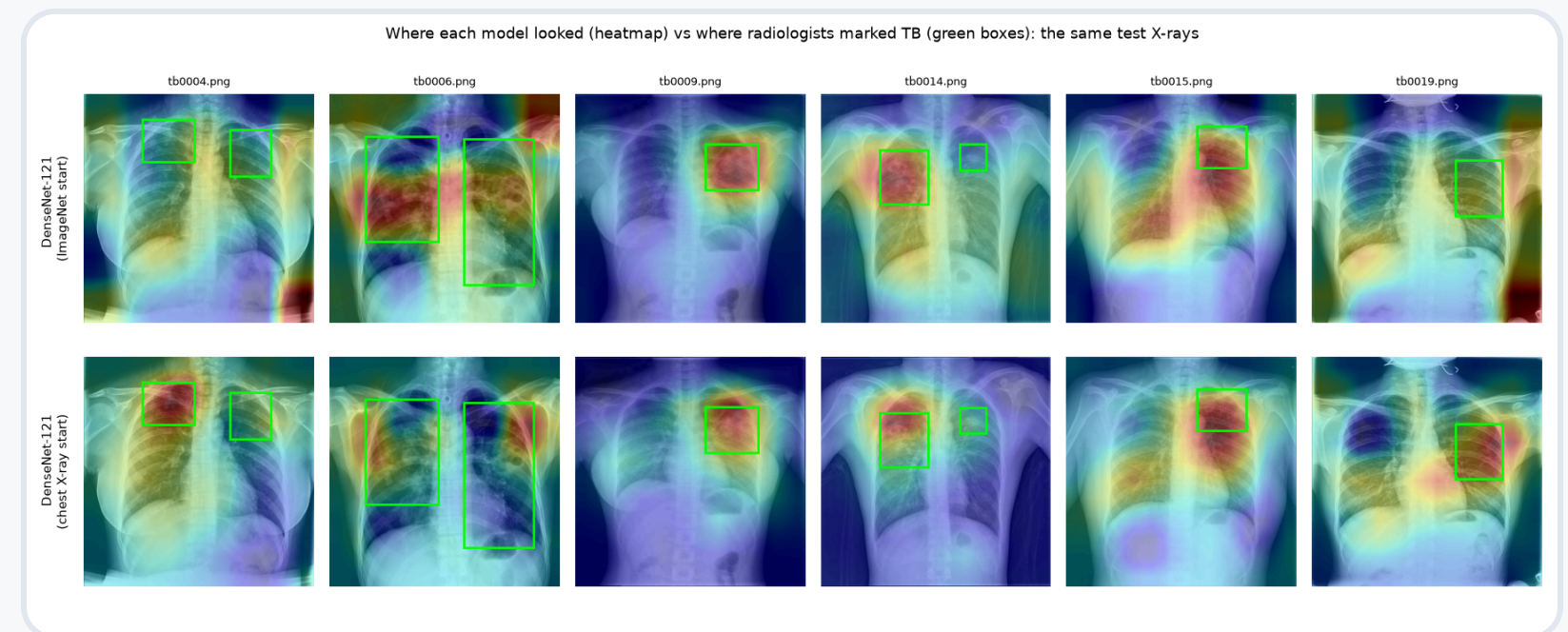


LungLens

TB screening from a chest X-ray, in your browser, with a heatmap you can check.

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Instructor: Dr. Munir Ahmad



Pakistan: one of the world's largest TB burdens

~670k

TB cases in 2024 (WHO 2025)

5th

highest in the world, 6.3% of all cases

2021

WHO: software may replace the human X-ray reader for TB screening, age 15+

X-rays are cheap and everywhere. People who can read them for TB are not.

Most TB student projects have a hidden shortcut

- Popular Kaggle TB dataset: TB and normal X-rays from **different hospitals**
- A model can learn "**which hospital**" instead of "which disease"
- So I used **TBX11K** (CVPR 2020): shared sources, and a class for **sick but not TB**

The real question is not "TB or healthy?"

It's "TB, or some other lung disease?"

Data: TBX11K, 8,399 labelled X-rays

SPLIT	HEALTHY	SICK, NOT TB	TB	TOTAL
Train	2,700	2,700	539	5,939
Validation	300	300	60	660
Test (untouched)	800	800	200	1,800

- TB areas boxed by radiologists · CC BY 4.0
- 384 × 384 grayscale · TB weighted ~5× in the loss · **no left-right flips**: the heart is on the left

Three models, one question at a time

CNN from scratch

5 conv blocks, 2.4M params.
The baseline.

DenseNet-121

starts from **ImageNet**
photos. The CheXNet
architecture.

DenseNet-121

starts from **chest X-rays** of 7
public datasets.

Same data, same augmentation, same schedule. The two DenseNets differ only in their starting weights.

Results on 1,800 test X-rays

MODEL	ACCURACY	BALANCED	TB AUC	SENSITIVITY	SPECIFICITY	POINTING
CNN from scratch	96.9%	97.0%	0.9952	98.0%	94.6%	34%
DenseNet-121 · ImageNet start	99.2%	98.4%	0.9996	100.0%	95.9%	36%
DenseNet-121 · X-ray start	98.3%	97.0%	0.9965	98.0%	95.8%	57%

Highlighted: deployed model, chosen on validation. Sensitivity / specificity: TB vs not-TB at the screening threshold.

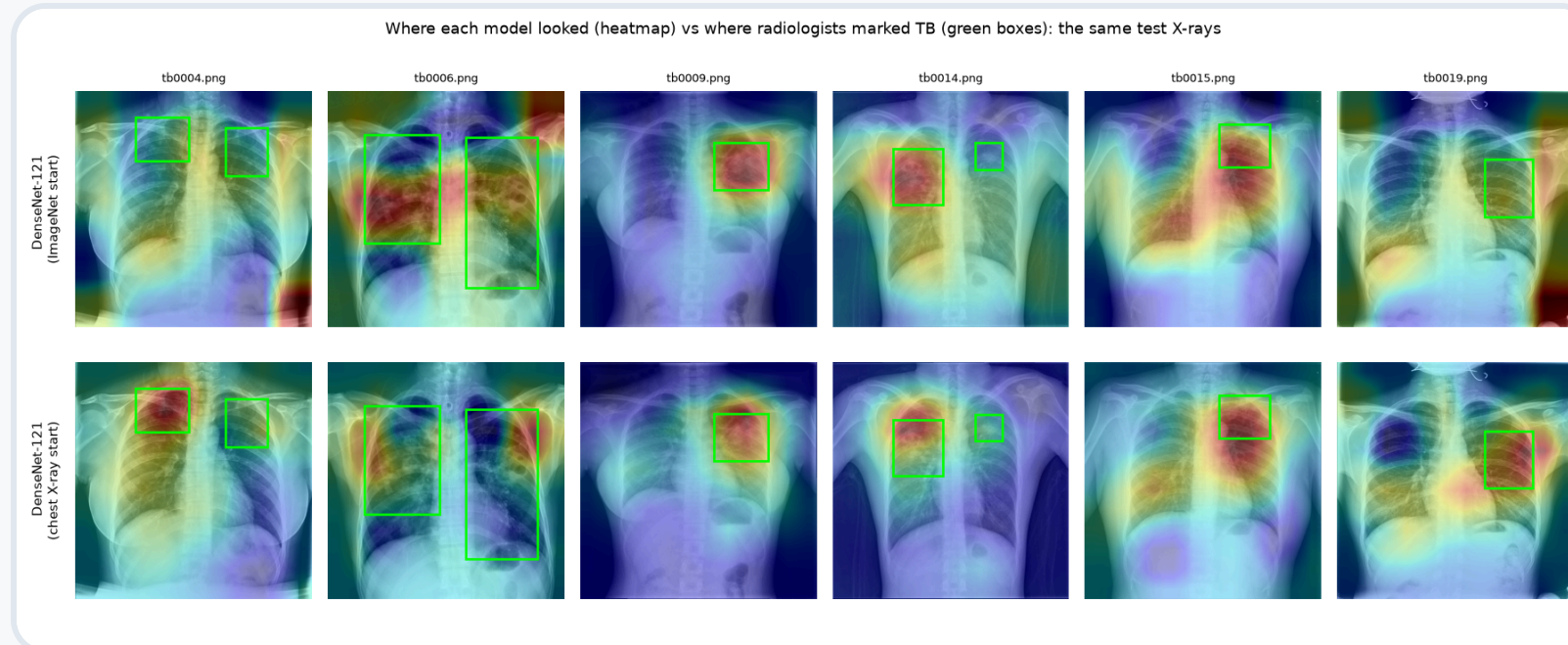
Does it look in the right place?

57%

DenseNet-121 · X-ray start: hottest heatmap point inside a doctor's TB box

36%

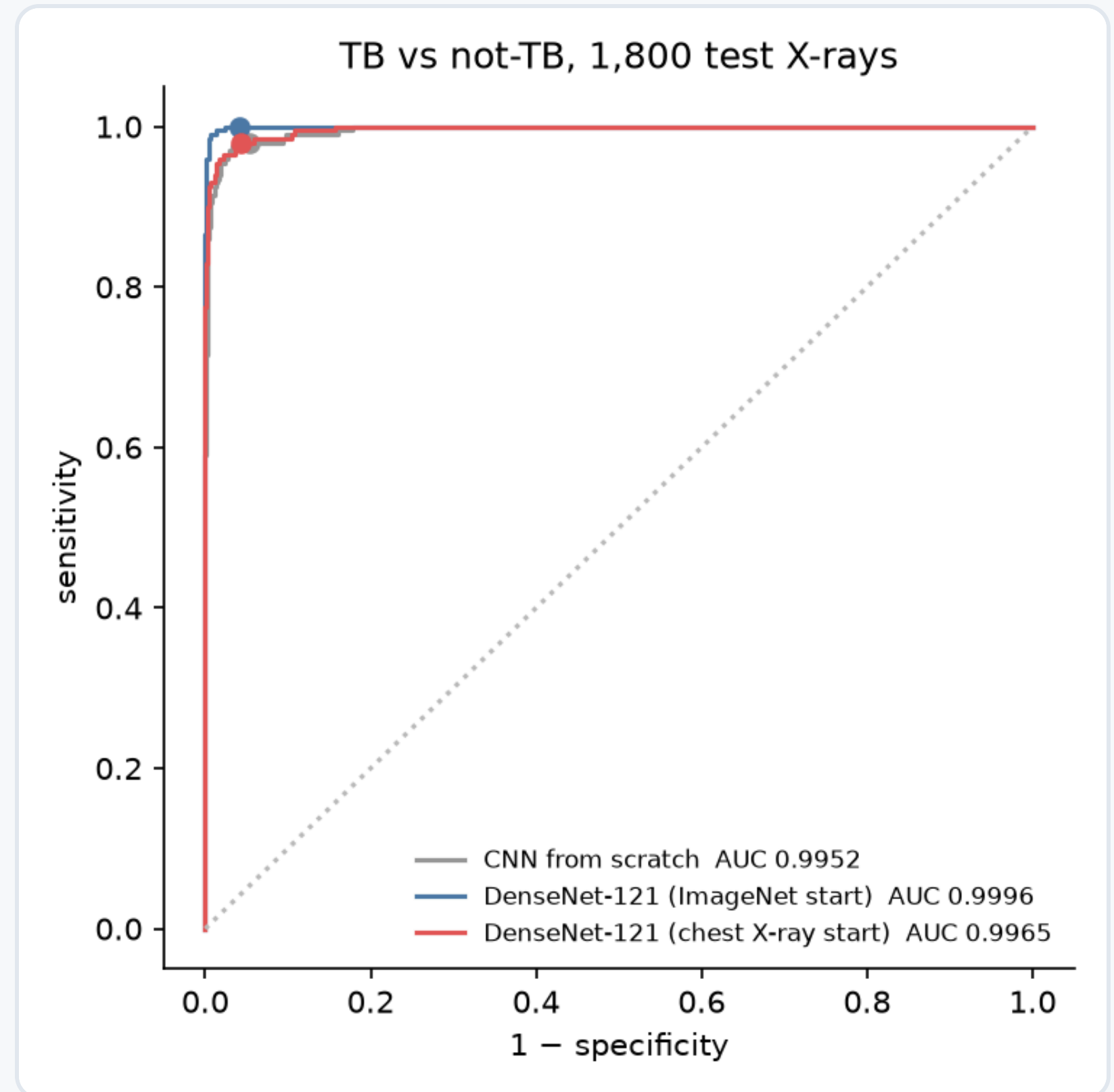
DenseNet-121 · ImageNet start: hottest heatmap point inside a doctor's TB box



A random point: 10%. Switch between the two on the website.

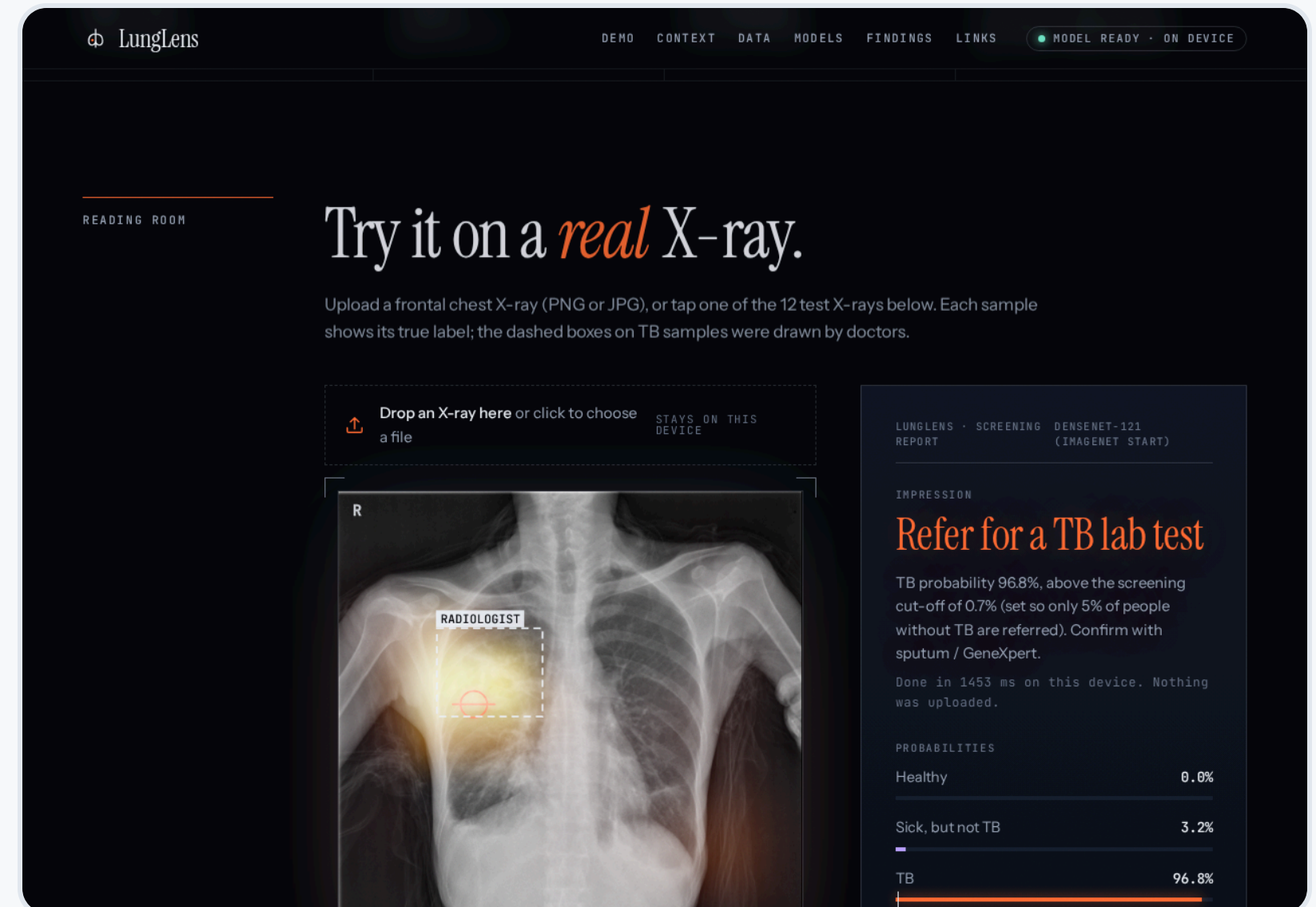
A lesson about thresholds

- First try: threshold for 90% sensitivity on **60** validation TB X-rays
- On the test set: only **85.0%**. Too few positives, too confident
- Fix: set it from the **600** non-TB X-rays (95% specificity)
- Now: **100.0%** sensitivity, **95.9%** specificity



Live demo

- Open <https://lunglens-tb.vercel.app>
- Upload an X-ray, or tap a sample
- About a second, on your own device
- Nothing is uploaded



Limits, and what's next

Limits

- Chinese hospital data: untested on Pakistani X-rays
- Adults only (WHO: age 15+)
- A screening aid, not a diagnosis

Next

- Test on X-rays from Pakistani hospitals
- Re-set the threshold for that population
- Lung segmentation, so attention stays in the lungs

Everything is open

- Try it: <https://lunglens-tb.vercel.app>
- Code, weights, splits, notebook: github.com/zyna-b/lunglens
- Report, slides, model card: linked on the site

Thank you, Dr. Munir Ahmad.