Thus, every bit increase in the A/D converter yields a 6 dB increase in the signal-to- noise ratio. The constant term **10log1.5** equals 1.76.

This derivation assumed the signal's amplitude lay in the range [−1, 1]. What would the amplitude quantization signal-to-noise ratio be if it lay in the range [−***A***, ***A***]?

**Exercise 5.4.2**

How many bits would be required in the A/D converter to ensure that the maximum amplitude quantization error was less than 60 db smaller than the signal's peak value?

**Exercise 5.4.3**

Music on a CD is stored to 16-bit accuracy. To what signal-to-noise ratio does this correspond?

**Exercise 5.4.4**

Once we have acquired signals with an A/D converter, we can process them using digital hardware or software. It can be shown that if the computer processing is linear, the result of sampling, computer processing, and unsampling is equivalent to some analog linear system. Why go to all the bother if the same function can be accomplished using analog techniques? Knowing when digital processing excels and when it does not is an important issue.

### Discrete-Time Signals and Systems

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Mathematically, analog signals are functions having as their independent variables continuous quantities, such as space and time. Discrete-time signals are functions defned on the integers; they are sequences. As with analog signals, we seek ways of decomposing discrete-time signals into simpler components. Because this approach leads to a better understanding of signal structure, we can exploit that structure to represent information (create ways of representing information with signals) and to extract information (retrieve the information thus represented). For symbolic-valued signals, the approach is diferent: We develop a common representation of all symbolic-valued signals so that we can embody the information they contain in a unifed way. From an information representation perspective, the most important issue becomes, for both real-valued and symbolic-valued signals, efciency: what is the most parsimonious and compact way to represent information so that it can be extracted later.