Binary Arithmetic TMs

I could do this with a one-tape TM, but for the sake of time I normally do this with a three tape TM. We discuss the basics of binary arithmetic and have the students construct a 3-tm that accepts binary representations of two binary numbers and form the sum on the third tape. We assume the first two tapes contain the two operand written with the high-order bits to the left. The catch – the two operands are not necessarily the same length.

Variation: Assume the numbers are written two-complement form – namely if the left most bit is a 1 the number is negative. If the shorter number has a left most 1 bit, then the tm must act as if the 1s are extended in performing the arithmetic.

The Issue: Many students forget to handle addition when the length of the result is bigger than the two initial operands.