
MushroomRL Benchmark Documentation

Release 1.1.0

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Reinforcement Learning python library

MushroomRL Benchmark is a benchmarking tool for the Mushroom RL library. The focus of this benchmarking tool is to benchmark the results of deep reinforcement learning algorithms, in particular Deep Actor-Critic. The idea behind MushroomRL Benchmarking is to have a complete platform to run batch comparisons of Deep RL algorithms implemented in MushroomRL under a set of standard benchmark tasks.

With MushroomRL Benchmarking you can:

- Run the benchmarks in a local machine, both sequentially and in parallel fashion
- Run experiments on a SLURM-based cluster.

CHAPTER 2

Download and installation

MushroomRL Benchmark can be downloaded from the [GitHub](#) repository. Installation can be done running

```
cd mushroom-rl-benchmark
pip install -e .[all]
```

To compile the documentation:

```
cd mushroom-rl-benchmark/docs
make html
```

or to compile the pdf version:

```
cd mushroom-rl-benchmark/docs
make latexpdf
```


3.1 Policy Search Benchmarks

We provide the benchmarks for the Policy Gradient algorithms:

- **REINFORCE**
- **GPOMDP**
- **eNAC**

We provide the benchmarks for the following Black-Box optimization algorithms:

- **RWR**
- **REPS**
- **PGPE**
- **ConstrainedREPS**

We consider the following environments in the benchmark

3.1.1 Classic Control Environments Benchmarks

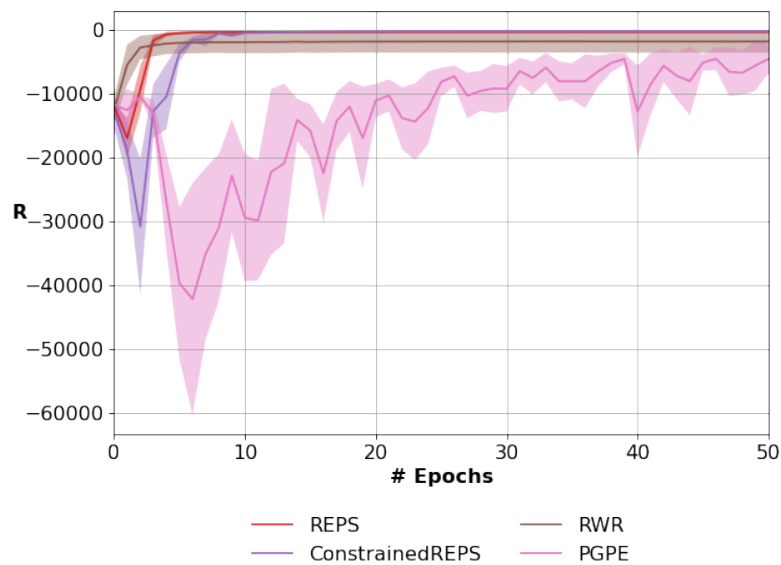
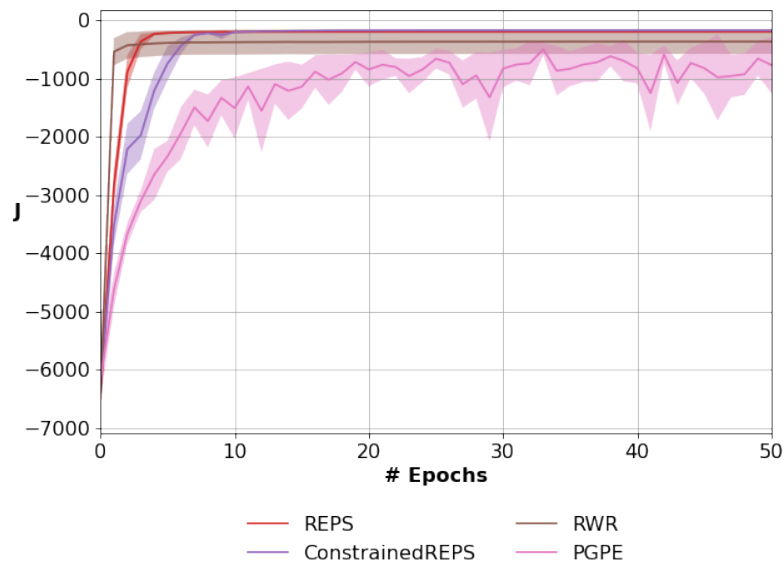
Segway

Run Parameters	
n_runs	25
n_epochs	50
n_episodes	100
n_episodes_test	10

```

ConstrainedREPS:
  eps: 0.5
  kappa: 0.1
  n_episodes_per_fit: 25
PGPE:
  alpha: 0.3
  n_episodes_per_fit: 25
REPS:
  eps: 0.5
  n_episodes_per_fit: 25
RWR:
  beta: 0.01
  n_episodes_per_fit: 25

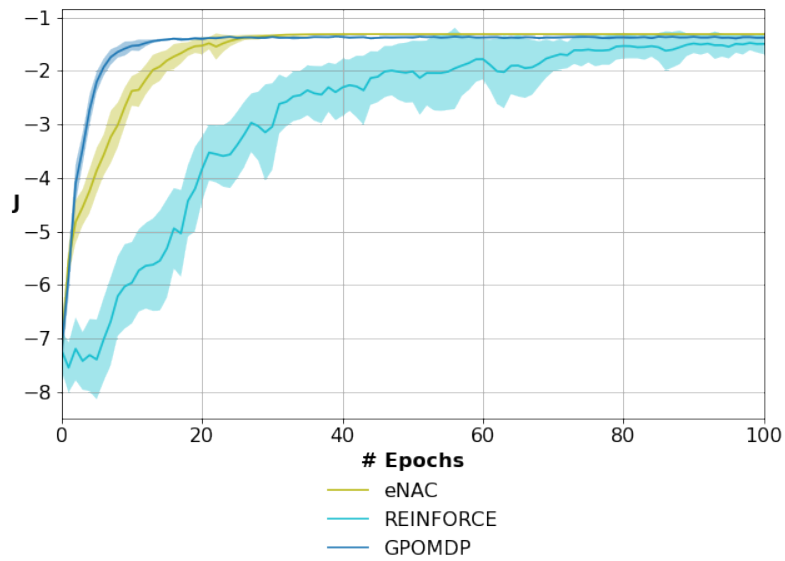
```

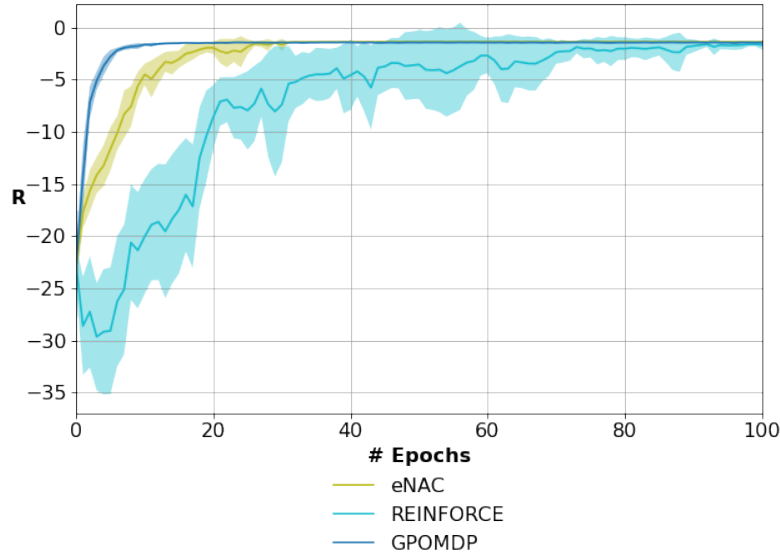


LQR

Run Parameters	
n_runs	25
n_epochs	100
n_episodes	100
n_episodes_test	10

```
GPOMDP:
  alpha: 0.01
  n_episodes_per_fit: 25
REINFORCE:
  alpha: 0.01
  n_episodes_per_fit: 25
eNAC:
  alpha: 0.01
  n_episodes_per_fit: 25
```





3.2 Actor-Critic Benchmarks

We provide the benchmarks for the following Deep Actor-Critic algorithms:

- **StochasticAC**
- **COPDAC_Q**

We provide the benchmarks for the following Deep Actor-Critic algorithms:

- **A2C**
- **PPO**
- **TRPO**
- **SAC**
- **DDPG**
- **TD3**

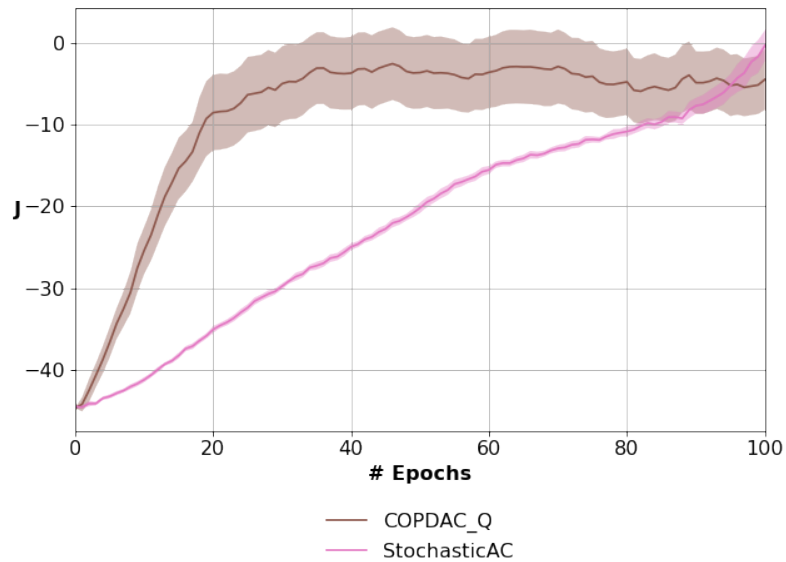
We consider the following environments in the benchmark

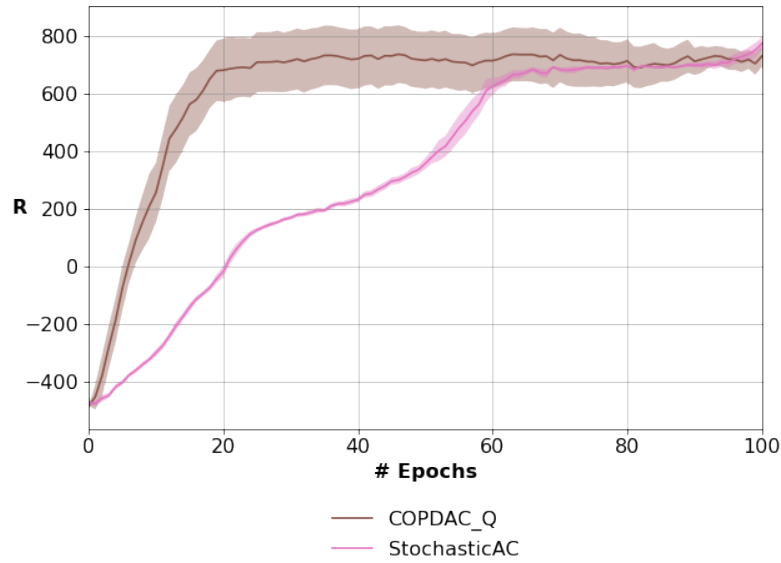
3.2.1 Classic Control Environments Benchmarks

Run Parameters	
n_runs	25
n_epochs	100
n_episodes	10
n_episodes_test	5

InvertedPendulum

```
COPDAC_Q:
  alpha_omega: 0.5
  alpha_theta: 0.005
  alpha_v: 0.5
  n_tiles: 11
  n_tilings: 10
  std_eval: 0.001
  std_exp: 0.1
StochasticAC:
  alpha_theta: 0.001
  alpha_v: 0.1
  lambda_par: 0.9
  n_tiles: 11
  n_tilings: 10
  std_0: 1.0
```





3.2.2 Gym Control Environments Benchmarks

Run Parameters	
n_runs	25
n_epochs	10
n_steps	30000
n_episodes_test	10

Pendulum-v0

A2C:

```

actor_lr: 0.0007
batch_size: 64
critic_lr: 0.0007
critic_network: A2CNetwork
ent_coeff: 0.01
eps_actor: 0.003
eps_critic: 1.0e-05
max_grad_norm: 0.5
n_features: 64
preprocessors: null

```

DDPG:

```

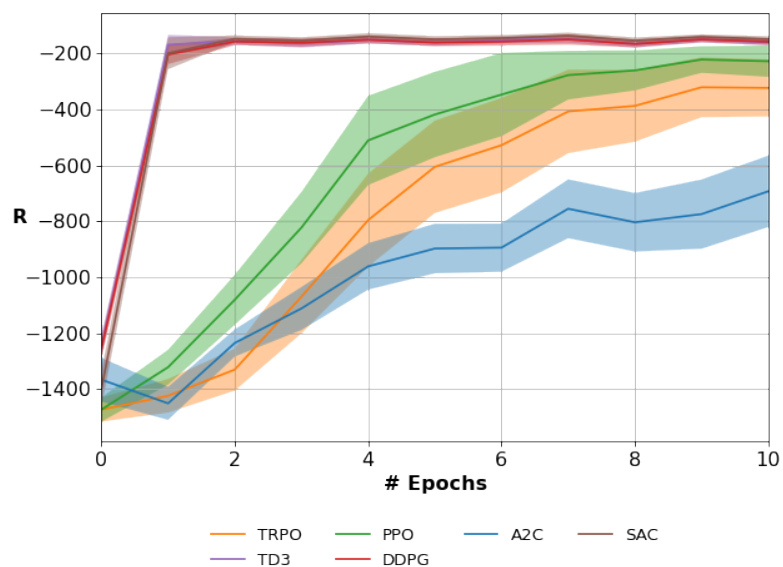
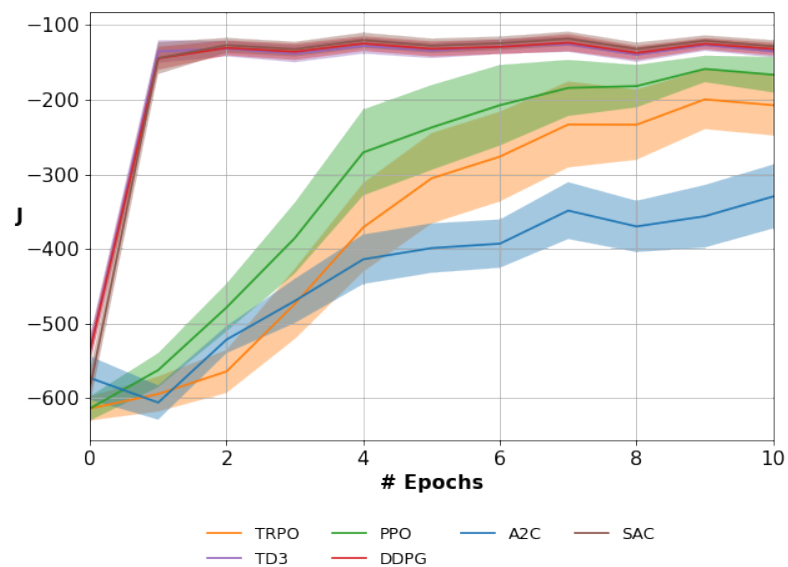
actor_lr: 0.0001
actor_network: DDPGActorNetwork
batch_size: 64
critic_lr: 0.001
critic_network: DDPGCriticNetwork
initial_replay_size: 128
max_replay_size: 1000000
n_features:
- 64
- 64

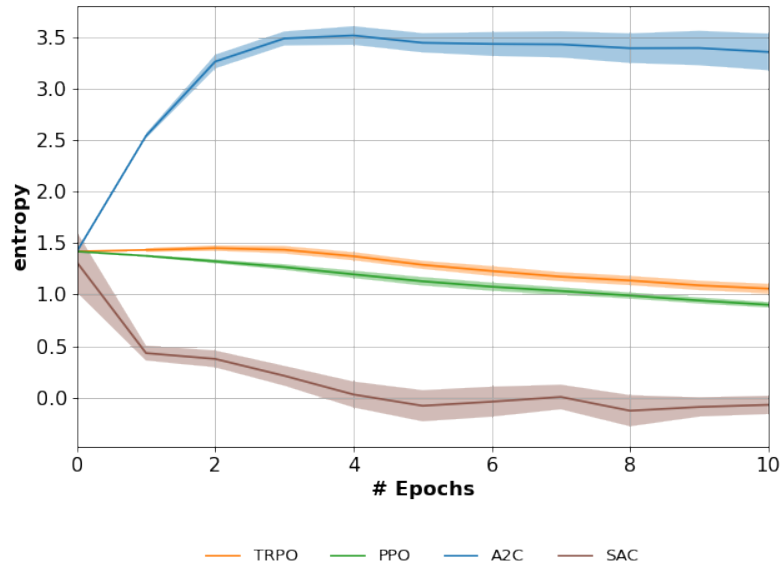
```

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```
    tau: 0.001
PPO:
  actor_lr: 0.0003
  batch_size: 64
  critic_fit_params: null
  critic_lr: 0.0003
  critic_network: TRPONetwork
  eps: 0.2
  lam: 0.95
  n_epochs_policy: 4
  n_features: 32
  n_steps_per_fit: 3000
  preprocessors: null
SAC:
  actor_lr: 0.0001
  actor_network: SACTActorNetwork
  batch_size: 64
  critic_lr: 0.0003
  critic_network: SACCriticNetwork
  initial_replay_size: 128
  lr_alpha: 0.0003
  max_replay_size: 500000
  n_features: 64
  preprocessors: null
  target_entropy: null
  tau: 0.001
  warmup_transitions: 128
TD3:
  actor_lr: 0.0001
  actor_network: TD3ActorNetwork
  batch_size: 64
  critic_lr: 0.001
  critic_network: TD3CriticNetwork
  initial_replay_size: 128
  max_replay_size: 1000000
  n_features:
    - 64
    - 64
  tau: 0.001
TRPO:
  batch_size: 64
  cg_damping: 0.01
  cg_residual_tol: 1.0e-10
  critic_fit_params: null
  critic_lr: 0.0003
  critic_network: TRPONetwork
  ent_coeff: 0.0
  lam: 0.95
  max_kl: 0.01
  n_epochs_cg: 100
  n_epochs_line_search: 10
  n_features: 32
  n_steps_per_fit: 3000
  preprocessors: null
```





LunarLanderContinuous-v2

A2C:

```

actor_lr: 0.0007
batch_size: 64
critic_lr: 0.0007
critic_network: A2CNetwork
ent_coeff: 0.01
eps_actor: 0.003
eps_critic: 1.0e-05
max_grad_norm: 0.5
n_features: 64
preprocessors: StandardizationPreprocessor

```

DDPG:

```

actor_lr: 0.0001
actor_network: DDPGActorNetwork
batch_size: 64
critic_lr: 0.001
critic_network: DDPGCriticNetwork
initial_replay_size: 128
max_replay_size: 1000000
n_features:
- 64
- 64
tau: 0.001

```

PPO:

```

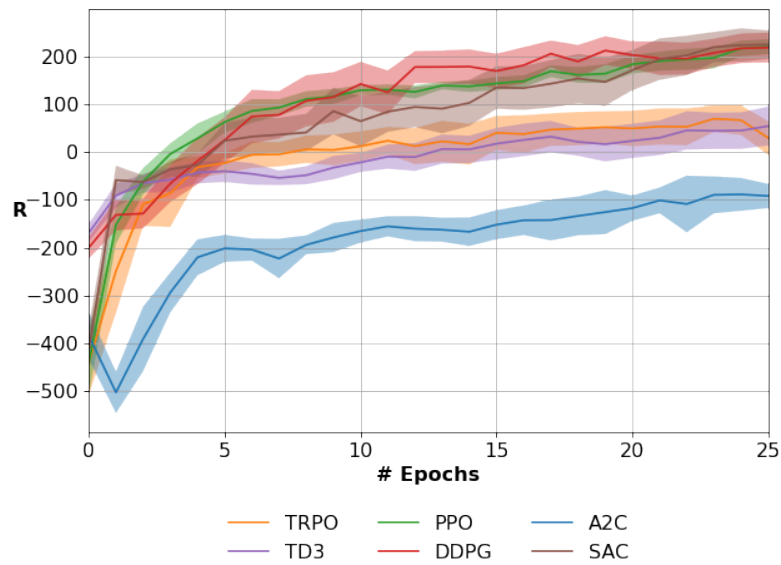
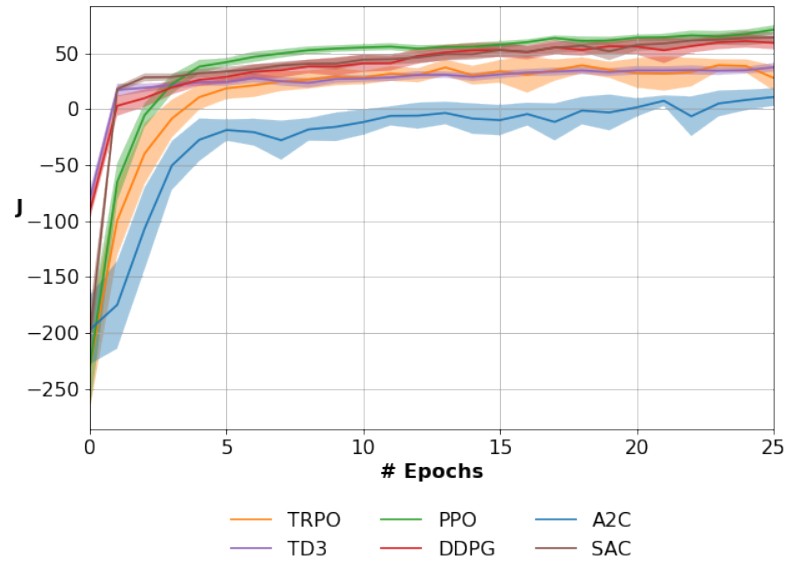
actor_lr: 0.0003
batch_size: 64
critic_fit_params: null
critic_lr: 0.003
critic_network: TRPONetwork
eps: 0.2
lam: 0.95
n_epochs_policy: 4
n_features: 32

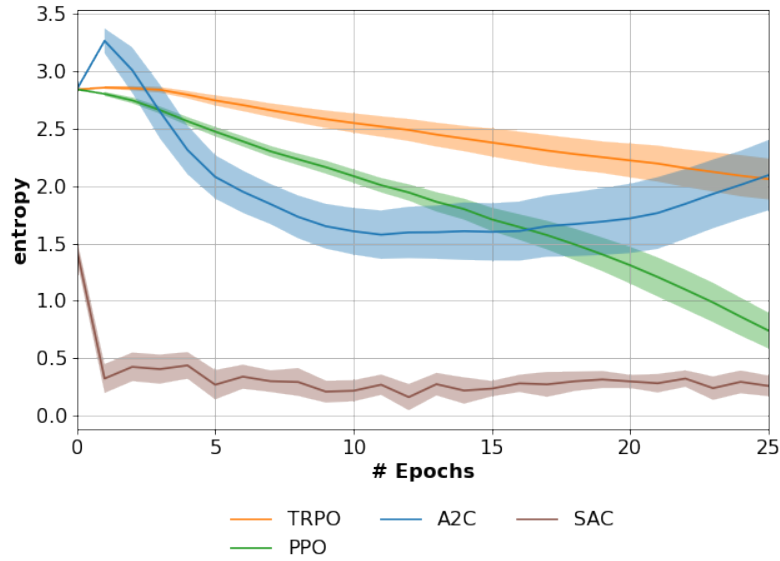
```

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```
n_steps_per_fit: 3000
preprocessors: StandardizationPreprocessor
SAC:
  actor_lr: 0.0001
  actor_network: SACActorNetwork
  batch_size: 64
  critic_lr: 0.0003
  critic_network: SACCriticNetwork
  initial_replay_size: 128
  lr_alpha: 0.0003
  max_replay_size: 500000
  n_features: 64
  preprocessors: null
  target_entropy: null
  tau: 0.005
  warmup_transitions: 128
TD3:
  actor_lr: 0.0001
  actor_network: TD3ActorNetwork
  batch_size: 64
  critic_lr: 0.001
  critic_network: TD3CriticNetwork
  initial_replay_size: 128
  max_replay_size: 1000000
  n_features:
    - 64
    - 64
  tau: 0.001
TRPO:
  batch_size: 64
  cg_damping: 0.01
  cg_residual_tol: 1.0e-10
  critic_fit_params: null
  critic_lr: 0.03
  critic_network: TRPONetwork
  ent_coeff: 0.0
  lam: 0.95
  max_kl: 0.01
  n_epochs_cg: 100
  n_epochs_line_search: 10
  n_features: 32
  n_steps_per_fit: 3000
  preprocessors: StandardizationPreprocessor
```





3.2.3 Mujoco Environments Benchmarks

Run Parameters	
n_runs	25
n_epochs	50
n_steps	30000
n_episodes_test	10

Hopper-v3

```

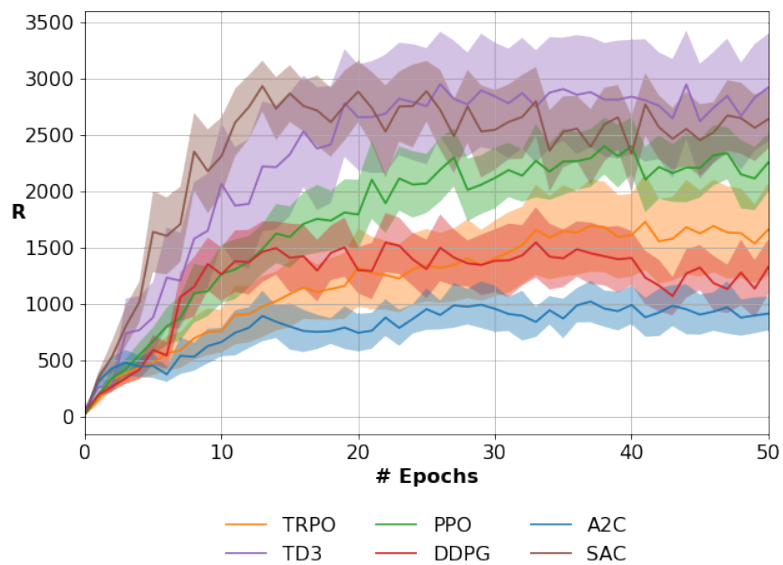
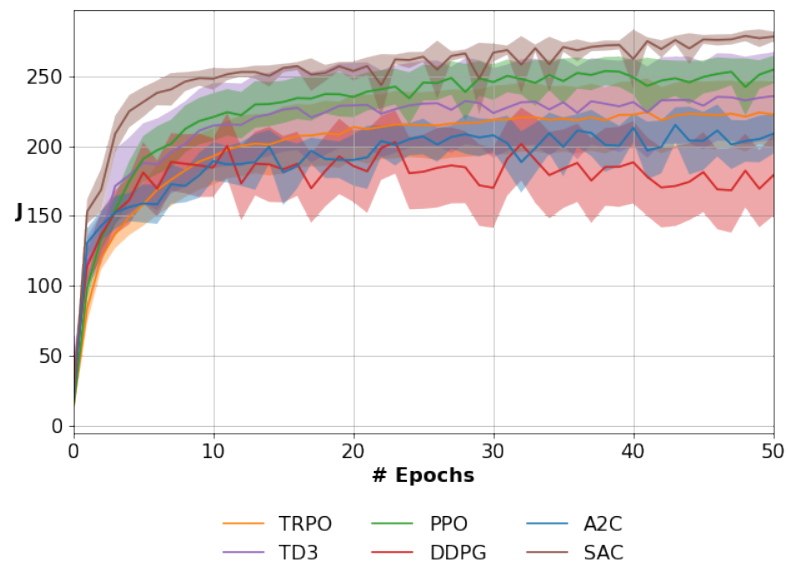
A2C:
  actor_lr: 0.0007
  batch_size: 64
  critic_lr: 0.0007
  critic_network: A2CNetwork
  ent_coeff: 0.01
  eps_actor: 0.003
  eps_critic: 1.0e-05
  max_grad_norm: 0.5
  n_features: 64
  preprocessors: StandardizationPreprocessor
DDPG:
  actor_lr: 0.0001
  actor_network: DDPGActorNetwork
  batch_size: 128
  critic_lr: 0.001
  critic_network: DDPGCriticNetwork
  initial_replay_size: 5000
  max_replay_size: 1000000
  n_features:
    - 400
    - 300

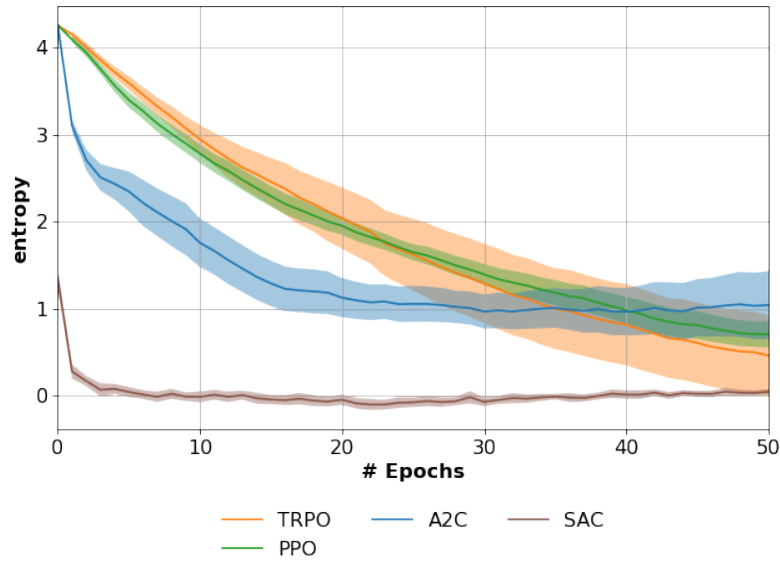
```

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```
    tau: 0.001
PPO:
  actor_lr: 0.0003
  batch_size: 32
  critic_fit_params: null
  critic_lr: 0.0003
  critic_network: TRPONetwork
  eps: 0.2
  lam: 0.95
  n_epochs_policy: 10
  n_features: 32
  n_steps_per_fit: 2000
  preprocessors: StandardizationPreprocessor
SAC:
  actor_lr: 0.0001
  actor_network: SACTActorNetwork
  batch_size: 256
  critic_lr: 0.0003
  critic_network: SACCriticNetwork
  initial_replay_size: 5000
  lr_alpha: 0.0003
  max_replay_size: 500000
  n_features: 256
  preprocessors: null
  target_entropy: null
  tau: 0.005
  warmup_transitions: 10000
TD3:
  actor_lr: 0.001
  actor_network: TD3ActorNetwork
  batch_size: 100
  critic_lr: 0.001
  critic_network: TD3CriticNetwork
  initial_replay_size: 1000
  max_replay_size: 1000000
  n_features:
    - 400
    - 300
  tau: 0.005
TRPO:
  batch_size: 64
  cg_damping: 0.01
  cg_residual_tol: 1.0e-10
  critic_fit_params: null
  critic_lr: 0.001
  critic_network: TRPONetwork
  ent_coeff: 0.0
  lam: 0.95
  max_kl: 0.01
  n_epochs_cg: 100
  n_epochs_line_search: 10
  n_features: 32
  n_steps_per_fit: 1000
  preprocessors: StandardizationPreprocessor
```





Walker2d-v3

A2C:

```

actor_lr: 0.0007
batch_size: 64
critic_lr: 0.0007
critic_network: A2CNetwork
ent_coeff: 0.01
eps_actor: 0.003
eps_critic: 1.0e-05
max_grad_norm: 0.5
n_features: 64
preprocessors: StandardizationPreprocessor

```

DDPG:

```

actor_lr: 0.0001
actor_network: DDPGActorNetwork
batch_size: 128
critic_lr: 0.001
critic_network: DDPGCriticNetwork
initial_replay_size: 5000
max_replay_size: 1000000
n_features:
- 400
- 300
tau: 0.001

```

PPO:

```

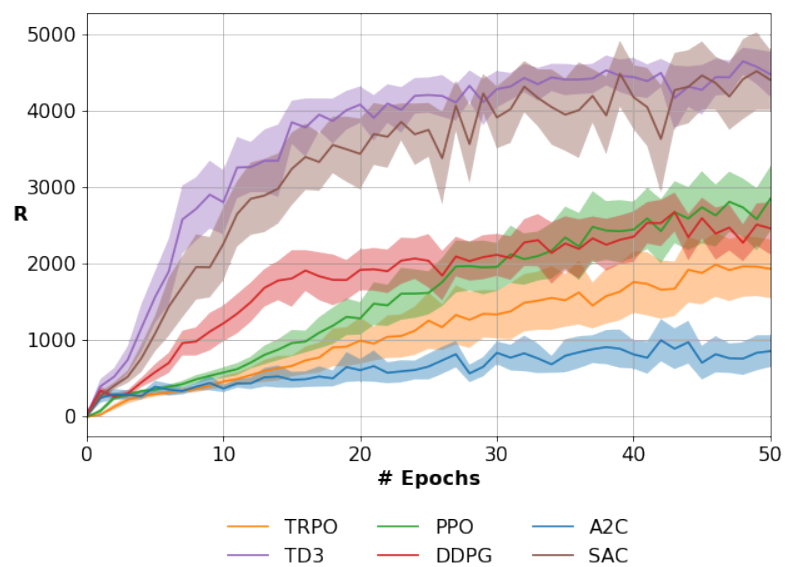
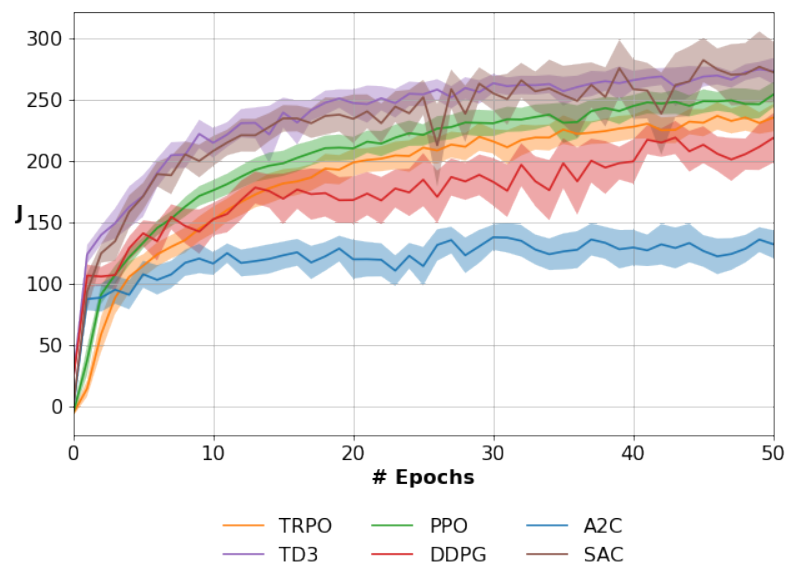
actor_lr: 0.0003
batch_size: 32
critic_fit_params: null
critic_lr: 0.0003
critic_network: TRPONetwork
eps: 0.2
lam: 0.95
n_epochs_policy: 10
n_features: 32

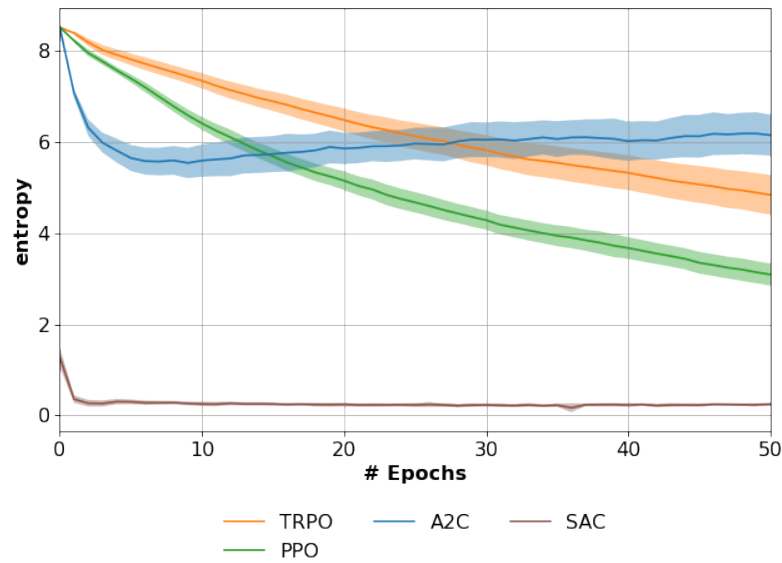
```

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```
n_steps_per_fit: 2000
preprocessors: StandardizationPreprocessor
SAC:
  actor_lr: 0.0001
  actor_network: SACTActorNetwork
  batch_size: 256
  critic_lr: 0.0003
  critic_network: SACCriticNetwork
  initial_replay_size: 5000
  lr_alpha: 0.0003
  max_replay_size: 500000
  n_features: 256
  preprocessors: null
  target_entropy: null
  tau: 0.005
  warmup_transitions: 10000
TD3:
  actor_lr: 0.001
  actor_network: TD3ActorNetwork
  batch_size: 100
  critic_lr: 0.001
  critic_network: TD3CriticNetwork
  initial_replay_size: 1000
  max_replay_size: 1000000
  n_features:
    - 400
    - 300
  tau: 0.005
TRPO:
  batch_size: 64
  cg_damping: 0.01
  cg_residual_tol: 1.0e-10
  critic_fit_params: null
  critic_lr: 0.001
  critic_network: TRPONetwork
  ent_coeff: 0.0
  lam: 0.95
  max_kl: 0.01
  n_epochs_cg: 100
  n_epochs_line_search: 10
  n_features: 32
  n_steps_per_fit: 1000
  preprocessors: StandardizationPreprocessor
```





HalfCheetah-v3

A2C:

```

actor_lr: 0.0007
batch_size: 64
critic_lr: 0.0007
critic_network: A2CNetwork
ent_coeff: 0.01
eps_actor: 0.003
eps_critic: 1.0e-05
max_grad_norm: 0.5
n_features: 64
preprocessors: StandardizationPreprocessor

```

DDPG:

```

actor_lr: 0.0001
actor_network: DDPGActorNetwork
batch_size: 128
critic_lr: 0.001
critic_network: DDPGCriticNetwork
initial_replay_size: 5000
max_replay_size: 1000000
n_features:
- 400
- 300
tau: 0.001

```

PPO:

```

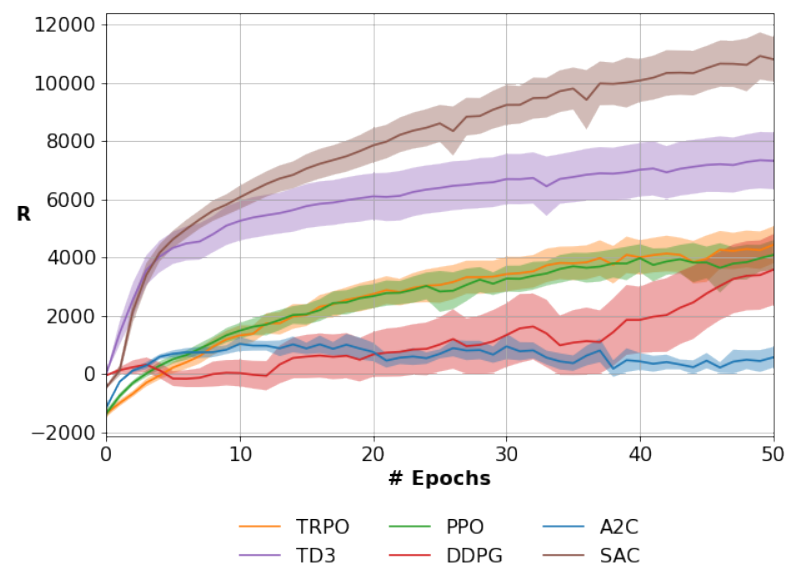
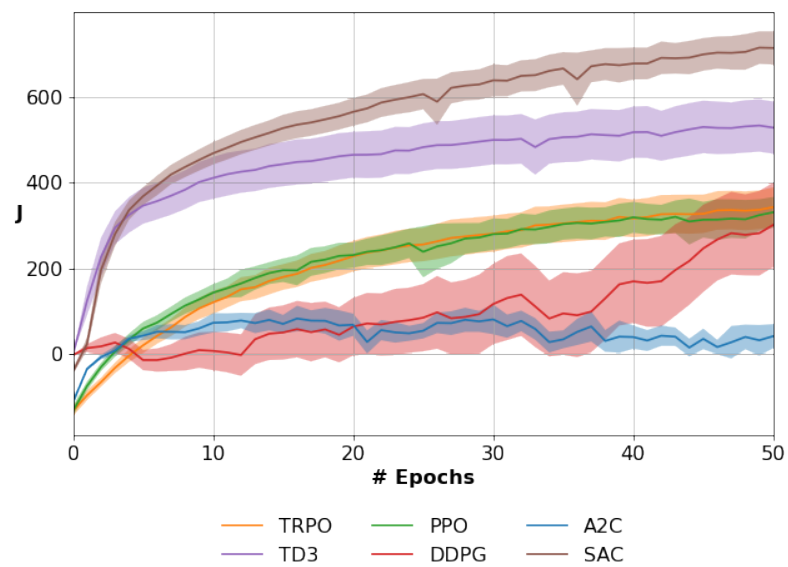
actor_lr: 0.0003
batch_size: 32
critic_fit_params: null
critic_lr: 0.0003
critic_network: TRPONetwork
eps: 0.2
lam: 0.95
n_epochs_policy: 10
n_features: 32

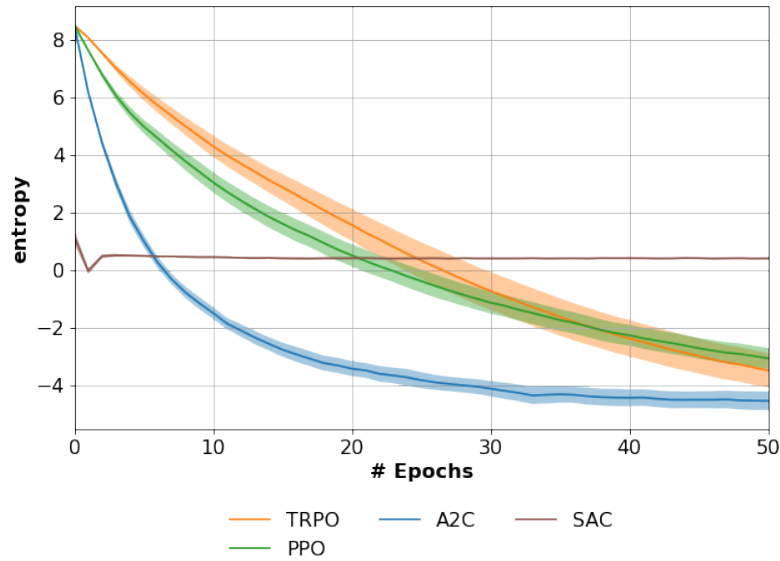
```

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```
n_steps_per_fit: 2000
preprocessors: StandardizationPreprocessor
SAC:
  actor_lr: 0.0001
  actor_network: SACTActorNetwork
  batch_size: 256
  critic_lr: 0.0003
  critic_network: SACCriticNetwork
  initial_replay_size: 5000
  lr_alpha: 0.0003
  max_replay_size: 500000
  n_features: 256
  preprocessors: null
  target_entropy: null
  tau: 0.005
  warmup_transitions: 10000
TD3:
  actor_lr: 0.001
  actor_network: TD3ActorNetwork
  batch_size: 100
  critic_lr: 0.001
  critic_network: TD3CriticNetwork
  initial_replay_size: 10000
  max_replay_size: 1000000
  n_features:
    - 400
    - 300
  tau: 0.005
TRPO:
  batch_size: 64
  cg_damping: 0.01
  cg_residual_tol: 1.0e-10
  critic_fit_params: null
  critic_lr: 0.001
  critic_network: TRPONetwork
  ent_coeff: 0.0
  lam: 0.95
  max_kl: 0.01
  n_epochs_cg: 100
  n_epochs_line_search: 10
  n_features: 32
  n_steps_per_fit: 1000
  preprocessors: StandardizationPreprocessor
```





Ant-v3

A2C:

```

actor_lr: 0.0007
batch_size: 64
critic_lr: 0.0007
critic_network: A2CNetwork
ent_coeff: 0.01
eps_actor: 0.003
eps_critic: 1.0e-05
max_grad_norm: 0.5
n_features: 64
preprocessors: StandardizationPreprocessor

```

DDPG:

```

actor_lr: 0.0001
actor_network: DDPGActorNetwork
batch_size: 128
critic_lr: 0.001
critic_network: DDPGCriticNetwork
initial_replay_size: 5000
max_replay_size: 1000000
n_features:
- 400
- 300
tau: 0.001

```

PPO:

```

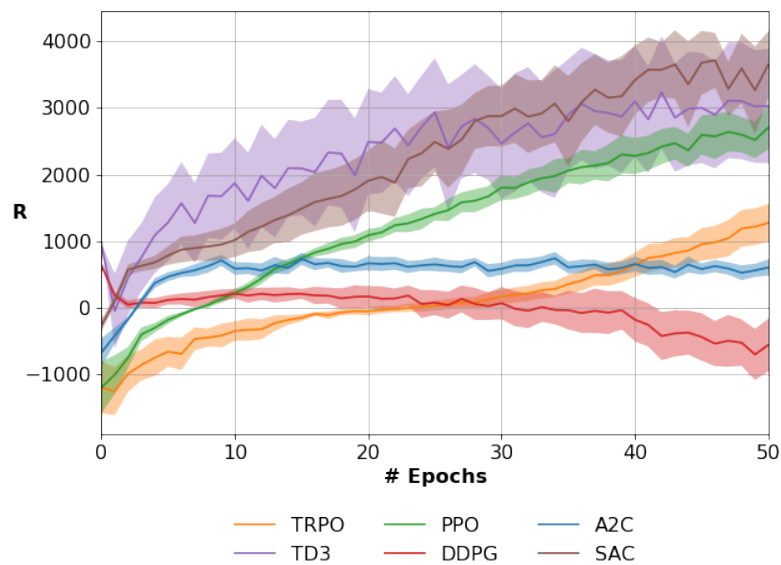
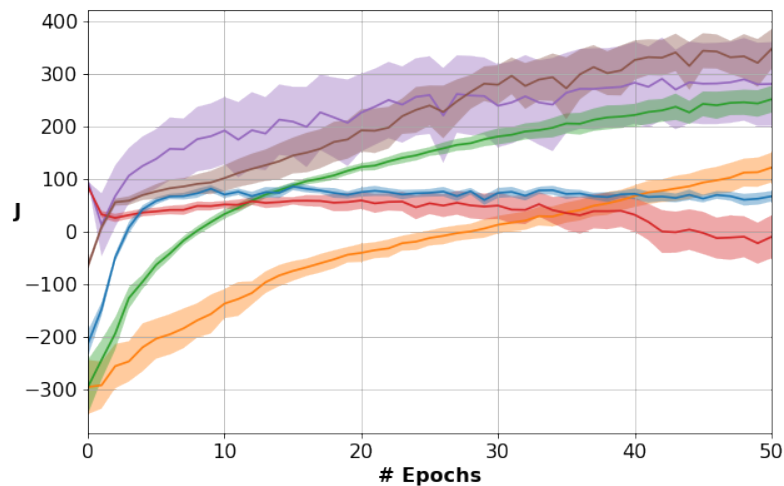
actor_lr: 0.0003
batch_size: 32
critic_fit_params: null
critic_lr: 0.0003
critic_network: TRPONetwork
eps: 0.2
lam: 0.95
n_epochs_policy: 10
n_features: 32

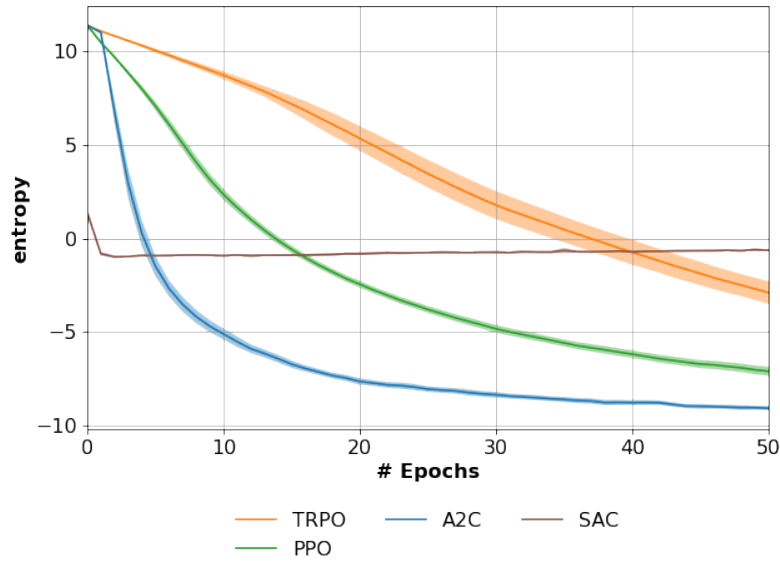
```

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```
n_steps_per_fit: 2000
preprocessors: StandardizationPreprocessor
SAC:
  actor_lr: 0.0001
  actor_network: SACActorNetwork
  batch_size: 256
  critic_lr: 0.0003
  critic_network: SACCriticNetwork
  initial_replay_size: 5000
  lr_alpha: 0.0003
  max_replay_size: 500000
  n_features: 256
  preprocessors: null
  target_entropy: null
  tau: 0.005
  warmup_transitions: 10000
TD3:
  actor_lr: 0.001
  actor_network: TD3ActorNetwork
  batch_size: 100
  critic_lr: 0.001
  critic_network: TD3CriticNetwork
  initial_replay_size: 10000
  max_replay_size: 1000000
  n_features:
    - 400
    - 300
  tau: 0.005
TRPO:
  batch_size: 64
  cg_damping: 0.01
  cg_residual_tol: 1.0e-10
  critic_fit_params: null
  critic_lr: 0.001
  critic_network: TRPONetwork
  ent_coeff: 0.0
  lam: 0.95
  max_kl: 0.01
  n_epochs_cg: 100
  n_epochs_line_search: 10
  n_features: 32
  n_steps_per_fit: 1000
  preprocessors: StandardizationPreprocessor
```





3.2.4 Bullet Environments Benchmarks

Run Parameters	
n_runs	25
n_epochs	50
n_steps	30000
n_episodes_test	10

HopperBulletEnv-v0

A2C:

```

actor_lr: 0.0007
batch_size: 64
critic_lr: 0.0007
critic_network: A2CNetwork
ent_coeff: 0.01
eps_actor: 0.003
eps_critic: 1.0e-05
max_grad_norm: 0.5
n_features: 64
preprocessors: null

```

DDPG:

```

actor_lr: 0.0001
actor_network: DDPGActorNetwork
batch_size: 128
critic_lr: 0.001
critic_network: DDPGCriticNetwork
initial_replay_size: 5000
max_replay_size: 1000000
n_features:
- 400
- 300

```

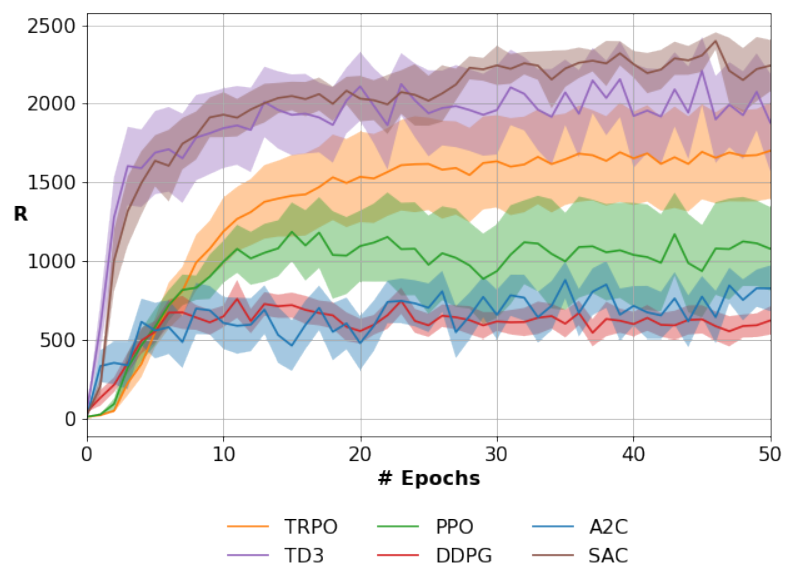
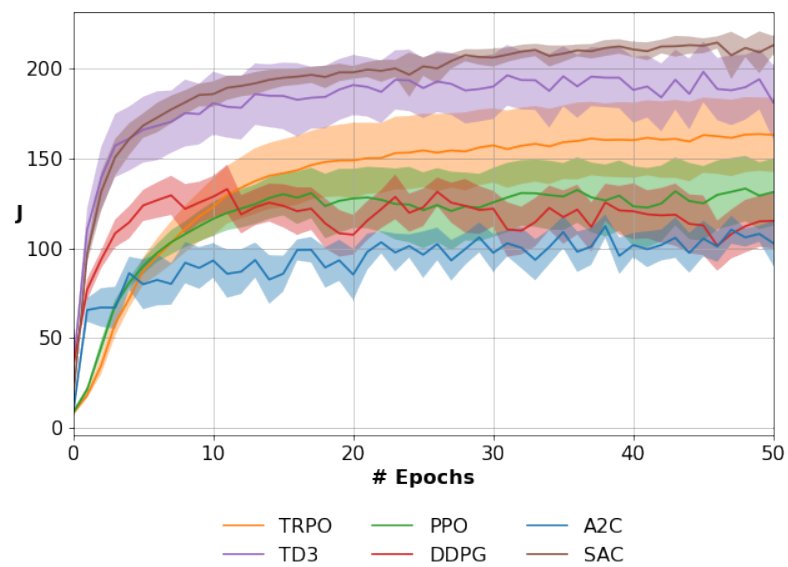
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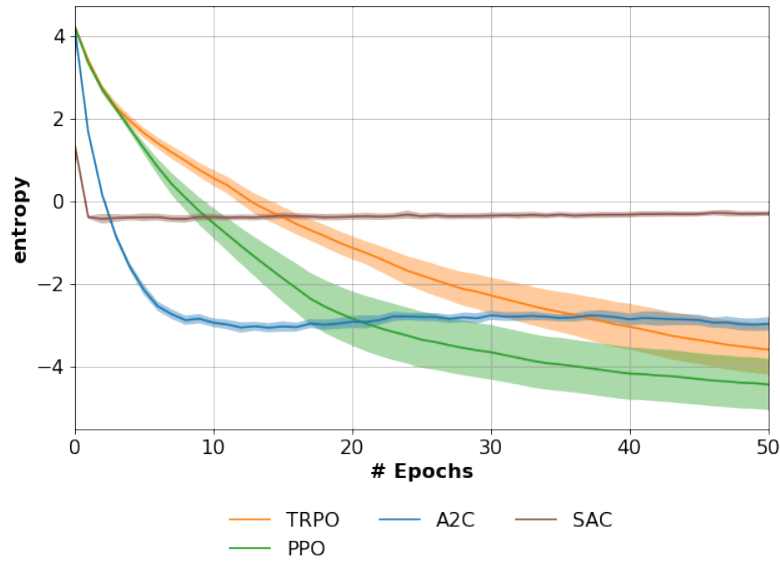
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```

    tau: 0.001
PPO:
    actor_lr: 0.0003
    batch_size: 64
    critic_fit_params: null
    critic_lr: 0.0003
    critic_network: TRPONetwork
    eps: 0.2
    lam: 0.95
    n_epochs_policy: 4
    n_features: 32
    n_steps_per_fit: 3000
    preprocessors: null
SAC:
    actor_lr: 0.0001
    actor_network: SACTActorNetwork
    batch_size: 256
    critic_lr: 0.0003
    critic_network: SACCriticNetwork
    initial_replay_size: 5000
    lr_alpha: 0.0003
    max_replay_size: 500000
    n_features: 256
    preprocessors: null
    target_entropy: null
    tau: 0.005
    warmup_transitions: 10000
TD3:
    actor_lr: 0.001
    actor_network: TD3ActorNetwork
    batch_size: 100
    critic_lr: 0.001
    critic_network: TD3CriticNetwork
    initial_replay_size: 1000
    max_replay_size: 1000000
    n_features:
    - 400
    - 300
    tau: 0.005
TRPO:
    batch_size: 64
    cg_damping: 0.01
    cg_residual_tol: 1.0e-10
    critic_fit_params: null
    critic_lr: 0.003
    critic_network: TRPONetwork
    ent_coeff: 0.0
    lam: 0.95
    max_kl: 0.01
    n_epochs_cg: 100
    n_epochs_line_search: 10
    n_features: 32
    n_steps_per_fit: 3000
    preprocessors: null

```





Walker2DBulletEnv-v0

A2C:

```
actor_lr: 0.0007
batch_size: 64
critic_lr: 0.0007
critic_network: A2CNetwork
ent_coeff: 0.01
eps_actor: 0.003
eps_critic: 1.0e-05
max_grad_norm: 0.5
n_features: 64
preprocessors: null
```

DDPG:

```
actor_lr: 0.0001
actor_network: DDPGActorNetwork
batch_size: 128
critic_lr: 0.001
critic_network: DDPGCriticNetwork
initial_replay_size: 5000
max_replay_size: 1000000
n_features:
- 400
- 300
tau: 0.001
```

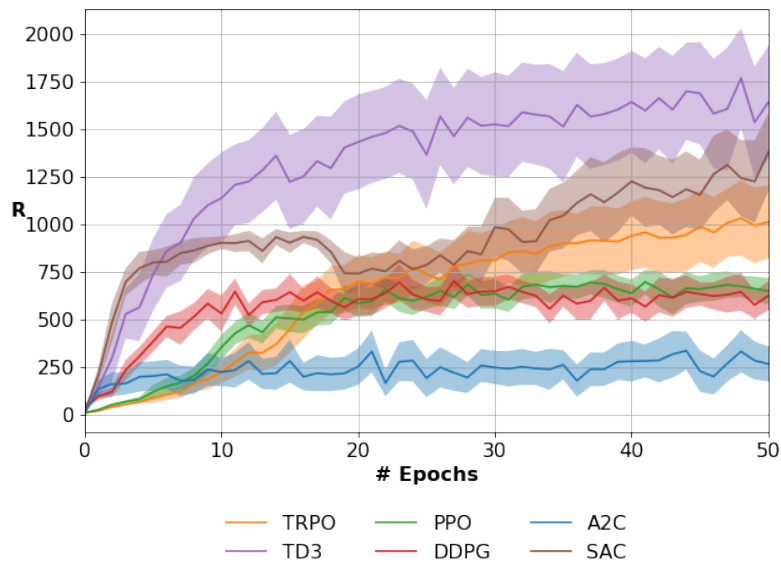
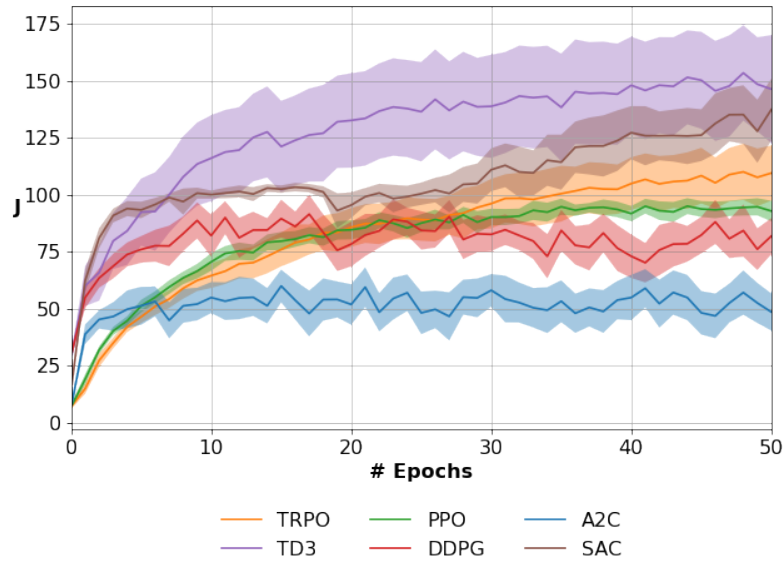
PPO:

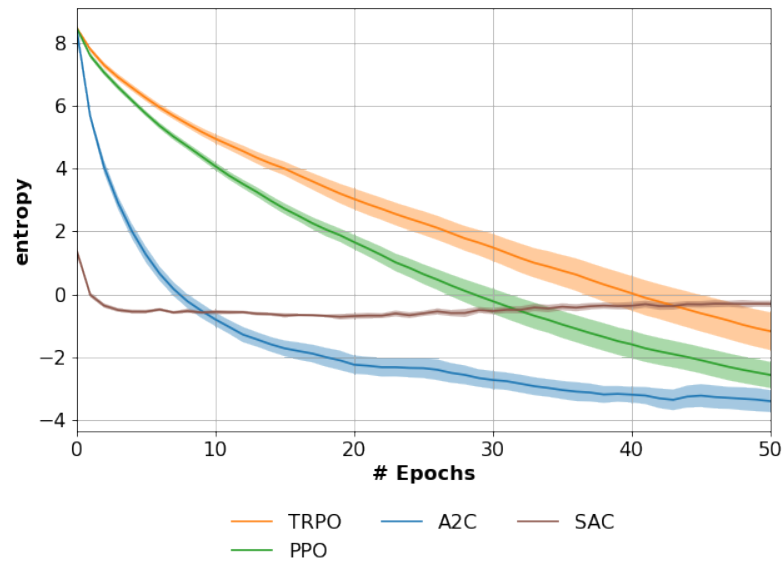
```
actor_lr: 0.0003
batch_size: 64
critic_fit_params: null
critic_lr: 0.0003
critic_network: TRPONetwork
eps: 0.2
lam: 0.95
n_epochs_policy: 4
n_features: 32
```

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```
n_steps_per_fit: 3000
preprocessors: null
SAC:
  actor_lr: 0.0001
  actor_network: SACActorNetwork
  batch_size: 256
  critic_lr: 0.0003
  critic_network: SACCriticNetwork
  initial_replay_size: 5000
  lr_alpha: 0.0003
  max_replay_size: 500000
  n_features: 256
  preprocessors: null
  target_entropy: null
  tau: 0.005
  warmup_transitions: 10000
TD3:
  actor_lr: 0.001
  actor_network: TD3ActorNetwork
  batch_size: 100
  critic_lr: 0.001
  critic_network: TD3CriticNetwork
  initial_replay_size: 1000
  max_replay_size: 1000000
  n_features:
    - 400
    - 300
  tau: 0.005
TRPO:
  batch_size: 64
  cg_damping: 0.01
  cg_residual_tol: 1.0e-10
  critic_fit_params: null
  critic_lr: 0.003
  critic_network: TRPONetwork
  ent_coeff: 0.0
  lam: 0.95
  max_kl: 0.01
  n_epochs_cg: 100
  n_epochs_line_search: 10
  n_features: 32
  n_steps_per_fit: 3000
  preprocessors: null
```





HalfCheetahBulletEnv-v0

A2C:

```

actor_lr: 0.0007
batch_size: 64
critic_lr: 0.0007
critic_network: A2CNetwork
ent_coeff: 0.01
eps_actor: 0.003
eps_critic: 1.0e-05
max_grad_norm: 0.5
n_features: 64
preprocessors: null

```

DDPG:

```

actor_lr: 0.0001
actor_network: DDPGActorNetwork
batch_size: 128
critic_lr: 0.001
critic_network: DDPGCriticNetwork
initial_replay_size: 5000
max_replay_size: 1000000
n_features:
- 400
- 300
tau: 0.001

```

PPO:

```

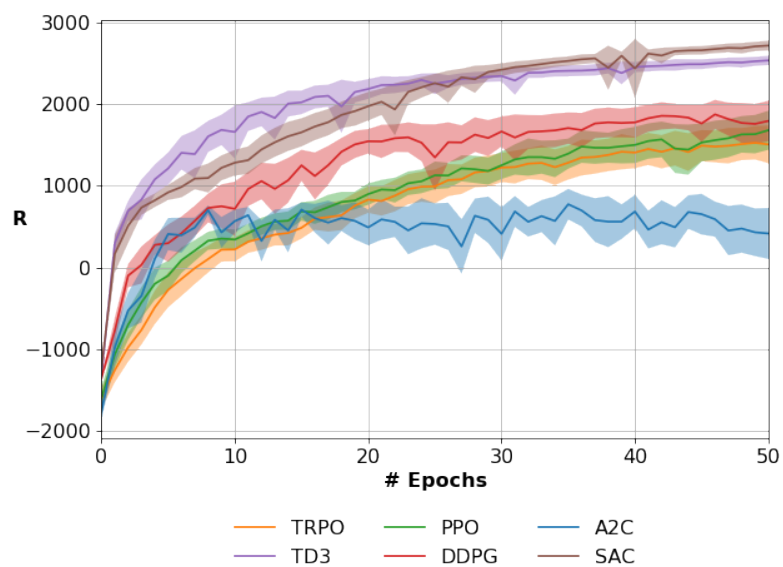
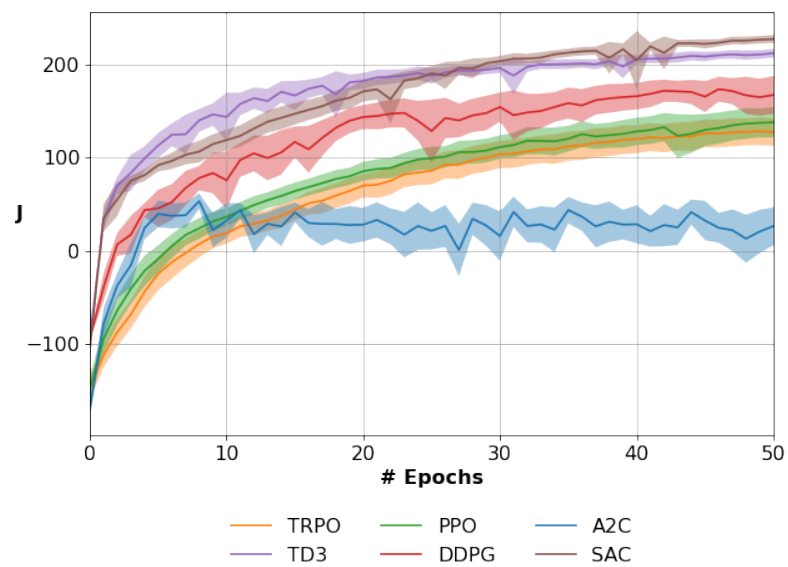
actor_lr: 0.0003
batch_size: 64
critic_fit_params: null
critic_lr: 0.0003
critic_network: TRPONetwork
eps: 0.2
lam: 0.95
n_epochs_policy: 4
n_features: 32

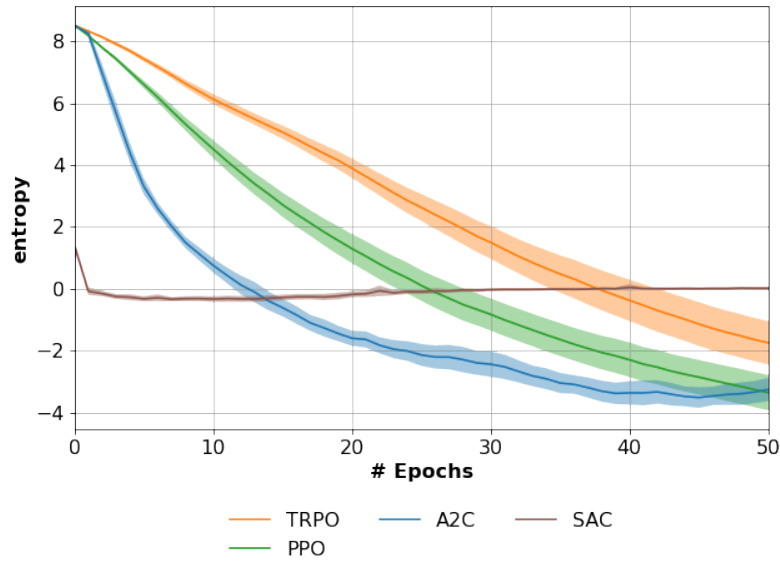
```

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```
n_steps_per_fit: 3000
preprocessors: null
SAC:
  actor_lr: 0.0001
  actor_network: SACActorNetwork
  batch_size: 256
  critic_lr: 0.0003
  critic_network: SACCriticNetwork
  initial_replay_size: 5000
  lr_alpha: 0.0003
  max_replay_size: 500000
  n_features: 256
  preprocessors: null
  target_entropy: null
  tau: 0.005
  warmup_transitions: 10000
TD3:
  actor_lr: 0.001
  actor_network: TD3ActorNetwork
  batch_size: 100
  critic_lr: 0.001
  critic_network: TD3CriticNetwork
  initial_replay_size: 10000
  max_replay_size: 1000000
  n_features:
    - 400
    - 300
  tau: 0.005
TRPO:
  batch_size: 64
  cg_damping: 0.01
  cg_residual_tol: 1.0e-10
  critic_fit_params: null
  critic_lr: 0.003
  critic_network: TRPONetwork
  ent_coeff: 0.0
  lam: 0.95
  max_kl: 0.01
  n_epochs_cg: 100
  n_epochs_line_search: 10
  n_features: 32
  n_steps_per_fit: 3000
  preprocessors: null
```





AntBulletEnv-v0

A2C:

```
actor_lr: 0.0007
batch_size: 64
critic_lr: 0.0007
critic_network: A2CNetwork
ent_coeff: 0.01
eps_actor: 0.003
eps_critic: 1.0e-05
max_grad_norm: 0.5
n_features: 64
preprocessors: null
```

DDPG:

```
actor_lr: 0.0001
actor_network: DDPGActorNetwork
batch_size: 128
critic_lr: 0.001
critic_network: DDPGCriticNetwork
initial_replay_size: 5000
max_replay_size: 1000000
n_features:
- 400
- 300
tau: 0.001
```

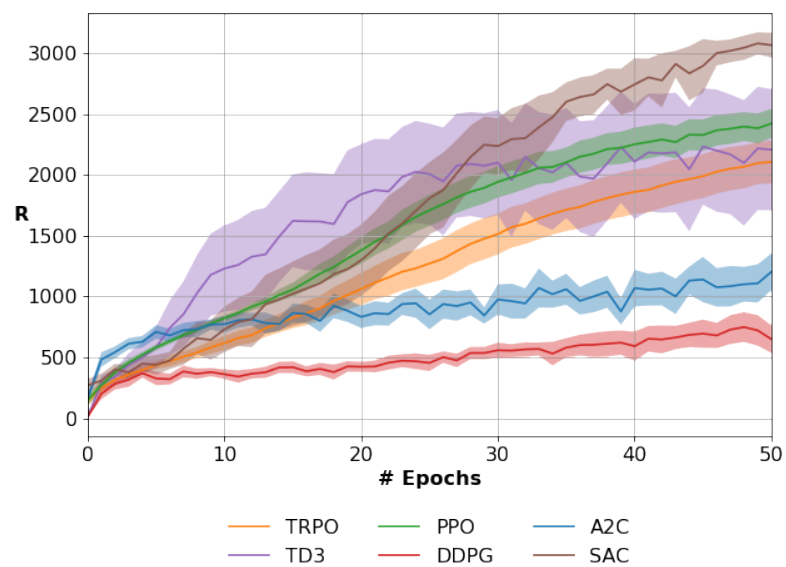
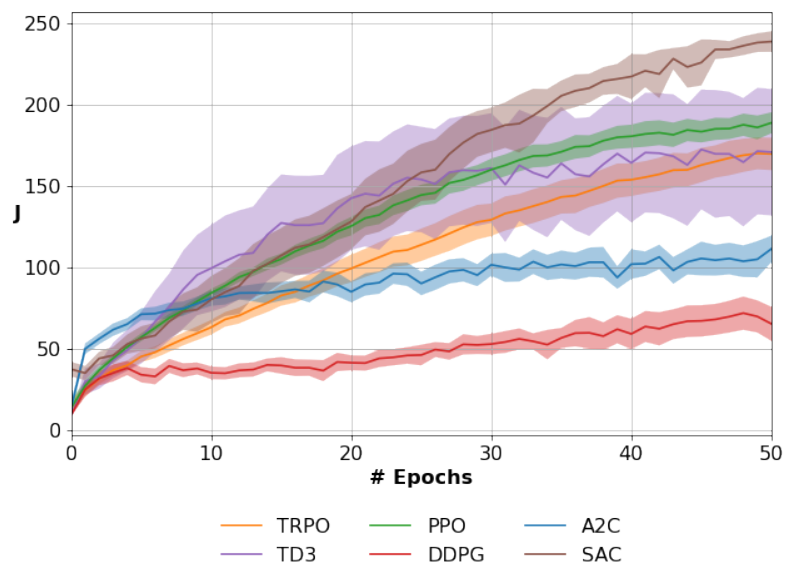
PPO:

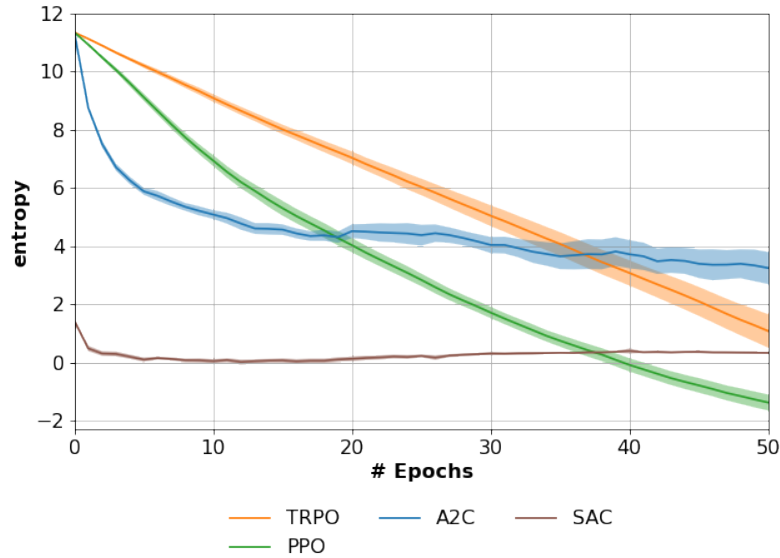
```
actor_lr: 0.0003
batch_size: 64
critic_fit_params: null
critic_lr: 0.0003
critic_network: TRPONetwork
eps: 0.2
lam: 0.95
n_epochs_policy: 4
n_features: 32
```

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```
n_steps_per_fit: 3000
preprocessors: null
SAC:
  actor_lr: 0.0001
  actor_network: SACActorNetwork
  batch_size: 256
  critic_lr: 0.0003
  critic_network: SACCriticNetwork
  initial_replay_size: 5000
  lr_alpha: 0.0003
  max_replay_size: 500000
  n_features: 256
  preprocessors: null
  target_entropy: null
  tau: 0.005
  warmup_transitions: 10000
TD3:
  actor_lr: 0.001
  actor_network: TD3ActorNetwork
  batch_size: 100
  critic_lr: 0.001
  critic_network: TD3CriticNetwork
  initial_replay_size: 10000
  max_replay_size: 1000000
  n_features:
    - 400
    - 300
  tau: 0.005
TRPO:
  batch_size: 64
  cg_damping: 0.01
  cg_residual_tol: 1.0e-10
  critic_fit_params: null
  critic_lr: 0.003
  critic_network: TRPONetwork
  ent_coeff: 0.0
  lam: 0.95
  max_kl: 0.01
  n_epochs_cg: 100
  n_epochs_line_search: 10
  n_features: 32
  n_steps_per_fit: 3000
  preprocessors: null
```





3.3 Value-Based Benchmarks

We provide the benchmarks for the following Finite Temporal-Difference algorithms:

- **SARSA**
- **QLearning**
- **SpeedyQLearning**
- **WeightedQLearning**
- **DoubleQLearning**
- **SARSALambda**
- **QLambda**

We provide the benchmarks for the following Continuous state Temporal-Difference algorithms:

- **SARSALambdaContinuous**
- **TrueOnlineSARSALambda**

We provide the benchmarks for the following DQN algorithms:

- **DQN**
- **PrioritizedDQN**
- **DoubleDQN**
- **AveragedDQN**
- **DuelingDQN**
- **MaxminDQN**
- **CategoricalDQN**
- **NoisyDQN**

We consider the following environments in the benchmark

3.3.1 Finite State Environment Benchmark

Run Parameters	
n_runs	25
n_epochs	100
n_steps	100
n_steps_test	1000

GridWorld

```

DoubleQLearning:
  decay_eps: 0.5
  decay_lr: 0.8
  epsilon: ExponentialParameter
  epsilon_test: 0.0
  learning_rate: ExponentialParameter
QLambda:
  decay_eps: 0.5
  decay_lr: 0.8
  epsilon: ExponentialParameter
  epsilon_test: 0.0
  lambda_coeff: 0.9
  learning_rate: ExponentialParameter
  trace: replacing
QLearning:
  decay_eps: 0.5
  decay_lr: 0.8
  epsilon: ExponentialParameter
  epsilon_test: 0.0
  learning_rate: ExponentialParameter
SARSA:
  decay_eps: 0.5
  decay_lr: 0.8
  epsilon: ExponentialParameter
  epsilon_test: 0.0
  learning_rate: ExponentialParameter
SARSLambda:
  decay_eps: 0.5
  decay_lr: 0.8
  epsilon: ExponentialParameter
  epsilon_test: 0.0
  lambda_coeff: 0.9
  learning_rate: ExponentialParameter
  trace: replacing
SpeedyQLearning:
  decay_eps: 0.5
  decay_lr: 0.8
  epsilon: ExponentialParameter
  epsilon_test: 0.0
  learning_rate: ExponentialParameter
WeightedQLearning:
  decay_eps: 0.5

```

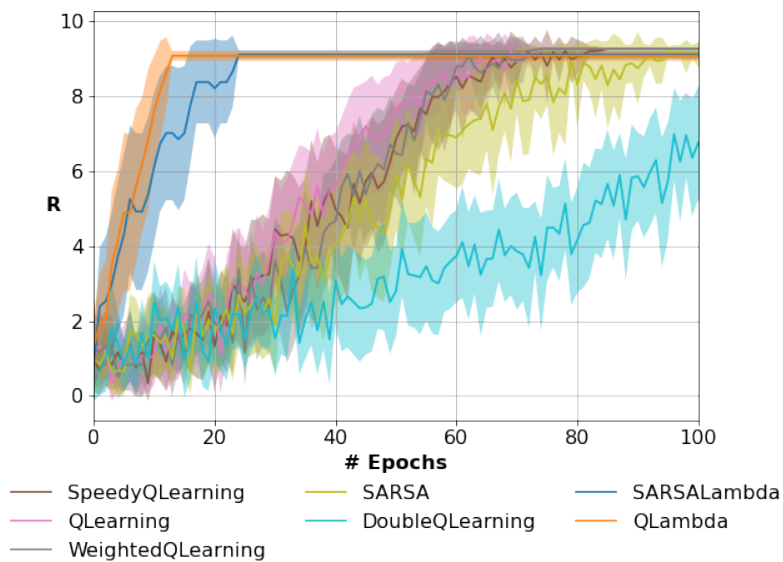
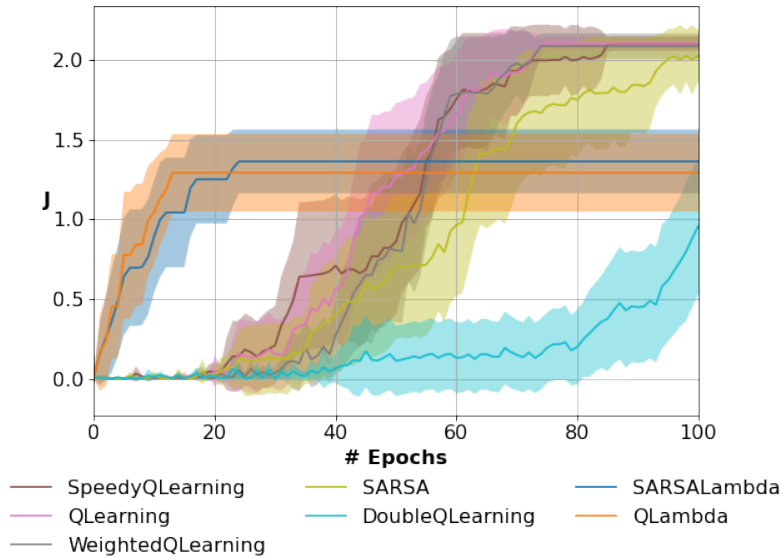
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```

decay_lr: 0.8
epsilon: ExponentialParameter
epsilon_test: 0.0
learning_rate: ExponentialParameter
precision: 1000
sampling: true

```



3.3.2 Gym Environments Benchmarks

Run Parameters	
n_runs	25
n_epochs	100
n_steps	1000
n_episodes_test	10

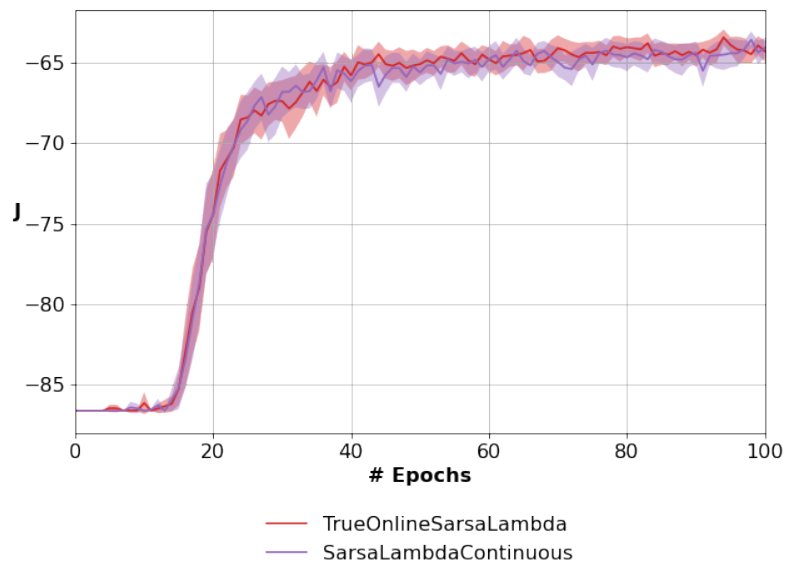
MountainCar-v0

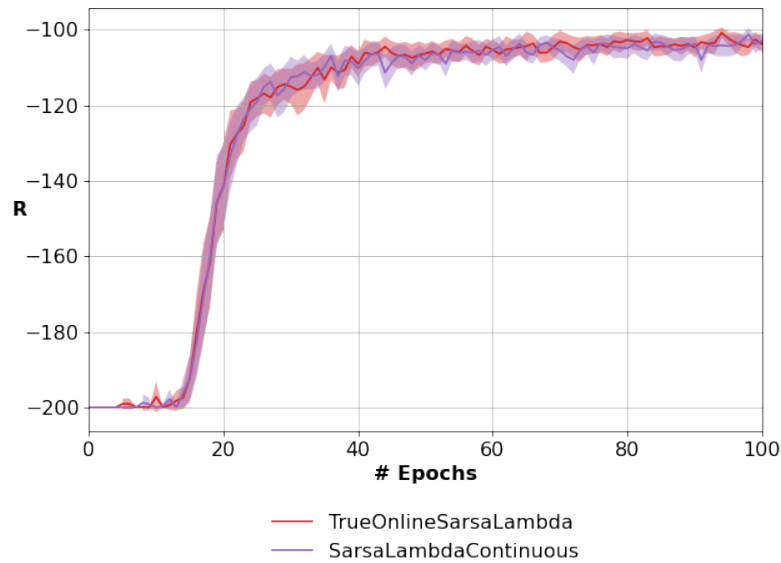
SarsaLambdaContinuous:

```
alpha: 0.1
epsilon: 0
epsilon_test: 0.0
lambda_coeff: 0.9
n_tiles: 10
n_tilings: 10
```

TrueOnlineSarsaLambda:

```
alpha: 0.1
epsilon: 0
epsilon_test: 0.0
lambda_coeff: 0.9
n_tiles: 10
n_tilings: 10
```





3.3.3 Atari Environment Benchmark

Run Parameters	
n_runs	5
n_epochs	200
n_steps	250000
n_episodes_test	125000

BreakoutDeterministic-v4

```

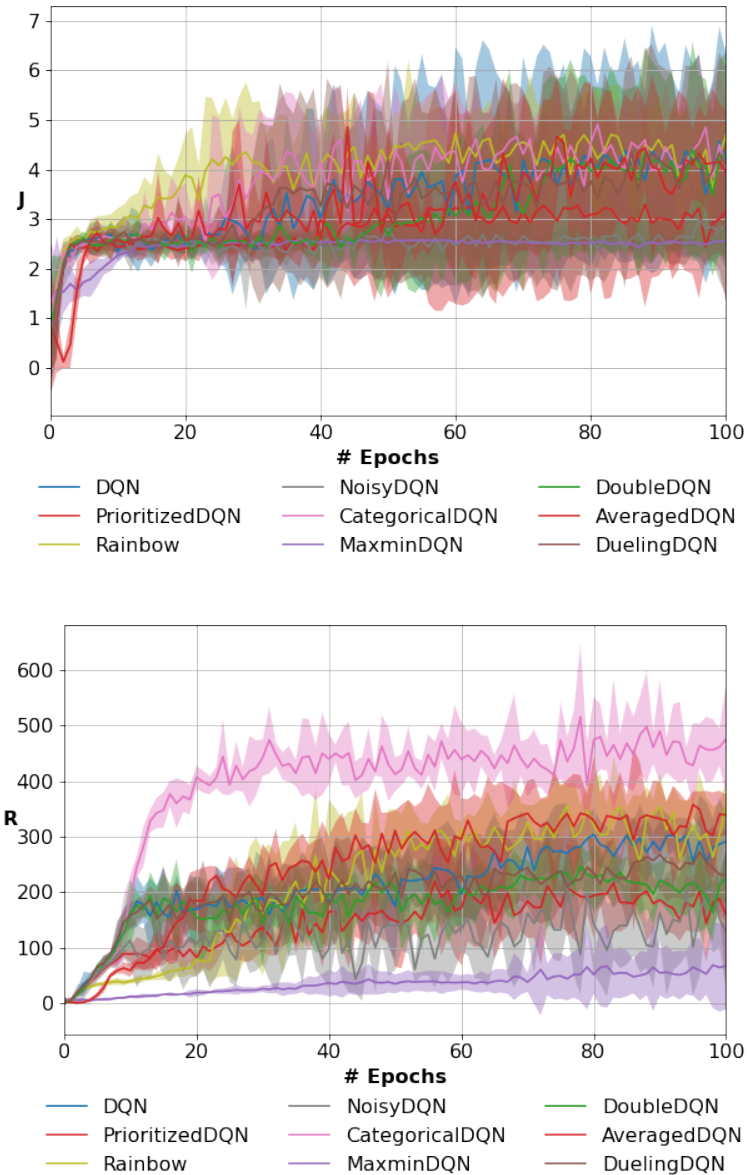
AveragedDQN:
  batch_size: 32
  initial_replay_size: 50000
  lr: 0.0001
  max_replay_size: 1000000
  n_approximators: 10
  n_steps_per_fit: 4
  network: DQNNetwork
  target_update_frequency: 2500
CategoricalDQN:
  batch_size: 32
  initial_replay_size: 50000
  lr: 0.0001
  max_replay_size: 1000000
  n_atoms: 51
  n_features: 512
  n_steps_per_fit: 4
  network: DQNFeatureNetwork
  target_update_frequency: 2500
  v_max: 10
  v_min: -10
DQN:

```

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```
batch_size: 32
initial_replay_size: 50000
lr: 0.0001
max_replay_size: 1000000
n_steps_per_fit: 4
network: DQNNetwork
target_update_frequency: 2500
DoubleDQN:
batch_size: 32
initial_replay_size: 50000
lr: 0.0001
max_replay_size: 1000000
n_steps_per_fit: 4
network: DQNNetwork
target_update_frequency: 2500
DuelingDQN:
batch_size: 32
initial_replay_size: 50000
lr: 0.0001
max_replay_size: 1000000
n_features: 512
n_steps_per_fit: 4
network: DQNFeatureNetwork
target_update_frequency: 2500
MaxminDQN:
batch_size: 32
initial_replay_size: 50000
lr: 0.0001
max_replay_size: 1000000
n_approximators: 3
n_steps_per_fit: 4
network: DQNNetwork
target_update_frequency: 2500
NoisyDQN:
batch_size: 32
initial_replay_size: 50000
lr: 0.0001
max_replay_size: 1000000
n_features: 512
n_steps_per_fit: 4
network: DQNFeatureNetwork
target_update_frequency: 2500
PrioritizedDQN:
batch_size: 32
initial_replay_size: 50000
lr: 0.0001
max_replay_size: 1000000
n_steps_per_fit: 4
network: DQNNetwork
target_update_frequency: 2500
```



3.4 Core functionality

3.4.1 Suite

class BenchmarkSuite

log_dir=None, log_id=None, use_timestamp=True, parallel=None, slurm=None Bases: object

Class to orchestrate the execution of multiple experiments.

__init__

log_dir=None, log_id=None, use_timestamp=True, parallel=None, slurm=None Constructor.

Parameters

- **log_dir** (*str*) – path to the log directory (Default: `./logs` or `/work/scratch/$USER`)

- **log_id** (*str*) – log id (Default: benchmark[_YYYY-mm-dd-HH-MM-SS])
- **use_timestamp** (*bool*) – select if a timestamp should be appended to the log id
- **parallel** (*dict*, *None*) – parameters that are passed to the run_parallel method of the experiment
- **slurm** (*dict*, *None*) – parameters that are passed to the run_slurm method of the experiment

add_experiments

environment_name, *environment_builder_params*, *agent_names_list*, *agent_builders_params*, ****run_params** Add a set of experiments for the same environment to the suite.

Parameters

- **environment_name** (*str*) – name of the environment for the experiment (E.g. Gym.Pendulum-v0);
- **environment_builder_params** (*dict*) – parameters for the environment builder;
- **agent_names_list** (*list*) – list of names of the agents for the experiments;
- **agent_builders_params** (*list*) – list of dictionaries containing the parameters for the agent builder;
- **run_params** – Parameters that are passed to the run method of the experiment.

add_experiments_sweeps

environment_name, *environment_builder_params*, *agent_names_list*, *agent_builders_params*, *sweeps_list*, ****run_params** Add a set of experiments sweeps for the same environment to the suite.

Parameters

- **environment_name** (*str*) – name of the environment for the experiment (E.g. Gym.Pendulum-v0);
- **environment_builder_params** (*dict*) – parameters for the environment builder;
- **agent_names_list** (*list*) – list of names of the agents for the experiments;
- **agent_builders_params** (*list*) – list of dictionaries containing the parameters for the agent builder;
- **sweeps_list** (*list*) – list of dictionaries containing the parameter sweep to be executed;
- **run_params** – Parameters that are passed to the run method of the experiment.

add_environment

environment_name, *environment_builder_params*, ****run_params** Add an environment to the benchmarking suite.

Parameters

- **environment_name** (*str*) – name of the environment for the experiment (E.g. Gym.Pendulum-v0);
- **environment_builder_params** (*dict*) – parameters for the environment builder;
- **run_params** – Parameters that are passed to the run method of the experiment.

add_agent

environment_name, *agent_name*, *agent_params* Add an agent to the benchmarking suite.

Parameters

- **environment_name** (*str*) – name of the environment for the experiment (E.g. Gym.Pendulum-v0);
- **agent_name** (*str*) – name of the agent for the experiments;
- **agent_params** (*list*) – dictionary containing the parameters for the agent builder.

add_sweep

environment_name, agent_name, agent_params, sweep_dict Add an agent sweep to the benchmarking suite.

Parameters

- **environment_name** (*str*) – name of the environment for the experiment (E.g. Gym.Pendulum-v0);
- **agent_name** (*str*) – name of the agent for the experiments;
- **agent_params** (*list*) – dictionary containing the parameters for the agent builder;
- **sweep_dict** (*dict*) – dictionary with the sweep configurations.

run

exec_type='sequential' Run all experiments in the suite.

print_experiments

Print the experiments in the suite.

save_parameters

Save the experiment parameters in yaml files inside the parameters folder

save_plots

***plot_params* Save the result plots to the log directory.

Parameters ***plot_params* – parameters to be passed to the suite visualizer.

show_plots

***plot_params* Display the result plots.

Parameters ***plot_params* – parameters to be passed to the suite visualizer.

3.4.2 Experiment

class BenchmarkExperiment

agent_builder, env_builder, logger Bases: object

Class to create and run an experiment using MushroomRL

__init__

agent_builder, env_builder, logger Constructor.

Parameters

- **agent_builder** (*AgentBuilder*) – instance of a specific agent builder;
- **env_builder** (*EnvironmentBuilder*) – instance of an environment builder;
- **logger** (*BenchmarkLogger*) – instance of a benchmark logger.

run

*exec_type='sequential', **run_params* Execute the experiment.

Parameters

- **exec_type** (*str*, 'sequential') – type of executing the experiment [sequential|parallel|slurm];
- ****run_params** – parameters for the selected execution type.

run_sequential

*n_runs, n_runs_completed=0, save_plot=True, **run_params* Execute the experiment sequential.

Parameters

- **n_runs** (*int*) – number of total runs of the experiment;
- **n_runs_completed** (*int*, 0) – number of completed runs of the experiment;
- **save_plot** (*bool*, *True*) – select if a plot of the experiment should be saved to the log directory;
- ****run_params** – parameters for executing a benchmark run.

run_parallel

*n_runs, n_runs_completed=0, threading=False, save_plot=True, max_concurrent_runs=None, **run_params* Execute the experiment in parallel threads.

Parameters

- **n_runs** (*int*) – number of total runs of the experiment;
- **n_runs_completed** (*int*, 0) – number of completed runs of the experiment;
- **threading** (*bool*, *False*) – select to use threads instead of processes;
- **save_plot** (*bool*, *True*) – select if a plot of the experiment should be saved to the log directory;
- **max_concurrent_runs** (*int*, -1) – maximum number of concurrent runs. By default it uses the number of cores;
- ****run_params** – parameters for executing a benchmark run.

run_slurm

*n_runs, n_runs_completed=0, aggregation_job=True, aggregate_hours=3, aggregate_minutes=0, aggregate_seconds=0, only_print=False, **run_params* Execute the experiment with SLURM.

Parameters

- **n_runs** (*int*) – number of total runs of the experiment;
- **n_runs_completed** (*int*, 0) – number of completed runs of the experiment;
- **aggregation_job** (*bool*, *True*) – select if an aggregation job should be scheduled;
- **aggregate_hours** (*int*, 3) – maximum number of hours for the aggregation job;
- **aggregate_minutes** (*int*, 0) – maximum number of minutes for the aggregation job;
- **aggregate_seconds** (*int*, 0) – maximum number of seconds for the aggregation job;
- **only_print** (*bool*, *False*) – if *True*, don't launch the benchmarks, only print the submitted commands to the terminal;
- ****run_params** – parameters for executing a benchmark run.

reset

Reset the internal state of the experiment.

resume

logger Resume an experiment from disk

start_timer

Start the timer.

stop_timer

Stop the timer.

save_builders

Save agent and environment builder to the log directory.

extend_and_save_J

J Extend *J* with another datapoint and save the current state to the log directory.

extend_and_save_R

R Extend *R* with another datapoint and save the current state to the log directory.

extend_and_save_V

V Extend *V* with another datapoint and save the current state to the log directory.

extend_and_save_entropy

entropy Extend entropy with another datapoint and save the current state to the log directory.

set_and_save_config

***settings* Save the experiment configuration to the log directory.

set_and_save_stats

***info* Save the run statistics to the log directory.

save_plot

Save the result plot to the log directory.

show_plot

Display the result plot.

3.4.3 Logger

class BenchmarkLogger

log_dir=None, log_id=None, use_timestamp=True Bases: `mushroom_rl.core.logger.console_logger.ConsoleLogger`

Class to handle all interactions with the log directory.

__init__

log_dir=None, log_id=None, use_timestamp=True Constructor.

Parameters

- **log_dir** (*str, None*) – path to the log directory, if not specified defaults to `./logs` or `/work/scratch/$USER` if the second directory exists;
- **log_id** (*str, None*) – log id, if not specified defaults to: `benchmark[_YY-mm-ddTHH:MM:SS.zzz]`;
- **use_timestamp** (*bool, True*) – select if a timestamp should be appended to the log id.

set_log_dir

log_dir Set the directory for logging.

Parameters **log_dir** (*str*) – path of the directory.

get_log_dir

Returns The path of the logging directory.

set_log_id

log_id, use_timestamp=True Set the id of the logged folder.

Parameters

- **log_id** (*str*) – id of the logged folder;
- **use_timestamp** (*bool*, *True*) – whether to use the timestamp or not.

get_log_id

Returns The id of the logged folder.

get_path

filename="" Get the path of the given file. If no filename is given, it returns the path of the logging folder.

Parameters **filename** (*str*, *' '*) – the name of the file.

Returns The complete path of the logged file.

get_params_path

filename="" Get the path of the parameters of the given file. If no filename is given, it returns the path of the parameters folder.

Parameters **filename** (*str*, *' '*) – the name of the file.

Returns The complete path of the logged file.

get_figure_path

filename="", subfolder=None Get the path of the figures of the given file. If no filename is given, it returns the path of the figures folder.

Parameters

- **filename** (*str*, *' '*) – the name of the file;
- **subfolder** (*None*) – the name of a subfolder to add.

Returns The complete path of the logged file.

save_J

J Save the log of the cumulative discounted reward.

load_J

Returns The log of the cumulative discounted reward.

save_R

R Save the log of the cumulative reward.

load_R

Returns The log of the cumulative reward.

save_V

V Save the log of the value function.

load_V

Returns The log of the value function.

save_entropy

entropy Save the log of the entropy function.

load_entropy

Returns The log of the entropy function.

exists_policy_entropy

Returns True if the log of the entropy exists, False otherwise.

exists_value_function

Returns True if the log of the value function exists, False otherwise.

save_best_agent

agent Save the best agent in the respective path.

Parameters **agent** (*object*) – the agent to save.

save_last_agent

agent Save the last agent in the respective path.

Parameters **agent** (*object*) – the agent to save.

exists_best_agent

Returns True if the entropy file exists, False otherwise.

load_best_agent

Returns The best agent.

load_last_agent

Returns The last agent.

save_environment_builder

env_builder Save the environment builder using the respective path.

Parameters **env_builder** (*str*) – the environment builder to save.

load_environment_builder

Returns The environment builder.

save_agent_builder

agent_builder Save the agent builder using the respective path.

Parameters **agent_builder** (*str*) – the agent builder to save.

load_agent_builder

Returns The agent builder.

save_config

config Save the config file using the respective path.

Parameters **config** (*str*) – the config file to save.

load_config

Returns The config file.

exists_stats

Returns True if the entropy file exists, False otherwise.

save_stats

stats Save the statistic file using the respective path.

Parameters **stats** (*str*) – the statistics file to save.

load_stats

Returns The statistics file.

save_params

env, params Save the parameters file.

Parameters

- **env** (*str*) – the environment used;
- **params** (*str*) – the parameters file to save.

save_figure

figure, filename, subfolder=None, as_pdf=False, transparent=True Save the figure file using the respective path.

Parameters

- **figure** (*object*) – the figure to save;
- **filename** (*str*) – the name of the figure;
- **subfolder** (*str, None*) – optional subfolder where to save the figure;
- **as_pdf** (*bool, False*) – whether to save the figure in PDF or not;
- **transparent** (*bool, True*) – whether the figure should be transparent or not.

classmethod from_path

path Method to create a BenchmarkLogger from a path.

3.4.4 Visualizer

class BenchmarkVisualizer

logger, data=None, has_entropy=None, has_value=None, id=1 Bases: `object`

Class to handle all visualizations of the experiment.

plot_counter = 0

__init__

logger, data=None, has_entropy=None, has_value=None, id=1 Constructor.

Parameters

- **logger** (`BenchmarkLogger`) – logger to be used;
- **data** (*dict, None*) – dictionary with data points for visualization;
- **has_entropy** (*bool, None*) – select if entropy is available for the algorithm.

is_data_persisted

Check if data was passed as dictionary or should be read from log directory.

get_J

Get J from dictionary or log directory.

get_R

Get R from dictionary or log directory.

get_V

Get V from dictionary or log directory.

get_entropy

Get entropy from dictionary or log directory.

get_report

Create report plot with matplotlib.

save_report

file_name='report_plot' Method to save an image of a report of the training metrics from a performed experiment.

show_report

Method to show a report of the training metrics from a performed experiment.

show_agent

episodes=5, mdp_render=False Method to run and visualize the best builders in the environment.

classmethod from_path

path Method to create a BenchmarkVisualizer from a path.

class BenchmarkSuiteVisualizer

logger, is_sweep, color_cycle=None, y_limit=None, legend=None Bases: `object`

Class to handle visualization of a benchmark suite.

plot_counter = 0

__init__

logger, is_sweep, color_cycle=None, y_limit=None, legend=None Constructor.

Parameters

- **logger** (`BenchmarkLogger`) – logger to be used;
- **is_sweep** (`bool`) – whether the benchmark is a parameter sweep.
- **color_cycle** (`dict, None`) – dictionary with colors to be used for each algorithm;
- **y_limit** (`dict, None`) – dictionary with environment specific plot limits.
- **legend** (`dict, None`) – dictionary with environment specific legend parameters.

get_report

env, data_type, selected_alg=None Create report plot with matplotlib.

get_boxplot

env, metric_type, data_type, selected_alg=None Create boxplot with matplotlib for a given metric.

Parameters

- **env** (`str`) – The environment name;
- **metric_type** (`str`) – The metric to compute.

Returns A figure with the desired boxplot of the given metric.

save_reports

as_pdf=True, transparent=True, alg_sweep=False Method to save an image of a report of the training metrics from a performed experiment.

Parameters

- **as_pdf** (`bool, True`) – whether to save the reports as pdf files or png;
- **transparent** (`bool, True`) – If true, the figure background is transparent and not white;
- **alg_sweep** (`bool, False`) – If true, the method will generate a separate figure for each algorithm sweep.

save_boxplots

as_pdf=True, transparent=True, alg_sweep=False Method to save an image of a report of the training metrics from a performed experiment.

Parameters

- **as_pdf** (*bool, True*) – whether to save the reports as pdf files or png;
- **transparent** (*bool, True*) – If true, the figure background is transparent and not white;
- **alg_sweep** (*bool, False*) – If true, thw method will generate a separate figure for each algorithm sweep.

show_reports

boxplots=True, alg_sweep=False Method to show a report of the training metrics from a performend experiment.

Parameters **alg_sweep** (*bool, False*) – If true, thw method will generate a separate figure for each algorithm sweep.

3.5 Builders

class EnvironmentBuilder

env_name, env_params Bases: object

Class to spawn instances of a MushroomRL environment

__init__

env_name, env_params Constructor

Parameters

- **env_name** – name of the environment to build;
- **env_params** – required parameters to build the specified environment.

build

Build and return an environment

static set_eval_mode

env, eval Make changes to the environment for evaluation mode.

Parameters

- **env** (*Environment*) – the environment to change;
- **eval** (*bool*) – flag for activating evaluation mode.

copy

Create a deepcopy of the environment_builder and return it

class AgentBuilder

n_steps_per_fit=None, n_episodes_per_fit=None, compute_policy_entropy=True, compute_entropy_with_states=False, compute_value_function=True, preprocessors=None Bases: object

Base class to spawn instances of a MushroomRL agent

__init__

n_steps_per_fit=None, n_episodes_per_fit=None, compute_policy_entropy=True, compute_entropy_with_states=False, compute_value_function=True, preprocessors=None Initialize AgentBuilder

get_fit_params

Get `n_steps_per_fit` and `n_episodes_per_fit` for the specific AgentBuilder

set_preprocessors

preprocessors Set preprocessor for the specific AgentBuilder

Parameters `preprocessors` – list of preprocessor classes.

get_preprocessors

Get preprocessors for the specific AgentBuilder

copy

Create a deepcopy of the AgentBuilder and return it

build

mdp_info Build and return the AgentBuilder

Parameters `mdp_info` (*MDPInfo*) – information about the environment.

compute_Q

agent, states Compute the Q Value for an AgentBuilder

Parameters

- **agent** (*Agent*) – the considered agent;
- **states** (*np.ndarray*) – the set of states over which we need to compute the Q function.

set_eval_mode

agent, eval Set the eval mode for the agent. This function can be overwritten by any agent builder to setup specific evaluation mode for the agent.

Parameters

- **agent** (*Agent*) – the considered agent;
- **eval** (*bool*) – whether to set eval mode (true) or learn mode.

classmethod default

*get_default_dict=False, **kwargs* Create a default initialization for the specific AgentBuilder and return it

3.5.1 Policy Search Builders

Policy Gradient

class PolicyGradientBuilder

*n_episodes_per_fit, optimizer, **kwargs* Bases: [*mushroom_rl_benchmark.builders.agent_builder.AgentBuilder*](#)

AgentBuilder for Policy Gradient Methods. The current builder uses a state dependant gaussian with diagonal standard deviation and linear mean.

__init__

*n_episodes_per_fit, optimizer, **kwargs* Constructor.

Parameters

- **optimizer** (*Optimizer*) – optimizer to be used by the policy gradient algorithm;
- ****kwargs** – others algorithms parameters.

build*mdp_info* Build and return the AgentBuilder**Parameters** *mdp_info* (*MDPInfo*) – information about the environment.**classmethod default***n_episodes_per_fit=25, alpha=0.01, get_default_dict=False* Create a default initialization for the specific AgentBuilder and return it**compute_Q***agent, states* Compute the Q Value for an AgentBuilder**Parameters**

- **agent** (*Agent*) – the considered agent;
- **states** (*np.ndarray*) – the set of states over which we need to compute the Q function.

class REINFORCEBuilder*n_episodes_per_fit, optimizer, **kwargs* Bases: *mushroom_rl_benchmark.builders.policy_search.policy_gradient.PolicyGradientBuilder***alg_class**alias of *mushroom_rl.algorithms.policy_search.policy_gradient.reinforce.REINFORCE***class GPOMDPBuilder***n_episodes_per_fit, optimizer, **kwargs* Bases: *mushroom_rl_benchmark.builders.policy_search.policy_gradient.PolicyGradientBuilder***alg_class**alias of *mushroom_rl.algorithms.policy_search.policy_gradient.gpomdp.GPOMDP***class eNACBuilder***n_episodes_per_fit, optimizer, **kwargs* Bases: *mushroom_rl_benchmark.builders.policy_search.policy_gradient.PolicyGradientBuilder***alg_class**alias of *mushroom_rl.algorithms.policy_search.policy_gradient.enac.eNAC***Black-Box optimization****class BBOBuilder***n_episodes_per_fit, **kwargs* Bases: *mushroom_rl_benchmark.builders.agent_builder.AgentBuilder*

AgentBuilder for Black Box optimization methods. The current builder uses a simple deterministic linear policy and gaussian Diagonal distribution.

__init__*n_episodes_per_fit, **kwargs* Constructor.**Parameters**

- **optimizer** (*Optimizer*) – optimizer to be used by the policy gradient algorithm;
- ****kwargs** – others algorithms parameters.

build*mdp_info* Build and return the AgentBuilder

Parameters **mdp_info** (*MDPInfo*) – information about the environment.

classmethod default

n_episodes_per_fit=25, alpha=0.01, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

compute_Q

agent, states Compute the Q Value for an AgentBuilder

Parameters

- **agent** (*Agent*) – the considered agent;
- **states** (*np.ndarray*) – the set of states over which we need to compute the Q function.

class PGPEBuilder

n_episodes_per_fit, optimizer Bases: *mushroom_rl_benchmark.builders.policy_search.black_box_optimization.BBOBuilder*

alg_class

alias of *mushroom_rl.algorithms.policy_search.black_box_optimization.pgpe.PGPE*

__init__

n_episodes_per_fit, optimizer Constructor.

Parameters

- **optimizer** (*Optimizer*) – optimizer to be used by the policy gradient algorithm;
- ****kwargs** – others algorithms parameters.

classmethod default

n_episodes_per_fit=25, alpha=0.3, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class RWRBuilder

n_episodes_per_fit, beta Bases: *mushroom_rl_benchmark.builders.policy_search.black_box_optimization.BBOBuilder*

alg_class

alias of *mushroom_rl.algorithms.policy_search.black_box_optimization.rwr.RWR*

__init__

n_episodes_per_fit, beta Constructor.

Parameters

- **optimizer** (*Optimizer*) – optimizer to be used by the policy gradient algorithm;
- ****kwargs** – others algorithms parameters.

classmethod default

n_episodes_per_fit=25, beta=0.01, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class REPSBuilder

n_episodes_per_fit, eps Bases: *mushroom_rl_benchmark.builders.policy_search.black_box_optimization.BBOBuilder*

```

alg_class
    alias of mushroom_rl.algorithms.policy_search.black_box_optimization.reps.
    REPS

__init__
    n_episodes_per_fit, eps Constructor.

Parameters
    • optimizer (Optimizer) – optimizer to be used by the policy gradient algorithm;
    • **kwargs – others algorithms parameters.

classmethod default
    n_episodes_per_fit=25, eps=0.05, get_default_dict=False Create a default initialization for the specific
    AgentBuilder and return it

class ConstrainedREPSBuilder
    n_episodes_per_fit, eps, kappa Bases: mushroom_rl_benchmark.builders.policy_search.
    black_box_optimization.BBOBuilder

alg_class
    alias of mushroom_rl.algorithms.policy_search.black_box_optimization.
    constrained_reps.ConstrainedREPS

__init__
    n_episodes_per_fit, eps, kappa Constructor.

Parameters
    • optimizer (Optimizer) – optimizer to be used by the policy gradient algorithm;
    • **kwargs – others algorithms parameters.

classmethod default
    n_episodes_per_fit=25, eps=0.05, kappa=0.01, get_default_dict=False Create a default initialization for
    the specific AgentBuilder and return it

```

3.5.2 Value Based Builders

Temporal Difference

```

class TDFiniteBuilder
    learning_rate, epsilon, epsilon_test, **alg_params Bases: mushroom_rl_benchmark.builders.
    agent_builder.AgentBuilder

    AgentBuilder for a generic TD algorithm (for finite states).

__init__
    learning_rate, epsilon, epsilon_test, **alg_params Constructor.

Parameters
    • epsilon (Parameter) – exploration coefficient for learning;
    • epsilon_test (Parameter) – exploration coefficient for test.

build
    mdp_info Build and return the AgentBuilder

Parameters mdp_info (MDPInfo) – information about the environment.

```

compute_Q

agent, states Compute the Q Value for an AgentBuilder

Parameters

- **agent** (*Agent*) – the considered agent;
- **states** (*np.ndarray*) – the set of states over which we need to compute the Q function.

set_eval_mode

agent, eval Set the eval mode for the agent. This function can be overwritten by any agent builder to setup specific evaluation mode for the agent.

Parameters

- **agent** (*Agent*) – the considered agent;
- **eval** (*bool*) – whether to set eval mode (true) or learn mode.

classmethod default

learning_rate=0.9, epsilon=0.1, decay_lr=0.0, decay_eps=0.0, epsilon_test=0.0, get_default_dict=False
Create a default initialization for the specific AgentBuilder and return it

class QLearningBuilder

learning_rate, epsilon, epsilon_test Bases: *mushroom_rl_benchmark.builders.value.td.td_finite.TDFiniteBuilder*

alg_class

alias of *mushroom_rl.algorithms.value.td.q_learning.QLearning*

__init__

learning_rate, epsilon, epsilon_test Constructor.

Parameters

- **epsilon** (*Parameter*) – exploration coefficient for learning;
- **epsilon_test** (*Parameter*) – exploration coefficient for test.

class SARSABuilder

learning_rate, epsilon, epsilon_test Bases: *mushroom_rl_benchmark.builders.value.td.td_finite.TDFiniteBuilder*

alg_class

alias of *mushroom_rl.algorithms.value.td.sarsa.SARSA*

__init__

learning_rate, epsilon, epsilon_test Constructor.

Parameters

- **epsilon** (*Parameter*) – exploration coefficient for learning;
- **epsilon_test** (*Parameter*) – exploration coefficient for test.

class SpeedyQLearningBuilder

learning_rate, epsilon, epsilon_test Bases: *mushroom_rl_benchmark.builders.value.td.td_finite.TDFiniteBuilder*

alg_class

alias of *mushroom_rl.algorithms.value.td.speedy_q_learning.SpeedyQLearning*

__init__

learning_rate, epsilon, epsilon_test Constructor.

Parameters

- **epsilon** (*Parameter*) – exploration coefficient for learning;
- **epsilon_test** (*Parameter*) – exploration coefficient for test.

class DoubleQLearningBuilder

learning_rate, epsilon, epsilon_test Bases: *mushroom_rl_benchmark.builders.value.td.td_finite.TDFiniteBuilder*

alg_class

alias of *mushroom_rl.algorithms.value.td.double_q_learning.DoubleQLearning*

__init__

learning_rate, epsilon, epsilon_test Constructor.

Parameters

- **epsilon** (*Parameter*) – exploration coefficient for learning;
- **epsilon_test** (*Parameter*) – exploration coefficient for test.

compute_Q

agent, states Compute the Q Value for an AgentBuilder

Parameters

- **agent** (*Agent*) – the considered agent;
- **states** (*np.ndarray*) – the set of states over which we need to compute the Q function.

class WeightedQLearningBuilder

learning_rate, epsilon, epsilon_test, sampling, precision Bases: *mushroom_rl_benchmark.builders.value.td.td_finite.TDFiniteBuilder*

alg_class

alias of *mushroom_rl.algorithms.value.td.weighted_q_learning.WeightedQLearning*

__init__

learning_rate, epsilon, epsilon_test, sampling, precision Constructor.

Parameters

- **sampling** (*bool*, *True*) – use the approximated version to speed up the computation;
- **precision** (*int*, *1000*) – number of samples to use in the approximated version.

classmethod default

learning_rate=0.9, epsilon=0.1, decay_lr=0.0, decay_eps=0.0, epsilon_test=0.0, sampling=True, precision=1000, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class TDTraceBuilder

learning_rate, epsilon, epsilon_test, lambda_coeff, trace Bases: *mushroom_rl_benchmark.builders.value.td.td_finite.TDFiniteBuilder*

Builder for TD algorithms with eligibility traces and finite states.

__init__

learning_rate, epsilon, epsilon_test, lambda_coeff, trace Constructor.

lambda_coeff ([float, *Parameter*]): eligibility trace coefficient; *trace* (str): type of eligibility trace to use.

classmethod default

learning_rate=0.9, epsilon=0.1, decay_lr=0.0, decay_eps=0.0, epsilon_test=0.0, lambda_coeff=0.9, trace='replacing', get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class SarsaLambdaBuilder

learning_rate, epsilon, epsilon_test, lambda_coeff, trace Bases: *mushroom_rl_benchmark.builders.value.td.td_trace.TDTraceBuilder*

alg_class

alias of *mushroom_rl.algorithms.value.td.sarsa_lambda.SarsaLambda*

class QLambdaBuilder

learning_rate, epsilon, epsilon_test, lambda_coeff, trace Bases: *mushroom_rl_benchmark.builders.value.td.td_trace.TDTraceBuilder*

alg_class

alias of *mushroom_rl.algorithms.value.td.q_lambda.QLambda*

class SarsaLambdaContinuousBuilder

policy, approximator, learning_rate, lambda_coeff, epsilon, epsilon_test, n_tilings, n_tiles Bases: *mushroom_rl_benchmark.builders.value.td.td_continuous.TDContinuousBuilder*

AgentBuilder for Sarsa(Lambda) Continuous. Using tiles as function approximator.

__init__

policy, approximator, learning_rate, lambda_coeff, epsilon, epsilon_test, n_tilings, n_tiles Constructor.

Parameters *approximator* (*class*) – Q-function approximator.

build

mdp_info Build and return the AgentBuilder

Parameters *mdp_info* (*MDPInfo*) – information about the environment.

classmethod default

alpha=0.1, lambda_coeff=0.9, epsilon=0.0, decay_eps=0.0, epsilon_test=0.0, n_tilings=10, n_tiles=10, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class TrueOnlineSarsaLambdaBuilder

policy, learning_rate, lambda_coeff, epsilon, epsilon_test, n_tilings, n_tiles Bases: *mushroom_rl_benchmark.builders.value.td.td_continuous.TDContinuousBuilder*

AgentBuilder for True Online Sarsa(Lambda) Continuous. Using tiles as function approximator.

__init__

policy, learning_rate, lambda_coeff, epsilon, epsilon_test, n_tilings, n_tiles Constructor.

build

mdp_info Build and return the AgentBuilder

Parameters *mdp_info* (*MDPInfo*) – information about the environment.

classmethod default

alpha=0.1, lambda_coeff=0.9, epsilon=0.0, decay_eps=0.0, epsilon_test=0.0, n_tilings=10, n_tiles=10, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

DQN

class DQNBuilder

policy, approximator, approximator_params, alg_params, n_steps_per_fit=1 Bases: *mushroom_rl_benchmark.builders.agent_builder.AgentBuilder*

AgentBuilder for Deep Q-Network (DQN).

__init__

policy, approximator, approximator_params, alg_params, n_steps_per_fit=1 Constructor.

Parameters

- **policy** (*Policy*) – policy class;
- **approximator** (*dict*) – Q-function approximator;
- **approximator_params** (*dict*) – parameters of the Q-function approximator;
- **alg_params** (*dict*) – parameters for the algorithm;
- **n_steps_per_fit** (*int, 1*) – number of steps per fit.

build

mdp_info Build and return the AgentBuilder

Parameters **mdp_info** (*MDPInfo*) – information about the environment.

compute_Q

agent, states Compute the Q Value for an AgentBuilder

Parameters

- **agent** (*Agent*) – the considered agent;
- **states** (*np.ndarray*) – the set of states over which we need to compute the Q function.

set_eval_mode

agent, eval Set the eval mode for the agent. This function can be overwritten by any agent builder to setup specific evaluation mode for the agent.

Parameters

- **agent** (*Agent*) – the considered agent;
- **eval** (*bool*) – whether to set eval mode (true) or learn mode.

classmethod default

lr=0.0001, network=<class 'mushroom_rl_benchmark.builders.network.dqn_network.DQNNetwork'>, initial_replay_size=50000, max_replay_size=1000000, batch_size=32, target_update_frequency=2500, n_steps_per_fit=1, use_cuda=False, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class DoubleDQNBuilder

policy, approximator, approximator_params, alg_params, n_steps_per_fit=1 Bases: [mushroom_rl_benchmark.builders.value.dqn.dqn.DQNBuilder](#)

build

mdp_info Build and return the AgentBuilder

Parameters **mdp_info** (*MDPInfo*) – information about the environment.

class AveragedDQNBuilder

policy, approximator, approximator_params, alg_params, n_steps_per_fit=1 Bases: [mushroom_rl_benchmark.builders.value.dqn.dqn.DQNBuilder](#)

build

mdp_info Build and return the AgentBuilder

Parameters **mdp_info** (*MDPInfo*) – information about the environment.

classmethod default

lr=0.0001, network=<class 'mushroom_rl_benchmark.builders.network.dqn_network.DQNNetwork'>, initial_replay_size=50000, max_replay_size=1000000, batch_size=32, target_update_frequency=2500, n_steps_per_fit=1, n_approximators=10, use_cuda=False, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class PrioritizedDQNBuilder

policy, approximator, approximator_params, alg_params, n_steps_per_fit=1 Bases: [*mushroom_rl_benchmark.builders.value.dqn.dqn.DQNBuilder*](#)

build

mdp_info Build and return the AgentBuilder

Parameters *mdp_info* (*MDPInfo*) – information about the environment.

classmethod default

lr=0.0001, network=<class 'mushroom_rl_benchmark.builders.network.dqn_network.DQNNetwork'>, initial_replay_size=50000, max_replay_size=1000000, batch_size=32, target_update_frequency=2500, n_steps_per_fit=1, use_cuda=False, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class DuelingDQNBuilder

policy, approximator, approximator_params, alg_params, n_steps_per_fit=1 Bases: [*mushroom_rl_benchmark.builders.value.dqn.dqn.DQNBuilder*](#)

build

mdp_info Build and return the AgentBuilder

Parameters *mdp_info* (*MDPInfo*) – information about the environment.

classmethod default

lr=0.0001, network=<class 'mushroom_rl_benchmark.builders.network.dqn_network.DQNFeatureNetwork'>, initial_replay_size=50000, max_replay_size=1000000, batch_size=32, target_update_frequency=2500, n_features=512, n_steps_per_fit=1, use_cuda=False, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class MaxminDQNBuilder

policy, approximator, approximator_params, alg_params, n_steps_per_fit=1 Bases: [*mushroom_rl_benchmark.builders.value.dqn.dqn.DQNBuilder*](#)

build

mdp_info Build and return the AgentBuilder

Parameters *mdp_info* (*MDPInfo*) – information about the environment.

classmethod default

lr=0.0001, network=<class 'mushroom_rl_benchmark.builders.network.dqn_network.DQNNetwork'>, initial_replay_size=50000, max_replay_size=1000000, batch_size=32, target_update_frequency=2500, n_steps_per_fit=1, n_approximators=3, use_cuda=False, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class NoisyDQNBuilder

policy, approximator, approximator_params, alg_params, n_steps_per_fit=1 Bases: [*mushroom_rl_benchmark.builders.value.dqn.dqn.DQNBuilder*](#)

build

mdp_info Build and return the AgentBuilder

Parameters *mdp_info* (*MDPInfo*) – information about the environment.

classmethod default

lr=0.0001, network=<class 'mushroom_rl_benchmark.builders.network.dqn_network.DQNFeatureNetwork'>,

initial_replay_size=50000, max_replay_size=1000000, batch_size=32, target_update_frequency=2500, n_features=512, n_steps_per_fit=1, use_cuda=False, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class CategoricalDQNBuilder

policy, approximator, approximator_params, alg_params, n_steps_per_fit=1 Bases: *mushroom_rl_benchmark.builders.value.dqn.dqn.DQNBuilder*

build

mdp_info Build and return the AgentBuilder

Parameters *mdp_info* (*MDPInfo*) – information about the environment.

classmethod default

lr=0.0001, network=<class 'mushroom_rl_benchmark.builders.network.dqn_network.DQNFeatureNetwork'>, initial_replay_size=50000, max_replay_size=1000000, batch_size=32, target_update_frequency=2500, n_features=512, n_steps_per_fit=1, v_min=-10, v_max=10, n_atoms=51, use_cuda=False, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

3.5.3 Actor Critic Builders

Classic AC

class StochasticACBuilder

*std_0, alpha_theta, alpha_v, lambda_par, n_tilings, n_tiles, **kwargs* Bases: *mushroom_rl_benchmark.builders.agent_builder.AgentBuilder*

Builder for the stochastic actor critic algorithm. Using linear approximator with tiles for mean, standard deviation and value function approximator. The value function approximator also uses a bias term.

__init__

*std_0, alpha_theta, alpha_v, lambda_par, n_tilings, n_tiles, **kwargs* Constructor.

Parameters

- **std_0** (*float*) – initial standard deviation;
- **alpha_theta** (*Parameter*) – Learning rate for the policy;
- **alpha_v** (*Parameter*) – Learning rate for the value function;
- **n_tilings** (*int*) – number of tilings to be used as approximator;
- **n_tiles** (*int*) – number of tiles for each state space dimension.

build

mdp_info Build and return the AgentBuilder

Parameters *mdp_info* (*MDPInfo*) – information about the environment.

classmethod default

std_0=1.0, alpha_theta=0.001, alpha_v=0.1, lambda_par=0.9, n_tilings=10, n_tiles=11, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

compute_Q

agent, states Compute the Q Value for an AgentBuilder

Parameters

- **agent** (*Agent*) – the considered agent;

- **states** (*np.ndarray*) – the set of states over which we need to compute the Q function.

class COPDAC_QBuilder

*std_exp, std_eval, alpha_theta, alpha_omega, alpha_v, n_tilings, n_tiles, **kwargs* Bases: *mushroom_rl_benchmark.builders.agent_builder.AgentBuilder*

Builder for the COPDAQ_Q actor critic algorithm. Using linear approximator with tiles for the mean and value function approximator.

__init__

*std_exp, std_eval, alpha_theta, alpha_omega, alpha_v, n_tilings, n_tiles, **kwargs* Constructor.

Parameters

- **std_exp** (*float*) – exploration standard deviation;
- **std_eval** (*float*) – evaluation standard deviation;
- **alpha_theta** (*Parameter*) – Learning rate for the policy;
- **alpha_omega** (*Parameter*) – Learning rate for the
- **alpha_v** (*Parameter*) – Learning rate for the value function;
- **n_tilings** (*int*) – number of tilings to be used as approximator;
- **n_tiles** (*int*) – number of tiles for each state space dimension.

build

mdp_info Build and return the AgentBuilder

Parameters *mdp_info* (*MDPInfo*) – information about the environment.

set_eval_mode

agent, eval Set the eval mode for the agent. This function can be overwritten by any agent builder to setup specific evaluation mode for the agent.

Parameters

- **agent** (*Agent*) – the considered agent;
- **eval** (*bool*) – whether to set eval mode (true) or learn mode.

classmethod default

std_exp=0.1, std_eval=0.001, alpha_theta=0.005, alpha_omega=0.5, alpha_v=0.5, n_tilings=10, n_tiles=11, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

compute_Q

agent, states Compute the Q Value for an AgentBuilder

Parameters

- **agent** (*Agent*) – the considered agent;
- **states** (*np.ndarray*) – the set of states over which we need to compute the Q function.

Deep AC

class A2CBuilder

policy_params, actor_optimizer, critic_params, alg_params, n_steps_per_fit=5, preprocessors=None Bases: *mushroom_rl_benchmark.builders.agent_builder.AgentBuilder*

AgentBuilder for Advantage Actor Critic algorithm (A2C)

`__init__`

policy_params, actor_optimizer, critic_params, alg_params, n_steps_per_fit=5, preprocessors=None
Constructor.

Parameters

- **policy_params** (*dict*) – parameters for the policy;
- **actor_optimizer** (*dict*) – parameters for the actor optimizer;
- **critic_params** (*dict*) – parameters for the critic;
- **alg_params** (*dict*) – parameters for the algorithm;
- **n_steps_per_fit** (*int*, 5) – number of steps per fit;
- **preprocessors** (*list*, *None*) – list of preprocessors.

`build`

mdp_info Build and return the AgentBuilder

Parameters *mdp_info* (*MDPInfo*) – information about the environment.

`compute_Q`

agent, states Compute the Q Value for an AgentBuilder

Parameters

- **agent** (*Agent*) – the considered agent;
- **states** (*np.ndarray*) – the set of states over which we need to compute the Q function.

`classmethod default`

actor_lr=0.0007, critic_lr=0.0007, eps_actor=0.003, eps_critic=1e-05, batch_size=64, max_grad_norm=0.5, ent_coeff=0.01, critic_network=<class 'mushroom_rl_benchmark.builders.network.a2c_network.A2CNetwork'>, n_features=64, preprocessors=None, use_cuda=False, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

`class DDPGBuilder`

policy_class, policy_params, actor_params, actor_optimizer, critic_params, alg_params, n_steps_per_fit=1

Bases: *mushroom_rl_benchmark.builders.agent_builder.AgentBuilder*

AgentBuilder for Deep Deterministic Policy Gradient algorithm (DDPG)

`__init__`

policy_class, policy_params, actor_params, actor_optimizer, critic_params, alg_params, n_steps_per_fit=1 Constructor.

Parameters

- **policy_class** (*Policy*) – policy class;
- **policy_params** (*dict*) – parameters for the policy;
- **actor_params** (*dict*) – parameters for the actor;
- **actor_optimizer** (*dict*) – parameters for the actor optimizer;
- **critic_params** (*dict*) – parameters for the critic;
- **alg_params** (*dict*) – parameters for the algorithm;
- **n_steps_per_fit** (*int*, 1) – number of steps per fit.

build

mdp_info Build and return the AgentBuilder

Parameters *mdp_info* (*MDPInfo*) – information about the environment.

compute_Q

agent, states Compute the Q Value for an AgentBuilder

Parameters

- **agent** (*Agent*) – the considered agent;
- **states** (*np.ndarray*) – the set of states over which we need to compute the Q function.

classmethod default

actor_lr=0.0001, actor_network=<class 'mushroom_rl_benchmark.builders.network.ddpg_network.DDPGActorNetwork'>, critic_lr=0.001, critic_network=<class 'mushroom_rl_benchmark.builders.network.ddpg_network.DDPGCriticNetwork'>, initial_replay_size=500, max_replay_size=50000, batch_size=64, n_features=[80, 80], tau=0.001, use_cuda=False, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class PPOBuilder

policy_params, actor_optimizer, critic_params, alg_params, n_steps_per_fit=3000, preprocessors=None
Bases: *mushroom_rl_benchmark.builders.agent_builder.AgentBuilder*

AgentBuilder for Proximal Policy Optimization algorithm (PPO)

__init__

policy_params, actor_optimizer, critic_params, alg_params, n_steps_per_fit=3000, preprocessors=None
Constructor.

Parameters

- **policy_params** (*dict*) – parameters for the policy;
- **actor_optimizer** (*dict*) – parameters for the actor optimizer;
- **critic_params** (*dict*) – parameters for the critic;
- **alg_params** (*dict*) – parameters for the algorithm;
- **n_steps_per_fit** (*int*, 3000) – number of steps per fit;
- **preprocessors** (*list*, *None*) – list of preprocessors.

build

mdp_info Build and return the AgentBuilder

Parameters *mdp_info* (*MDPInfo*) – information about the environment.

compute_Q

agent, states Compute the Q Value for an AgentBuilder

Parameters

- **agent** (*Agent*) – the considered agent;
- **states** (*np.ndarray*) – the set of states over which we need to compute the Q function.

classmethod default

eps=0.2, ent_coeff=0.0, n_epochs_policy=4, actor_lr=0.0003, critic_lr=0.0003, critic_fit_params=None, critic_network=<class 'mushroom_rl_benchmark.builders.network.trpo_network.TRPONetwork'>, lam=0.95, batch_size=64, n_features=32, n_steps_per_fit=3000, std_0=1.0, preprocessors=None,

use_cuda=False, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class SACBuilder

actor_mu_params, actor_sigma_params, actor_optimizer, critic_params, alg_params, n_q_samples=100, n_steps_per_fit=1, preprocessors=None Bases: *mushroom_rl_benchmark.builders.agent_builder.AgentBuilder*

AgentBuilder Soft Actor-Critic algorithm (SAC)

`__init__`

actor_mu_params, actor_sigma_params, actor_optimizer, critic_params, alg_params, n_q_samples=100, n_steps_per_fit=1, preprocessors=None Constructor.

Parameters

- **actor_mu_params** (*dict*) – parameters for actor mu;
- **actor_sigma_params** (*dict*) – parameters for actor sigma;
- **actor_optimizer** (*dict*) – parameters for the actor optimizer;
- **critic_params** (*dict*) – parameters for the critic;
- **alg_params** (*dict*) – parameters for the algorithm;
- **n_q_samples** (*int*, 100) – number of samples to compute value function;
- **n_steps_per_fit** (*int*, 1) – number of steps per fit;
- **preprocessors** (*list*, *None*) – list of preprocessors.

`build`

mdp_info Build and return the AgentBuilder

Parameters **mdp_info** (*MDPInfo*) – information about the environment.

`compute_Q`

agent, states Compute the Q Value for an AgentBuilder

Parameters

- **agent** (*Agent*) – the considered agent;
- **states** (*np.ndarray*) – the set of states over which we need to compute the Q function.

`classmethod default`

actor_lr=0.0003, actor_network=<class 'mushroom_rl_benchmark.builders.network.sac_network.SACAActorNetwork'>, critic_lr=0.0003, critic_network=<class 'mushroom_rl_benchmark.builders.network.sac_network.SACCriticNetwork'>, initial_replay_size=64, max_replay_size=50000, n_features=64, warmup_transitions=100, batch_size=64, tau=0.005, lr_alpha=0.003, preprocessors=None, target_entropy=None, use_cuda=False, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class TD3Builder

policy_class, policy_params, actor_params, actor_optimizer, critic_params, alg_params, n_steps_per_fit=1 Bases: *mushroom_rl_benchmark.builders.agent_builder.AgentBuilder*

AgentBuilder for Twin Delayed DDPG algorithm (TD3)

`__init__`

policy_class, policy_params, actor_params, actor_optimizer, critic_params, alg_params, n_steps_per_fit=1 Constructor.

Parameters

- **policy_class** (*Policy*) – policy class;
- **policy_params** (*dict*) – parameters for the policy;
- **actor_params** (*dict*) – parameters for the actor;
- **actor_optimizer** (*dict*) – parameters for the actor optimizer;
- **critic_params** (*dict*) – parameters for the critic;
- **alg_params** (*dict*) – parameters for the algorithm;
- **n_steps_per_fit** (*int*, 1) – number of steps per fit.

build

mdp_info Build and return the AgentBuilder

Parameters *mdp_info* (*MDPInfo*) – information about the environment.

compute_Q

agent, states Compute the Q Value for an AgentBuilder

Parameters

- **agent** (*Agent*) – the considered agent;
- **states** (*np.ndarray*) – the set of states over which we need to compute the Q function.

classmethod default

actor_lr=0.0001, actor_network=<class 'mushroom_rl_benchmark.builders.network.td3_network.TD3ActorNetwork'>, critic_lr=0.001, critic_network=<class 'mushroom_rl_benchmark.builders.network.td3_network.TD3CriticNetwork'>, initial_replay_size=500, max_replay_size=50000, batch_size=64, n_features=[80, 80], tau=0.001, use_cuda=False, get_default_dict=False Create a default initialization for the specific AgentBuilder and return it

class TRPOBuilder

policy_params, critic_params, alg_params, n_steps_per_fit=3000, preprocessors=None Bases: [*mushroom_rl_benchmark.builders.agent_builder.AgentBuilder*](#)

AgentBuilder for Trust Region Policy optimization algorithm (TRPO)

__init__

policy_params, critic_params, alg_params, n_steps_per_fit=3000, preprocessors=None Constructor.

Parameters

- **policy_params** (*dict*) – parameters for the policy;
- **critic_params** (*dict*) – parameters for the critic;
- **alg_params** (*dict*) – parameters for the algorithm;
- **n_steps_per_fit** (*int*, 3000) – number of steps per fit;
- **preprocessors** (*list*, *None*) – list of preprocessors.

build

mdp_info Build and return the AgentBuilder

Parameters *mdp_info* (*MDPInfo*) – information about the environment.

compute_Q

agent, states Compute the Q Value for an AgentBuilder

Parameters

- **agent** (*Agent*) – the considered agent;
- **states** (*np.ndarray*) – the set of states over which we need to compute the Q function.

classmethod default

critic_lr=0.0003, critic_network=<class 'mushroom_rl_benchmark.builders.network.trpo_network.TRPONetwork'>, max_kl=0.01, ent_coeff=0.0, lam=0.95, batch_size=64, n_features=32, critic_fit_params=None, n_steps_per_fit=3000, n_epochs_line_search=10, n_epochs_cg=100, cg_damping=0.01, cg_residual_tol=1e-10, std_0=1.0, preprocessors=None, use_cuda=False, get_default_dict=False
 Create a default initialization for the specific AgentBuilder and return it

3.6 Networks

class A2CNetwork

*input_shape, output_shape, n_features, **kwargs* Bases: `torch.nn.modules.module.Module`

__init__

*input_shape, output_shape, n_features, **kwargs* Initializes internal Module state, shared by both `nn.Module` and `ScriptModule`.

forward

*state, **kwargs* Defines the computation performed at every call.

Should be overridden by all subclasses.

Note: Although the recipe for forward pass needs to be defined within this function, one should call the `Module` instance afterwards instead of this since the former takes care of running the registered hooks while the latter silently ignores them.

class DDPGCriticNetwork

*input_shape, output_shape, n_features, **kwargs* Bases: `torch.nn.modules.module.Module`

__init__

*input_shape, output_shape, n_features, **kwargs* Initializes internal Module state, shared by both `nn.Module` and `ScriptModule`.

forward

state, action Defines the computation performed at every call.

Should be overridden by all subclasses.

Note: Although the recipe for forward pass needs to be defined within this function, one should call the `Module` instance afterwards instead of this since the former takes care of running the registered hooks while the latter silently ignores them.

class DDPGActorNetwork

*input_shape, output_shape, **kwargs* Bases: `torch.nn.modules.module.Module`

__init__

*input_shape, output_shape, **kwargs* Initializes internal Module state, shared by both `nn.Module` and `ScriptModule`.

forward

state Defines the computation performed at every call.

Should be overridden by all subclasses.

Note: Although the recipe for forward pass needs to be defined within this function, one should call the `Module` instance afterwards instead of this since the former takes care of running the registered hooks while the latter silently ignores them.

class SACriticNetwork

*input_shape, output_shape, n_features, **kwargs* Bases: `torch.nn.modules.module.Module`

__init__

*input_shape, output_shape, n_features, **kwargs* Initializes internal Module state, shared by both `nn.Module` and `ScriptModule`.

forward

state, action Defines the computation performed at every call.

Should be overridden by all subclasses.

Note: Although the recipe for forward pass needs to be defined within this function, one should call the `Module` instance afterwards instead of this since the former takes care of running the registered hooks while the latter silently ignores them.

class SAActorNetwork

*input_shape, output_shape, n_features, **kwargs* Bases: `torch.nn.modules.module.Module`

__init__

*input_shape, output_shape, n_features, **kwargs* Initializes internal Module state, shared by both `nn.Module` and `ScriptModule`.

forward

state Defines the computation performed at every call.

Should be overridden by all subclasses.

Note: Although the recipe for forward pass needs to be defined within this function, one should call the `Module` instance afterwards instead of this since the former takes care of running the registered hooks while the latter silently ignores them.

class TD3CriticNetwork

*input_shape, output_shape, n_features, **kwargs* Bases: `torch.nn.modules.module.Module`

__init__

*input_shape, output_shape, n_features, **kwargs* Initializes internal Module state, shared by both `nn.Module` and `ScriptModule`.

forward

state, action Defines the computation performed at every call.

Should be overridden by all subclasses.

Note: Although the recipe for forward pass needs to be defined within this function, one should call the `Module` instance afterwards instead of this since the former takes care of running the registered hooks

while the latter silently ignores them.

class TD3ActorNetwork

*input_shape, output_shape, n_features, **kwargs* Bases: `torch.nn.modules.module.Module`

__init__

*input_shape, output_shape, n_features, **kwargs* Initializes internal Module state, shared by both `nn.Module` and `ScriptModule`.

forward

state Defines the computation performed at every call.

Should be overridden by all subclasses.

Note: Although the recipe for forward pass needs to be defined within this function, one should call the `Module` instance afterwards instead of this since the former takes care of running the registered hooks while the latter silently ignores them.

class TRPONetwork

*input_shape, output_shape, n_features, **kwargs* Bases: `torch.nn.modules.module.Module`

__init__

*input_shape, output_shape, n_features, **kwargs* Initializes internal Module state, shared by both `nn.Module` and `ScriptModule`.

forward

*state, **kwargs* Defines the computation performed at every call.

Should be overridden by all subclasses.

Note: Although the recipe for forward pass needs to be defined within this function, one should call the `Module` instance afterwards instead of this since the former takes care of running the registered hooks while the latter silently ignores them.

3.7 Experiment

exec_run

*agent_builder, env_builder, n_epochs, n_steps=None, n_episodes=None, n_steps_test=None, n_episodes_test=None, seed=None, save_agent=False, quiet=True, **kwargs* Function that handles the execution of an experiment run.

Parameters

- **agent_builder** (`AgentBuilder`) – agent builder to spawn an agent;
- **env_builder** (`EnvironmentBuilder`) – environment builder to spawn an environment;
- **n_epochs** (`int`) – number of epochs;
- **n_steps** (`int, None`) – number of steps per epoch;
- **n_episodes** (`int, None`) – number of episodes per epoch;
- **n_steps_test** (`int, None`) – number of steps for testing;

- **n_episodes_test** (*int*, *None*) – number of episodes for testing;
- **seed** (*int*, *None*) – the seed;
- **save_agent** (*bool*, *False*) – select if the agent should be logged or not;
- **quiet** (*bool*, *True*) – select if run should print execution information.

compute_metrics

core, eval_params, agent_builder, env_builder Function to compute the metrics.

Parameters

- **eval_params** (*dict*) – parameters for running the evaluation;
- **agent_builder** (*AgentBuilder*) – the agent builder;
- **env_builder** (*EnvironmentBuilder*) – environment builder to spawn an environment;

print_metrics

logger, epoch, J, R, V, E Function that pretty prints the metrics on the standard output.

Parameters

- **logger** (*Logger*) – MushroomRL logger object;
- **epoch** (*int*) – the current epoch;
- **J** (*float*) – the current value of J;
- **R** (*float*) – the current value of R;
- **V** (*float*) – the current value of V;
- **E** (*float*) – the current value of E (Set None if not defined).

3.7.1 Slurm utilities

aggregate_results

res_dir, res_id, console_log_dir=None Function to aggregate the benchmark results from running in SLURM mode.

Parameters

- **res_dir** (*str*) – path to the result directory;
- **res_id** (*str*) – log id of the result directory;
- **console_log_dir** (*str*, *None*) – path to be used to log console.

make_arguments

***params* Create a script argument string from dictionary

read_arguments_run

arg_string=None Parse the arguments for the run script.

Parameters **arg_string** (*str*, *None*) – pass the argument string.

read_arguments_aggregate

arg_string=None Parse the arguments for the aggregate script.

Parameters **arg_string** (*str*, *None*) – pass the argument string.

create_slurm_script

*slurm_path, slurm_script_name='slurm.sh', **slurm_params* Function to create a slurm script in a specific directory

Parameters

- **slurm_path** (*str*) – path to locate the slurm script;
- **slurm_script_name** (*str, slurm.sh*) – name of the slurm script;
- ****slurm_params** – parameters for generating the slurm file content.

Returns The path to the slurm script.

generate_slurm

exp_name, exp_dir_slurm, python_file, gres=None, project_name=None, n_exp=1, max_concurrent_runs=None, memory=2000, hours=24, minutes=0, seconds=0 Function to generate the slurm file content.

Parameters

- **exp_name** (*str*) – name of the experiment;
- **exp_dir_slurm** (*str*) – directory where the slurm log files are located;
- **python_file** (*str*) – path to the python file that should be executed;
- **gres** (*str, None*) – request cluster resources. E.g. to add a GPU in the IAS cluster specify `gres='gpu:rtx2080:1'`;
- **project_name** (*str, None*) – name of the slurm project;
- **n_exp** (*int, 1*) – number of experiments in the slurm array;
- **max_concurrent_runs** (*int, None*) – maximum number of runs that should be executed in parallel on the SLURM cluster;
- **memory** (*int, 2000*) – memory limit in mega bytes (MB) for the slurm jobs;
- **hours** (*int, 24*) – maximum number of execution hours for the slurm jobs;
- **minutes** (*int, 0*) – maximum number of execution minutes for the slurm jobs;
- **seconds** (*int, 0*) – maximum number of execution seconds for the slurm jobs.

Returns The slurm script as string.

to_duration

hours, minutes, seconds

3.8 Utils

get_init_states

dataset Get the initial states of a MushroomRL dataset

Parameters **dataset** (*Dataset*) – a MushroomRL dataset.

extract_arguments

args, method Extract the arguments from a dictionary that fit to a methods parameters.

Parameters

- **args** (*dict*) – dictionary of arguments;
- **method** (*function*) – method for which the arguments should be extracted.

object_to_primitive

obj Converts an object into a string using the class name

Parameters *obj* – the object to convert.

Returns A string representing the object.

dictionary_to_primitive

data Function that converts a dictionary by transforming any objects inside into strings

Parameters *data* (*dict*) – the dictionary to convert.

Returns The converted dictionary.

get_mean_and_confidence

data Compute the mean and 95% confidence interval

Parameters *data* (*np.ndarray*) – Array of experiment data of shape (n_runs, n_epochs).

Returns The mean of the dataset at each epoch along with the confidence interval.

plot_mean_conf

data, ax, color='blue', line='-', facecolor=None, alpha=0.4, label=None Method to plot mean and confidence interval for data on pyplot axes.

build_sweep_list

algs, sweep_conf, base_name='c_' Build the sweep list, from a compact dictionary specification, for every considered algorithm.

Parameters

- **algs** (*list*) – list of algorithms to be considered;
- **sweep_conf** (*dict*) – dictionary with a compact sweep configuration for every algorithm;
- **base_name** (*str*, 'c_') – base name for the sweep configuration.

Returns The sweep list to be used with the suite.

build_sweep_dict

*base_name='c_', **kwargs* Build the sweep dictionary, from a set of variable specifications.

Parameters

- **base_name** (*str*, 'c_') – base name for the sweep configuration;
- ****kwargs** – the parameter specifications for the sweep.

Returns The sweep dictionary, where the key is the sweep name and the value is a dictionary with the sweep parameters.

generate_sweep

*base_name='c_', **kwargs* Generator that returns tuples with sweep name and parameters

Parameters

- **base_name** (*str*, 'c_') – base name for the sweep configuration;
- ****kwargs** – the parameter specifications for the sweep.

generate_sweep_params

***kwargs* Generator that returns sweep parameters

Parameters ****kwargs** – the parameter specifications for the sweep.

m

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