ETH zürich

Department of Physics
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Increasing the Robustness of Complex Networks

Master's Thesis

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For science.

If life gives you lemons, make lemonade. Life will be like "Whoa!"
— Phil Dunphy

ACKNOWLEDGEMENTS

I would like to thank everyone.

ABSTRACT

This is a thesis that does a lot of science.

CONTENTS

1

INTRODUCTION

People talk. Why do they talk? We don't need to know. When trying to improve the resilience of a network all we need to know is when do people talk.

1.1 ABOUT THE THESIS

Lorem ipsum

2

BACKGROUND

This chapter provides a general description and minimum introduction to the various concepts and tools (of both mathematical and computational nature) used in this thesis. The following sections will hopefully be self-contained and will act as a springboard for understanding the results presented in this thesis and their relevance in the broader network research paradigm. Wherever possible references are provided for further consultation.

2.1 COMPLEX NETWORKS

2.2 STATISTICAL METHODS

2.3 DATA FITTING METHODS

2.4 GRAPH TOOLS

2.5 PROGRAMMING LANGUAGES

The bulk of the work in this thesis was done in Python 2.7[1]. Apart from the core pre-installed modules, the essential trio of scientific programming – `SciPy`, `NumPy` and `matplotlib`, were used. The `igraph`, `graph_tool` and PATHPY packages mentioned in the previous sections were also run in Python. The pseudocode provided in the later chapters are also based on Python syntax.

The gHypE package was used in R[2]. The typesetting of this manuscript was done using LaTeX.

1 Python programming language: www.python.org
2 R Project: www.r-project.org

3

SAMPLE CHAPTER

This is a generic chapter with code on how to add figures, quotes, code snippets etc.

> Oh look, quoted text! Such magical.
>
> 1. There is even a list inside the quote!
> 2. Science has come so far.

Aha a figure.

FIGURE 3.1: Best dog in the world.

Here's how to add a code snippet. Put the file in the "code" folder in this chapter's directory and direct the path to it. Also set the language and caption as you need.

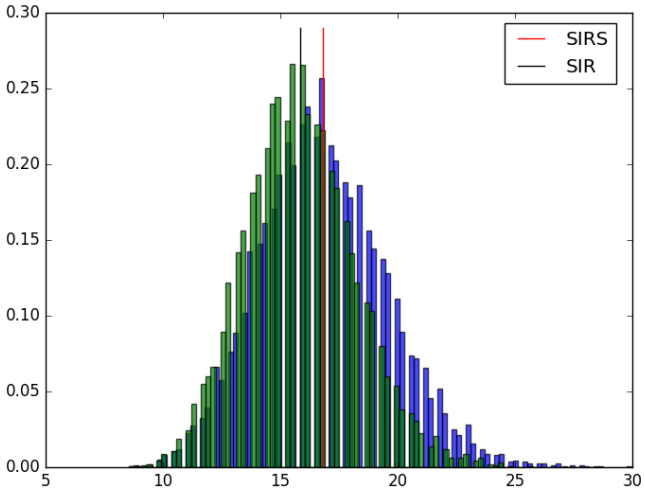
```
1 def sample_function(x):
2     if x > 5:
3         print("Wow. Big number.")
4     else:
5         print("Small number.")
```

LISTING 3.1: Sample pseudocode.

And now here's how to add a piece of code in-line, by typing it out in the TEXfile itself.

Number of interactions	Number of pairs
1	1787
2	694
3	442
42	13
100	1
1983	1
Maximum number of interactions	2949 (1 pair)
Mean number of interactions	32.40
Median number of interactions	3

(a) Statistics on the degree of edges.



(b) Some shit.

FIGURE 3.2: The distribution follows a heavy-tailed power law as seen in **??** inset.

```
1 sample = [10,5,2,3,6]
2 print(sample)
```

And now a table!

Notice how the table and the figure are added as "sub-figures". You can use this code to add two images side by side.

And while writing the thesis if there's something you want to come back to later, just add a highlighted comment like this. Citation Needed

This is how you refer to different labels in your document. Appendix and Background.

You might also want to add citations. Add your citations to the "bib" file then add them to the text using the `\Cite` command (looks like this [1]) or `\Citeauthor` command (looks like this Rosvall *et al.* For your citations to actually work you first need to compile your TEXfile using PDFLaTeX, then by BibTeX and then by PDFLaTeX again.

4

AGENT BASED MODEL

The final task of the thesis is to develop an agent-based model (ABM) that reproduces the repeated interactions of individuals according to the relations found in the data. This ABM would allow us to not only verify any control strategies found in the preceding analysis but also validate our SynTG algorithm.

4.1 DEFINING AGENT PROPERTIES

4.2 INITIALIZING AGENTS

5

RESULTS

Proof that science was done in this thesis.

6

DISCUSSION

7

CONCLUSION

With this we conclude that this was a science-filled thesis.

BIBLIOGRAPHY

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2. Rosvall, M., Esquivel, A. V., Lancichinetti, A., West, J. D. & Lambiotte, R. Memory in network flows and its effects on spreading dynamics and community detection. *Nature communications* **5** (2014).

A

APPENDIX

Nothing clears up a case so much as stating it to another person.

— Arthur C. Doyle

B

MORE APPENDIX

Lorem ipsum dolor sit amet.

C

EVEN MORE APPENDIX

D

ENOUGH WITH THE APPENDIX

The End.

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