

# Something something

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# Summary (English)

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The goal of the thesis is to ...



# Preface

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This thesis was prepared at the department of Informatics and Mathematical Modelling at the Technical University of Denmark in fulfilment of the requirements for acquiring an M.Sc. in Informatics.

The thesis deals with ...

The thesis consists of ...

Lyngby, 01-January-2013

*Not Real*

Luke Herbert



# Acknowledgements

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I would like to thank my...





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## CHAPTER 1

# Introduction

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## CHAPTER 2

# Related work

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There is a high interest and a huge amount of work the scientific community dedicates to understanding the patterns of human mobility. The knowledge we can gain from the results of this work has the potential to benefit a wide variety of industries from the modeling and maintenance of the transportation infrastructure, to the medical industry where we can use this knowledge in trying to prevent the spreading of epidemics. ??

Various studies have been conducted in order to gain a better understanding of the human mobility patterns. These studies give us results that seem to support each other in the idea that people are less spontaneous than they would like to think themselves and that, indeed, our behaviour shows that we are quite rooted into habits when it comes to the way we travel.

### 2.1 Mobility patterns uncovered by the dispersion on bank notes

Brockmann, Hufnagel and Geisel?? have analyzed the human movement based on the way bank notes were dispersed through the United States (excluding Alaska and Hawaii). Their study shows that a relatively small percentage of

bank notes (23.6%) traveled for more than 800 km, while a fraction of 19.1% did not traveled for more than 50 km even after a year of being observed. The possible explanation the authors have given for these findings are that, in general, people would be less inclined to leave the areas of the large cities or the places they usually conduct their lives.

## 2.2 Mobility patterns of mobile phone users

A. L. Barabasi, M. C. Gonzalez and C. A. Hidalgo have conducted a study ?? that deals with studying the trajectories of over 100000 mobile phone users with anonymized identities. The study was conducted in order to see if there are any patterns in our mobility habits. Among the things that have been subjected to testing was the return probability of individuals in the same place as in the past. The study shows there is, in general, a peak in the return probability after 24, 48 or 72 since they have left a particular location. This shows that we humans tend to visit locations periodically. This can be explained by our going to places such as work, school, grocery shops near our home etc.

The authors have also ranked the locations the mobile phone users frequented based on the number of times they have been spotted nearby. The results for this have shown that the probability of finding someone near a location that is ranked for them with a level  $L$  can be estimated with  $1/L$ . Another interesting finding that is mentioned in the paper is that, in general, people seem to be spending the majority of their time in just a few locations, while dividing the remaining time just between a limited number of locations that varies for the subjects from as low as 5 to around 50.

There are some noteworthy plots that the authors present in the paper. They can be seen in figure and they show that most people travel over short distances, yet there is a small number of people that regularly travel over big distances.

The results of this study are a major indicator that individuals display a high level of regularity and that we have a tendency to spend most of our times in places that are familiar to us, or that require us to visit them regularly (e.g. home, work).

## 2.3 Mobility patterns in massive multiplayer online games

R. Sinatra and M. Szell have studied the way in which users of a massive multiplayer online game behave inside the virtual universe provided by the mentioned game [??](#). It has been established that the massive multiplayer games provide people with a virtual reality where they can interact with others through their characters and can, in fact, form groups and, as such, display both individual as well as collective behaviour actions that can translate to the non-virtual world [??](#).

This study gives an interesting insight into the habits and actions of the characters which are controlled by the players. Among the things the authors have analyzed are the predictability of the characters, the entropy generated by the mobility of the characters in the virtual universe and general strategies or patterns that could be observed.

The game the authors have been using for the study is called Pardus <sup>1</sup>. This game is quite complex, as it allows the manifestation of normal real-life activities such as the creation of alliances or friendships, communication between the players, economic related action, or even actions which have a negative connotation such as attack of another user, removal of a friendship link etc. The universe of the game consists in hundreds of nodes which represent cities or sectors in the game. These virtual cities are tied to each other through links which mark the possibility for the users to move their characters from one place to another.

By analyzing the way in which characters have interacted through the years, the authors have observed that the mobility of the characters through the universe is highly predictable, as users in general will seem to be choosing a random location to visit next in just about 10% of the cases.

Other methods that have been used in trying to forecast human mobility patterns include Markov chain models [??](#) [??](#), neural networks [??](#), Bayesian networks [??](#), and finite automaton [??](#).

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<sup>1</sup>[http://en.wikipedia.org/wiki/Pardus\\_\(browser\\_game\)](http://en.wikipedia.org/wiki/Pardus_(browser_game))





## APPENDIX A

# Stuff

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This appendix is full of stuff ...



# Bibliography

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