Part I

1.
$$y = -3x + 4$$

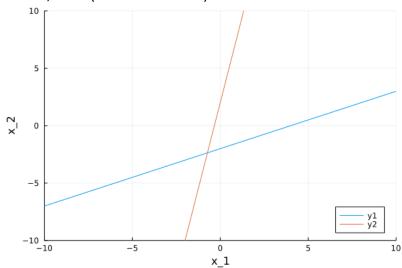
a.
$$\rightarrow y + 3x = 4 \rightarrow \boldsymbol{a} = \begin{pmatrix} 1 \\ 3 \end{pmatrix} \rightarrow \boldsymbol{a} \cdot \boldsymbol{x} = b \rightarrow \frac{1}{\left\| \begin{pmatrix} 1 \\ 3 \end{pmatrix} \right\|} \begin{pmatrix} 1 \\ 3 \end{pmatrix} \cdot \boldsymbol{x} = \frac{4}{\left\| \begin{pmatrix} 1 \\ 3 \end{pmatrix} \right\|} \rightarrow$$
Unit vector normal $= \begin{pmatrix} \frac{1}{\sqrt{10}} \\ \frac{3}{\sqrt{10}} \end{pmatrix} \approx \begin{pmatrix} 0.316 \\ 0.949 \end{pmatrix}$

b.
$$\frac{4}{\sqrt{10}} \approx 1.265$$

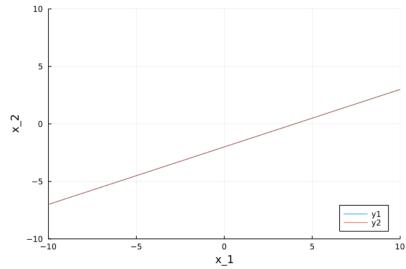
c.
$$\left(\frac{6}{5}, \frac{2}{5}\right)$$

2.

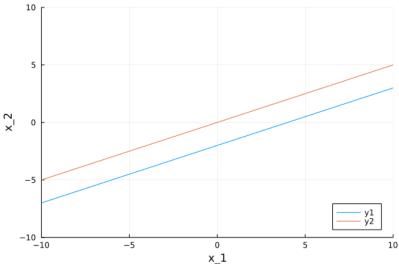
a.
$$a = 0.5$$
, $b = 1$ (infinite solutions)



b.
$$a = 6$$
, $b = -12$ (only solution)



c. a = 6, b = 0 (a must equal 6 and b cannot equal -12)



Part II

```
1. load('HW5_data.mat');
2. T1 = table2array(training_lines)';
   -1 -1]';
   % 1 : IDC
   % -1 : DC
   M = fitcsvm(T1,I_DC)
     ClassificationSVM
               ResponseName: 'Y'
       CategoricalPredictors: []
             ClassNames: [-1 1]
ScoreTransform: 'none'
            NumObservations: 28
                     Alpha: [26×1 double]
                     Bias: -0.0392
           KernelParameters: [1×1 struct]
             BoxConstraints: [28×1 double]
            ConvergenceInfo: [1×1 struct]
            IsSupportVector: [28×1 logical]
Solver: 'SMO'
3. xval4 = crossval(M, 'Kfold',4)
   kfoldLoss(xval4)
   xval28 = crossval(M,'Kfold',28)
   kfoldLoss(xval28)
```

```
Properties, Methods
xval4 =
  ClassificationPartitionedModel
    CrossValidatedModel: 'SVM'
         PredictorNames: {1×8750 cell}
          ResponseName: 'Y'
        NumObservations: 28
                 KFold: 4
              Partition: [1×1 cvpartition]
             ClassNames: [-1 1]
         ScoreTransform: 'none'
  Properties, Methods
ans = 0.2500
xva128 =
  ClassificationPartitionedModel
    CrossValidatedModel: 'SVM'
         PredictorNames: {1×8750 cell}
           ResponseName: 'Y'
        NumObservations: 28
                  KFold: 28
              Partition: [1×1 cvpartition]
             ClassNames: [-1 1]
         ScoreTransform: 'none'
  Properties, Methods
ans = 0.2143
              ans = 0.2500
                                                  ans = 0.2143
```

```
ans = 0.2143

ans = 0.2143
```

- 4. 4-fold repeats: ans = 0.2500 Leave-one-out repeats: ans = 0.2143
 - a. Accuracy changes depending on the method because when the number of groups, k, is smaller than the number of datapoints, there is stochasticity in the validation.

```
5. P = table2array(patient_samples)';
   TestResults = predict(M,P)
```

Patients 1 and 2 are predicted to have regular DC, and Patient 3 is predicted to have IDC.

```
TestResults = 3×1
-1
-1
1
```