MAX78000FTHR – A Platform for Innovation

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> “Just as electricity transformed almost everything 100 years ago, AI has advanced to the point where it has the power to transform every major industry.”
>
> Andrew Ng

Machines Can Learn…

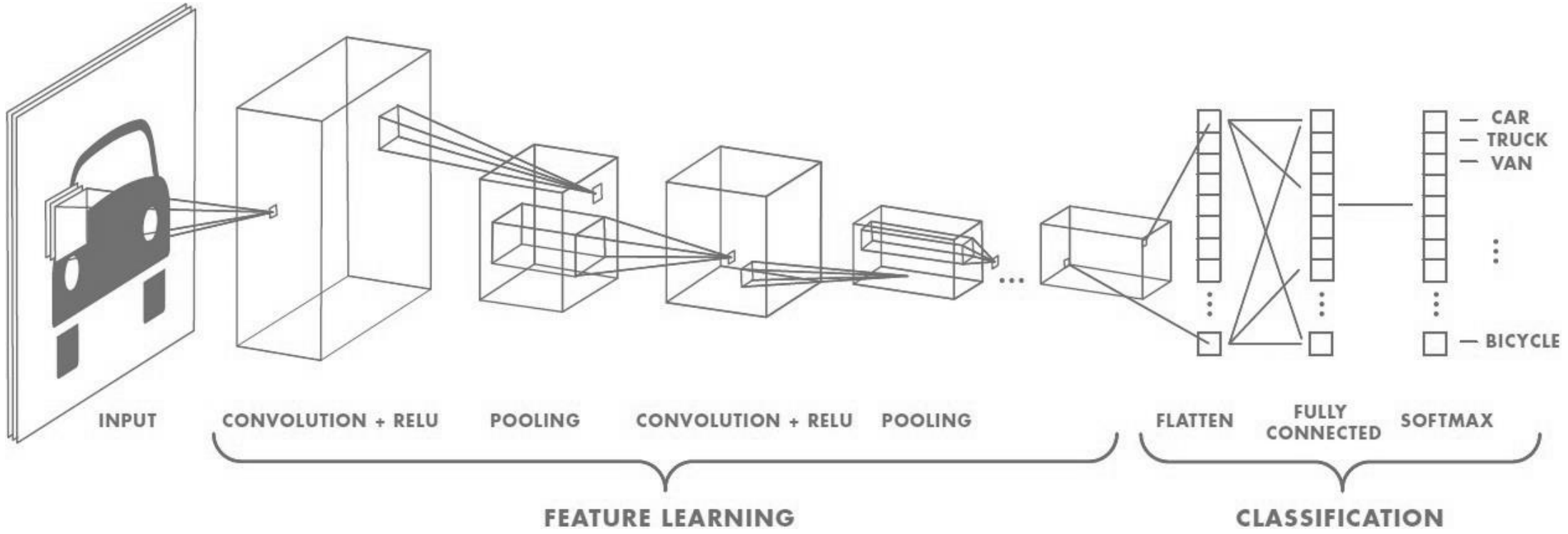
… to see

… and sense the world around them

… to hear

Convolutional Neural Networks are the Workhorse

…but are computationally expensive!



Millions/billions of multiplications!

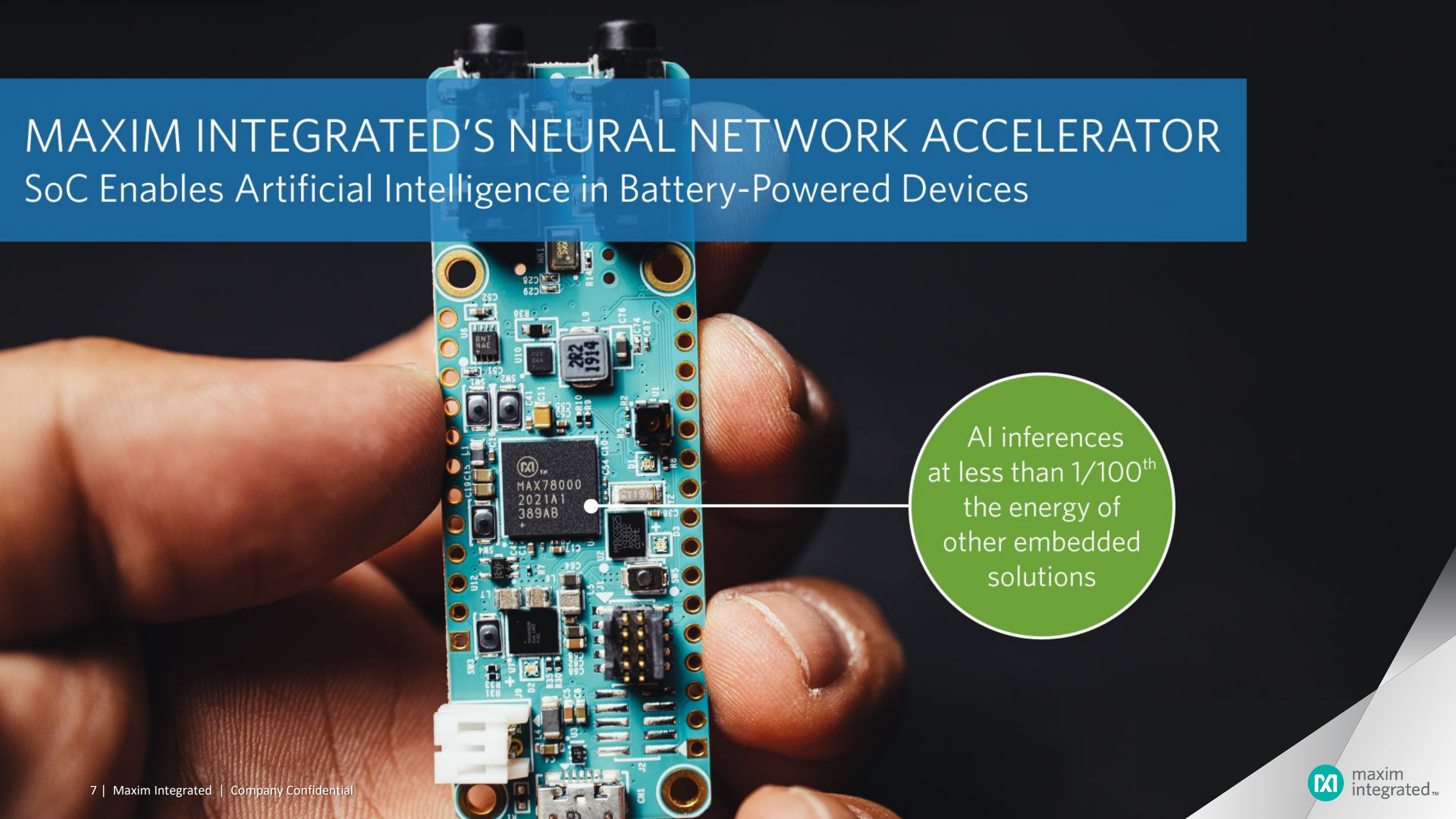
MAX78000's Neural Network Accelerator

- New, novel architecture designed to minimize data movement, maximize parallelism and optimize energy spend
- No μC involvement except to load and start
- No external memory required
- Highly optimized for Convolutional Neural Networks
- Flexible clock control to run fast at higher current or run slow at lower current

Making Inference Energy Practically Irrelevant

MAXIM INTEGRATED'S NEURAL NETWORK ACCELERATOR

SoC Enables Artificial Intelligence in Battery-Powered Devices



AI inferences at less than 1/100th the energy of other embedded solutions

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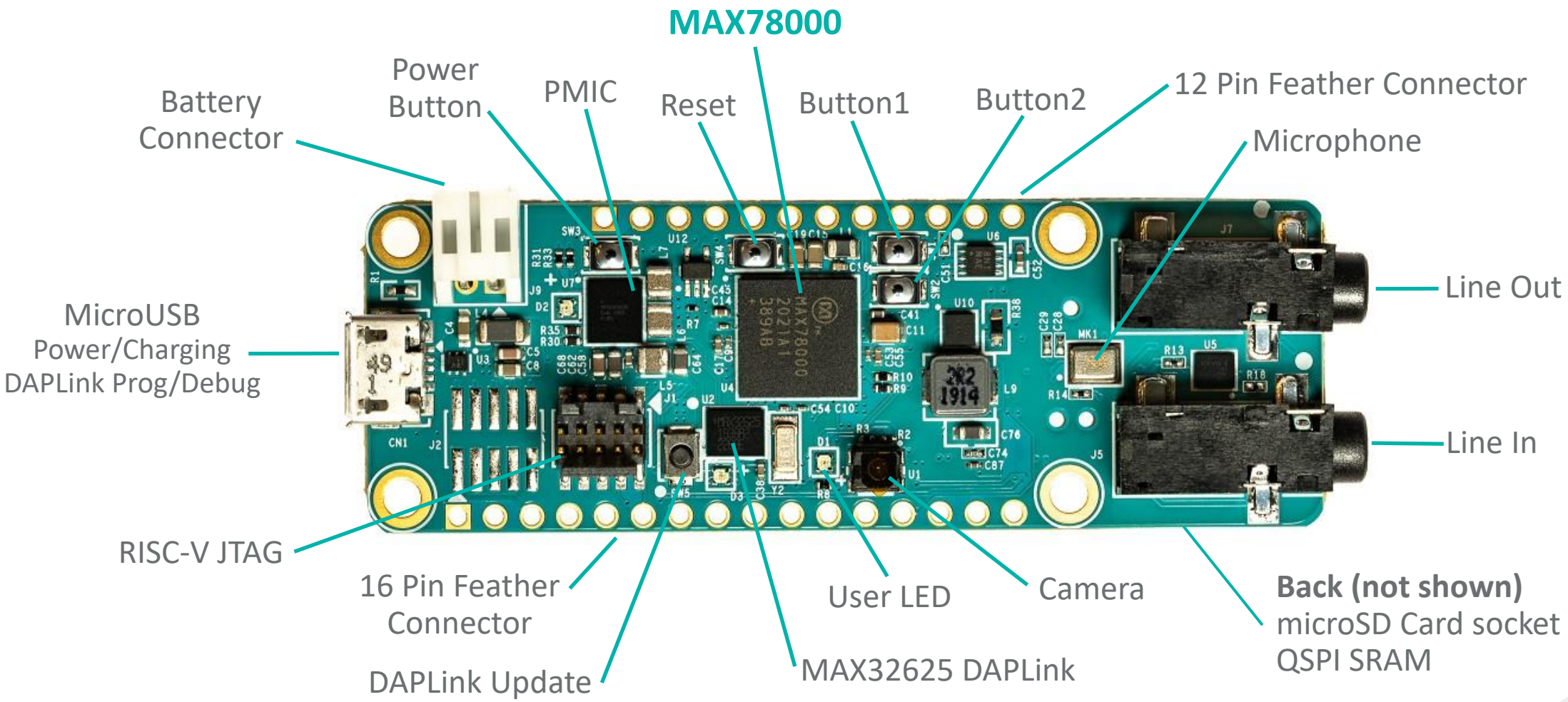
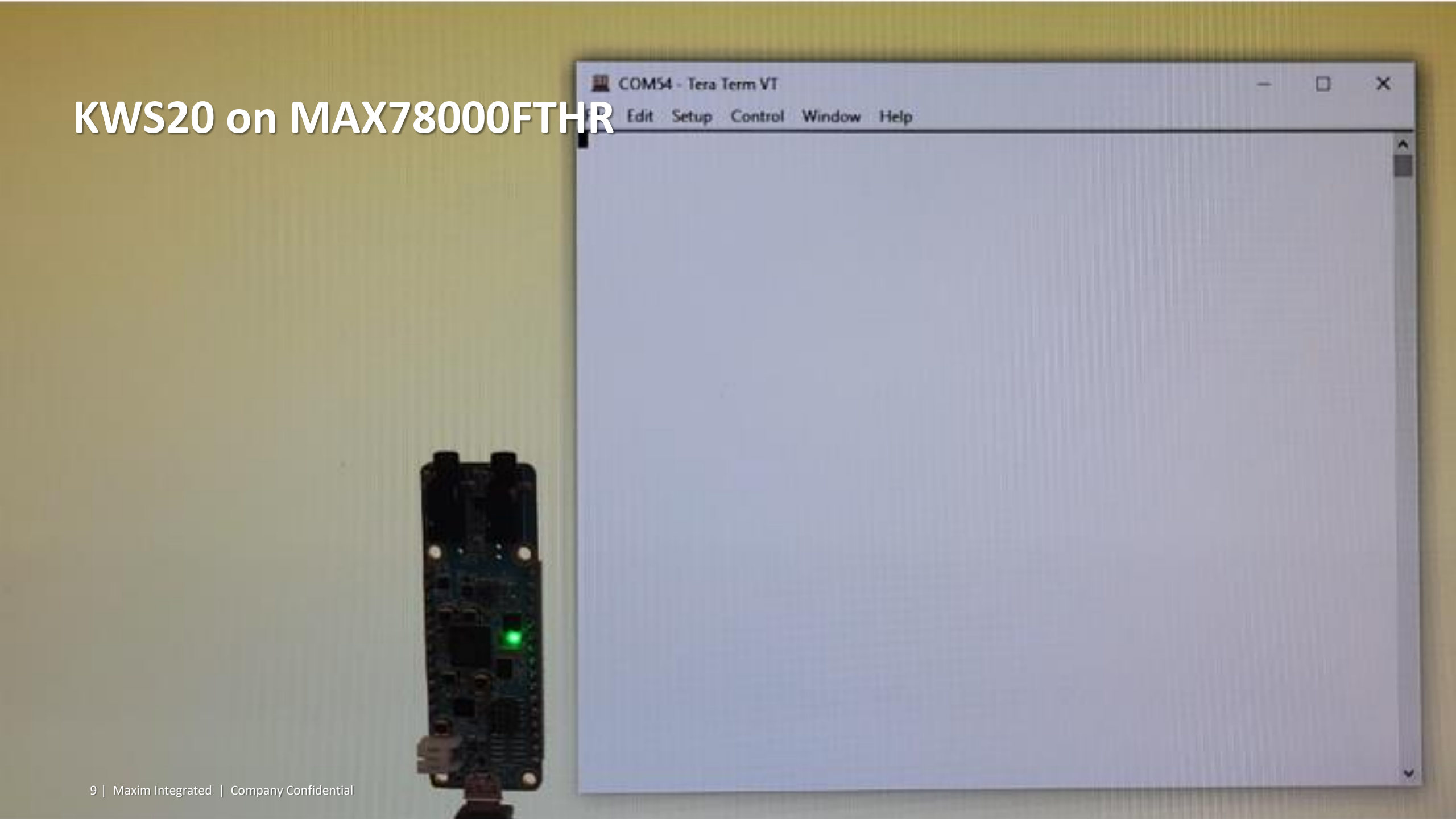
MAX78000FTHR# – 23mm × 66mm (0.9” × 2.6”)



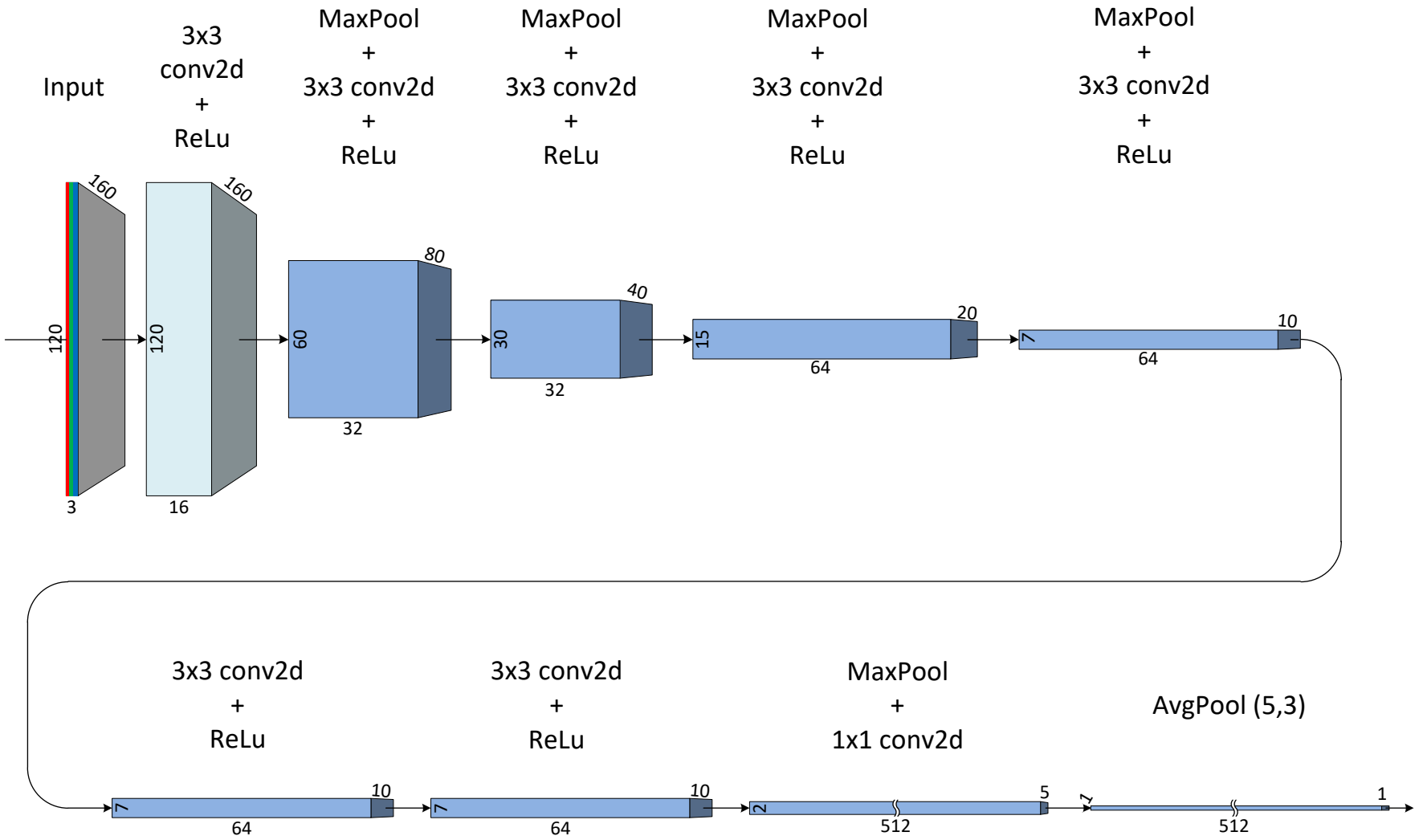
KWS20 on MAX78000FTHR



FaceID on MAX78000FTHR

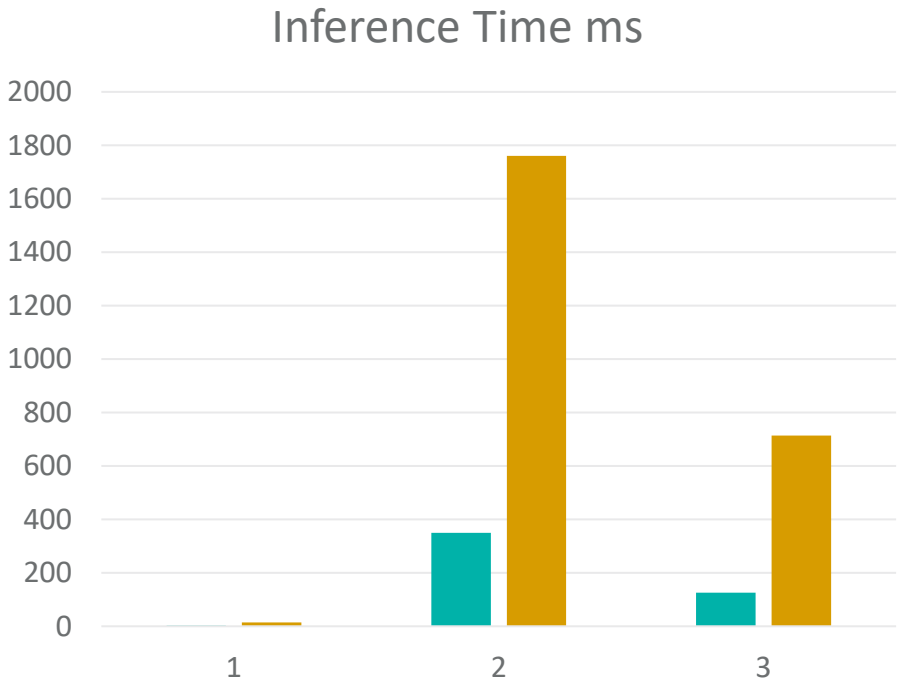
KWS20-v3 Model Diagram

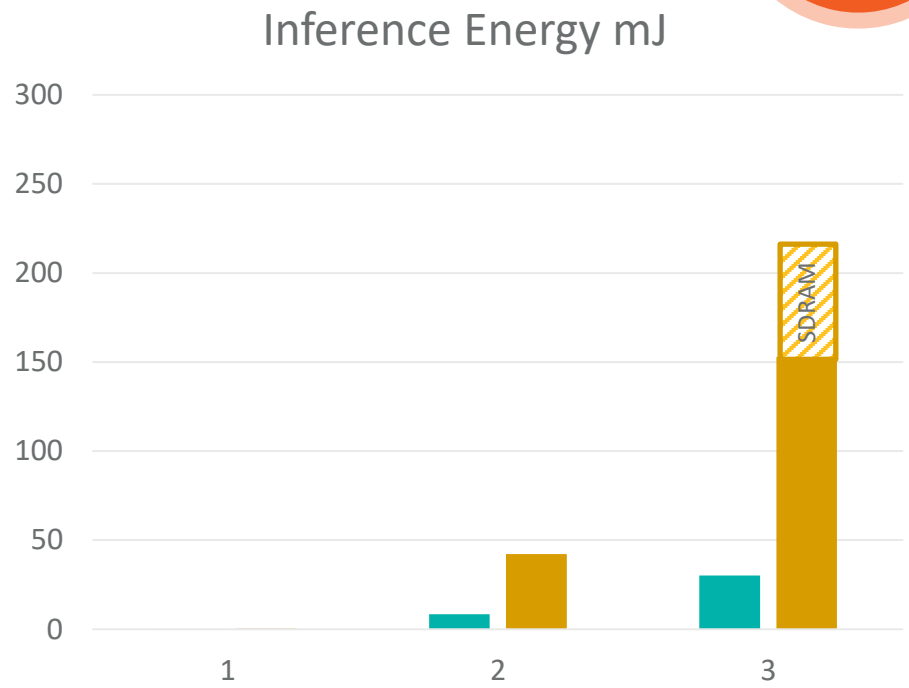
FaceID Model Diagram



MAX78000 Real Benchmarks

Application Note AN7417





Network	MACC	MAX78000 CNN at 50 MHz[1], 1.2V	MAX32650[2] Cortex-M4, 120 MHz, 1.2V	STM32F7[2] Cortex-M7, 216 MHz, 2.1V
KWS20	13,801,088	2.0ms, 0.14mJ	350ms, 8.37mJ	125ms, 30.1mJ[3]
FaceID	55,234,560	13.89ms[4], 0.40mJ	1760ms[5], 42.1mJ	714ms[5], 153mJ + 59mJ[6]

[1]28 billion operations/second, [2]ARM DSP with CMSIS-NN, running exact same INT8 network as MAX78000, [3]STMF722ZE, internal memory, [4]Includes time to load input, [5]Does not include time to load input, [6]STMF746NG + external 3.3V SDRAM IS42S32400F-6BL + SDRAM controller

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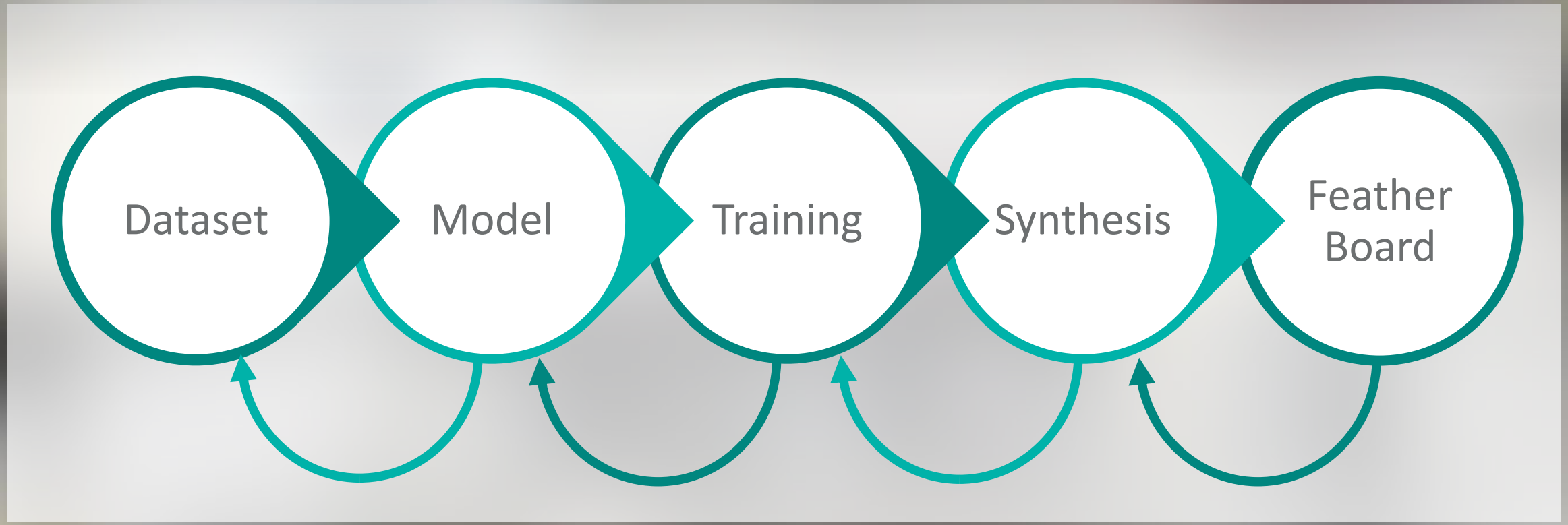
Development Flow



> “It’s not who has the best algorithm that wins.
> It’s who has the most data.”

Andrew Ng

Where to Get Enough Data

- Start with open-source datasets
- Use data augmentation to increase number of training samples
  - > Add rotation, contrast, saturation, hue, etc.
  - > Increase the number of corner case samples
- Synthesize data if possible
- Include data from the target system's camera, microphone and other sensor(s)
  - > Increases accuracy and robustness by training the model with noise and distortions it will "see" when deployed

kaggle

OpenML

AudioSet

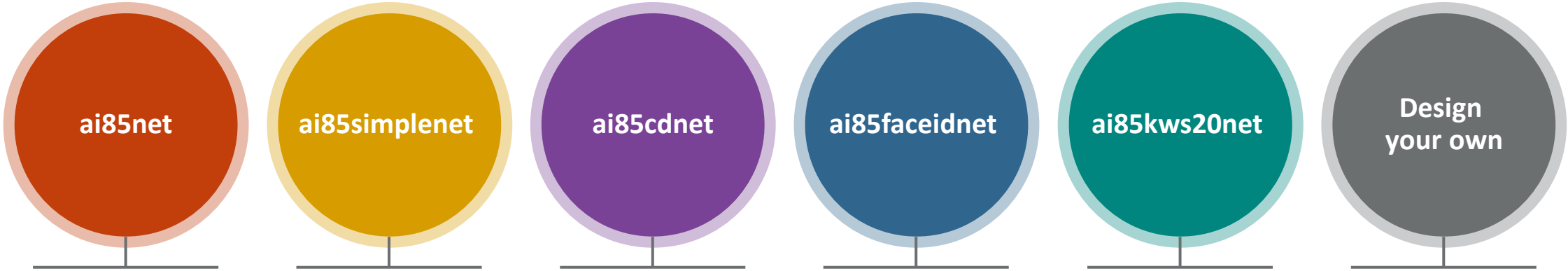
VisualData

IEEE DataPort™

KDnuggets™

Some dataset sources

Where to Get Models



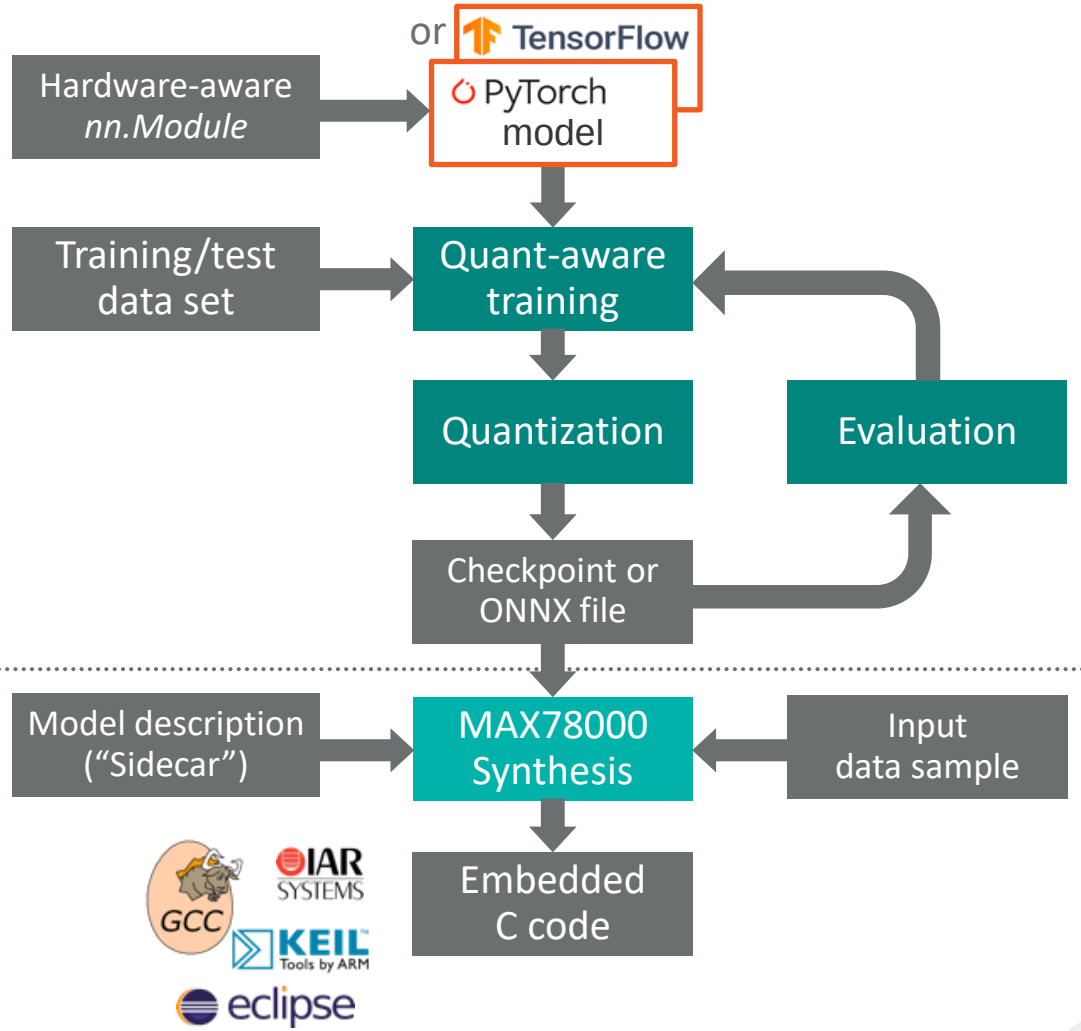
Find these models at Maxim Integrated on GitHub
https://github.com/MaximIntegratedAI

Development Flow

Machine learning training repo

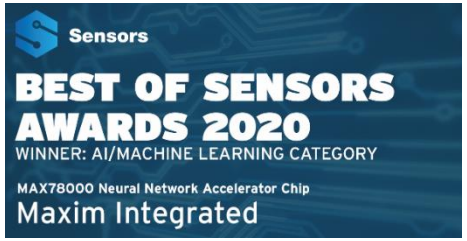
Find these repos at
Maxim Integrated on GitHub
https://github.com/MaximIntegratedAI

Embedded development SYNTHESIS repo



Available Resources

- Visit the Maxim Integrated website
  - > https://maximintegrated.com/MAX78000
  - > Datasheet
  - > App Notes
  - > EVKITs
- Maxim Integrated on GitHub
  - > https://github.com/MaximIntegratedAI
  - > Documentation and examples
  - > Software tools and SDK
  - > Training
  - > Synthesis



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Thank You!