```
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

Question 1

Solution 1.a

```
In [1]: cd /home/ubuntu/Desktop/pyrf.net/HW4_DENOISING
/home/ubuntu/Desktop/pyrf.net/HW4_DENOISING
```

```
In [2]: ls -ltrh *.jpg
```

```
-rw-rw-r-- 1 ubuntu ubuntu 1.1K Oct 15 05:24 checkerboard.jpg
```

Solution 1.b

```
In [3]: ls -ltrh checkerboard.jpg
```

```
-rw-rw-r-- 1 ubuntu ubuntu 1.1K Oct 15 05:24 checkerboard.jpg
```

Solution 1.c.i

```
In [4]: ls -ltrh checkerboard.jpg checkerboard_noise.jpg
```

```
-rw-rw-r-- 1 ubuntu ubuntu 1.1K Oct 15 05:24 checkerboard.jpg
-rw-rw-r-- 1 ubuntu ubuntu 1.1K Oct 15 05:24 checkerboard_noise.jpg
```

Solution 1.c.ii

```
In [5]: ls -ltrh checkerboard.jpg checkerboard_noise.jpg checkerboard_noise_denoised.jpg
```

```
-rw-rw-r-- 1 ubuntu ubuntu 1.1K Oct 15 05:24 checkerboard.jpg
-rw-rw-r-- 1 ubuntu ubuntu 1.1K Oct 15 05:24 checkerboard_noise.jpg
-rw-rw-r-- 1 ubuntu ubuntu 1.1K Oct 15 05:24 checkerboard_noise_denoised.jpg
```

Solution 1.b

```
In [6]: %load_ext rpy2.ipynb
```

```
The rpy2.ipynb extension is already loaded. To reload it, use:
  %reload_ext rpy2.ipynb
```

```
In [7]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [8]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [9]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [10]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [11]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [12]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [13]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [14]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [15]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [16]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [17]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [18]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [19]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [20]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [21]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [22]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [23]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [24]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [25]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [26]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [27]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [28]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [29]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [30]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [31]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [32]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [33]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [34]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [35]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [36]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [37]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [38]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [39]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [40]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [41]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [42]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [43]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [44]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [45]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [46]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [47]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [48]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [49]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [50]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [51]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [52]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [53]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [54]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [55]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [56]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [57]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [58]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [59]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [60]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [61]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [62]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [63]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [64]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [65]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [66]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [67]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [68]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [69]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [70]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [71]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [72]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [73]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [74]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [75]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [76]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [77]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [78]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [79]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [80]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [81]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [82]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [83]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [84]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [85]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [86]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [87]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [88]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [89]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [90]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [91]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [92]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [93]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [94]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [95]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [96]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [97]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [98]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [99]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [100]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [101]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [102]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [103]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [104]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [105]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [106]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [107]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [108]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [109]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [110]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [111]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [112]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [113]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [114]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [115]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [116]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [117]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [118]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [119]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [120]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [121]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [122]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [123]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [124]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [125]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [126]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [127]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [128]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [129]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [130]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [131]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [132]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [133]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [134]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [135]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [136]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [137]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [138]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [139]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [140]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [141]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [142]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [143]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [144]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [145]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [146]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [147]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [148]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
```

```
In [149]: %matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2.ipynb
%matplotlib inline
%load_ext rpy2
```

```
Saved image to image_hough_line_1.png
```

Solution 1b

```
Done
```

```
Saving lab_1_1_1b_Canny_hough_line_0.mat
Saving lab_1_1_1b_Canny_hough_line_1.mat
Saving lab_1_1_1b_Canny_hough_line_2.mat
Saving lab_1_1_1b_Canny_hough_line_3.mat
Saving lab_1_1_1b_Canny_hough_line_4.mat
Saving lab_1_1_1b_Canny_hough_line_5.mat
Saving lab_1_1_1b_Canny_hough_line_6.mat
Saving lab_1_1_1b_Canny_hough_line_7.mat
Saving lab_1_1_1b_Canny_hough_line_8.mat
Saving lab_1_1_1b_Canny_hough_line_9.mat
Saving lab_1_1_1b_Canny_hough_line_10.mat
Saving lab_1_1_1b_Canny_hough_line_11.mat
Saving lab_1_1_1b_Canny_hough_line_12.mat
Saving lab_1_1_1b_Canny_hough_line_13.mat
Saving lab_1_1_1b_Canny_hough_line_14.mat
Saving lab_1_1_1b_Canny_hough_line_15.mat
Saving lab_1_1_1b_Canny_hough_line_16.mat
Saving lab_1_1_1b_Canny_hough_line_17.mat
Saving lab_1_1_1b_Canny_hough_line_18.mat
Saving lab_1_1_1b_Canny_hough_line_19.mat
Saving lab_1_1_1b_Canny_hough_line_20.mat
Saving lab_1_1_1b_Canny_hough_line_21.mat
Saving lab_1_1_1b_Canny_hough_line_22.mat
Saving lab_1_1_1b_Canny_hough_line_23.mat
Saving lab_1_1_1b_Canny_hough_line_24.mat
Saving lab_1_1_1b_Canny_hough_line_25.mat
Saving lab_1_1_1b_Canny_hough_line_26.mat
Saving lab_1_1_1b_Canny_hough_line_27.mat
Saving lab_1_1_1b_Canny_hough_line_28.mat
Saving lab_1_1_1b_Canny_hough_line_29.mat
Saving lab_1_1_1b_Canny_hough_line_30.mat
Saving lab_1_1_1b_Canny_hough_line_31.mat
Saving lab_1_1_1b_Canny_hough_line_32.mat
Saving lab_1_1_1b_Canny_hough_line_33.mat
Saving lab_1_1_1b_Canny_hough_line_34.mat
Saving lab_1_1_1b_Canny_hough_line_35.mat
Saving lab_1_1_1b_Canny_hough_line_36.mat
Saving lab_1_1_1b_Canny_hough_line_37.mat
Saving lab_1_1_1b_Canny_hough_line_38.mat
Saving lab_1_1_1b_Canny_hough_line_39.mat
Saving lab_1_1_1b_Canny_hough_line_40.mat
Saving lab_1_1_1b_Canny_hough_line_41.mat
Saving lab_1_1_1b_Canny_hough_line_42.mat
Saving lab_1_1_1b_Canny_hough_line_43.mat
Saving lab_1_1_1b_Canny_hough_line_44.mat
Saving lab_1_1_1b_Canny_hough_line_45.mat
Saving lab_1_1_1b_Canny_hough_line_46.mat
Saving lab_1_1_1b_Canny_hough_line_47.mat
Saving lab_1_1_1b_Canny_hough_line_48.mat
Saving lab_1_1_1b_Canny_hough_line_49.mat
Saving lab_1_1_1b_Canny_hough_line_50.mat
```

Solution 1c

```
Done
```

```
Saving lab_1_1_1c_Canny_hough_line_0.mat
Saving lab_1_1_1c_Canny_hough_line_1.mat
Saving lab_1_1_1c_Canny_hough_line_2.mat
Saving lab_1_1_1c_Canny_hough_line_3.mat
Saving lab_1_1_1c_Canny_hough_line_4.mat
Saving lab_1_1_1c_Canny_hough_line_5.mat
Saving lab_1_1_1c_Canny_hough_line_6.mat
Saving lab_1_1_1c_Canny_hough_line_7.mat
Saving lab_1_1_1c_Canny_hough_line_8.mat
Saving lab_1_1_1c_Canny_hough_line_9.mat
Saving lab_1_1_1c_Canny_hough_line_10.mat
Saving lab_1_1_1c_Canny_hough_line_11.mat
Saving lab_1_1_1c_Canny_hough_line_12.mat
Saving lab_1_1_1c_Canny_hough_line_13.mat
Saving lab_1_1_1c_Canny_hough_line_14.mat
Saving lab_1_1_1c_Canny_hough_line_15.mat
Saving lab_1_1_1c_Canny_hough_line_16.mat
Saving lab_1_1_1c_Canny_hough_line_17.mat
Saving lab_1_1_1c_Canny_hough_line_18.mat
Saving lab_1_1_1c_Canny_hough_line_19.mat
Saving lab_1_1_1c_Canny_hough_line_20.mat
Saving lab_1_1_1c_Canny_hough_line_21.mat
Saving lab_1_1_1c_Canny_hough_line_22.mat
Saving lab_1_1_1c_Canny_hough_line_23.mat
Saving lab_1_1_1c_Canny_hough_line_24.mat
Saving lab_1_1_1c_Canny_hough_line_25.mat
Saving lab_1_1_1c_Canny_hough_line_26.mat
Saving lab_1_1_1c_Canny_hough_line_27.mat
Saving lab_1_1_1c_Canny_hough_line_28.mat
Saving lab_1_1_1c_Canny_hough_line_29.mat
Saving lab_1_1_1c_Canny_hough_line_30.mat
Saving lab_1_1_1c_Canny_hough_line_31.mat
Saving lab_1_1_1c_Canny_hough_line_32.mat
Saving lab_1_1_1c_Canny_hough_line_33.mat
Saving lab_1_1_1c_Canny_hough_line_34.mat
Saving lab_1_1_1c_Canny_hough_line_35.mat
Saving lab_1_1_1c_Canny_hough_line_36.mat
Saving lab_1_1_1c_Canny_hough_line_37.mat
Saving lab_1_1_1c_Canny_hough_line_38.mat
Saving lab_1_1_1c_Canny_hough_line_39.mat
Saving lab_1_1_1c_Canny_hough_line_40.mat
Saving lab_1_1_1c_Canny_hough_line_41.mat
Saving lab_1_1_1c_Canny_hough_line_42.mat
Saving lab_1_1_1c_Canny_hough_line_43.mat
Saving lab_1_1_1c_Canny_hough_line_44.mat
Saving lab_1_1_1c_Canny_hough_line_45.mat
Saving lab_1_1_1c_Canny_hough_line_46.mat
Saving lab_1_1_1c_Canny_hough_line_47.mat
Saving lab_1_1_1c_Canny_hough_line_48.mat
Saving lab_1_1_1c_Canny_hough_line_49.mat
Saving lab_1_1_1c_Canny_hough_line_50.mat
```

Solution 2.1

```
Done
```

```
Saving lab_1_2_2.1_Canny_Hough_Mag_1.mat
Saving lab_1_2_2.1_Canny_Hough_Mag_2.mat
Saving lab_1_2_2.1_Canny_Hough_Mag_3.mat
```


Solution 2.2

```
Done
```

```
Processing 1 Canny Hough
image_1_2_2.2_Canny_Hough_Mag_1.mat, 1Mag, Approximate 0.5
image_1_2_2.2_Canny_Hough_Mag_1.mat, 1Mag, Approximate 0.5, 0.01, maxnumpeaks=50,
                                                    fillgap=20
Processing 2 Canny Hough
Max line 20 found
Max line 20 found
image_1_2_2.2_Canny_Hough_Mag_2.mat, 2Mag, Approximate 0.5, 0.01, 50, 20
Saved image to image_hough_line_1.mat
```



```
Processing 3 Canny Hough
image_1_2_2.2_Canny_Hough_Mag_3.mat, 3Mag, Approximate 0.5, 0.01, maxnumpeaks=50,
                                                    fillgap=20
Max line 20 found
Max line 20 found
Max line 20 found
image_1_2_2.2_Canny_Hough_Mag_3.mat, 3Mag, Approximate 0.5, 0.01, 50, 20
Saved image to image_hough_line_2.mat
```


Solution 3.1

```
Done
```

```
Saving lab_1_3_3.1_Canny_Hough_Mag_1.mat
Saving lab_1_3_3.1_Canny_Hough_Mag_2.mat
Saving lab_1_3_3.1_Canny_Hough_Mag_3.mat
```


Solution 3.2

```
Done
```

```
Processing 1 Canny Hough
image_1_3_3.2_Canny_Hough_Mag_1.mat, 1Mag, Approximate 0.5
image_1_3_3.2_Canny_Hough_Mag_1.mat, 1Mag, Approximate 0.5, 0.01, maxnumpeaks=50,
                                                    fillgap=20
Processing 2 Canny Hough
Max line 20 found
Max line 20 found
image_1_3_3.2_Canny_Hough_Mag_2.mat, 2Mag, Approximate 0.5, 0.01, 50, 20
Saved image to image_hough_line_3.mat
```



```
Processing 3 Canny Hough
image_1_3_3.2_Canny_Hough_Mag_3.mat, 3Mag, Approximate 0.5, 0.01, maxnumpeaks=50,
                                                    fillgap=20
Max line 20 found
Max line 20 found
Max line 20 found
image_1_3_3.2_Canny_Hough_Mag_3.mat, 3Mag, Approximate 0.5, 0.01, 50, 20
Saved image to image_hough_line_4.mat
```



```
Done
```

```
Saving lab_1_4_4_Canny_Hough_Mag_1.mat
Saving lab_1_4_4_Canny_Hough_Mag_2.mat
Saving lab_1_4_4_Canny_Hough_Mag_3.mat
```



```
Done
```

```
Saving lab_1_5_5_Canny_Hough_Mag_1.mat
Saving lab_1_5_5_Canny_Hough_Mag_2.mat
Saving lab_1_5_5_Canny_Hough_Mag_3.mat
```



```
Done
```

```
Saving lab_1_6_6_Canny_Hough_Mag_1.mat
Saving lab_1_6_6_Canny_Hough_Mag_2.mat
Saving lab_1_6_6_Canny_Hough_Mag_3.mat
```



```
Saving lab_1_7_7_Canny_Hough_Mag_1.mat
Saving lab_1_7_7_Canny_Hough_Mag_2.mat
Saving lab_1_7_7_Canny_Hough_Mag_3.mat
```



```
Saved image to image_hough_line_5.mat
```


The Canny edge detector is giving the best results for houghlinepeaks. Bias through transform can detect the lines of the image clearly. Hough transform with houghlinepeaks function is giving better results than the bias transform. Bias transform and hough transform both have a very rough transform. Since the images mostly has sound degrade the line detector doesn't work well with all the. Using Hough(only) image of Hough(line) will give better results. The Canny edge detector works well for the image as well.