Kurs Adı: Görüntü İşleme

Kurs Grubu: Grup 1

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Öğrenci Adı ve Soyadı: Arda Kaşıkçı

Öğrenci Numarası: 18011092

Video Linki: https://youtu.be/80_bfRwVoco

Yöntem

Verilen problemde bizden verilen veri seti üzerinde obje tespiti yapan bir konvolüsyonel sinir ağı kurmamız istenmiştir. Bu sorunun çözümü için sırasıyla gerçekleşen işlemler şu şekildedir;

- Keras.datasets kütüphanesi içinden cifar.load_data() ile train ve test seti alınmıştır.
- Dokümandan istendiği üzere train_test_split kullanılarak, train-validation setleri %80-%20 olarak ayrılmıştır.
- Veri setinde sınıflar numaralandırılmış haldeydi, bu durum sinir ağlarında ağırlıklandırma aşamasında hatalı sonuçlar vereceğinden dolayı, to_categorical fonksiyonu ile one hot encoding yöntemiyle sınıflar binary hale getirilmiştir.
- Sırasıyla:
  Model-1-3 CONV, 32 FİLTRE, 3X3 KERNEL
  Model2-3 CONV, 32 FİLTRE, 5X5 KERNEL
  Model3-3 CONV, 64 FİLTRE, 3X3 KERNEL
  Model4-3 CONV, 64 FİLTRE, 5X5 KERNEL
  Model5-5 CONV, 64 FİLTRE, 3X3 KERNEL
  Model6-5 CONV, 32 FİLTRE, 3X3 KERNEL
  Model7-5 CONV, 32 FİLTRE, 5X5 KERNEL
  Model8-5 CONV, 64 FİLTRE, 5X5 KERNEL denenmiştir. Tüm modeller kurulurken doğrulama başarısı-eğitim başarısı arasındaki denge kontrol edilerek ezberlemenin önüne geçilmeye çalışılmıştır. Ezberlemenin önüne geçebilmek için 2 katmanda bir değerleri artacak şekilde dropout katmanları eklenmiştir. Her model ardından evaluate fonksiyonu ile test seti başarısı çıkarılmıştır.

- Model başarıları kıyaslandığında en başarılı model:
  Model6-5 CONV, 32 FİLTRE, 3X3 KERNEL olarak belirlenmiştir. Test sonucu:

  ```
  Test değerlendirmesi 313/313 [==============================] - 1s
  4ms/step - loss: 0.8376 - accuracy: 0.7204
  Test Loss - Test Accuracy: [0.8375741243362427, 0.7203999757766724]
  ```

  olarak alınmıştır.

- Model-6 eğitim parametreleri şu şekildedir:

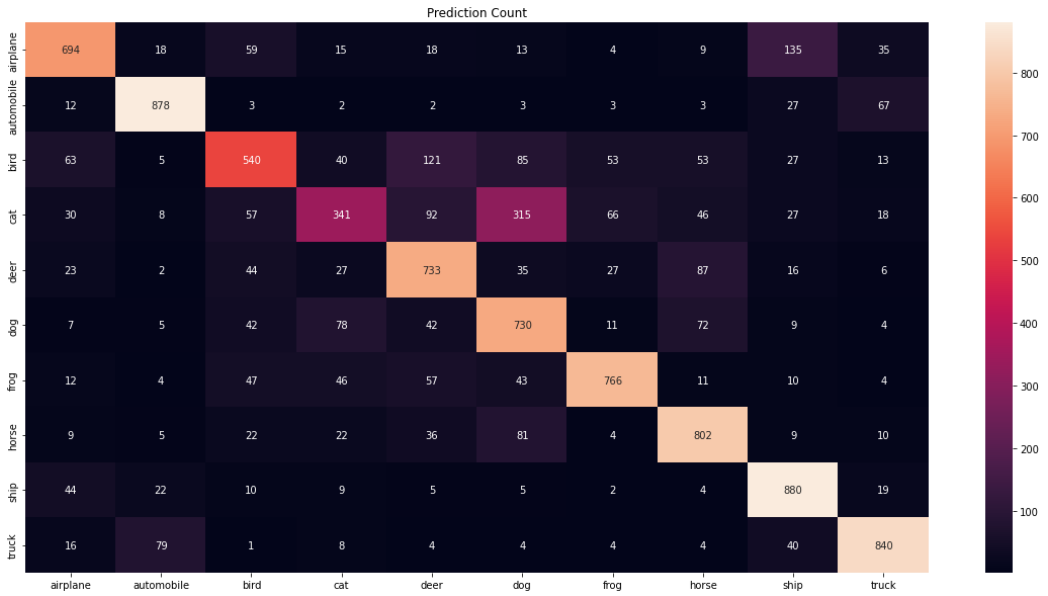
```
model6.fit(X_train, y_train, epochs = 50, batch_size=64 ,
verbose=1,validation_data=(X_val , y_val))
```

- Model 6 için yapay sinir ağ modeli şu şekildedir:

```
#Model kurulması
#Model ezberlemeye yatkınlığından dropout sayısı arttırıldı.
model6 = Sequential()
model6.add(Conv2D(32,(3,3),input_shape = (32,32,3),activation='relu'))
model6.add(Conv2D(32,(3,3),activation='relu'))
model6.add(Dropout(0.20))
model6.add(Conv2D(32,(3,3),activation='relu'))
model6.add(Conv2D(32,(3,3),activation='relu'))
model6.add(Dropout(0.30))
model6.add(Conv2D(32,(3,3),activation='relu'))
model6.add(MaxPooling2D(pool_size = (2,2)))
model6.add(Dropout(0.40))
model6.add(Flatten())
model6.add(Dense(128, activation ='relu'))
model6.add(Dropout(0.30))
model6.add(Dense(10, activation ='softmax'))
model6.compile(loss ='categorical_crossentropy', optimizer ='adam',
metrics =['accuracy'])

#Model Sonucu
model6.summary()
```

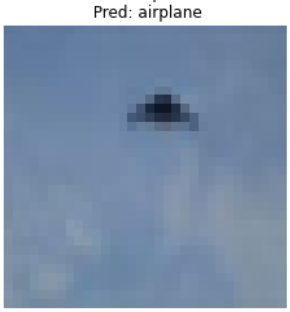
- Model 6 için tahmin ve test sonuçları üzerinden çıkarılan confusion matrix şu şekildedir:



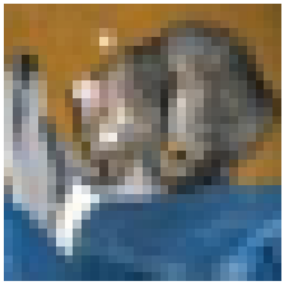
- Model 6 için bu bilgiler çıkarıldıktan sonra test seti içinden rastgele her sınıftan 3 adet olmak üzere 30 adet resim seçilmiştir. Bu işlem test seti içinden 100er 100er atlanıp her sınıf için 3 örnek toplanana kadar devam edicek şekilde yazılmıştır. Bu resimler için tahmin sonuçları, yüzdeleri ve confusion matrix çıktıları uygulama bölümünde sunulacaktır.

Uygulama

A)

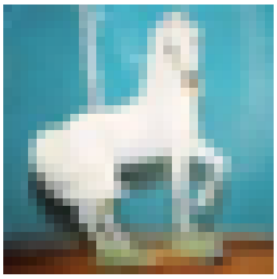
True: airplane Pred: bird 	Predicted as : airplane with probabilty: 0.443957 Predicted as : automobile with probabilty: 0.000109 Predicted as : bird with probabilty: 0.500233 Predicted as : cat with probabilty: 0.001612 Predicted as : deer with probabilty: 0.010770 Predicted as : dog with probabilty: 0.000511 Predicted as : frog with probabilty: 0.009047 Predicted as : horse with probabilty: 0.000062 Predicted as : ship with probabilty: 0.033631 Predicted as : truck with probabilty: 0.000068
True: airplane Pred: airplane 	Predicted as : airplane with probabilty: 0.990003 Predicted as : automobile with probabilty: 0.000006 Predicted as : bird with probabilty: 0.006392 Predicted as : cat with probabilty: 0.000042 Predicted as : deer with probabilty: 0.000145 Predicted as : dog with probabilty: 0.000049 Predicted as : frog with probabilty: 0.000005 Predicted as : horse with probabilty: 0.000004s Predicted as : ship with probabilty: 0.003352 Predicted as : truck with probabilty: 0.000001
True: airplane Pred: airplane 	Predicted as : airplane with probabilty: 0.838206 Predicted as : automobile with probabilty: 0.001999 Predicted as : bird with probabilty: 0.102348 Predicted as : cat with probabilty: 0.001278 Predicted as : deer with probabilty: 0.001015 Predicted as : dog with probabilty: 0.000526 Predicted as : frog with probabilty: 0.000304 Predicted as : horse with probabilty: 0.000053 Predicted as : ship with probabilty: 0.054162 Predicted as : truck with probabilty: 0.000111
True: automobile Pred: automobile 	Predicted as : airplane with probabilty: 0.001596 Predicted as : automobile with probabilty: 0.837230 Predicted as : bird with probabilty: 0.000000 Predicted as : cat with probabilty: 0.000001 Predicted as : deer with probabilty: 0.000000 Predicted as : dog with probabilty: 0.000000 Predicted as : frog with probabilty: 0.000000 Predicted as : horse with probabilty: 0.000000 Predicted as : ship with probabilty: 0.004538 Predicted as : truck with probabilty: 0.156634

True: automobile Pred: automobile 	Predicted as : airplane with probabilty: 0.000006 Predicted as : automobile with probabilty: 0.929628 Predicted as : bird with probabilty: 0.000126 Predicted as : cat with probabilty: 0.000352 Predicted as : deer with probabilty: 0.000021 Predicted as : dog with probabilty: 0.000195 Predicted as : frog with probabilty: 0.065229 Predicted as : horse with probabilty: 0.000004 Predicted as : ship with probabilty: 0.001694 Predicted as : truck with probabilty: 0.002745
True: automobile Pred: automobile 	Predicted as : airplane with probabilty: 0.006991 Predicted as : automobile with probabilty: 0.551217 Predicted as : bird with probabilty: 0.000000 Predicted as : cat with probabilty: 0.000004 Predicted as : deer with probabilty: 0.000000 Predicted as : dog with probabilty: 0.000000 Predicted as : frog with probabilty: 0.000001 Predicted as : horse with probabilty: 0.000000 Predicted as : ship with probabilty: 0.005246 Predicted as : truck with probabilty: 0.436541
True: bird Pred: dog 	Predicted as : airplane with probabilty: 0.002829 Predicted as : automobile with probabilty: 0.001485 Predicted as : bird with probabilty: 0.165725 Predicted as : cat with probabilty: 0.141330 Predicted as : deer with probabilty: 0.132208 Predicted as : dog with probabilty: 0.379128 Predicted as : frog with probabilty: 0.074283 Predicted as : horse with probabilty: 0.100105 Predicted as : ship with probabilty: 0.000534 Predicted as : truck with probabilty: 0.002373
True: bird Pred: bird 	Predicted as : airplane with probabilty: 0.007854 Predicted as : automobile with probabilty: 0.000232 Predicted as : bird with probabilty: 0.828784 Predicted as : cat with probabilty: 0.051460 Predicted as : deer with probabilty: 0.034761 Predicted as : dog with probabilty: 0.016580 Predicted as : frog with probabilty: 0.043769 Predicted as : horse with probabilty: 0.013391 Predicted as : ship with probabilty: 0.002967 Predicted as : truck with probabilty: 0.000203

True: bird Pred: deer 	Predicted as : airplane with probabilty: 0.000406 Predicted as : automobile with probabilty: 0.000011 Predicted as : bird with probabilty: 0.213411 Predicted as : cat with probabilty: 0.016728 Predicted as : deer with probabilty: 0.338851 Predicted as : dog with probabilty: 0.050153 Predicted as : frog with probabilty: 0.044987 Predicted as : horse with probabilty: 0.335440 Predicted as : ship with probabilty: 0.000001 Predicted as : truck with probabilty: 0.000011
True: cat Pred: cat 	Predicted as : airplane with probabilty: 0.005708 Predicted as : automobile with probabilty: 0.001055 Predicted as : bird with probabilty: 0.080659 Predicted as : cat with probabilty: 0.557422 Predicted as : deer with probabilty: 0.094648 Predicted as : dog with probabilty: 0.110215 Predicted as : frog with probabilty: 0.042258 Predicted as : horse with probabilty: 0.021748 Predicted as : ship with probabilty: 0.076738 Predicted as : truck with probabilty: 0.009549
True: cat Pred: deer 	Predicted as : airplane with probabilty: 0.073495 Predicted as : automobile with probabilty: 0.007686 Predicted as : bird with probabilty: 0.130638 Predicted as : cat with probabilty: 0.073446 Predicted as : deer with probabilty: 0.259162 Predicted as : dog with probabilty: 0.143699 Predicted as : frog with probabilty: 0.011453 Predicted as : horse with probabilty: 0.207504 Predicted as : ship with probabilty: 0.082677 Predicted as : truck with probabilty: 0.010238
True: cat Pred: deer 	Predicted as : airplane with probabilty: 0.002580 Predicted as : automobile with probabilty: 0.004227 Predicted as : bird with probabilty: 0.095187 Predicted as : cat with probabilty: 0.126050 Predicted as : deer with probabilty: 0.263956 Predicted as : dog with probabilty: 0.220944 Predicted as : frog with probabilty: 0.020664 Predicted as : horse with probabilty: 0.243584 Predicted as : ship with probabilty: 0.002388 Predicted as : truck with probabilty: 0.020419

True: deer Pred: deer 	Predicted as : airplane with probabilty: 0.000243 Predicted as : automobile with probabilty: 0.000000 Predicted as : bird with probabilty: 0.024499 Predicted as : cat with probabilty: 0.001256 Predicted as : deer with probabilty: 0.547770 Predicted as : dog with probabilty: 0.032990 Predicted as : frog with probabilty: 0.000025 Predicted as : horse with probabilty: 0.393215 Predicted as : ship with probabilty: 0.000001 Predicted as : truck with probabilty: 0.000001
True: deer Pred: deer 	Predicted as : airplane with probabilty: 0.000288 Predicted as : automobile with probabilty: 0.000007 Predicted as : bird with probabilty: 0.056474 Predicted as : cat with probabilty: 0.016028 Predicted as : deer with probabilty: 0.851943 Predicted as : dog with probabilty: 0.026209 Predicted as : frog with probabilty: 0.004926 Predicted as : horse with probabilty: 0.043878 Predicted as : ship with probabilty: 0.000029 Predicted as : truck with probabilty: 0.000219
True: deer Pred: deer 	Predicted as : airplane with probabilty: 0.000009 Predicted as : automobile with probabilty: 0.000001 Predicted as : bird with probabilty: 0.054750 Predicted as : cat with probabilty: 0.035232 Predicted as : deer with probabilty: 0.867876 Predicted as : dog with probabilty: 0.019260 Predicted as : frog with probabilty: 0.019255 Predicted as : horse with probabilty: 0.003607 Predicted as : ship with probabilty: 0.000000 Predicted as : truck with probabilty: 0.000009
True: dog Pred: dog 	Predicted as : airplane with probabilty: 0.000050 Predicted as : automobile with probabilty: 0.000013 Predicted as : bird with probabilty: 0.033500 Predicted as : cat with probabilty: 0.185447 Predicted as : deer with probabilty: 0.007233 Predicted as : dog with probabilty: 0.751642 Predicted as : frog with probabilty: 0.002050 Predicted as : horse with probabilty: 0.020007 Predicted as : ship with probabilty: 0.000014 Predicted as : truck with probabilty: 0.000044

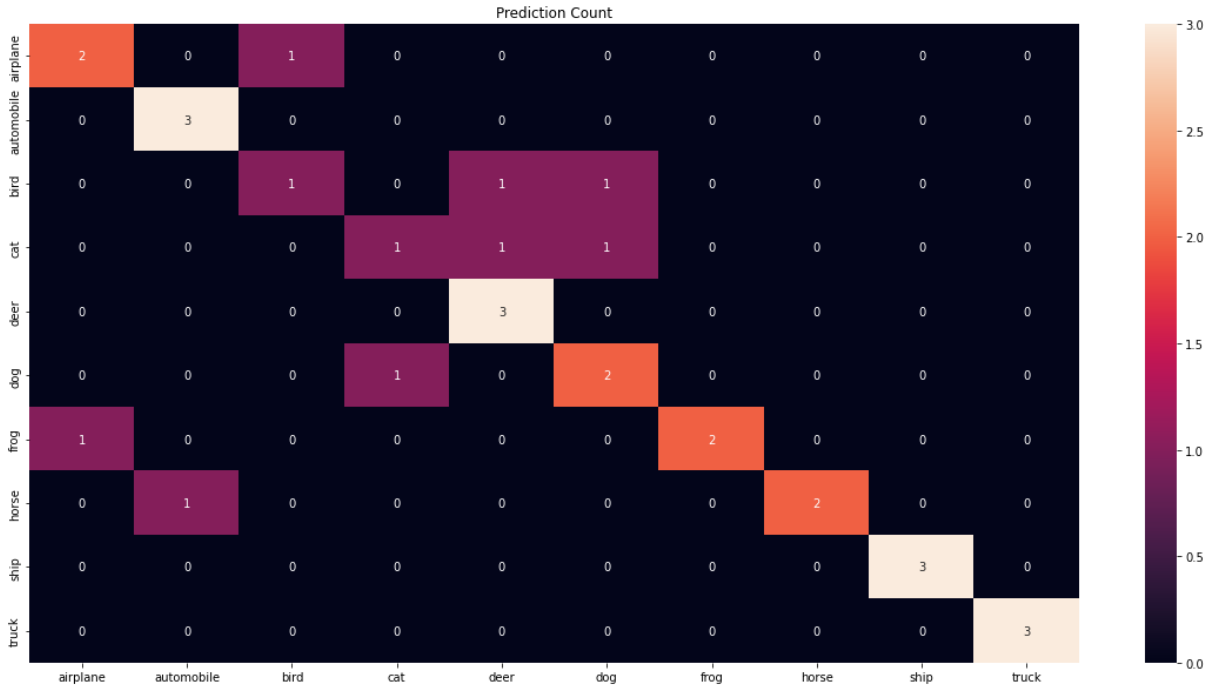
True: dog Pred: dog 	Predicted as : airplane with probabilty: 0.000002 Predicted as : automobile with probabilty: 0.000000 Predicted as : bird with probabilty: 0.018246 Predicted as : cat with probabilty: 0.026775 Predicted as : deer with probabilty: 0.002244 Predicted as : dog with probabilty: 0.942614 Predicted as : frog with probabilty: 0.000579 Predicted as : horse with probabilty: 0.009526 Predicted as : ship with probabilty: 0.000001 Predicted as : truck with probabilty: 0.000013
True: dog Pred: cat 	Predicted as : airplane with probabilty: 0.002726 Predicted as : automobile with probabilty: 0.000036 Predicted as : bird with probabilty: 0.087391 Predicted as : cat with probabilty: 0.476808 Predicted as : deer with probabilty: 0.003369 Predicted as : dog with probabilty: 0.316583 Predicted as : frog with probabilty: 0.105546 Predicted as : horse with probabilty: 0.002310 Predicted as : ship with probabilty: 0.004627 Predicted as : truck with probabilty: 0.000602
True: frog Pred: frog 	Predicted as : airplane with probabilty: 0.000001 Predicted as : automobile with probabilty: 0.000005 Predicted as : bird with probabilty: 0.000856 Predicted as : cat with probabilty: 0.001287 Predicted as : deer with probabilty: 0.001456 Predicted as : dog with probabilty: 0.000882 Predicted as : frog with probabilty: 0.995445 Predicted as : horse with probabilty: 0.000009 Predicted as : ship with probabilty: 0.000007 Predicted as : truck with probabilty: 0.000052
True: frog Pred: ship 	Predicted as : airplane with probabilty: 0.124926 Predicted as : automobile with probabilty: 0.214558 Predicted as : bird with probabilty: 0.035877 Predicted as : cat with probabilty: 0.009485 Predicted as : deer with probabilty: 0.006579 Predicted as : dog with probabilty: 0.003128 Predicted as : frog with probabilty: 0.090270 Predicted as : horse with probabilty: 0.000689 Predicted as : ship with probabilty: 0.503943 Predicted as : truck with probabilty: 0.010545

True: frog Pred: frog 	Predicted as : airplane with probabilty: 0.006328 Predicted as : automobile with probabilty: 0.027789 Predicted as : bird with probabilty: 0.014761 Predicted as : cat with probabilty: 0.020201 Predicted as : deer with probabilty: 0.024840 Predicted as : dog with probabilty: 0.025497 Predicted as : frog with probabilty: 0.820733 Predicted as : horse with probabilty: 0.045986 Predicted as : ship with probabilty: 0.005878 Predicted as : truck with probabilty: 0.007988
True: horse Pred: horse 	Predicted as : airplane with probabilty: 0.000000 Predicted as : automobile with probabilty: 0.000000 Predicted as : bird with probabilty: 0.000000 Predicted as : cat with probabilty: 0.000000 Predicted as : deer with probabilty: 0.000045 Predicted as : dog with probabilty: 0.000002 Predicted as : frog with probabilty: 0.000000 Predicted as : horse with probabilty: 0.999953 Predicted as : ship with probabilty: 0.000000 Predicted as : truck with probabilty: 0.000000
True: horse Pred: horse 	Predicted as : airplane with probabilty: 0.000001 Predicted as : automobile with probabilty: 0.000003 Predicted as : bird with probabilty: 0.000037 Predicted as : cat with probabilty: 0.000096 Predicted as : deer with probabilty: 0.000186 Predicted as : dog with probabilty: 0.000485 Predicted as : frog with probabilty: 0.000003 Predicted as : horse with probabilty: 0.999180 Predicted as : ship with probabilty: 0.000004 Predicted as : truck with probabilty: 0.000005
True: horse Pred: automobile 	Predicted as : airplane with probabilty: 0.027308 Predicted as : automobile with probabilty: 0.486473 Predicted as : bird with probabilty: 0.000715 Predicted as : cat with probabilty: 0.000666 Predicted as : deer with probabilty: 0.000695 Predicted as : dog with probabilty: 0.000384 Predicted as : frog with probabilty: 0.000578 Predicted as : horse with probabilty: 0.001418 Predicted as : ship with probabilty: 0.087781 Predicted as : truck with probabilty: 0.393982

True: ship Pred: ship 	Predicted as : airplane with probabilty: 0.000663 Predicted as : automobile with probabilty: 0.000215 Predicted as : bird with probabilty: 0.000001 Predicted as : cat with probabilty: 0.000004 Predicted as : deer with probabilty: 0.000001 Predicted as : dog with probabilty: 0.000000 Predicted as : frog with probabilty: 0.000001 Predicted as : horse with probabilty: 0.000000 Predicted as : ship with probabilty: 0.996408 Predicted as : truck with probabilty: 0.002707
True: ship Pred: ship 	Predicted as : airplane with probabilty: 0.000567 Predicted as : automobile with probabilty: 0.001675 Predicted as : bird with probabilty: 0.000001 Predicted as : cat with probabilty: 0.000002 Predicted as : deer with probabilty: 0.000000 Predicted as : dog with probabilty: 0.000001 Predicted as : frog with probabilty: 0.000001 Predicted as : horse with probabilty: 0.000000 Predicted as : ship with probabilty: 0.997583 Predicted as : truck with probabilty: 0.000170
True: ship Pred: ship 	Predicted as : airplane with probabilty: 0.276295 Predicted as : automobile with probabilty: 0.023579 Predicted as : bird with probabilty: 0.098238 Predicted as : cat with probabilty: 0.056811 Predicted as : deer with probabilty: 0.021525 Predicted as : dog with probabilty: 0.010591 Predicted as : frog with probabilty: 0.016274 Predicted as : horse with probabilty: 0.005430 Predicted as : ship with probabilty: 0.449283 Predicted as : truck with probabilty: 0.041974
True: truck Pred: truck 	Predicted as : airplane with probabilty: 0.010736 Predicted as : automobile with probabilty: 0.026416 Predicted as : bird with probabilty: 0.000057 Predicted as : cat with probabilty: 0.000255 Predicted as : deer with probabilty: 0.000022 Predicted as : dog with probabilty: 0.000028 Predicted as : frog with probabilty: 0.000024 Predicted as : horse with probabilty: 0.000421 Predicted as : ship with probabilty: 0.015480 Predicted as : truck with probabilty: 0.946562

True: truck Pred: truck 	Predicted as : airplane with probabilty: 0.044400 Predicted as : automobile with probabilty: 0.119178 Predicted as : bird with probabilty: 0.001128 Predicted as : cat with probabilty: 0.015286 Predicted as : deer with probabilty: 0.000212 Predicted as : dog with probabilty: 0.002409 Predicted as : frog with probabilty: 0.000567 Predicted as : horse with probabilty: 0.000861 Predicted as : ship with probabilty: 0.034127 Predicted as : truck with probabilty: 0.781832
True: truck Pred: truck 	Predicted as : airplane with probabilty: 0.000163 Predicted as : automobile with probabilty: 0.040327 Predicted as : bird with probabilty: 0.000000 Predicted as : cat with probabilty: 0.000000 Predicted as : deer with probabilty: 0.000000 Predicted as : dog with probabilty: 0.000000 Predicted as : frog with probabilty: 0.000000 Predicted as : horse with probabilty: 0.000000 Predicted as : ship with probabilty: 0.048278 Predicted as : truck with probabilty: 0.911232

B) Test Resimleri İçin Çıkarılan Confusion Matrix



Sonuç

Sonuç olarak, birden fazla model denenmiş ve en başarılı olarak 5 adet conv katmanı bulunan, 32 adet filtre kullanan ve 3x3 kernel kullanan modelin doğruluğu en fazla çıkmıştır. Bu modelde dropout katmanı doğru kullanılmadığında ezberlemeye çok yatkın olduğu görülmüş ve dropout katmanları ile değerleri denenerek en optimize sonuç elde edilmiştir. Modelde 5x5 kernel kullanıldığında görüntü boyutu küçük olduğundan her katman sonucu kenarlardan bilgi kaybı fazla olmaktaydı bu yüzden 3x3 kernel kullanmak daha başarılı sonuç vermiştir. Conv katman sayısı fazlalığı dropout katmanları ile beraber kullanıldığında daha optimize çalıştığı görülmüştür. Batch size parametresi bilgisayar olanakları da göz önünde bulundurularak 64 olarak belirlenmiştir. Bu parametre converge diye adlandırılan kısma daha hızlı eğitim sağlayarak ulaşmamızı sağlar fakat çok yüksek olduğunda başarıya ulaşılan kısmı kaçırmamızı sağlayabilir. Tek dropout katmanı ile ezberleme yüksek olduğundan ara katmanlara birden fazla dropout eklenerek model optimizasyonu sağlanmış ve eğitilmiş model %72 doğruluk ile çalışmıştır.