

CAM-family Methods: Evolution of Class Activation Mapping

Evolution: CAM → Grad-CAM → Grad-CAM++ → Score-CAM → Layer-CAM



CAM

2016

Global average pooling
required



Grad-CAM

2017

Any CNN architecture



Grad-CAM++

2018

Better localization



Score-CAM

2020

Gradient-free



Layer-CAM

2021

Layer-wise mapping

Key Methods



CAM

Global average pooling + linear layer weights

$$L_{CAM} = \sum w_k \cdot A_k$$



Grad-CAM

Gradient-weighted class activation

$$L = \text{ReLU}(\sum \alpha_k \cdot A_k), \quad \alpha_k = 1/Z \sum_i \sum_j \frac{\partial y^c}{\partial A_k^{ij}}$$



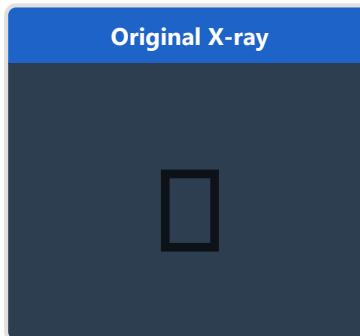
Score-CAM

Ablation-based, no gradients needed

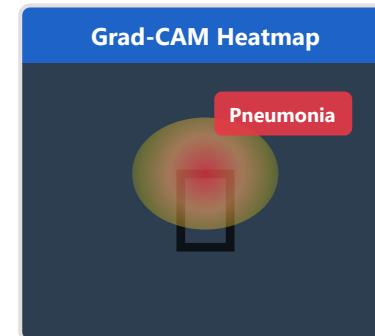
$$L = \text{ReLU}(\sum w_k \cdot A_k), \quad w_k \text{ from forward pass}$$

Application: Medical X-ray

Original X-ray



Grad-CAM Heatmap



Key Applications

- **Medical Imaging:** Pathology localization
- **Object Detection:** Region proposals
- **Segmentation:** Boundary refinement
- **Quality Control:** Defect detection

Best for: CNNs, visual tasks

Advantage: **Fast** computation

Limitation: CNN-specific