Figure 36-14. *Peephole connection*

Gated Recurrent Unit (GRU)

The gated recurrent unit (GRU) is a more recent recurrent neural network architecture than the LSTM, and it is also comparable simpler to implement with respect to the number of components within the unit and their operations. Despite its comparative simplicity, GRUs are high-performing recurrent architectures and, in most cases, even perform better than the LSTM in sequence modeling problems.

GRUs combine the forget and the input gates to decide on what information should be committed to the long-term memory or the memory cell and what information should be left out. Moreover, the GRU combines the cell (i.e., long-term state) and short-term states into a single state vector h_t. Also, the GRU removes the output gate and returns the state vector h_t at each time instant. This is further illustrated in Figure 36-15. In TensorFlow 2.0, the GRU layer is implemented in the method **'tf.keras.layers.GRU()'**.
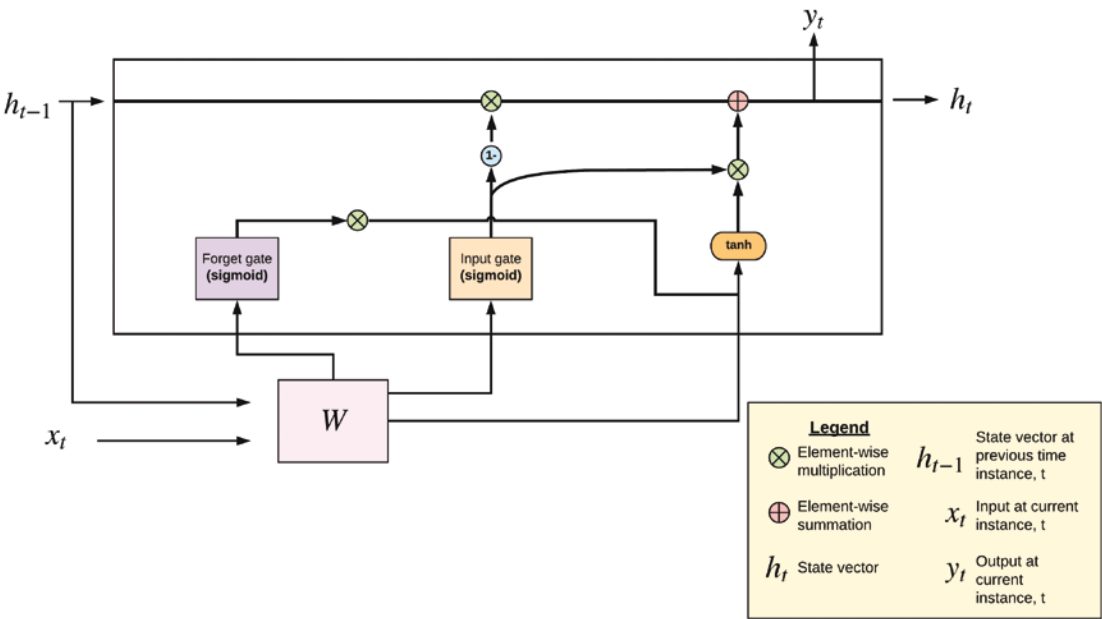
Figure 36-15. *Gated recurrent unit*

Recurrent Neural Networks Applied to Sequence Problems

Recurrent neural networks have many application areas for using LSTM models for sequence tasks. A couple of problems under this domain include sentiment analysis, machine translation, image captioning, video captioning, and voice recognition. As mentioned earlier, these problems can be modeled as a one-to-many model, a many-to-one model, or a many-to-many model. The section will survey a few LSTM architectures for tackling/modeling sequence problems:

- Long-term recurrent convolutional neural network, also known as CNN LSTM

- Encoder-Decoder LSTMs

- Bidirectional recurrent neural networks