ECE 595 HW2

Ruijie Song

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Exercise 1: Loading Data via Python

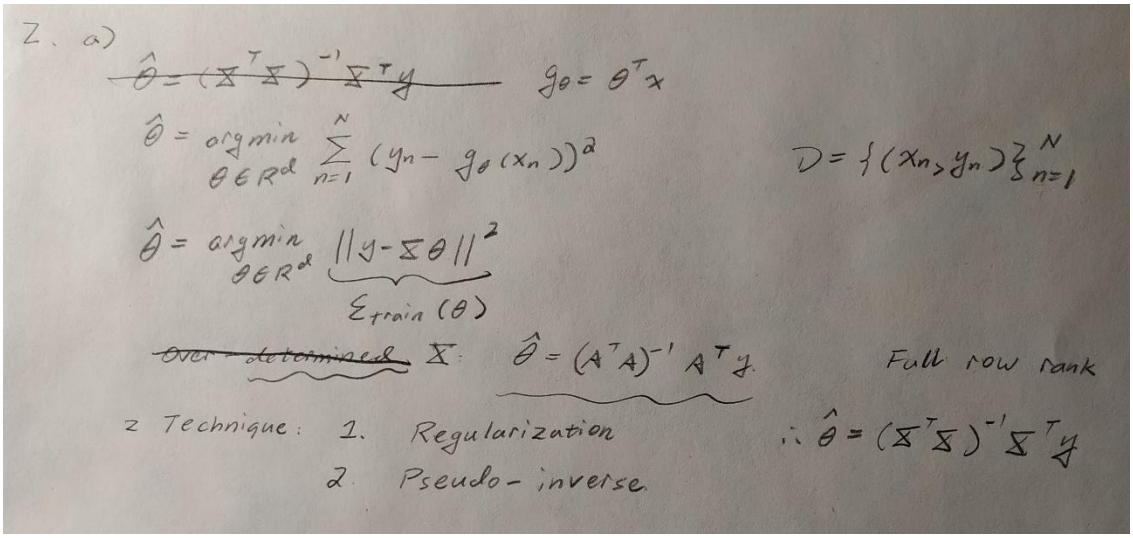
```
['index', 'male_bmi', 'male_stature_mm']
['0', '3.0', '1.679']
['1', '2.56', '1.586']
['2', '2.42', '1.773']
['3', '2.7399999999999998', '1.816']
['4', '2.59', '1.809']
['5', '2.5300000000000002', '1.662']
['6', '2.27', '1.829']
['7', '2.54', '1.686']
['8', '3.41', '1.761']
['9', '3.34', '1.797']

['index', 'female_bmi', 'female_stature_mm']
['0', '2.82', '1.563']
['1', '2.2199999999999998', '1.716']
['2', '2.71', '1.484']
['3', '2.81', '1.651']
['4', '2.55', '1.548']
['5', '2.3', '1.665']
['6', '3.56', '1.564']
['7', '3.1100000000000003', '1.676']
['8', '2.46', '1.69']
['9', '4.3', '1.704']
```

Figure 1. Exercise 1 result

Exercise 2: Build a Linear Classifier via Optimization

a.



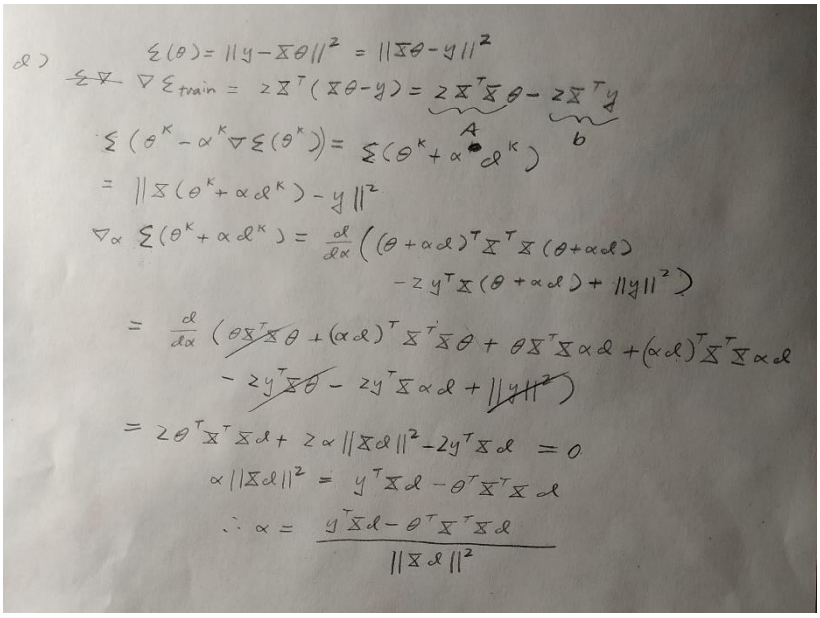
b.

theta = [-1.070e+01; -1.233e-01; 6.674e+00]

c.

theta = [-1.070e+01; -1.233e-01; 6.674e+00]

d.



e.

theta = [-1.070e+01; -1.233e-01; 6.674e+00]

f.

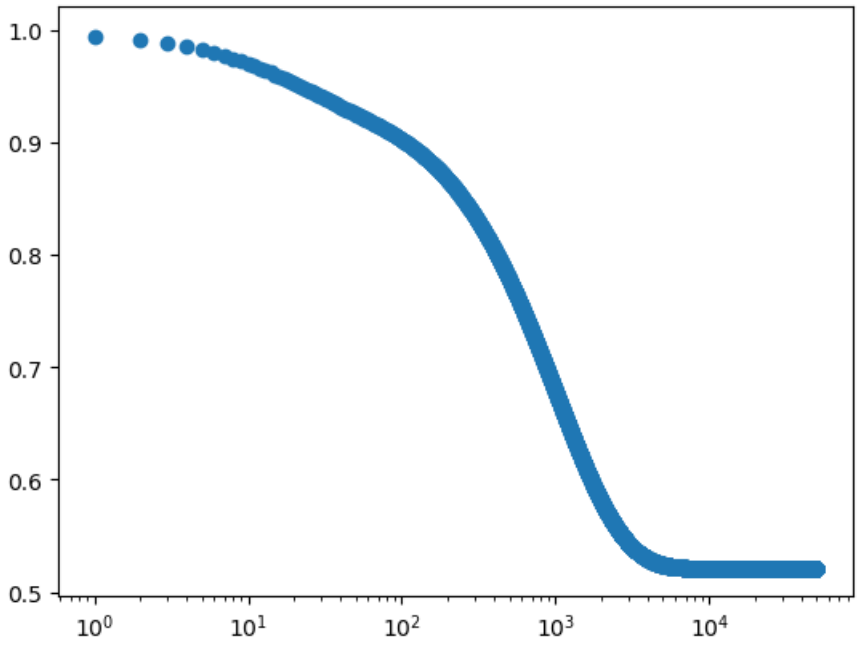


Figure 2. plot of the training loss

g.

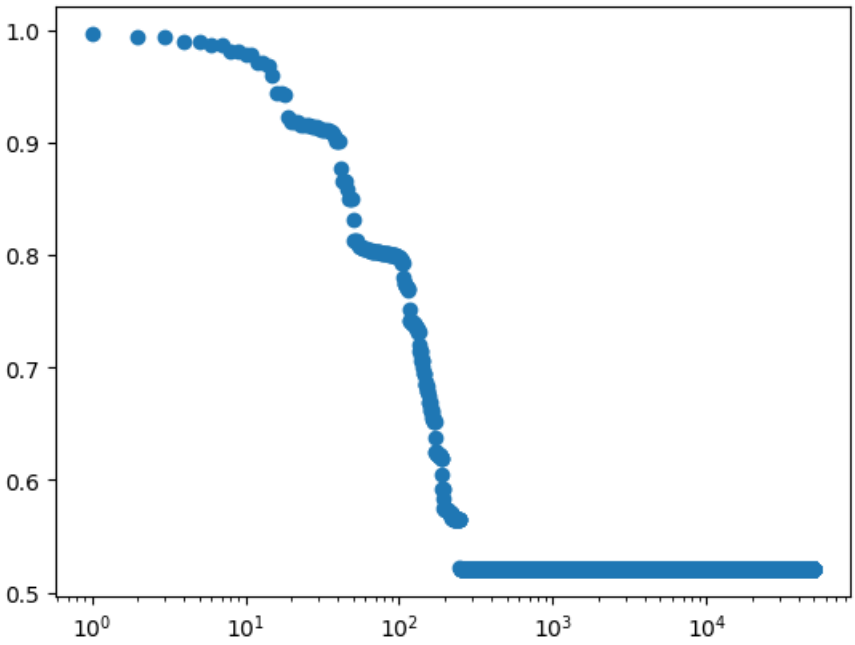
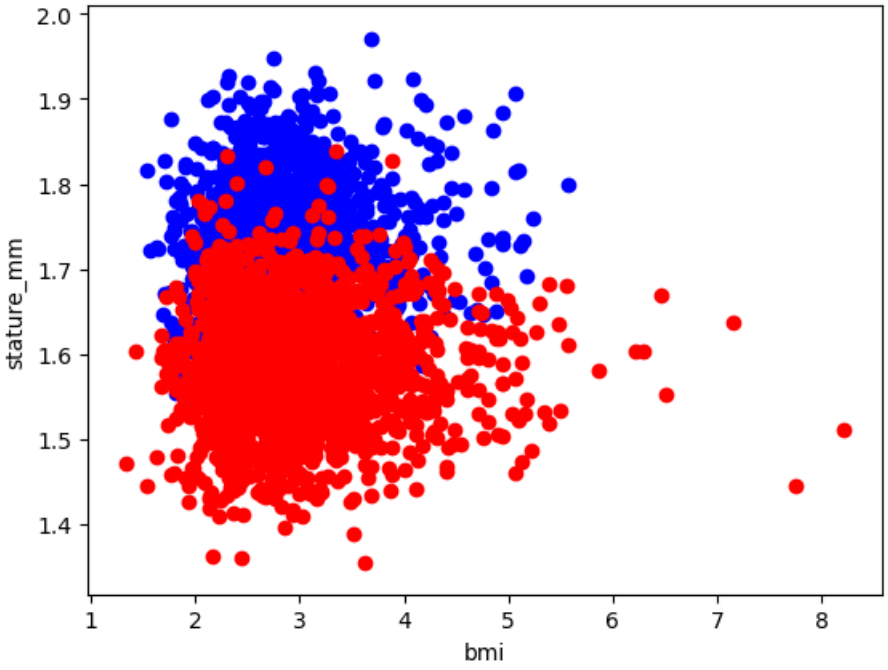


Figure 3. plot of the training loss

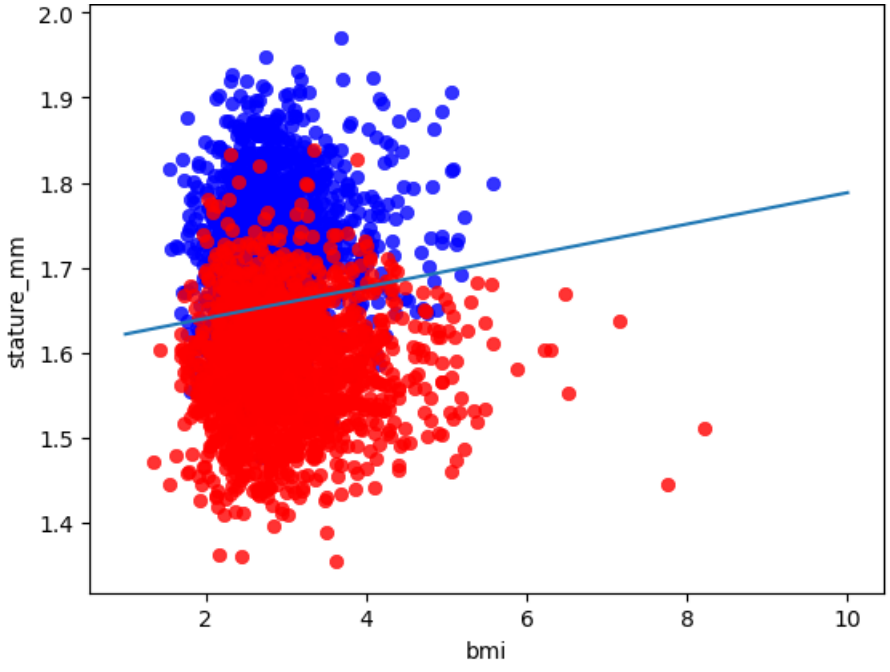
Exercise 3: Visualization and Testing

a.

i.



ii.

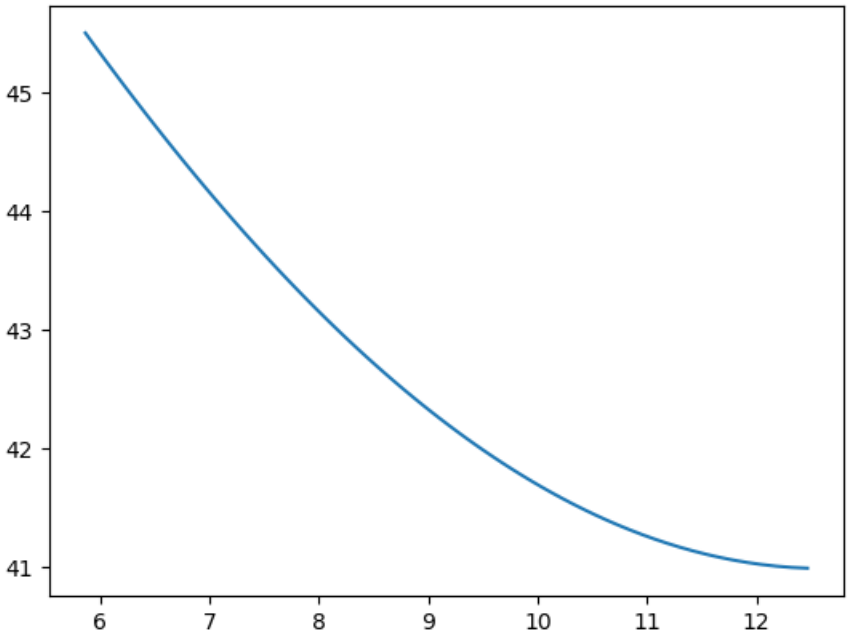


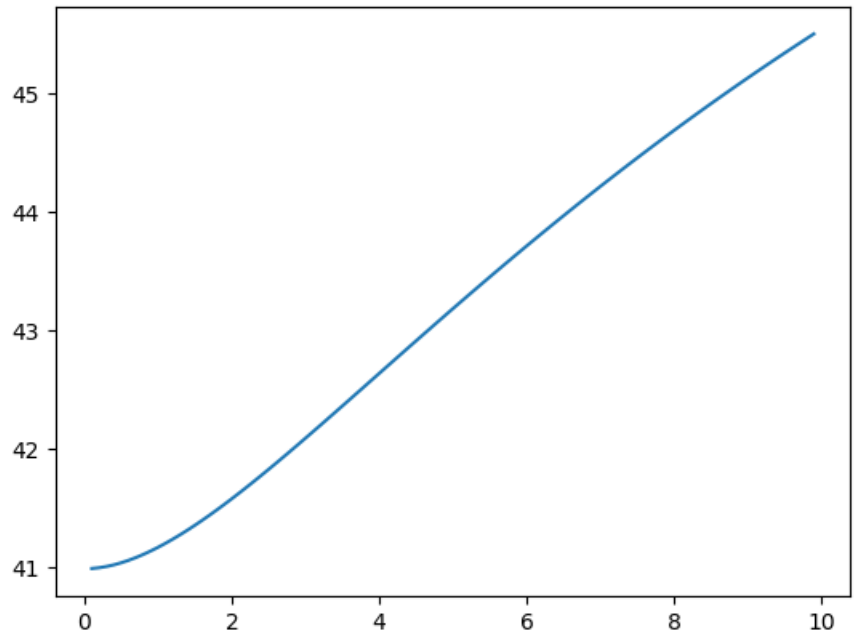
b

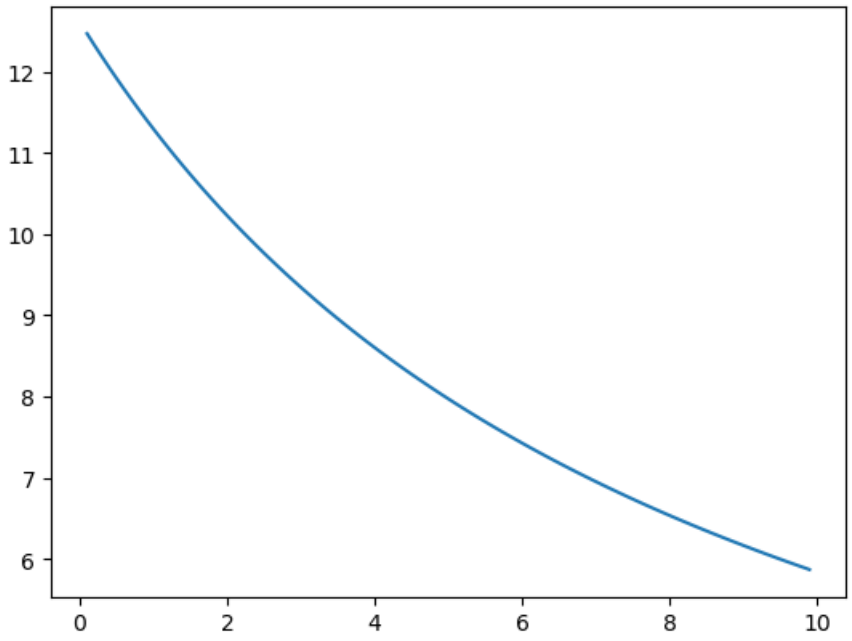
False Alarm = 15.02403846153846%
Miss = 18.653846153846154%
Precision = 0.9998804240631164
Recall = 0.9999036898201988

Exercise 4: Regularization

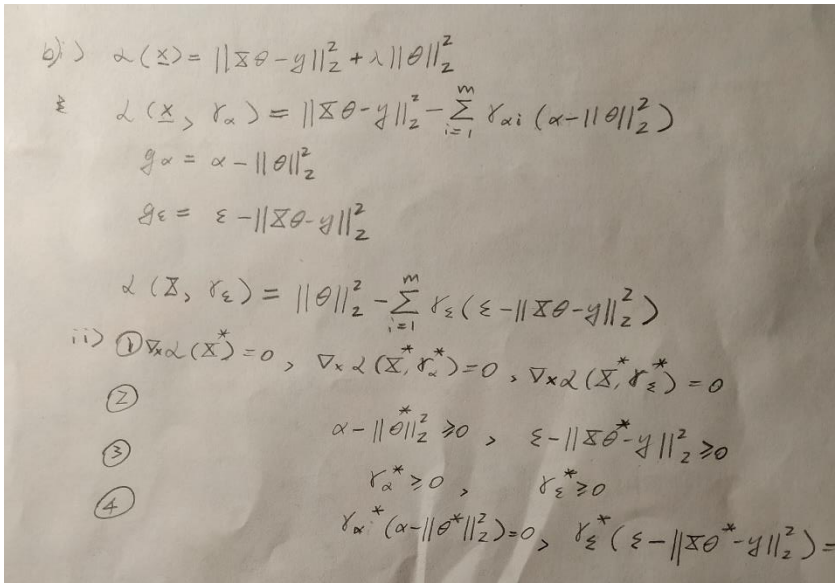
a.






12
11
10
9
8
7
6
0
2
4
6
8
10

b.


b)) $\alpha(\underline{x}) = \|X\theta - y\|_2^2 + \lambda\|\theta\|_2^2$
$\alpha(\underline{x}, \gamma_\alpha) = \|X\theta - y\|_2^2 - \sum_{i=1}^{m} \gamma_{\alpha i}(\alpha - \|\theta\|_2^2)$
$g_\alpha = \alpha - \|\theta\|_2^2$
$g_\varepsilon = \varepsilon - \|X\theta - y\|_2^2$
$\alpha(X, \gamma_\varepsilon) = \|\theta\|_2^2 - \sum_{i=1}^{m} \gamma_\varepsilon(\varepsilon - \|X\theta - y\|_2^2)$
ii) ① $\nabla_x \alpha(X^*) = 0$, $\nabla_x \alpha(X^*, \gamma_\alpha^*) = 0$, $\nabla_x \alpha(X^*, \gamma_\varepsilon^*) = 0$
②
③ $\alpha - \|\theta^*\|_2^2 \geq 0$, $\varepsilon - \|X\theta^* - y\|_2^2 \geq 0$
④ $\gamma_\alpha^* \geq 0$, $\gamma_\varepsilon^* \geq 0$
$\gamma_\alpha^*(\alpha - \|\theta^*\|_2^2) = 0$, $\gamma_\varepsilon^*(\varepsilon - \|X\theta^* - y\|_2^2) =$

iii)

$$\hat{\theta}_\lambda = \underset{\theta \in \mathbb{R}^d}{\arg\min} \|X\theta - y\|_2^2 + \lambda \|\theta\|_2^2$$

$$L(x) = \|X\theta - y\|_2^2 + \lambda \|\theta\|_2^2$$

$$\nabla_x L(x) = 2\|X\theta - y\| \pm = 0$$

$$\|X\theta - y\| = 0 \Rightarrow X\theta = y \qquad \hat{\theta}_\lambda = X^{-1}y$$

$$\gamma_\alpha (\alpha - \|\hat{\theta}_\lambda\|_2^2) = 0 \Rightarrow \gamma_\alpha (\alpha - \|X^{-1}y\|_2^2) = 0$$

~~$\gamma_{\alpha i}(\alpha - (x_i^{-1}y_i)^2) = 0$~~

~~if $\gamma_{\alpha i} = 0 \quad \alpha - (x_i^{-1}y_i)^2 > 0 \quad \alpha > (x_i^{-1}y_i)^2$~~

if $\gamma_\alpha = 0$, $\alpha \geq \|X^{-1}y\|_2^2$

if $\alpha - \|X^{-1}y\|_2^2 = 0$, $\gamma_\alpha > 0$

$$\alpha = \|X^{-1}y\|_2^2$$

iv)

$$\gamma_\varepsilon (\varepsilon - \|XX^{-1}y - y\|_2^2) = 0 \Rightarrow \gamma_\varepsilon \cdot \varepsilon = 0$$

$\gamma_\varepsilon = 0$ or $\varepsilon = 0$

v) $\nabla_\theta \left(\|X\theta - y\|_2^2 - \sum_{i=1}^{m} \gamma_\alpha (\alpha - \|\theta\|_2^2) \right) = 0$

$$2(X\theta - y) + \gamma_\alpha \cdot 2\theta = 0$$

$$(X + \gamma_\alpha)\theta = y \qquad \theta = (X + \gamma_\alpha)^{-1} y$$

If $\gamma_\alpha = 0$, . Yes

If $\gamma_\alpha > 0$, ~~Yes~~ No

$$\gamma_\alpha (\alpha - \|(X + \gamma_\alpha)^{-1}y\|_2^2) = 0$$

Since $\gamma_\alpha > 0$

$$(X + \gamma_\alpha)^{-1} y \neq X^{-1}y \neq \alpha$$

```python
# -*- coding: utf-8 -*-
"""
Created on Tue Feb 16 21:22:39 2021

@author: 11327
"""

import numpy as np
import matplotlib.pyplot as plt
import cvxpy as cp
import csv

# Exercise 1

# Reading csv file for male data
with open("./data/male_train_data.csv", "r") as csv_file:
    reader = csv.reader(csv_file, delimiter=',')
    # Add your code here to process the data into usable form
    i = 0
    data_m = np.array([])
    for line in reader:
        try:
            line[1] = str(float(line[1])/10) # normalizing BMI
        except:
            None
        try:
            line[2] = str(float(line[2])/1000) # normalizing stature_mm
        except:
            None
        if i == 0:
            data_m = np.array(line)
        else:
            data_m = np.row_stack((data_m,np.array(line)))
        i = i+1
    print(data_m[0:11,:])

csv_file.close()

print()

# Reading csv file for female data
with open("./data/female_train_data.csv", "r") as csv_file:
    reader = csv.reader(csv_file, delimiter=',')
    # Add your code here to process the data into usable form
    i = 0
    data_f = np.array([])
    for line in reader:
        try:
            line[1] = str(float(line[1])/10) # normalizing BMI
        except:
            None
        try:
            line[2] = str(float(line[2])/1000) # normalizing stature_mm
        except:
            None
        if i == 0:
            data_f = np.array(line)
        else:
            data_f = np.row_stack((data_f,np.array(line)))
        i = i+1
    print(data_f[0:11,:])
```

```
csv_file.close()



# Exercise 2
# b

data_m = np.around(data_m[1:,1:].astype(np.float), decimals = 3)
data_f = np.around(data_f[1:,1:].astype(np.float), decimals = 3)

X = np.row_stack((data_m,data_f))
# X = X.astype(np.float)

# add a column of 1 to the X
X = np.c_[np.ones(len(X)), X]

# Producing yn
len_m = len(data_m)
len_f = len(data_f)
y = np.concatenate((np.array(np.ones(len_m)), np.array(-1.0*np.ones(len_f))))

# Calculating theta
theta = np.dot(np.dot(np.linalg.pinv(np.dot(X.T,X)),X.T),y)

# c
THETA = cp.Variable(X.shape[1])
objective = cp.Minimize(cp.sum_squares(y - X@THETA))
prob = cp.Problem(objective)

result = prob.solve()
THETA_c = THETA.value

# e: Gradient descent
# Initialize gradient descent
d = X.shape[1]
max_itr = 50000
cost = np.zeros(max_itr)
theta_e = [0.,0.,0.]
XtX = np.dot( np.transpose(X), X)
theta_store = np.zeros((d,max_itr+1))
for i in range(d):
    theta_store[i,0] = 0

# Gradient descent
for itr in range(max_itr):
  dJ     = 2*(np.dot(XtX,theta_e) - np.dot(X.T,y))
  dd     = -1 * dJ
  alpha  = (np.dot(np.dot(y.T,X),dd) - np.dot(np.dot(theta_e,XtX),dd)) / np.sum((np.dot(X,dd))*
  theta_e  = theta_e + alpha*dd
  theta_store[:,itr+1] = theta_e
  cost[itr] = np.linalg.norm(y-np.dot(X, theta_e))**2/X.shape[0]

# f
plt.figure(1)
plt.semilogx(cost,'o',linewidth=8)

# g
beta = 0.9
# Initialize gradient descent
d = X.shape[1]
```

```
max_itr = 50000
cost = np.zeros(max_itr)
theta_g = [0.,0.,0.]
XtX = np.dot( np.transpose(X), X)
theta_store = np.zeros((d,max_itr+1))
for i in range(d):
    theta_store[i,0] = 0

# Gradient descent
itr = 0
dJ     = 2*(np.dot(XtX,theta_g) - np.dot(X.T,y))
dJ_lasttime = 2*(np.dot(XtX,theta_store[:,itr]) - np.dot(X.T,y))
dd     = -1 * (beta*dJ_lasttime + (1-beta)*dJ)
alpha  = (np.dot(np.dot(y.T,X),dd) - np.dot(np.dot(theta_g,XtX),dd)) / np.sum((np.dot(X,dd))**2)
theta_g  = theta_g + alpha*dd
theta_store[:,itr+1] = theta_g
cost[itr] = np.linalg.norm(y-np.dot(X, theta_g))**2/X.shape[0]

for itr in range(1,max_itr):
    dJ     = 2*(np.dot(XtX,theta_g) - np.dot(X.T,y))
    dJ_lasttime = 2*(np.dot(XtX,theta_store[:,itr-1]) - np.dot(X.T,y))
    dd     = -1 * (beta*dJ_lasttime + (1-beta)*dJ)
    alpha  = (np.dot(np.dot(y.T,X),dd) - np.dot(np.dot(theta_g,XtX),dd)) / np.sum((np.dot(X,dd))
    theta_g  = theta_g + alpha*dd
    theta_store[:,itr+1] = theta_g
    cost[itr] = np.linalg.norm(y-np.dot(X, theta_g))**2/X.shape[0]

# h
plt.figure(2)
plt.semilogx(cost,'o',linewidth=8)



# Exercise 3

# a
# i
plt.figure(3)
plt.scatter(data_m[:,0],data_m[:,1],c = 'b',alpha = 0.8,linewidth = 0.5)
plt.scatter(data_f[:,0],data_f[:,1],c = 'r',alpha = 0.8,linewidth = 0.5)
plt.xlabel('bmi')
plt.ylabel('stature_mm')

# ii
xaxis = np.linspace(1,10,100)
yaxis = (-1*theta[0]-theta[1]*xaxis) / theta[2]
plt.plot(xaxis,yaxis)

# b
f_predicted_mm =  (-1*theta[0]-theta[1]*data_f[:,0]) / theta[2]
m_predicted_mm =  (-1*theta[0]-theta[1]*data_m[:,0]) / theta[2]

false_alarm = 0
for i in range(len_f):
    if (data_f[i,1] > f_predicted_mm[i]):
        false_alarm = false_alarm + 1
false_alarm = false_alarm / len_f

Miss = 0
for i in range(len_m):
    if (data_m[i,1] < m_predicted_mm[i]):
```

```
        Miss = Miss + 1
Miss = Miss / len_m

TP = len_m - Miss
FP = Miss
FN = false_alarm
precision = (TP)/(TP+FP)
recall = TP/(TP+FN)



# Exercise 4: Regularization
# a

THETA_4 = []
lambd = np.arange(0.1,10,0.1)

for i in range(len(lambd)):
    THETA = cp.Variable(X.shape[1])
    objective = cp.Minimize(cp.sum_squares(X@THETA - y)+lambd[i]*cp.sum_squares(THETA))
    prob = cp.Problem(objective)

    result = prob.solve()
    THETA_4.append(THETA.value)

x_4a = []
y_4a = []
for i in range(len(lambd)):
    x_4a.append(np.linalg.norm(THETA_4[i], ord=2))
    y_4a.append(np.linalg.norm(X@THETA_4[i] - y, ord=2))
plt.figure(1)
plt.plot(x_4a, y_4a)

plt.figure(2)
plt.plot(lambd, y_4a)

plt.figure(3)
plt.plot(lambd, x_4a)
```

Implementing Noise2Noise for Dynamic Scenes

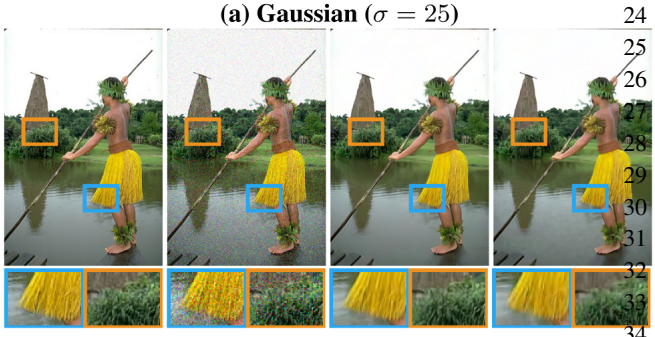
Ruijie Song M.S. [*1]

Abstract

Implementing Noise2Noise for Dynamic Scenes

1. Dataset

(a) Gaussian ($\sigma = 25$)



There's the dataset.

1.1. Codes

```
# Copyright (c) 2018, NVIDIA CORPORATION.
#
# This work is licensed under the Creative
# 4.0 International License. To view a cop
# http://creativecommons.org/licenses/by-n
# Creative Commons, PO Box 1866, Mountain

import tensorflow as tf

def parse_tfrecord_tf(record):
    features = tf.parse_single_example(rec
        'shape': tf.FixedLenFeature([3], t
        'data': tf.FixedLenFeature([], tf.
    data = tf.decode_raw(features['data'],
    return tf.reshape(data, features['shape

# [c,h,w] -> [h,w,c]
def chw_to_hwc(x):
    return tf.transpose(x, perm=[1, 2, 0])

# [h,w,c] -> [c,h,w]
def hwc_to_chw(x):
    return tf.transpose(x, perm=[2, 0, 1])

def resize_small_image(x):
    shape = tf.shape(x)
    return tf.cond(
        tf.logical_or(
            tf.less(shape[2], 256),
            tf.less(shape[1], 256)
        ),
        true_fn=lambda: hwc_to_chw(tf.image.resize_i
        false_fn=lambda: tf.cast(x, tf.float32)
    )

def random_crop_noised_clean(x, add_noise):
    cropped = tf.random_crop(resize_small_image(x),
    return (add_noise(cropped), add_noise(cropped),

def create_dataset(train_tfrecords, minibatch_size,
    print('Setting up dataset source from', train_
    buffer_mb  = 256
    num_threads = 2
    dset = tf.data.TFRecordDataset(train_tfrecords,
    dset = dset.repeat()
    buf_size = 1000
    dset = dset.prefetch(buf_size)
    dset = dset.map(parse_tfrecord_tf, num_parallel
    dset = dset.shuffle(buffer_size=buf_size)
    dset = dset.map(lambda x: random_crop_noised_cl
    dset = dset.batch(minibatch_size)
    it = dset.make_one_shot_iterator()
    return it
```

2. check point 2 basline

We recommend that you build supplementary material in a separate document. If you must create one PDF and cut it up, please be careful to use a tool that doesn't alter the margins, and that doesn't aggressively rewrite the PDF file. pdftk usually works fine.

[*]Equal contribution [1]Department of Electrical and Computer Engineering, Purdue University, West Lafayette, USA. Correspondence to: Cieua Vvvvv <c.vvvvv@googol.com>, Eee Pppp <ep@eden.co.uk>.

Proceedings of the 38th International Conference on Machine Learning, PMLR 139, 2021.

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