

Proposal for GSoC 2021

Implement and publish state-of-the-art ML models in TensorFlow 2 & deploy them on mobile devices using TensorFlow Lite

(Proposal by Vasudev Gupta)

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Introduction

Deep learning research is progressing very rapidly & frameworks like TensorFlow makes the process very efficient. TensorFlow enables us to get highly optimized features with just a few lines of code. This enables efficient & faster training on hardware like GPU / TPU's.

I propose to implement the state-of-art models using **TensorFlow2** & to add them to the **TensorFlow Garden**. I am also proposing to deploy those models on IOS / Android devices using TensorFlow Lite.

Project Goals

Model

I am proposing to implement **Wav2Vec2** from [paper](#)- **Wav2Vec 2.0: A Framework for Self-Supervised Learning of Speech Representations**.

Wav2Vec2 is the pre-trained model for Automatic Speech Recognition (ASR). It has achieved state-of-art results in tasks related to Automatic speech recognition by fine-tuning on just a few hours of training data.

Implementation Plan

Currently, Wave2Vec2 is available only in PyTorch. I will be implementing this model in TensorFlow 2. Since Wave2Vec2 is a pre-trained model, I will be converting its pre-trained checkpoints into TensorFlow compatible format using mapping recipes (from this [blog post](#)). This will allow us to get the pre-trained TensorFlow checkpoints without pre-training the TensorFlow model.

I will also try to reproduce the results mentioned in the paper by fine-tuning the pre-trained model on the [TIMIT](#) & transcribed the [LibriSpeech](#) dataset. Further, I will try to convert the pre-trained checkpoint of **XLSR-Wave2Vec2** (from [paper](#)- **Unsupervised Cross-lingual Representation Learning for Speech Recognition**) into TensorFlow compatible format. Since this paper extends Wave2Vec2 architecture to multiple languages, I will use the same implementation with XLSR-Wave2Vec2 pre-trained checkpoints. I will fine-tune this pre-trained model for multiple Indian languages using this [dataset](#). Hence, I will be adding models which will support multiple languages to TensorFlow Garden.

I am further planning to deploy fine-tuned Wave2Vec2 on mobile devices using TensorFlow Lite & will make video (YouTube) tutorials for helping people who are struggling to deploy their TensorFlow models on mobile devices. This video tutorial will cover all my learnings while deploying Wave2Vec2.

I will be using Colab notebooks and my personal GPU's for fine-tuning this model. So, I won't require any other compute resources.

Timeline Proposal

Timeline		Work description
	Week-1	Interaction with the mentor & finalize papers for implementing
	Week-2	Reading papers & deciding strategy to implement papers

May 17 - June 7	Week-3	Discussion with the mentor on the possible strategies to implement paper
June 7 - Aug 16	Week-4	Implementing Wave2Vec2 in TensorFlow 2
	Week-5	Converting pre-trained Wave2Vec2 PyTorch checkpoints into TensorFlow. Fine-tuning model for downstream tasks to get state-of-art Speech Recognition models in TensorFlow.
	Week-6	
	Week-7	Converting pre-trained XLSR-Wave2Vec2 PyTorch checkpoints into TensorFlow, Fine-tuning on other languages datasets, Export pre-trained / fine-tuned checkpoints to TensorFlow Hub
	Week-8	Add tests, Code porting to TensorFlow Garden, Blog post, Prepare Colab notebooks for showing demos of using fine-tuned models
	Mid-Evaluation	
	Week-9	Converting TensorFlow SavedModel to TensorFlow Lite format, Deployment on IOS / Android device, Model optimization
	Week-10	
	Week-11	Video tutorial on using TensorFlow Lite, export code to TensorFlow Lite examples
	Week-12	Buffer time
Aug 16 - Aug 23	Week-13	Final Submission

Buffer time is kept for compensating for an unpredictable delay during the project.

Why do I want to work on this one?

This project will enable me to implement state-of-art models which will be useful for several researchers / ML engineers. I would get a chance to work on implementing deep learning papers under the guidance of really nice people in the field. This may change my style of reading papers & make me more productive. I will also get a chance to discuss my ideas on improving papers with a few variations.

Benefits to Community

Currently, there is no official implementation of the Wave2Vec2 model in TensorFlow. Also, pre-trained checkpoints of Wave2Vec2 are available only in PyTorch. Getting those pre-trained checkpoints in TensorFlow will help ASR researchers to expand their research using TensorFlow. Since my model will cover multiple languages, it will help researchers / ML engineers from various regions.

Also, I am planning to summarize the paper & my learnings in the blog post which will help the community to understand the current research in the field of deep learning. I am also planning to work on a video tutorial explaining TensorFlow to TensorFlow Lite conversion. This will help those who are struggling to use TensorFlow Lite.

Open-source contributions

I have contributed to several open-sourced projects and got recognition from organizations for my contributions. Please refer to the below table to see the list of contributions, I have made.

Date of Merge	Library	Description	Pull Request / Commits
In progress	HuggingFace Transformers	Working on porting Google's BigBird-Pegasus into 🤗 Transformers library	#10991
March 30, 2021	HuggingFace Transformers	Ported Google's BigBird-RoBERTa into 🤗 Transformers library. Original BigBird's implementation is in TensorFlow, I converted all the pre-trained checkpoints & code to PyTorch.	#10183
March 18, 2021	HuggingFace Hub	Built a Python utility to ease uploading, downloading any PyTorch model to/from 🤗 Hub	#11
Dec 2020	HuggingFace Datasets	Contributed several datasets to 🤗 Datasets	#935 , #1091 , #1183 , #1228 , #1505
March - April 2020	Analytic Club weekly-sessions	Added content on data analysis & ML algorithms for the community	Commits

The above table summarizes some of my open-source contributions to the world of machine learning.

Technical Blog Posts

- 1) Understanding BigBird's Block Sparse Attention [*Published by HuggingFace*] [\[Link\]](#) [*Dated March 31, 2020*]
- 2) DCGAN's with TensorFlow-2 [\[Link\]](#) [*Dated April 6, 2020*]

Experience

Courses Taken

- Fundamentals of Deep Learning (IIT Madras)
- Probability & Statistics (IIT Madras)
- Mathematical Foundations of Data Science (IIT Madras)
- Differential Equations (IIT Madras)
- Series & Matrices (IIT Madras)

Books referred

- Deep Learning by *Ian Goodfellow and Yoshua Bengio and Aaron Courville*
- Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition by *Aurélien Géron*
- TensorFlow & PyTorch documentations

Projects

- Implemented paper- **Incorporating BERT into parallel sequence decoding with Adapters** [\[GitHub\]](#)
- Optimized Adapters for Neural Machine Translation [\[GitHub\]](#)
- Implemented paper- **Attention Is All You Need** in **TensorFlow2** [\[GitHub\]](#)
- Built a utility on the top of **TensorFlow2** to standardize the training loop [\[GitHub\]](#)
- Built a python utility to fetch trending papers in deep learning [\[GitHub\]](#)

Competitions

- Secured **Gold** at **InterIIT Tech Meet 2021**, hosted by [IIT Guwahati](#). Built an end2end pipeline for tweets analysis & headline generation using state-of-art & innovative approaches in NLP. [\[GitHub\]](#)

About Me

I am a 3rd-year Dual degree (M.Tech. in Data Science + B.Tech. in Mechanical Engineering) undergraduate at [IIT Madras](#). IIT Madras is one of the best institutes in India (as per [NIRF ranking](#)). I chose Data Science as my major in Masters because of my interest in this field. I enjoy doing projects in data science, deep learning. You can find all my projects [here](#).

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Professional

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Social Media

Twitter

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Skills

Languages

Python, C++, Markdown, MATLAB, Julia

Libraries

TensorFlow, 🧠 Transformers, PyTorch, TensorFlow-datasets

Tools

Git, GitHub, VS Code

I got featured by **Hugging Face** several times on their Twitter handle for my open source contributions in their library. [\[1\]](#) [\[2\]](#)

Why I am good for this project?

- Good exposure to implementing deep learning papers
- Have worked on several projects using TensorFlow
- Good experience in training large models on large datasets (~100 GB) using distributed strategies
- Great interest in Deep Learning / Machine Learning
- Have a great knowledge of converting code & checkpoints in one framework to another

Thank you!