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## 2 Boolean Arithmetic

*Counting is the religion of this generation, its holy book is the abacus.*  
—Gertrude Stein (1874–1946)

In this chapter we build gate logic designs that perform arithmetic operations on them. Our starting point is a full adder from chapter 1, and our ending point is a full adder. The ALU is the centerpiece chip that executes the operations performed by the computer. Hence, building a full adder is a first step toward understanding how the Centurion computer works.

As usual, we approach this task gradually. We start with ground on how binary codes and Boolean algebra represent and add signed numbers. The first step is to design the adder chips, designed to add two bits, through a full adder. This sets the stage for the ALU specific implementation of a simple logic design. The Implementation section provides guidelines on how to build the adder chip using the hardware simulator supplied with the Centurion.

Binary addition is a simple operation. The full adder performs operations performed by digital computer: adding two binary numbers. Therefore, constructing a full adder is a key to the implementation of numerous computer operations in one way or another.