# Tone Locator

## *A tool to detect skin tone from grayscale photos*

**Breon Haskett,[1,4] David Coomes,[2,4] Elizabeth Pelletier[3,4]**

**1** Department of Sociology, University of Washington | **2** Department of Epidemiology, University of Washington

**3** Evans School of Public Policy & Governance, University of Washington | **4** Center for Studies in Demography & Ecology, University of Washington

## MOTIVATION

*Can we detect skin tone in old, black & white photos?*

- Skin complexion is salient in many social processes (Monk, 2021)
- Old and/or scuffed black and white photos don't explicitly display complexion on a color scale, but it's possible that skin tone could be assessed using computer vision
- Research applications include analysis of photos from early 1900s (work in progress by Peter Catron & Breon Haskett)


*The Monk skin tone scale (https://skintone.google/)*

## USE CASES

*Tools to support researchers using photos*

**1: Pre-process an image of a face**

- *User loads set of photos*
- *Tool returns images cropped to faces*

**2: Detect prevalence of Monk scale bins in color image**

- *User loads set of color photos*
- *Tool returns dataframe of composition across Monk scale*

**3: Detect prevalence of Monk scale bins in B&W image**

- *User loads set of black & white photos*
- *Tool returns dataframe of estimated composition across color Monk scale*

**4. Test the effectiveness of different methods of colorizing**

- *User loads set of true and predicted Monk scale composition values*
- *Tool returns confusion matrix, overall MSE and MSE by bin*

USER STORY A: Peter is a professional in the social sciences who wants to derive probabilistic skin tone from old photographs for research. He uses our repository to upload images and output a spreadsheet with probable skin tones for each photo. He will use this as a tool to output a dataframe that is clearly documented and easy to export, graph, and interpret, but will not adjust the code and would struggle in troubleshooting technical issues.

USER STORY B: Sally is a researcher who is developing her own methods of detecting skin tone in non-color photos. She uses our two methods as a starting point to inspire her work. She develops her own methods, and uses our effectiveness assessment framework to test how well her methods perform.

## TECHNOLOGIES

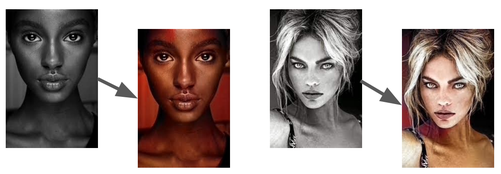
*OpenCV*

**OpenCV (Open Source Computer Vision Library):** Computer vision and machine learning library

**Preprocessor**: crops images to face, blurs or marks images, converts color to grayscale.

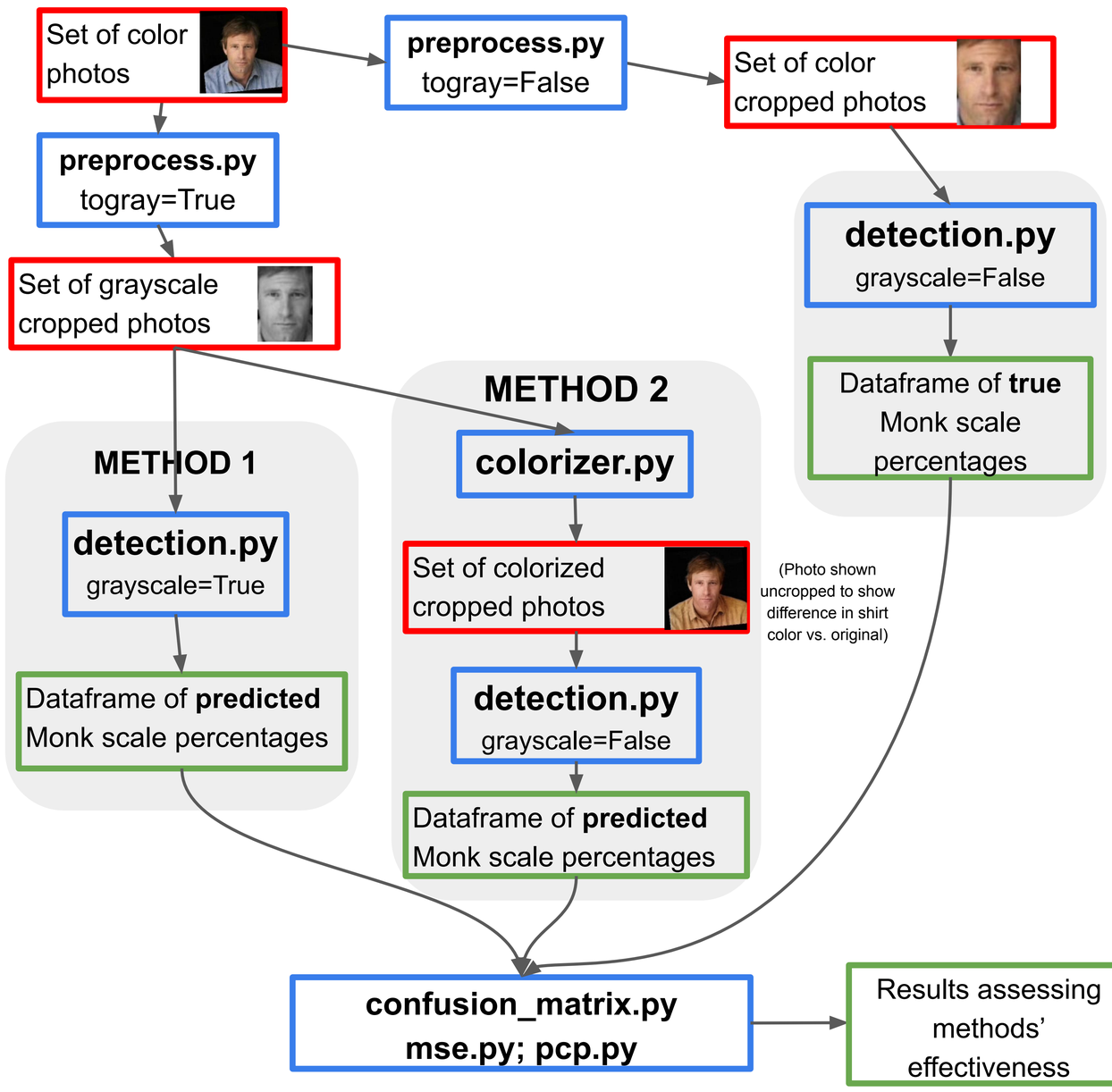
**Detection**: Detects % of color from each bin of Monk's scale in image. Can be applied to grayscale image to detect grayscale Monk's scale.

**Colorizer**: uses convoluted neural networks to predict colors from grayscale images. Model was trained on one million images, and applied to our photos.



## DESIGN & COMPONENTS

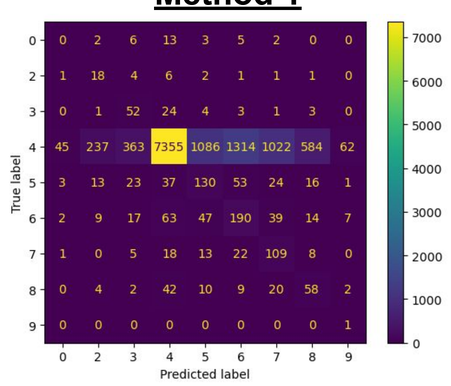
*Comparing two methods for detecting skin tone*




## PRELIMINARY RESULTS

*Method 2 (using the colorizer) performs better*

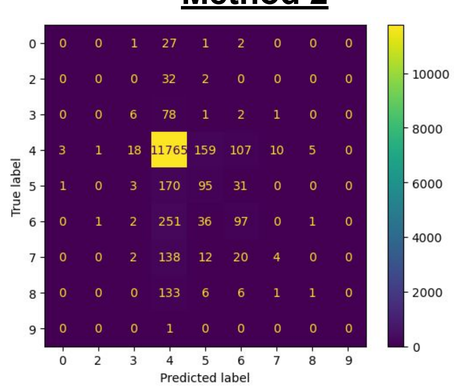
**Method 1**




***Percent correctly predicted: 59.8%***

***Mean squared error: 0.0087***

**Method 2**




***Percent correctly predicted: 90.4%***

***Mean squared error: 0.0005***

- Challenge: for the vast majority of photos, the predominant color is Bin 4. Is this an issue with data set representativeness, or some other problem? What are implications for generalizability?
- CAVEAT: The above results do not yet incorporate the face cropping pre-processing. Full results forthcoming.

## NEXT STEPS

- Assess if our metrics are fully capturing the methods' accuracy
- See how various methods of blurring & scuffing affect the accuracy of the methods; consider applying machine learning methods
- Apply methods to research projects!

**WORKS CITED**

Monk, E. P. The Unceasing Significance of Colorism: Skin Tone Stratification in the United States. *Daedalus* 2021; 150 (2): 76–90.

Zhang, R., Isola, P., & Efros, A.;. Colorful image colorization. In *European conference on computer vision (2016, October);* (pp. 649-666). Springer, Cham.

Many thanks to Dave Beck and Erin Wilson for support throughout our project!

Partial support for this research came from a Shanahan Endowment Fellowship and a Eunice Kennedy Shriver National Institute of Child Health and Human Development training grant, T32 HD101442, to the Center for Studies in Demography & Ecology at the University of Washington. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.