

# Transfer Learning Vs Fine-Tuning

## Transfer Learning

- A broader concept that encompasses any scenario where a model developed for one task is repurposed on a second related task.
- It involves taking a pre-trained model, typically trained on a large dataset like ImageNet, and adapting it to a new but related problem.
- For instance, a model trained to recognize a wide array of animals might be adapted to specialize in identifying different breeds of dogs. In this case, the original model's learned features, such as edges and textures, can be leveraged for the new task, thereby reducing the need for extensive training data and computational resources.

## **Fine-Tuning**

- A specific form of transfer learning.
- It involves taking a pre-trained model and continuing the training process on a new, typically smaller, dataset. This allows the model to adjust its weights and biases to better suit the new task.
- Fine-tuning often involves adjusting the learning rate to prevent overwriting the previously learned features too rapidly.
- For example, a model trained to perform general object recognition might be fine-tuned on a dataset of medical images to specialize in identifying specific pathologies.

<i><b>Method</b></i>	<i><b>Feature Extractor</b></i>	<i><b>Classifier</b></i>
Transfer Learning	Pre-Trained (freeze)	Train From Scratch
Fine Tuning	Pre-Trained (freeze) Fine Tune	Train From Scratch

Aspect	Transfer Learning	Fine-Tuning
Objective	use knowledge from a pre-trained model to enhance performance on a related task	Adapt pre-trained model to a specific new task
Training Approach	freeze some layers of pre-trained model and train specific layers on the new task	Train the entire model with new data
Data Requirement	Can be effective with smaller datasets	requires more data specific to the new task
Case	When limited labeled data or computational resources are available, and tasks share similarities	When task-specific data is available and computational resources allow full retraining
Complexity	Less complex as it involves freezing some layers and training specific layers	More complex as it involves retraining the entire model
Example	Using a pre-trained ImageNet model to improve image classification on a new dataset	Fine-tuning BERT for sentiment analysis on a new dataset