



# An Approach for Linking Score and Audio Recordings in Makam Music in Turkey

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# Outline

- Introduction
- Background
- Methodology
- Initial Experiments
- Conclusion



# Introduction and Motivation

- Audio recordings and scores are highly valuable sources of information to study music
  - Different representations of a music piece
  - Provide complementary information
- Linking relevant representations from both sources is beneficial
- Section linking is an important step to assess the structural organization of the performance of a piece.
  - Complementary to other computational tasks
  - Analysis might be focused in the section level
  - Provide a deeper insight on various properties of music



# Makam Music in Turkey

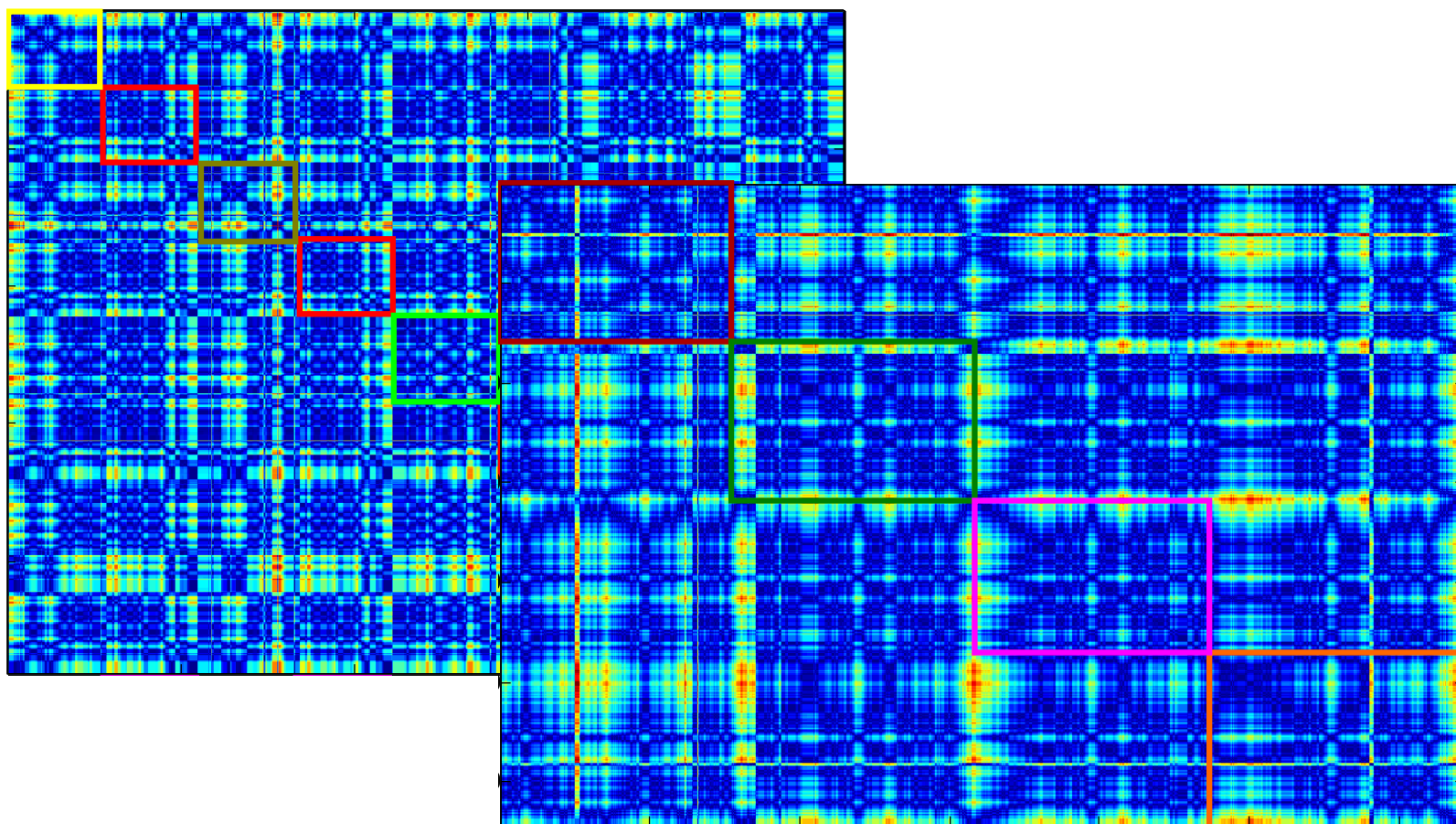
- At least 17 intervals in an octave
- Different tunings (*ahenk*)
- A score representation based on extending Western notation
  - Typically follows Arel-Ezgi-Uzdilek theory
  - Generally devoid of the expressive elements such as embellishments, heterophony etc...
  - Most are transcriptions of the performances with the intent to help people study the music piece



# Related Computational Research



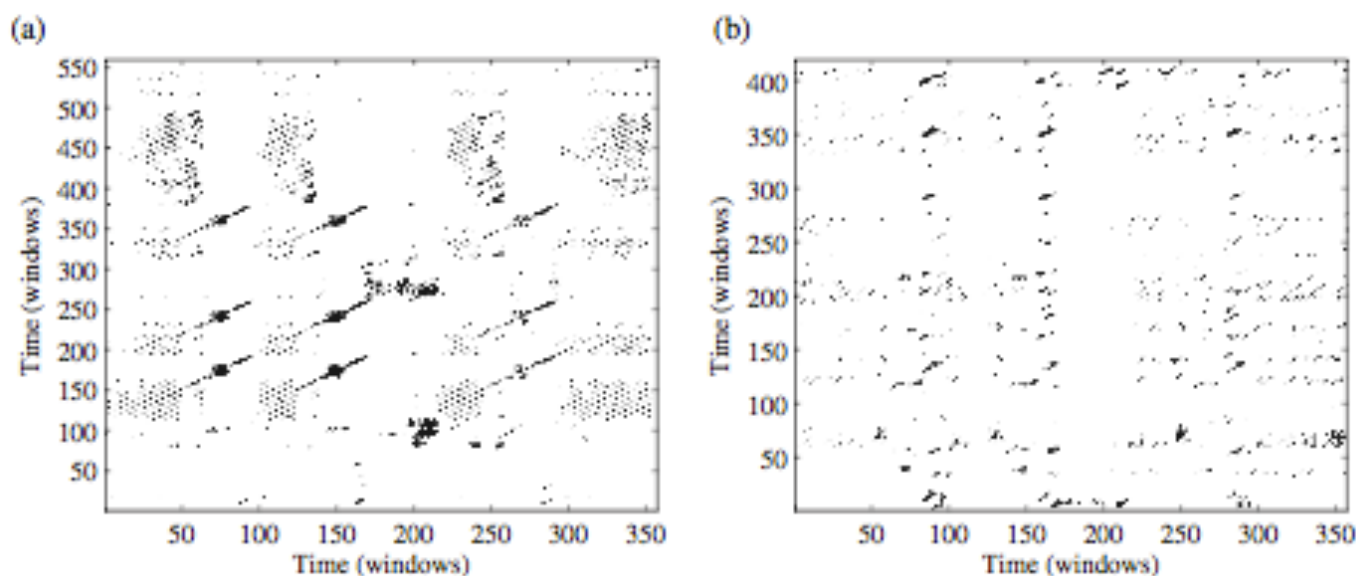
- Verse-Chorus Detection



# Related Computational Research



- Cover Song Detection



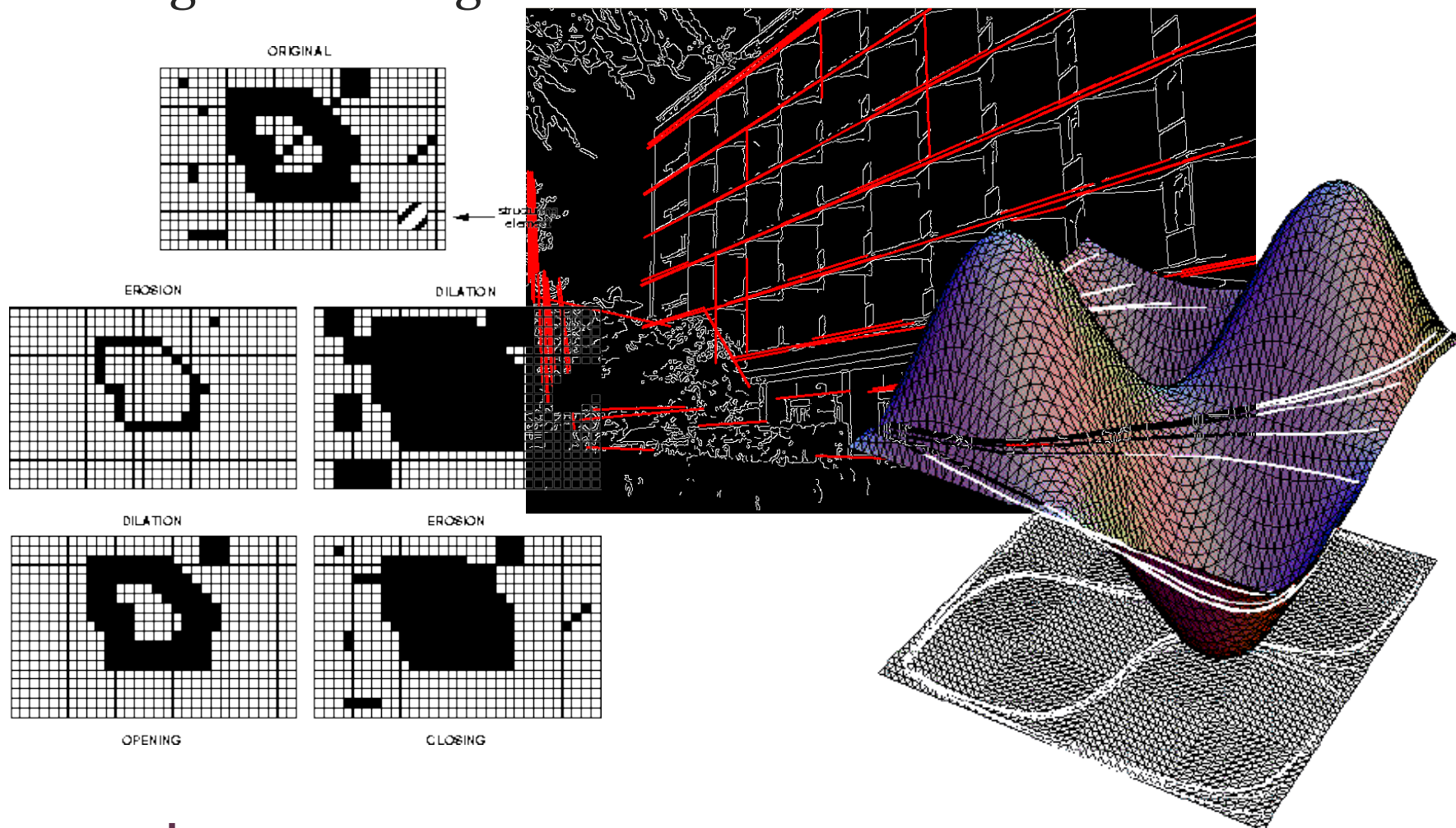
**Figure 3.** CRPs for the song *Day Tripper* as performed by The Beatles, taken as song *X*, versus two different songs, taken as song *Y*. These are a cover made by the group Ocean Colour Scene (a) and the song *I've Got a Crush on You* as performed by Frank Sinatra (b). Parameters are  $m = 9$ ,  $\tau = 1$ , and  $\kappa = 0.08$ .

(Serrà et. al, 2009)

# Related Computational Research

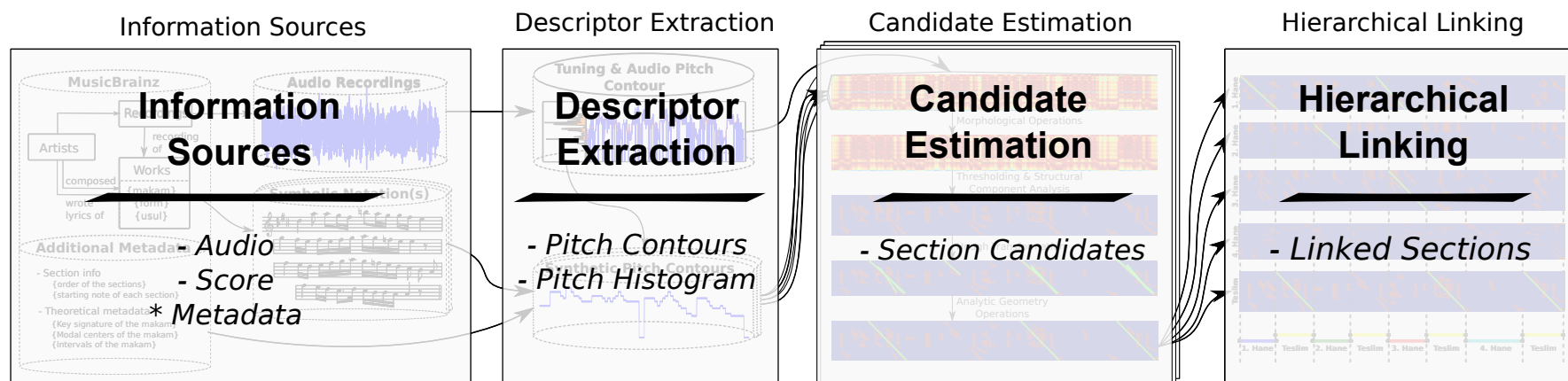


- Image Processing





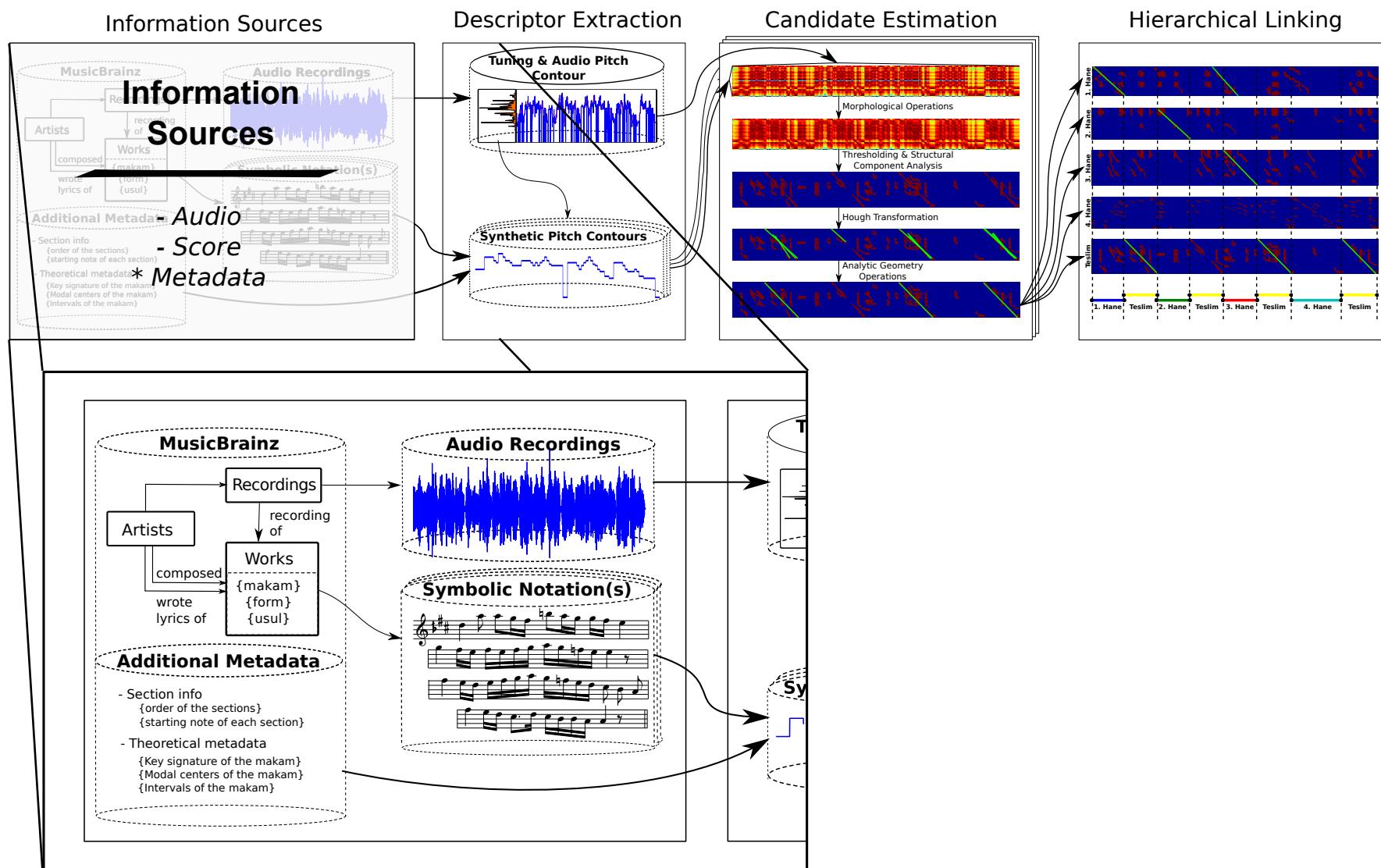
# Methodology





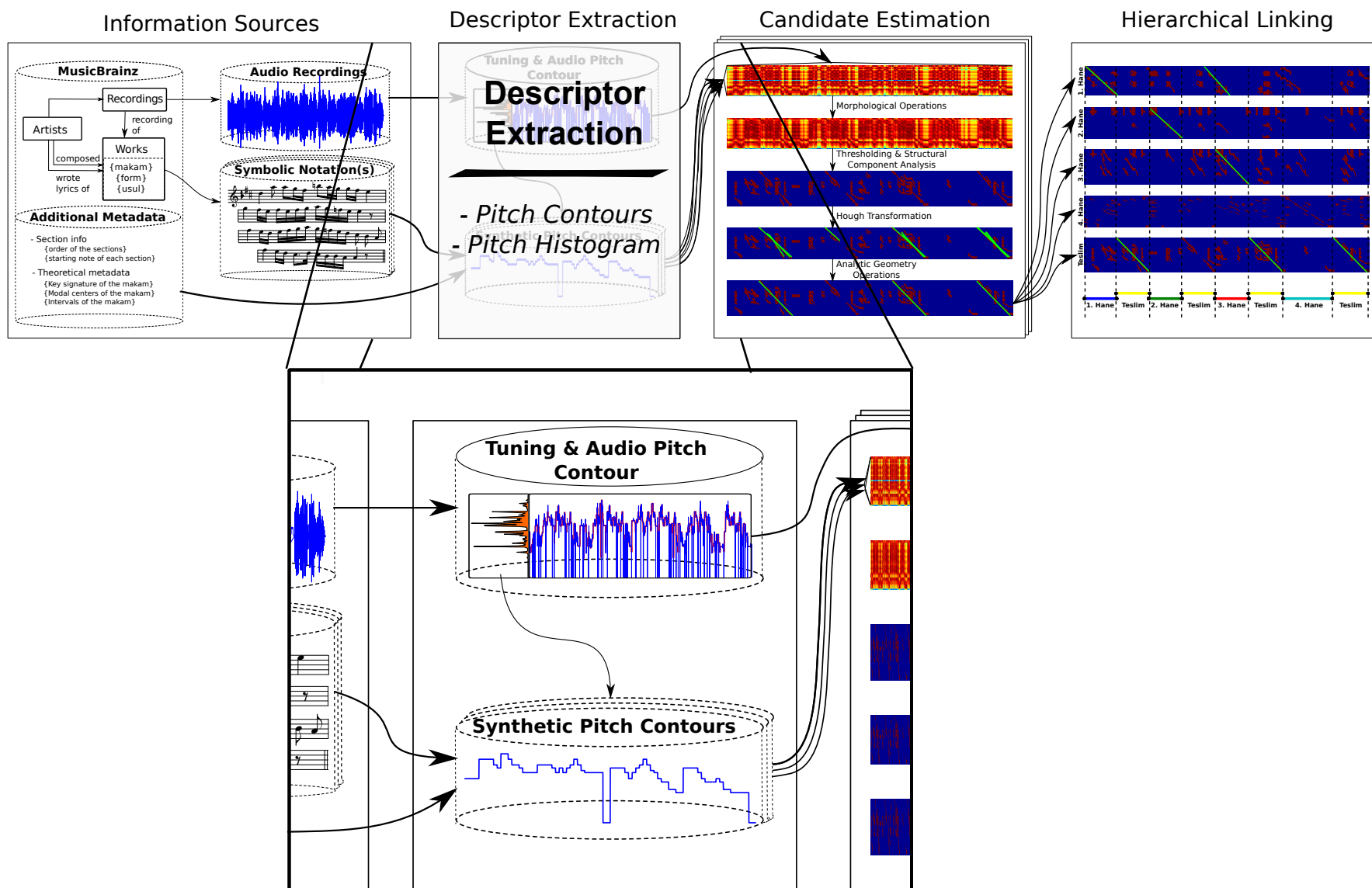


# Information Sources



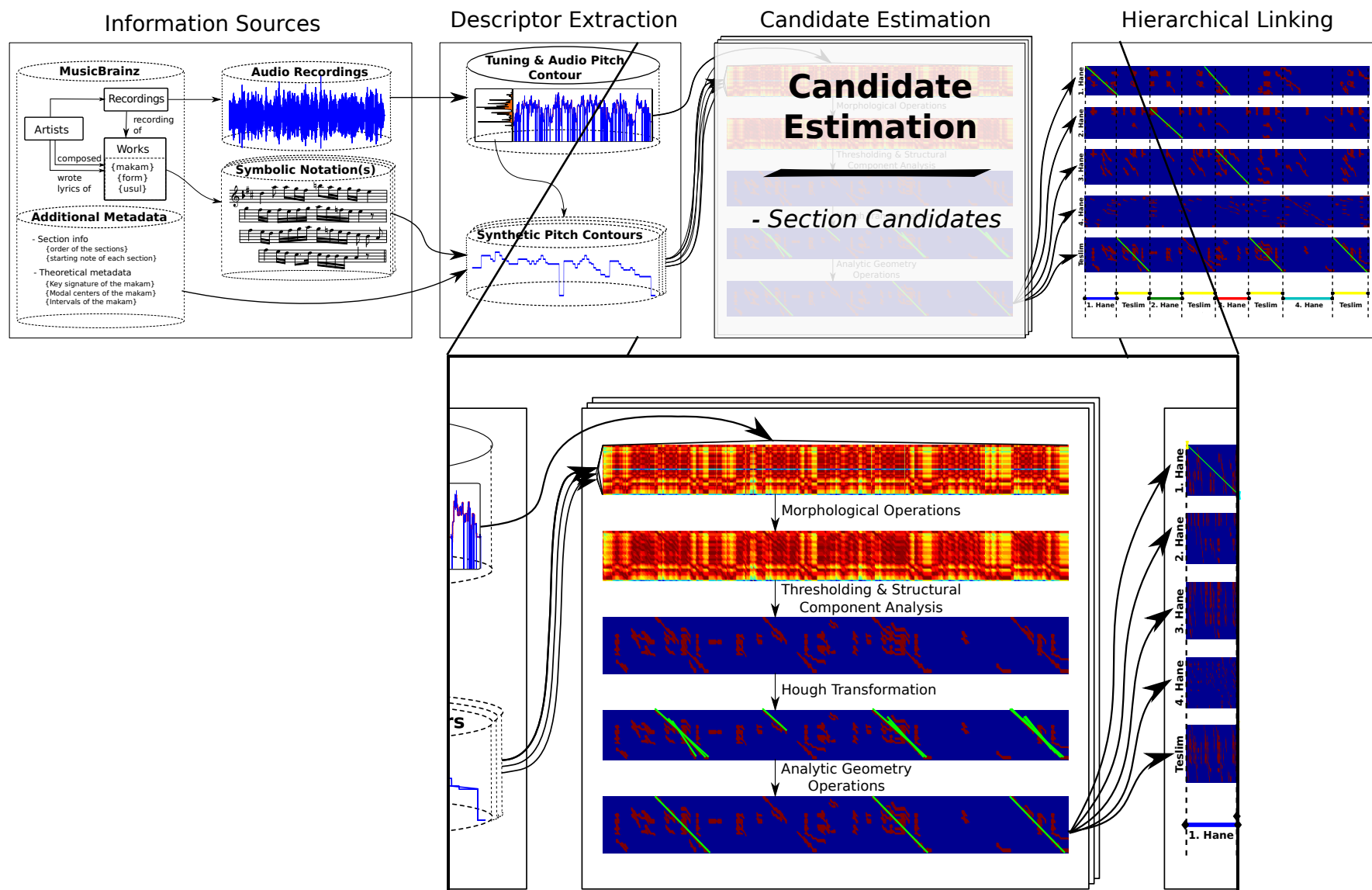


# Descriptor Extraction



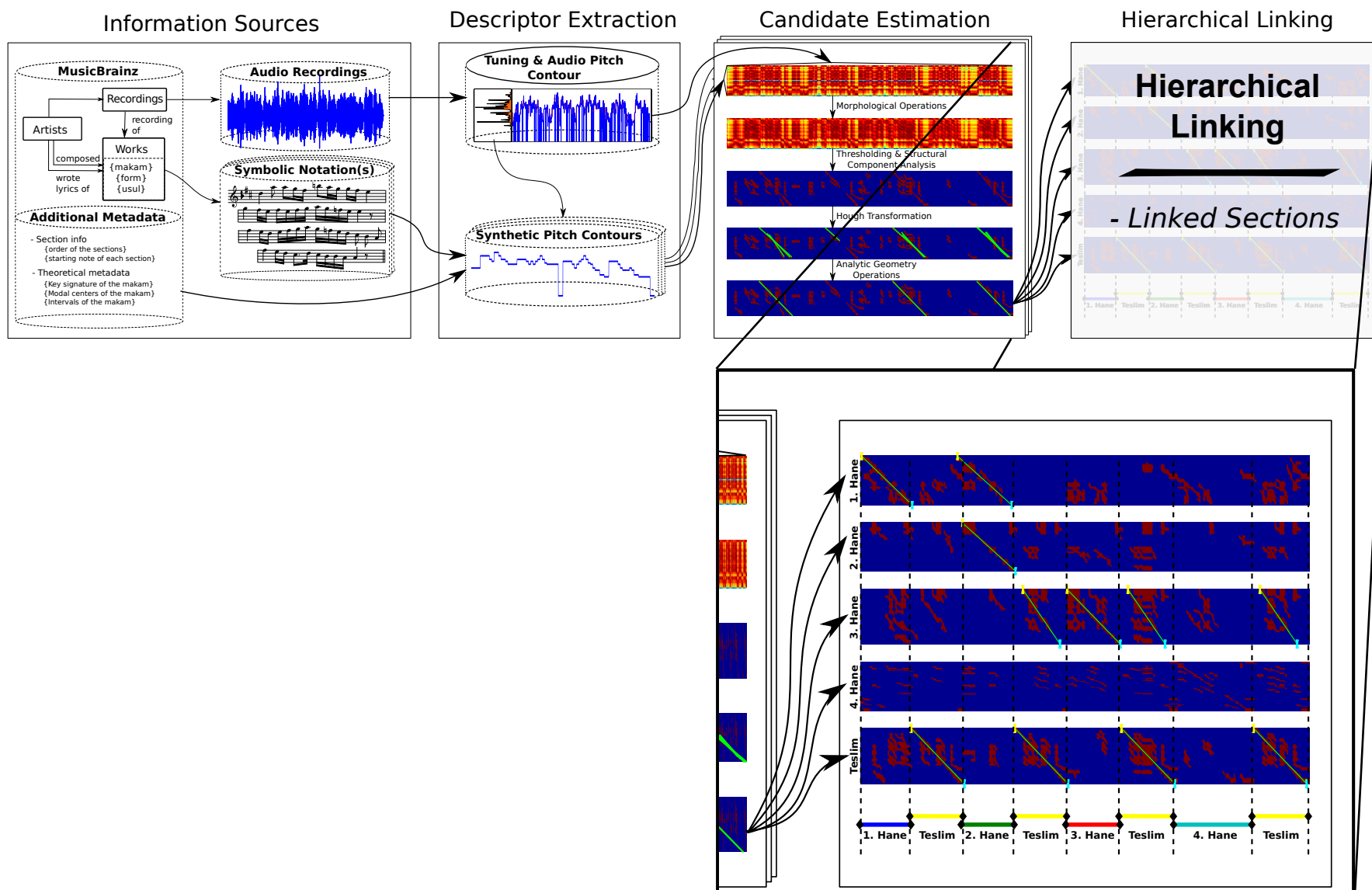


# Candidate Estimation





# Hierarchical Linking







# Implementation

- Symbolic notation in symbTr format (Karaosmanoğlu, 2012)
- Makam Toolbox (Bozkurt, 2008) used for tuning analysis and fo estimation
  - Makam Toolbox uses YIN (Cheveigné & Kawahara, 2002) and applies post-processing
- Main framework implemented in MATLAB



# Dataset

- “*Instrumental Pieces Played with the Ney*” collection from [neyzen.com](http://neyzen.com). The musicians:
  - Look at a few versions of the same piece, pick a preferred one
  - Check the score and make corrections, if necessary;
  - Perform the piece while referring to the score

Composition	Composer	Structure	#Events in Score	# Sections in Recording	Neyzen / Ney
Hicaz Saz Semai	Muhittin Erev	4 Hane 1 Teslim	265	8, 8	Salih Bilgin/Kız Salih Bilgin/Mansur
Hüseyini Peşrev	Kul Mehmet	<b>4 Hane</b>	592	4, 4	Salih Bilgin/Kız Salih Bilgin/Mansur
Hüseyini Saz Semai	Lavtacı Andon	4 Hane 1 Teslim	307	8, 8	Salih Bilgin/Kız Salih Bilgin/Mansur
Rast Saz Semai	Osman Bey	4 Hane 1 Teslim	323	8, 8	Salih Bilgin/Kız Salih Bilgin/Mansur
Uşşak Saz Semai	Salih Dede	4 Hane 1 Teslim	429	8, 8, <b>12 (teslim repetition)</b>	Salih Bilgin/Kız Salih Bilgin/Mansur <b><u>Volkan Yılmaz/Müstahsen</u></b>



# Results: Pre-Hierarchical

<b>Pre-Hierarchical Linking</b>	<b>Candidate Estimated</b>	<b>Candidate Not Estimated</b>
Link Present	72	12
Link Not Present	13	-

**72 / 84** correct links



# Results: Pre-Hierarchical

Pre-Hierarchical Linking	Candidate Estimated	Candidate Not Estimated
Link Present	72	8 + 4
Link Not Present	14	-

72 / 84 correct links

*Karar* detection failed in 2 pieces!  
Manual correction...



# Results: Post-Hierarchical

Post-Hierarchical Linking	Candidate Estimated	Candidate Not Estimated
Link Present	84	0
Link Not Present	0	-

**84 / 84** correct links!

**Note:** No claim of statistical significance...



# Discussion & Conclusion

- The results might be regarded as “proof-of-the-concept”
  - Currently adding more data from commercial recordings with *various instruments*
- Implemented system is pretty fast:
  - ~ **5-7 seconds** on Ubuntu 64- bit computer with 3.33GHz Intel processor and 13.5 GB ram
- Initial experiments on audio-score alignment
  - Qualitatively (i.e. listening) **adequate** but needs more work
- Plan to carry comparative studies on section matching
  - Generalized Hough Transform, Geodesics, Time Series Analysis...



# References

- J. Serrá, X. Serra, and R. Andrzejak, “Cross recurrence quantification for cover song identification,” *New Journal of Physics*, vol. 11, p. 093017, 2009.
- M. K. Karaosmanoğlu, “A Turkish Makam Music Symbolic Database for Music Information Retrieval: SymbTr,” *ISMIR 2012*
- B. Bozkurt, “An automatic pitch analysis method for Turkish makam music,” *Journal of New Music Research*, vol. 37, no. 1, pp. 1–13, 2008.
- A. De Cheveigné and H. Kawahara, “YIN, a fundamental frequency estimator for speech and music,” *Journal of Acoustical Society of America*, vol. 111, no. 4, pp. 1917–1930, 2002.