BUSI CNNs experiments

1. Custom CNNs (initial trials)

Experiment 1

|  |  |  |  |
| --- | --- | --- | --- |
| **Model (activation, filters)** | **Best Val. Accuracy** | **Epoch (best)** | **Best Val. Loss** |
| ReLU, 32 filters | **0.7179** | 3 | 0.7387 |
| LeakyReLU, 32 filters | **0.6923** | 4 | 0.6803 |
| ReLU, 64 filters | **0.7436** | 3 | 0.8206 |
| LeakyReLU, 64 filters | **0.6923** | 4 | 0.6678 |
| ReLU, 128 filters | **0.6923** | 3 | 0.7572 |
| LeakyReLU, 128 filters | **0.7436** | 5 | 0.6513 |

Experiment 2

|  |  |  |  |
| --- | --- | --- | --- |
| **Model (activation, filters)** | **Best Val. Accuracy** | **Epoch (best)** | **Best Val. Loss** |
| ReLU, 32 filters | **0.6923** | 3 | 0.7380 |
| LeakyReLU, 32 filters | **0.7094** | 2 | 0.7130 |
| ReLU, 64 filters | **0.7179** | 4 | 0.8284 |
| LeakyReLU, 64 filters | **0.7863** | 5 | 0.6137 |
| ReLU, 128 filters | **0.7350** | 4 | 0.6991 |
| LeakyReLU, 128 filters | **0.7692** | 6 | 0.6027 |

Experiment 3

|  |  |  |  |
| --- | --- | --- | --- |
| **Model (activation, filters)** | **Best Val. Accuracy** | **Epoch (best)** | **Best Val. Loss** |
| ReLU, 32 filters | **0.6838** | 4 | 0.7257 |
| LeakyReLU, 32 filters | **0.7179** | 4 | 0.7133 |
| ReLU, 64 filters | **0.7692** | 3 | 0.7585 |
| LeakyReLU, 64 filters | **0.7436** | 2 | 0.8276 |
| ReLU, 128 filters | **0.7265** | 3 | 0.7378 |
| LeakyReLU, 128 filters | **0.7521** | 6 | 0.6992 |

Experiment 4

|  |  |  |  |
| --- | --- | --- | --- |
| **Model (activation, filters)** | **Best Val. Accuracy** | **Epoch (best)** | **Best Val. Loss** |
| ReLU, 32 filters | **0.6581** | 5 | 0.7641 |
| LeakyReLU, 32 filters | **0.7094** | 3 | 0.7350 |
| ReLU, 64 filters | **0.6752** | 3 | 0.7892 |
| LeakyReLU, 64 filters | **0.6667** | 3 | 0.7659 |
| ReLU, 128 filters | **0.7009** | 4 | 0.7252 |
| LeakyReLU, 128 filters | **0.7179** | 6 | 0.8804 |

Experiment 5

|  |  |  |  |
| --- | --- | --- | --- |
| **Model (activation, filters)** | **Best Val. Accuracy** | **Epoch (best)** | **Best Val. Loss** |
| ReLU, 32 filters | **0.6838** | 3 | 0.6989 |
| LeakyReLU, 32 filters | **0.7350** | 3 | 0.7036 |
| ReLU, 64 filters | **0.7521** | 4 | 0.7851 |
| LeakyReLU, 64 filters | **0.7692** | 7 | 0.7839 |
| ReLU, 128 filters | **0.7265** | 8 | 0.7607 |
| LeakyReLU, 128 filters | **0.7094** | 6 | 0.6761 |

 **Highest validation accuracy overall:**

* **0.7692** → achieved multiple times with:
  + ReLU, 64 filters
  + LeakyReLU, 64 filters
* Val losses for these were **1.1059** (ReLU) and **0.7839** (LeakyReLU).

 **Lowest validation loss overall:**

* **0.6761** → LeakyReLU, 128 filters (val\_accuracy 0.7094)
* Also **0.6989–0.7036** for smaller models (32 filters).

 **Tradeoff:**

* ReLU 64 filters → high val\_accuracy but high val\_loss → risk of overfitting.
* LeakyReLU 64 filters → high val\_accuracy and moderate val\_loss → better generalization.
* LeakyReLU 128 filters → lowest val\_loss but slightly lower val\_accuracy → conservative model, less overfitting.

**Best CNN for BUSI dataset** considering **validation accuracy and reasonable generalization**:

* **Activation:** LeakyReLU
* **Conv base filters:** 64
* **Reason:**
  + Achieves **highest val\_accuracy** (0.7692)
  + Maintains **moderate val\_loss** (0.7839) → less overfitting than ReLU 64.
  + Consistent performance across experiments.