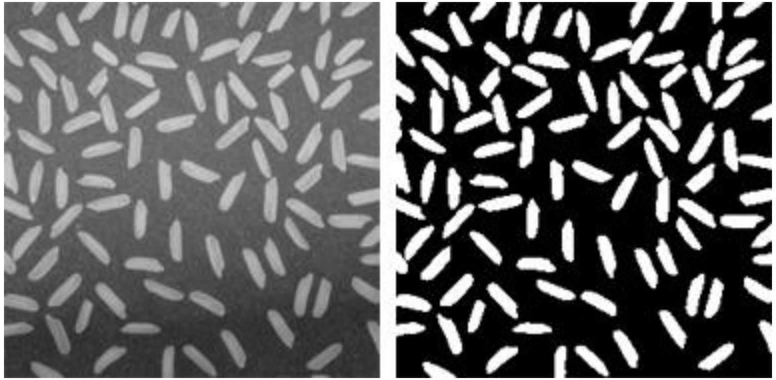
Image Segmentation

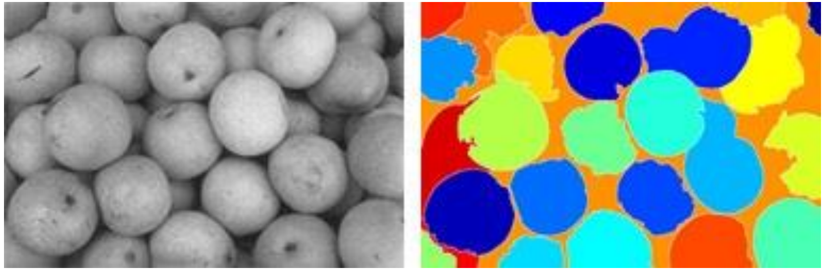
Loop

Introduction

image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super-pixels).

Segmentation subdivides an image into its constituent regions or objects





Introduction

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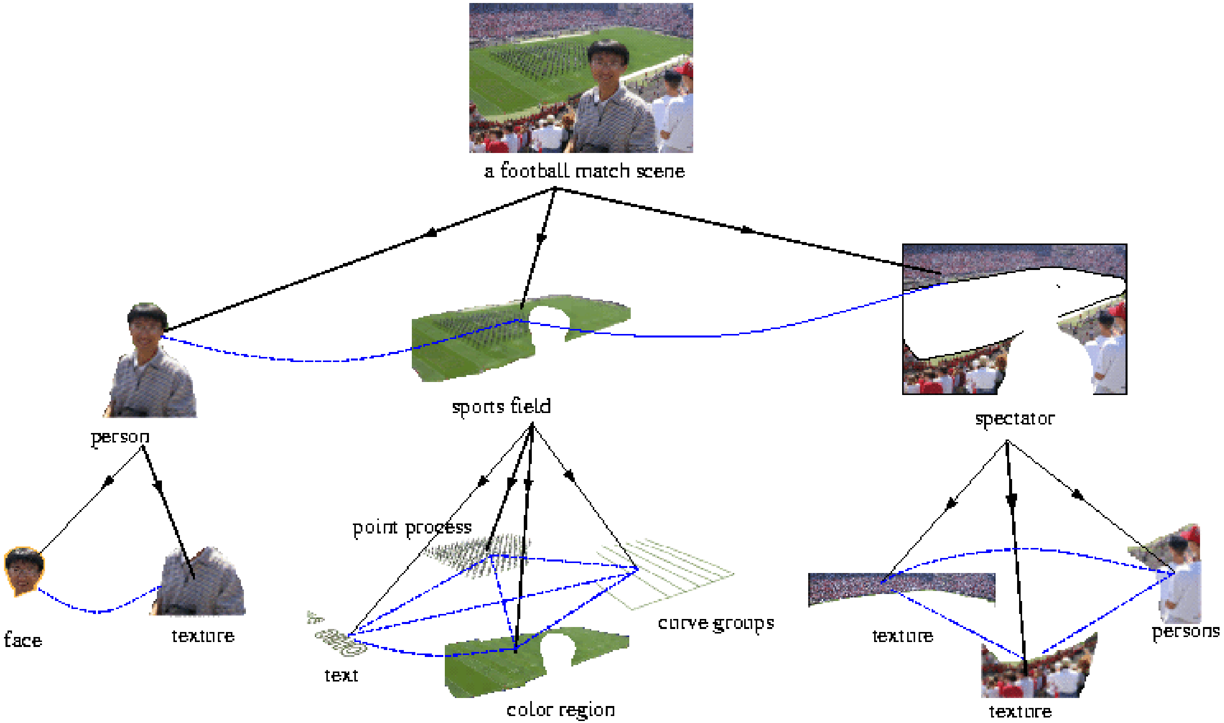


Introduction

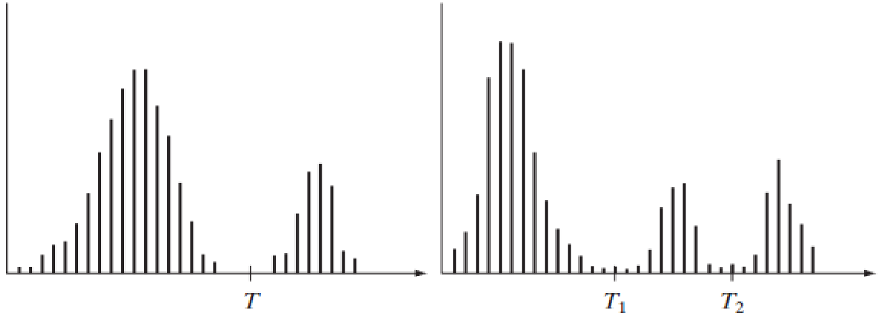
Segmentation algorithms for monochrome images generally are based on one of two basic categories dealing with properties of intensity values: **similarity** and **discontinuity.**

Thresholding Method

Watershed Method

Thresholde Method

The Histogram



- $$g(x,y)=\begin{cases}1 & f(x,y)>T\\ 0 & f(x,y)<T\end{cases}$$

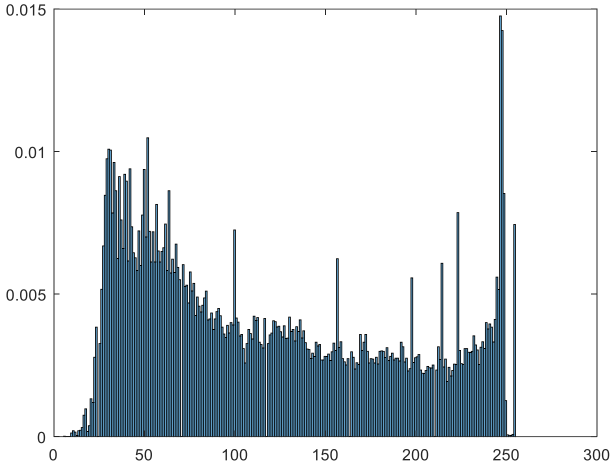
$$g(x,y)=\begin{cases}a & f(x,y)>T_2\\ b & T_1<f(x,y)<T_2\\ c & f(x,y)<T_1\end{cases}$$

Global Thresholding

1. Select an initial estimate for the global threshold $\boldsymbol{T}$
2. Segment the image .This will produce two groups of pixels.
3. Compute the average (mean) intensity values m_1 and m_2 and for the pixels in two groups of pixels.
4. Update the threshold value: $T = 1/2(m_1 + m_2)$
5. Repeat Steps 2 through 4 until the difference between values of in successive iterations is smaller than a predefined parameter ΔT

Global Thresholding

Otsu's method



$$P_1 = \sum_{i=0}^{k} p_i \qquad P_2 = 1 - P_1$$

$$m_1 = \frac{1}{P_1(k)} \sum_{i=0}^{k} iP_i \qquad m_2 = \frac{1}{P_2(k)} \sum_{i=k+1}^{L-1} iP_i$$

The between-class variance, $\boldsymbol{\sigma}_{\mathbf{B}}$, can be defined as

$$\sigma_B^2 = P_1(m_1 - m_G)^2 + P_2(m_2 - m_G)^2$$

When change the value of k

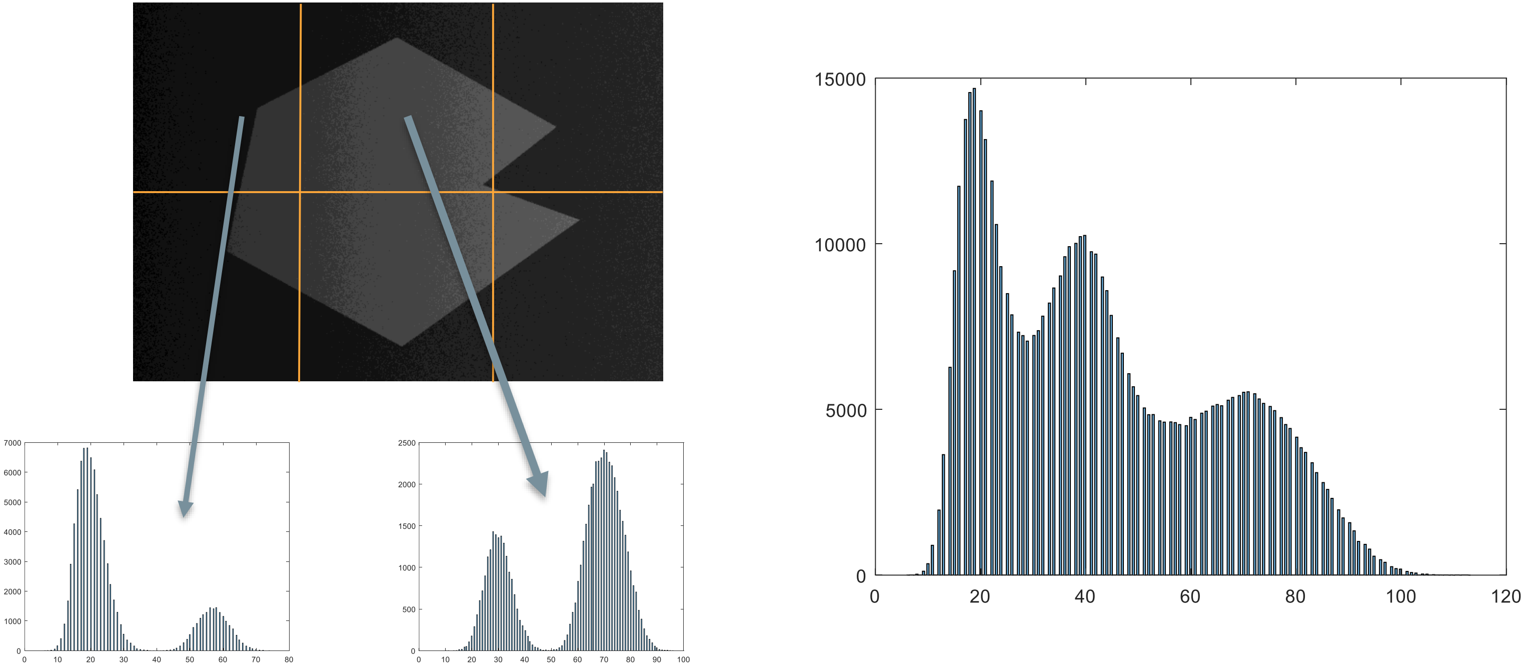
$$\sigma_B^2(k) = \frac{\left(\mathrm{m_G P_1(k) - m(k)}\right)^2}{P_1(k)(1 - P_1(k))}$$

Global Thresholding

- Otsu's algorithm

1. Compute the normalized histogram of the input image.
2. Compute the cumulative sums, $P_1(k)$
3. Compute the cumulative means, $m_1(k)$
4. Compute the global intensity mean, m_G
5. Compute the between-class variance, $\sigma_B^2(k)$.
6. Obtain the Otsu threshold T, as the value k of for which $\sigma_B^2(k)$ is maximum. If the maximum is not unique, obtain by averaging the values of corresponding to the various maxima detected.

Problem

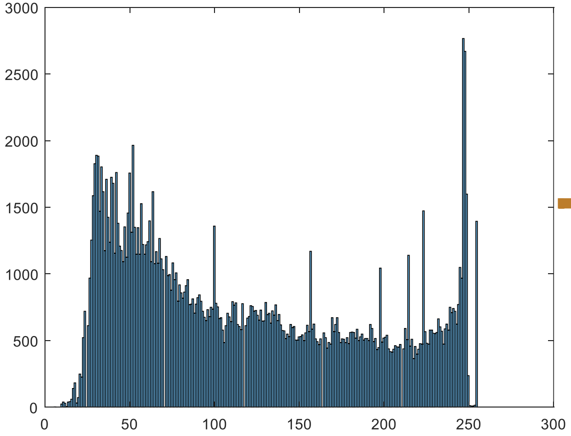


Problem

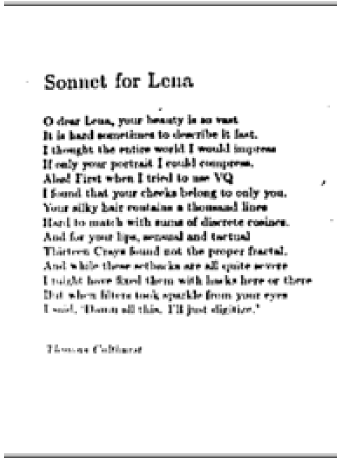

Sonnet for Lena

O dear Lena, your beauty is so vast
It is hard sometimes to describe it fast.
I thought the entire world I would impress
If only your portrait I could compress.
Alas! First when I tried to use VQ
I found that your cheeks belong to only you.
Your silky hair contains a thousand lines
Hard to match with sums of discrete cosines.
And for your lips, sensual and tactual
Thirteen Crays found not the proper fractal.
And while these setbacks are all quite severe
I might have fixed them with hacks here or there
But when filters took sparkle from your eyes
I said, 'Damn all this. I'll just digitize.'

Thomas Colthurst



How?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Locally adaptive thresholding

- Slide a window over the image
- For each window position, decide whether to perform thresholding

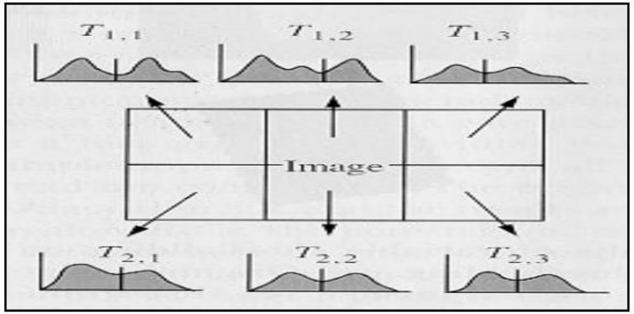
  apply Otsu's method

  classify the entire area as foreground or background

Or another way, change sliding window to scaling Line

The threshold value is $T_{xy} = bm_{xy}$, the b is vary from

$$m(k+1) = \frac{1}{n} \sum_{i=k+2-n}^{k+1} z_i$$

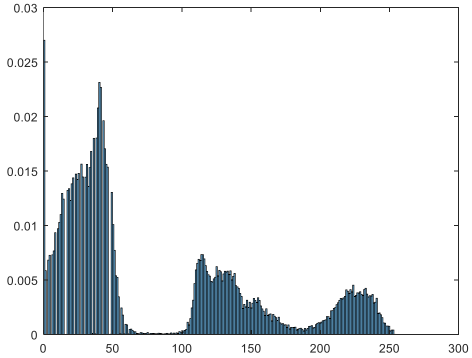


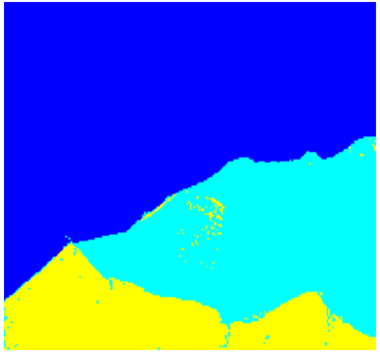
Multiple Thresholds

Single threshold is rarely sufficient for the whole image, similar to one threshold

$$P_1 + P_2 + P_3 = 1$$

$$\sigma_B^2 = P_1(m_1 - m_G)^2 + P_2(m_2 - m_G)^2 + P_3(m_3 - m_G)^2$$

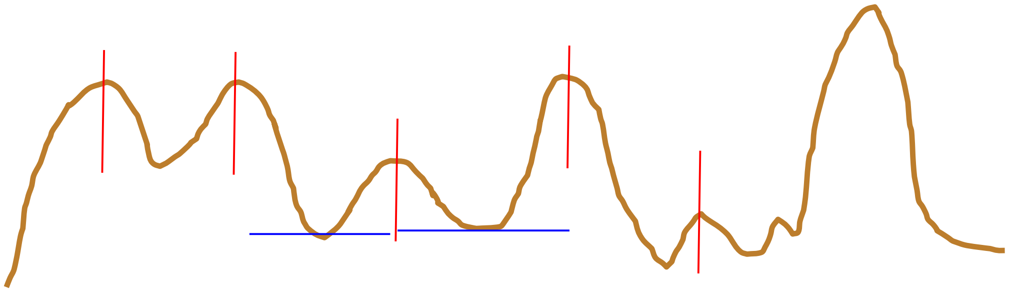




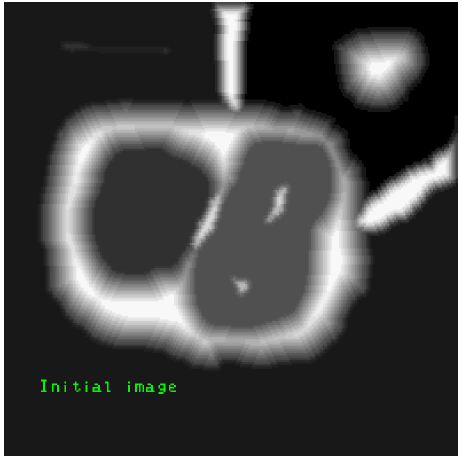
Morphological Watersheds

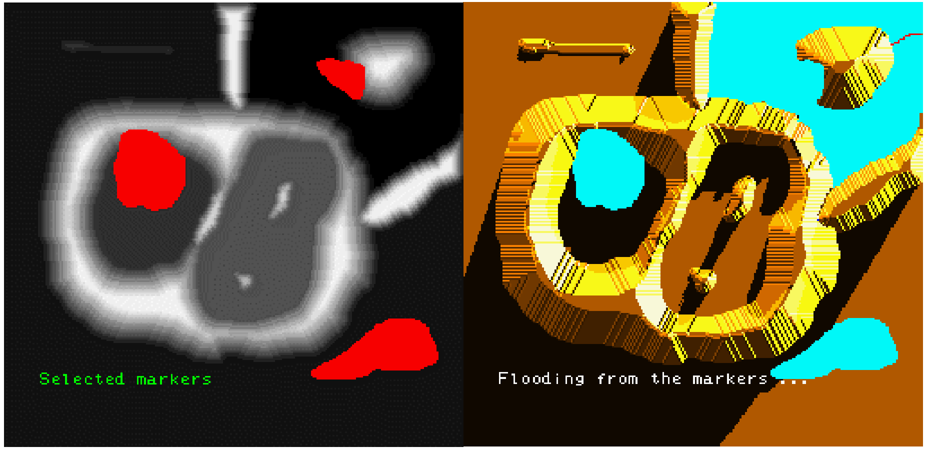
treating an image as a height field or landscape, regions where the rain would flow into the same lake

Start flooding from local minima, and label ridges



Morphological Watersheds

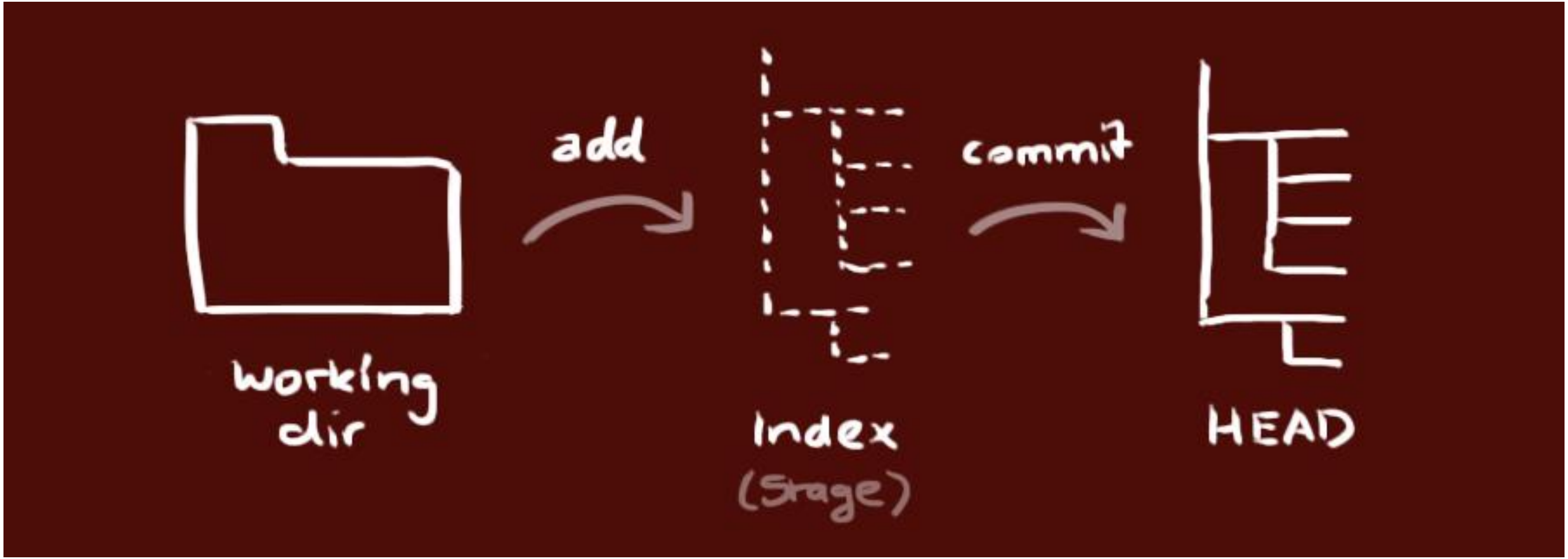




Marker-controlled watershed

flood this surface from its minima

Git Basic Concepts



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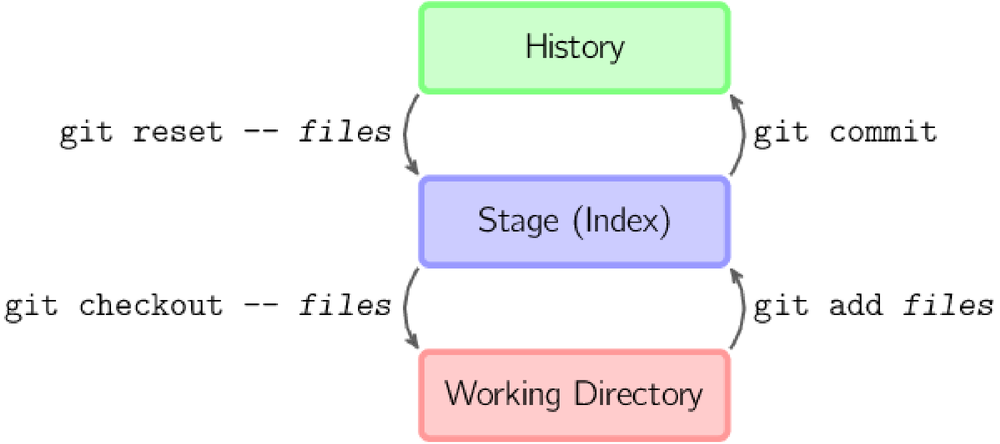

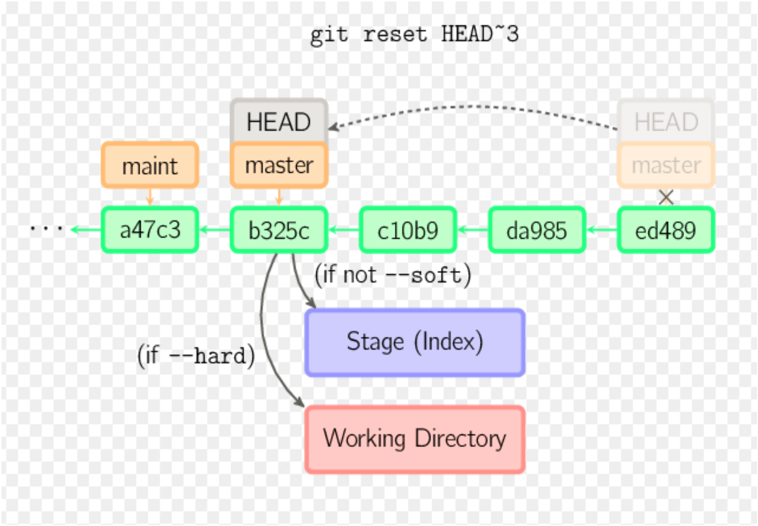

Git Basic Usage

- 创建项目
- 简易指南
- Git合并申请

How to submit your work

- make sure you can connect to github
- Sign up for Github
- search HUST_RM(not sure)
- fork the project and send pull request

Task

Maybe

Reference

https://cn.mathworks.com/discovery/image-segmentation.html

https://en.wikipedia.org/wiki/Image_segmentation

https://en.wikipedia.org/wiki/Otsu%27s_method

https://en.wikipedia.org/wiki/Watershed_(image_processing)