Implementation Notes / Properties

- Always normalize angular components (be aware of wraparound $2\pi n$)
- Depending how you implement, you may not need to make F matrices

Loop Closing

↳ recognizing an already mapped area

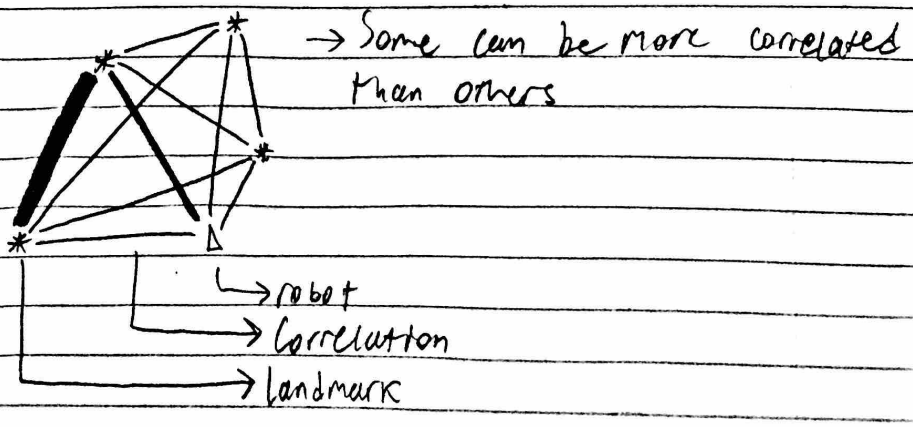
- Data association under:
  - ↳ high ambiguity
  - ↳ Possible environment symmetries
- Uncertainties collapse after a loop closure (whether or not the closure was correct)
  - ↳ the uncertainty reduces this way through the correlation between the robot's poses & the landmarks

Loop Closures in SLAM.

- wrong loop closure leads to filter divergence
  - ↳ very critical
- can explicitly try to find loop closures for sake of accurately exploring environment.

EKF SLAM Correlations

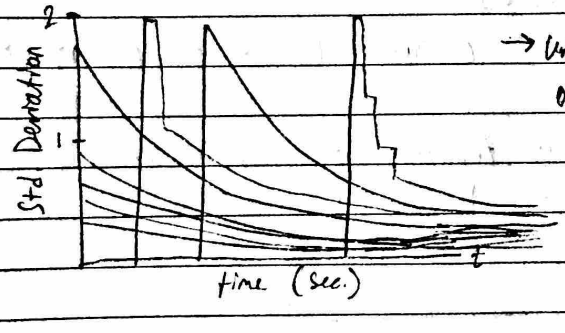
- in the limit, all landmark estimates become fully correlated



- Correlations between robot's pose & landmarks cannot be ignored
  ↳ generates too optimistic estimate of uncertainty & very likely to fail

EKF SLAM - Uncertainties

- new landmarks initialized w/ max uncertainty
- The determinant of any sub-matrix of the map covariance mtx decreases monotonically



→ uncertainty decr the more you observe it.

Uncertainty Limit

- no matter how many times you view landmarks, any observation uncertainty can never be less than your initial covariance in the vehicle location estimate (uncertainty of first landmark observed)

Complexity

- n^3 complexity depends on measurement dimension (# landmarks) only
- Cost per step: (dominated by # landmarks: $O(n^2)$
- Memory Consumption: $O(n^2)$
- The EKF becomes computationally limiting for large maps
  → prediction step is actually linear

EKF SLAM Summary

- first SLAM Soln.
- linearization of functions helps since world is non-lin. but can be critical if uncertainty is large → the larger the uncertainty the more non-gaussian the resulting "linear distribution" is.
- Can only deal with a single mode → gaussian, ∴ Can only predict 1 location at a time. Can't say "here or here"
- Successful in medium-scale scenes / where you can place certain landmarks
- Approximations exist to reduce the computational complexity.