COMP 478/6771 (FALL 2020)

Digital Image Processing

Image Manipulation and Histogram Equalization

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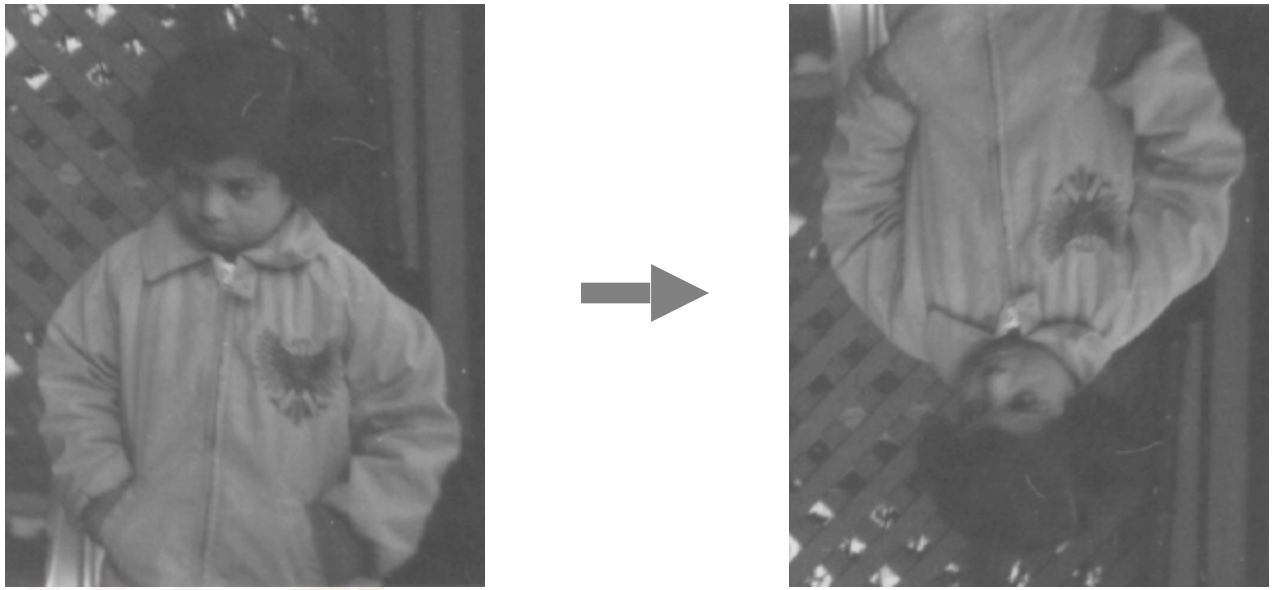
Tutors:

Materials provided by Dr. T. D. Bui

Manipulating Images

- Example. Write a function to flip an image vertically:



Manipulating Images

- Example. Write a function to flip an image vertically:
  - Start with a script
    ```
    >> edit flipv
    ```
    - Make sure you have chosen a unique name for your script/function. Do not overwrite MATLAB functions.

Manipulating Images

- Example. Write a function to flip an image vertically:
  - The way we do it in other (general purpose) programming languages:

```
I = imread('pout.tif');
    if ndims(I) == 3
        I = rgb2gray(I);
    end

    nrows = size(I,1);
    ncoloumns = size(I,2);
    for r = 1:floor(nrows / 2)
        for c = 1:ncoloumns
            pval = I(r, c);
            I(r, c) = I(nrows - r + 1, c);
            I(nrows - r + 1, c) = pval;
        end
    end
    imshow(I);
    imwrite(I, 'poutinv.bmp');
```

Manipulating Images

- Example. Write a function to flip an image vertically:
  - The way we do it in MATLAB:

```
I = imread('pout.tif');
    if ndims(I) == 3
        I = rgb2gray(I);
    end

    nrows = size(I,1);
    for r = 1:floor(nrows / 2)
        R = I(r, :);
        I(r, :) = I(nrows - r + 1, :);
        I(nrows - r + 1, :) = R;
    end
    imshow(I);
    imwrite(I, 'poutinv.bmp');
```

works for colour images as well

~4 times faster

Useful functions: `tic`, `toc`

Manipulating Images

- Example. Write a function to flip an image vertically:
  - Now convert it to a function:
    >> edit flipv
    - Here is the function body:

flipv.m

```
function J = flipv(I)

nrows = size(I,1);
for r = 1:floor(nrows / 2)
   R = I(r, :);
   I(r, :) = I(nrows - r + 1, :);
   I(nrows - r + 1, :) = R;
 end
 J = I;
```

Same name

Functions in MATLAB:

- are call-by-value
- can return multiple values

Manipulating Images

- Example. Write a function to flip an image vertically:
  - Here is how we may use our function:

```
>> I = imread('pout.tif');
>> imshow( flipv(I) ), figure, imshow(I)
```

Image Histogram

- Firstly we have to discritize the range of gray/ colour component values.
- Here is an script to compute/plot the 256-bin histogram of a uint8 image:

```
H = zeros(1,256);
J = I(:);

for i1 = 1:length(J)
  H(J(i1) + 1) = H(J(i1) + 1) + 1;
end
plot(H);
```

Useful functions: **`axis`**

```
H3 = zeros(1, 256);
for i = 1:length(H)
      H3(i) = sum(sum(I == i - 1));
End
 plot(H3);
```

Image Histogram

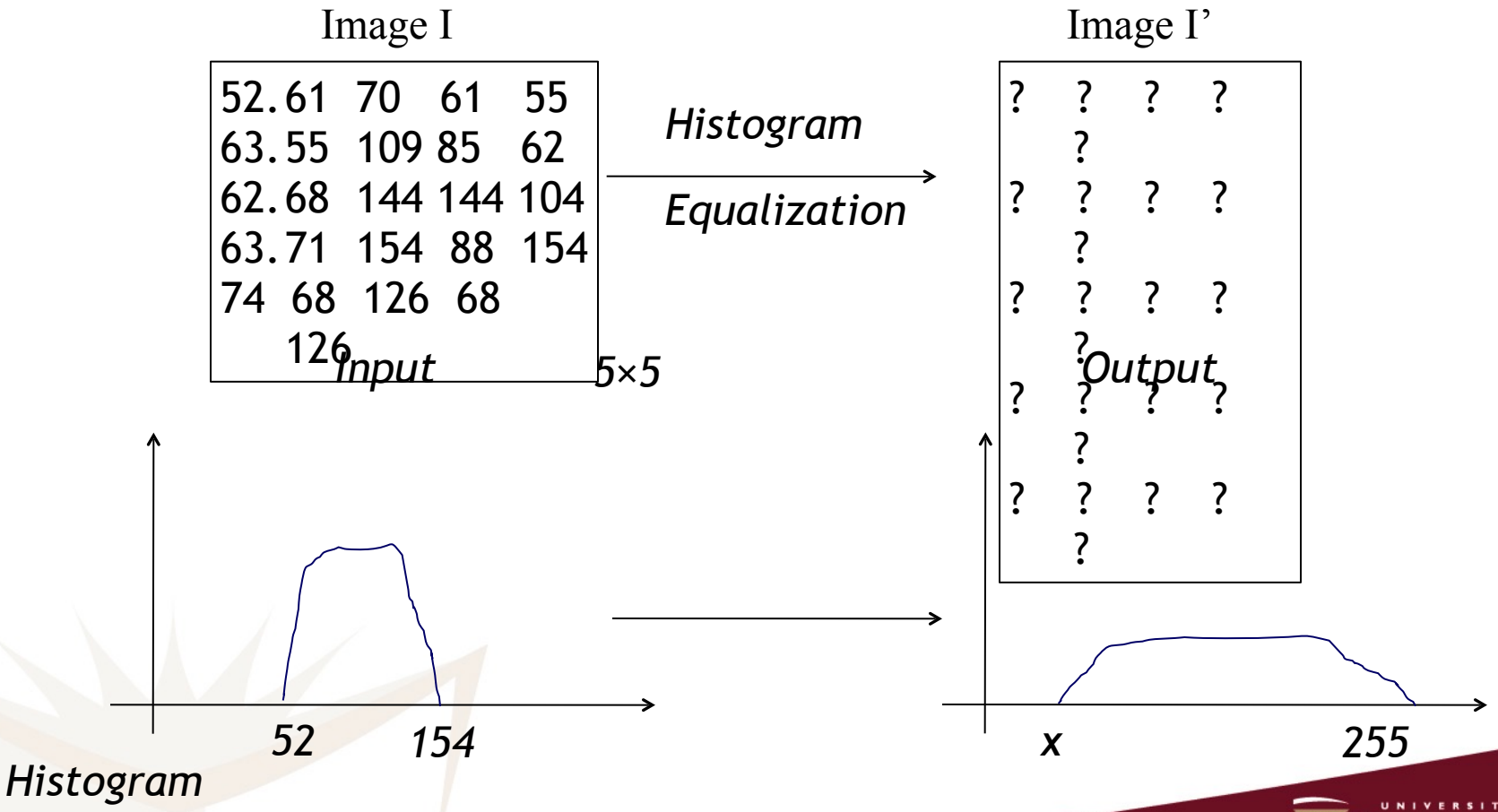
- Compare our script with the corresponding MATLAB function: imhist

```
>> H2 = imhist(I);
>> sum( abs(H – H2') )
```

  - The result is the same of course.
    - But MATLAB's function is faster!

Histogram Equalization

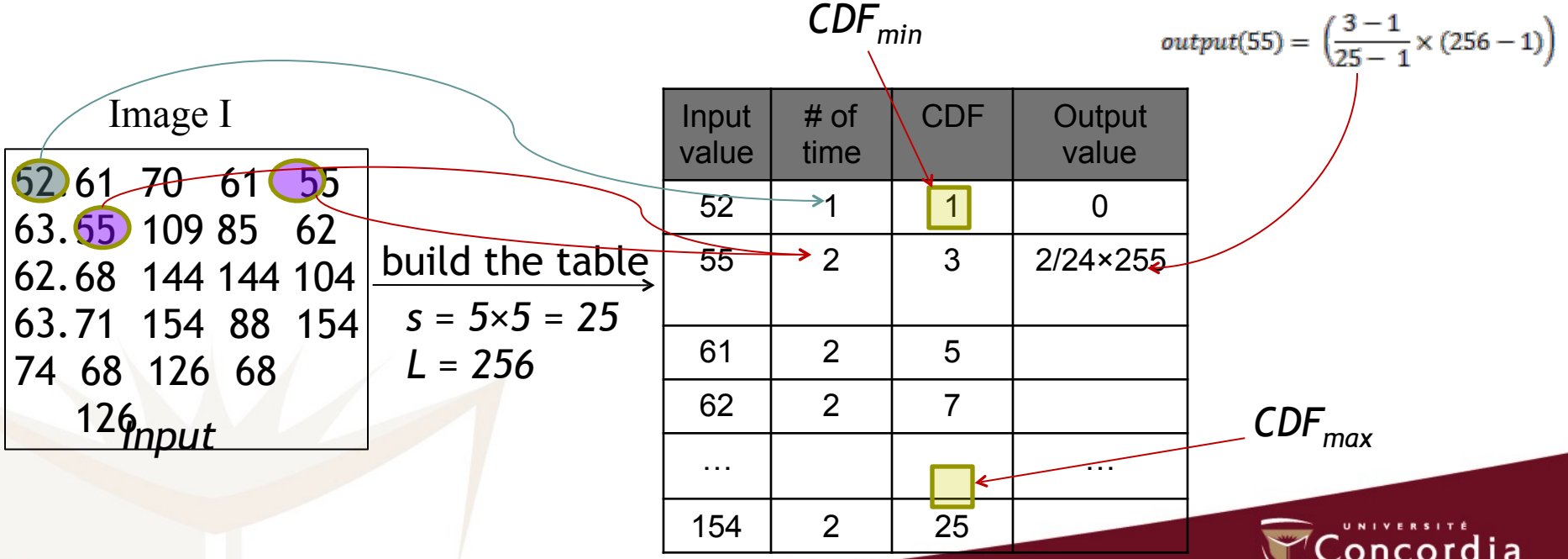
Example:



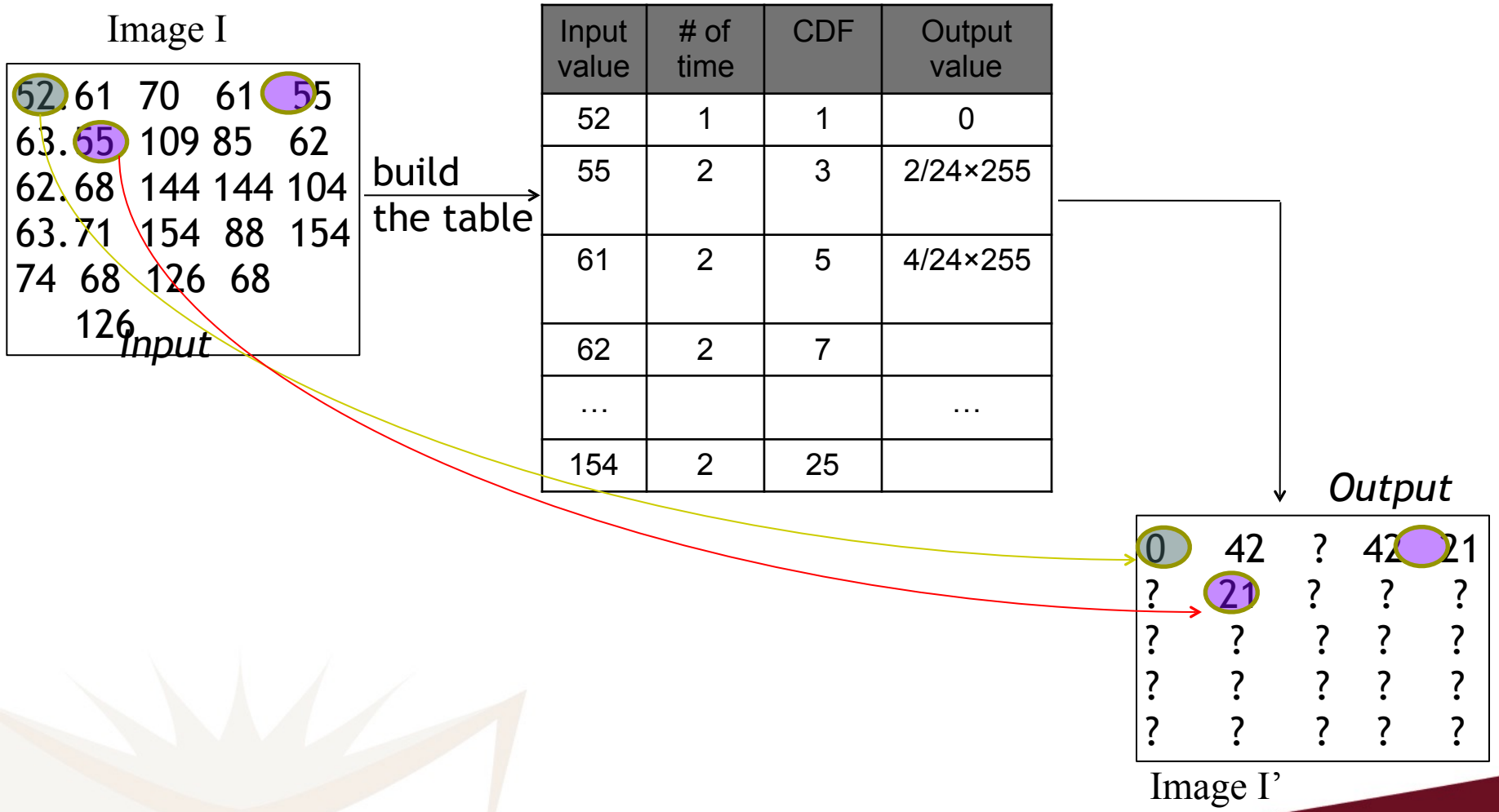
Histogram Equalization

Methods

- Calculate the image size: s = M×N
- And the gray-scale level: L
- Calculate the CDF (Cumulative Distribution Function) values
- Calculate the new pixel values: $new\ value(x_i) = round\left(\frac{CDF(x_i) - CDF_{min}}{M \times N - CDF_{min}} \times (L-1)\right)$



Histogram Equalization



Further Reading

- **Digital Image Processing Using MATLAB**
  R. C. Gonzelaz, R. E. Woods and S. L. Eddins
- **Image Processing Toolbox User Guide**
  http://www.mathworks.com/access/helpdesk/help/pdf_doc/images/images_tb.pdf