Instituto Tecnológico y de Estudios Superiores de Monterrey
Campus Monterrey
School of Engineering and Sciences

APPLICATION OF EVOLUTIONARY ALGORITHMS TO SOLVE THE INFINITE MONKEY THEOREM

A thesis presented by:

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Submitted to the School of Engineering and Sciences
in partial fulfillment of the requirements for the degree of

Master of Science in Intelligent Systems

Monterrey, N.L.

December, 2014

Instituto Tecnológico y de Estudios Superiores de Monterrey
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The committee members, hereby, certify that have read the thesis presented by Arthur Philip Dent and that it is fully adequate in scope and quality as a partial requirement for the degree of Master of Science in Intelligent Systems.

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I, Arthur Philip Dent declare that this thesis titled, APPLICATION OF EVOLUTIONARY ALGORITHMS TO SOLVE THE INFINITE MONKEY THEOREM and the work presented in it are my own. I confirm that:

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- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

ARTHUR PHILIP DENT
Monterrey, N.L., December, 2014

Dedicatory

To my family and friends

Acknowledgments

To my principal adviser Dr. Principal Adviser for his friendship and support along this work.

To my family and friends

ARTHUR PHILIP DENT

Instituto Tecnológico y de Estudios Superiores de Monterrey
December, 2014

Abstract

APPLICATION OF EVOLUTIONARY ALGORITHMS TO SOLVE THE INFINITE MONKEY THEOREM

Arthur Philip Dent
Instituto Tecnológico y de Estudios Superiores de Monterrey, 2014

Principal adviser: Dr. Principal Adviser

The infinite monkey theorem states that a monkey hitting keys at random on a typewriter keyboard for an infinite amount of time will almost surely type a given text, such as the complete works of William Shakespeare.

In this context, *almost surely* is a mathematical term with a precise meaning, and the *monkey* is not an actual monkey, but a metaphor for an abstract device that produces an endless random sequence of letters and symbols. One of the earliest instances of the use of the *monkey metaphor* is that of French mathematician Émile Borel in 1913 [1], but the earliest instance may be even earlier. The relevance of the theorem is questionable—the probability of a universe full of monkeys typing a complete work such as Shakespeare's Hamlet is so tiny that the chance of it occurring during a period of time hundreds of thousands of orders of magnitude longer than the age of the universe is extremely low (but technically not zero).

Variants of the theorem include multiple and even infinitely many typists, and the target text varies between an entire library and a single sentence. The history of these statements can be traced back to Aristotle's On Generation and Corruption and Cicero's De natura deorum (On the Nature of the Gods), through Blaise Pascal and Jonathan Swift, and finally to modern statements with their iconic simians and typewriters. In the early 20th century, Émile Borel and Arthur Eddington used the theorem to illustrate the timescales implicit in the foundations of statistical mechanics [2].

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Chapter 1

Introduction

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1.1 Justification

Solving this problems is likely to solve another monkey problems.

1.2 Hypothesis

Electronic simulated monkeys are likely to learn to write Shakespeare.

1.3 Objectives

The general objective is to propose, implement, and characterize a model to solve the infinite monkey problem.

Specific objectives are listed below:

1. Propose a model to solve the infinite monkey problem.
2. Make them read Shakespeare.
3. Make then write like Shakespeare.

1.4 Thesis contributions

The present work contributes with a mathematical and computational model to study perturbations in time and space given the modeling of probabilistic monkeys.

- Construct a monkey database.
- Select equation parameters to model monkey performance.
- Run spelling-bee contests with monkeys.

1.5 Thesis organization

The organization of this thesis is as follows: Chapter 2 introduces to basic concepts in monkey theory. In chapter 3, the materials and methods are shown. This chapter comprises the source and describes each datasets employed. The results, discussion, conclusions and future work are shown in chapters 4, 5 and 6 respectively.

Chapter 2

Background

Through this chapter, a short introduction to the infinite monkey theorem is presented

2.1 Monkeys as complex systems

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2.2 Summarizing notes

In synthesis, we have briefly presented how monkeys works to form complex interaction networks.

Chapter 3

Materials and methods

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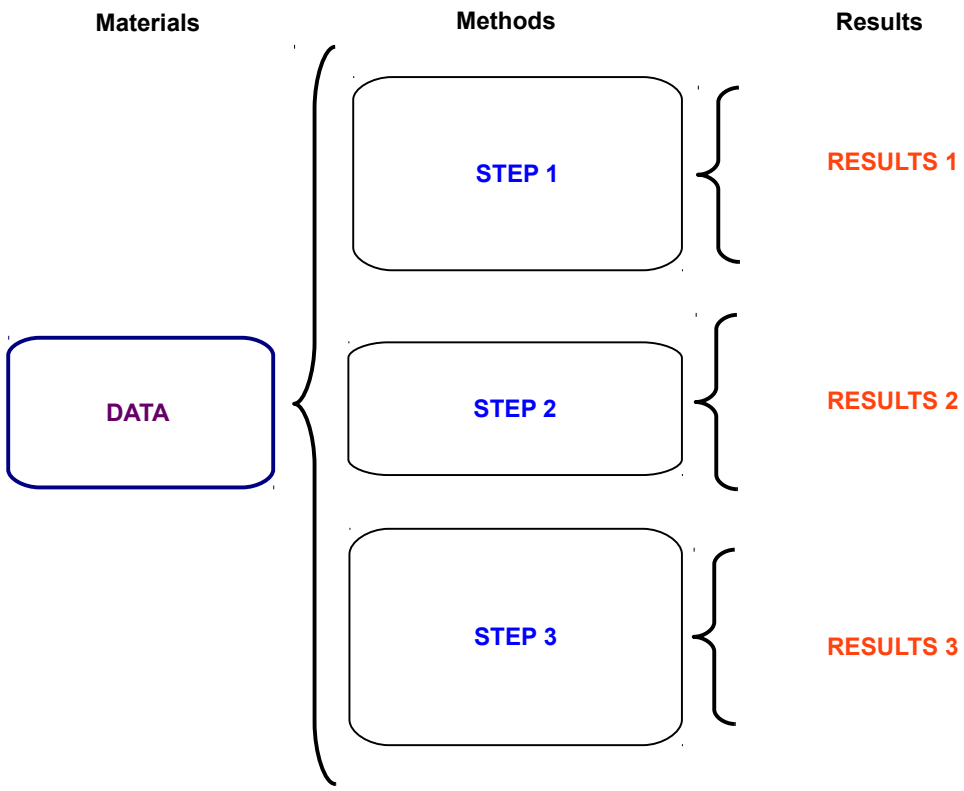

Figure 3.1: ***Flux diagram of general methodology***

Chapter 4

Results

The infinite monkey theorem states that a monkey hitting keys at random on a typewriter keyboard for an infinite amount of time will almost surely type a given text, such as the complete works of William Shakespeare.

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Table 4.1 shows the number of bananas eaten by each electronic monkey tested:

Monkey	Bananas eaten
1	2
2	3
3	6
4	15
5	6
6	8
7	2
8	4
9	9
10	4

Table 4.1: Monkeys vs bananas

Figure 4.1 shows the same as table 4.1:

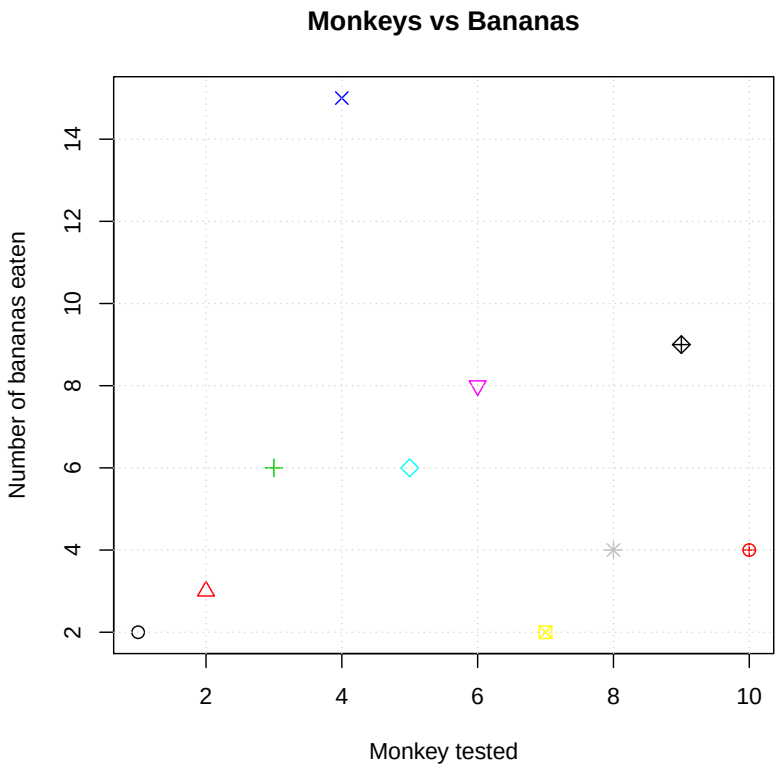

Figure 4.1: ***Monkeys vs bananas eaten***

Chapter 5

Discussion

The infinite monkey theorem states that a monkey hitting keys at random on a typewriter keyboard for an infinite amount of time will almost surely type a given text, such as the complete works of William Shakespeare.

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Chapter 6

Conclusions and future work

In this chapter, the conclusions derived from the results (chapter 4) are shown in section 6.1. Additionally, future work and suggestions to extend the current investigation are shown in section 6.2.

6.1 Conclusions

Evolutionary algorithms are helpful to solve optimization problems. We conclude that the hypothesis proposed (see section 1.2) is true, our evidence is that we solved the infinite monkey problem.

As a final comment, we expect that experimental and computational advances will lead to better modeling and understanding of typing monkeys.

6.2 Future work

There are some research questions arising from this work which should be addressed.

- **Get real monkeys:** In order to test experimentally our hypothesis, real monkeys are needed.
- **Pursue a scientific publication**.

Chapter 7

Bibliography

[1] É. Borel, "La mécanique statique et l'irréversibilité," *J. Phys. Theor. Appl.*, vol. 3, no. 1, pp. 189–196, 1913.

[2] Wikipedia, "Infinite monkey theorem," December 2014.

Vita

Arthur Philip Dent is a fictional character and protagonist of the comic science fiction series The Hitchhikers Guide to the Galaxy by Douglas Adams. Sadly, he was not accepted in the graduate programs in Information Technologies on January 2013 at Instituto Tecnológico y de Estudios Superiores de Monterrey, Monterrey Campus.

The typography of this thesis was
made with LaTeX by Arthur Philip Dent. [1]

December, 2014

[1] This thesis was compiled using *thesis.sty* package. The author of the package is Benjamin Tovar Cisneros and is available at: https://github.com/TATABOX42