

Senior Design Project Description

We would like to apply a log-linear model based on those found in machine translation systems to the problem of creating a harmony for a given melody. The log-linear model will consist of two main components: the language model and the translation model. The language model will model the likelihood of a given harmony line $H = \{h_0, h_1, \dots, h_{l-1}\}$ where $l = |H|$. We propose it use 3-grams for context and apply a penalty function d to discourage large differences in notes' positions on the staff. More fomrally, the language model can be defined as:

$$p_{LM}(H) = \prod_{i=1}^l P[h_i|h_{i-1}, h_{i-2}, h_{i-3}] * d(h_i - h_{i-1})$$

The second component of our model will be the translation model, which will model the probability that a harmony H is a good translation for a melody M . It can be defined as:

$$p_{TM}(M|H) = \prod_{i=1}^l P[m_i|h_i]$$

Putting these two components together, given a melody M we would like to find a harmony H s.t.

$$H = \operatorname{argmax}_H p(H|M) = p_{TM}(M|H)p_{LM}(H).$$

To simplify computation, we will actually minimize the log of the function above so that

$$\begin{aligned} H &= \operatorname{argmax}_H \log(p_{TM}(M|H)) + \log(p_{LM}(H)) \\ &= \operatorname{argmax}_H \sum_{i=1}^l \log(P[m_i|h_i]) + \log(P[h_i|h_{i-1}, h_{i-2}, h_{i-3}]) + \log(d(h_i - h_{i-1})) \end{aligned}$$