A rational version of geometric algebra
Si Chun Choi, School of Mathematics, University of New South Wales

Rational version of geometric algebra is a new theory based on Rational Trigonometry introduced by Norman Wildberger. It replaces distance and angle with quadrance and spread which are defined algebraically. Hence a complete theory of planar Euclidean geometry over a general field is developed.

The aim of our project is to use Rational Trigonometry to investigate properties of the Universal Parabola which is a parabola defined over a general field. We begin by looking through some old classical texts on conics to find some theorems of parabola and we attempt to prove it over a general field. I also attempt to come up with new theorems by examining spread at various parts of the parabola. I realised that every calculation should be neatly recorded in a book rather than on a piece of scrap paper to avoid calculating the same thing more than once. We also experimented with some new concepts but they didn't turn out to be useful.

The project went slow at first. However towards the last couple of weeks of the project, Norman introduces me a piece of software called The Geometer's sketchpad. This enables us to accurately draw parabolas and various other geometric figures so that we could conveniently experiment and explore many properties of parabola. It helps us to push the boundary of what theorems we hypothesised because they could be quickly verified by the software. We believe some theorems are new in the mathematical literature. All theorems that we proved throughout the project were written on a paper to be submitted to a journal.

I also took part in the CSIRO's "Big Day In" where I presented the results of our project. Students from universities from all over Australia attended my talk and they showed deep interest in my talk.

This project overall is very rewarding. I learnt a lot from Norman Wildberger and working with him is a valuable experience. During the course of the project, I refined my team working skills as well as skills in using Latex, Corel draw used to write the paper. I also realised that research is a cumulative experience because Eureka aren't achieved in a single day but rather after numerous attempts over many days. This project gives me a rare opportunity to get a touch on the frontier of mathematics and seeing other people having appreciation in our research is a fulfilling experience.