DSCI 565: BUILDER'S GUIDE

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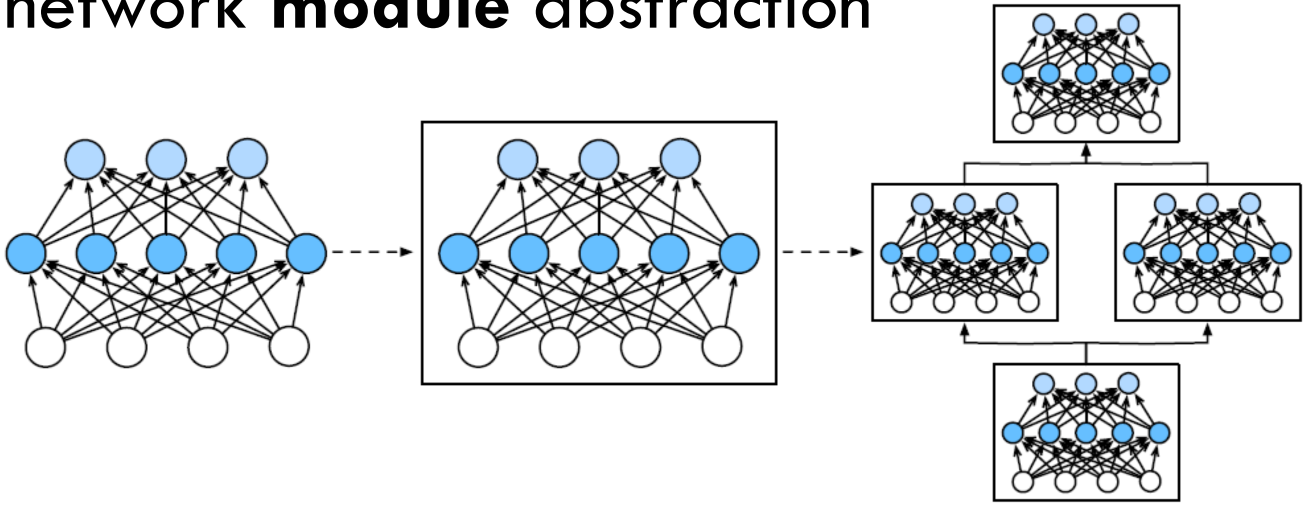
Builder's Guide

Layers and Modules

- So far, we have seen networks with one neuron, one layer and multiple-layers. Each network
  - Takes inputs
  - Generates outputs
  - Described by a set of tunable parameters
- They all fall under the neural network **module** abstraction



Define a Custom Module

- □ Inherit from PyTorch's `nn.Module`
- □ Implement `forward` function
  - Ingest input data
  - Generate output data
  - By default, gradient is computed automatically
- □ Store and provide access to model parameters needed by `forward`
- □ Initialize model parameters

Notebook

- chapter_builders-guide/model-construction.ipynb
  - MLP module
  - MySequential module
    - `nn.Module.add_module(name, a_module)` adds a module
    - `nn.Module.children()` returns iterator over children
  - FixedHiddenMLP
    - Defining constant parameters that are not updated during optimization
    - E.g., `rand_weight` (not `nn.Parameter`)
  - NestMLP
    - Can mix and connect sequential module with regular layer

Parameter Management

- Goal of training is to minimize the loss function by tuning model parameters
- Access and examine the parameters by calling
  - Function `state_dict()`
  - Function: `named_parameters()`
- Also, we can share parameters across multiple layers: *tied parameters*

Notebook: chapter_builders-guide/parameters.ipynb

Parameter Initialization

- Instead of hardcoding parameter initialization in Module.__init__()
  - Create a separate initialization function
  - Then call `Module.apply()` with the initialization function
- Easier to try out different initialization approaches
- `Module.apply(initialization_func)`
  - Recursively applies `initialization_func` to its child modules
  - Then, apply `initialization_func` to itself

chapter_builders-guide/init-param.ipynb

Custom Layers

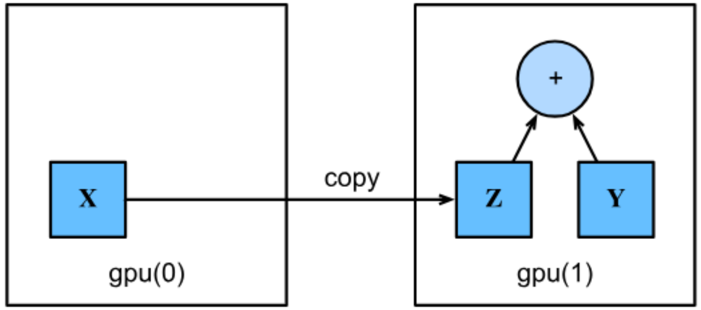
- Like custom modules, custom layers also inherit from `nn.Module`
  - Layers without parameters
  - Layers with parameters
    - nn.Parameter defined in within __init__() are automatically added to the layer's parameters

See chapter_builders-guide/custom-layer.ipynb

Saving and Loading Networks

- chapter_builders-guide/read-write.ipynb

Running on GPUs



- By default, tensors are allocated on the CPU
- Use the `device` keyword argument to allocate on GPU
  - E.g., torch.Tensor([0, 1, 2], device=torch.device('cuda'))
  - E.g., torch.Tensor([0, 1, 2], device=torch.device('cuda:0'))
- To copy to another device use
  - `Tensor.gpu(0)`, `Tensor.cpu()`, or `Tensor.to('cuda:1’)`
- Tensors must be on the same device in order to perform operations
- Moving tensor across devices is SLOW!!!

Running on GPUs

- To move a network to GPU
  - Do `net.to(‘gpu:0’)`
- This command moves all the parameters of the network to gpu:0
- See chapter_builders-guide/use-gpu.ipynb