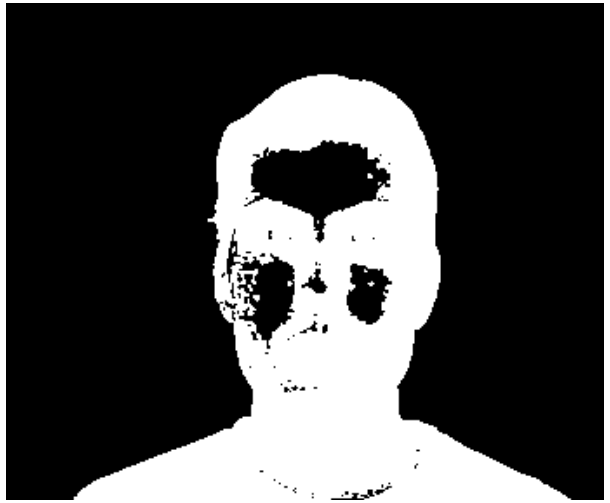
Opening and closing

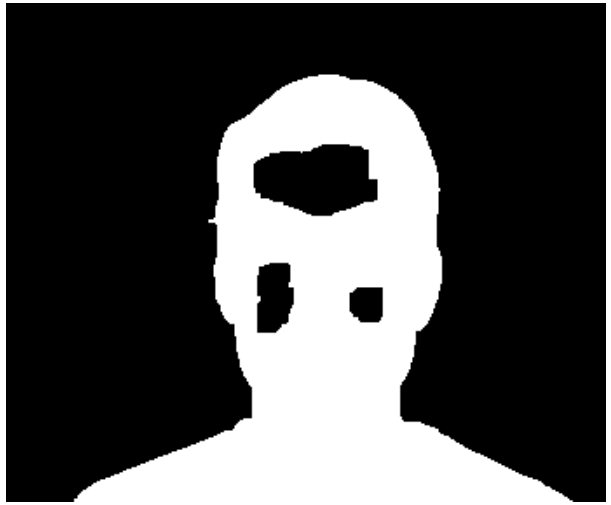
- Goal: smoothing without size change
- Open filter
$$open(f,W) = dilate(erode(f,W),W)$$
- Close filter
$$close(f,W) = erode(dilate(f,W),W)$$
- Open filter and close filter are biased
  - Open filter removes small 1-regions
  - Close filter removes small 0-regions
  - Bias is often desired for enhancement or detection!
- Unbiased size-preserving smoothers
$$close - open(f,W) = close(open(f,W),W)$$
$$open - close(f,W) = open(close(f,W),W)$$
- *close-open* and *open-close* are duals, but not inverses of each other.

Small hole removal by closing

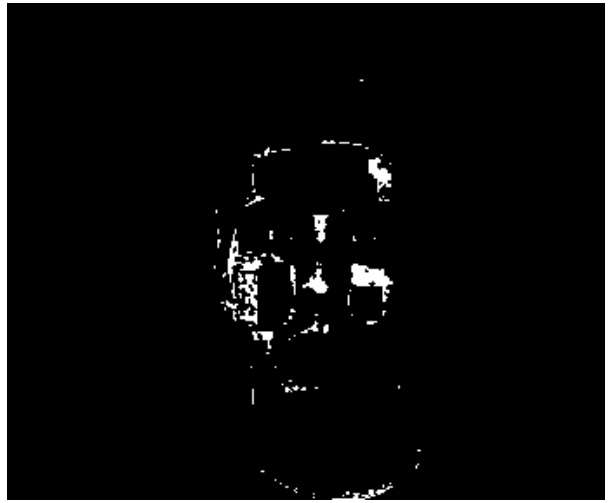


Original binary mask

Dilation
10x10



Closing 10x10



Difference to original mask