

Assignment 3 Instructions

Purpose

The purpose of this assignment is to assist you with mastering the topics in Modules 6 and 7.

Learning Outcomes

This assignment aligns to the following module learning outcomes:

- Module 6
 - Explain the key idea of support vector machine (SVM) algorithm. (CLO 1, 2, 3)
 - Describe the advantages and disadvantages of SVM models. (CLO 1, 2, 3)
 - Demonstrate how SVM can be implemented. (CLO 4)
- Module 7
 - Explain the key idea of artificial neural networks. (CLO 1, 2, 3)
 - Describe how a perceptron learner work. (CLO 1, 2, 3)
 - Demonstrate how a feedforward neural networks can be implemented. (CLO 4)

Instructions

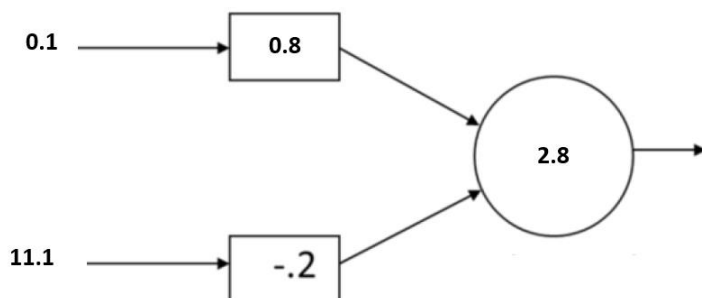
Part A

Please read the following questions carefully and answer each question.

QA1. What is the difference between SVM with hard margin and soft margin? (10% of total points)

QA2. What is the role of the cost parameter, C , in SVM (with soft margin) classifiers? (10% of total points)

QA3. Will the following perceptron be activated (2.8 is the activation threshold) (10% of total points)



QA4. What is the role of alpha, the learning rate in the delta rule? (10% of total points)

Part B

This part of the assignment involves building SVM and neural network regression models to answer a number of questions. We will use the Carseats dataset that is part of the ISLR package (you need to install and load the library). We may also need the following packages: caret, dplyr and glmnet

Let's start by loading these libraries:

```
library(ISLR)
```

```
## Warning: package 'ISLR' was built under R version 4.0.3
```

```
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 4.0.2
```

```
## Warning: replacing previous import 'vctrs::data_frame' by 'tibble::data_frame'
```

```
## when loading 'dplyr'
```

```
##
```

```
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
```

```
##
```

```
## filter, lag
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
## intersect, setdiff, setequal, union
```

```
library(glmnet)
```

```
## Warning: package 'glmnet' was built under R version 4.0.2
```

```
## Loading required package: Matrix
```

```
## Loaded glmnet 4.0-2
```

```
library(caret)
```

```
## Warning: package 'caret' was built under R version 4.0.3
```

```
## Loading required package: lattice
```

```
## Loading required package: ggplot2
```

```
## Warning: package 'ggplot2' was built under R version 4.0.2
```

For this assignment, we only need the following attributes: "Sales", "Price", "Advertising", "Population", "Age", "Income" and "Education". The goal of the assignment is to build models to predict the sales of the carseats ("Sales" attribute) using the other attributes.

We can use the dplyr select function to select these attributes.

```
Carseats_Filtered <- Carseats %>% select("Sales", "Price",  
"Advertising", "Population", "Age", "Income", "Education")
```

QB1. Build a linear SVM regression model to predict Sales based on all other attributes ("Price", "Advertising", "Population", "Age", "Income" and "Education"). Hint: use caret train() with method set to "svmLinear". What is the R-squared of the model? (15 % of total points)

QB2. Customize the search grid by checking the model's performance for C parameter of 0.1,.5,1 and 10 using 2 repeats of 5-fold cross validation. (15% of total points)

QB3. Train a neural network model to predict Sales based on all other attributes ("Price", "Advertising", "Population", "Age", "Income" and "Education"). Hint: use caret train() with method set to "nnet". What is the R-square of the model with the best hyper parameters (using default caret search grid) – hint: don't forget to scale the data. (15% of total points)

QB4. Consider the following input:

- Sales=9
- Price=6.54
- Population=124
- Advertising=0
- Age=76
- Income= 110
- Education=10

What will be the estimated Sales for this record using the above neuralnet model? (15% of total points)

General Submission Instructions:

All work must be your own. Copying other people's work or from the Internet is a form of plagiarism and will be prosecuted as such.

You may submit a Microsoft Word (.doc/.docx) document as an attachment using the Canvas Assignment tool, or you may copy and paste your answer into the provided box within the Assignment tool. If you attach a document for your assignment, be sure to include your name in the text of the document and in the name of the document.

- You can only submit once, so make sure you are completely finished before submitting and that you attach the correct word .doc/.docx file.
- Submissions sent by email will NOT be accepted.

Due dates are listed in the Assignment Schedule document.