Analytics for Neural Networks (A4NN):

Accelerating Neural Architecture Search

Ariel Rorabaugh*, Ian Lumsden, Michael Wyatt, Silvina Caino-Lores, Travis Johnston, Michela Taufer

THE UNIVERSITY OF TENNESSEE KNOXVILLE

Background: Neural Architecture Search

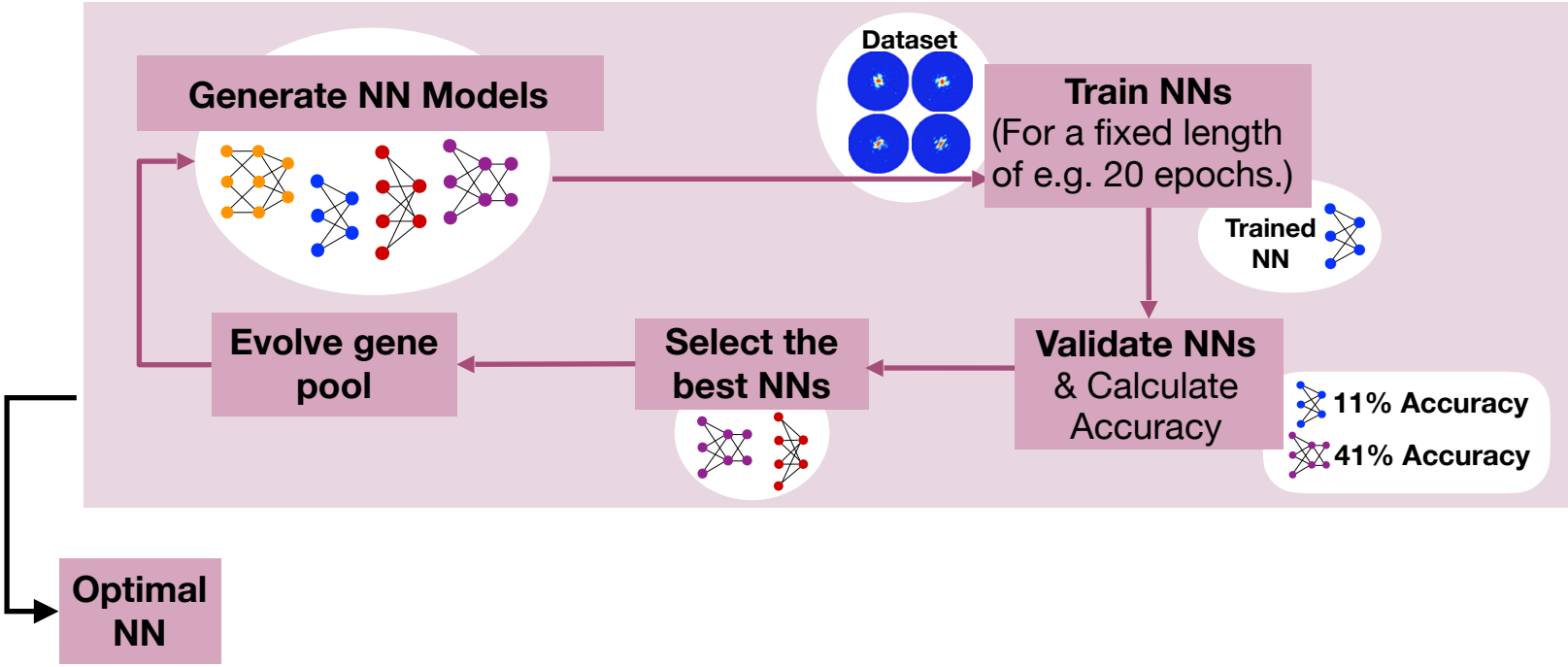
A **Neural Network** (NN) classifies a dataset. Different NNs are needed for different datasets.

Goal of **Neural Architecture Search**: find an optimal NN to classify a given dataset.

Background: Neural Architecture Search

A **Neural Network** (NN) classifies a dataset. Different NNs are needed for different datasets.

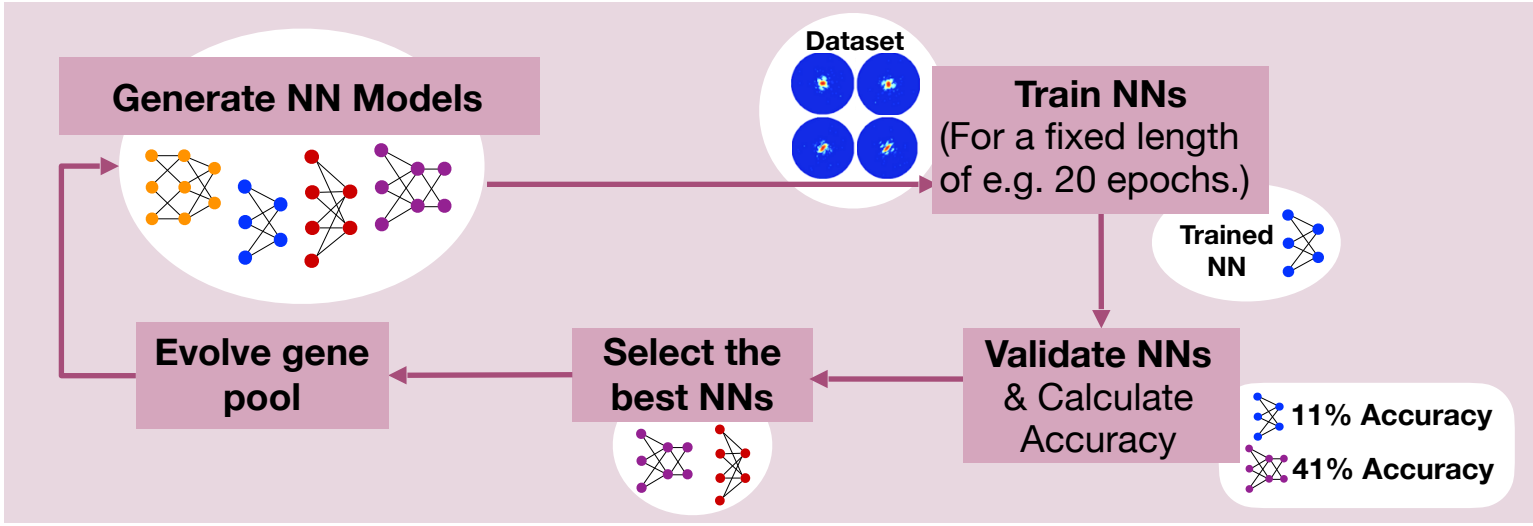
Goal of **Neural Architecture Search**: find an optimal NN to classify a given dataset.

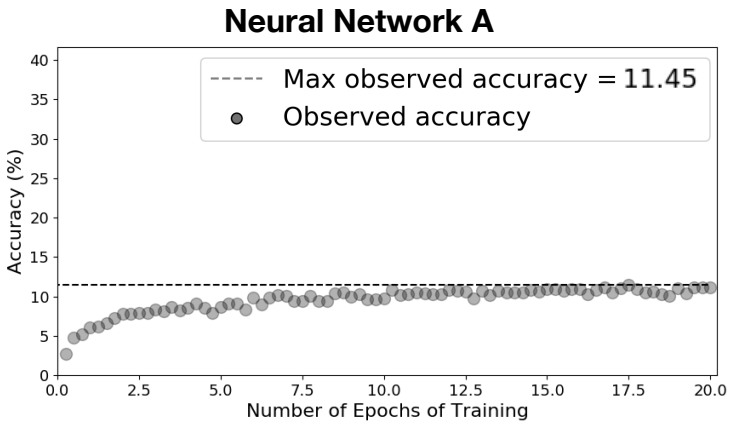


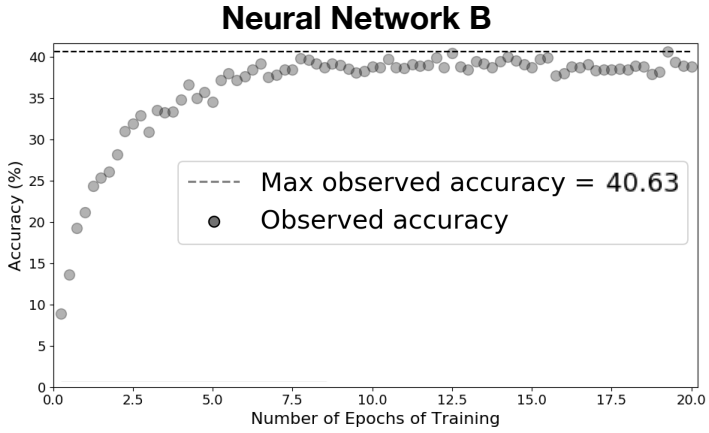
Background: Neural Architecture Search

A **Neural Network** (NN) classifies a dataset. Different NNs are needed for different datasets.

Goal of **Neural Architecture Search**: find an optimal NN to classify a given dataset.



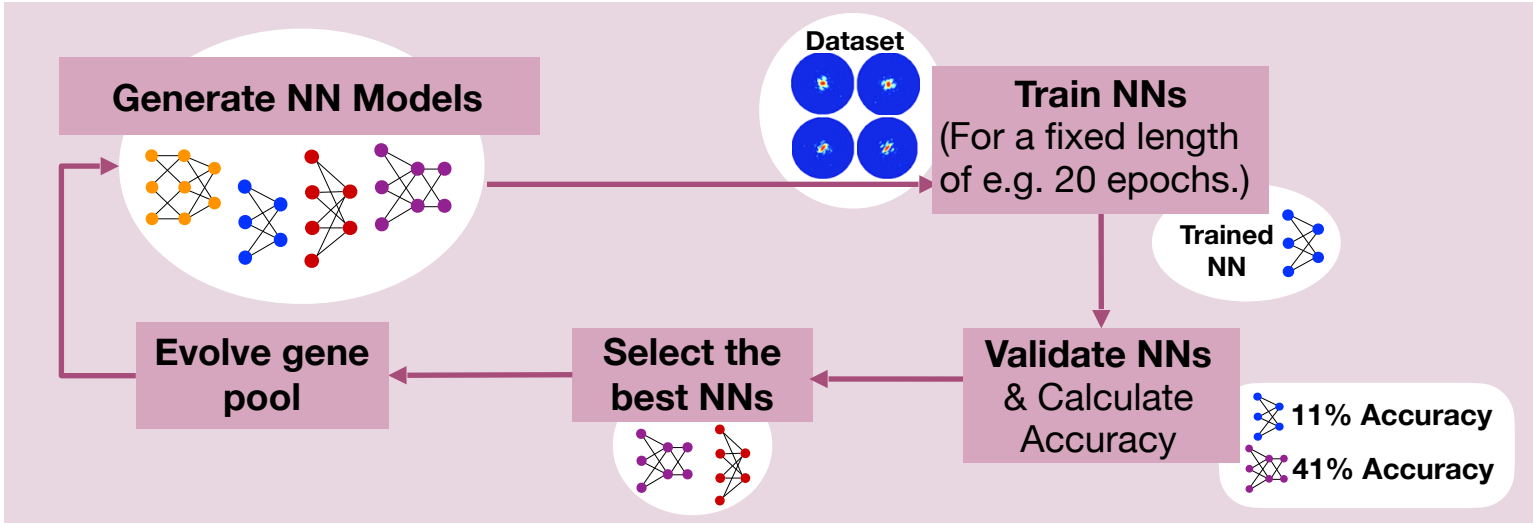


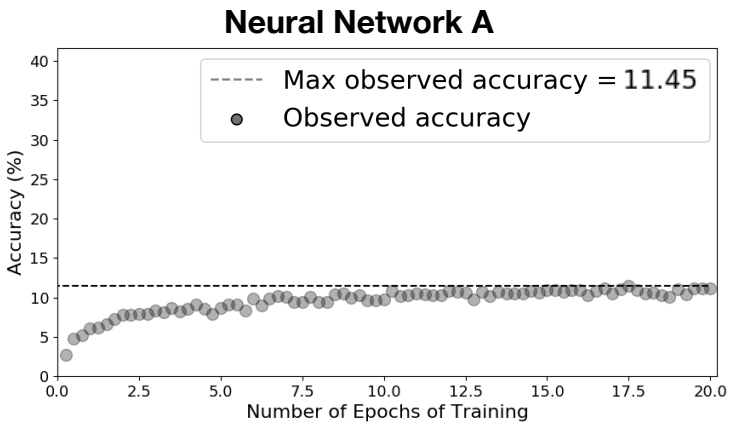


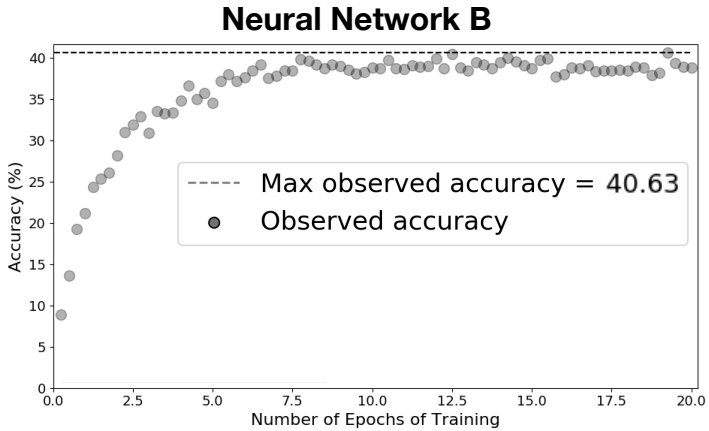
Background: Neural Architecture Search

A **Neural Network** (NN) classifies a dataset. Different NNs are needed for different datasets.

Goal of **Neural Architecture Search**: find an optimal NN to classify a given dataset.







Can we predict accuracy growth and save training time?

Analytics for Neural Networks (A4NN)

Can we predict accuracy growth and save training time?

Analytics for Neural Networks (A4NN)

Can we predict accuracy growth and save training time?

Goals of A4NN

Accelerate Neural Architecture Search by:

Analytics for Neural Networks (A4NN)

Can we predict accuracy growth and save training time?

Goals of A4NN

Accelerate Neural Architecture Search by:

- Transforming neural network (NN) training and validation steps from blocking to non-blocking

Analytics for Neural Networks (A4NN)

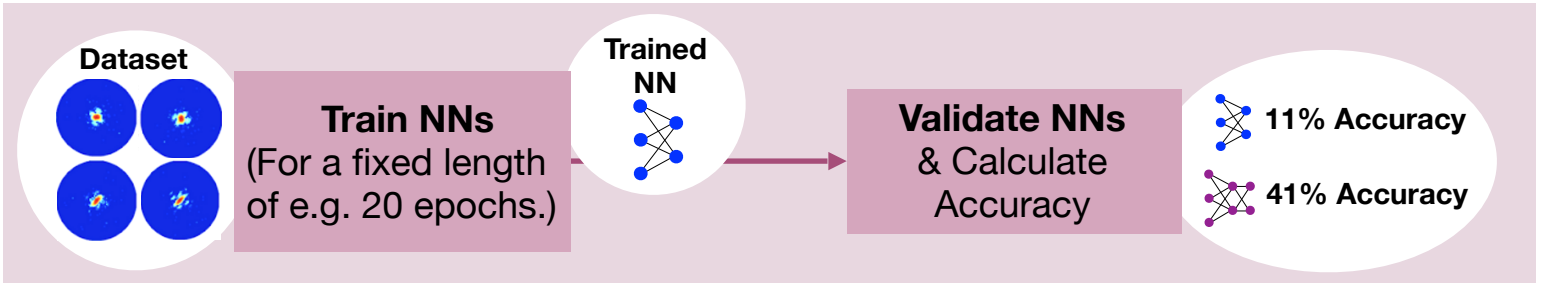
Can we predict accuracy growth and save training time?

Goals of A4NN

Accelerate Neural Architecture Search by:

- Transforming neural network (NN) training and validation steps from blocking to non-blocking

Blocking:



Analytics for Neural Networks (A4NN)

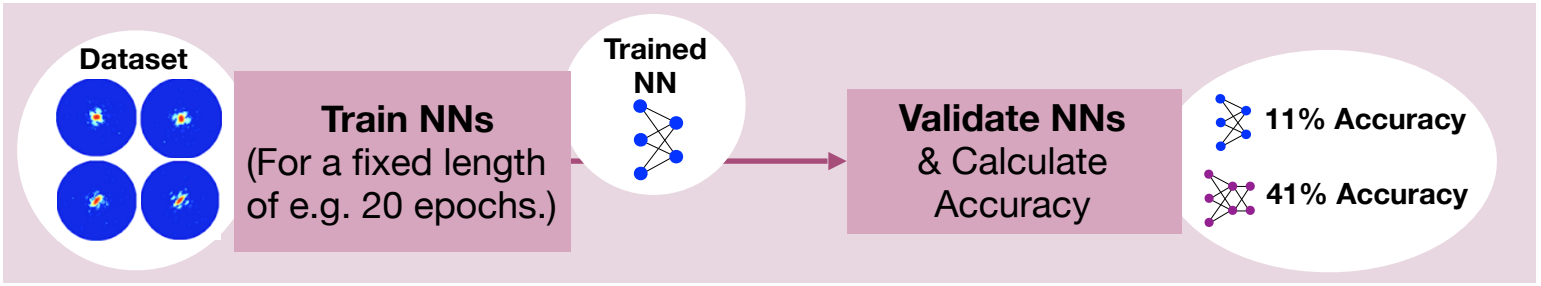
Can we predict accuracy growth and save training time?

Goals of A4NN

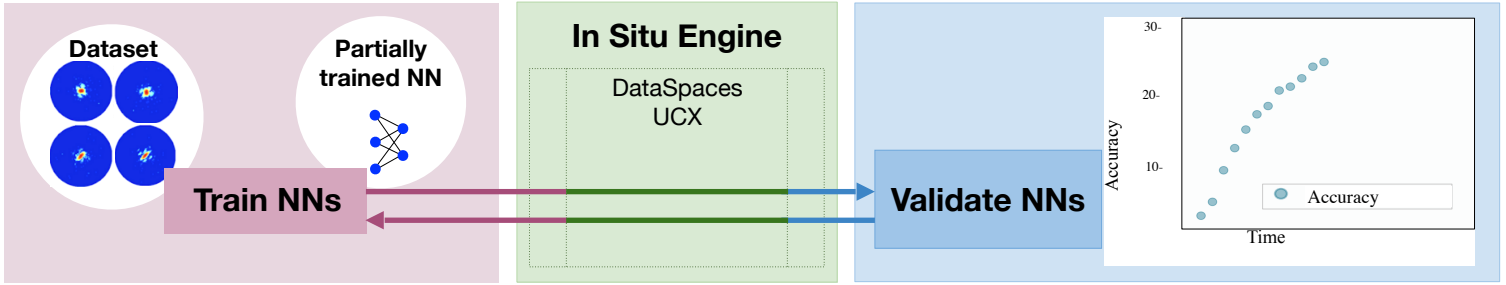
Accelerate Neural Architecture Search by:

- Transforming neural network (NN) training and validation steps from blocking to non-blocking

Blocking:



Non-blocking:



Analytics for Neural Networks (A4NN)

Can we predict accuracy growth and save training time?

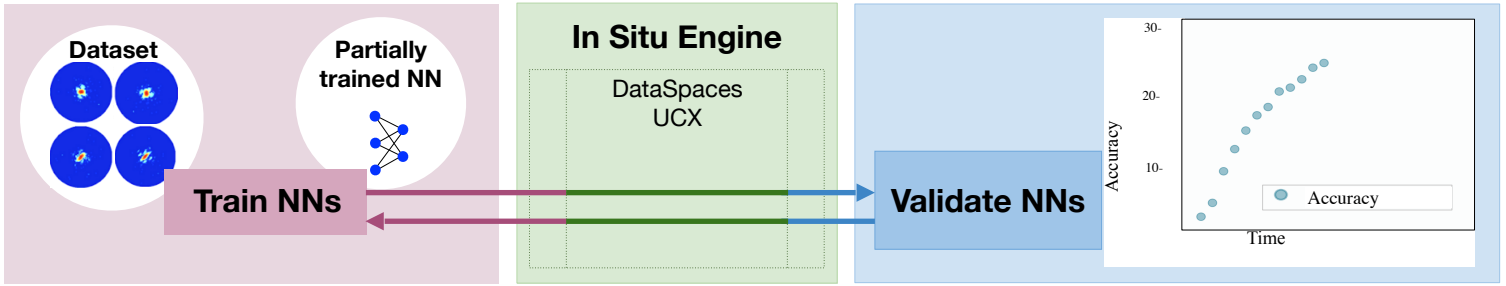
Goals of A4NN

Accelerate Neural Architecture Search by:

- Transforming neural network (NN) training and validation steps from blocking to non-blocking

- Implementing in-situ predictive analysis of NNs to identify and terminate poorly-performing networks.

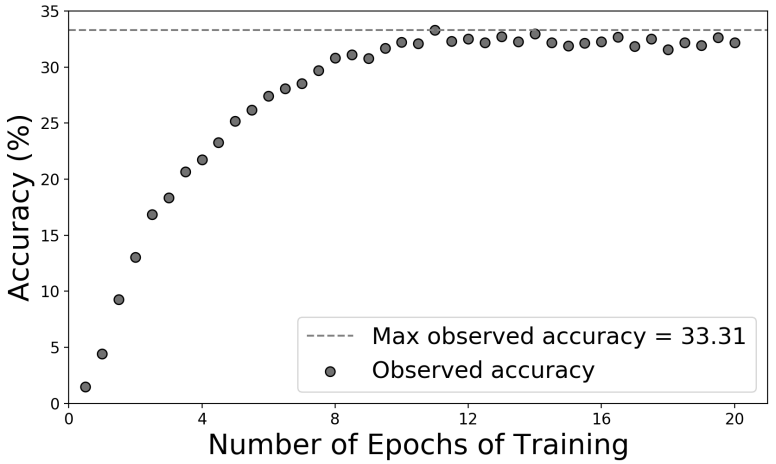
Non-blocking:



A4NN: predictive analysis

“Curve Fit Predict”: Modeling Accuracy Growth of NN

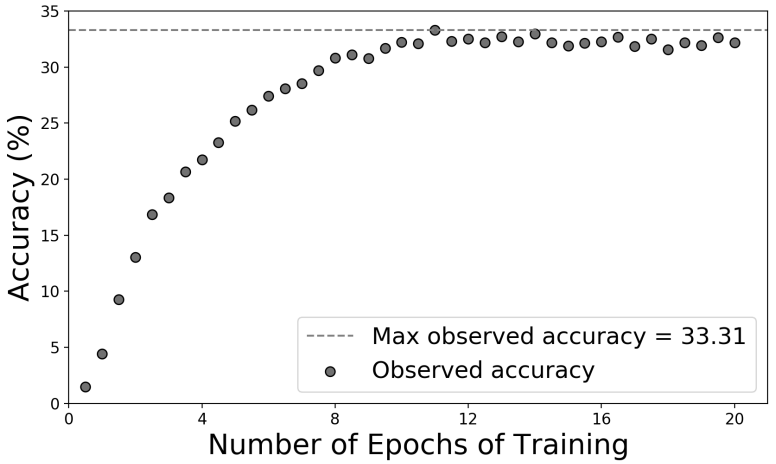
Accuracy of a CNN trained on CIFAR100 for 20 epochs.



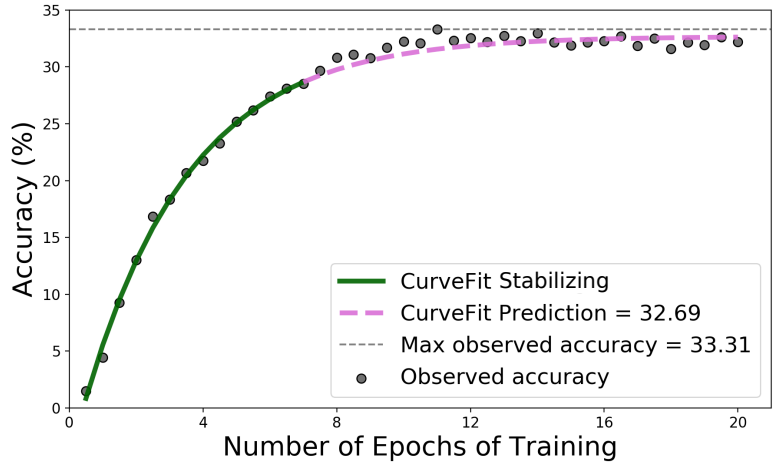
A4NN: predictive analysis

“Curve Fit Predict”: Modeling Accuracy Growth of NN

Accuracy of a CNN trained on CIFAR100 for 20 epochs.



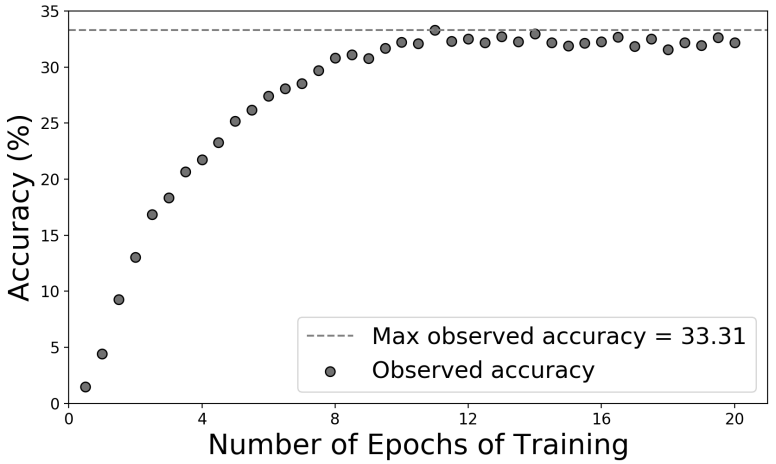
Prediction from Curve Fit Predict.



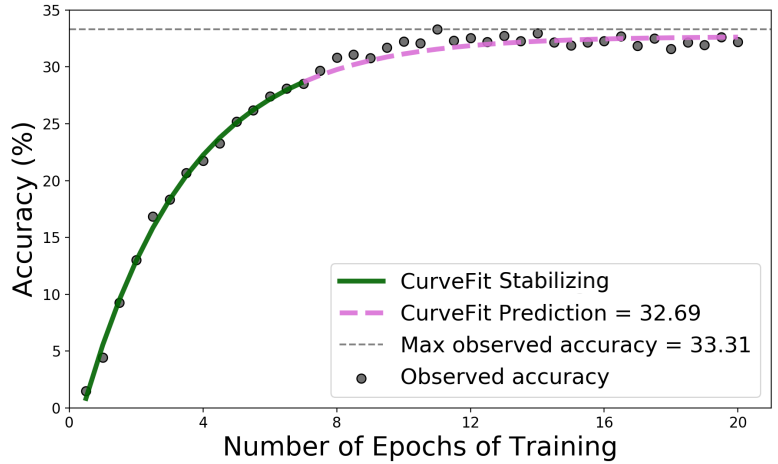
A4NN: predictive analysis

“Curve Fit Predict”: Modeling Accuracy Growth of NN

Accuracy of a CNN trained on CIFAR100 for 20 epochs.



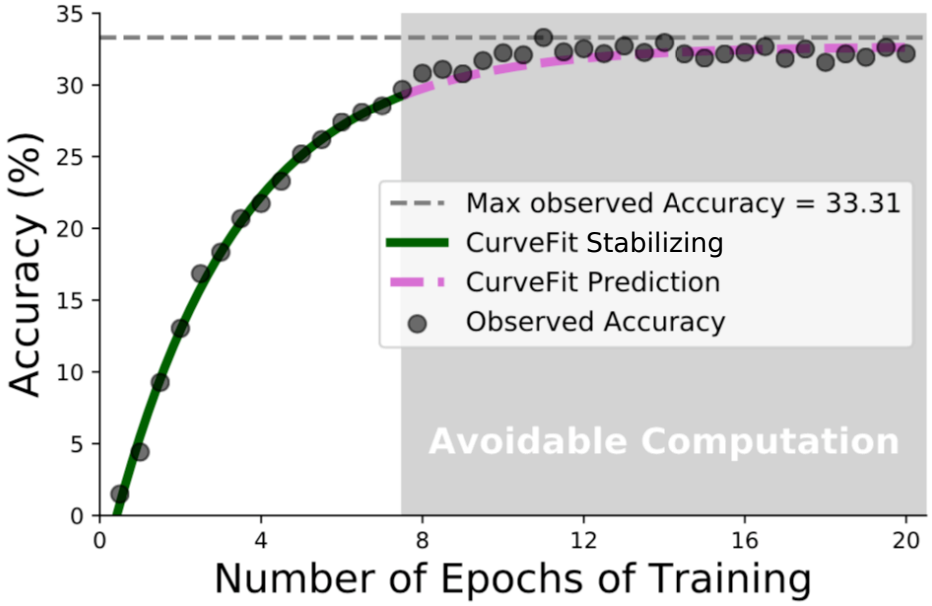
Prediction from Curve Fit Predict.



- Once Curve Fit Predict has stabilized, we can terminate training.

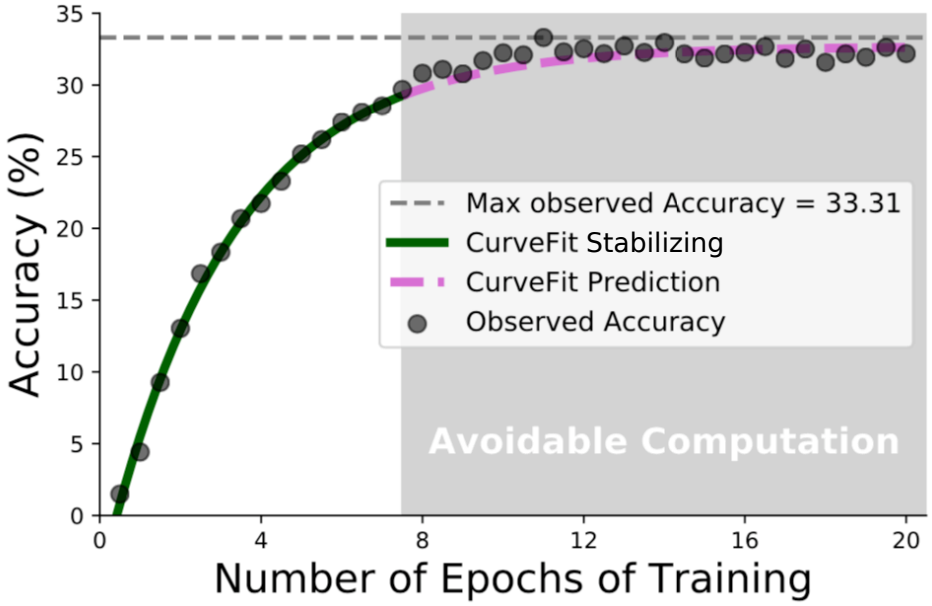
A4NN: predictive analysis

“Curve Fit Predict”: Modeling Accuracy Growth of NN



A4NN: predictive analysis

“Curve Fit Predict”: Modeling Accuracy Growth of NN



- Early experiments show average computation savings of over 50%.
- Suggests that Curve Fit Predict enables neural architecture search to assess up to twice as many NNs in a given time unit.

A4NN: Future Directions

- **Create NN Model Database**

  - Generate openly available repository of trained NN models, including NN metadata and accuracy/loss throughout training process.
  - Utilize database to leverage NN history in our analytics.

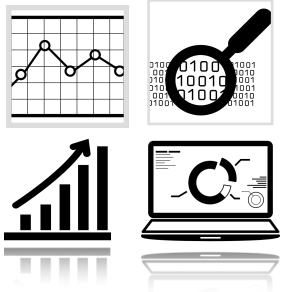
Analytics images by Freepik

A4NN: Future Directions

- **Create NN Model Database**

  - Generate openly available repository of trained NN models, including NN metadata and accuracy/loss throughout training process.
  - Utilize database to leverage NN history in our analytics.

- **Expand Analytics**



  - Predict NN performance to reduce wall-time for NN training & evaluation.
  - Steer search process via statistically guided, interpretable decision making.
  - Leverage past experience for architecture search initialization. (i.e. start from a reasoned initial projection, not a blank slate)

Analytics images by Freepik

Analytics for Neural Networks (A4NN):

Accelerating Neural Architecture Search

Ariel Rorabaugh*, Ian Lumsden, Michael Wyatt, Silvina Caino-Lores, Travis Johnston, Michela Taufer

THE UNIVERSITY OF TENNESSEE KNOXVILLE