The comparison of sound sequences (words, morphemes) constitutes the core of many techniques and methods in historical linguistics. With the help of these techniques, corresponding sounds can be determined, historically related words can be identified, and the history of languages can be uncovered. So far, the application of traditional techniques for sequence comparison is very tedious and time-consuming, since scholars have to apply them manually, without computational support. In this study, algorithms from bioinformatics are used to develop computational methods for sequence comparison in historical linguistics. The new methods automatize several steps of the traditional comparative method and can thus help to ease the painstaking work of language comparison.