

Abstract

Recently the so-called Balls-Into-Bins Game attained a lot of attention in the investigation of Load-Balancing and related problems. The Balls-Into-Bins Game is given by a set of Balls each of which is to be allocated to one of d bins chosen at random from a set of bins. The problem is to choose this allocation such that the number of balls in the fullest bin is small. Frequently this problem is called *allocation problem*.

Application problems model a lot of applications all corresponding to the distribution of jobs (modeled by the balls) to a set of identical servers (modeled by the bins). This does not restrict to Load-Balancing on parallel computers, only. Allocation problems are also used to achieve results on the design of Video on Demand Servers, or hashing. In this thesis we further present an application to some routing problems.

The main contribution of this thesis is a single lemma which allows to obtain sharp results on the performance of a wide range of generalized allocation problems. In particular, our lemma allows to consider

- weighted balls, corresponding to applications where the amount of resources demanded by the jobs is not the same for each job, and
- a large scale of distributing functions for the random choices of the bins for each ball. We obtain results for all distribution functions not obviously leading to poor performance,
- large numbers of balls,
- settings where the number of balls is not finite, and several ways controlling the life-cycle of a ball,

and combinations of these. Our results cover all known previous work in this area. Several known results are improved.