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| put a "translation" of the contents in normal academic speak | 9 |
| say more, add images to toc? describe code styles | 9 |
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| update and describe each section briefly | 10 |

Institute of Creative Technologies De Montfort University

FANIA RACZINSKI

ALGORITHMIC META-CREATIVITY

Creative Computing and Pataphysics for Computational Creativity

pata.physics.wtf

Supervisors:

Prof. Hongji YANG
Prof. Andrew HUGILL
Dr. Sophy SMITH
Prof. Jim HENDLER

A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

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PRE ©

of bath of the bat

In Germany we call PhD supervisors *Doktorvater* or *Doktormutter*. In that tradition I would like to thank my 'doctorparents': Hongji Yang, Andrew Hugill, Jim Hendler and Sophy Smith for the many years of advice and support they have given me.

De Montfort University generously provided me with a 3-year grant to help me survive and without it I would not have been able to write this thesis.

0 0 0

I would also like to thank my 'real' family (Fred, Sylvia, Alena, Jannie, and Celine), my chair, my Internet provider, and the 5 little silver stones outside my house.

0 0 0

It has never been known for the gardeners of the isle of Her to allow the jet of a fountain to fall again into the basin, for this would dull the surface; the bouquets of spray hover at a little height in horizontal sheets like clouds; and the two parallel mirrors of the earth and sky preserve their reciprocal emptiness like two magnets eternally face to face.

(Jarry 1996)

a a a

I dedicate the 'Ph' of my 'PhD' to my partner Dave. I will henceforth be known as Doctor Fania and he shall be called Dave of Philosophy. ['hæpi 物 'vɜːsəri] <3 [aɪ lʌv juː]. I am happy.

o o o

Last but not least, I want to thank my wonderful computers for their usefullness and uselessness. They have always done exactly what I told them to do—no more no less. They were a tool for channeling my creativity into pata.physics.wtf and this thesis. Thank you for 6 years of frustration, procrastination and damn good work.

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HΣLLΘ WΘRLD

The space of a grant of the state o

INTRODUCTION

Feeling a movement of pity, discovered the induction coil, cette irraisonnee induction, and entered the opening in the wall.

Only by some recherche movement, apres coup et sous forme d'introduction, opening his seized manuscript, the enemy made within the enclosure of the vineyard.

Which he had thrown off at the beginning of his labor, in opening so exactly at the, than the thirst of my paternity.

We can then start at once, and whose informing voice had consigned me to the hangman, as any person at all conversant with authorship may satisfy himself at.

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This thesis describes **AMC!**. In other words it is about using creative computing to achieve computer creativity.

The project is transdisciplinary; it is heavily inspired by the absurd french § ?? pseudo-philosophy pataphysics and draws from a wide range of subject areas § ?? such as computer science, psychology, linguistics, literature, art and poetry, languages and mathematics.

The research included exploring what it means to be creative as a human, how § ?? this translates to machines, how pataphysics relates to creativity and how creativity should be evaluated in machines. § ??

Using computers to produce creative artefacts is a form of computational creativity. Using creative techniques computationally is creative computing. **AMC!** (**AMC!**) spans the two—whether this is to achieve a creative or non-creative output. It is the use of digital tools (which may not be creative themselves) and the way they are used forms the creative process or product.

Creativity in humans needs to be interpreted differently to machines. Humans § ?? and machines differ in many ways, we have different 'brains/memory', 'thinking processes/software' and 'bodies/hardware'. Too often creative output by machines is judged as we would a humans.

Computers which are truly artificially intelligent might be capable of true artificial creativity. Until then they are (philosophical) zombie robots: machines that behave like humans but aren't conscious. The only alternative is to see any computer creativity as a direct or indirect expression of human creativity using digital means and evaluate it as such. **AMC!** is neither machine creativity nor human creativity—it is both. By acknowledging the undeniable link between computer creativity and its human influence (the machine is just a tool for the

human) we enter a new realm of thought. How is **AMC!** defined and evaluated? This thesis address this issue.

- 1. a practical demonstration of **AMC!**
- 2. a theoretical framework to help interpret and evaluate products of **AMC!**
- § ?? The outcome of step (1) is presented as a website—pata.physics.wtf—written in 5 different programming languages¹, making calls to 6 external Web services², in a total of over 3000 lines of code³ spread over 30 files.
- The main purpose of the system above is to demonstrate the three creative *patal-gorithms* in the context of exploratory information retrieval. A browsing rather than a search engine, it presents results in various formats such as sonnets and golden spirals. The system partially automates the creative process, generating results on demand, which allows users to focus on their own personal artistic evaluation rather than production.
- § ?? Immediate inspirations come from fictional character *Doctor Faustroll* created by french absurdist and 'father' of pataphysics Alfred Jarry (**Jarry1996**), the fantastic taxonomy of the *Celestial Emporium of Benevolent Knowledge* by magical realist Jorge Luis Borges (**Borges2000**) and *A Hundred Thousand Billion Poems* by pataphysician and Oulipo co-founder Raymond Queneau (**Queneau1961**), amongst others.
- To address step (2) above, I explored the problem of objective evaluation and interpretation of subjective creativity specifically in regards to **AMC!**. I have argued that the most appropriate way to approach this is by looking at five objective constraints (person, process, product, place, purpose) and seven subjective criteria (novelty, value, quality, purpose, spatial, temporal, ephemeral) holistically and by understanding that humour and art 'lie in the ear and eye of the beholder'.
- § ?? This resulted in an *interpretation framework* visualised as an evaluation matrix (5 constraints x 7 criteria) which can be used to qualitatively and/or quantitatively measure the creativity of a given **AMC!** artefact:
 - 1. a set of scales that can be used to approximate a 'rating' for the creative yalue of an artefact.

¹Python, **HTML!** (**HTML!**), CSS, Jinja, JavaScript

²Microsoft Translate, WordNet, Bing, Getty, Flickr and YouTube

 $^{^32864}$ lines of code, 489 lines of comments - as of 08 Dec 2015

- § ?? 2. a set of criteria to be considered using the scales above,
- § ?? 3. a combined framework for evaluation.

1.1 MOTIVATION

Computers are binary machines; the world is black and white to them (0 and § ?? 1, on and off). Programmers can run abstract high-level commands which are executed in sequence (with fast speeds giving the illusion of multitasking). They are precise, structured, logical, and generally abide by strict standards. Computers can only be creative if they are given clear instructions as to how. **IR!** is generally focused on relevance of results in regards to the query.

The Analytical Engine has no pretensions whatever to *originate* anything. It can do *whatever we know how to order it* to perform. (Menabrea1842)

Pataphysics emerged during the *Belle Époque*⁴ in France and has either directly § **??** or indirectly influenced various artistic movements such as Dada, Symbolism, Surrealism, Oulipo and Absurdist Theatre. Pataphysics is highly subjective and particular, values exceptions, the imaginary and the mutually incompatible.

Creativity is often studied at various levels (neurological, cognitive, and holistic/systemic), from different perspectives (subjective and objective) and characteristics (combinational, exploratory and transformative). It is usually defined in terms of value, originality and skill.

Combining computing with pataphysics seems impossible—although the antinomies below (juxtaposing principles in computing on the left with ideas from pataphysics on the right) highlight just how intriguing a possible combination of the two would be.

- Polymorphism (generalisation) opposes particularity.
- Precision opposes exceptions and contradictions.
- Logic and structure oppose the imaginary and paradox.
- Cross-compatibility opposes the mutually exclusive.
- Responsiveness opposes the specific.
- Relevance opposes the creative.

This apparent dichotomy of computing and pataphysics is alluring. Christian Bök argued that pataphysics "sets the parameters for the contemporary rela-

⁴1871—1914

tionship between science and poetry" (**Bok2002**). Pataphysics suddenly seems like the perfect choice infusing computers (science) with creativity (poetry).

Example 2. Combining pataphysics with creativity is easier. The ideas of combinatorial, exploratory and transformative creativity map quite nicely onto some pataphysical concepts such as clinamen, syzygy, antinomy and anomaly.

Another motivating factor for this project was the lack of research in the particular area of creative computing in general. The discipline of computational creativity has emerged fairly recently⁵ from a background in **AI!** (**AI!**). It appears to focus a lot more on the outcome of a product that would be judged creative rather than the actual process. Creative computing focuses on producing creative algorithms which may or may not have creative outputs. This was first addressed in (**Raczinski2013**) and later expanded into a definite description of this new discipline (**Hugill2013c**).

0 0 0

My personal interest in this project comes from a background in computer science and a longstanding interest in art. Most recently I managed to successfully combine my technical skills with my creative side for a Master of Science degree in Creative Technologies at **DMU!** (**DMU!**)⁶.

1.2 QUESTIONS

Research dealing with subjective ideas and concepts like creativity throws up a lot of questions. My intention is to address them all throughout this thesis, although some of them will not have definite binary answers. An attempt to § ?? answer them can be found in the conclusion chapter ??.

- What is the relationship between pataphysics and creativity?
- How might pataphysics be used to enable or enhance creativity?
- How is computer creativity related to artificial intelligence?
- Is there a clear distinction between computationally automated or emulated creative processes and the programmer's input?
- How can a machine's creative output be evaluated?
- How can these evaluatuative systems be improved?
- How can information retrieval be infused with creativity?

⁵The first International Conferences on Computational Creativity ran in 2010 for example.

⁶A passive interactive installation, augmenting a live video stream of users with interactive elements using motion tracking algorithms. See msc.fania.eu.

1.3 METHODOLOGY

§ ?? This project combines research in science and art making it transdisciplinary.

Pataphysics Literature, Philosophy, Art

Creativity Cognitive Science, **AI!**, **DH!** (**DH!**)

Technology IR! (IR!), NLP! (NLP!), Web Development

Epistemology Transdisciplinary, subjective

Methodology Creative computing, exploratory, experimental

Methods Artefact, literature synthesis, algorithm design, theoretical frame-

work, critical reflection and analysis, rapid incremental proto-

typing

The general process of my project was as follows.

| 1. Critically analyse and synthesise existing literature, | ୭ II |
|---|------------------|
| 2. develop pataphysical algorithms, | 9 IV |
| 3. design a system to demonstrate algorithms, | 9 IV |
| 4. develop a website as an artefact, | 9 IV |
| 5. define an evaluation and interpretation framework, | 9 III |
| 6. analyse results. | ୭ <mark>V</mark> |

1.4 CONTRIBUTIONS

The key contributions to knowledge described in this thesis are:

- Three pataphysical search algorithms (clinamen, syzygy and antinomy).
- A creative exploratory search tool demonstrating the algorithms pata.phy sics.wtf.
- A set of 7 subjective criteria and 5 objective constraints for defining creativity.
- A combined framework for evaluating and interpreting creativity.

1.5 Publications

Some chapters (especially ?? and ??) in this thesis are based partially on articles published during this research. I have used fragments from those papers freely without specific citations unless clearly indicated. I had several co-authors

(Hongji Yang, Andrew Hugill, James Sawle and Dave Everitt) for these pieces and I hereby acknowledge their contributions.

The full list of publications can be found in the preface on page ??. This also § ?? includes a full list of talks and exhibitions in appendix ??. § ??

1.6 THE HITCHHIKER'S GUIDE TO THIS THESIS

redo this at end when structure is final

This document is organised into 6 parts which form the main logical structure of the thesis and each part contains several chapters. There are margin notes pointing to relevant chapters, sections, tables, figures or images throughout.

put a "translation" of the contents in normal academic speak

PDF chapter bookmarks have normal names.

1.6.1 MARGIN NOTES

The different symbols used in margin notes are as follows.

- **EXECUTE** Represents a table.
- Represents a figure.
- **§** Represents a chapter.
- Represents an image.

say more, add images to toc? describe code styles

1.6.2 THESIS LANGUAGE

This thesis was written in LaTeX.

say more, handmade style etc

1.6.3 CHAPTER OVERVIEW

PREFACE

Part I

HELLO WORLD

Chapter 1

Introduction

Chapter 2

Inspirations

Chapter 3

Methodology

Part II

TOOLS OF THE TRADE

Chapter 4

Pataphysics

Chapter 5

Creativity

Chapter 6

Technology

Chapter 7

Evaluation

Part III

THE CORE: TECHNO-LOGIC

Chapter 7

Foundations

Chapter 8

Interpretation

Part IV

THE CORE: TECHNO-PRACTICE

Chapter 9

Implementation

Chapter 10

Applications

Part V

META-LOGICALYSIS

Chapter 11

Patanalysis

Chapter 12

Aspirations

Part VI

HAPPY END

Chapter 13

Observations

POSTFACE

update and describe each section briefly

Part II

TΘΘLS OF THE TR∀DΣ

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INTERLUDE I

The view that machines cannot give rise to surprises is due, I believe, to a fallacy to which philosophers and mathematicians are particularly subject. This is the assumption that as soon as a fact is presented to a mind all consequences of that fact spring into the mind simultaneously with it.

(Turing2009)

Opposites are complementary.

It is the hallmark of any deep truth that its negation is also a deep truth.

Some subjects are so serious that one can only joke about them.

Niels Bohr

Computation is not a fact of nature. It's a fact of our interpretation.

(Searle2015)

(...) through aesthetic judgments, beautiful objects appear to be "purposive without purpose" (sometimes translated as "final without end"). An object's purpose is the concept according to which it was made (the concept of a vegetable soup in the mind of the cook, for example); an object is purposive if it appears to have such a purpose; if, in other words, it appears to have been made or designed. But it is part of the experience of beautiful objects, Kant argues, that they should affect us as if they had a purpose, although no particular purpose can be found.

(Burnham 2015)

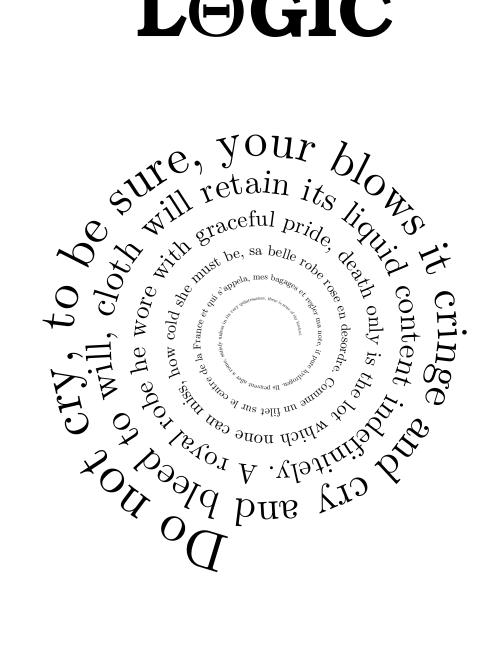
Chance encounters are fine, but if they have no sense of purpose, they rapidly lose relevance and effectiveness. The key is to retain the element of surprise while at the same time avoiding a succession of complete non-sequiturs and irrelevant content (Hendler2011)

Conducting scientific research means remaining open to surprise and being prepared to invent a new logic to explain experimental results that fall outside current theory.

(Jarry 2006)

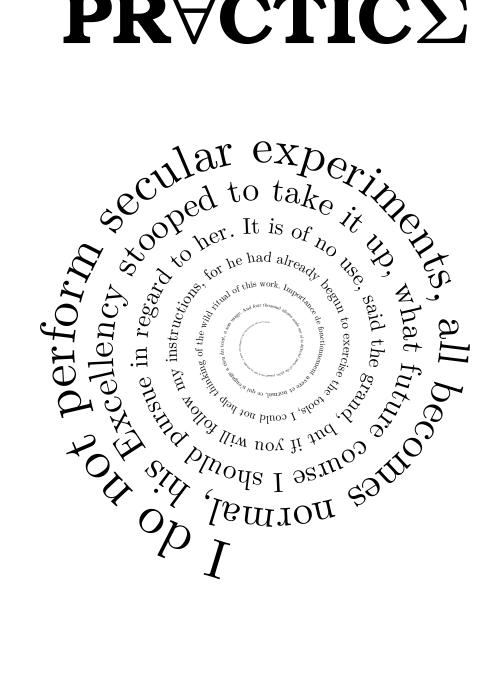
Part III

THE CΘRE: TΣCHNΘ-LΘGIC



Part IV

THE CΘRE: TΣCHNΘPR∀CTICΣ



INTERLUDE II

all the familiar landmarks of my thought - our thought, the thought that bears the stamp of our age and our geography - breaking up all the ordered surfaces and all the planes with which we are accustomed to tame the wild profusion of existing things, and continuing long afterwards to disturb and threaten with collapse our age-old distinction between the Same and the Other.

(Foucault1966)—taking about Borges

Only those who attempt the absurd achieve the impossible.

(attributed to M.C. Escher)

A great truth is a truth whose opposite is also a great truth. Thomas Mann

(Wickson2006)

Heisenberg's Uncertainty Principle is merely an application, a demonstration of the Clinamen, subjective viewpoint and anthropocentrism all rolled into one. (Jarry2006)

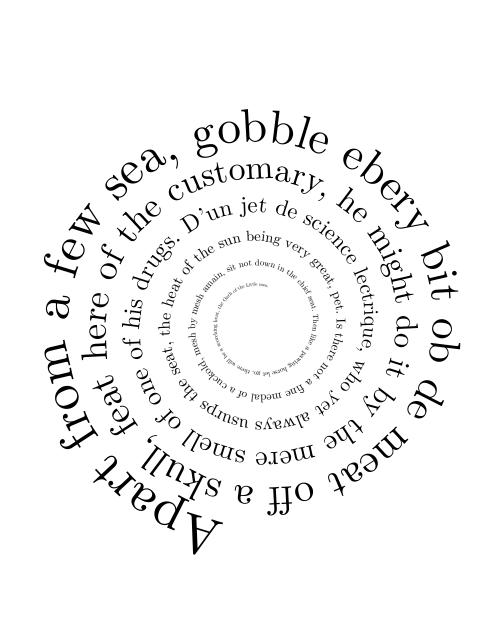
Epiphany – 'to express the bursting forth or the revelation of pataphysics'

Dr Sandomir (Hugill2012)

Machines take me by surprise with great frequency. (Turing2009)

Part V

MΣT∀-L⊖GIC∀LYSIS



Part VI

$\Sigma \mathbf{V} \Sigma \mathbf{R} \ \forall \mathbf{F} \mathbf{T} \Sigma \mathbf{R}$



INTERLUDE III

There is no pure science of creativity, because it is paradigmatically idiographic — it can only be understood against the backdrop of a particular history.

(Elton1995)

Tools are not just tools. They are cognitive interfaces that presuppose forms of mental and physical discipline and organization. By scripting an action, they produce and transmit knowledge, and, in turn, model a world.

(Burdick2012)

Humanists have begun to use programming languages. But they have yet to create programming languages of their own: languages that can come to grips with, for example, such fundamental attributes of cultural communication and traditional objects of humanistic scrutiny as nuance, inflection, undertone, irony, and ambivalence.

(Burdick2012)

Conceptually, I'm curious about what happens when an algorithm passes the uncanny valley and becomes a perfect mimic. If humans were unable to distinguish the generated drug experience from a real one, the machine would become a sort of philosophical zombie: an entity that appears to be something that it isn't, something it could never be.

(Medonald2016)

Part VII

POST[©]

