Assignment 2

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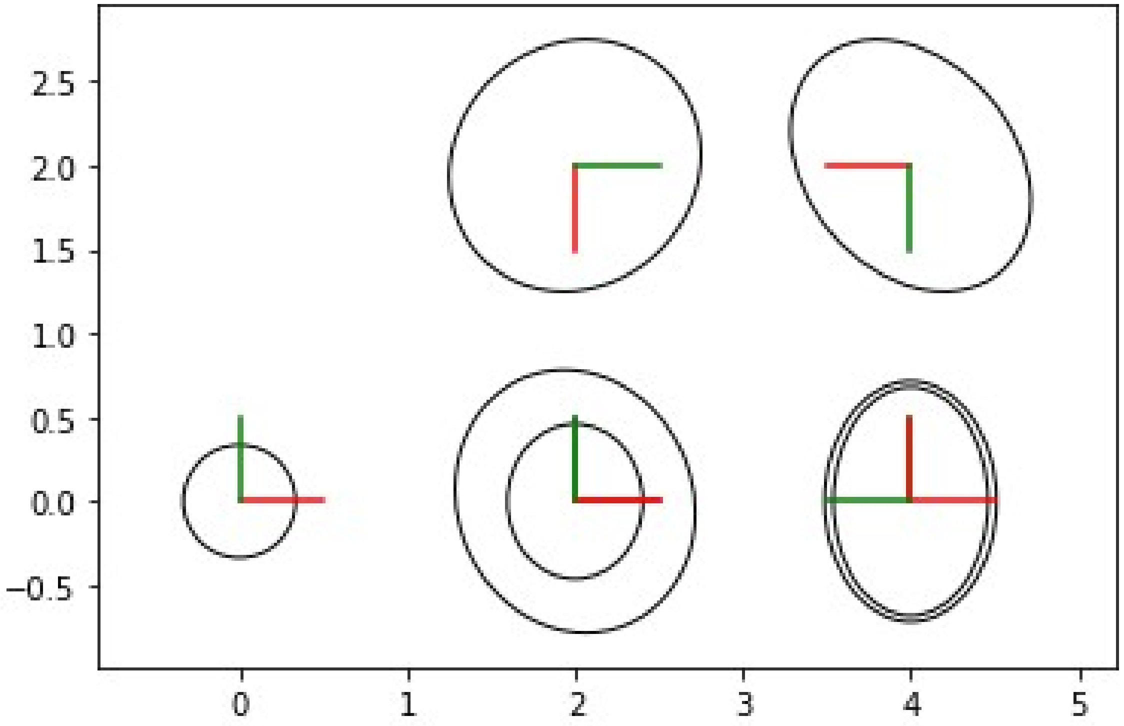
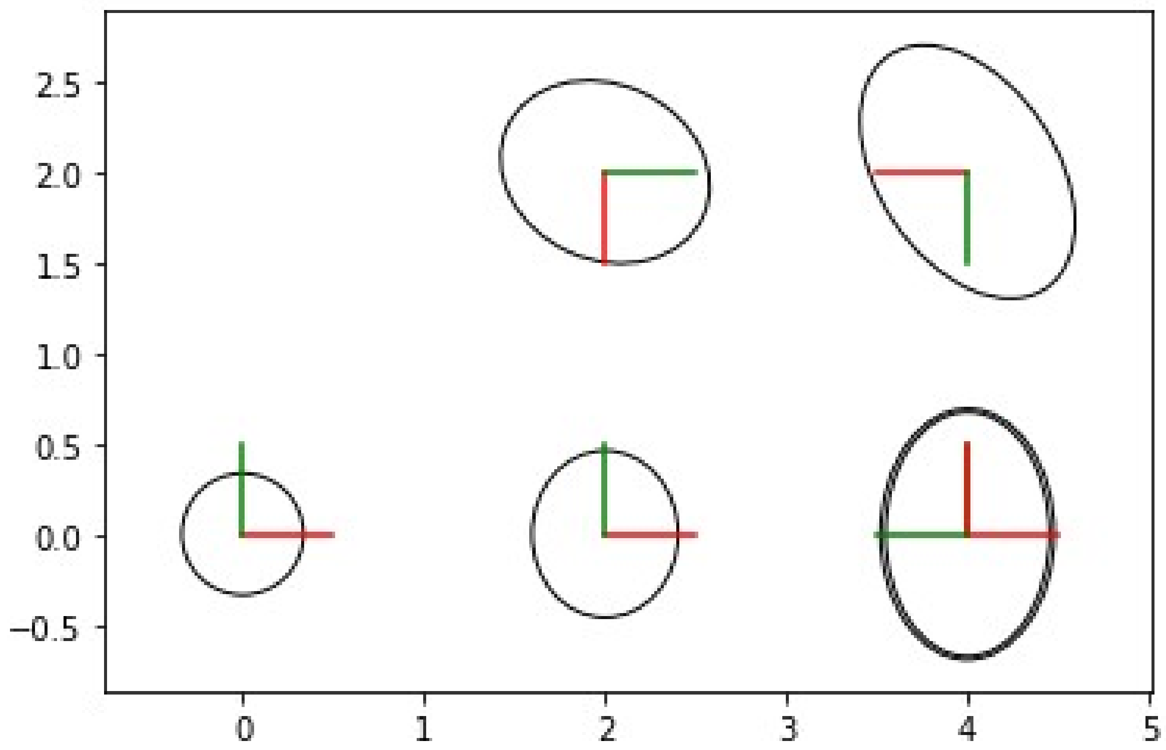
Exercise 1: Take a screen of the plot and put it on the PPT file. Give a brief explanation on why the circle are getting bigger.



- As the robot moves, the location uncertainty grows due to the compounding noise of the “odometry” reading. The circles are a projection of the gaussian estimation of the location.

Exercise 2: Make the loop closure work. Take a screen and give a brief explanation on what happen with the covariance of each state.

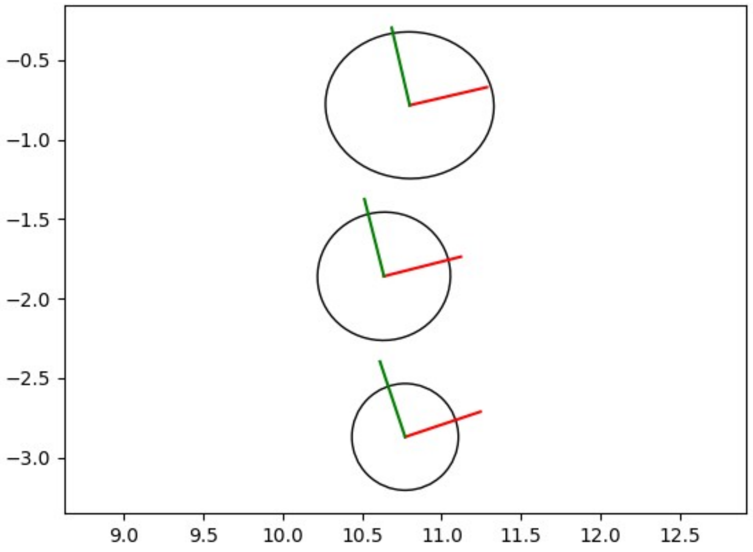


- State 1: roughly the same
- State 2: roughly the same
- State 3: the diagonal of the covariance decreased slightly (~ 0.00645)
- State 4: decreased along diagonal, but had some added variance in other cells
- State 5: co-variance decreased or stayed the same across all dimensions.
- State 6: decreased by almost a factor of 2. Additionally the co-variance shifted slightly to have the principal component (direction of maximum variance) orthogonal to what it was without loop closure
- State 7: joined with state 2-essentially removed

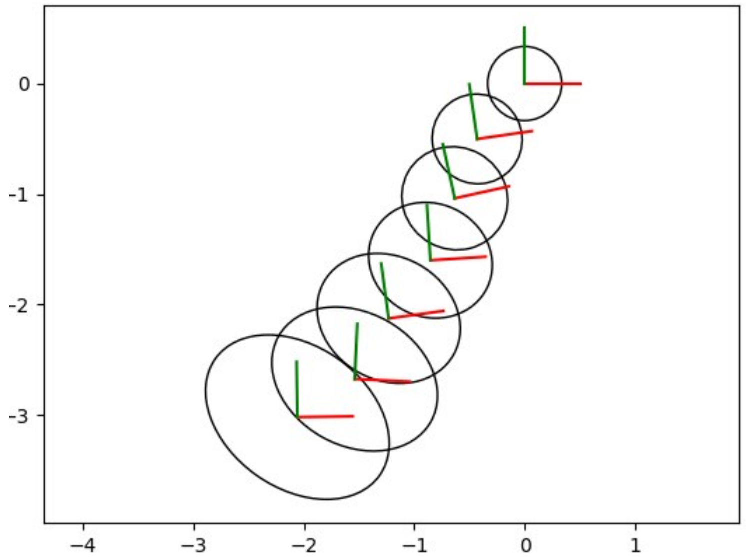
Exercise 3: Comment what happens when you don't have a prior for the initial state in the graph and relate it to the gauge freedom.

- When you do not have a prior for the initial state in the graph, the code gives an error because the optimization problem is indeterminate. Without a prior, there are infinintely many possible solutions. The relative locations are defined but they could be any location (x,y) or orientation (theta). There is complete gauge freedom in SE(2); any origin could be defined in SE(2) and a valid solution could be found.

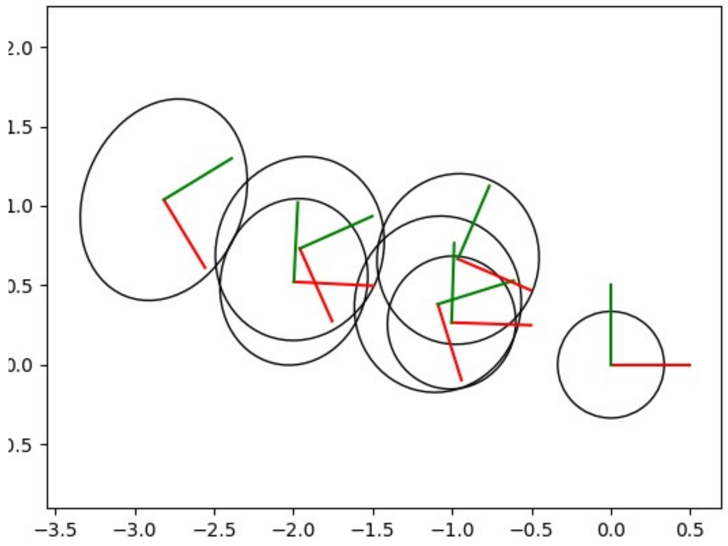
Exercise 4: Show the plot of the factor graph just like in part 1 of the assignment for three different moments in time, as you teleop the robot around. At least one of the plots needs to have a loop closure.



No loop closure move. The location uncertainty grows with each move. 3 times steps. Start [-3, -10.8]



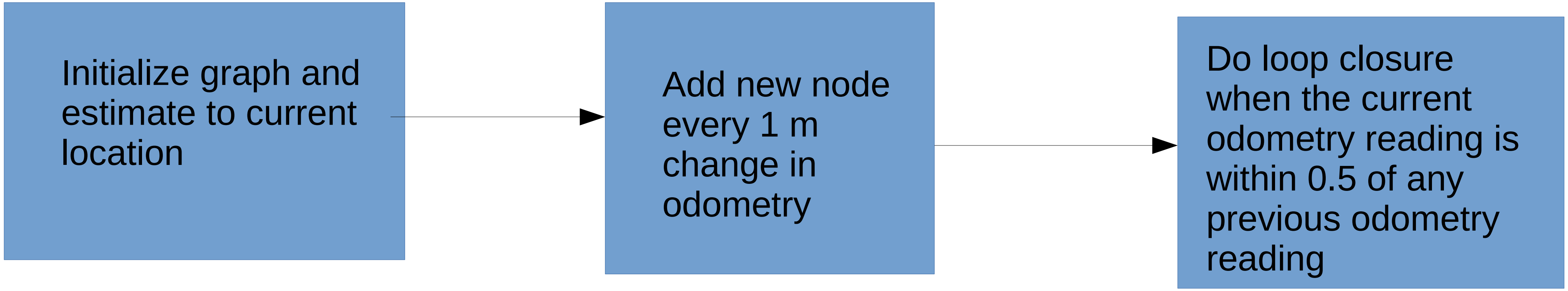
No loop closure again. 7 time steps this time to emphasize the increasing uncertainty. Start: [0, 0]



With loop closure, it can clearly be seen that the location uncertainty does not grow as much through 7 time steps as the previous image. Start [0,0]

Exercise 5: Give a brief explanation/diagram of what is the flow of the program. Include what are the relevant topics that are being published, who subscribes to them, and a high level explanation how you use this information to create your factor graph and find loop closures.

- Explanation Here



- Only subscribed to Odometry topic
- Used teleop with Fetch to move robot
- Stored previous node locations in a dictionary for loop closure