Requirement 3 Report - Research MineRL Platforms

What are the different MineRL platform versions?

There are 3 MineRL platform versions: v0.3.7, v0.4.4, and v1.0.0. v0.3.7 was used in the 2019 and 2020 MineRL competitions, runs on Minecraft 1.11.2, and is the fastest version, but it does not support the BASALT Gym environments. v0.4.4 was used in the 2021 competitions, runs on Minecraft 1.11.2, is 30% slower than 0.3.7, and includes the BASALT environments and tasks. v1.0.0 is the current version, was used in the 2022 competition, runs on Minecraft 1.16.5, is the slowest version, and disallows autocrafting. All versions of MineRL have interactive capabilities. In addition, there is another platform, MineDojo, built on MineRL v0.4, which is quite similar to it, allowing autocrafting, etc., but it includes a larger dataset, allows for text interaction, and is highly customizable for research needs.

What are the software requirements for each MineRL version (e.g., Python versions, packages, etc.)?

All MineRL versions and MineDojo require Java JDK 8 for Minecraft, and similar common Python packages like gym from OpenAI, opencv, numpy, psutil, and matplotlib.

What constraints does each MineRL version impose on the training data it can use (ex: video input only)?

The 0.3.7 version of MineRL accepts training data through a common dataset minerl.data.download, which is built from community driven demonstrations of how to do certain tasks, such as gathering diamonds or cutting down a tree. However, code samples in the documentation show that the MineRL AI can run without ever importing the dataset. This combined with the fact that MineRL AI instances are written in plain Python scripts means that with the construction of additional interfaces any dataset could be used in theory to train the MineRL.

The 0.4.4 version keeps a similar training data infrastructure, but supports additional datasets, namely the datasets from the BASALT (Benchmark for Agents that Solve Almost-Lifelike Task) competition.

The 1.0.0 version also keeps a similar training data infrastructure, adding a new Obtain Diamond training environment dataset.

Depending on the model design and training process, MineRL has also been demonstrated to be capable of integrating multiple different datasets at the same time. The Align-RUDDER paper featured in the MineRL documentation includes procedures to combine different skilled model outcomes (which they refer to as expert trajectories) in order to create an agent proficient in the skills of all of the datasets at once [1].

What constraints does each MineRL version impose on the machine learning training styles it can use (ex: reinforcement learning)?

According to the documentation, in addition to scripting agents, MineRL v0.4.4 can be used to train agents with reinforcement learning, and imitation learning (including behavioral cloning). It is probably safe to assume v0.3.7 also supports these as the only difference between the two is the environments they support [2]. Based on the MineRL v1.0.0 description, it appears to support the same training techniques as well as video pre-training (subset of imitation learning) using the OpenAI dataset [3]. Based on the MineDojo paper, it supports the same training techniques as MineRL v1.0.0 [4]. Therefore, the primary restriction imposed is by MineRL v0.4.4 and v0.3.7, which are not compatible with video pre-training (VPT).

What are the advantages and disadvantages of each version?

- MineRL v0.3.7
    - Advantages
        - Fast
        - Supports interactor
        - Allows autocrafting
    - Disadvantages
        - Limited dataset
        - No OpenAI VPT compatibility
- MineRL v0.4.4
    - Advantages
        - Supports interactor
        - Allows autocrafting
        - Decent documentation and tutorials
    - Disadvantages
        - Limited dataset (larger than v0.3.7 though)
        - No OpenAI VPT compatibility
- MineRL v1.0.0
    - Advantages
        - Huge dataset
        - Gym Action Environment is more extensive (more actions available not featured in other documentation)
    - Disadvantages
        - Doesn't allow crafting scripts (mouse, keyboard, and GUI only)
            - See [5] for discussion of this
- MineDojo
    - Advantages
        - Huge dataset
        - Allows autocrafting
    - Disadvantages
        - Doesn't have interactor capabilities

        - Should be doable to reimplement though
    - Limited documentation/tutorials

What MineRL version will your group be moving forward with, and why?

The group decided to move forward with MineRL v0.4.4. We chose this version for a few reasons. We ruled out MineRL v0.3.7 early on as it had the most limited dataset and little advantage over MineRL v0.4.4. We also ruled out MineRL v1.0.0 because we thought the lack of autocrafting capabilities would severely degrade the performance of our AI agent and complicate training. Between MineDojo and MineRL v0.4.4, we chose v0.4.4 because it had superior documentation, and we were concerned that the prevalence of text-based data with MineDojo would complicate training.

References

[1] V. P. Patil et al., “Align-rudder: Learning from few demonstrations by reward redistribution,” arXiv.org, https://arxiv.org/abs/2009.14108 (accessed Sep. 23, 2023).

[2] Minerllabs, “Minerllabs/getting-started-tasks: Tasks to get you started with Minerl,” GitHub, https://github.com/minerllabs/getting-started-tasks/ (accessed Sep. 23, 2023).

[3] “BASALT Competition 2022,” MineRL, https://minerl.io/basalt/ (accessed Sep. 23, 2023).

[4] L. Fan et al., “Minedojo: Building open-ended embodied agents with internet-scale knowledge,” arXiv.org, https://arxiv.org/abs/2206.08853 (accessed Sep. 23, 2023).

[5] B. Baker et al., “Video pretraining (VPT): Learning to act by watching unlabeled online videos,” arXiv.org, https://doi.org/10.48550/arXiv.2206.11795 (accessed Sep. 23, 2023).