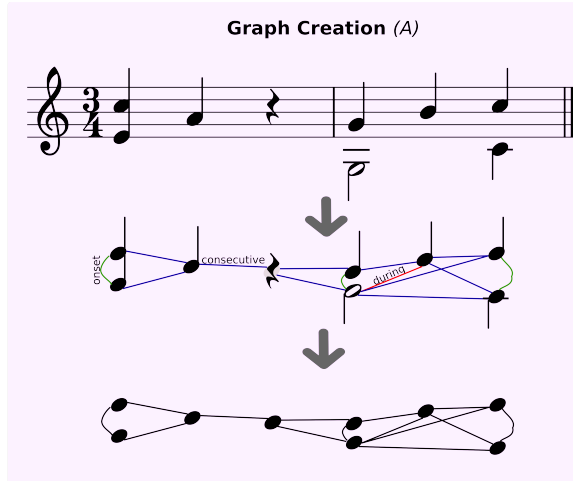


Cadence Detection in Symbolic Music using Graph Neural Networks

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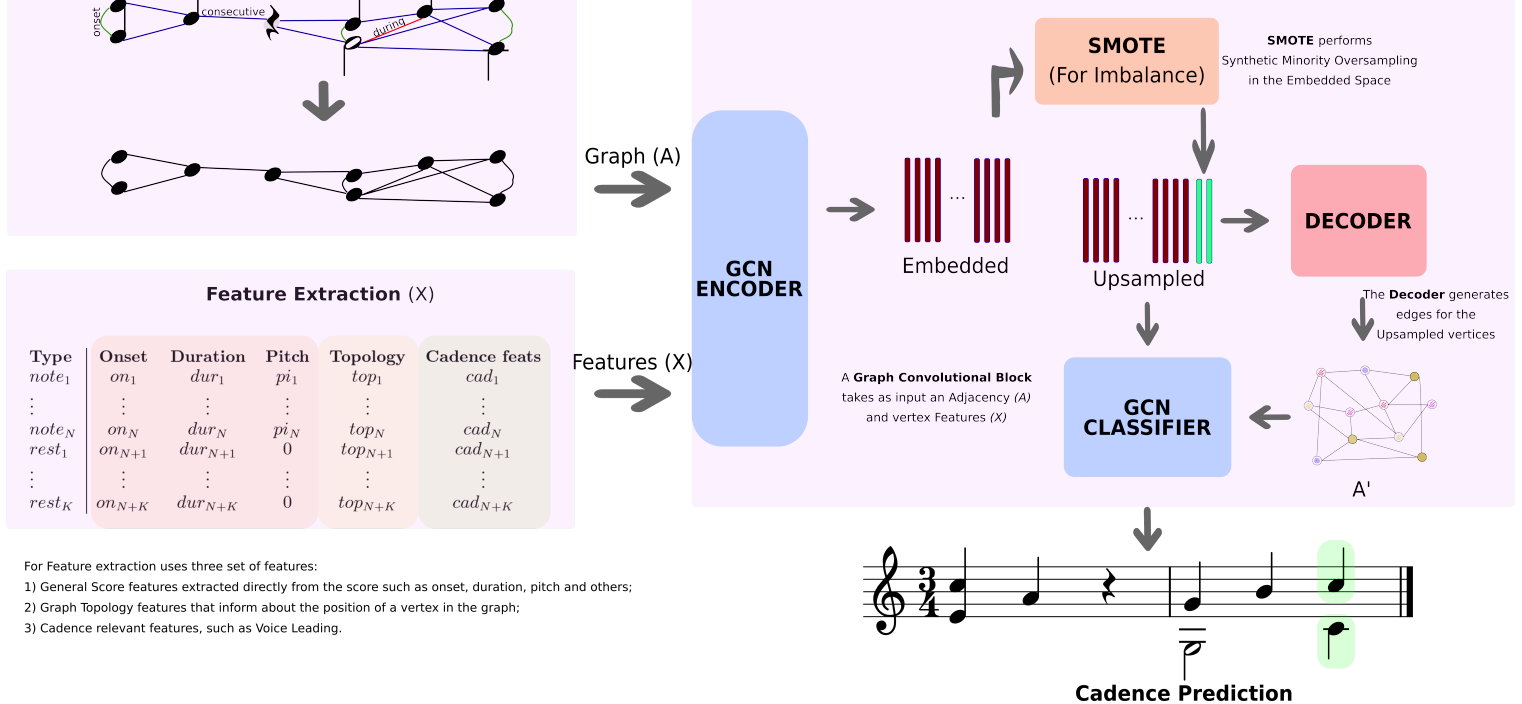
Framework



Dataset	Pieces	Nodes	Edges	PAC	rIAC	HC
Bach Fugues	24	24,567	229,107	237	78	15
Haydn String Quartets	45	38,661	441,491	434	24	340

Cadence nodes constitute less than 2% of all nodes.

STOCHASTIC GRAPHSMOTE for Cadence Detection



For Feature extraction uses three set of features:

- 1) General Score features extracted directly from the score such as onset, duration, pitch and others;
- 2) Graph Topology features that inform about the position of a vertex in the graph;
- 3) Cadence relevant features, such as Voice Leading.

Feature Extraction (X)

Type	Onset	Duration	Pitch	Topology	Cadence feats
$note_1$	on_1	dur_1	pi_1	top_1	cad_1
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$note_N$	on_N	dur_N	pi_N	top_N	cad_N
$rest_1$	on_{N+1}	dur_{N+1}	0	top_{N+1}	cad_{N+1}
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$rest_K$	on_{N+K}	dur_{N+K}	0	top_{N+K}	cad_{N+K}

Results

Dataset	Model	F1 Note	F1 Onset	F1 Beat	Prec. Beat	Recall Beat
Bach Fugues (PAC) (12 fugues)	Bigo et al. model	-	-	0.80	0.89	0.72
	SGSMOTE	0.85	0.75	0.73	0.70	0.77
	Pretrained SGSMOTE	0.90	0.83	0.80	0.74	0.89
Bach Fugues (rIAC) (12 fugues)	Bigo et al. model	-	-	0.68	0.71	0.65
	SGSMOTE	0.87	0.75	0.73	0.75	0.72
	Pretrained SGSMOTE	0.87	0.73	0.71	0.62	0.82
Haydn String Quartets (PAC) (21 pieces)	Bigo et al. model	-	-	0.69	0.60	0.82
	SGSMOTE	0.77	0.56	0.59	0.47	0.78
	Pretrained SGSMOTE	0.81	0.63	0.64	0.54	0.78
Haydn String Quartets (HC) (21 pieces)	Bigo et al. model	-	-	0.29	0.19	0.56
	SGSMOTE	0.65	0.32	0.30	0.33	0.27
	Pretrained SGSMOTE	0.69	0.44	0.41	0.41	0.41

Results using half of the dataset for training, half for testing.
Bach: fugues no.1-12 were used for training, no.13-24 for testing; Haydn: random 21:21 split.

The pretrained network was trained on the other dataset, i.e. Pretrained SGSMOTE for Bach Fugues was pre-trained on string quartets, etc.

Classification is binary, the presented F1 scores are for the positive class, i.e., the cadence (PAC: Perfect Authentic Cadence; rIAC: root position Imperfect AC; HC: Half Cadence)

Contributions

Graph Modelling of Musical Scores :

- How Nodes and Edges are created
- How Node Features are extracted

GCN for Cadence Detection :

- GCN to deal with heavy imbalance in large graphs.
- Fine gain predictions on three levels: Note, Onset and Beat.

Read Our Paper



<https://tinyurl.com/cadet-2022>

See the Code



<https://github.com/manoskary/cadet>

String Quartet 29. Op. 54 No. 1 mtv ii

J. Haydn

Violin I, Violin II, Viola, Violoncello

Theme: G, Bb, Db
1st Variation: Bb, Db

Modulating Melodic and Harmonic Sequence