Baseball Tracking part

Algrithms:

- Kalman Filter : a predictive model that estimate the state of a linear dynamic system from a series of noisy measurements
- Hungarian algorithm : matching detections with trackers
  - Assign detected objects to existing tracks in a way that minimizes the total cost
  - The cost is filled with values representing the "distance" between each detection and each track. The distance is calculated using the Euclidean distance between the Kalman Filter predictions and detected positions --就是Kalman Filter会根据历史状态预测当前追踪物体(track)的下一个位置 计算当前detection的中心点于这个预测值的欧几里得距离 最后这个预测值会被assign to欧几里得距离最小的tracker中 作为这个tracker的历史 让它继续预测下一个位置
- Pipeline
  - Read videos
  - Baseball detection on each frame
  - Tracking with Kalman Filter and Hungarian Algorithm
    - **Track Initialization**: For each detected object, if it does not match with an existing track, a new track is initialized using a Kalman Filter
    - **Kalman Filter Prediction and Update**: For each track, the Kalman Filter predicts the next state based on the previous state and updates its prediction with the new measurement (detection)
    - **Hungarian Algorithm**: This algorithm is used to assign detections to the best-matching tracks based on the cost matrix, minimizing overall tracking error
    - **Track Management**:
      - Tracks are updated with new detections, and their histories are maintained
      - Tracks without detections for a consecutive number of frames are discarded
  - Visualization : the prediction & trace are visualized in each frame and put together into a video
    - Blue points : Kalman Filter predictions as the first highlight
    - Pink points : History predicctions that represent the trace of the base ball as the second high light
    - False positives : There are some false dections of the baseball hince there will be some trackers being assignment wrongly. To eluminate this, you can those in the videos those false positive will disappear over time and only the true trace are preserved -- this is because the third highlight -- false positive不会被持续地检测到 如果短时间内没有新的detection被asssign给这个tracker, 这个tracker就会被删除 最后只留下baseball的trace