Computational Musicology perspective to Indian Music

Xavier Serra

Music Technology Group

Universitat Pompeu Fabra, Barcelona

Music Technology Group

- 40 researchers (+ 20 Master students/year)
- Research topics:
  - Audio signal processing
  - Machine learning
  - Human computer interaction
  - Music information retrieval
  - Computational musicology

Computational Musicology

- **Object of study:** music data
- **Methodology:** Statistics, Signal Processing, Natural Language Processing, Machine Learning, …
- **Goal:** understand music

…. different from Music Information Retrieval

Digital music objects

- Digital objects are composed of data, metadata and (ideally) an identifier.

- The data is the actual object. The metadata is textual information describing it.

- Main types of objects:
  - digital audio recordings of musical performances
  - machine-readable music scores
  - machine-readable music-related texts

Research topics (1 of 3)

- **Data processing:** audio signal processing; symbolic music processing; metadata, tags, linked data, and semantic web; lyrics and other textual data, web mining, and natural language processing; multimodality; machine learning.

- **Musical features:** melody; harmony, chords and tonality; rhythm, beat, tempo; structure, segmentation and form; timbre, instrumentation and voice; musical style and genre; musical affect, emotion and mood; expression and performative aspects of music.

Research topics (2 of 3)

- **Music processing:** sound source separation; music transcription and annotation; optical music recognition; alignment, synchronization and score following; music summarization; music synthesis and transformation; fingerprinting; automatic classification; indexing and querying; pattern matching and detection; similarity metrics.

- **User-centered processing:** user behavior and modeling; human-computer interaction and interfaces; personalization; user-centered evaluation; legal, social and ethical issues.

Research topics (3 of 3)

- **Applications:** digital libraries and archives; music retrieval systems; music recommendation and playlist generation; music and health, well-being and therapy; music training and education; music composition, performance and production; gaming; business and marketing.

- **Evaluation and Methodology:** philosophical and methodological foundations; evaluation methodology and reproducibility; statistical methods for evaluation; datasets and annotation protocols; evaluation metrics.

Computational models
for the discovery of the World's Music

compmusic

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English

HOME

CompMusic is a research project funded by the European Research Council from 2011 to 2017 and coordinated by Xavier Serra from the Music Technology Group of the Universitat Pompeu Fabra in Barcelona (Spain). It aims to advance in the automatic description of music by emphasizing cultural specificity, carrying research within the field of music information processing with a domain knowledge approach. The project focuses on five music traditions of the world: Hindustani (North India), Carnatic (South India), Turkish-makam (Turkey), Arab-Andalusian (Maghreb), and Beijing Opera (China).

dunya.compmusic.upf.edu

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Dunya comprises the music corpora and related software tools that have been developed as part of the CompMusic project. These corpora have been created with the aim of studying particular music traditions and they include audio recordings plus complementary information that describes the recordings. Each corpus has specific characteristics and the developed software tools allow to process the available information in order to study and explore the characteristics of each musical repertoire.

Explore our collections

Latest news

MOOC on North Indian Classical Music by the MTG on the Kadenze platform
16/03/2018 - 15:36

The MTG, in collaboration with Ragasphere and on the Kadenze on-line...

Xavier Serra invited to talk at the University of Rochester in New York
01/03/2018 - 00:24

Xavier Serra gives two seminars at the

Latest blogs

Interviews published in a Chinese Wechat Official Account 04/09/2017

WeChat Official Accounts can be understood as the WeChat equivalent of a Facebook page. They are drawing a lot of interest these days, as WeChat has risen to dominate the Chinese social media space (Chinese users spend ⅓ of their smartphone time...

Final Report 24/08/2017

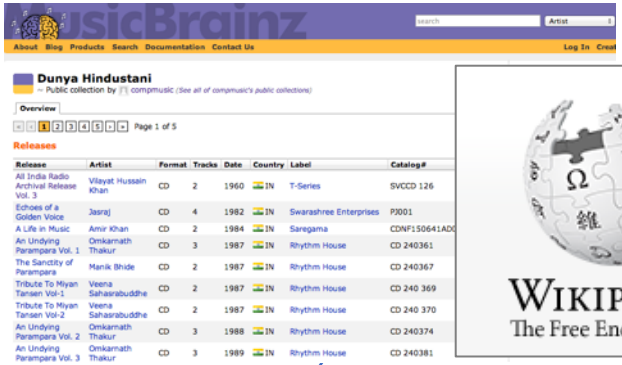
CompMusic has finished, and our funding agency, ERC, asked us to write a brief report. Here is it. Achievements along the main objectives/activities The CompMusic project has been a big and long project with many achievements...

Technology and Multiculturality 17/04/2016

[Article published in the daily newspaper La Vanguardia on Sunday 17th 2016. English translation of the original text written in catalan.] The violin, typewriter or mobile are examples of technological devices that were born in certain contexts...

Music traditions studied

CompMusic team



Signal processing

Machine learning

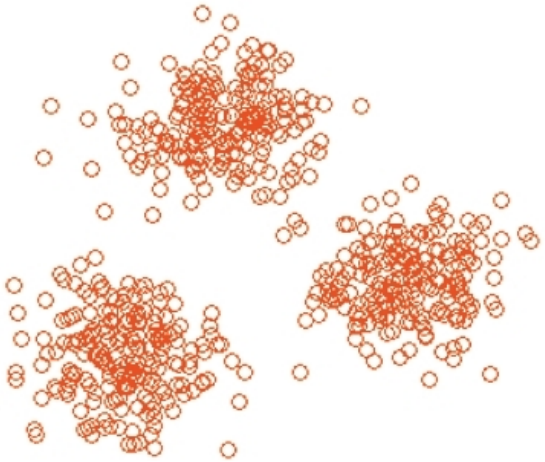
Semantic analysis

Melodic patterns

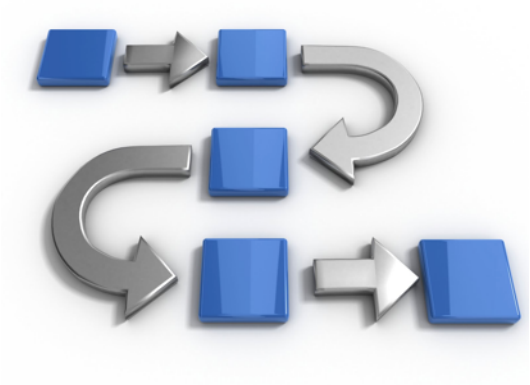
Rhythmic patterns

Semantic relationships

Problem



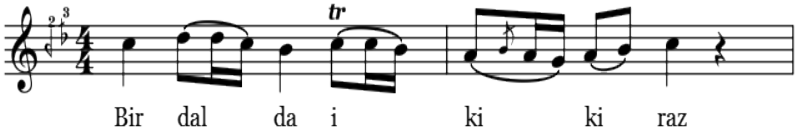
Data



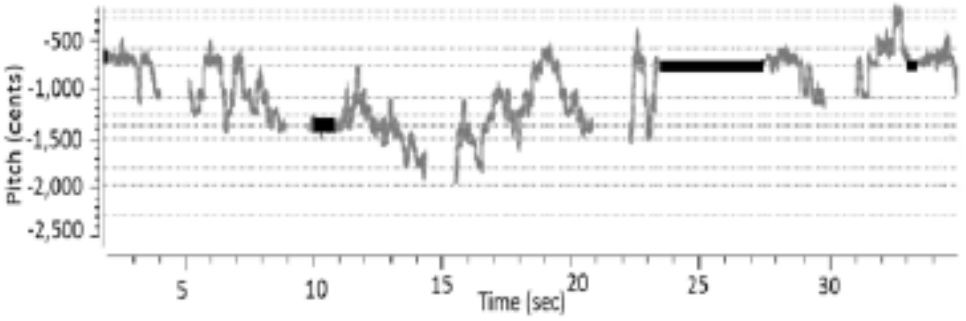
Methodology

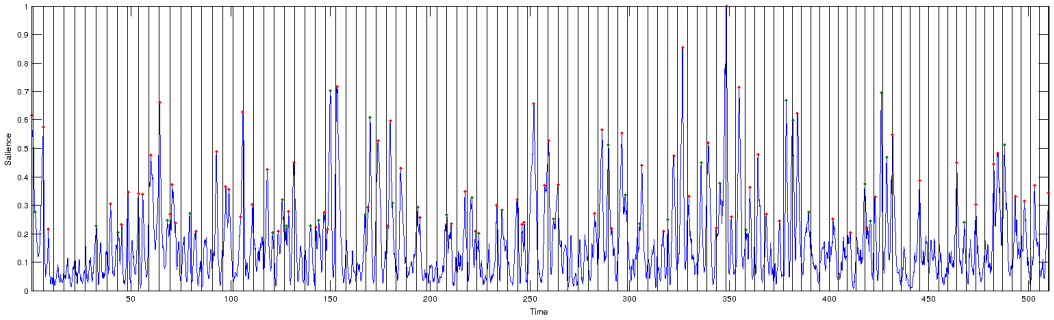
Evaluation

Problem

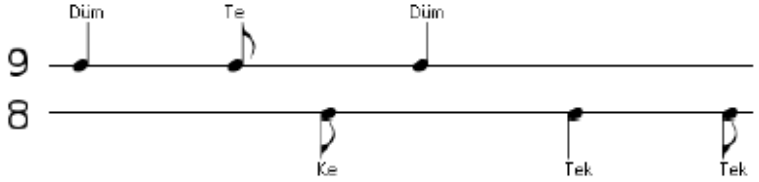


Melody

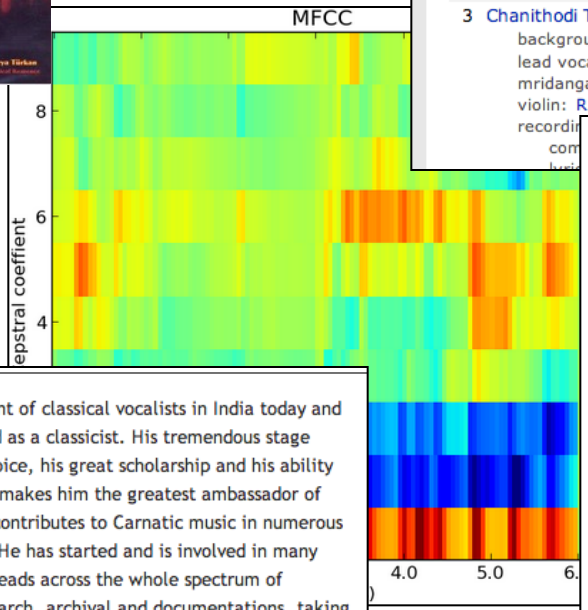




Rhythm



Data



CD 1

1 Tharunam Eedamma - D.K.Jayaraman
- background vocals: Sukanya Sankararaman, Balaji Shankar
- lead vocals: D. K. Jayaraman
- mridangam: J Vaidyanathan
- violin: R. K. Shriramkumar
- recording of: Tarunam Edamma
  - composer: Syama Sastri
  - lyricist: Syama Sastri

2 Parvathi Pathim
- background vocals: Sukanya Sankararaman, Balaji Shankar
- lead vocals: D. K. Jayaraman
- mridangam: J Vaidyanathan
- violin: R. K. Shriramkumar
- recording of: Parvathi Pathim
  - composer: Muthuswamy Dikshitar
  - lyricist: Muthuswamy Dikshitar

3 Chanithodi Theve
- background vocals: Sukanya Sankararaman, Balaji Shankar
- lead vocals: D. K. Jayaraman
- mridangam: J Vaidyanathan
- violin: R. K. Shriramkumar
- recordi
- com

قدام الأصبهان

توشية الميزان 32

الصنعة 1 . شغل - اصبهان . زجل

يَا كَوْكَبَ الأخلاكْ قَلْبِي هَوَاكْ

"توشية"

هَوَاكَ يَا فَتَّانْ
قَدْ حَيَّرَ الأذْهَانْ
بِاللهِ يَا سُلْطَانْ
رِفْقًا بِمَنْ هَوَاكْ وَدَعْ جَفَاكْ

الصنعة 2 249 . اصبهان . توشيح

سَقْطَ الدُمُوعِ جَارِي مِنْ مُقْلَتِي سَقَطْ
كَالدُرِّ فِي انْحِطَاطِ لَوْ كَانَ يَلْتَقَطْ
يَا نَاثِرَ اللَّآلِي مِنْ دَمْعِيَ الفَرِيدْ
يَا مُشْبِهَ الغَزَالِ يَا كَعْبَةَ الجَمَالِ بِمُقْلَةٍ وَجِيدْ
يَا غِيدَ كُلَّ غِيدْ
يَا جَنَّتِي وَنَارِي كَلَّفْتِنِي شَطَطْ
مُذْ بِتُّ بِالنَّقَارِ مِنِّي عَلَى شَطَطْ

T.M. Krishna

Vocal

ARTIST'S WEBSITE

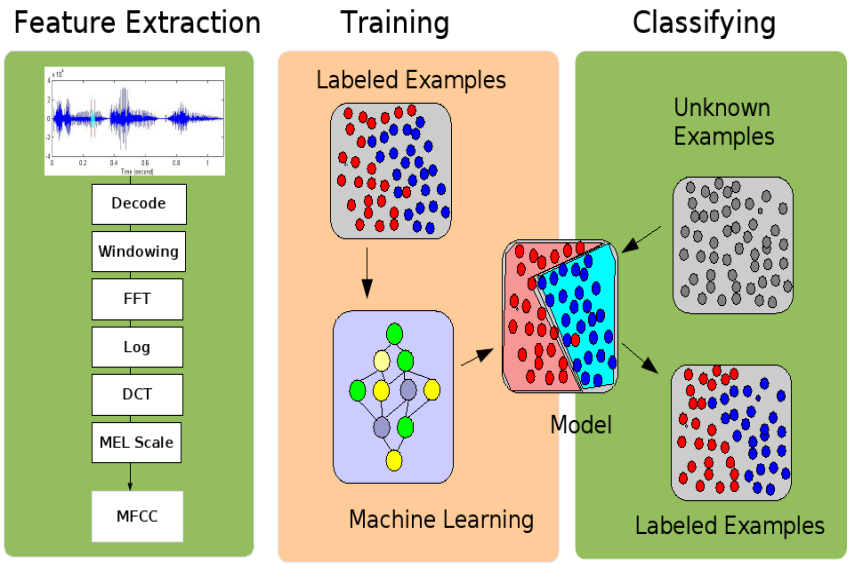
ARTIST'S FACEBOOK

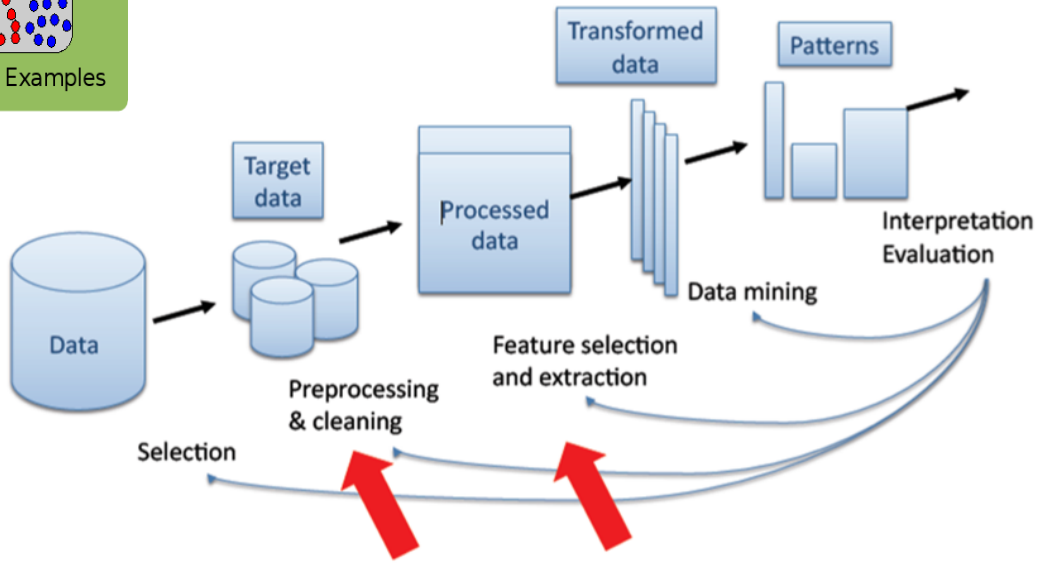
ARTIST'S TWITTER

ARTIST'S YOUTUBE

T.M. Krishna is at the forefront of classical vocalists in India today and is known in the musical world as a classicist. His tremendous stage presence, his awe inspiring voice, his great scholarship and his ability to transcend cultural borders makes him the greatest ambassador of Carnatic classical music. He contributes to Carnatic music in numerous ways other than performing. He has started and is involved in many organisations whose work spreads across the whole spectrum of Carnatic music including research, archival and documentations, taking Carnatic music to various parts of society and to smaller towns and villages, conducting festivals focused at the youth, supporting artists from rural south India who need opportunities to widen their horizons and spotting youth talent and giving them opportunities. He conducts creativity workshops for corporates and has lectured in various organisations like IIM Bangalore, IIT Madras, CII, and Harvard university. He is an author who has co authored 'Voices within' a book dedicated to some of the greats of Carnatic music and contributes regularly to various journals and newspapers. He has also always been in the forefront to raise very many sensitive issues that affects Carnatic music over many years. A multifaceted personality.

Methodology





Evaluation

	Algo.	f_b	$AML_{t,b}$	$\mathfrak{I}_b$ Bits	f_s	Tempo CML	Tempo AML	Tāḷa %
CMR	HMM_0	0.718	0.722	1.44	0.440	0.718	0.938	64
	$AMPF_0$	0.825	0.906	2.17	0.574	0.802	1.000	68
HMR_s	HMM_0	0.759	0.698	1.21	0.551	0.533	0.721	60
	$AMPF_0$	0.828	0.834	1.54	0.569	0.714	0.946	63
HMR_l	HMM_0	0.338	0.225	0.77	0.280	0.119	0.350	37
	$AMPF_0$	0.390	0.427	1.35	0.268	0.350	0.740	27
Blrm.	HMM_0	0.853	0.910	2.52	0.666	0.755	0.988	91
	$AMPF_0$	0.813	0.850	2.15	0.529	0.709	0.957	89

quantitative (algorithms)

qualitative (systems)

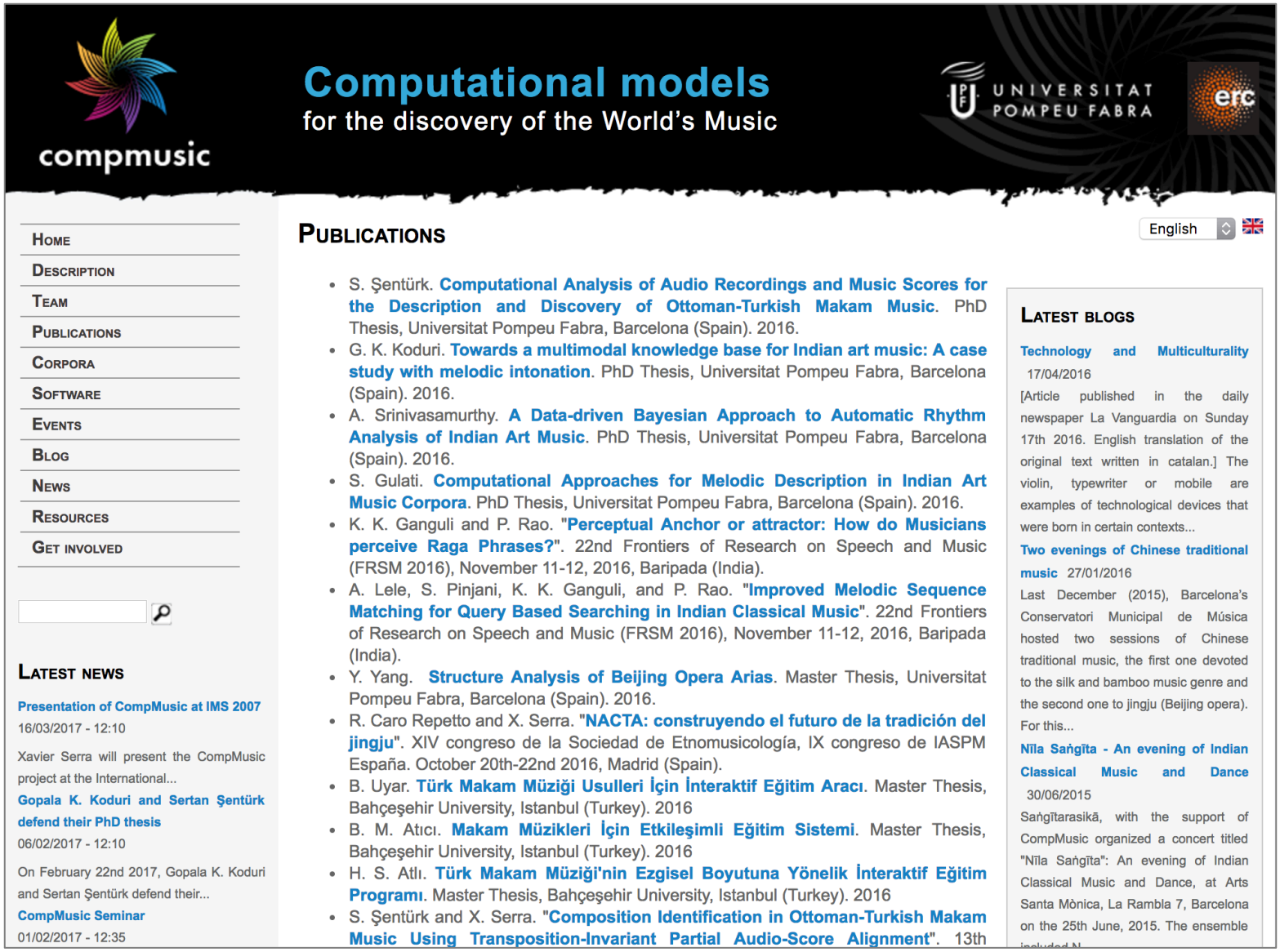
Results: data processing methods

- Prominent pitch detection (Atlı et al. 2015)
- Tonic detection and pitch representations (Gulati et al. 2014)
- Structural analysis (Sarala and Murthy 2013)
- Melodic/rhythm pattern detection (Gulati, 2016; Srinivasamurthy 2016)
- Lyrics to audio alignment (Dzhambazov et al. 2016)
- Score to audio alignment (Şentürk 2016)

Results: musicology

- Hindustani and Carnatic
  - Comparison of intonation characteristics (Serrà et al. 2011)
  - Raga grammar in improvisations (Ganguli et al., 2016)
  - Raga identification through the characteristic motives (Gulati et al., 2016)
- Turkish-makam
  - Metrical contradiction in *usuls* (Holzapfel and Bozkurt, 2012)
  - *Makam* characterization through their *seyir* (Bozkurt, 2015)
- Jingju
  - Linguistic tones and pitch contours relationships (Zhang et al., 2015)
  - Characterization of schools of *dan* role-types (Caro Repetto et al., 2015)

Publications



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- Description
- Team
- Publications
- Corpora
- Software
- Events
- Blog
- News
- Resources
- Get involved

English

Publications

- S. Şentürk. **Computational Analysis of Audio Recordings and Music Scores for the Description and Discovery of Ottoman-Turkish Makam Music**. PhD Thesis, Universitat Pompeu Fabra, Barcelona (Spain). 2016.
- G. K. Koduri. **Towards a multimodal knowledge base for Indian art music: A case study with melodic intonation**. PhD Thesis, Universitat Pompeu Fabra, Barcelona (Spain). 2016.
- A. Srinivasamurthy. **A Data-driven Bayesian Approach to Automatic Rhythm Analysis of Indian Art Music**. PhD Thesis, Universitat Pompeu Fabra, Barcelona (Spain). 2016.
- S. Gulati. **Computational Approaches for Melodic Description in Indian Art Music Corpora**. PhD Thesis, Universitat Pompeu Fabra, Barcelona (Spain). 2016.
- K. K. Ganguli and P. Rao. "**Perceptual Anchor or attractor: How do Musicians perceive Raga Phrases?**". 22nd Frontiers of Research on Speech and Music (FRSM 2016), November 11-12, 2016, Baripada (India).
- A. Lele, S. Pinjani, K. K. Ganguli, and P. Rao. "**Improved Melodic Sequence Matching for Query Based Searching in Indian Classical Music**". 22nd Frontiers of Research on Speech and Music (FRSM 2016), November 11-12, 2016, Baripada (India).
- Y. Yang. **Structure Analysis of Beijing Opera Arias**. Master Thesis, Universitat Pompeu Fabra, Barcelona (Spain). 2016.
- R. Caro Repetto and X. Serra. "**NACTA: construyendo el futuro de la tradición del jingju**". XIV congreso de la Sociedad de Etnomusicología, IX congreso de IASPM España. October 20th-22nd 2016, Madrid (Spain).
- B. Uyar. **Türk Makam Müziği Usulleri İçin İnteraktif Eğitim Aracı**. Master Thesis, Bahçeşehir University, Istanbul (Turkey). 2016
- B. M. Atıcı. **Makam Müzikleri İçin Etkileşimli Eğitim Sistemi**. Master Thesis, Bahçeşehir University, Istanbul (Turkey). 2016
- H. S. Atlı. **Türk Makam Müziği'nin Ezgisel Boyutuna Yönelik İnteraktif Eğitim Programı**. Master Thesis, Bahçeşehir University, Istanbul (Turkey). 2016
- S. Şentürk and X. Serra. "**Composition Identification in Ottoman-Turkish Makam Music Using Transposition-Invariant Partial Audio-Score Alignment**". 13th

Latest news

Presentation of CompMusic at IMS 2007
16/03/2017 - 12:10

Xavier Serra will present the CompMusic project at the International...

Gopala K. Koduri and Sertan Şentürk defend their PhD thesis
06/02/2017 - 12:10

On February 22nd 2017, Gopala K. Koduri and Sertan Şentürk defend their...

CompMusic Seminar
01/02/2017 - 12:35

Latest blogs

Technology and Multiculturality 17/04/2016

[Article published in the daily newspaper La Vanguardia on Sunday 17th 2016. English translation of the original text written in catalan.] The violin, typewriter or mobile are examples of technological devices that were born in certain contexts...

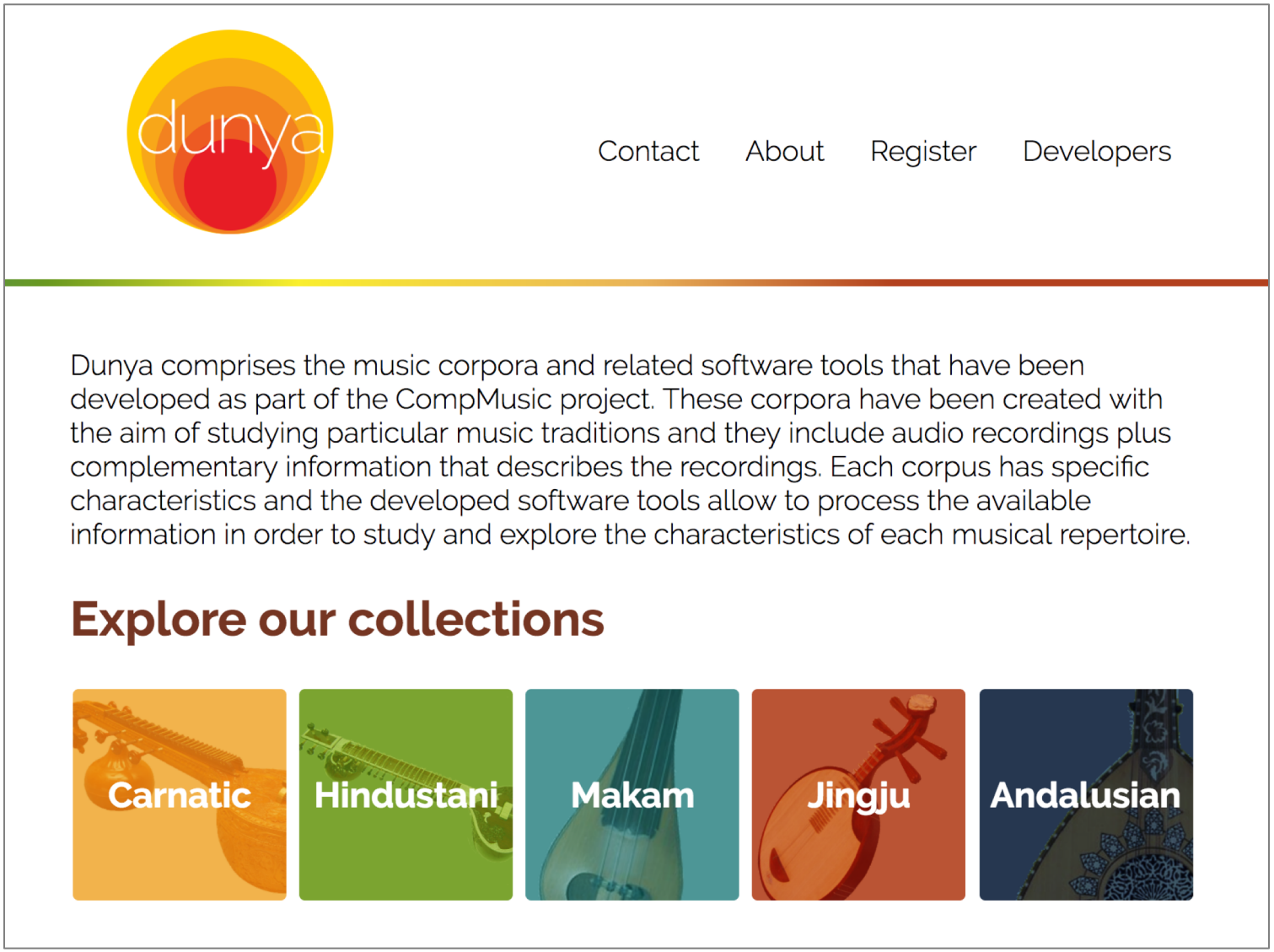
Two evenings of Chinese traditional music 27/01/2016

Last December (2015), Barcelona's Conservatori Municipal de Música hosted two sessions of Chinese traditional music, the first one devoted to the silk and bamboo music genre and the second one to jingju (Beijing opera). For this...

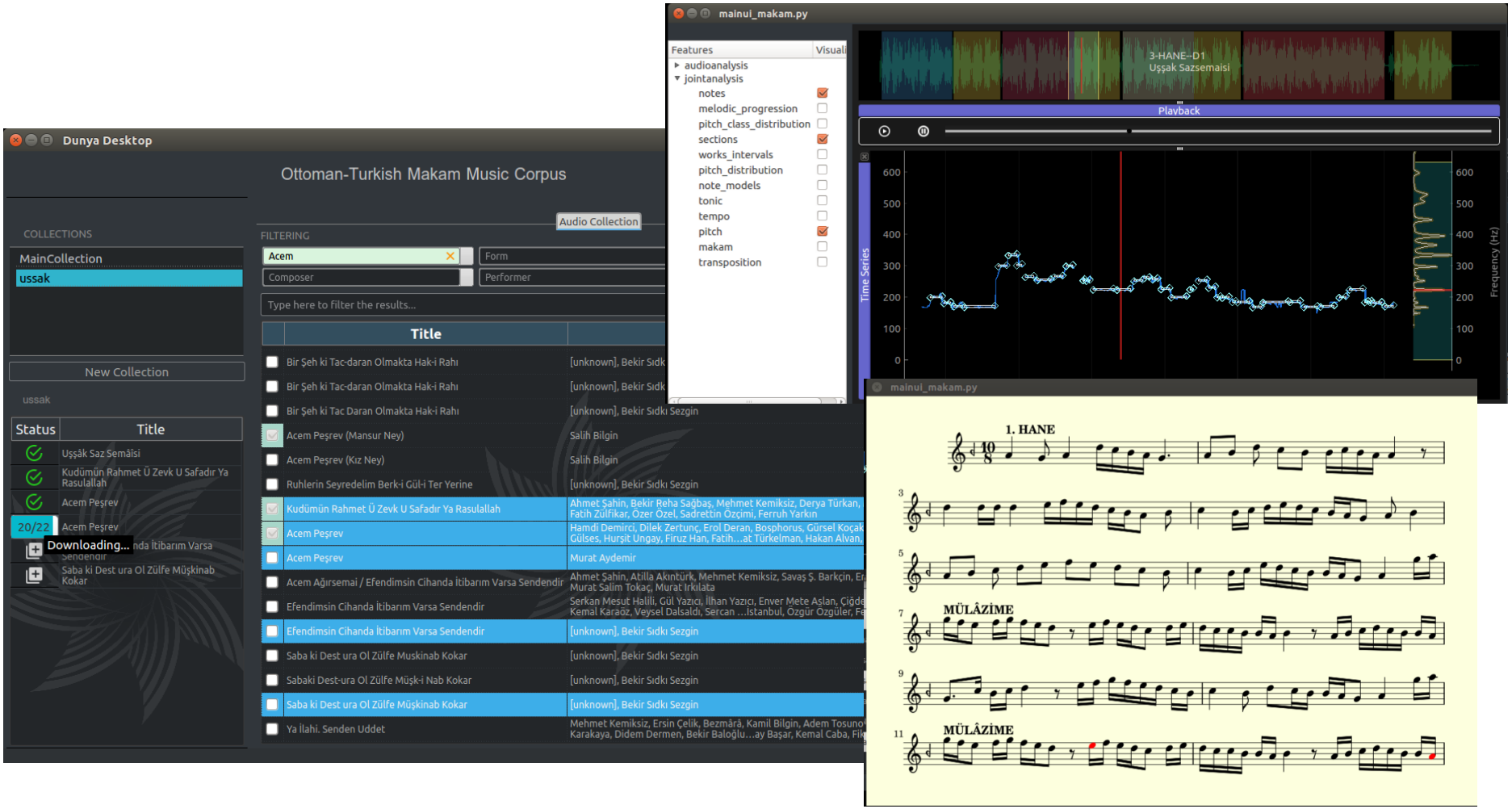
Nīla Saṅgīta - An evening of Indian Classical Music and Dance 30/06/2015

Saṅgītarasikā, with the support of CompMusic organized a concert titled "Nīla Saṅgīta": An evening of Indian Classical Music and Dance, at Arts Santa Mònica, La Rambla 7, Barcelona on the 25th June, 2015. The ensemble

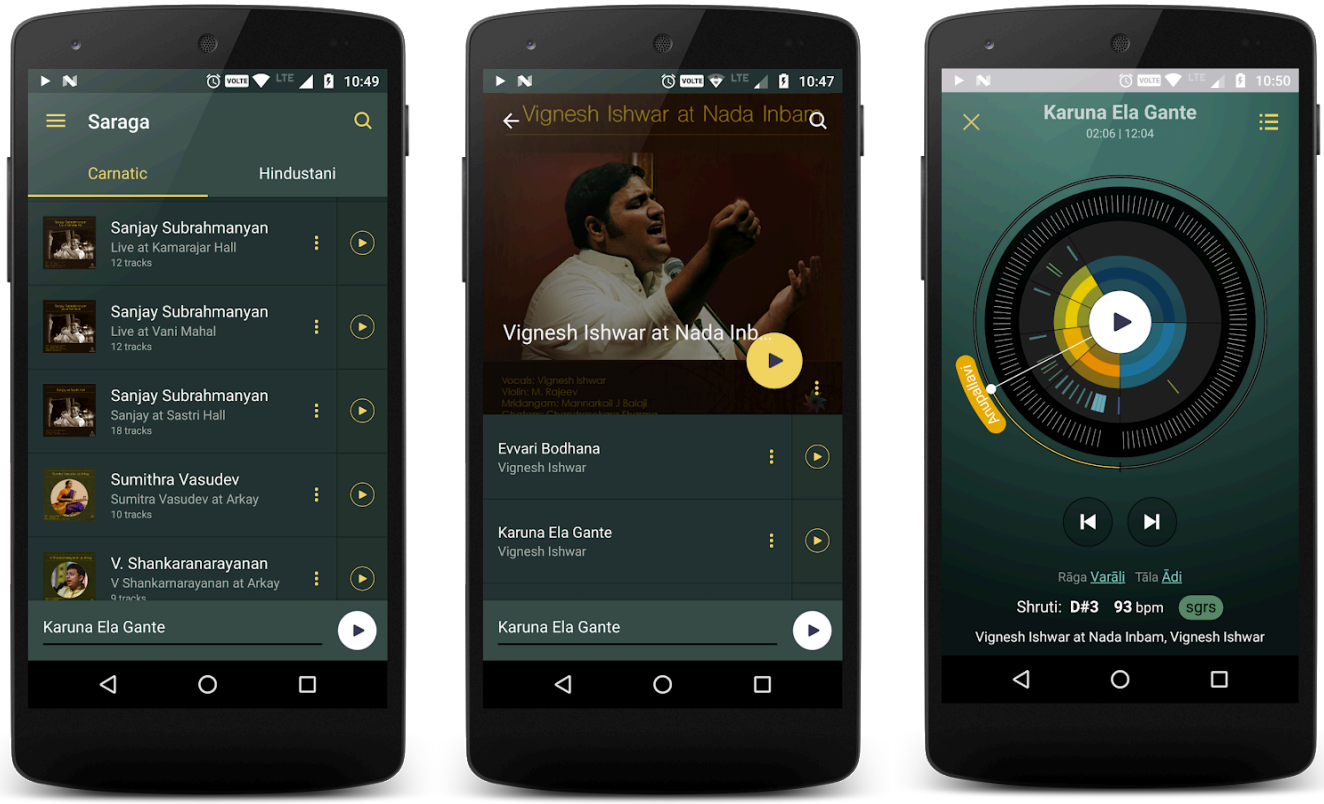
Tools: data + software



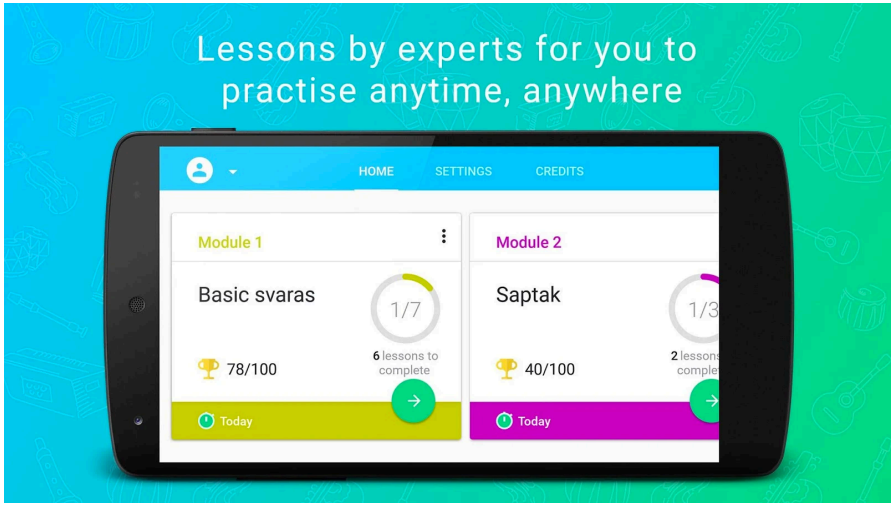
Applications: Dunya Desktop

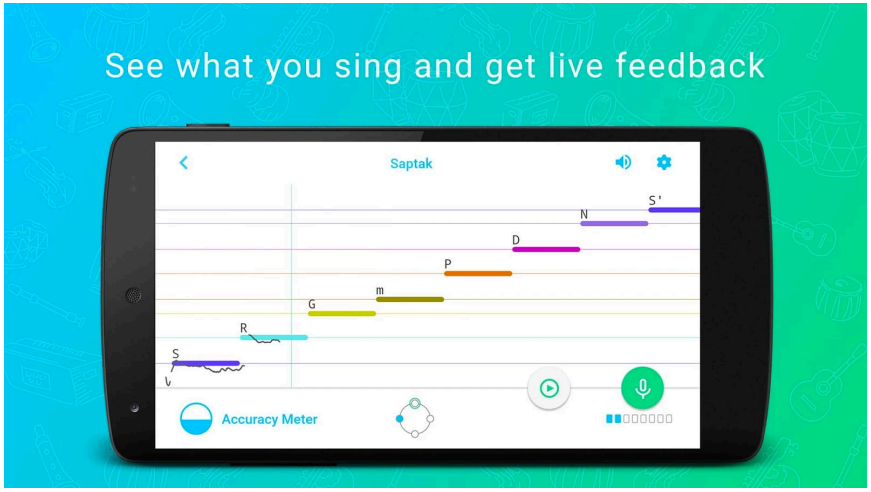


Applications: Saraga

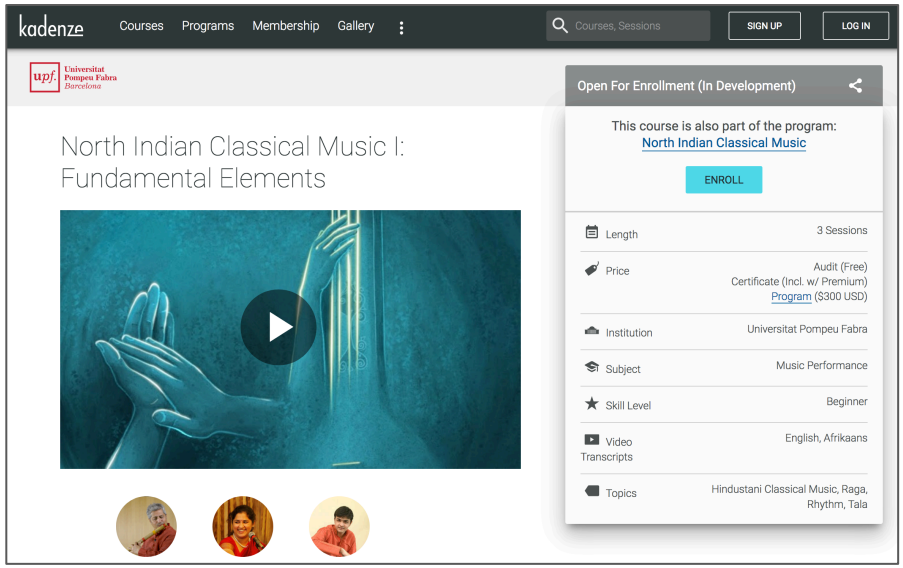


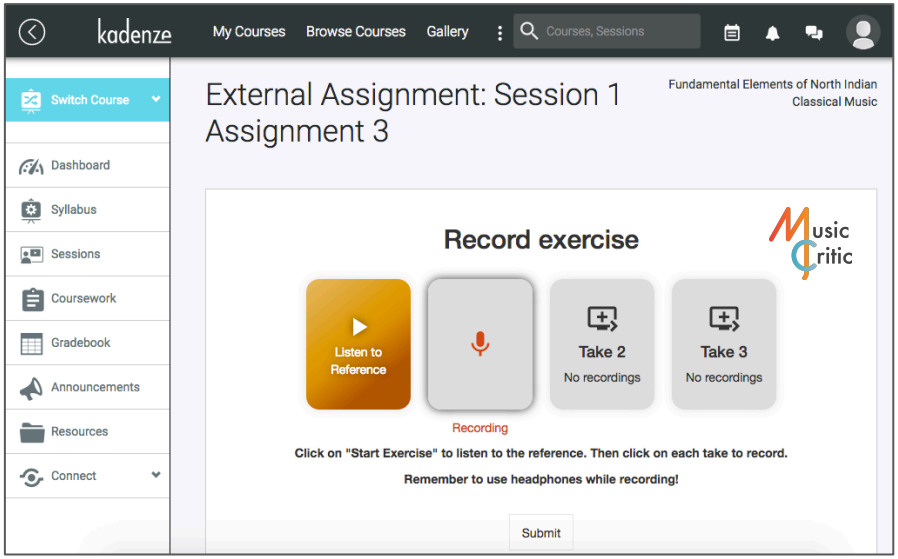
Applications: Riyaz





Applications: Music Critic





References

- MTG: https://www.upf.edu/web/mtg/
- CompMusic: http://compmusic.upf.edu