



Neural Network

Layer and Operation Support Guide

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Application Note:

VIP Neural Network Layer and Operation Support

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1 Overview

This document provides a summary of the neural network layers and operation supported by the VIP ACUITY Tool Kit and compatible Driver Software stack.

2 Deep Learning Frameworks - ACUITY Operation Mapping

The following neural-network operations and corresponding supported API functions are listed in the following table:

- **Caffe**: some non-standard Caffe layers may be supported according to release schedule.
- **TensorFlow API r1.13**: all activation ops apply component-wise, and produce a tensor of the same shape as the input tensor.
- **TensorFlow (TF) Lite Ops (Schema v3)**
- **Onnx (v1.6)**
- **Darknet**: generated from <https://pjreddie.com/darknet/>
- **Keras**: generated by Tensorflow 1.13.x.

2.1 Caffe to ACUITY Mapping

Table 1. Caffe-ACUITY Operations Mapping
(Caffe in gray rows; below is ACUITY equivalent in white row)

| | | | | |
|----------------------|------------------|----------------------|----------------------------|------------------|
| absval | axpy | batchnorm/bn | convolution | concat |
| abs | a_times_b_plus_c | batchnormalize | convolution | concat |
| convolutiondepthwise | dropout | depthwiseconvolution | deconvolution | elu |
| convolution | dropout | convolution | deconvolution | elu |
| eltwise | flatten | innerproduct | lrn | l2normalizescale |
| eltwise | flatten | fullconnect | localresponsenormalization | l2normalizescale |
| leakyrelu | lstm | normalize | poolwithargmax | permute |
| leakyrelu | lstm | l2normalize | poolwithargmax | permute |
| priorbox | prelu | proposal | pooling | roipooling |
| priorbox | prelu | proposal | pooling | roipooling |
| reorg | relu | reshape | reverse | swish |
| reorg | relu | reshape | reverse | swish |
| slice | scale | shufflechannel | softmax | sigmoid |
| split | multiply | shuffle | softmax | sigmoid |
| tanh | | | | |
| tanh | | | | |



2.2 TensorFlow to ACUITY Mapping

Table 2. TensorFlow - ACUITY Operations Mapping
(TensorFlow in gray rows; below is ACUITY equivalent in white row)

| | | | | |
|---|--|--|------------------------------|---|
| tf.abs | tf.add/tf.nn.bias_add | tf.add_n | tf.argmin | tf.argmax |
| abs | add | addn/add | argmin | argmax |
| tf.batch_to_space_nd | tf.nn.batch_normalization | tf.nn.fused_batchnorm | tf.clip_by_value | tf.concat |
| batch2space | batchnormalize/ instancenormalize/layer normalize/batchnorm_si ngle | batchnormalize | clipbyvalue | concat |
| tf.nn.conv1d | tf.nn.conv2d/tf.nn.dept hwise_conv2d | tf.nn.conv3d | tf.image.crop_and_resiz e | tf.nn.conv2d_transpose d |
| conv1d | convolution | conv3d | cropsandresize | deconvolution |
| tf.depth_to_space | tf.equal | tf.exp | tf.nn.elu | tf.nn.embedding_looku p |
| depth2space | equal | exp | elu | embedding_lookup |
| tf.maximum | tf.floor | tf.matmul | tf.floordiv | tf.gather_nd |
| eltwise(MAX) | floor | fullconnect | floor_div | gathernd |
| tf.gather/ tf.nn.embedding_looku p | tf.nn.rnn_cell_GRUCell tf.nn.dynamic_rnn | tf.nn.rnn_cell_GRUCell | tf.greater | tf.greater_equal |
| gather | gru | gru_cell | greater | greater_equal |
| tf.image.resize_bilinear/ tf.image.resize_nearest _neighbor | tf.contrib.layersinstanc e_norm / tf.nn.fused_batch_norm | tf.nn.local_response_no rmalization | tf.nn.l2_normalize | tf.nn.rnn_cell_LSTMCell tf.nn.dynamic_rnn |
| image_resize | instancenormalize | localresponsenormalizat ion_tf | l2normalize | lstm |
| tf.rnn_cell.LSTMCell | tf.less | tf.less_equal | tf.logical_or | tf.logical_add |
| lstm_unit | less | less_equal | logical_or | logical_and |
| tf.nn.leaky_relu | tf.multiply | tf.nn.moments | tf.minimum | tf.matmul/ tf.batch_matmul |
| leakyrelu | multiply | moments | minimum | matmul |
| tf.not_equal | tf.negative | tf.pad | tf.transpose | tf.nn.avg_pool/tf.nn.ma x_pool/ tf.reduce_mean |
| not_equal | neg | pad | permute | pooling |
| tf.nn.max_pool_with_ar gmax | tf.pow | tf.reduce_mean | tf.reduce_sum | tf.reverse/tf.reverse_se quence |
| poolwithargmax | pow | reducemean | reducesum | reverse |
| tf.nn.relu | tf.nn.relu6 | tf.rsqrt | tf.realdiv | tf.reshape/ tf.expand_dims/ tf.squeeze |
| relu | relun | rsqrt | real_div | reshape |
| tf.strided_slice | tf.sqrt | tf.square | tf.subtract | tf.scatter_nd |
| stridedslice | sqrt | square | subtract | scatternd |
| tf.stack | tf.nn.sigmoid | tf.signal.frame | tf.slice | tf.nn.softmax |
| stack | sigmoid | signalframe | slice | softmax |
| tf.space_to_batch_nd | tf.space_to_depth | tf.split | tf.nn.swish | tf.tile |
| space2batch | space2depth | split | swish | tile |
| tf.nn.tanh | tf.unstack | tf.where/tf.select | | |
| tanh | unstack | where | | |



2.3 TFLite to ACUITY Mapping

Table 3. TFLite - ACUITY Operations Mapping
(TFLite in gray rows; below is ACUITY equivalent in white row)

| | | | | |
|------------------|---------------------------|--|------------------------------|------------------------------|
| ADD | ADD_N | AVERAGE_POOL_2D/MAX_POOL_2D | ABS | BATCH_TO_SPACE_ND |
| add | addn | pooling | abs | batch2space |
| CAST | CONV_2D/DEPTHWISE_CONV_2D | CONCATENATION | DEQUANTIZE | DIV |
| cast | convolution | concat | dequantize | divide |
| EMBEDDING_LOOKUP | EXP | EQUAL | EXPAND_DIMS | FLOOR_DIV |
| embedding_lookup | exp | equal | expanddims | floor_div |
| FLOOR | FULLY_CONNECTED | GATHER_ND | GATHER | GREATER |
| floor | fullconnet/fullconnet_op | gathernd | gather | greater |
| GREATER_EQUAL | HARD_SWISH | LOGICAL_OR | LOCAL_RESPONSE_NORMALIZATION | LOGISTIC |
| greater_equal | hard_swish | logical_or | localresponsenormalization | sigmoid |
| LSTM | L2_NORMALIZATION | L2_POOL_2D | LESS_EQUAL | LOGICAL_AND |
| lstmunit | l2normalize | l2pooling | less_equal | logical_and |
| LOG_SOFTMAX | LESS | LEAKY_RELU | MAXIMUM | MUL |
| log_softmax | less | leakyrelu | maximum | multiply |
| MEAN | NOT_EQUAL | NEG | POW | PACK |
| reducemean | not_equal | neg | pow | stack |
| PAD | PRELU | REDUCE_MIN | RSQRT | REDUCE_MAX |
| pad | prelu | reducemin | rsqrt | reducemax |
| RELU | RELU1/RELU_N1_TO_1/RELU6 | RESIZE_BILINEAR/RESIZE_NEAREST_NEIGHB OR | SQUEEZE/RESHAPE | SPLIT |
| relu | relun | image_resize | reshape | split |
| SOFTMAX | SVDF | SQUARE | WHERE | SUB |
| softmax | svdf | square | where | subtract |
| SLICE | SPACE_TO_BATCH_ND | STRIDED_SLICE | SPACE_TO_DEPTH | TRANSPOSE_CONV |
| slice | space2batch | stridedslice | space2depth | deconvolution |
| TRANSPOSE | TILE | TANH | UNPACK | UNIDIRECTIONAL_SEQUENCE_LSTM |
| permute | tile | tanh | unstack | lstm |



2.4 ONNX to ACUITY Mapping

Table 4. ONNX - ACUITY Operations Mapping

(ONNX in gray rows; below is ACUITY equivalent in white row)

| | | | | |
|--|------------------|-----------|---------------------------------------|--------------------------------|
| ArgMin | ArgMax | Add | Abs | And |
| argmin | argmax | add | abs | logical_and |
| BatchNormalization | Clip | Cast | Concat | ConvTranspose |
| batchnormalize | clipbyvalue | cast | concat | deconvolution |
| Conv | Div | Dropout | DepthToSpace | Equal |
| conv1d/group_conv1d/ depthwise_conv1d/conv olution/conv2d_op/dep thwise_conv2d_op | divide | dropout | depth2space | equal |
| Exp | Elu | Floor | InstanceNormalization | Gemm |
| exp | elu | floor | instancenormalize | matmul/ fullconnect |
| Gather | Greater | GatherND | Logsoftmax | LRN |
| gather | greater | gathernd | log_softmax | localresponsenormalizat ion |
| Log | LeakyRelu | Less | MatMul | Max |
| log | leakyrelu | less | matmul/ fullconnect | eltwise(MAX) |
| MaxPool/AveragePool/ GlobalAveragePool/Glo balMaxPool | Mul | Neg | Or | Prelu |
| pooling | multiply | neg | logical_or | prelu |
| Pad | POW | Relu | Reshape/Squeeze/Unsq ueeze/Flatten | ReduceSum |
| pad | pow | relu | reshape | reducesum |
| ReduceMean | ReverseSequence | ReduceMax | ReduceMin | Sum |
| reducemean | reverse_sequence | reducemax | reducemin | eltwise(SUM) |
| SpaceToDepth | Sqrt | Split | Slice | Squeeze |
| space2depth | sqrt | split | slice | squeeze |
| Softmax | Sub | Sigmoid | Tile | Transpose |
| softmax | subtract | sigmoid | tile | permute |
| Tanh | Upsample | Where | | |
| tanh | image_resize | where | | |

2.5 Darknet to ACUITY Mapping

Table 5. Darknet-ACUITY Operations Mapping

(Darknet in gray rows; below is ACUITY equivalent in white row)

| | | | | |
|-----------|-----------------|-------------|---------------------------|-------------------------|
| avgpool | batch_normalize | connected | convolutional | depthwise_convolutional |
| pooling | batchnormalize | fullconnect | convolution | convolution |
| leaky | logistic | maxpool | region | reorg |
| leakyrelu | logistic | pooling | region | reorg |
| relu | route | softmax | shortcut | scale_channels |
| relu | concat | softmax | add/split+add/pad +add | multiply |
| swish | upsample | yolo | | |
| swish | upsampling | yolo | | |



2.6 Keras to ACUIITY Mapping

Table 6. Keras-ACUIITY Operations Mapping
(Keras in gray rows; below is ACUIITY equivalent in white row)

| Dense | Flatten/Reshape | LSTM/SimpleRNN | Embedding | BatchNormalization/ BatchNormalizationV1 |
|-----------------------|---|---------------------|------------------|---|
| fullconnect | reshape | lstm_keras | embedding_lookup | batchnormalize |
| Conv2D | Activation(sigmoid) | Activation(softmax) | Activation(tanh) | Activation(relu) |
| convolution | sigmoid | softmax | tanh | relu |
| ZeroPadding2D | MaxPooling2D/ AveragePooling2D/ GlobalAveragePooling2D/ GlobalMaxPooling2D | RELU | Softmax | LeakyRelu |
| pad | pooling | relu_keras | softmax | leakyrelu |
| PReLU | ThresholdedReLU | Conv1D | Conv2DTranspose | DepthwiseConv2D |
| prelu | relun | conv1d | deconvolution | depthwise_convolution |
| SeparableConv2D | UpSampling2D | Dropout | Subtract | Multiply |
| depthwise_convolution | image_resize | dropout | subtract | multiply |
| Concatenate | Cropping2D | RNN | Add | GRU |
| concat | slice | keras_rnn_lstm | add | gru |



3 ACUITY to OVXLIB Operation Mapping

The following table lists ACUITY operations and their corresponding OVXLIB APIs.

Table 7. ACUITY - OVXLIB Operation Mapping
(ACUITY in white rows; below is OVXLIB equivalent in gray rows)

| | | | | |
|---------------------|---------------------------|----------------------------|-------------------------------|--------------------------------|
| elu | floor | leakyrelu | prelu | relu |
| ELU | FLOOR | LEAKY_RELU | PRELU | RELU |
| relun | relu_keras | swish | hard_swish | rsqrt |
| RELUN/CLIP | RELU_KERAS | SWISH | HSWISH | RSQRT |
| sigmoid | softmax | softrelu | sqrt | tanh |
| SIGMOID | SOFTMAX | SOFTRELU | SQRT | TANH |
| convolutionrelu | convolutionrelupool | fullconnectrelu | abs | add |
| CONV_RELU | CONV_RELU_POOL | FCL_RELU | ABS | ADD |
| addn | clipbyvalue | divide | real_div | equal |
| ADDN | CLIP | DIVIDE | DIVIDE | RELATIONAL_OPS_EQUAL |
| exp | log | floor_div | greater | greater_equal |
| EXP | LOG | FLOORDIV | RELATIONAL_OPS_NOT_GREAT | RELATIONAL_OPS_NOT_GREAT_EQUAL |
| less | less_equal | logical_and | logical_or | minimum |
| RELATIONAL_OPS_LESS | RELATIONAL_OPS_LESS_EQUAL | LOGICAL_AND | LOGICAL_OR | MINIMUM |
| maximum | multiply | neg | not_equal | pow |
| MAXIMUM | MULTIPLY | NEG | RELATIONAL_OPS_NOT_EQUAL | POW |
| square | subtract | where | max | a_times_b_plus_c |
| SQUARE | SUBTRACT | WHERE | ELTWISEMAX | A_TIMES_B_PLUS_C |
| upsampling | downsample | resizebilinear_image | resizenearest_image | image_resize |
| RESIZE | RESIZE | RESIZE | RESIZE | RESIZE |
| upsample | fullconnect | matmul | batchnormalize | instancenormlize |
| UPSAMPLE | FCL | MATRIXMUL | BATCH_NORM | INSTANCE_NORM |
| l2normalize | layernormalize | localresponsenormalization | localresponsenormalization_tf | l2normalizescale |
| L2_NORMALIZE | LAYER_NORM | LRN | LRN2 | L2NORMALIZESCALE |
| fullconnectaxis | fullconnectreluaxis | batch2space | concat | crop |
| FCL2 | FCL2 | BATCH2SPACE | CONCAT | CROP |
| depth2space | gather | gathernd | pad | permute |
| DEPTH2SPACE | GATHER | GATHER_ND | PAD | PERMUTE |
| reducemean | reducesum | reducemax | reducemin | reorg |
| REDUCE_MEAN | REDUCE_SUM | REDUCE_MAX | REDUCE_MIN | REORG |
| reverse | slice | space2batch | space2depth | split |
| REVERSE | SLICE | SPACE2BATCH | SPACE2DEPTH | SPLIT |
| squeeze | reshape | stack | stridedslice | stack_concat |
| RESHAPE | RESHAPE | STACK | STRIDED_SLICE | TENSORSTACKCONCAT |
| unstack | gru | gru_cell | lstm | lstm |
| UNSTACK | GRU_OVXLIB | GRUCELL_OVXLIB | LSTM | LSTM_OVXLIB |
| lstmunit | convolution | conv2d_op | depthwise_conv2d_op | depthwise_convolution |
| LSTMUNIT_OVXLIB | CONV2D | CONV2D | CONV2D | CONV2D |
| deconvolution | depthwise_conv1d | group_conv1d | conv1d | log_softmax |
| DECONVOLUTION | DEPTHWISE_CONV1D | CONV1D | CONV1D | LOG_SOFTMAX |
| pooling | l2pooling | poolwithargmax | argmax | argmin |
| POOL | POOL | POOLWITHARGMAX | ARGMAX | ARGMIN |



Vivante App Note: VIP Neural Network Layer and Operation Support

| | | | | |
|-----------------|------------------|---------------------|------------------|--------------|
| dtype_converter | dequantize | quantize | cast | proposal |
| DATACONVERT | DATACONVERT | DATACONVERT | DATACONVERT | PROPOSAL |
| roipooling | shuffle | variable | dropout | signalframe |
| ROI_POOL | SHUFFLECHANNEL | VARIABLE | DROPOUT | SIGNAL_FRAME |
| svdf_ext | concatshift | spatialtransformer | embedding_lookup | tile |
| SVDF | CONCATSHIFT | SPATIAL_TRANSFORMER | EMBEDDING_LOOKUP | TILE |
| moments | batchnorm_single | fullconnect_op | mish | hard_sigmoid |
| MOMENTS | BATCHNORM_SINGLE | FCL2 | MISH | HARD_SIGMOID |

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4 VIP Neural Network Layer and Operation Support Overview

The neural-network layers and operations are supported by the following VIP ACUITY Tool Kit and compatible Driver Software stack, where the ACUITY Tool Kit can convert networks containing these layers and generate corresponding Driver Software API calls for inferencing on the VIP hardware.

- ACUITY Tool Kit 5.14.0 or later.
- OVXLIB 1.1.24 or later, High level wrapper library with additional NN APIs for OpenVX, vx_kernel() provides for customized kernel implementations.
- Vivante GALVIP Unified Driver 6.4.x version 6.4.3 or later
- Support level as of software releases versions contemporary with this App Note.

Compatible VIP hardware is required where the computing engine provides NN and PPU support. Some operations are hardware independent in the Vivante implementation.

- NN – **Neural-Network Engine**
- PPU – **Parallel Processing Unit**
- TP – **Tensor Processor**
- CPU – **Central Processor Unit**

This support list is subject to change with routine software updates. Unless specified otherwise, all listed layers are supported for V7x, v80x and V81x VIP and NPU hardware.

Table 8. VIP Neural Network Engine Operation Support

| OVXLIB Operation Name | NN | PPU | TP |
|-----------------------|---------|-----|----|
| ELU | | ✓ | |
| FLOOR | | ✓ | |
| LEAKY_RELU | ✓ (8.2) | | ✓ |
| PRELU | ✓ (8.2) | ✓ | ✓ |
| RELU | ✓ (8.x) | | ✓ |
| RELUN | | | ✓ |
| RELU_KERAS | | ✓ | ✓ |
| SWISH | | | ✓ |
| HSWISH | | | ✓ |
| RSQRT | | ✓ | |
| SIGMOID | | | ✓ |
| SOFTMAX | | ✓ | |
| SOFTRELU | | ✓ | |
| SQRT | | ✓ | |
| TANH | | | ✓ |
| CONV_RELU | ✓ | | |
| CONV_RELU_POOL | ✓ | | |
| FCL_RELU | ✓ | | |
| ABS | | | ✓ |
| ADD | ✓ | | |



Vivante App Note: VIP Neural Network Layer and Operation Support

| OVXLIB Operation Name | NN | PPU | TP |
|--------------------------------|----|-----|----|
| ADDN | ✓ | | |
| CLIP | | ✓ | |
| DIVIDE | | ✓ | |
| RELATIONAL_OPS_EQUAL | | ✓ | |
| EXP | | ✓ | |
| LOG | | ✓ | |
| FLOORDIV | | ✓ | |
| RELATIONAL_OPS_NOT_GREAT | | ✓ | |
| RELATIONAL_OPS_NOT_GREAT_EQUAL | | ✓ | |
| RELATIONAL_OPS_LESS | | ✓ | |
| RELATIONAL_OPS_LESS_EQUAL | | ✓ | |
| LOGICAL_AND | | ✓ | |
| LOGICAL_OR | | ✓ | |
| MINIMUM | | ✓ | |
| MAXIMUM | | ✓ | |
| MULTIPLY | | ✓ | |
| NEG | | ✓ | |
| RELATIONAL_OPS_NOT_EQUAL | | ✓ | |
| POW | | ✓ | |
| SQURAE | | ✓ | |
| SUBTRACT | | ✓ | |
| WHERE | | ✓ | |
| ELTWISEMAX | | ✓ | |
| A_TIMES_B_PLUS_C | | ✓ | |
| RESIZE | | ✓ | |
| UPSAMPLE | | ✓ | |
| PRE_PROCESS | | ✓ | |
| FCL | ✓ | | |
| MATRIXMUL | | ✓ | |
| BATCH_NORM | | ✓ | |
| INSTANCE_NORM | | ✓ | |
| L2_NORMALIZE | | ✓ | |
| LAYER_NORM | | ✓ | |
| LRN | | | ✓ |
| LRN2 | | | ✓ |
| L2NORMALIZESCALE | | ✓ | |
| FCL2 | | | ✓ |
| BATCH2SPACE | | | ✓ |
| CONCAT | | | ✓ |



Vivante App Note: VIP Neural Network Layer and Operation Support

| OVXLIB Operation Name | NN | PPU | TP |
|-----------------------|----|-------|----|
| CROP | | | ✓ |
| DEPTH2SPACE | | | ✓ |
| GATHER | | ✓ | |
| GATHER_ND | | ✓ | |
| PAD | | | ✓ |
| PERMUTE | | | ✓ |
| REDUCE_MEAN | | ✓ | |
| REDUCE_SUM | | ✓ | |
| REDUCE_MAX | | ✓ | |
| REDUCE_MIN | | ✓ | |
| REORG | | | ✓ |
| REVERSE | | | ✓ |
| SLICE | | | ✓ |
| SPACE2BATCH | | | ✓ |
| SPACE2DEPTH | | | ✓ |
| SPLIT | | | |
| (SQUEEZE)RESHAPE | | | ✓ |
| STACK | | | ✓ |
| STRIDED_SLICE | | | ✓ |
| TENSORSTACKCONCAT | | ✓ | |
| UNSTACK | | | ✓ |
| GRU_OVXLIB | ✓ | ✓ | ✓ |
| GRUCELL_OVXLIB | ✓ | ✓ | ✓ |
| LSTM | ✓ | ✓ | ✓ |
| LSTM_OVXLIB | ✓ | ✓ | ✓ |
| LSTMUNIT_OVXLIB | | ✓ | ✓ |
| CONV2D | ✓ | | |
| DECONVOLUTION | ✓ | | |
| DEPTHWISE_CONV1D | | ✓ | |
| (group_conv1d) CONV1D | ✓ | | |
| LOG_SOFTMAX | | ✓ | |
| (l2_pool) POOL | | ✓ | |
| POOLWITHARGMAX | | ✓ | |
| ARGMAX | | ✓ | |
| ARGMIN | | ✓ | |
| DATACONVERT | | | ✓ |
| PROPOSAL | | ✓+CPU | |
| ROI_POOL | | | ✓ |
| SHUFFLECHANNEL | | ✓ | |



Vivante App Note: VIP Neural Network Layer and Operation Support

| OVXLIB Operation Name | NN | PPU | TP |
|-----------------------|----|-----|----|
| VARIABLE | | | ✓ |
| DROPOUT | | ✓ | |
| SIGNAL_FRAME | | ✓ | |
| SVDF | | | ✓ |
| CONCATSHIFT | | ✓ | |
| SPATIAL_TRANSFORMER | | ✓ | |
| EMBEDDING_LOOKUP | | ✓ | |
| TILE | | ✓ | |
| MOMENTS | | ✓ | |
| BATCHNORM_SINGLE | | ✓ | |
| HARD_SIGMOID | | ✓ | |
| MISH | | ✓ | |

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Document Revision History

| Version | Date | Compatible HW rev | Notes |
|---------|------------|--------------------------------------|--|
| 1.17 | 2020-06-23 | Vivante SW releases from June 2020 | Update Section 2 tables. Table 7: Add operations: fullconnect_op, mish, hard_sigmoid. Table 8: update swish, h_swish support engine, add hard_sigmoid, mish. |
| 1.16 | 2020-06-12 | Vivante SW releases from May 2020 | Update Section 4 OVXLIB bullet text. |
| 1.15 | 2020-05-26 | Vivante SW releases from May 2020 | Update Section 2. Table 7, 8: Add operations: moments, batchnorm_single |
| 1.14 | 2020-04-28 | Vivante SW releases from April 2020 | Add Section 2. Add Section 3. Table 8: Add and enrich ACUITY ops / OVXLIB columns |
| 1.13 | 2020-03-23 | Vivante SW releases from Mar 2020 | Tables 1 and 2: Add operations: hard_swish, depthwise_conv1d, group_conv1d and log_softmax. |
| 1.12 | 2020-03-16 | Vivante SW releases from Dec 2019 | Legal Notices: distribution level changed from C to B. Update NN support levels for relu, prelu and leaky_relu. |
| 1.11 | 2020-02-25 | Vivante SW release of Dec 2019 | Legal Notices: distribution level changed from D to C. |
| 1.10 | 2019-12-24 | Vivante SW release of Dec 2019 | Section 1: Update compatible sw versions. Table 1 and Table 2: Add Ops: swish, log, maximum. Table 2: add ONNX column. |
| 1.09 | 2019-12-03 | Vivante SW release of Nov 2019 | Section 1: Update compatible sw versions. Table 1: Update Operation Support Engine: gather, add_n, matrix_mul Table 2: Update gather openvx_api |
| 1.08 | 2019-11-25 | Vivante SW release of Nov 2019 | Table 1: Update Operation Support Engine. Changed: add, equal, prelu, floor_div, logical_and, where, stack, unstack, argmin. Removed CPU column |
| 1.07 | 2019-10-28 | Vivante SW release of late Oct 2019 | Section 1: Update compatible sw versions. Sections 2 and 3, Tables 1 and 2: Added ops: gru_cell, gru, reverse_squeeze and argmin. Miscellaneous refinements, including alphabetic sorting |
| 1.06 | 2019-07-26 | Vivante SW as of v6.4.0.RC2 release. | Table1 and Table 2: Added ops: equal, minimum, where, real_div, add_n, exp, square, negative, abs, clip_by_value, unstack, gather |
| 1.05 | 2019-05-22 | Vivante SW as of v6.3.3.4 release. | Section 2: Added version numbers Section 3: revised Tensorflow API link, added Caffe layer link Table 1: added CPU column for each layer Table1 and Table 2: Added ops: logical_and, resize_nearestneighbor, expand_dims, reduce_sum, stack |
| 1.04 | 2019-01-08 | Vivante SW | Changed from Memo to AppNote. |



Vivante App Note: VIP Neural Network Layer and Operation Support

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| | | as of v6.3.1 release. | Table 1: added column for TP support. Updated names and support. Added Table 2. Neural Network API Reference Names. Changed page orientation to landscape for Table 2. |
| 1.03 | 2018-10-04 | Vivante SW as of v6.3.1 release. | <p>Table 1 changes:</p> <ul style="list-style-type: none"> - Changed category Activations to Activation. - Element Wise category: changed floor from PPU to NN, removed max, added mean, removed scale. - Normalization category: changed batch_normalize from NO-OP to PPU, removed I2_normalize_scale. - RNN category: change lstm from PPU to NN. - Changed category Tensor Reshape to Reshape. - Reshape category: changed concat, flatten, reshape, split and squeeze from NO-OP to NN, changed depth_to_space and space_to_depth from PPU to NN, moved reverse from Other category and changed from PPU to NN, added shuffle_channel. - Others category: removed dropout, embedded_lookup, hashtable_lookup, lsh_projection and svdf; change roi_pool from NN to PPU. <p>Removed Notes (1)~(3) at the bottom of Table 1.</p> |
| 1.02 | 2018-09-20 | Vivante SW as of v6.3.1 release. | Updated Table 1. Minor refinements. |
| 1.01 | 2018-07-03 | Vivante SW as of v6.3.1 release. | Updated Table 1. |
| 1.00 | 2018-03-14 | Vivante SW as of v6.3.1 release. | Initial |

