## Research Question

1. Reputation on fostering collaboration amongst decision makers: recreating the results and programs developed by Santos, Santos, Pacheco in their paper *Social Norms of Cooperation in Small-Scale Societies*.

Should be a 2-3 page project description to your supervisor. This should provide a brief description of the research project including motivation, aims, intended outcomes, proposed research methodology and an indicative timeline

## Motivation

In order to understand our behaviour and our willingness and ability to cooperate with those around us in both small and large populations, it is vital that we can create detailed and accurate simulations based on proven mathematical models which explain and model how random populations reach states with a high rate of cooperation. The area of indirect reciprocity using reputation in prisoner’s dilemma games played between individuals in a larger population has been the focus of recent research in game theory. A number of papers have been published exploring the effect of strategies based on reputation in the prisoner’s dilemma game and a detailed look at those which foster cooperation in small populations. The main research paper on which this project will be based is “Social Norms of Cooperation in Small-Scale Societies” by Santos, Santos, and Pacheco.

In order to create a platform for further research to be conducted on this model, it is necessary that the simulation itself is robust, fast, extensible and allows the user to test multiple conditions with ease. In addition to this, the results of the simulation should be evident and clear, and easily exportable to a number of data analysis packages.

## Aims

The primary aim of this project is to recreate the findings of Santos, Santos, and Pacheco which will allow further exploration into more detailed models of the prisoner’s dilemma game within populations. The paper outlines simulation parameters based on equations to model the process in which the prisoner’s dilemma game is played over time in a population. In order to allow for greater research to be done in this area based on the simulation developed to test the mathematical models by Santos et al. it is necessary that the simulation can be recreated and tested under similar variables and constraints to verify their results.

## Intended Outcomes

The goal of this project is to write a program utilising a number of equations detailed in Santos et al. to model a prisoner’s dilemma game in a population which involved reputation dynamics. The simulation that will be produced should be efficient and extensible. The program itself will be programmed in Python and will utilise a number of libraries to maximise efficiency and speed of computation including *numpy*­­[3].

## Proposed Research Methodology

The application to be developed in this project will be created in the Python programming language to allow for ease of prototype development. However, this program may be ported to a C++ base depending on the available speed of computation for the simulation to run.

There do exist a number of Python modules which allow a great speedup in computation time utilising CUDA cores on the GPU (such as Anaconda and Anaconda Accelerate) or simply compile Python code for faster computation (using modules such as Numba).

## Timeline

The expected progression of the project should be as follows:

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Week:  Phase: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Initial Meeting | - | - |  |  |  |  |  |  |  |  |  |  |  |
| Review of Literature | - | - |  |  |  |  |  |  |  |  |  |  |  |
| Writing Proposal | - | - |  |  |  |  |  |  |  |  |  |  |  |
| \*\*\* Development of models and resources for outcome | - | - |  |  |  |  |  |  |  |  |  |  |  |
|  | - | - |  |  |  |  |  |  |  |  |  |  |  |
| Project Presentation | - | - |  |  |  |  |  |  |  |  |  |  |  |
| Final Report | - | - |  |  |  |  |  |  |  |  |  |  |  |

## Bibliography

[1] Manapat, M. L. (2012) *Delayed and Inconsistent Information and the Evolution of Trust*. (Accessed 12/08/2016), <http://link.springer.com/article/10.1007/s13235-012-0055-6>

[2] Santos, Santos, Pacheco (2016) *Social Norms of Cooperation in Small-Scale Societies*,

[3] *Numpy* (2016) <http://www.numpy.org/>

[4] *Anaconda* & *Anaconda Accelerate* (2016) <https://docs.continuum.io/>