*Figure 36-6.* *Computations within a recurrent layer*

Recurrent Connection Schemes

There are two main schemes for forming recurrent connections from one recurrent layer to another. The first is to have recurrent connections between hidden units, and the other is recurrent connections between the hidden unit and the output of the previous layer. The different schemes are visually illustrated in Figure 36-7.
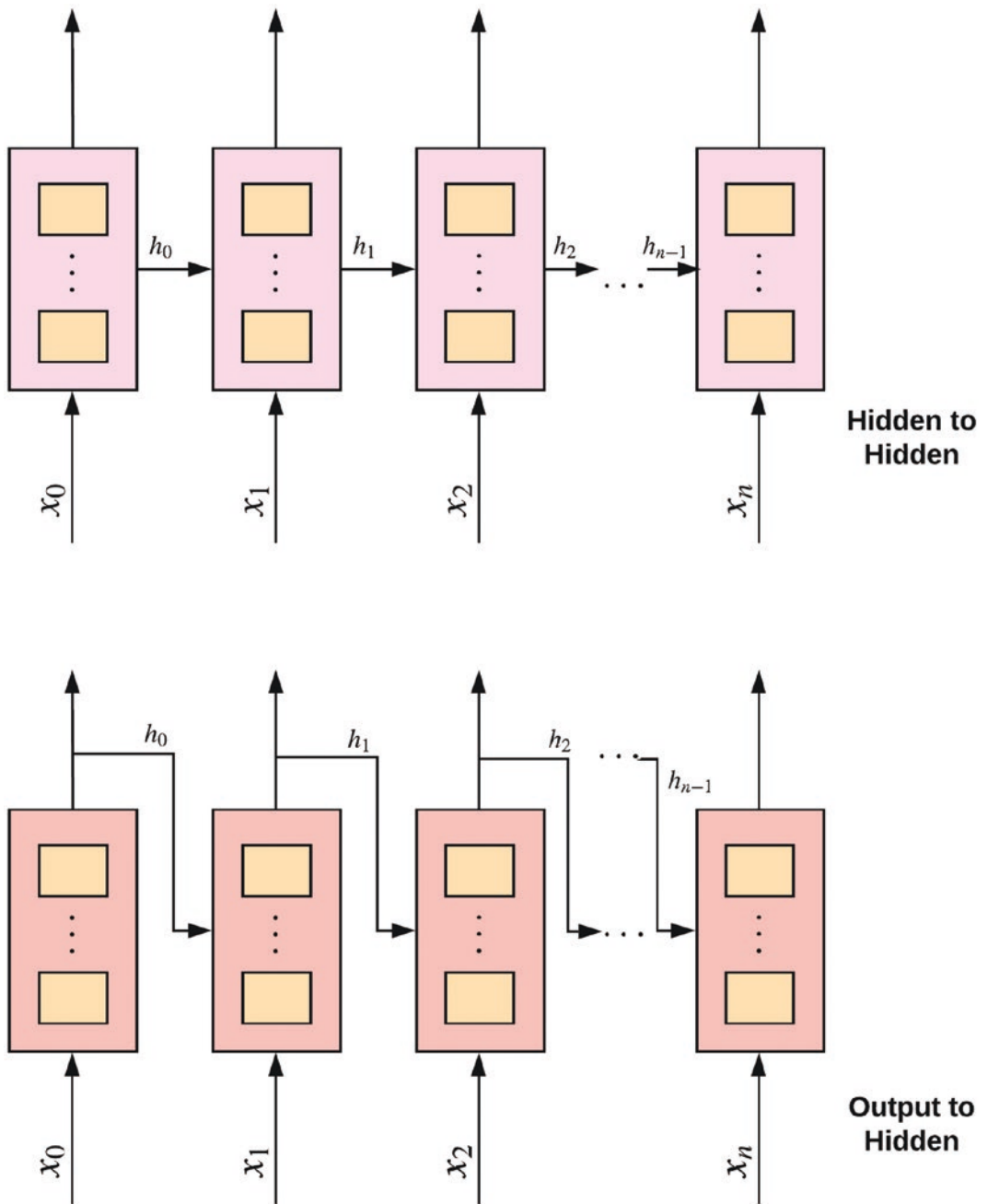
*Figure 36-7. Recurrent connection schemes*

The hidden-to-hidden recurrent configuration is found to be superior to the output-to-hidden form because it better captures the high-dimensional feature information about the past. In any case, the output-to-hidden recurrent form is less computationally expensive to train and can more easily be parallelized.

Sequence Mappings

Recurrent neural networks can represent sequence problems in a variety of ways. The flexibility of RNN mappings is that it operates on inputs and outputs of the network as sequences, thus freeing the network from the fixed sized input-output constraints found in other neural network architectures such as MLP and CNN.

Here are a few examples of variating sequence problems solved using RNNs:

1.   An input to a sequence of output. This configuration is used for image captioning problems when an image is passed as an input to the network, and the output is a sequence of words. See Figure 36-8.
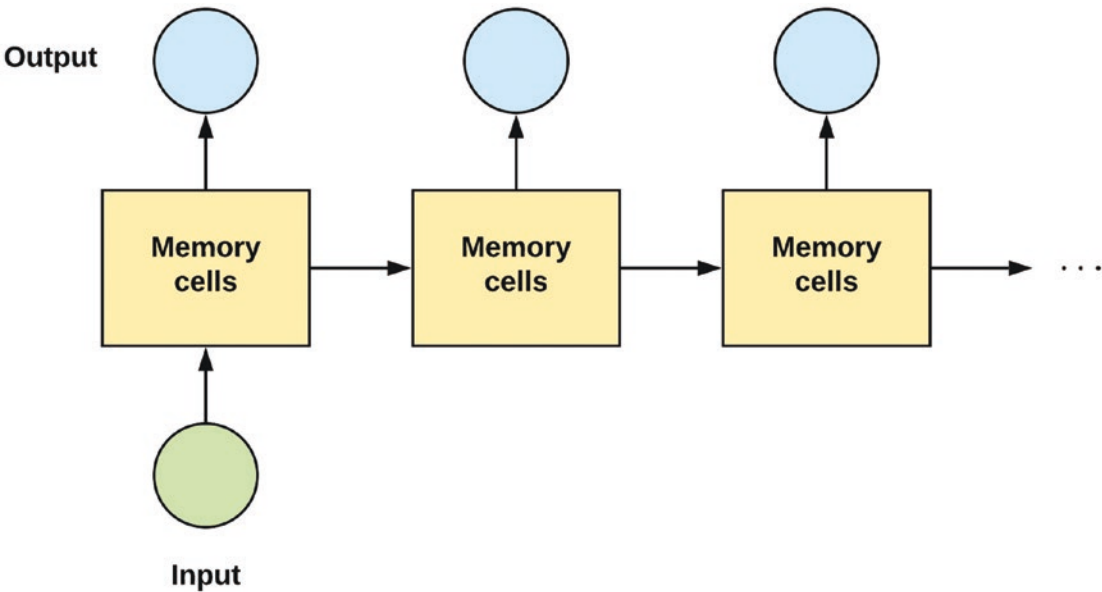
Figure 36-8. *An input to a sequence of output*