Comparison of Hyperparameter Optimization Approaches for Deep Reinforcement Learning

LA-MCTS, SMAC3, Ray-Tune, Gymnasium, CleanRL
Motivation

Deep Learning

Actor-Critic Networks

Non-Stationarity

Source: Jaderberg et al., 2017
An active area of research...

Learning Search Space Partition for Black-box Optimization using Monte Carlo Tree Search

Linna Wang
Brown University
linnawang@brown.edu
Rodrigo Fonseca
Brown University
rfonseca@cs.brown.edu

On hyperparameter optimization of machine learning algorithms: Theory and practice
Li Yang, Abdallah Shami
Department of Electrical and Computer Engineering, University of Western Ontario, 1151 Richmond St, London, ON N6A 3K7, Canada

Hyperband: A Novel Bandit-Based Approach to Hyperparameter Optimization
Lisha Li
Carnegie Mellon University, Pittsburgh, PA 15213
Kevin Jamieson
University of Washington, Seattle, WA 98195
Giulia DeSalvo
Google Research, New York, NY 10011
Ahsin Rostamizadeh
Google Research, New York, NY 10011
Ameet Talwalkar
Carnegie Mellon University, Pittsburgh, PA 15213
Determined AI

Hyper-Parameter Optimization: A Review of Algorithms and Applications
Tong Yu
Department of AI and HPC
Insper Electronic Information Industry Co., Ltd
1036 Langchao Rd, Jinan, Shandong, China

Hong Zhu
Department of AI and HPC
Insper (Beijing) Electronic Information Industry Co., Ltd
2F, Block C, 2 Xincu Rd., Shangdi, Haidian Dist, Beijing, China

SMAC3: A Versatile Bayesian Optimization Package for Hyperparameter Optimization
Marius Lindauer
linsauer@tnt.uni-hannover.de

Population Based Training of Neural Networks
Simon Osindero Wojciech M. Czarnecki
Vinylas Tim Green Iain Dunning
Fernando Koray Kavukcuoglu
London, UK
Open-Source Project

Approaches

Environments: Gymnasium

RL Algorithms: CleanRL

LA-MCTS

SMAC3

Ray-Tune
Latent Action Monte Carlo Tree Search (LA-MCTS)

LEARNING & SPLITTING

SELECT

Sampling

Integration with TuRBO

Source: Wang et al., 2020
Ray-Tune

Two simple APIs for integration with model training

Trial schedulers implement strategies for distributed optimization

Ray Tune API

HyperBand
Grid Search
Bayesian Optimization
Population Based Training

# Function-based API
def train():
    for _ in range(N):
        tune.report(...)

# Class-based API
class MyModel(Trainable):
    def _setup(); def _train();
    def _save(); def _restore();
Comparison

Environments

Algorithms

Scalability
Work Plan

- Experimental design and setup
- Implementation of common optimizer interface
- Run experiments
  - LA-MCTS
  - SMAC3
  - Ray-Tune
- Evaluation on distributed setup
- If time permits, extension to the Meta-World benchmark
Questions / Discussion
References


Image Sources

- https://1.cms.s81c.com/sites/default/files/2021-01-06/ICLH_Diagram_Batch_01_03_DeepNeuralNetwork-WHITEBG.png
- https://i0.wp.com/upaspro.com/wp-content/uploads/2020/08/1y_oM_CnrT2_-7hTq_pe_g.png?w=1400&ssl=1
- https://miro.medium.com/max/1400/0*WC4l7u90TsKs_eXj.png
- https://www.gym-library.dev/_images/cart_pole.png
- https://www.gym-library.dev/_images/humanoid.png
- https://www.gym-library.dev/_images/lunar_lander.png
- https://thegradient.pub/content/images/size/w1600/2019/11/kernel_cookbook-2.png
- https://images.coursera-acecdn.com/content/v1/3af472c7723c2570b32d9f156421640195-WTELE82CWK1C80FYVN/discussion+cc3.0.png?format=1500w