Convolution Can Incur Foveation Effects

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Proposed Format

An web-based animated visualization demonstrating how boundary treatment in convolutional networks can incur foveation effects: Impacted pixels have fewer ways to contribute to the computation than center pixels. This effect has been reported in an ICLR 2021 paper and illustrated for a few boundary treatment methods via a lengthy appendix.

- Benefits over the lengthy PDF appendix (18 pages):
  - **Presentation**
    The animated visualization better communicates foveation effects:
    - It better reveals how the padding mechanism shapes these effects, e.g. 0-padding, reflection, circular padding, or partial convolution.
    - It better reveals, under which padding method these effects are insensitive to dilation and kernel size.
    - It enables examining the effect for every pixel the user clicks, whereas in PDF appendix only focuses on exemplar pixels.
    - It is suited both for asynchronous research presentation as well as for virtual conferences or education.
  - **Reviewing**
    The animated visualization are easier to review:
    - They are significantly more concise.
    - They provide visual intuition that helps convince the reviewers.
- Interoperability:
  The interactive visualizations can be converted to animated GIFs to showcase particlular examples. They do not fit in PDF format, however, snapshots can be embedded in PDF to illustrate particlular cases.
- Potential limitations:
    - While version control is possible in the GitHub repository, the effect of changes is not always easy to realize. In paritcular, it is not straightforward to compare two versions, as in the case of PDF.
    - Durability: changes in web standards might impact the layout of our animated visualizations. While we strictly used standard HTML elements, we cannot warrant the layout will be correctly rendered after potentially massive changes after decades.

Accessibility Statement

Our animated visualizations rely on a simplified point-and-click user interface. At its current accessibility level, our implementation expect users to operate such a graphical interface. Steps taken to improve accessibility concerns:

- We reduced user affordance to increase accessible to users with motor disabilities. Our UI does not demand users to enter any text or to drag sliders. It is composed solely of buttons the enable the user to switch between padding mechanisms and pre-defined cases (e.g. dilation = 2, kernel size = 5x5).
- We used color scales that make different values distinguishable to color-blind users (see colorbrewer2.org).
- The UI works on tablets and smartphones, besides desktop and laptop computers.

We will enable users to open issues and submit pull requests on GitHub to report issues with operating the UI, including exceptions to intended accessibility levels, aiming to continuously improve accessibility.