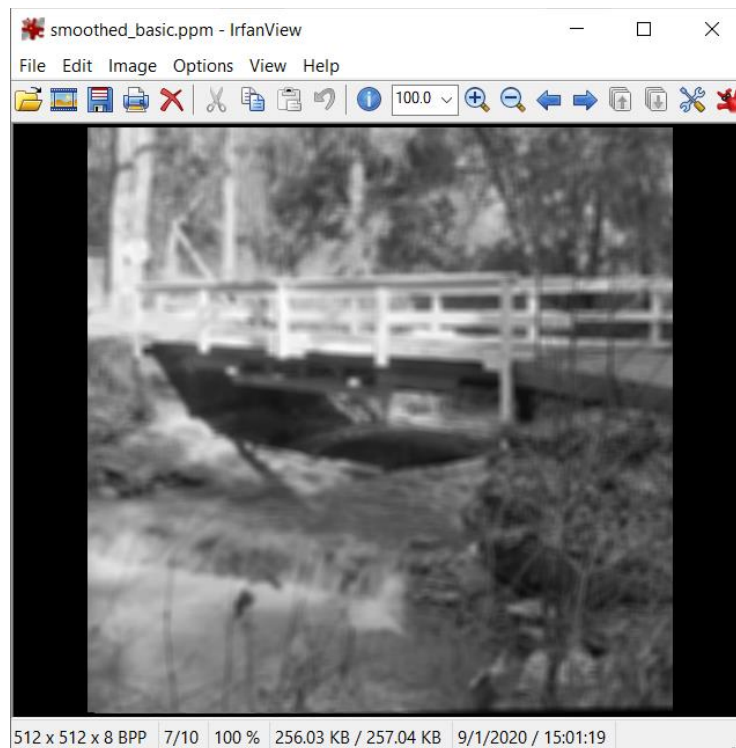


ECE 6310 – Introduction to Computer Vision – LAB 1 REPORT**Convolution and Timing****TASKS**

- Use 7x7 mean filter, perform regular 2D convolution
- Use 1x7 and 7x1 separable filters to perform two 1D convolutions and obtain the same output
- Use separable filters and sliding window to obtain the same output
- Use diff to compare output images

Basic 2D Convolution

Output Image:



Average Time Taken:

21254990 nsec

Measurements:

20987000	21942300
20943200	19986100
19911400	26927100
19985600	20951700
19972100	20943400

Sample:

```
mingw64 /c/CV/lab1
niral@DESKTOP-C5Q0AIR MINGW64 ~
$ cd /c/cv/lab1

niral@DESKTOP-C5Q0AIR MINGW64 /c/cv/lab1
$ gcc basic-conv.c -o basic-conv_out.exe

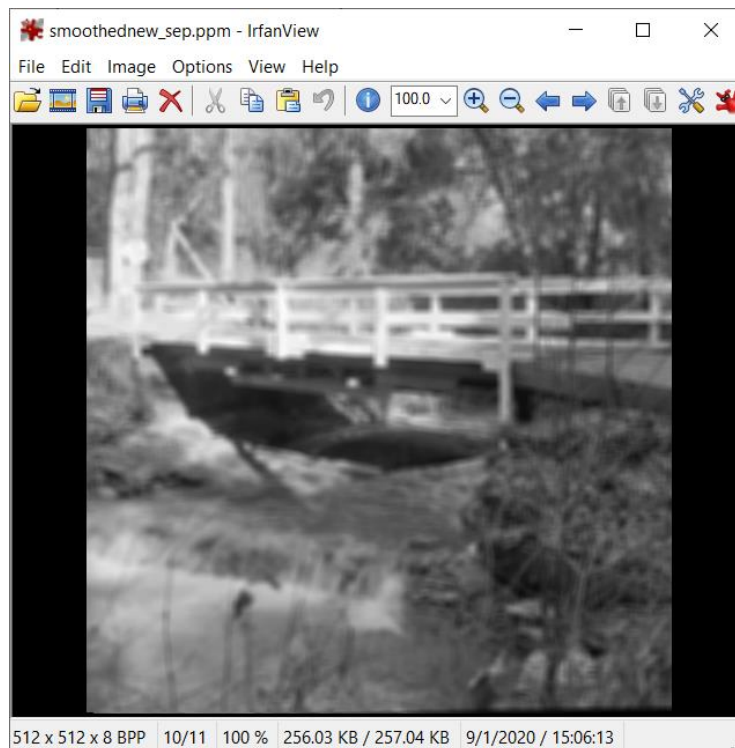
niral@DESKTOP-C5Q0AIR MINGW64 /c/cv/lab1
$ ./basic-conv_out bridge.ppm
Start Time: 1598986614 64052100
End Time: 1598986614 85039100
Time Taken: 20987000

niral@DESKTOP-C5Q0AIR MINGW64 /c/cv/lab1
$ ./basic-conv_out bridge.ppm
Start Time: 1598986626 183073400
End Time: 1598986626 204016600
Time Taken: 20943200

niral@DESKTOP-C5Q0AIR MINGW64 /c/cv/lab1
$ ./basic-conv_out bridge.ppm
Start Time: 1598986629 2238700
End Time: 1598986629 22150100
Time Taken: 19911400
```

Separable Filters

Output Image:



Average Time Taken:

8102110 nsec

Measurements:

8026500	8023400
7018400	9009100
7979300	6981500
8990500	8012800
8003600	8976000

Sample:

```

/cv/lab1
niral@DESKTOP-C5Q0AIR MINGW64 /c/cv/lab1
$ gcc sepfilter.c -o sepout.exe

niral@DESKTOP-C5Q0AIR MINGW64 /c/cv/lab1
$ ./sepout bridge.ppm
Start Time: 1598987161 738546600
End Time: 1598987161 746573100
Time Taken: 8026500

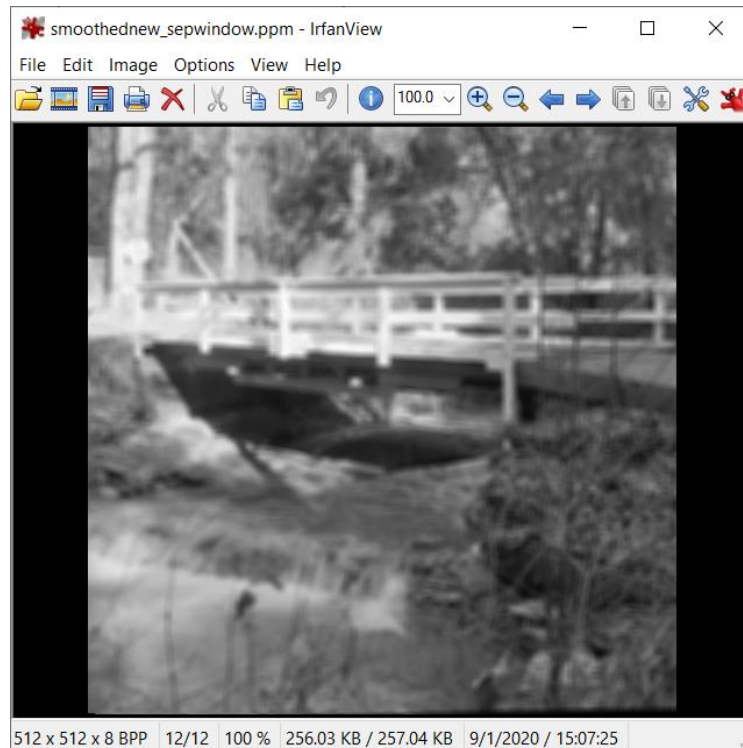
niral@DESKTOP-C5Q0AIR MINGW64 /c/cv/lab1
$ ./sepout bridge.ppm
Start Time: 1598987164 441848200
End Time: 1598987164 448866600
Time Taken: 7018400

niral@DESKTOP-C5Q0AIR MINGW64 /c/cv/lab1
$ ./sepout bridge.ppm
Start Time: 1598987165 458860800
End Time: 1598987165 466840100
Time Taken: 7979300

niral@DESKTOP-C5Q0AIR MINGW64 /c/cv/lab1
$ ./sepout bridge.ppm
```

Separable Filters with Sliding Window:

Output Image:



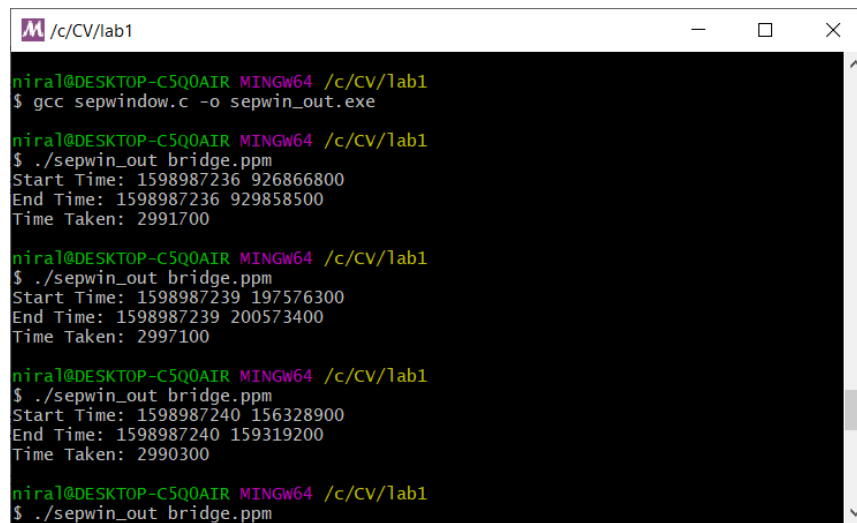
Average Time Taken:

2998780 nsec

Measurements:

2991700	3003100
2997100	2991800
2990300	4035700
3037500	2957400
2025300	2957900

Sample:



```

/c/CV/lab1
niral@DESKTOP-C5Q0AIR MINGW64 /c/cv/lab1
$ gcc sepwindow.c -o sepwin_out.exe

niral@DESKTOP-C5Q0AIR MINGW64 /c/cv/lab1
$ ./sepwin_out bridge.ppm
Start Time: 1598987236 926866800
End Time: 1598987236 929858500
Time Taken: 2991700

niral@DESKTOP-C5Q0AIR MINGW64 /c/cv/lab1
$ ./sepwin_out bridge.ppm
Start Time: 1598987239 197576300
End Time: 1598987239 200573400
Time Taken: 2997100

niral@DESKTOP-C5Q0AIR MINGW64 /c/cv/lab1
$ ./sepwin_out bridge.ppm
Start Time: 1598987240 156328900
End Time: 1598987240 159319200
Time Taken: 2990300

niral@DESKTOP-C5Q0AIR MINGW64 /c/cv/lab1
$ ./sepwin_out bridge.ppm

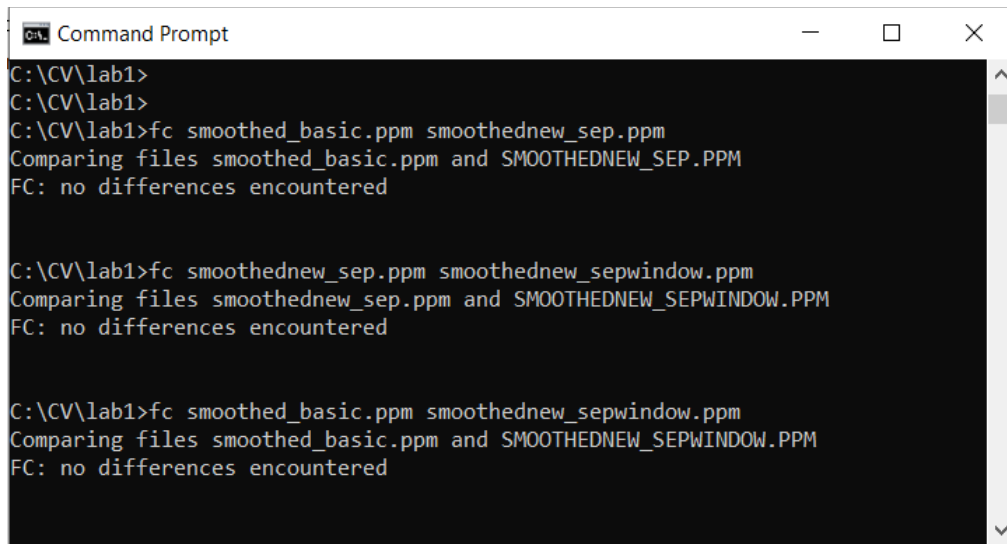
```

Comparing the Average Time Taken:

Basic 2D Convolution	21254990 nsec	takes most amount of time
Separable Filters	8102110 nsec	takes lesser time
Separable Filters with Sliding Window	2998780 nsec	takes the least amount of time

Comparing the Output Images

Using fc command on the cmd:

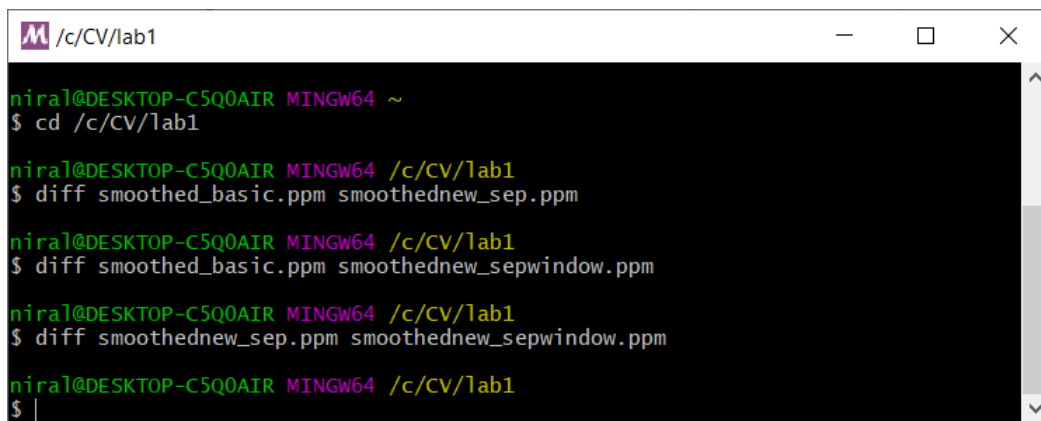


```
Command Prompt
C:\CV\lab1>
C:\CV\lab1>
C:\CV\lab1>fc smoothed_basic.ppm smoothednew_sep.ppm
Comparing files smoothed_basic.ppm and SMOOTHEDNEW_SEP.PPM
FC: no differences encountered

C:\CV\lab1>fc smoothednew_sep.ppm smoothednew_sepwindow.ppm
Comparing files smoothednew_sep.ppm and SMOOTHEDNEW_SEPWINDOW.PPM
FC: no differences encountered

C:\CV\lab1>fc smoothed_basic.ppm smoothednew_sepwindow.ppm
Comparing files smoothed_basic.ppm and SMOOTHEDNEW_SEPWINDOW.PPM
FC: no differences encountered
```

Using the diff command on msys2 Shell:



```
/c/CV/lab1
niral@DESKTOP-C5Q0AIR MINGW64 ~
$ cd /c/CV/lab1

niral@DESKTOP-C5Q0AIR MINGW64 /c/CV/lab1
$ diff smoothed_basic.ppm smoothednew_sep.ppm

niral@DESKTOP-C5Q0AIR MINGW64 /c/CV/lab1
$ diff smoothed_basic.ppm smoothednew_sepwindow.ppm

niral@DESKTOP-C5Q0AIR MINGW64 /c/CV/lab1
$ diff smoothednew_sep.ppm smoothednew_sepwindow.ppm

niral@DESKTOP-C5Q0AIR MINGW64 /c/CV/lab1
$ |
```

Difficulties Encountered and Fixes

1. Indexing – Not indexing properly in the separable filters with sliding window produced a very noisy image with little resemblance to the original image. Fixed by switching the outer for loop and inner for loop while convolving vertically.
2. Rounding – Occurred because of difference in division. One was directly divided by 49 while the other was divided by 7 twice. Fixed by storing the entire sum in an int array and producing the smoothed image by directly dividing joint sum by 49.