Theoretisch-Physikalisches Seminar
QuantenComputer – WS 2007/2008

Prof. Dr. Heiko Rieger mit Dr. Yu-Cheng Lin

Elementare Quantenalgorithmen

Manuel Noll

In order to explain quantum computation, it is the easiest to investigate it via its realisation as algorithms. There the enormous power of these machines comes apparent. Therefore we have to take a closer look at computational complexity theory and its notion, the Landau notation. With this in back-hand we are able to analyse the great advantages that quantum machines have over classical computer devices. Since quantum machines are probabilistic in their inner nature, quantum algorithms have to be so too. Therefore these algorithms have resemblance to randomized algorithms which we will discuss briefly. But since randomized algorithms are just a subclass of classical complexity classes we consider quantum complexity classes and classical complexity classes in the following. Thus quantum machines differ by their nature from classical ones, it is necessary to explore the realisation of bits, registers and gates on this new kind of machines. In this context we clear the import role of unitary matrices and their meaning in quantum algorithmic design. Having now all tools together we start to address the quantum algorithms, beginning with an easy example, the Deutsch's problem, giving us a shortly introduction in to the usage of the introduced notations. Being familiar with the elementary realisation of an quantum algorithm we are able to deepen our understand of quantum algorithms by Simon's problem of determining whether a function is periodic or bijective. At the end we will focus on Grover's search algorithm, performing searches on databases. That algorithm is indeed better than its classical equivalents, though not exponentially better. We close this discussion with an outline of quantum networks as an possible way to implement quantum algorithm and quantum computers respectively.

Mi, 30.Jan.2008, 16-18 Uhr
E2.6 Seminarraum 4.18