In the recent years a new type of NoSQL databases, called Graph databases (GDBs), has gained significant popularity due to the increasing need of processing and storing data in the form of a graph. The objective of this thesis is a research on possibilities and limitations of GDBs and conducting an experimental comparison of selected GDB implementations. For this purpose the requirements of a universal GDB benchmark have been formulated and an extensible benchmarking tool, named BlueBench, has been developed.