Operator Guideline for Efficient Image Denoiser

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# Precautions

* TFLite is only input format to run on our mobile device, and detailed information can be found in Tensorflow TFLite site: <https://www.tensorflow.org/lite>.
* GPU acceleration is possible when participants follow this guideline for operator limitation. In other case, performance drop might be happened.
* Higher score could be guaranteed when model is generated in accordance with this guideline.
* The execution of a model on device may fail for a variety of uncontrollable reasons. In such a case, “runtime error” will be reported instead of the score.

# Common Definitions

* n\_input: the number of input tensors for one operator
* n\_output: the number of output tensors for one operator
* N\_in: the batch size of input tensor
* C\_in: the channel of input tensor
* H\_in: the height of input tensor
* W\_in: the width of input tensor
* N\_out: the batch size of input tensor
* C\_out: the channel of output tensor
* H\_out: the height of output tensor
* W\_out: the width of output tensor
* input\_dim: (N\_in, H\_in, W\_in, C\_in)
* output\_dim: (N\_out, H\_out, W\_out, C\_out)
* K\_h: the kernel height of convolution
* K\_w: the kernel width of convolution

# Operator Tips

* All the operators listed below will be accelerated by GPU, but recommended configurations might get better acceleration effect than other configurations.
* The Tensorflow TFLite operators which don't appear in the below list will run on CPU fallback.

|  |  |  |  |
| --- | --- | --- | --- |
| ID | Operator | Recommended Configuration | Remark |
| 1 | ADD | 1. n\_input == 2 && input\_dim == output\_dim
2. For input\_dim != output\_dim && n\_input == 2, one input tensor should have: H\_in == 1 && W\_in == 1
 |  |
| 2 | AVERAGE\_POOL\_2D | - |  |
| 3 | BIDIRECTIONAL\_SEQUENCE\_LSTM | - |  |
| 4 | CONCATENATION | 1. (axis == 0 || axis == 1 || axis == 2) && n\_input == 2
2. axis == 3 && n\_input <= 6
 | axis: the concate axis for CONCATENATION in NHWC order |
| 5 | CONV\_2D | 1. group\_size == 1 && dilation\_width\_factor == 1 && dilation\_height\_factor == 1 && K\_h == K\_w && K\_h == 1, 3, 5, 7, 9
 | 1. Satisfying "W\_out%8==0, C\_out % 8 == 0, C\_in % 8 == 0" would be better
2. group\_size: the group number of one convolution
3. Dilation related definitions are as below in TFLite:

_scroll_external/attachments/image2021-1-13_19-38-25-9eac174725a9db8fc612ecb64b00eb7fe679f3093737cf7bd0a07762a90dfa84.png |
| 6 | DEPTHWISE\_CONV\_2D | 1. depth\_multiplier == 1 && ( (dilation\_height\_factor == 4 && dilation\_width\_factor == 4) || (dilation\_height\_factor == 2 && dilation\_width\_factor == 2) ) && K\_h == 3 && K\_w == 3 && stride\_width == 1 && stride\_height == 1
2. dilation\_height\_factor == 1 && dilation\_width\_factor == 1 && K\_h == 3 && K\_w == 3 && ( (stride\_width == 1 && stride\_height == 1) || (stride\_width == 2 && stride\_height == 2) )
 | 1. Related definitions are as below in TFLite:

_scroll_external/attachments/image2021-1-13_19-46-36-238bba0f7251f3374f35fdd4e2a1d7ac792c171aff8df7436387f7b1eb8f25d2.png |
| 7 | DEPTH\_TO\_SPACE | - |  |
| 8 | DIV | 1. n\_input == 2 && input\_dim == output\_dim
 |  |
| 9 | FULLY\_CONNECTED | 1. (C\_in \* H\_in \* W\_in) % 256 == 0 would be better
 |  |
| 10 | GATHER | - |  |
| 11 | LOGISTIC | - |  |
| 12 | MAX\_POOL\_2D | - |  |
| 13 | MEAN | 1. axis == 0 && H\_in == 1 && W\_in == 1 && C\_in == 1
2. axis == 3 && H\_in == 1 && W\_in == 1
3. axis == 1 && W\_in == 1
4. axis == 2
 | axis: the parameter for MEAN in NHWC order |
| 14 | MUL | 1. n\_input == 2 && input\_dim == output\_dim
 |  |
| 15 | REDUCE\_MIN | - |  |
| 16 | RELU |  1. Directly follow ADD , CONV\_2D, DEPTHWISE\_CONV\_2D, TRANSPOSE\_CONV |  |
| 17 | RESHAPE | - |  |
| 18 | RESIZE\_BILINEAR | - | RESIZE\_BILINEAR may have accuracy problem on GPU, so it may use CPU fallback |
| 19 | SOFTMAX | 1. axis == 3 && C\_in % 8 == 0
 | axis: the parameter for SOFTMAX in NHWC order |
| 20 | SPLIT | 1. N\_in = 1 && axis == 3 && n\_output == 2
 | axis: the parameter for SPLIT in NHWC order |
| 21 | SQUEEZE | - |  |
| 22 | SUB | 1. n\_input == 2 && input\_dim == output\_dim
 |  |
| 23 | TANH | - |  |
| 24 | TRANSPOSE\_CONV | 1. group\_size == 1 && TfLitePadding == kTfLitePaddingValid && stride\_height == K\_h && stride\_width == K\_w && stride\_height == 2 && stride\_width == 2
2. group\_size == 1 && K\_h \* K\_w % 4 == 0
 | 1. group\_size: the group number of transpose convolution
2. Related definitions are as below in TFLite:

_scroll_external/attachments/image2021-1-13_19-49-22-bc8d4a5f1e7c327e026f95bfdcb2c2e71317fe5cd8caab67e914583bd4d0d2cc.png_scroll_external/attachments/image2021-1-13_19-50-15-a2489e3e7cc6c5ba32d1065240f105e1ebc155f2941b7d6f63eca48dcad017b3.png |

* For full list of supported operators by Tensorflow TFLite, please refer to: <https://www.tensorflow.org/mlir/tfl_ops>