2 = (3, 7), y_2 = 1; x_3 = (3, 3), y_3 = 1; x_4 = (7, 3), y_4 = 2$. Suppose the Manhattan distance is used. What is the label for $x = (0, 0)$ in the following settings? Show the calculation steps.

1. 1-nearest neighbors.

2. 3-nearest neighbors.

3. 3-nearest neighbors, distance weighted. The weight for the $i$-th neighbor $z$ is $1/d(x, z)^2$.

Solution goes here.

## 4 Performance Measurements [25/4 pts]

Consider the following confusion matrix for 2 classes.

|  | actual positive | actual negative |
|---|---|---|
| predict positive | 76 | 18 |
| predict negative | 24 | 82 |

Compute the accuracy, error, true positive rate, false positive rate, precision, and recall.
Solution goes here.