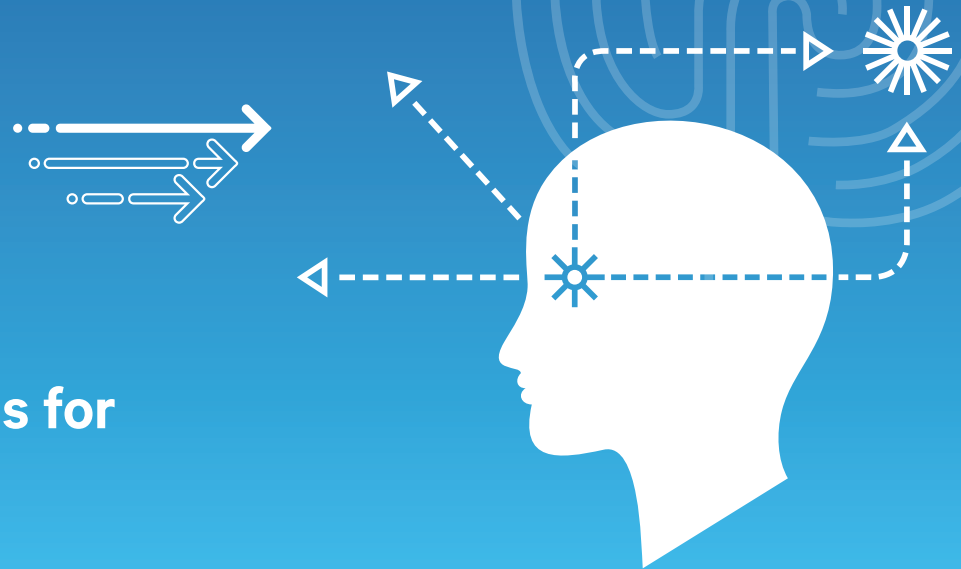# A Developer's Guide to Artificial Intelligence (AI)

Definitions, Insights & Tools for Getting Started in AI

AI is complex – developers must stay up to date

Artificial Intelligence is changing the world as we know it at an ever-increasing pace. From news aggregators to selfie filters, we're seeing AI affect us in many aspects of our lives. Self-driving cars and personal assistants with voice control will soon be the norm. This industry is predicted to grow at an exponential rate thanks to big data and more powerful processors.

As a developer, it's important to know the lexicon of terminology and the tools available to solve problems and create new applications.

In this eBook, we define AI and its subsets, explain how they work and give you the tools to get started.
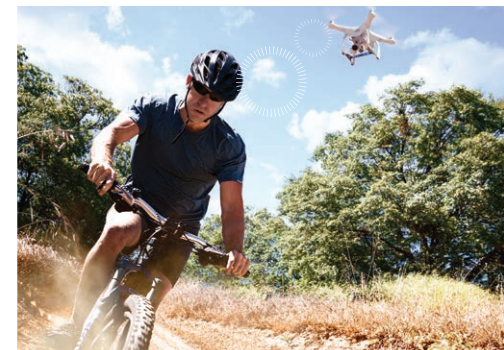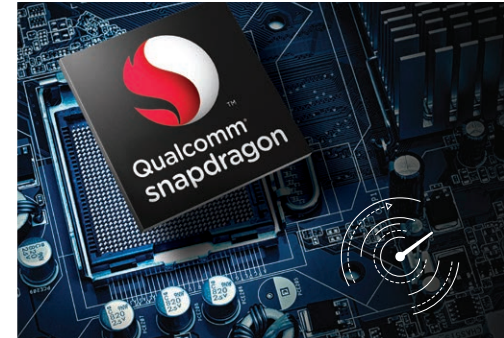
AI, ML, DL, ANN, CNN — what do they all mean?

Artificial Intelligence is a broad term that covers a machine's ability to categorize, predict, and make decisions without human interaction. You've probably used AI in some form in your development of algorithms with simple if-then rules and decision trees.

As computing power has advanced over the years, so have the algorithms used to control the behavior of AI. This advancement of AI has led to the subsets of **Machine Learning** (ML) and **Deep Learning** (DL).

The primary algorithms used to power ML and DL are known as **Artificial Neural Networks** (ANN), which are inspired by the biological neural networks in human brains.

The most common ANN used by DL is the **Convolutional Neural Network** (CNN), which consists of an input and an output layer as well as multiple hidden layers. The hidden layers apply an operation to the input, and then pass the result to the next layer. Each layer builds upon the one before to increase its ability to categorize information.
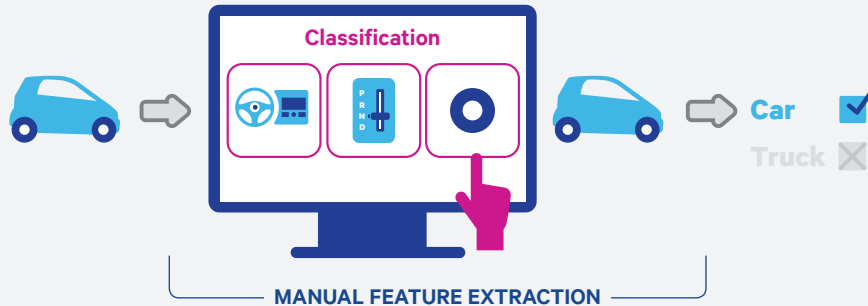
Training your model is the process of providing known inputs and outputs to the ANN so the model can learn. Providing more data to your model during this phase increases its accuracy.
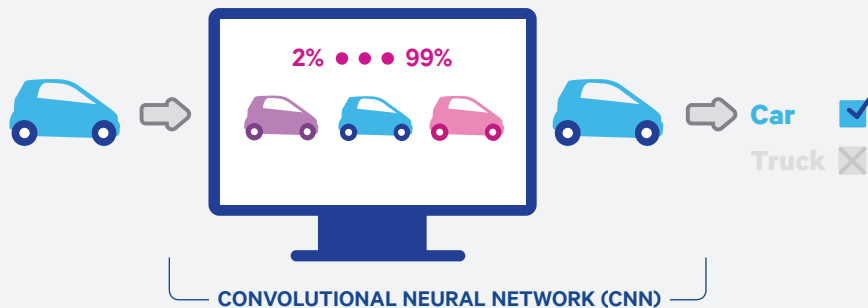
Levels of AI

Artificial Intelligence

Machine Learning
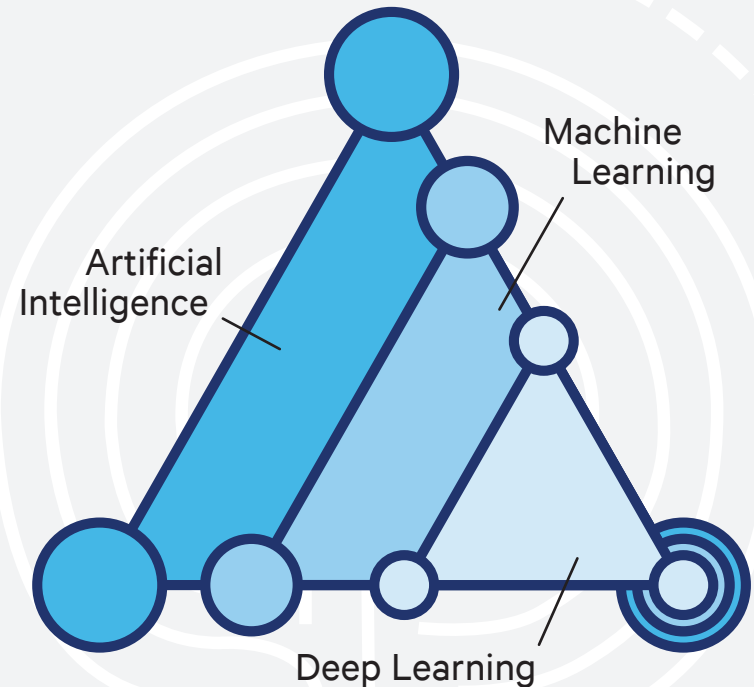
Deep Learning

The association of deep learning and machine learning as subsets of artificial intelligence.

Machine Learning

An ML algorithm would need all features of a car specified up front (tires, wheels, body, etc.).

Deep Learning

A DL algorithm could deduce the features of a car given enough examples of cars.

Machine Learning vs. Deep Learning

A key difference between Machine Learning and Deep Learning is how they learn. With ML, the input features of the CNN are determined by humans. This tuning is called Feature Extraction, and can be time consuming to attain the best results.

Deep Learning algorithms start with known good results and deduce each layer of the CNN along the way. The features can be learned by the model, which improves speed and accuracy since it's not dependent on human intervention. DL relies on good quality training data because a simple change, such as color, can confuse it without proper training.

Human specification of CNN features in a ML algorithm is Supervised Learning, which needs to be monitored by a human. A DL model that can set its own features based on known good results is said to be doing Unsupervised Learning.

Development Frameworks

The explosion of AI research and development has produced several frameworks for developing algorithms that will help get you started.

TensorFlow started in 2011 as an internal Google project named Google Brain. It was publicly released in 2017 as an open source deep learning neural network that can run across multiple CPUs and GPUs. It is used for training neural networks to detect and decipher patterns and correlations, analogous to human learning and reasoning.

tensorflow.org

Caffe was created by Berkeley Artificial Intelligence Research (BAIR) in 2014, and saw popularity in academic research. It is a deep learning framework using convolution nets.

bair.berkeley.edu
caffe.berkeleyvision.org

Caffe2 was released by Facebook in 2017 as a commercial successor to Caffe. It was created to address concerns around the scalability of Caffe, and to make it more light-weight. It allows for distributed computing, deployment, and quantized computations.

caffe2.ai

ONNX, or the Open Neural Network exchanged was just announced in September 2017 by Facebook and Microsoft. ONNX is an interchange format intended to make it possible to transfer deep learning models between the frameworks used to create them. This initiative should make it easier for developers to utilize multiple frameworks.
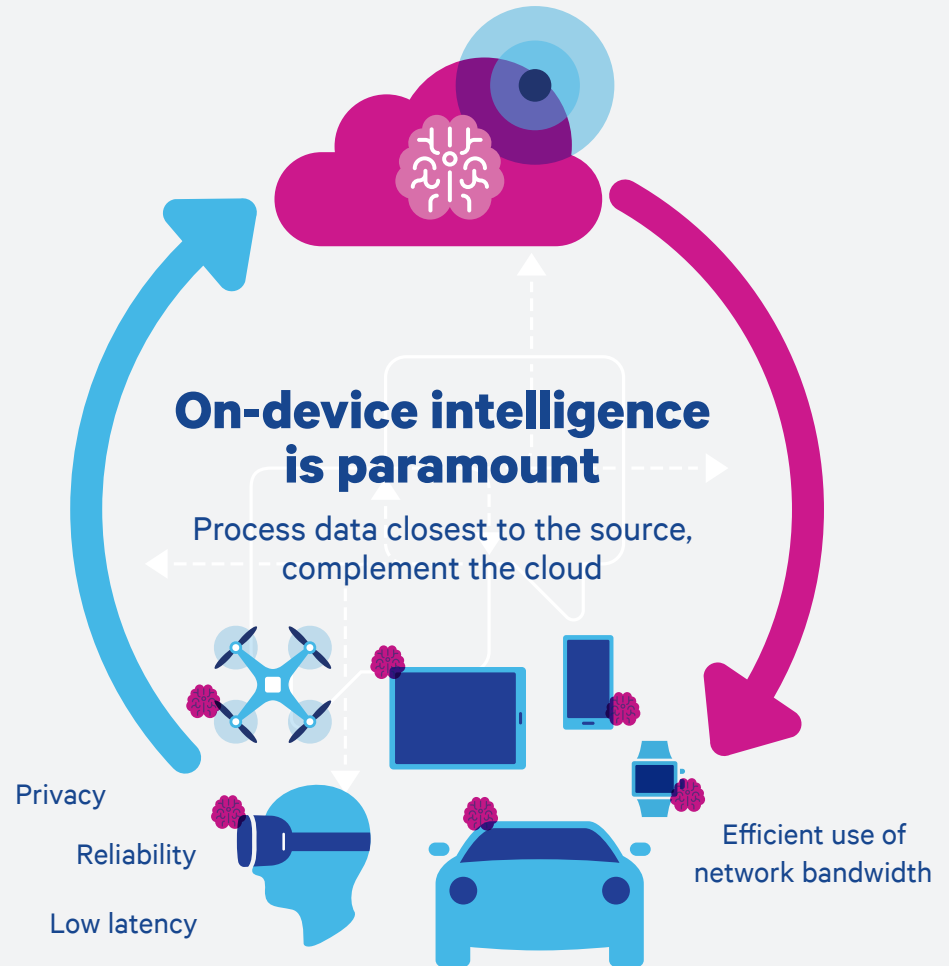
onnx.ai

Computing on the Edge

Traditionally, AI has required vast amounts of computing power from mainframes and cloud services. The increased computing power that has allowed for powerful algorithms has also seen the advances in processors allowing for **on-device AI** or **Computing on the Edge**.

This is revolutionizing the field of AI, as it allows for cloud free processing of mission critical data where real-time results and security are crucial. If your self-driving car loses its connection to the Internet, you want it to immediately be able to continue making decisions on its own.
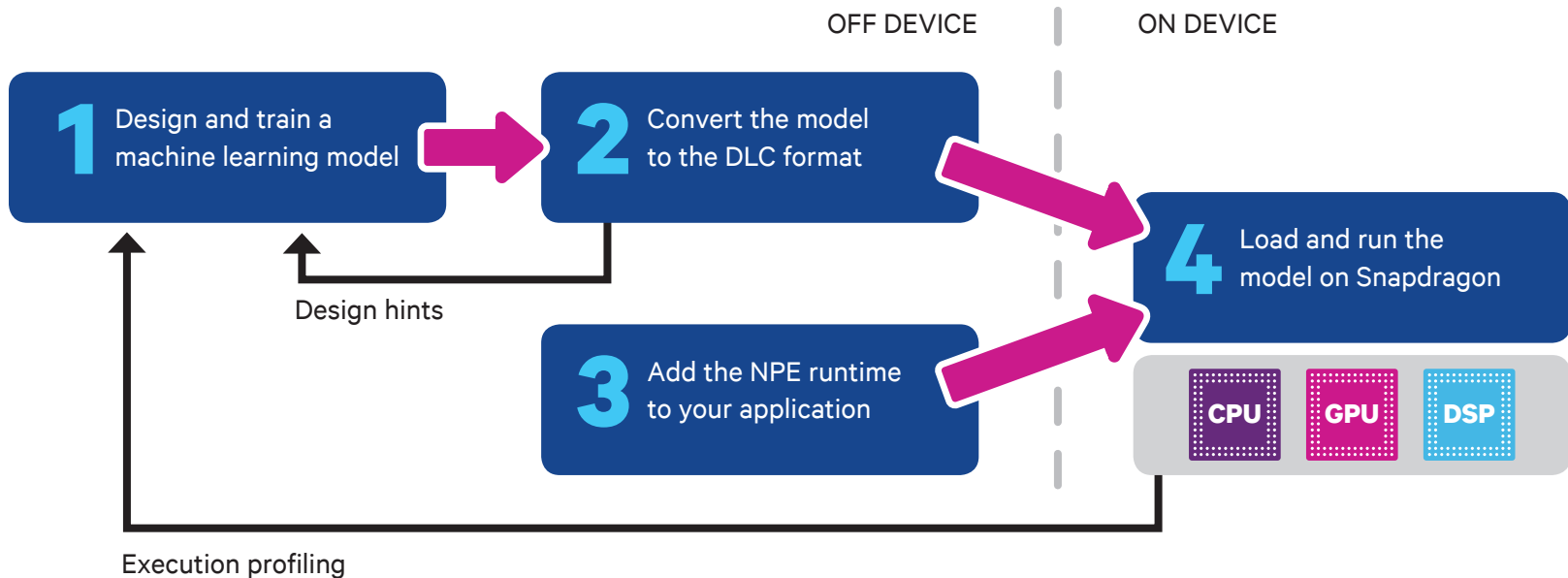
On-device AI also helps reduce latency of tasks and is designed to make efficient use of the network so that consumers can enjoy a much better experience.

On-device intelligence is paramount

Process data closest to the source, complement the cloud

Privacy

Reliability

Low latency

Efficient use of network bandwidth

The Qualcomm Technologies, Inc. (QTI) Advantage

Deep Learning algorithms are computationally intensive, so having a dedicated tool such as the **Qualcomm® Snapdragon™ Neural Processing Engine SDK (NPE SDK)** helps developers determine how best to run their applications on device, without a connection to the cloud. The NPE SDK supports TensorFlow/Caffe/Caffe2 frameworks, and allows for optimized execution on the Qualcomm® Snapdragon™ mobile platform CPU and acceleration on the GPU and DSP.

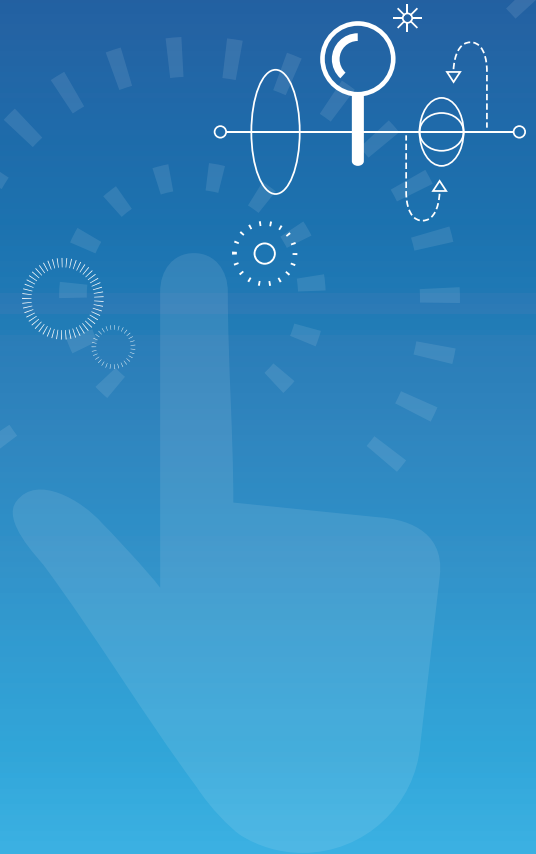## Workflow for Deep Learning Success

OFF DEVICE | ON DEVICE

1 Design and train a machine learning model

2 Convert the model to the DLC format

Design hints

3 Add the NPE runtime to your application

4 Load and run the model on Snapdragon

CPU GPU DSP

Execution profiling

Terminology Snapshot

	Artificial Intelligence (AI)	**Machine Learning (ML)**	**Deep Learning (DL)**
What It Is	The science of building algorithms to make intelligent, human-like decisions.	Algorithms that can predict an output based on a large set of previous examples.	A refined Machine Learning algorithm that is more accurate and requires less human supervision.
How It Works	A set of rules that determine how to behave when encountering unknown input data.	Large data sets, combined with human intervention, train a model to make predictions when seeing unknown inputs.	Neural networks are trained using known good data without human intervention to make predictions when seeing unknown inputs.
Example Application	• Photo is uploaded to a social network • Suggested tagging of photo based on facial recognition	• Identification of objects in pictures – cars, animals etc. • Product recommendations based on previous purchases.	• Self-driving cars. • Map route calculations. • Speech recognition.

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