



# **Image Classification using CNN and Transfer Learning**

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# Problem & Dataset

Introduction to the dataset and  
strategies

# Introduction

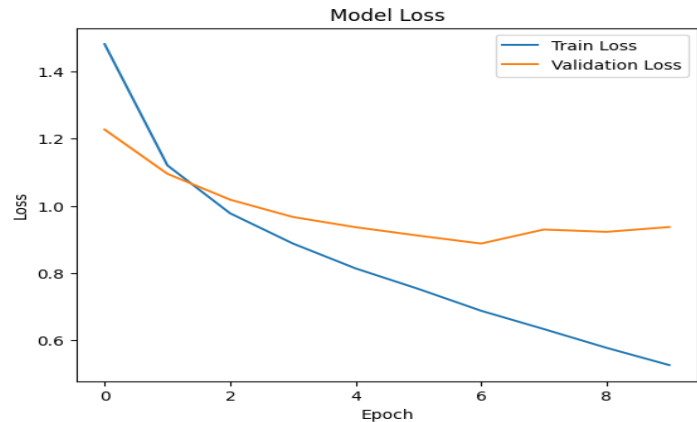
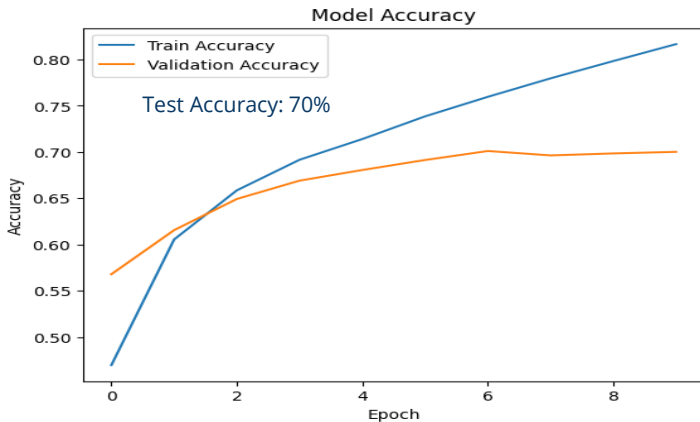
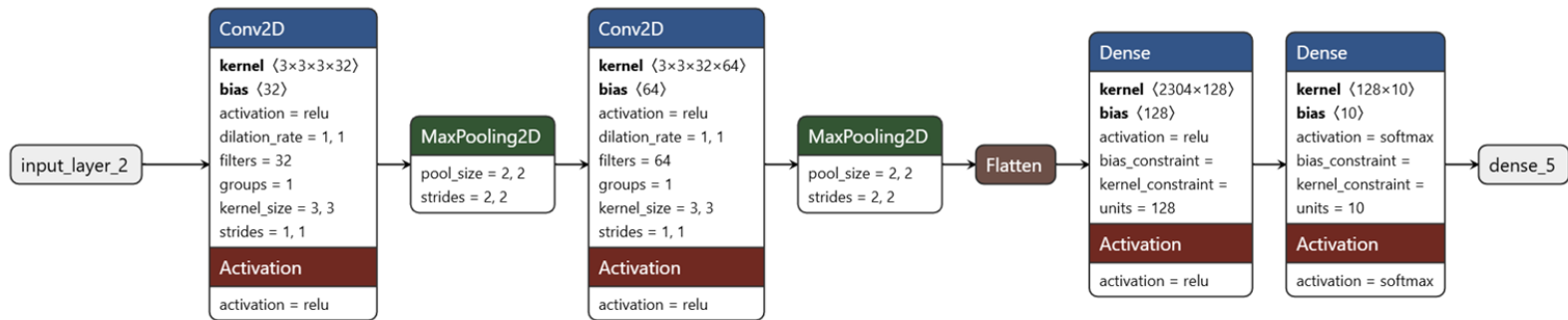
- Dataset - CIFAR-10
- Classes - 10 (airplane, car, bird, etc)
- Train/Test - 50000 / 10000
- Samples per class: Balanced (5000 per class)
- Image Size - 32 X 32 X 3

**\*\* Small images, high noise – perfect for testing CNNs\*\***



# Baseline CNN Architecture

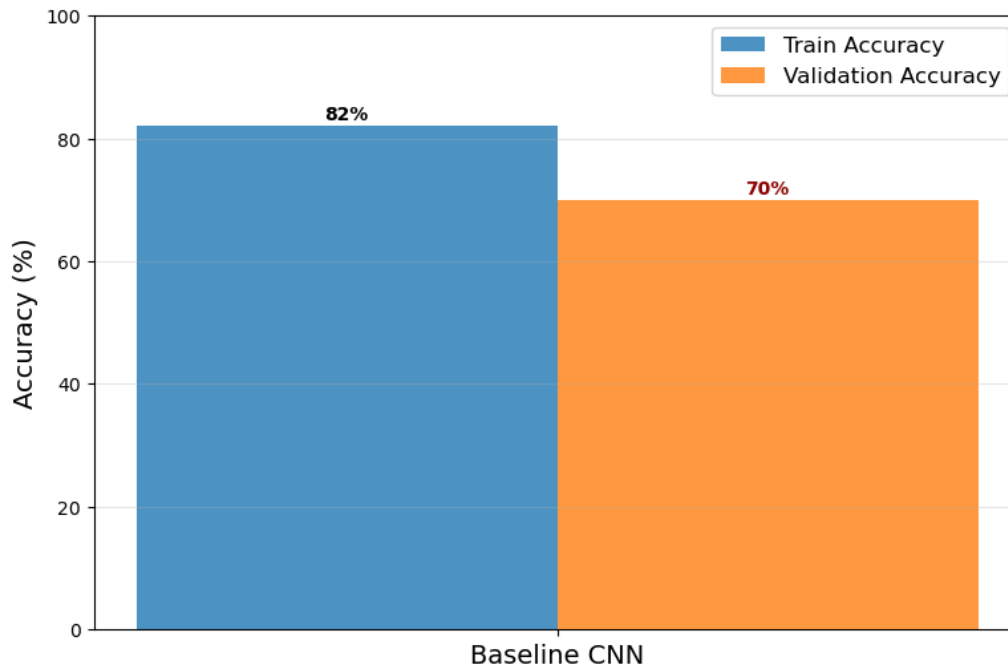
# Baseline CNN: Simple but Limited



Simple 2-block CNN achieves 82% training accuracy but only 70% validation → 12% overfitting gap → Need better regularization & architecture

# Why We Need Better Models

**Baseline CNN: 12% Generalization Gap**



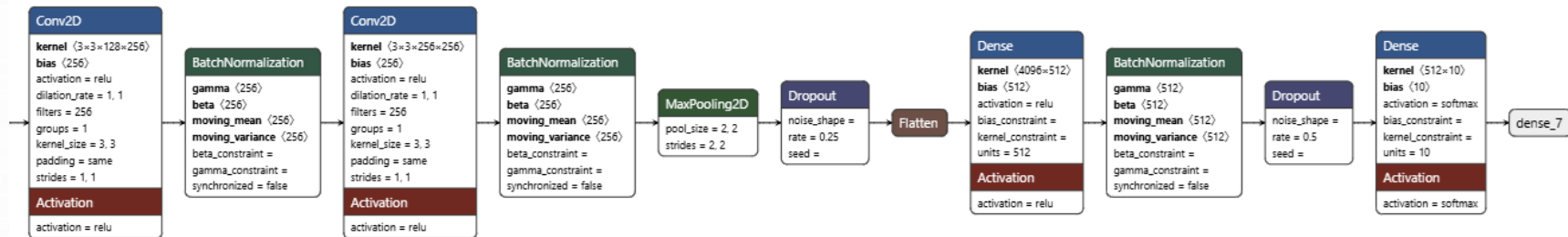
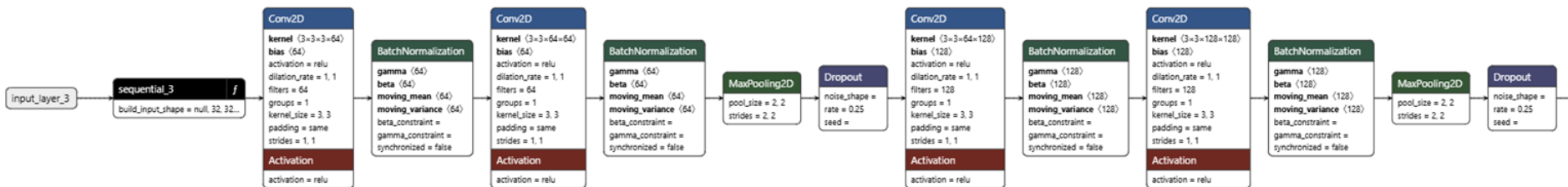
Clear overfitting → motivates move to optimized CNN & transfer learning



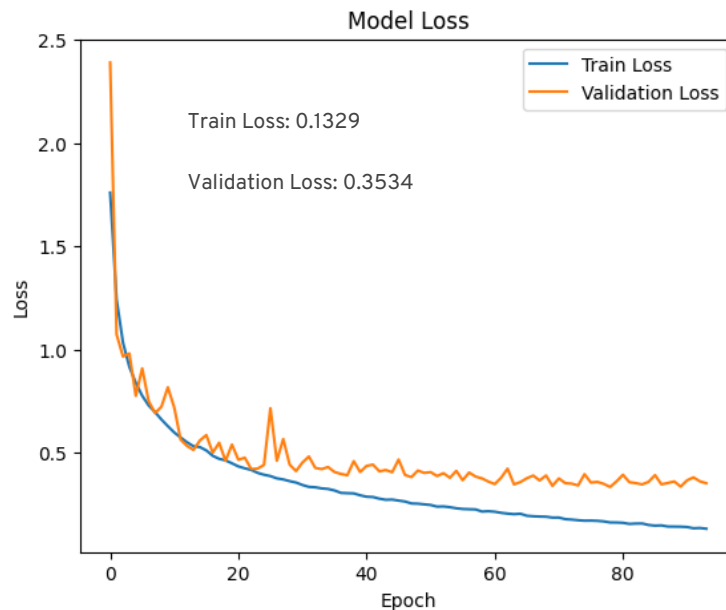
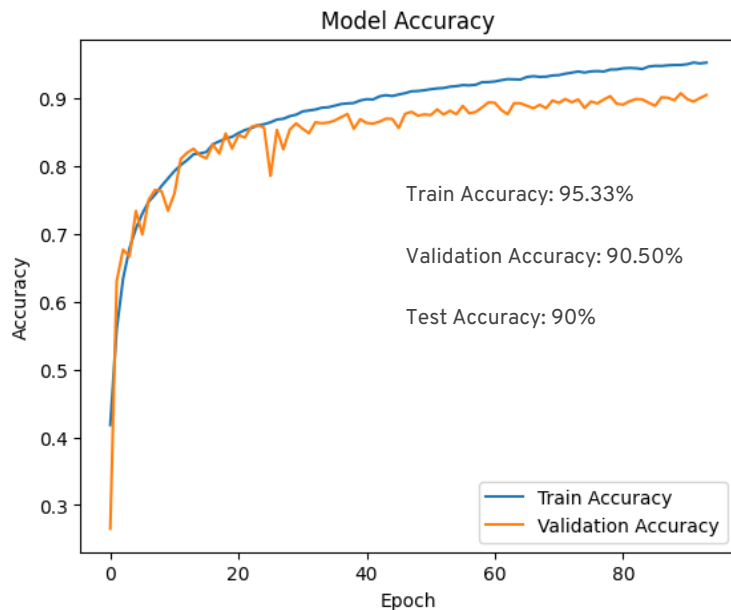
# **Optimized CNN Architecture**



# Optimized CNN: Deeper Architecture



# Optimized CNN: Deeper Architecture

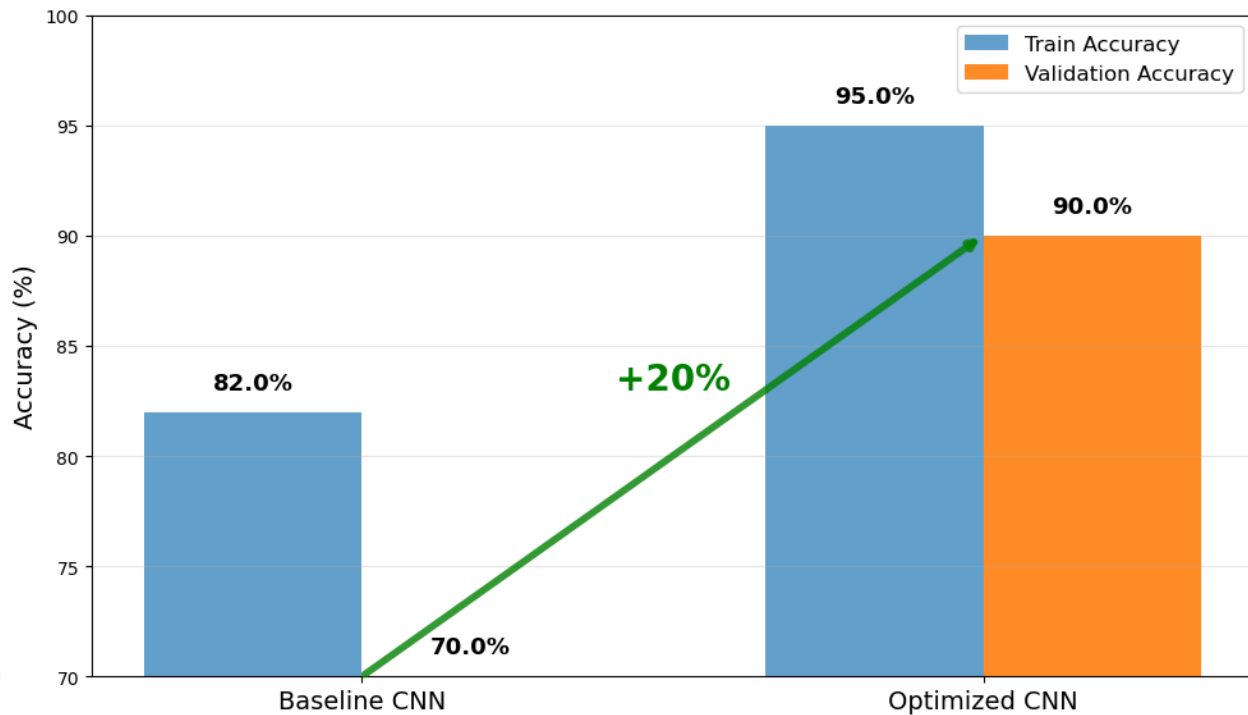


From 2 conv blocks → 6 conv blocks with BatchNorm, Dropout(0.25), Data Augmentation & LR scheduling

→ Validation accuracy: 70.0% → 90% (+20% absolute gain)

# Optimized CNN vs Baseline: +20% Validation Accuracy

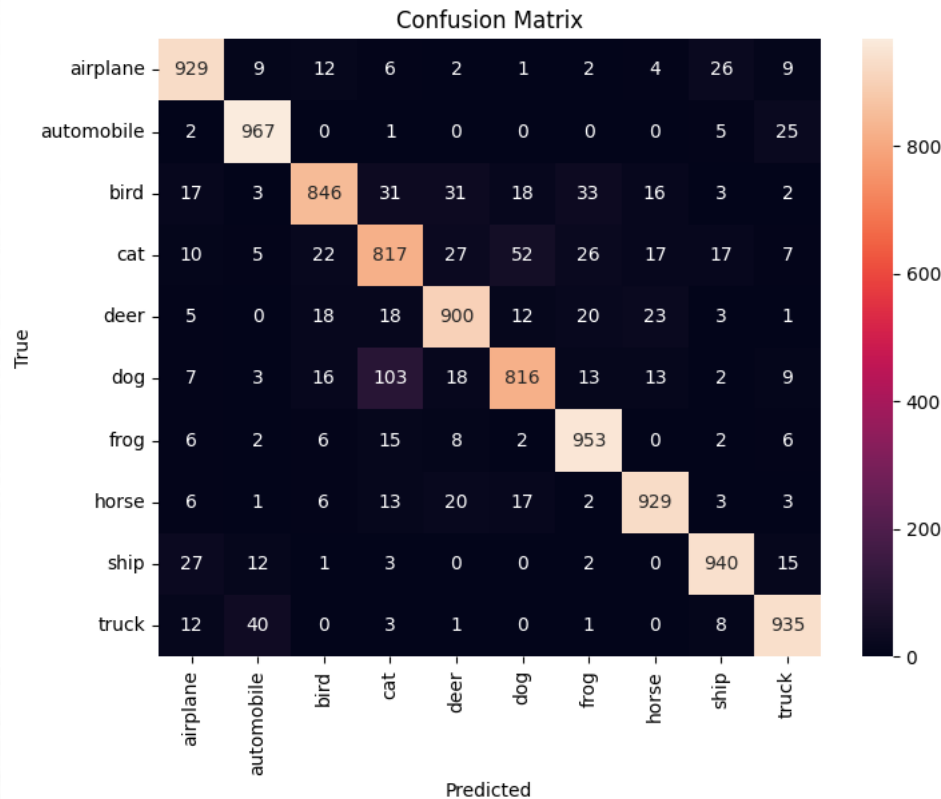
**Optimized CNN: +20% Validation Accuracy  
(Overfitting Fixed)**



# Optimized CNN Confusion Matrix

precision recall f1-score support

airplane	0.91	0.93	0.92	1000
automobile	0.93	0.97	0.95	1000
bird	0.91	0.85	0.88	1000
cat	0.81	0.82	0.81	1000
deer	0.89	0.90	0.90	1000
dog	0.89	0.82	0.85	1000
frog	0.91	0.95	0.93	1000
horse	0.93	0.93	0.93	1000
ship	0.93	0.94	0.94	1000
truck	0.92	0.94	0.93	1000
accuracy			0.90	10000
macro avg	0.90	0.90	0.90	10000
weighted avg	0.90	0.90	0.90	10000



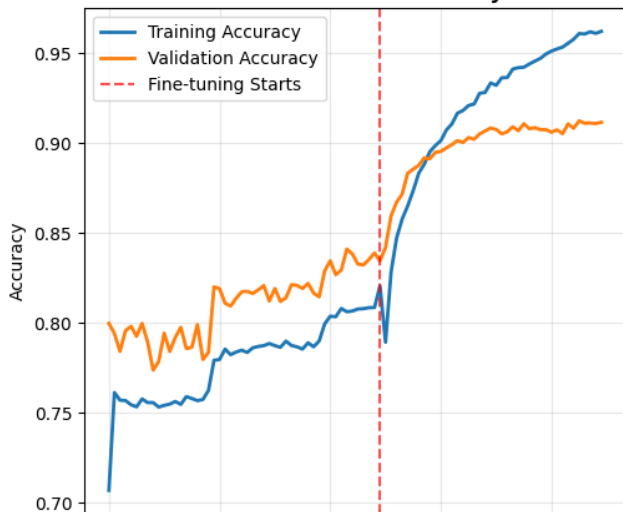


# Transfer Learning

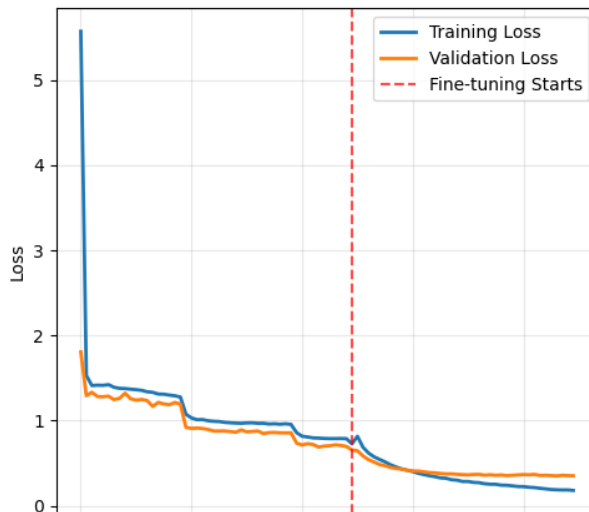
# Transfer Learning: Two-Phase Fine-Tuning

- Used EfficientNetB0 with partial layer unfreezing.
- Two-phase training with lower LR in fine-tuning.
- Achieved ~96% accuracy, ~93% validation accuracy.
- Fine-tuning improved feature learning and performance.

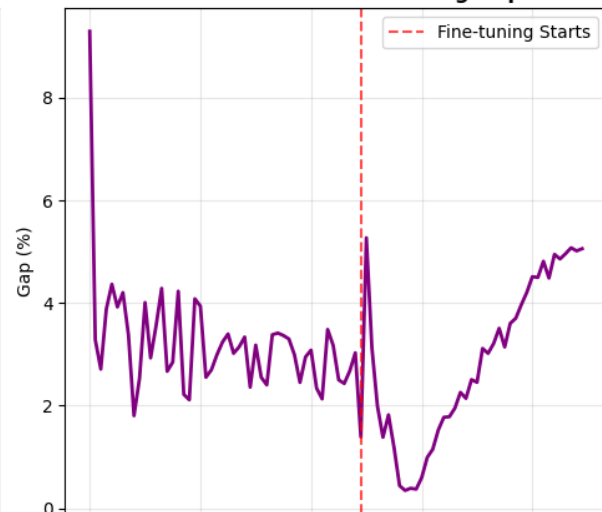
EfficientNetB0 - Accuracy



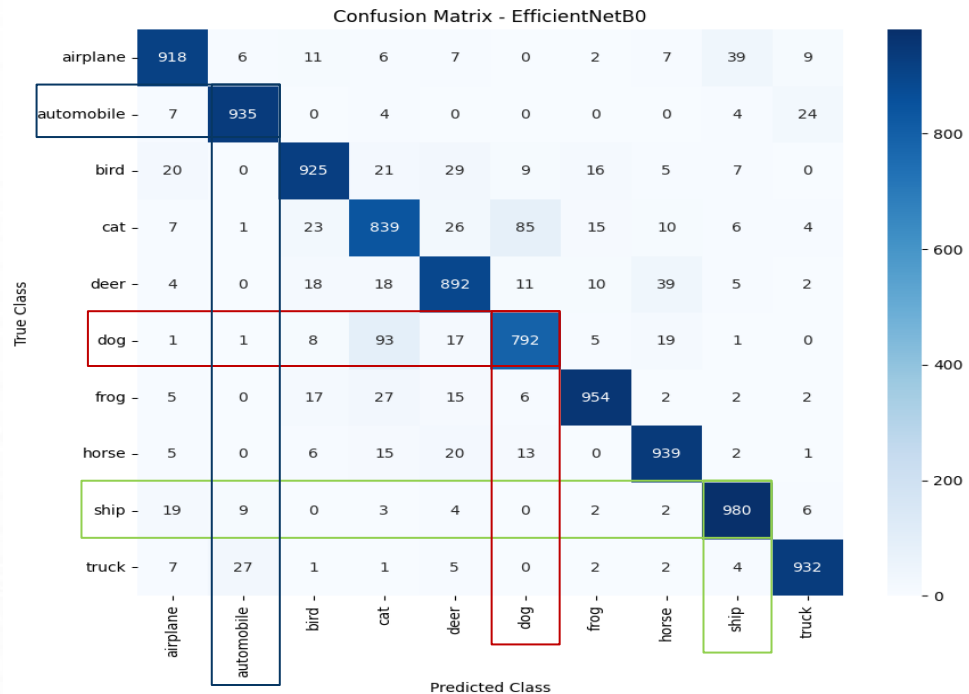
EfficientNetB0 - Loss



EfficientNetB0 - Overfitting Gap



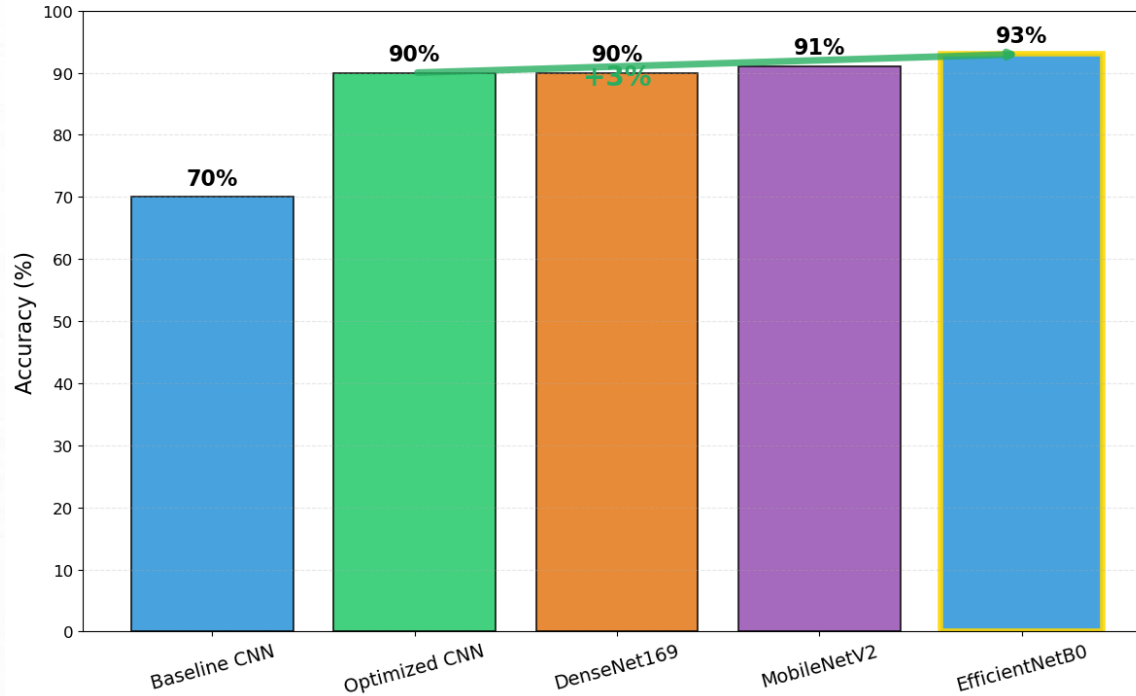
# Transfer Learning: Confusion Matrix



- 918 airplanes correctly identified as airplanes
- 935 automobiles correctly identified as automobiles
- 980 ships correctly identified as ships (highest accuracy - marked in green)
- 792 dogs correctly identified as dogs (lowest accuracy - marked in red)

# Model comparison & conclusion

Model Comparison: test Accuracy





# Challenges & Limitations

- Overfitting on small datasets
- Low accuracy, weak features
- Training instability issues
- Data hungry, needs large datasets
- High computational cost
- Limited generalization across domains

The background features a light cream color with large, soft watercolor splashes in shades of light blue and pale green. Scattered throughout are numerous small, dark blue dots. On the left and right sides, there are faint, hand-drawn teal outlines of abstract shapes, possibly representing leaves or petals.

**Thank you!**