Image Segmentation

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Sources

- https://www.boost.org/doc/libs/1_54_0/libs/graph/doc/boykov_kolmogorov_max_flow.html
- https://www.boost.org/doc/libs/1_54_0/boost/graph/boykov_kolmogorov_max_flow.hpp

Steps

- Ask the user to mark the ‘object’ and the ‘background’ in the input image
- Group some pixels of the image into sets of pixels that are called super pixels
- Use the Boykov Kolmogorov Algorithm on these bigger sets of pixels to get a set of pixels. This is used to make a mask to black out the background
    - We have used NetworkX for this and their implementation for this

Step 1:

- Use OpenCV functions and events to achieve this
- Press ‘O’ to start marking objects (In red) and press ‘B’ to start marking the background (In blue). Press ‘Esc’ when done

C:\Windows\System32\cmd.exe - python main.py

```
Microsoft Windows [Version 10.0.18363.836]
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C:\Users\ajkad\Desktop\DSA Project\src>python main.py
```
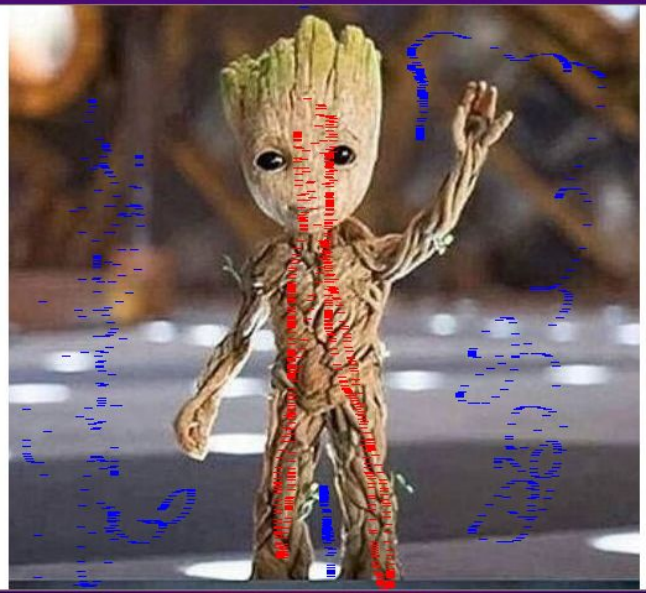
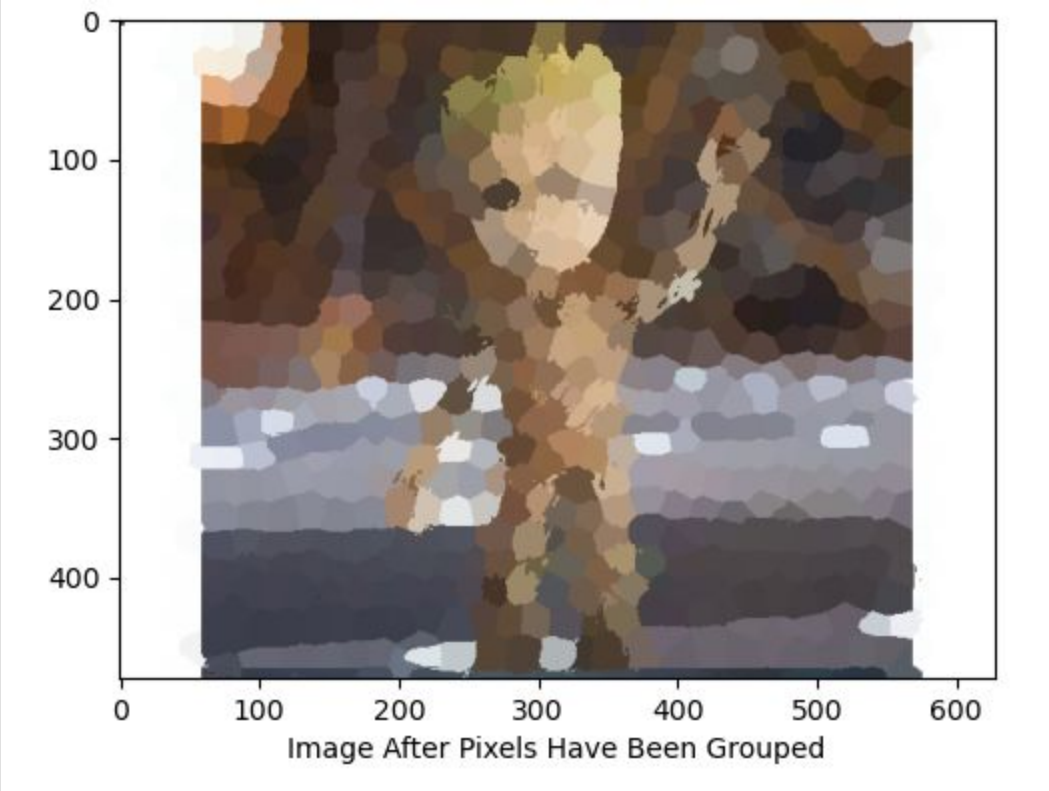

Window 1



Step 2:

- The groups of pixels defined in a class ‘SPNode’ are made
- Each groups properties are also calculated (The centroid, colour etc)


0
100
200
300
400
0
100
200
300
400
500
600
Image After Pixels Have Been Grouped

Step 3: The Algorithm (Runtime: $O(V^2*E)*$(Cost of the Min Cut))

- There are 2 trees - Source tree and Target tree
- Initially the source tree contains only 1 node, the initial source node. The target tree also contains only 1 node, the initial target node
- The algorithm basically finds the “shortest” paths from the source to the target nodes
- Each node can either be “active” or “passive”
- There are 3 phases
  - Grow phase (This is the main part)
  - Augment phase
  - Adopt phase

Grow Phase:

- In this phase, active nodes are allowed to acquire neighbor nodes that are “similar” (This is decided by the edge capacity, to make things simple we just thought of capacity like a weight or a measure of similarity)
- Acquiring means that those nodes become active and belong to the tree of the current node
- If there are no more valid neighbors, the current node becomes passive and the grow phase continues to the next active node
- The grow phase terminates if there are no more active nodes left or a node discovers a node from the other tree. In this case a path from source to target is found

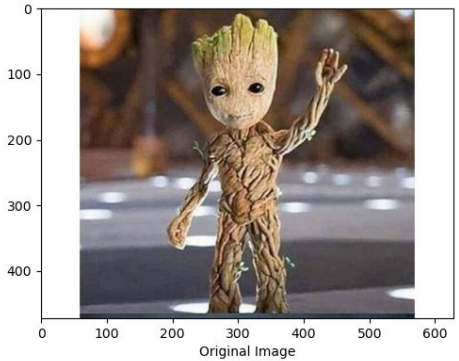
Augment Phase:

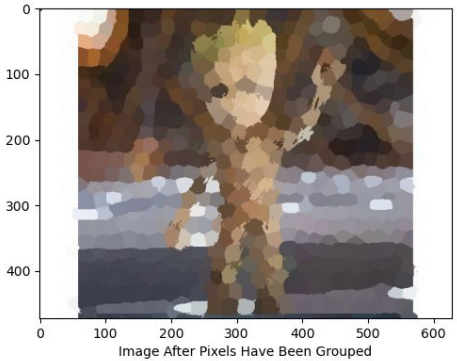
- This phase augments the path that was found in the grow phase by breaking down the trees.

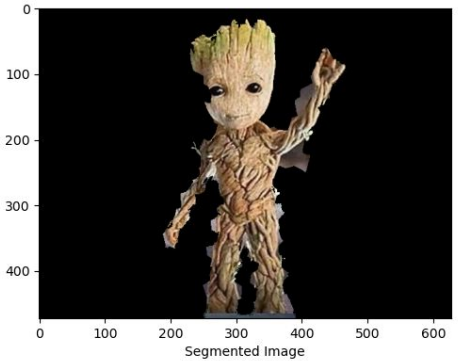
Adoption Phase:

- The trees that were broken down and separated are put back together
- But we've just considered all these separated parts as "free" nodes and put them back into the trees
- This phase terminates when there are no more orphaned/disconnected nodes

Figure 1







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The End