Deep learning Lab3

Advanced representation of saliency maps

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Introduction

In this lasb3, I compute saliency maps and explore different methods to represent them in various forms. The objective is to create alternative visual representations for saliency maps that will be used in subsequent lessons. To accomplish this, I will leverage the capabilities of the Pillow library (PIL), which is a powerful Python library for image processing.

Methodology

heatmap representation / represent_heatmap (saliency: Saliency, cmap='gist_heat)

Represent heatmap is a function that produces a saliency map into a heatmap and after it is normalized into 0 and 1.

Heat(x, y) = Colormap (Saliency (x, y))

Overlay: represent_heatmap_overlaid(saliency_path, image_path, cmap):

produce the image that represents saliency overlaid on the corresponding test image.

RGBA (Red, Green, Blue, Alpha) : In this mode, each pixel is represented by four values: the red, green, and blue color components, and the alpha channel, which controls transparency.

Heat2(x, y) = Combine (Heat(x, y), Img(x, y)).

```
overlay2 = Image.blend(overlay_image.convert("RGBA"),
    Image.fromarray((normalized_saliency_map * 255).astype(np.uint8)).convert("RGBA"), alpha=0.7)
```

By changing alpha (blending factor). It controls the weight of the second image (saliency map overlay) in the final result. An alpha value of 0.7 means that the overlay image will be somewhat transparent, allowing the background image to show through partially. The higher the alpha value, the less transparent the overlay will be.

Implement isoline representation few other functions

Isolines allow to visualize boundaries of values in the saliency map by displaying lines of constant values.

- represent_isolines(saliency_path, cmap): Iso(x, y) = Colormap (Countour(Img) (x, y))
  Generates an isoline representation of the saliency map using contour lines with the specified colormap.
- represent_isolines_superimposed(saliency_path, image_path, cmap):
  Overlays the isoline representation on top of another image and displays the result. It blends the isolines and the image shows overlaid isolines

- represent_hard_selection(saliency_path, image_path, threshold: float):

Applies hard selection to overlay an image with saliency values greater than or equal to a specified threshold. that produces the image that contains only the pixels where the saliency value is higher or equal than the threshold

- represent_soft_selection(saliency, image, threshold): that produces the image that represents contains only the pixels intensity depends on the saliency map

Results

The main saliency map class has been tested with a few other image pairs: the results are the following. Except for test.png, I wanted to try out some pairs with the zoom version and zoom out version**: winning approach:** I discovered the heatmap is a bit similar but isolines are clearly difference most importantly the hard and soft selection is interesting to see because those are difference even though the images are same group:

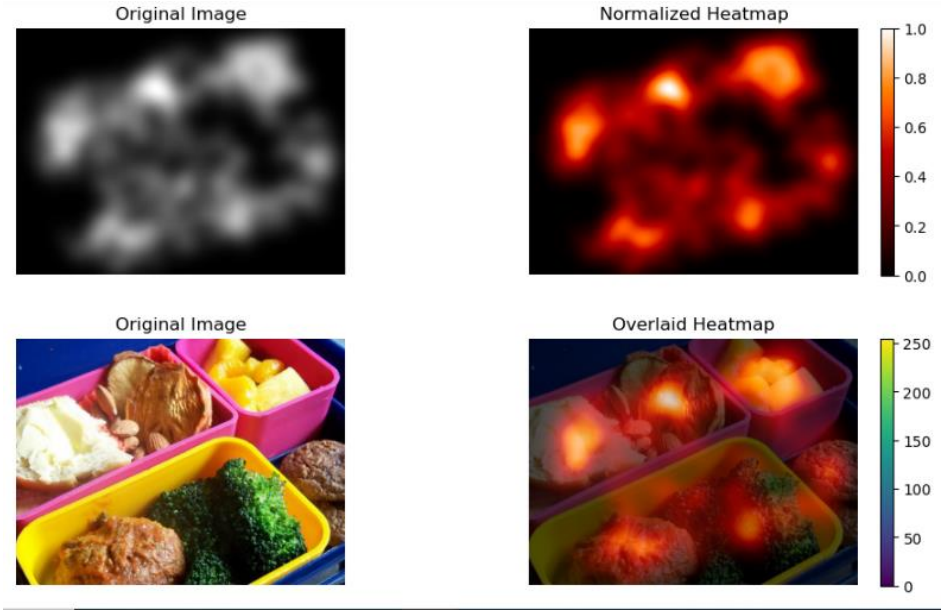

Fig_01: test.png:

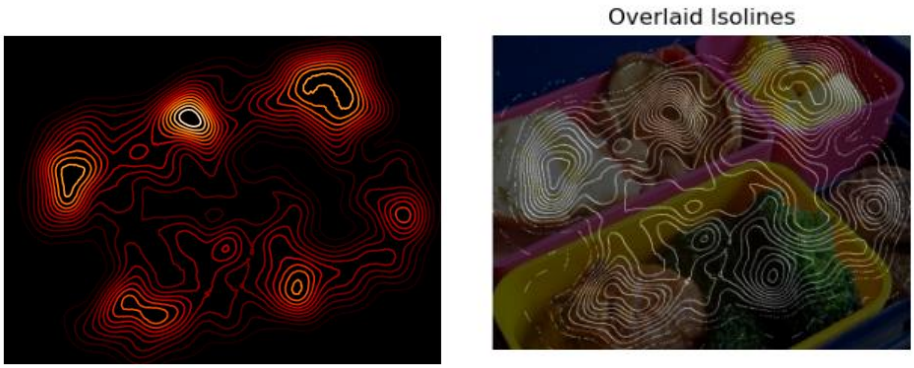

Fig_02: test.png:

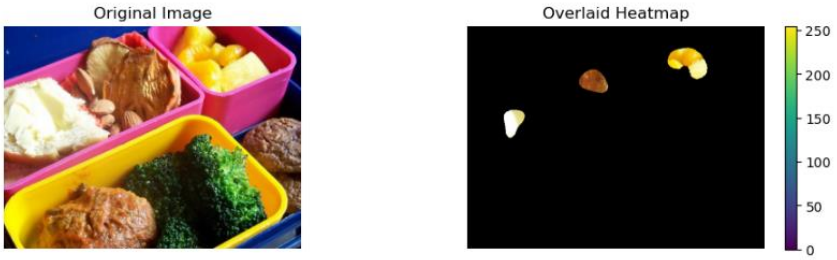

Fig_03: test.png:

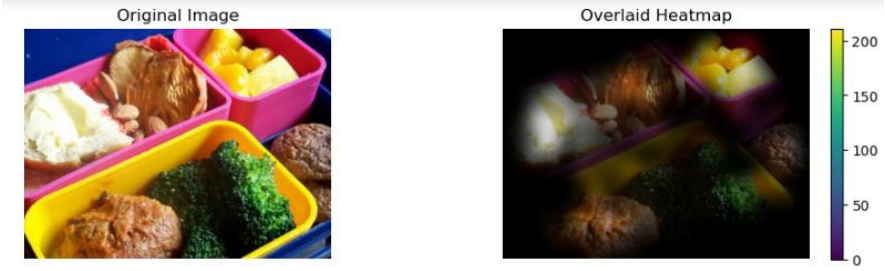

Fig_04: test.png:

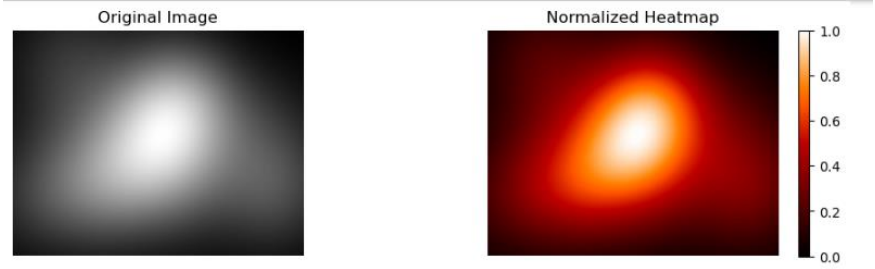

Fig_05: Colonial_AcademiaDeBellasArtes_Queretaro_GFDM_N_1.png:

Fig_06: Colonial_AcademiaDeBellasArtes_Queretaro_GFDM_N_1.png:

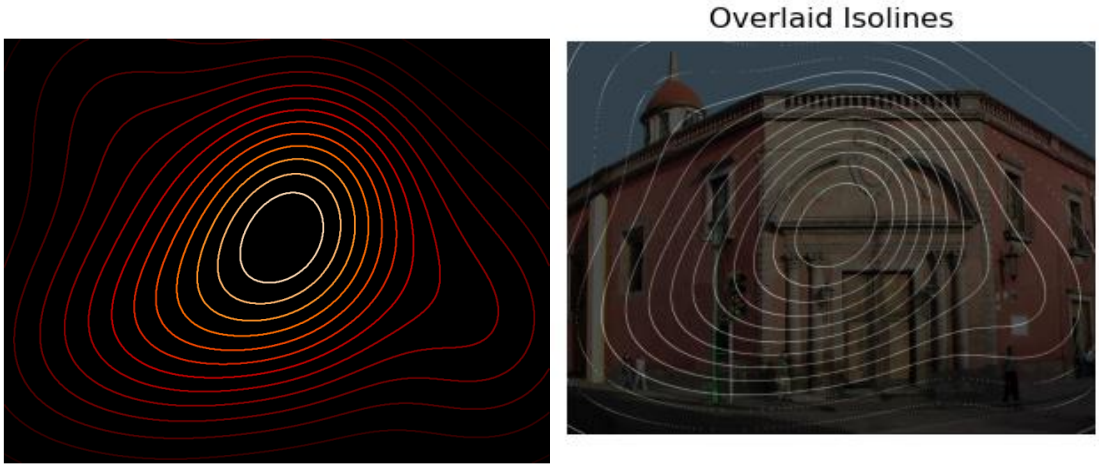

Fig_07: Colonial_AcademiaDeBellasArtes_Queretaro_GFDM_N_1.png:

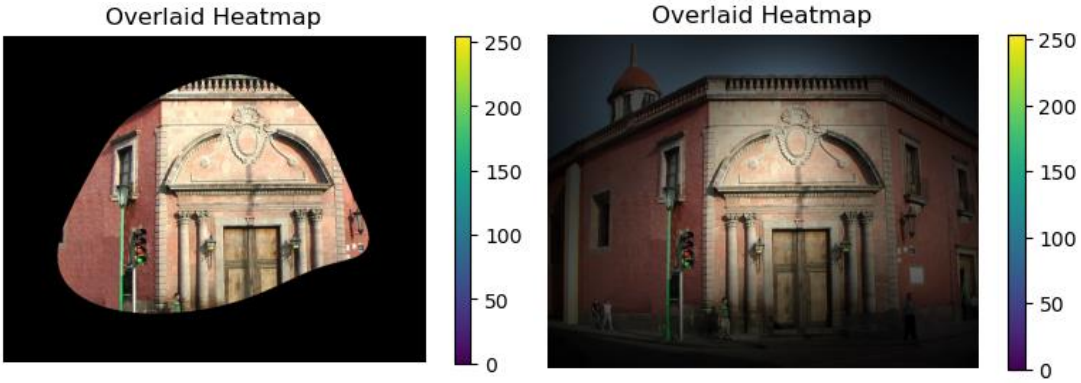

Fig_07: Colonial_AcademiaDeBellasArtes_Queretaro_GFDM_N_1.png:

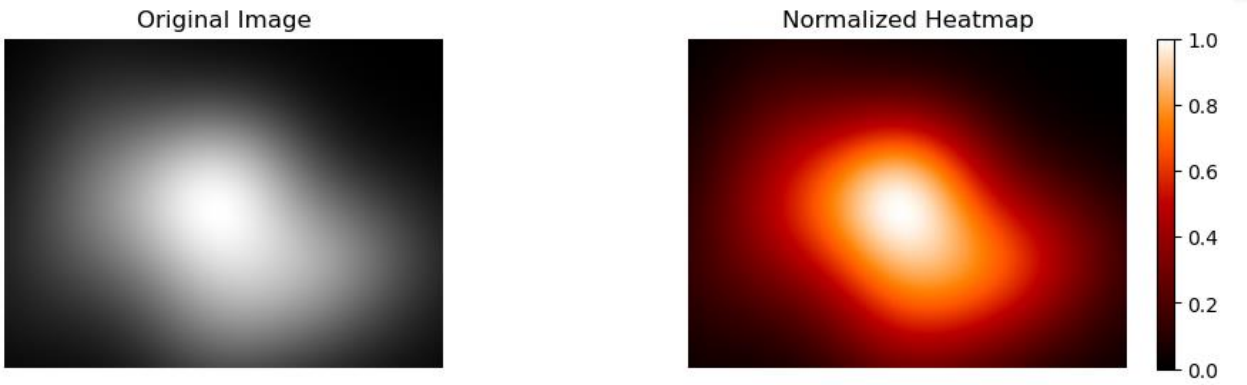

Fig_08: Colonial_AcademiaDeBellasArtes_Queretaro_GFDM_N_2.png:

Fig_09: Colonial_AcademiaDeBellasArtes_Queretaro_GFDM_N_2.png:

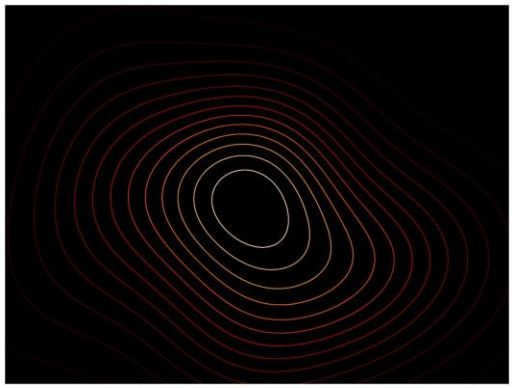

Fig_10: Colonial_AcademiaDeBellasArtes_Queretaro_GFDM_N_2.png:

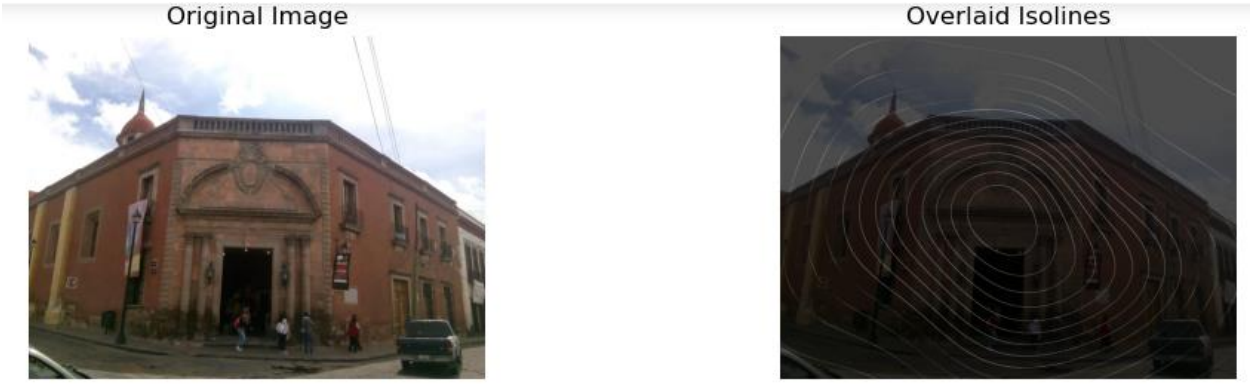

Fig_11: Colonial_AcademiaDeBellasArtes_Queretaro_GFDM_N_2.png:

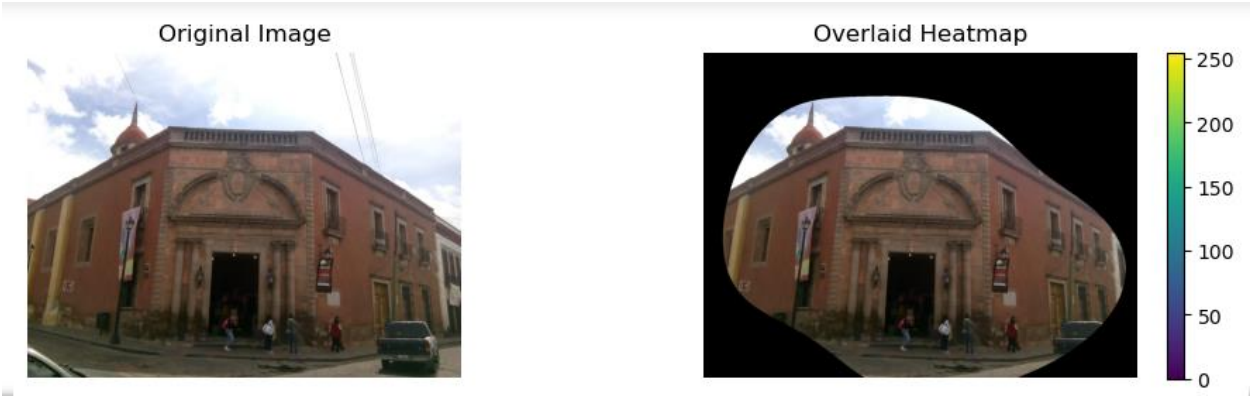

Fig_12: Colonial_AcademiaDeBellasArtes_Queretaro_GFDM_N_2.png:

Fig_13: Colonial_AcademiaDeBellasArtes_Queretaro_GFDM_N_2.png:

Discussion

According to the given task I managed to compute an advanced representation of saliency maps and try with different image pairs. **Heatmap Representation:** Heatmaps are efficient for highlighting regions of interest in a saliency map. They provide a clear indication of where the most important areas are. This approach is particularly effective when you want to identify key areas quickly.

Overlay on Original Image: Overlaying the saliency map on the original image helps viewers understand how salient regions correspond to the actual content of the image. This can be valuable for interpreting the importance of regions in context.

Isolines Representation: Isolines show contours of different saliency levels. This approach can be beneficial when you want to visualize gradient saliency, indicating transitions from less salient to more salient regions.

Superimposed Isolines on Image: Superimposing isolines on the original image provides a balanced view between isolines and the image content. It can be helpful for understanding how the saliency map relates to the image, especially when there are gradient transitions.

Hard Selection: Hard selection visually demonstrates the regions that surpass a given threshold. This can be efficient when you want to emphasize areas that are highly salient and filter out less important areas.

Soft Selection: Soft selection blends the image and saliency map, giving weight to each pixel according to the saliency value. This allows for a smooth transition between salient and non-salient regions. It can be a good choice when you want to retain the image's context.

The most efficient approach depends on our specific task and the nature of the given data. If we need a quick and clear identification of salient regions, the heatmap representation may be sufficient. If we want a more detailed analysis of transitions and how salient regions relate to the content, the isolines or superimposed isolines might be preferable.

In general, it's often valuable to use a combination of these visualization techniques depending on the context and audience, starting with a heatmap to identify general areas of interest, then switching to an overlaid image for context, and use isolines for detailed analysis.