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<pre>#!/bin/env python3.8 """ Example assignment. Author: Chris Curro """ import os import logging # from turtle import shape import matplotlib import matplotlib.pyplot as plt import numpy as np import tensorflow as tf import math from absl import app from absl import flags from tqdm import trange from dataclasses import dataclass, field, InitVar script_path = os.path.dirname(os.path.realpath(__file__)) @dataclass class LinearModel: weights: np.ndarray bias: float @dataclass class Data: model: LinearModel rng: InitVar[np.random.Generator] num_features: int num_samples: int sigma: float x: np.ndarray = field(init=False) y: np.ndarray = field(init=False) def __post_init__(self, rng): self.index = np.arange(self.num_samples) self.x = rng.uniform(0.1, 2, size=(self.num_samples, self.num_features)) clean_y = tf.math.sin(2 * math.pi * self.x) self.y = rng.normal(loc=clean_y, scale=self.sigma) def get_batch(self, rng, batch_size): """ Select random subset of examples for training batch """ choices = rng.choice(self.index, size=batch_size) return self.x[choices], self.y[choices].flatten() def compare_linear_models(a: LinearModel, b: LinearModel): for w_a, w_b in zip(a.weights, b.weights): print(f"{w_a:0.2f}, {w_b:0.2f}") print(f"{a.bias:0.2f}, {b.bias:0.2f}")</pre>		

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<pre>font = { # "family": "Adobe Caslon Pro", "size": 10, } matplotlib.style.use("classic") matplotlib.rc("font", **font) FLAGS = flags.FLAGS flags.DEFINE_integer("num_features", 1, "Number of features in record") flags.DEFINE_integer("num_samples", 120, "Number of samples in dataset") flags.DEFINE_integer("batch_size", 3, "Number of samples in batch") flags.DEFINE_integer("num_iters", 100, "Number of SGD iterations") flags.DEFINE_float("learning_rate", 0.1, "Learning rate / step size for SGD") flags.DEFINE_integer("random_seed", 31415, "Random seed") flags.DEFINE_float("sigma_noise", 0.1, "Standard deviation of noise random variable") flags.DEFINE_bool("debug", False, "Set logging level to debug") class Model(tf.Module): def __init__(self, rng, num_features): """ A plain linear regression model with a bias term """ self.m = 3 self.num_features = num_features self.w = tf.constant(tf.ones([self.m, self.num_features], dtype=tf.dtypes.float32, name=N one)) # self.sigma = tf.constant(tf.fill([self.num_features, self.m], 0.5)) # self.w = tf.Variable(rng.normal(shape=[self.m, self.num_features])) self.b = tf.Variable(tf.zeros(shape=[1, 1])) self.mu = tf.Variable(rng.normal(shape=[self.num_features, self.m])) self.sigma = tf.Variable(rng.normal(shape=[self.num_features, self.m])) def __call__(self, x): print(x) leni = tf.shape(x).numpy()[0] step_1 = tf.cast(tf.broadcast_to(x, [leni, self.m]), tf.float32) print("STEP 1: " + str(tf.shape(step_1))) print("STEP MU: " + str(tf.shape(self.mu))) print("MU: " + str(self.mu.numpy())) step_2 = tf.cast(tf.broadcast_to(self.mu, [leni, self.m]), tf.float32) print("STEP 2: " + str(tf.shape(step_2))) print("STEP 2: " + str(step_2.numpy())) step_3 = step_1 - step_2 print("STEP 3: " + str(step_3.numpy())) step_4 = -((step_3) ** 2) / tf.broadcast_to(self.sigma, [leni, self.m]) print("sigma" + str(self.sigma.numpy())) print("STEP 4: " + str(step_4.numpy())) print("WEIGHTS: " + str(self.w.numpy())) step_5 = step_4 @ self.w + self.b print("STEP 5: " + str(step_5.numpy())) # print(step_5) # print(tf.shape(tf.squeeze(x @ self.w + self.b))) return tf.squeeze(step_5)</pre>		

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@property
def model(self):
    return LinearModel(self.w.numpy().reshape([self.m]), self.b.numpy().squeeze())

def main(a):
    logging.basicConfig()

    if FLAGS.debug:
        logging.getLogger().setLevel(logging.DEBUG)

    # Safe np and tf PRNG
    seed_sequence = np.random.SeedSequence(FLAGS.random_seed)
    np_seed, tf_seed = seed_sequence.spawn(2)
    np_rng = np.random.default_rng(np_seed)
    tf_rng = tf.random.Generator.from_seed(tf_seed.entropy)

    data_generating_model = LinearModel(
        weights=np_rng.integers(low=0, high=5, size=(FLAGS.num_features)), bias=
2
    )
    logging.debug(data_generating_model)

    data = Data(
        data_generating_model,
        np_rng,
        FLAGS.num_features,
        FLAGS.num_samples,
        FLAGS.sigma_noise,
    )

    model = Model(tf_rng, FLAGS.num_features)
    logging.debug(model.model)

    optimizer = tf.optimizers.SGD(learning_rate=FLAGS.learning_rate)

    bar = trange(FLAGS.num_iters)
    for i in bar:

        with tf.GradientTape() as tape:
            x, y = data.get_batch(np_rng, FLAGS.batch_size)
            y_hat = model(x)
            loss = 0.5 * tf.reduce_mean((y_hat - y) ** 2)
            print(loss)

        grads = tape.gradient(loss, model.trainable_variables)
        optimizer.apply_gradients(zip(grads, model.trainable_variables))

        bar.set_description(f"Loss @ {i} => {loss.numpy():0.6f}")
        bar.refresh()

    logging.debug(model.model)

    if FLAGS.num_features > 1:
        # Only continue to plotting if x is a scalar
        exit(0)

    fig, ax = plt.subplots(1, 1, figsize=(11, 8), dpi=200)

    ax.set_title("Linear fit")
    ax.set_xlabel("x")

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ax.set_ylim(np.amin(data.y) * 10.5, np.amax(data.y) * 10.5)
h = ax.set_ylabel("y", labelpad=10)
h.set_rotation(0)

xs = np.linspace(0, 2, 10)
xs = xs[:, np.newaxis]
ax.plot(xs, np.squeeze(model(xs)), "-", np.squeeze(data.x), data.y, "o")

plt.tight_layout()
plt.savefig(f"{script_path}/fit.pdf")

if __name__ == "__main__":
    app.run(main)

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