Research Topic Selection

# Week 1: Online Search and Topic Selection

## Research Topic Selected

\*\*Topic\*\*: Vision Transformers for COVID-19 Chest X-ray Classification

## Search Process and Sources

### Initial Search Strategy

I focused my search on finding practical implementations of Vision Transformers for medical imaging, specifically COVID-19 detection.

### Key Search Terms Used:

* "Vision Transformer COVID-19 chest X-ray"
* "ViT medical imaging implementation"
* "COVID-19 detection transformer PyTorch"
* "chest X-ray classification deep learning"

### Primary Sources Found:

**1. GitHub Repository**

* \*\*URL\*\*: https://github.com/Wissem-i/covid-chest-xray-vit
* \*\*Content\*\*: Complete implementation with trained models
* \*\*Value\*\*: Ready-to-use code and processed data
* \*\*Analysis\*\*: Professional implementation following best practices

**2. Related Academic Papers**

* Vision Transformer applications in medical imaging
* COVID-19 detection using deep learning
* Comparison studies: ViT vs CNN for medical images
* Medical data handling and ethics papers

**3. Technical Documentation**

* PyTorch Vision Transformer tutorials
* timm library documentation for pre-trained models
* Medical imaging preprocessing best practices
* Patient privacy and data splitting guidelines

## Why This Topic?

### Personal Interest

* Medical AI has real-world impact on healthcare
* Vision Transformers are cutting-edge technology
* COVID-19 detection is socially relevant
* Combines computer vision with healthcare applications

### Technical Learning Value

* Modern transformer architecture
* Transfer learning from natural images to medical
* Attention mechanism visualization
* Medical data handling best practices

### Practical Feasibility

* Repository provides working implementation
* Dataset is manageable size for local development
* Clear documentation and code structure
* Results are reproducible and verifiable

## Research Questions Developed

1. \*\*Architecture\*\*: How do Vision Transformers compare to CNNs for medical imaging?
2. \*\*Transfer Learning\*\*: How effectively can ViT pre-trained on natural images adapt to chest X-rays?
3. \*\*Attention Analysis\*\*: What parts of chest X-rays do transformers focus on for COVID-19 detection?
4. \*\*Data Efficiency\*\*: How much medical data is needed for effective ViT training?
5. \*\*Clinical Relevance\*\*: Can ViT attention maps help radiologists understand AI decisions?

## Implementation Approach

### Technical Stack Identified:

* \*\*Framework\*\*: PyTorch with timm library
* \*\*Model\*\*: Pre-trained Vision Transformer (ViT-B/16)
* \*\*Dataset\*\*: COVID-19 chest X-ray images
* \*\*Evaluation\*\*: Standard medical imaging metrics

### Repository Analysis Results:

* Complete implementation available
* Processed data splits following medical best practices
* Training scripts and evaluation tools
* Visualization and results analysis

## Expected Outcomes

1. \*\*Technical Understanding\*\*: Deep knowledge of Vision Transformers
2. \*\*Medical AI Knowledge\*\*: Understanding of healthcare AI challenges
3. \*\*Practical Skills\*\*: Experience with PyTorch and modern deep learning
4. \*\*Research Output\*\*: Comprehensive analysis and documentation
5. \*\*Portfolio Addition\*\*: Showcase project for future opportunities

This topic provides an excellent balance of technical challenge, practical relevance, and learning value for understanding modern AI applications in healthcare.