

```
1 from nndl.layers import *
2 from utils.fast_layers import *
3
4
5 def conv_relu_forward(x, w, b, conv_param):
6     """
7     A convenience layer that performs a convolution followed by a ReLU.
8
9     Inputs:
10    - x: Input to the convolutional layer
11    - w, b, conv_param: Weights and parameters for the convolutional layer
12
13    Returns a tuple of:
14    - out: Output from the ReLU
15    - cache: Object to give to the backward pass
16    """
17    a, conv_cache = conv_forward_fast(x, w, b, conv_param)
18    out, relu_cache = relu_forward(a)
19    cache = (conv_cache, relu_cache)
20    return out, cache
21
22
23 def conv_relu_backward(dout, cache):
24     """
25     Backward pass for the conv-relu convenience layer.
26     """
27    conv_cache, relu_cache = cache
28    da = relu_backward(dout, relu_cache)
29    dx, dw, db = conv_backward_fast(da, conv_cache)
30    return dx, dw, db
31
32
33 def conv_relu_pool_forward(x, w, b, conv_param, pool_param):
34     """
35     Convenience layer that performs a convolution, a ReLU, and a pool.
36
37     Inputs:
38    - x: Input to the convolutional layer
39    - w, b, conv_param: Weights and parameters for the convolutional layer
40    - pool_param: Parameters for the pooling layer
41
42    Returns a tuple of:
43    - out: Output from the pooling layer
44    - cache: Object to give to the backward pass
45    """
46    a, conv_cache = conv_forward_fast(x, w, b, conv_param)
47    s, relu_cache = relu_forward(a)
48    out, pool_cache = max_pool_forward_fast(s, pool_param)
49    cache = (conv_cache, relu_cache, pool_cache)
50    return out, cache
51
52
53 def conv_relu_pool_backward(dout, cache):
54     """
55     Backward pass for the conv-relu-pool convenience layer
56     """
57    conv_cache, relu_cache, pool_cache = cache
58    ds = max_pool_backward_fast(dout, pool_cache)
59    da = relu_backward(ds, relu_cache)
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60 | dx, dw, db = conv_backward_fast(da, conv_cache)
61 | return dx, dw, db
```