Project Timeline (March 10 - April 17)

Milestone 1 (March 10 - March 20) → Code Understanding & Initial Re-Implementation

- Read and discuss the entire paper thoroughly.
- Explore and analyze the available code in the repo.
- Identify missing parts (experiments from Tables 1-4).

Milestone 2 (March 20 - March 31) → Code Understanding & Initial Re-Implementation

Ablation Study (Table 5) – Understanding Design Choices

The **Ablation Study** in Table 5 analyzes different architectural and training choices for XFeat and XFeat*. The goal is to determine how specific modifications impact accuracy.

Variants Tested in the Ablation Study

1. **Default (Baseline XFeat & XFeat*)** → Standard version of XFeat.
2. **No Synthetic Data** → Trained only on real images (Megadepth).
3. **Smaller Model** → Reducing the number of channels in later convolutional layers.
4. **Joint Keypoint Extraction & Descriptor Learning** → Instead of a separate keypoint branch, descriptors are directly used for keypoint extraction.

Relative Pose Estimation (Table 1 & Table 2)

Goal: Estimate **relative camera pose** (rotation & translation) between two images using **feature correspondences**.

Datasets Used

- Megadepth-1500 (Table 1, outdoor scenes)

- ScanNet-1500 (Table 2, indoor scenes)

Metrics Evaluated

- AUC@5°, 10°, 20° (Higher is better)
- Acc@10° (% of poses with angular error < 10°)
- MIR (Mean Inlier Ratio) (Higher = better matches)
- # Inliers (Number of feature correspondences)
- FPS (Frames per second on CPU)

Milestone 3 (March 31 - April 6)

Homography Estimation (Table 3) → HPatches Dataset

Goal:

Estimate homographies (2D perspective transformations) between image pairs using feature correspondences and evaluate the accuracy of estimated transformations.

Dataset:

- **HPatches: Contains image sequences with controlled illumination & viewpoint changes.**

Metrics Evaluated:

- MHA (Mean Homography Accuracy) @3, 5, 7 pixels

Visual Localization (Table 4) → Aachen Day-Night Dataset

Goal:

Estimate camera pose of query images by matching keypoints to a 3D Structure-from-Motion (SfM) map.

Dataset:

- Aachen Day-Night (Day & Night images for localization in a known environment).

Metrics Evaluated:

- Localization Accuracy (%) at (0.25m, 0.5m, 5m) / (2°, 5°, 10°) thresholds.

Milestone 4 (April 7 - April 13) → Implement Novel Contributions

Homography-Guided Feature Detection & Matching:

- Implement homography-based image patch warping before feature extraction.
- Evaluate impact on robustness (viewpoint/illumination changes) using metrics like MIR, # Inliers, and Homography Accuracy (if applicable).

*Outlier Removal for Semi-Dense Matching (XFeat):**

- Implement DBSCAN filtering for semi-dense match outlier removal in XFeat*.
- Integrate DBSCAN *before* XFeat*'s match refinement.
- Benchmark against original XFeat* (MIR, # Inliers, pose accuracy if applicable).
- Tune DBSCAN parameters (eps, min_samples).

Milestone 5 (April 14 - April 17) → Finalization & Submission

Final Debugging & Performance Validation:

- Debug all code.
- Validate performance (XFeat, XFeat*, variations) on benchmarks.
- Ensure results are consistant and reproducible.

Ensure Completeness:

- Verify code and integration.
- Confirm all experiments and results.
- Double-check results accuracy.

Prepare Results and Visualization:

- Create figures/tables comparing methods and contributions.
- Visualize match quality, keypoint repeatability, etc.

Report/Presentation Writing & Finalization:

- Write report/presentation detailing project, methods, experiments, results, conclusions.
- Finalize and proofread.