









# 1. Basic Morphological Operators

Using morphological operators, separate each note into three parts as shown below. The output of your program should include 3 images, one containing the note's circle, another containing the stem, and a third containing the note's top bar.

## Task A: Single Note

Original	Output 1	Output 2	Output 3
			

## Task B: Double Note

Original	Output 1	Output 2	Output 3
			

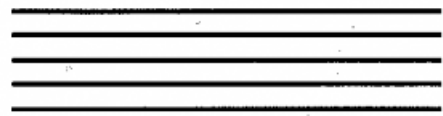
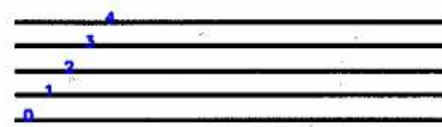
### Code

```
-----
Insert MATLAB code here.
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Insert C++ code here.
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```

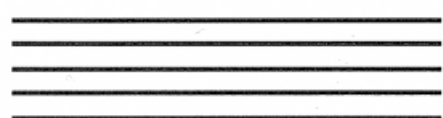
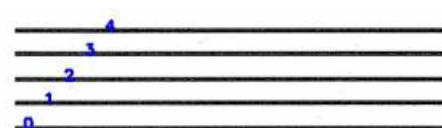
# 2. Line Segmentation

Segment the 5 lines from the music staff and enumerate them. To demonstrate success, your output image should have a number placed close to each line. Solve this part using both MATLAB and C++.

## Task A:

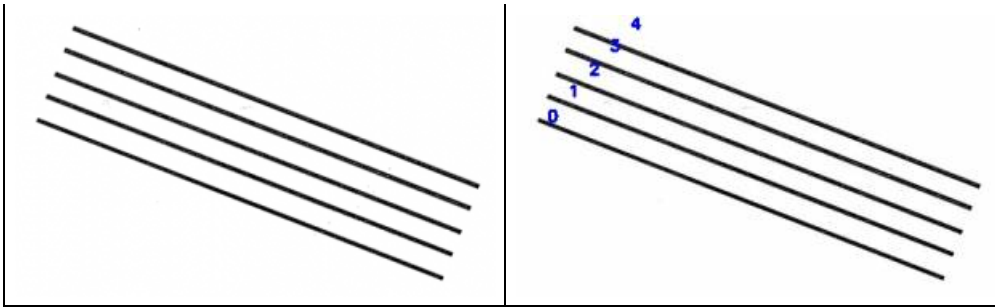
Original	Output
	

## Task B:

Original	Output
	

## Task C:

Original	Output



### Code

```

-----
: Insert MATLAB code here.
-----
: Insert C++ code here.
-----
    
```

### 3. Note Segmentation

For part 3, your task is to segment the notes and their bars from the background lines. Your solution should demonstrate that the notes and the bars can be segmented out and in addition, show that the notes can be separated from a bar that may connect two consecutive notes (see Task C). Solve this part using both MATLAB and C++.

#### Task A:

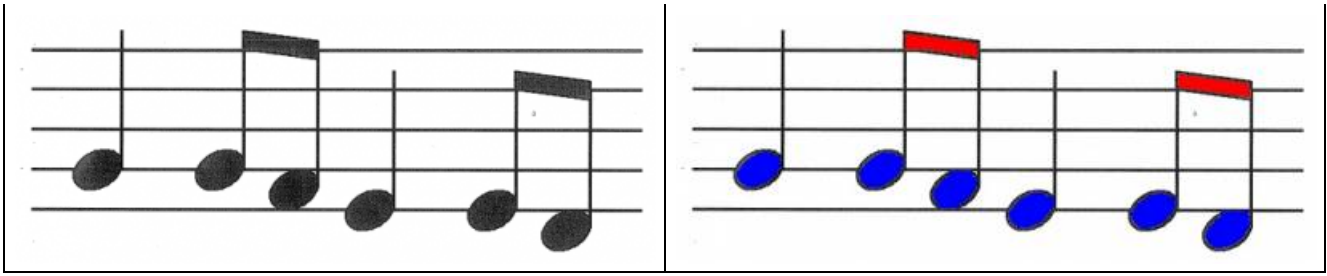
Original	Output

#### Task B:

Original	Output

#### Task C:

Original	Output



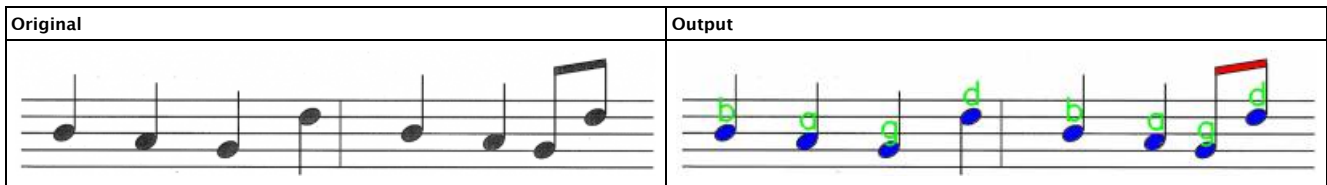
**Code**

```
-----
: Insert MATLAB code here.
:
: Insert C++ code here.
:
-----
```

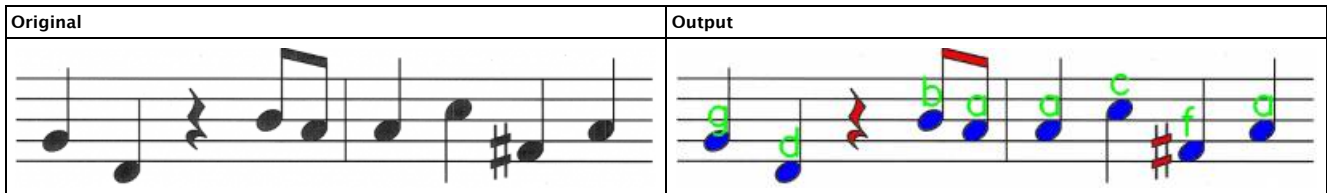
**4. Note Annotation**

For the last part, your task is to label each note on the staff with its corresponding letter (assuming the treble clef). An image showing the name for each note can be found here [http://upload.wikimedia.org/wikipedia/commons/thumb/d/d3/Bass\_and\_Treble\_clef.svg/400px-Bass\_and\_Treble\_clef.svg.png]. Solve this part using *either* MATLAB *or* C++.

**Task A:**



**Task B:**

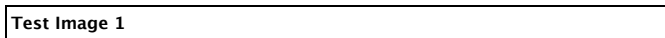


**Code**

```
-----
: Insert MATLAB code here.
:
: Insert C++ code here.
:
-----
```

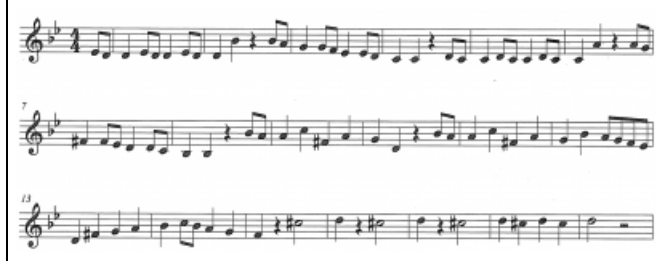
**5. Extra Credit**

For extra credit, solve the problems described above on the image posted below. The main difference is that now there are multiple staff lines. You can assume that there are at least two, but there could be more than that.





Test Image 2



## 6. Useful Links

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- \* Inverting an image using OpenCV [<http://opencv.wikispaces.com/4%29+Inverting+the+Image>]
- \* Finding connected components with OpenCV [<http://superkkt.com/488>]
- \* Finding connected components with MATLAB [<http://www.mathworks.com/help/toolbox/images/ref/bwconncomp.html>]

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