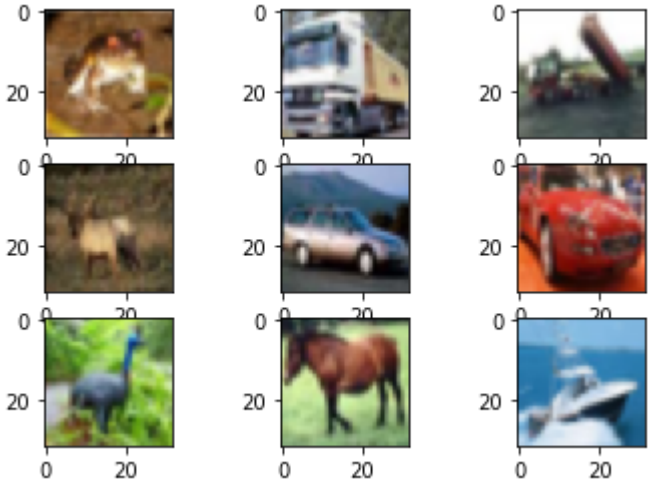
In [14]:
```
import sys
from matplotlib import pyplot
from keras.datasets import cifar10
from keras.utils import to_categorical
from keras.models import Sequential
from keras.layers import Conv2D
from keras.layers import MaxPooling2D
from keras.layers import Dense
from keras.layers import Flatten
from keras.optimizers import SGD
```

In [1]:
```
# example of loading the cifar10 dataset
from matplotlib import pyplot
from keras.datasets import cifar10
# load dataset
(trainX, trainy), (testX, testy) = cifar10.load_data()
# summarize loaded dataset
print('Train: X=%s, y=%s' % (trainX.shape, trainy.shape))
print('Test: X=%s, y=%s' % (testX.shape, testy.shape))
# plot first few images
for i in range(9):
 # define subplot
 pyplot.subplot(330 + 1 + i)
 # plot raw pixel data
 pyplot.imshow(trainX[i])
# show the figure
pyplot.show()
```

```
Downloading data from https://www.cs.toronto.edu/~kriz/cifar-10-python.tar.gz
170498071/170498071 [==============================] - 102s 1us/step
Train: X=(50000, 32, 32, 3), y=(50000, 1)
Test: X=(10000, 32, 32, 3), y=(10000, 1)
```



In [6]:
```
# load train and test dataset
def load_dataset():
 # load dataset
 (trainX, trainY), (testX, testY) = cifar10.load_data()
 # one hot encode target values
 trainY = to_categorical(trainY)
```

```
 testY = to_categorical(testY)
 return trainX, trainY, testX, testY
```

In [7]:

```
# scale pixels
def prep_pixels(train, test):
 # convert from integers to floats
 train_norm = train.astype('float32')
 test_norm = test.astype('float32')
 # normalize to range 0-1
 train_norm = train_norm / 255.0
 test_norm = test_norm / 255.0
 # return normalized images
 return train_norm, test_norm
```

In [18]:

```
# define cnn model
def define_model():
 model = Sequential()
 model.add(Conv2D(32, (3, 3), activation='relu', kernel_initializer='he_uniform', paddi
 model.add(Conv2D(32, (3, 3), activation='relu', kernel_initializer='he_uniform', paddi
 model.add(MaxPooling2D((2, 2)))
 model.add(Flatten())
 model.add(Dense(128, activation='relu', kernel_initializer='he_uniform'))
 model.add(Dense(10, activation='softmax'))
 # compile model
 opt = SGD(lr=0.001, momentum=0.9)
 model.compile(optimizer=opt, loss='categorical_crossentropy', metrics=['accuracy'])
 return model
```

In [22]:

```
# plot diagnostic learning curves
def summarize_diagnostics(history):
 # plot loss
 pyplot.subplot(211)
 pyplot.title('Cross Entropy Loss')
 pyplot.plot(history.history['loss'], color='blue', label='train')
 pyplot.plot(history.history['val_loss'], color='orange', label='test')
 # plot accuracy
 pyplot.subplot(212)
 pyplot.title('Classification Accuracy')
 pyplot.plot(history.history['accuracy'], color='blue', label='train')
 pyplot.plot(history.history['val_accuracy'], color='orange', label='test')
 # save plot to file
 filename = sys.argv[0].split('/')[-1]
 pyplot.savefig(filename + '_plot.png')
 pyplot.close()
```

In [20]:

```
# run the test harness for evaluating a model
def run_test_harness():
 # load dataset
 trainX, trainY, testX, testY = load_dataset()
 # prepare pixel data
 trainX, testX = prep_pixels(trainX, testX)
 # define model
 model = define_model()
 # fit model
```

```
    history = model.fit(trainX, trainY, epochs=100, batch_size=64, validation_data=(testX,
    # evaluate model
    _, acc = model.evaluate(testX, testY, verbose=0)
    print('> %.3f' % (acc * 100.0))
    # learning curves
    summarize_diagnostics(history)

# entry point, run the test harness
run_test_harness()
```

```
C:\ProgramData\Anaconda3\lib\site-packages\keras\optimizers\optimizer_v2\gradient_descen
t.py:108: UserWarning: The `lr` argument is deprecated, use `learning_rate` instead.
  super(SGD, self).__init__(name, **kwargs)
> 67.000
```

In [ ]: