RadiPOP

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Chapter 1

Namespace Index

1.1 Packages

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

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

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

Chapter 3

Class Index

3.1 Class List

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

Chapter 4

File Index

4.1 File List

Here is a list of all files with brief descriptions:

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

mask	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

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

mask	mask corresponding to image
img	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

mask	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

regions_map	mask to guess labels for
reference_map	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

img	type numpy.ndarray
thres	Threshold value
min_size	Minimum size of an organ in the mask
squaresize	For greyscale morphological closing
title	Title of plot
show_plot	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 )
```

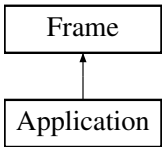
Chapter 6

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 (buttonParition) - 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

event	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_organs 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

controls	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_organs on current slice with new thresholds
- Updates self.masks at current slice index

Parameters

self	self
event	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_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()

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)

Index