Computer Vision HW1 Report

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Part 1.

- **Visualize the DoG images of 1.png.**

	DoG Image (threshold = 3)		DoG Image (threshold = 3)
DoG1-1.png		DoG2-1.png	
DoG1-2.png		DoG2-2.png	
DoG1-3.png		DoG2-3.png	
DoG1-4.png		DoG2-4.png	

- **Use three thresholds (1,2,3) on 2.png and describe the difference.**

Threshold	Image with detected keypoints on 2.png
1	
2	
3	

(describe the difference)

The number of keypoints decreases as the threshold increases. The higher threshold remains stronger keypoints (mainly on the margin of Winnie the Pooh between the background, especially the paper on his hands). The lower threshold keeps more keypoints but with weaker features (curtain in the background).

Part 2.

- **Report the cost for each filtered image.**

Gray Scale Setting	Cost (1.png)
cv2.COLOR_BGR2GRAY	1207799
R*0.0+G*0.0+B*1.0	1439568
R*0.0+G*1.0+B*0.0	1305961
R*0.1+G*0.0+B*0.9	1391110
R*0.1+G*0.4+B*0.5	1279340
R*0.8+G*0.2+B*0.0	1127756

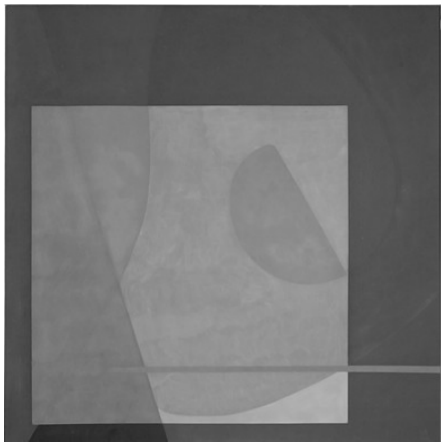
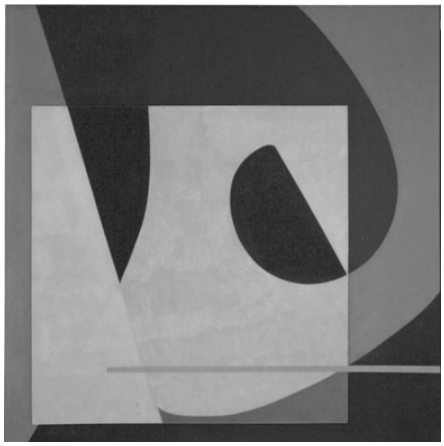
Gray Scale Setting	Cost (2.png)
cv2.COLOR_BGR2GRAY	183850
R*0.1+G*0.0+B*0.9	77989
R*0.2+G*0.0+B*0.8	85972
R*0.2+G*0.8+B*0.0	188130
R*0.4+G*0.0+B*0.6	128257
R*1.0+G*0.0+B*0.0	110862

- **Show original RGB image / two filtered RGB images and two grayscale images with highest and lowest cost.**

Original RGB image (1.png)	Filtered RGB image and Grayscale image of Highest cost	Filtered RGB image and Grayscale image of Lowest cost
		
		

(Describe the difference between those two grayscale images)

The contrast of the lowest-cost grayscale image is higher than the highest-cost one. Which is easier to distinguish the maple leaf from the background. Furthermore, the details in the background (grasses and stems) are more obvious in lowest-cost image.

Original RGB image (2.png)	Filtered RGB image and Grayscale image of Highest cost	Filtered RGB image and Grayscale image of Lowest cost
		
		

(Describe the difference between those two grayscale images)

The intensity of geometries in two grayscale images are different from each other. In the highest-cost image, the boundaries in outer loop are implicit. But in the lowest-cost image, the boundaries are more obvious and are easier to distinguish the different color regions from each other.

- **Describe how to speed up the implementation of bilateral filter.**
  - Instead of moving the filter kernel through each pixel, moving (rolling) the vectorized image over the filter kernel requires fewer iterations.
    - Reduce the nested for loops: 4-level for loops → 2-level for loops
    - For image size $M \times N$ and kernel size K: reduce the iterations $M*N \rightarrow K^2$ (usually $M, N >> K$)
  - Using the pre-constructed Gaussian kernel coefficient look-up table, which avoids the repeated computations in each iteration.