

音楽的期待に基づく漸進的構造解析による ジャズ和声の意外性に関する考察

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2.2 漸進的チャート解析

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認知的音楽理論

(cognitive musicology)

伝統的音楽理論：音楽を「作る側」の理論

認知的音楽理論：「聴く側」の認知過程を踏まえた分析理論

GTTM, IRモデル 等



伝統的音楽理論



認知的音楽理論

音楽認知の計算モデルを作りたい！

従来の認知的音楽理論

Generative Syntax Model [1]

和声構造を分析

The image shows a musical score in 4/4 time, divided into three measures. The first measure contains a Dm7 chord. The second measure contains a G7 chord. The third measure contains a CM7 chord. An orange arrow points from the G7 chord to the CM7 chord, indicating a transition or expectation. The score is written in treble and bass clefs.

G7の時に次の和音を（何か来るだろうと）期待する
CM7で期待が実現したような感じ

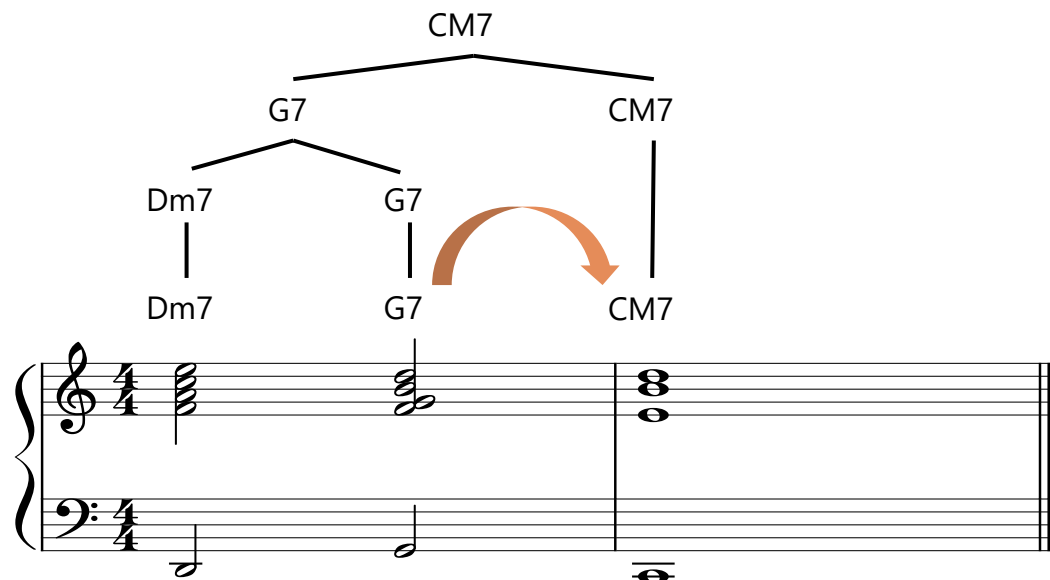
[1] M. Rohrmeier, *Towards a generative syntax of tonal harmony*, Journal of Mathematics and Music, 2011

従来の認知的音楽理論

Generative Syntax Model [1]

音楽認知に基づく文脈自由規則
(CFG)を定義

CM7 → G7 CM7
G7 → Dm7 G7
Dm7 → Dm7
G7 → G7
CM7 → CM7 etc.



和声進行の期待-実現の関係を階層的に表現可能であると提案

Generative Syntax Model の問題点

楽曲途中の認知構造が表現できない

楽曲全体に対する解析のみである



A musical score snippet in 4/4 time. The top staff is a melody in treble clef. The middle staff shows two chords: Dm7 and G7. The bottom staff is a bass line in bass clef. The snippet is followed by a large green rectangle containing a white question mark.



Generative Syntax Model の問題点

和声進行の**意外性**が音楽の面白さになりうる

The image shows a musical score in 4/4 time with three staves. The top staff contains a melody of eighth notes. The middle staff shows chords: Dm7, G7, Db7, and CM7. The bottom staff shows a bass line. The Db7 chord is circled in orange.

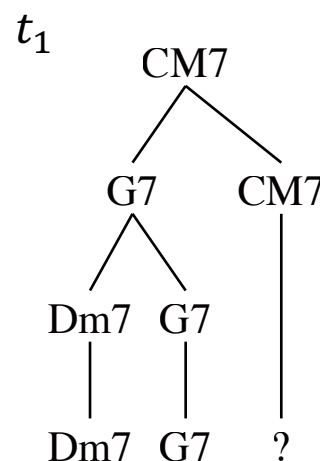
楽曲**途中**の構造を表示して
コード進行の**意外性**を評価する

2. 確率文脈自由文法に基づく漸進的構造解析

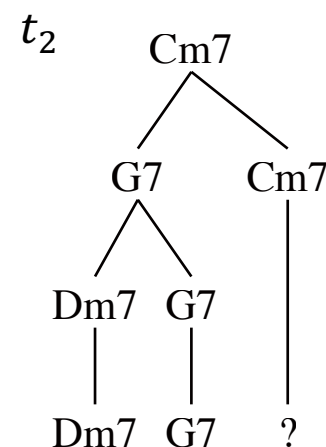
確率文脈自由文法 (Probabilistic Context-Free Grammar)

各構文規則に適用確率を付与
→構文木の生成確率を計算可能

Rule	Prob.
CM7 → G7 CM7	0.7
CM7 → CM7 CM7	0.3
Cm7 → G7 Cm7	0.4
Cm7 → Cm7 Cm7	0.6
G7 → Dm7 G7	0.4
G7 → G7 G7	0.3
G7 → D7 G7	0.3



$$\text{ex.) } P(t_1) = 0.7 \times 0.4 \\ = 0.28$$



$$P(t_2) = 0.4 \times 0.4 \\ = 0.16$$

木構造どうしの比較が可能に

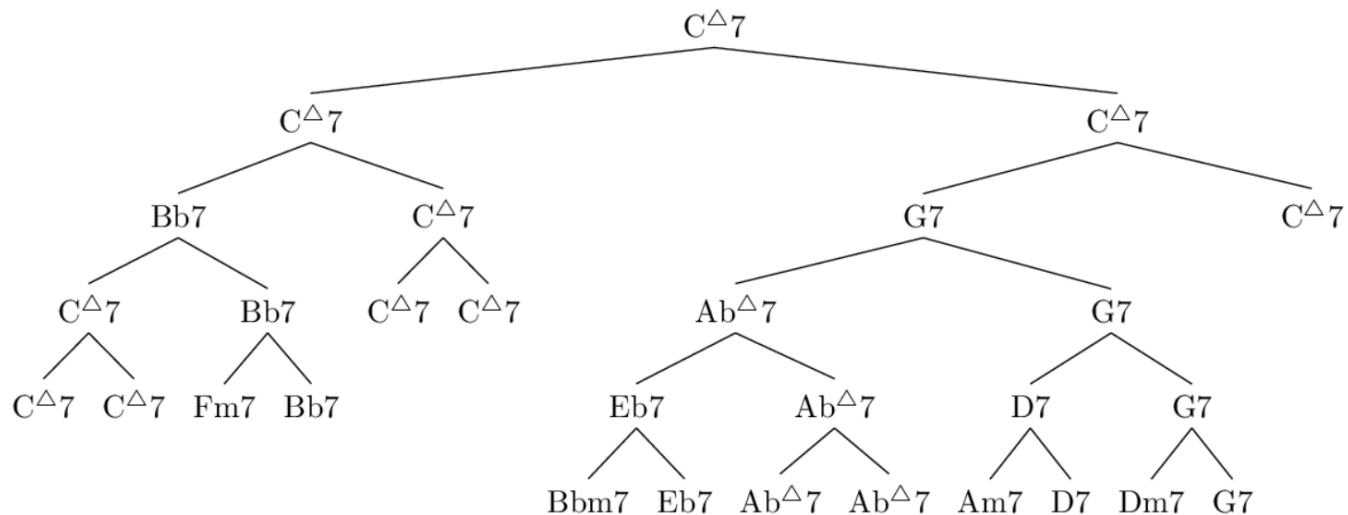
PCFG 適用確率の推定

[4]

Jazz Harmony Treebank

- ・ 確率文脈自由文法のパラメータ決定に使用
- ・ 150のジャズコード進行に対して人手で構文木をアノテーション
- ・ 平均27.75コードシンボル長 （合計11697コード,92種類）

Lady Bird



[4] Daniel Harasim, Christoph Finkensiep, Petter Ericson, Timothy J O'donnell, and Martin Rohrmeier. The jazz harmony treebank, International Society for Music Information Retrieval (ISMIR), 2020.

楽曲途中の木構造の表示

漸進的チャート解析^[3]

1. 辞書引き

語彙規則を参照し, Local Chartに追加

2. 規則適用

文法規則を参照し, Local Chartを構成

3. 項の置き換え

Local Chart中の項を用いて
Global Chartの未決定項を書き換え

input chord	global_chart			
	ID	edge	term	rules
	(1)	0-0	$\langle u \rangle_s$	
Cmaj7	(6)	0-1	$[[Cmaj7]_{IC}]_s$	(1)(3)
	(7)	0-1	$[[Cmaj7]_{IC}[\langle u \rangle]_{IC}]_s$	(1)(5)
D7	(14)	0-2	$[[Cmaj7]_{IC}[[D7]_{V_G}[\langle u \rangle]_{V_C}[\langle u \rangle]_{IC}]_s$	(7)(10)
	(15)	0-2	$[[Cmaj7]_{IC}[[D7]_{V_G}[\langle u \rangle]_{V_C}[\langle u \rangle]_{IC}[\langle u \rangle]_{IC}]_s$	(7)(12)
Dmin7	(22)	0-3	$[[Cmaj7]_{IC}[[D7]_{V_G}[[Dmin7]_{IC}[\langle u \rangle]_{V_C}[\langle u \rangle]_{IC}]_s$	(14)(17)
	(23)	0-3	$[[Cmaj7]_{IC}[[D7]_{V_G}[[Dmin7]_{IC}[\langle u \rangle]_{V_C}[\langle u \rangle]_{IC}[\langle u \rangle]_{IC}]_s$	(15)(17)
G7	(29)	0-4	$[[Cmaj7]_{IC}[[D7]_{V_G}[[Dmin7]_{IC}[[G7]_{V_C}[\langle u \rangle]_{IC}]_s$	(22)(24)
	(30)	0-4	$[[Cmaj7]_{IC}[[D7]_{V_G}[[Dmin7]_{IC}[[G7]_{V_C}[\langle u \rangle]_{IC}[\langle u \rangle]_{IC}]_s$	(23)(24)

Algorithm 1 Algorithm of incremental parsing

```

function CHART_PARSING( $G\_chart, w$ )
   $L\_chart \leftarrow \{\}$     \*Local charts*\
   $temp \leftarrow \{\}$ 

```

```

  \*step1 Lexicon Consultation*\
  for  $X \in \text{Lexicon}$  do
    if  $w = X$  then
       $L\_chart \leftarrow L\_chart \cup \{[w]_X\}$ 

```

```

  \*step2 Rule Application*\
  for  $\sigma \in L\_chart$  and  $A \rightarrow XY \dots Z \in \text{Rules}$  do
    if  $\sigma = X$  then
       $L\_chart \leftarrow$ 
         $L\_chart \cup \{[\sigma[\langle u \rangle]_Y \dots [\langle u \rangle]_Z]_A\}$ 

```

```

  \*step3 Term Replacement*\
  for  $\phi \in G\_chart$  and  $\psi \in L\_chart$  do
    if  $\exists \gamma \gamma = lut(\phi) \wedge \gamma = \psi$  then
      replace  $lut(\phi)$  with  $\psi$ 
       $temp \leftarrow temp \cup \{\phi\}$ 
   $G\_chart \leftarrow temp$     \*Global charts*\
  return  $G\_chart$ 

```

```

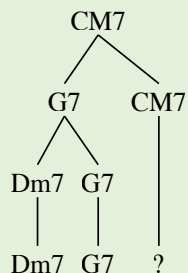
  \*main*\
   $G\_chart \leftarrow [\langle u \rangle]_s$ 
  for  $i = 1, \dots, \text{last}$  do
     $w_i \leftarrow \text{input\_chord}$ 
     $G\_chart \leftarrow \text{CHART\_PARSING}(G\_chart, w_i)$ 

```

[3] S. Matsubara, S. Arai, K. Toyama, Y. Inagaki,
Chart-based parsing and transfer in incremental spoken language translation,
 in Proc. the 4th Natural Language Processing Pacific Rim Symposium, 1997

確率文脈自由文法 (PCFG)

Rule	Prob.
CM7 → G7 CM7	0.7
G7 → Dm7 G7	0.4



$$P(t_1) = 0.7 \times 0.4 = 0.28$$

木構造どうしの比較

漸進的チャート解析

input chord	global_chart			
	ID	edge	term	rules
Cmaj7	(1)	0-0	{(u)}s	
	(6)	0-1	{[Cmaj7] _{IC} }s	(1)(3)
	(7)	0-1	{[[Cmaj7] _{IC} {(u)}] _{IC} }s	(1)(5)
D7	(14)	0-2	{[[Cmaj7] _{IC} {[D7] _{VC} {(u)}] _{VC} {(u)}] _{IC} }s	(7)(10)
	(15)	0-2	{[[Cmaj7] _{IC} {[D7] _{VC} {(u)}] _{VC} {(u)}] _{IC} {(u)}] _{IC} }s	(7)(12)
Dmin7	(22)	0-3	{[[Cmaj7] _{IC} {[D7] _{VC} {[Dmin7] _{IC} {(u)}] _{VC} {(u)}] _{IC} }s	(14)(17)
	(23)	0-3	{[[Cmaj7] _{IC} {[D7] _{VC} {[Dmin7] _{IC} {(u)}] _{VC} {(u)}] _{IC} {(u)}] _{IC} }s	(15)(17)
G7	(29)	0-4	{[[Cmaj7] _{IC} {[D7] _{VC} {[Dmin7] _{IC} {G7] _{VC} {(u)}] _{IC} }s	(22)(24)
	(30)	0-4	{[[Cmaj7] _{IC} {[D7] _{VC} {[Dmin7] _{IC} {G7] _{VC} {(u)}] _{IC} {(u)}] _{IC} }s	(23)(24)

楽曲途中の木構造の表示

➡ 意外性の指標 U の導入

計算式は解析例の中で説明

3. 楽曲CUTEの解析例と意外性評価

Expectation-based Chord Sequence Analyzer (ECSA)

音楽的期待に基づくジャズ和声の漸進的構造解析システム

Incremental Tree Analysis

コード進行を入力

chord sequence: Dm7 G7 CM7 Dm7 G7 Gm7 C7 FM7 Bb7 Em7 Am7 Dm7 G7 CM7

ANALYSE

Dm7 U = 1.0 ← その時点での意外性U

(0) 1.0

Dm7

(1) 0.31746031746031744

Dm7

Dm7 Dm7

Dm7 ?

(2) 0.09615384615384616

Gm7

Dm7 Gm7

Dm7 ?

Dm7 G7 U = 0.0901386748844376

(0) 0.0901386748844376

CM7

G7 CM7

Dm7 G7

Dm7 G7 ?

(1) 0.08021390374331551

Cm7

G7 Cm7

Dm7 G7

Dm7 G7 ?

(2) 0.07523510971786833

CM

G7 CM

Dm7 G7

Dm7 G7 ?


楽曲途中の和声構造


CUTE

ジャズスタンダード (一部を抜粋)

The musical score is presented in four lines, each with a treble clef and a 4/4 time signature. The notes are written in a simplified manner, focusing on the harmonic structure. The chords are indicated above the notes.

- Line 1: Dm7, G7, CM7
- Line 2: Dm7, G7, Gm7, C7
- Line 3: FM7, Bb7, Em7, Am7
- Line 4: Dm7, G7, CM7

Piano trio ver. 

Quartet ver. 

CUTE

ECSAによる解析の前に・・・

Dm7 G7 CM7

キーCメジャーのダイアトニックコード

CM7 Dm7 Em7 FM7 G7 Am7 Bm7(b5)

IM7 IIm7 IIIm7 IVM7 V7 VIIm7 VIIIm7(b5)

Dm7 G7 CM7

CUTE

ECSAによる解析の前に・・・

The image displays four staves of musical notation in 4/4 time, each with chord annotations above the notes. The notation is as follows:

- Staff 1:** Chords are Dm7, G7, and CM7. The melody consists of eighth and quarter notes.
- Staff 2:** Chords are Dm7, G7, Gm7, and C7. The melody continues with eighth and quarter notes.
- Staff 3:** Chords are FM7, Bb7, Em7, and Am7. The melody includes eighth, quarter, and half notes.
- Staff 4:** Chords are Dm7, G7, and CM7. The melody consists of eighth and quarter notes, ending with a double bar line.

CUTE

ECSAによる解析の前に・・・

Dm7 G7 CM7

Dm7 G7 Gm7 C7

FM7

Dm7

キーFメジャーのダイアトニックコード

FM7 Gm7 Am7 BbM7 bC7 Dm7 Em7(b5)

IM7 IIm7 IIIIm7 IVM7 V7 VIIm7 VIIIm7(b5)

CUTE

ECSA での解析結果

Ex-based Chord Sequence Analyzer

Incremental Tree Analysis

chord sequence
Dm7 G7 CM7 Dm7 G7 Gm7 C7 FM7 Bb7 Em7 Am7 Dm7 G7 CM7

ANALYSE

Dm7 U = 1.0

(0) 1.0

```
graph TD; A[Dm7] --> B[Dm7];
```

(1) 0.31746031746031744

```
graph TD; A[Dm7] --> B[Dm7]; A --> C[Dm7]; B --> D[Dm7]; C --> E[?];
```

(2) 0.09615384615384616

```
graph TD; A[Gm7] --> B[Dm7]; A --> C[Gm7]; B --> D[Dm7]; C --> E[?];
```

>

Dm7 G7 U = 0.0901386748844376

(0) 0.0901386748844376

```
graph TD; A[CM7] --> B[G7]; A --> C[CM7]; B --> D[Dm7]; B --> E[G7]; D --> F[Dm7]; E --> G[G7]; C --> H[?];
```

(1) 0.08021390374331551

```
graph TD; A[CM7] --> B[G7]; A --> C[CM7]; B --> D[Dm7]; B --> E[G7]; D --> F[Dm7]; E --> G[G7]; C --> H[?];
```

(2) 0.07523510971786833

```
graph TD; A[CM] --> B[G7]; A --> C[CM]; B --> D[Dm7]; B --> E[G7]; D --> F[Dm7]; E --> G[G7]; C --> H[?];
```

>

3.2 楽曲 *CUTE* の漸進的構造解析

17

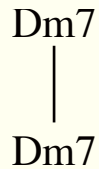
ECSA での 解析結果



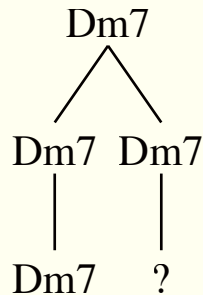
• Dm7

(順位*完全部分木) 生成確率値

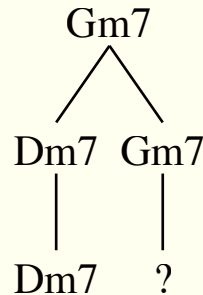
(1*)1.0



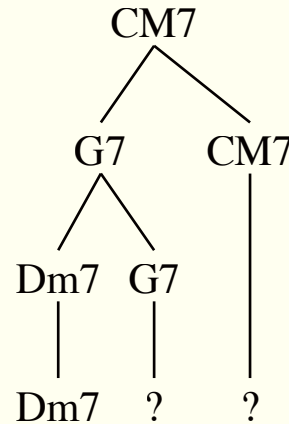
(2)0.317



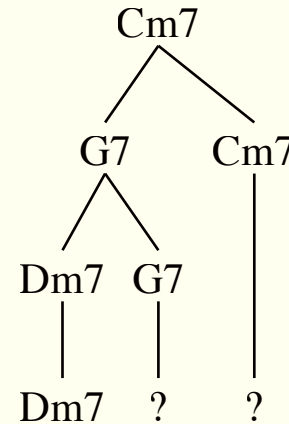
(3)0.0961



(4)0.0901



(5)0.0802



...

? : 次に期待されるコード(カテゴリ)
完全部分木* : その時点で和声進行が完結(安定)

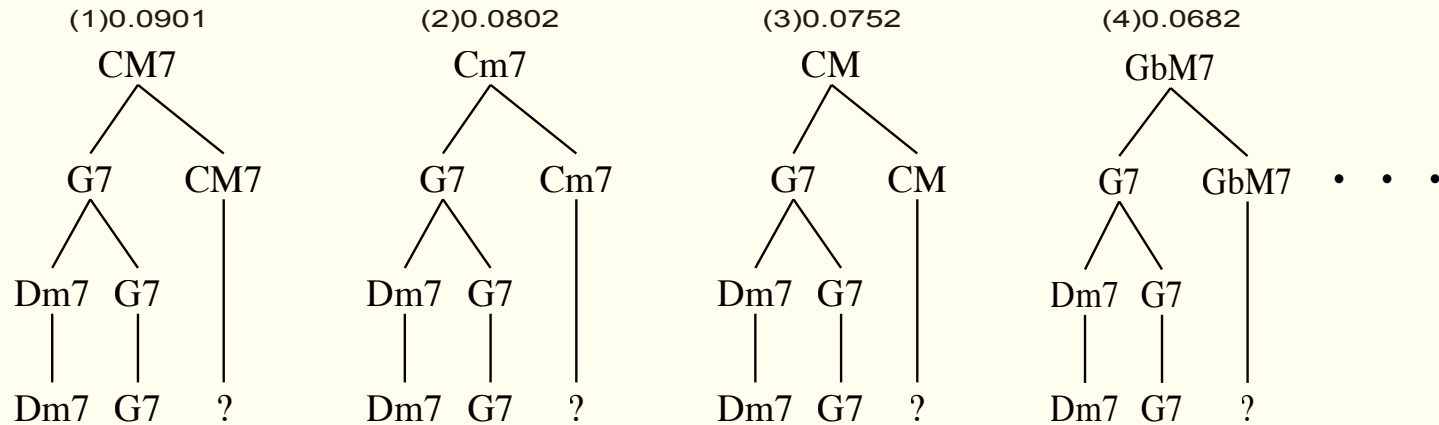
3.2 楽曲 *CUTE* の漸進的構造解析

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ECSA での 解析結果



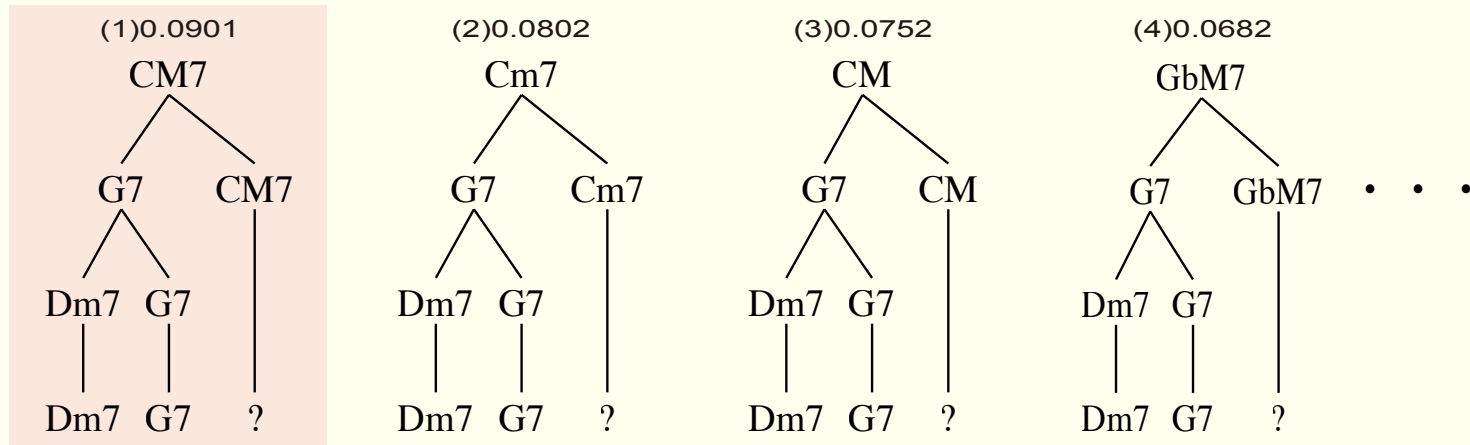
• Dm7 G7



ECSA での 解析結果



• Dm7 G7



各コードステップにおける認知構造を代表するものとして、
最大の生成確率を持つ木構造に注目する

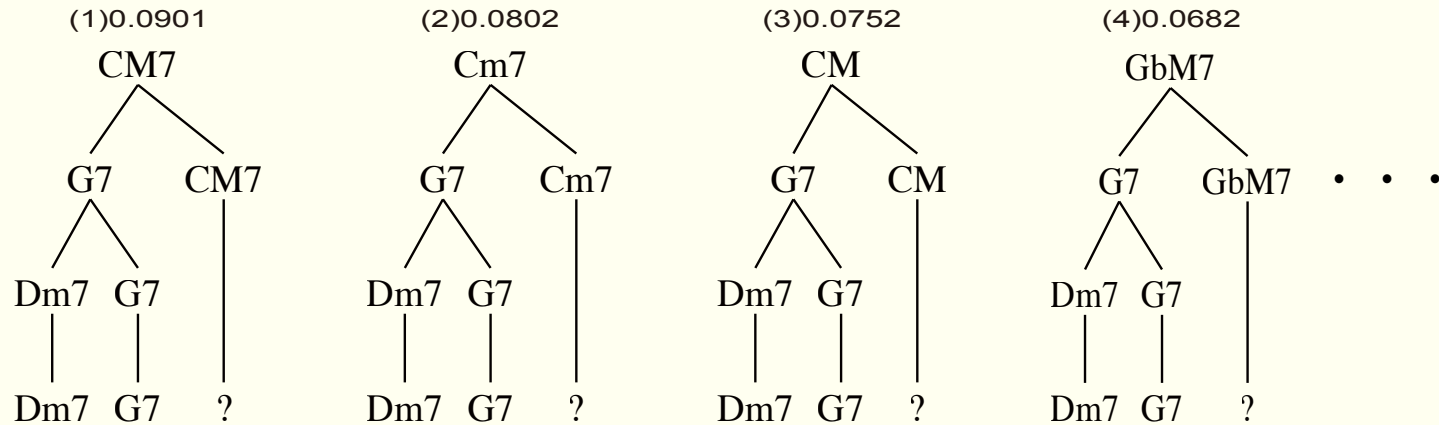
3.2 楽曲 *CUTE* の漸進的構造解析

18

ECSA での 解析結果



• Dm7 G7



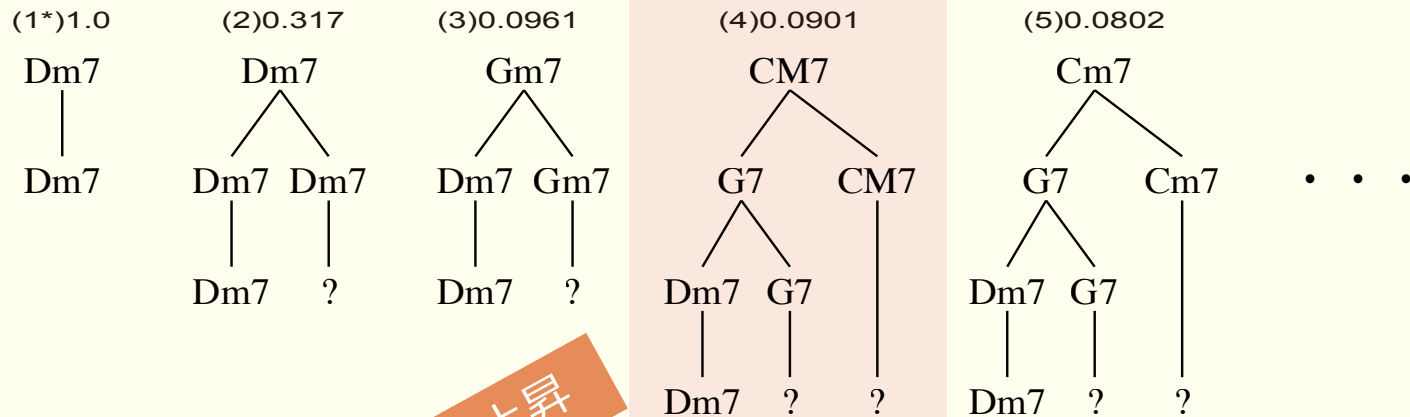
3.2 楽曲 *CUTE* の漸進的構造解析

19

ECSA での 解析結果

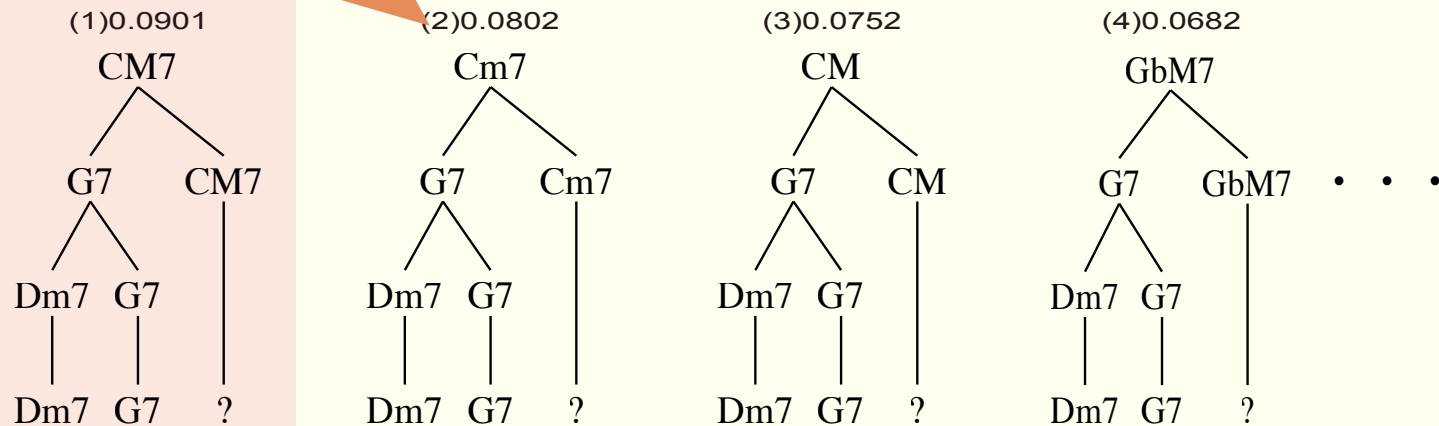


• Dm7



順位の上昇

• Dm7 G7



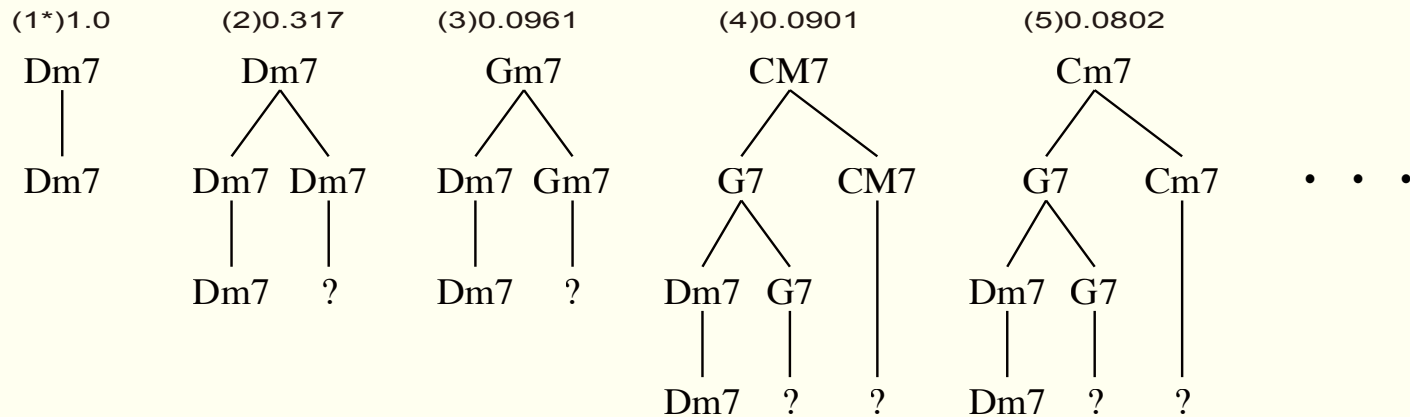
3.2 楽曲 *CUTE* の漸進的構造解析

20

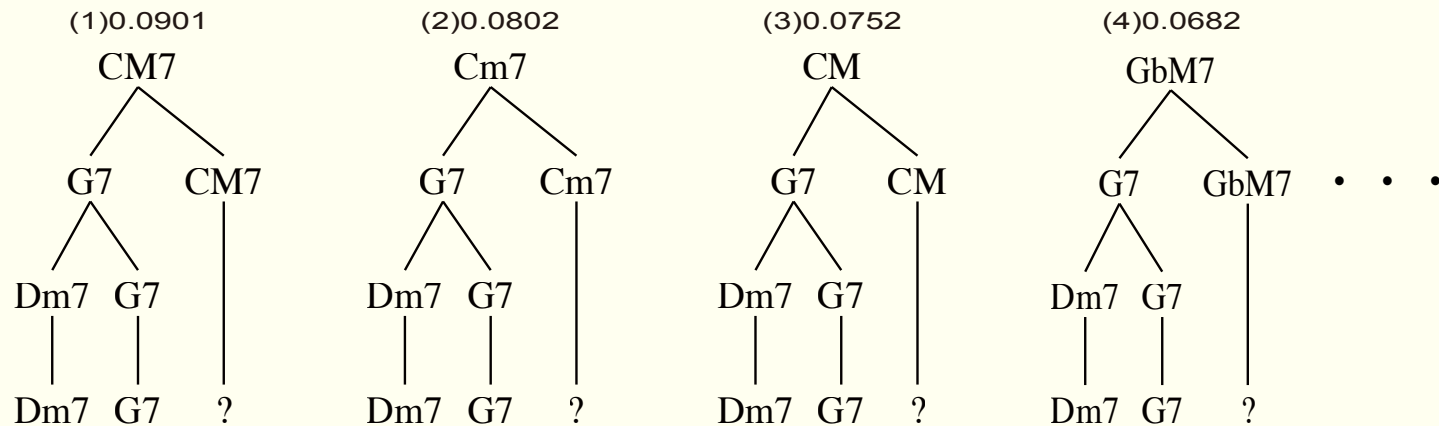
ECSA での解析結果



• Dm7



• Dm7 G7



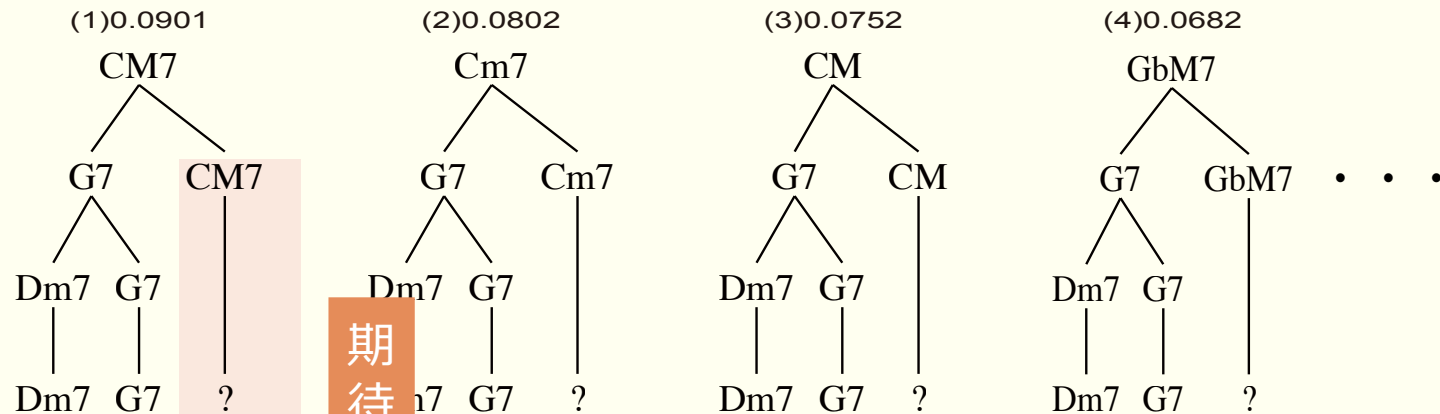
3.2 楽曲 *CUTE* の漸進的構造解析

20

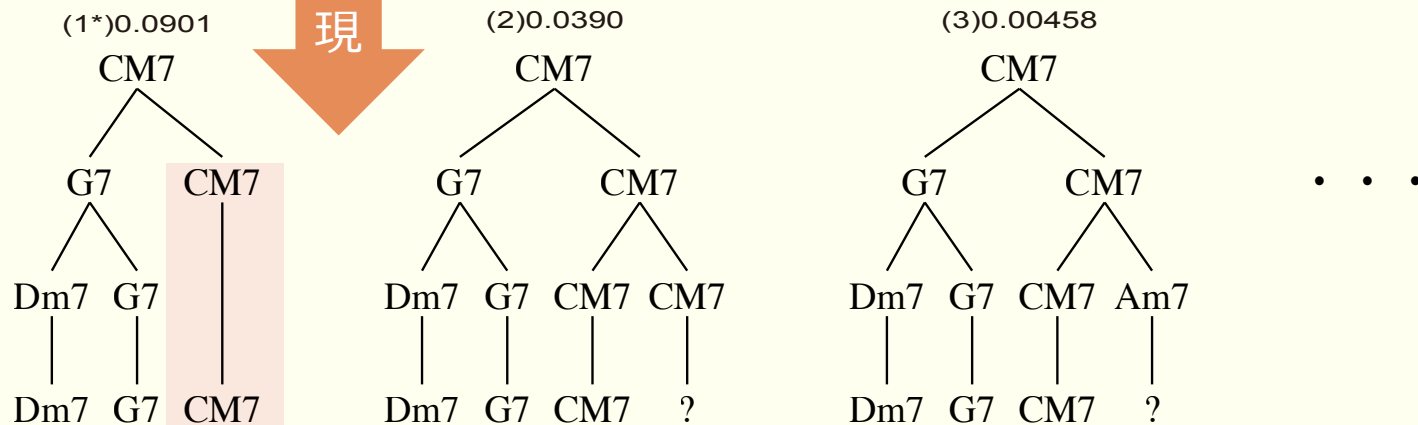
ECSA での解析結果



• Dm7 G7



• Dm7 G7 CM7



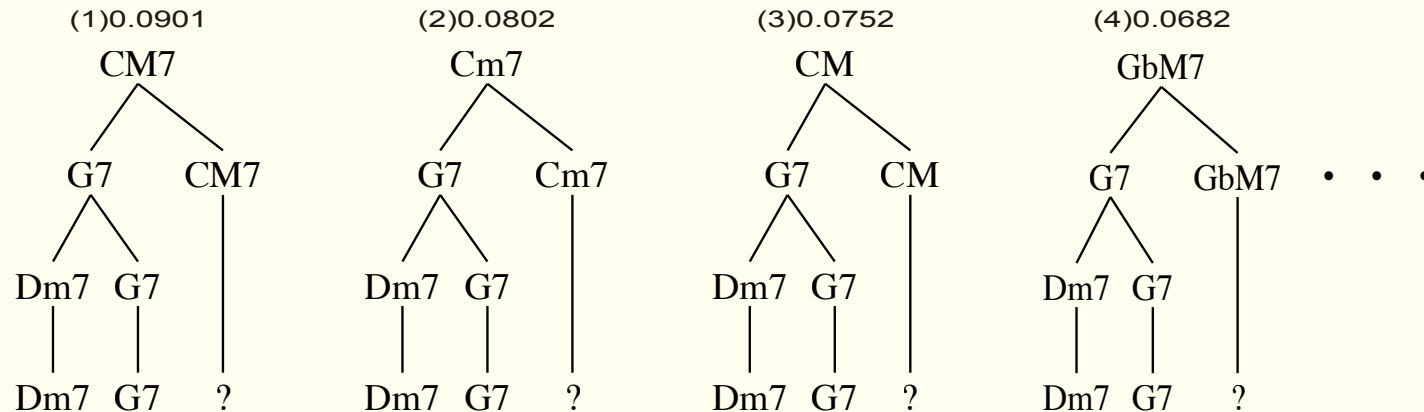
3.2 楽曲 *CUTE* の漸進的構造解析

21

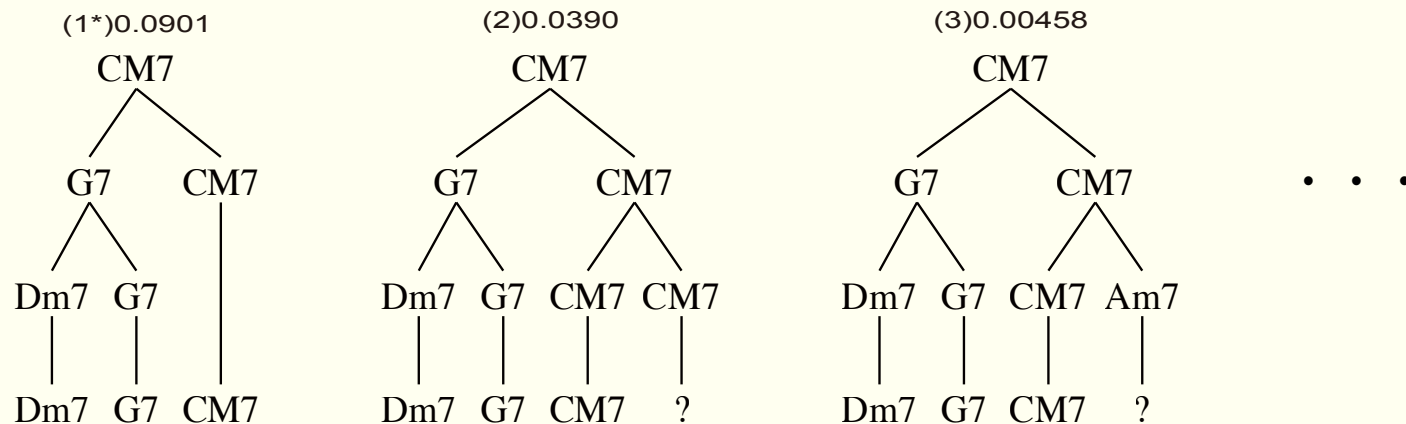
ECSA での 解析結果



• Dm7 G7



• Dm7 G7 CM7



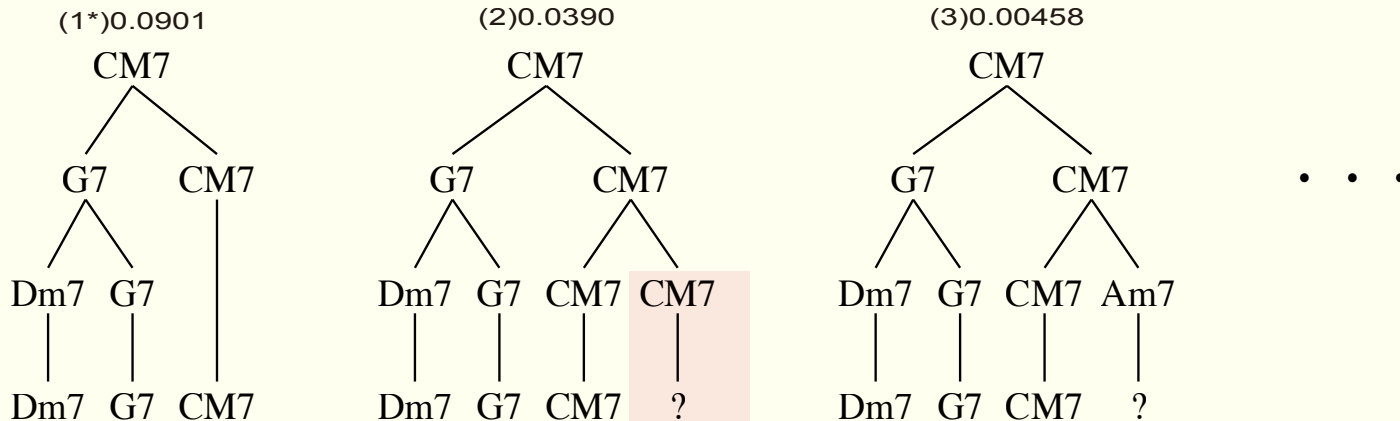
3.2 楽曲 CUTE の漸進的構造解析

21

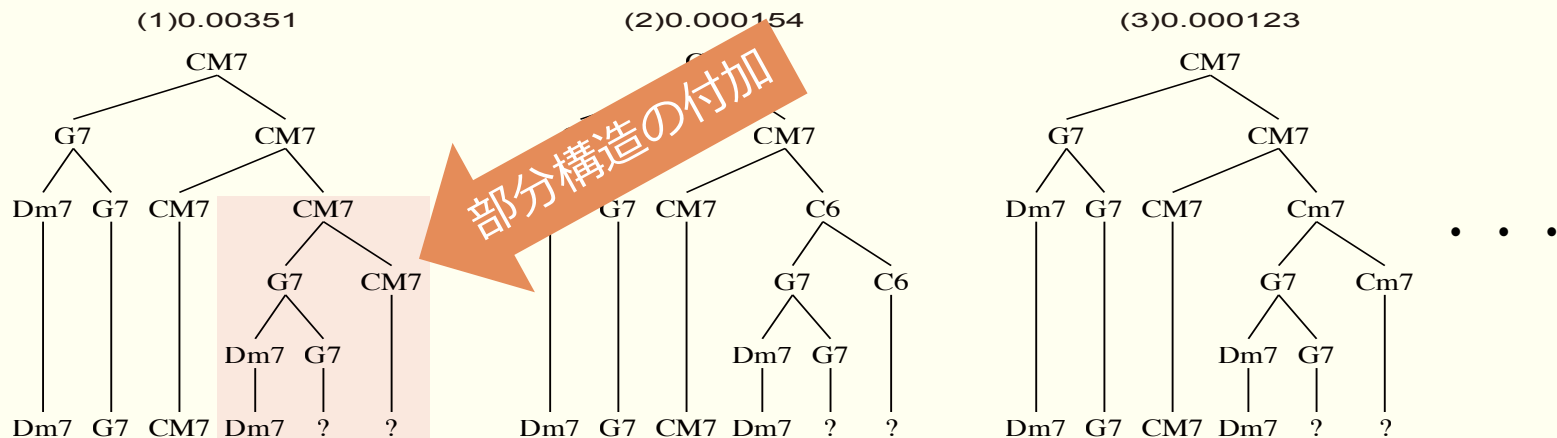
ECSA での解析結果



• Dm7 G7 CM7



• Dm7 G7 CM7 Dm7



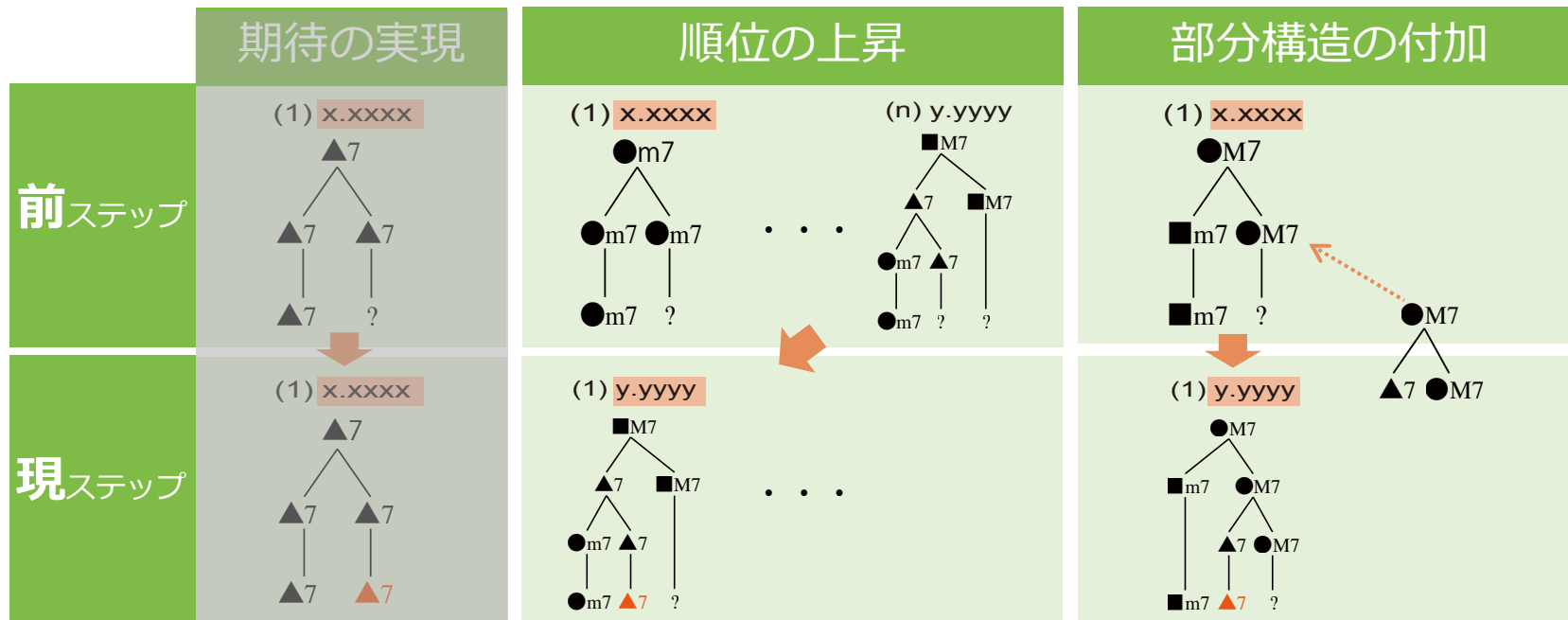
CUTE の意外性を考察する

あるコードステップの意外性 (unexpectedness) U ($0 < U \leq 1$) を以下で与える

$U = \text{前ステップでの希少度合い} \times \text{新しく付加された部分木の確率}$

$$= \frac{\text{導出元木構造の生成確率}}{\text{前ステップ1位の生成確率}} \times \frac{\text{現ステップ1位の生成確率}}{\text{導出元木構造の生成確率}}$$

小さいほど意外性がある



CUTE

各コードステップにおいてU(unexpectedness)を計算

The image displays four staves of musical notation in 4/4 time, each showing a sequence of chords and corresponding notes. The chords are labeled above the staves:

- Staff 1: Dm7, G7, CM7
- Staff 2: Dm7, G7, Gm7, C7
- Staff 3: FM7, Bb7, Em7, Am7
- Staff 4: Dm7, G7, CM7

The notes are written on a treble clef staff. The first staff shows a sequence of notes: D4, E4, F4, G4, A4, B4, C5, D5, E5, F5, G5, A5, B5, C6, D6, E6, F6, G6, A6, B6, C7, D7, E7, F7, G7, A7, B7, C8, D8, E8, F8, G8, A8, B8, C9, D9, E9, F9, G9, A9, B9, C10, D10, E10, F10, G10, A10, B10, C11, D11, E11, F11, G11, A11, B11, C12, D12, E12, F12, G12, A12, B12, C13, D13, E13, F13, G13, A13, B13, C14, D14, E14, F14, G14, A14, B14, C15, D15, E15, F15, G15, A15, B15, C16, D16, E16, F16, G16, A16, B16, C17, D17, E17, F17, G17, A17, B17, C18, D18, E18, F18, G18, A18, B18, C19, D19, E19, F19, G19, A19, B19, C20, D20, E20, F20, G20, A20, B20, C21, D21, E21, F21, G21, A21, B21, C22, D22, E22, F22, G22, A22, B22, C23, D23, E23, F23, G23, A23, B23, C24, D24, E24, F24, G24, A24, B24, C25, D25, E25, F25, G25, A25, B25, C26, D26, E26, F26, G26, A26, B26, C27, D27, E27, F27, G27, A27, B27, C28, D28, E28, F28, G28, A28, B28, C29, D29, E29, F29, G29, A29, B29, C30, D30, E30, F30, G30, A30, B30, C31, D31, E31, F31, G31, A31, B31, C32, D32, E32, F32, G32, A32, B32, C33, D33, E33, F33, G33, A33, B33, C34, D34, E34, F34, G34, A34, B34, C35, D35, E35, F35, G35, A35, B35, C36, D36, E36, F36, G36, A36, B36, C37, D37, E37, F37, G37, A37, B37, C38, D38, E38, F38, G38, A38, B38, C39, D39, E39, F39, G39, A39, B39, C40, D40, E40, F40, G40, A40, B40, C41, D41, E41, F41, G41, A41, B41, C42, D42, E42, F42, G42, A42, B42, C43, D43, E43, F43, G43, A43, B43, C44, D44, E44, F44, G44, A44, B44, C45, D45, E45, F45, G45, A45, B45, C46, D46, E46, F46, G46, A46, B46, C47, D47, E47, F47, G47, A47, B47, C48, D48, E48, F48, G48, A48, B48, C49, D49, E49, F49, G49, A49, B49, C50, D50, E50, F50, G50, A50, B50, C51, D51, E51, F51, G51, A51, B51, C52, D52, E52, F52, G52, A52, B52, C53, D53, E53, F53, G53, A53, B53, C54, D54, E54, F54, G54, A54, B54, C55, D55, E55, F55, G55, A55, B55, C56, D56, E56, F56, G56, A56, B56, C57, D57, E57, F57, G57, A57, B57, C58, D58, E58, F58, G58, A58, B58, C59, D59, E59, F59, G59, A59, B59, C60, D60, E60, F60, G60, A60, B60, C61, 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G162, A162, B162, C163, D163, E163, F163, G163, A163, B163, C164, D164, E164, F164, G164, A164, B164, C165, D165, E165, F165, G165, A165, B165, C166, D166, E166, F166, G166, A166, B166, C167, D167, E167, F167, G167, A167, B167, C168, D168, E168, F168, G168, A168, B168, C169, D169, E169, F169, G169, A169, B169, C170, D170, E170, F170, G170, A170, B170, C171, D171, E171, F171, G171, A171, B171, C172, D172, E172, F172, G172, A172, B172, C173, D173, E173, F173, G173, A173, B173, C174, D174, E174, F174, G174, A174, B174, C175, D175, E175, F175, G175, A175, B175, C176, D176, E176, F176, G176, A176, B176, C177, D177, E177, F177, G177, A177, B177, C178, D178, E178, F178, G178, A178, B178, C179, D179, E179, F179, G179, A179, B179, C180, D180, E180, F180, G180, A180, B180, C181, D181, E181, F181, G181, A181, B181, C182, D182, E182, F182, G182, A182, B182, C183, D183, E183, F183, G183, A183, B183, C184, D184, E184, F184, G184, A184, B184, C185, D185, E185, F185, G185, A185, B185, C186, D186, 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D281, E281, F281, G281, A281, B281, C282, D282, E282, F282, G282, A282, B282, C283, D283, E283, F283, G283, A283, B283, C284, D284, E284, F284, G284, A284, B284, C285, D285, E285, F285, G285, A285, B285, C286, D286, E286, F286, G286, A286, B286, C287, D287, E287, F287, G287, A287, B287, C288, D288, E288, F288, G288, A288, B288, C289, D289, E289, F289, G289, A289, B289, C290, D290, E290, F290, G290, A290, B290, C291, D291, E291, F291, G291, A291, B291, C292, D292, E292, F292, G292, A292, B292, C293, D293, E293, F293, G293, A293, B293, C294, D294, E294, F294, G294, A294, B294, C295, D295, E295, F295, G295, A295, B295, C296, D296, E296, F296, G296, A296, B296, C297, D297, E297, F297, G297, A297, B297, C298, D298, E298, F298, G298, A298, B298, C299, D299, E299, F299, G299, A299, B299, C300, D300, E300, F300, G300, A300, B300, C301, D301, E301, F301, G301, A301, B301, C302, D302, E302, F302, G302, A302, B302, C303, D303, E303, F303, G303, A303, B303, C304, D304, E304, F304, G304, A304, B304, C305, D305, E305, F305, G305, A305, B305, C306, D306, E306, F306, G306, A306, B306, C307, D307, E307, F307, G307, A307, B307, C308, D308, E308, F308, G308, A308, B308, C309, D309, E309, F309, G309, A309, B309, C310, D310, E310, F310, G310, A310, B310, C311, D311, E311, F311, G311, A311, B311, C312, D312, E312, F312, G312, A312, B312, C313, D313, E313, F313, G313, A313, B313, C314, D314, E314, F314, G314, A314, B314, C315, D315, E315, F315, G315, A315, B315, C316, D316, E316, F316, G316, A316, B316, C317, D317, E317, F317, G317, A317, B317, C318, D318, E318, F318, G318, A318, B318, C319, D319, E319, F319, G319, A319, B319, C320, D320, E320, F320, G320, A320, B320, C321, D321, E321, F321, G321, A321, B321, C322, D322, E322, F322, G322, A322, B322, C323, D323, E323, F323, G323, A323, B323, C324, D324, E324, F324, G324, A324, B324, C325, D325, E325, F325, G325, A325, B325, C326, D326, E326, F326, G326, A326, B326, C327, D327, E327, F327, G327, A327, B327, C328, D328, E328, F328, G328, A328, B328, C329, D329, E329, F329, G329, A329, B329, C330, D330, E330, F330, G330, A330, B330, C331, D331, E331, F331, G331, A331, B331, C332, D332, E332, F332, G332, A332, B332, C333, D333, E333, F333, G333, A333, B333, C334, D334, E334, F334, G334, A334, B334, C335, D335, E335, F335, G335, A335, B335, C336, D336, E336, F336, G336, A336, B336, C337, D337, E337, F337, G337, A337, B337, C338, D338, E338, F338, G338, A338, B338, C339, D339, E339, F339, G339, A339, B339, C340, D340, E340, F340, G340, A340, B340, C341, D341, E341, F341, G341, A341, B341, C342, D342, E342, F342, G342, A342, B342, C343, D343, E343, F343, G343, A343, B343, C344, D344, E344, F344, G344, A344, B344, C345, D345, E345, F345, G345, A345, B345, C346, D346, E346, F346, G346, A346, B346, C347, D347, E347, F347, G347, A347, B347, C348, D348, E348, F348, G348, A348, B348, C349, D349, E349, F349, G349, A349, B349, C350, D350, E350, F350, G350, A350, B350, C351, D351, E351, F351, G351, A351, B351, C352, D352, 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CUTE

各コードステップにおいてU(unexpectedness)を計算

The image displays four musical staves, each representing a different chord progression. Above each staff, the chords and their corresponding unexpectedness (U) values are listed. The staves are in 4/4 time and use a treble clef. The chords are written in a simplified notation (e.g., Dm7, G7, CM7).

Staff 1: Dm7 U=1.00, G7 U=0.09, CM7 U=1.00

Staff 2: Dm7 U=0.03, G7 U=1.00, Gm7 U=0.00088, C7 U=0.04

Staff 3: FM7 U=1.00, Bb7 U=0.05, Em7 U=0.00081, Am7 U=0.14

Staff 4: Dm7 U=1.00, G7 U=0.33, CM7 U=1.00

4. まとめ・今後の展望

まとめ

本研究の概要

- 音楽的期待に基づくジャズ和声解析手法の提案
- 確率文脈自由文法による漸進的解析により
楽曲途中の認知構造を表示
- 木構造の比較によって意外性の生じるポイントを議論

今後の展望

- 意外性 U の認知的リアリティの調査
- 複数楽曲間における意外性 U の比較