In [8]:
```
# -*- coding: utf-8 -*-
"""
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"""

import numpy as np
from requiredFunctions.train_Perceptron import PerceptronClassifier
from requiredFunctions.gaussX import gaussX
import matplotlib as mpl
import matplotlib.pyplot as plt
import matplotlib.ticker as mtick

height = 10
width = 10

mpl.rcParams['figure.figsize'] = (width, height)
mpl.rcParams['font.size'] = 20
mpl.rcParams['figure.titlesize'] = 'small'
mpl.rcParams['legend.fontsize'] = 'small'
mpl.rcParams['xtick.major.size'] = 12
mpl.rcParams['xtick.minor.size'] = 8
mpl.rcParams['xtick.labelsize'] = 18
mpl.rcParams['ytick.major.size'] = 12
mpl.rcParams['ytick.minor.size'] = 8
mpl.rcParams['ytick.labelsize'] = 18

N = 500
trials = 30
max_epochs=100

trial_acc = np.zeros((trials,max_epochs))
trial_cost = np.zeros((trials,max_epochs))
for i in range(trials):
    data = gaussX(N, 0.5, seed=0)
    x_train, y_train = data[:,:2], data[:,2]
    perceptron = PerceptronClassifier()
    perceptron.fit_Batch(x_train, y_train, threshold=0, max_epochs=max_epochs)
    trial_acc[i,:] = perceptron.accuracy_log
    trial_cost[i,:] = perceptron.cost_log

# Find average iteration error and plot
acc_avg = trial_acc.mean(axis=0)
cost_avg = trial_cost.mean(axis=0)

# Predict for the data points and assign indeces of what's right and wrong
y_pred = perceptron.predict(x_train)
y_right = np.where(y_pred == y_train)[0]
y_wrong = np.where(y_pred != y_train)[0]
last_one = np.where(y_train == -1)[0][-1]
blue_ind = y_right[np.where(y_right<=last_one)]
green_ind = y_right[np.where(y_right>last_one)]
```

In [9]:
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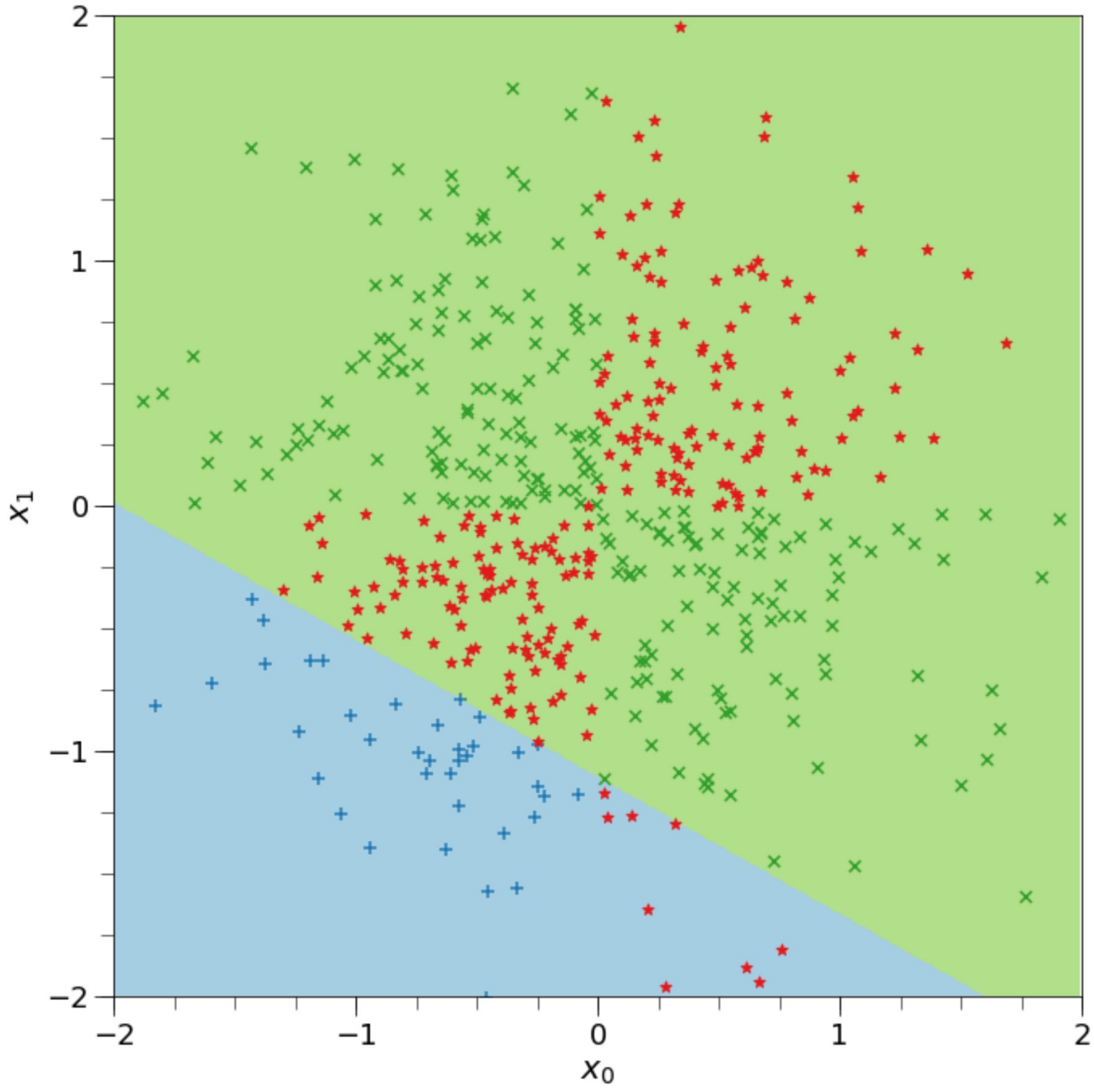
# Make mesh for decision regions and predict for the points within
x0_min, x0_max = -2, 2
x1_min, x1_max = -2, 2
xx0, xx1 = np.meshgrid(np.arange(x0_min, x0_max, 0.01),
                       np.arange(x1_min, x1_max, 0.01))
cc = perceptron.predict(np.c_[xx0.ravel(), xx1.ravel()]).reshape(xx0.shape)

# Plotting of decision regions and data points
cmap = plt.get_cmap('Paired')
cmap_scatter = mpl.colors.ListedColormap(cmap((1, 3, 5)))
cmap_contour = mpl.colors.ListedColormap(cmap((0, 2)))
fig, ax = plt.subplots()
ax.contourf(xx0, xx1, cc, cmap=cmap_contour)
ax.scatter(x_train[:,0][blue_ind], x_train[:,1][blue_ind], 50,
              c=[cmap_scatter(0)], marker='+')
ax.scatter(x_train[:,0][green_ind], x_train[:,1][green_ind], 50,
              c=[cmap_scatter(1)], marker='x')
ax.scatter(x_train[:,0][y_wrong], x_train[:,1][y_wrong], 50,
              c=[cmap_scatter(2)], marker='*')
ax.set_xlim(-2, 2)
ax.set_ylim(-2, 2)
ax.xaxis.set_major_locator(mtick.MultipleLocator(1))
ax.xaxis.set_minor_locator(mtick.MultipleLocator(0.25))
ax.yaxis.set_major_locator(mtick.MultipleLocator(1))
ax.yaxis.set_minor_locator(mtick.MultipleLocator(0.25))
ax.set_xlabel(r'$x_0$')
ax.set_ylabel(r'$x_1$')
fig.tight_layout()
#plt.savefig('../prob3e.eps', dpi=500)
```

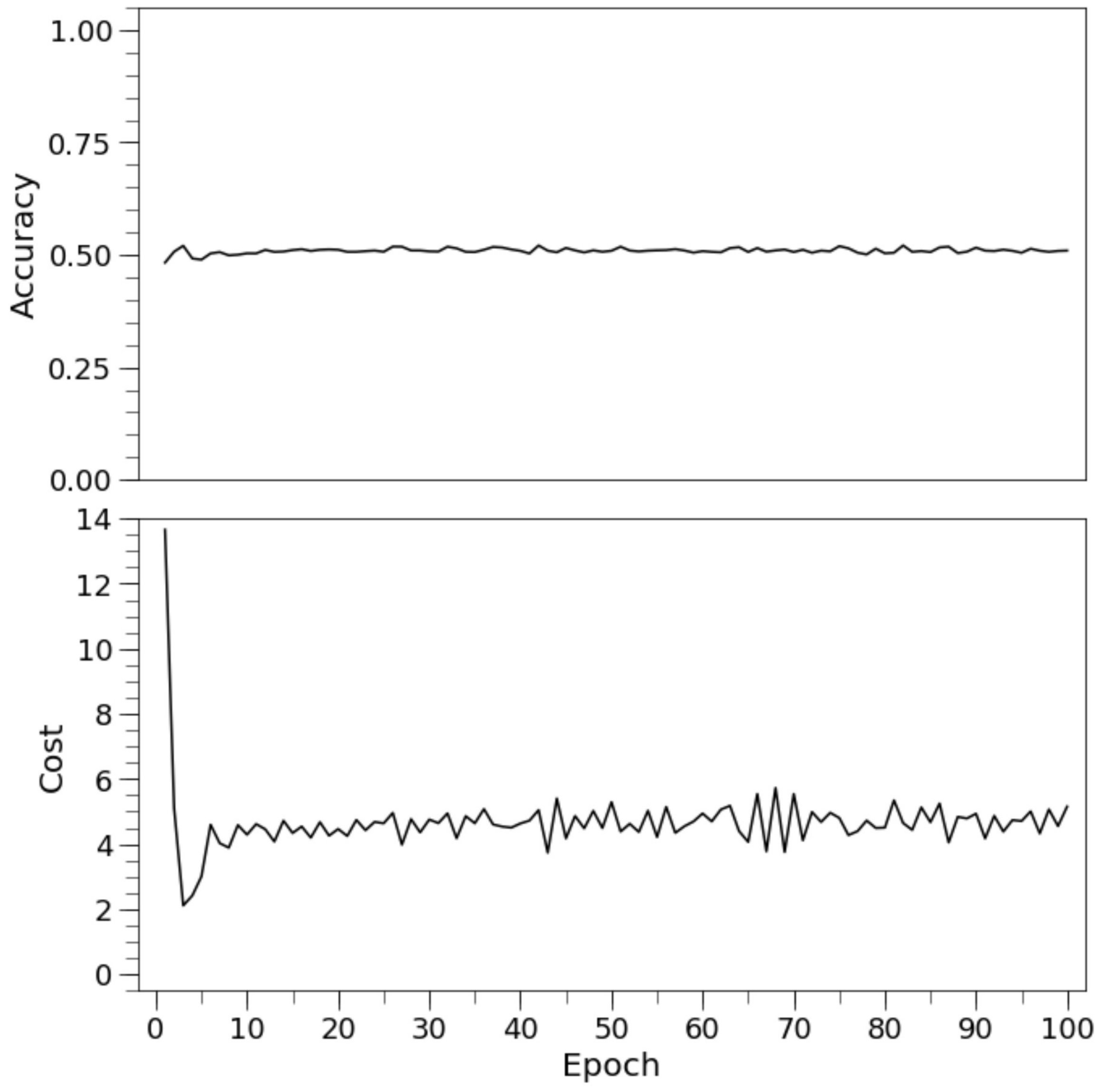


2
1
0
−1
−2
x_1
−2
−1
0
1
2
x_0

In [10]:
```
epoch_grid = np.arange(1, 100+1, 1)

fig, ax = plt.subplots(nrows=2, sharex=True)
ax[0].plot(epoch_grid, acc_avg, color='black')
ax[0].set_xlim(-2, 102)
ax[0].set_ylim(0, 1.05)
ax[0].tick_params(axis='x', which='both', bottom=False)
ax[0].yaxis.set_major_locator(mtick.MultipleLocator(0.25))
ax[0].yaxis.set_minor_locator(mtick.MultipleLocator(0.05))
ax[0].set_ylabel('Accuracy')

ax[1].plot(epoch_grid, cost_avg, color='black')
ax[1].set_xlim(-2, 102)
ax[1].set_ylim(-0.5, np.ceil(cost_avg.max()))
ax[1].xaxis.set_major_locator(mtick.MultipleLocator(10))
ax[1].xaxis.set_minor_locator(mtick.MultipleLocator(5))
ax[1].yaxis.set_major_locator(mtick.MultipleLocator(2))
ax[1].yaxis.set_minor_locator(mtick.MultipleLocator(0.5))
ax[1].set_xlabel('Epoch')
ax[1].set_ylabel('Cost')
fig.tight_layout(h_pad=0)
#plt.savefig('../prob3f.eps', dpi=500)
```


Accuracy
Cost
Epoch