PREFACE

These notes originated from a series of lectures I delivered at the Centre for Mathematical Analysis at Canberra. The purpose of the lectures was to introduce mathematicians familiar with the basic notions and results of linear elliptic partial differential equations and Riemannian geometry to the subject of harmonic mappings. I selected some topics to the presentation of which I felt I could contribute something, while on the other hand it was possible to provide complete and detailed proofs of them during these lectures. Thus, these notes are not meant to cover all that is known about harmonic maps, but nevertheless I believe that they give a good account of many of the interesting aspects of the subject and a fair idea of the variety of techniques used in the field.

After some introductory material in chapter 1, we present useful geometric constructions in chapter 2. In particular, we introduce almost linear functions on Riemannian manifolds and prove some properties of approximate fundamental solutions and harmonic coordinates. Most of this material originated from [JK1]. In chapter 3, we present the heat flow method to obtain existence, regularity, and uniqueness properties of harmonic maps into nonpositively curved manifolds. This covers the basic results of Eells-Sampson [ES]. Our approach also uses some ideas as presented by Hartman [Ht], von Wahl [vW], and Jost [J4].

In chapter 4, we prove the existence (due to Hildebrandt-Kaul-Widman [HKW3]) and uniqueness (due to Jäger-Kaul [JäK2]) of harmonic maps with image contained in a strictly convex ball, which solve a Dirichlet problem. The a-priori estimates based on the work of Hildebrandt-Widman [HW2] will be simplified by using the results of chapter 2. In chapter 5, we finally are concerned with harmonic maps between surfaces. We prove the existence