ECE 438 Digital Signal Processing
Week 15: Image Processing (Lab 10b)

Date 5/3/2020

Section 2

Name		Sign	Time spent outside lab
David Dang	[%]	David Dang	18 hrs.
Benedict Lee	[%]	Benedict Lee	18 hrs.

Grading Rubric (Spring 2020)

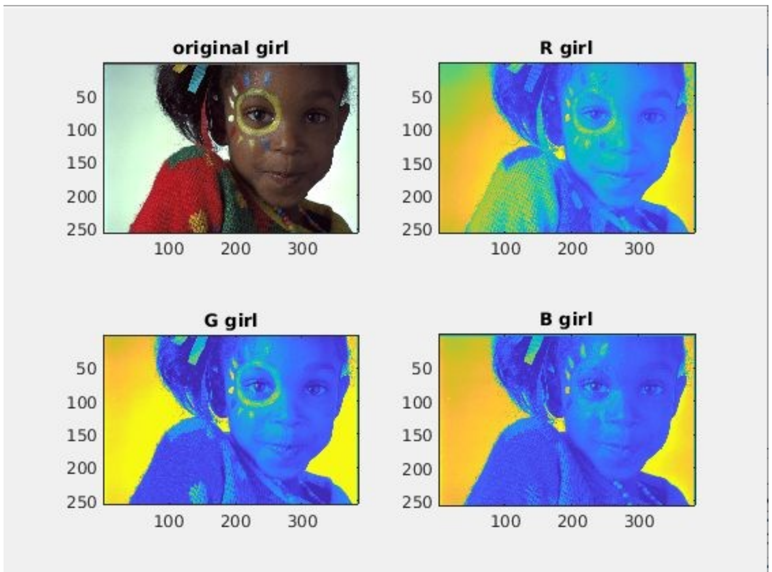
	below expectations	lacks in some respect	meets all expectations
Completeness of the report			
Organization of the report *One-sided, with cover sheet, answers are in the same order as questions in the lab, copies of the questions*			
Quality of figures *Correctly labeled with title, x-axis, y-axis, and name(s)*			
Understanding of color images and color spaces (40 pts) *Matlab figures with color components, code (ycbcr2rgb), filtered images, questions*			
Understanding of halftoning (60 pts) *Original and binary images with MSE, error images, table of MSE's for filered and nonfiltered images, questions*			

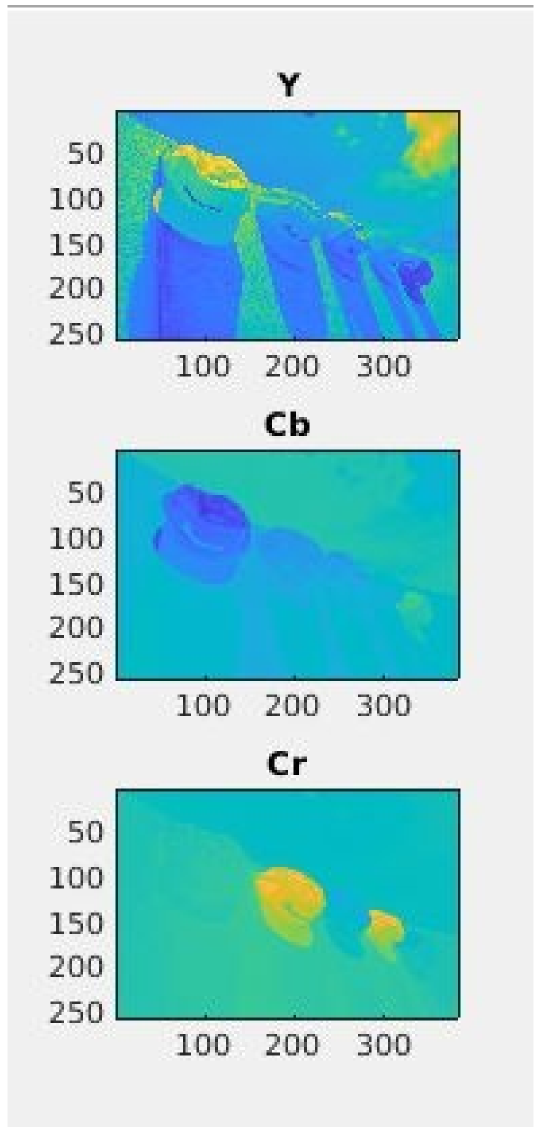
ECE 438 Lab 10b
David Dang & Benedict Lee

2.3 Color Exercise

INLAB REPORT:

1. Submit the figure containing the components of girl.tif.
2. Submit the figure containing the components of ycbcr.
3. Submit your code for the transformation from Y CbCr to RGB.
4. Submit the figure containing the original and filtered versions of ycbcr. Comment on the result of filtering the luminance and chrominance components of this image. Based on this, what conclusion can you draw about the human visual system?





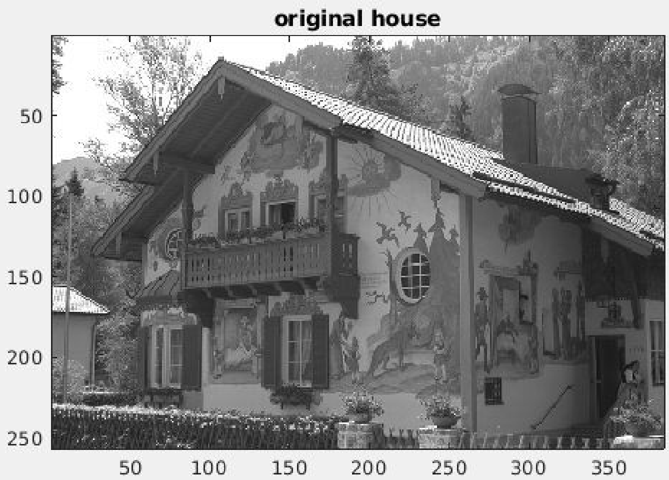

```
function [RGB] = ycbcr_to_RGB(YCBCR)
%UNTITLED2 Summary of this function goes here
%   Detailed explanation goes here

Y = YCBCR(:,:,1);
Cb = YCBCR(:,:,2);
Cr = YCBCR(:,:,3);

R = Y + 1.4025.*(Cr - 128);
G = Y - 0.3443.*(Cb - 128) - 0.7144.*(Cr - 128);
B = Y + 1.7730.*(Cb - 128);

RGB = cat(3,R,G,B);


end
```

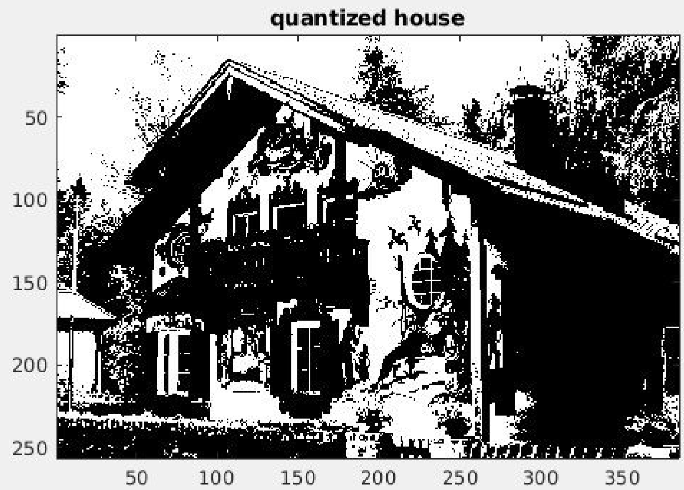
- When the luminance part of the image was filtered, the whole image became noticeably blurrier. When the chrominance part was filtered, there wasn't much of a difference. The human visual system is more sensitive to the luminance part of the image.

<u>**3.4 Halftoning Exercise**</u>

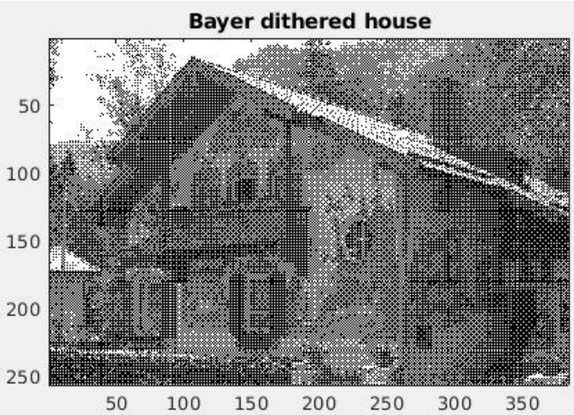
INLAB REPORT:

1. Hand in the original image and the three binary images. Make sure that they are all labeled, and that the mean square errors are noted on the binary images.
2. Compare the performance of the three methods based on the visual quality of the halftoned images. Also compare the resultant MSE's. Is the MSE consistent with the visual quality?
3. Submit the three error images. Which method appears to be the least signal dependent? Does the signal dependence seem to be correlated with the visual quality?
4. Compare the MSE's of the filtered versions with the nonfiltered versions for each method. What is the implication of these observations with respect to how we perceive halftone images.

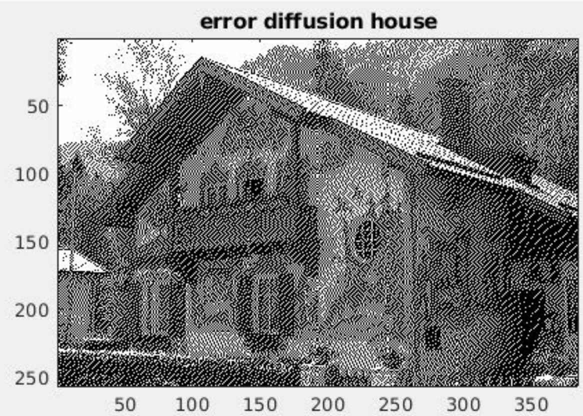




MSE: 0.0845

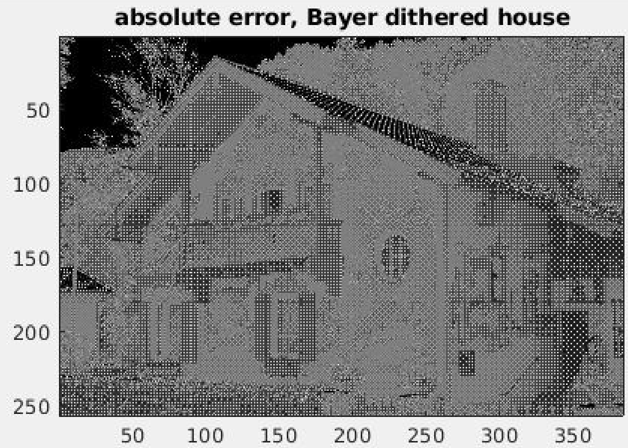


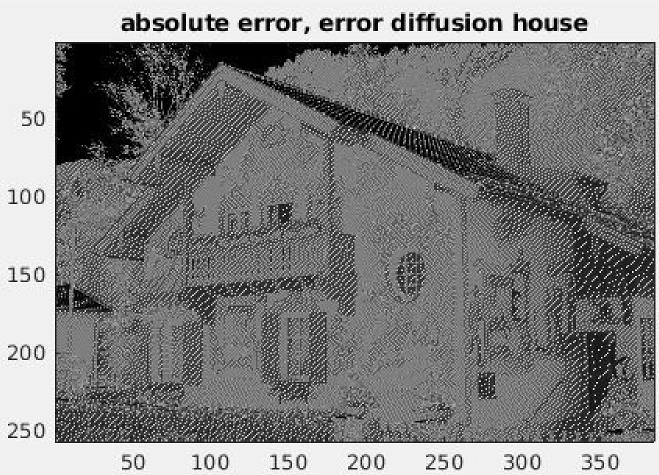
MSE: 0.1327



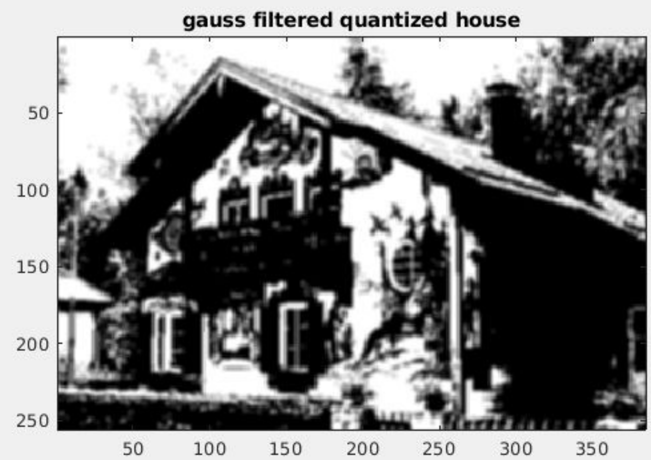
MSE: 0.1251

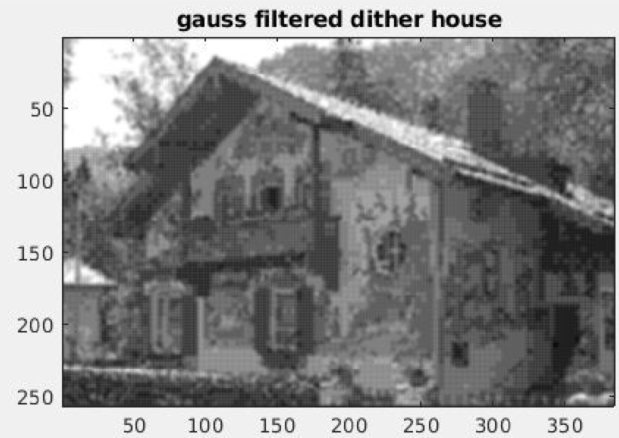
- In terms of visual quality, the images ranking from low to high quality are the Bayer dithered house, the error diffusion house, and the quantized house. The MSEs are consistent with the visual quality.

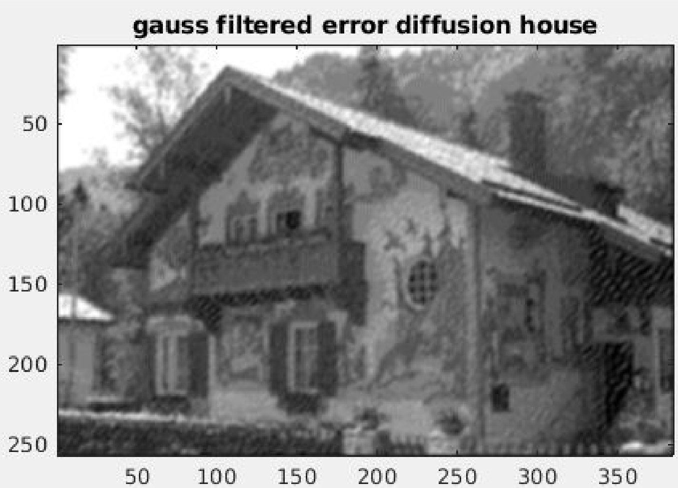




- The quantized house appears to be the least signal dependent since it has the lowest MSE and will be a closer replica of the actual image than the other halftoned images. For this reason, signal dependence is correlated with the visual quality







- The MSEs of the filtered images are lower than the MSEs of the non-filtered images. The human eye acts as a low-pass filter and automatically filters halftoned images.

MSE of non-filtered and filtered images			
	quantized house	Bayer dithered house	error diffusion house
Non-filtered	0.0845	0.1327	0.1251
filtered	0.0486	0.005	0.0043