# Generating Fast Operators for Binarizable Networks

Meghan Cowan

# Running Binarizable Networks?

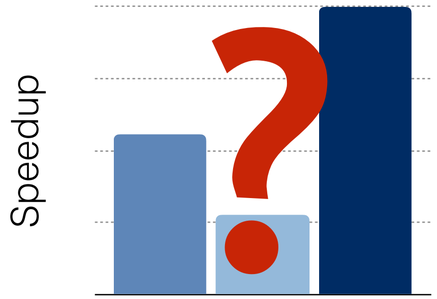
# Running Binarizable Networks?



Training in frameworks with no binarizable operators.

# Running Binarizable Networks?

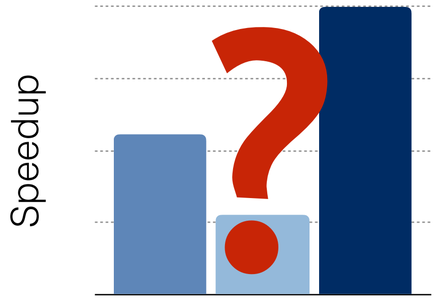

Training in frameworks with no binarizable operators.



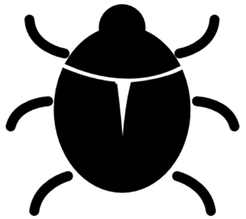

Can’t evaluate performance gains

# Running Binarizable Networks?


Training in frameworks with no binarizable operators.



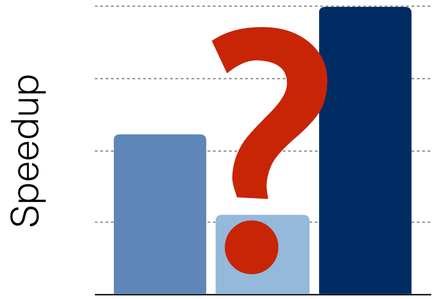

Can’t evaluate performance gains



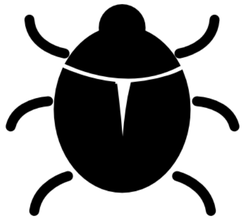
Easy to introduce bugs

# Running Binarizable Networks?


Training in frameworks with no binarizable operators.

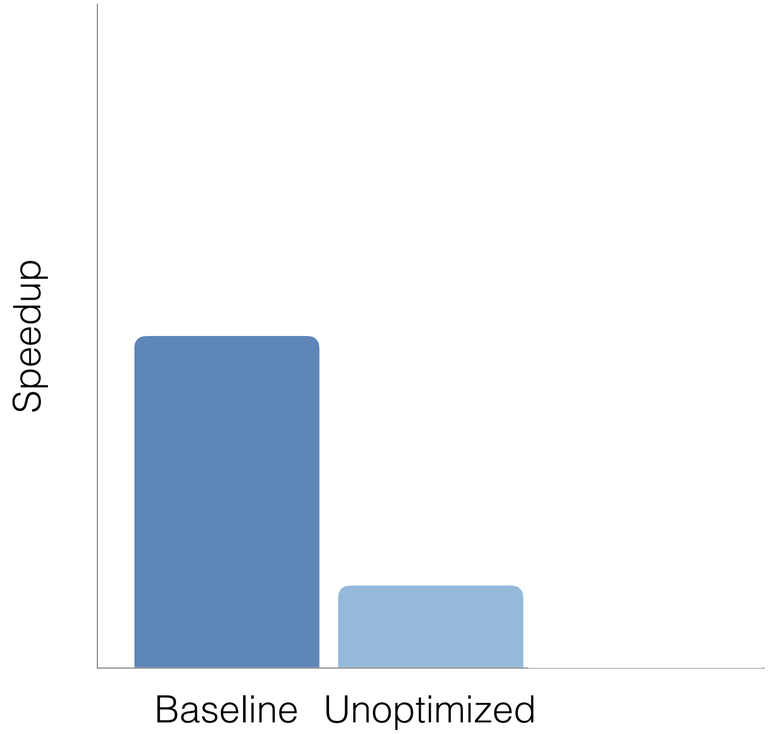



Can’t evaluate performance gains



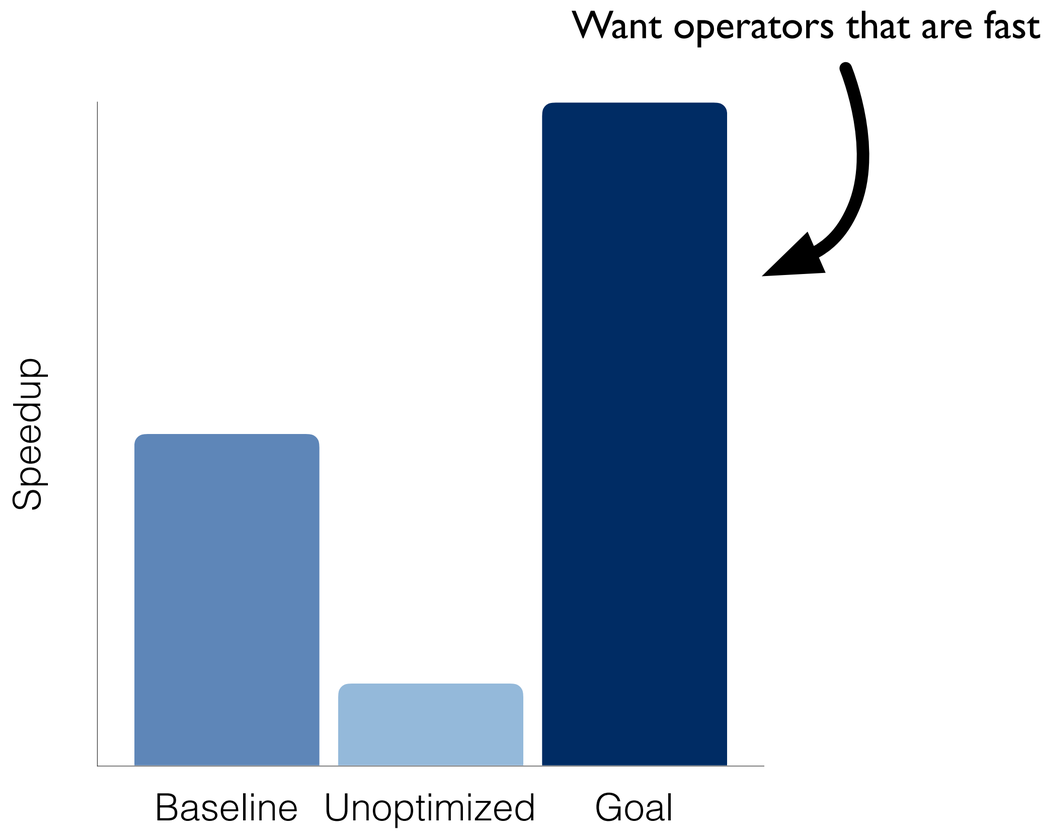
Easy to introduce bugs

**Need to generate binarizable operators ourselves!**



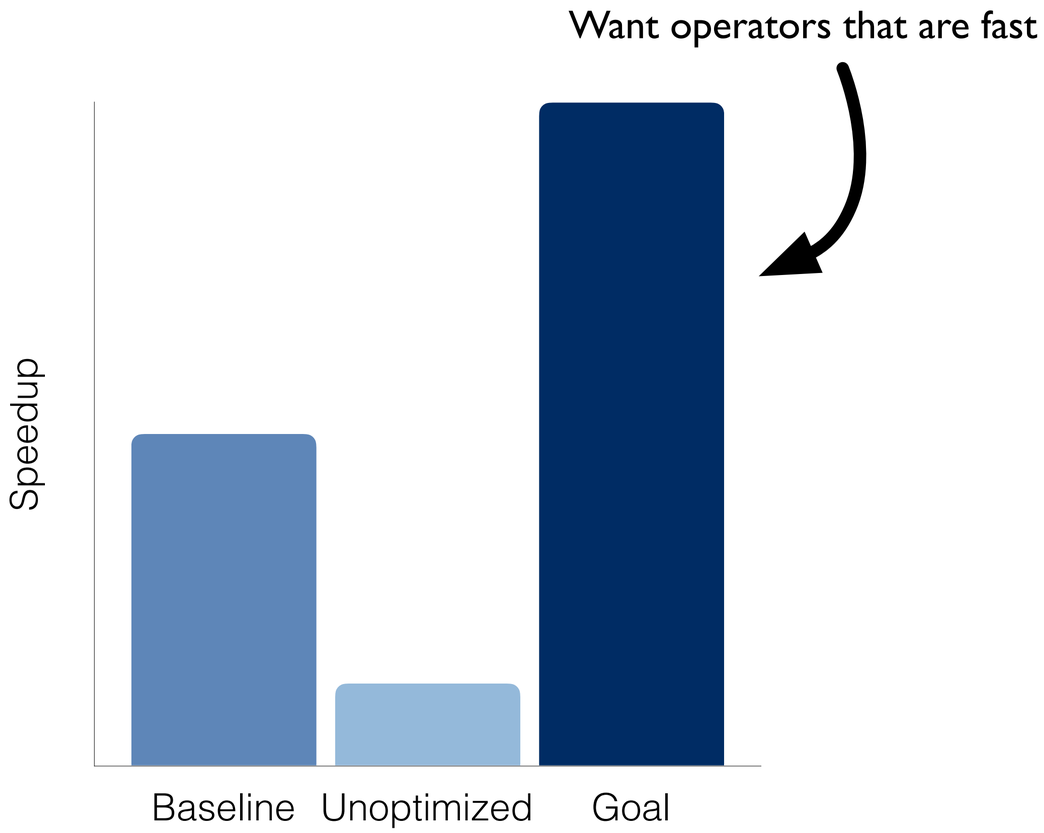

Baselines are incredibly well optimized

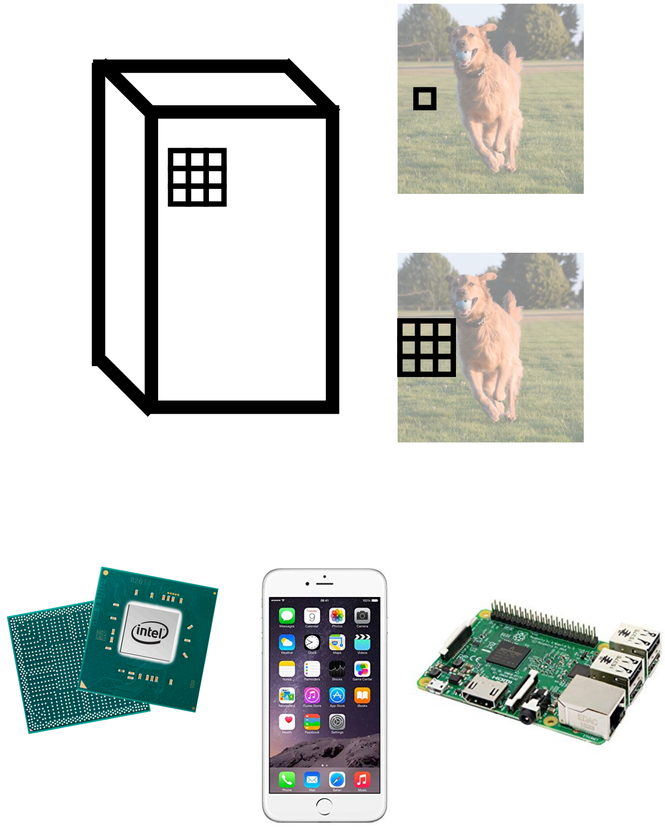
Without optimizations low precision can’t compete




Baselines are incredibly well optimized

Without optimizations low precision can’t compete



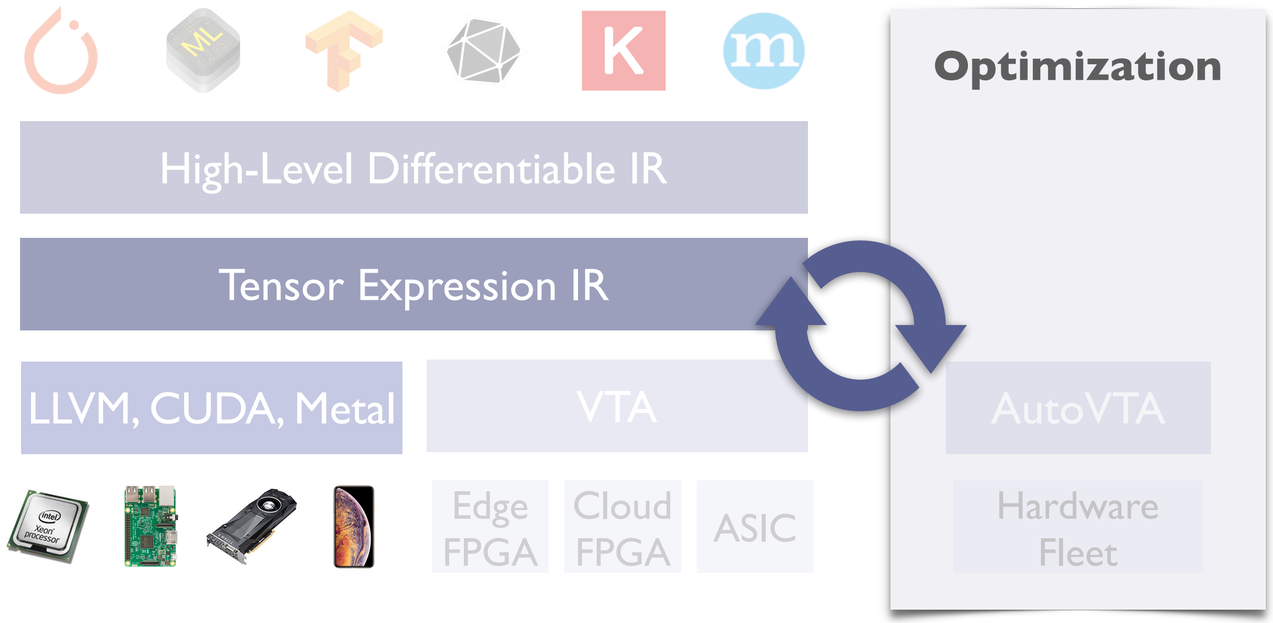



Baselines are incredibly well optimized

Without optimizations low precision can't compete

Need optimized operators for all workloads
Performance portability across different CPUs

# Generating Fast Operators for Binarizable Networks



# Generating Fast Operators for Binarizable Networks

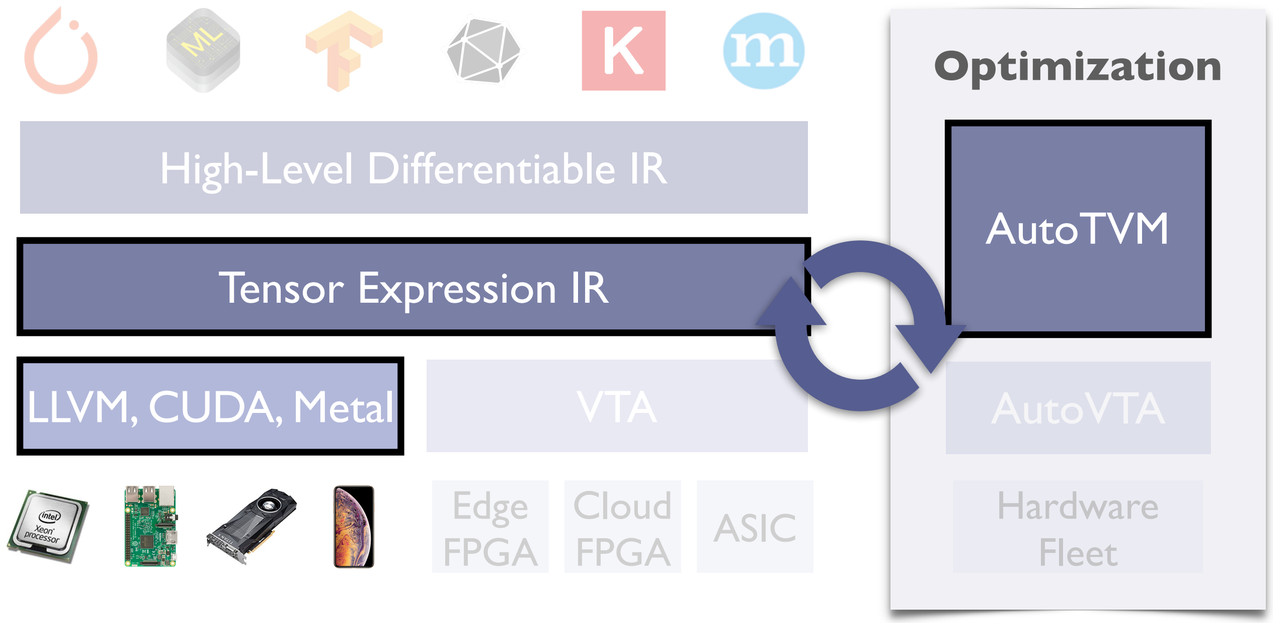

Declare bitserial computation and CPU schedule describing an optimization space

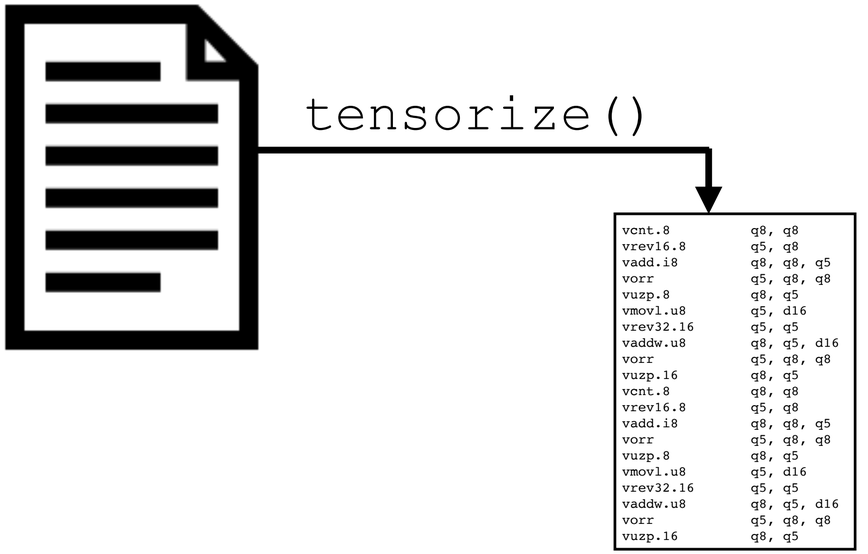
# Generating Fast Operators for Binarizable Networks


Declare bitserial computation and CPU schedule describing an optimization space

Use AutoTVM use to find schedule parameters for different operators and backends

# Generating Fast Operators for Binarizable Networks



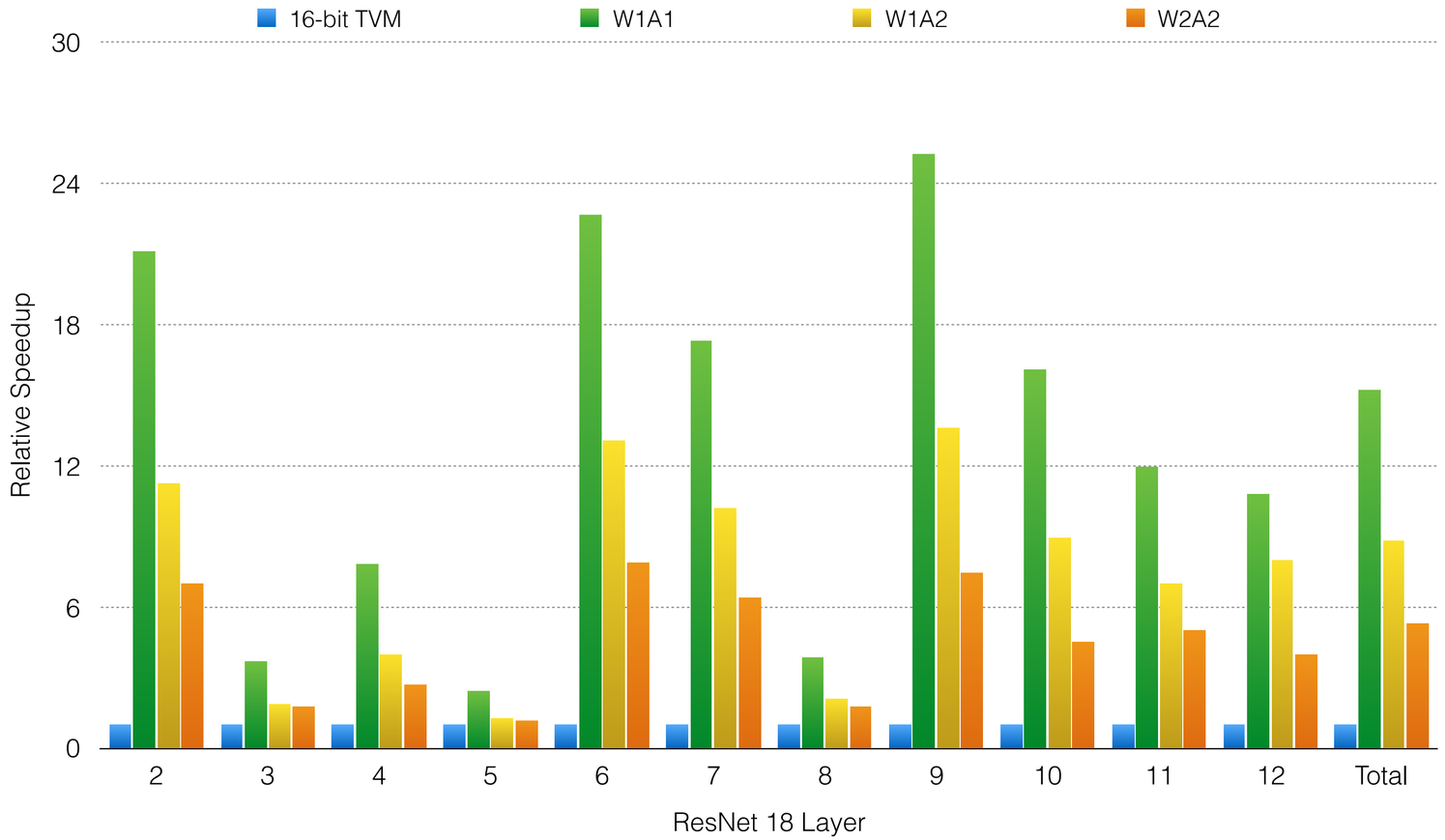

Declare bitserial computation and CPU schedule describing an optimization space

Use AutoTVM use to find schedule parameters for different operators and backends

Overrule LLVM code generation with custom microkernel

Use tensorize primitive to replace inner-most loop of computation

# Convolutions on Raspberry Pi




Can generate low precision convolutions
5.5x to 15.2x faster than optimized 16-bit integer