I pledge to adhere to the Stevens Graduate Student Code of Academic Integrity, and I have discussed the proposal with my Project Advisor.

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Date: February 7th 2025

Signature: *Jessica Kamman*

Predict the Dynamic Replicator Evolution of Competing Technologies with AI

Student Name: Jessica Kamman

Advisor: Prof. Cristina Comaniciu

Course Section and Terms: AAI 800 Spring 2025

Introduction

In this current mobile market, we have Android and iOS competing for the US market share. Users often choose which operating system to go with based on the UI, how easy the phone is to use, and personal preferences. A new model for Replicator Dynamics was introduced by past research which added the idea of external influences to, invest resources to increase their product's standing and increase their market share. In the past study it was found that dynamic influences can change each time each step of the game, and that in result will directly modify the payoff matrix of the population interactions. The study analyzed how each new technology can compel and attempt to become the market leader in that technology. A relationship between the external influences and population payoff matrix was used to predict the outcomes in a real market simulating the rise of the Android mobile operation system over its primary competition between the time frame of 2009 to 2017. The proposed model incorporated the external market influence into the replicator dynamics model, by assuming a linear dependence of the A matrix derived from the classical formulation of replicator dynamics to the two market inputs. With the linear dependence modeled by the alpha which in this case were learned through an exhaustive search.

The linear combination of input is as follows:

$$A_k = \alpha_k y \qquad\qquad (1)$$

where a_k is the kth row of the coefficient matrix α. The updated payoff matrix expression insured that external influences can take on different values during each iteration of the simulation.

Problem Description

Replicator Dynamics model considers external factors which then leads to the companies to increase their market share. With ever evolving machine learning techniques, we are now able to automate some of the exhaustive learnings of a model, as well as machine learning can offer a way how we can predict the likelihood for a company to bolster their market shares with the external influences. The past study on Replicator Dynamics and the Android market share setup the model only in a simulation based on the mathematics, but it is missing the machine learning techniques that one could utilize. In the past study, it was proven mathematically that the proposed payoff matrix worked and showed that external forces due influence the payoff and in

result a business could gain a higher market share. However, the study has not dived into using any modern machine learning techniques. With the use of modern machine learning techniques, the manual alpha weights that influence the Aij matrix coefficient could be found with the modern machine learning techniques which would lead to an accurate market share being predicted.

Expected Contributions

To complete the expected outcome of the Problem Statement the following actions will be taken:

- Study various reinforcement learning techniques and train the data with the market share information found
- Learn the alpha weight that influence the Aij matrix coefficient
- Find potential dependencies between the external forces and the payoffs/ increased market share
- Use Regression techniques with the desired output being given by the equilibrium solution of the replicator that depends on Aij and compare this with the data market share

Project Timeline

February 3-7 Project Initiation and Scope discussion

February 10-21 Information Gathering, finding any relevant Data Sets for earnings of Android and iOS sales and market share information. Additional finding possible supporting research on Replicators Dynamics on another Subject

February 24-28 Training the model, and looking into various ways to predict the outcome

March 3rd – March 21 Mid-stage report submission with current findings, any scope alterations and any limitations

March 24th – April 4th Full Simulation of the model, and Analyze Results

April 7th -18th Make any necessary adjustments to the Simulation based on the results and feedback given by advisor

April 21 – May 7th Finalize the results and visualization, and submit the final reports with all feedback given by advisor

Note: Weekly cadence with advisor to track my progress and to receive any feedback

References

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Propagation of Competing Technologies. *IEEE Transactions on Evolutionary
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