Requirement 6 Report - Hardware Capabilities

What hardware specifications do people tend to utilize for machine learning in minecraft?

As we are basing our project on the task and data linked to the NeurIPS MineRL Yearly Competitions, using the timeframe and hardware requirements listed in those competitions as a baseline for the project is a good place to start. The maximum hardware specifications for various different years are as follows:

- 2019: 6 CPU cores, 112 GiB RAM, 736 GiB SDD, & NVIDIA P100 GPU [6]
- 2020: 1 P100 GPU [7]
- 2021: 6 CPU cores, 56 GB RAM, --- SDD, K80 GPU (12GB vRAM) [5]

Interestingly, these hardware specifications get less intensive with time, as K80 processors are significantly less powerful than P100 GPUs, reflecting the competition's drive towards making things more accessible. None of these specifications are for the actual hardware that people used to train their ML models, but can be used as a good benchmark for systems running these complex tasks.

How long does it take to train Minecraft machine learning models on common hardware specifications?

Finding information on the time spent training proved to be a very difficult task. The closest measure I could find is that per the rules of the MineRL competitions, participants are allowed 4 days (96 hours) to train their algorithms for solving the four tasks of the project. Abstracting these measurements, this creates the theoretical conceptual timing of 24 hours per task on the hardware specified for the competitions.

Upon not finding documentation on the actual runtimes of the training phases for these programs, this task switched to trying to calculate a theoretical runtime for the training phase. This can be theoretically accomplished by comparing performance benchmarks for specific GPUs. The cloud computing service Lambda has a page dedicated to performance comparisons for many common commercial graphics cards [3]. Using this as a means of comparison, it is possible to provide a rough estimate for time by comparing throughputs for the contest GPUs to the types of GPUs we would likely be able to access. However, doing calculations like this will require a great deal of abstraction as the list of GPUs Lambda maintains does not have benchmarks for the two GPUs specifically mentioned in the rules for the contest [3]. When searching for comparisons between the GPUs listed by Lambda and the contest GPUs, the best estimate found was an article by a cloud GPU provider E2E Cloud that put the performance of a Nvidia P100 at about 3x slower than a Nvidia V100 at intensive ML tasks [4]. Combining the information from both of these sites would put the P100 at about the performance of the Nvidia RTX 3070 for machine learning computations.

How does the hardware we currently have access to compare to the hardware others are using?

Comparing the hardware we have access to, the most glaringly obvious issues in our systems will be a lack of memory and a lack of GPU computing power. To run these programs locally would likely take a system with a large amount of memory and the approximate equivalent of a Nvidia RT3070 to run in a timely manner.

The most feasible method likely available to us would be to outsource these computations to services like Microsoft Azure or Google Colab. Sources, such as this YouTube video [2], demonstrate how to utilize Google Colab for use in this specific type of project, ensuring that the startup for running the program on Google's system would be a fairly straightforward process.

The base version of Google Colab is a free service; however, the free version of google colab does not guarantee availability of their service at all times [1]. Colab offers two subscription services, a 'Pro' and a 'Pro+' for $9.99 a month and $49.99 a month respectively [1]. These two services would allow for limited guarantees of GPU hardware in concert with the terms of the respective subscriptions [1].

References

[1] "Choose the Colab plan that's right for you," Colaboratory, https://colab.research.google.com/signup?utm_source=faq&utm_medium=link&utm_campaign=seems_too_good (accessed Sep. 24, 2023).

[2] "First steps with MineRL - Colab included!" YouTube: Martin Andrews, https://www.youtube.com/watch?v=8yIrWcyWGek (accessed Sep. 24, 2023).

[3] "Deep Learning GPU Benchmarks," Lambda, https://lambdalabs.com/gpu-benchmarks (accessed Sep. 23, 2023).

[4] "Tesla V100 vs. P100: Do you know the differences?," E2 Cloud, https://www.e2enetworks.com/blog/tesla-v100-vs-p100-do-you-know-the-differences (accessed Sep. 23, 2023).

[5] "NEURIPS 2022: MineRL BASALT Competition: Challenge Rules," AICrowd, https://www.aicrowd.com/challenges/neurips-2022-minerl-basalt-competition/challenge_rules (accessed Sep. 23, 2023).

[6] "NeurIPS 2019 : MineRL Competition," AICrowd, https://www.aicrowd.com/challenges/neurips-2019-minerl-competition (accessed Sep. 23, 2023).

[7] "MineRL NeurIPS 2020 Competition," AICrowd, https://www.aicrowd.com/challenges/neurips-2020-minerl-competition (accessed Sep. 23, 2023).