

# Music & the Internet

## MUMT301

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# Plan

- Last class:
  - Web-based sound generation
  - Web-based recording and sequencing applications
  - Web-based collaborative applications
- Final project proposal guidelines and round
- Online music editors
- Online music scores and libraries
- Music Information Retrieval
- In-class final project proposal help

# Final project

## Final project proposal

- Written proposal
  - Two pages: abstract, goals, subgoals, and partial bibliography)
- Powerpoint-style or HTML presentation of what you plan to do
  - Goal, subgoals, and timeline
  - Partial bibliography
  - References to similar projects/code/music

## Final project submission

- Web-based application with description (2- to 4-page report)
- Music project with description (2- to 4-page report)
- Research paper (6 to 10 pages)

# Final project proposal

The final project proposal consists of:

1. The submission of a written **project proposal**.
  - You will describe your **goal** for the project, dividing it into **sub-goals**, and arranging them into a **timeline**.
  - You must also present **references**. These may be **bibliographical**, **code** examples, **music** examples, **software** applications, or any kind of **creative** or **intellectual work** that you think is relevant to the development of your project. Follow any citation style (e.g., Chicago, APA, MLA, IEEE), but follow one and be consistent.
  - The report should be 2 pages long, 11 pt, single-spaced.

# Final project proposal

2. The presentation of your project proposal.

- You will present your project in class by means of a Powerpoint-style slideshow or an HTML webpage.
- You will describe your **goals**, **sub-goals**, and will present **references** you consider relevant for doing your project.
- The presentation will be **25 minutes** (15-minute presentation, 10-minute round for questions.)

The final project proposal presentation will be on Tuesday, 3 December

The final project submission is due on noon, Monday, 16 December

Depending on your topic chosen, you must submit:

1. Web-based application with report (2 to 4 pages)
2. Music project with report (2 to 4 pages)
3. Research paper (6 to 10 pages)

# Round of ideas for final project

# Online music editors

- Noteflight (web based app)
- Flat (web based app)
- Scorecloud (sync across devices)
- Verovio (open-source engraving library)

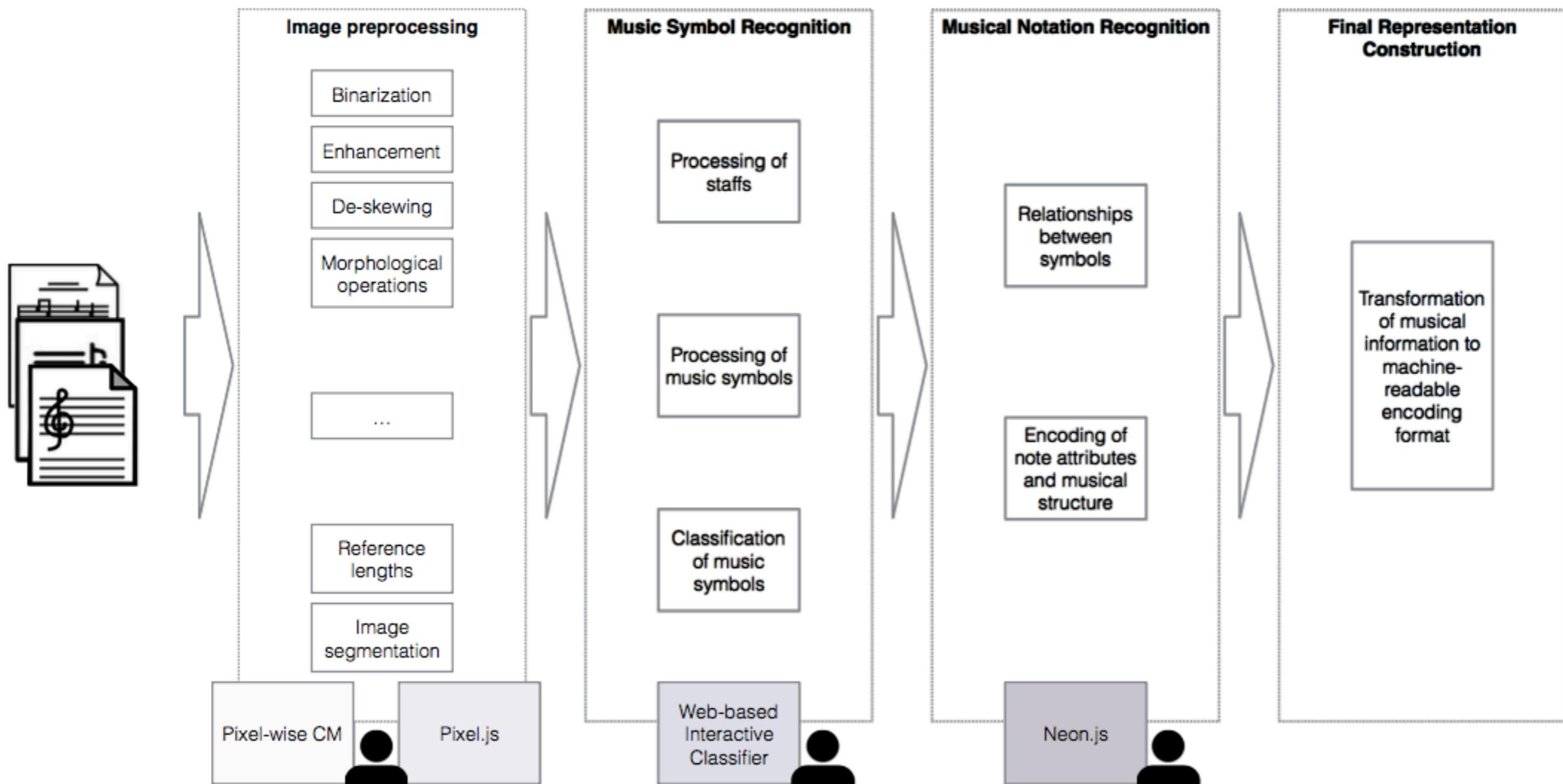
# Online music scores and libraries

- Online Digital Musical Document Libraries
- IMSLP

# SIMSSA: Single Interface for Music Score Searching and Analysis

- Prototype for “Google Books” for music, minus Google
- OMR (optical music recognition) is required for full-text search
- Access to digitized scores world-wide from a single website

# SIMSSA technologies

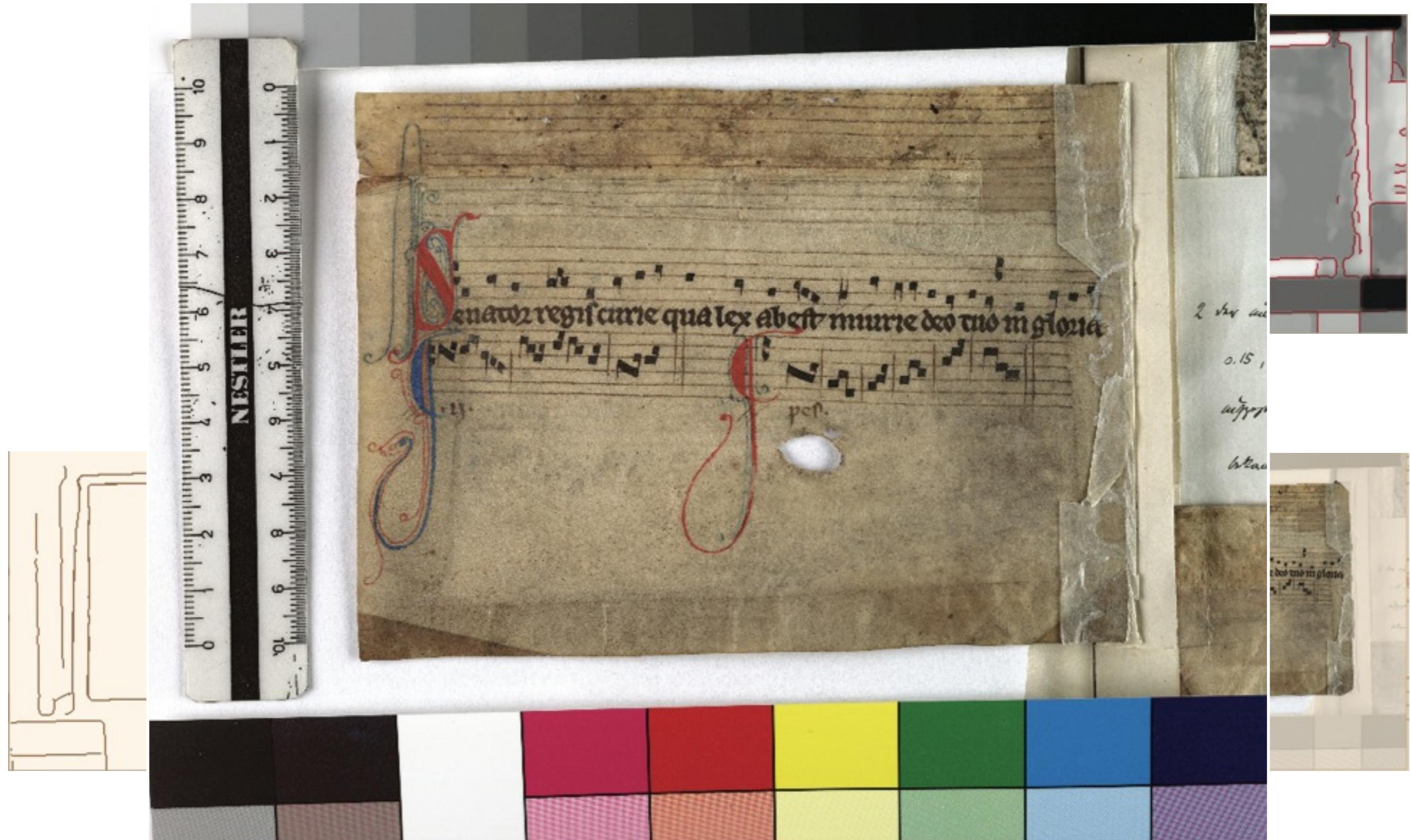


# SIMSSA technologies

- Web-based optical music recognition (OMR) system with score editor
  - Rodan (Remote Online Document Analysis Network)
  - Gamera and Aruspix for image preprocessing and music symbol recognition
  - Neon.js (web-based neume editor)
  - Crowdsource for error correction
- Web-based user interface to view, search, annotate, and analyze scores
  - Diva.js
  - MEI (Music Encoding Initiative)
  - music21

# Preprocessing for OMR

# I Bte higant deceptibng



# More intelligent cropping

Original



Greyscale



Cropped



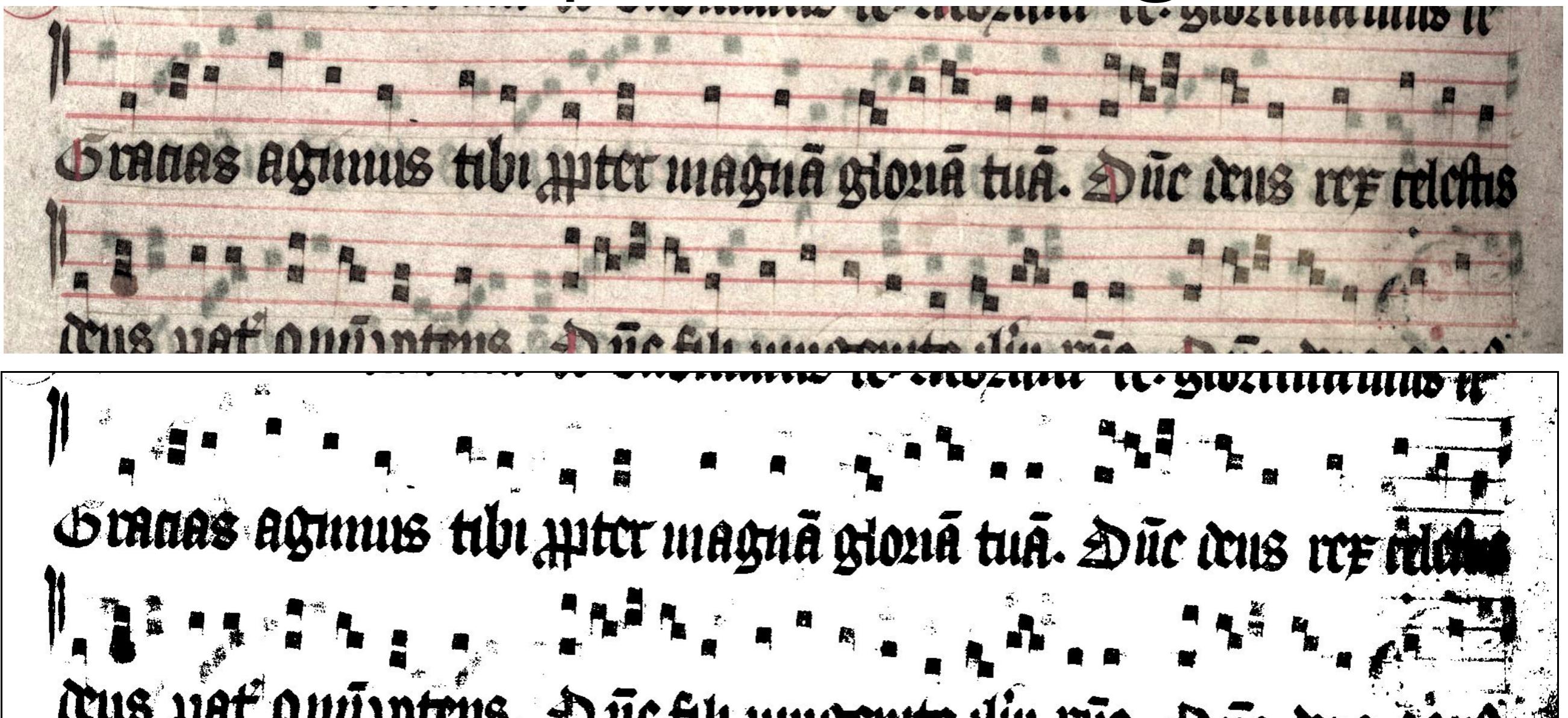
DIAMM: GB-Cantebury Add.128/62r

# Preprocessing



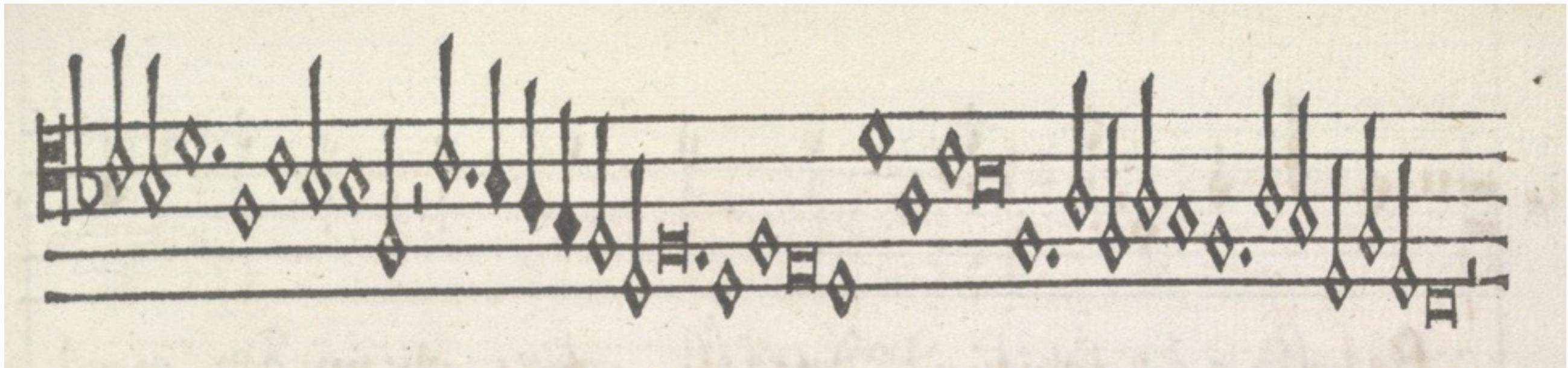
Brightness enhancement

# Preprocessing

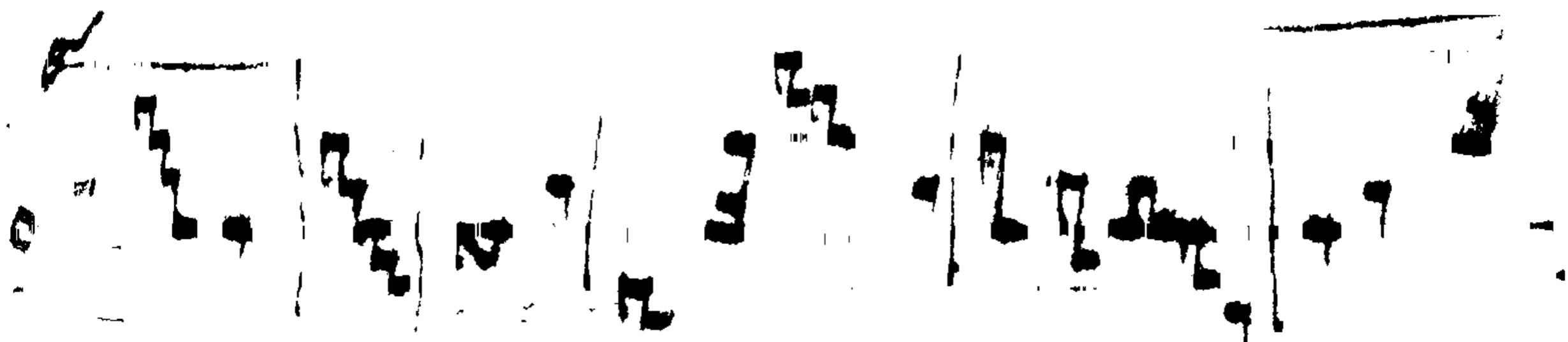


Thresholding

# Staffline Removal

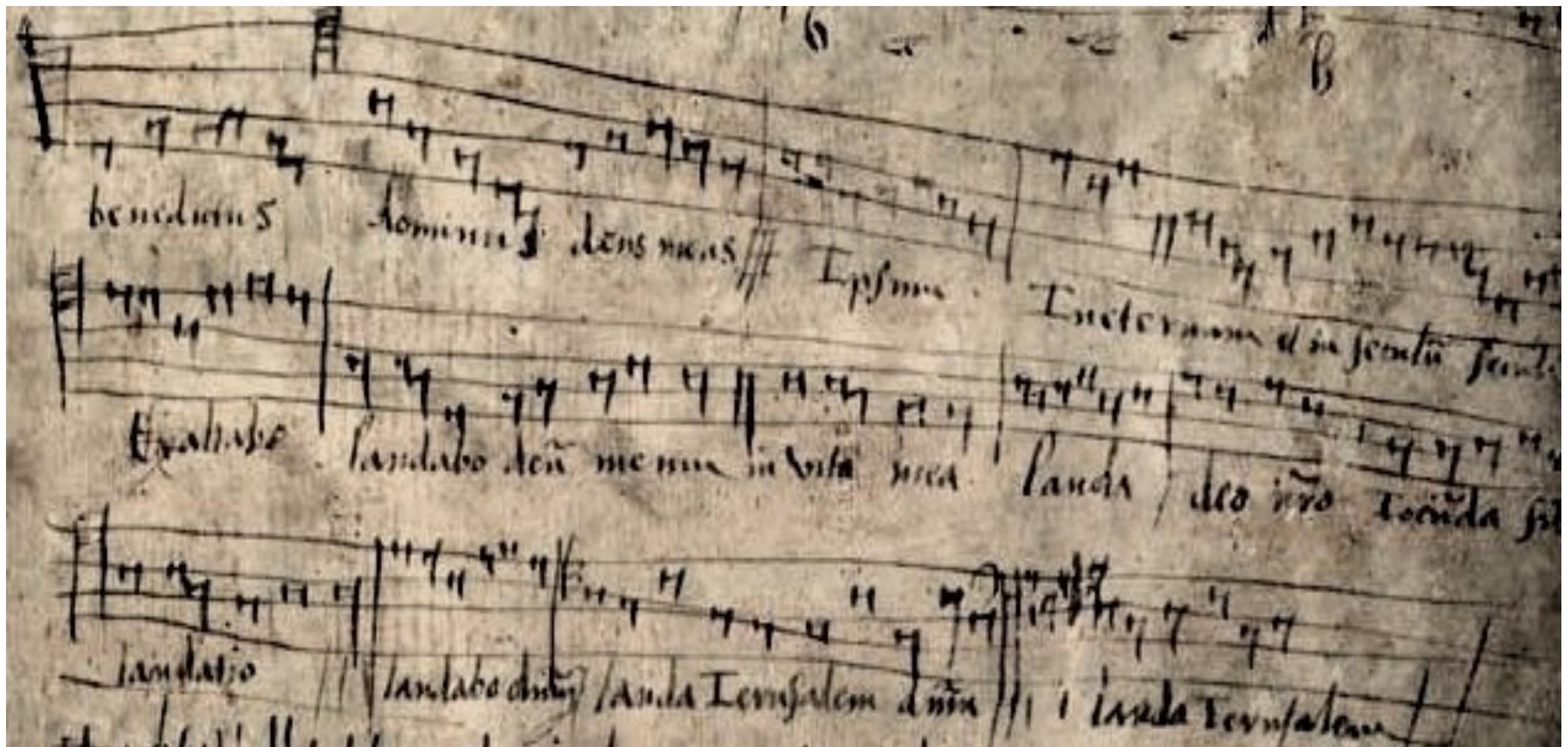


# Staffline Removal



Four-line hand-drawn staff example

# Staffline Removal



Difficult

# Extracting lyrics from Early music



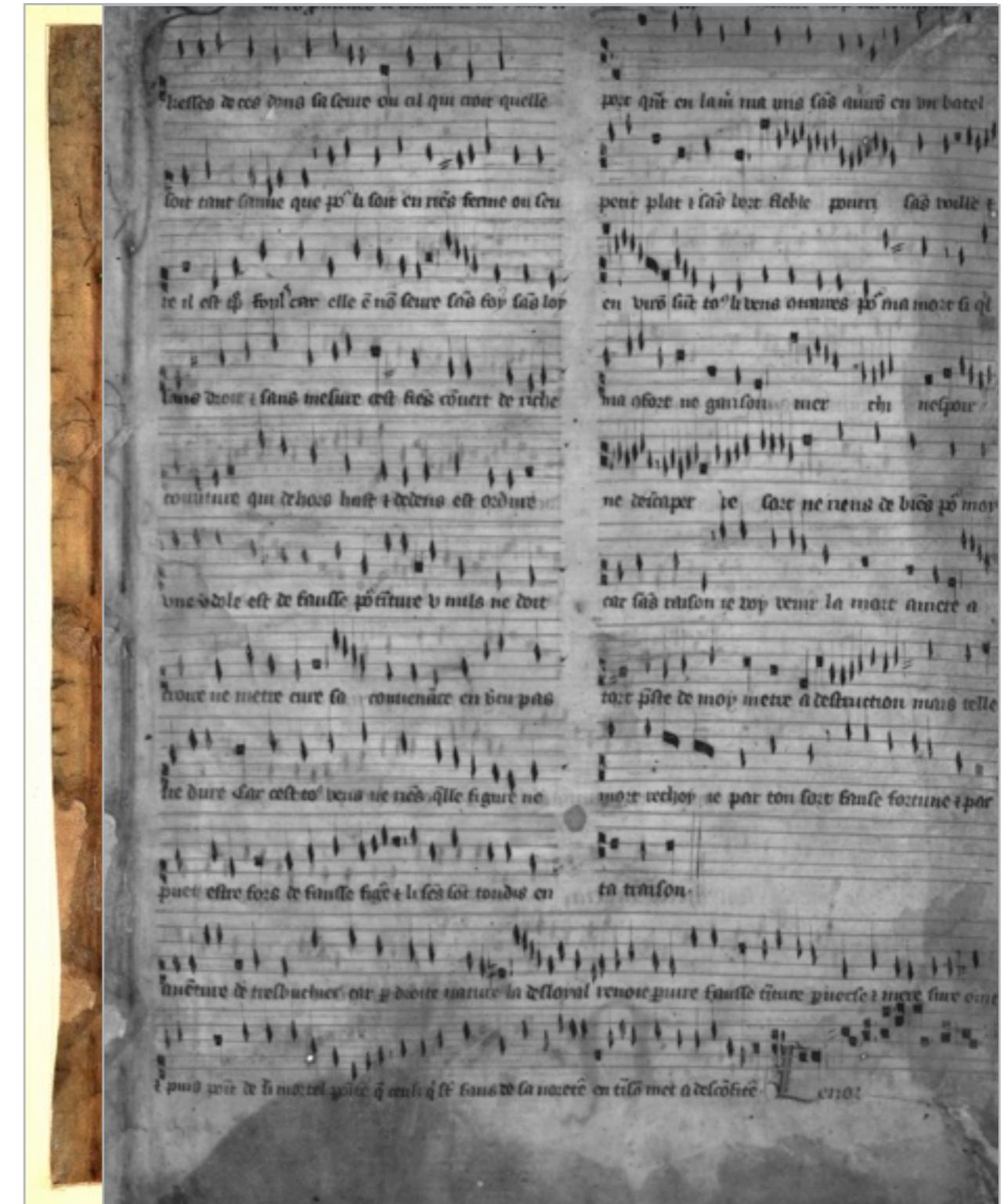
Images Courtesy of

# Extracting lyrics from Early music

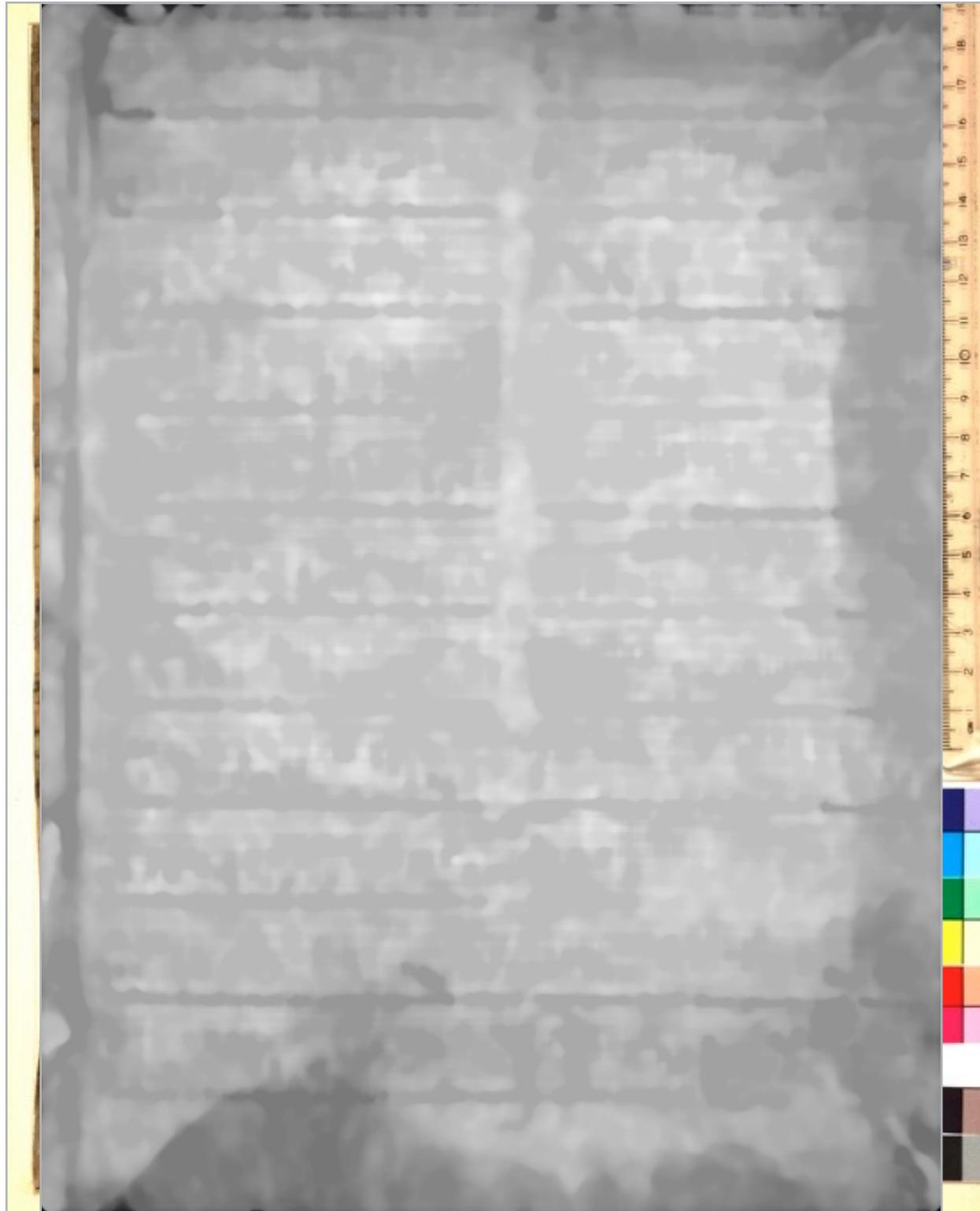
Images Courtesy of



# Preprocessing: Greyscale

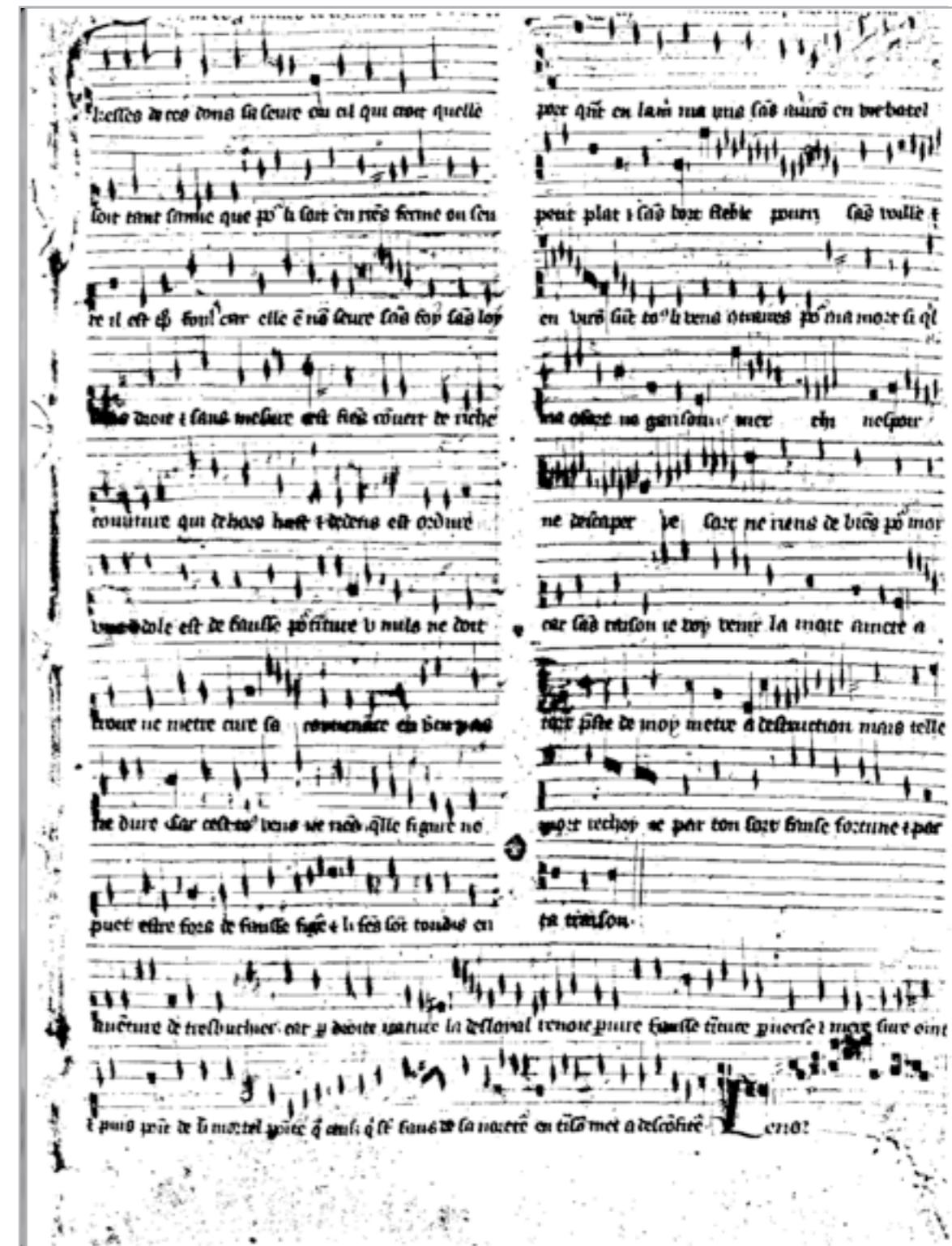


# Preprocessing: BG estimation



helles de ces dans la leure ou al qui amer quelle  
loit tout simme que po' tu soit en rès ferme ou leu  
te il est q' foul car elle e nō leure los moy las lor  
lme droit i sans mesme est ries couert de riche  
rousture qui dehos hant t dehors est ordure  
une vole est de fausse pouture v mis ne dit  
troue ne mette cure so conuenante en deu pas  
lie dure l'ar cest le deus ne rès quelle figure ne  
puet estre fors de fausse figure le ses lois toutes en  
l'autre de tressbutier sur p doute nature la defforal renvoie poutre fausse figure poutre t mere sive oint  
t poutre poutre de la moutre q' ceul q' le bonz de la moutre en tels met a descoirre

# Preprocessing: Binarisation



# Preprocessing: Staff removal

A page from a medieval musical manuscript featuring two staves of music. The music is written in black ink on white paper, with square neumes on four-line red staves. The lyrics are written in French in a Gothic script below the staves.

The lyrics are as follows:

blesses de ces dons la leue ou ai qui croit quelle  
loit tenu simie que po' la foy en mes feme ou seu  
re il est qd son car elle e n'e leue los soy las loy  
me dore i sans meure est foy couert de riche  
couiture qui debors hest i deus est ordure  
quandole est de faulx porteur u nuls ne sont  
trouer ne metre oute sa remonance en bres pas  
ne dure sur ceste leys we ried qd elle figure no  
puet estre foy de faulx figure & li foy lor toutes en  
huncure de tresbueher est y deute ipartue la destral renoue puer faulx tenue puer & mes foy  
et puer poy de la mortel poy qd ambi qd foy de la morte en tis met a deschofie enor

# Connected-component analysis



# Lyric extraction

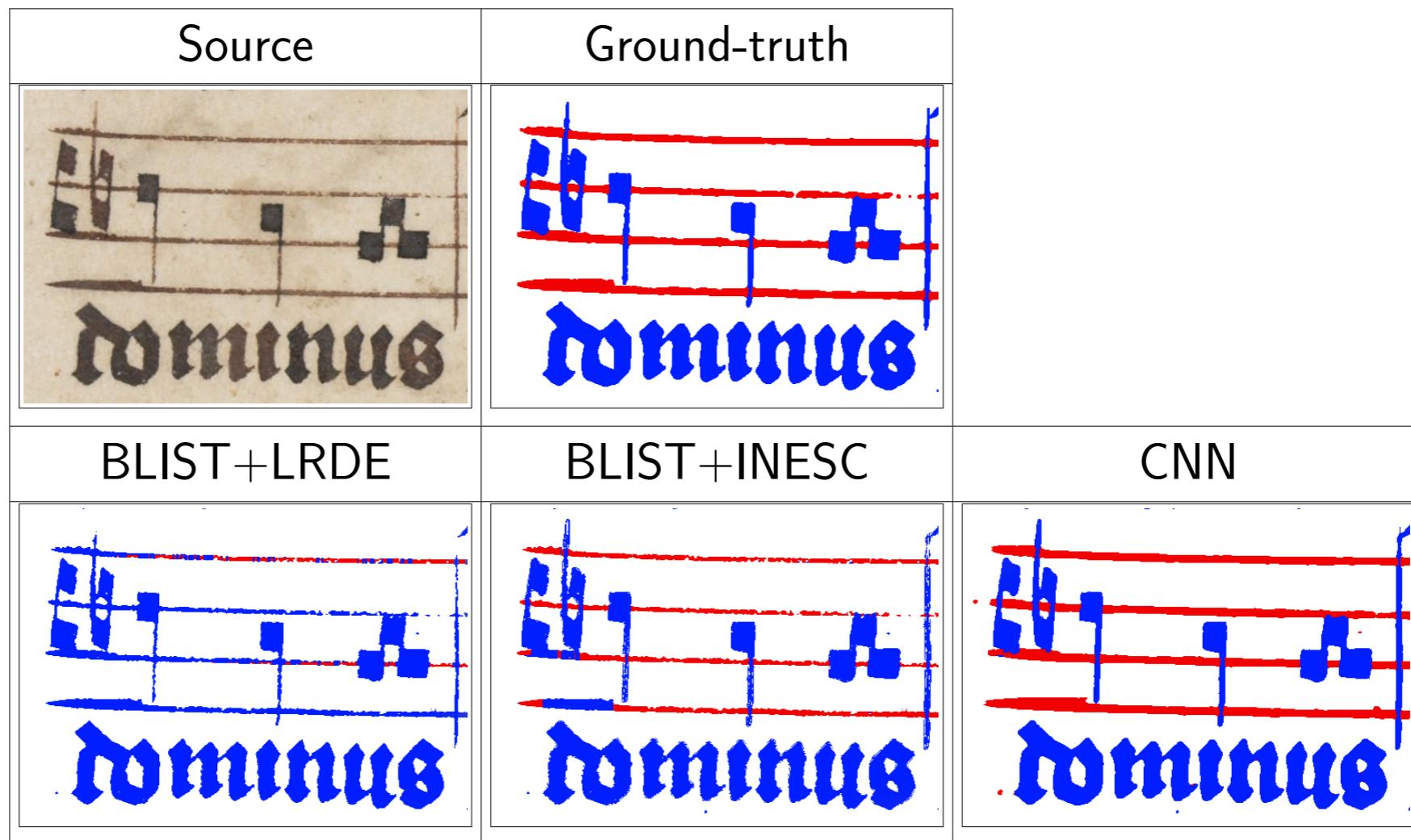
besses de ces dons la leure ou ou qui voit quelle  
 soit tenu simile que po la soit en mes feme ou seu  
 re il est qd foul car elle e na leure los for las loy  
 ma dore i sans meurt est fies couer de riche  
 couture qui debors hest tedenis est ordure  
 une chose est de faulx porteur u nuls ne doit  
 trouer ne mette oute sa rumeur en bres  
 ne dure sur ceste leys we rach qd elle figure no  
 puet estre foy de faulx figure & le fei lor toutes en  
 aueture de trebuchier est y deute iparue la delaval tenore puer faulx tenuer puer le meur leure oint  
 e puer puer de la mortel puer qd ambi qd sans de la morte en tis met a deschoie eno?

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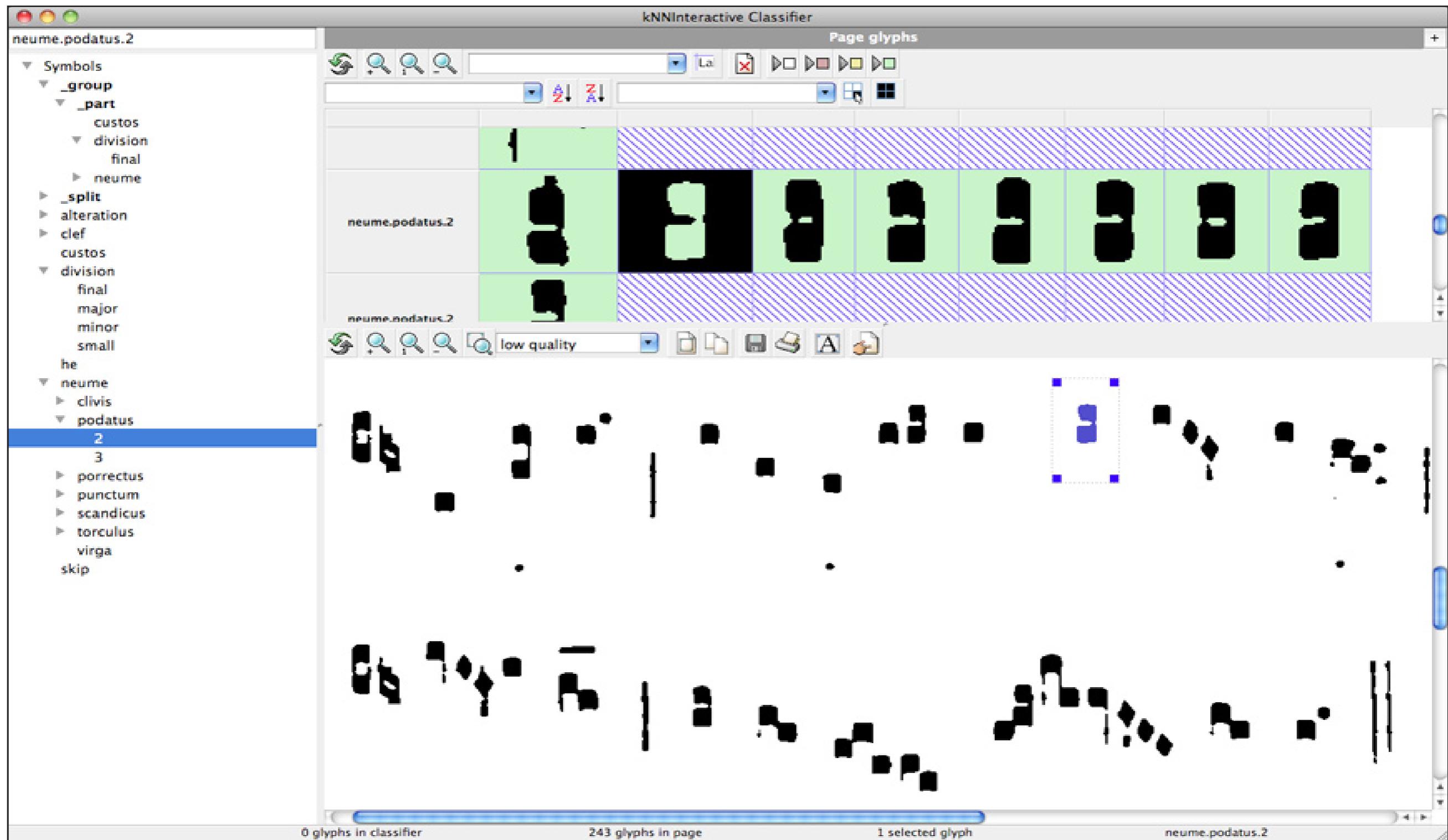
# One-step detection of elements in music scores using machine learning

(Calvo-Zaragoza et al., 2017)

## QUALITATIVE RESULTS



# Symbol classifier / Gamera



# Web visualizer: Diva.js



Zoom level: 2

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Go



# Neume correction: Neon.js

Neon.js File ▾ Hotkey Glossary | Help | Developers | DDMAL

## Editing CF-012

MODE + Insert Edit

INSERT ■ Neume || Division System C/F Clef

Select Head Shape

- Punctum
- Quilisma
- Custos

VI.

flece quia cito veniet salus tu a. dicitur  
In laud. Antiphona. Alleluia. ps. Misericordie. R.  
Ueni ad liberandum nos. Domine deus virtutum. da t ostende faciem  
tuam et salutem erimus. Domine. pmi.  
Splendor paternae. verbi. Emitte agnum domine dominatorem terrae. De petra deserti ad montem filie syon. Ad benedictus antiphona.

# SIMSSA proof-of-concept projects

- Liber Usualis
- Cantus Ultimus
- Musiclibs

# MIR: Music Information Retrieval

- Similarity
  - Melody, timbre, rhythm, form, style, tempo, mood, etc.
- Recognition, analysis, classification
  - Instrument, timbre, singer identification
  - Structural analysis
  - Style analysis
    - recommendation system
    - playlist generation
  - Optical music recognition
- Knowledge Representation
  - Standards (metadata, audio file formats, symbolic, song / artist unique IDs)
  - Taxonomy (categorization: genre, tags, mood, etc.)
  - Summarizations
  - Indexing and metadata

# MIR: Music Information Retrieval

- Human-computer interaction and interfaces
  - Usability
  - Multi-modal user interfaces
  - Visualization tools
    - The loudness war (another example)
    - Everynoise
    - Charting-the-Beatles
  - Mobile applications
- Corpora and databases
  - Digital music libraries and archives
  - Text and web mining
  - Web services and APIs

# MIR: Music Information Retrieval

- Socio-cultural aspects
  - Business models
  - Music and cultural heritage value
  - Non-Western music
  - Personalization / privacy
- Intellectual property issues
  - Watermarking and digital rights management
  - Audio fingerprinting
- Evaluations of MIR systems
  - User needs and expectations
  - Building test collections (ground truth)
  - Experimental design
  - Metrics and benchmarks
  - [http://www.music-ir.org/mirex/wiki/MIREX\\_HOME](http://www.music-ir.org/mirex/wiki/MIREX_HOME)
    - Annual evaluation campaign for MIR algorithms
    - Different tasks!

# MIR: Music Information Retrieval

- Automatic searching, transcription, and annotation
  - Podcastle
- Active Music Listening interfaces
  - Songle and Songle API!
  - Songrium
- Unmixer

# The End!