



Melodic Search: Strategies and Formats



CS 275B/Music 254

Melody

On melody

- ▶ What is a theme?
- ▶ What is an incipit?
- ▶ Are all themes incipits?
- ▶ Can you tell the key from a melody?
- ▶ Can you tell whether something you hear begins at the beginning?
- ▶ Is melody one-dimensional?
- ▶ How can we isolate a melody algorithmically?

On melody

- ▶ What is a theme? Significant content
- ▶ What is an incipit? Beginning phrase
- ▶ Are all themes incipits? No
- ▶ Can you tell the key from a melody? Sometimes
- ▶ Can you tell whether something you hear begins at the beginning? Sometimes
- ▶ Is melody one-dimensional? Most of the time
- ▶ How can we isolate a melody algorithmically? ???
- ▶ *

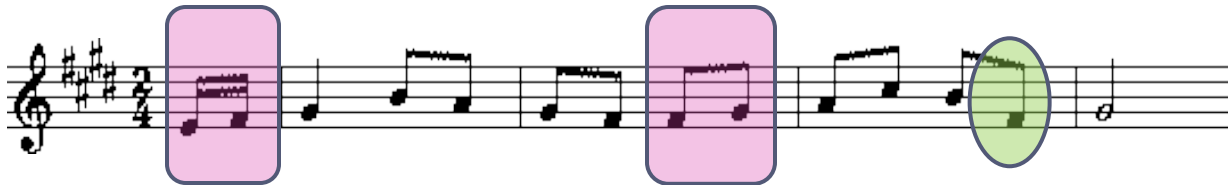
Musical similarity (in general)

Kinds of musical similarity

- ▶ Librarians: titles, metadata (rism)
 - ▶ Meter
 - ▶ Mode
- ▶ Cognitive psychologists: weighted features
 - ▶ Duple vs triple vs other meter
- ▶ Audio engineers, recommendation services:
 - ▶ Affect: Crosses repertoires in bizarre ways
 - ▶ Timbre:
 - ▶ Dynamics:
 - ▶ Tempo:
- ▶ Ear-worms: attentional elements

What is an attentional feature?

- ▶ Anything unexpected event
 - ▶ An atypical duration
 - ▶ An atypical pitch
 - ▶ A sudden change in tempo
 - ▶ A sudden change of register



Beethoven

Non-musical search strategies

Non-musical search strategies

- **Probability** ranking
- **Sorting** and categorization
- **String matching**, edit distance
- **N-grams**
- **Dynamic** programming
- **“Pattern detection”**

Probability ranking (L. Smith, 1995)

“Query-by-humming”: work of Lloyd Smith et al, c. 1995.

The screenshot shows a Netscape browser window titled "Netscape: Tune Matches: 1-10". The address bar shows the URL "http://www.nzdl.org/cgi-bin/gw". The page is titled "THE NEW ZEALAND DIGITAL LIBRARY The University of Waikato" and "MELOdy inDEX". It features a musical notation input area with the text "What you sang" and "What I heard". Below this, the "QUERY RESULTS" section states "Your melody matched 77 tunes". A table lists the top matches:

Tune	Database	Match
Auld Lang Syne	North American	100%
The Bonny Lass of Fyvie	North American	100%
A Bhreathnach Bhéasach, S. 36	Irish	90%
A Fool Such As I	North American	90%
A Man's a Man For All That	North American	90%
Alleluia	North American	90%
BONEY	North American	90%
Ballad of Richard III	North American	90%
Banks of Allan Water	North American	90%
Before They Close the Minstrel Show	North American	90%

In the background, another window shows the "RealAudio Player" interface with the title "Auld Lang Syne".

Example: MELDEX

Melodic sorting (Schlichte, 1997)

[Ranking??]

Examples from RISM

The image displays five musical staves illustrating melodic sorting. The first three staves are in treble clef with a key signature of one sharp (F#) and a common time signature (C). The first staff shows a sequence of eighth and quarter notes. The second and third staves are in 2/4 time and show a sequence of eighth and quarter notes, with blue arrows pointing from the first staff to the second and third. The fourth staff is in treble clef with a key signature of two flats (Bb, Eb) and a 2/4 time signature, enclosed in a light blue rectangular box. The fifth staff is in treble clef with a key signature of one sharp (F#) and a common time signature (C), enclosed in a light brown rectangular box. A text box on the right side of the image contains the following text:

John Howard, "Strategies for sorting melodic incipits," CM 11 (1998).

Edit distance: text

1. Item-by-item comparison

2. Penalties for

- substitutions
- insertions
- deletions

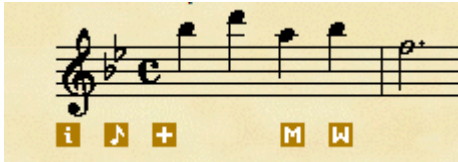
Bag
Bat
Cat
Catch

```
Target=bag
Matches=bag, Bag, BAG
Non-matches [different order]=gab, abg, bga

Direction of comparison=L→R
Match=L→R
Non-matches [different direction]=R→L; T→B; B→T;
ZZ

Literal content required for match=bag
Matches=baggage, cabbage
Non-matches [different literal content]=beagle, bang, bad
and good
```

N-grams



Beethoven: Archduke Trio

Method

Pick a string length
Seek all its permutations

IMSLP Music Search by Peachnote



Please enter a melody or a sequence of [chords](#) (advanced use)



5 8 4 -5 1 -5 melody Search
Petrucchi Music Library Smoothing: 0 Normalized



[Keyboard shortcuts](#)

filter search results (e.g. Mozart, winds, or quartet)

6 Capricen, Op.27 [\[score\]](#) pages 1,6
Kirchner, Theodor (1877)

[\[score\]](#) page 7
[\[score\]](#) page 5
[\[score\]](#) page 10

6 Partitas

Bach, Johann Sebastian (1726)

Piano Trio No. 7 in B-flat major
Beethoven, Ludwig van (1811)

[\[score\]](#) page 1
[\[score\]](#) page 1
more ...

Piano Trio
Pienné, Gabriel (1920)

[\[score\]](#) page 1
[\[score\]](#) pages 2,4,10
[\[score\]](#) page 4

Antigone
Mendelssohn, Felix (1841)

[\[score\]](#) pages 31,34,35

Giulio Cesare in Egitto
Handel, George Frideric (1724)

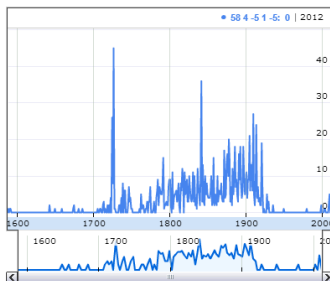
[\[score\]](#) page 26
[\[score\]](#) page 12
more ...

The Nutcracker
Tchaikovsky, Pyotr (1892)

[\[score\]](#) page 8
[\[score\]](#) page 51
more ...

Symphony No. 9 in D minor
Bruckner, Anton (1896)

[\[score\]](#) page 23
[\[score\]](#) page 2
more ...



Duke University Library Music Search by Peachnote



Please enter a melody or a sequence of [chords](#) (advanced use)



5 8 4 -5 1 -5 melody Search
Duke University Library Smoothing: 0 Normalized



[Keyboard shortcuts](#)

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My old home and friends [\[score\]](#) page 3
Cory Brothers (1874)

Huckleberry Finn cake walk; Two-step [\[score\]](#) page 3
Jos. Morris (1900)

Fishing for the moon; Green bird [\[score\]](#) page 5
empire Music (1907)

Mandy's ragtime waltz [\[score\]](#) page 6
Sam Fox (1912)

Dreaming dreams of you [\[score\]](#) page 4
Hamilton S. Gordon (1913)

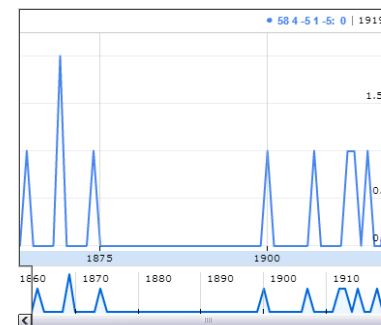
Down among the sheltering palms [\[score\]](#) page 2
Leo Feist (1915)

When the good Lord makes a record of a heros' [\[score\]](#) page 4
deed he draws no color line

M. Witmark & Sons (1918)

[next](#)

you can also browse using the chart



N-grams (Vero)



Music n-gram viewer

<http://www.peachnote.com/datasets.html>



The first line tells us that in 1804, the melody occurred 94 times overall.

The format of the total counts file is identical, except that the `ngram` field is absent: there is only one value `match_count` per year.

Inside each file the `norams` are sorted alphabetically and then chronologically.

IMSLP Music Search by Peachnote



Please enter a melody or a sequence of [chords](#) (advanced use)



58 4 -5 1 -5 melody Search
Petrucchi Music Library Smoothing: 0 Normalized



Keyboard shortcuts

filter search results (e.g. Mozart, winds, or quartet)

6 Capricen, Op.27 [\[score\]](#) pages 1,6
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[\[score\]](#) page 10

Piano Trio No. 7 in B-flat major
Beethoven, Ludwig van (1811)

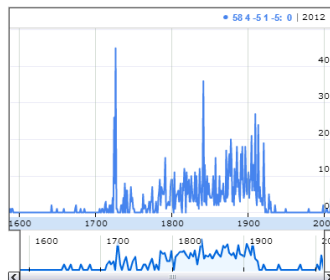
Piano Trio [\[score\]](#) page 1
Piermé, Gabriel (1920) [\[score\]](#) pages 2,4,10
[\[score\]](#) page 4

Antigone [\[score\]](#) pages 31,34,35
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more ...

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more ...

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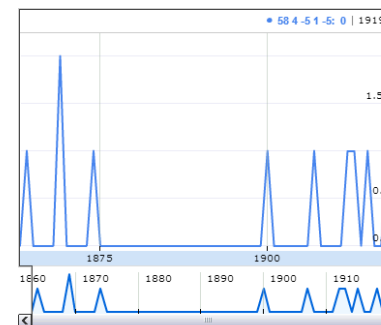
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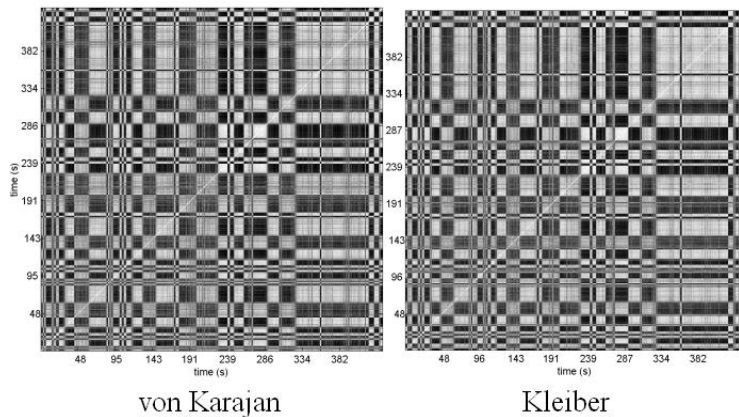
[next](#)

you can also browse using the chart



Dynamic programming (Foote, 2002)

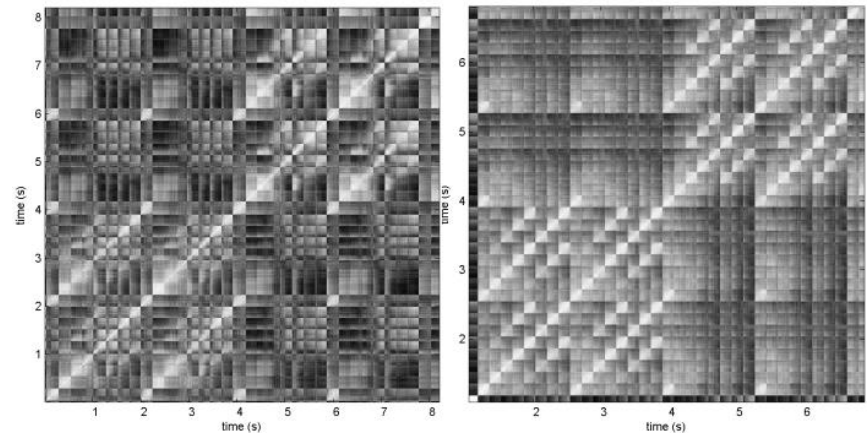
Example: 2 performances of Beethoven's
Symphony No. 5



Performance-based
self-similarity matrices

Examples: Jonathan Foote

Example: Bach



Rhythmic similarity

Pattern detection

Pattern detection: parameters

▶ **Types**

- ▶ Rhythmic cells
- ▶ Melodic cells
- ▶ Word-tone relations

▶ **Confounds**

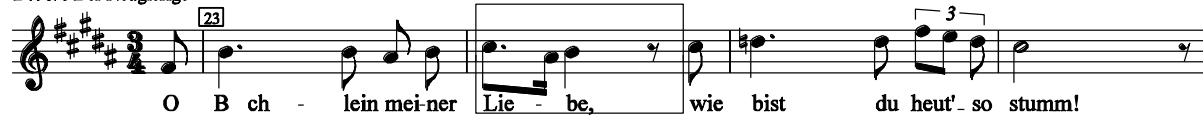
- ▶ Boundary issues
- ▶ “Noise” issues
- ▶ ... many more

Pattern detection: word-tone

Settings of the word "Liebe"

Nettheim: MuSearch (SCORE)

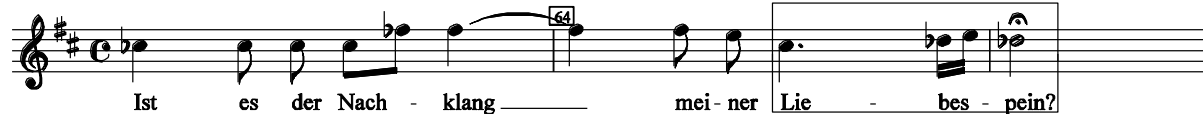
D795/6 Der Neugierige



D795/9 Des M llers Blumen



D795/12 Pause



D795/19 Der M ller und der Bach

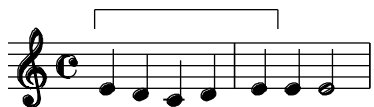


Pattern realms

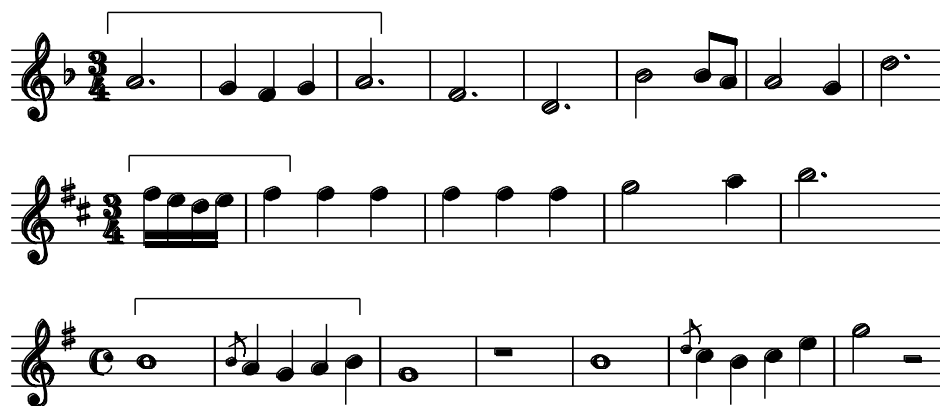
- Lyrics
- Pitch
- Duration
- Phrase structure

Vulnerabilities: rhythms differentiate melodies

Query



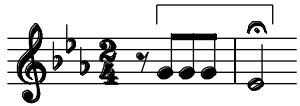
Target (scale degree): 32123



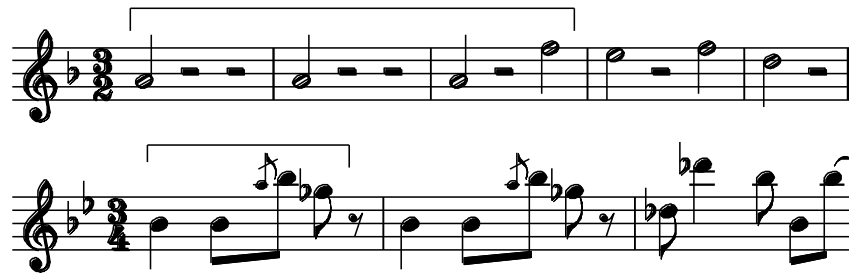
Pitch (scale-degree) matching without **rhythmic, metric invariance**

Vulnerabilities: register confounds

Query



Target: 3331



Pattern-matching without:

- Rests
- Register considerations
- Repeated notes

Themefinder

A search application for melodic data

Themefinder (themefinder.org)

Themefinder
[[About](#) | [Search options](#) | [Help](#)]
[[New Links](#) | [Composers](#) | [Random](#)]

[Take the Quartet Quiz.](#)

Repertory	<input type="text" value="Classical"/>	? type of music to search
Pitch	<input type="text"/>	? A-G, sharp=#, flat=- e.g. C E- G F#
Interval	<input type="text"/>	? maj=M, min=m, aug=A, dim=a per=P, fifth=5, up=+, down=-. e.g. +m9 -P8 +M3 P1
Scale Degree	<input type="text"/>	? do=1, re=2, mi=3, fa=4, so=5, la=6, ti=7 (mode insensitive). e.g. 34554321
Gross Contour	<input type="text"/>	? up=/, down=\, unison=-. e.g. //\-/ or uudsu
Refined Contour	<input type="text"/>	? up step=a, up leap=u, down step=d, down leap=D, same=s. e.g. uUDsdu
Location	<input checked="" type="radio"/> beginning of theme only, or <input type="radio"/> anywhere in theme	?
Key	Any <input type="text"/> Mode: Any <input type="text"/>	?
Meter	<input type="text"/> / <input type="text"/>	?

Sponsored by the
[Center for Computer Assisted Research in the Humanities](#)

Classical = themes
Folk = incipits
Renaissance = incipits

Search examples

...in decreasing order of precision



pitch: D A G F E D D D D D D D C#

interval: +P5 -M2 -M2 -m2 -M2 +P8 P1 P1 P1 P1 P1 -m2

scale degree: 1 5 4 3 2 1 1 1 1 1 1 1 7

gross contour: / \ \ \ \ / - - - - - \

refined contour: U d d d d U s s s s s s d

<http://www.themefinder.org>

Thought for the day

- ▶ “The dictionary describes melody as a series of notes strung together in a *meaningful* sequence.”

Source: U.S. Patent application
20060254411 (Nov. 16, 2006)