# Audio: Lung Sounds Analysis

**Classify respiratory diseases such as pneumonia, asthma, and COPD using CNN after converting auscultation sounds to spectrograms**

## Types of Lung Sounds

Major auscultation sound patterns

- Normal lung sounds: Vesicular sounds
- Wheezes: Airway constriction
- Crackles: Fluid/inflammation
- Rubs: Pleural inflammation

## Audio Preprocessing

Acoustic signal transformation and augmentation

- Spectrogram generation (STFT)
- Mel-frequency transformation
- Noise removal (heart sounds, etc.)
- Time segmentation (windowing)

## Deep Learning Architecture

Acoustic classification models

- 2D CNN: Spectrogram processing
- ResNet: Deep feature extraction
- RNN: Temporal patterns
- Audio Transformer: Attention

## Multimodal Fusion

Integration of auscultation sounds with other data

- Lung sounds + Chest X-ray
- Lung sounds + Pulmonary function tests
- Lung sounds + Clinical symptoms
- Spatial-acoustic alignment

**Early pneumonia detection**

**COPD monitoring**

**Asthma exacerbation prediction**