1 GNU R

1. Define a vector x of three real numbers 1,2,3 in R
   answer

```
> x = c(1, 2, 3)
```

2. Define a list x of values "a" and "b" in R
   answer

```
> x = list("a", "b")
```

3. List data types in R
   answer

- vector
- list
- environment

4. Given two lists x and y produce list containing all values in x and y preserving their order
   answer

```
> c(x, y)
```

5. Given vectors $x = (1, 2, 3)$ and $y = (2, 4, 6)$ calculate linear regression

$$y \propto \beta x$$

and print β
   answer

```
> x <- c(1, 2, 3)
> y <- c(2, 4, 6)
> r <- lm( y~x )
> r$coefficients[2]
```

6. What is JOIN operation between two data frames?
   answer

Given sets of tuples $A = (a_l, k_l)$ and $B = (b_r, k_r)$ with key k JOIN operation produces set of tuples (a_j, b_j, k_j) so that for each j there exist some l_j and r_j such that $k_{l_j} = k_{r_j}$

7. How one could join two data frames in R by common column "key"?

answer

```
> library(dplyr)
> d1 <- tibble(a=c(1,2),key=c("one","two"))
> d2 <- tibble(b=c(10,20),key=c("one","two"))
> inner_join(d1,d2,by="key")
A tibble: 2 x 3
      a key        b
  <dbl> <chr> <dbl>
1     1 one      10
2     2 two      20
```

2 General Machine learning

8. What dimensity reduction methods you have heard about?

answer

- Principal Components analysis (PCA)
- Linear discriminant analysis (LDA)

9. What is Principal Components Analysis

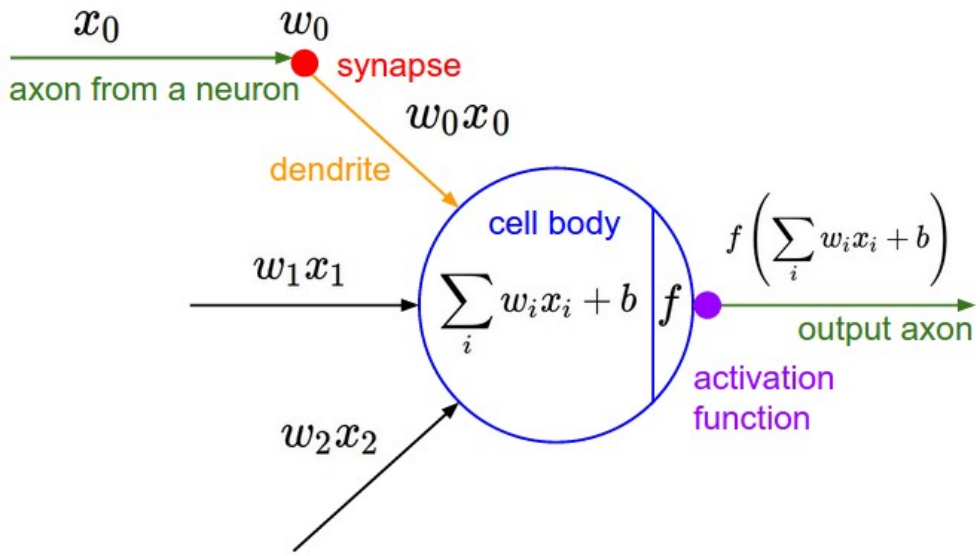
answer

TODO Source: https://medium.com/@jonathan_hui/machine-learning-singular-value-decomposition-svd-principal-component-analysis-pca-1d45e885e491

3 Neural networks

10. What is neuron model

answer



source: https://www.cs.utoronto.ca/ fidler/teaching/2015/slides/CSC2523/CNN-tutorial.pdf

11. Give examples of activation functions

answer

- Step-function
$$f(x) = \begin{cases} 1, x > 0 \\ 0, x < 0 \end{cases}$$
- Sigmoid
$$f(x) = \frac{1}{1 + e^{-x}}$$
- TanH
$$f(x) = \tanh(x)$$
- ReLU
$$f(x) = \max(0, x)$$
- Maxout
$$f(x) = \max(w_0 x + b_0, w_1 x + b_1)$$

source: https://www.cs.utoronto.ca/ fidler/teaching/2015/slides/CSC2523/CNN-tutorial.pdf

12. What are the strong and weak sides of sigmoid activation function

answer

Strong:

- Captures non-linearity in the data
- Differentiable, thus could be used in gradient descent and backpropagation methods for calculating weights

Weak:

- Problem of vanishing gradients when training network

source: https://towardsdatascience.com/understanding-neural-networks-from-neuron-to-rnn-cnn-and-deep-learning-cd88e90e0a90

13. For image and speech recognition, what kind of neural networks are better used and why?

answer

- CNN (Convolution Neural Networks) are used for image recognition.
- RNN (Recurring Neural Networks) are used for speech recognition

source: https://www.cs.utoronto.ca/ fidler/teaching/2015/slides/CSC2523/CNN-tutorial.pdf