# 2D PLOTS OF SOME UNARY FUNCTIONS

Below are 2D plots of some unary functions on bit strings that are reinterpreted as functions on integers. These plots were produced by Mathematica. For most functions, two plots are shown, one for a word size of four bits and the other for a word size of seven bits.

This material was suggested by Guy Steele.

By the "Gray code function," we mean a function that maps an integer that represents a displacement or rotation amount to the Gray encoding for that displacement or rotation amount. The inverse Gray code function maps a Gray encoding to a displacement or rotation amount. See *Hacker's Delight* Figure 13–1 on page 237.

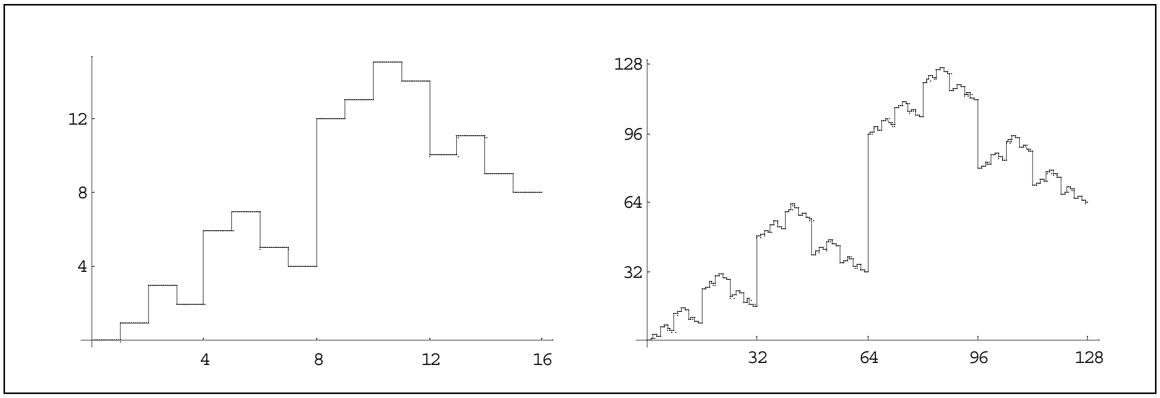


FIGURE 1. Plots of the Gray code function.

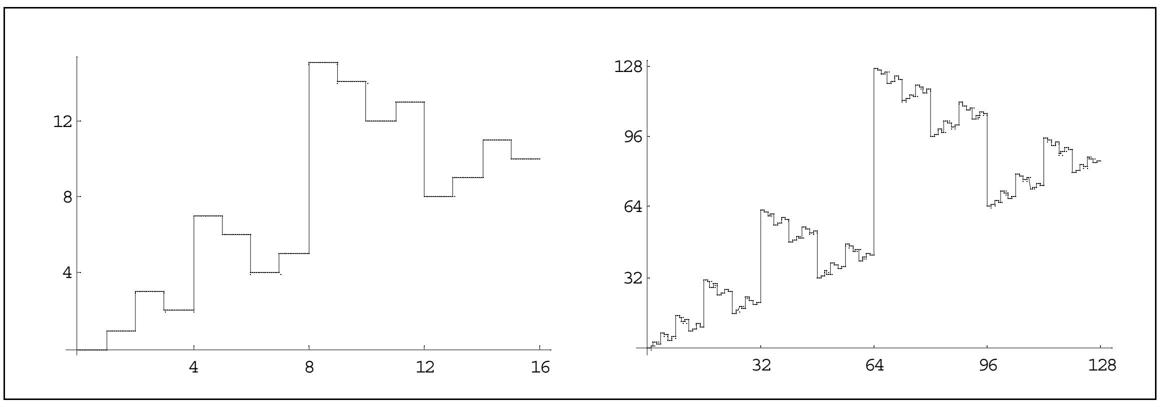


FIGURE 2. Plots of the inverse Gray code function.

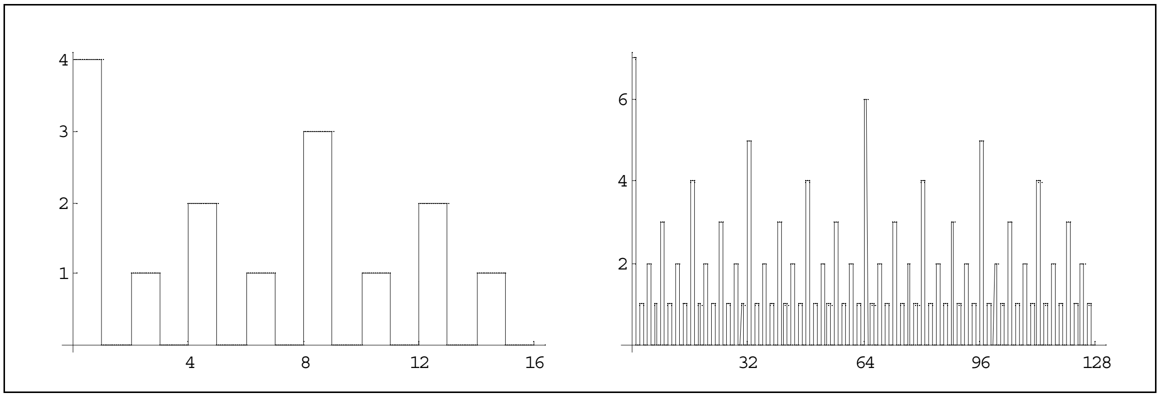


FIGURE 3. Plots of the ruler function (number of trailing zeros).

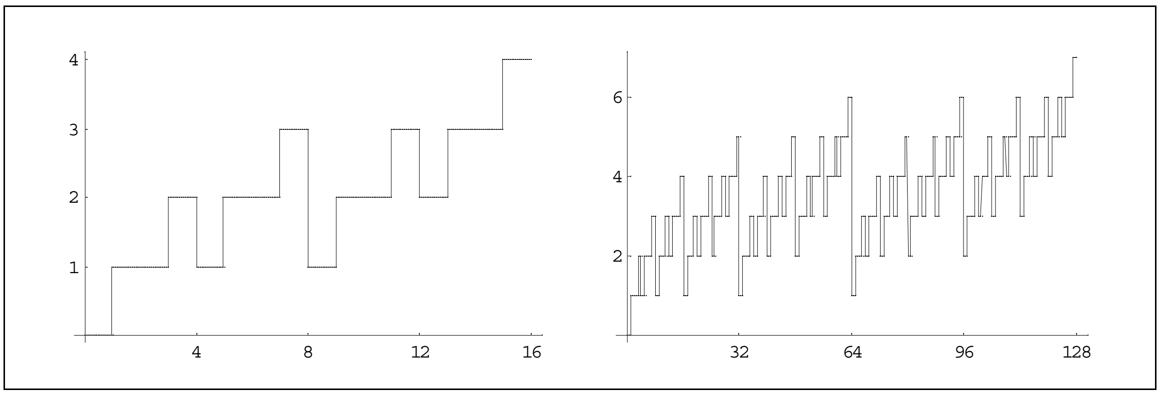


FIGURE 4. Plots of the population count function (number of 1-bits).

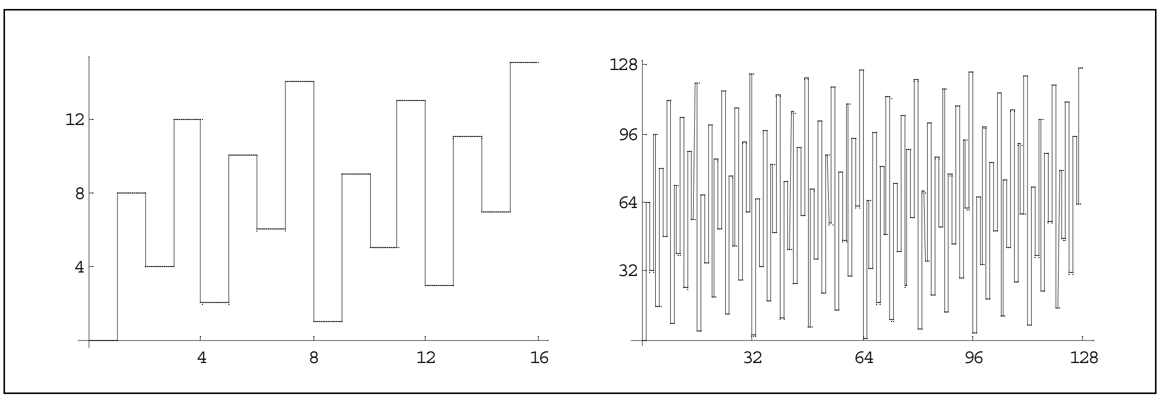


FIGURE 5. Plots of the bit reversal function.

Figure 6 shows what happens to a deck of 16 cards, numbered 0 to 15, after one, two, and three outer perfect shuffles (in which the first and last cards do not move). Figure 7 is the same for one, two, and three perfect *inner* shuffles. Figures 8 and 9 are for the inverse operations.

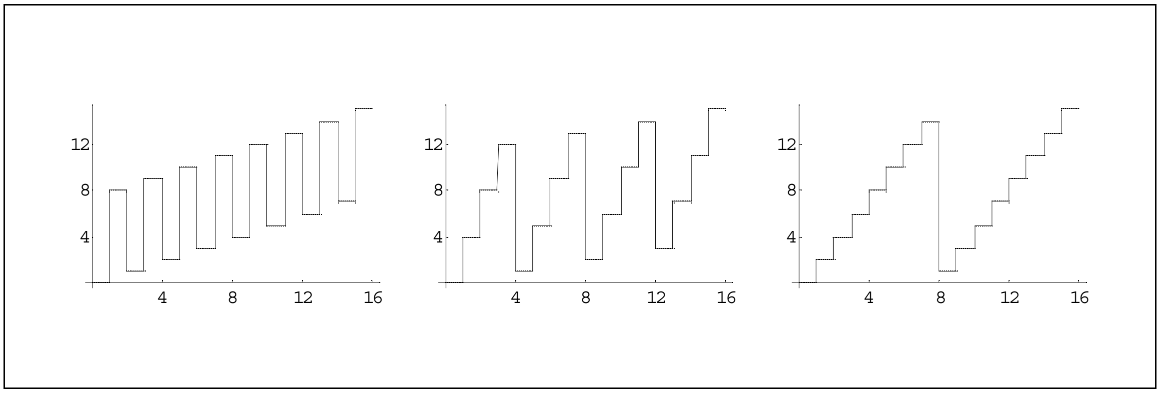

FIGURE 6. Plots of the outer perfect shuffle function.

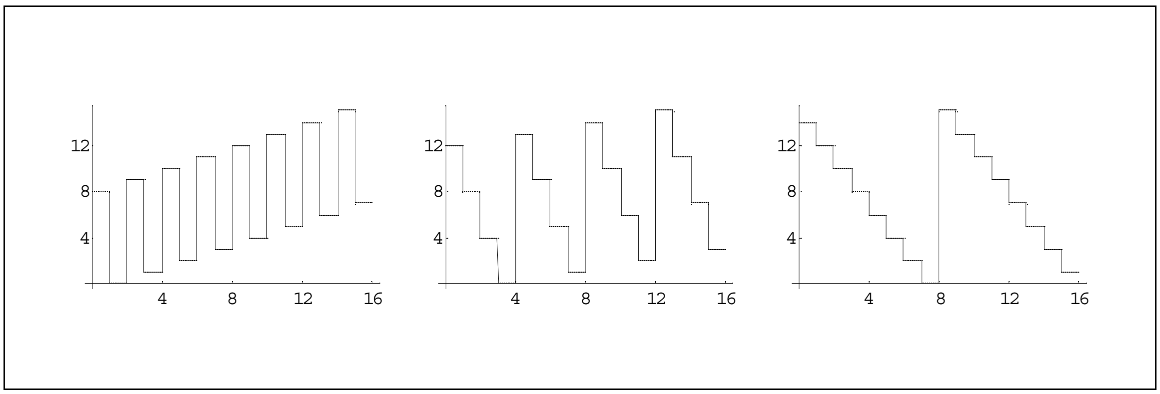

FIGURE 7. Plots of the inner perfect shuffle function.

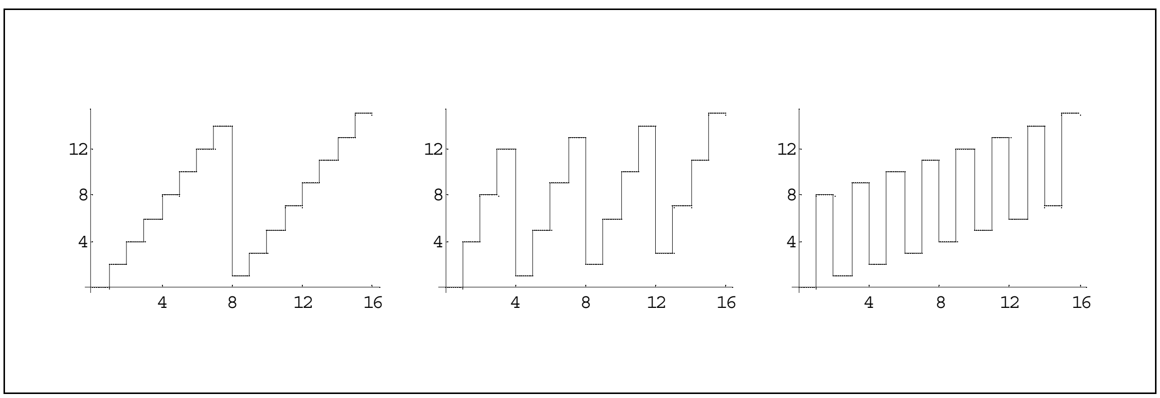

FIGURE 8. Plots of the outer perfect unshuffle function.

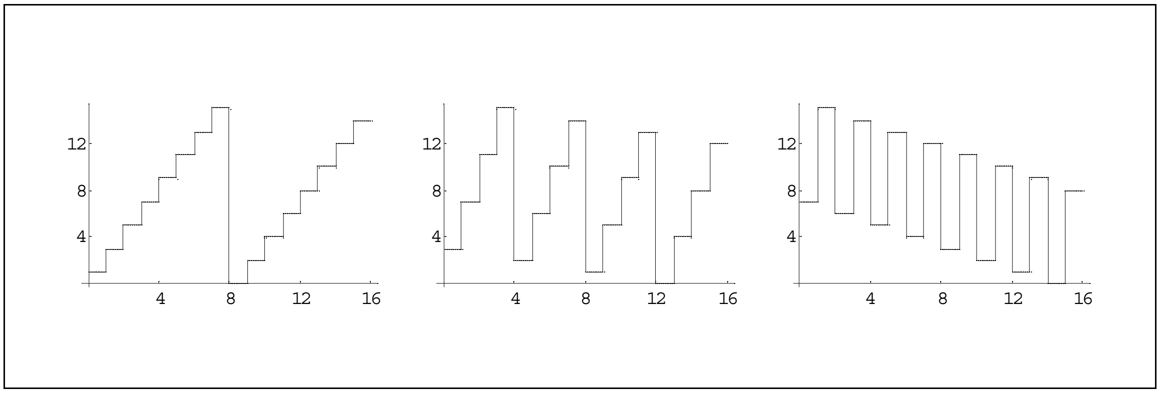


FIGURE 9. Plots of the inner perfect unshuffle function.

Figures 10 and 11 show the mapping that results from shuffling the bits of an integer of four and eight bits. Informally,

$$\text{shuffleBits}(x) = \text{asInteger}(\text{shuffle}(\text{bits}(x))).$$

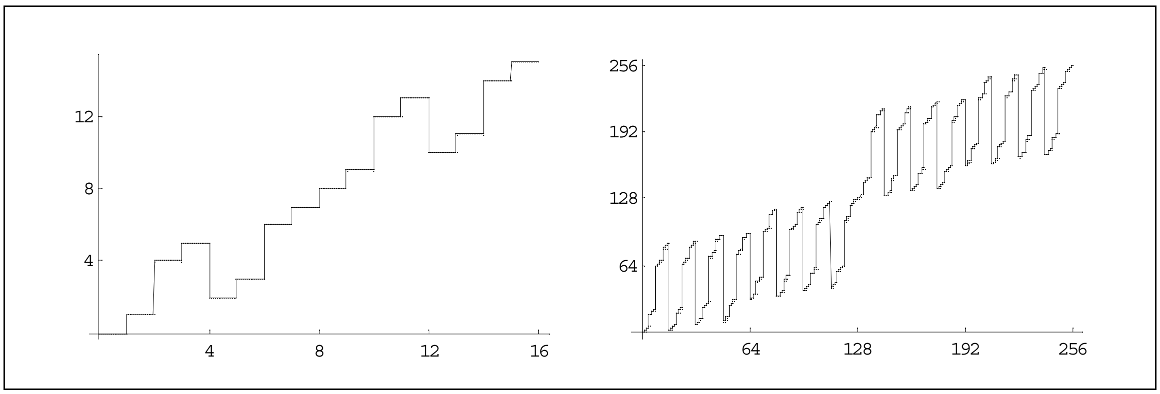


FIGURE 10. Plots of the outer perfect shuffle bits function.

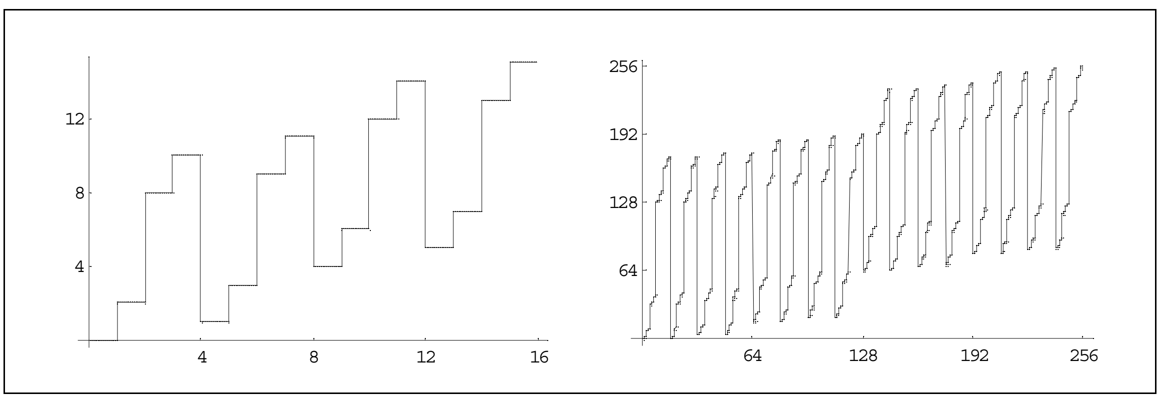


FIGURE 11. Plots of the inner perfect shuffle bits function.