# 实验1：使⽤Pytorch构建多层感知机报告

# 实验背景

实验的主要目标是使用PyTorch构建一个多层感知机（MLP），并应用于电离层数据集（ionosphere.csv）的二分类任务。数据集有351个观测值，每个观测值包括34个自变量（输入特征）和1个因变量（输出类别），类别为good（表示正样本）和bad（表示负样本）。

根据实验预习内容，实验用到的MLP由多层全连接神经元组成，通过层与层之间的权重矩阵实现输入向输出的映射。MLP能够学习输入特征与输出类别之间的复杂非线性关系，因此在二分类问题中具有较好的应用前景。本实验旨在通过构建并训练MLP模型，验证其在电离层数据集上的分类效果，并评估模型性能。

# 实验方案设计

首先使用pandas库加载数据集，并对数据进行初步处理。所有输入特征均转换为浮点数类型，因变量（类别）进行标签编码，使其转换为数值形式。接着，将数据集划分为训练集和测试集，训练集占70%（246个），测试集占30%（105个）。

然后基于PyTorch框架，设计一个包含三个隐藏层的MLP模型。输入层的维度为34（与输入特征数一致），第一个隐藏层的神经元数设置为10，第二个隐藏层设置为8，第三个隐藏层设置为1，输出层使用Sigmoid函数来预测类别概率。激活函数采用ReLU，损失函数选择二元交叉熵损失函数BCELoss，优化器使用SGD（随机梯度下降）。

实验中使用的超参数选择：

批处理大小（batch size）：32

学习率（learning rate）：0.01

动量（momentum）：0.9

训练轮数（epochs）：100

# 实验过程

在模型训练过程中，随着训练轮次的增加，损失函数值逐步下降，这表明模型在逐步学习输入特征与输出类别之间的关系。最初的几轮训练中，损失下降较快，随后逐渐趋于平稳。为了更直观地展示训练过程中的变化，修改了实验所给的代码，添加了Matplotlib来绘制训练损失曲线。模型实际输出见附录。

# train the model

def train\_model(train\_dl, model):

    # define the optimization

    criterion = BCELoss()

    optimizer = SGD(model.parameters(), lr=0.01, momentum=0.9)

    # list to store the loss for each epoch

    loss\_values = []

    # enumerate epochs

    for epoch in range(100):

        epoch\_loss = 0  # accumulate loss for this epoch

        # enumerate mini batches

        for i, (inputs, targets) in enumerate(train\_dl):

            # clear the gradients

            optimizer.zero\_grad()

            # compute the model output

            yhat = model(inputs)

            # calculate loss

            loss = criterion(yhat, targets)

            epoch\_loss += loss.item()  # accumulate loss

            # credit assignment

            loss.backward()

            print("epoch: {}, batch: {}, loss: {}".format(epoch, i, loss.data))

            # update model weights

            optimizer.step()

        # calculate average loss for the epoch and store it

        avg\_epoch\_loss = epoch\_loss / len(train\_dl)

        loss\_values.append(avg\_epoch\_loss)

        print("Epoch: {}, Average Loss: {}".format(epoch, avg\_epoch\_loss))

    # Plotting the loss curve

    plt.figure(figsize=(10, 5))

    plt.plot(loss\_values, label="Loss")

    plt.title("Training Loss Curve")

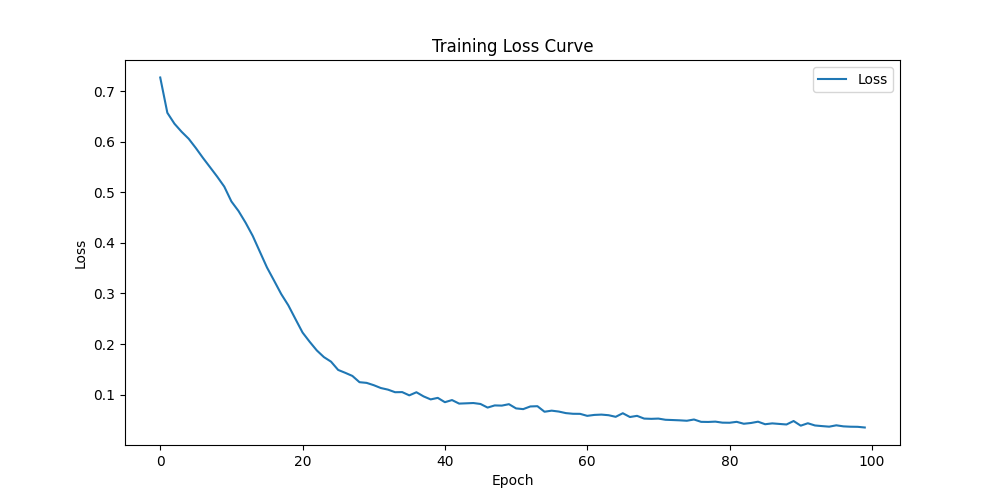
    plt.xlabel("Epoch")

    plt.ylabel("Loss")

    plt.legend()

    plt.show()

以下是训练过程中损失值的变化曲线：



观察曲线可知，随着训练的进行，测试集性能也在逐步提升。在模型训练接近完成时，测试集的准确率达到了预期目标，超过了90%。

# 性能测试

代码输出模型的具体架构如下：

MLP(

  (hidden1): Linear(in\_features=34, out\_features=10, bias=True)

  (act1): ReLU()

  (hidden2): Linear(in\_features=10, out\_features=8, bias=True)

  (act2): ReLU()

  (hidden3): Linear(in\_features=8, out\_features=1, bias=True)

  (act3): Sigmoid()

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由上一节可知，训练初期损失值(loss)较高，但随着训练的进行，损失值逐渐下降，模型的性能也逐步提升，在各个batch中的损失值持续下降，表明模型正在有效地学习输入数据的特征，并逐渐拟合训练集。

第100轮训练完成后，模型在测试集上的准确率达到了 91.4%，超过了90%的实验目标，表明所构建的多层感知机在处理电离层数据集的二分类任务时表现良好。

随后，代码手动构建了单个数据样本，并要求模型对其进行预测，以下是预测结果：

Predicted: 1.000 (class=1)

可见，模型准确预测了该样本的类别为1，即正样本（good）。该结果进一步验证了模型的预测能力。

# 实验习题

1. 写出一个单层MLP的数学表达式并求他对于输入的导数

一个单层MLP的数学表达式可以表示为：

其中，为权重矩阵，为输入向量，为偏置，为激活函数。

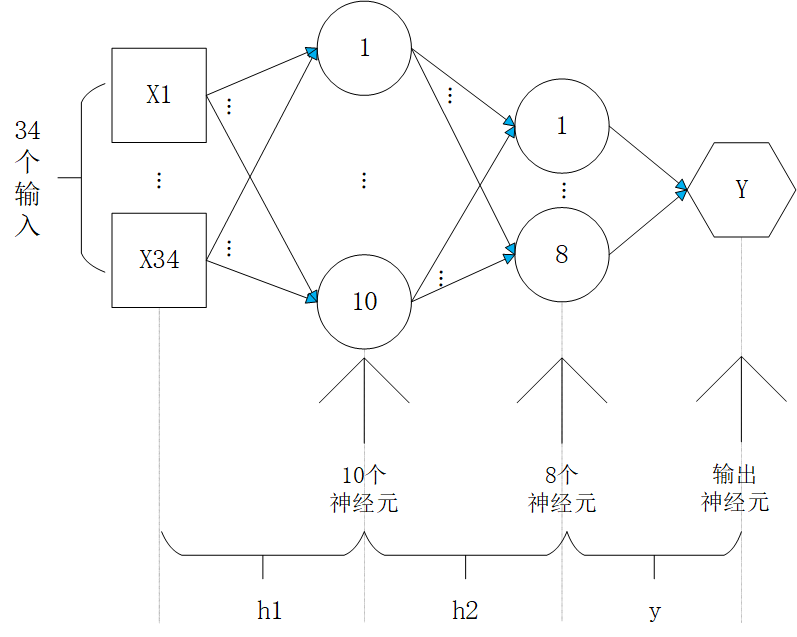
对于输入的导数为：

1. 根据你设置的超参数，写出你构建的MLP的数学表达式，画出他的计算图

本实验中使用的MLP模型的数学表达式可以分层表示为：

其中，分别是每层的权重矩阵，为对应的偏置，为Sigmoid激活函数。

该MLP模型的计算图如下：



# 附录

模型具体输出：

246 105

MLP(

(hidden1): Linear(in\_features=34, out\_features=10, bias=True)

(act1): ReLU()

(hidden2): Linear(in\_features=10, out\_features=8, bias=True)

(act2): ReLU()

(hidden3): Linear(in\_features=8, out\_features=1, bias=True)

(act3): Sigmoid()

)

epoch: 0, batch: 0, loss: 0.8417666554450989

epoch: 0, batch: 1, loss: 0.772466778755188

epoch: 0, batch: 2, loss: 0.7094777822494507

epoch: 0, batch: 3, loss: 0.719751238822937

epoch: 0, batch: 4, loss: 0.6945536732673645

epoch: 0, batch: 5, loss: 0.73636394739151

epoch: 0, batch: 6, loss: 0.6860942840576172

epoch: 0, batch: 7, loss: 0.6549153923988342

Epoch: 0, Average Loss: 0.7269237190485001

epoch: 1, batch: 0, loss: 0.6551534533500671

epoch: 1, batch: 1, loss: 0.6802740693092346

epoch: 1, batch: 2, loss: 0.6175668835639954

epoch: 1, batch: 3, loss: 0.642990231513977

epoch: 1, batch: 4, loss: 0.6717426180839539

epoch: 1, batch: 5, loss: 0.6607526540756226

epoch: 1, batch: 6, loss: 0.6339252591133118

epoch: 1, batch: 7, loss: 0.6949878334999084

Epoch: 1, Average Loss: 0.6571741253137589

epoch: 2, batch: 0, loss: 0.6476538181304932

epoch: 2, batch: 1, loss: 0.6204129457473755

epoch: 2, batch: 2, loss: 0.6219193935394287

epoch: 2, batch: 3, loss: 0.6541128754615784

epoch: 2, batch: 4, loss: 0.6224231719970703

epoch: 2, batch: 5, loss: 0.6245962381362915

epoch: 2, batch: 6, loss: 0.6248388290405273

epoch: 2, batch: 7, loss: 0.6683423519134521

Epoch: 2, Average Loss: 0.6355374529957771

epoch: 3, batch: 0, loss: 0.5536317825317383

epoch: 3, batch: 1, loss: 0.643585205078125

epoch: 3, batch: 2, loss: 0.6161159873008728

epoch: 3, batch: 3, loss: 0.6054742336273193

epoch: 3, batch: 4, loss: 0.619148850440979

epoch: 3, batch: 5, loss: 0.6635103821754456

epoch: 3, batch: 6, loss: 0.6453801989555359

epoch: 3, batch: 7, loss: 0.6105735898017883

Epoch: 3, Average Loss: 0.6196775287389755

epoch: 4, batch: 0, loss: 0.5301998853683472

epoch: 4, batch: 1, loss: 0.6583524942398071

epoch: 4, batch: 2, loss: 0.5325090885162354

epoch: 4, batch: 3, loss: 0.6018328666687012

epoch: 4, batch: 4, loss: 0.6417794227600098

epoch: 4, batch: 5, loss: 0.5935553908348083

epoch: 4, batch: 6, loss: 0.6466256380081177

epoch: 4, batch: 7, loss: 0.6414130926132202

Epoch: 4, Average Loss: 0.6057834848761559

epoch: 5, batch: 0, loss: 0.5376172661781311

epoch: 5, batch: 1, loss: 0.6439237594604492

epoch: 5, batch: 2, loss: 0.597144365310669

epoch: 5, batch: 3, loss: 0.5197843313217163

epoch: 5, batch: 4, loss: 0.604340672492981

epoch: 5, batch: 5, loss: 0.6095055937767029

epoch: 5, batch: 6, loss: 0.5997053980827332

epoch: 5, batch: 7, loss: 0.5884044170379639

Epoch: 5, Average Loss: 0.5875532254576683

epoch: 6, batch: 0, loss: 0.6047599911689758

epoch: 6, batch: 1, loss: 0.5294039845466614

epoch: 6, batch: 2, loss: 0.5607686042785645

epoch: 6, batch: 3, loss: 0.5549383759498596

epoch: 6, batch: 4, loss: 0.580489993095398

epoch: 6, batch: 5, loss: 0.5822665095329285

epoch: 6, batch: 6, loss: 0.5935101509094238

epoch: 6, batch: 7, loss: 0.5381736755371094

Epoch: 6, Average Loss: 0.5680389106273651

epoch: 7, batch: 0, loss: 0.5882469415664673

epoch: 7, batch: 1, loss: 0.5448492765426636

epoch: 7, batch: 2, loss: 0.5929021835327148

epoch: 7, batch: 3, loss: 0.5235788226127625

epoch: 7, batch: 4, loss: 0.4853336811065674

epoch: 7, batch: 5, loss: 0.5421438813209534

epoch: 7, batch: 6, loss: 0.5708804130554199

epoch: 7, batch: 7, loss: 0.5485910177230835

Epoch: 7, Average Loss: 0.549565777182579

epoch: 8, batch: 0, loss: 0.5805886387825012

epoch: 8, batch: 1, loss: 0.5244076251983643

epoch: 8, batch: 2, loss: 0.4817081689834595

epoch: 8, batch: 3, loss: 0.5520917177200317

epoch: 8, batch: 4, loss: 0.49618983268737793

epoch: 8, batch: 5, loss: 0.4718369245529175

epoch: 8, batch: 6, loss: 0.5804911255836487

epoch: 8, batch: 7, loss: 0.5606428384780884

Epoch: 8, Average Loss: 0.5309946089982986

epoch: 9, batch: 0, loss: 0.4410742223262787

epoch: 9, batch: 1, loss: 0.5931527614593506

epoch: 9, batch: 2, loss: 0.5173013806343079

epoch: 9, batch: 3, loss: 0.5255926847457886

epoch: 9, batch: 4, loss: 0.5002996325492859

epoch: 9, batch: 5, loss: 0.40200990438461304

epoch: 9, batch: 6, loss: 0.5333284139633179

epoch: 9, batch: 7, loss: 0.5766564011573792

Epoch: 9, Average Loss: 0.5111769251525402

epoch: 10, batch: 0, loss: 0.46261319518089294

epoch: 10, batch: 1, loss: 0.4436350464820862

epoch: 10, batch: 2, loss: 0.5201382637023926

epoch: 10, batch: 3, loss: 0.580115556716919

epoch: 10, batch: 4, loss: 0.4115663766860962

epoch: 10, batch: 5, loss: 0.6064856648445129

epoch: 10, batch: 6, loss: 0.4268040657043457

epoch: 10, batch: 7, loss: 0.40378904342651367

Epoch: 10, Average Loss: 0.4818934015929699

epoch: 11, batch: 0, loss: 0.45995157957077026

epoch: 11, batch: 1, loss: 0.5351737141609192

epoch: 11, batch: 2, loss: 0.474710613489151

epoch: 11, batch: 3, loss: 0.49496695399284363

epoch: 11, batch: 4, loss: 0.4498426914215088

epoch: 11, batch: 5, loss: 0.41071048378944397

epoch: 11, batch: 6, loss: 0.3865468204021454

epoch: 11, batch: 7, loss: 0.49199387431144714

Epoch: 11, Average Loss: 0.46298709139227867

epoch: 12, batch: 0, loss: 0.5089336633682251

epoch: 12, batch: 1, loss: 0.5189834833145142

epoch: 12, batch: 2, loss: 0.42809876799583435

epoch: 12, batch: 3, loss: 0.3164841830730438

epoch: 12, batch: 4, loss: 0.47785475850105286

epoch: 12, batch: 5, loss: 0.4406757950782776

epoch: 12, batch: 6, loss: 0.32992708683013916

epoch: 12, batch: 7, loss: 0.497254341840744

Epoch: 12, Average Loss: 0.4397765100002289

epoch: 13, batch: 0, loss: 0.3963588774204254

epoch: 13, batch: 1, loss: 0.3705998957157135

epoch: 13, batch: 2, loss: 0.32004666328430176

epoch: 13, batch: 3, loss: 0.42453673481941223

epoch: 13, batch: 4, loss: 0.43684667348861694

epoch: 13, batch: 5, loss: 0.4473190903663635

epoch: 13, batch: 6, loss: 0.4157046675682068

epoch: 13, batch: 7, loss: 0.49848318099975586

Epoch: 13, Average Loss: 0.4137369729578495

epoch: 14, batch: 0, loss: 0.5083547234535217

epoch: 14, batch: 1, loss: 0.31246307492256165

epoch: 14, batch: 2, loss: 0.49492794275283813

epoch: 14, batch: 3, loss: 0.3236238360404968

epoch: 14, batch: 4, loss: 0.369150847196579

epoch: 14, batch: 5, loss: 0.3775016665458679

epoch: 14, batch: 6, loss: 0.3257945477962494

epoch: 14, batch: 7, loss: 0.34812843799591064

Epoch: 14, Average Loss: 0.38249313458800316

epoch: 15, batch: 0, loss: 0.3445466458797455

epoch: 15, batch: 1, loss: 0.3657532036304474

epoch: 15, batch: 2, loss: 0.3715549409389496

epoch: 15, batch: 3, loss: 0.3680657744407654

epoch: 15, batch: 4, loss: 0.3582238256931305

epoch: 15, batch: 5, loss: 0.2916965186595917

epoch: 15, batch: 6, loss: 0.4213947653770447

epoch: 15, batch: 7, loss: 0.2894967794418335

Epoch: 15, Average Loss: 0.3513415567576885

epoch: 16, batch: 0, loss: 0.41884565353393555

epoch: 16, batch: 1, loss: 0.324619323015213

epoch: 16, batch: 2, loss: 0.3615240752696991

epoch: 16, batch: 3, loss: 0.2901644706726074

epoch: 16, batch: 4, loss: 0.273660808801651

epoch: 16, batch: 5, loss: 0.3602886199951172

epoch: 16, batch: 6, loss: 0.23746131360530853

epoch: 16, batch: 7, loss: 0.3357718586921692

Epoch: 16, Average Loss: 0.3252920154482126

epoch: 17, batch: 0, loss: 0.3245902955532074

epoch: 17, batch: 1, loss: 0.3360474407672882

epoch: 17, batch: 2, loss: 0.25731030106544495

epoch: 17, batch: 3, loss: 0.34765300154685974

epoch: 17, batch: 4, loss: 0.28548184037208557

epoch: 17, batch: 5, loss: 0.26708662509918213

epoch: 17, batch: 6, loss: 0.2329118847846985

epoch: 17, batch: 7, loss: 0.33948227763175964

Epoch: 17, Average Loss: 0.29882045835256577

epoch: 18, batch: 0, loss: 0.21308764815330505

epoch: 18, batch: 1, loss: 0.24000564217567444

epoch: 18, batch: 2, loss: 0.18683381378650665

epoch: 18, batch: 3, loss: 0.23937484622001648

epoch: 18, batch: 4, loss: 0.23380833864212036

epoch: 18, batch: 5, loss: 0.30660519003868103

epoch: 18, batch: 6, loss: 0.3818059265613556

epoch: 18, batch: 7, loss: 0.41064193844795227

Epoch: 18, Average Loss: 0.2765204180032015

epoch: 19, batch: 0, loss: 0.2184334695339203

epoch: 19, batch: 1, loss: 0.22061248123645782

epoch: 19, batch: 2, loss: 0.19759762287139893

epoch: 19, batch: 3, loss: 0.305101603269577

epoch: 19, batch: 4, loss: 0.31369003653526306

epoch: 19, batch: 5, loss: 0.17640385031700134

epoch: 19, batch: 6, loss: 0.23156091570854187

epoch: 19, batch: 7, loss: 0.33209410309791565

Epoch: 19, Average Loss: 0.2494367603212595

epoch: 20, batch: 0, loss: 0.22442930936813354

epoch: 20, batch: 1, loss: 0.29125964641571045

epoch: 20, batch: 2, loss: 0.23142223060131073

epoch: 20, batch: 3, loss: 0.23589055240154266

epoch: 20, batch: 4, loss: 0.2468494027853012

epoch: 20, batch: 5, loss: 0.12353300303220749

epoch: 20, batch: 6, loss: 0.2681725323200226

epoch: 20, batch: 7, loss: 0.16022717952728271

Epoch: 20, Average Loss: 0.22272298205643892

epoch: 21, batch: 0, loss: 0.2529391646385193

epoch: 21, batch: 1, loss: 0.16554711759090424

epoch: 21, batch: 2, loss: 0.22763016819953918

epoch: 21, batch: 3, loss: 0.28017616271972656

epoch: 21, batch: 4, loss: 0.21814918518066406

epoch: 21, batch: 5, loss: 0.12484392523765564

epoch: 21, batch: 6, loss: 0.15702518820762634

epoch: 21, batch: 7, loss: 0.20902809500694275

Epoch: 21, Average Loss: 0.20441737584769726

epoch: 22, batch: 0, loss: 0.24401961266994476

epoch: 22, batch: 1, loss: 0.25296327471733093

epoch: 22, batch: 2, loss: 0.11421307176351547

epoch: 22, batch: 3, loss: 0.14671644568443298

epoch: 22, batch: 4, loss: 0.20111621916294098

epoch: 22, batch: 5, loss: 0.13814972341060638

epoch: 22, batch: 6, loss: 0.2551642060279846

epoch: 22, batch: 7, loss: 0.14668750762939453

Epoch: 22, Average Loss: 0.18737875763326883

epoch: 23, batch: 0, loss: 0.16595524549484253

epoch: 23, batch: 1, loss: 0.14282865822315216

epoch: 23, batch: 2, loss: 0.1389916092157364

epoch: 23, batch: 3, loss: 0.18589991331100464

epoch: 23, batch: 4, loss: 0.21370583772659302

epoch: 23, batch: 5, loss: 0.12546837329864502

epoch: 23, batch: 6, loss: 0.2285093069076538

epoch: 23, batch: 7, loss: 0.19196835160255432

Epoch: 23, Average Loss: 0.17416591197252274

epoch: 24, batch: 0, loss: 0.19024473428726196

epoch: 24, batch: 1, loss: 0.15839852392673492

epoch: 24, batch: 2, loss: 0.12684111297130585

epoch: 24, batch: 3, loss: 0.11224734783172607

epoch: 24, batch: 4, loss: 0.1901300698518753

epoch: 24, batch: 5, loss: 0.13095535337924957

epoch: 24, batch: 6, loss: 0.12351943552494049

epoch: 24, batch: 7, loss: 0.28886353969573975

Epoch: 24, Average Loss: 0.16515001468360424

epoch: 25, batch: 0, loss: 0.14614173769950867

epoch: 25, batch: 1, loss: 0.16042764484882355

epoch: 25, batch: 2, loss: 0.11964921653270721

epoch: 25, batch: 3, loss: 0.16315533220767975

epoch: 25, batch: 4, loss: 0.09174364060163498

epoch: 25, batch: 5, loss: 0.25232625007629395

epoch: 25, batch: 6, loss: 0.1638379991054535

epoch: 25, batch: 7, loss: 0.09320522099733353

Epoch: 25, Average Loss: 0.1488108802586794

epoch: 26, batch: 0, loss: 0.08217886835336685

epoch: 26, batch: 1, loss: 0.2121293842792511

epoch: 26, batch: 2, loss: 0.1450330764055252

epoch: 26, batch: 3, loss: 0.15013520419597626

epoch: 26, batch: 4, loss: 0.11610785126686096

epoch: 26, batch: 5, loss: 0.12384182214736938

epoch: 26, batch: 6, loss: 0.10833163559436798

epoch: 26, batch: 7, loss: 0.20685218274593353

Epoch: 26, Average Loss: 0.1430762531235814

epoch: 27, batch: 0, loss: 0.1199742779135704

epoch: 27, batch: 1, loss: 0.1459863781929016

epoch: 27, batch: 2, loss: 0.08651673793792725

epoch: 27, batch: 3, loss: 0.19430838525295258

epoch: 27, batch: 4, loss: 0.17128519713878632

epoch: 27, batch: 5, loss: 0.05959472805261612

epoch: 27, batch: 6, loss: 0.11359834671020508

epoch: 27, batch: 7, loss: 0.20432844758033752

Epoch: 27, Average Loss: 0.1369490623474121

epoch: 28, batch: 0, loss: 0.14153751730918884

epoch: 28, batch: 1, loss: 0.09100569039583206

epoch: 28, batch: 2, loss: 0.23138557374477386

epoch: 28, batch: 3, loss: 0.055960893630981445

epoch: 28, batch: 4, loss: 0.14229625463485718

epoch: 28, batch: 5, loss: 0.13289368152618408

epoch: 28, batch: 6, loss: 0.1513727903366089

epoch: 28, batch: 7, loss: 0.04999234899878502

Epoch: 28, Average Loss: 0.12455559382215142

epoch: 29, batch: 0, loss: 0.09008929133415222

epoch: 29, batch: 1, loss: 0.22080902755260468

epoch: 29, batch: 2, loss: 0.16761961579322815

epoch: 29, batch: 3, loss: 0.11433140933513641

epoch: 29, batch: 4, loss: 0.14600956439971924

epoch: 29, batch: 5, loss: 0.06691881269216537

epoch: 29, batch: 6, loss: 0.0863785371184349

epoch: 29, batch: 7, loss: 0.09346592426300049

Epoch: 29, Average Loss: 0.12320277281105518

epoch: 30, batch: 0, loss: 0.19407859444618225

epoch: 30, batch: 1, loss: 0.08156824856996536

epoch: 30, batch: 2, loss: 0.0978492870926857

epoch: 30, batch: 3, loss: 0.12681588530540466

epoch: 30, batch: 4, loss: 0.0855148583650589

epoch: 30, batch: 5, loss: 0.15143577754497528

epoch: 30, batch: 6, loss: 0.07599738240242004

epoch: 30, batch: 7, loss: 0.13595889508724213

Epoch: 30, Average Loss: 0.11865236610174179

epoch: 31, batch: 0, loss: 0.09496675431728363

epoch: 31, batch: 1, loss: 0.060349948704242706

epoch: 31, batch: 2, loss: 0.1904391050338745

epoch: 31, batch: 3, loss: 0.08269305527210236

epoch: 31, batch: 4, loss: 0.16092106699943542

epoch: 31, batch: 5, loss: 0.14428316056728363

epoch: 31, batch: 6, loss: 0.12400957942008972

epoch: 31, batch: 7, loss: 0.04650824889540672

Epoch: 31, Average Loss: 0.11302136490121484

epoch: 32, batch: 0, loss: 0.09071597456932068

epoch: 32, batch: 1, loss: 0.04094061627984047

epoch: 32, batch: 2, loss: 0.08915425091981888

epoch: 32, batch: 3, loss: 0.07414578646421432

epoch: 32, batch: 4, loss: 0.15580879151821136

epoch: 32, batch: 5, loss: 0.16456753015518188

epoch: 32, batch: 6, loss: 0.1602131873369217

epoch: 32, batch: 7, loss: 0.10319802165031433

Epoch: 32, Average Loss: 0.10984301986172795

epoch: 33, batch: 0, loss: 0.11268917471170425

epoch: 33, batch: 1, loss: 0.12170573323965073

epoch: 33, batch: 2, loss: 0.10870827734470367

epoch: 33, batch: 3, loss: 0.08465547114610672

epoch: 33, batch: 4, loss: 0.15510821342468262

epoch: 33, batch: 5, loss: 0.08511249721050262

epoch: 33, batch: 6, loss: 0.12145631015300751

epoch: 33, batch: 7, loss: 0.04857717826962471

Epoch: 33, Average Loss: 0.10475160693749785

epoch: 34, batch: 0, loss: 0.04530269652605057

epoch: 34, batch: 1, loss: 0.06420309841632843

epoch: 34, batch: 2, loss: 0.17043110728263855

epoch: 34, batch: 3, loss: 0.09016397595405579

epoch: 34, batch: 4, loss: 0.18321852385997772

epoch: 34, batch: 5, loss: 0.04315862059593201

epoch: 34, batch: 6, loss: 0.1138281524181366

epoch: 34, batch: 7, loss: 0.1293061077594757

Epoch: 34, Average Loss: 0.10495153535157442

epoch: 35, batch: 0, loss: 0.10118947178125381

epoch: 35, batch: 1, loss: 0.1522877961397171

epoch: 35, batch: 2, loss: 0.0778578445315361

epoch: 35, batch: 3, loss: 0.061544306576251984

epoch: 35, batch: 4, loss: 0.12942685186862946

epoch: 35, batch: 5, loss: 0.052001953125

epoch: 35, batch: 6, loss: 0.1643899381160736

epoch: 35, batch: 7, loss: 0.04960314929485321

Epoch: 35, Average Loss: 0.09853766392916441

epoch: 36, batch: 0, loss: 0.06716550886631012

epoch: 36, batch: 1, loss: 0.05999819189310074

epoch: 36, batch: 2, loss: 0.09567240625619888

epoch: 36, batch: 3, loss: 0.0999767854809761

epoch: 36, batch: 4, loss: 0.05184419825673103

epoch: 36, batch: 5, loss: 0.1126929521560669

epoch: 36, batch: 6, loss: 0.1195274293422699

epoch: 36, batch: 7, loss: 0.23043900728225708

Epoch: 36, Average Loss: 0.10466455994173884

epoch: 37, batch: 0, loss: 0.04662654548883438

epoch: 37, batch: 1, loss: 0.08895489573478699

epoch: 37, batch: 2, loss: 0.08232234418392181

epoch: 37, batch: 3, loss: 0.08908059448003769

epoch: 37, batch: 4, loss: 0.07661307603120804

epoch: 37, batch: 5, loss: 0.2095535695552826

epoch: 37, batch: 6, loss: 0.05552767217159271

epoch: 37, batch: 7, loss: 0.12354081124067307

Epoch: 37, Average Loss: 0.09652743861079216

epoch: 38, batch: 0, loss: 0.09567618370056152

epoch: 38, batch: 1, loss: 0.09657780826091766

epoch: 38, batch: 2, loss: 0.09957360476255417

epoch: 38, batch: 3, loss: 0.07003545761108398

epoch: 38, batch: 4, loss: 0.060442548245191574

epoch: 38, batch: 5, loss: 0.192404642701149

epoch: 38, batch: 6, loss: 0.056398726999759674

epoch: 38, batch: 7, loss: 0.053131379187107086

Epoch: 38, Average Loss: 0.09053004393354058

epoch: 39, batch: 0, loss: 0.08510830998420715

epoch: 39, batch: 1, loss: 0.19583368301391602

epoch: 39, batch: 2, loss: 0.036074452102184296

epoch: 39, batch: 3, loss: 0.11417683959007263

epoch: 39, batch: 4, loss: 0.0538368858397007

epoch: 39, batch: 5, loss: 0.07565151900053024

epoch: 39, batch: 6, loss: 0.027619965374469757

epoch: 39, batch: 7, loss: 0.16019201278686523

Epoch: 39, Average Loss: 0.09356170846149325

epoch: 40, batch: 0, loss: 0.08872894197702408

epoch: 40, batch: 1, loss: 0.06957791745662689

epoch: 40, batch: 2, loss: 0.040223635733127594

epoch: 40, batch: 3, loss: 0.08121384680271149

epoch: 40, batch: 4, loss: 0.12132592499256134

epoch: 40, batch: 5, loss: 0.17477361857891083

epoch: 40, batch: 6, loss: 0.08059897273778915

epoch: 40, batch: 7, loss: 0.023662561550736427

Epoch: 40, Average Loss: 0.08501317747868598

epoch: 41, batch: 0, loss: 0.049589551985263824

epoch: 41, batch: 1, loss: 0.07400573045015335

epoch: 41, batch: 2, loss: 0.053478848189115524

epoch: 41, batch: 3, loss: 0.06376729160547256

epoch: 41, batch: 4, loss: 0.07031764835119247

epoch: 41, batch: 5, loss: 0.15393683314323425

epoch: 41, batch: 6, loss: 0.09495482593774796

epoch: 41, batch: 7, loss: 0.1536964774131775

Epoch: 41, Average Loss: 0.08921840088441968

epoch: 42, batch: 0, loss: 0.08279640227556229

epoch: 42, batch: 1, loss: 0.06946080923080444

epoch: 42, batch: 2, loss: 0.09638997912406921

epoch: 42, batch: 3, loss: 0.14535950124263763

epoch: 42, batch: 4, loss: 0.05803598836064339

epoch: 42, batch: 5, loss: 0.06972690671682358

epoch: 42, batch: 6, loss: 0.07891076803207397

epoch: 42, batch: 7, loss: 0.05715469270944595

Epoch: 42, Average Loss: 0.08222938096150756

epoch: 43, batch: 0, loss: 0.13420000672340393

epoch: 43, batch: 1, loss: 0.09411528706550598

epoch: 43, batch: 2, loss: 0.06687036156654358

epoch: 43, batch: 3, loss: 0.07268186658620834

epoch: 43, batch: 4, loss: 0.10709855705499649

epoch: 43, batch: 5, loss: 0.051439568400382996

epoch: 43, batch: 6, loss: 0.09494902193546295

epoch: 43, batch: 7, loss: 0.04096824303269386

Epoch: 43, Average Loss: 0.08279036404564977

epoch: 44, batch: 0, loss: 0.04217442497611046

epoch: 44, batch: 1, loss: 0.11047142744064331

epoch: 44, batch: 2, loss: 0.04646177589893341

epoch: 44, batch: 3, loss: 0.10767483711242676

epoch: 44, batch: 4, loss: 0.036608003079891205

epoch: 44, batch: 5, loss: 0.06130536273121834

epoch: 44, batch: 6, loss: 0.13945512473583221

epoch: 44, batch: 7, loss: 0.12269306927919388

Epoch: 44, Average Loss: 0.0833555031567812

epoch: 45, batch: 0, loss: 0.15885549783706665

epoch: 45, batch: 1, loss: 0.010108381509780884

epoch: 45, batch: 2, loss: 0.053623881191015244

epoch: 45, batch: 3, loss: 0.09464938938617706

epoch: 45, batch: 4, loss: 0.0699017345905304

epoch: 45, batch: 5, loss: 0.08442381024360657

epoch: 45, batch: 6, loss: 0.06294824928045273

epoch: 45, batch: 7, loss: 0.11742589622735977

Epoch: 45, Average Loss: 0.08149210503324866

epoch: 46, batch: 0, loss: 0.16606393456459045

epoch: 46, batch: 1, loss: 0.06690767407417297

epoch: 46, batch: 2, loss: 0.11611998826265335

epoch: 46, batch: 3, loss: 0.0433821938931942

epoch: 46, batch: 4, loss: 0.052086036652326584

epoch: 46, batch: 5, loss: 0.07950317859649658

epoch: 46, batch: 6, loss: 0.05005121976137161

epoch: 46, batch: 7, loss: 0.020918108522892

Epoch: 46, Average Loss: 0.07437904179096222

epoch: 47, batch: 0, loss: 0.044363051652908325

epoch: 47, batch: 1, loss: 0.09228391945362091

epoch: 47, batch: 2, loss: 0.06145966425538063

epoch: 47, batch: 3, loss: 0.1604505032300949

epoch: 47, batch: 4, loss: 0.03208838775753975

epoch: 47, batch: 5, loss: 0.054521344602108

epoch: 47, batch: 6, loss: 0.13287484645843506

epoch: 47, batch: 7, loss: 0.05098998546600342

Epoch: 47, Average Loss: 0.07862896285951138

epoch: 48, batch: 0, loss: 0.18197453022003174

epoch: 48, batch: 1, loss: 0.03310761600732803

epoch: 48, batch: 2, loss: 0.10944032669067383

epoch: 48, batch: 3, loss: 0.03940531983971596

epoch: 48, batch: 4, loss: 0.02891344390809536

epoch: 48, batch: 5, loss: 0.11649816483259201

epoch: 48, batch: 6, loss: 0.08739689737558365

epoch: 48, batch: 7, loss: 0.02928839437663555

Epoch: 48, Average Loss: 0.07825308665633202

epoch: 49, batch: 0, loss: 0.03592941537499428

epoch: 49, batch: 1, loss: 0.07693718373775482

epoch: 49, batch: 2, loss: 0.06997407972812653

epoch: 49, batch: 3, loss: 0.15925666689872742

epoch: 49, batch: 4, loss: 0.02931884117424488

epoch: 49, batch: 5, loss: 0.030940528959035873

epoch: 49, batch: 6, loss: 0.07201740890741348

epoch: 49, batch: 7, loss: 0.17421983182430267

Epoch: 49, Average Loss: 0.081074244575575

epoch: 50, batch: 0, loss: 0.06647200882434845

epoch: 50, batch: 1, loss: 0.05198477953672409

epoch: 50, batch: 2, loss: 0.05755201727151871

epoch: 50, batch: 3, loss: 0.061956264078617096

epoch: 50, batch: 4, loss: 0.04859548434615135

epoch: 50, batch: 5, loss: 0.15947246551513672

epoch: 50, batch: 6, loss: 0.049935273826122284

epoch: 50, batch: 7, loss: 0.08600656688213348

Epoch: 50, Average Loss: 0.07274685753509402

epoch: 51, batch: 0, loss: 0.031201058998703957

epoch: 51, batch: 1, loss: 0.13529013097286224

epoch: 51, batch: 2, loss: 0.08356280624866486

epoch: 51, batch: 3, loss: 0.0561150424182415

epoch: 51, batch: 4, loss: 0.053250525146722794

epoch: 51, batch: 5, loss: 0.06963362544775009

epoch: 51, batch: 6, loss: 0.09929658472537994

epoch: 51, batch: 7, loss: 0.04206855967640877

Epoch: 51, Average Loss: 0.07130229170434177

epoch: 52, batch: 0, loss: 0.02436068467795849

epoch: 52, batch: 1, loss: 0.0501721166074276

epoch: 52, batch: 2, loss: 0.09673930704593658

epoch: 52, batch: 3, loss: 0.02980946935713291

epoch: 52, batch: 4, loss: 0.07594403624534607

epoch: 52, batch: 5, loss: 0.04550900310277939

epoch: 52, batch: 6, loss: 0.25746992230415344

epoch: 52, batch: 7, loss: 0.03257125988602638

Epoch: 52, Average Loss: 0.07657197490334511

epoch: 53, batch: 0, loss: 0.19572389125823975

epoch: 53, batch: 1, loss: 0.014802378602325916

epoch: 53, batch: 2, loss: 0.04035443067550659

epoch: 53, batch: 3, loss: 0.043815143406391144

epoch: 53, batch: 4, loss: 0.06550182402133942

epoch: 53, batch: 5, loss: 0.0898360013961792

epoch: 53, batch: 6, loss: 0.02382788434624672

epoch: 53, batch: 7, loss: 0.14305751025676727

Epoch: 53, Average Loss: 0.0771148829953745

epoch: 54, batch: 0, loss: 0.06639470160007477

epoch: 54, batch: 1, loss: 0.10599560290575027

epoch: 54, batch: 2, loss: 0.06921390444040298

epoch: 54, batch: 3, loss: 0.053610000759363174

epoch: 54, batch: 4, loss: 0.08115269243717194

epoch: 54, batch: 5, loss: 0.0828605368733406

epoch: 54, batch: 6, loss: 0.03612383455038071

epoch: 54, batch: 7, loss: 0.03374476730823517

Epoch: 54, Average Loss: 0.06613700510933995

epoch: 55, batch: 0, loss: 0.02598409540951252

epoch: 55, batch: 1, loss: 0.16657854616641998

epoch: 55, batch: 2, loss: 0.02984125353395939

epoch: 55, batch: 3, loss: 0.009674937464296818

epoch: 55, batch: 4, loss: 0.06400634348392487

epoch: 55, batch: 5, loss: 0.09311977028846741

epoch: 55, batch: 6, loss: 0.028559669852256775

epoch: 55, batch: 7, loss: 0.12849873304367065

Epoch: 55, Average Loss: 0.06828291865531355

epoch: 56, batch: 0, loss: 0.1274452954530716

epoch: 56, batch: 1, loss: 0.05858022719621658

epoch: 56, batch: 2, loss: 0.02331831492483616

epoch: 56, batch: 3, loss: 0.03601055219769478

epoch: 56, batch: 4, loss: 0.07586023211479187

epoch: 56, batch: 5, loss: 0.0793905258178711

epoch: 56, batch: 6, loss: 0.03967458754777908

epoch: 56, batch: 7, loss: 0.09174761176109314

Epoch: 56, Average Loss: 0.06650341837666929

epoch: 57, batch: 0, loss: 0.022275518625974655

epoch: 57, batch: 1, loss: 0.047583162784576416

epoch: 57, batch: 2, loss: 0.029514053836464882

epoch: 57, batch: 3, loss: 0.05378071963787079

epoch: 57, batch: 4, loss: 0.053839489817619324

epoch: 57, batch: 5, loss: 0.09700234979391098

epoch: 57, batch: 6, loss: 0.1377384513616562

epoch: 57, batch: 7, loss: 0.06570776551961899

Epoch: 57, Average Loss: 0.06343018892221153

epoch: 58, batch: 0, loss: 0.06262704730033875

epoch: 58, batch: 1, loss: 0.07088857144117355

epoch: 58, batch: 2, loss: 0.032284773886203766

epoch: 58, batch: 3, loss: 0.06626541167497635

epoch: 58, batch: 4, loss: 0.059105996042490005

epoch: 58, batch: 5, loss: 0.022836532443761826

epoch: 58, batch: 6, loss: 0.13603250682353973

epoch: 58, batch: 7, loss: 0.046758998185396194

Epoch: 58, Average Loss: 0.06209997972473502

epoch: 59, batch: 0, loss: 0.053589317947626114

epoch: 59, batch: 1, loss: 0.12022452056407928

epoch: 59, batch: 2, loss: 0.08273707330226898

epoch: 59, batch: 3, loss: 0.048805125057697296

epoch: 59, batch: 4, loss: 0.02813664823770523

epoch: 59, batch: 5, loss: 0.03826133906841278

epoch: 59, batch: 6, loss: 0.07550796866416931

epoch: 59, batch: 7, loss: 0.04839935526251793

Epoch: 59, Average Loss: 0.061957668513059616

epoch: 60, batch: 0, loss: 0.06587514281272888

epoch: 60, batch: 1, loss: 0.09815492480993271

epoch: 60, batch: 2, loss: 0.040429942309856415

epoch: 60, batch: 3, loss: 0.04386249929666519

epoch: 60, batch: 4, loss: 0.06882860511541367

epoch: 60, batch: 5, loss: 0.05467832833528519

epoch: 60, batch: 6, loss: 0.06717953085899353

epoch: 60, batch: 7, loss: 0.025071583688259125

Epoch: 60, Average Loss: 0.05801006965339184

epoch: 61, batch: 0, loss: 0.040875427424907684

epoch: 61, batch: 1, loss: 0.05182147026062012

epoch: 61, batch: 2, loss: 0.05336110666394234

epoch: 61, batch: 3, loss: 0.03504480794072151

epoch: 61, batch: 4, loss: 0.03509330749511719

epoch: 61, batch: 5, loss: 0.14041003584861755

epoch: 61, batch: 6, loss: 0.059923943132162094

epoch: 61, batch: 7, loss: 0.06236398220062256

Epoch: 61, Average Loss: 0.05986176012083888

epoch: 62, batch: 0, loss: 0.036463458091020584

epoch: 62, batch: 1, loss: 0.03896111622452736

epoch: 62, batch: 2, loss: 0.03204304724931717

epoch: 62, batch: 3, loss: 0.010907991789281368

epoch: 62, batch: 4, loss: 0.16877368092536926

epoch: 62, batch: 5, loss: 0.042110949754714966

epoch: 62, batch: 6, loss: 0.04388346150517464

epoch: 62, batch: 7, loss: 0.11067764461040497

Epoch: 62, Average Loss: 0.06047766876872629

epoch: 63, batch: 0, loss: 0.05558271333575249

epoch: 63, batch: 1, loss: 0.015686459839344025

epoch: 63, batch: 2, loss: 0.06204359978437424

epoch: 63, batch: 3, loss: 0.0990680605173111

epoch: 63, batch: 4, loss: 0.0808427557349205

epoch: 63, batch: 5, loss: 0.018116308376193047

epoch: 63, batch: 6, loss: 0.037123434245586395

epoch: 63, batch: 7, loss: 0.10573117434978485

Epoch: 63, Average Loss: 0.05927431327290833

epoch: 64, batch: 0, loss: 0.057033319026231766

epoch: 64, batch: 1, loss: 0.03354103863239288

epoch: 64, batch: 2, loss: 0.02450169250369072

epoch: 64, batch: 3, loss: 0.0331682525575161

epoch: 64, batch: 4, loss: 0.17573538422584534

epoch: 64, batch: 5, loss: 0.03670588508248329

epoch: 64, batch: 6, loss: 0.052655041217803955

epoch: 64, batch: 7, loss: 0.035459548234939575

Epoch: 64, Average Loss: 0.05610002018511295

epoch: 65, batch: 0, loss: 0.02010166272521019

epoch: 65, batch: 1, loss: 0.01770106516778469

epoch: 65, batch: 2, loss: 0.09000428766012192

epoch: 65, batch: 3, loss: 0.036088474094867706

epoch: 65, batch: 4, loss: 0.055477261543273926

epoch: 65, batch: 5, loss: 0.0500728078186512

epoch: 65, batch: 6, loss: 0.04327969253063202

epoch: 65, batch: 7, loss: 0.19270138442516327

Epoch: 65, Average Loss: 0.06317832949571311

epoch: 66, batch: 0, loss: 0.02905390039086342

epoch: 66, batch: 1, loss: 0.06644580513238907

epoch: 66, batch: 2, loss: 0.12068647146224976

epoch: 66, batch: 3, loss: 0.02817215584218502

epoch: 66, batch: 4, loss: 0.013928319327533245

epoch: 66, batch: 5, loss: 0.05477599427103996

epoch: 66, batch: 6, loss: 0.09832160919904709

epoch: 66, batch: 7, loss: 0.034315623342990875

Epoch: 66, Average Loss: 0.055712484871037304

epoch: 67, batch: 0, loss: 0.02707028016448021

epoch: 67, batch: 1, loss: 0.030502663925290108

epoch: 67, batch: 2, loss: 0.022814348340034485

epoch: 67, batch: 3, loss: 0.01993207260966301

epoch: 67, batch: 4, loss: 0.13852857053279877

epoch: 67, batch: 5, loss: 0.06479878723621368

epoch: 67, batch: 6, loss: 0.024635037407279015

epoch: 67, batch: 7, loss: 0.13582782447338104

Epoch: 67, Average Loss: 0.05801369808614254

epoch: 68, batch: 0, loss: 0.014507059939205647

epoch: 68, batch: 1, loss: 0.058283790946006775

epoch: 68, batch: 2, loss: 0.11861879378557205

epoch: 68, batch: 3, loss: 0.03358395770192146

epoch: 68, batch: 4, loss: 0.039071258157491684

epoch: 68, batch: 5, loss: 0.07236821204423904

epoch: 68, batch: 6, loss: 0.04948456957936287

epoch: 68, batch: 7, loss: 0.034822553396224976

Epoch: 68, Average Loss: 0.052592524443753064

epoch: 69, batch: 0, loss: 0.041730478405952454

epoch: 69, batch: 1, loss: 0.008735893294215202

epoch: 69, batch: 2, loss: 0.06690946221351624

epoch: 69, batch: 3, loss: 0.14052090048789978

epoch: 69, batch: 4, loss: 0.047300852835178375

epoch: 69, batch: 5, loss: 0.023226778954267502

epoch: 69, batch: 6, loss: 0.045263610780239105

epoch: 69, batch: 7, loss: 0.043097760528326035

Epoch: 69, Average Loss: 0.052098217187449336

epoch: 70, batch: 0, loss: 0.026087548583745956

epoch: 70, batch: 1, loss: 0.041886232793331146

epoch: 70, batch: 2, loss: 0.045885663479566574

epoch: 70, batch: 3, loss: 0.02886386588215828

epoch: 70, batch: 4, loss: 0.031613852828741074

epoch: 70, batch: 5, loss: 0.10019024461507797

epoch: 70, batch: 6, loss: 0.06849236786365509

epoch: 70, batch: 7, loss: 0.07779613137245178

Epoch: 70, Average Loss: 0.052601988427340984

epoch: 71, batch: 0, loss: 0.11182025074958801

epoch: 71, batch: 1, loss: 0.048425789922475815

epoch: 71, batch: 2, loss: 0.034763384610414505

epoch: 71, batch: 3, loss: 0.03609728068113327

epoch: 71, batch: 4, loss: 0.046695973724126816

epoch: 71, batch: 5, loss: 0.03857395425438881

epoch: 71, batch: 6, loss: 0.06905485689640045

epoch: 71, batch: 7, loss: 0.016644872725009918

Epoch: 71, Average Loss: 0.0502595454454422

epoch: 72, batch: 0, loss: 0.02310447208583355

epoch: 72, batch: 1, loss: 0.04613413289189339

epoch: 72, batch: 2, loss: 0.1159796267747879

epoch: 72, batch: 3, loss: 0.03768554702401161

epoch: 72, batch: 4, loss: 0.019763357937335968

epoch: 72, batch: 5, loss: 0.06182192265987396

epoch: 72, batch: 6, loss: 0.0509563609957695

epoch: 72, batch: 7, loss: 0.04235149547457695

Epoch: 72, Average Loss: 0.049724614480510354

epoch: 73, batch: 0, loss: 0.0564555749297142

epoch: 73, batch: 1, loss: 0.019722605124115944

epoch: 73, batch: 2, loss: 0.04715066775679588

epoch: 73, batch: 3, loss: 0.04259825125336647

epoch: 73, batch: 4, loss: 0.045244187116622925

epoch: 73, batch: 5, loss: 0.10673896968364716

epoch: 73, batch: 6, loss: 0.03840937837958336

epoch: 73, batch: 7, loss: 0.036874666810035706

Epoch: 73, Average Loss: 0.049149287631735206

epoch: 74, batch: 0, loss: 0.020094921812415123

epoch: 74, batch: 1, loss: 0.05508626997470856

epoch: 74, batch: 2, loss: 0.11371604353189468

epoch: 74, batch: 3, loss: 0.03494347631931305

epoch: 74, batch: 4, loss: 0.03708667308092117

epoch: 74, batch: 5, loss: 0.020336080342531204

epoch: 74, batch: 6, loss: 0.07130330055952072

epoch: 74, batch: 7, loss: 0.03392237052321434

Epoch: 74, Average Loss: 0.048311142018064857

epoch: 75, batch: 0, loss: 0.026295531541109085

epoch: 75, batch: 1, loss: 0.015571445226669312

epoch: 75, batch: 2, loss: 0.0227716863155365

epoch: 75, batch: 3, loss: 0.0592743381857872

epoch: 75, batch: 4, loss: 0.03435971960425377

epoch: 75, batch: 5, loss: 0.09023982286453247

epoch: 75, batch: 6, loss: 0.11814725399017334

epoch: 75, batch: 7, loss: 0.03969797119498253

Epoch: 75, Average Loss: 0.050794721115380526

epoch: 76, batch: 0, loss: 0.02755085565149784

epoch: 76, batch: 1, loss: 0.0214292760938406

epoch: 76, batch: 2, loss: 0.03552279621362686

epoch: 76, batch: 3, loss: 0.02105986513197422

epoch: 76, batch: 4, loss: 0.07039974629878998

epoch: 76, batch: 5, loss: 0.1206945851445198

epoch: 76, batch: 6, loss: 0.04126133769750595

epoch: 76, batch: 7, loss: 0.03144371137022972

Epoch: 76, Average Loss: 0.04617027170024812

epoch: 77, batch: 0, loss: 0.05704442411661148

epoch: 77, batch: 1, loss: 0.037227846682071686

epoch: 77, batch: 2, loss: 0.030535200610756874

epoch: 77, batch: 3, loss: 0.01721663773059845

epoch: 77, batch: 4, loss: 0.1386033594608307

epoch: 77, batch: 5, loss: 0.026234833523631096

epoch: 77, batch: 6, loss: 0.04663728550076485

epoch: 77, batch: 7, loss: 0.014049243181943893

Epoch: 77, Average Loss: 0.04594360385090113

epoch: 78, batch: 0, loss: 0.01275817770510912

epoch: 78, batch: 1, loss: 0.031178856268525124

epoch: 78, batch: 2, loss: 0.0136093869805336

epoch: 78, batch: 3, loss: 0.14302892982959747

epoch: 78, batch: 4, loss: 0.022381268441677094

epoch: 78, batch: 5, loss: 0.0644209161400795

epoch: 78, batch: 6, loss: 0.03602304309606552

epoch: 78, batch: 7, loss: 0.04934069141745567

Epoch: 78, Average Loss: 0.04659265873488039

epoch: 79, batch: 0, loss: 0.11068995296955109

epoch: 79, batch: 1, loss: 0.024603039026260376

epoch: 79, batch: 2, loss: 0.02638903260231018

epoch: 79, batch: 3, loss: 0.04218923673033714

epoch: 79, batch: 4, loss: 0.028153469786047935

epoch: 79, batch: 5, loss: 0.08628063648939133

epoch: 79, batch: 6, loss: 0.020223552361130714

epoch: 79, batch: 7, loss: 0.018008802086114883

Epoch: 79, Average Loss: 0.044567215256392956

epoch: 80, batch: 0, loss: 0.015561104752123356

epoch: 80, batch: 1, loss: 0.024289395660161972

epoch: 80, batch: 2, loss: 0.03386685252189636

epoch: 80, batch: 3, loss: 0.09720392525196075

epoch: 80, batch: 4, loss: 0.11593473702669144

epoch: 80, batch: 5, loss: 0.015803275629878044

epoch: 80, batch: 6, loss: 0.03879069164395332

epoch: 80, batch: 7, loss: 0.013369407504796982

Epoch: 80, Average Loss: 0.04435242374893278

epoch: 81, batch: 0, loss: 0.12002818286418915

epoch: 81, batch: 1, loss: 0.015448769554495811

epoch: 81, batch: 2, loss: 0.011607212945818901

epoch: 81, batch: 3, loss: 0.09818984568119049

epoch: 81, batch: 4, loss: 0.034552011638879776

epoch: 81, batch: 5, loss: 0.028455490246415138

epoch: 81, batch: 6, loss: 0.029207246378064156

epoch: 81, batch: 7, loss: 0.03202730417251587

Epoch: 81, Average Loss: 0.04618950793519616

epoch: 82, batch: 0, loss: 0.03868626430630684

epoch: 82, batch: 1, loss: 0.0906425341963768

epoch: 82, batch: 2, loss: 0.06290028989315033

epoch: 82, batch: 3, loss: 0.02028762549161911

epoch: 82, batch: 4, loss: 0.03436897322535515

epoch: 82, batch: 5, loss: 0.04996224120259285

epoch: 82, batch: 6, loss: 0.01991921290755272

epoch: 82, batch: 7, loss: 0.02242308296263218

Epoch: 82, Average Loss: 0.04239877802319825

epoch: 83, batch: 0, loss: 0.018737003207206726

epoch: 83, batch: 1, loss: 0.0369175523519516

epoch: 83, batch: 2, loss: 0.08346565067768097

epoch: 83, batch: 3, loss: 0.11054430156946182

epoch: 83, batch: 4, loss: 0.014184355735778809

epoch: 83, batch: 5, loss: 0.01871039904654026

epoch: 83, batch: 6, loss: 0.03678683191537857

epoch: 83, batch: 7, loss: 0.03167629614472389

Epoch: 83, Average Loss: 0.04387779883109033

epoch: 84, batch: 0, loss: 0.1038845106959343

epoch: 84, batch: 1, loss: 0.04197760671377182

epoch: 84, batch: 2, loss: 0.04230671375989914

epoch: 84, batch: 3, loss: 0.005180426873266697

epoch: 84, batch: 4, loss: 0.0358823761343956

epoch: 84, batch: 5, loss: 0.012462344951927662

epoch: 84, batch: 6, loss: 0.0456743948161602

epoch: 84, batch: 7, loss: 0.08429458737373352

Epoch: 84, Average Loss: 0.04645787016488612

epoch: 85, batch: 0, loss: 0.017806027084589005

epoch: 85, batch: 1, loss: 0.02992590330541134

epoch: 85, batch: 2, loss: 0.17262649536132812

epoch: 85, batch: 3, loss: 0.012036265805363655

epoch: 85, batch: 4, loss: 0.03504783287644386

epoch: 85, batch: 5, loss: 0.022808387875556946

epoch: 85, batch: 6, loss: 0.007189313415437937

epoch: 85, batch: 7, loss: 0.03412400186061859

Epoch: 85, Average Loss: 0.04144552844809368

epoch: 86, batch: 0, loss: 0.037301793694496155

epoch: 86, batch: 1, loss: 0.02511155977845192

epoch: 86, batch: 2, loss: 0.015061268582940102

epoch: 86, batch: 3, loss: 0.021986830979585648

epoch: 86, batch: 4, loss: 0.024411190301179886

epoch: 86, batch: 5, loss: 0.17189709842205048

epoch: 86, batch: 6, loss: 0.026221318170428276

epoch: 86, batch: 7, loss: 0.023052774369716644

Epoch: 86, Average Loss: 0.04313047928735614

epoch: 87, batch: 0, loss: 0.018427493050694466

epoch: 87, batch: 1, loss: 0.02618800848722458

epoch: 87, batch: 2, loss: 0.04655657708644867

epoch: 87, batch: 3, loss: 0.02100820280611515

epoch: 87, batch: 4, loss: 0.03507927060127258

epoch: 87, batch: 5, loss: 0.019598109647631645

epoch: 87, batch: 6, loss: 0.10016932338476181

epoch: 87, batch: 7, loss: 0.06907841563224792

Epoch: 87, Average Loss: 0.0420131750870496

epoch: 88, batch: 0, loss: 0.0886189416050911

epoch: 88, batch: 1, loss: 0.061425112187862396

epoch: 88, batch: 2, loss: 0.021903853863477707

epoch: 88, batch: 3, loss: 0.0655084028840065

epoch: 88, batch: 4, loss: 0.024611521512269974

epoch: 88, batch: 5, loss: 0.023843221366405487

epoch: 88, batch: 6, loss: 0.03260029852390289

epoch: 88, batch: 7, loss: 0.009096137247979641

Epoch: 88, Average Loss: 0.04095093614887446

epoch: 89, batch: 0, loss: 0.025193192064762115

epoch: 89, batch: 1, loss: 0.07495149970054626

epoch: 89, batch: 2, loss: 0.004649056121706963

epoch: 89, batch: 3, loss: 0.021938133984804153

epoch: 89, batch: 4, loss: 0.00820019468665123

epoch: 89, batch: 5, loss: 0.045743636786937714

epoch: 89, batch: 6, loss: 0.027466222643852234

epoch: 89, batch: 7, loss: 0.17417334020137787

Epoch: 89, Average Loss: 0.04778940952382982

epoch: 90, batch: 0, loss: 0.01368248462677002

epoch: 90, batch: 1, loss: 0.021260874345898628

epoch: 90, batch: 2, loss: 0.04509303346276283

epoch: 90, batch: 3, loss: 0.006327397655695677

epoch: 90, batch: 4, loss: 0.1156768798828125

epoch: 90, batch: 5, loss: 0.0645151287317276

epoch: 90, batch: 6, loss: 0.02683253586292267

epoch: 90, batch: 7, loss: 0.015406311489641666

Epoch: 90, Average Loss: 0.03859933075727895

epoch: 91, batch: 0, loss: 0.043987877666950226

epoch: 91, batch: 1, loss: 0.07441935688257217

epoch: 91, batch: 2, loss: 0.04676027595996857

epoch: 91, batch: 3, loss: 0.024091780185699463

epoch: 91, batch: 4, loss: 0.012829924002289772

epoch: 91, batch: 5, loss: 0.038651660084724426

epoch: 91, batch: 6, loss: 0.02243088372051716

epoch: 91, batch: 7, loss: 0.08388358354568481

Epoch: 91, Average Loss: 0.043381917756050825

epoch: 92, batch: 0, loss: 0.008769038133323193

epoch: 92, batch: 1, loss: 0.0984409973025322

epoch: 92, batch: 2, loss: 0.014795426279306412

epoch: 92, batch: 3, loss: 0.05317755043506622

epoch: 92, batch: 4, loss: 0.028265759348869324

epoch: 92, batch: 5, loss: 0.0701318234205246

epoch: 92, batch: 6, loss: 0.01925544999539852

epoch: 92, batch: 7, loss: 0.019142108038067818

Epoch: 92, Average Loss: 0.038997269119136035

epoch: 93, batch: 0, loss: 0.05819385126233101

epoch: 93, batch: 1, loss: 0.009036114439368248

epoch: 93, batch: 2, loss: 0.022507857531309128

epoch: 93, batch: 3, loss: 0.013532971031963825

epoch: 93, batch: 4, loss: 0.04536674916744232

epoch: 93, batch: 5, loss: 0.11406328529119492

epoch: 93, batch: 6, loss: 0.021872567012906075

epoch: 93, batch: 7, loss: 0.017387505620718002

Epoch: 93, Average Loss: 0.03774511266965419

epoch: 94, batch: 0, loss: 0.04497621953487396

epoch: 94, batch: 1, loss: 0.012999963015317917

epoch: 94, batch: 2, loss: 0.011697364039719105

epoch: 94, batch: 3, loss: 0.018020600080490112

epoch: 94, batch: 4, loss: 0.0621819943189621

epoch: 94, batch: 5, loss: 0.11203521490097046

epoch: 94, batch: 6, loss: 0.019686557352542877

epoch: 94, batch: 7, loss: 0.011409950442612171

Epoch: 94, Average Loss: 0.03662598296068609

epoch: 95, batch: 0, loss: 0.022420240566134453

epoch: 95, batch: 1, loss: 0.013053902424871922

epoch: 95, batch: 2, loss: 0.02514071948826313

epoch: 95, batch: 3, loss: 0.12125653028488159

epoch: 95, batch: 4, loss: 0.015895022079348564

epoch: 95, batch: 5, loss: 0.02282806858420372

epoch: 95, batch: 6, loss: 0.021829914301633835

epoch: 95, batch: 7, loss: 0.0720512643456459

Epoch: 95, Average Loss: 0.03930945775937289

epoch: 96, batch: 0, loss: 0.04779653251171112

epoch: 96, batch: 1, loss: 0.052081815898418427

epoch: 96, batch: 2, loss: 0.01710422709584236

epoch: 96, batch: 3, loss: 0.015798596665263176

epoch: 96, batch: 4, loss: 0.1061418354511261

epoch: 96, batch: 5, loss: 0.03471583500504494

epoch: 96, batch: 6, loss: 0.014429776929318905

epoch: 96, batch: 7, loss: 0.009786928072571754

Epoch: 96, Average Loss: 0.0372319434536621

epoch: 97, batch: 0, loss: 0.06255816668272018

epoch: 97, batch: 1, loss: 0.026158466935157776

epoch: 97, batch: 2, loss: 0.009771225973963737

epoch: 97, batch: 3, loss: 0.10065776109695435

epoch: 97, batch: 4, loss: 0.01304524578154087

epoch: 97, batch: 5, loss: 0.007322767283767462

epoch: 97, batch: 6, loss: 0.033375583589076996

epoch: 97, batch: 7, loss: 0.03936709091067314

Epoch: 97, Average Loss: 0.036532038531731814

epoch: 98, batch: 0, loss: 0.019621485844254494

epoch: 98, batch: 1, loss: 0.022614801302552223

epoch: 98, batch: 2, loss: 0.02068142220377922

epoch: 98, batch: 3, loss: 0.04260041564702988

epoch: 98, batch: 4, loss: 0.037091195583343506

epoch: 98, batch: 5, loss: 0.02432316355407238

epoch: 98, batch: 6, loss: 0.09186910092830658

epoch: 98, batch: 7, loss: 0.0318962037563324

Epoch: 98, Average Loss: 0.036337223602458835

epoch: 99, batch: 0, loss: 0.011517182923853397

epoch: 99, batch: 1, loss: 0.04341188818216324

epoch: 99, batch: 2, loss: 0.04138576239347458

epoch: 99, batch: 3, loss: 0.025214070454239845

epoch: 99, batch: 4, loss: 0.021940059959888458

epoch: 99, batch: 5, loss: 0.020300501957535744

epoch: 99, batch: 6, loss: 0.09656990319490433

epoch: 99, batch: 7, loss: 0.019505955278873444

Epoch: 99, Average Loss: 0.03498066554311663

Accuracy: 0.914

/home/lkyu/AI-Learning/ionosphere.py:215: DeprecationWarning: Conversion of an array with ndim > 0 to a scalar is deprecated, and will error in future. Ensure you extract a single element from your array before performing this operation. (Deprecated NumPy 1.25.)

print("Predicted: %.3f (class=%d)" % (yhat, yhat.round()))

Predicted: 1.000 (class=1)