Answers Machine Learning Exercises 1 - Alternative Set

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1 Vectors and Matrices

Answers exercise 1.

a.) $\begin{pmatrix}1\\2\\5\end{pmatrix} + \begin{pmatrix}9\\0\\-2\end{pmatrix} = \begin{pmatrix}10\\2\\3\end{pmatrix}$

b.) $\begin{pmatrix}5\\6\\9\end{pmatrix} - 3\begin{pmatrix}-1\\2\\2\end{pmatrix} = \begin{pmatrix}8\\0\\3\end{pmatrix}$

c.) $\begin{pmatrix}8 & 3 & 4 & 5\\9 & -4 & 6 & 6\\5 & 1 & -1 & 3\end{pmatrix} - \begin{pmatrix}-2 & 7 & 8 & 3\\9 & -7 & -8 & 7\\7 & 6 & 6 & 0\end{pmatrix} = \begin{pmatrix}10 & -4 & -4 & 2\\0 & 3 & 14 & -1\\-2 & -5 & -7 & 3\end{pmatrix}$

d.) $\begin{pmatrix}-1 & 8\\0 & 9\end{pmatrix} + 2\begin{pmatrix}2 & -5\\6 & 9\end{pmatrix} = \begin{pmatrix}3 & -2\\12 & 27\end{pmatrix}$

e.) $\begin{pmatrix}2 & 5 & 9 & -3 & -5\\5 & 7 & 5 & 0 & 5\end{pmatrix}^\top = \begin{pmatrix}2 & 5\\5 & 7\\9 & 5\\-3 & 0\\-5 & 5\end{pmatrix}$

f.) $\left\langle \begin{pmatrix}8\\7\\3\\8\end{pmatrix}, \begin{pmatrix}3\\7\\1\\-16\end{pmatrix} \right\rangle = -52$

g.) $\begin{pmatrix}3 & 4\\9 & 4\\2 & -5\end{pmatrix}\begin{pmatrix}5 & 3 & 9\\5 & 1 & 1\end{pmatrix} = \begin{pmatrix}35 & 13 & 31\\65 & 31 & 85\\-15 & 1 & 13\end{pmatrix}$

h.) $\left(\begin{pmatrix}3 & 7\\3 & -3\\-7 & 4\end{pmatrix}^\top + \begin{pmatrix}7 & 4 & 7\\1 & 5 & -2\end{pmatrix}\right)\begin{pmatrix}2\\-1\\7\end{pmatrix} = \begin{pmatrix}10 & 7 & 0\\8 & 2 & 2\end{pmatrix}\begin{pmatrix}2\\-1\\7\end{pmatrix} = \begin{pmatrix}13\\28\end{pmatrix}$

Grading of Exercise 1: For each part of Exercise 1 you can gain 5/8 points. As a consequence you can gain a maximum of 5 points in total.

2 Supervised Learning Problems

Exercise 2. *Give an example (not from class or from the book) of each of the following learning problems:*

- *prediction,*
- *classification,*
- *regression.*

How would you represent the labels and feature vectors (if applicable) mathematically? For either the classification or regression case (your choice), give at least two possible representations of your feature vectors.

Your examples do not need to be very realistic, but they do need to be about objects in the real world. For example, the answer "let $\mathbb{R}^6$ be the set of possible feature vectors" is not sufficient. You need to say what the feature vectors represent.

Answers Exercise 2: See the slides of the first three lectures for examples.

- Slides 23 and 24 of `mlslides1.pdf` provide examples of prediction that relate to phenomena in the real world.
- Slides 29 and 30 of `mlslides2.pdf` provide classification examples. Slide 31 provides a regression example.
- Slides 15 and 16 of `mlslides3.pdf` provide a classification example of representing the available data in two different ways using feature vectors.

Grading of Exercise 2: For examples of prediction, classification and regression in Exercise 2 you can get at most 1 point each. You get another 1 point for providing an alternative feature vector representation of the data in the classification or regression case. Thus you can get at most 4 points for this exercise.

3 Grading Policy

- Grades are between 1 and 10.
- You always start with 1 point.
- Partial points may be awarded for partially correct exercises.
- The last question of Exercise 2, about two possible representations of feature vectors, was perhaps unclear. It is therefore made a bonus question. If your grade according to the scoring above is x, then your final grade will be the minimum of $\frac{10}{9}x$ and 10.

4 Comment on Sources

In general web resources do not meet scientific standards. Nevertheless, I've consulted the ones below during the preparation of these exercises.

References

[1] J. Kolter. Linear algebra review and reference. Available online: `http://www.stanford.edu/class/cs229/section/cs229-linalg.pdf`, October 2006.