# Assignment 2 Texture Synthesis

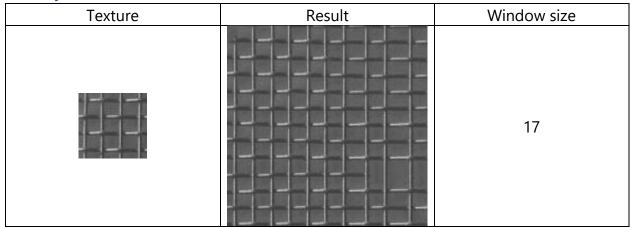
Kshitij Shah - ks1223

## Part 1: Texture Synthesis

Texture synthesis was performed on windows sizes 5, 9, 11, 13, 15, 17, 19, and 21. A 200x200 image was synthesized with all the above window sizes. Texture 1 and Texture 5 (Text) posited some quality issues. Due to the large size of 'Texton' Texture 1 failed to produce good results for smaller window size. However, with window size of 15 and 17 the results were satisfactory. All the textures improved in quality up to window size 17. Texture 1 degraded in quality after window size 17, other mostly remained the same.



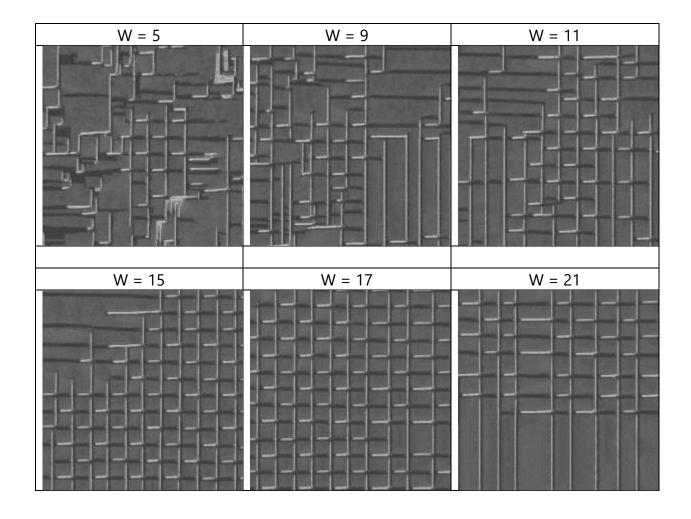
## Best Synthesis for each Texture



		21
		17
		21
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# Detailed Synthesis Results

## Texture 1



Texture 2

W = 5	W = 9	W = 11
W = 15	W = 17	W = 21

Texture 3

W = 5	W = 9	W = 11
W = 15	W = 17	W = 21
W = 15	W = 17	W = 21

# Texture 4

W = 5	W = 9	W = 11
W = 15	\\/ _ 17	\\\ _ 21
W = 15	W = 17	W = 21

# Texture 5

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Part 2: Image Inpainting
Original Images

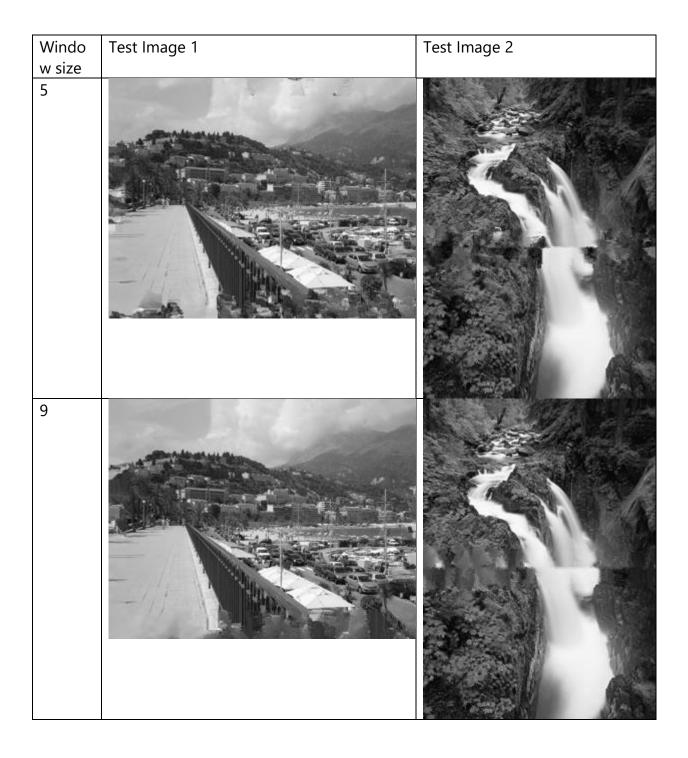
Test Image 1

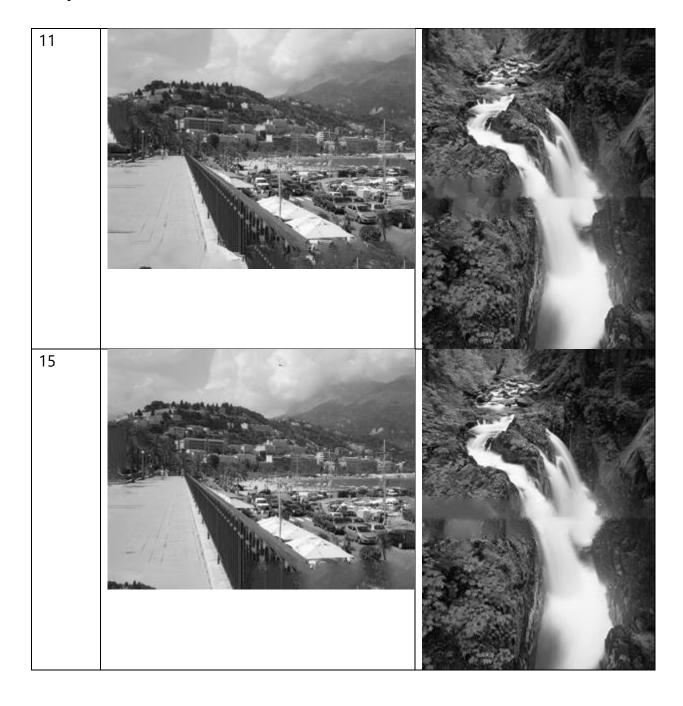


Test Image 2



# Results

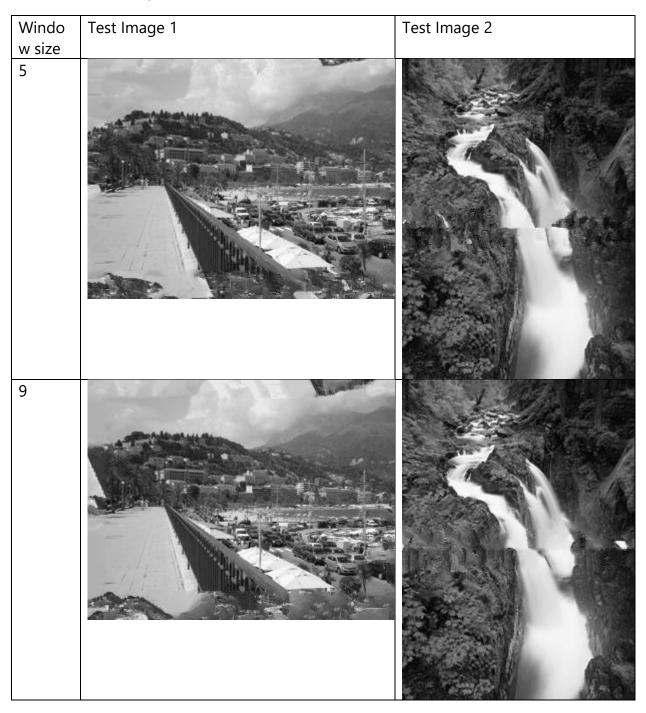


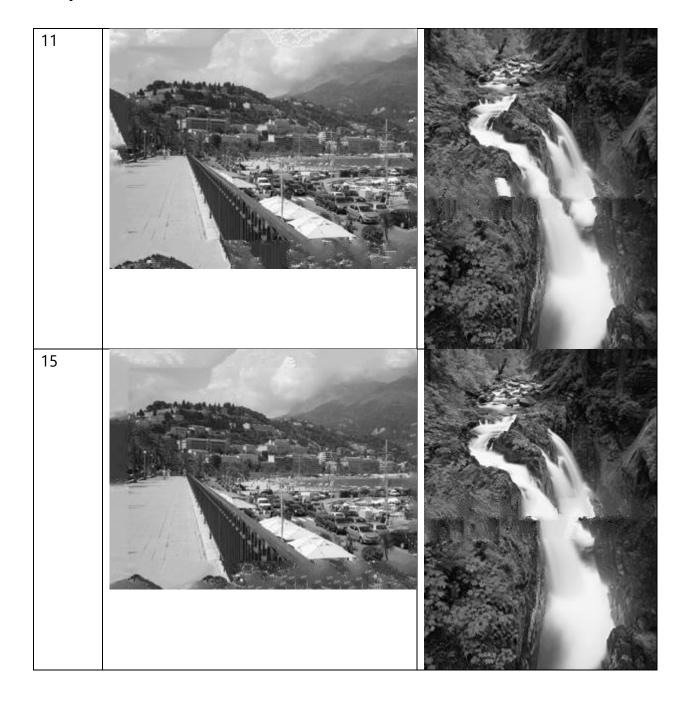


## Size Reduction to improve speed

Because of the large size of sample, which is the original image. The algorithm is quite slow. I improvised it a bit by resizing the sample to achieve speed up. The result of course deteriorated, but was acceptable in some cases.

Here are the results,



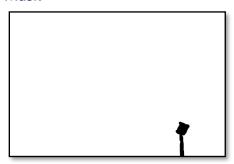


## Part 3

Creminis' approach uses techniques to carefully chooses the order in which pixels are synthesized. Hence, gives better results with object removal. Here are the results from Creminis' algorithm.

## Test image with board removed

#### Mask

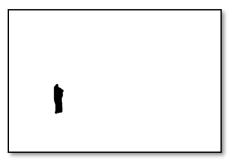


#### Image



# Test image with man removed

# Mask

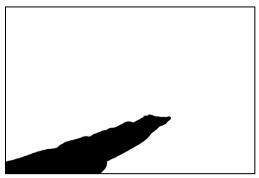


# Image



# Test image with saturated area removed

# Mask



Image



Saturated area removal generated unsatisfactory results.

## Comparison with Efros and Leung

Criminisi's algorithm performs better than Efros and Leung's method as it preserves the dominant edges in the image. Also because of the path based approach it's faster and does not introduce blur like Efros algorithm.

Due to the size of test image 3, Efros and Leung's approach is computationally infeasible for it. Criminisi's approach can handle such sizes and gives plausible results.

## Part 4: Image Quilting

It is obvious from the beginning that texture synthesis using Efros and Leung's method would be slow. The reason is it constructs texture pixel by pixel. It would be better if the unit of construction would be a patch rather than a single pixel.

Efros and Freeman's approach does exactly the same. Picking up patches at random from the sample and putting them on the output image. However, to make texture consistent patches needs to be overlapped. This overlapping is done in a manner that the difference between overlapped region of patches (error) is minimized.

#### **Running Time**

With large path size and high error threshold this algorithm is significantly faster. In my test runs the time taken to synthesize similar quality textures were improved by a factor of 2. For sensitive textures like text, the running time was not improvement was less.

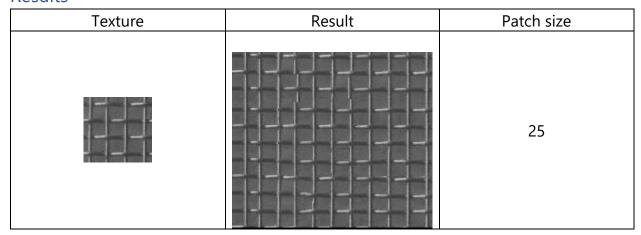
### Quality

This approach produced slightly better quality textures, especially for texture 1 and 5. For texture 1 the issue of missing lines present in the first approach was no longer there. However, there were broken lines where the patches overlap.

#### Takeaway

This approach is an improvement over the first one. However, the patch size and error threshold needs to be carefully chosen to get the desired quality, while still keeping the running time less.

#### Results



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The results were obtained using the code from <a href="https://github.com/afrozalm/Patch-Based-Texture-Synthesis">https://github.com/afrozalm/Patch-Based-Texture-Synthesis</a>

## Reference

1. <a href="http://graphics.cs.cmu.edu/people/efros/research/EfrosLeung.html">http://graphics.cs.cmu.edu/people/efros/research/EfrosLeung.html</a>

- 2. <a href="https://github.com/afrozalm/Patch-Based-Texture-Synthesis">https://github.com/afrozalm/Patch-Based-Texture-Synthesis</a>
- 3. A.A. Efros and W.T. Freeman, Image Quilting for Texture Synthesis and Transfer, SIGGRAPH 01.
- 4. https://www.microsoft.com/en-us/research/publication/region-filling-and-object-removal-by-exemplar-based-inpainting/