

Deadline: April 19th

1. Consider the array multiplier depicted below. Describe the functionality of the “circles”. Prove the correctness of the design. Extend the design to handle multiplication of numbers encoded in two’s complement. Prove the correctness of your extension. Apply the extension to adding partial products in logarithmic time (using 4:2-adders and the divide-and-conquer addition tree).

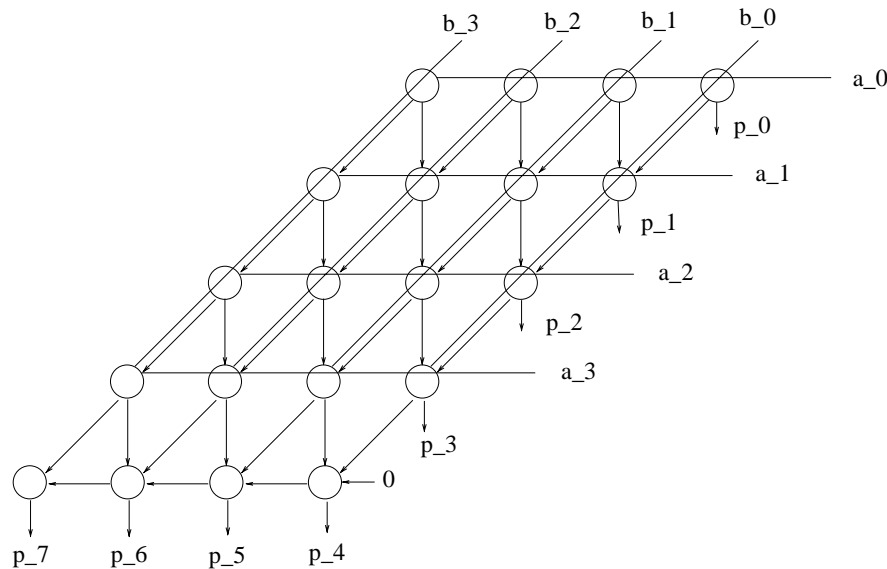


Figure 1: array multiplier - unsigned numbers

2. Compare the cost and delay of an adder tree based on 3:2-adders and an adder tree based on 4:2-adders, when used for multiplying $n \times n$ unsigned numbers. Write the recurrence equations, and compute the values for $n = 16, 23, 32, 52, 64$.
3. Consider the toy depicted below. In each cycle, a marble is dropped in at A or B (but not both), Levers x, y, z cause the marble to fall either to the left or to the right. If a marble encounters a lever, then it causes the lever to change its state, so that the next marble to encounter the same lever will take the opposite branch.

Model this toy by a Moore machine A (the branch through which a marble exits is output in the cycle after the marble is input). Construct a finite-state machine F that implements A using the algorithm presented in class. Analyze the cost and delays of your implementation.

