Image Classification in Mixed Martial Arts

Recognition of fighting techniques

Mateusz Maj

Business Analyst in Otomoto.pl, OLX Group

www.linkedin.com/in/mateusz-maj-04743549/

INTRODUCTION

Sports' image classification is considered by analysts as an interesting topic. In this paper an application of image classification for Mixed Martial Arts (MMA) is presented. MMA are known as a chaotic and brutal confrontations of athletes that take advantage of numerous techniques originating from other combat sports like boxing, muay-thai, brazilian jiu-jitsu, judo and other. The aim of the analysis is to develop model recognizing **punching**, **kicking** or **ground fight** scenes taking place in 'the cage'.

DIFFICULTIES

Variety of fighting techniques may be observed:

- **Punches**: straight punches, hooks or uppercuts.
- **Kicks**: low-, middle-, high- or front-kicks, but also knee kicks that require short distance.
- **Ground fight** – are mostly expected in MMA struggles as they often enable to win by submission or even knock-out and are represented by many of grappling or wrestling actions.

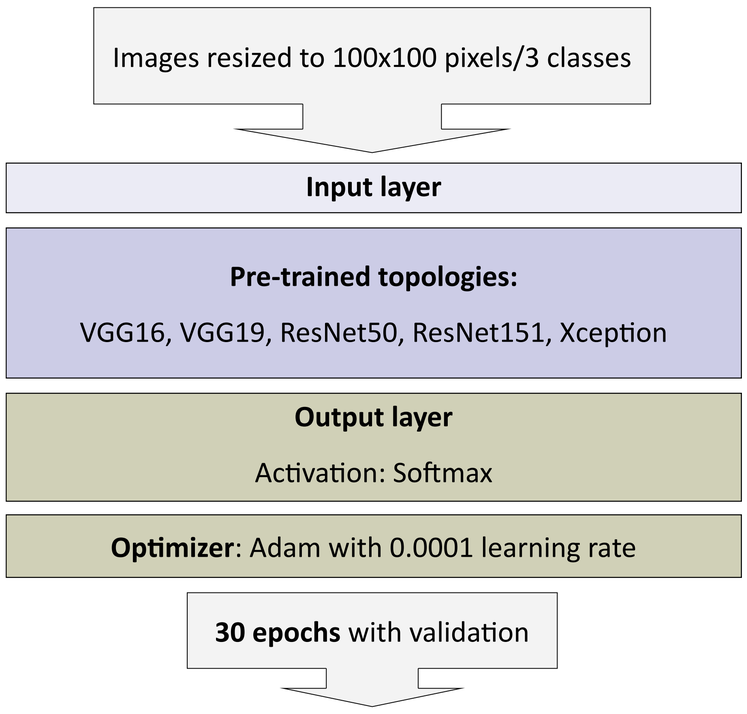
Most of abovementioned basal techniques may be seen in different (minor) variations.

Images analyzed in this research present series of simultaneous offensive and defensive fighters' activities. Blockades and counterattacks may be misleading in such situation. Moreover, additional body movements at the moment of observed actions e.g. balancing or blocking with arms during a kick or overhand punches in ground fight, may make the recognition task more challenging.

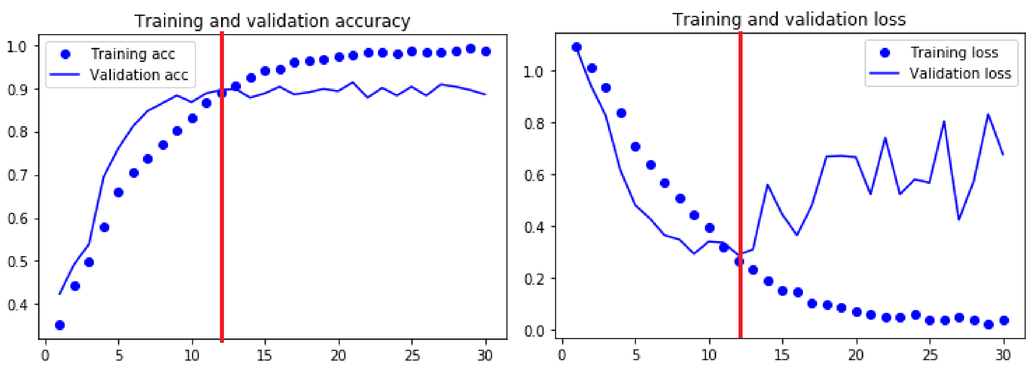
Complex features that are present in pictures, are created by additional elements, attendance of referees, elements of octagon, background noise and many others. Furthermore, a way of taking a shot by photographer e.g. distance, view from audience or above the octagon may have an impact on the interpretation by the model.

METHODOLOGY

The dataset used in this research contains 1,792 images (collected and annotated by the author), not including 392 images used for validation and 388 for testing. The training dataset was augmented to 14,264 images by flipping and rotating of the original pictures.

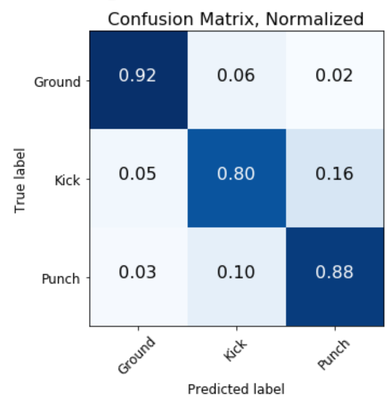


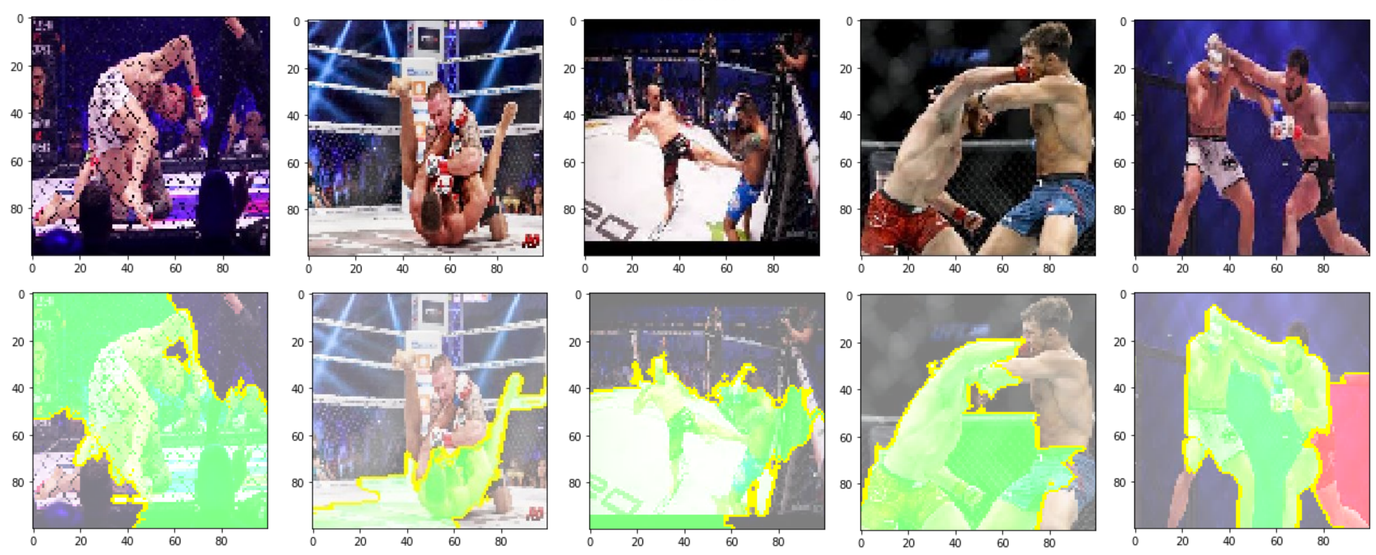
The selected model (after testing various scenarios) is **VGG19** due to the compromise accuracy and stability. To avoid overfitting, early stopping after the 12th epoch was applied.



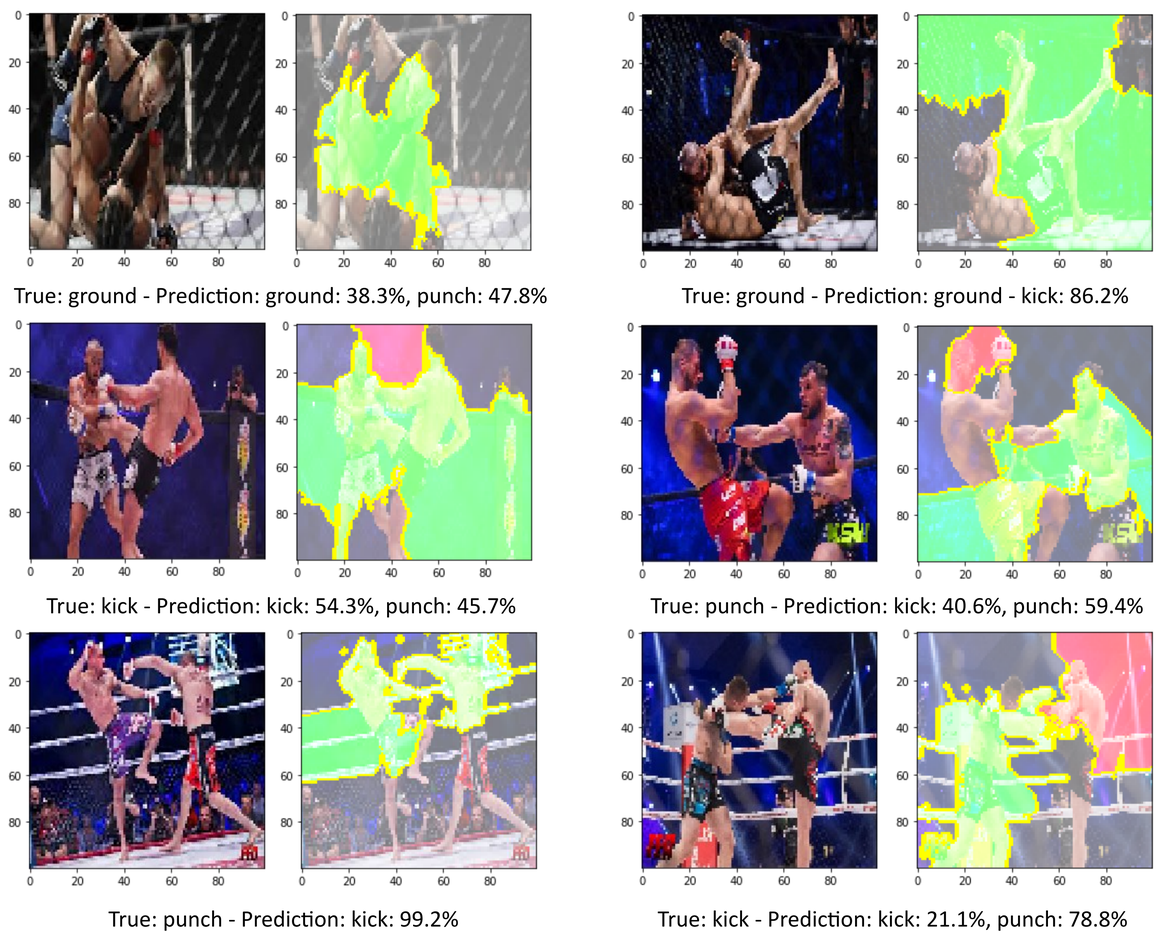
RESULTS

The model trained with augmented training dataset obtains **86.1% accuracy** (on the test set):





However, some situations are misleading. A clear distinction between kick and punch is particularly troublesome (even for a human). In spite of low misclassification error, model not always explicitly indicates adequate classes what may be affected by athletes' interaction in stand-up fight.



True: ground - Prediction: ground: 38.3%, punch: 47.8%

True: ground - Prediction: ground - kick: 86.2%

True: kick - Prediction: kick: 54.3%, punch: 45.7%

True: punch - Prediction: kick: 40.6%, punch: 59.4%

True: punch - Prediction: kick: 99.2%

True: kick - Prediction: kick: 21.1%, punch: 78.8%

CONCLUSION & FURTHER WORK

High classification accuracy obtained by the model demonstrates that deep learning is able to find patterns distinguishing significant fighting techniques—in other words is able to find a kind of order in chaotic MMA struggles. The future work might consider tracking particular fighters and recognizing their actions.

REFERENCES

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