

Projective RNN

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1 Projective RNN

Receiving a sequence of inputs RNN models maintain hidden state as recurrent function $h_t = \text{RNN}(x_t, h_{t-1})$.

The idea of projective RNN is to couple arbitrary RNN (e.g. LSTM, GRU) module with two dynamically updated matrices X_t and H_t , consisting of important events in input and state spaces respectively.

Having an input x we project it to linear span of dictionary X . The optimal projection $\pi_X(x)$ is found by minimizing $\|x - X\alpha\|^2$ and is equal to:

$$\pi_X(x) := X(X^T X)^{-1} X^T x.$$

We now define projective RNN:

$$\begin{aligned} X_t &= \begin{cases} X_{t-1} & \text{if } \|x_t - \pi_{X_{t-1}}(x_t)\| < \epsilon_x, \\ [X_{t-1}, x_t] & \text{otherwise,} \end{cases} \\ h_t &= \text{RNN}(\pi_{X_t}(x_t), \pi_{H_{t-1}}(h_{t-1})). \\ H_t &= \begin{cases} H_{t-1} & \text{if } \|h_t - \pi_{H_{t-1}}(h_t)\| < \epsilon_h, \\ [H_{t-1}, h_t] & \text{otherwise.} \end{cases} \end{aligned} \tag{1}$$

where X_t and H_t are dictionaries of inputs and hidden states, and ϵ_x and ϵ_h are two thresholds controlling their updates.