Model Card - Rooftop Solar PV Detection

Model Details
- Object Detection model for identifying rooftop solar PV panels in satellite imagery.
- Built using YOLOv8s (Ultralytics) object detection architecture.
- Final predictions combined using post-training ensemble techniques, specifically Weighted Box Fusion (WBF).

Intended Use
- Detection of rooftop solar PV installations in aerial/satellite imagery.
- Large-scale Renewable energy (Solar energy) planning and adoption.
- Pre-screening and auditing of rooftop solar PV installations.

Factors
- Image quality and resolution.
- Shadows.
- Roof material/orientation/design.

Metrics
- Mean Average Precision(mAP).
- Precision and recall.
- False positive and false negative rates.
- Confidence-weighted bounding boxes fusion using WBF.
- F1 score.

Quantitative Analysis

Confusion Matrix

Training and Validation Metrics

PR Curve   **F1-Confidence Curve**

Training Data
- Alfred Weber Institute of Economics(2025) Custom Workflow Object Detection Dataset.
- ProjectSolarPanel (2025) LSGI547 Project Dataset.
- Piscinas y Tenistable (2023) Solar Panels Dataset.
- Additional hard-negative dataset generated using Google Static Maps API.
- Images processed into 640x640 resolution patches.

Evaluation Data
- Held-out test splits from each dataset.
- Covers varied roof textures, lighting conditions and urban/rural settings.
- Evaluated after ensemble prediction using WBF.
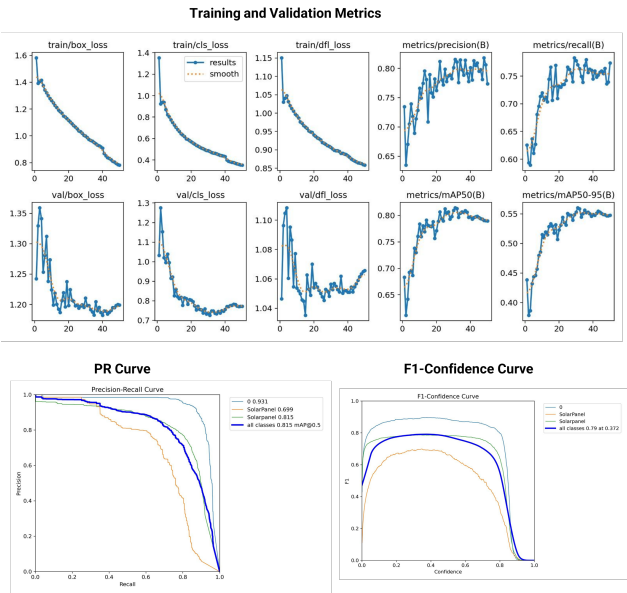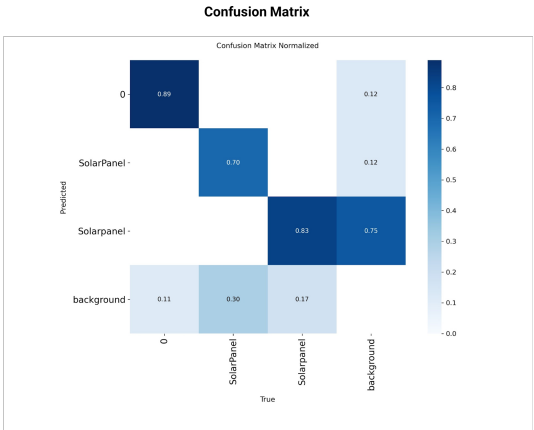- Includes positive and hard-negative rooftop samples.

Ethical Considerations
- Uses satellite imagery that may contain private property.
- Must comply with Google API terms and geospatial regulations.

Caveats and Recommendations
- Performance depends on image quality and capture conditions.
- Ensemble inference improves accuracy however adds additional compute cost.
- Local validation is recommended for new geographic locations.