

Project Proposal

Playing card detection and classification

Frank Gabel – Matrikel Nr. 3537204
Daniel Gonzalez – Matrikel Nr. 3112012

07.06.2018

Project Description

- **Team:**

1. Frank Gabel

Creation of the fake dataset, Implementation and Training of YOLO/Faster-RCNN, Evaluation, project report

2. Daniel Gonzalez

Creation of the fake dataset, Evaluation, project report, deployment onto webcam

- **Problem Definition:** In order to be able to cheat efficiently in live card games such as Black Jack with means of machine learning, we need to be able to localize and detect cards that are in the field of view of a player. Our idea for this project is to train a particular CNN for detecting both the suits (Hearts, Diamonds, Clubs, Spades) and the ranks of a card in an image. To make the task more interesting, we will not only, we aim not only for multi-object classification, but also localization. As the algorithm should work on small devices in real time, the algorithm will also have to be very fast. ¹

- **Dataset:** As we are not aware of a dataset containing playing cards and corresponding bounding boxes, we will create it on our own by taking photographs of each card and then using image augmentations such as scaling, rotation, changing of background textures as well as changes in illumination in order to get a somewhat accurate depiction of reality. Also, we will put cards on top of each other to make the algorithm capable of detecting several cards at once.

- **Approach:**

- Create a sufficiently large artificial dataset of playing cards with corresponding bounding boxes around the suit and the rank of each playing card (see Figure 1) - common playing cards display 2 or 4 of these suit/rank identifiers - this is not a problem as each card is unique. The creation of bounding boxes is achieved by extracting convex hulls which we can later (after

¹We are trying to extend the idea that has been presented within the following youtube videos: <https://www.youtube.com/watch?v=m-QPj0-2IkA>, <https://www.youtube.com/watch?v=pnntrewH0xg>

performing affine transformations on both the image and the hulls) use to calculate rectangular bounding boxes (using `cv2` / `scipy.spatial` heavily for these tasks).

- Employ a deep learning algorithm for object detection. The particular algorithm will be either **YOLOv3** or **Faster R-CNN**. We will be implementing the training and evaluation loop ourselves, but also plan on using existing network architecture (which is commonly termed *model.py*) from the reference implementation as YOLOv3, for example, consists of 102 layers.
- If there is enough time, we'd like to deploy our model to work on a laptop's webcam for live playing card detection.
- **Evaluation & Expected Results:** We will evaluate the algorithm on a validation set that is not being used for training. As a performance measure of these algorithms, we will use **Intersection-over-Union (IoU)** for the bounding boxes and **mean average precision (mAP)** for the classification within these bounding boxes. If all goes well, we should be able to reach a value of at least 90 % in both these measures.
- **Hardware:** We have access to a number of Quadro P5000 GPUs with sufficient RAM as well as a personal GTX 1060 which will both be adequate for this task.

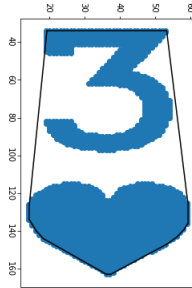


Figure 1: Example of a convex hull of suit and rank of a playing card