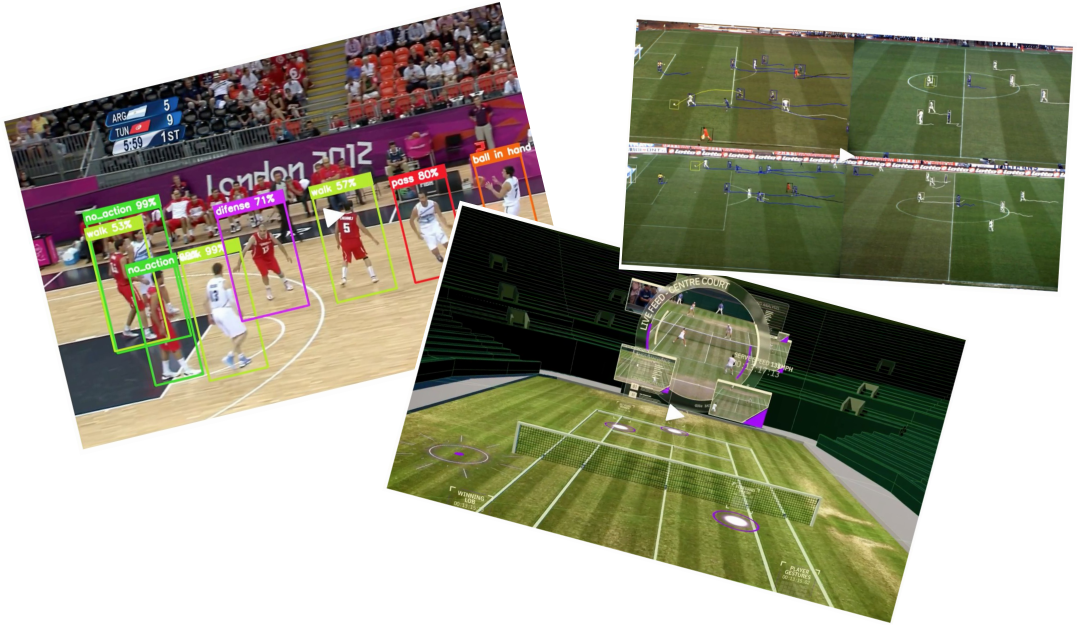
Automated “And-1”

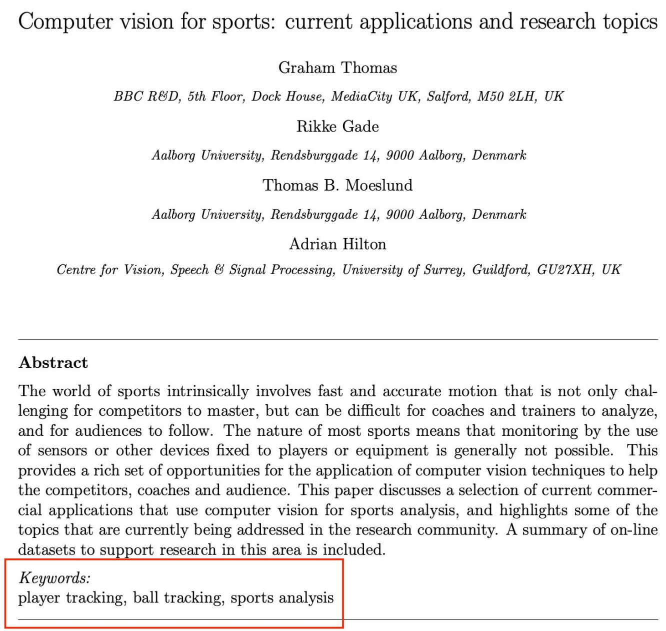
Shvetank Prakash

Deep Learning For Computer Vision
Fall 2020

Background

- ML and CV in Sports
- My Project's Premise/Goal
- Problem Addressed & Use Application





Computer vision for sports: current applications and research topics

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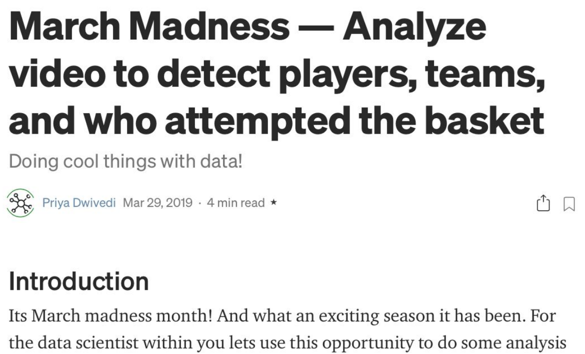
Abstract

The world of sports intrinsically involves fast and accurate motion that is not only challenging for competitors to master, but can be difficult for coaches and trainers to analyze, and for audiences to follow. The nature of most sports means that monitoring by the use of sensors or other devices fixed to players or equipment is generally not possible. This provides a rich set of opportunities for the application of computer vision techniques to help the competitors, coaches and audience. This paper discusses a selection of current commercial applications that use computer vision for sports analysis, and highlights some of the topics that are currently being addressed in the research community. A summary of on-line datasets to support research in this area is included.

Keywords:
player tracking, ball tracking, sports analysis



March Madness — Analyze video to detect players, teams, and who attempted the basket

Doing cool things with data!

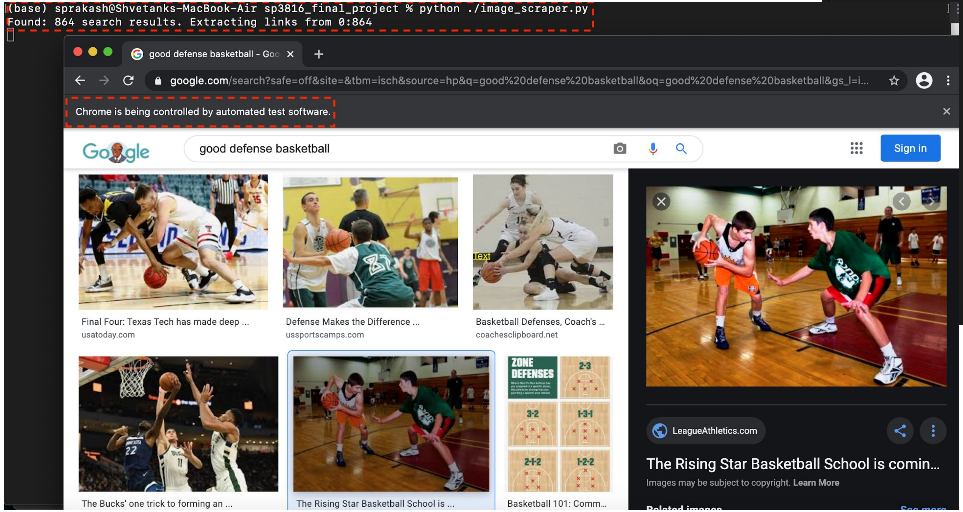
Priya Dwivedi Mar 29, 2019 · 4 min read ★

Introduction

Its March madness month! And what an exciting season it has been. For the data scientist within you lets use this opportunity to do some analysis

Data Collection

- Self curated dataset (2 classes)
- Scraped approx. 10,000 images
- Manually cleaned data
- Left with only 500 images...



```
(base) sprakash@Shvetanks-MacBook-Air sp3816_final_project % python ./image_scraper.py
Found: 864 search results. Extracting links from 0:864
```

good defense basketball - Goo

google.com/search?safe=off&site=&tbm=isch&source=hp&q=good%20defense%20basketball&oq=good%20defense%20basketball&gs_l=i...

Chrome is being controlled by automated test software.

good defense basketball

Final Four: Texas Tech has made deep ...
usatoday.com

Defense Makes the Difference ...
ussportscamps.com

Basketball Defenses, Coach's ...
coachesclipboard.net

The Bucks' one trick to forming an ...

The Rising Star Basketball School is ...

Basketball 101: Comm...

LeagueAthletics.com

The Rising Star Basketball School is comin...

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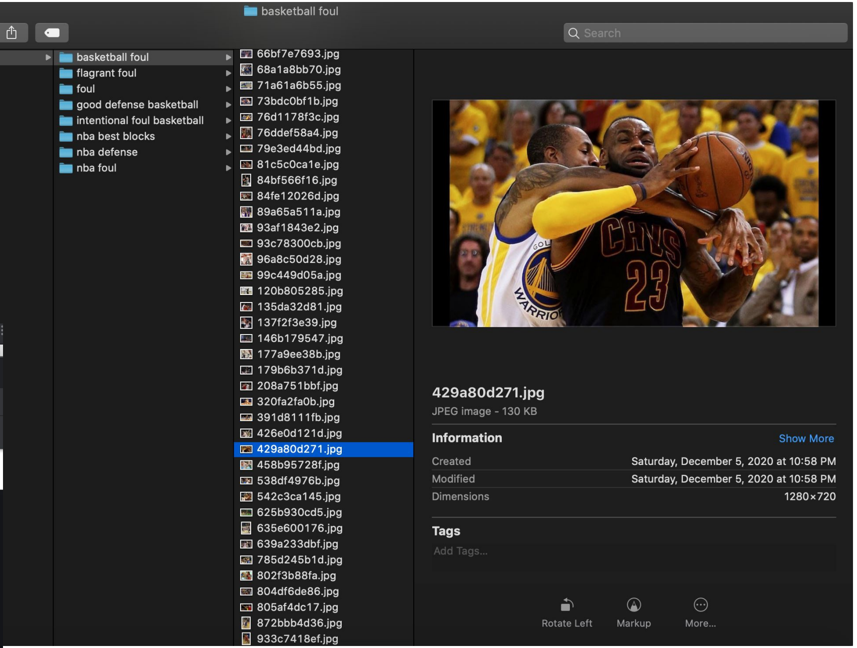

basketball foul

data

- basketball foul
- flagrant foul
- foul
- good defense basketball
- intentional foul basketball
- nba best blocks
- nba defense
- nba foul

66bf7e7693.jpg
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429a80d271.jpg
JPEG image - 130 KB

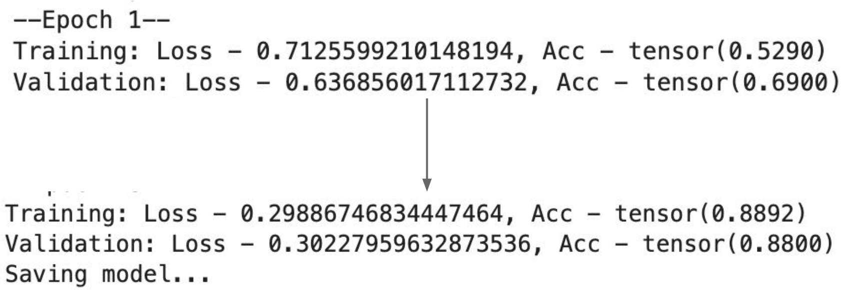
Information

Created Saturday, December 5, 2020 at 10:58 PM
Modified Saturday, December 5, 2020 at 10:58 PM
Dimensions 1280×720

Tags
Add Tags...

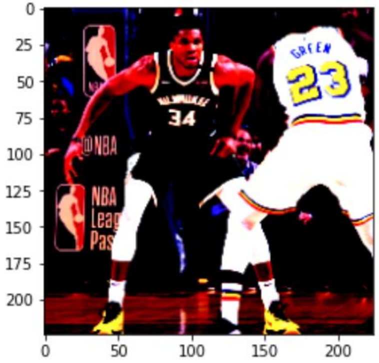
Transfer Learning

- Not original plan
- ResNet18
- Results
  - Loss (Training, Validation, & Test)
  - Accuracy (Training, Validation, & Test)

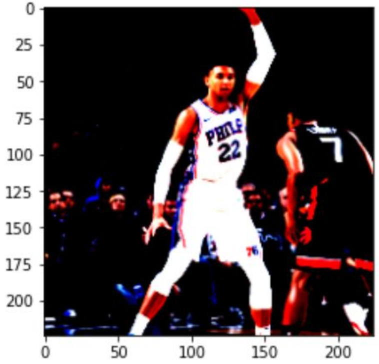


```
--Epoch 1--
Training: Loss - 0.7125599210148194, Acc - tensor(0.5290)
Validation: Loss - 0.636856017112732, Acc - tensor(0.6900)
```

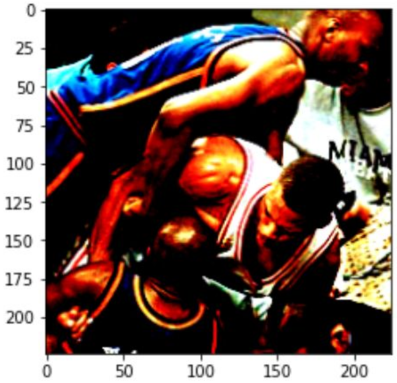
```
Training: Loss - 0.29886746834447464, Acc - tensor(0.8892)
Validation: Loss - 0.30227959632873536, Acc - tensor(0.8800)
Saving model...
```



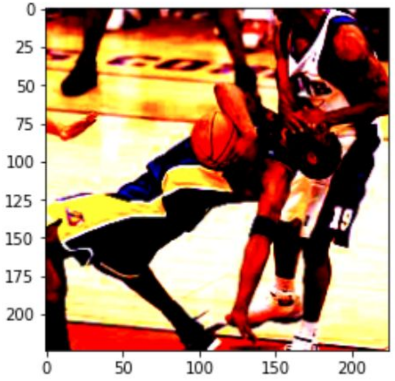
```
Prediction: clean
Label: clean
```



```
Prediction: clean
Label: clean
```



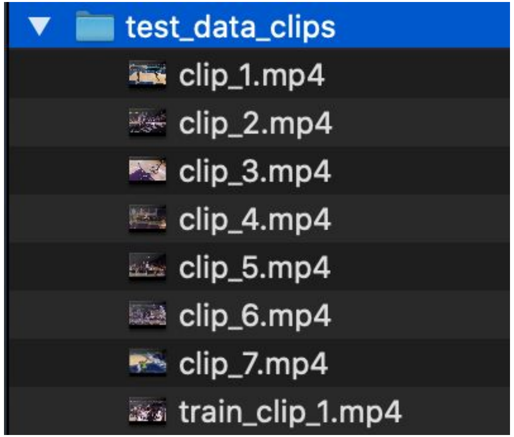
```
Prediction: foul
Label: foul
```



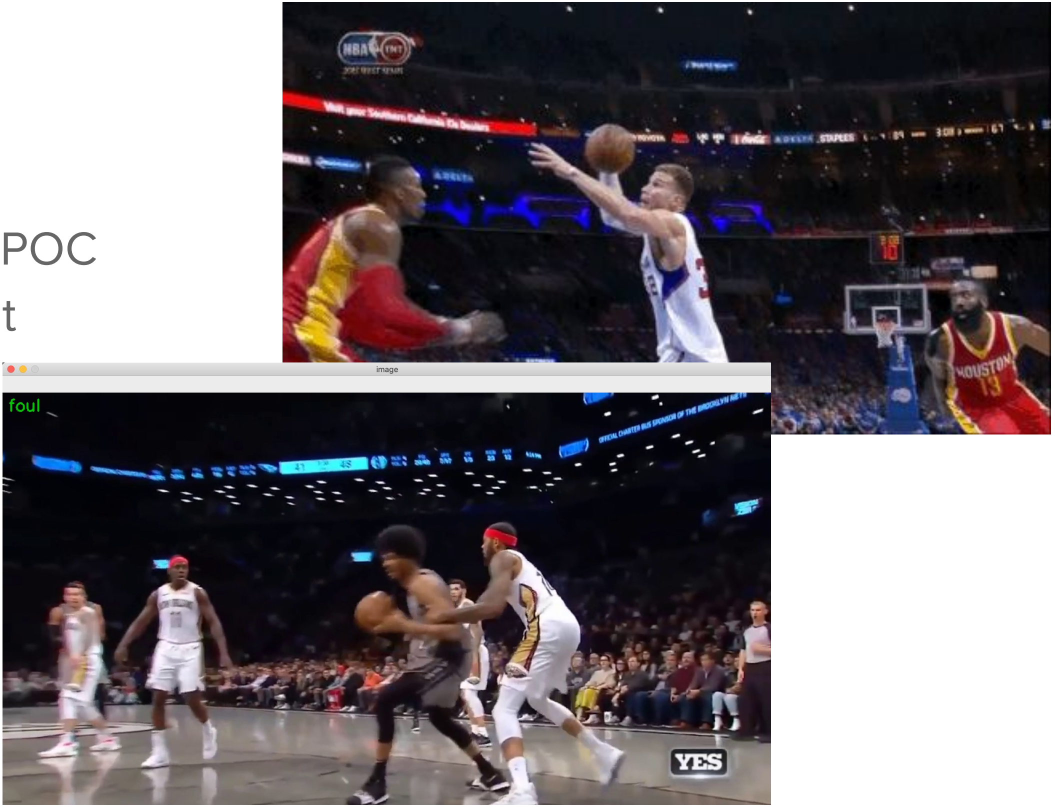
```
Prediction: clean
Label: foul
```

Video - “Real Time” Inference

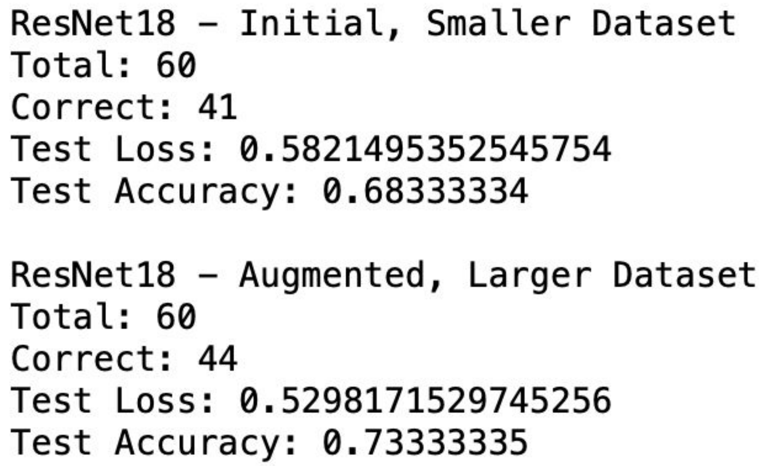
- Stretch goal
- Testing with Video
- OpenCV
- Alternative & More Realistic POC
- Frames not labeled...eye test



test_data_clips
clip_1.mp4
clip_2.mp4
clip_3.mp4
clip_4.mp4
clip_5.mp4
clip_6.mp4
clip_7.mp4
train_clip_1.mp4

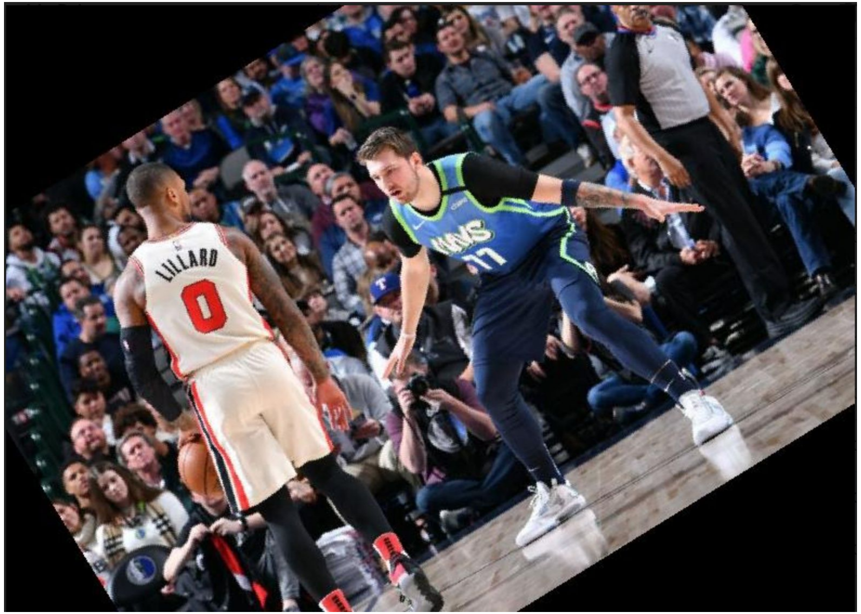


Improvements - Data Augmentation

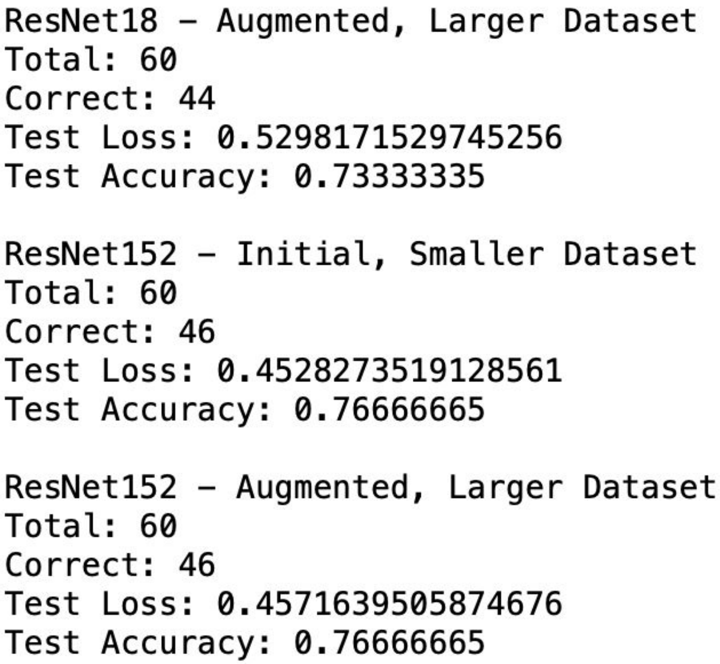


```
ResNet18 - Initial, Smaller Dataset
Total: 60
Correct: 41
Test Loss: 0.5821495352545754
Test Accuracy: 0.68333334

ResNet18 - Augmented, Larger Dataset
Total: 60
Correct: 44
Test Loss: 0.5298171529745256
Test Accuracy: 0.73333335
```



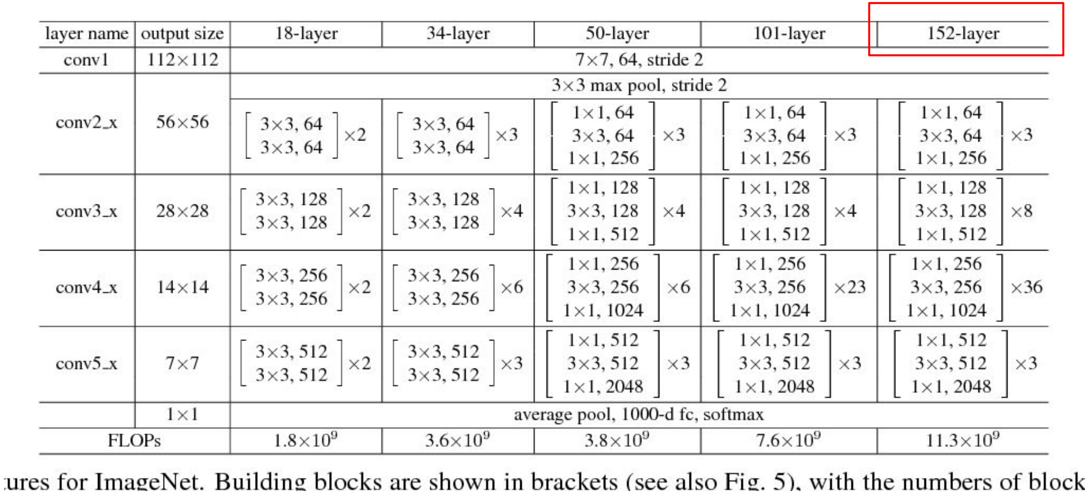
Improvements - ResNet152



```
ResNet18 – Augmented, Larger Dataset
Total: 60
Correct: 44
Test Loss: 0.5298171529745256
Test Accuracy: 0.73333335

ResNet152 – Initial, Smaller Dataset
Total: 60
Correct: 46
Test Loss: 0.4528273519128561
Test Accuracy: 0.76666665

ResNet152 – Augmented, Larger Dataset
Total: 60
Correct: 46
Test Loss: 0.4571639505874676
Test Accuracy: 0.76666665
```



layer name	output size	18-layer	34-layer	50-layer	101-layer	152-layer
conv1	112×112	7×7, 64, stride 2				
conv2_x	56×56	3×3 max pool, stride 2				
		$\begin{bmatrix}3\times3, 64\\3\times3, 64\end{bmatrix}\times2$	$\begin{bmatrix}3\times3, 64\\3\times3, 64\end{bmatrix}\times3$	$\begin{bmatrix}1\times1, 64\\3\times3, 64\\1\times1, 256\end{bmatrix}\times3$	$\begin{bmatrix}1\times1, 64\\3\times3, 64\\1\times1, 256\end{bmatrix}\times3$	$\begin{bmatrix}1\times1, 64\\3\times3, 64\\1\times1, 256\end{bmatrix}\times3$
conv3_x	28×28	$\begin{bmatrix}3\times3, 128\\3\times3, 128\end{bmatrix}\times2$	$\begin{bmatrix}3\times3, 128\\3\times3, 128\end{bmatrix}\times4$	$\begin{bmatrix}1\times1, 128\\3\times3, 128\\1\times1, 512\end{bmatrix}\times4$	$\begin{bmatrix}1\times1, 128\\3\times3, 128\\1\times1, 512\end{bmatrix}\times4$	$\begin{bmatrix}1\times1, 128\\3\times3, 128\\1\times1, 512\end{bmatrix}\times8$
conv4_x	14×14	$\begin{bmatrix}3\times3, 256\\3\times3, 256\end{bmatrix}\times2$	$\begin{bmatrix}3\times3, 256\\3\times3, 256\end{bmatrix}\times6$	$\begin{bmatrix}1\times1, 256\\3\times3, 256\\1\times1, 1024\end{bmatrix}\times6$	$\begin{bmatrix}1\times1, 256\\3\times3, 256\\1\times1, 1024\end{bmatrix}\times23$	$\begin{bmatrix}1\times1, 256\\3\times3, 256\\1\times1, 1024\end{bmatrix}\times36$
conv5_x	7×7	$\begin{bmatrix}3\times3, 512\\3\times3, 512\end{bmatrix}\times2$	$\begin{bmatrix}3\times3, 512\\3\times3, 512\end{bmatrix}\times3$	$\begin{bmatrix}1\times1, 512\\3\times3, 512\\1\times1, 2048\end{bmatrix}\times3$	$\begin{bmatrix}1\times1, 512\\3\times3, 512\\1\times1, 2048\end{bmatrix}\times3$	$\begin{bmatrix}1\times1, 512\\3\times3, 512\\1\times1, 2048\end{bmatrix}\times3$
	1×1	average pool, 1000-d fc, softmax				
FLOPs		1.8×10^9	3.6×10^9	3.8×10^9	7.6×10^9	11.3×10^9

ures for ImageNet. Building blocks are shown in brackets (see also Fig. 5), with the numbers of block

Improvements - Confidence Levels

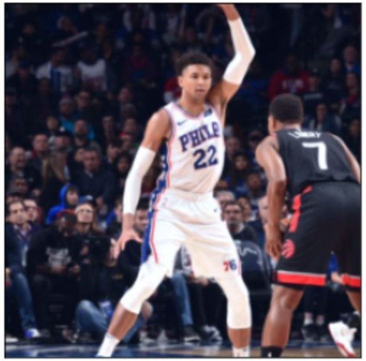
Prediction: foul, Label: clean

Confidence: 0.7527798

Prediction: clean, Label: clean

Confidence: 0.86338127

Prediction: clean, Label: clean



Confidence: 0.9731209

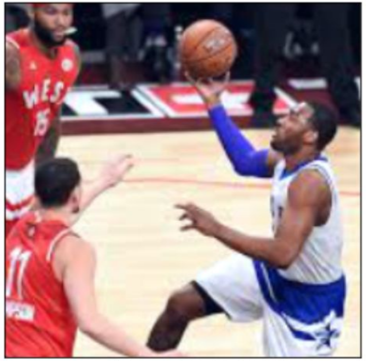
Prediction: clean, Label: clean

Confidence: 0.9016342

Prediction: foul, Label: clean

Confidence: 0.7114985

Prediction: foul, Label: clean



Confidence: 0.76341975

Thank you!