1. Consider the recursive construction of an $N \times N$ rearrangeably non-blocking Clos network using only $p \times p$ crossbars only.

   (a) Show that the number of crosspoints n_{cp} is given by

   $$n_{cp} = Np\left(2\log_p N - 1\right)$$

   as a function N and p. Hint: you should first find out how many rounds of factorisation is required to deconstruct an $N \times N$ Clos network and then apply the recursive construction.

   (b) For large N, show that $p = 3$ minimises the crosspoint count.

2. Compute the crosspoint complexity, logical depth (the number of logical gates in a path), and fan-out (the number of logical gates driven by the input or by any gate in the network) for the following networks.

   (a) The full $N \times N$ crosspoint switch.

   (b) The three stage rearrangeable Clos network constructed using $\sqrt{N} \times \sqrt{N}$ switches.

   (c) The Benes network.

3. A 2×2 crossbar has 4 crosspoints. How many crosspoint settings (valid and invalid) there are? Use the results of Ex-1 b) and c) to determine how many legimate point-to-point and multicast connection patterns there are. Give the crossbar setup for connection patterns as logical truth tables ('0' crosspoint open, '1' crosspoint connected).

4. Show that the Bayan, baseline, and omega networks (slide L5-(46?)) have the self-routing property.

5. For the 8×8 Benes network, use the looping algorithm to find the paths for the following permutation:

input	1	2	3	4	5	6	7	8
output	7	6	5	3	8	4	2	1