

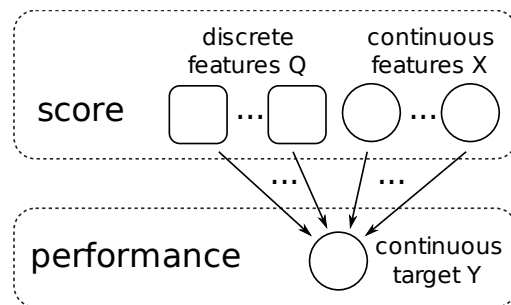
## A Model for Expressive Music Performance

### Data

- Performances of **Mozart Piano Sonatas** by Roland Batik
- Performances of **Chopin Piano Pieces** by Nikita Magaloff

### Method

- Model score-performance dependencies as a **probabilistic network**:



- Model  $p(Y|Q, X)$  as a **gaussian distribution**  $\mathcal{N}(\mu, \sigma^2)$  that varies linearly with  $X$ : when  $Q = \bar{q}$  and  $X = \bar{x}$ :

$$\mu = d_{\bar{q}} + \bar{k}_{\bar{q}} \cdot \bar{x}$$

Estimate the parameters  $d_{\bar{q}}$  and  $\bar{k}_{\bar{q}}$  by **linear regression** (least squares);  $\sigma^2$  is the average residual error

### Features/Targets

- **Targets (Y)**: timing, loudness, articulation
- **Discrete Features (Q)**: pitch interval, rhythmic context, I-R label, I-R position
- **Continuous Features (X)**: I-R closure, duration ratio

### Performance Rendering

Steps:

1. Read **Expressive hints** from score (trill, cresc., rit., p, f, etc.)
  - Set up basic tempo curve
  - Set up basic loudness curve
2. **Extract features** from score
3. Predict **expressive deviations** from model; For every note and every target:
  - Enter features as **evidence**  $\bar{q}$ ,  $\bar{x}$  in network
  - **Infer** most likely timing/loudness/articulation value  $\mu = d_{\bar{q}} + \bar{k}_{\bar{q}} \cdot \bar{x}$
4. **Combine** basic curves and predicted deviations (for tempo/loudness respectively)