important because discrete-time signals can be manipulated by systems instantiated as computer programs. Subsequent modules describe how virtually all analog signal processing can be performed with software.

As important as such results are, discrete-time signals are more general, encompassing signals derived from analog ones **and** signals that aren't. For example, the characters forming a text fle form a sequence, which is also a discrete-time signal. We must deal with such symbolic valued (p. 180) signals and systems as well.

As with analog signals, we seek ways of decomposing real-valued discrete-time signals into simpler components. With this approach leading 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.

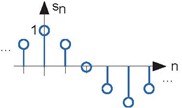
#### Real-and Complex-valued Signals

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A discrete-time signal is represented symbolically as *s (n)*, where n = {..., −1, 0, 1,... }. We usually draw discrete-time signals as stem plots to emphasize the fact they are functions defned only on the integers. We can delay a discrete-time signal by an

integer just as with analog ones. A delayed unit sample has the expression *δ (n − m*,*)*

and equals one when *n = m*.



**Figure 2.7 Discrete-Time Cosine Signal** The discrete-time cosine signal is plotted as a stem plot. Can you fnd the formula for this signal?

#### Complex Exponentials

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The most important signal is, of course, the **complex exponential sequence**.

