



DEPARTMENT OF INFORMATICS

TECHNISCHE UNIVERSITÄT MÜNCHEN

Master's Thesis in Informatics

**Developing a Scalable, Secure, and  
Privacy-preserving Platform for Collection,  
Aggregation, and Analysis of Mobility Data**

**Dinh Le Khanh Duy**





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Privacy-preserving Platform for Collection,  
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**Entwicklung einer skalierbaren, sicheren,  
privatsphäre-erhaltenden Plattform zur  
Sammlung, Aggregation und Analyse von  
Mobilitätsdaten**

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Submission Date:	15.03.2020



I confirm that this master's thesis in informatics is my own work and I have documented all sources and material used.

Munich, 15.03.2020

Dinh Le Khanh Duy



# Contents

<b>Abstract</b>	<b>iii</b>
<b>1. Introduction</b>	<b>1</b>
1.1. Motivation . . . . .	1
1.2. Research Questions . . . . .	1
1.3. Contributions . . . . .	1
<b>2. Related Work</b>	<b>2</b>
2.1. Attack Vectors . . . . .	2
2.1.1. Dangers of central databases . . . . .	2
2.1.2. Dangers of location tracking . . . . .	2
2.1.3. Dangers of identity inference . . . . .	2
2.2. Countermeasures . . . . .	2
2.2.1. k-Anonymity . . . . .	2
2.2.2. Spatial Cloaking . . . . .	2
<b>3. Methodology</b>	<b>3</b>
3.1. Trust and Anonymity . . . . .	3
3.2. Different Approaches . . . . .	3
3.2.1. Decentralized . . . . .	3
3.2.2. Centralized . . . . .	3
<b>4. Design and Implementation</b>	<b>4</b>
4.1. Technology Stack . . . . .	4
4.2. Decentralized Approach . . . . .	4
4.2.1. IPFS . . . . .	4
4.2.2. Limitations . . . . .	4
4.3. Centralized Approach . . . . .	4
4.3.1. First Approach . . . . .	4
4.3.2. Second Approach . . . . .	4
<b>5. Performance and Evaluation</b>	<b>5</b>
5.1. Test Environment . . . . .	5
5.2. Performance . . . . .	5
5.2.1. Accuracy . . . . .	5
5.2.2. Data Consumption . . . . .	5

5.3. Privacy Evaluation . . . . .	5
5.3.1. Collected Data . . . . .	5
<b>6. Conclusion</b>	<b>6</b>
6.1. Research Questions . . . . .	6
6.2. Limitations . . . . .	6
6.3. Future Work . . . . .	6
6.3.1. Additional Information . . . . .	6
6.3.2. Decentralization and Blockchain . . . . .	6
6.3.3. Reproducibility . . . . .	6
<b>7. Introduction</b>	<b>7</b>
7.1. Section . . . . .	7
7.1.1. Subsection . . . . .	7
<b>8. Second Introduction</b>	<b>10</b>
<b>A. General Agenda</b>	<b>11</b>
A.1. Detailed Addition . . . . .	11
<b>B. Figures</b>	<b>12</b>
B.1. Example 1 . . . . .	12
B.2. Example 2 . . . . .	12
<b>List of Figures</b>	<b>13</b>
<b>List of Tables</b>	<b>14</b>

# **1. Introduction**

Use with pdfLaTeX and Biber.

## **1.1. Motivation**

## **1.2. Research Questions**

## **1.3. Contributions**

## **2. Related Work**

### **2.1. Attack Vectors**

**2.1.1. Dangers of central databases**

**2.1.2. Dangers of location tracking**

**2.1.3. Dangers of identity inference**

### **2.2. Countermeasures**

**2.2.1. k-Anonymity**

**2.2.2. Spatial Cloaking**



## **3. Methodology**

### **3.1. Trust and Anonymity**

### **3.2. Different Approaches**

#### **3.2.1. Decentralized**

#### **3.2.2. Centralized**

## **4. Design and Implementation**

### **4.1. Technology Stack**

### **4.2. Decentralized Approach**

#### **4.2.1. IPFS**

#### **4.2.2. Limitations**

### **4.3. Centralized Approach**

#### **4.3.1. First Approach**

#### **4.3.2. Second Approach**

**API**

**NodeJS**

**Android**

**Benefits and Sacrifices**

## **5. Performance and Evaluation**

### **5.1. Test Environment**

### **5.2. Performance**

#### **5.2.1. Accuracy**

#### **5.2.2. Data Consumption**

### **5.3. Privacy Evaluation**

#### **5.3.1. Collected Data**

## **6. Conclusion**

### **6.1. Research Questions**

### **6.2. Limitations**

### **6.3. Future Work**

#### **6.3.1. Additional Information**

#### **6.3.2. Decentralization and Blockchain**

#### **6.3.3. Reproducibility**

# 7. Introduction

Use with pdfLaTeX and Biber.

## 7.1. Section

Citation test (with Biber) [latex].

### 7.1.1. Subsection

See Table 7.1, Figure 7.1, Figure 7.2, Figure 7.3, Figure 7.4, Figure 7.5.

Table 7.1.: An example for a simple table.

A	B	C	D
1	2	1	2
2	3	2	3

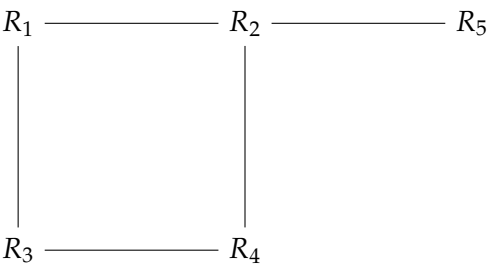


Figure 7.1.: An example for a simple drawing.

This is how the glossary will be used.

Donor dye, ex. Alexa 488 ( $D_{\text{dye}}$ ), Förster distance, Förster distance ( $R_0$ ), and  $k_{DEAC}$ . Also, the TUM has many computers, not only one Computer. Subsequent acronym usage will only print the short version of Technical University of Munich (TUM) (take care of plural, if needed!), like here with TUM, too. It can also be  $\rightarrow$  hidden<sup>1</sup>  $\leftarrow$ .

[(TODO: Now it is your turn to write your thesis.

This will be a few tough weeks.)]

[(DONE: NEVERTHELESS, CELEBRATE IT WHEN IT IS DONE!)]

<sup>1</sup>Example for a hidden TUM glossary entry.

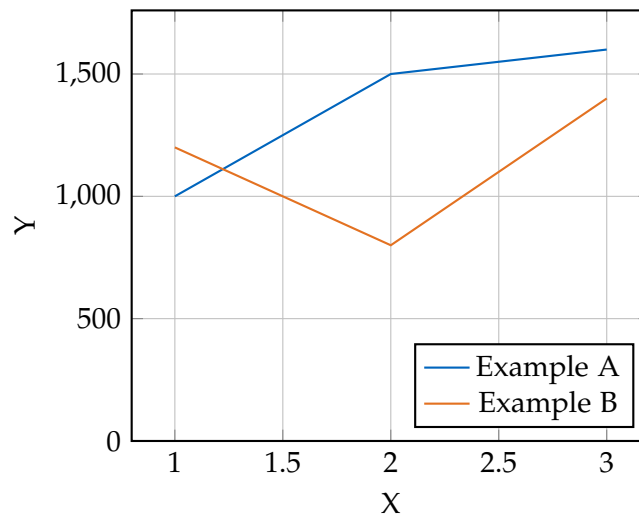


Figure 7.2.: An example for a simple plot.

```
SELECT * FROM tbl WHERE tbl.str = "str"
```

Figure 7.3.: An example for a source code listing.



Figure 7.4.: Includegraphics searches for the filename without extension first in logos, then in figures.



Figure 7.5.: For pictures with the same name, the direct folder needs to be chosen.



(a) The logo.



(b) The famous slide.

Figure 7.6.: Two TUM pictures side by side.

## 8. Second Introduction

Use with pdfLaTeX and Biber.



## **A. General Agenda**

If there are several additions you want to add, but they do not fit into the thesis itself, they belong here.

### **A.1. Detailed Addition**

Even sections are possible, but usually only used for several elements in, e.g. tables, images, etc.

## B. Figures

### B.1. Example 1

✓

### B.2. Example 2

✗

# List of Figures

7.1. Example drawing . . . . .	7
7.2. Example plot . . . . .	8
7.3. Example listing . . . . .	8
7.4. Something else can be written here for listing this, otherwise the caption will be written! . . . . .	8
7.5. For pictures with the same name, the direct folder needs to be chosen. . . . .	9
7.6. Two TUM pictures side by side. . . . .	9

# List of Tables

7.1. Example table . . . . . 7