Breaking CAPTCHAs on the Dark Web

Using neural networks to enable scraping

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Introduction

Scraping the Dark Web

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... sometimes hard to get to.

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Mainly the blockades, such as CAPTCHAs, is an issue for the scrapers.

CAPTCHA

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- Test to determine whether the user is human or not

Main question

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How would a scraper be able to circumvent CAPTCHAs that prevent it from properly scraping dark web websites?

Sub-questions:

1. Impact of solving CAPTCHAs
2. Solve CAPTCHAs by using Optical Character Recognition (OCR)?
3. Solving CAPTCHAs by using Machine Learning (ML)

Related Work

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2. Ryan Mitchell demonstrated how to solve CAPTCHAs using Optical Character Recognition with Tesseract [2]
3. Torch has previously been used to train a neural network to solve CAPTCHAs by Arun Patala [3]

Methods

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Two methods to solve the questions:

1. Categorizing dark web websites
2. Breaking CAPTCHAs

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- Which ones are up?
- Are there any duplicates?
- Which ones block scraping?
- What kind of blockade are they using?

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2. Breaking CAPTCHAs - Dataset

Testing two common types of CAPTCHA:

Figure 2: CAPTCHAs set 1, generated using PHP

Figure 3: CAPTCHAs set 2, generated with Python

2. Breaking CAPTCHAs

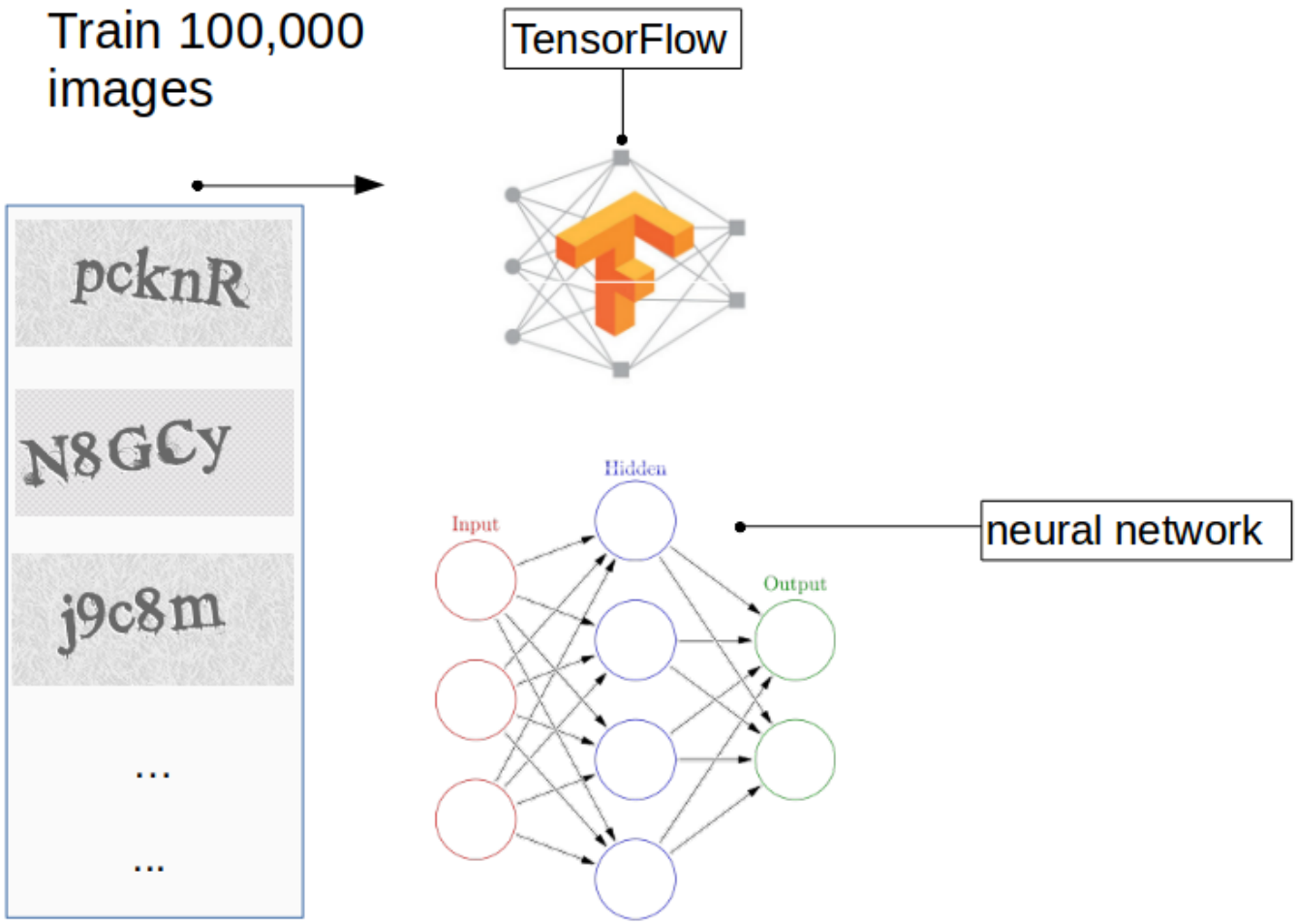

Figure 4: Training the neural network

Figure 5: Login web page with generated CAPTCHA

2. Breaking CAPTCHAs

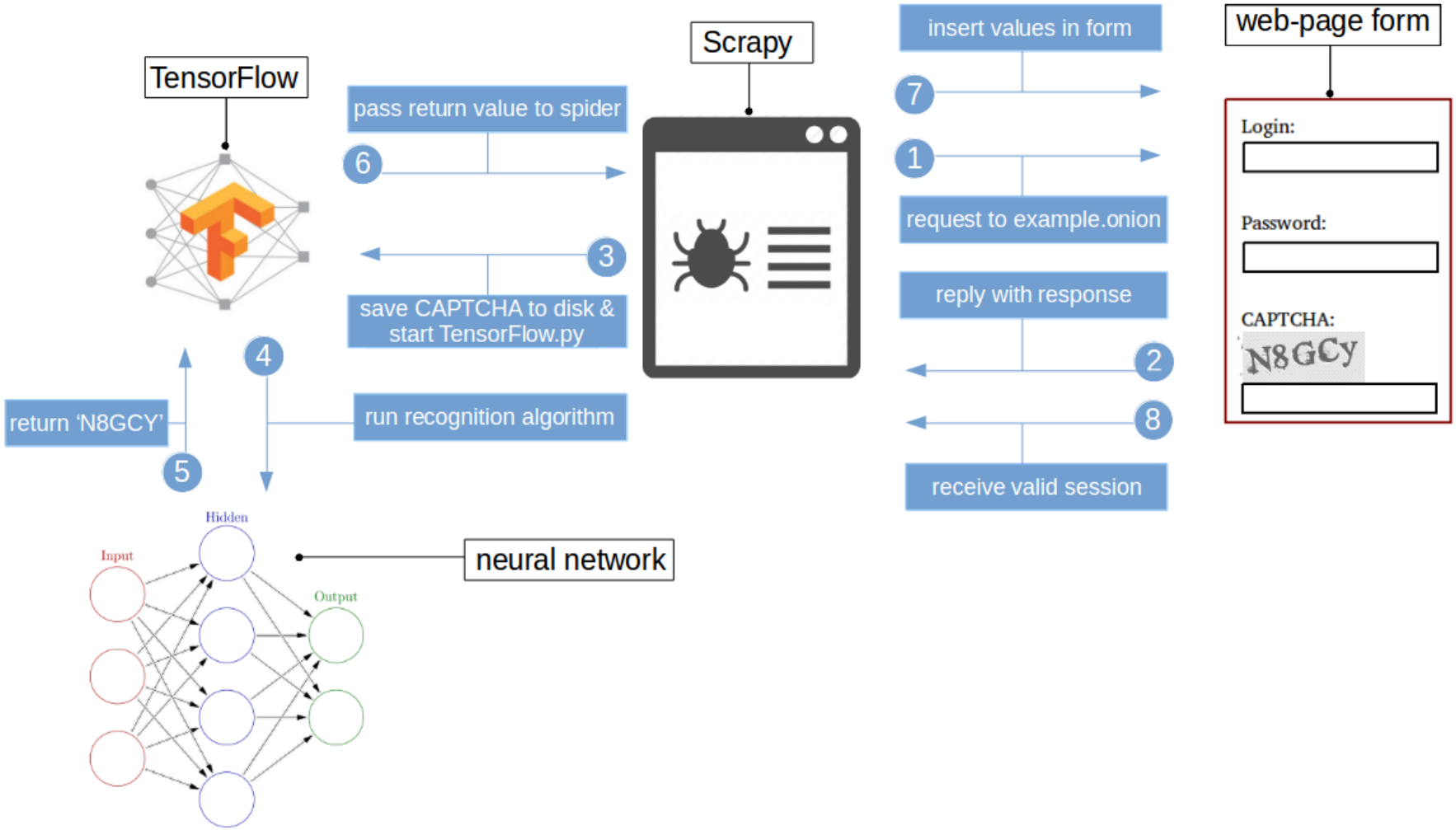

Figure 6: Workflow of solving CAPTCHA with TensorFlow via Scrapy

Results

1. Categorizing websites

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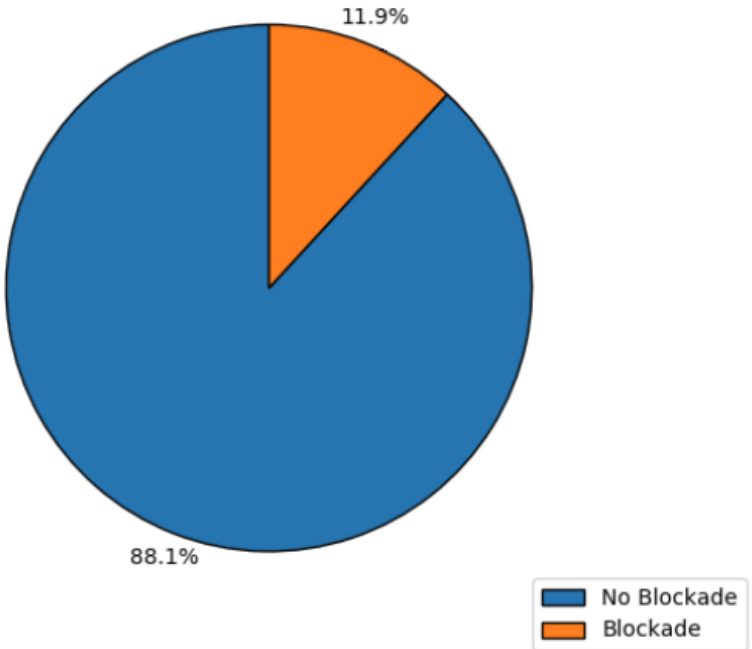

Figure 7: Percentage of scraping blockade using CAPTCHAs (n = 465)

1. Categorizing websites

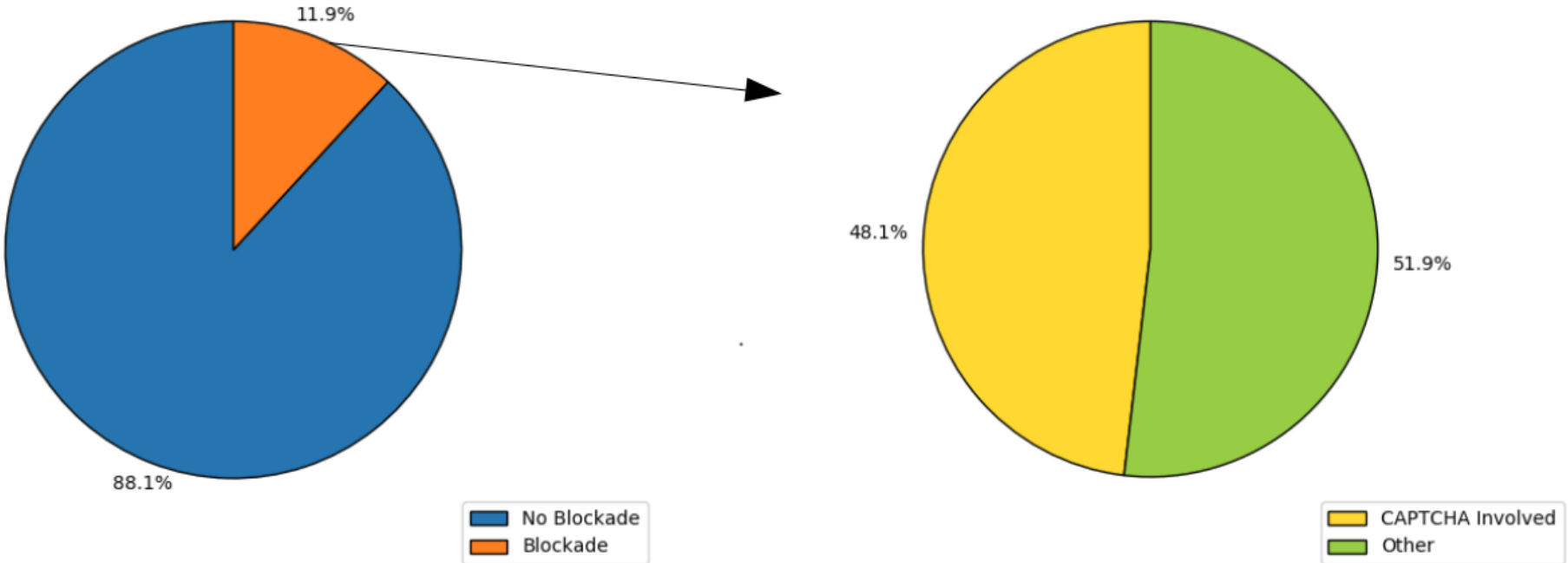

Figure 8: Percentage of scraping blockades using CAPTCHAs ($n = 465$, $n = 55$)

2. Breaking CAPTCHAs - TensorFlow vs. Tesseract

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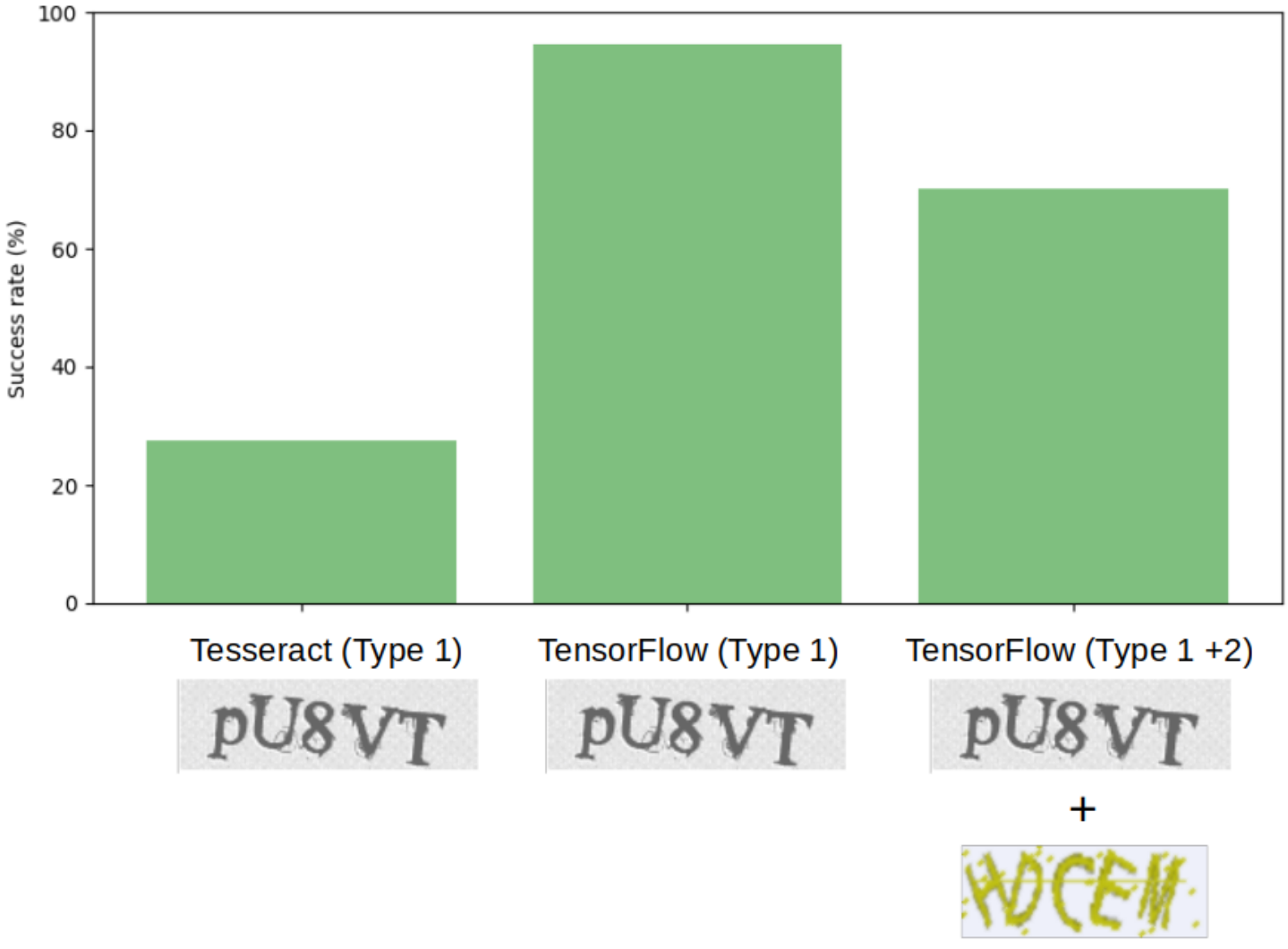

Figure 9: Success rate of Tesseract and TensorFlow (n = 1,000), higher is better

2. Breaking CAPTCHAs - TensorFlow vs. Tesseract

Levenshtein distance: minimal edit distance to get the correct result [5]

E.g. kitten to mitten $= 1$

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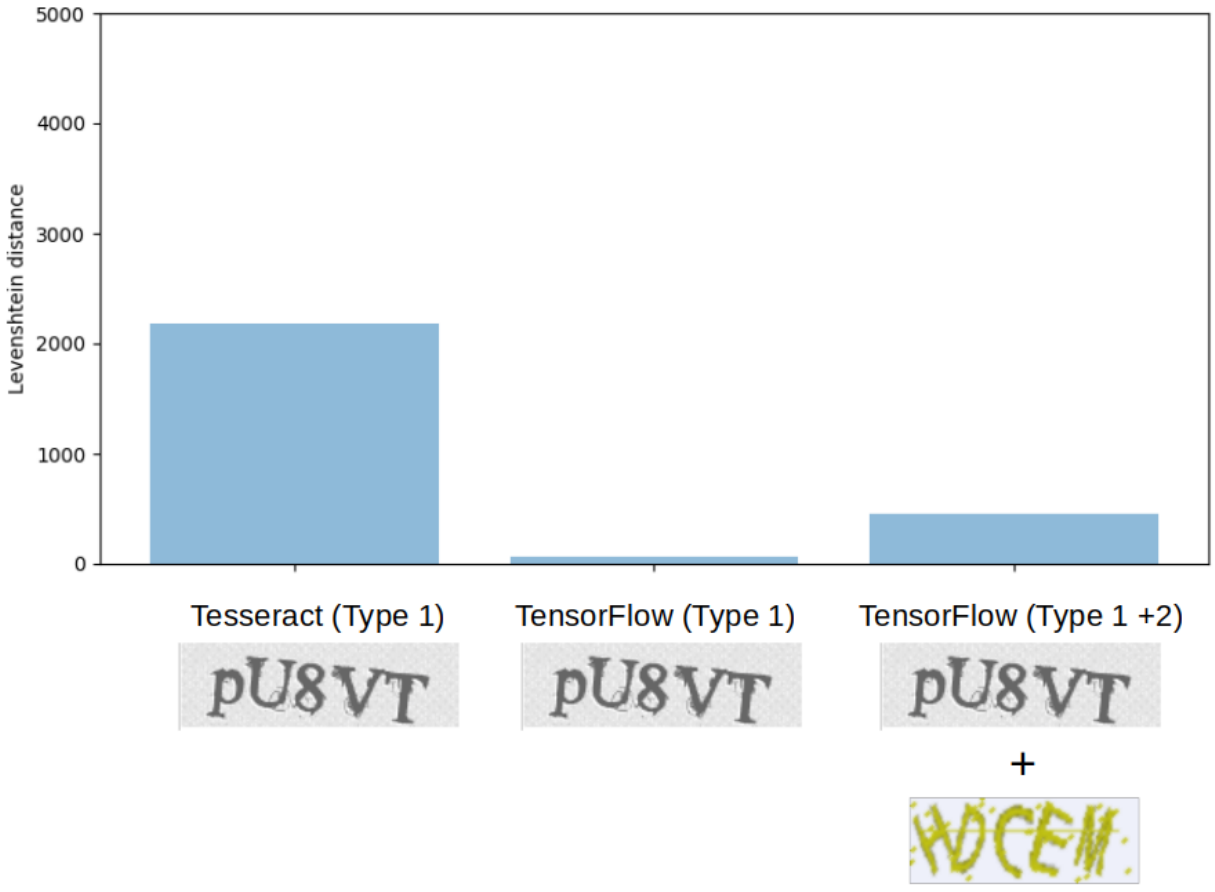

Figure 10: Combined Levenshtein distance, lower is better

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- Circumventing CAPTCHAs is necessary to scrape blocked parts of websites
- Machine Learning is most effective
- However, if immediacy takes precedent over success rate and accuracy, then Tesseract (OCR) might be a better option

Future Research

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A more granular analysis of dark web websites:

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- What content?

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- What content?
- Any content hidden, due to lack of privileges?

Future Research

Increase readability for Tesseract by "cleaning up" the image

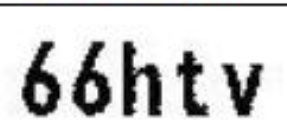
Original	Thresholded	OCR
		66htv

Figure 11: Removing noise from CAPTCHA [6]

Future Research

Achieve a more efficient training model, by using character segmentation

Figure 12: CAPTCHA character segmentation [7]

Future Research

Try more CAPTCHAs:

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Try more CAPTCHAs:

- Increased difficulty
- If software to generate the CAPTCHAs, including the answers, is not available; send a training set to be solved by human labor. This costs money, $ 1,39 per 1,000 images [8]

Questions

?

References

[1] Lawrence, H., Hughes, A., Tonic, R., & Zou, C. (2017, October). D-miner: A framework for mining, searching, visualizing, and alerting on darknet events. In Communications and Network Security (CNS), 2017 IEEE Conference on (pp. 1-9). IEEE.

[2] Mitchell, R. (2015). Web scraping with Python: collecting data from the modern web. " O'Reilly Media, Inc.".

[3] Arun Patala. https://deepmlblog.wordpress.com/2016/01/03/how-to-break-a-captcha-system/

[4]people.cs.pitt.edu

[5]extremetech.com

[6]ahm3dibrahim.wordpress.com

[7] medium.com

[8] http://www.deathbycaptcha.com/