

Mine-RPN

Or how we were able to recognize pigs et. familia in Minecraft



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Breaking the ice

FACCIAMO QUALCOSA DI SCEMO

Faster RCNN

Developed in 2015 by Facebook's researches, Faster-RCNN is still today an industry standard thanks to it's accuracy and performance, getting a step closer to real time object detection

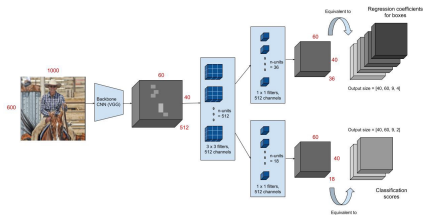


Figure: Faster-RCNN architecture.

Why minecraft?

Minecraft has several desirable qualities:

- Simple graphics.
- Sandbox.
- Available to every team member.
- Distinguishable entity silhouettes.



Figure: A Minecraft promotional image.

Behold, data!

4000 images spread across 40 videos!

How did we collect these videos?

- 1 minute long (circa).
- As many biomes as possible.
- One mob per video (except test).

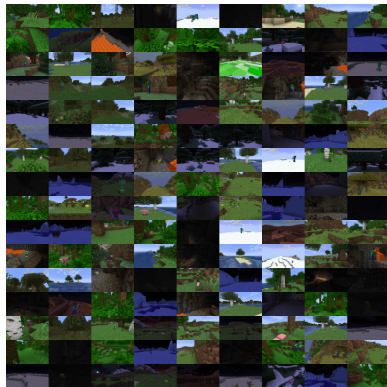


Figure: A representative chunk of our dataset

Augmentation Techniques

In order to prevent overfitting and increase the amount of information available, we employed various data augmentation techniques, such as:

- Rotation and Reflections.
- Adjustments to Contrast, Brightness and Saturation.
- Sharpening and Blurring the image.

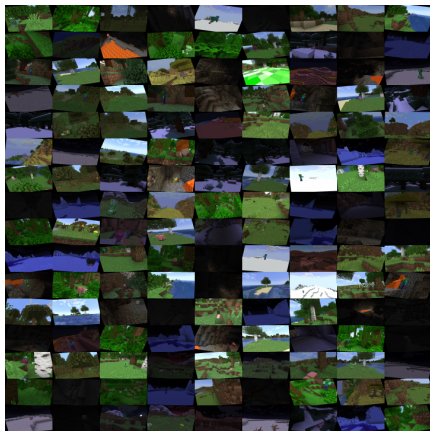


Figure: Our Dataset, Augmented.

Tool

How to label 4000 images?

1. Load image
2. Create box / purge
3. Next

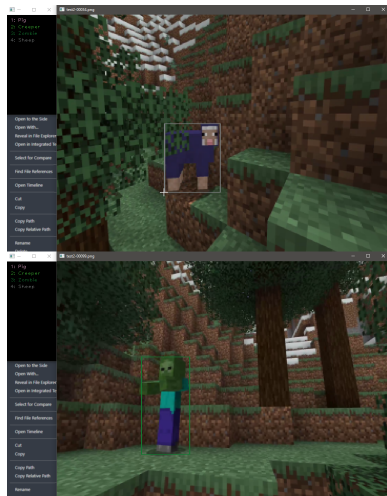


Figure: BBoxing in our tool

Our Backbone

The backbone is the convolutional *heart* of our model, it is:

- Blazingly fast.
- Adaptable to any resolution.

While also offering:

- A 92% accuracy when used as a Classifier.
- A mean training time of $\approx 2h$.

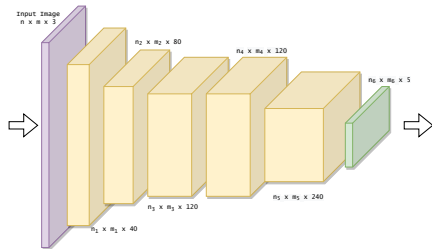


Figure: Our backbone.

Our RPN

Our RPN network extends our Backbone and is composed mainly of two twin layers:

1. A Classification layer.
2. A Regression layer.

Before feeding data into those, it also performs some pre-processing:

- Anchor Splashing.
- Base convolution.
- Flattening (how do we get to fully connected otherwise?)

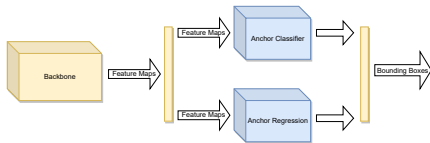


Figure: Our network's proposal layer.

Our Tricks

In order to allow our Backbone and RPN to *punch above their weight*, that is, learn a complex task with fewer parameters or with a smaller dataset, we employed two popular regularization techniques:

- Batchnorm. A Layer that computes a running μ and σ^2 , standardizing the input at inference time, this increases capacity.
- Dropout. A Layer that randomly zeroes out outputs of the preceding layer, adding bagging¹ to our network and making it more robust.

¹Essentially, simulating an ensemble without performance costs.

Examples (1/2)

Even if many proposal are presented, the network realizes which is the objects to focus on, and which to discard
It is not always that easy...



Figure: A creeper in it's natural environment

Examples (2/2)



Figure: A very confusing sunset^a

^aThe issue is talked about in-depth in our paper.



Figure: The network struggling

In Conclusion. . .

We believe that, even if the model has its hiccups when presented with weird scenarios, the mere fact of being able to deploy such an architecture on a novel dataset, having trained it completely from scratch, is quite a good result.

Most importantly, the model is able to identify objects at inference time at an impressive speed, and, thanks to optimization techniques such as *model freezing* and *quantization*, it could be used as a tool for real-time object detection.

The End.

Question Time! (it's an exam after all...).

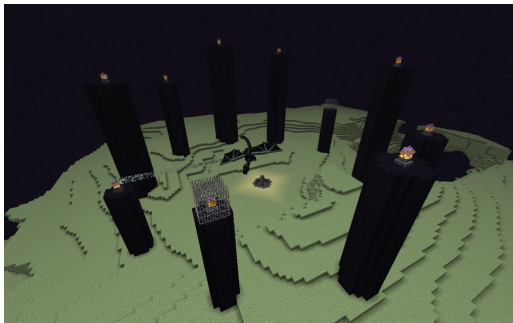


Figure: The End.