Universitat Pompeu Fabra Barcelona

MTG Music Technology Group

Department | School of Engineering

Can I play it?
Estimating piano performance difficulty
Using multiple modalities.

Department | School of Engineering

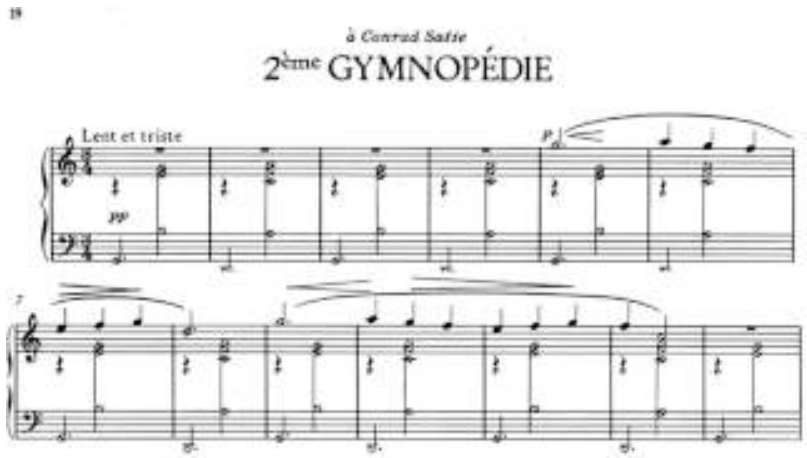
Reaserch Group | Music Technology Group

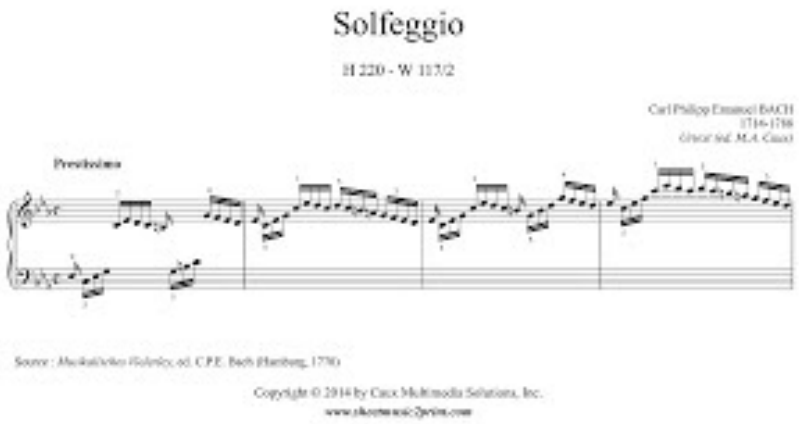
Thesis author: Pedro Ramoneda

Thesis Supervisor: Xavier Serra

CAN I PLAY IT?

Estimating piano performance difficulty using multiple modalities.





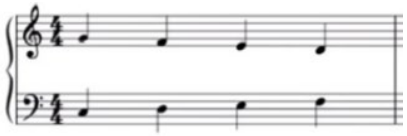
CAN I PLAY IT?

Estimating piano performance difficulty using **multiple modalities.**

<note> <pitch> <step> G </step> <octave> 4 </octave> </pitch><duration> 1 </duration> <voice> 1 </voice><type> quarter </type> <stem> up </stem> <staff> 1 </staff> </note> <note> <pitch><step> F </step> <octave> 4 </octave> </pitch> <duration> 1 </duration> <voice> 1 </voice><type> quarter </type> <stem> up </stem> <staff> 1 </staff> </note> <note> <pitch> <step> E </step> <octave> 4 .....

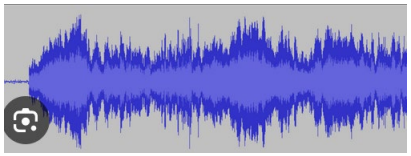
Machine Readable Scores

Limited but structured data



Images (PDF) scores

Medium Data, Public Domain, structured corpora



Audio

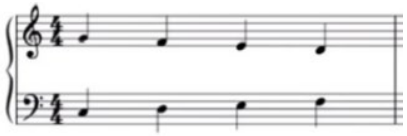
Large Data (youtube)

CAN I PLAY IT?

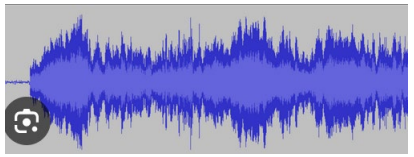
Estimating piano performance difficulty using **multiple modalities.**

<note> <pitch> <step> G </step> <octave> 4 </octave> </pitch><duration> 1 </duration> <voice> 1 </voice><type> quarter </type> <stem> up </stem> <staff> 1 </staff> </note> <note> <pitch><step> F </step> <octave> 4 </octave> </pitch> <duration> 1 </duration> <voice> 1 </voice><type> quarter </type> <stem> up </stem> <staff> 1 </staff> </note> <note> <pitch> <step> E </step> <octave> 4 .....

Machine Readable Scores



Images (PDF) scores



Audio

AI is data hungry!!

Open science contributions

- 10 papers
- 10 software repositories
- major contributions to 2 software repos
- 10 IA models repos
- 5 datasets

1. A first prototype of difficulty analysis

```
<note>
  <pitch>
    <step>E</step>
    <alter>-1</alter>
    <octave>4</octave>
  </pitch>
  <duration>2</duration>
  <type>half</type>
</note>
```

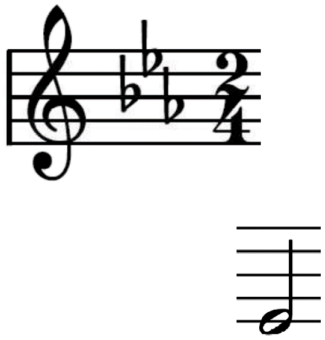
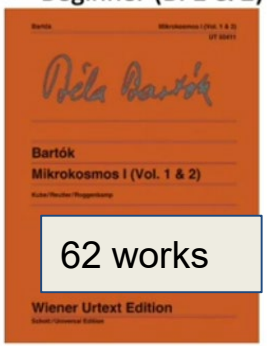


Figure 1.15 from [Müller, FMP, Springer 2015]

Symbolic Score encoding

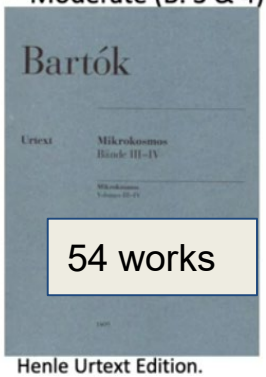
- Béla Bartók's *Mikrokosmos* Sz. 107 is a collection of progressive difficulty pieces
- It is progressively ordered (Bartók and Henle rankings). It can be grouped in 3 clases

- Beginner (B. 1 & 2)



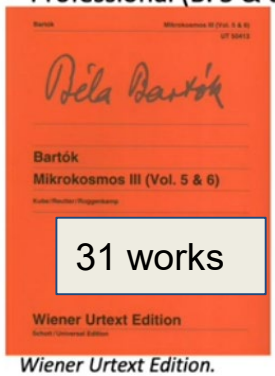
Wiener Urtext Edition.
Retrieved from:
https://tinyurl.com/2p9f4jh6

- Moderate (B. 3 & 4)



Henle Urtext Edition.
Retrieved from:
https://tinyurl.com/2p9f4jh6

- Professional (B. 5 & 6)



Wiener Urtext Edition.
Retrieved from:
https://tinyurl.com/mr3bchc7

Ramoneda, P., Jeong, P., Nakamura, E., Miron, M. & Serra, X (2022).
"**Automatic Piano Fingering from Partially Annotated Scores using Autoregressive Neural Networks**". In Proceedings of the 30th ACM MM '22, October 10–14, 2022, Lisboa, Portugal

2. Symbolic: A more real dataset

Table 1. Comparison between MKD and CIPI, showing the number of composers, levels, pieces, notes, and measures in both datasets.

	MKD	CIPI
No. composers	1	29
No. levels	3	9
No. pieces	147	652
No. notes	42699	1672699
No. measures	5041	115523

Ramoneda, P., Jeong, D., Eremenko, V., Tamer, N. C., Miron, M. and Serra, X. (2024). Combining piano performance dimensions for score difficulty classification . Expert Systems with Applications, 238.

3. PDF Data Collections

Dataset	MK	CIPI	PS	FS	HV
Pieces	147	652	2816	4193	17

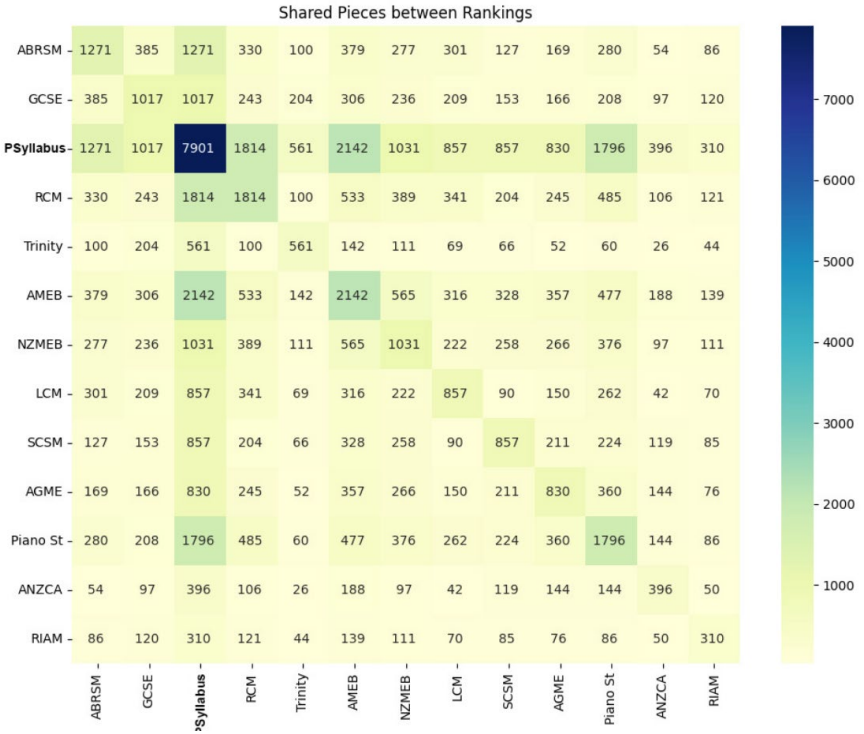
- **5** datasets: **7,500+** scores across 9 difficulty levels.
- Mikrokosmos (MK) and Can I play it? (CIPI): derived from **symbolic** data.
- PianoStreet (PS) & Freescores (FS): **Crowdsourced**
- Hidden voices (HV): spotlight on **black women** composers.

P. Ramoneda, J. J. Valero-Mas, D. Jeong and X. Serra (2023). Predicting performance difficulty from piano sheet music images . In Proc. of the 24th Int. Society for Music Information Retrieval Conf., Milan, Italy.

4. Audio Data Collections

TABLE I
STASTISTICS OF THE DATASETS AVAILABLE FOR ESTIMATING PIANO PERFORMANCE DIFFICULTY.

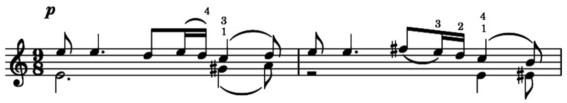
Dataset	Pieces	Classes	AIR	Noteheads	Composers
Symbolic data					
MK [13]	147	147	.78	49.2k	1
CIPI [14]	652	9	.33	1.1M	29
Image sheets					
PS [25]	2816	9	.24	7.2M	92
FS [25]	4193	5	.37	5.8M	747
HV [25]	17	4	1	21.5k	10
Audio recordings					
PSyllabus	7901	11	1.02	1.1M	1233



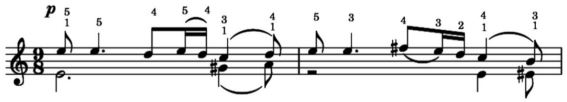
Ramoneda, P., Lee, M., Jeong, D., Valero-Mas, J.J., & Serra, X. Can Audio Reveal Music Performance Difficulty? Insights from the Piano Syllabus Dataset. Submitted to IEEE TASLP (2024).

5. Improving Automatic Piano Fingering

Partial annotation



Fully annotation



We introduce a novel dataset for the task, the ThumbSet dataset, containing 2523 pieces with partial annotations of piano fingering crowdsourced from non-expert annotators.

	ThumbSet Statistics		
	LH	RH	total
n pieces	2370	1781	2523
n windows	70613	108124	178737
ave length of window	43	44	44
prop of annotated notes	52%	52%	52%

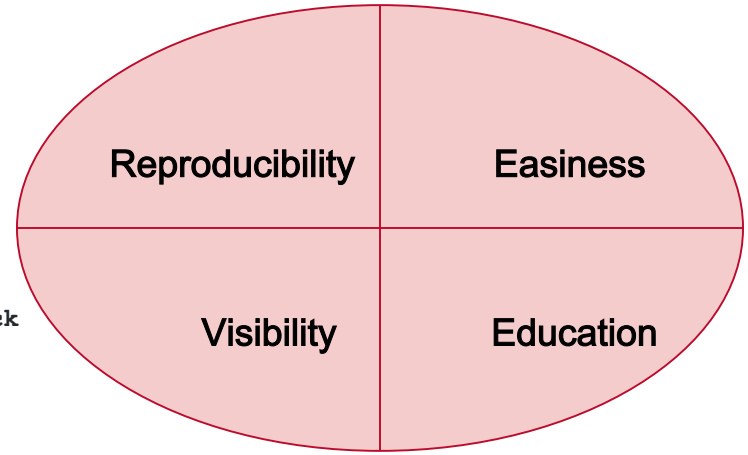
Pedro Ramoneda, Dasaem Jeong, Eita Nakamura, Xavier Serra, and Marius Miron. 2022. "**Automatic Piano Fingering from Partially Annotated Scores using Autoregressive Neural Networks**". In Proceedings of the 30th ACM MM '22, October 10–14, 2022, Lisboa, Portugal

Mirdata

https://github.com/mir-dataset-loaders/mirdata

```
import mirdata


orchset = mirdata.initialize('orchset')
orchset.download()  # download the dataset
orchset.validate()  # validate that all the expected files are there
example_track = orchset.choice_track()  # choose a random example track
  print(example_track)  # see the available data
```



Demos

Demo of the paper P. Ramoneda, J. J. Valero-Mas, D. Jeong & X. Serra, Predicting performance difficulty from piano sheet music images, in Proc. of the 24th Int. Society for Music Information Retrieval Conf., Milan, Italy (2023).

Code | Paper | Dataset

This demo will predict the difficulty of a piano piece based on music sheet images. The outputs are performance difficulty levels estimated from 3 public datasets: CIPI (9 levels), PS (9 levels), and FS (5 levels). Further information can be found in the paper.

Click here or drag a PDF sheet music to predict its difficulty!

musiccritic.upf.edu

upf. Universitat Pompeu Fabra Barcelona

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PDF difficulty datasets. (difficulty, PDF format)
P. Ramoneda, J. J. Valero-Mas, D. Jeong and X. Serra (2023). Predicting performance difficulty from piano sheet music images . In Proc. of the 24th Int. Society for Music Information Retrieval Conf., Milan, Italy.

CIPI dataset (difficulty, machine-readable format)
Ramoneda, P., Jeong, D., Eremenko, V., Tamer, N. C., Miron, M. and Serra, X. (2024). Combining piano performance dimensions for score difficulty classification . Expert Systems with Applications, 238.

ThumbSet (Piano fingering, machine-readable format)
Pedro Ramoneda, Dasaem Jeong, Eit
a Nakamura, Xavier Serra, and Marius Miron (2022). Automatic Piano Fingering from Partially Annotated Scores using Autoregressive Neural Networks . In Proceedings of the 30th ACM International Conference on Multimedia (MM '22), October 10–14, 2022, Lisboa, Portugal.

Mikrokosmos-difficulty dataset (difficulty, machine-readable format)
Ramoneda, P., Tamer, N. C., Eremenko, V., Miron, M. & Serra, X (2022). Score difficulty analysis for piano performance education based on fingering . In ICASSP 2022 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP).

In review, Piano Syllabus dataset (difficulty, audio format)
Ramoneda, P., Lee, M., Jeong, D., Valero-Mas, J.J., & Serra, X. Can Audio Reveal Music Performance Difficulty? Insights from the Piano Syllabus Dataset. Submitted to IEEE TASLP (2024).