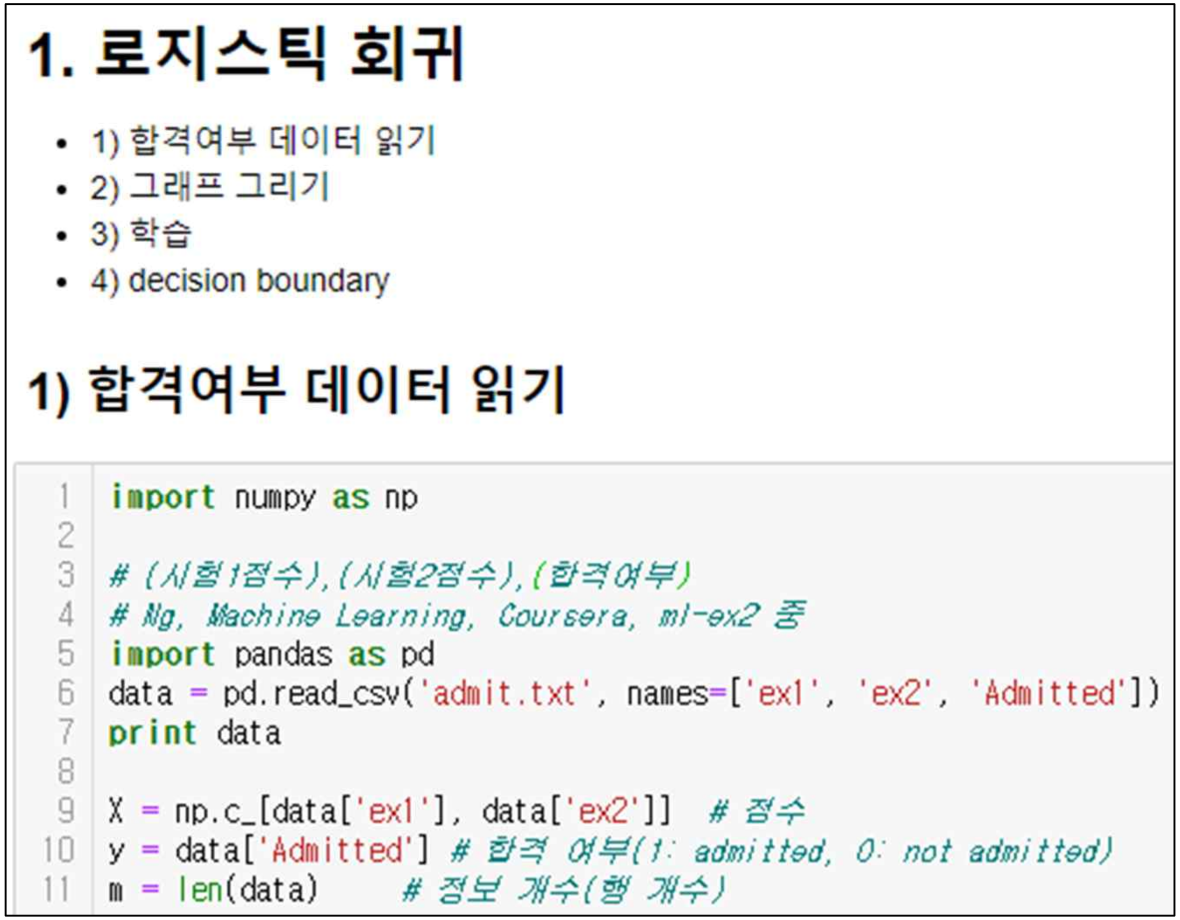
# 기계학습
# [실습04,05] 로지스틱 회귀와 정규화

SW융합학부 양희경

# 1. 로지스틱 회귀: 합격 여부 판단

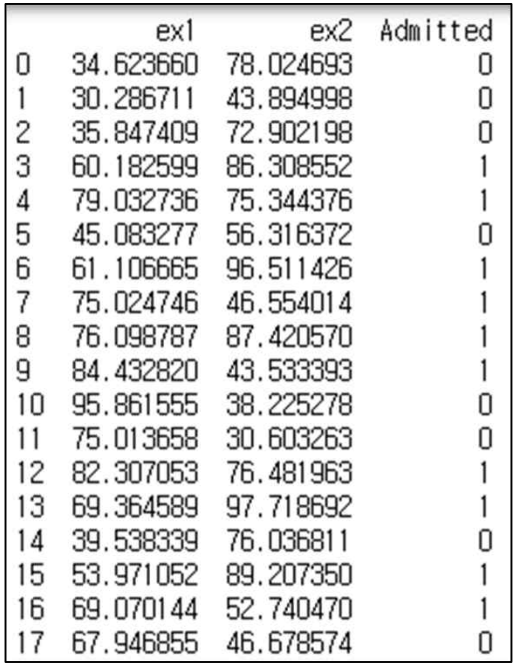


# 1. 로지스틱 회귀

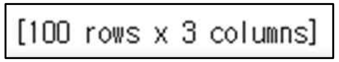
- 1) 합격여부 데이터 읽기
- 2) 그래프 그리기
- 3) 학습
- 4) decision boundary

## 1) 합격여부 데이터 읽기

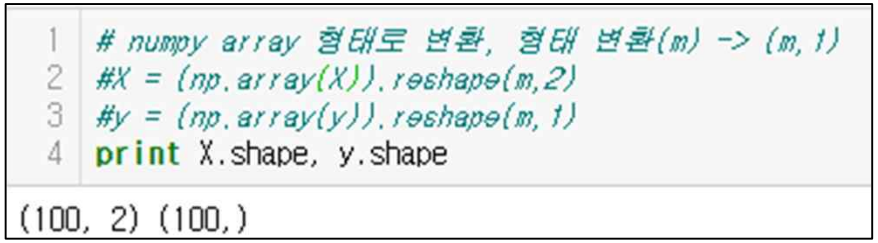
```python
import numpy as np

# (시험1점수),(시험2점수),(합격여부)
# Ng, Machine Learning, Coursera, ml-ex2 중
import pandas as pd
data = pd.read_csv('admit.txt', names=['ex1', 'ex2', 'Admitted'])
print data

X = np.c_[data['ex1'], data['ex2']]  # 점수
y = data['Admitted'] # 합격 여부(1: admitted, 0: not admitted)
m = len(data)      # 정보 개수(행 개수)
```



```
          ex1        ex2  Admitted
0   34.623660  78.024693         0
1   30.286711  43.894998         0
2   35.847409  72.902198         0
3   60.182599  86.308552         1
4   79.032736  75.344376         1
5   45.083277  56.316372         0
6   61.106665  96.511426         1
7   75.024746  46.554014         1
8   76.098787  87.420570         1
9   84.432820  43.533393         1
10  95.861555  38.225278         0
11  75.013658  30.603263         0
12  82.307053  76.481963         1
13  69.364589  97.718692         1
14  39.538339  76.036811         0
15  53.971052  89.207350         1
16  69.070144  52.740470         1
17  67.946855  46.678574         0
```

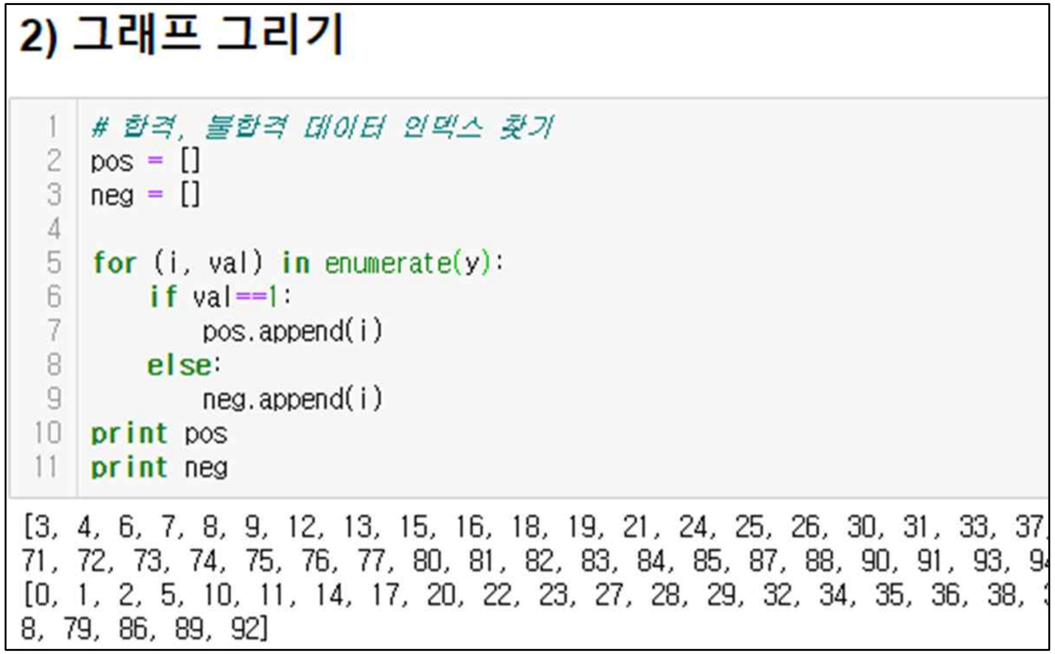


```
[100 rows x 3 columns]
```



```python
# numpy array 형태로 변환, 형태 변환(m) -> (m,1)
#X = (np.array(X)).reshape(m,2)
#y = (np.array(y)).reshape(m,1)
print X.shape, y.shape
```

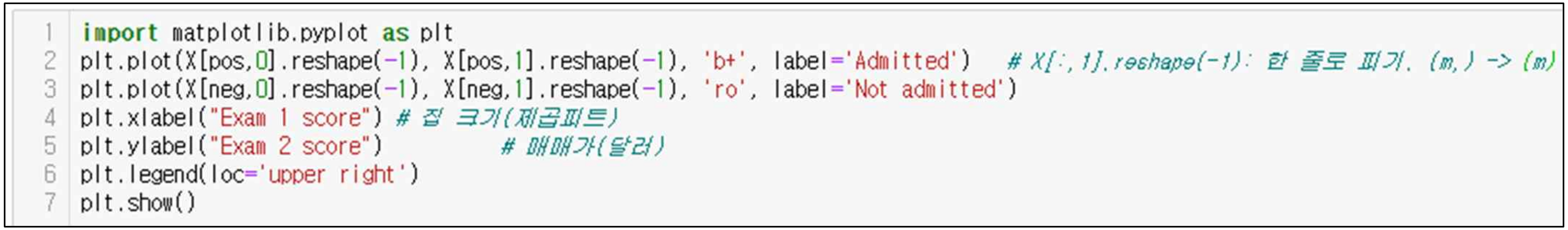
```
(100, 2) (100,)
```



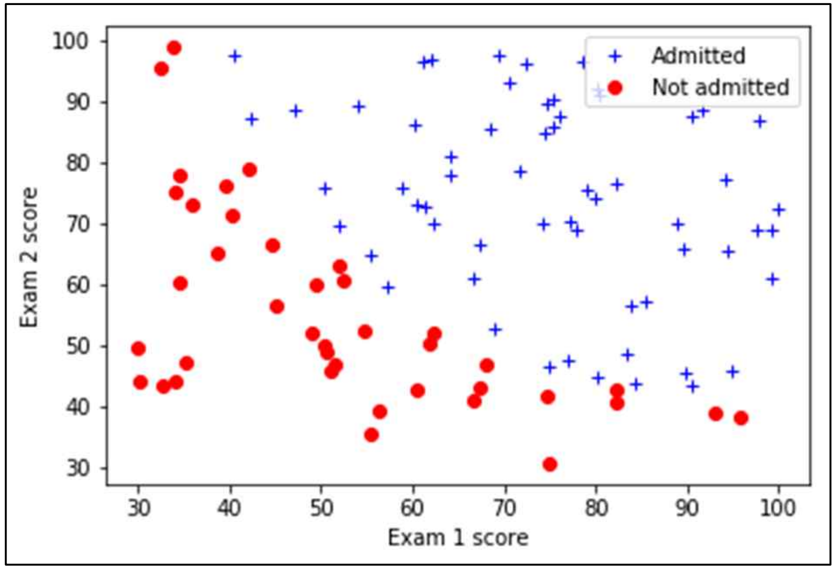
## 2) 그래프 그리기

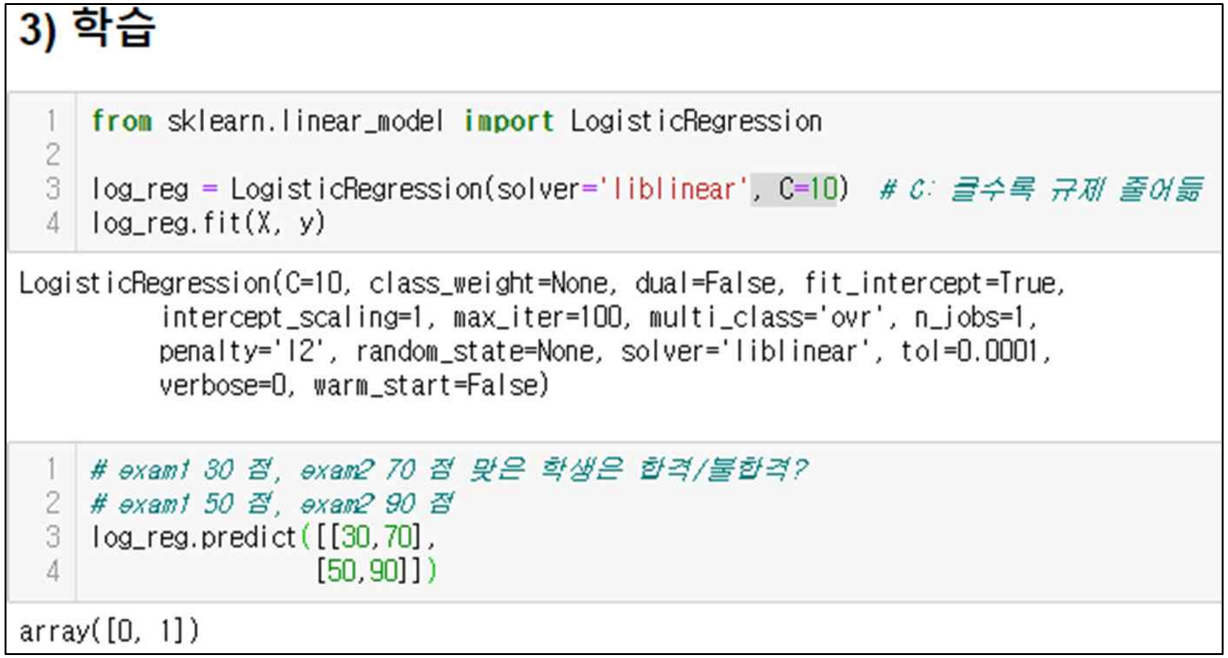
```
# 합격, 불합격 데이터 인덱스 찾기
pos = []
neg = []

for (i, val) in enumerate(y):
    if val==1:
        pos.append(i)
    else:
        neg.append(i)
print pos
print neg
```

```
[3, 4, 6, 7, 8, 9, 12, 13, 15, 16, 18, 19, 21, 24, 25, 26, 30, 31, 33, 37,
71, 72, 73, 74, 75, 76, 77, 80, 81, 82, 83, 84, 85, 87, 88, 90, 91, 93, 9
[0, 1, 2, 5, 10, 11, 14, 17, 20, 22, 23, 27, 28, 29, 32, 34, 35, 36, 38,
8, 79, 86, 89, 92]
```



```
import matplotlib.pyplot as plt
plt.plot(X[pos,0].reshape(-1), X[pos,1].reshape(-1), 'b+', label='Admitted')   # X[:, 1].reshape(-1): 한 줄로 펴기. (m,) -> (m)
plt.plot(X[neg,0].reshape(-1), X[neg,1].reshape(-1), 'ro', label='Not admitted')
plt.xlabel("Exam 1 score") # 집 크기(제곱피트)
plt.ylabel("Exam 2 score")          # 매매가(달러)
plt.legend(loc='upper right')
plt.show()
```





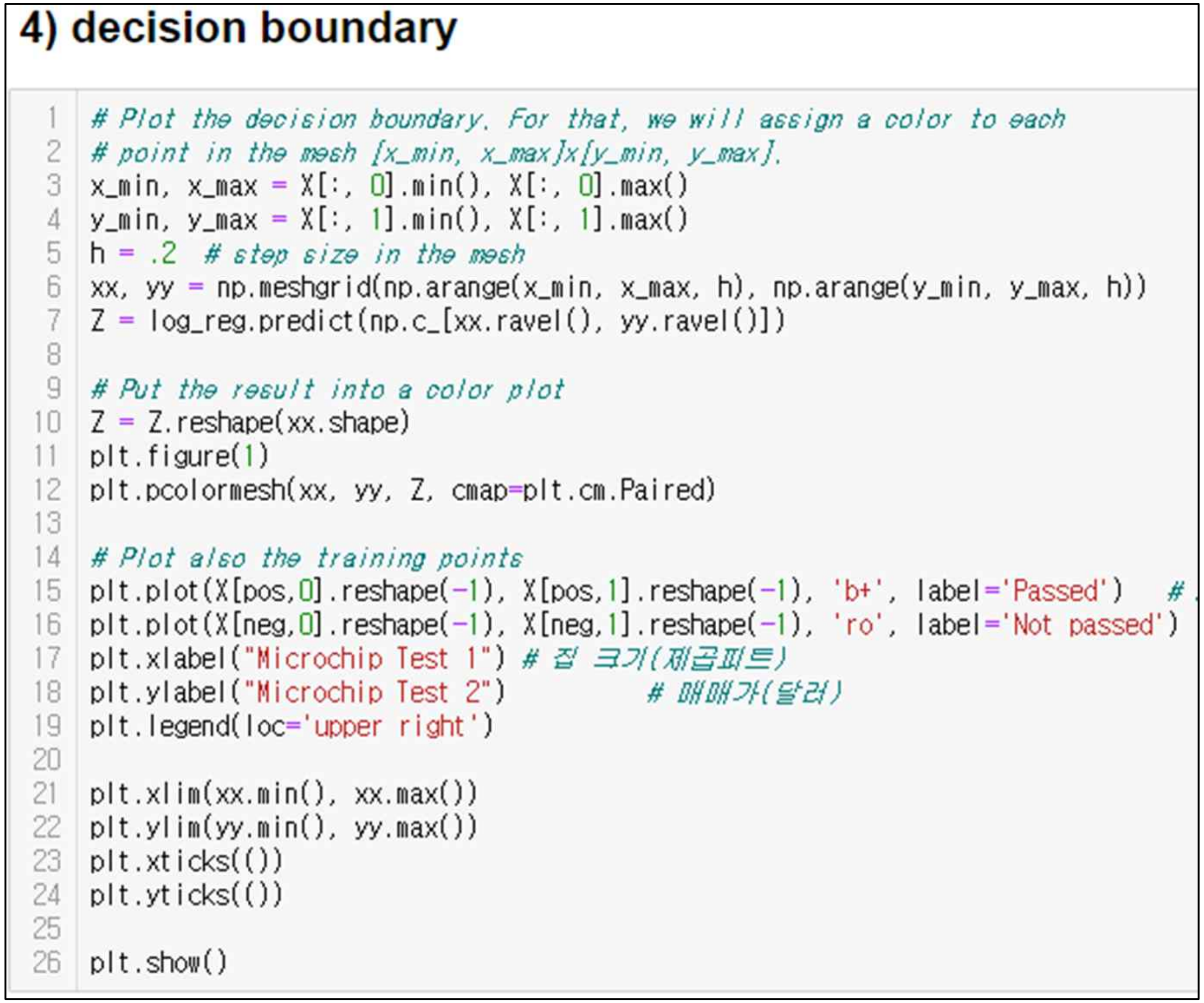
### 3) 학습

```
from sklearn.linear_model import LogisticRegression

log_reg = LogisticRegression(solver='liblinear', C=10)  # C: 클수록 규제 줄어듦
log_reg.fit(X, y)
```

```
LogisticRegression(C=10, class_weight=None, dual=False, fit_intercept=True,
          intercept_scaling=1, max_iter=100, multi_class='ovr', n_jobs=1,
          penalty='l2', random_state=None, solver='liblinear', tol=0.0001,
          verbose=0, warm_start=False)
```

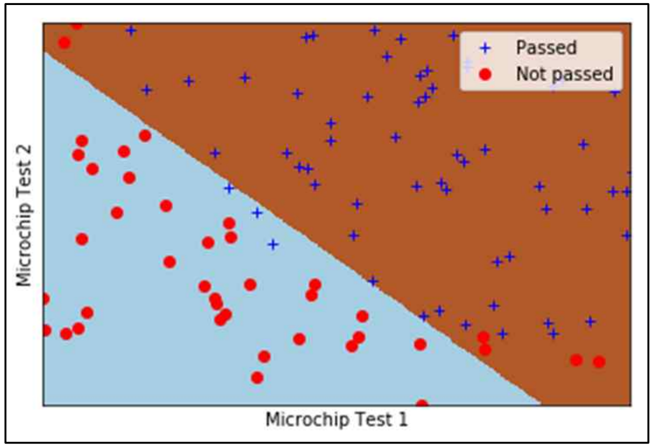
```
# exam1 30 점, exam2 70 점 맞은 학생은 합격/불합격?
# exam1 50 점, exam2 90 점
log_reg.predict([[30,70],
                 [50,90]])
```

```
array([0, 1])
```

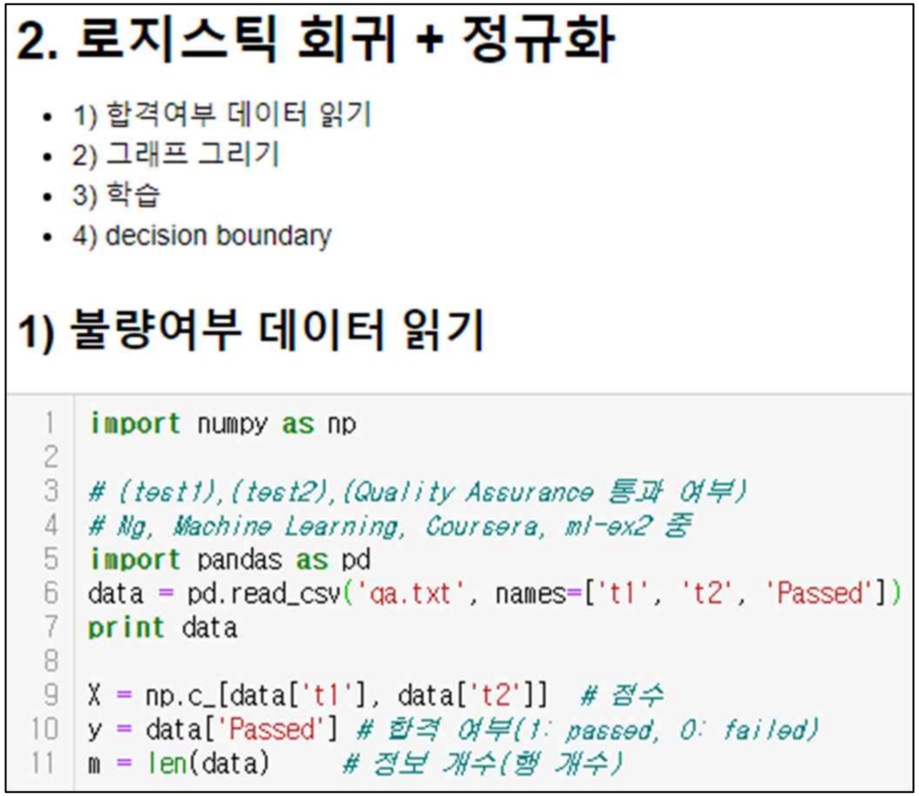


## 4) decision boundary

```
# Plot the decision boundary. For that, we will assign a color to each
# point in the mesh [x_min, x_max]x[y_min, y_max].
x_min, x_max = X[:, 0].min(), X[:, 0].max()
y_min, y_max = X[:, 1].min(), X[:, 1].max()
h = .2  # step size in the mesh
xx, yy = np.meshgrid(np.arange(x_min, x_max, h), np.arange(y_min, y_max, h))
Z = log_reg.predict(np.c_[xx.ravel(), yy.ravel()])

# Put the result into a color plot
Z = Z.reshape(xx.shape)
plt.figure(1)
plt.pcolormesh(xx, yy, Z, cmap=plt.cm.Paired)

# Plot also the training points
plt.plot(X[pos,0].reshape(-1), X[pos,1].reshape(-1), 'b+', label='Passed')   #
plt.plot(X[neg,0].reshape(-1), X[neg,1].reshape(-1), 'ro', label='Not passed')
plt.xlabel("Microchip Test 1") # 집 크기(제곱피트)
plt.ylabel("Microchip Test 2")          # 매매가(달러)
plt.legend(loc='upper right')

plt.xlim(xx.min(), xx.max())
plt.ylim(yy.min(), yy.max())
plt.xticks(())
plt.yticks(())

plt.show()
```



# 2. 로지스틱 회귀+정규화
# : 반도체 불량품 여부 판단

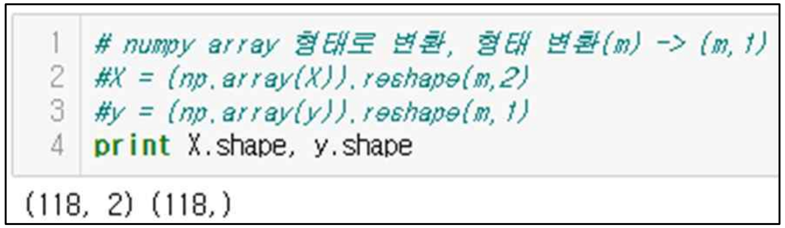


# 2. 로지스틱 회귀 + 정규화

- 1) 합격여부 데이터 읽기
- 2) 그래프 그리기
- 3) 학습
- 4) decision boundary

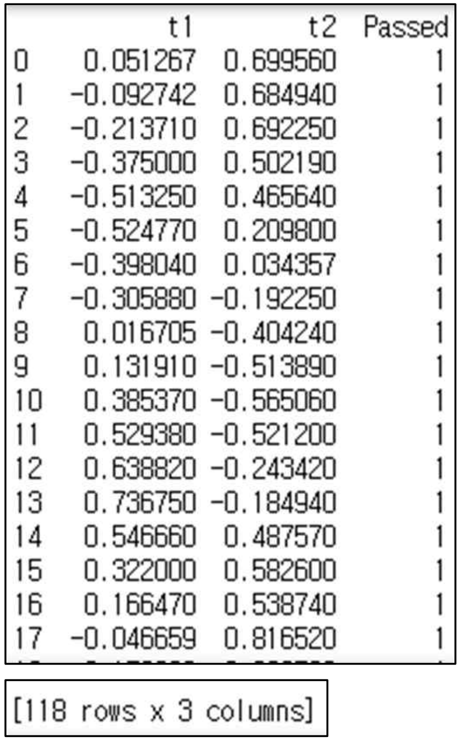
## 1) 불량여부 데이터 읽기

```python
import numpy as np

# (test1),(test2),(Quality Assurance 통과 여부)
# Ng, Machine Learning, Coursera, ml-ex2 중
import pandas as pd
data = pd.read_csv('qa.txt', names=['t1', 't2', 'Passed'])
print data

X = np.c_[data['t1'], data['t2']]  # 점수
y = data['Passed'] # 합격 여부(1: passed, 0: failed)
m = len(data)      # 정보 개수(행 개수)
```



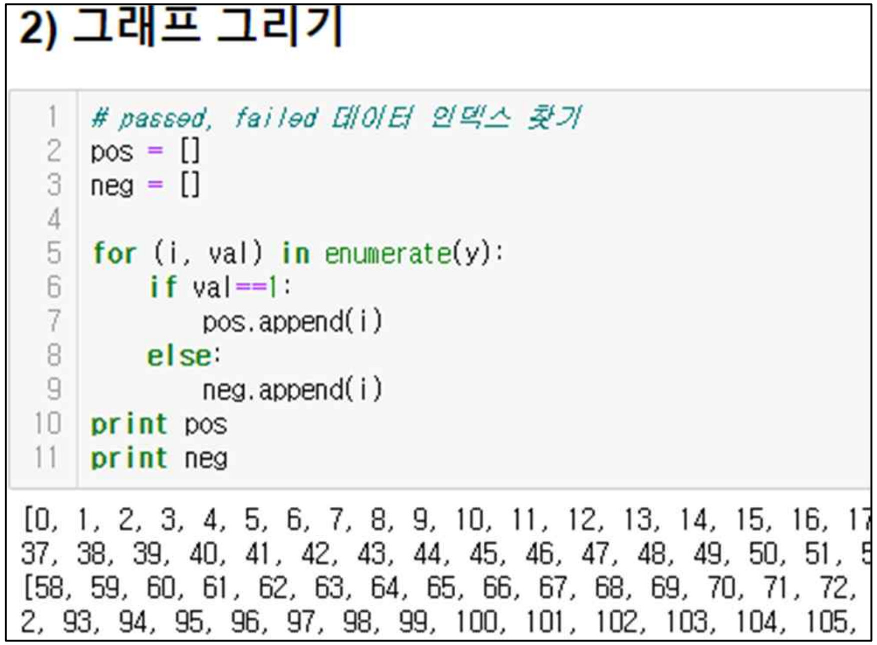
```python
# numpy array 형태로 변환, 형태 변환(m) -> (m,1)
#X = (np.array(X)).reshape(m,2)
#y = (np.array(y)).reshape(m,1)
print X.shape, y.shape
```

```
(118, 2) (118,)
```



```
          t1        t2  Passed
0   0.051267  0.699560       1
1  -0.092742  0.684940       1
2  -0.213710  0.692250       1
3  -0.375000  0.502190       1
4  -0.513250  0.465640       1
5  -0.524770  0.209800       1
6  -0.398040  0.034357       1
7  -0.305880 -0.192250       1
8   0.016705 -0.404240       1
9   0.131910 -0.513890       1
10  0.385370 -0.565060       1
11  0.529380 -0.521200       1
12  0.638820 -0.243420       1
13  0.736750 -0.184940       1
14  0.546660  0.487570       1
15  0.322000  0.582600       1
16  0.166470  0.538740       1
17 -0.046659  0.816520       1
```

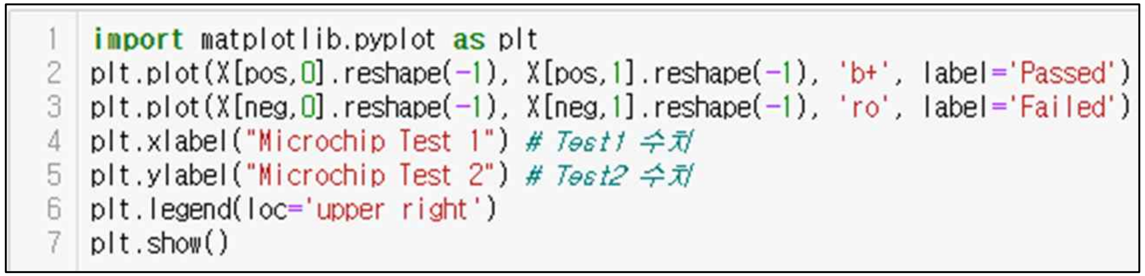
```
[118 rows x 3 columns]
```



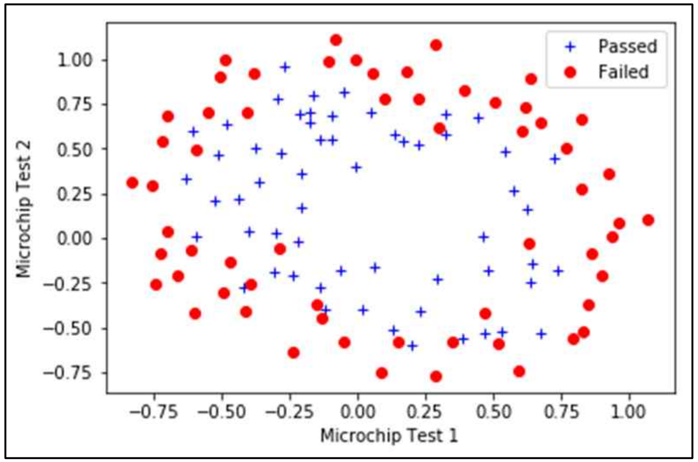
## 2) 그래프 그리기

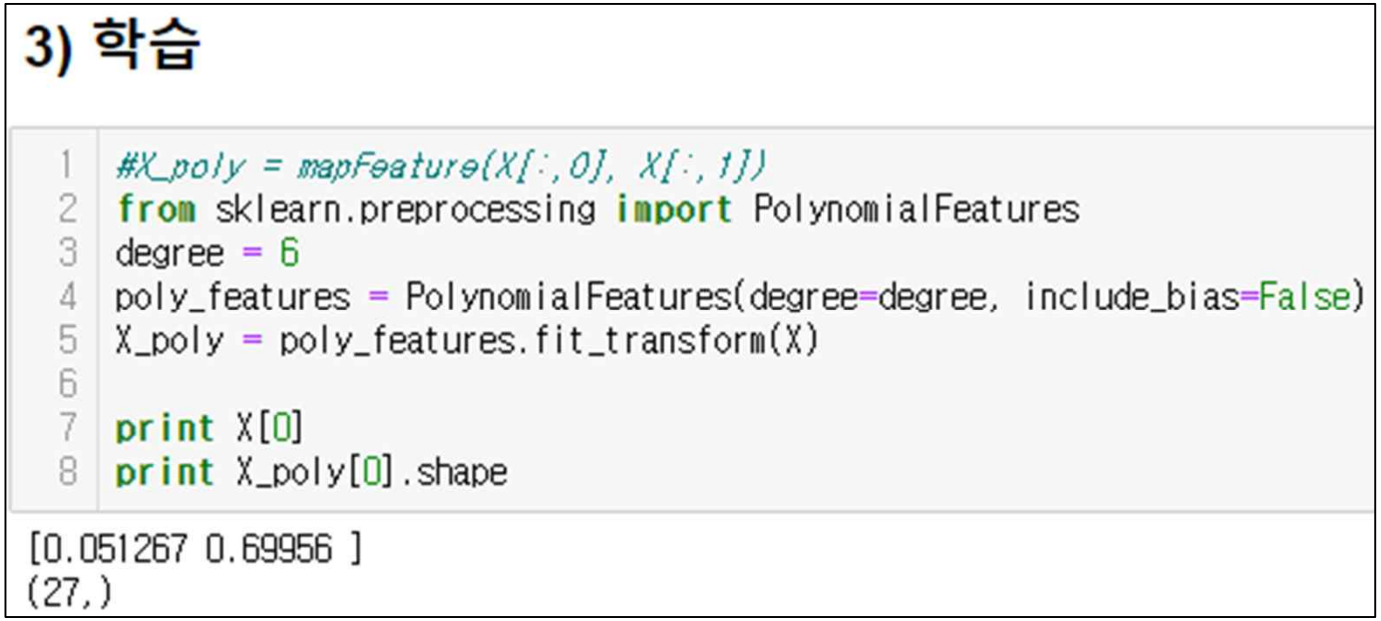
```python
# passed, failed 데이터 인덱스 찾기
pos = []
neg = []

for (i, val) in enumerate(y):
    if val==1:
        pos.append(i)
    else:
        neg.append(i)
print pos
print neg
```

```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 5
[58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72,
2, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105,
```



```python
import matplotlib.pyplot as plt
plt.plot(X[pos,0].reshape(-1), X[pos,1].reshape(-1), 'b+', label='Passed')
plt.plot(X[neg,0].reshape(-1), X[neg,1].reshape(-1), 'ro', label='Failed')
plt.xlabel("Microchip Test 1") # Test1 수치
plt.ylabel("Microchip Test 2") # Test2 수치
plt.legend(loc='upper right')
plt.show()
```

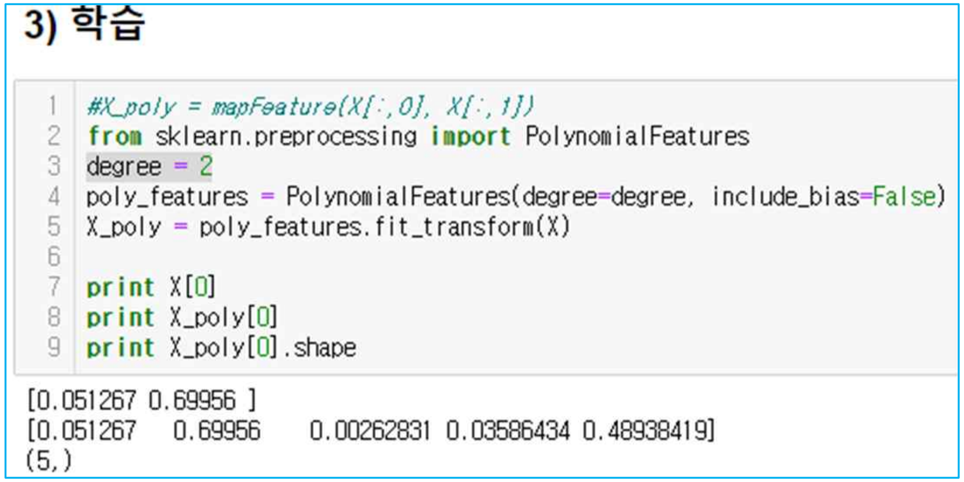




## 3) 학습

```
#X_poly = mapFeature(X[:,0], X[:,1])
from sklearn.preprocessing import PolynomialFeatures
degree = 6
poly_features = PolynomialFeatures(degree=degree, include_bias=False)
X_poly = poly_features.fit_transform(X)

print X[0]
print X_poly[0].shape
```

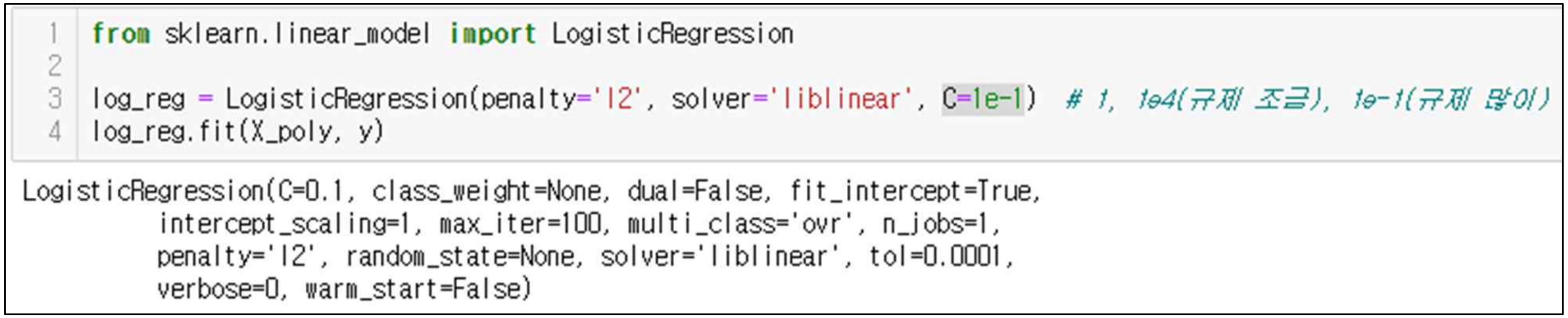
```
[0.051267 0.69956 ]
(27,)
```



## 3) 학습

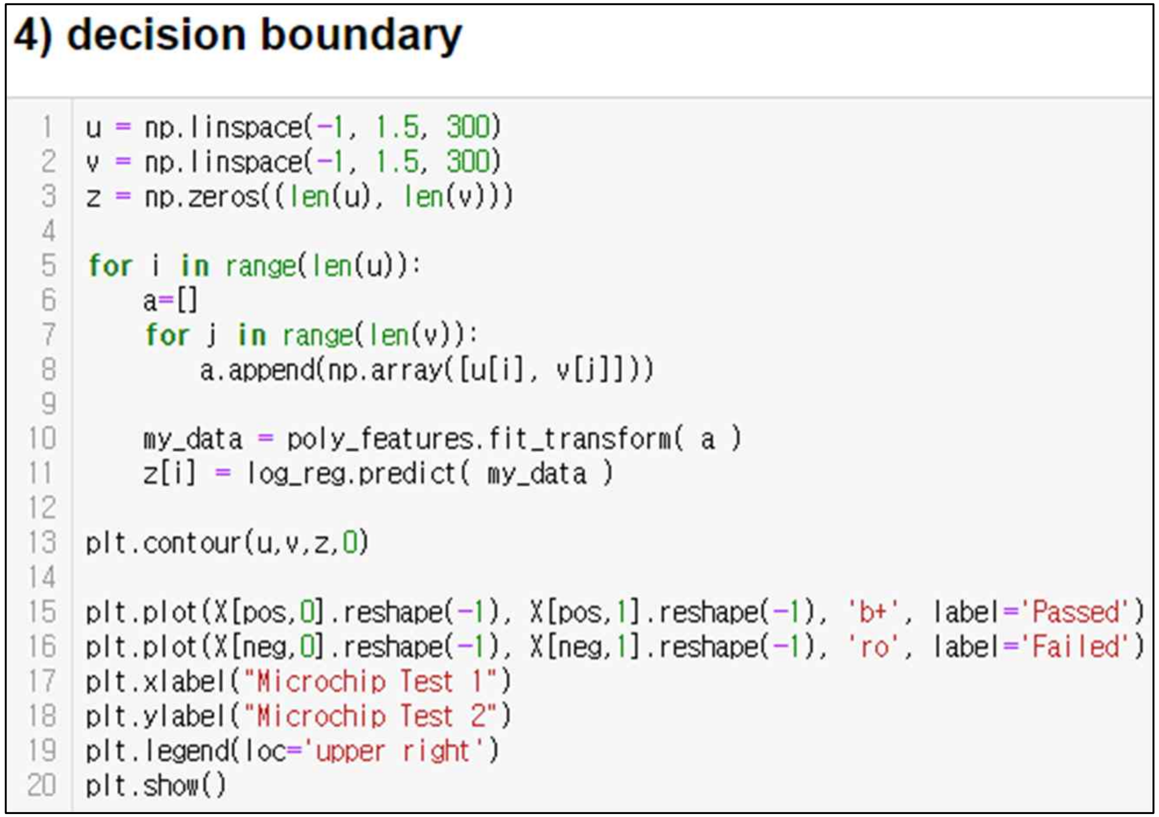
```
#X_poly = mapFeature(X[:,0], X[:,1])
from sklearn.preprocessing import PolynomialFeatures
degree = 2
poly_features = PolynomialFeatures(degree=degree, include_bias=False)
X_poly = poly_features.fit_transform(X)

print X[0]
print X_poly[0]
print X_poly[0].shape
```

```
[0.051267 0.69956 ]
[0.051267   0.69956    0.00262831 0.03586434 0.48938419]
(5,)
```



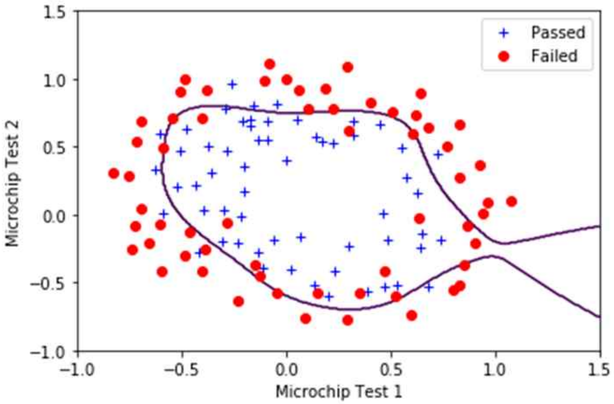
```python
from sklearn.linear_model import LogisticRegression

log_reg = LogisticRegression(penalty='l2', solver='liblinear', C=1e-1)  # 1, 1e4(규제 조금), 1e-1(규제 많이)
log_reg.fit(X_poly, y)
```

```
LogisticRegression(C=0.1, class_weight=None, dual=False, fit_intercept=True,
          intercept_scaling=1, max_iter=100, multi_class='ovr', n_jobs=1,
          penalty='l2', random_state=None, solver='liblinear', tol=0.0001,
          verbose=0, warm_start=False)
```



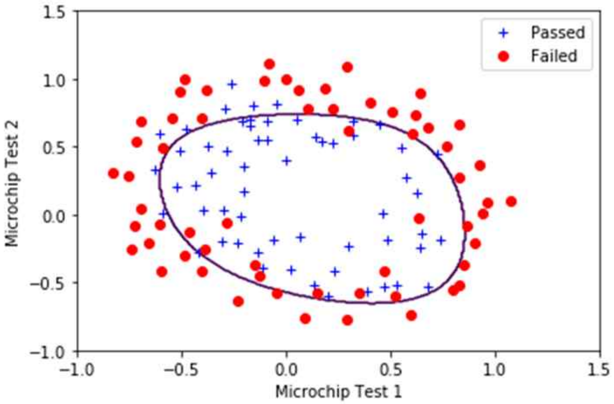
## 4) decision boundary

```
u = np.linspace(-1, 1.5, 300)
v = np.linspace(-1, 1.5, 300)
z = np.zeros((len(u), len(v)))

for i in range(len(u)):
    a=[]
    for j in range(len(v)):
        a.append(np.array([u[i], v[j]]))

    my_data = poly_features.fit_transform( a )
    z[i] = log_reg.predict( my_data )

plt.contour(u,v,z,0)

plt.plot(X[pos,0].reshape(-1), X[pos,1].reshape(-1), 'b+', label='Passed')
plt.plot(X[neg,0].reshape(-1), X[neg,1].reshape(-1), 'ro', label='Failed')
plt.xlabel("Microchip Test 1")
plt.ylabel("Microchip Test 2")
plt.legend(loc='upper right')
plt.show()
```



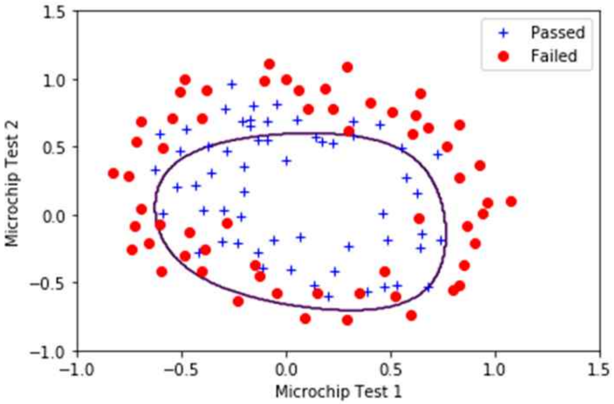
$$\frac{1}{\lambda} = 1e4$$

$$\lambda = 1/10000$$



$$\frac{1}{\lambda} = 1$$

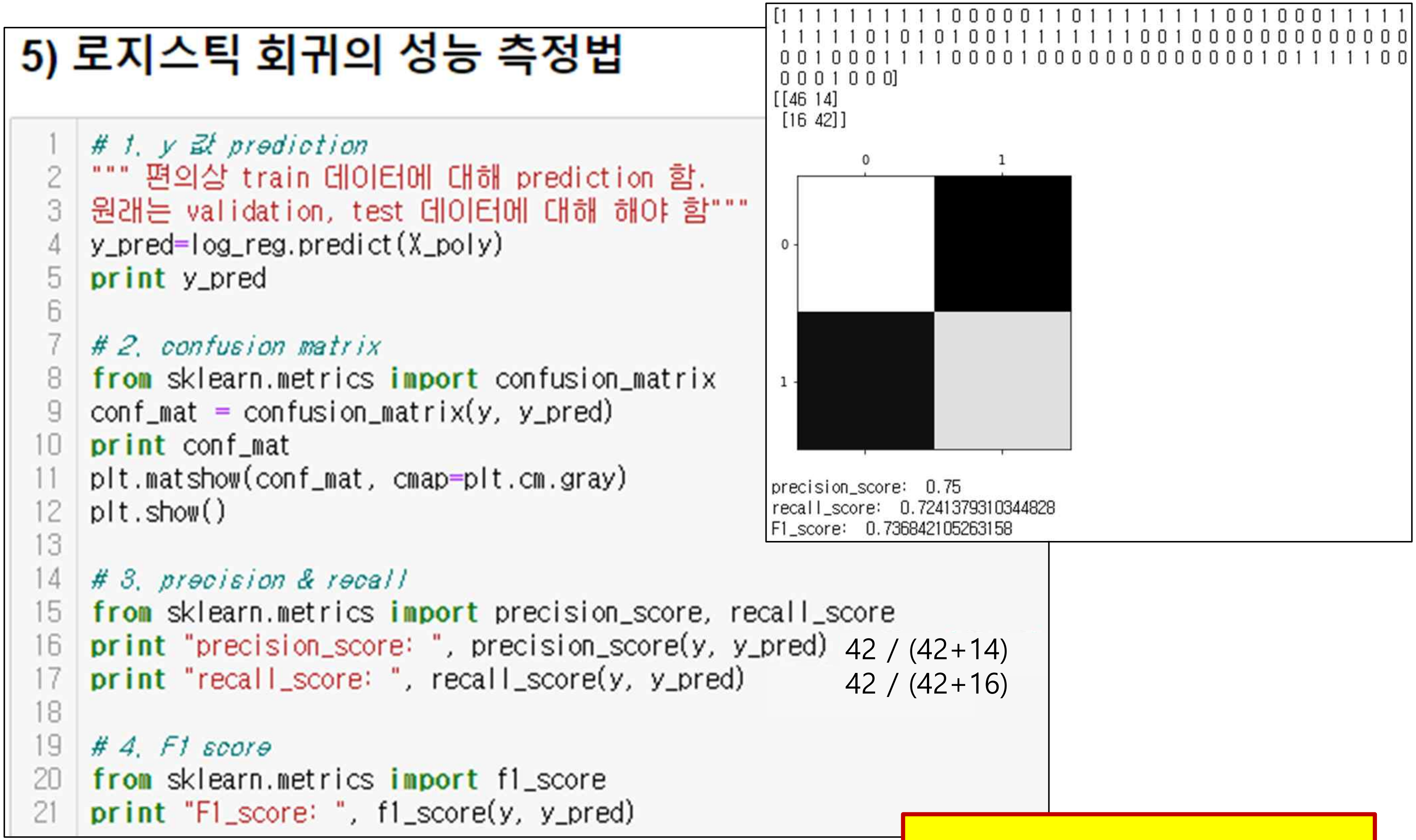
$$\lambda \ = 1$$



$$\frac{1}{\lambda} = 1e - 1$$

$$\lambda = 10$$

## 5) 로지스틱 회귀의 성능 측정법



```
# 1. y 값 prediction
""" 편의상 train 데이터에 대해 prediction 함.
원래는 validation, test 데이터에 대해 해야 함"""
y_pred=log_reg.predict(X_poly)
print y_pred

# 2. confusion matrix
from sklearn.metrics import confusion_matrix
conf_mat = confusion_matrix(y, y_pred)
print conf_mat
plt.matshow(conf_mat, cmap=plt.cm.gray)
plt.show()

# 3. precision & recall
from sklearn.metrics import precision_score, recall_score
print "precision_score: ", precision_score(y, y_pred)
print "recall_score: ", recall_score(y, y_pred)

# 4. F1 score
from sklearn.metrics import f1_score
print "F1_score: ", f1_score(y, y_pred)
```

```
[1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 1 1 0 1 1 1 1 1 1 1 1 0 0 1 0 0 0 1 1 1 1 1
 1 1 1 1 1 0 1 0 1 0 1 0 0 1 1 1 1 1 1 1 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0 1 0 0 0 1 1 1 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 1 1 1 1 0 0
 0 0 0 1 0 0 0]
[[46 14]
 [16 42]]
```

```
precision_score:  0.75
recall_score:  0.7241379310344828
F1_score:  0.736842105263158
```

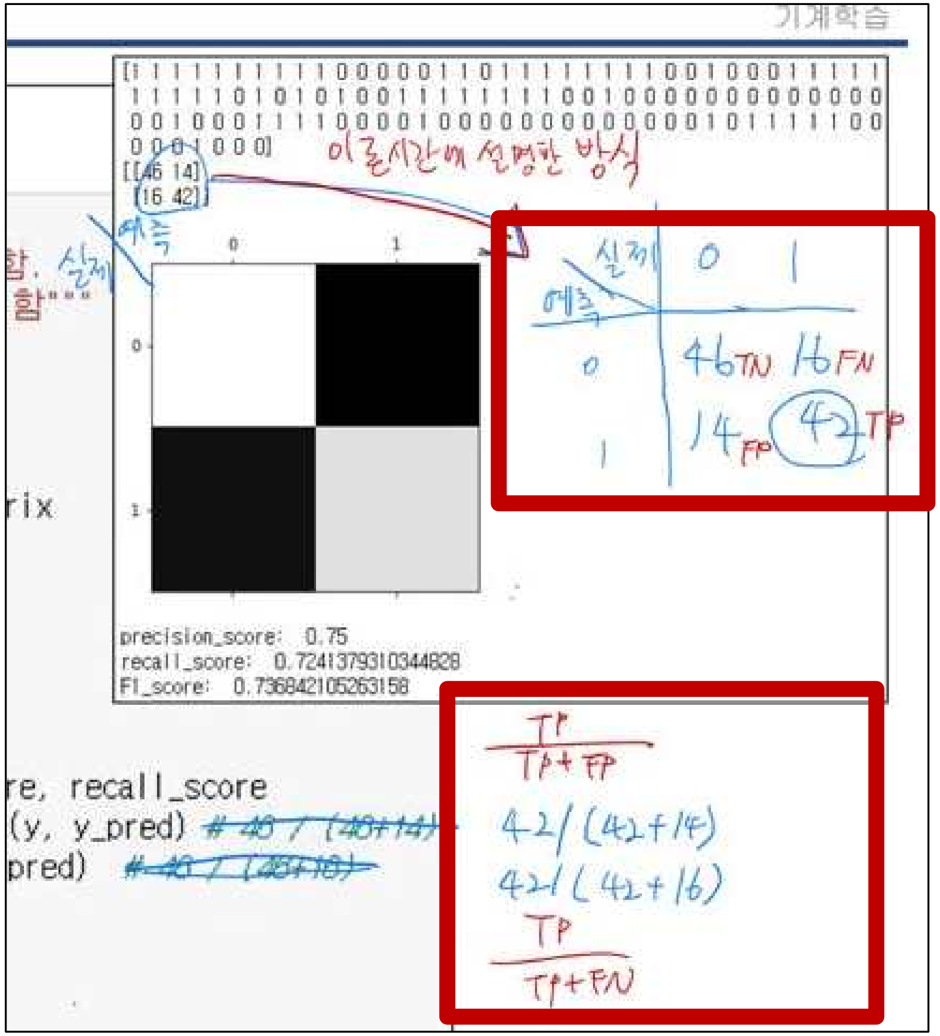
42 / (42+14)

42 / (42+16)

여기서부터 실습의 이론적인 배경은 'c성능 측정법'참고바랍니다.

# [실습04,05] p. 15 설명 오류 정정

- 이론 시간 설명과 반대로, sklearn 에서 제공하는 confusion matrix 함수는
  행: 실제값, 열: 예측값
- 이를 이론시간에 설명한 방식으로 바꿔 그리면, 오른쪽 파란색으로 표시한 매트릭스.
- 따라서, 코드 속 '# ' 이하 주석 또한 고쳐줘야 함
- 시험에 나온다면, 행과 열이 의미하는 바를 표기하겠음.
- 이론 시간 설명대로 공부할 것
  행: 예측값, 열: 실제값



```
[1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 1 1 0 1 1 1 1 1 1 1 1 1 0 0 1 0 0 0 1 1 1 1 1
 1 1 1 1 1 0 1 0 1 0 1 0 0 1 1 1 1 1 1 1 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0 1 0 0 0 1 1 1 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 1 1 1 1 0 0
 0 0 0 1 0 0 0]
[[46 14]
 [16 42]]
```

```
precision_score:  0.75
recall_score:  0.7241379310344828
F1_score:  0.7368421052631158
```

```
re, recall_score
(y, y_pred) ~~# 40 / (40+14)~~
pred)  ~~# 40 / (40+16)~~
```

이론시간에 설명한 방식

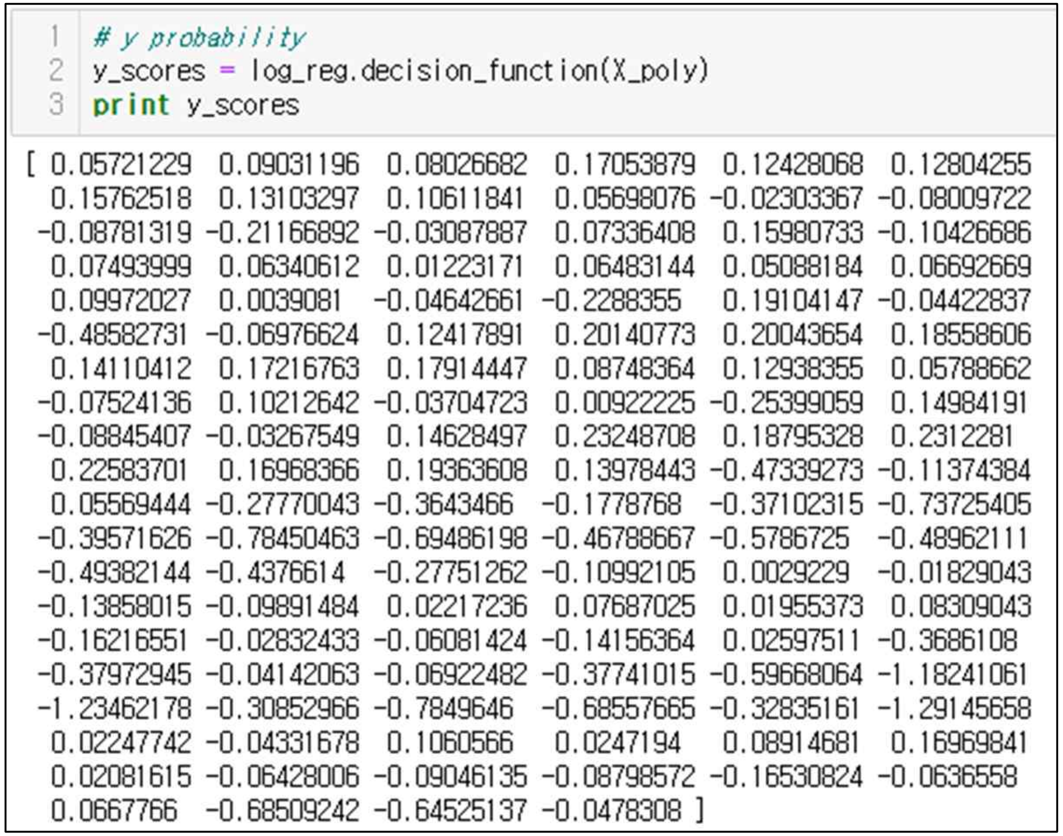
| 실제 \ 예측 | 0 | 1 |
|---|---|---|
| 0 | 46TN | 16FN |
| 1 | 14FP | 42TP |

$\frac{TP}{TP+FP}$

42/(42+14)

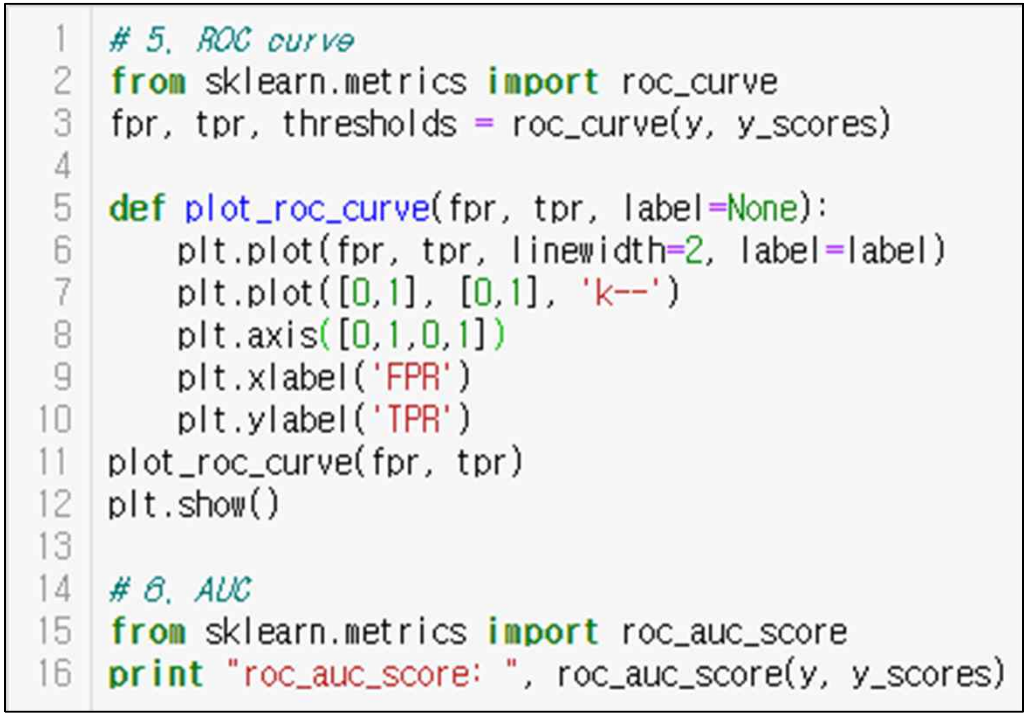
42/(42+16)

$\frac{TP}{TP+FN}$

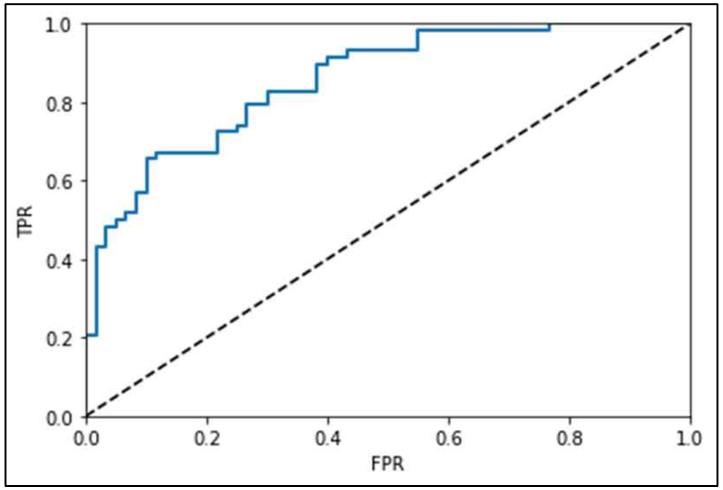


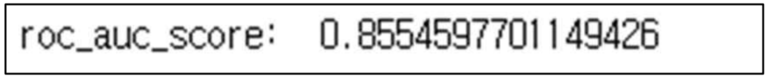
```python
# y probability
y_scores = log_reg.decision_function(X_poly)
print y_scores
```

```
[ 0.05721229  0.09031196  0.08026682  0.17053879  0.12428068  0.12804255
  0.15762518  0.13103297  0.10611841  0.05698076 -0.02303367 -0.08009722
 -0.08781319 -0.21166892 -0.03087887  0.07336408  0.15980733 -0.10426686
  0.07493999  0.06340612  0.01223171  0.06483144  0.05088184  0.06692669
  0.09972027  0.0039081  -0.04642661 -0.2288355   0.19104147 -0.04422837
 -0.48582731 -0.06976624  0.12417891  0.20140773  0.20043654  0.18558606
  0.14110412  0.17216763  0.17914447  0.08748364  0.12938355  0.05788662
 -0.07524136  0.10212642 -0.03704723  0.00922225 -0.25399059  0.14984191
 -0.08845407 -0.03267549  0.14628497  0.23248708  0.18795328  0.2312281
  0.22583701  0.16968366  0.19363608  0.13978443 -0.47339273 -0.11374384
  0.05569444 -0.27770043 -0.3643466  -0.1778768  -0.37102315 -0.73725405
 -0.39571626 -0.78450463 -0.69486198 -0.46788667 -0.5786725  -0.48962111
 -0.49382144 -0.4376614  -0.27751262 -0.10992105  0.0029229  -0.01829043
 -0.13858015 -0.09891484  0.02217236  0.07687025  0.01955373  0.08309043
 -0.16216551 -0.02832433 -0.06081424 -0.14156364  0.02597511 -0.3686108
 -0.37972945 -0.04142063 -0.06922482 -0.37741015 -0.59668064 -1.18241061
 -1.23462178 -0.30852966 -0.7849646  -0.68557665 -0.32835161 -1.29145658
  0.02247742 -0.04331678  0.1060566   0.0247194   0.08914681  0.16969841
  0.02081615 -0.06428006 -0.09046135 -0.08798572 -0.16530824 -0.0636558
  0.0667766  -0.68509242 -0.64525137 -0.0478308 ]
```



```
# 5. ROC curve
from sklearn.metrics import roc_curve
fpr, tpr, thresholds = roc_curve(y, y_scores)

def plot_roc_curve(fpr, tpr, label=None):
    plt.plot(fpr, tpr, linewidth=2, label=label)
    plt.plot([0,1], [0,1], 'k--')
    plt.axis([0,1,0,1])
    plt.xlabel('FPR')
    plt.ylabel('TPR')
plot_roc_curve(fpr, tpr)
plt.show()

# 6. AUC
from sklearn.metrics import roc_auc_score
print "roc_auc_score: ", roc_auc_score(y, y_scores)
```





```
roc_auc_score:  0.8554597701149426
```

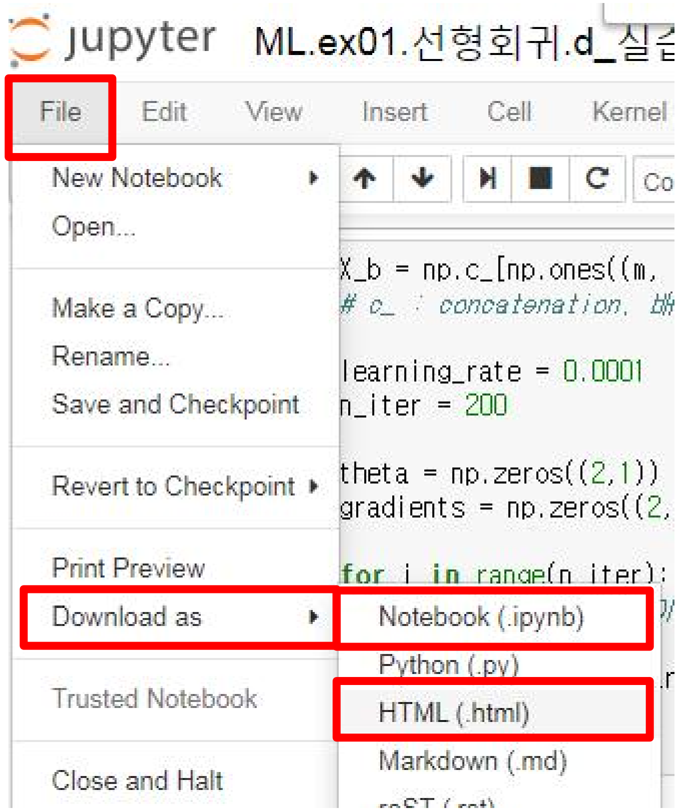
# 실습 숙제 제출 요령

# 실습 숙제 제출 요령1

- 완성된 코드를 실행시킨다.

# 실습 숙제 제출 요령2

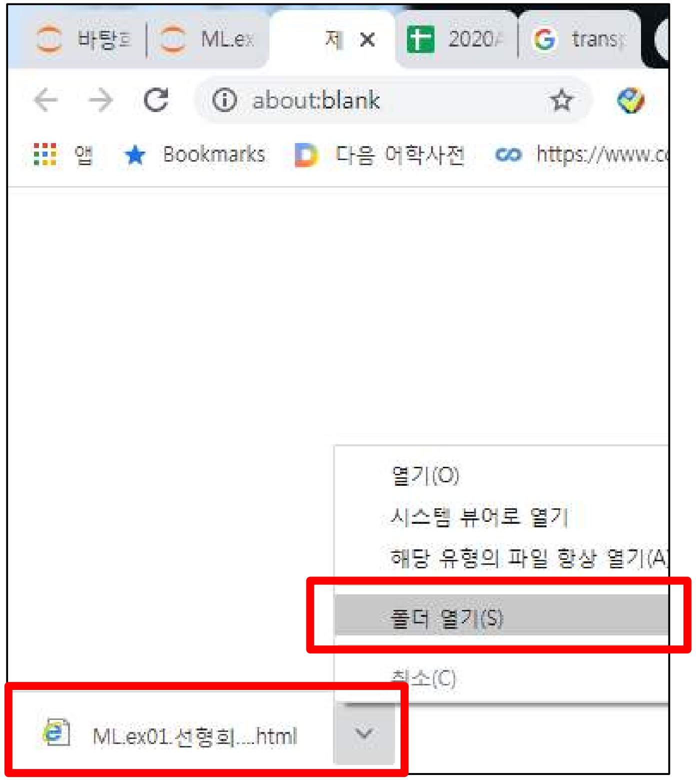
- Jupyter notebook 에서 'File- Download as- HTML(.html)' 로 저장한다.

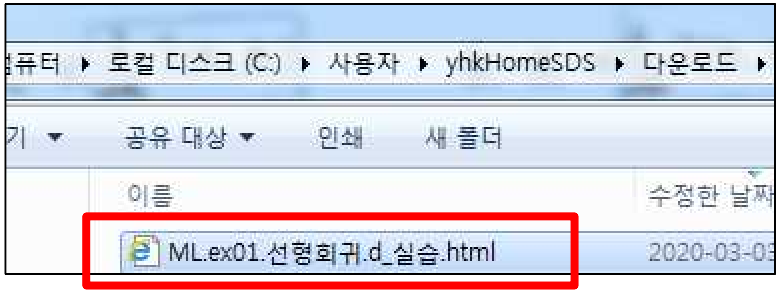


```
X_b = np.c_[np.ones((m,
# c_ : concatenation, 배

learning_rate = 0.0001
n_iter = 200

theta = np.zeros((2,1))
gradients = np.zeros((2,

for i in range(n_iter):
```

# 실습 숙제 제출 요령3

- 저장된 HTML 파일을 e-campus 에 업로드한다.




퓨터 ▸ 로컬 디스크 (C:) ▸ 사용자 ▸ yhkHomeSDS ▸ 다운로드 ▸
기 ▾
공유 대상 ▾
인쇄
새 폴더
이름
수정한 날짜
ML.ex01.선형회귀.d_실습.html
2020-03-0

# 실습 숙제 제출 요령4

- (Optional) GitHub 에 업로드한다.
  - 코드 ‘.ipynb’
  - 데이터 ‘.txt’