Modeling Form for On-line Following of Musical Performances

Adapted from slides by:

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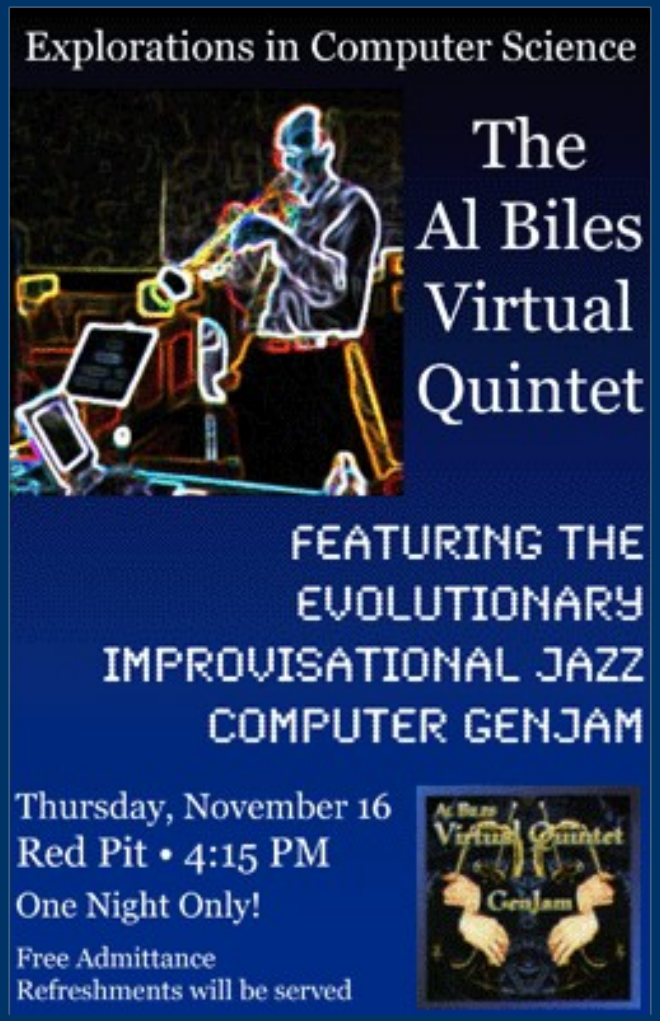
Motivation: A Peer Musician

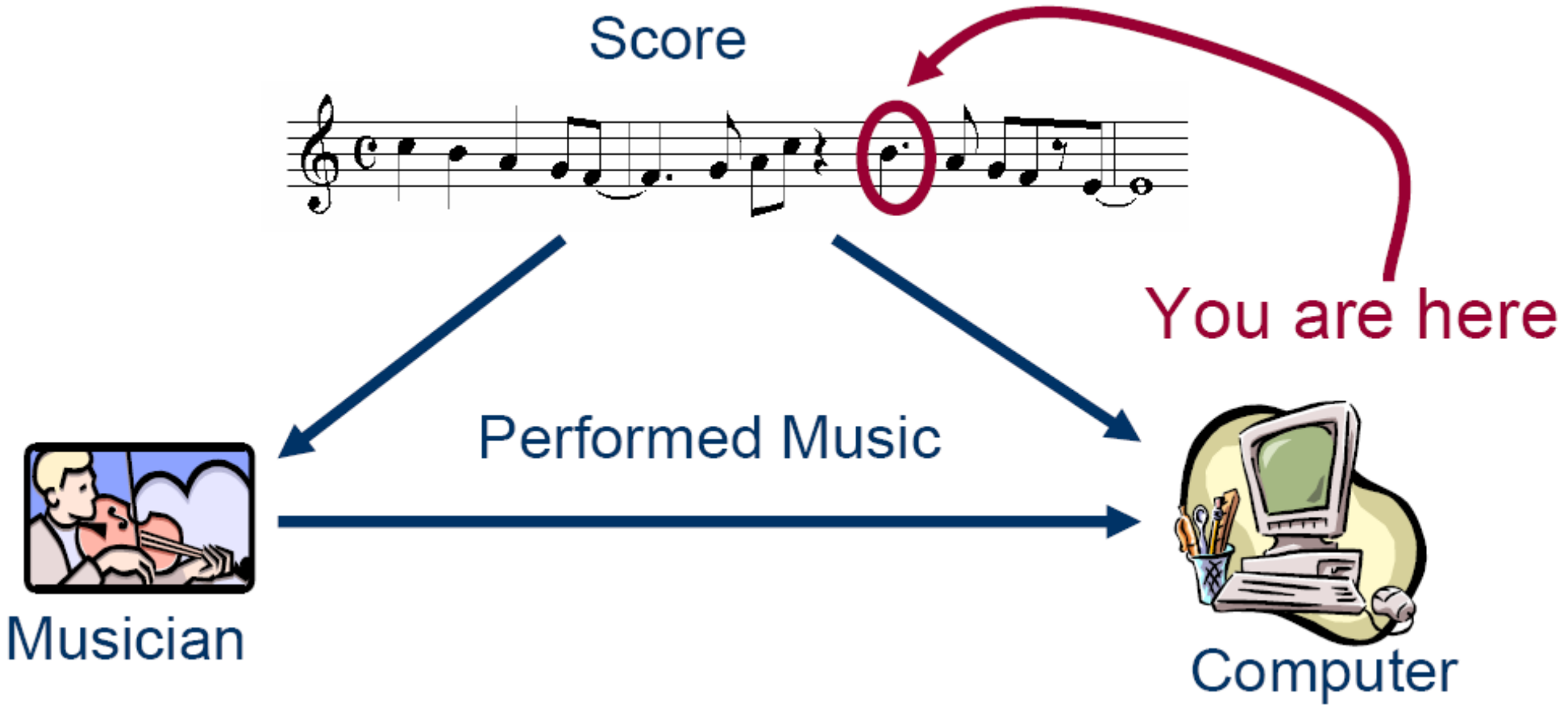
- Listens: musical performance as input
- Understands: beat, melody and harmony
- Interacts: enhances performance

Example: Al Biles Virtual Quartet

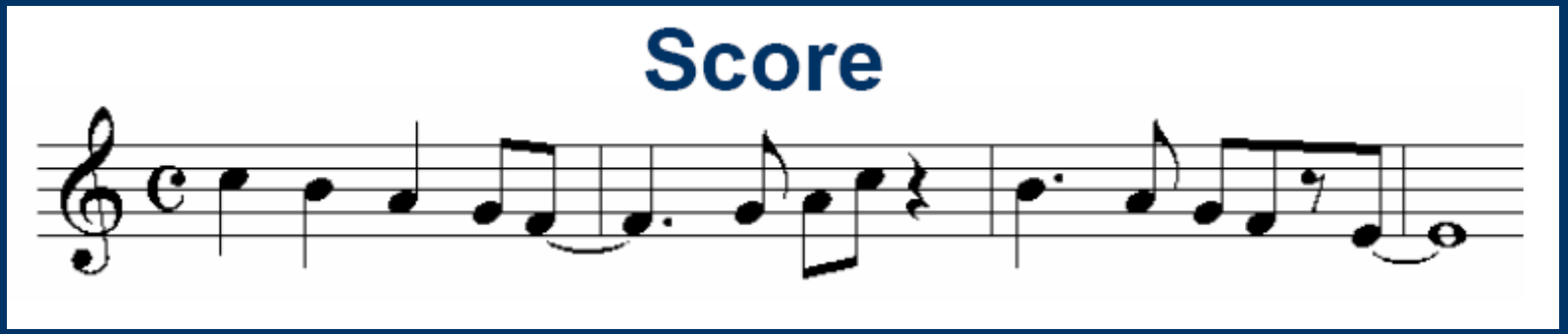


- Follows musical performance
- Improvises, given the performance
- Some accompaniment ability

Score Following

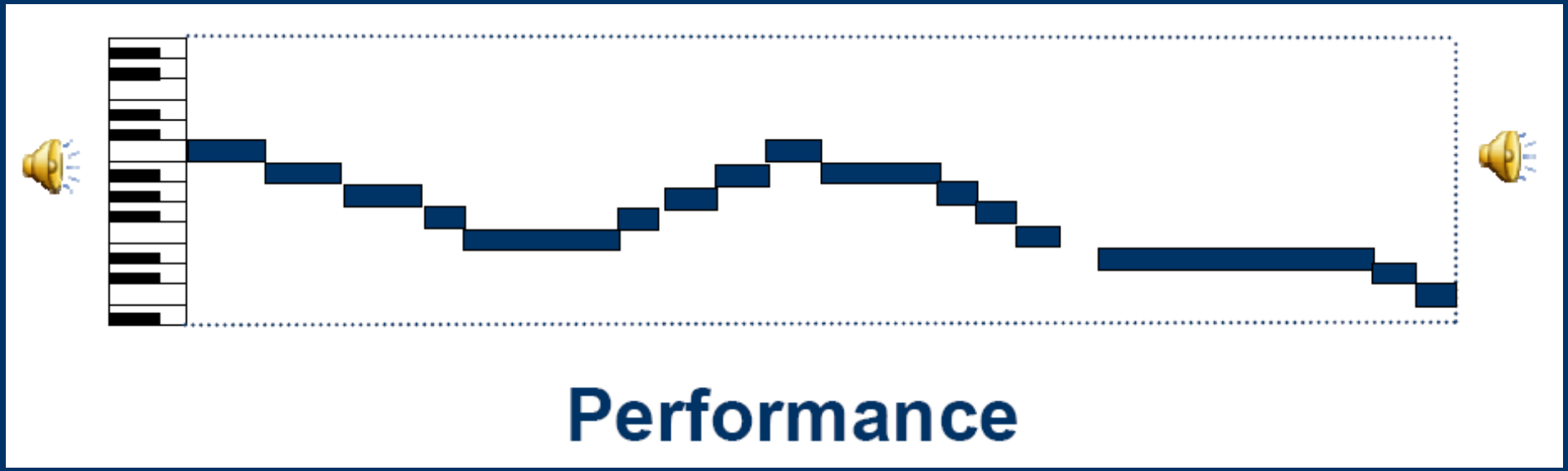


Classical Score Following



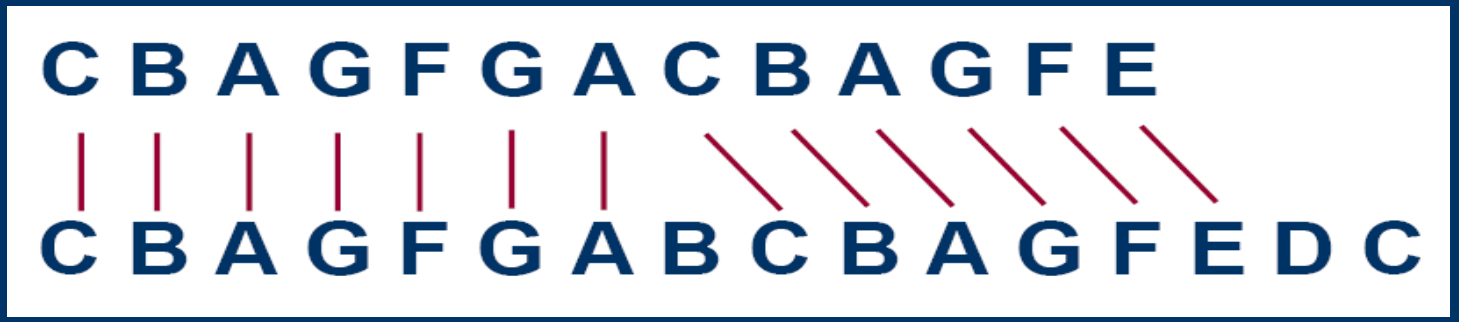
Totally ordered sequence of exact pitches

Faithful reproduction from start to finish



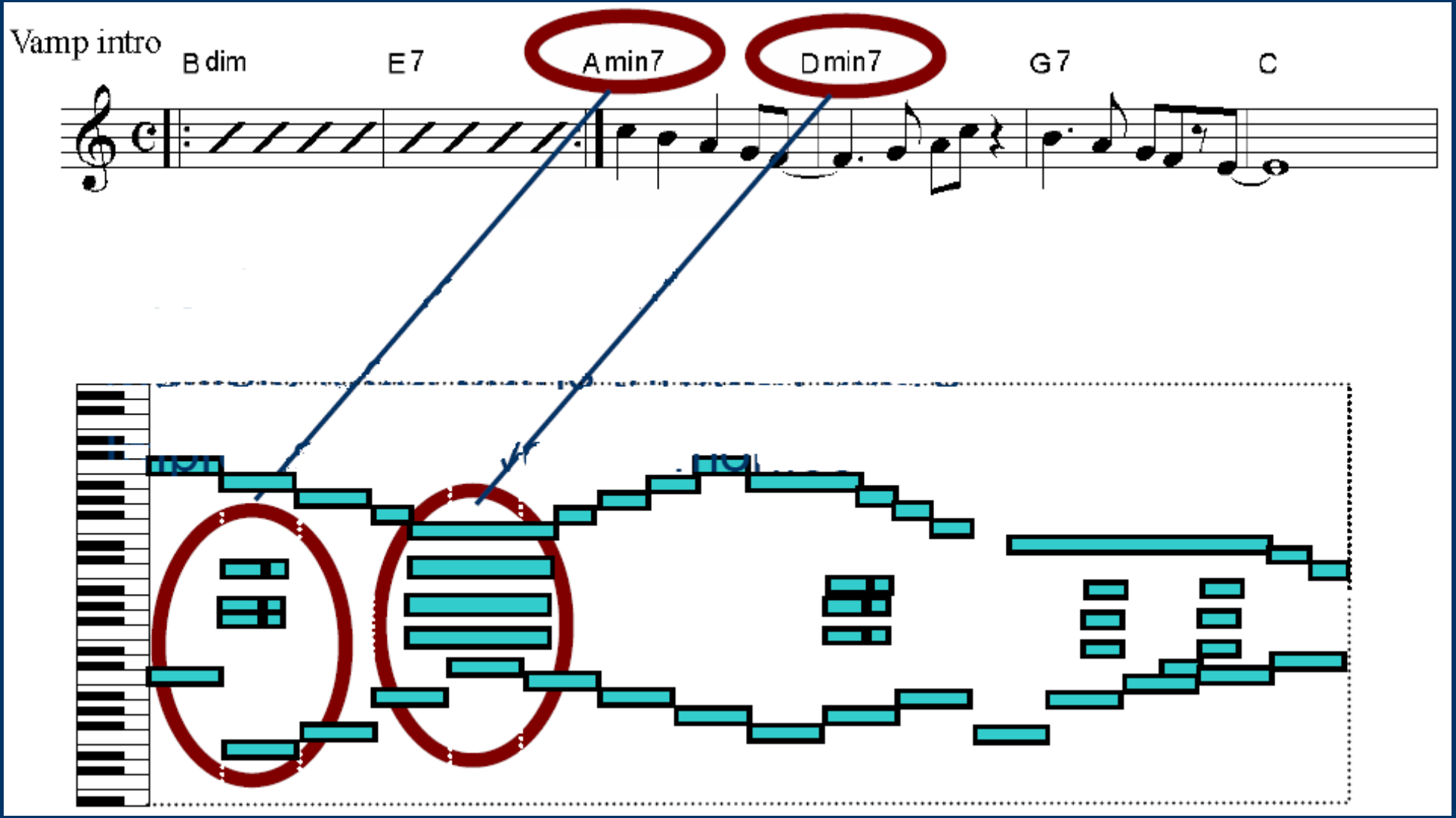
Score Following

- Transcription
  - Used MIDI encoding
- Alignment (matching)
  - Find the 'best' alignment between performance and written score
- Can use string matching algorithms,



However...

Semi-improvised Score Following

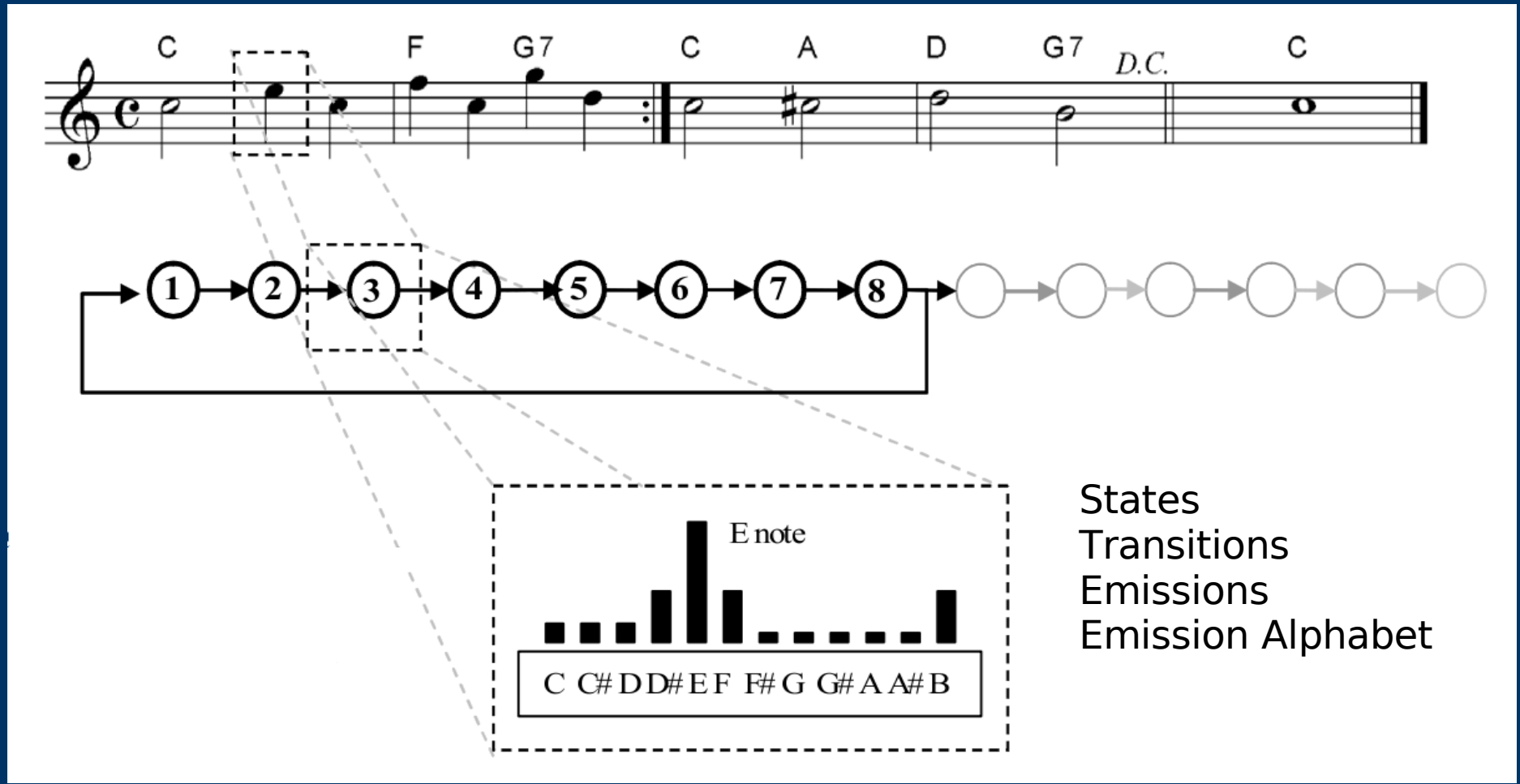


Modeling Uncertainty?

- Capture arbitrary repeats
- Capture dropped or added notes (symbols)
- Use chords, lyrics, etc... as events

- Markov Assumption over the performance
- Use a Markov Model!

Score Model



States
Transitions
Emissions
Emission Alphabet

Task

- Given Markov assumption over performance...
- Infer prob. of being in state j given observation i
- Formulae...

Evaluation Vs. String Matching

- Model small-scale variation:
  - Skip or repeat single note
- Model large-scale variation:
  - Skip or repeat a section of notes
- Use previously shown model

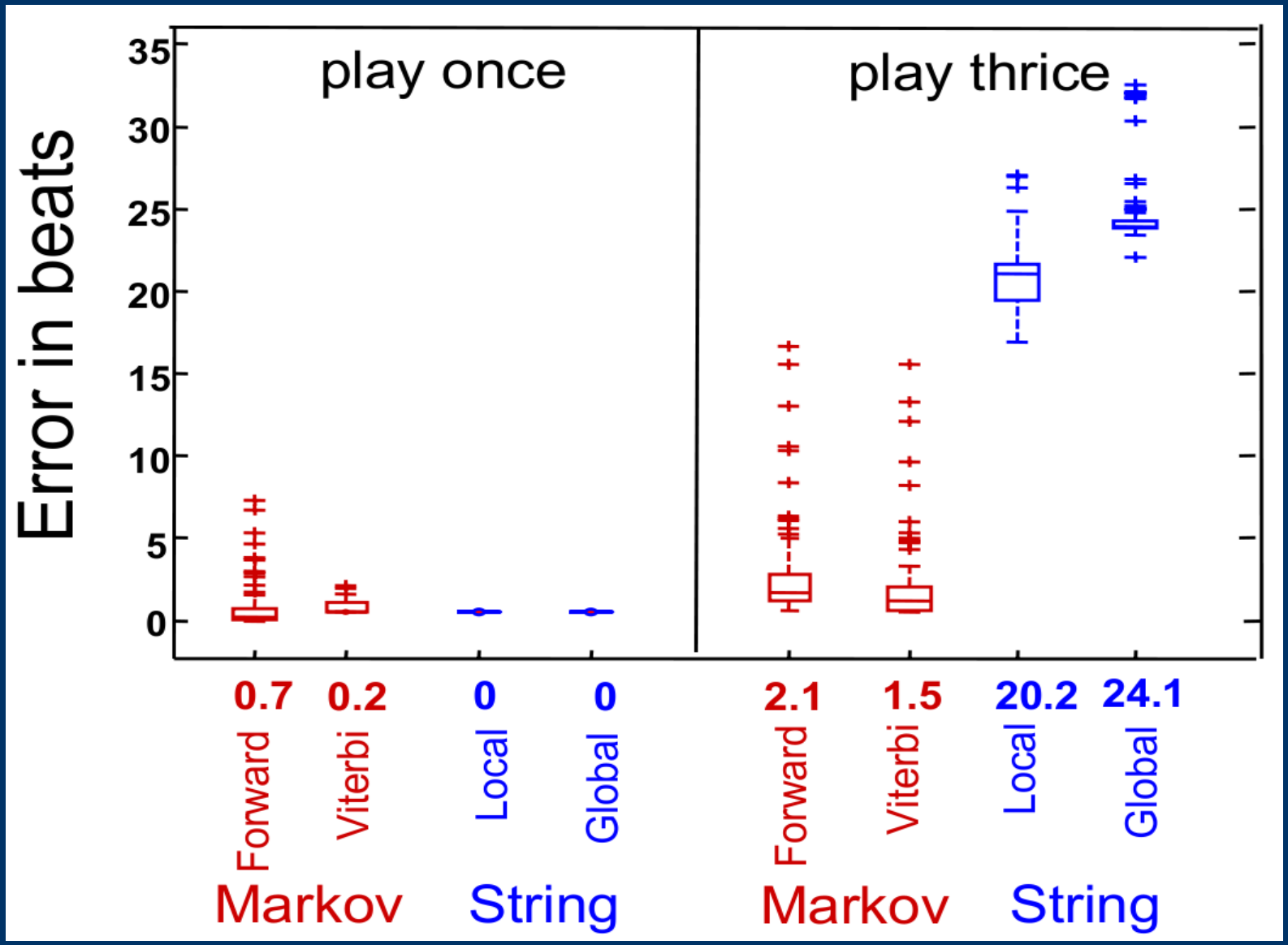
Evaluation Vs. String Matching

- 98 Jazz melodies
  - Skip first section
  - Play first section:
    - Once
    - Twice
    - Thrice
- Forward-backward and Viterbi Vs. local and global string matching.

Predictions

- String matchers can't encode repeats.
  - Performance should be poor for any number of unexpected repeats
- Markov models should remain same for any number.

Results


play once
play thrice
Error in beats
35
30
25
20
15
10
5
0
0.7
0.2
0
0
2.1
1.5
20.2
24.1
Forward
Viterbi
Local
Global
Forward
Viterbi
Local
Global
Markov
String
Markov
String

Conclusions

- Unified representation for chords, notes and keys
- Model based on structure of score & collection of previously observed probabilities
- No score specific training
- Beats string matching for arbitrary repeats in performance