

# A Creative Improvisational Companion based on Idiomatic Harmonic Bricks

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# Motivation

- Educating (jazz) improvisers
- Provide feedback (visual and aural) on solos over chord changes:
  - Through-composed solos
  - Contrafacts (new melodies over chord changes of existing tunes)
  - Improvised solos (through MIDI input)

# Aside on the Origin of “jazz”

- Said to be derived from **Irish**: “teas”, pronounced “jass” or “chass”
- Meaning:
  - Heat, passion
- Reference:  
[www.counterpunch.org/2006/07/14/how-the-irish-invented-jazz/](http://www.counterpunch.org/2006/07/14/how-the-irish-invented-jazz/)

# Impro-Visor (Improvisation Advisor)

- Free, open-source, software
- Developed at Harvey Mudd College since 2005
- Over 7000 users registered in community forum
- Classroom use for 5 years

# “Leadsheet”

- Commonly used by jazz and other musicians
- A leadsheet abstracts a tune:
  - Melody
  - Chord progression
  - Minimal or no arrangement

# Sample Impro-Visor Leadsheet

## In Dublin's Fair City

James Yorkston

Style: waltz

The musical score is written in treble clef with a key signature of one sharp (F#) and a 3/4 time signature. The style is indicated as 'waltz'. The score consists of four staves of music, with measure numbers 1 through 16. Chord changes are indicated above the staff at the beginning of each measure. The chords used are G, Em, Am, and D7. The melody is primarily composed of quarter and eighth notes, with some slurs and accents. A blue note is present in measure 13, and a green note is present in measure 16. The score ends with a double bar line in measure 16.

Chord changes: G, Em, Am, D7, G, Em, Am, D7, G, Em, Am, D7, G, Em, Am, D7, G, D7.

Measure numbers: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16.

# Chords Only

## In Dublin's Fair City

James Yorkston

Style: waltz

1 **G** 2 **Em** 3 **Am** 4 **D7**

5 **G** 6 **Em** 7 **Am** 8 **D7**

9 **G** 10 **Em** 11 **Am** 12 **D7**

13 **G** 14 **Em** 15 **Am** **D7** 16 **G** **D7**

# Human-Composed Solo

## In Dublin's Fair City

James Yorkston

Style: waltz

The musical score is written in treble clef, 3/4 time, with a key signature of one sharp (F#). It consists of four staves of music, each containing a solo line and guitar chords. The chords are G, Em, Am, and D7. The solo line is marked with green dots for fingerings and blue dots for accidentals. The score is divided into measures 1 through 16. The first staff contains measures 1-4, the second staff contains measures 5-8, the third staff contains measures 9-12, and the fourth staff contains measures 13-16. The solo line starts with a rest in measure 1, followed by a series of eighth and sixteenth notes. The chords are placed above the staff, and the solo line is marked with green dots for fingerings and blue dots for accidentals. The score ends with a double bar line in measure 16.

Chords: G, Em, Am, D7

Measures: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16



# Impro-Visor Creativity

- Creates background (e.g. bass, piano, drums) from
  - Chord progression
  - Style specification
- Creates demonstrative improvised melodies
  - Based on probabilistic grammar & melody abstraction/induction
  - Tries to express various player styles

# Induced Solo

Generated by Dave Liebman grammar

In Dublin's Fair City

James Yorkston

Style: waltz

The musical score is written in G major (one sharp) and 3/4 time. It consists of four staves of music, each with a key signature of one sharp (F#) and a 3/4 time signature. The style is indicated as 'waltz'. The chord progression is as follows:

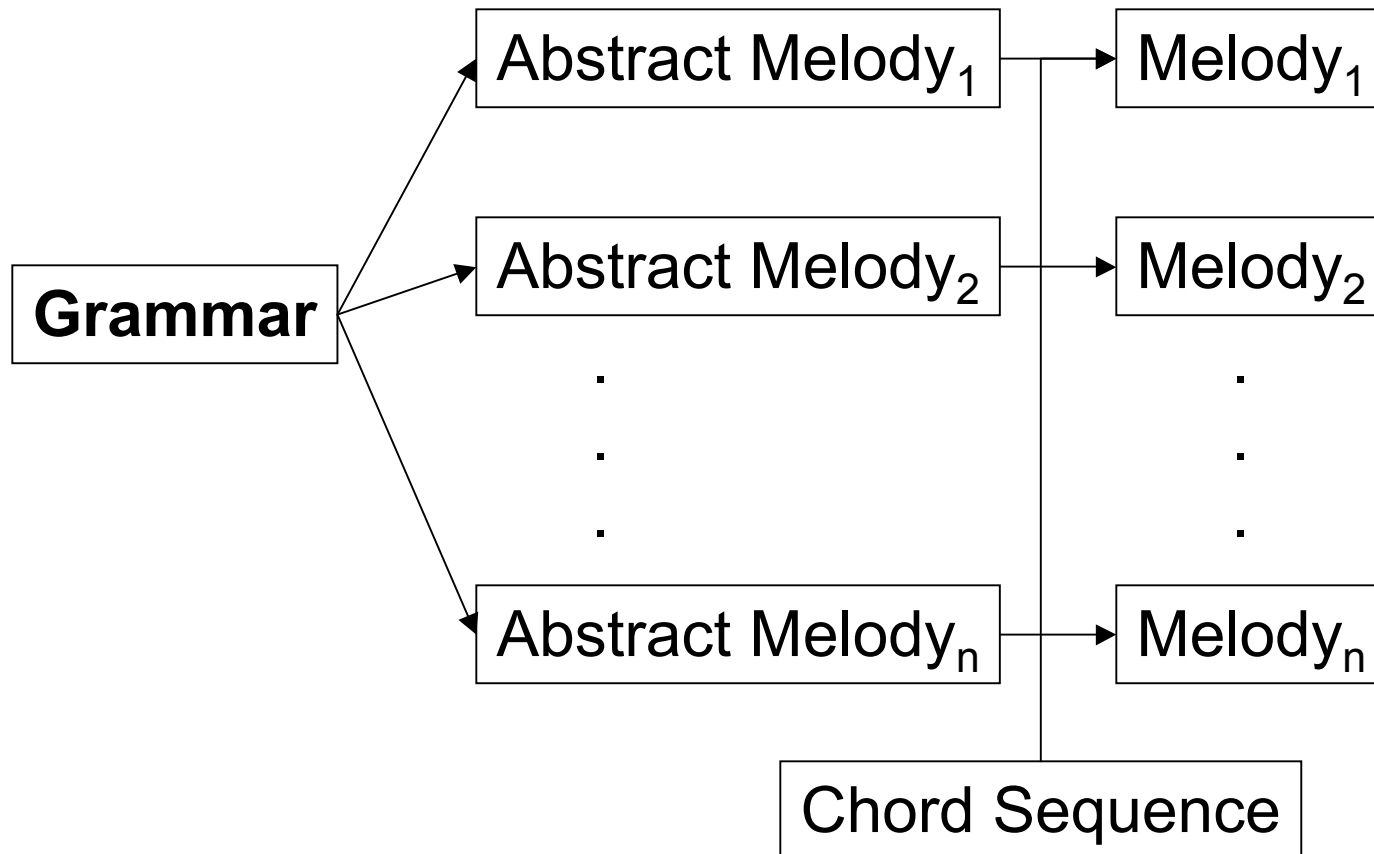
- Staff 1: Measures 1-4. Chords: G (1), Em (2), Am (3), D7 (4).
- Staff 2: Measures 5-8. Chords: G (5), Em (6), Am (7), D7 (8).
- Staff 3: Measures 9-12. Chords: G (9), Em (10), Am (11), D7 (12).
- Staff 4: Measures 13-16. Chords: G (13), Em (14), Am (15), D7 (16), G (16), D7 (16).

The melody features various rhythmic patterns, including eighth and sixteenth notes, and rests. Some notes are highlighted in green. The score includes measure numbers 1 through 16 and chord labels above the staff.

# Melody Induction

**Generation**

**Instantiation**



# What can be improved?

- Coherence of generated melodic line
- “Bricks” provide an approach to enhancing coherence.

# Bricks

- After Conrad Cork (1988, ..., 2008):  
“Jazz Harmony using LEGO Bricks”
- Reverse-engineering chord progression into **idiomatic sub-progressions** (“bricks”).
- **Explain the tune** by providing an abstraction of a tune’s harmony, coarser-grained than a sequence of chords.

# Chord Sequence for “In Dublin’s Fair City”

G | Em | Am | D7 |  
G | Em | Am | D7 |  
G | Em | Am | D7 |  
G | Em | Am / D7 | G / D7 |

# Brick Analysis = "Roadmap" of Tune

In Dublin's Fair City

4 of same brick + 1

G Major			
POT			
G	Em	Am	D7

POT			
G	Em	Am	D7

POT			
G	Em	Am	D7

				On Off Major V	
POT					
G	Em	Am	D7	G	D7

POT = "Plain Old Turnaround"

# Roadmap of a Jazz Tune

## Blue Bossa

4 distinct brick types

C Minor				
On Off Minor IV				
Cm69		Fm7		
Backslider				
C Minor				
Sad Cadence				
Dm7b5	G7alt	Cm69		
Cherokee				
Db Major				
Straight Cadence				
Ebm7	Ab7	DbM7		
Downwinder				
C Minor				
Sad Cadence + ...		Minor POT		
Dm7b5	G7alt	Cm69	Dm7b5	G7alt



# Textual Input for the Jazz Tune

Cm69 | / | Fm7 | / |  
Dm7b5 | G7alt | Cm69 | / |  
Ebm7 | Ab7 | DbM7 | / |  
Dm7b5 | G7alt | Cm69 | Dm7b5 G7alt |

# Brick Analysis

- Impro-Visor automates analysis of chord progression into bricks.
- Based on “brick dictionary”, an empirically-derived grammar.
- (Analysis algorithms are described in another paper, currently under review.)

# Brick Dictionary

- About 100 brick types
- John Elliott: “Insights in Jazz” (2009)
- About 500 rules for brick expansion
- For more examples, google  
“The Roadmap Garden”:  
<http://www.cs.hmc.edu/~keller/jazz/improvisor/RoadmapGarden508a.htm>

Interaction

# Interactive Companions for Jazz

- Al Biles: **GenJam** (1994)
- William Walker (1997)
- Belinda Thom: **BoB** (Band out of a Box, 2000)
- The above are either proprietary or not generally available.

# Using Bricks for an **Interactive Companion**

- Play-along: point at brick to play / loop

- Auto-improvisation based on bricks

- Trading based on bricks

(work in progress)

# Impro-Visor Grammars

- Currently productions expand to fill space, without discriminating on specific chord patterns.
- To add **coherence**, abstract window units (e.g. 1-bar in length) are sequenced by embedding Markov chains in grammar.

# Brick-Based Grammars

- Intended to achieve greater coherence of generated melodic lines.
- Brick names used as non-terminals.
- Presence of brick in the roadmap determines possible melodic expansions.



# Learning Aspects

# Learning Creativity: Degrees

- No learning
- Scripted learning Impro-Visor
- Autonomous learning

# Grammar Learning: Current

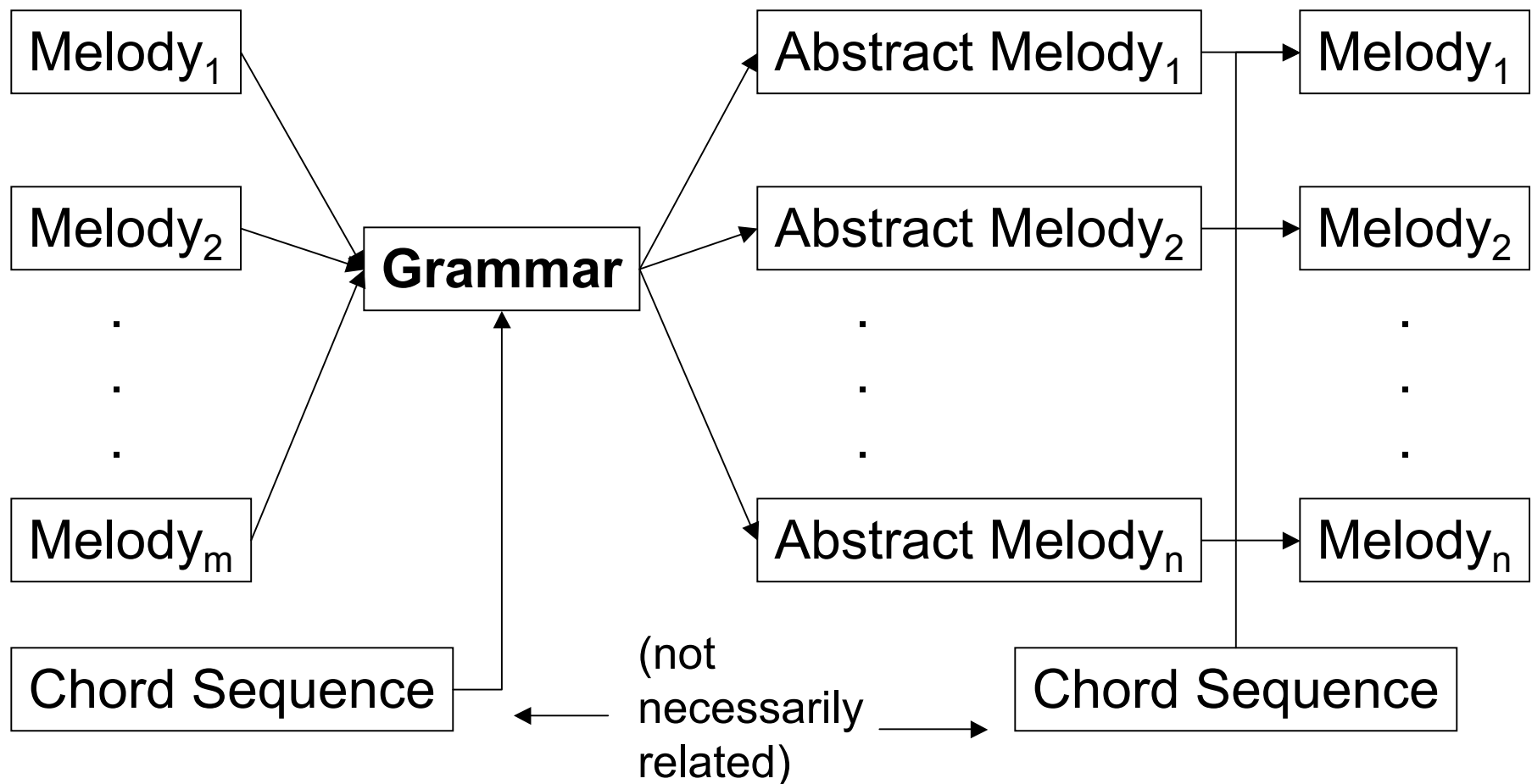
- Gillick, Tang, and Keller (CMJ, 2010)  
Grammar learning based on abstract *window* units that don't necessarily relate to harmonic phrasing.

# Learning = Grammar Inference

**Learning**

**Generation**

**Instantiation**



# Grammar Learning Direction

- Brick-based scheme
  - Use bricks as the grammatical unit.
  - Use the existing scheme to fill in any gaps in brick analysis.

# Brick-Based Grammar Learning

- Transcribed solo melody is segmented according to bricks, rather than fixed-length windows.
- Segmented melodies are mapped to *abstract melodies*, as in current Impro-Visor.
- Productions are derived:
  - Left-hand sides: Brick names + duration argument
  - Right-hand sides: Abstract melodies

# Remaining Work

- **Implementation** of brick-based grammars and learning.  
(Technology exists, integration required.)
- **Evaluation** of brick-based method.