بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

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AI for Perfecting Quran Recitation

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Problem

2+ Billion Muslims recite the Quran 5 times a day

Only 15.5% speak native Arabic

Quran Ijaza continues through oral transmission

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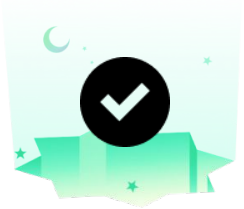
Automate the Quran learning process with tools powered by Artificial Intelligence

Training

Recitation

Correction



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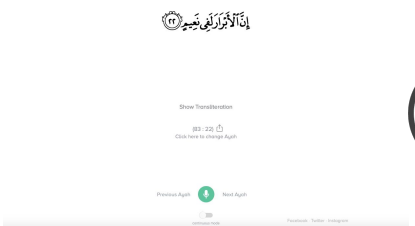
History

2018 S2 | 2019 S1 | 2019 S2 | 2020 S1

Hackathon

Data Collection
Data labelling



Transcription

ML Model v0.1
Transcription
Memorization Mode

Launch

Mobile App Release
Multiple features + translations

Growth

Collaboration w/ Masajid
ML Model optimizations
Transcription improvements

MASSCHALLENGE

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2021 Roadmap

Understanding

Side-by-Side Transcription & Translations

Nationwide Partnerships

Correction

Word-by-Word correction

Tashkeel Correction

Growth

B2C Focus

Premium Metrics & Features

Ascension

Expand to other markets, opportunities

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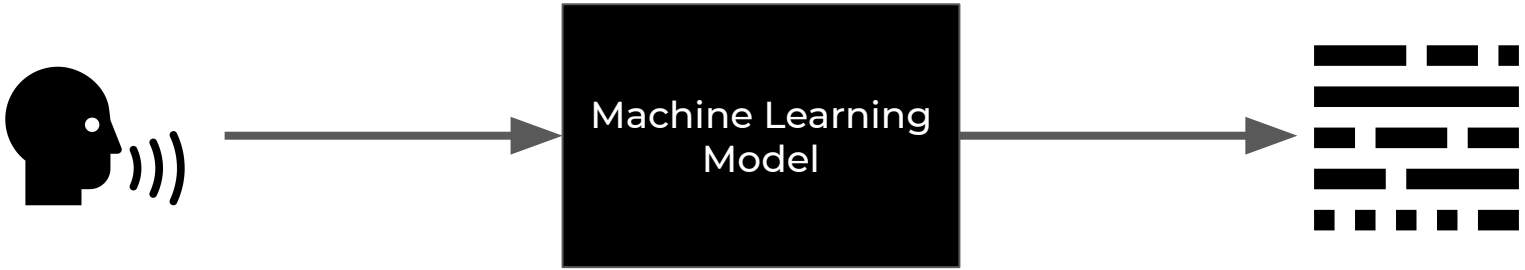
The Machine Learning Problem



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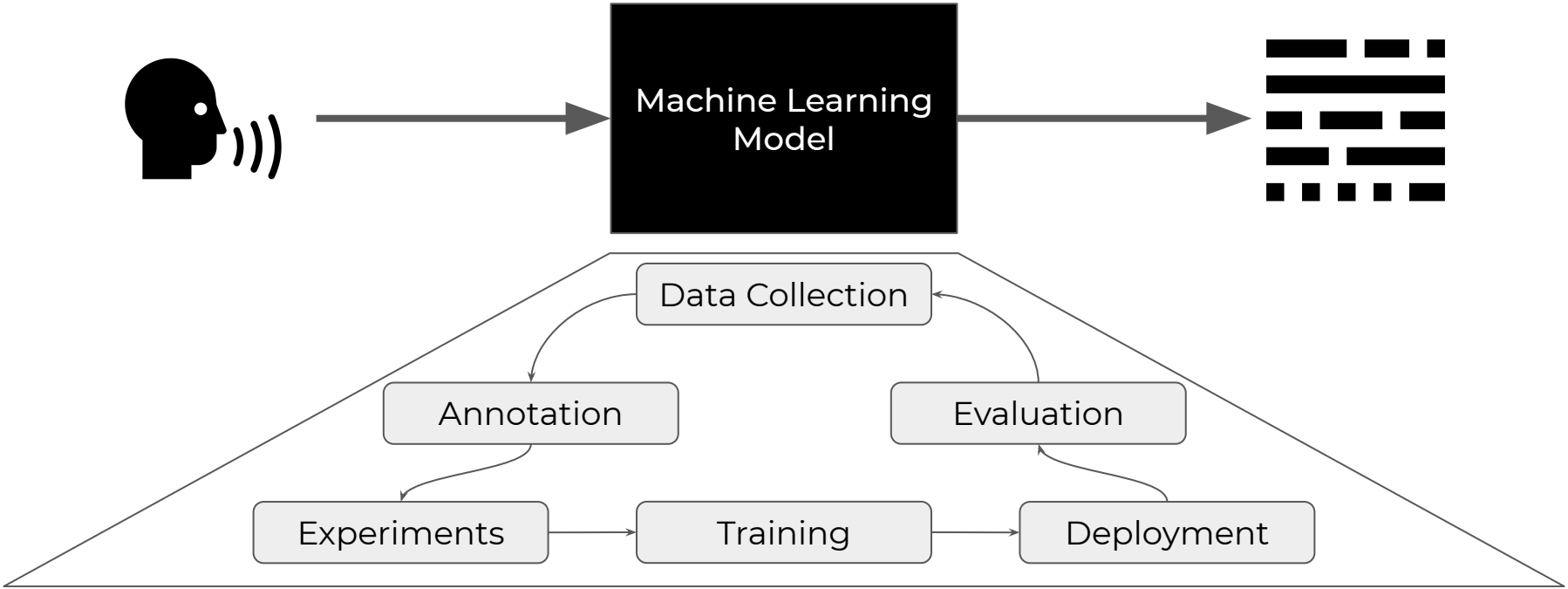
The Machine Learning Problem



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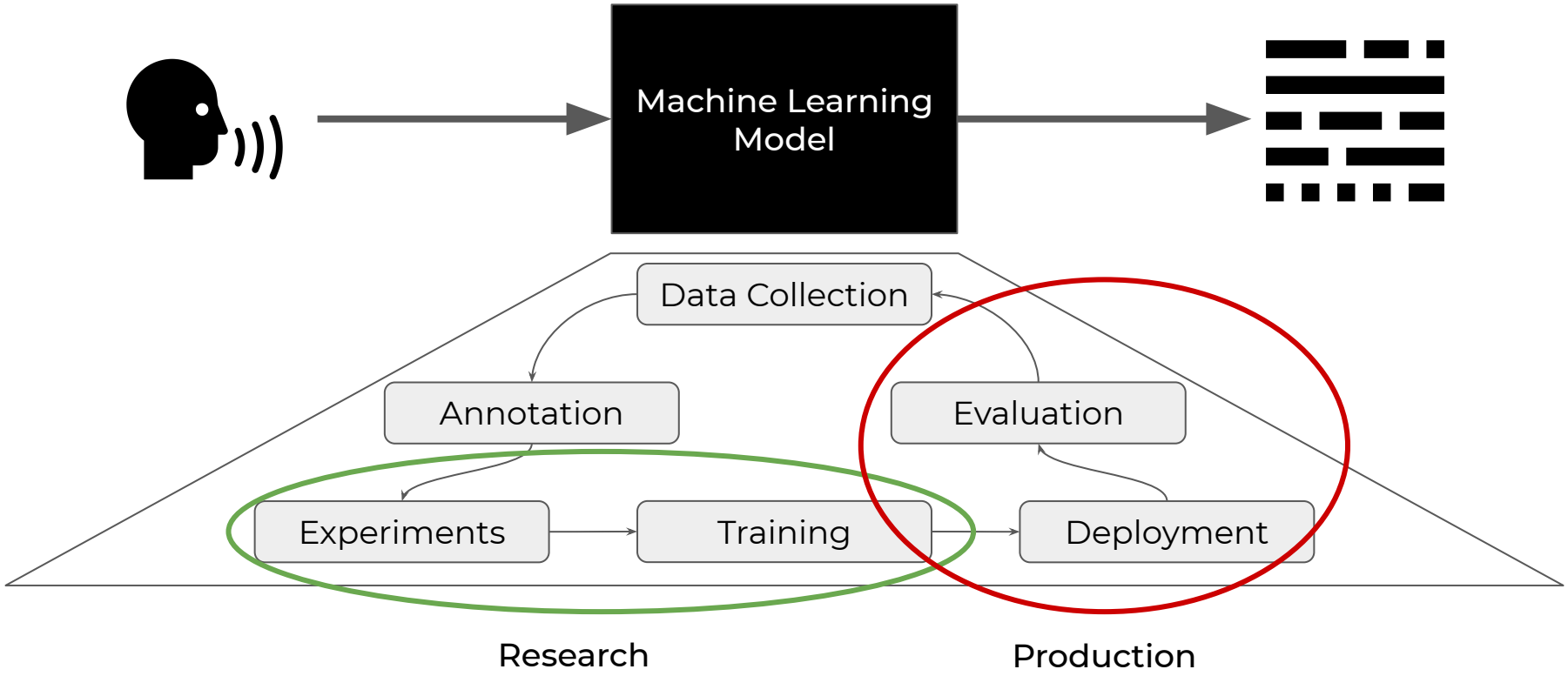
The Machine Learning Problem



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Data Collection

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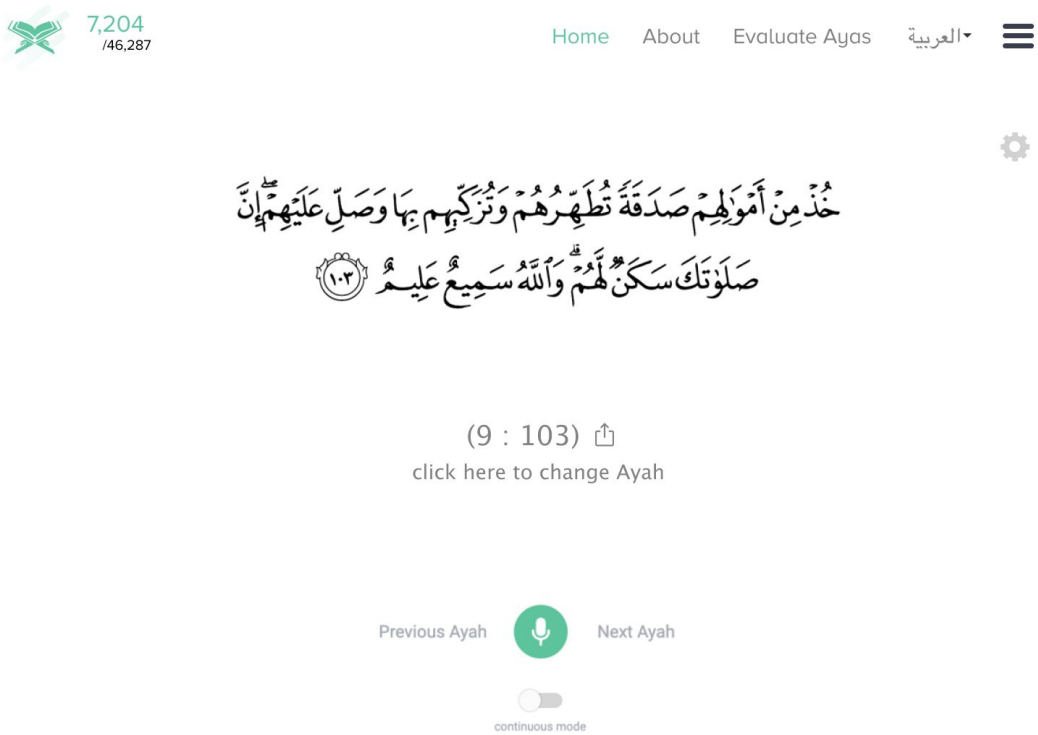
Data Collection



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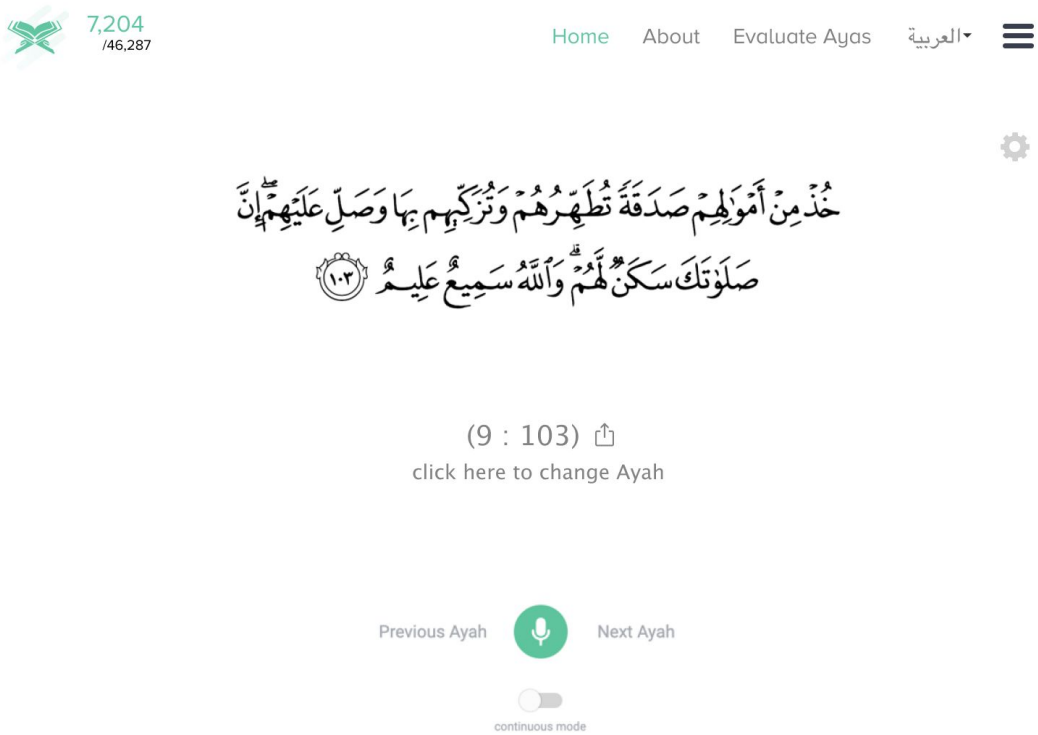
Data Collection



+ Marketing
+ Demos
+ Iftar Fundraisers

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Data Annotation

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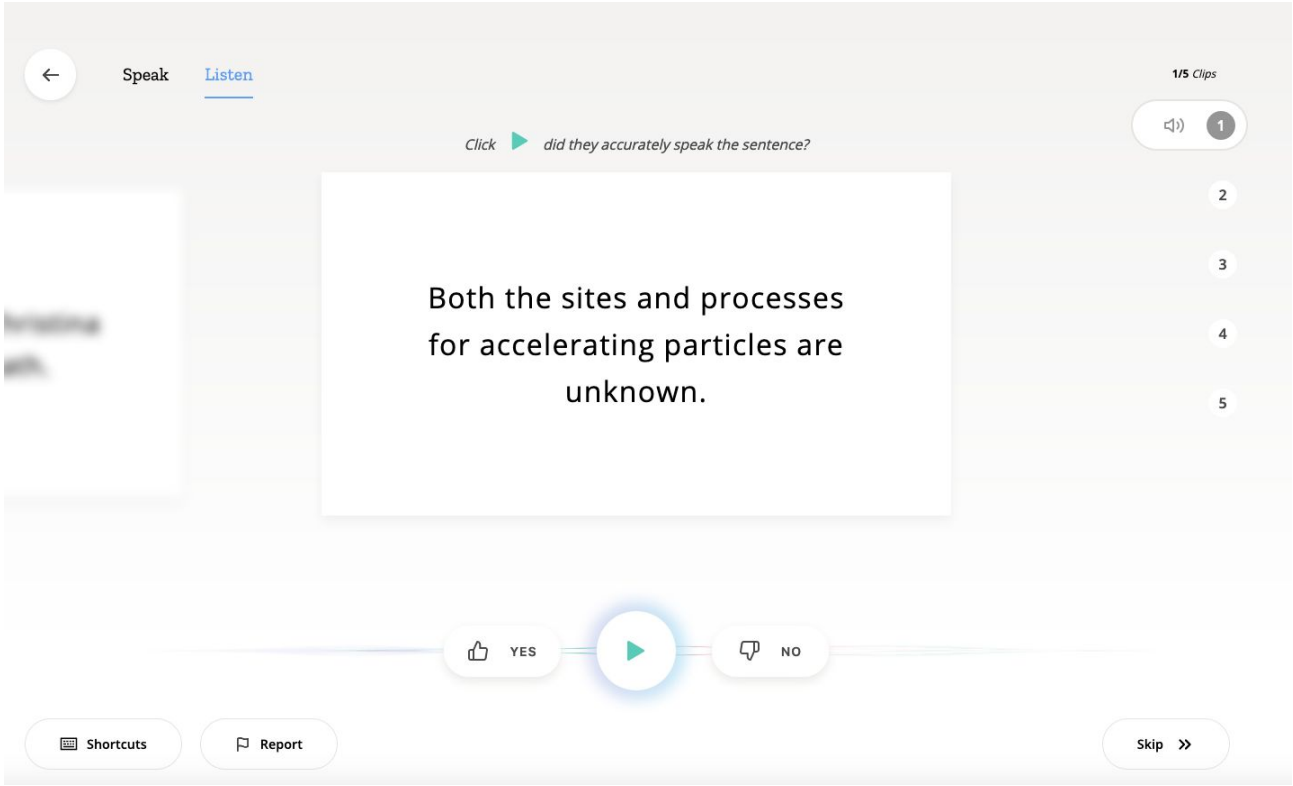
Data Annotation - Learning from Mozilla



Taken from https://voice.mozilla.org/en/listen

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What about privacy?

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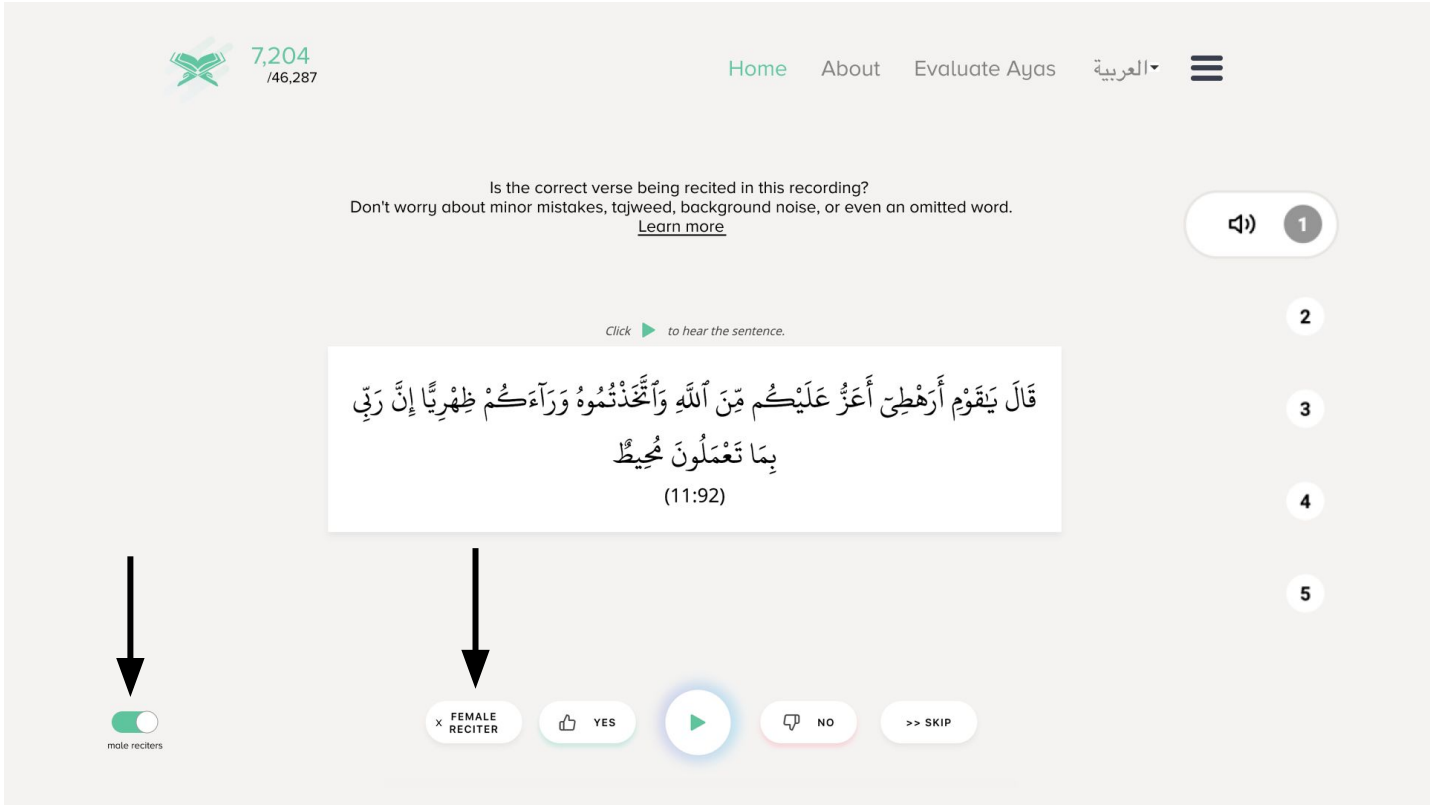
Data Annotation



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18 Months Later...

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DeepSpeech

A Recurrent Neural Network (RNN)

RNN: A deep learning model used for analysis of sequential data (time series data prediction).

Theory: RNNs are capable of handling “long-term dependencies.”

Practice: RNNs don’t seem to be able to learn them...

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https://arxiv.org/pdf/1412.5567.pdf

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DeepSpeech

Long Short Term Memory (LSTM) Network

LSTM: A special type of RNN, capable of learning long-term dependencies.

LSTM units are units of an RNN.

A common LSTM unit is composed of a **cell**, an **input gate**, an **output gate** and a **forget gate**.

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https://www.bioinf.jku.at/publications/older/2604.pdf

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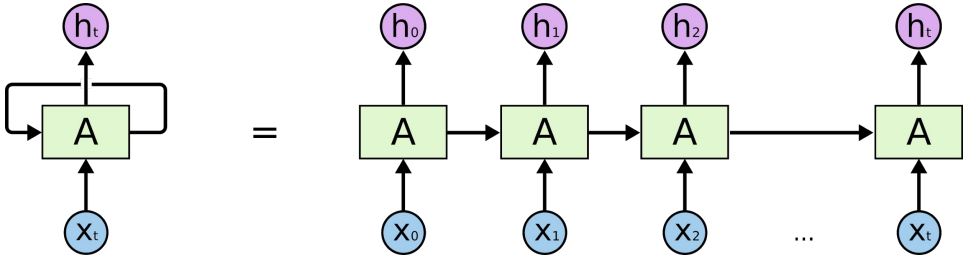
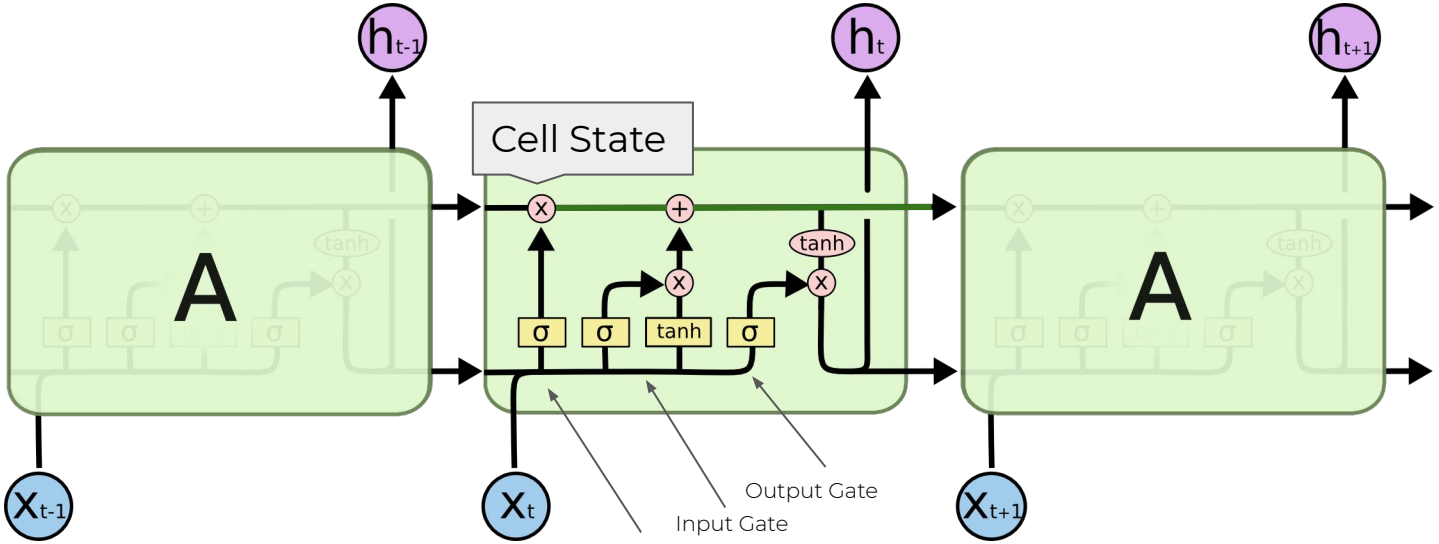

h_t
A
x_t
=
h_0
h_1
h_2
h_t
A
A
A
A
x_0
x_1
x_2
...
x_t


h_t-1
h_t
h_t+1
Cell State
A
A
tanh
σ
σ
tanh
σ
tanh
x_t-1
x_t
x_t+1
Output Gate
Input Gate
Forget Gate

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DeepSpeech + CTC Decoding

https://distill.pub/2017/ctc/

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CTC Decoding

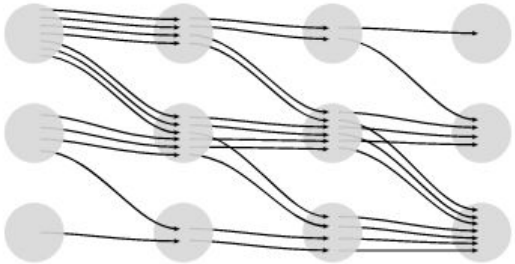
$$p(Y \mid X) = \sum_{A \in \mathcal{A}_{X,Y}} \prod_{t=1}^{T} p_t(a_t \mid X)$$

The CTC conditional **probability**

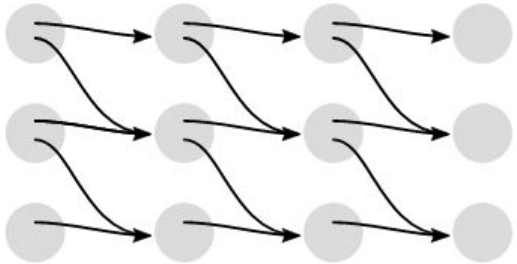
marginalizes over the set of valid alignments

computing the **probability** for a single alignment step-by-step.

Inference for each alignment will get costly → Use Dynamic Programming



Summing over all alignments can be very expensive.



Dynamic programming merges alignments, so it's much faster.

https://distill.pub/2017/ctc/

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Deployment

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Deployment v0.1

Keep It Simple Stupid :)

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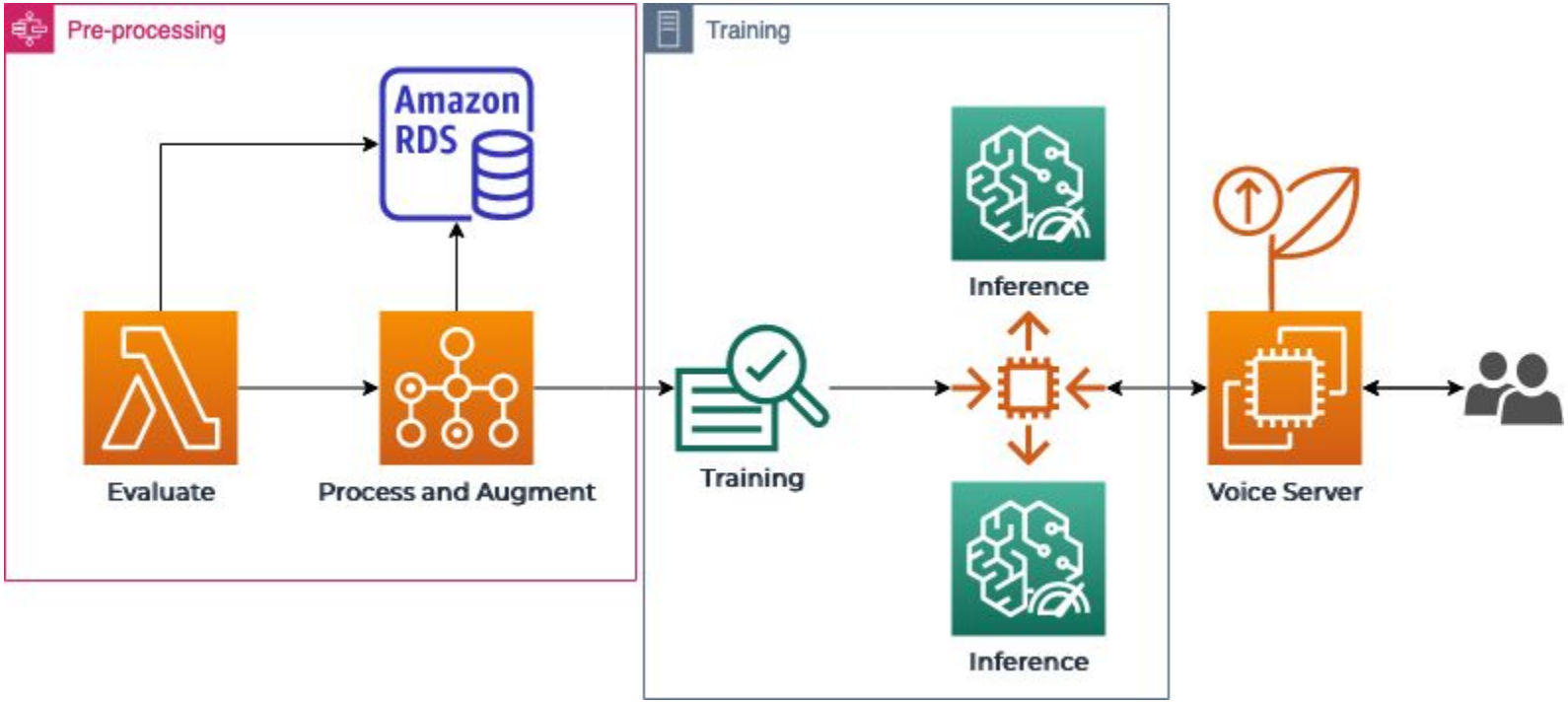
Deployment v1



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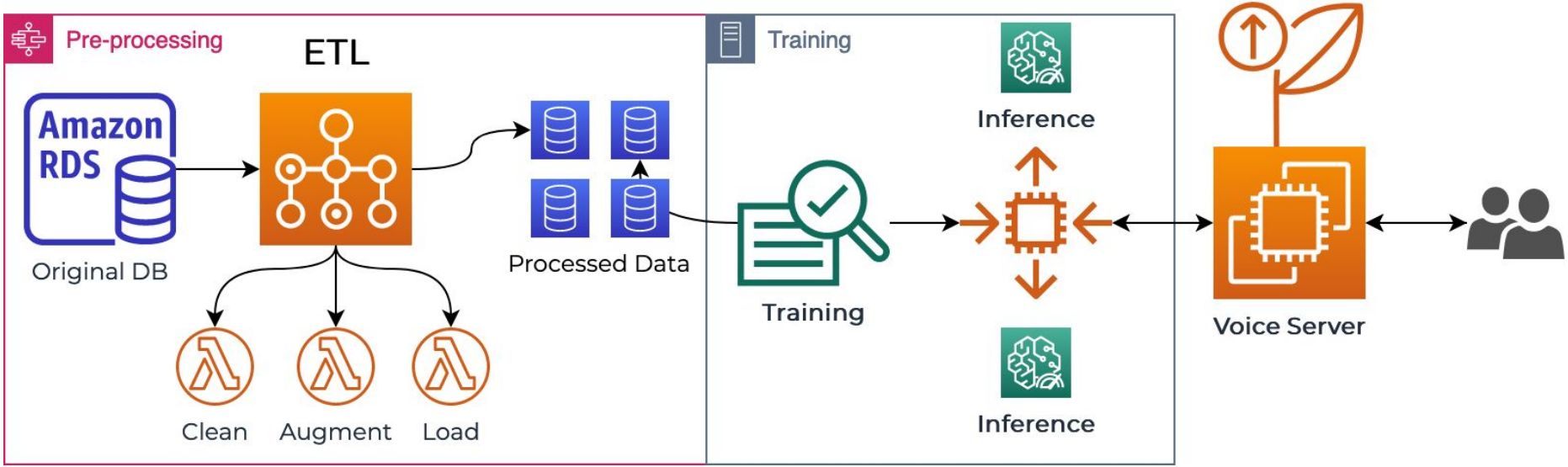
Deployment v2 - ETL Workflow



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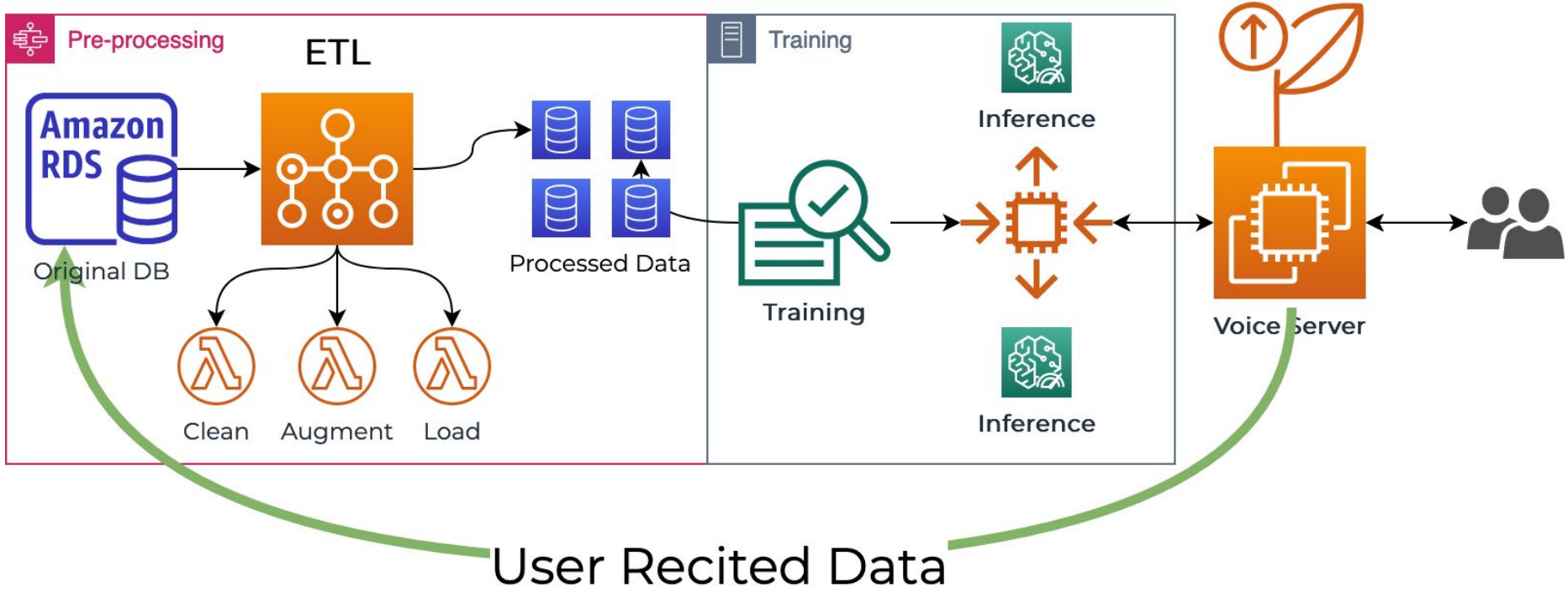
Deployment v2 - ETL Workflow + Data Network!



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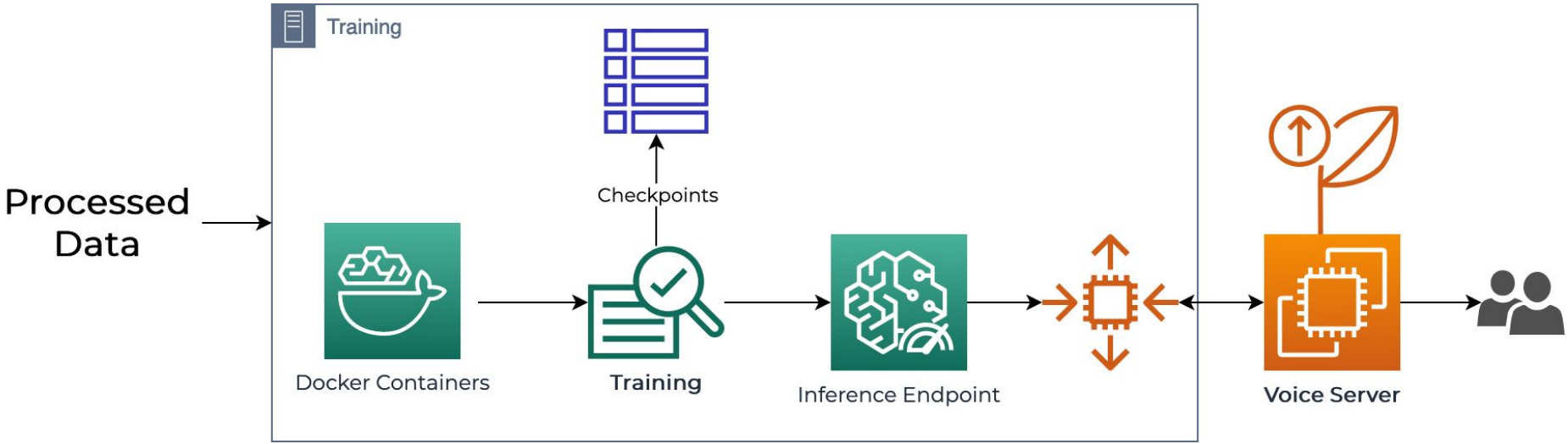
Deployment v3 - Containers



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Evaluation

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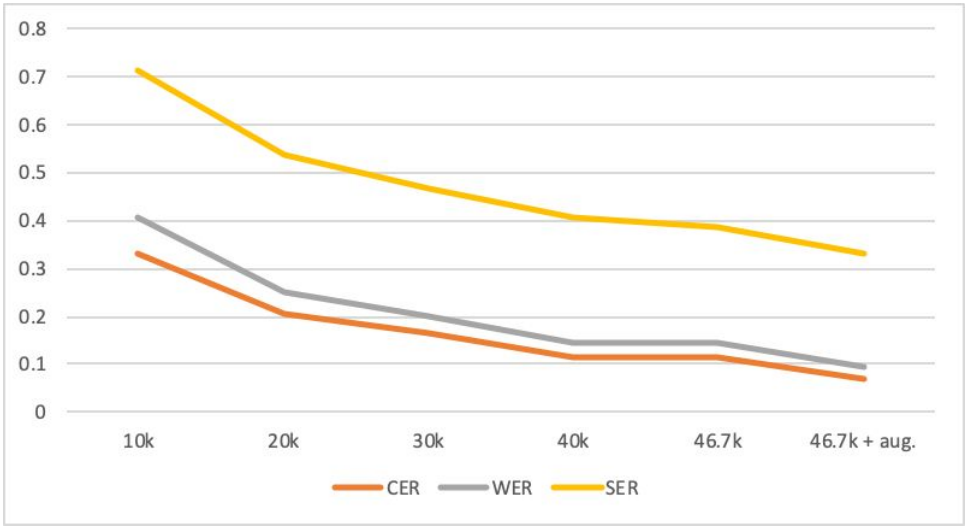
Evaluation

Simple Excel Sheets (for now)

Ideally automated pipeline
- Experiment with different parameters/sets
- Record previous results & model diff

~92% WER on ~50k files

Training in progress for 250k files...



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Demo!

github.com/Tarteel-io/tarteel-ml

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References

An Intuitive Explanation of Connectionist Temporal Classification

Connectionist Temporal Classification: Labelling Unsegmented Sequence Data with Recurrent Neural Networks

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