

Modeling Form for On-line Following of Musical Performances

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Motivation: A Peer Musician

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




Musician



Computer

Example: AI Biles Virtual Quartet


Explorations in Computer Science



The
AI Biles
Virtual
Quintet

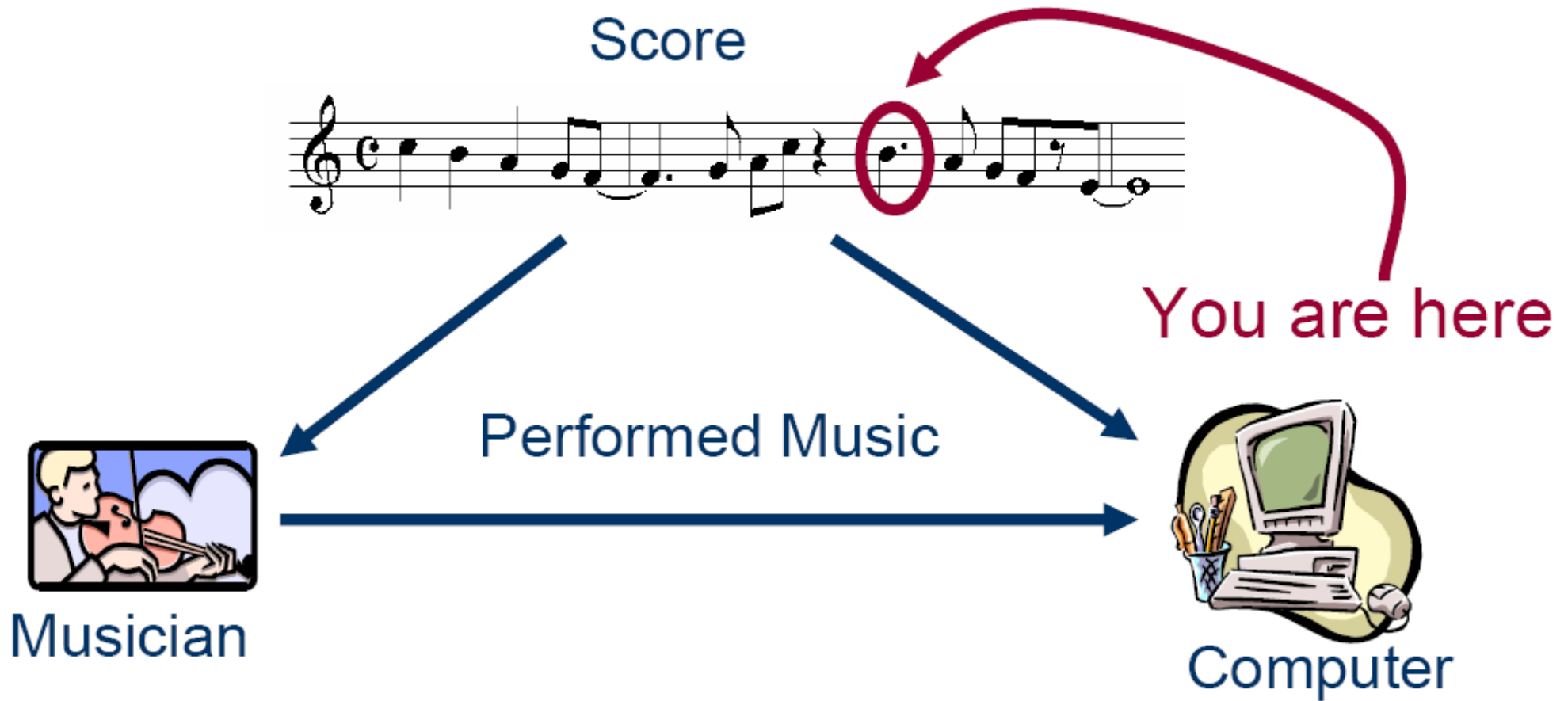
FEATURING THE
EVOLUTIONARY
IMPROVISATIONAL JAZZ
COMPUTER GENJAM

Thursday, November 16
Red Pit • 4:15 PM
One Night Only!
Free Admittance
Refreshments will be served



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

Score Following



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

Vamp intro

B dim E7 **Amin7** **Dmin7** G7 C

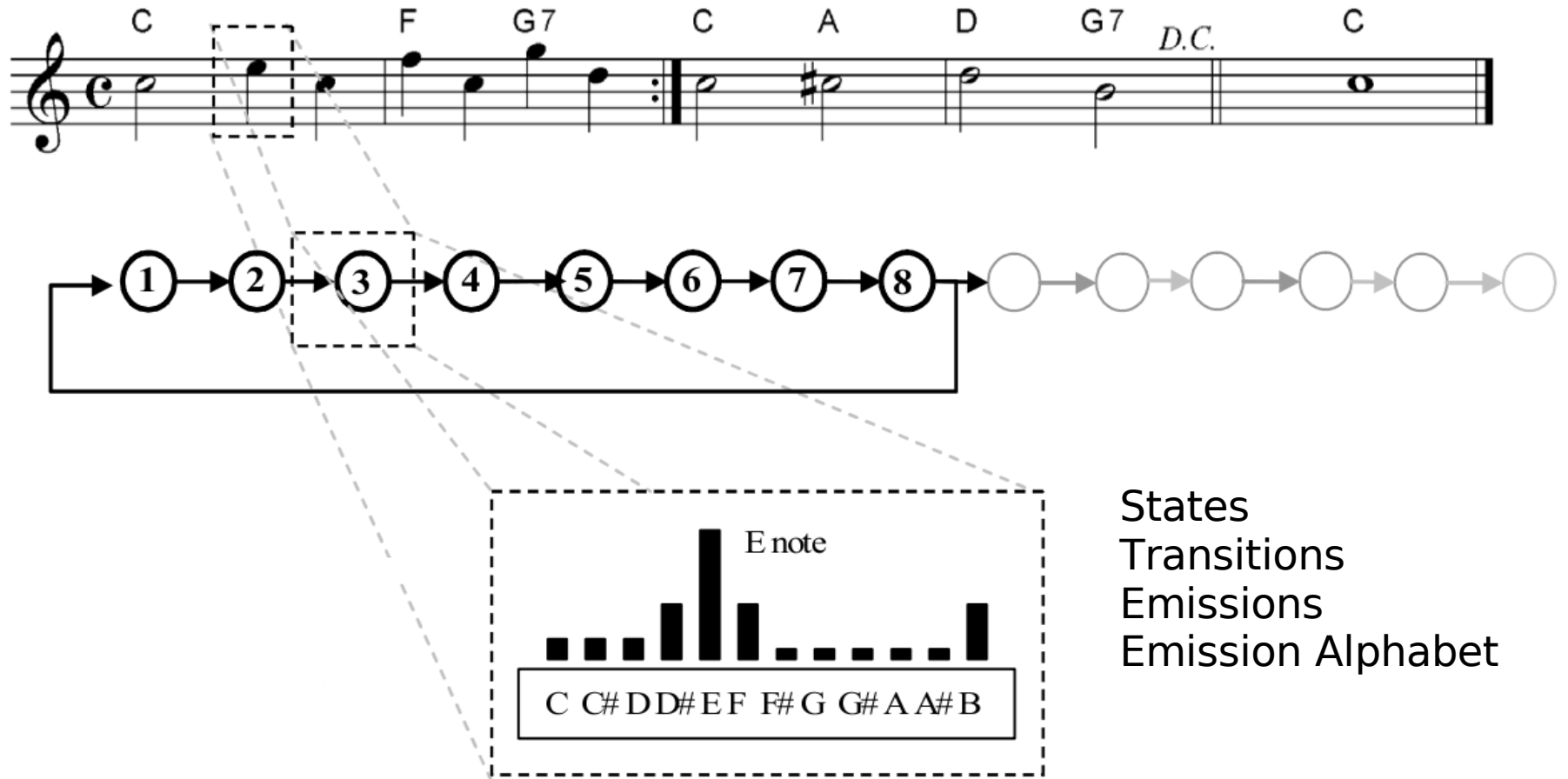
The image displays a musical score for a 'Vamp intro' in C major. The score is written on a single treble clef staff with a common time signature (C). It begins with a double bar line and a repeat sign. The first two measures are filled with diagonal slashes, indicating a vamp. The third measure is marked with the chord **Amin7**, and the fourth with **Dmin7**. Both of these chord labels are circled in red. The fifth measure is marked with G7, and the sixth with C. Below the staff, a piano keyboard diagram shows the corresponding chord voicings for Amin7 and Dmin7, which are also circled in red. Blue arrows point from the circled chord labels in the score to their respective voicings on the keyboard. The keyboard diagram shows the left hand playing the root and fifth of the chords (A and D) and the right hand playing the minor third and seventh (C and E for Amin7, E and F for Dmin7).

Modeling Uncertainty?

- Capture arbitrary repeats
 - Capture dropped or added notes (symbols)
 - Use chords, lyrics, etc... as events
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- Markov Assumption over the performance
 - Use a Markov Model!



Score Model



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

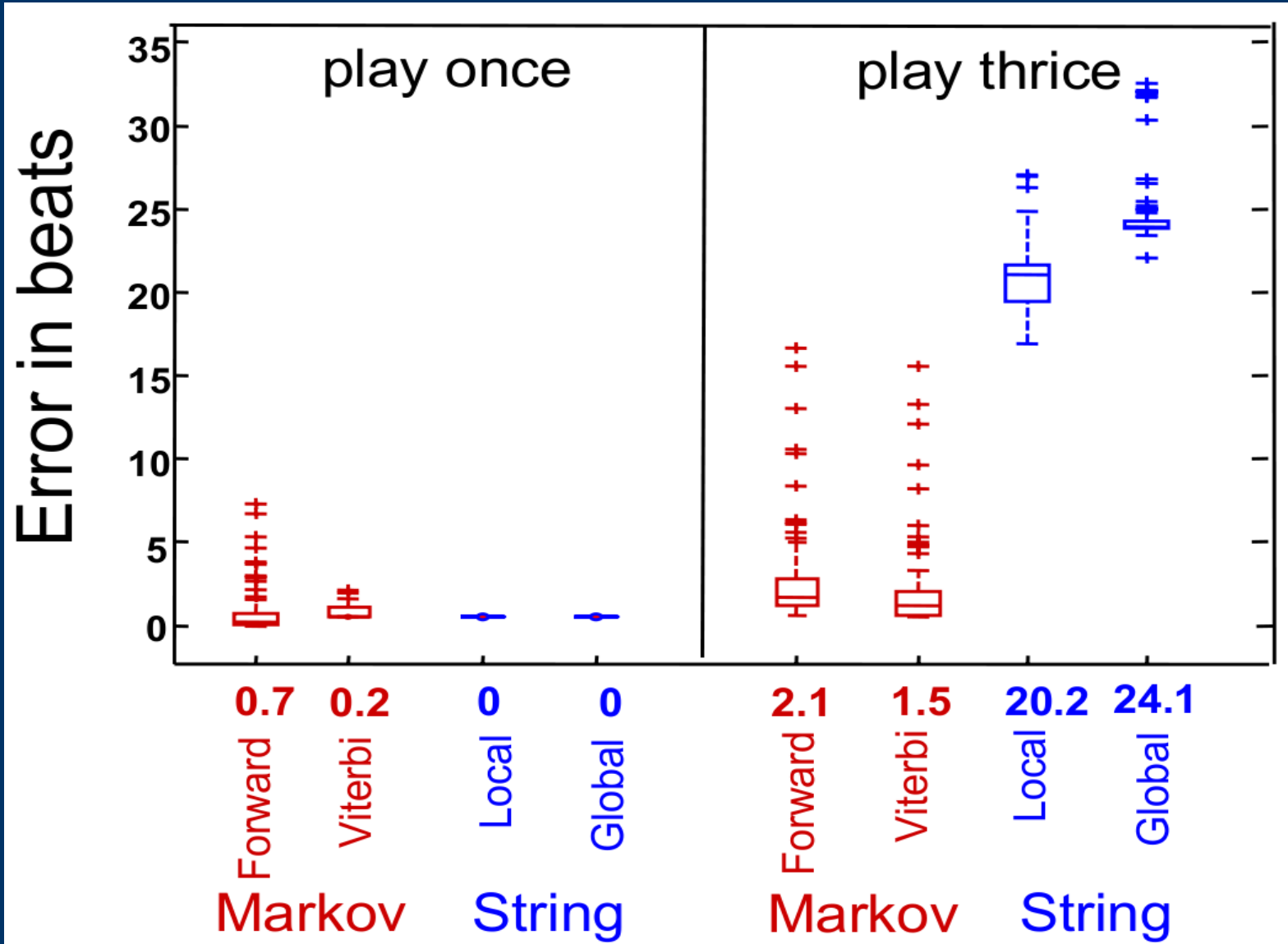
- 98 Jazz melodies
 - Skip first section
 - Play first section:
 - Once
 - Twice
 - Thrice
 - Forward-backward and Viterbi Vs. local and global string matching.
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Predictions

- 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



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
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