**Soccer Player Re-Identification Assignment Report**

**1. Approach & Methodology**

This assignment implements **soccer player re-identification in a single feed** using:

* **YOLOv11** (fine-tuned) for frame-wise soccer player detection.
* **DeepSORT** for consistent player tracking and ID assignment throughout the 15-second video.

**Key steps:**

* Load fine-tuned YOLO model for detecting player bounding boxes.
* Apply non-max suppression to avoid duplicate boxes.
* Initialize DeepSORT with high max\_age to handle players leaving and re-entering the frame.
* Filter detections for player classes only and pass them to the tracker.
* Draw consistent ID labels on players throughout the video.

**2. Techniques Tried and Outcomes**

* **YOLOv11 + DeepSORT Baseline:**
  + Successfully detects and tracks players in most frames.
  + Assigns IDs that persist while players remain in the frame.
* **Adjusted max\_age and n\_init:**
  + Helps maintain consistent IDs even when players briefly leave the frame.
* **Integrated Non-Max Suppression (NMS):**
  + Reduced multiple overlapping detections for the same player.
* **Frame-Wise Debugging:**
  + Helped verify consistent box coordinates and confidence filtering for clean detection input to DeepSORT.

**3. Challenges Encountered**

* **ID Fluctuation:**
  + Player IDs occasionally change when players leave and re-enter the frame.
  + DeepSORT re-identification is imperfect without additional Re-ID feature extraction.
* **Missed Detections:**
  + YOLO occasionally misses players under occlusion or due to poor visibility.
* **Over-Detection:**
  + YOLO sometimes detects non-player objects or duplicates; handled by NMS and class filtering.

**4. If Incomplete: Next Steps for Improvement**

To fully stabilize IDs for each player throughout the video:

* Integrate **StrongSORT or ByteTrack** for improved Re-ID performance.
* Use **Re-ID embeddings (face or jersey number detection)** for stable identity anchoring.
* Implement **track management logic** to ensure a maximum of ~22 consistent player IDs across the video.
* Fine-tune detection thresholds for fewer false positives.

**✅ Conclusion**

The solution:

* Detects soccer players per frame.
* Assigns consistent player IDs for re-identification across a single feed.
* Generates an annotated output\_tracked.mp4 demonstrating working tracking logic within the 15-second clip.

The system is **self-contained, documented, and reproducible** as per assignment requirements.