

# Digital Image Capture of Musical Scores

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# [ Outline ]

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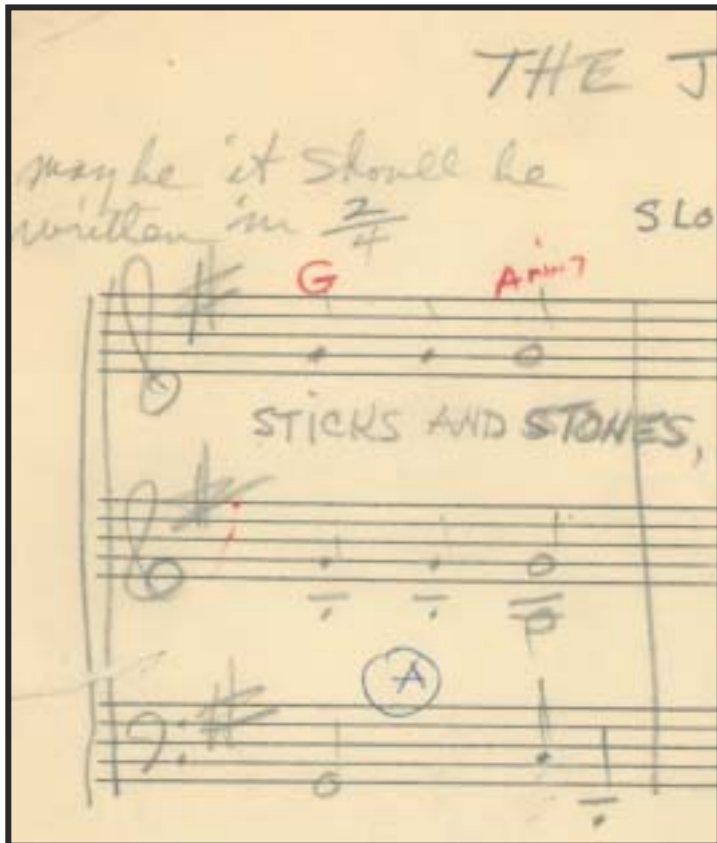
- Why is this necessary?
- Defining the purpose of scanning
- Master file specifications
  - Resolution
  - Color reproduction and bit depth
  - Master file formats
- Web delivery
- Printing

# [ Why Is This Necessary? ]

- Successful information retrieval depends on quality data
- Musical scores are visually complex
- Digital imaging standards do not explicitly cover musical notation so the principles they present must be adapted
- Master digital files should be adequate for many different uses

# Defining the Purpose of Scanning

- Artifactual



Handwritten musical score for "THE J STICKS AND STONES". The score is written on three staves. The title "THE J" is written at the top right. The lyrics "STICKS AND STONES," are written below the first staff. The score includes handwritten annotations: "maybe it should be written in  $\frac{2}{4}$ " and "SLO" in the top right, "G" and "A<sup>7</sup>" in red above the first staff, and a circled "A" below the second staff. The score is in G major and 2/4 time.

- Content-based



Printed musical score for "Allegro" with a tempo of  $\text{♩} = 126$ . The score is in G major and 2/4 time. It features a first ending bracketed section with a piano (*p*) dynamic marking. The first ending consists of two measures: the first measure has a quarter note G and a quarter note A, and the second measure has a quarter note B and a quarter note G. The second ending is a sixteenth-note triplet (G, A, B) followed by a quarter note G, with a fortissimo (*sf*) dynamic marking. The score concludes with a fortissimo (*ff*) dynamic marking.

# [ Master File Specifications ]

- What is a master file?
- Resolution
- Color reproduction and bit depth
- Master file formats

# [ What Is A Master File? ]

- For long-term storage and future migration
- Used to create derivatives for specific purposes
- Captures all “important” information from the analog original

# Resolution

- One method\*: calculate necessary resolution to capture the smallest detail with three pixels

$$r = 3 \text{ px} / .039d$$

for .1 mm detail:

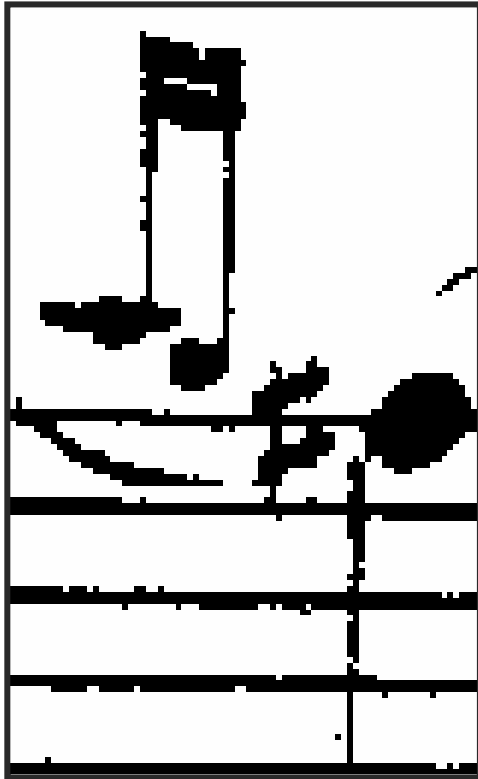
$$r = 3 / .039(.1)$$

$$r = 769.23 \text{ ppi}$$

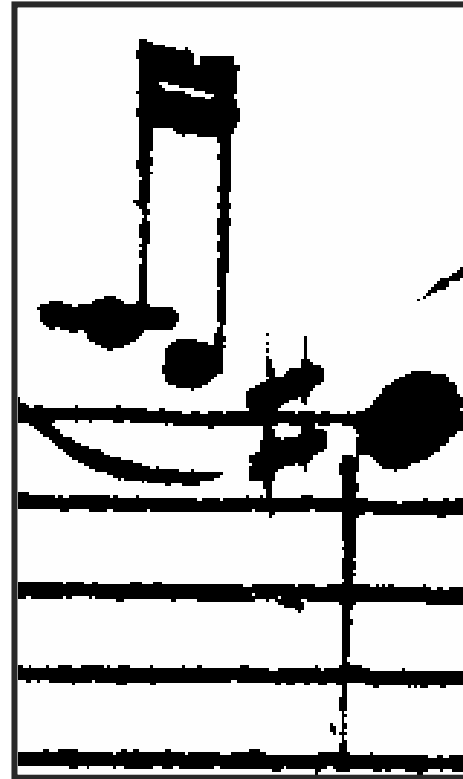
\* adapted from Kenney, A., and O. Rieger. 2000. *Moving Theory into Practice*. Mountain View, California: Research Libraries Group. 46-47.

# [ Resolution, cont'd. ]

■ 300 dpi



■ 600 dpi





# [ Resolution, cont'd. ]

- 600 dpi scans generally capture all relevant detail on all but the smallest printed scores. Some examples can be found at <http://www.dlib.indiana.edu/~jenlrile/ismir2002/resolution/>.
- Bottom line: resolution recommendations from best practices are a starting point, not a complete answer

# [ Color Reproduction and Bit Depth ]

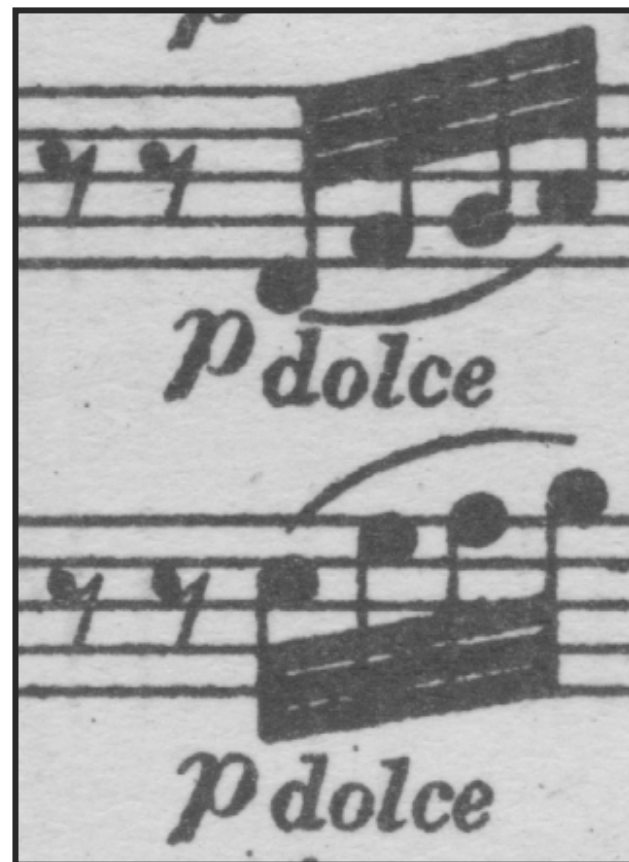
- Color may be necessary for artifactual image capture, but probably won't be for content-based capture
- 8-bit grayscale is preferred over bitonal capture, even for content-only purposes

# Bitonal vs. 8-bit Grayscale

- Bitonal



- 8-bit Grayscale



# [ Master File Formats ]

- Open, non-proprietary
- If compression is used, it must be lossless
- Digital imaging best practices overwhelmingly recommend uncompressed TIFF, even though it is not a true open standard
- PNG may be an emerging alternative, but there is no uncompressed version

# [ Web Delivery – Pixel Dimensions ]

- Due to the wide range of sizes of type and importance of small details, fixed pixel dimension images are not appropriate for delivery of score images
- 100-200 dpi files, based on original page dimensions, with attention to resulting image size fitting on screen may be a better approach. Some examples are at <http://www.dlib.indiana.edu/~jenlrile/ismir2002/webdelivery/>.

# [ Web Delivery – File Formats ]

- Formats viewable with standard browsers and common plug-ins desirable
  - JPEG, GIF, PNG, PDF meet this requirement
  - TIFF, DjVu do not
- IR system considerations may also affect choice of formats
  - Integration with other forms of musical representation: notation files, sound, annotation tools, etc.

# [ Printing ]

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- Necessary capability for performance and study
- Depending on original page size, 250-400 dpi files should fit on 8.5" x 11" or A4 paper and provide readable results
- Generally there will be no need for grayscale or color images for printing

# [ Printing, cont'd. ]

- PNG and TIFF are perhaps best formats
- Bitonal PNG files smaller at lower resolutions, but Group 4 compressed bitonal TIFFs are smaller at higher resolutions

Original page size 8.5"x11"	<b>PNG</b>	<b>TIFF (Group 4)</b>
800dpi	329 KB	192 KB
400dpi	183 KB	146 KB
250dpi	90 KB	96 KB
200dpi	64 KB	71 KB
100dpi	25 KB	38 KB



# [ More Information ]

- Supporting materials can be found at:  
<http://www.dlib.indiana.edu/~jenlrile/ismir2002>
- A list of digital imaging standards and best practices can be found at:  
<http://www.dlib.indiana.edu/dmic/general/standards.html>

# Contact Information

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