The University of York Department of Computer Science

**Submitted in part fulfilment for the degree of BEng.**

# Evolutionary agent-based simulation modelling of human life-history evolution

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Number of words = 2001, as counted by `wc -w`.
This includes the body of the report only.

**Abstract**

This is an abstract. Should be about 500 words long.

# Contents

# List of Figures

# List of Tables

# 1 Introduction

## 1.1 Motivation

Menopause unsolved problem in biology – many different hypotheses
Better population models
Replicating model can be used to check results found elsewhere
Model can be adapted for use for other hypotheses to do with menopause and/or population modelling.

## 1.2 Aims

To check validity of existing model by replicating it
To rewrite the model into an object oriented language (python)
Address some of it shortcomings (allowing preference to coevolve)

## 1.3 Thesis Outline

Chapter Two Literature Review: reviewing past work relevant to the project
Chapter Three Problem Description: looking at what the problem consists of
Chapter Four Design and Implementation: designing a solution to the problem
Chapter Five Results and Evaluation: presenting and analysing the results produced by the solution
Chapter Six Conclusion: making judgement of the solution and the results, suggesting new work.

## 1.4 Statement of Ethics

Model – no ethical concerns

# 2 Literature Review

## 2.1 Menopause

What is menopause. Somatic vs reproductive senescence.

What animals does it occur in. Wild vs captive.

Possible reasons for menopause Patriarch Hypothesis, Grandmother, reproductive conflict

### 2.1.1 Patriarch hypothesis

Proposed by [1] , Males having preference for younger females caused menopause

Deterministic model done in [2] but this has fixed age of end of reproduction – something not true now.

Stochastic model done in [3] – main focus of report. Fixes many of the flaws of [2] (including removing the fixed age of the end of reproduction) but still has problems.

### 2.1.2 Grandmother hypothesis

### 2.1.3 Reproductive conflict

### 2.1.4 Other hypotheses

Follicular depletion, healthcare/lifespan improvements - not evolutionary but epiphenomenon, Risk from late age reproduction.

## 2.2 Evolution

Overview [4]

### 2.2.1 Key concepts/terms

**Selection**

Description of selection

**Mutation**
Description of mutation

**Crossover**
Description of crossover

**Coevolution**
Description of co-evolution

### 2.2.2 Biological relevance to project

Project looking at evolution of long post-reproductive lifespans

### 2.2.3 Computational relevance to project

Genetic algorithms for optimisation

## 2.3 Modelling in biology

### 2.3.1 Deterministic modelling

Populations often modelled with exponential growth/differential equations

### 2.3.2 Stochastic modelling

Multiagent systems, genetic algorithms, neural networks, machine learning to reduce dimensionality,

## 2.4 Conclusions from Literature

# 3 Problem Description

This should be about 1500 words long.

# 4 Design and Implemenation

This should be about 2500 words long.

# 5 Results and Evaluation

This should be about 2500 words long.

# 6 Conclusion

This should be about 1000 words long.

# Bibliography

[1] F. Marlowe, "The patriarch hypothesis," *Human Nature*, 2000. [Online]. Available: http://dx.doi.org/10.1007/s12110-000-1001-7

[2] S. D. Tuljapurkar, C. O. Puleston, and M. D. Gurven, "Why men matter: Mating patterns drive evolution of human lifespan," *PLOS ONE*, 2007. [Online]. Available: http://dx.doi.org/10.1371%2Fjournal.pone.0000785

[3] R. A. Morton, J. R. Stone, and R. S. Singh, "Mate choice and the origin of menopause," *PLOS Computational Biology*, 2013. [Online]. Available: http://dx.doi.org/10.1371%2Fjournal.pcbi.1003092

[4] C. Darwin, *On the origin of species*. John Murray, 1859.