In [1]:
```
import pandas as pd

url = "Credit_Risk_Prediction.csv"
data = pd.read_csv(url)
```

In [2]:
```
#Convert the unit of Loan and MonthlyPaid to (k)
data["Loan"] = data["Loan"] / 1000
data["MonthlyPaid"] = data["MonthlyPaid"] / 1000
```

In [3]:
```
data["Gender"] = data["Gender"].map({"m":1 , "f":0})
data["Credit Risk Prediction"] = data["Credit Risk Prediction"].map({"Yes":1 , "No"
```

In [4]:
```
data
```

Out[4]:

	Age	Loan	MonthlyPaid	Gender	Credit Risk Prediction
0	25	586.0	2.25	1	1
1	63	869.0	4.95	0	0
2	49	665.0	4.50	1	1
3	66	245.0	4.70	1	0
4	21	282.0	1.00	0	1
...	...	...	...	...	...
294	62	662.0	0.60	0	0
295	40	195.0	3.85	0	1
296	22	215.0	1.00	0	1
297	59	349.0	2.15	1	0
298	34	533.0	3.15	0	1

299 rows × 5 columns

In [5]:
```
from sklearn.model_selection import train_test_split

x = data[["Age","Loan","MonthlyPaid","Gender"]]
y = data["Credit Risk Prediction"]

x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.2,random_state=87)
x_train = x_train.to_numpy()
x_test = x_test.to_numpy()
y_train = y_train.to_numpy()
y_test = y_test.to_numpy()
```

Standardization

In [6]:
```
from sklearn.preprocessing import StandardScaler

scaler = StandardScaler()
scaler.fit(x_train)
x_train = scaler.transform(x_train)
x_test = scaler.transform(x_test)
```

In [7]:
```
import torch
```

In [8]:
```
device = "cuda" if torch.cuda.is_available() else "cpu"
device
```

Out[8]:
```
'cuda'
```

In [9]:
```
from torch import nn

class LogisticRegressionModel(nn.Module):
    def __init__(self):
        super().__init__()
        self.linear_layer = nn.Linear(in_features=4,out_features=1,dtype=torch.floa
        self.sigmoid = nn.Sigmoid() # https://docs.pytorch.org/docs/stable/generate

    def forward(self,x):
        return self.sigmoid(self.linear_layer(x))
```

In [10]:
```
torch.manual_seed(87)
model = LogisticRegressionModel()
model = model.to(device)
model, model.state_dict()
```

Out[10]:
```
(LogisticRegressionModel(
   (linear_layer): Linear(in_features=4, out_features=1, bias=True)
   (sigmoid): Sigmoid()
 ),
 OrderedDict([('linear_layer.weight',
               tensor([[-0.4710,  0.1380, -0.1459, -0.1397]], device='cuda:0',
                      dtype=torch.float64)),
              ('linear_layer.bias',
               tensor([-0.4544], device='cuda:0', dtype=torch.float64))]))
```

In [11]:
```
x_train = torch.from_numpy(x_train)
x_test = torch.from_numpy(x_test)
y_train = torch.from_numpy(y_train)
y_test = torch.from_numpy(y_test)
```

In [12]:
```
x_train = x_train.to(device)
x_test = x_test.to(device)
y_train = y_train.to(device)
y_test = y_test.to(device)
```

In [13]:
```
y_train = y_train.reshape(-1,1)
y_test = y_test.reshape(-1,1)
```

In [14]:
```
y_train = y_train.type(torch.double)   # https://docs.pytorch.org/docs/stable/tenso
y_test = y_test.type(torch.double)
```

In [15]:
```
cost_fn = nn.BCELoss() # https://docs.pytorch.org/docs/stable/generated/torch.nn.BC
y_pred = model(x_train)
cost = cost_fn(y_pred,y_train)
print(model.state_dict()) #before
print(cost) #before

optimizer = torch.optim.SGD(params=model.parameters(),lr=1)
optimizer.zero_grad()
cost.backward()
optimizer.step()

y_pred = model(x_train)
cost = cost_fn(y_pred,y_train)
print(model.state_dict()) #after
print(cost) #after
```

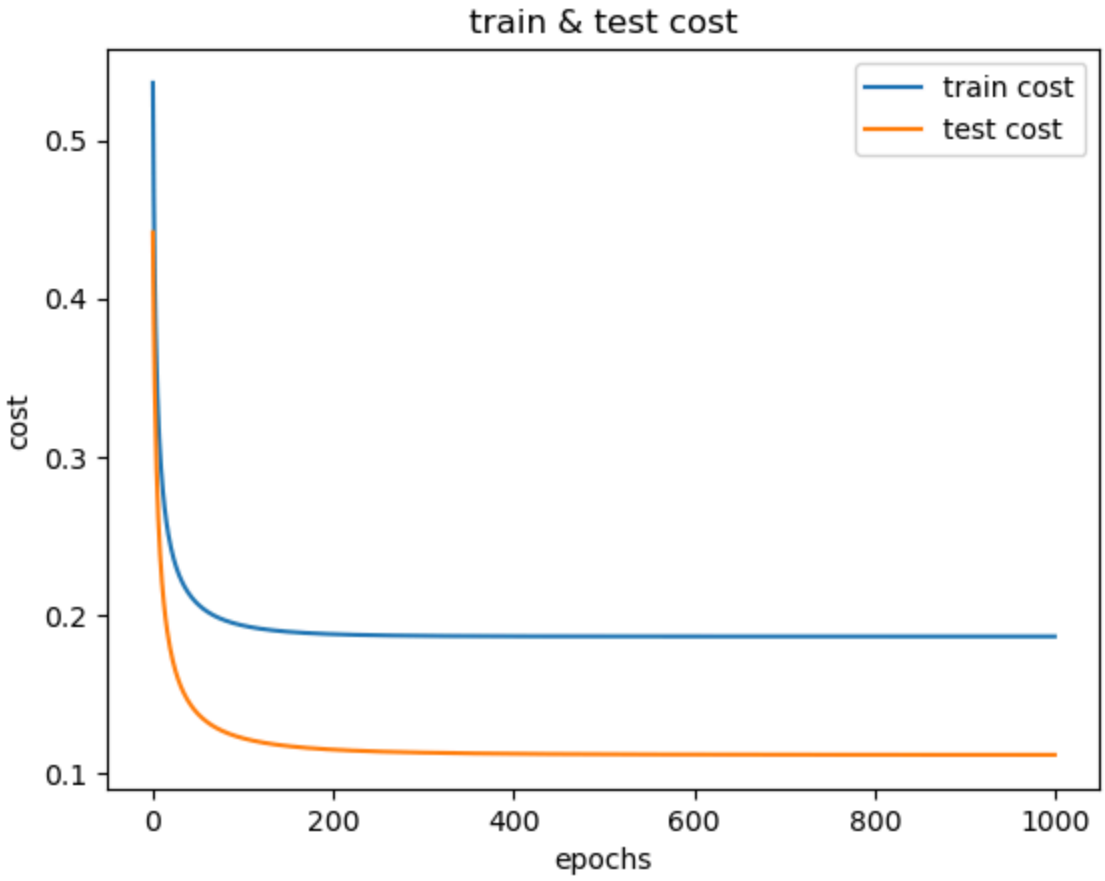
```
OrderedDict([('linear_layer.weight', tensor([[-0.4710,  0.1380, -0.1459, -0.1397]],
device='cuda:0',
       dtype=torch.float64)), ('linear_layer.bias', tensor([-0.4544], device='cuda:
0', dtype=torch.float64))])
tensor(0.6555, device='cuda:0', dtype=torch.float64,
       grad_fn=<BinaryCrossEntropyBackward0>)
OrderedDict([('linear_layer.weight', tensor([[-0.6844, -0.0477,  0.0376, -0.0613]],
device='cuda:0',
       dtype=torch.float64)), ('linear_layer.bias', tensor([-0.3352], device='cuda:
0', dtype=torch.float64))])
tensor(0.5364, device='cuda:0', dtype=torch.float64,
       grad_fn=<BinaryCrossEntropyBackward0>)
```

In [16]:
```
#Loop
epochs = 1000

train_cost_hist = []
test_cost_hist = []
train_acc_hist = []
test_acc_hist = []

for epoch in range(epochs):
    model.train() # to indicate now is in train phase
    #model.eval() # to indicate in test phase

    y_pred = model(x_train)
    train_cost = cost_fn(y_pred, y_train)
    train_cost_hist.append(train_cost.cpu().detach().numpy()) # .detach().numpy() i

    train_acc = (torch.round(y_pred)==y_train).sum() / len(y_train) * 100
    train_acc_hist.append(train_acc.cpu().detach().numpy())

    optimizer.zero_grad()
    train_cost.backward()
    optimizer.step()
```

```
    model.eval() #test phase
    with torch.inference_mode():   #no need to run gradient descent because it is i
        test_pred = model(x_test)
        test_cost = cost_fn(test_pred,y_test)
        test_cost_hist.append(test_cost.cpu())

        test_acc = (torch.round(test_pred)==y_test).sum() / len(y_test) * 100
        test_acc_hist.append(test_acc.cpu())

    if epoch%100==0:
        print(f"{epoch:5} - train_cost : {train_cost: .4e} : test_cost : {test_cost
```

```
    0 - train_cost :  5.3640e-01 : test_cost :  4.4179e-01 : train_acc : 74.06% : te
st_acc : 86.67%
  100 - train_cost :  1.9309e-01 : test_cost :  1.2182e-01 : train_acc : 92.89% : te
st_acc : 95.00%
  200 - train_cost :  1.8765e-01 : test_cost :  1.1462e-01 : train_acc : 92.89% : te
st_acc : 95.00%
  300 - train_cost :  1.8661e-01 : test_cost :  1.1274e-01 : train_acc : 92.89% : te
st_acc : 95.00%
  400 - train_cost :  1.8634e-01 : test_cost :  1.1202e-01 : train_acc : 92.89% : te
st_acc : 95.00%
  500 - train_cost :  1.8627e-01 : test_cost :  1.1169e-01 : train_acc : 92.89% : te
st_acc : 95.00%
  600 - train_cost :  1.8624e-01 : test_cost :  1.1152e-01 : train_acc : 92.89% : te
st_acc : 95.00%
  700 - train_cost :  1.8623e-01 : test_cost :  1.1143e-01 : train_acc : 92.89% : te
st_acc : 95.00%
  800 - train_cost :  1.8623e-01 : test_cost :  1.1138e-01 : train_acc : 92.89% : te
st_acc : 95.00%
  900 - train_cost :  1.8623e-01 : test_cost :  1.1136e-01 : train_acc : 92.89% : te
st_acc : 95.00%
```

In [17]:
```
import matplotlib.pyplot as plt

plt.plot(range(0,1000), train_cost_hist, label = "train cost")
plt.plot(range(0,1000), test_cost_hist, label = "test cost")
plt.title("train & test cost")
plt.xlabel("epochs")
plt.ylabel("cost")
plt.legend()
plt.show()
```



In [36]:
```
model.eval()
with torch.inference_mode():
    y_pred = model(x_test)
result = (torch.round(y_pred)==y_test).sum() / len(y_test) * 100
print(f"acc: {result:.2f}%")
```

```
acc: 95.00%
```

Check data here

In [32]:
```
age = 65
loan = 300000 / 1000 #unit(k)
monthlypaid = 3500 / 1000 #unit(k)
gender = 0  #female

# x_realData = np.array([[age,loan,monthlypaid,gender]])
# x_realData = scaler.transform(x_realData)
# y_realData = (x_realData * w_final).sum(axis = 1) + b_final
# y_realData = sigmoid(y_realData)

model.eval()
with torch.inference_mode():
    x_realData = torch.tensor(scaler.transform([[age, loan, monthlypaid, gender]]),
    x_realData = x_realData.to(device)
    y_realData = round(model(x_realData).item(), 2)

if y_realData > 0.5:
```

```
    print("Congratulations, you may get the loan")
else:
    print("Sorry, your loan are rejected")
```

```
Sorry, your loan are rejected
```

In [ ]: