

RadiPOP

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Chapter 1

Namespace Index

1.1 Packages

Here are the packages with brief descriptions (if available):

segmentation	9
segmentation_utils	11

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Frame	
Application	15

Chapter 3

Class Index

3.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Application	
Tkinter frame	15

Chapter 4

File Index

4.1 File List

Here is a list of all files with brief descriptions:

/Users/lorenz/Desktop/release/radipop/ segmentation.py	33
/Users/lorenz/Desktop/release/radipop/ segmentation_utils.py	33

Chapter 5

Namespace Documentation

5.1 segmentation Namespace Reference

Classes

- class [Application](#)
Tkinter frame.

Functions

- def [assign_colors](#) (mask)
Display utility; colors every region green with a darker green outline; regions labeled 1 and 2 are special (they are known liver/spleen) and are colored bright red/blue.
- def [find_organs](#) (slice_idx, patient_id, bones_thresh, blood_vessels_thresh, liver_thresh)
Uses three threshold values to find organs.

Variables

- [app](#) = [Application](#)(root)
- [root](#) = Tk()

5.1.1 Function Documentation

5.1.1.1 [assign_colors\(\)](#)

```
def segmentation.assign_colors (  
    mask )
```

Display utility; colors every region green with a darker green outline; regions labeled 1 and 2 are special (they are known liver/spleen) and are colored bright red/blue.

Parameters

<i>mask</i>	labelled mask
-------------	---------------

Returns

colored mask

5.1.1.2 find_organs()

```
def segmentation.find_organs (
    slice_idx,
    patient_id,
    bones_thresh,
    blood_vessels_thresh,
    liver_thresh )
```

Uses three threshold values to find organs.

The algorithm is:

- After some smoothing, remove every pixel above bones threshold from the image.
- After some smoothing, remove every pixel above blood vessel threshold.
- Everything that then remains above liver threshold is called an organ.
- Use contiguous area divisions to roughly split into organs.

Parameters

<i>slice_inx</i>	Index of slice on which to find organs
<i>patient_id</i>	Id of Patient
<i>bones_thres</i>	bones threshold: [threshold, square_size , min_size]
<i>blood_vessels_thresh</i>	blood vessels threshold: [threshold, square_size , min_size]
<i>liver_thresh</i>	liver threshold: [threshold, square_size , min_size]

Returns

New binary mask (same size as slice)

5.1.2 Variable Documentation**5.1.2.1 app**

```
app = Application(root)
```


5.1.2.2 root

```
root = Tk()
```

5.2 segmentation_utils Namespace Reference

Functions

- def [add_sobel_edges](#) (mask, img)
Smooth edges Steps:
- def [draw_region_outlines](#) (mask)
Color the mask light green.
- def [guess_bounds](#) (regions_map, reference_map)
Guess the bounds/labels of the region based on reference region Guess the bounds/labels of the region based on reference region (generally neighboring slice).
- def [partition_at_threshold](#) (img, thresh, square_size, min_size, title=None, show_plot=True)
After some smoothing, calculate new mask for img Steps:
- def [save_partition](#) (mask, path)
- def [trim_background](#) (img, dims=None)

5.2.1 Function Documentation

5.2.1.1 add_sobel_edges()

```
def segmentation_utils.add_sobel_edges (
    mask,
    img )
```

Smooth edges Steps:

- Edge filter image using the Canny algorithm.
- euclidean distance transform

Parameters

<i>mask</i>	mask corresponding to image
<i>img</i>	image corresponding to mask

Returns

mask with smoothed edges

5.2.1.2 draw_region_outlines()

```
def segmentation_utils.draw_region_outlines (
    mask )
```

Color the mask light green.

Color the edges of the mask darker green.

Parameters

<i>mask</i>	mask for which to color the outlines
-------------	--------------------------------------

Returns

mask with colored outlines

5.2.1.3 guess_bounds()

```
def segmentation_utils.guess_bounds (
    regions_map,
    reference_map )
```

Guess the bounds/labels of the region based on reference region Guess the bounds/labels of the region based on reference region (generally neighboring slice).

Parameters

<i>regions_map</i>	mask to guess labels for
<i>reference_map</i>	reference mask (already labelled)

Returns

mask (labelled)

5.2.1.4 partition_at_threshold()

```
def segmentation_utils.partition_at_threshold (
    img,
    thresh,
    square_size,
    min_size,
    title = None,
    show_plot = True )
```

After some smoothing, calculate new mask for img Steps:

- gaussian filter,
- remove small objects,
- greyscale morphological closing,
- euclidean distance transform

Parameters

<i>img</i>	type numpy.ndarray
<i>thres</i>	Threshold value
<i>min_size</i>	Minimum size of an organ in the mask
<i>squaresize</i>	For greyscale morphological closing
<i>title</i>	Title of plot
<i>show_plot</i>	Show plot True/False

Returns

New binary mask (same size as img)

5.2.1.5 save_partition()

```
def segmentation_utils.save_partition (
    mask,
    path )
```

5.2.1.6 trim_background()

```
def segmentation_utils.trim_background (
    img,
    dims = None )
```

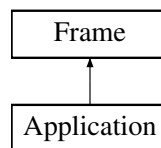

Chapter 6

Class Documentation

6.1 Application Class Reference

Tkinter frame.

Inheritance diagram for Application:



Public Member Functions

- def `__init__` (self, master)
- def `createWidgets` (self)
Creates all input elements of GUI.
- def `deleteAll` (self)
Deletes lines drawn by the user.
- def `deleteAndReload` (self)
Discards lines drawn by user on the canvas and reloads current slice.
- def `displayMask` (self)
Shows mask on canvas if self.showMask is true.
- def `enableLineDrawing` (self, event)
Draw lines on display area Activated if user clicks on display area/canvas and the drawing mode is enabled (correct↔ ParitionButton)
- def `extend_labels` (self)
Extend labels from current slice to neighbouring slices Extends labels left and right from current slice How far the labels are extended is taken from left and right expansion bounds.
- def `extend_thresholds` (self)
Extends the three thresholds to all slices Also runs find_organs on all slices and updates the masks.
- def `fileSave` (self)
- def `hide_button` (self)
- def `hide_controls` (self, controls)
Hide given GUI control element.

- def [highlightOrgan](#) (self, event)
Highlights regions of the mask (organs) that were clicked on by user.
- def [label_controls](#) (self)
- def [label_quest](#) (self)
- def [labelLiver](#) (self)
- def [labelSpleen](#) (self)
- def [load_masks](#) (self, [patient_id](#))
- def [loadSlice](#) (self)
Reset canvas and load slice of current index and patient Also deactivates drawing mode.
- def [navigation_controls](#) (self)
- def [partitionOrgans](#) (self)
Activates drawing mode Enables drawing lines on slice which mark regions of the mask that should be removed.
- def [save_controls](#) (self)
- def [set_liver_intensity](#) (self, event)
Sets threshold for liver intensity Steps:
- def [set_threshold_toggles](#) (self)
- def [setPartition](#) (self)
Apply changes made in drawing mode Removes regions of the mask that were marked by the user with lines Deactivates drawing mode Deletes lines drawn by user after the masks have been partitioned.
- def [SetPatient](#) (self, choice)
- def [setSlice](#) (self, event)
- def [show_button](#) (self)
- def [show_controls](#) (self, controls, offset)
- def [slice_editing_controls](#) (self)
- def [toggleMask](#) (self)
Display/Hide mask Sets self.showMask to true/false Deletes mask from canvas Changes label of button: show mask/hide mask.

Public Attributes

- [blood_vessel_var](#)
Variable value: blood vessel intensity slider.
- [bloodVesselIntensityScale](#)
Slider: blood vessel intensity.
- [bone_var](#)
Variable value: bone intensity slider.
- [boneIntensityScale](#)
Slider: bone intensity.
- [buttonAccept](#)
Button: Deactivates drawing mode and applies manual changes to mask.
- [buttonDeleteAll](#)
Button: Revokes manual changes of mask made in drawing mode (buttonPartition) - only works in drawing mode.
- [buttonExtend](#)
expansion bounds --> propagate labelling to left and right from current slice
- [buttonExtendInt](#)
Button: Apply thresholds on all slices.
- [buttonLabelLiver](#)
- [buttonLabelSpleen](#)
- [buttonPartition](#)
Button: Activates drawing mode --> delete regions of masks manually.
- [buttonSave](#)

- [buttonToggleMask](#)
Button: Hide/Display mask Button.
- [drawLine](#)
Drawing mode on/off.
- [entry_label](#)
Set expansion Bounds - section text.
- [entryFrame](#)
- [file_dir](#)
- [highlight_img](#)
- [img](#)
- [label](#)
- [labelBloodVesselIntensity](#)
Text label: blood vessel intensity slider.
- [labelBoneIntensity](#)
Text label: bone intensity slider.
- [labelLiverIntensity](#)
Text label: liver intensity slider.
- [labelThickness](#)
- [last_clicked_x](#)
- [last_clicked_y](#)
- [leftFrame](#)
- [line_segments](#)
Line segments, created from the points the user clicked on on the canvas.
- [lines](#)
Line drawn on canvas.
- [liver_var](#)
Variable value: liver intensity slider.
- [liverIntensityScale](#)
Slider: liver intensity.
- [mask](#)
- [mask_img](#)
- [masks](#)
- [myCanvas](#)
- [myEntry1](#)
Left expansion bound.
- [myEntry2](#)
Right expansion bound.
- [myScale](#)
- [patient_id](#)
- [patients](#)
- [pixel_value](#)
- [previousX](#)
Last X coordinate user clicked on, on the canvas.
- [previousY](#)
Last Y coordinate user clicked on, on the canvas.
- [quest](#)
- [questCheck](#)
- [questionable_slices](#)
- [radiobuttonValue](#)
- [rgb](#)
- [showMask](#)
- [slice_idx](#)
- [slices](#)
- [thresholds](#)
- [tkvar](#)
- [toolsThickness](#)

6.1.1 Detailed Description

Tkinter frame.

6.1.1.1 Features:

- Open patient and flip through frames - v1 done
- Draw line to separate organs - line drawing is done
- Label liver (lobes, spleen)
- Organ lights up when clicked - v1 done
- Organ label consistency across slices
- Mark and ignore messed up slices
- Still missing:
- Check that save button works
- Make configurable how far to extend corrections to each side - done
- Display which slices were hand-corrected and which have liver/spleen
- Extend threshold adjustments - done

6.1.2 Constructor & Destructor Documentation

6.1.2.1 `__init__()`

```
def __init__ (
    self,
    master )
```

6.1.3 Member Function Documentation

6.1.3.1 `createWidgets()`

```
def createWidgets (
    self )
```

Creates all input elements of GUI.

6.1.3.2 deleteAll()

```
def deleteAll (
    self )
```

Deletes lines drawn by the user.

Resets canvas.

6.1.3.3 deleteAndReload()

```
def deleteAndReload (
    self )
```

Discards lines drawn by user on the canvas and reloads current slice.

6.1.3.4 displayMask()

```
def displayMask (
    self )
```

Shows mask on canvas if self.showMask is true.

6.1.3.5 enableLineDrawing()

```
def enableLineDrawing (
    self,
    event )
```

Draw lines on display area Activated if user clicks on display area/canvas and the drawing mode is enabled (correctParitionButton)

Parameters

<i>event</i>	GUI event
--------------	-----------

6.1.3.6 extend_labels()

```
def extend_labels (
    self )
```

Extend labels from current slice to neighbouring slices Extends labels left and right from current slice How far the labels are extended is taken from left and right expansion bounds.

6.1.3.7 extend_thresholds()

```
def extend_thresholds (
    self )
```

Extends the three thresholds to all slices Also runs find_organ on all slices and updates the masks.

6.1.3.8 fileSave()

```
def fileSave (
    self )
```

6.1.3.9 hide_button()

```
def hide_button (
    self )
```

6.1.3.10 hide_controls()

```
def hide_controls (
    self,
    controls )
```

Hide given GUI control element.

Parameters

<i>controls</i>	control element to hide from GUI
-----------------	----------------------------------

6.1.3.11 highlightOrgan()

```
def highlightOrgan (
    self,
    event )
```

Highlights regions of the mask (organs) that were clicked on by user.

The function is bound to the canvas.

6.1.3.12 label_controls()

```
def label_controls (
    self )
```

6.1.3.13 label_quest()

```
def label_quest (
    self )
```

6.1.3.14 labelLiver()

```
def labelLiver (
    self )
```

6.1.3.15 labelSpleen()

```
def labelSpleen (
    self )
```

6.1.3.16 load_masks()

```
def load_masks (
    self,
    patient_id )
```

6.1.3.17 loadSlice()

```
def loadSlice (
    self )
```

Reset canvas and load slice of current index and patient Also deactivates drawing mode.

6.1.3.18 navigation_controls()

```
def navigation_controls (
    self )
```

6.1.3.19 partitionOrgans()

```
def partitionOrgans (
    self )
```

Activates drawing mode Enables drawing lines on slice which mark regions of the mask that should be removed.

6.1.3.20 save_controls()

```
def save_controls (
    self )
```

6.1.3.21 set_liver_intensity()

```
def set_liver_intensity (
    self,
    event )
```

Sets threshold for liver intensity Steps:

- Sets thresholds for current slice (self.slice_idx)
- Runs self.find_organ on current slice with new thresholds
- Updates self.masks at current slice index

Parameters

<i>self</i>	self
<i>event</i>	Unused - kept just in case

6.1.3.22 set_threshold_toggles()

```
def set_threshold_toggles (
    self )
```

6.1.3.23 setPartition()

```
def setPartition (
    self )
```

Apply changes made in drawing mode Removes regions of the mask that were marked by the user with lines
Deactivates drawing mode Deletes lines drawn by user after the masks have been partitioned.

6.1.3.24 SetPatient()

```
def SetPatient (
    self,
    choice )
```

6.1.3.25 setSlice()

```
def setSlice (
    self,
    event )
```

6.1.3.26 show_button()

```
def show_button (
    self )
```

6.1.3.27 show_controls()

```
def show_controls (
    self,
    controls,
    offset )
```

6.1.3.28 slice_editing_controls()

```
def slice_editing_controls (
    self )
```

6.1.3.29 toggleMask()

```
def toggleMask (
    self )
```

Display/Hide mask Sets self.showMask to true/false Deletes mask from canvas Changes label of button: show mask/hide mask.

6.1.4 Member Data Documentation

6.1.4.1 blood_vessel_var

```
blood_vessel_var
```

Variable value: blood vessel intensity slider.

6.1.4.2 bloodVesselIntensityScale

```
bloodVesselIntensityScale
```

Slider: blood vessel intensity.

6.1.4.3 bone_var

```
bone_var
```

Variable value: bone intensity slider.

6.1.4.4 boneIntensityScale

```
boneIntensityScale
```

Slider: bone intensity.

6.1.4.5 buttonAccept

`buttonAccept`

Button: Deactivates drawing mode and applies manual changes to mask.

6.1.4.6 buttonDeleteAll

`buttonDeleteAll`

Button: Revokes manual changes of mask made in drawing mode (`buttonParition`) - only works in drawing mode.

6.1.4.7 buttonExtend

`buttonExtend`

expansion bounds --> propagate labelling to left and right from current slice

6.1.4.8 buttonExtendInt

`buttonExtendInt`

Button: Apply thresholds on all slices.

6.1.4.9 buttonLabelLiver

`buttonLabelLiver`

6.1.4.10 buttonLabelSpleen

`buttonLabelSpleen`

6.1.4.11 buttonPartition

`buttonPartition`

Button: Activates drawing mode --> delete regions of masks manually.

6.1.4.12 buttonSave

`buttonSave`

6.1.4.13 buttonToggleMask

`buttonToggleMask`

Button: Hide/Display mask Button.

6.1.4.14 drawLine

`drawLine`

Drawing mode on/off.

6.1.4.15 entry_label

`entry_label`

Set expansion Bounds - section text.

6.1.4.16 entryFrame

`entryFrame`

6.1.4.17 file_dir

`file_dir`

6.1.4.18 highlight_img

highlight_img

6.1.4.19 img

img

6.1.4.20 label

label

6.1.4.21 labelBloodVesselIntensity

labelBloodVesselIntensity

Text label: blood vessel intensity slider.

6.1.4.22 labelBoneIntensity

labelBoneIntensity

Text label: bone intensity slider.

6.1.4.23 labelLiverIntensity

labelLiverIntensity

Text label: liver intensity slider.

6.1.4.24 labelThickness

labelThickness

6.1.4.25 last_clicked_x

`last_clicked_x`

6.1.4.26 last_clicked_y

`last_clicked_y`

6.1.4.27 leftFrame

`leftFrame`

6.1.4.28 line_segments

`line_segments`

Line segments, created from the points the user clicked on on the canvas.

6.1.4.29 lines

`lines`

Line drawn on canvas.

6.1.4.30 liver_var

`liver_var`

Variable value: liver intensity slider.

6.1.4.31 liverIntensityScale

`liverIntensityScale`

Slider: liver intensity.

6.1.4.32 mask

mask

6.1.4.33 mask_img

mask_img

6.1.4.34 masks

masks

6.1.4.35 myCanvas

myCanvas

6.1.4.36 myEntry1

myEntry1

Left expansion bound.

6.1.4.37 myEntry2

myEntry2

Right expansion bound.

6.1.4.38 myScale

myScale

6.1.4.39 patient_id

patient_id

6.1.4.40 patients

patients

6.1.4.41 pixel_value

pixel_value

6.1.4.42 previousX

previousX

Last X coordinate user clicked on, on the canvas.

6.1.4.43 previousY

previousY

Last Y coordinate user clicked on, on the canvas.

6.1.4.44 quest

quest

6.1.4.45 questCheck

questCheck

6.1.4.46 questionable_slices

questionable_slices

6.1.4.47 radiobuttonValue

radiobuttonValue

6.1.4.48 rgb

rgb

6.1.4.49 showMask

showMask

6.1.4.50 slice_idx

slice_idx

6.1.4.51 slices

slices

6.1.4.52 thresholds

thresholds

6.1.4.53 tkvar

tkvar

6.1.4.54 toolsThickness

toolsThickness

The documentation for this class was generated from the following file:

- /Users/lorenz/Desktop/release/radipop/[segmentation.py](#)

Chapter 7

File Documentation

7.1 /Users/lorenz/Desktop/release/radipop/segmentation.py File Reference

Classes

- class [Application](#)
Tkinter frame.

Namespaces

- namespace [segmentation](#)

Functions

- def [assign_colors](#) (mask)
Display utility; colors every region green with a darker green outline; regions labeled 1 and 2 are special (they are known liver/spleen) and are colored bright red/blue.
- def [find_organisms](#) (slice_idx, patient_id, bones_thresh, blood_vessels_thresh, liver_thresh)
Uses three threshold values to find organs.

Variables

- [app](#) = Application(root)
- [root](#) = Tk()

7.2 /Users/lorenz/Desktop/release/radipop/segmentation_utils.py File Reference

Namespaces

- namespace [segmentation_utils](#)

Functions

- def [add_sobel_edges](#) (mask, img)
Smooth edges Steps:
- def [draw_region_outlines](#) (mask)
Color the mask light green.
- def [guess_bounds](#) (regions_map, reference_map)
Guess the bounds/labels of the region based on reference region Guess the bounds/labels of the region based on reference region (generally neighboring slice).
- def [partition_at_threshold](#) (img, thresh, square_size, min_size, title=None, show_plot=True)
After some smoothing, calculate new mask for img Steps:
- def [save_partition](#) (mask, path)
- def [trim_background](#) (img, dims=None)

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