**BABEȘ-BOLYAI UNIVERSITY CLUJ-NAPOCA**

**FACULTY OF MATHEMATICS AND COMPUTER**

**SCIENCE**

**SPECIALIZATION COMPUTER SCIENCE**

**DIPLOMA THESIS**

Car registration by document classification using

computer vision

**Supervisor**

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**UNIVERSITATEA BABEȘ-BOLYAI CLUJ-NAPOCA**

**FACULTATEA DE MATEMATICĂ ȘI INFORMATICĂ**

**SPECIALIZAREA INFORMATICĂ**

**LUCRARE DE LICENȚĂ**

Inmatriculare autovehicul prin clasificare de documente folosind viziune computerizata

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Table of Contents

[1. Introduction 5](#_Toc159444708)

[2. Existing methods for document classification 6](#_Toc159444709)

[2.1 Deep learning 6](#_Toc159444710)

# 1. Introduction

In an era where the volume of digital documents is expanding exponentially, the need for effective organization and classification methods is paramount. Document classification, the task of automatically assigning predefined categories to text documents, plays a pivotal role in numerous real-world applications such as registering a car. The main problem in this thesis is classifying documents using computer vision. Generally, there are two solutions: manual classification and automatic classification. The manual approach implies that the user specifies the type of document. The automatic approach makes use of the technology Optical Character Recognition, known as OCR. This approach does not come without problems. Text extraction is made using OCR engines. Such an engine is built to recognize characters in various fonts and sizes. Problems which might arise when using an OCR engine could be characters are not textual, hence using an OCR engine on an image is not enough to get the text. This system needs to consider different transformations to have better accuracy for character recognition. Such kind of transformations are: different qualities, blurring, warp perspective, rotating. The proposed solution warps the image and apply the above-mentioned transformations to get the text match and find the document from given templates. Another problem that arises is data privacy. The system uses all the privacy configuration needed from password hashing, session management up to image persistence on cloud services. All these features can be used using an android app interface written in Dart using the Flutter framework. The focus of this thesis is the system behind it which is exposed as an API written in object-oriented language, namely C#. Document classification microservice is written in Python using the OpenCV library. The technique use to classify documents will be presented in the third chapter. The explanation and trade-offs with advantages and disadvantages against other technologies and architecture decisions are presented in the fourth chapter.

# Existing methods for document classification

In this section, we will explore two approaches of how we can classify documents. Firstly, we will review a machine learning method based on deep learning, then a computer vision method based on OCR and pattern matching using regular expressions.

## Machine Learning

Logistic regression is one of the known and used supervised learning algorithms that are used to indicate the probability of a category is logistic regression. Given a document d represented by a set of features , the probability that P( belongs to a class is calculated as follows:

P = σ()

A text classifier is implemented in several steps. In the first step, labeled documents are represented as vectors of a certain length. The documents will be then filtered using data sanitization such as removing unwanted characters, punctuation and symbols. Furthermore, the documents will be divided into two sets, the training set and the test set. The training set will used to fed into classifiers to train them, while the test set will be used to evaluate and predict the results [1].

## Computer Vision