Module 4.4 - What's Next

Outline

- Review: Course
- What's to Come

What should I do after MLE?

ChatGPT

Review

Class Focus

- **Machine Learning** Engineering
- Machine Learning **Engineering**
- Focus: software engineering behind machine learning

MLE

- Systems course disguised as ML
- Algorithms implemented Fast
- Testing / Debugging / Scaling

Module 0 - Foundations

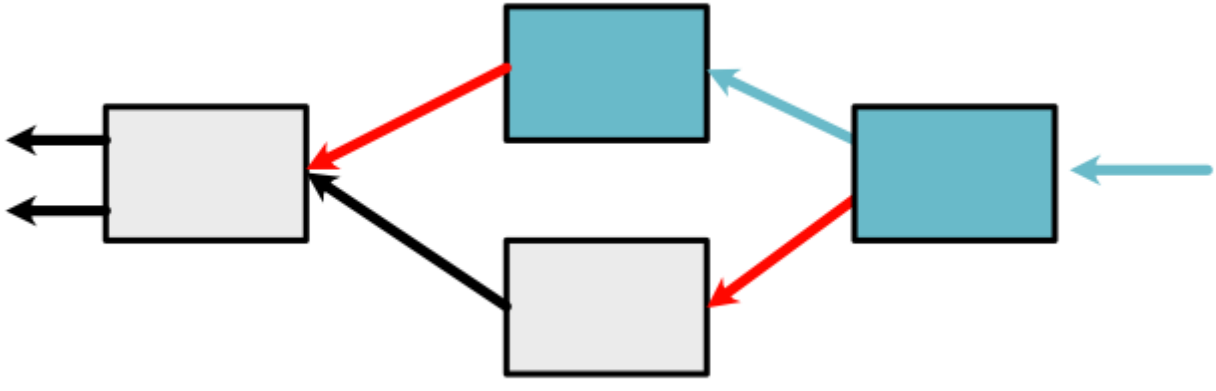
Module

Module 0 - Foundations

- Testing
- Higher-Order Functions
- Data Structures

Module 1 - Auto-Diff

Module

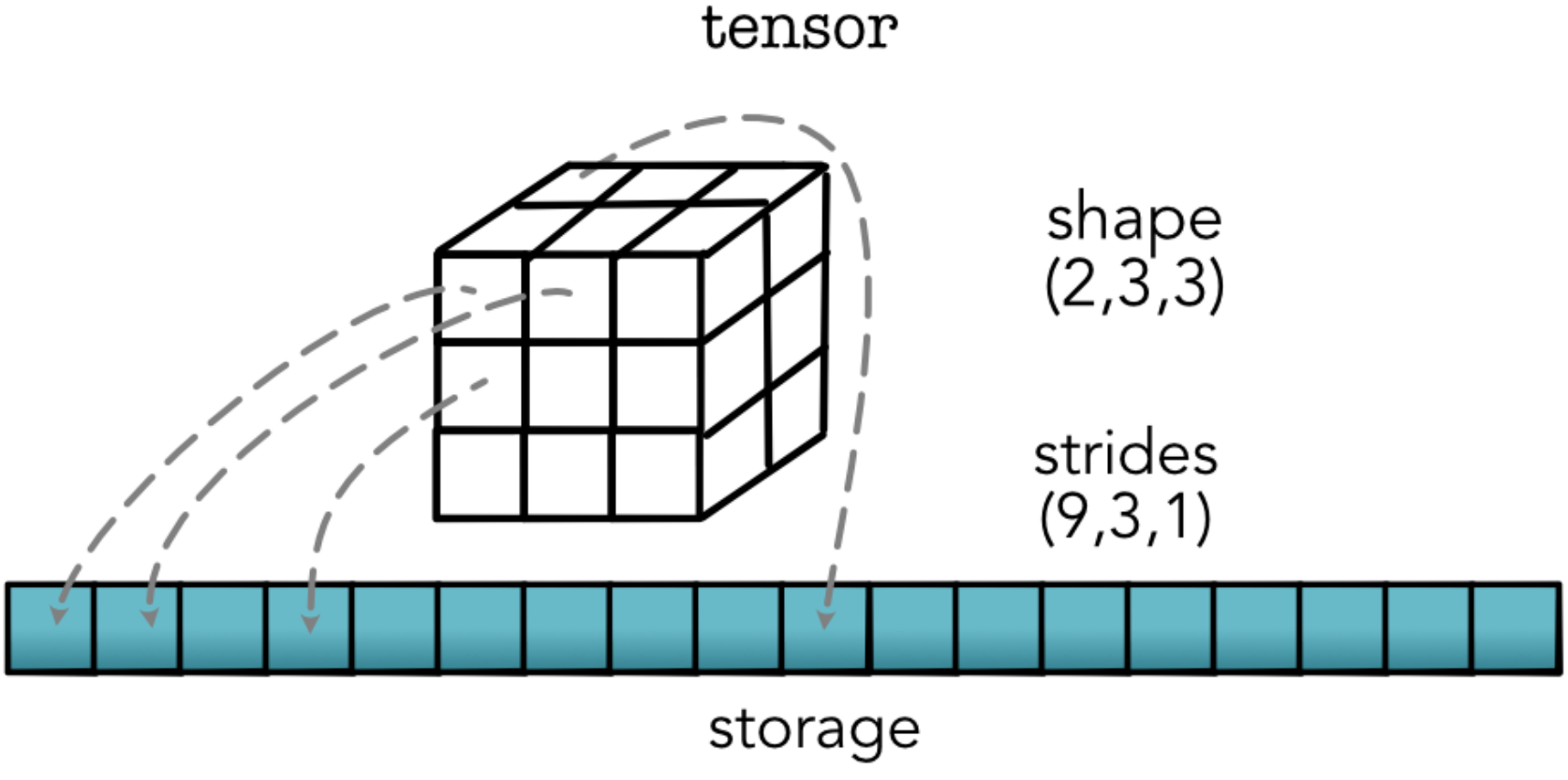


Module 1 - Auto-Diff

- Variables
- Autodifferentiation
- ML Basics

Module 2 - Tensors

Module



Module 2 - Tensors

- Multidimensional Arrays
- Map / Zip / Reduce
- Broadcasting

Module 3 - Effiency

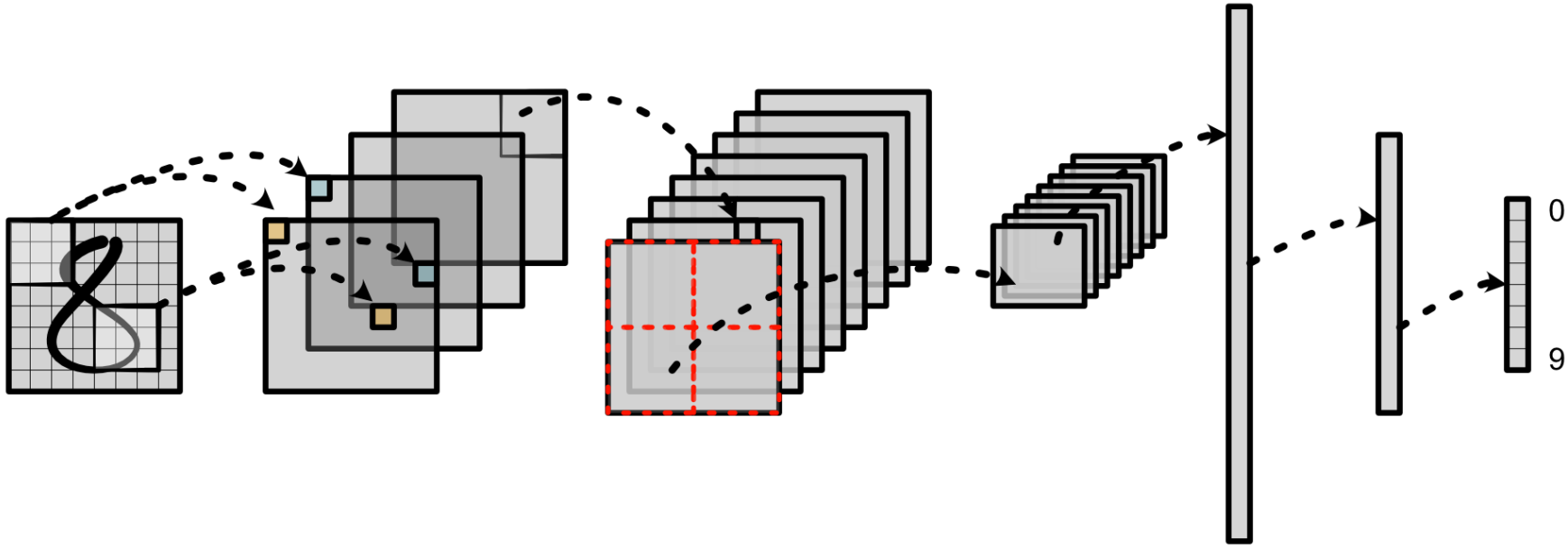
Module

Module 3 - Effiency

- JIT / Types
- Parallel
- CUDA / Shared Memory

Module 4 - Networks

Module



Module 4 - Networks

- Convolutions
- Tiling
- Softmax

What do you know?

- How neural networks works...
- How autodifferentiation works...
- How it all scales ...

What did you learn?

- Systems are made by humans
- Debugging, testing, organization
- Filing bugs and asking questions

EdStem

- Justin Chiu - 143 answers!
- Top Students:
    - Hariharan Vijayachandran
    - Courtney Beckham
    - Abhinav Girish

Course Reviews

https://apps.engineering.cornell.edu/CourseEval/

What's Next

Many Forks

- ML Engineering
- ML Systems
- ML Models

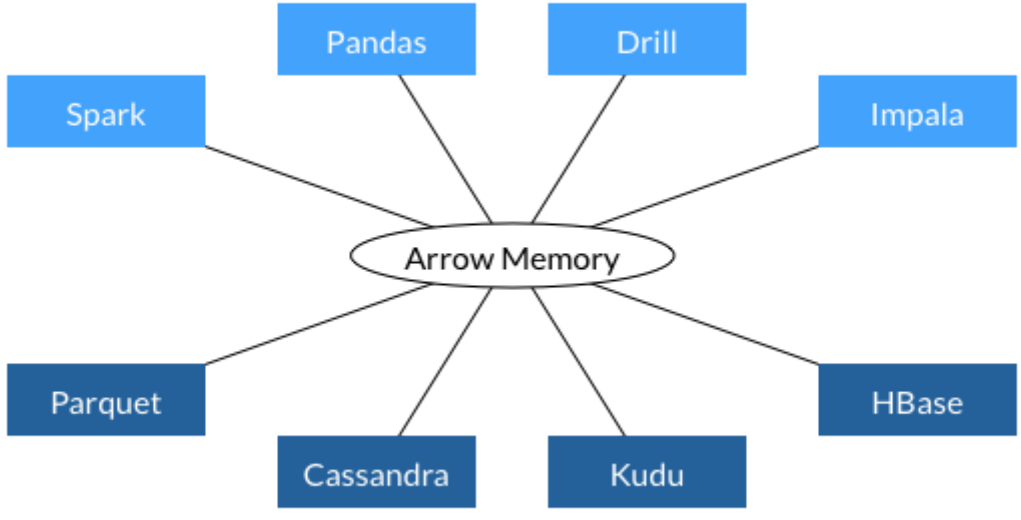
ML Engineering

- Many questions beyond training
- Data sets and data availability
- Data collection / preprocessing / robustness

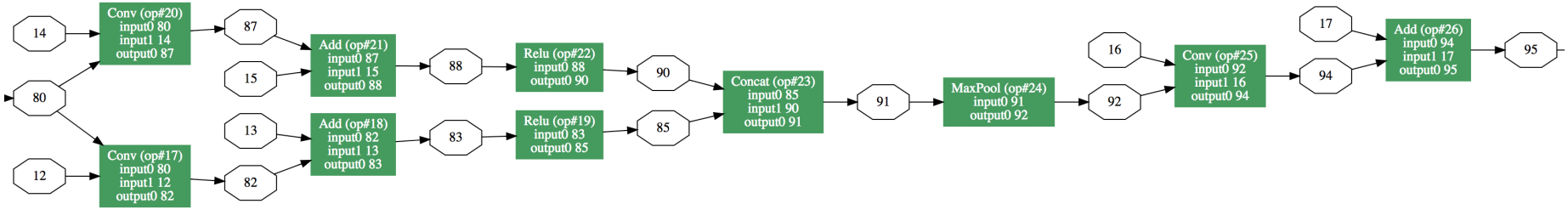
Tools of the Trade : PyTorch 2

```
PyTorch 2.0 offers the same eager-mode development and user experience, while
fundamentally changing and supercharging how PyTorch operates at compiler level
under the hood. We are able to provide faster performance and support for Dynamic
Shapes and Distributed.
```

Tools of the Trade : Arrow



Tools of the Trade : ONNX



ML Systems

- Many languages beyond torch
- Different Tensor access forms

Tools of the Trade: Jax

- Introduces `vector map` in addition to broadcasting
- Can apply a function to a tensor across an entire dimension. `vmap(model.forward, x)`

Tools of the Trade: Julia

- Programming language for mathematical code
- Pluto -> https://mybinder.org/v2/gh/fonsp/pluto-on-binder/master?urlpath=pluto

ML Models

- Modern models are complicated, but made up of the parts we have seen
- Many are open source and available to play with.

My Bet

- You can read models!

NLP Models

- Transformer
  https://github.com/huggingface/transformers/blob/master/sr

Protein Folding

- Distance Prediction

  https://github.com/Urinx/alphafold_pytorch/blob/master/netw

Tips of the Trade

- Fancy models are not always necessary
- Build something robust and fast on your hardware.
- Develop multiple expertise to be flexible to users

Future Steps

Courses

- Mohamed
- Machine Learning Hardware and Systems

Deep Learning

- New Version of the course offered in the spring
-

Independent Study

- I will be taking students for an applied Independent Study
- Topic will be information extraction for zoning

Graduate Seminar CS 6741

- https://forms.gle/jvjN8A6YkYZNbaCF9

Q & A

- What is it like to work in industry?
- What does academic ML look like?
- How do I contribute to open-source?