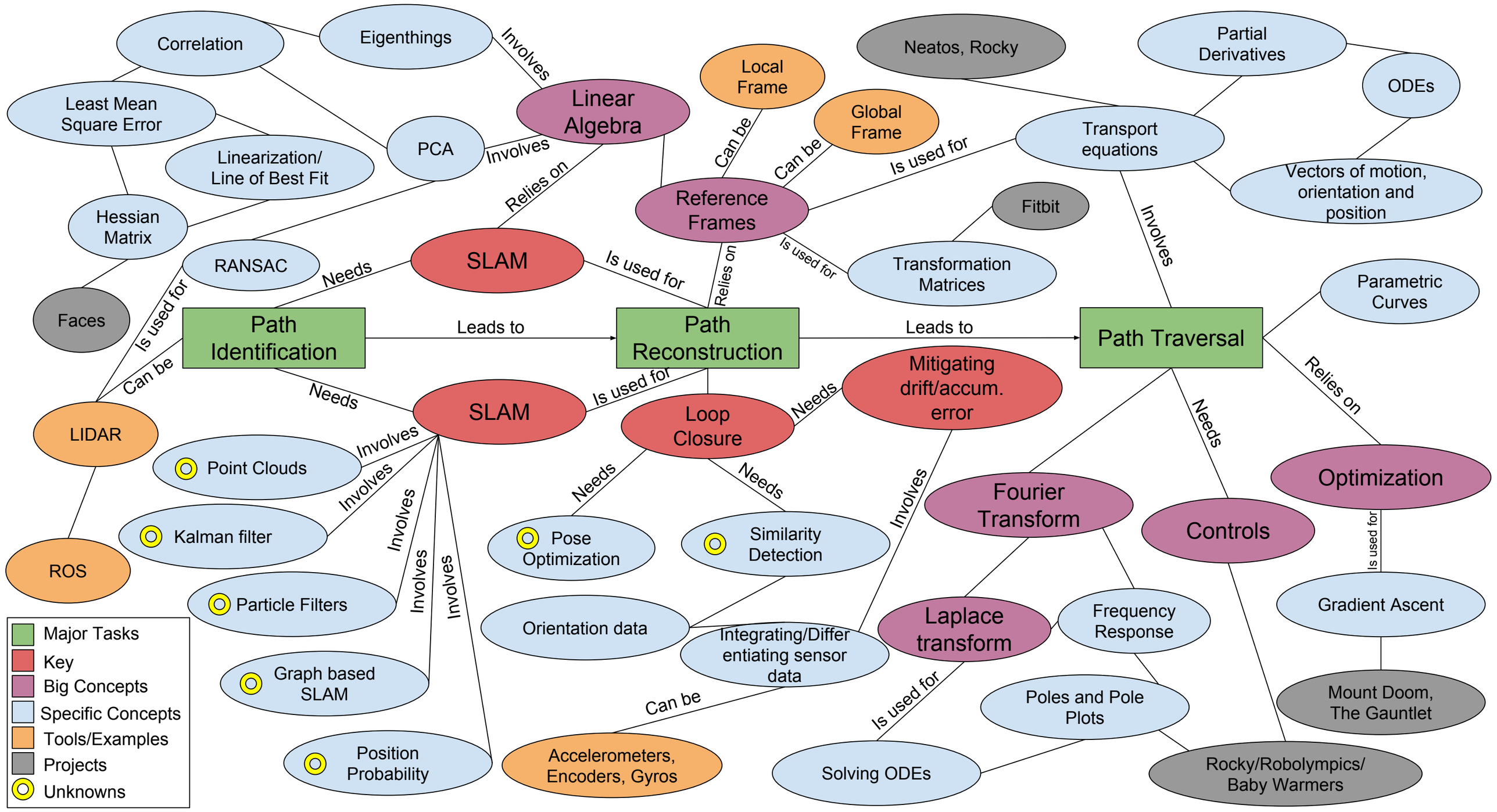
1) Overall Project Concept:
    a) Use a Neato to perform SLAM based on lidar. We want the neato to traverse and make a map for a path defined by cones.
2) Proposed Tangible Artifact:
    a) Have a Neato traverse a course of our own design and map the path that it takes
3) How does the project address the learning objectives
    a) Jon: This project is pretty heavy with linear algebra, which is something that I want to improve in and get practice with. In addition, if we have extra time, there are a lot of ways that we could expand this project and revist topics such as gradient ascent and controls. Also, self driving cars are just really cool.
    b) Naomi: This project is reliant on linear algebra for SLAM which is an area that I would like to learn more about as well as use for more applications. This project also provides me with an opportunity for computational implementation of mathematical concepts which is something that I want to get better at.
4) 5 Metrics that identify the quality of a concept map
    a) Number of concepts
    b) Number of links
    c) Number of cross links
    d) Number of hierarchy levels
    e) Number of examples
5) Digital Tool
    a) We will be using Google Drawings for our concept map. We chose Google Drawings because it is very easy to work collaboratively on this platform. In addition, Google Drawings has a simple interface with all the relevant tools needed to create an accurate and clear concept map.
6) [See image at bottom]
7) Unknowns
    a) GRAPH based SLAM - item B
    b) Particle Filters -
    c) Kalman Filters - item E
    d) Bayesian Statistics -
    e) Loop Closure - item C, item D
    f) Pose optimization -
    g) Similarity Detection -
8) Bibliography

    a) “Real-time loop closure in 2D LIDAR SLAM,” *2016 IEEE International Conference on Robotics and Automation (ICRA), Robotics and Automation (ICRA), 2016 IEEE International Conference on*, p. 1271, 2016.
    b) K. Sharma, “Improved visual SLAM: a novel approach to mapping and localization using visual landmarks in consecutive frames,” *Multimedia Tools & Applications*, vol. 77, no. 7, p. 7955, Apr. 2018.

c) H. Tian, J. Ni, and J. Hu, “Autonomous Driving System Design for Formula Student Driverless Racecar,” *arXiv:1809.07636 [cs]*, Sep. 2018.
d) N. B. Gosala *et al.*, “Redundant Perception and State Estimation for Reliable Autonomous Racing,” *arXiv:1809.10099 [cs]*, Sep. 2018.
e) “Understanding Kalman Filters, Part 1: Why Use Kalman Filters? - YouTube.” [Online]. Available: https://www.youtube.com/watch?v=mwn8xhgNpFY&list=PLn8PRpmsu08pzi6EMiYnR-076Mh-q3tWr. [Accessed: 15-Nov-2018].


Correlation
Eigenthings
Involves
Linear Algebra
Least Mean Square Error
PCA
Involves
Linearization/ Line of Best Fit
Relies on
Hessian Matrix
RANSAC
Needs
SLAM
Is used for
Faces
Is used for
Can be
Path Identification
Leads to
Path Reconstruction
Leads to
Path Traversal
Needs
SLAM
Is used for
LIDAR
Can be
Involves
Point Clouds
Involves
Kalman filter
Involves
Particle Filters
Involves
Graph based SLAM
Involves
Position Probability
ROS
Local Frame
Can be
Global Frame
Can be
Reference Frames
Relies on
Is used for
Transformation Matrices
Fitbit
Neatos, Rocky
Partial Derivatives
ODEs
Transport equations
Is used for
Vectors of motion, orientation and position
Involves
Parametric Curves
Relies on
Mitigating drift/accum. error
Needs
Loop Closure
Needs
Needs
Pose Optimization
Needs
Similarity Detection
Involves
Orientation data
Integrating/Differentiating sensor data
Can be
Accelerometers, Encoders, Gyros
Needs
Optimization
Is used for
Gradient Ascent
Mount Doom, The Gauntlet
Fourier Transform
Controls
Laplace transform
Frequency Response
Is used for
Poles and Pole Plots
Solving ODEs
Rocky/Robolympics/ Baby Warmers
Major Tasks
Key
Big Concepts
Specific Concepts
Tools/Examples
Projects
Unknowns