The proposed Local Binary Convolutional Neural Networks (LBCNN) aims at:

- **Statistical efficiency**
  1. Significant parameter savings: 9x to 169x in the number of learnable parameters.
  2. Less prone to overfitting, converges faster, can learn from much fewer training samples.

- **Computation efficiency**
  1. Significant model size savings: 9x to 169x.
  2. Significant computation savings: due to sparse binary convolutions.

- **On-par performance** with standard CNNs (ImageNet, CIFAR-10, MNIST, SVHN)

### The Inspiration

The LBCNN is inspired by the Local Binary Patterns (LBP) descriptor: the LBP is one of the most successful and widely used feature descriptor in computer vision, especially in face recognition. There are several tuning knobs that lead to different LBP configurations.

- **Base v**
- **Pivot**
- **Ordering of the encoding neighbors**

We will generalize these factors in a learnable framework for LBCNN.

### Generating LBCNN filters:

- Stochastically generated filter weights.
- Sparse binary weights \{-1, 0, 1\}.
- Efficient convolutions by +/- operations.

### Theoretical analysis

We have shown theoretically that the proposed LBCNN layer is a good approximation of the standard CNN layer.

### The Experiments

1. **Experiments (small scale):** CIFAR-10, MNIST, SVHN
   - LBCNN ResNet, CNN ResNet (baseline)
   - We have experimented with an 8848-layer LBCNN (NetEverest), trainable on a single nVidia Titan X GPU.

2. **Experiments (statistical efficiency):**
   - Prevents over-fitting. Due to much smaller model complexity.
   - Converges faster. Experiments on the FRGC face recognition dataset, and LBCNN converges faster than CNN (R3:10, 50, and 100 class).

3. **Experiments (large scale):** ImageNet
   - Architecture: AlexNet.
   - Follow the LR schedule of the CNN (could be improved).
   - LBCNN saves 6.622x learnable parameters.