Bilinear Interpolation Upsampling on CUDA
Project Phase-I

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Problem

- A deep network for object segmentation.
- This network has 5 two-by-two max-pooling layer, each of which down-samples its input by factor two.
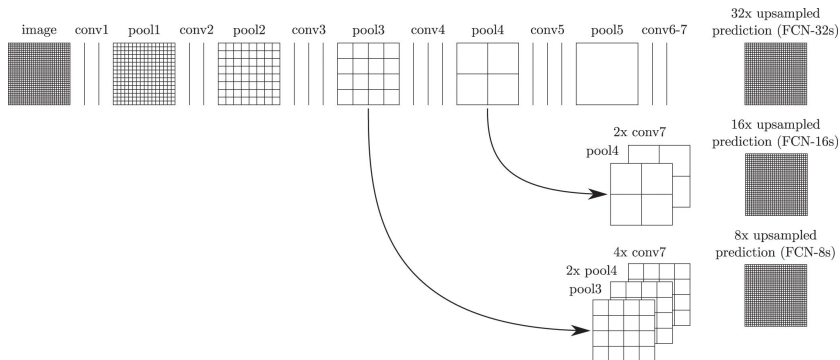

Figure 1 : Network Architecture-Long et al.[1]

Problem (cont'd)

- After pool3, the activation size have been reduced by factor $8 = 2^3$.
- After pool4, the activation size have been reduced by factor $16 = 2^4$.
- After pool5, the activation size have been reduced by factor $32 = 2^5$.

Problem (cont'd)

- Sum three activations and calculate the error(loss) and back-propagate the error at the end of the final layer.
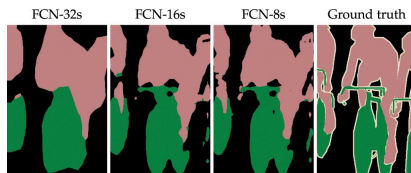

Figure 2 :   Activations of Pooling Layers-Long et al.[1]

Problem (cont'd)

- I will implement a bilinear interpolation upsampling kernel and my kernel will not only upsample the activations but also produce the final result by summing the activations.

Literature Survey

- **Bilinear Interpolation:** Bilinear interpolation is used to know values at random position from the weighted average of the four closest pixels to the specified input coordinates, and assigns that value to the output coordinates.[2] (1)
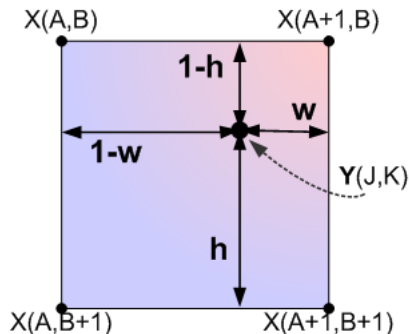
Figure 3 : Image from https://www.giassa.net/?page_id=240[3]

$$Y(J, K) = (1 - W)(1 - H)X(A, B) + (W)(1 - H)X(A + 1, B) +$$
$$(1 - W)(H)X(A, B + 1) + (W)(H)X(A + 1, B + 1) \quad (1)$$

OpenCV CPU

```
void cv::resize (
InputArray src, OutputArray dst, Size dsize, double
    fx=0, double fy=0, int interpolation=INTER_LINEAR
)
```

OpenCV GPU

```
void cv::cuda::resize (
InputArray  src, OutputArray  dst, Size  dsize,
    double  fx = 0, double  fy = 0, int
    interpolation = INTER_LINEAR, Stream &  stream =
    Stream::Null()
)
```

References

[1] J. Long, E. Shelhamer, and T. Darrell, "Fully convolutional networks for semantic segmentation," in *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, pp. 3431–3440, 2015.

[2] S. Fadnavis, "Image interpolation techniques in digital image processing: An overview," *International Journal of Engineering Research and Applications*, vol. 4, no. 10, pp. 70–73, 2014.

[3] "Bilinear interpolation." https://www.giassa.net/?page_id=240.