What is Res Net?

ResNet (Residual Network) is a deep learning architecture introduced by Kaiming He et al. in 2015 through the paper “Deep Residual Learning for Image Recognition”.

- Allows training of very deep neural networks (up to hundreds of layers).
- Solves the vanishing gradient problem using skip (residual) connections.
- Won 1st place in the ImageNet 2015 classification task.

Working of Res Net

🧱 1. **The Residual Block**

At the heart of ResNet is the Residual Block — a clever structure that allows the model to learn residual functions rather than direct mappings.

🔁 *Standard vs Residual Learning*

- Without ResNet:
- The network tries to learn output H(x) directly.
- With ResNet:
- The network learns a residual F(x) = H(x) - x, and then computes:
- Output=F(x)+x\text{Output} = F(x) + xOutput=F(x)+x

This "shortcut connection" helps avoid vanishing gradients in deep networks.

🔄 2. **Skip/Shortcut Connection**

- The input x is added directly to the output of the convolution layers.
- No extra parameters are introduced.
- Helps preserve information from earlier layers.

🔢 3. **Deep Stacking of Blocks**

- Residual blocks are stacked together to form deep networks like ResNet-50, ResNet-101, etc.
- Each block learns incremental improvements over the previous representation.

🧠 4. **Feature Extraction + Classification**

- Early layers learn edges, shapes.
- Deeper layers learn object parts and class-specific features.
- Final output goes to a fully connected layer with Softmax for classification.

✅ **Benefits of This Workflow**

- Stable training of very deep networks (up to 100+ layers)
- Faster convergence
- Better generalization performance
- No degradation problem (accuracy doesn't drop with depth)

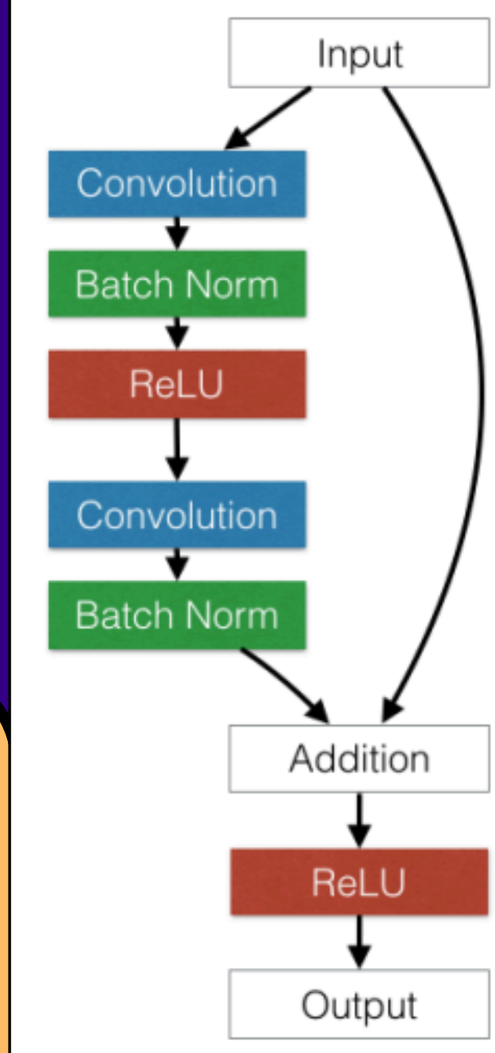

Figure 1. A RestNet basic block

Applications

Medical Imaging
- Detects diseases in X-rays, MRIs, CT scans (e.g., pneumonia, tumors)
- Classifies skin lesions (e.g., melanoma vs benign)

Plant Disease Detection
- Identifies crop diseases from leaf images
- Used in precision agriculture for early diagnosis

Facial Recognition
- Face ID and biometric verification
- Surveillance and identity verification systems

Applications

Autonomous Vehicles
- Classifies traffic signs and road objects
- Helps in pedestrian and vehicle detection

Wildlife Monitoring
- Classifies animal species from camera trap images
- Used in biodiversity and conservation projects

Art & Heritage Analysis
- Classifies art styles and periods
- Assists in artwork restoration and forgery detection

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