17 ADVANCED TECHNOLOGY DAYS

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What Are Limits of OCR?

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SPONZORI KONFERENCIJE

ZLATNI SPONZOR

SREBRNI SPONZOR

BRONČANI SPONZOR

SPONZOR COFFEE BREAKA

POKROVITELJ

MEDIJSKI POKROVITELJI

GENERALNI MEDIJSKI POKOROVITELJ

GENERALNI MEDIJSKI POKOROVITELJ

ORGANIZATOR

Agenda

- Introduction to Computer Vision and OCR
- How do we do OCR?
- What are the latest trends?
- Some state-of-the-art research examples

Who Am I?

- Junior Software Engineer Student at Unitfly
    - since 2020
- Computer Science masters' student at FER
    - research in AI image/video upscale
    - some experience in NLP research

Put It into Context: Analyzing the Effects of Context Delimiters and Emojis in Emotion Analysis

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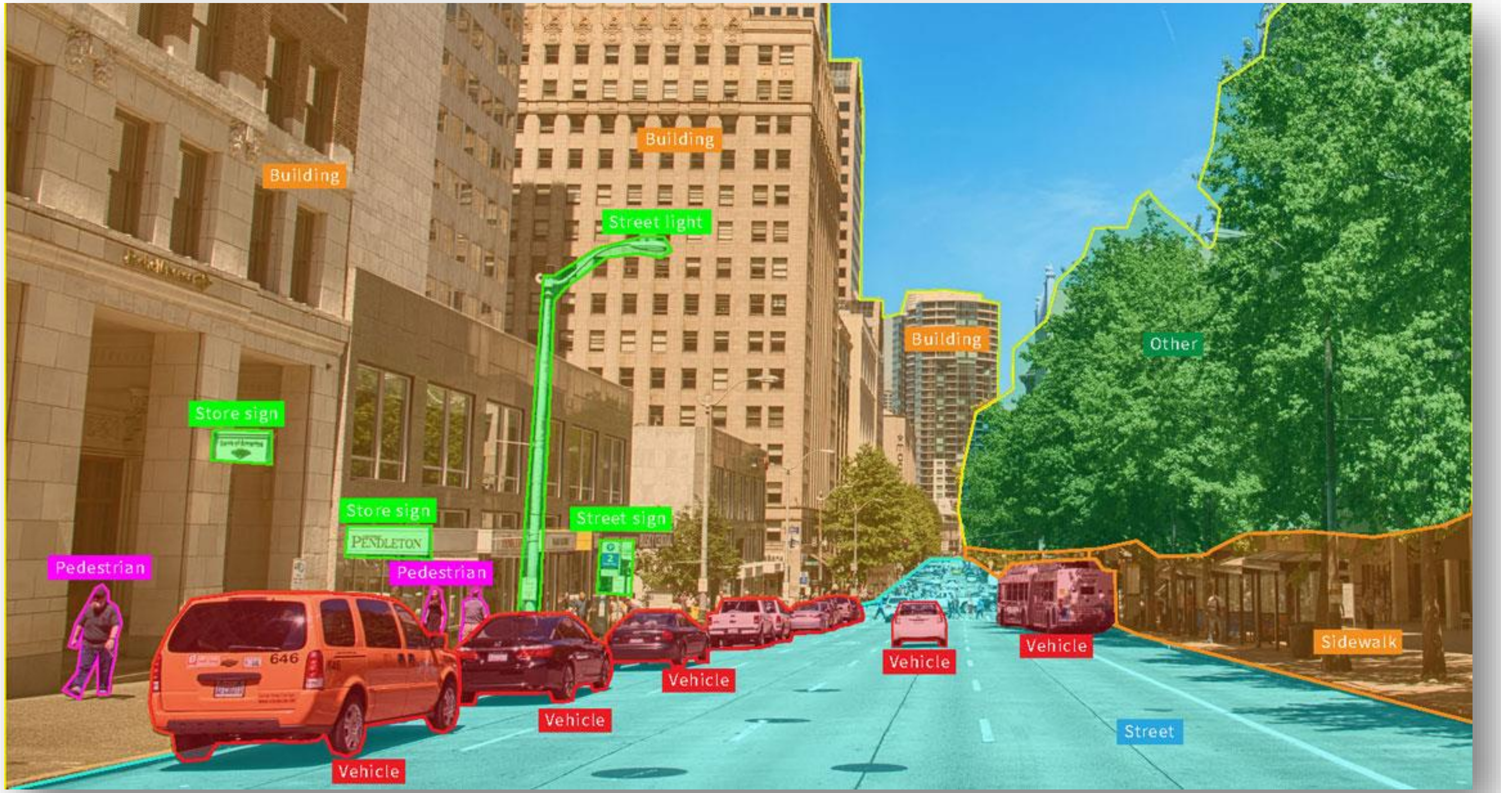
Abstract

A large amount of user-generated data is being created daily due to social media communication. Sentiment and emotion analysis of this data can give us valuable insight, which can be applied in a wide range of situations: enhancing the customer experience, reputation management, market research, analyzing public opinion on different topics, and so on. In this paper, we conduct two experiments. Firstly, we show that using special delimiter tokens to signify the switch between the different utterances in the same dialogue results in improved task performance across three different models. We also experiment with the significance of emojis in emotion classification.

Dino Grgić
Software Engineer

What Is Computer Vision?

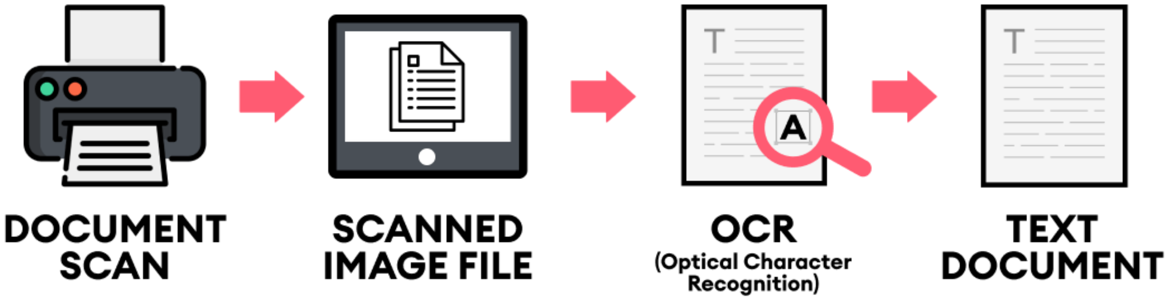
- field of computer science
- TASK: enable computers to **identify** and **understand objects in images** and **video**



source https://appen.com

What Is OCR?

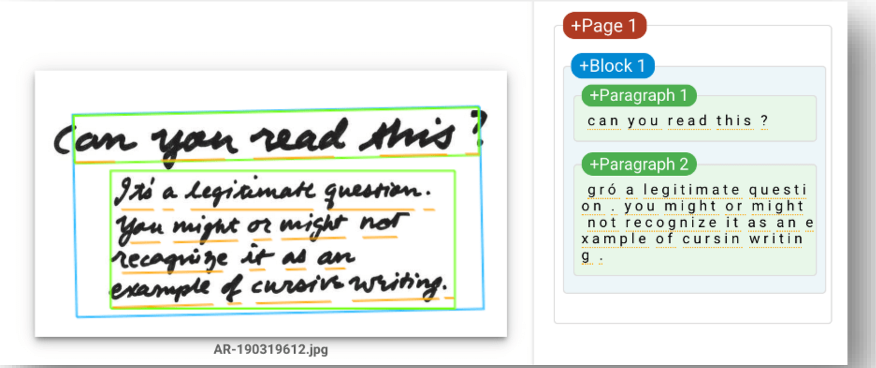
- task of computer vision
- Optical Character Recognition
  - text in image → machine readable text data

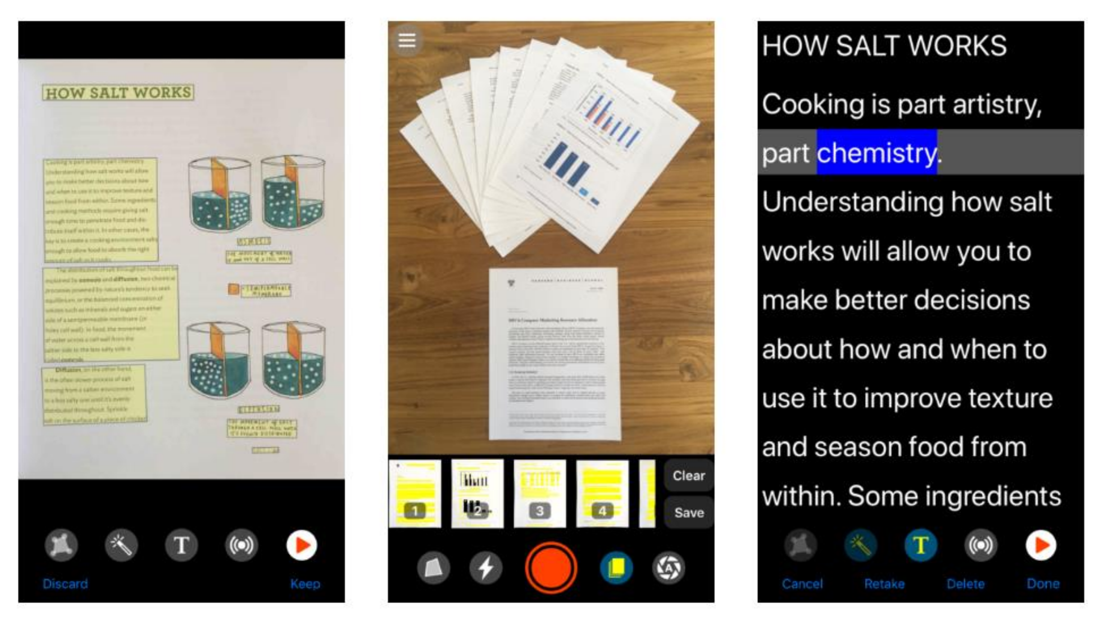


source: https://www.superannotate.com

Where Is OCR Used?

- traffic sign recognition
- scanning license plates
- aids for visually impaired
- data entry for business documents
- converting handwritten notes to machine-readable text
- …





Where Is OCR Used?

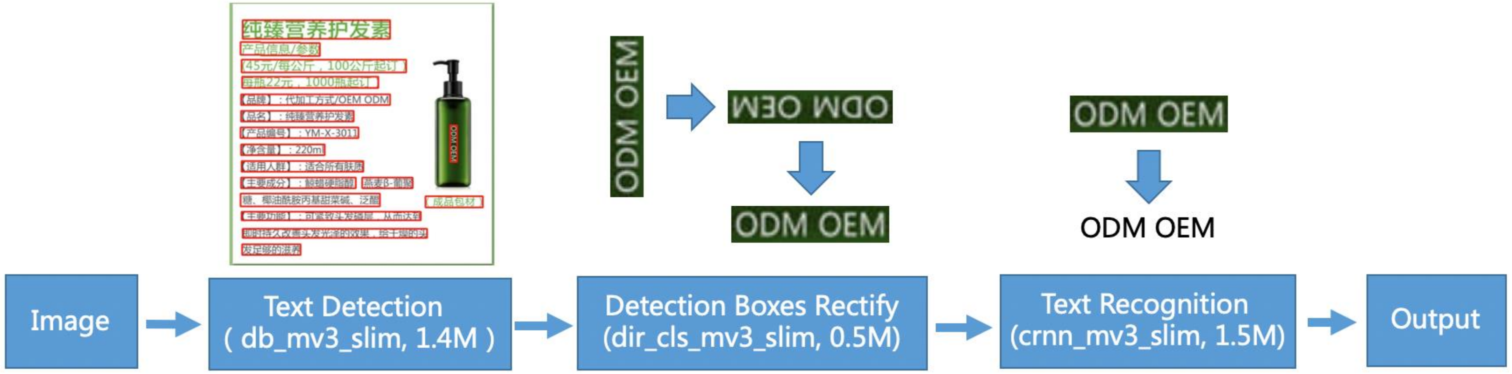

Wong, please develop an invoice identification APP in one week. If you can't finish it, you'll deduct the bonus.
What?!

What Do We Need for OCR?

- Model
  - pretrained
  - train on your own
- Dataset
  - Unstructured
  - Structured
- No free lunch!

How We Do OCR?

- Approach
  - Computer Vision
  - Deep Learning
- (mostly) 3 step process
  - Pre-processing
  - Text detection + text recognition
  - Post-processing



Text Detection:

1. Light Backbone
2. Light Head
3. Remove SE
4. Cosine Learning Rate Decay
5. Learning Rate Warm-up
6. FPGM Pruner

Detection Boxes Rectify:

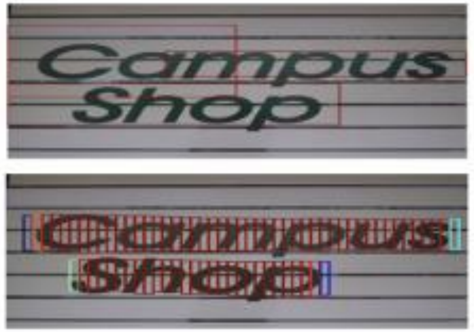
1. Light Backbone
2. Data Augmentation
3. Input Resolution
4. PACT Quantization

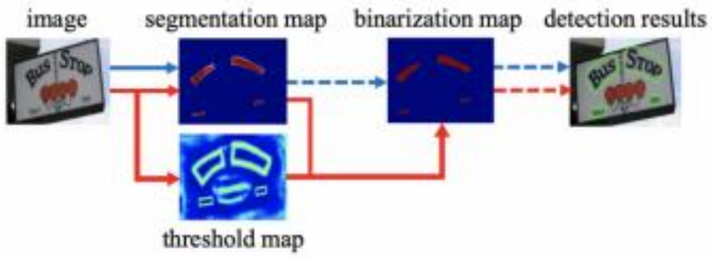
Text Recognition:

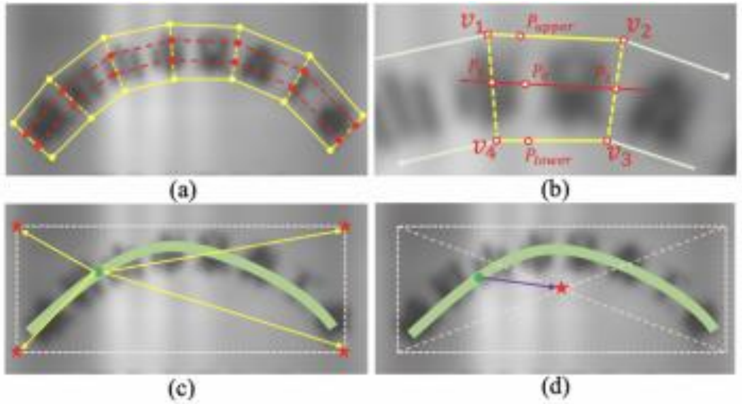
1. Light Backbone
2. Data Augmentation
3. Cosine Learning Rate Decay
4. Feature Map Resolution
5. Regularization Parameters
6. Learning Rate Warm-up
7. Light Head
8. Pre-trained Model
9. PACT Quantization

Text Detection

- **locate text regions** in the input image
- problem: bounding box of the text







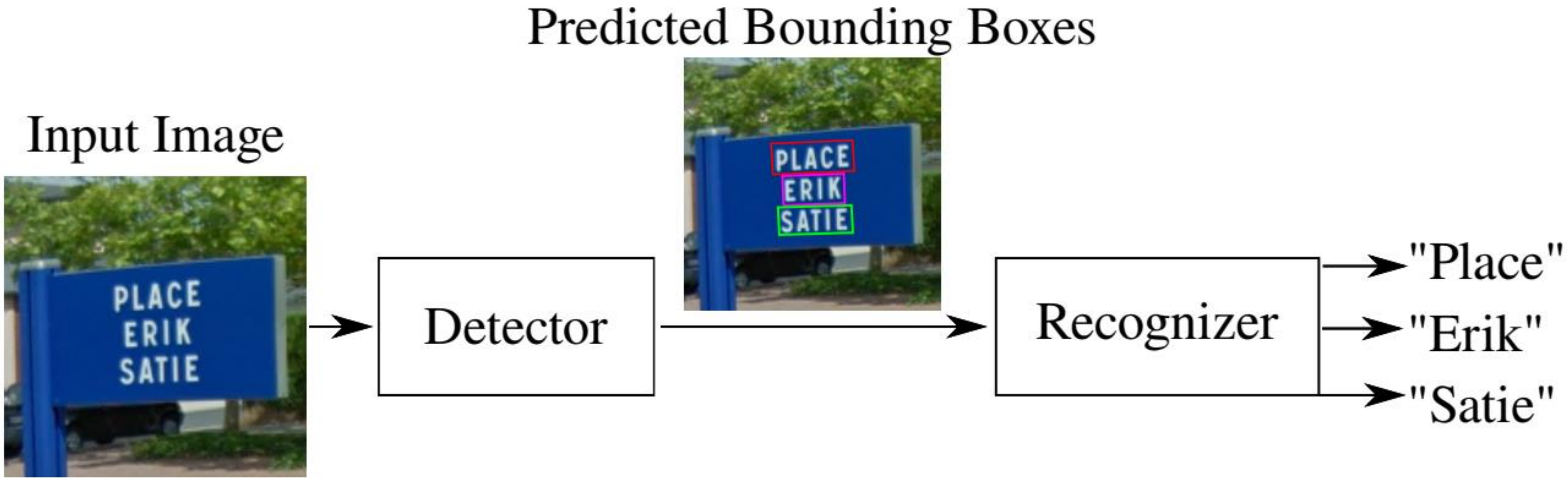
Text Recognition

- **extract text** from input image
  - uses input from text detection
- two categories
  1. regular text
  2. irregular text – **research focus**

Figure 9: (Left) Regular texts VS. (Right) Irregular texts

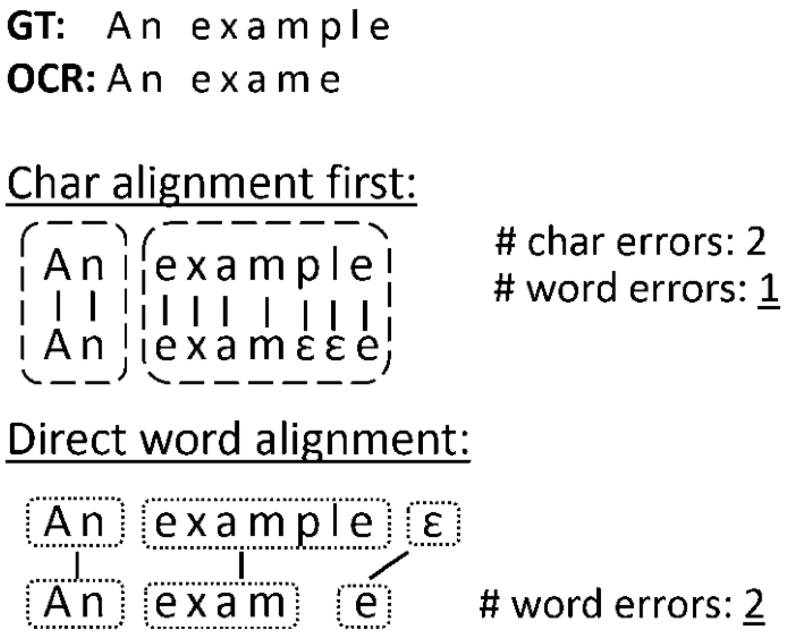
Text Detection vs Text Recognition

- text detection = detect placement of the text in image
- text recognition = extract the text



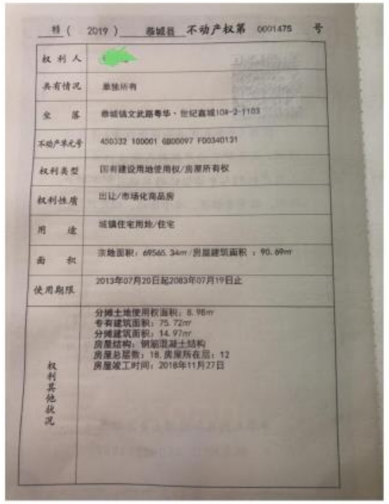
How Good Is OCR Model?

- evaluation metrics
- **CER (%)** – Character Error Rate
  - less is better
  - how are we correct with characters
- **WER (%)** – Word Error Rate
  - less is better
  - how are we correct with words
- **Sequence Accuracy (%)**
  - more is better
  - the whole sequence must be correct



Document Structure Recognition

- Layout Analysis
  - structure of the document
- Table Recognition
  - table content extraction
- Key Information Extraction



Q1: What's the address of the house?

A1: Room XXX, Building No.X, XX District, Beijing, China

Q2: What is the area of the house ?

A2 : 90.69 square meters

Figure 15: DocVQA tasks

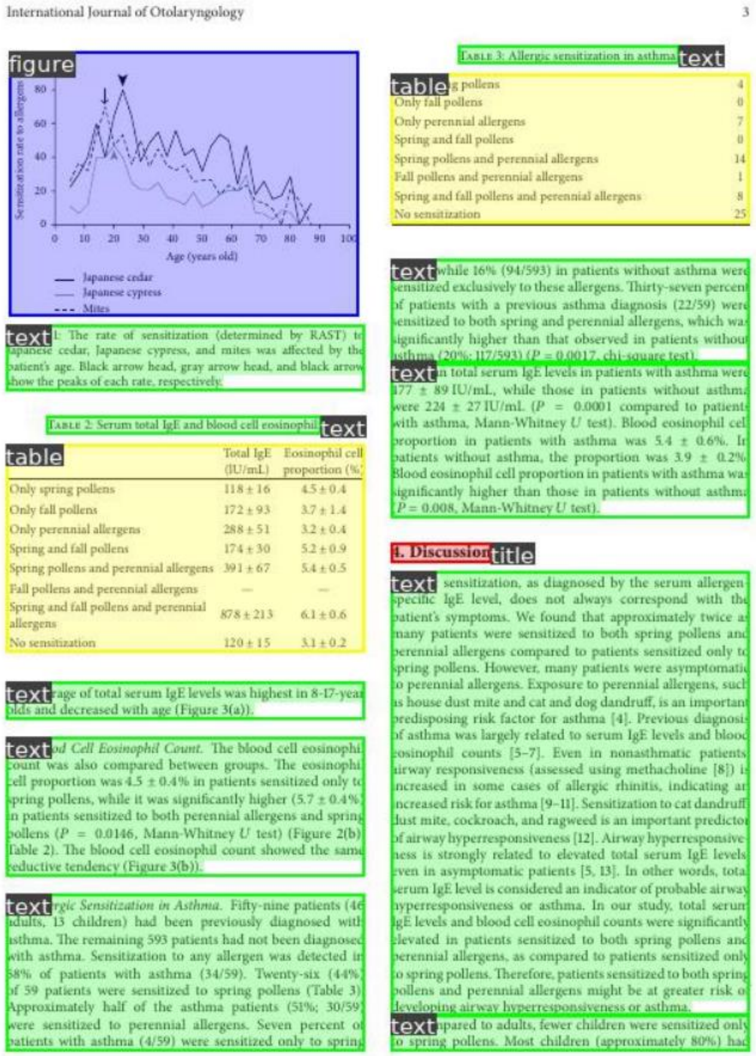
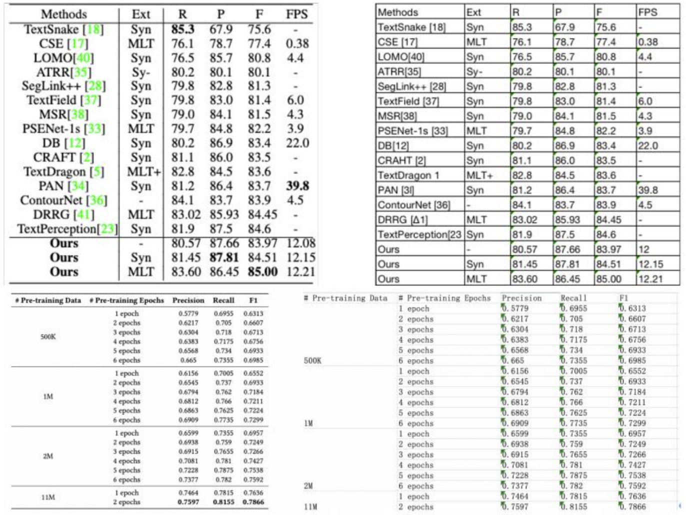


Figure 12: Layout analysis



Methods	Ext	R	P	F	FPS
TextSnake [18]	Syn	**85.3**	67.9	75.6	-
CSE [17]	MLT	76.1	78.7	77.4	0.38
LOMO[40]	Syn	76.5	85.7	80.8	4.4
ATRR[35]	Sy-	80.2	80.1	80.1	-
SegLink++ [28]	Syn	79.8	82.8	81.3	-
TextField [37]	Syn	79.8	83.0	81.4	6.0
MSR[38]	Syn	79.0	84.1	81.5	4.3
PSENet-1s [33]	MLT	79.7	84.8	82.2	3.9
DB [12]	Syn	80.2	86.9	83.4	22.0
CRAFT [2]	Syn	81.1	86.0	83.5	-
TextDragon [5]	MLT+	82.8	84.5	83.6	-
PAN [34]	Syn	81.2	86.4	83.7	**39.8**
ContourNet [36]	-	84.1	83.7	83.9	4.5
DRRG [41]	MLT	83.02	85.93	84.45	-
TextPerception[23]	Syn	81.9	87.5	84.6	-
Ours	-	80.57	87.66	83.97	12.08
Ours	Syn	81.45	**87.81**	84.51	12.15
Ours	MLT	83.60	86.45	**85.00**	12.21

# Pre-training Data	# Pre-training Epochs	Precision	Recall	F1
500K	1 epoch	0.5779	0.6955	0.6313
	2 epochs	0.6217	0.705	0.6607
	3 epochs	0.6304	0.718	0.6713
	4 epochs	0.6383	0.7175	0.6756
	5 epochs	0.6568	0.734	0.6933
	6 epochs	0.665	0.7355	0.6985
1M	1 epoch	0.6156	0.7005	0.6552
	2 epochs	0.6545	0.737	0.6933
	3 epochs	0.6794	0.762	0.7184
	4 epochs	0.6812	0.766	0.7211
	5 epochs	0.6863	0.7625	0.7224
	6 epochs	0.6909	0.7735	0.7299
2M	1 epoch	0.6599	0.7355	0.6957
	2 epochs	0.6938	0.759	0.7249
	3 epochs	0.6915	0.7655	0.7266
	4 epochs	0.7081	0.781	0.7427
	5 epochs	0.7228	0.7875	0.7538
	6 epochs	0.7377	0.782	0.7592
11M	1 epoch	0.7464	0.7815	0.7636
	2 epochs	**0.7597**	**0.8155**	**0.7866**

Figure 13: Table recognition

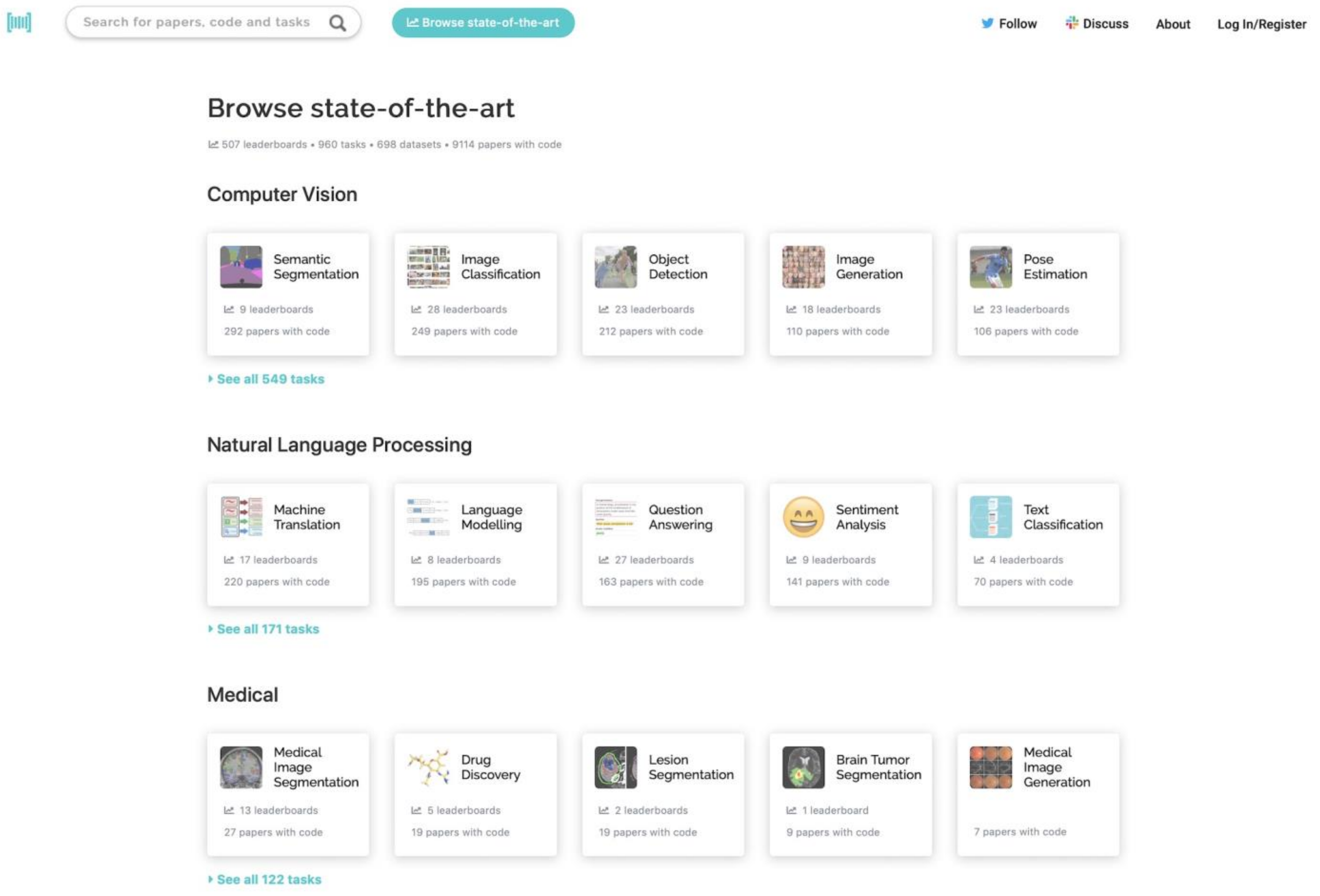
Current OCR Challenges

Figure 4: Technical challenges of OCR algorithms

source: https://github.com/PaddlePaddle/PaddleOCR

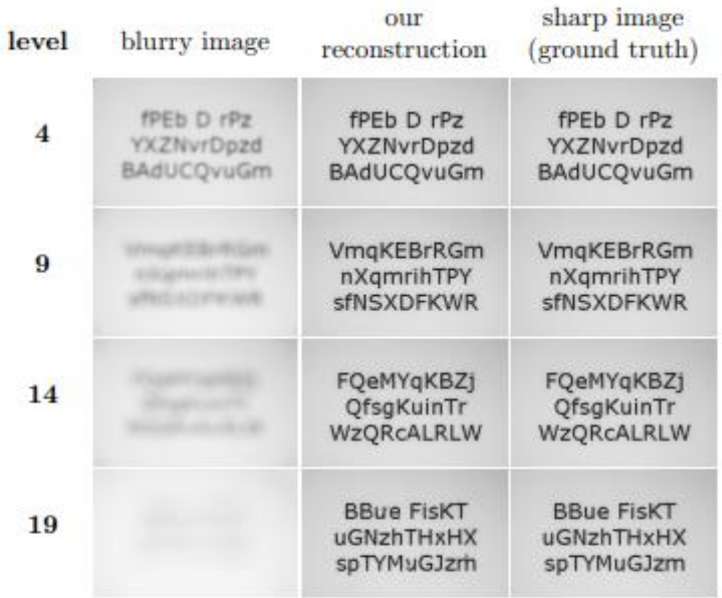
Following ML Trends

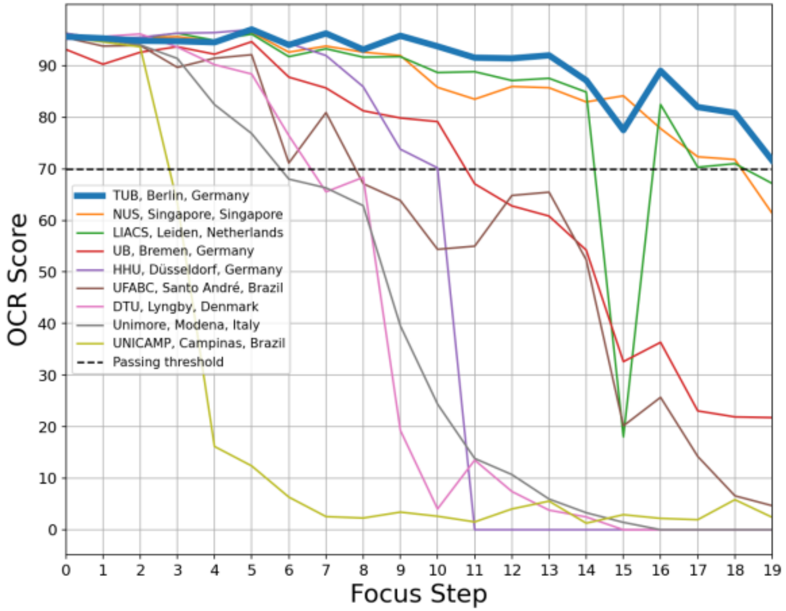
- paperswithcode.com
- public OCR tools
  - Azure Computer Vision
- scientific conference / meetings
  - OCR
    - ICDAR – International Conference on Document Analysis and Recognition
  - NLP
    - ACL – Association for Computational Linguistics



Research Example (2022)

- Solving problem: **Pre-processing - Blur**
- *Let's Enhance: A Deep Learning Approach to Extreme Deblurring of Text Image (Trippe et al., 2022)*
  - Technische Universität Berlin & Utrecht University
  - Helsinki Deblur Challenge 2021 (1st place)





Computer Vision

Optical Character Recognition

Edit

203 papers with code • 4 benchmarks • 49 datasets

Optical character recognition or optical character reader (OCR) is the electronic or mechanical conversion of images of typed, handwritten or printed text into machine-encoded text, whether from a scanned document, a photo of a document, a scene-photo (for example the text on signs and billboards in a landscape photo, license plates in cars...) or from subtitle text superimposed on an image (for example: from a television broadcast)

Benchmarks

Add a Result

These leaderboards are used to track progress in Optical Character Recognition

Trend	Dataset	Best Model	Paper	Code	Compare
	Benchmarking Chinese Text Recognition: Datasets, Baselines, and an Empirical Study	MaskOCR-L			See all
	FSNS - Test	AttentionOCR_Inception-resnet-v2_Location			See all
	I2L-140K	I2L-NOPOOL			See all
	im2latex-100k	I2L-STRIPS			See all

Libraries

Use these libraries to find Optical Character Recognition models and implementations

PaddlePaddle/PaddleOCR	18 papers	26,901 ★
open-mmlab/mmocr	5 papers	2,977 ★
Media-Smart/vedastr	5 papers	497 ★
huggingface/transformers	3 papers	74,915 ★

See all 7 libraries.

Content

Datasets

IAM
FUNSD
ICDAR 2003
ST-VQA
TextCaps
SciTSR
DocBank
TextOCR
UFPR-ALPR
MLe2e

See all 49 optical character recognition datasets

Subtasks

Active Learning
Handwriting Recognition
Handwritten Digit Recognition
Irregular Text Recognition

Show all 8 subtasks

Most implemented papers

Most implemented Social Latest No code

Search for a paper, author or keyword

An End-to-End Trainable Neural Network for Image-based Sequence Recognition and Its Application to Scene Text Recognition

79

PaddlePaddle/PaddleOCR • 21 Jul 2015

In this paper, we investigate the problem of scene text recognition, which is among the most important and challenging tasks in image-based sequence recognition.

Paper Code

EAST: An Efficient and Accurate Scene Text Detector

30

PaddlePaddle/PaddleOCR • CVPR 2017

Previous approaches for scene text detection have already achieved promising performances across various benchmarks.

Paper Code

Azure Computer Vision

Use one of your own files or choose from a sample below.

Drag and drop a file here
or
Browse for a file
or
Take a photo

Sample form #3

Detected attributes   JSON

Nutrition Facts Amount Per Serving
Serving size: 1 bar (40g)
Serving Per Package: 4
Total Fat 13g
Saturated Fat 1.5g
Amount Per Serving
Trans Fat 0g
alories 190
Cholesterol 0mg
ories from Fat 110
Sodium 20mg
nt Daily Values are based on
Vitamin A 50%
calorie diet.

Optical Character Recognition (OCR)

The Computer Vision Read API supports many languages. The `Read` API can extract text from images and documents with mixed languages, including from the same text line, without requiring a language parameter.

> ⓘ Note
>
> **Language code optional**
>
> `Read` OCR's deep-learning-based universal models extract all multi-lingual text in your documents, including text lines with mixed languages, and do not require specifying a language code. Do not provide the language code as the parameter unless you are sure about the language and want to force the service to apply only the relevant model. Otherwise, the service may return incomplete and incorrect text.

See How to specify the Read model to use the new languages.

Handwritten text

The following table lists the OCR supported languages for handwritten text by the most recent `Read` GA model.

Language	Language code (optional)	Language	Language code (optional)
English	en	Japanese	ja
Chinese Simplified	zh-Hans	Korean	ko
French	fr	Portuguese	pt
German	de	Spanish	es
Italian	it		

Print text

The following table lists the OCR supported languages for print text by the most recent `Read` GA model.

Language	Code (optional)	Language	Code (optional)
Afrikaans	af	Khasi	kha
Albanian	sq	K'iche'	quc
Angika (Devanagiri)	anp	Korean	ko
Arabic	ar	Korku	kfq
Asturian	ast	Koryak	kpy
Awadhi-Hindi (Devanagiri)	awa	Kosraean	kos
Azerbaijani (Latin)	az	Kumyk (Cyrillic)	kum
Bagheli	bfy	Kurdish (Arabic)	ku-arab

Is OCR Solved?

- there are always problems to be solved
- no model is 100% accurate
- OCR is base for many systems
- OCR improvement → CV models improvement

Figure 4: Technical challenges of OCR algorithms

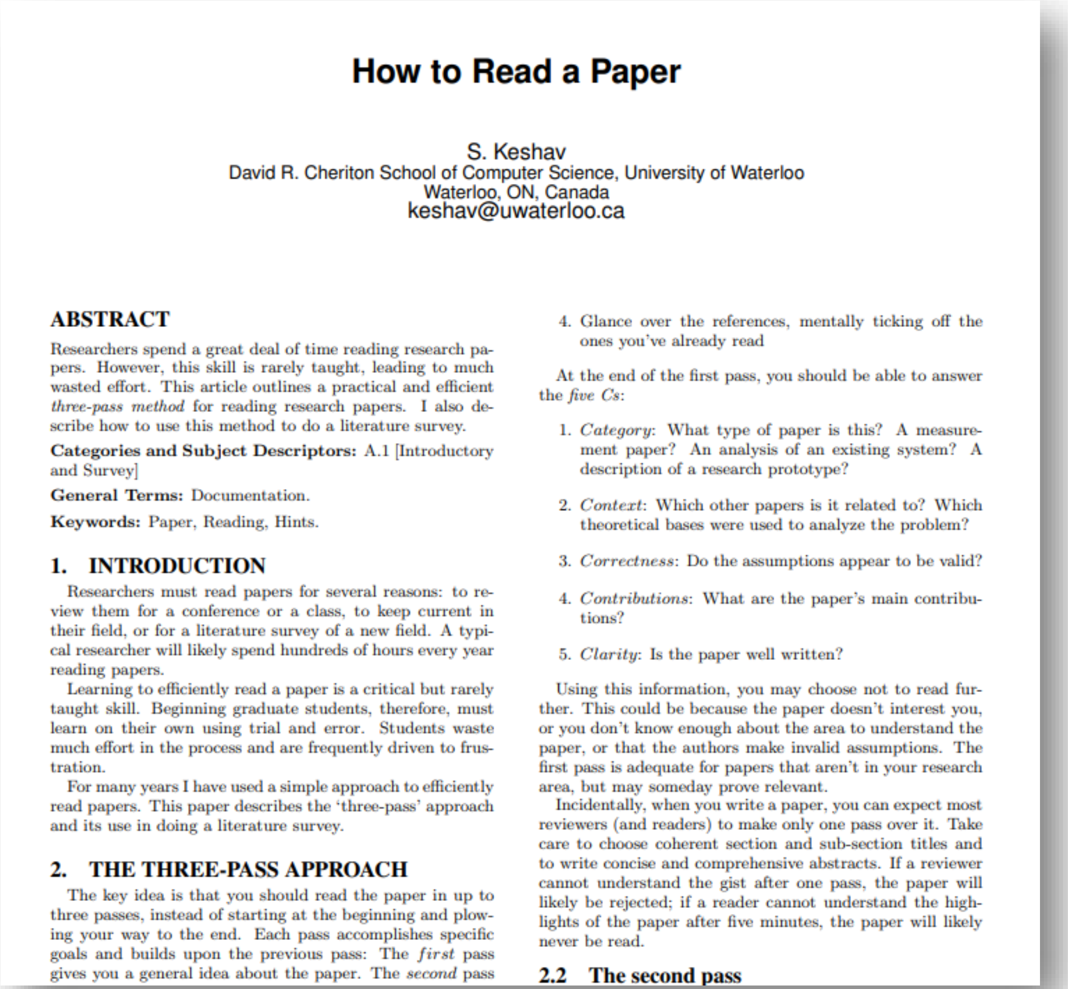
Demo

Useful Links

- https://paperswithcode.com/sota
- https://dl.acm.org/doi/10.1145/1273445.1273458
- https://github.com/PaddlePaddle/PaddleOCR

Digression: Reading Papers

- *How to Read a Paper (Keshav, 2007)*
- three pass approach
  1. Pass one – **least technical**
     - Reading only the title, abstract, and first paragraph of each section
     - 5 – 10 minutes
  2. Pass two
     - Everything but details (formulas, figures, code)
     - 1 hour
  3. Pass three – **most technical**
     - Fully understand the paper
     - 4-5 hours



How to Read a Paper

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ABSTRACT

Researchers spend a great deal of time reading research papers. However, this skill is rarely taught, leading to much wasted effort. This article outlines a practical and efficient *three-pass method* for reading research papers. I also describe how to use this method to do a literature survey.

Categories and Subject Descriptors: A.1 [Introductory and Survey]

General Terms: Documentation.

Keywords: Paper, Reading, Hints.

1. INTRODUCTION

Researchers must read papers for several reasons: to review them for a conference or a class, to keep current in their field, or for a literature survey of a new field. A typical researcher will likely spend hundreds of hours every year reading papers.

Learning to efficiently read a paper is a critical but rarely taught skill. Beginning graduate students, therefore, must learn on their own using trial and error. Students waste much effort in the process and are frequently driven to frustration.

For many years I have used a simple approach to efficiently read papers. This paper describes the 'three-pass' approach and its use in doing a literature survey.

2. THE THREE-PASS APPROACH

The key idea is that you should read the paper in up to three passes, instead of starting at the beginning and plowing your way to the end. Each pass accomplishes specific goals and builds upon the previous pass: The *first* pass gives you a general idea about the paper. The *second* pass

4. Glance over the references, mentally ticking off the ones you've already read

At the end of the first pass, you should be able to answer the *five Cs*:

1. *Category*: What type of paper is this? A measurement paper? An analysis of an existing system? A description of a research prototype?
2. *Context*: Which other papers is it related to? Which theoretical bases were used to analyze the problem?
3. *Correctness*: Do the assumptions appear to be valid?
4. *Contributions*: What are the paper's main contributions?
5. *Clarity*: Is the paper well written?

Using this information, you may choose not to read further. This could be because the paper doesn't interest you, or you don't know enough about the area to understand the paper, or that the authors make invalid assumptions. The first pass is adequate for papers that aren't in your research area, but may someday prove relevant.

Incidentally, when you write a paper, you can expect most reviewers (and readers) to make only one pass over it. Take care to choose coherent section and sub-section titles and to write concise and comprehensive abstracts. If a reviewer cannot understand the gist after one pass, the paper will likely be rejected; if a reader cannot understand the highlights of the paper after five minutes, the paper will likely never be read.

2.2 The second pass

Questions?