R2.B.09

Real-Time Identification of Common and Extended Musical Chords using Neural Networks

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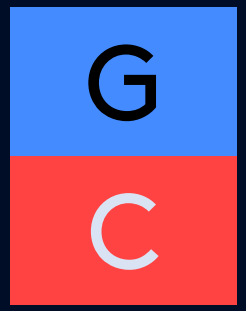
Pitch Classes / Notes

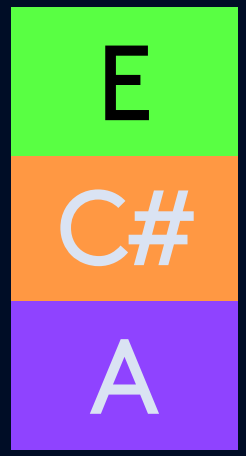
C	C#	D	D#	E	F
B	A#	A	G#	G	F#

Musical Chords

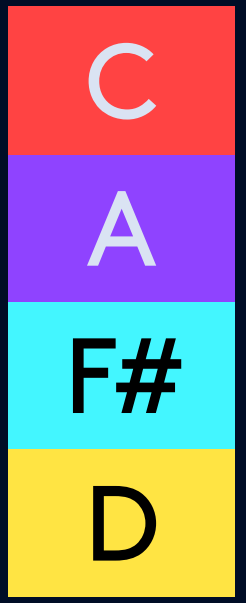
BACKGROUND



2 or more notes



Played together



Follow “rules of harmony”

(Leino, Brattico, Tervaniemi, & Vurst, 2007)

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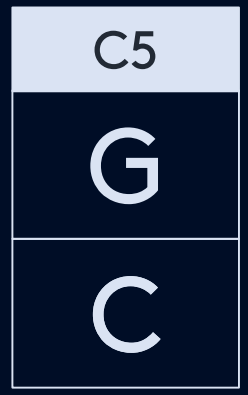
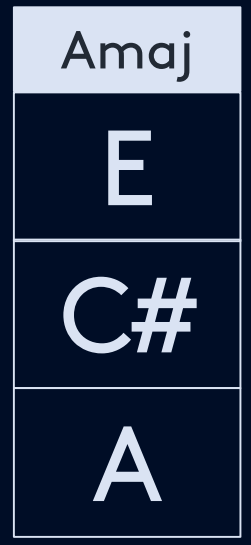
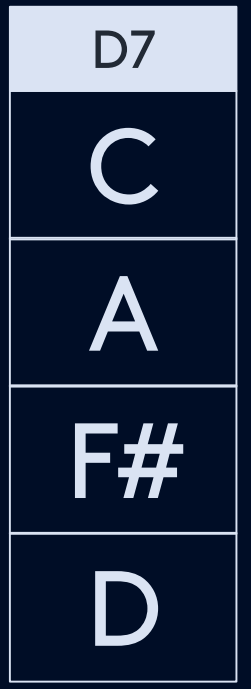
Musical Chords

BACKGROUND

Each has a name



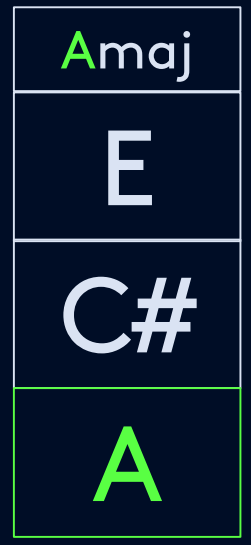


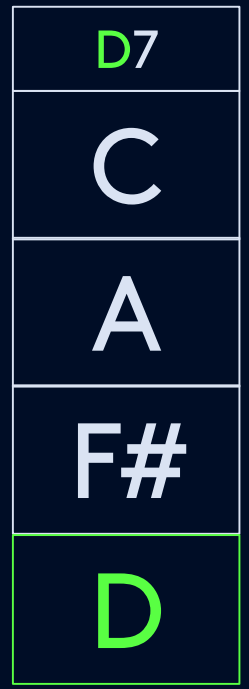


Musical Chords

BACKGROUND

Each has a root note

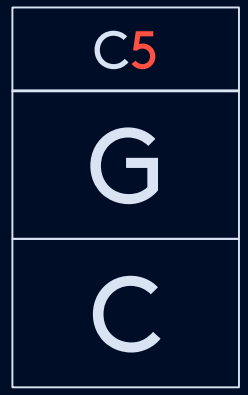


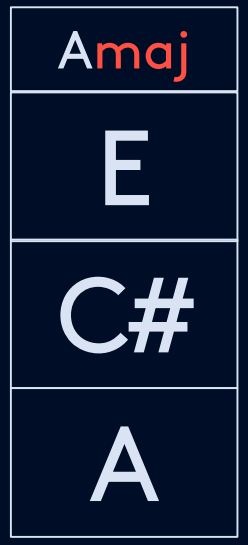


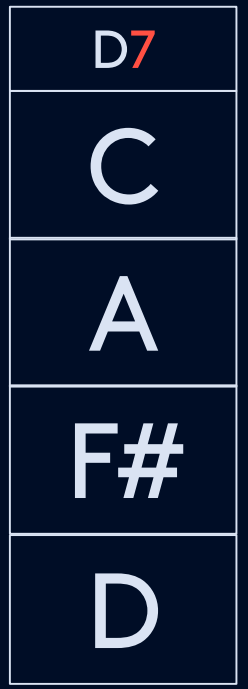
Musical Chords

BACKGROUND

Each has a type







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Musical Chords

BACKGROUND

Each has an inversion number

C5
G
C
0

Amaj
E
C#
A
0

D7
C
A
F#
D
0

Not part of the scope of the study

Chord Identification DEFINITION

The determination of the name of the chord

Definition of chord identification

Chord Identification

PROBLEM

> "The general music learning public places a high demand on chord-based representations of popular music."
>
> Humphrey, Bello, & Cho, n.d., par. 1

Chord Identification

PROBLEM

A majority of the general music learning public can't do this by themselves.

Why?

Inference

Absolute pitch

PROBLEM

Absolute pitch

PROBLEM

Absolute pitch

PROBLEM

Rare amongst music-learning individuals

Zatorre, Perry, Beckett, Westbury, & Evans, 1998

Absolute pitch

PROBLEM

Expressed in a low percentage of the human population

Baharloo, Service, Risch, Gitschier, & Freimer, 2000

Absolute pitch

Acquired through favorable genes and early music training

Baharloo, Service, Risch, Gitschier, & Freimer, 2000

Absolute pitch

PROBLEM

What role does absolute pitch play in chord identification?

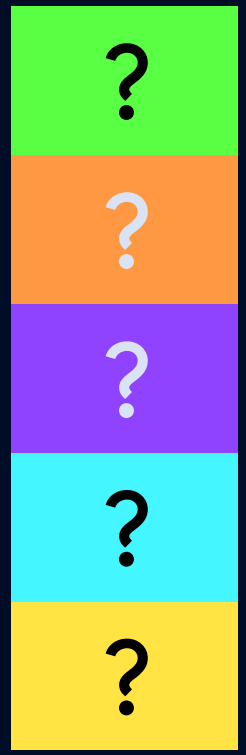
Question

Chord Id'n and A.P.

PROBLEM

Notes of chord cannot be identified

Without AP

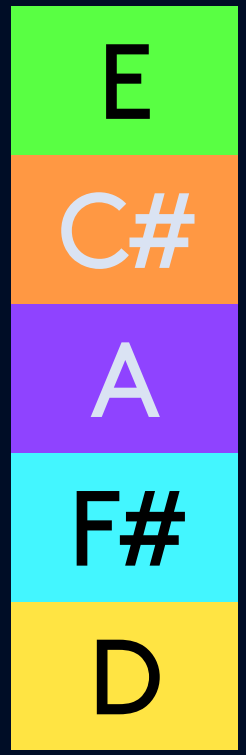


Chord Id'n and A.P.

PROBLEM

Notes of chord are identified exactly

With AP

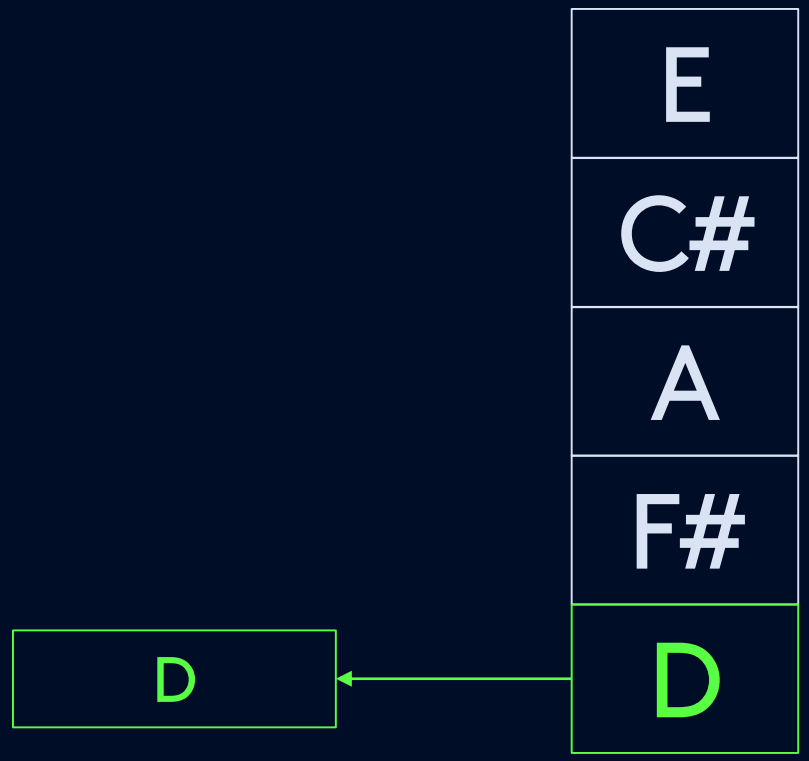


Chord Id'n and A.P.

PROBLEM

Root note
is identified

With AP

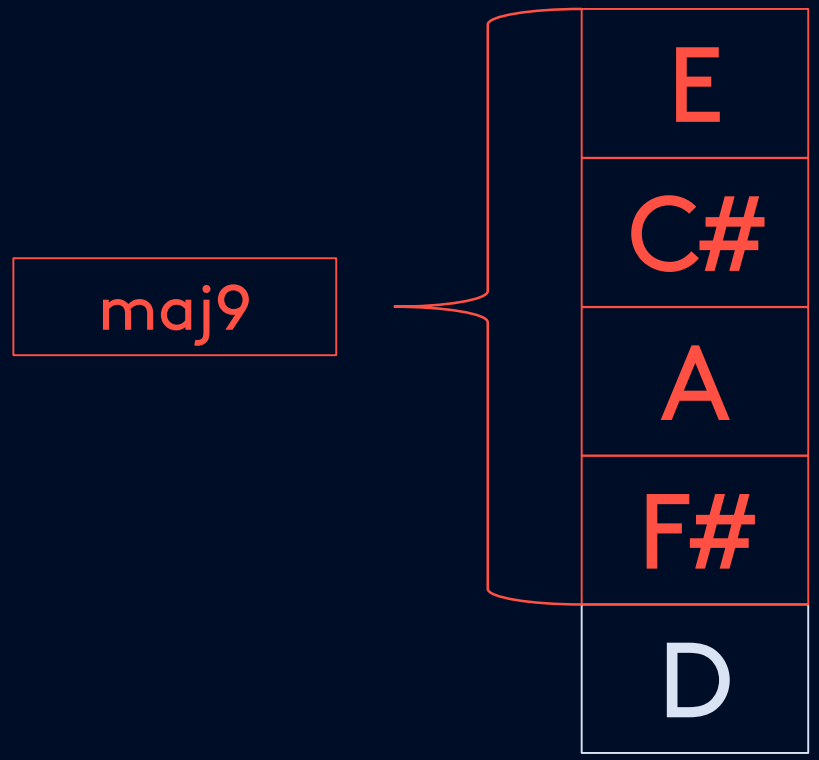


Chord Id'n and A.P.

PROBLEM

Chord type is identified

With AP & common RP

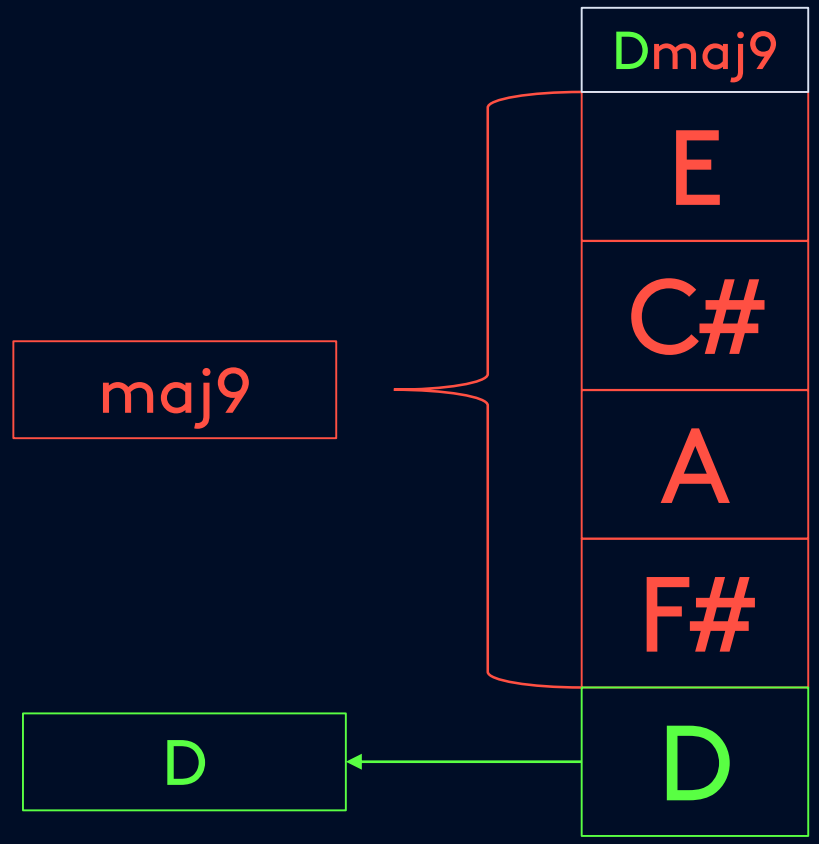


Chord Id'n and A.P.

PROBLEM

Chord name is identified

With AP & common RP



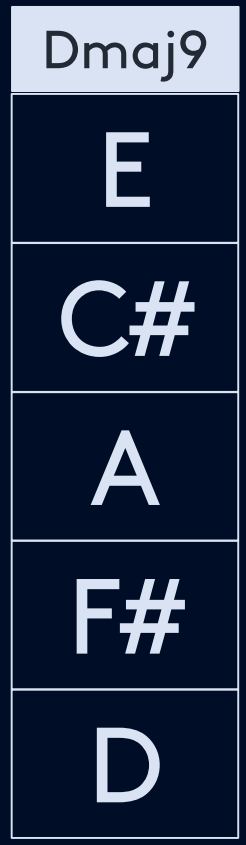
*The process of determining the name of a chord is called chord identification.

Chord Id'n and A.P.

PROBLEM

Chord name is identified

With AP & common RP



*The process of determining the name of a chord is called chord identification.

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Why neural networks?

PROBLEM

Previous studies with neural network implementations have not included extended chords in their research

Osmalskyj, Embrechts, Piérard, & Van Droogenbroeck, 2012
Perera & Kodithuwakku, 2005
Zhou & Lerch, 2015

Problem statement

PROBLEM

Using neural networks to identify both common and extended chords is **unexplored**

Osmalskyj, Embrechts, Piérard, & Van Droogenbroeck, 2012
Perera & Kodithuwakku, 2005
Zhou & Lerch, 2015

Major

Develop a neural network that quickly identifies common and extended musical chords

Minor

Input is a group of 3 or more MIDI signals played in real-time

Minor

Input chords have one root and are in the 0^{th} inversion

Minor

Identification must be quick enough to be used in live performance

Minor

Implemented in programming languages with neural network, real-time MIDI, and GPU processing libraries

thestk, 2017; Bretschneider, 2017

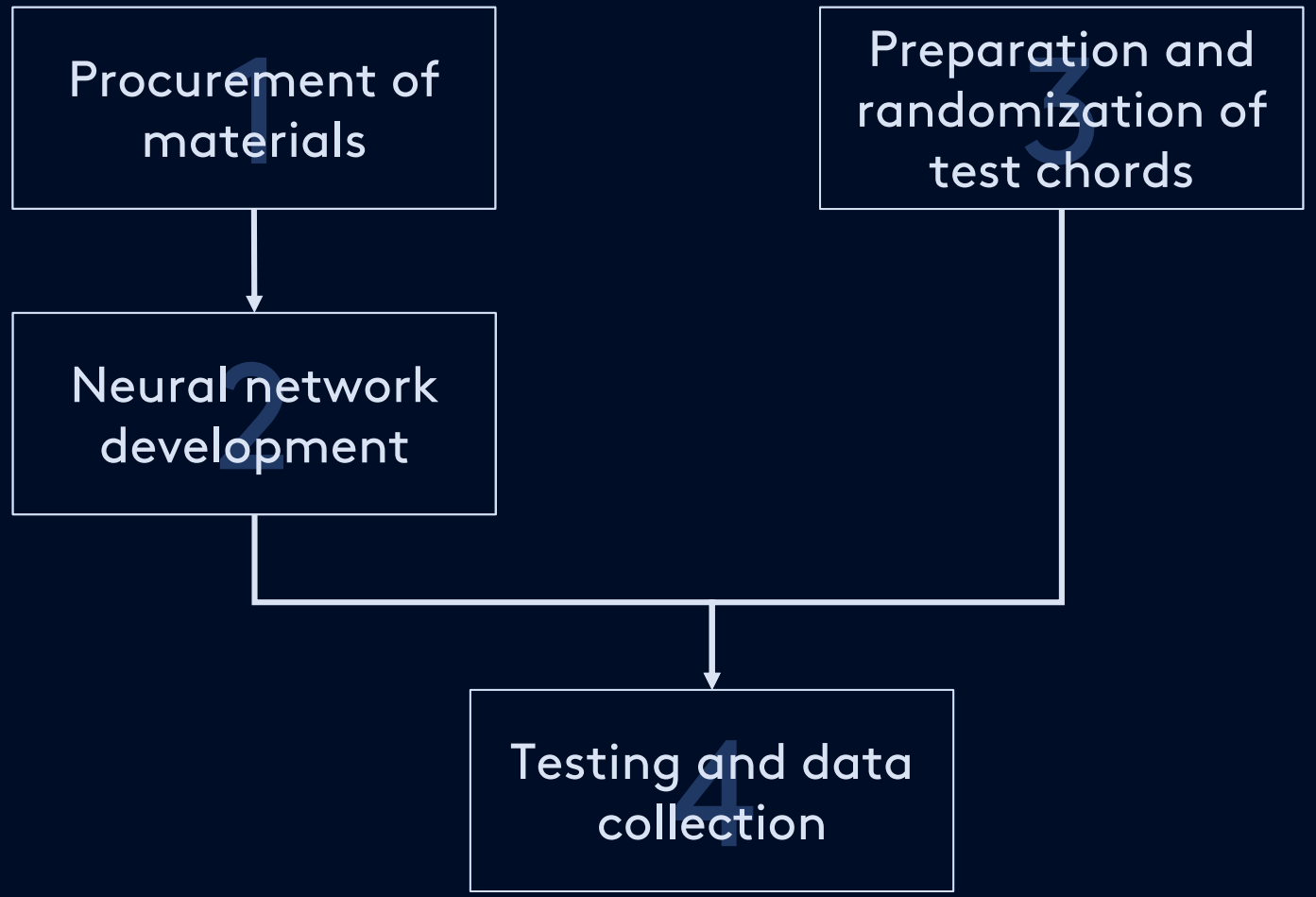
Minor

Neural network must be run on a GPU for efficient processing

Nickolls, Buck, Garland, & Skadron, 2008

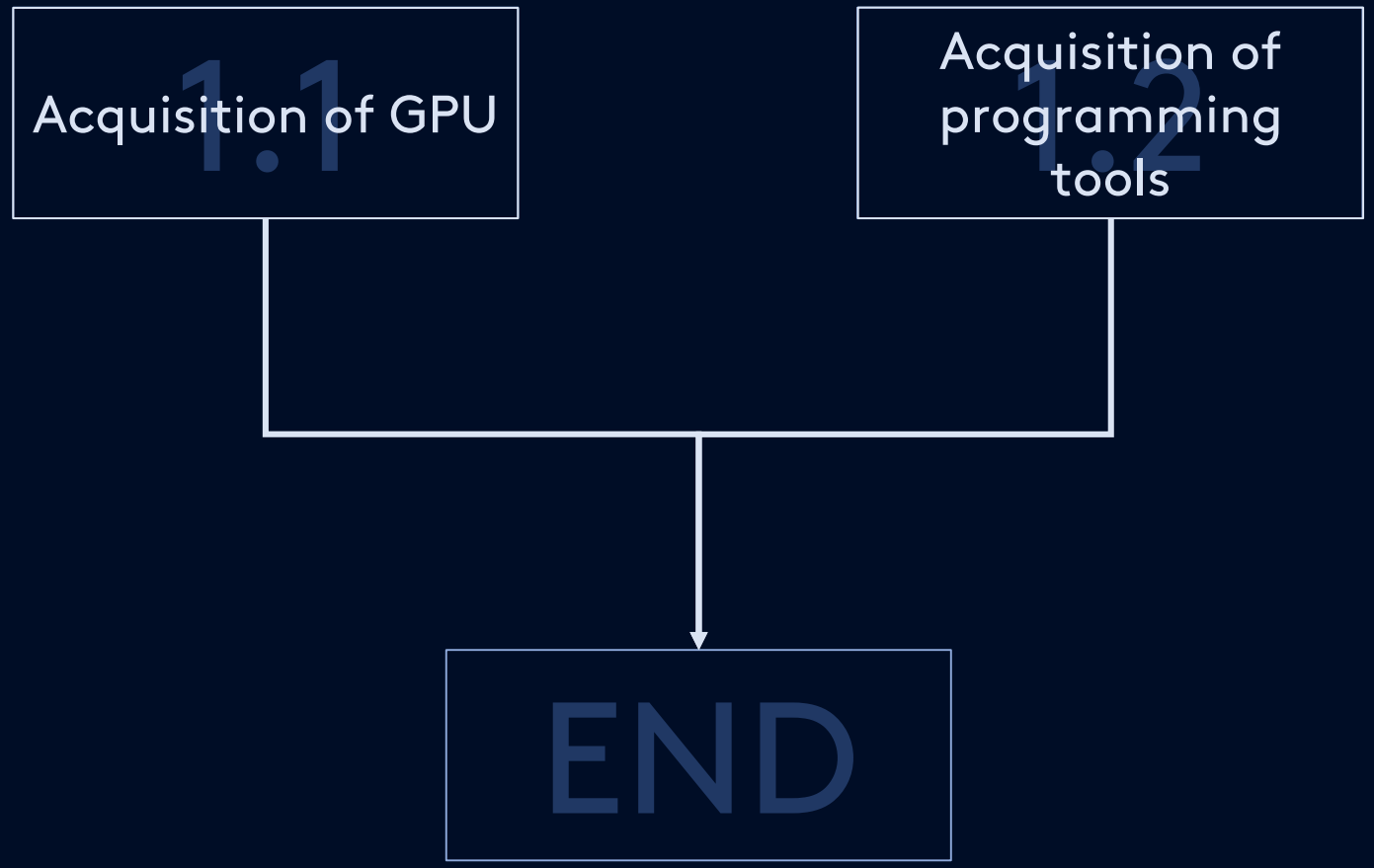
Level 0

PROCESS



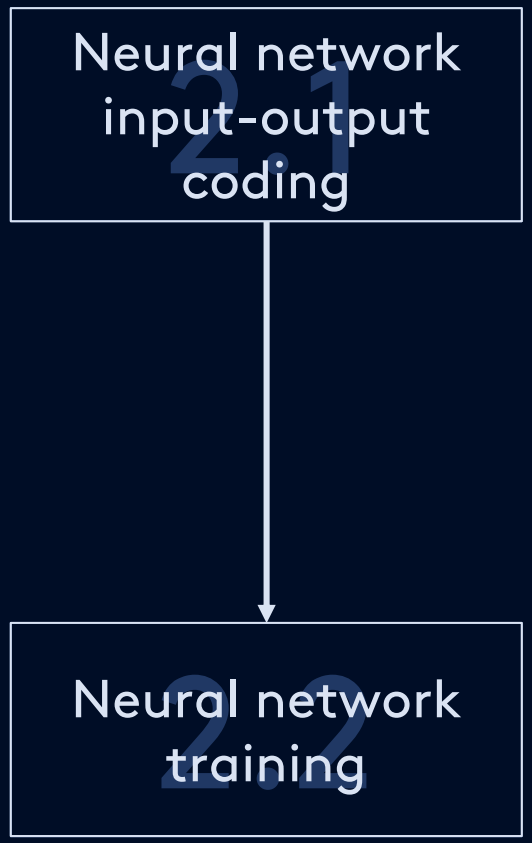
1 Procurement

PROCESS



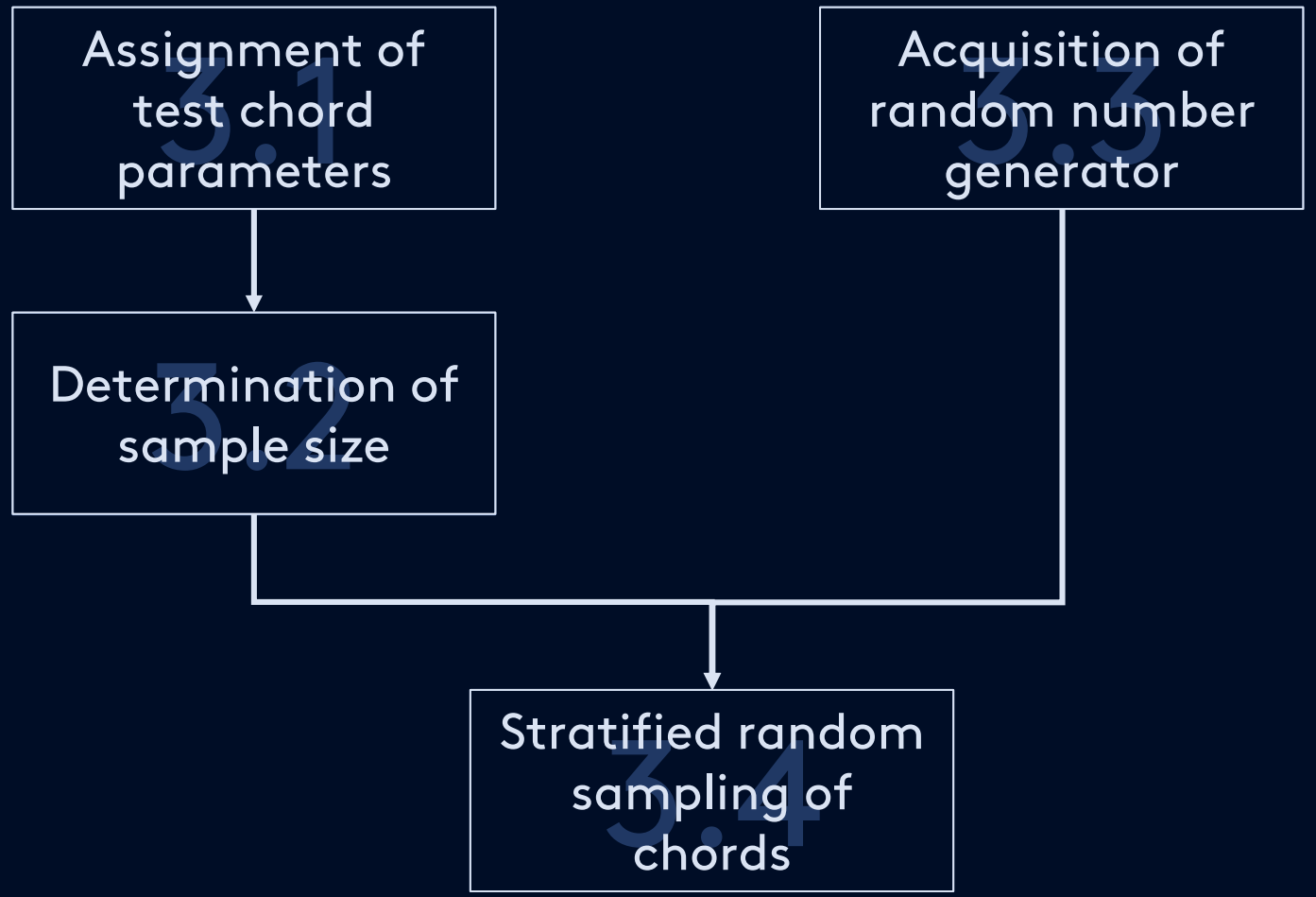
2 NN Development

PROCESS



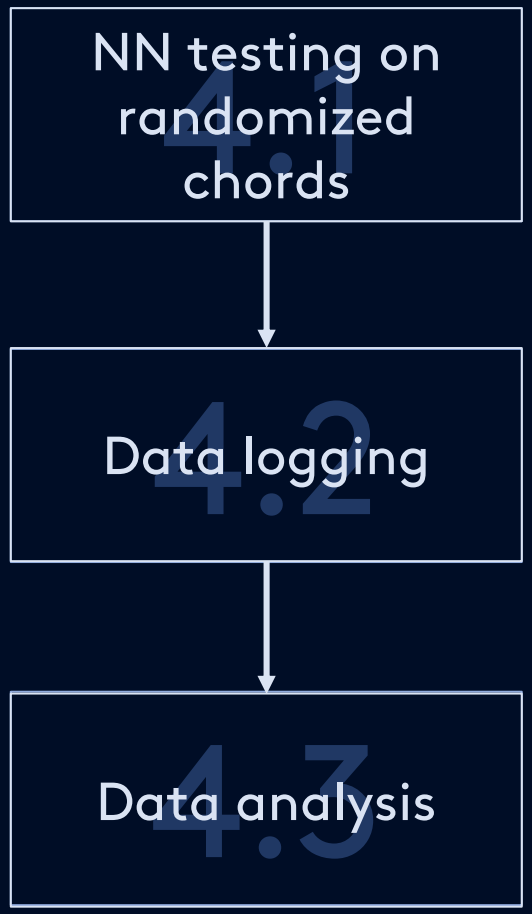
3 Test Chord Prep & Rn

PROCESS



4 Testing & DC

PROCESS



T	H	E	Rev.1	E	N	D