

Final Report

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| School of Computing  Faculty of Engineering AND PHYSICAL SCIENCES |

<Object Detection Website Based on Deep Learning>

<Yunjia Feng>

Submitted in accordance with the requirements for the degree of  
<BSc Computer Science>

**<2021/22>**

The candidate confirms that the following have been submitted*:*

*<As an example>*

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| **Items** | **Format** | **Recipient(s) and Date** |
| *Final Report* | *Hard copy and PDF file* | *Hard copy handed to SSO (DD/MM/YY); PDF uploaded to Minerva (DD/MM/YY)* |
| *Participant consent forms* | *PDF file / file archive* | *Uploaded to Minerva (DD/MM/YY)* |
| *Link to online code repository* | *URL* | *Sent to supervisor and assessor (DD/MM/YY)* |
| *User manuals* | *PDF and/or hard copy* | *Sent to client and supervisor (DD/MM/YY)* |

The candidate confirms that the work submitted is their own and the appropriate credit has been given where reference has been made to the work of others.

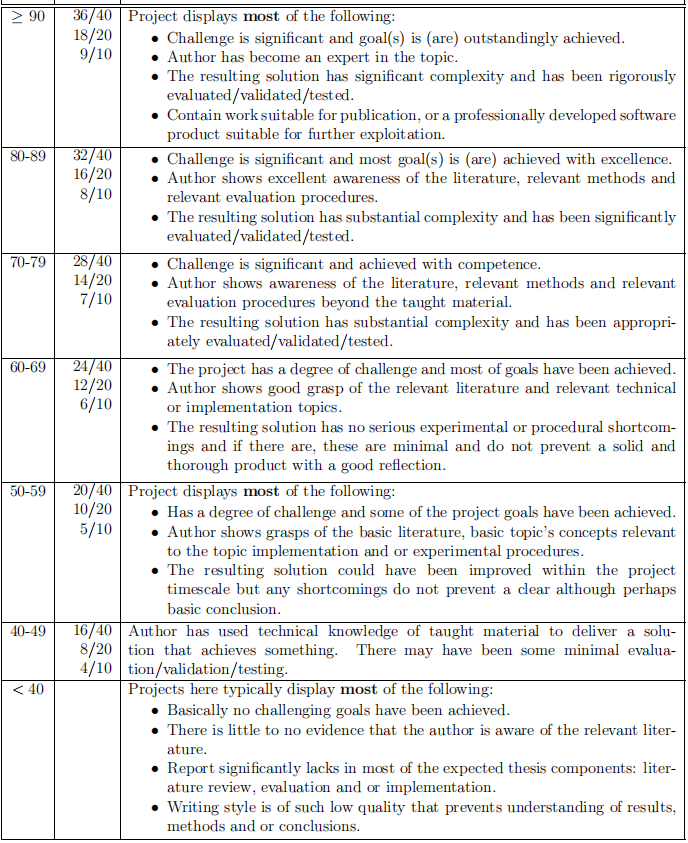
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(Signature of student) Yunjia Feng

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# Summary

*<Concise statement of the problem you intended to solve and main achievements (no more than one A4 page)>*



# Acknowledgements

*<This page should contain any acknowledgements to those who have assisted with your work. Where you have worked as part of a team, you should, where appropriate, reference to any contribution made by others to the project.>*

*Note that it is not acceptable to solicit assistance on ‘proof reading’ which is defined as “the systematic checking and identification of errors in spelling, punctuation, grammar and sentence construction, formatting and layout in the text”; see*

https:://www.leeds.ac.uk/secretariat/documents/proof\_reading\_policy.pdf

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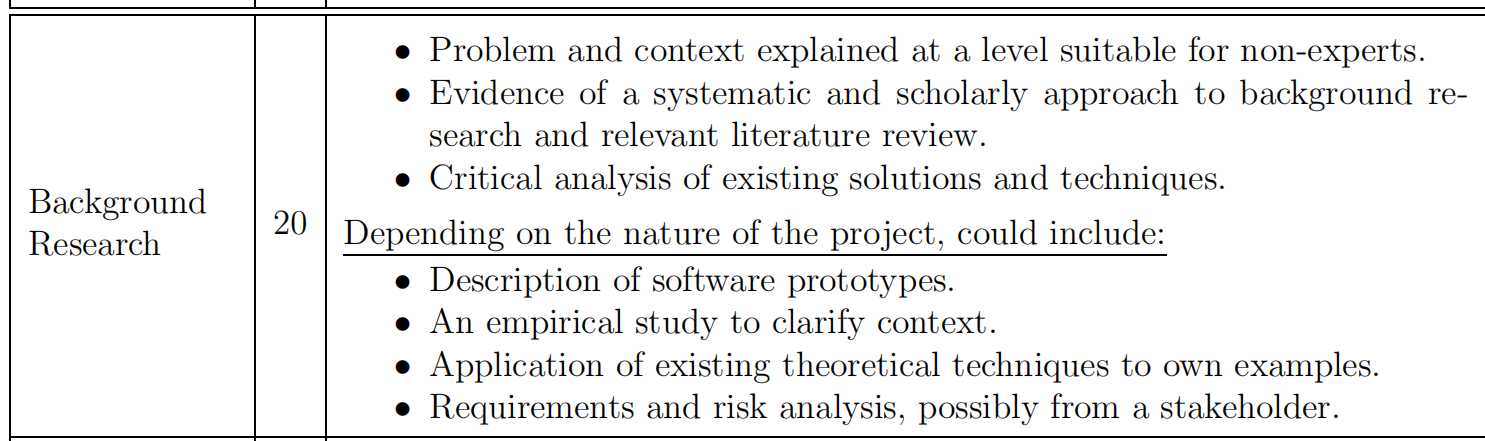
# Chapter 1 Introduction and Background Research

<Recommend using ‘Heading 1’ for chapter titles, ‘Heading 2’ style for section headings, ‘Heading 3’ for subsection headings, and ‘Heading 4’ for sub-subsection headings, but whatever you choose you must be consistent. Don’t forget that text (other than headings) should be 11 point.>

Problem and Context

Analysis of existing solutions and techiniques

Description of software prototypes,



## 1.1 Introduction

<A brief introduction suitable for a non-specialist, *i.e.* without using technical terms or jargon, as far as possible. This may be similar/the same as that in the 'Outline and Plan' document. The remainder of this chapter will normally cover everything to be assessed under the `Background Research` criterion in the mark scheme.>

Object detection has always been of great significance in the field of computer vision whose main objective is to enable the computer to accurately classify the objects in a given picture or video and find the position of each object. In recent years, many computer vision researchers at home and abroad have developed a large number of excellent object detection neural network algorithms, including Faster R-CNN, SSD, YOLO. The goal of this project is to select appropriate object detection algorithms and data sets and train the deep learning model, then develop a website for users which allows users to complete object detection tasks easily.

From the perspective of research, the significance of object detection is that object detection is one of the fundamental tasks in the field of computer vision, which is also the basis of many other high-level tasks: image classification, face recognition, target tracking, pedestrian re-recognition. Meanwhile, there is a large number of well-known research teams both at home and abroad, had been focused on the field of object detection, for instance, MIT Computer Science and Artificial Intelligence Laboratory, Stanford Computer Vision Lab, National Laboratory of Pattern Recognition of Chinese Academy of Sciences, LAMDA Institute of Nanjing University.

While from the perspective of the application, object detection has shown a wide range of practical usages: face detection technology, pedestrian detection technology applied in video surveillance, entrance and exit statistics, traffic sign detection technology, vehicle detection technology applied in aided driving, automatic driving. At the same time, major technology companies, for example, Microsoft, Google, Ali, and Baidu, have also spent a lot of manpower and material resources to explore the object detection field, which indicates the significance and prospect of object detection.

## 1.2 Literature Review

<This section heading is purely a suggestion -- you should subdivide this chapter in whatever manner you think makes most sense for your project. It may also make sense to spread the `Background Research' over more than one chapter, in which case they should be named sensibly.>

Since 2006, in the lead of Hinton, Bengio, Lecun, and other researchers, a large number of deep neural network papers have been published, especially after Hinton's research group participated in the ImageNet image recognition competition in 2012 and won the championship using AlexNet[1], constructed by CNN network, then neural network began to receive extensive attention from then on.

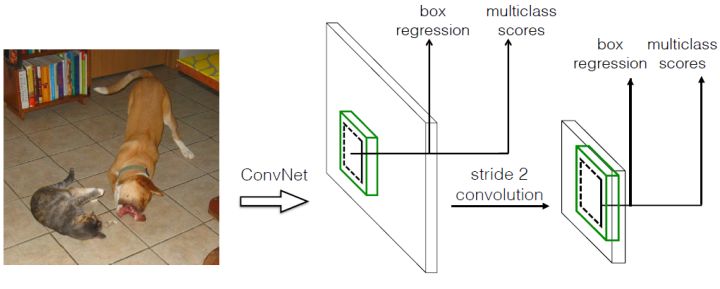
Computer vision analysis of target motion can be roughly divided into three levels: motion segmentation and object detection, target tracking, action recognition, and behavior description[2]. Object detection is not only one of the basic tasks to be solved in the field of computer vision, but also the basic task of video surveillance technology among the other tasks. However, object detection is still a challenging task with great potential and space for improvement, since the objects in the video have different poses and often appear to overlap, especially when their movements are irregular. Meanwhile, the resolution, weather, illumination, and other conditions of the surveillance video or images as well as the diversity of scenes should also be taken into consideration, which makes this task more challenging.

Overall, object detection is a task to find all the objects of interest in the image for two sub-tasks, including object positioning and object classification[3]. The traditional object detection method, for example, the sliding window algorithm is generally divided into three stages: firstly, select some candidate regions on a given image, then extract features from these regions, and finally classify them using trained classifiers.

At present, the mainstream object detection algorithms are mainly based on a deep learning model, which can be roughly divided into two categories: (1) One-stage object detection algorithm. This kind of detection algorithm does not need the Region Proposal Stage and can directly generate the category probability and position coordinates of objects through only one stage, One-stage typical algorithms include YOLO, SSD, and CornerNet[4]. (2) Two-stage object detection algorithms divide detection problems into Two stages, the first stage is the generation of Region Proposals, which includes the approximate location information of the object, and the second stage is the classification and location refinement of the candidate regions. The representatives of two-stages algorithms are R-CNN. Fast R-CNN, Faster R-CNN.

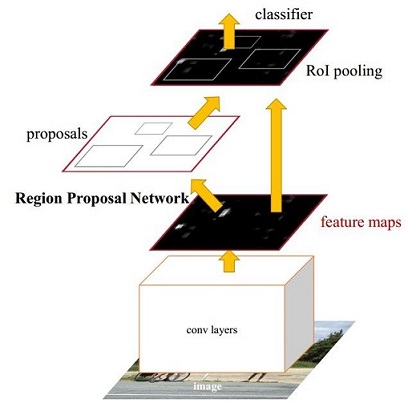
The main performance indicator of the object detection model is the accuracy and processing speed, and the accuracy mainly considers the positioning and classification accuracy of the object. In general, the two-stage algorithm has advantages in accuracy, while the one-stage algorithm has advantages in processing speed.

(1) SSD stands for Single Shot MultiBox Detector, is a single-stage, multiple proposal object detection algorithm, SSD use CNN network to detect with multi-scale feature map, the basic structure like the figure below:

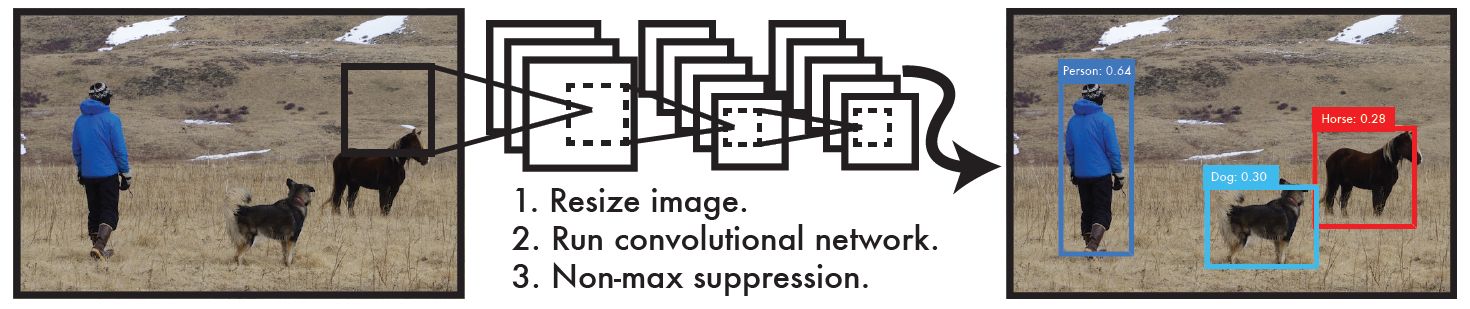


Additionally, SSD adopts VGG16 as the basic model, and then adds a convolution layer based on VGG16 to obtain more feature maps for detection[5]. There are also some improved algorithm based on SSD, for instance, DSSD[6] and FSSD[7], which has different structure for their CNN module.

(2) Faster R-CNN, after the evolvement of R-CNN and Fast R-CNN, Ross B. Girshick proposed Faster R-CNN in 2016[8]. In terms of structure, the Faster R-CNN integrated feature extraction, bounding box regression (rect refine), and classification into one network, which greatly improves the overall performance[9], especially in the detection speed, the structure of the network is listed below. Furthermore, Cascade R-CNN is proposaled as a multiple stage method[10], which has better accuracy in detection.



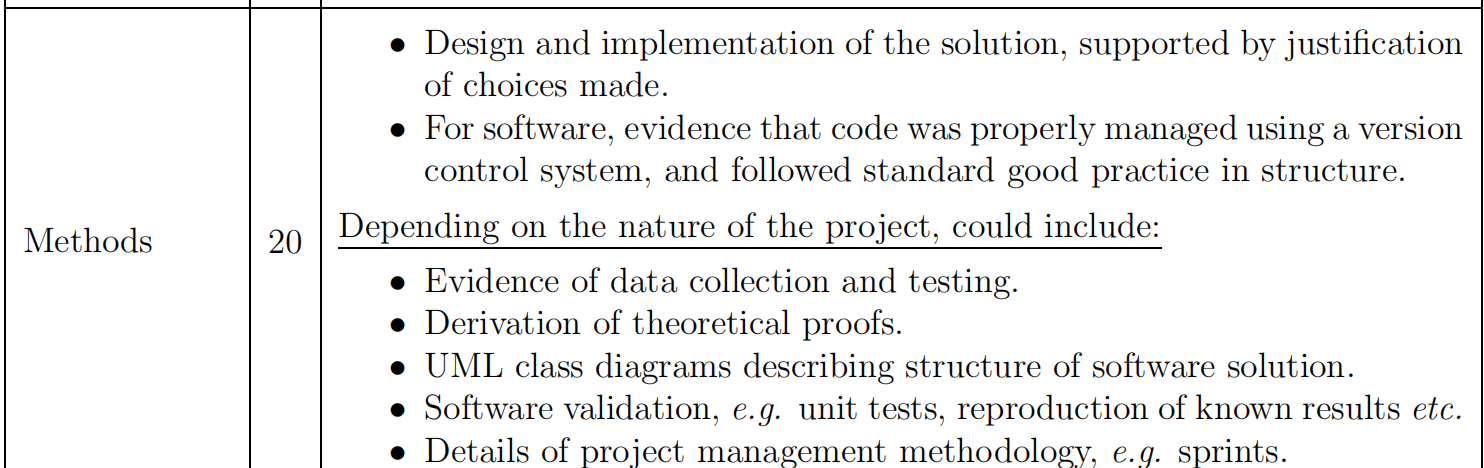
Yolo, stands for You Only Look Once, which adopts a separate CNN model to achieve end-to-end object detection. The whole system is shown in the figure below: the input image is resized and sent to the CNN network, then the detected object results are obtained by processing network prediction. Compared with the R-CNN algorithm, it is a unified framework with faster speed while the training process of Yolo is also end-to-end[11].



In general, object detection is an active research direction in the field of computer vision. Although one-stage detection algorithm and two-stage detection algorithm have achieved good results, there is still a great potential for promotion for application in real scenes, and this is also a meaningful and challenging topic for now and future.

# Chapter 2 Methods

<Everything that comes under the `Methods' criterion in the mark scheme should be described in one, or possibly more than one, chapter(s). Note that it is not normally relevant to include extensive code, but short snippets for key aspects may be suitable.>



Justification of choices made

Version control system evidence,

good practice in structure

Data collection(format transform, VOC2007), testing(Postman, Selenium, pytest...)

UML class diagrams describing structure of software solution

Software validation (unit tests, reproduction fo known results)

Details of project managemnet methodology (sprints) ? Agile???

## 2.1 Table example

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| **Heading One** | **Heading Two** | **Heading Three** |
| 1.1 | 1.2 | 1.3 |
| 1.21 | 1.22 | 12.3 |
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**Table 2.1** This is the table description in the ‘table description’ style.

## 2.2 Figure example

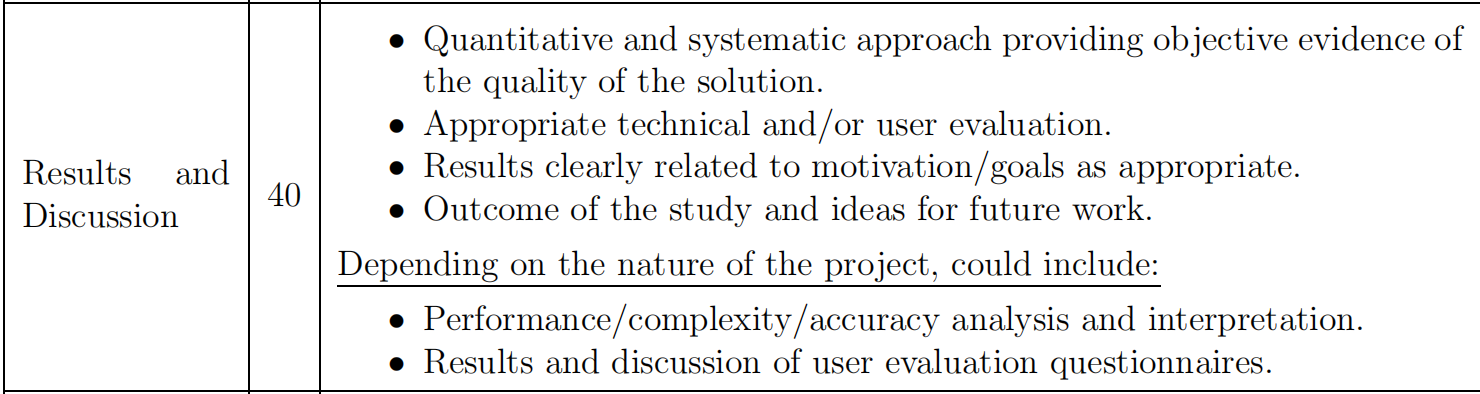
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**Figure 2.1** This is the figure description in the ‘figure description’ style.

# Chapter 3 Results

<Results, evaluation (including user evaluation) *etc*. should be described in one or more chapters. See the `Results and Discussion' criterion in the mark scheme for the sorts of material that may be included here.>



Quantitative and systematic approach (mAP...)

Techinical /user evaluation ???

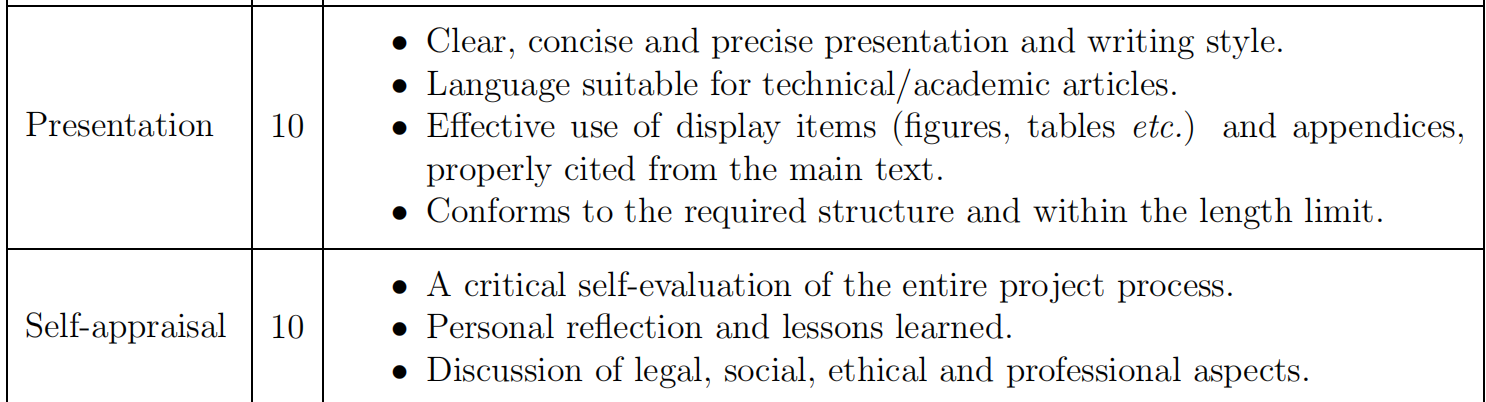
Outcome of the study and ideas for future work

Performance/complexity/ accurarcy analysis and inerpretation

Results and discussion of user evaluatin questionnaires ??? to be determined

# Chapter 4 Discussion

<Everything that comes under the `Results and Discussion' criterion in the mark scheme that has not been addressed in an earlier chapter should be included in this final chapter. The following section headings are suggestions only.>



## 4.1 Conclusions

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## 4.2 Ideas for future work

<Text in 11-point size and 1.5 line spacing.>

# List of References

*<It is expected that the list would reflect the breadth and depth of scholarly research undertaken by the student during the course of the project.>*

[1] A. Krizhevsky, I. Sutskever, and G. E. Hinton, “Imagenet classification with deep convolutional neural networks,” in Advances in neural information processing systems, 2012, pp. 1097–1105.

[2] Vishwakarma S, Agrawal A. A survey on activity recognition and behavior understanding in video surveillance [J]. The Visual Computer, 2012: 1-27.

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and semantic segmentation. In CVPR, 2014.

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[12] Alexey Bochkovskiy, Chien-Yao Wang, and HongYuan Mark Liao. Yolov4: Optimal speed and accuracy of object detection. arXiv preprint arXiv:2004.10934, 2020.

[13] Joseph Redmon and Ali Farhadi. YOLOv3: An incremental improvement. arXiv preprint arXiv:1804.02767, 2018.

[14] J. Redmon and A. Farhadi. YOLO9000: Better, faster, stronger. In CVPR, 2017.

# Appendix A Self-appraisal

<This appendix must contain everything covered under the ’self-appraisal’ criterion in the mark scheme. Although there is no length limit for this section, 2-4 pages will normally be suﬃcient. The format of this section is not prescribed, but you may like to consider the following sections and subsections.>

## A.1 Critical self-evaluation

## A.2 Personal reﬂection and lessons learned

## A.3 Legal, social, ethical and professional issues

<Refer to each of these issues in turn. If one or more is not relevant to your project, you should still explain *why* you think it was not relevant.>

### A.3.1 Legal issues

<Discussion of legal issues>

### A.3.2 Social issues

### <Discussion of social issues>

### A.3.3 Ethical issues

### <Discussion of ethical issues>

### A.3.4 Professional issues

<Discussion of professional Issues>

# Appendix B External Materials

<This appendix should provide a brief record of materials used in the solution that are not the student's own work. Such materials might be pieces of codes made available from a research group/company or from the internet, datasets prepared by external users or any preliminary materials/drafts/notes provided by a supervisor. It should be clear what was used as ready-made components and what was developed as part of the project. This appendix should be included even if no external materials were used, in which case a statement to that effect is all that is required.>

Code: Yolov5 developed as part of the project

Dataset: VOC2007 ready-made components