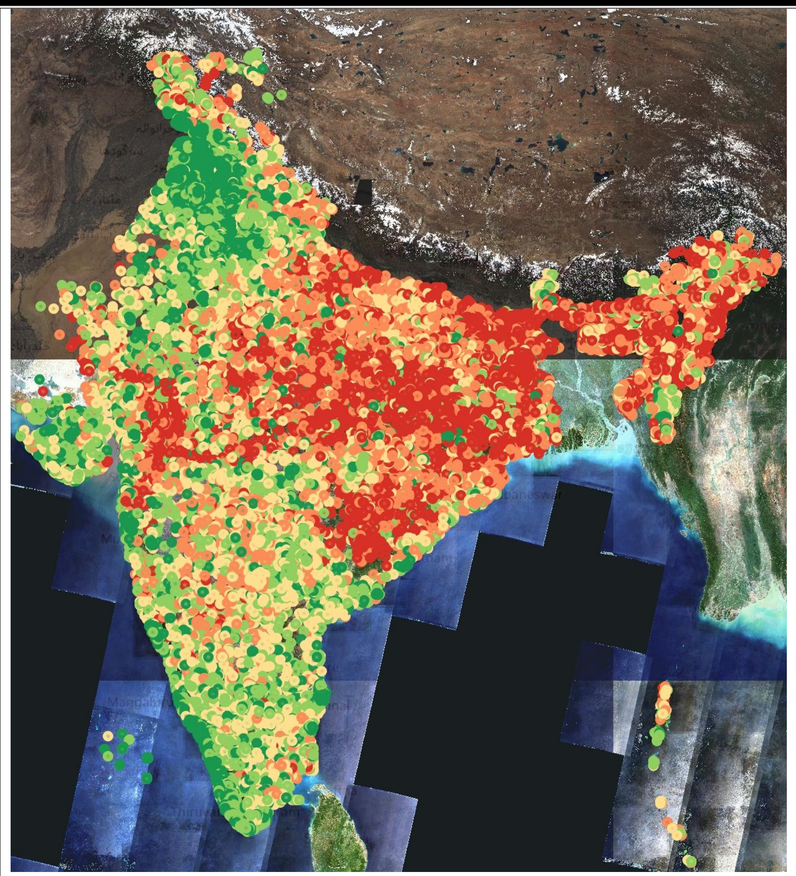
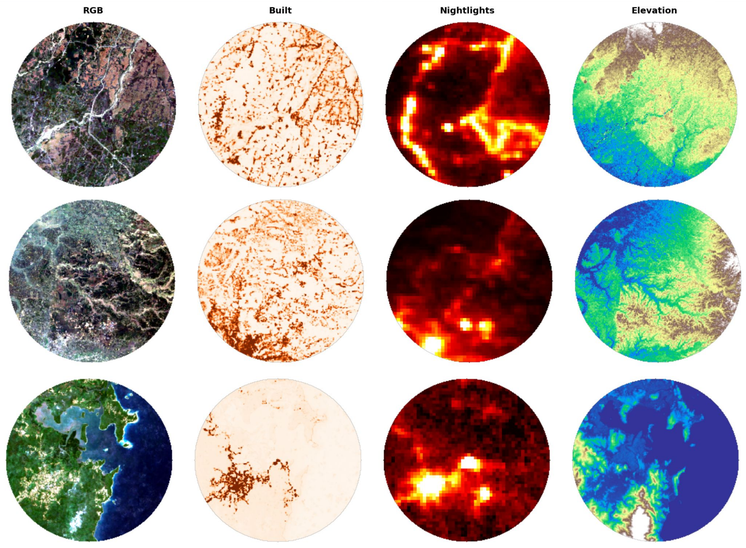
Learning from Nightlights: Predicting Poverty via Satellite Transfer Learning

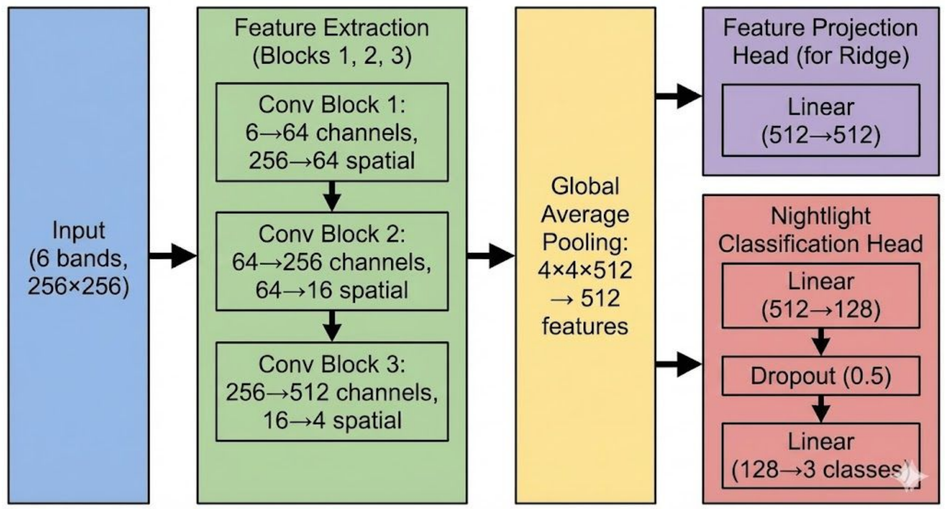
Replication and Adaptation of Jean et al. (2016) for COMP0173: AI for Sustainable Development Coursework

Arun Josephraj Arokiaraj (Student ID: 25056813)



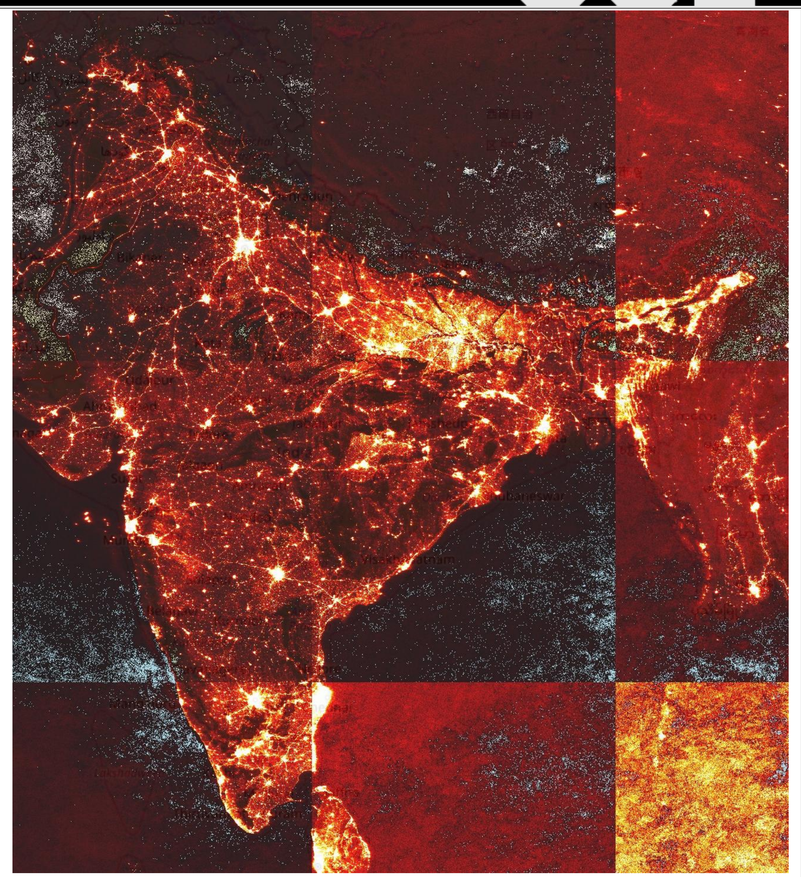


Replication of Jean et al. (2016) for India using 6-band satellite imagery. CNN trained on nightlight classification, then used as feature extractor for wealth prediction via Ridge regression.



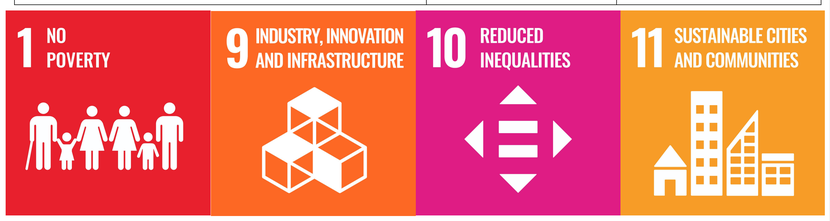
LightCNN256

Input	3 bands (RGB)	6 bands	Richer multi-spectral data from GEE
Model	VGG-F (ImageNet)	LightCNN256	6-band input prevents ImageNet transfer
Data	500k random images	29k DHS clusters	DHS-only approach is more targeted
Context	5 African countries	India only	Country - specific validation



Metric	**Jean et al.**	**Ours**
Nightlight Classification Accuracy	~75%	90.7%
Nightlight-only Baseline R^2	~0.04	0.016
Wealth R^2	0.50-0.55	0.48
Improvement over Baseline	12x	30.7x

Top-left: 30,052 DHS clusters colored by wealth (red=poor, green=rich). **Top-right:** VIIRS nightlights showing economic activity patterns. **Center:** LightCNN256 architecture trained on nightlight classification, then used for wealth prediction via Ridge regression. The **bottom-left** shows sample clusters from each wealth quintile across multiple spectral bands (RGB, built area, nightlights, elevation), revealing visible differences between poor and wealthy regions (Poor to Rich). Finally, the **results table** confirms our model achieves R^2=0.48, within 5% of Jean et al., while improving 30.7x over simple nightlight regression. The different SDGs that project addresses are highlighted in the **bottom right corner.**



Reference: Jean, N. et al. "Combining satellite imagery and machine learning to predict poverty."
Science 353, 790-794 (2016). DOI:10.1126/science.aaf7894
Acknowledgments: DHS Program, Google Earth Engine, ESA Sentinel-2, NASA/NOAA VIIRS
AI Assistance: Google Antigravity and Gemini used for coding and Image Editing

Arun Arokiaraj | MSc AI for Sustainable Development 2025-26
arun.arokiaraj.25@ucl.ac.uk
GitHub: ArunJoseph19/Poverty-Mapping-from-Space