Type		Method	Key Tech.	Tricks			
				ST	OP	AQ	GA
Naive Binary Neural Networks		BinaryConnect [59]	FP: sign(x) BP: STE	-	A	-	-
		Bitwise Neural Networks [69]		-	-	-	-
		Binarized Neural Networks [57]		-	AM	-	-
Optimization Based Binary Neural Networks	Minimize the Quantization Error	Binary Weight Networks [57]	$J(\mathbf{b}, \alpha) =$ $\|x - \alpha\mathbf{b}\|^2$ $\alpha^*, \mathbf{b}^* =$ $\arg\min_{\alpha, \mathbf{b}} J(\mathbf{b}, \alpha)$	-	S	-	-
		XNOR-Net [58]		RB+RP	A	-	-
		DoReFa-Net [60]		-	A	-	-
		High-Order Residual Quantization [70]		-	A	-	-
		ABC-Net [71]		-	S	-	-
		Two-Step Quantization [72]		RB	-	-	-
		Binary Weight Networks via Hashing[73]		-	S	-	-
		PArameterized Clipping acTivation [74]		-	A	-	-
		LQ-Nets [61]		RB	-	-	-
		Wide Reduced-Precision Networks [75]		WD	A	-	-
		XNOR-Net++ [76]		-	A	-	-
		Learning Symmetric Quantization [77]		-	-	✓	-
		BBG [78]		SC	-	-	-
		Real-to-Bin [79]		SC	A	-	✓
	Improve Network Loss Function	Distilled Binary Neural Network [80]	$\mathcal{L}_{total}^b =$ $\mathcal{L}_{original}^b +$ $\lambda \mathcal{L}_{Customized}^b$	-	S	-	-
		Distillation and Quantization [81]		-	S	-	-
		Apprentice [82]		-	-	-	-
		Loss-Aware Binarization [83]		-	A	-	-
		Incremental Network Quantization [84]		-	S	✓	-
		BNN-DL [85]		-	R	-	✓
		CI-BCNN [86]		-	R	-	✓
		Main/Subsidiary Network [87]		RB	-	-	-
	Reduce the Gradient Error	Bi-Real Net [62]	Customized ApproxFunc (FP) or QuantFunc (BP) or UpdateFunc (BP)	SC	S	-	✓
		Circulant Binary Convolutional Networks[88]		SC	S	-	✓
		Half-wave Gaussian Quantization [89]		RB	S	-	✓
		BNN+ [90]		RB	A	-	✓
		Differentiable Soft Quantization [63]		-	A	-	✓
		BCGD [91]		-	-	-	✓
		ProxQuant [92]		-	A	-	✓
		Quantization Networks [93]		-	S	-	✓
		Self-Binarizing Networks [94]		-	A	-	✓
		Improved Training BNN [95]		-	A	-	✓
		IR-Net [96]		-	S	✓	✓