CONVOLUTIONAL NETWORK FOR CANCER DETECTION IN TWO VIEWS MAMMOGRAMS USING TPU

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Objectives

This work aims to verify the advantages of implementing a convolutional neural network that detects cancer in mammograms in a TPU (Tensor Processing Unit).

Typically, GPUs (Graphics Processing Units) are used for this type of task, but TPUs generally have much more internal memory, allowing them to train and test mammograms at high resolutions. We want to see if increasing the resolution of the input images improves the detection of this type of cancer. To do this, we will use the Tensorflow/Keras framework, which is well-adapted to run on TPU.

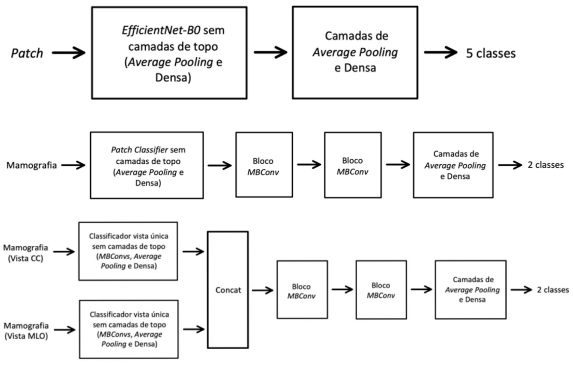
Some types of cancer appear as textures on the exam, so a higher resolution can improve their detection.

Materials and Methods

The first step was to transcribe the convolutional neural network that detects breast cancer in mammograms developed by Petrini et al. [1], from the PyTorch framework to Tensorflow, in order to be able to run the model on TPU. Tensorflow is better adapted than PyTorch to run on TPU, as the Google company produced both TensorFlow and TPU.

The model obtained is based on Efficient¬Net-B0 [2], from which the patch classifier, single-view classifier, and two-view classifier, shown in picture 1, are generated.

The public dataset CBIS-DDSM (Curated Breast Imaging Subset of Digital Database for Screening Mammography) [3] was chosen, using the original division into training and test sets and using different resolutions for the tests.



Picture 1: Classifier components

Results

Table 1 shows the performance metrics for each component. It is important to note that the

resolution of the patch classifier is 224x224 for the case in which the complete classifier has a resolution of 1152x896, and 448x448 for the other. Table 2 shows the training time per epoch.

Table 1: Results for each component

Classifier (Metric) / Device (Resolution)	Patches (Accuracy)	One View (AUC-ROC)	Two Views (AUC-ROC)
Original	75,54%	0,8033± 0,0183	0,8419± 0,0258
GPU (1152x896)	74,04%	0,8143± 0,0179	0,8498± 0,0227
TPU (1152x896)	76,37%	0,8003± 0,0184	0,8327± 0,0264
TPU (2304x1792)	79,52%	0,8154± 0,0178	0,8466± 0,0264

Table 2: Training time per season for each component in seconds

Classifier/ Device (Resolution)	Patches	One View	Two Views
GPU (1152x896)	363	376	73
TPU (1152x896)	19	22	17
TPU (2304x1792)	50	71	28/

Based on the above results, only the patch classifier showed a considerable improvement when increasing the resolution using the TPU. However, there was a significant decrease in training time per epoch, reaching nineteen times faster in the best case and four times faster in the worst case.

Conclusions

Considering the system's classification performance, there was no significant improvement when using a higher resolution, which may be due to the use of a dataset formed from scanned images. This is because there has already been a loss of information during the scanning process, thus suppressing the details of a higher-resolution image. A test using a dataset with innately digital images could be used to verify this hypothesis.

Despite this, the use of TPU has not been in vain. The considerable increase in training speed makes it possible to carry out a greater number of hyperparameter tests, thus obtaining more refined models. It also makes it easier to use a larger amount of data. Finally, it makes it possible to use more complex models.

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References

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