

Software Infrastructure
in the Current MMM
Project (on automated
pop music analysis) at
Goldsmiths

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in the Current MMM
Project (on automated
pop music analysis) at
Goldsmiths~~



David Lewis, d.lewis@gold.ac.uk

Systematic
Musicology

Historical
Musicology

Cognitive
Science

Information
Theory

Computer
Science

Systematic
Musicology

Electronic
Corpus of
Lute Music

Cognitive
Science

Information
Theory

Tim Crawford
Michael Gale
David Lewis

Computer
Science

Systematic
Musicology

Electronic
Corpus of
Lute Music

Cognitive
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Information
Theory

Tim Crawford
Michael Gale
David Lewis
Frans Wiering

Computer
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Musicology

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Science

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Theory

Tim Crawford
Michael Gale
David Lewis
Frans Wiering
Christophe Rhodes

Computer
Science

Systematic
Musicology

ECOLM

Cognitive
Science

Information
Theory

Computer
Science

Systematic
Musicology

ECOLM

Cognitive
Science

Methodologies
and Technologies
for Advanced
Musical Score
Encoding

Information
Theory

David Meredith
Geraint Wiggins
Tim Crawford

Algorithms
/ OMRAS

Systematic
Musicology

ECOLM

Cognitive
Science

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Musical Score
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Theory

David Meredith
Geraint Wiggins
Tim Crawford
Raphael Clifford
Costas Iliopoulos
Jeremy Pickens

Algorithms
/ OMRAS

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Geraint Wiggins
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David Lewis
Alastair Craft

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Geraint Wiggins
Tim Crawford
David Lewis
Alastair Craft
Variations2

Algorithms
/ OMRAS

Systematic
Musicology

ECOLM

Cognitive
Science

MeTAMuSE

Information
Theory

Algorithms
/ OMRAS

Modeling
Music Memory
& Melodic
Similarity

ECOLM

MeTAMuSE

Information
Dynamics of
Music

Marcus Pearce
Geraint Wiggins
Raymond Whorley

Algorithms
/ OMRAS

Modeling
Music Memory
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MeTAMuSE

Information
Dynamics of
Music

Marcus Pearce
Geraint Wiggins
Raymond Whorley
Mark Plumley
Samer Abdallah

Algorithms
/ OMRAS

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Information
Dynamics of
Music

MeTAMuSE

Algorithms
/ OMRAS

M⁴S

ECOLM

MeTAMuSE

IDyoM

Daniel Müllensiefen
David Lewis
Geraint Wiggins
Hamish Allan
(Jason Pearson)
Klaus Frieler

Algorithms
/ OMRAS

M⁴S

ECOLM

MeTAMuSE

IDyoM

Daniel Müllensiefen

David Lewis

Geraint Wiggins

Hamish Allan

(Jason Pearson)

Klaus Frieler

Algorithms
/ OMRAS

M⁴S

ECOLM

MeTAMuSe

IDyoM

Algorithms
/ OMRAS

+ *Media Futures Lab (OMRAS2)*

M⁴S

ECOLM

MeTAMuSe

IDyoM

Melody
segmentation

Algorithms
/ OMRAS

M⁴S

ECOLM

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M⁴S

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Algorithms
/ OMRAS

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M⁴S

ECOLM

MeTAMuSe

IDyoM

Algorithms
/ OMRAS

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M⁴S

ECOLM

MeTAMuSe

IDyoM

Formal
segmentation
and labelling

Algorithms
/ OMRAS

M⁴S

ECOLM

MeTAMuSe

IDyoM

Formal
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Algorithms
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M⁴S

ECOLM

MeTAMuSe

IDyoM

Algorithms
/ OMRAS

+ *Media Futures Lab (OMRAS2)*

M⁴S

ECOLM

MeTAMuSe

IDyoM

Algorithms
/ OMRAS

+ *Media Futures Lab (OMRAS2)*

M⁴S

ECOLM

MeTAMuSe

IDyoM

Variation / cover
detection and
labelling

Algorithms
/ OMRAS

M⁴S

ECOLM

MeTAMuSe

IDyoM

Variation / cover
detection and
labelling

Algorithms
/ OMRAS

M⁴S

ECOLM

MeTAMuSe

IDyoM

Algorithms
/ OMRAS

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M⁴S

ECOLM

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IDyoM

Algorithms
/ OMRAS

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M⁴S

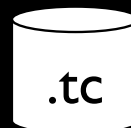
ECOLM



IDyoM

MeTAMuSe

Algorithms
/ OMRAS



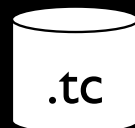
M⁴S

ECOLM

MeTAMuSe

IDyoM

Algorithms
/ OMRAS



M⁴S

ECOLM

MeTAMuSe

IDyoM

Algorithms
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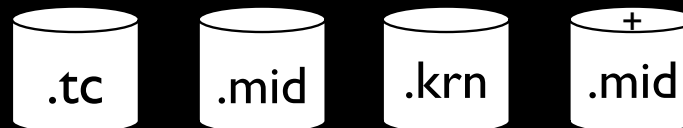
M⁴S

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Algorithms
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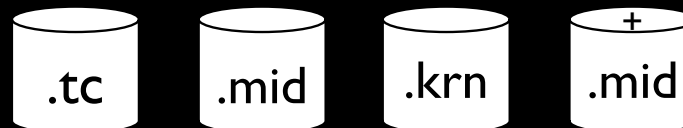
M⁴S

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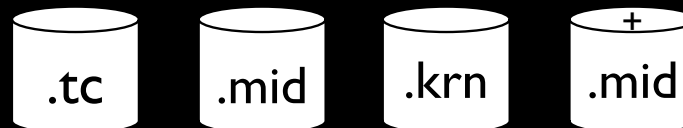
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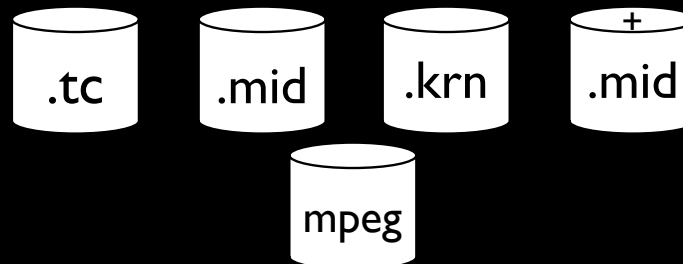
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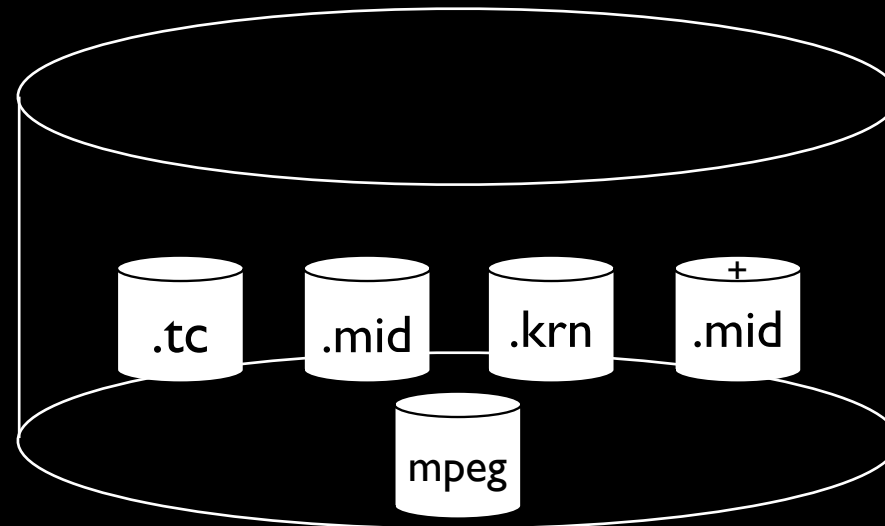
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Algorithms
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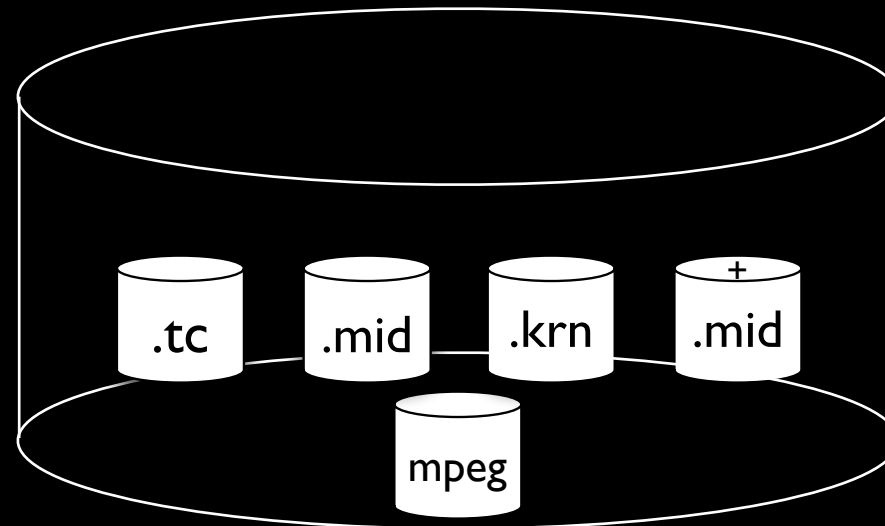
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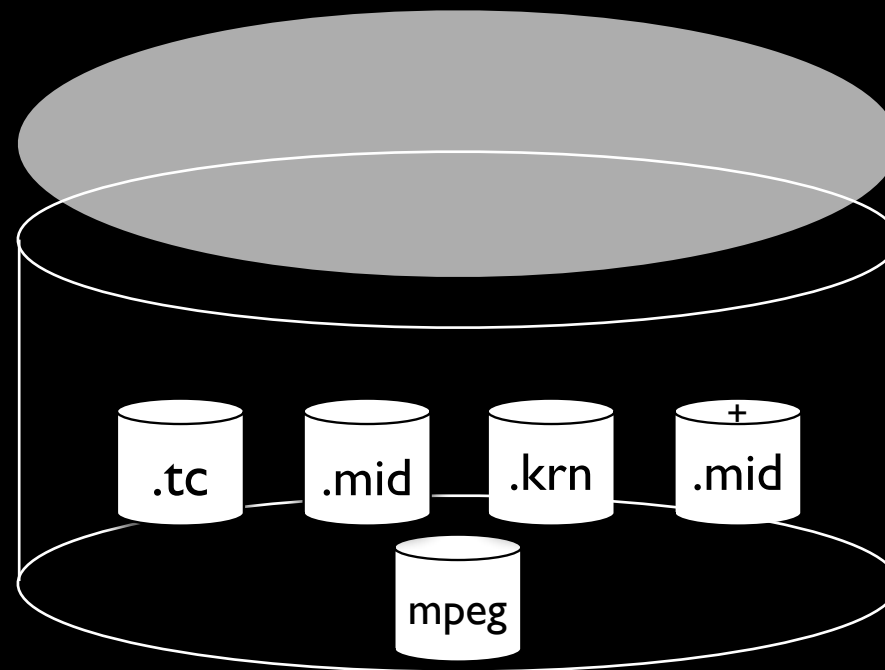
+ *Media Futures Lab (OMRAS2)*

M⁴S

ECOLM

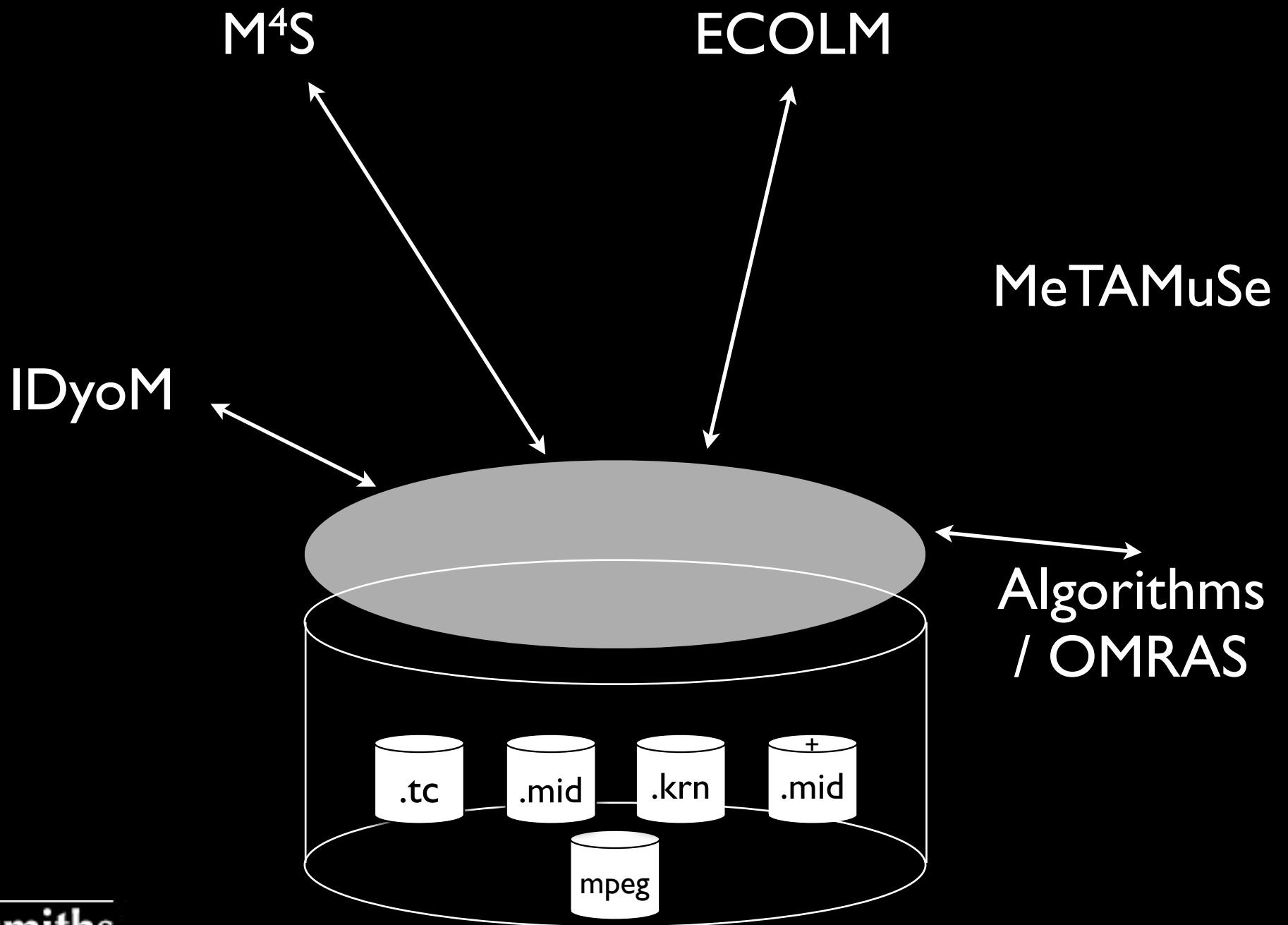
MeTAMuSe

IDyoM

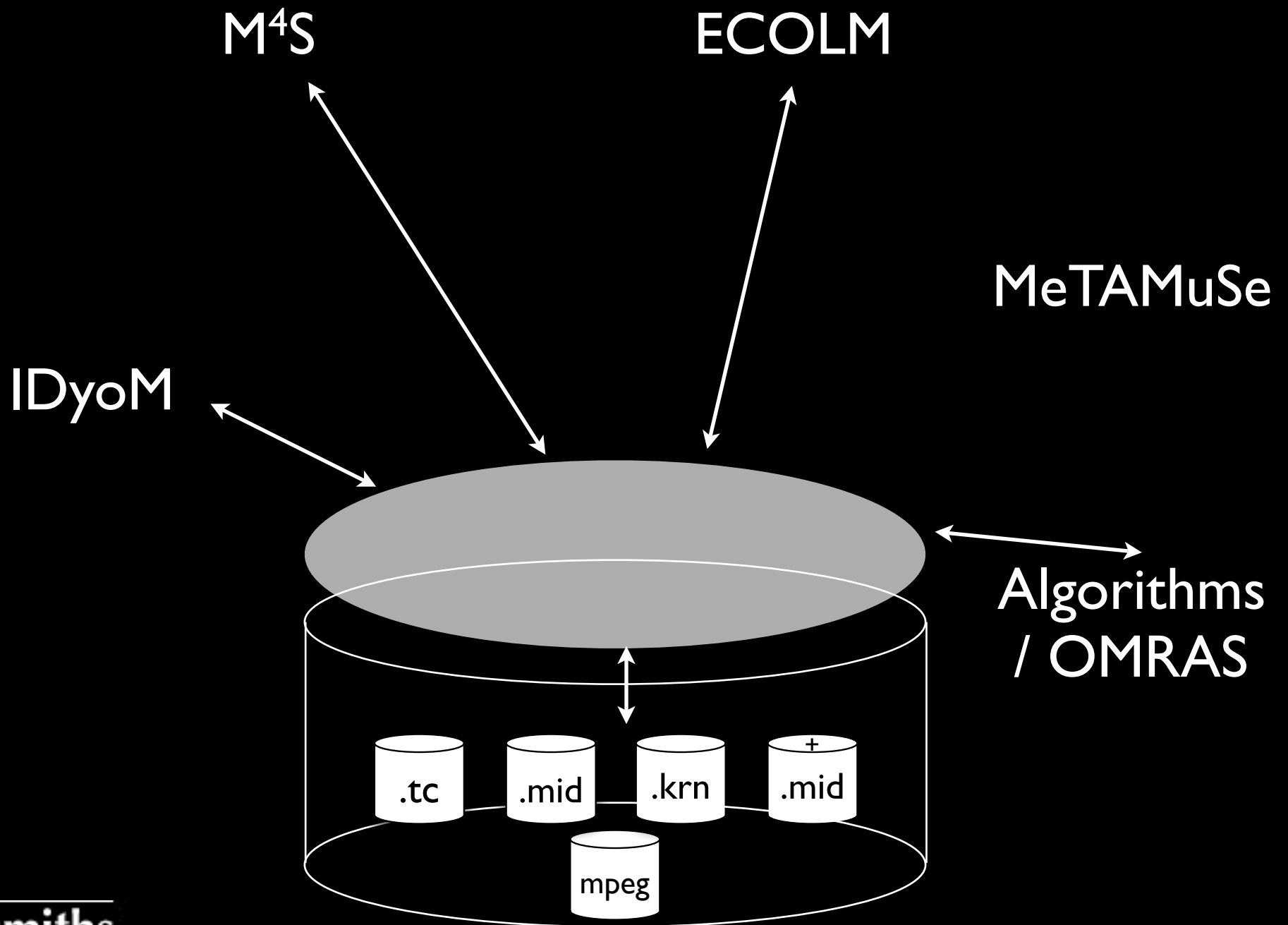


Algorithms
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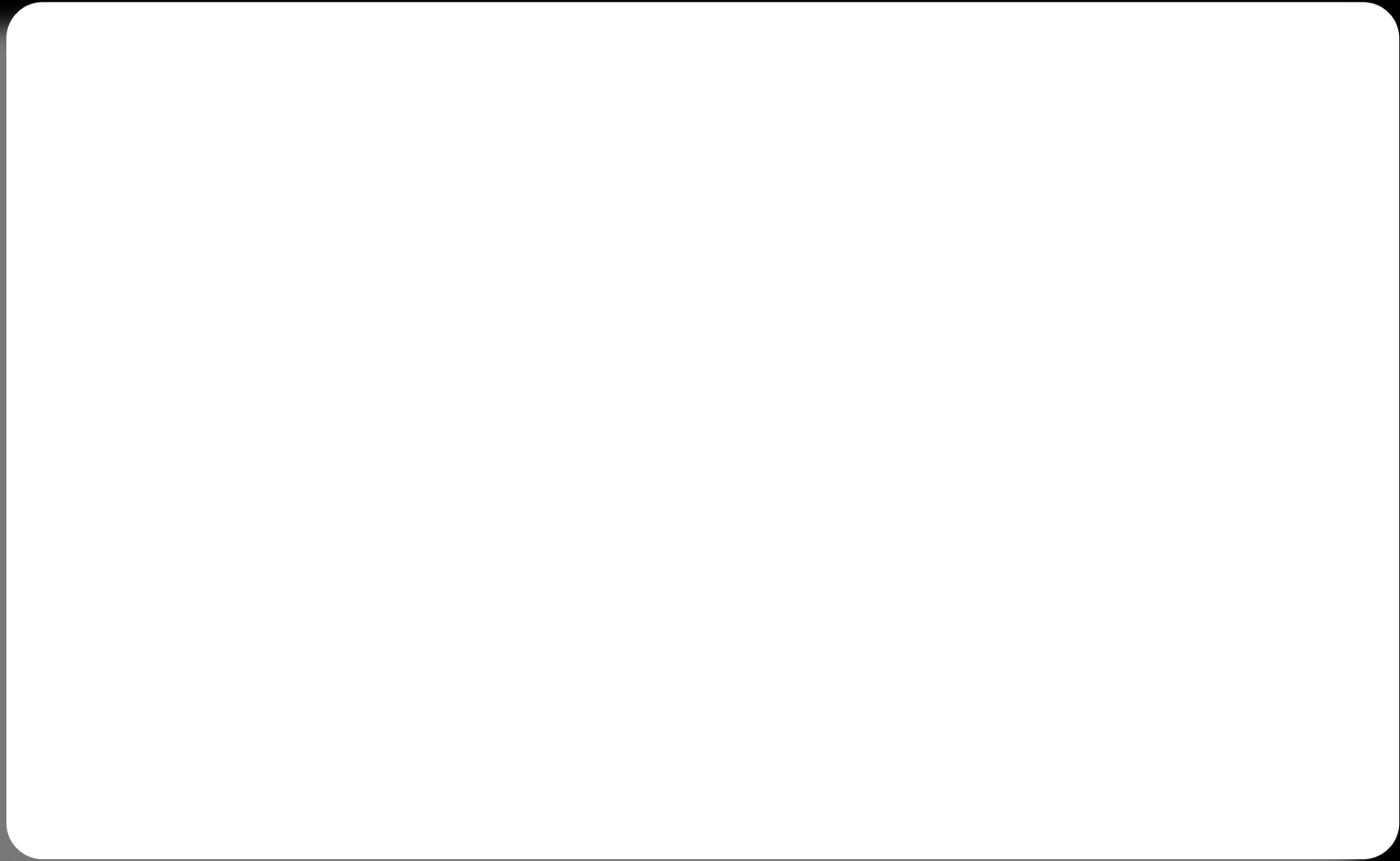


+ Media Futures Lab (OMRAS2)



+ *Media Futures Lab (OMRAS2)*

Chord Labelling



Chord Labelling

- Summarising the harmonic content of a piece at a given time in terms that reproduce those used by expert analysts or performers

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- Not functional harmony

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- Not functional harmony
- Currently, purely triadic (extensions represent a post-processing stage)
- This is an *analytical* step and no claim is made about deep structure, compositional practice or even (yet) perception, merely that the analysis mirrors human analysis

Chord Labelling

Bayesian probability models

$$p(H | D) = \frac{p(D | H) p(H)}{p(D)}$$

Chord Labelling

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Chord Labelling

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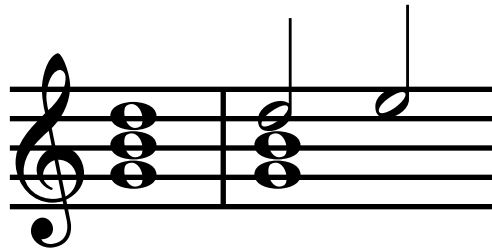
Chord Labelling

Bayesian probability models

$$p(H | D) = \frac{p(D | H) p(H)}{p(D)} \quad p(\text{chord:non-chord}) \times p(\text{tonic:mediant:dominant})$$
$$p(c_i | D) = \frac{p(D | c_i) p(c_i)}{p(D)} \quad \times \text{ [other knowledge goes here]}$$

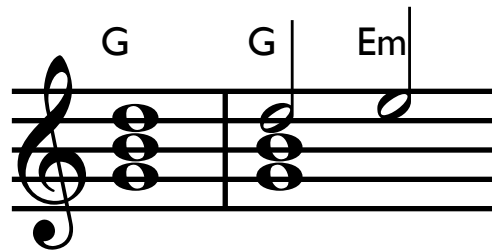
Chord Labelling

Dividing the bar



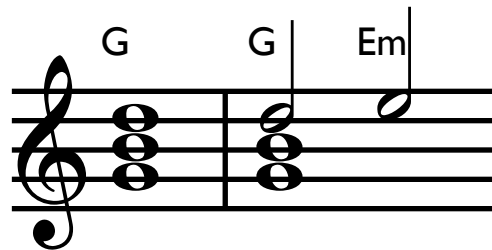
Chord Labelling

Dividing the bar



Chord Labelling

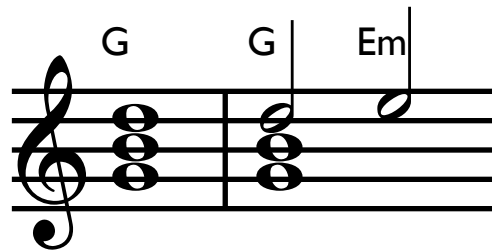
Dividing the bar



$p(G, \circ)$

Chord Labelling

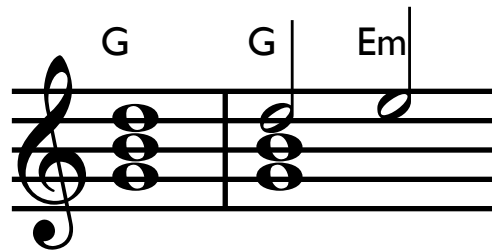
Dividing the bar



$p(G, \circ)$
 $p(G, \circ)$

Chord Labelling

Dividing the bar



$p(G, \circ)$

$p(G, \circ)$

$p(G, d) \times p(Em, d)$

Chord Labelling

Dirichlet distribution:

Chord Labelling

Dirichlet distribution:

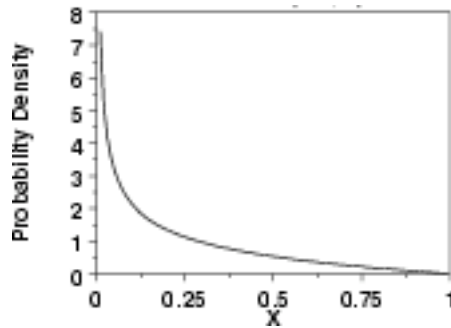
$$g(x; \alpha) = \frac{1}{B(\alpha)} \prod_{i=1}^K x_i^{\alpha_i - 1}, \quad \sum_{i=1}^K x_i = 1.$$

Chord Labelling

Dirichlet distribution:

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Chord vs. non-chord notes

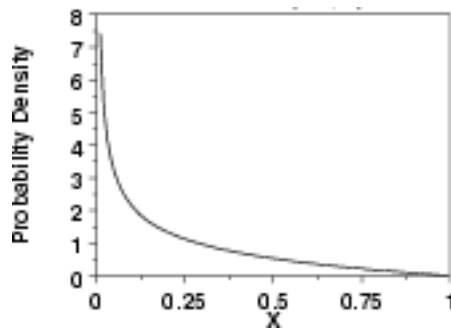


Chord Labelling

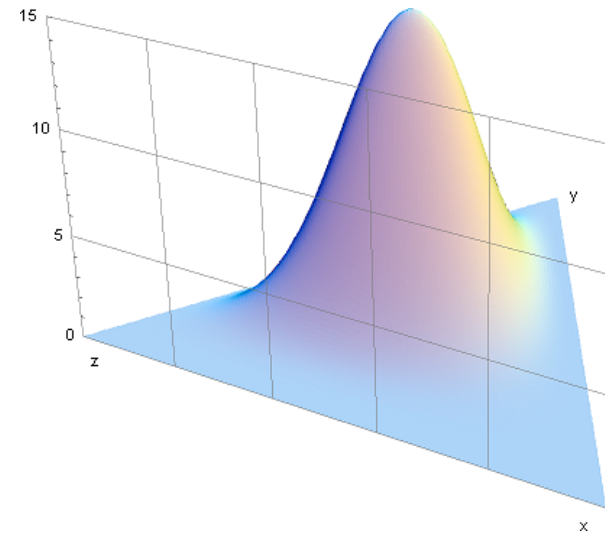
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$$g(x; \alpha) = \frac{1}{B(\alpha)} \prod_{i=1}^K x_i^{\alpha_i - 1}, \quad \sum_{i=1}^K x_i = 1.$$

Chord vs. non-chord notes



Tonic/Mediant/Dominant relationship



http://en.wikipedia.org/wiki/Dirichlet_distribution

<http://www.itl.nist.gov/div898/handbook/eda/section3/gif/betpdf4.gif>

http://upload.wikimedia.org/wikipedia/en/3/3e/Dirichlet_distributions.png