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Exercise 4
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1. A VBR connection has three negotiated connection parameters: peak cell rate PCR=$1/T$, sustainable cell rate SCR=$1/T_s$ and burst tolerance τ_s. In addition to monitoring the PCR, UPC monitors the traffic stream with the GCRA(T_s, τ_s) algorithm, which in the "leaky bucket"analogy means that if we have a bucket with volume $T_s + \tau_s$ and it drains with a speed of 1 unit, then for each arriving cell we add an amount of T_s fluid into the bucket. The arriving cells are conforming as long as the bucket does not overflow. Let MBS (maximum burst size) denote the maximum number of consecutive cells that can arrive with the PCR. Show that

$$\text{MBS} = 1 + \lfloor \tau_s/(T_s - T) \rfloor$$

2. Apply the recursive method described in the lecture material to compute the throughput of an unbuffered Banyan network. The parameters are the following: load of each input line is 0.7 (the probability that an arbitrary time slot contains a cell), the switch has 5 stages (i.e. it is a 32×32 switch) and the traffic is evenly spread across the output ports.

3. Consider the Batcher sorting network shown in the figure below. Each element sorts the incoming cells such that the cell which has a greater destination address is transmitted in the output port designated by the arrow. If only one input port contains a cell, it is transmitted in the output port corresponding to the smaller destination address. In the situation depicted in the figure, mark the route of each cell in the input ports through the network (mark the number of the transmitted cell in each output port). A star in an input port means that it is empty (no cell to transmit). What is the order of the cells in the real output ports of the switch (after the 6^{th} stage) ?