INTERNATIONAL CENTRE OF EXCELLENCE FOR EDUCATION IN MATHEMATICS

Category Theory

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My vacation scholarship was spent at the University of Queensland studying category theory with Victor Scharaschkin. Category theory is the study of general mathematical structure that unifies the form of varied areas of mathematics, like algebra, topology and logic.

The first part was spent learning about the categories, morphisms and functors. I also looked at the common set-theoretical foundations of category theory, and it was here I first learnt about the idea that category theory could provide an alternative foundation for mathematics (using a category called a *topos*) as opposed to set theory.

Because category theory aims to unify many different branches of mathematics I spent a good deal of time looking at specific examples, especially in group, ring and module theory. This highlighted to me the important role that *morphisms* play in determining structure. A morphism is a structure preserving map between two objects, for groups (resp rings) these are group (resp ring) homomorphisms. I also looked at specific types of morphisms like monomorphisms, epimorphisms and isomorphisms.

I was still very interested in topoi (the plural of topos mentioned above). To learn about topoi I needed to learn about limits and exponentials. Limits are quite abstract and so I spent time looking at specific examples of limits like pullbacks and equalisers to get a good feel for their properties. By the end of my project I still hadn't learnt enough about limits to satisfy me, but I plan on continuing my investigations now that the scholarship has ended.

The usefulness of category theory astounded me. I knew when I started that category theory was meant to generalise many different areas of mathematics but its power - of which I have only just scratched the surface of - is amazing.

I enjoyed my project immensely, the main drawback was my inexperience with some of the specific mathematics examples of categorical objects. However, this just let me experience other interesting areas of mathematics that I wasn't yet familiar with, like homology and homotophy, and tensor products. It was great to be able to spend time researching an area of mathematics I was interested in but which is not provided as a course. I am very glad to have had the opportunity to take part in the scholarship program and especially enjoyed the conference. It has given me a better idea of what I want to do when I eventually do my honours.

I would like to thank the AMSI, the ICE-EM and the CSIRO for providing the opportunity, and Victor for being my supervisor.

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See http://www.ice-em.org.au/students.html#scholarships2007