CSC320
Di Sun
Zhisong Ni

CSC320 Assignment 2

Image Inpainting

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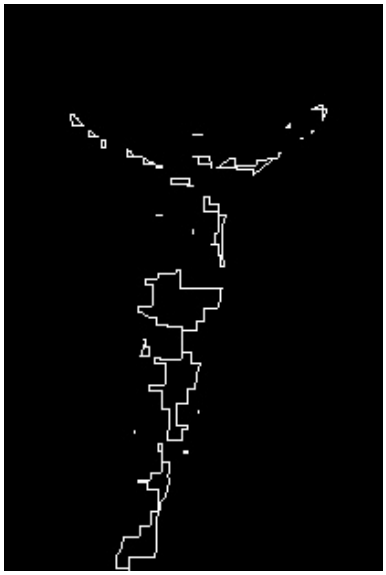
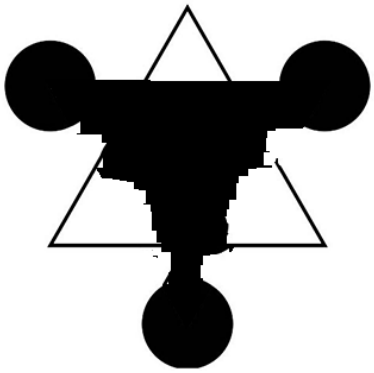
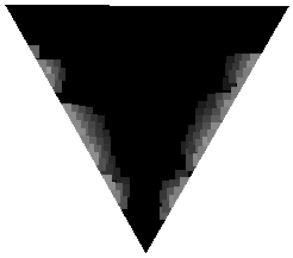
Part B2.1+2.2
Input:

inpainted confidence fillFront filledpixels






inpainted confidence

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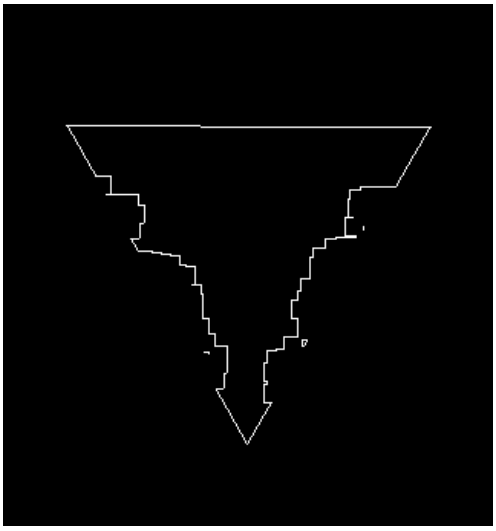
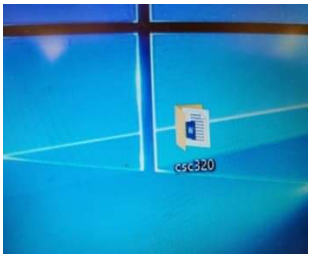
fillFront



filledpixels

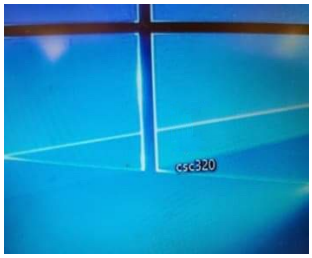
The following results are achieved by reference solution

Source 1: dimension 352*288



Source1.png

Mask1.png

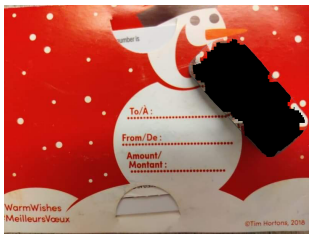


Source1.inpainted.png

Source 2: dimension 800*600

Source2.png

Mask2.png



Source2.inpainted.png

CSC320
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We used online photoshop to black out the part to be inpainted, made the rest of the image white as our resources, then wrote our utility script to grayscale the mask to be single channeled.
The script is as following:

```
import numpy as np
import cv2

ii = cv2.imread("./eraserm1.bmp")
gray_img = cv2.cvtColor(ii,cv2.COLOR_BGR2GRAY)
cv2.imwrite("gray.bmp", gray_img)
```

Good Example for Image Inpainting:
The folder on the desktop is relatively small compared to the entire image, therefore, there are more resources for the algorithm to fill in the masked area with. Also, around where the folder is placed on the desktop, the white lines on the blue background will produce very strong gradient changes, as well as the dark to light blue contrast and the black gaps. These environments will help the algorithm to determine which area is the good choice to be carried over to the masked area so that no obvious artifacts will show. For example, around the folder area, two white lines are connected to the folder, one at each side, which means that similar and strong gradient changes are happening at each side of the folder. With this information, it is easy for the algorithm to make a decision that it should choose the area with the white line as well so that the gradient change would be continuous.
Bad Example for Image Inpainting:
The eraser is proportionally bigger compared to the example above, therefore, there is relatively less resources that the algorithm can cut and paste from. Also, when we were trying to create the binary mask for the eraser, we found that there is shadow area around the edge of the eraser. With this affection, magnetic lasso select from photoshop cannot select the exact pixels for the edge,i.e., the edge will be more or less than it should be. If there is shadow area outside our mask, then the algorithm will be less confident to paste resources in the masked area. Apart from the object itself, the background is less consistent compared with the desktop above, for example, the frequent occurrence of the white dots and the borders of red and white.This results in that the algorithm is only confident with small patches, cutting and pasting a very very small numbers of pixels into the masked area. It is difficult for the algorithm to decide what to copy paste into the area where there is a curve underneath the eraser.

Artifacts

In this example we can see that there are some vertical “scratches” like artifacts on the inpainted result. This is resulted by very subtle noises on the background. They have very little gradient change so that the algorithm will not even consider it as a change of pattern, therefore, still copy and paste them over into the masked area as part of the painting.

CSC320
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On the blue circles, one of the dot is connected to the mask, so that there are enough information of how the gradient goes on the edge. On the other dot, which is not connected to the edge, it is obvious that the white dot is copied over and pasted several times together. This is because locally we have the gradient change similar to the white dot, but globally(entire image) the pattern is not like that. But when the algorithm is trying find a patch to copy paste, it will look at the patch with a gradient change pattern, but locally.

Similarly on the orange circles, the shadow on the edge will make the gradient change not as sharp and there is no enough pattern for the algorithm to decide how the gradient looks like underneath the eraser.

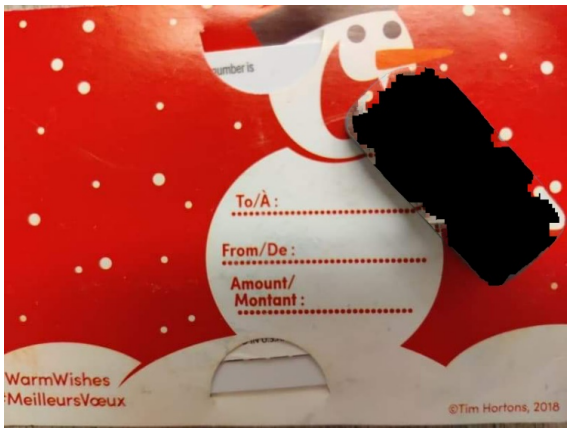
Part C

The newer image processing application that we decided to use is Nvidia's smart inpainting. It uses deep learning algorithm developed by engineers at Nvidia and Nvidia hardware. It is much faster and can inpaint more than Exemplar-Based Image Inpainting technique by Criminisi el al.

Here is a bad example on Exemplar-Based Image Inpainting technique:

Original image:

End result:



CSC320
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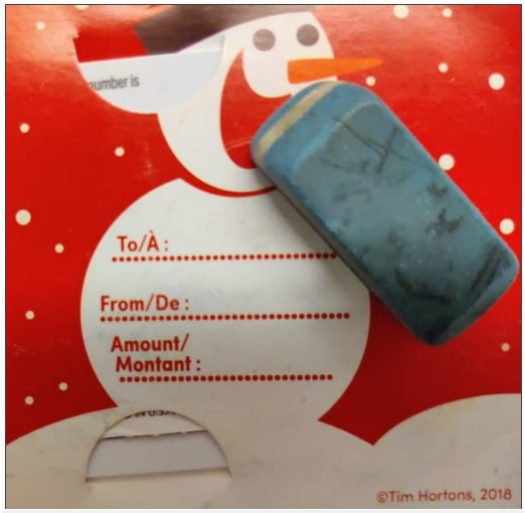
Mask:

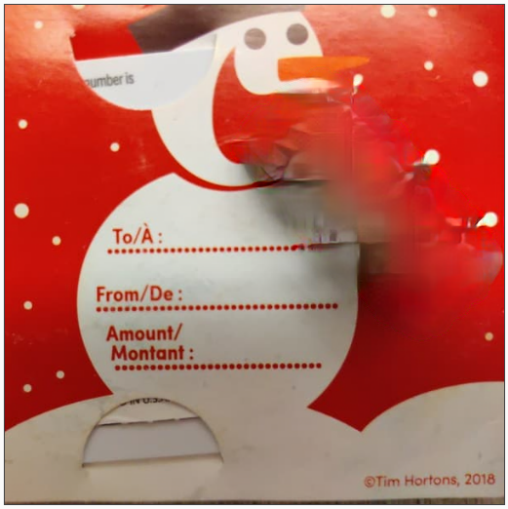
The Exemplar-Based Image Inpainting technique was only able to paint small part of the eraser's mask that is close to a strong gradient on the background image. Moreover, due to the bottom right dot not being connected with mask, the algorithm incorrectly filled the bottom right of the eraser with white colour instead of red.

Here is the experiment of the bad example with Nvidia's deep learning inpainting:

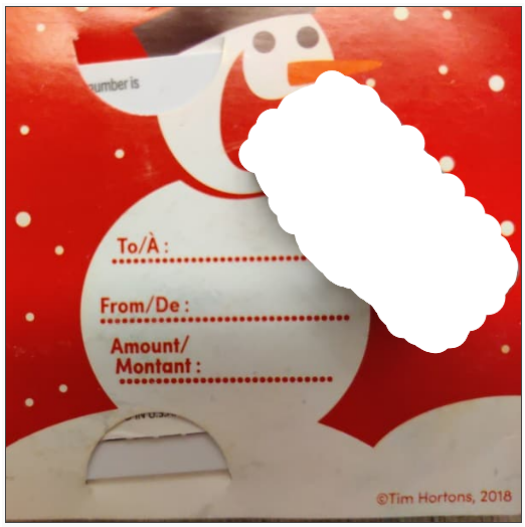
Original image:



Result:



Mask:



This technique performed better because the algorithm does not only take the area around the gradient in the background into account when it does inpainting. Deep learning can account for the area all around the eraser. This is why that despite it not being perfect, the algorithm was able to fill the majority of the eraser with red background and predict the shape of the snowman's bottom half and filling that part with white. The reason why there is a darker area on the left side of the eraser is because

the algorithm incorrectly thought that the shadow is part of the background because it is not entirely covered by the mask. This technique is able to become better with a higher resolution and more dynamic background. To explore this technique further, we tried a higher resolution image that would take Exemplar-Based Image Inpainting forever to process.

Original image:

Result:

Mask:

With more features and more image to process, the newer technique was able to almost complete inpaint the objects out of the image and replace them with almost perfect background predictions. We also wanted to try this image and the same mask with the Exemplar-Based Image Inpainting technique, but we did not have enough time to run it as it was very slow.