CAS 781 Assignment 3

1. (a) Suppose that a system has total resources available of 100 CPUs and 10000 GB of memory. Application A requires 2 CPUs and 300 GB of memory (per instance). Application B requires 6 CPUs and 100 GB of memory. What assignment of resources would be yielded by DRF?

   (b) Suppose that there are an additional 50 CPUs added to the pool of resources, what would be the new assignment? Comment on the fairness of the resulting assignment.

2. Consider a system with three application types: A requires 2 cores, B requires 8 cores, and C requires 16 cores. A server has 40 cores. A configuration on a server is a triple that gives the numbers of each type of application, so (3,1,1) means that the server has 3 instances of type A, 1 instance of type B, and 1 instance of type C. The total core usage for this configuration is $(3)(2)+(1)(8)+(1)(16) = 30$ cores. Suppose that there are currently eight servers active with configurations: (1,1,1), (1,1,1), (3,1,1), (0,2,1), (0,2,1), (0,2,1), (0,0,2), (0,0,2).

   (a) We would like to consolidate the current instances on the minimum number of servers. What is the minimum number of servers and an appropriate set of configurations? Describe how you derived your solution and why you believe that you have achieved the minimum number?

   (b) Suppose that you want a solution to (a) that minimizes the number of application movements. Can you devise (and solve) a formal optimization problem?

3. Consider the following simple erasure coding scheme that operates on four bits of data: $b_0 b_1 b_2 b_3$. The three servers store the following two bits of data: server 1: b_0, b_1, server 2: b_2, b_3, server 3: $b_0 \oplus b_2$, $b_1 \oplus b_3$.

   (a) Give the distribution matrix, B, for this system.

   (b) Suppose that server 2 fails. Calculate $(B')^{-1}$ and show how to use $(B)^{-1}$ to recover the original data.