CS 360: Machine Learning

Prof. Sara Mathieson

Fall 2020

Admin

- **Roster** is finalized

- **Lab 1** due Tues night

- **TA/office hours**

  Sunday 8:30-10pm (Fiona)

  Monday 9:45-11am (Sara)

  Tuesday 4:30-6pm (Sara)

  Thursday 8-9:30pm (Jason)

Outline for Sept 11

- Informal reading check-in
- Style guidelines for Python
- K-nearest neighbors (KNN) algorithm
- Featurization (intro)

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2. Is it okay to look at the test data (the features, labels, or both) during training? Why or why not?

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   Regression

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Python style

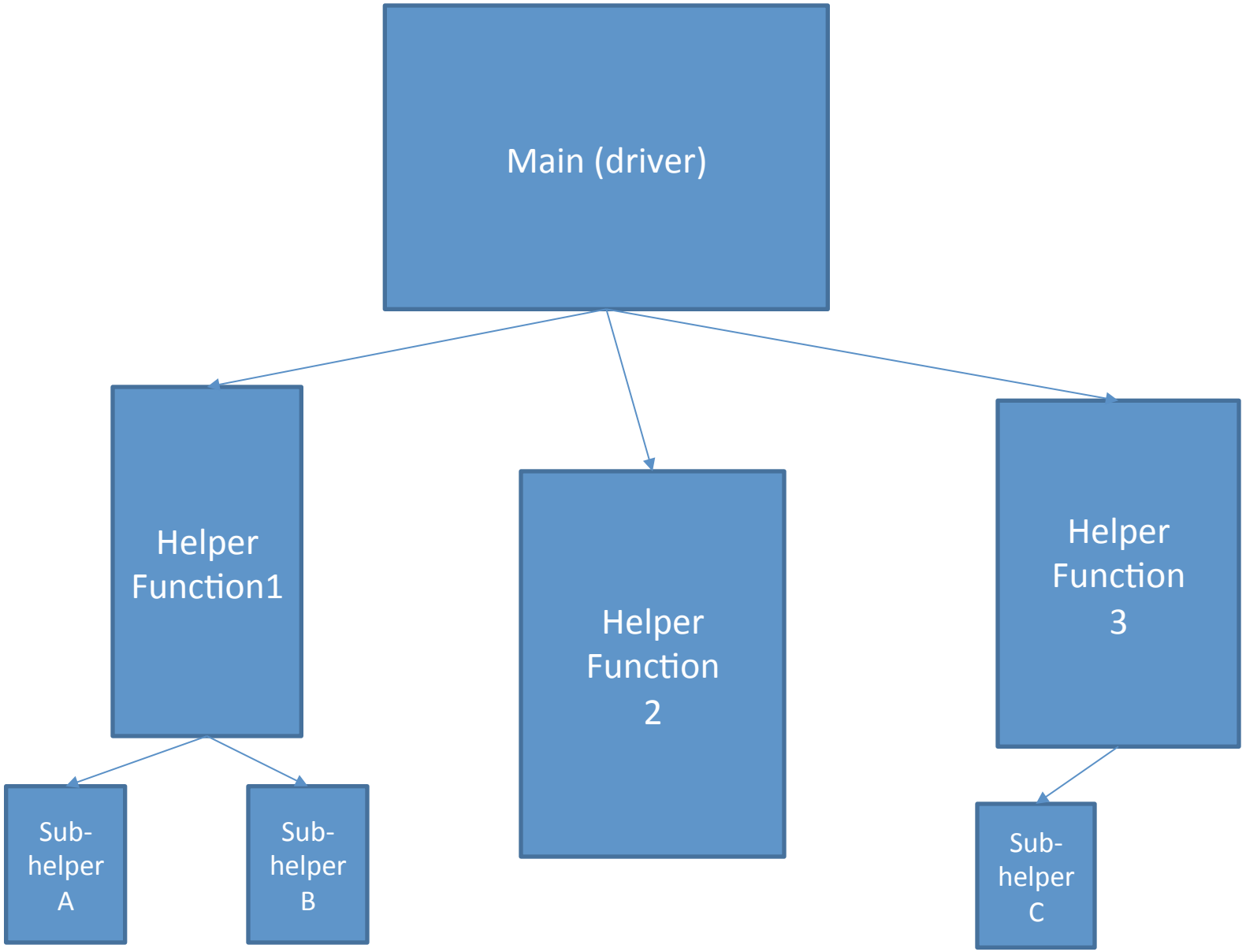
- Decompose code into natural functions
- Avoid global variables (sometimes useful)
- Include a file header with purpose, author, and date
- Include headers for each function
- No lines over 80 chars
- Variable names implicitly show type
- Include line breaks and comments!

Python style examples

```
"""
Ask the user for their name and welcome them to CS21.
Author: Sara Mathieson
Date: 9/7/18
"""

def main():

    # ask user for their name and print greeting
    name = input("Enter your name: ")
    print("Hello", name, "!")

main()
```

```
def factorial(n):
    """
    Given a non-negative integer n, return n! = n*(n-1)*(n-2)....3*2*1.
    """
    fact = 1 # set up an accumulator variable
    for i in range(n):
        fact = fact * (i+1) # accumulator pattern
    return fact
```

Structure of main and “helper” functions



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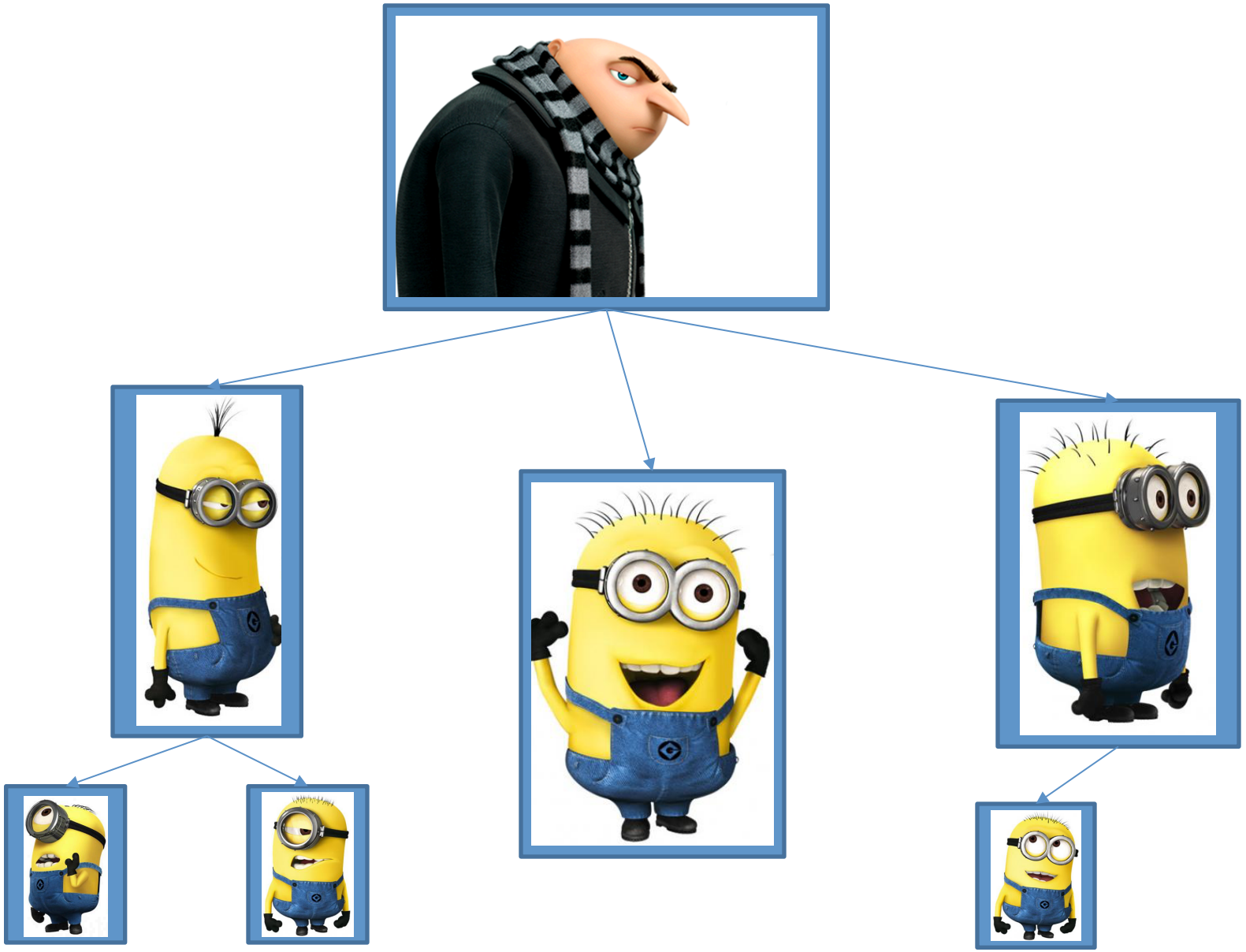

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4) Iterate on your design until you have a working main and stubbed out functions. Then start implementing the functions, starting from the "bottom up".

Reasons to use TDD

- Creates code that is easier to implement, debug, modify, and extend
- Avoids going off in the wrong direction (i.e. implementing functions that are not useful or don't serve the program)
- Creates code that is easier for you or someone else to read and understand later on

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Input and Output

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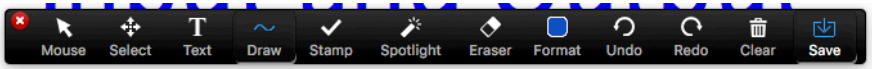


$X = \begin{bmatrix} — \vec{x}_i^T — \end{bmatrix}$ n examples rows, $n \times p$

p features

Y = label or output

$X_{train} \approx 80\%$

$X_{test} \approx 20\%$

$Y = \begin{bmatrix} 0 \\ \vdots \\ 0 \\ \vdots \\ C \end{bmatrix}$ $n \times 1$

- Regression

  $y \in \mathbb{R}$

- Binary classification

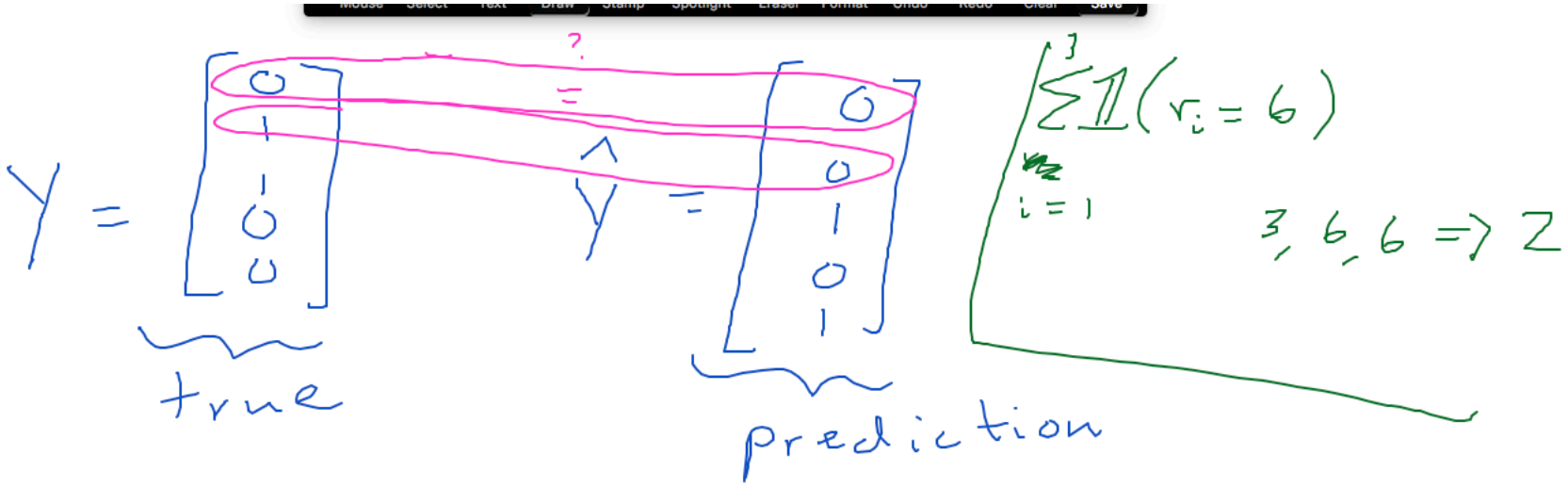
  $y \in \{0, 1\}$, $y \in \{-1, +1\}$

- Multiclass classification

  $y \in \{1, 2, 3, \cdots, C\}$

- Ranking

Accuracy



$$acc = \frac{1}{n} \sum_{i=1}^{n} \mathbb{1}(y_i = \hat{y}_i)$$

?

$\mathbb{1}$(statement) =

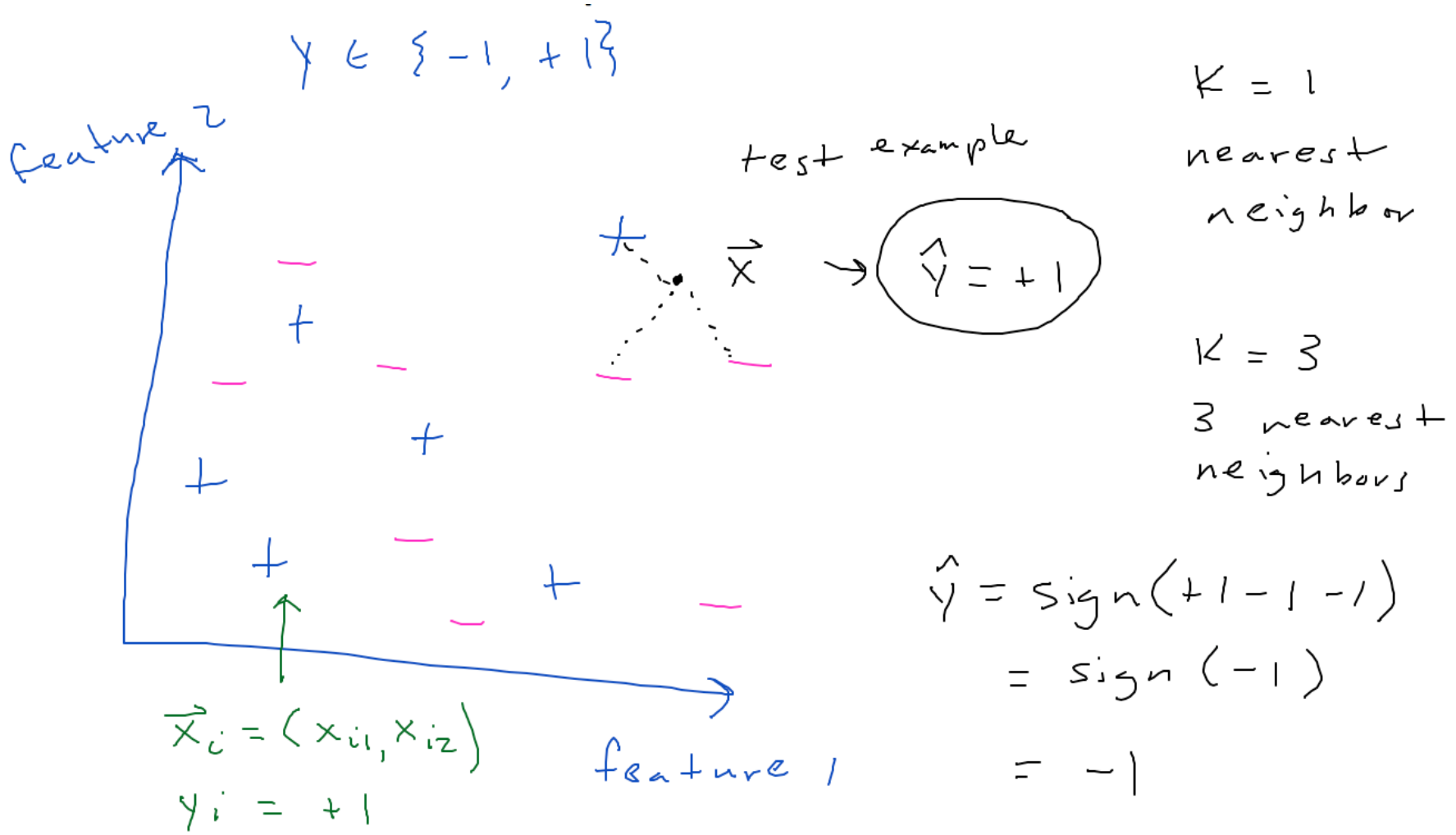
indicator { 1 if true
0 otherwise

ex : $\frac{1}{5}(1 + 0 + 1 + 1 + 0) = \frac{3}{5}$

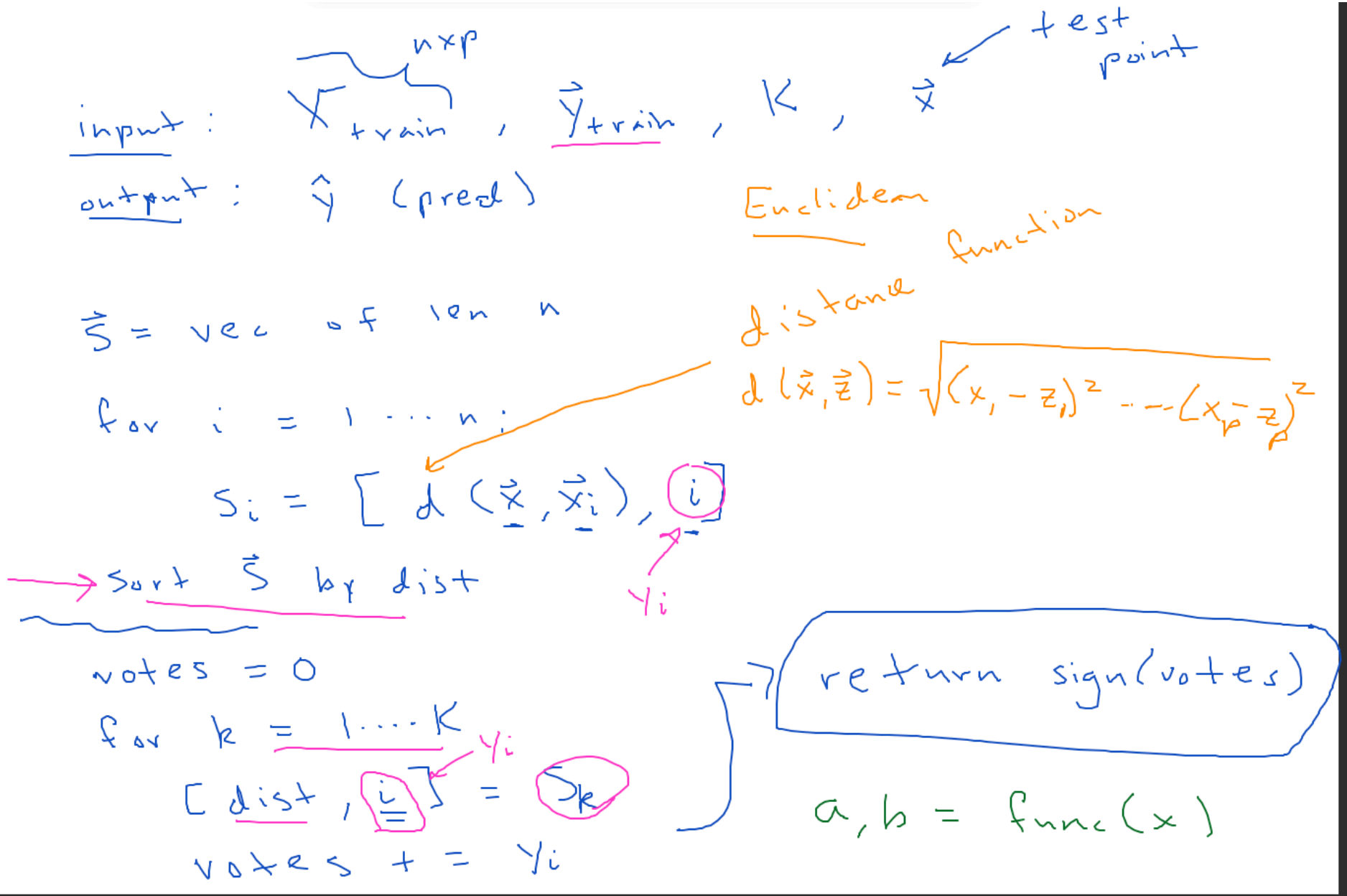
$$error = \frac{1}{n} \sum \mathbb{1}(y_i \neq \hat{y}_i) = 1 - acc$$

K-nearest neighbors

Idea: predict that the new example has the same label as the most similar example we've seen before



KNN Algorithm



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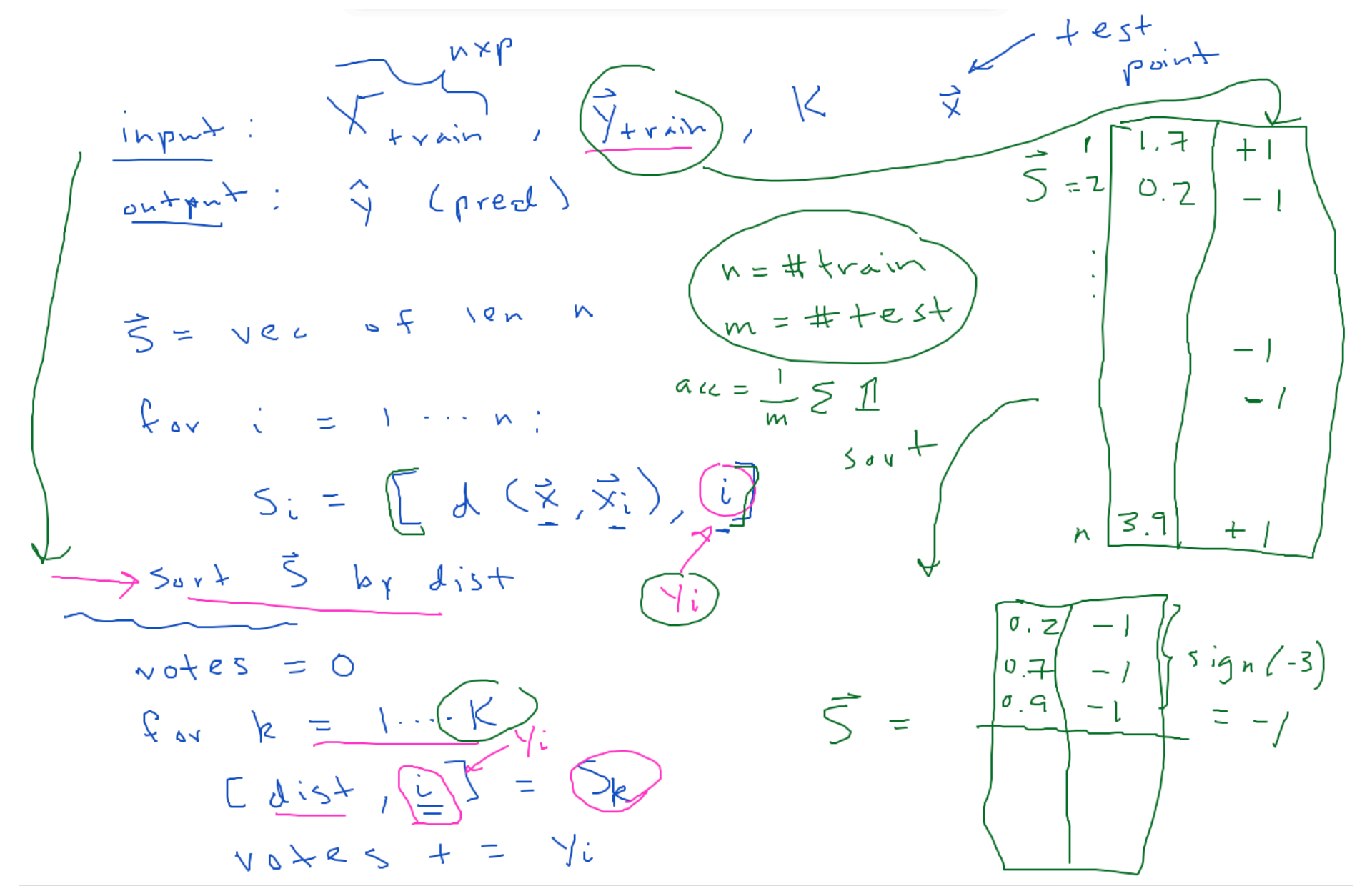

Multiclass KNN

Next time!

K-nearest neighbors creates implicit decision boundaries

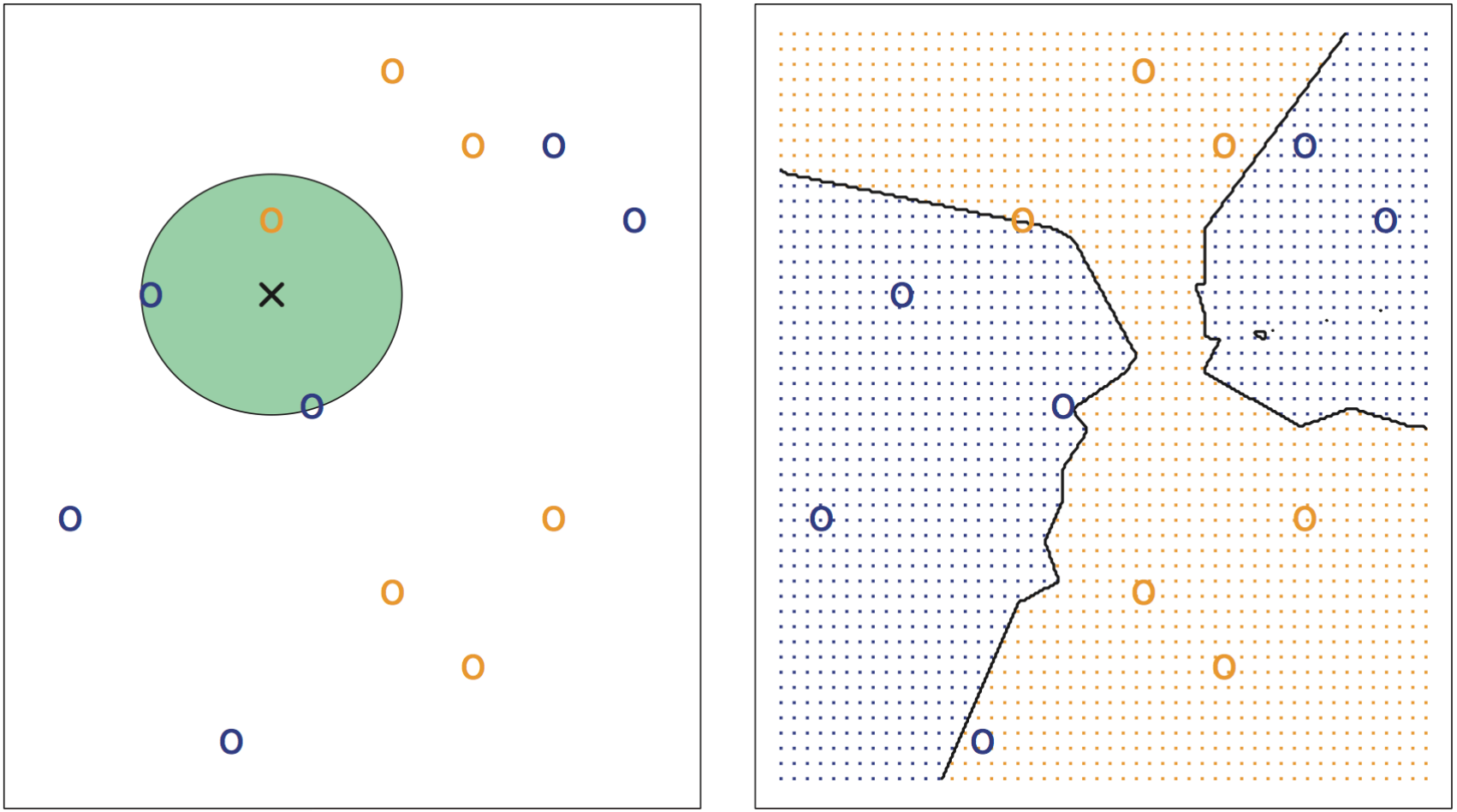

Figure 2.14 from ISL book, KNN with two classes (C=2), and K=3

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Lab 1 notes, zip code data