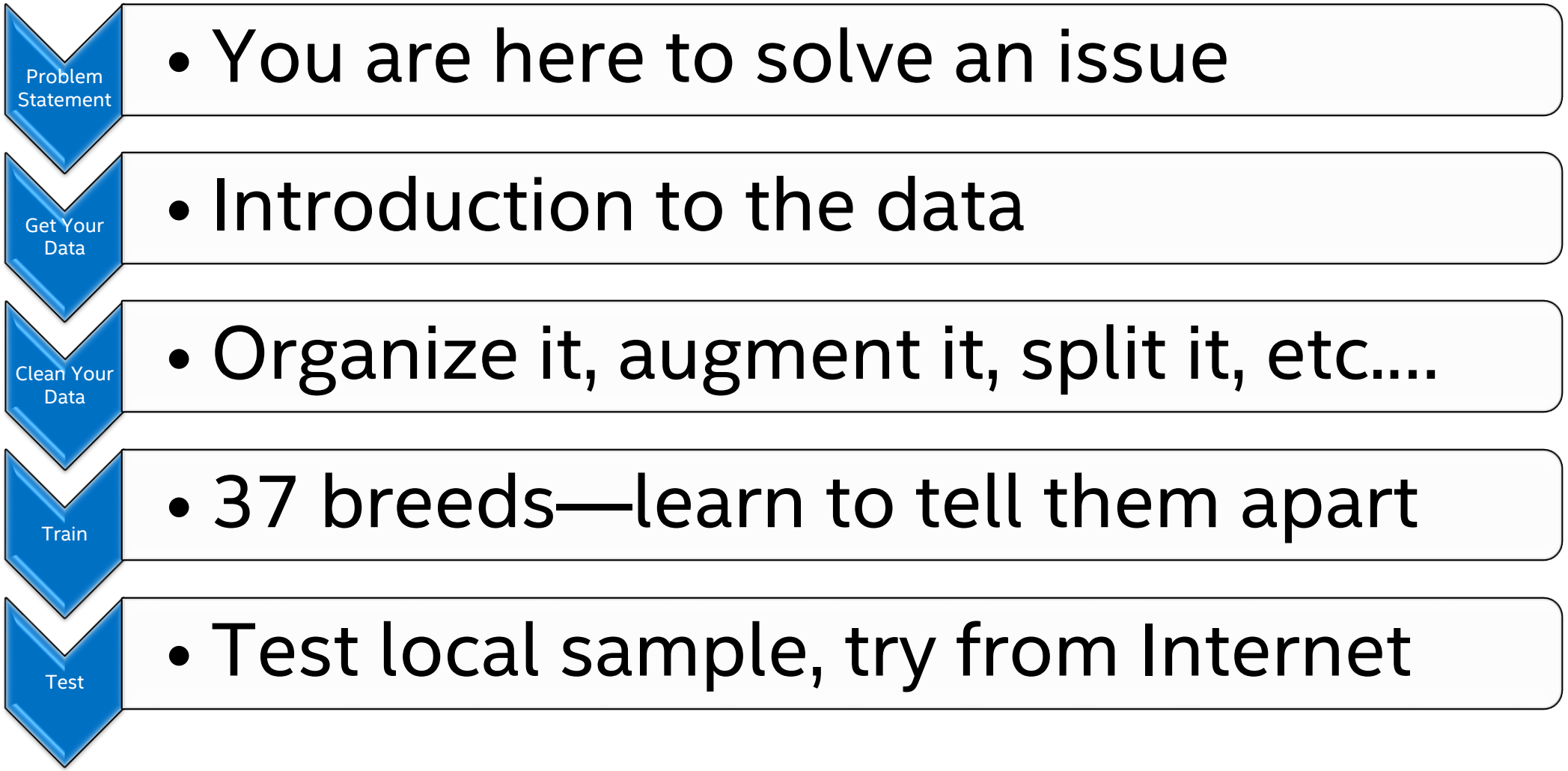
END-TO-END TENSORFLOW MODEL DEVELOPMENT

Outline: What Students Will Learn

- Part 1: Data Wrangling with Breeds on CPU
  - Find a Data set and Fetch Data
  - Clean and Normalize the Data
  - Organize and Optimize Data for Consumption by TensorFlow*
  - After All of This Data Wrangling We Can Actually Begin the Training Process
- Part 2: Training Cat v. Dog with TensorFlow* and GoogLeNet Inception* v1 on CPU
  - Understand the stages of preparing for training using the TensorFlow* framework and an GoogLeNet Inception v1 topology
- Part 3: Evaluate, Freeze and Test Your Training Results
  - Evaluate Your Latest Training Checkpoint
  - Export Your Inference Graph of Inception v1
  - Freeze Your Graph
  - Run a Test Inference on an Image (use as jump off point to OpenVINO™ inference)

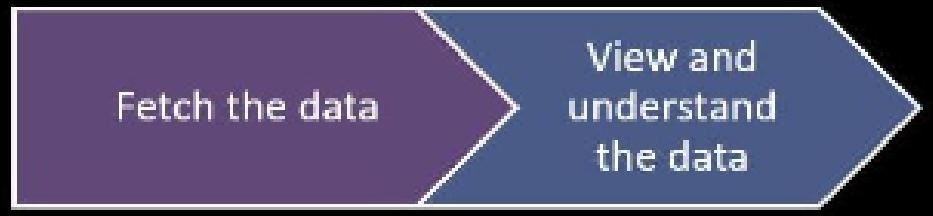


Part 1: fetch the data

[The Oxford Pets Database]

- 37 categories
- ~200 images of each class
- 25 dogs
- 12 cats
- [Paper talks about data and their techniques]

Part 1: view the baseline data



Part 1: clean and normalize the data

- **Extract, Transform and Load (ETL)**
  - **Data cleaning** – Eliminates noise and resolves inconsistencies in the data.
  - **Data integration** – Migrates data from various different sources into one coherent source, such as a data warehouse.
  - **Data transformation** – Standardizes or normalizes any form of data.
  - **Data reduction** – Reduces the size of the data by aggregating it.
- **Prepare data as expected by topology.**
- **Ensure you have enough processing and storage capacity.**

Part 1: organize data for consumption by Tensorflow*

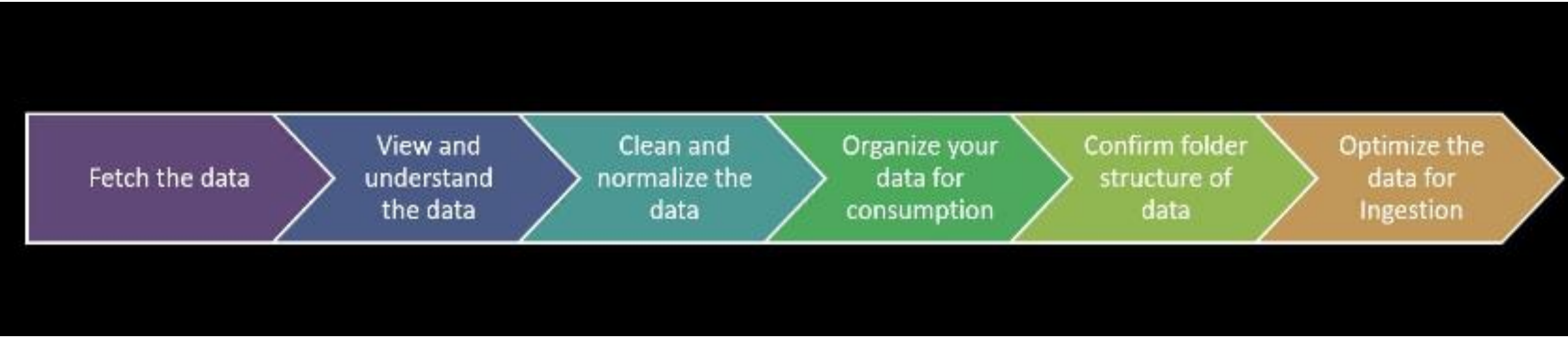
Part 1: Organize data for consumption - categorize

- TensorFlow* expects images to be organized into categories.
- Once complete, each category would look something like this (there are 37 categories).

```
breeds/
    sorted/
        british_shorthair/
            British_Shorthair_184.jpg
            British_Shorthair_269.jpg
            British_Shorthair_37.jpg
            British_Shorthair_71.jpg
            British_Shorthair_167.jpg
        japanese_chin/
            japanese_chin_167.jpg
            japanese_chin_182.jpg
            japanese_chin_191.jpg
            japanese_chin_38.jpg
            japanese_chin_17.jpg
        wheaten_terrier/
            wheaten_terrier_74.jpg
            wheaten_terrier_128.jpg
            wheaten_terrier_137.jpg
            wheaten_terrier_4.jpg
            wheaten_terrier_9.jpg
```

Part 1: Confirm folder structure

Part 1: Optimize data for ingestion



Part 1: Optimize data for ingestion - Create TFRecords

- TFRecord is the TensorFlow* recommended format for ingestion.
- It is a sequence of binary strings.
- If the dataset is too large, we could create multiple shards of the TFRecords to make it more manageable.
- We create two TFRecords, one for training and another for validation.

https://en.wikipedia.org/wiki/Lightning_Memory-Mapped_Database

Part 2: Training

Step 1: Choose the right topology.

Step 2: Set up a pre-trained model to use breeds dataset.

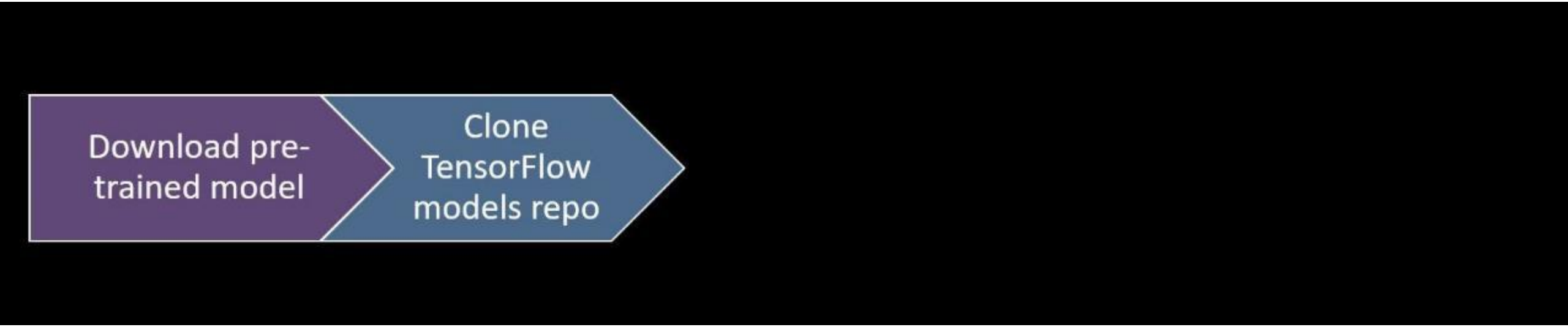
Step 3: Evaluate, freeze, and test results.

Part 2: Step 1 - Select the right topology

- **Criteria:**
  - Time to train: Depends on number of layers and computation required.
  - Size: Keep in mind the edge device you want to deploy to, networks it supports and resources like memory.
  - Inference speed: Tradeoff between accuracy and latency.
  - **GoogLeNet (Inception V1) was our topology of choice**

Part 2: Download pre-trained model

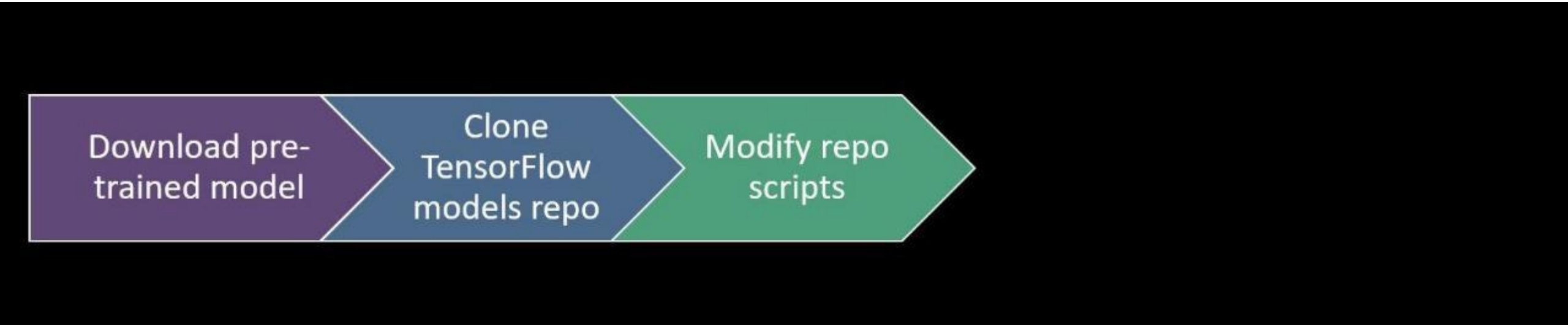
Part 2: Clone Tensorflow*/models github repo



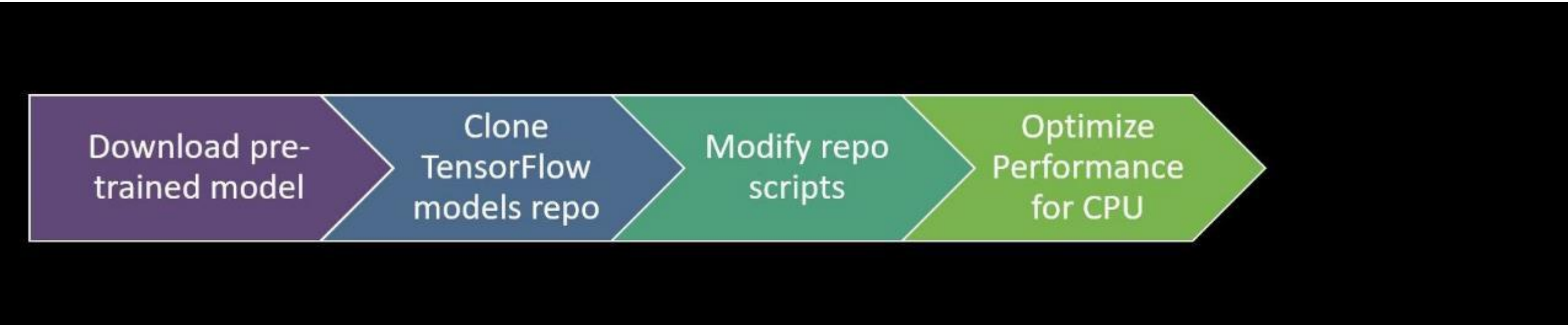
Clone TensorFlow*/models GitHub* repo

We use transfer learning using a Convolutional Neural Network pre-trained on ISLVRC-2012-CLS image classification dataset (https://github.com/tensorflow/models)

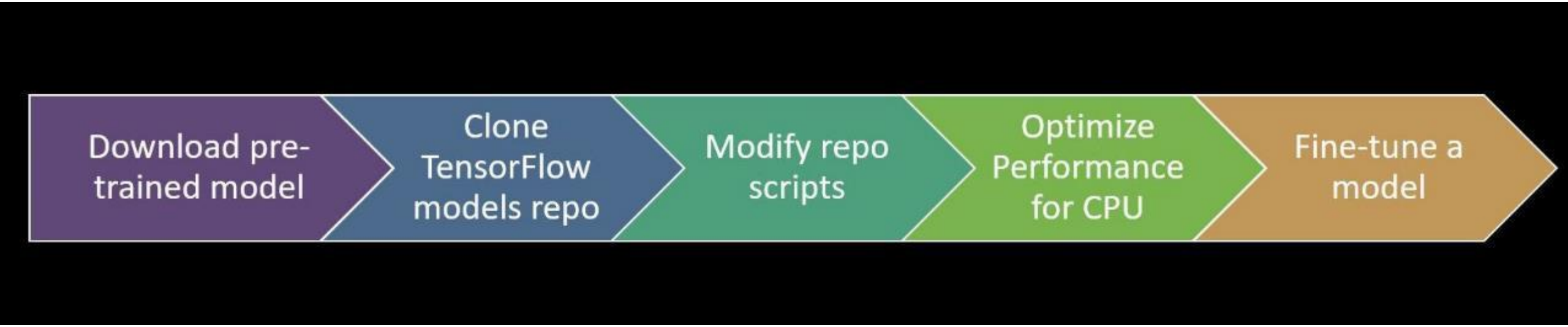
Part 2: Modify/Add files to slim repo to work with breeds dataset



Part 2: Optimize Performance for cpu



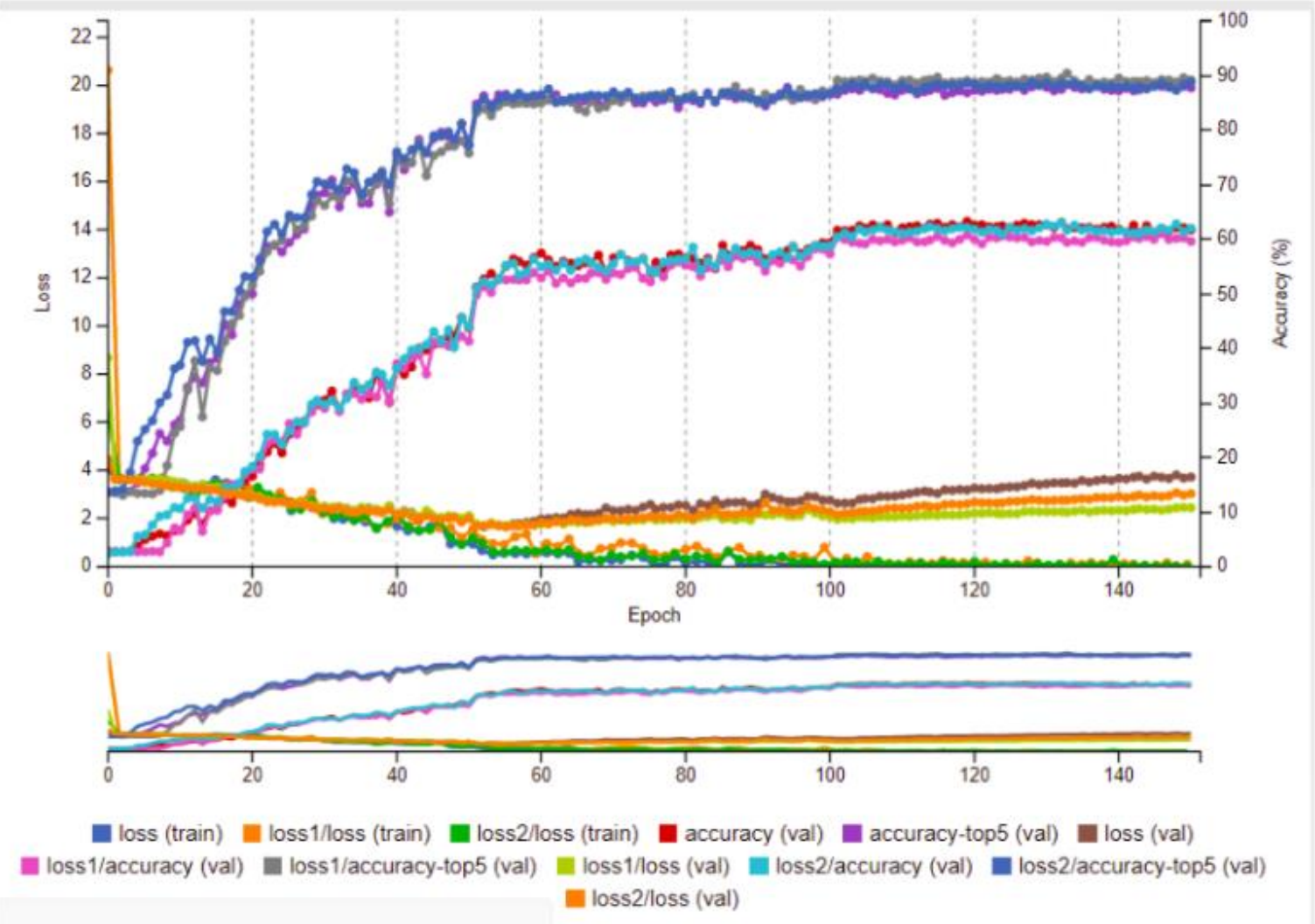
Part 2: Initiate training



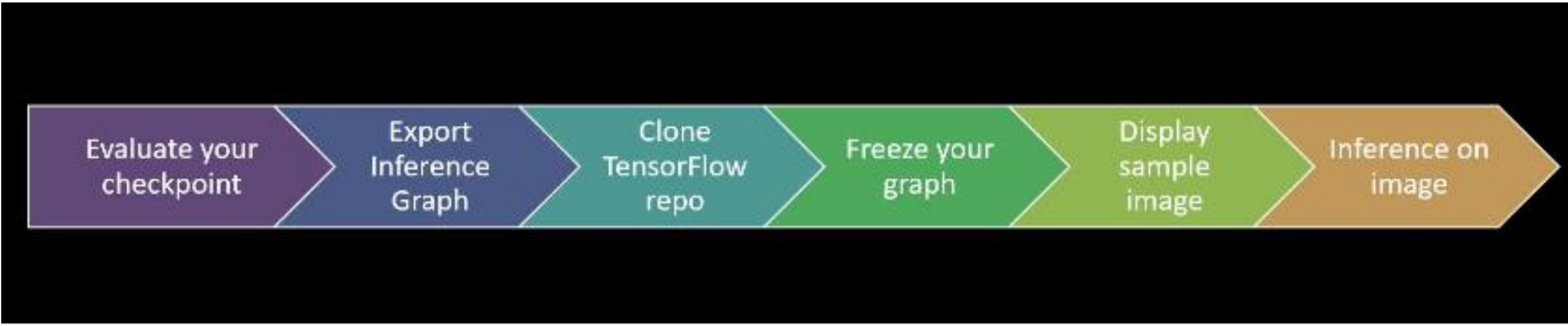
Initiate training and review live training logs:

- When using a pre-trained model on a different dataset, note that the final layer will change to indicate the new set of categories.
- Indicate which subset of layers to retrain while keeping others frozen.
- View results.

Part 2: Results on googlenet inception v1 using breeds



Part 3: evaluate, freeze graph, and test



SUMMARY

Summary

- End-to-End TensorFlow workflow presents in steps how all of the pets imaging data that is to be used in the final custom inception_V1 model is curated – all the way from data aggregation, clean-up and preparation for consumption by TensorFlow.
- The next steps in the workflow is about preparing for training using the TensorFlow framework and an GoogLeNet Inception v1 topology. It initiates training and view a completed graph, and learn about the relationship between accuracy and loss.
- The final steps in the workflow perform a test evaluation of the trained graph and prepares it for exporting out of TensorFlow for eventual runtime usage by either the OpenVINO toolkit or Windows Machine Learning.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