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Game Theory in Wireless Networks

Research Plan for Bachelor's Thesis in
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ABSTRACT

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Research Plan

This is a research plan for a bachelor's thesis in computer science. The aim of this thesis is to see how game theory can be used to analyze and model interaction between wireless devices. The aim of this research plan is to give an outline on the thesis which will be done. That includes, but is not limited to, research problems and the outline of the thesis with some brief descriptions on what is going to be covered within each chapter. I will also include a preliminary schedule.

Keywords: thesis, game theory, wireless networks, research plan

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1 DESCRIPTION

The aim of this thesis is to find out how game theory can be used to analyze the interaction of wireless networks and if it is possible then what kind of applications can be derived from the results.

Merriam-Webster defines game theory, as “the analysis of a situation involving conflicting interests (as in business or military strategy) in terms of gains and losses among opposing players”. Therefore, it is an excellent tool studying the interaction that is happening between different users, or in this case mobile devices. A strategic game consists of three things (Osborne, 2004). There needs to be a set of *players*, who's actions are being analyzed. Secondly, each player has a set of *actions* that they can choose. Lastly, each player has preferences over the potential outcomes of the game. The outcomes of the game are called *payoffs* and they can represent power output, money, votes etc. Games can also be divided in to subgroups based on certain criteria.

Wireless devices are devices that are connected to each other via wireless connections. All devices need to access the limited spectrum that has been assigned for their usage. There has been many different ways to access the spectrum but in the future as the number of devices increases the protocols will need to be able do adapt to the increase of devices. In order to achieve this, the devices, *players,* need to consider how other devices act in order to maximize the resources, *payoffs*, available to then.

This means that game theory should be able to model and analyze wireless networks and the interactions happening between different wireless devices. The aim of this thesis is to serve as an overview of the research that has been done and to give out a few simple examples on how game theoretic models can help improve the efficiency of future generation mobile devices.

2 RESEARCH PROBLEM

The thesis will be a literary review on the research that has been done in the field of game theory and wireless networks. First, it will cover the basics of game theory and wireless networks and then proceed on to how that information can be used to analyze wireless networks. Main focus will be on how different types of games can be used to analyze interaction between wireless networks. A good overview of the topic covered in the thesis can be found in Charilas& Panagopoulos 2010; Félegyházi & Hubaux, 2006; MacKenzie & DaSilva, 2006; Maharjan, Zhang, Gjessing, 2010; Mehta & Kwak, 2009; Saad, Han, Debbah, Hjorungnes & Basar 2009.

With this thesis there will be research on how wireless networks have been modeled from a game theoretic point of view. How are the viewpoints of cooperative and non-cooperative games different when looking at wireless networks and devices. Are the games always modeled as games of perfect information or imperfect information and what differences are there between these two. Finally, how does modeling the interaction as a repeated game change the outcome if games are usually modeled as one-shots.

3 PRELIMINARY STRUCTURE

1.1 Introduction

An introduction is given in this chapter. It will consist of a brief explanation on why game theory can be used when analyzing wireless networks and how it can be done. I will also give some other applications can be seen. This chapter will also feature a brief introduction of the other chapters.

1.2 Game Theory

What is game theory? What are games and how do they work? Where can one seen game theory in action? In this chapter I will give a brief history of game theory and how it was developed. In subsections I will go over different types of games and how to solve them. I will also give out examples of situations where different games can be used.

1.3 Wireless Networks

How will the next generation networks differ from the current generation networks? What are the differences and why? This chapter will feature a brief overview on next generation(4G & 5G) wireless networks.

1.4 Game Theory in wireless networks

Why can game theory be used to analyze wireless networks? If it can be used then how? What are the differences in cooperative games and non-cooperative games? What kind of research has been done? This is the main body of work and therefore I will divide this section in to two subsections. One for cooperative and one for non-cooperative games. Within each section I will present what research has been done and how it can be applied. The applications are derived from recent publications that are useful in this thesis.

1.5 Summary

In this chapter I will summarize the things that I've gone over in the thesis. This will include cooperative and non-cooperative games in wireless networks, strategies to increase cooperation etc. I will also go over future research topics and possible topics that I will cover in my master's thesis.

1.6 References

Articles that have been imported to Refworks

4 PRELIMINARY SCHEDULE

10.11.2010 Research of useful publications, game theory section written

01.12.2010 Introduction, wireless networks, cooperative games subsection done

10.12.2010 Thesis finished

16.12.2010 Presentation of thesis

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