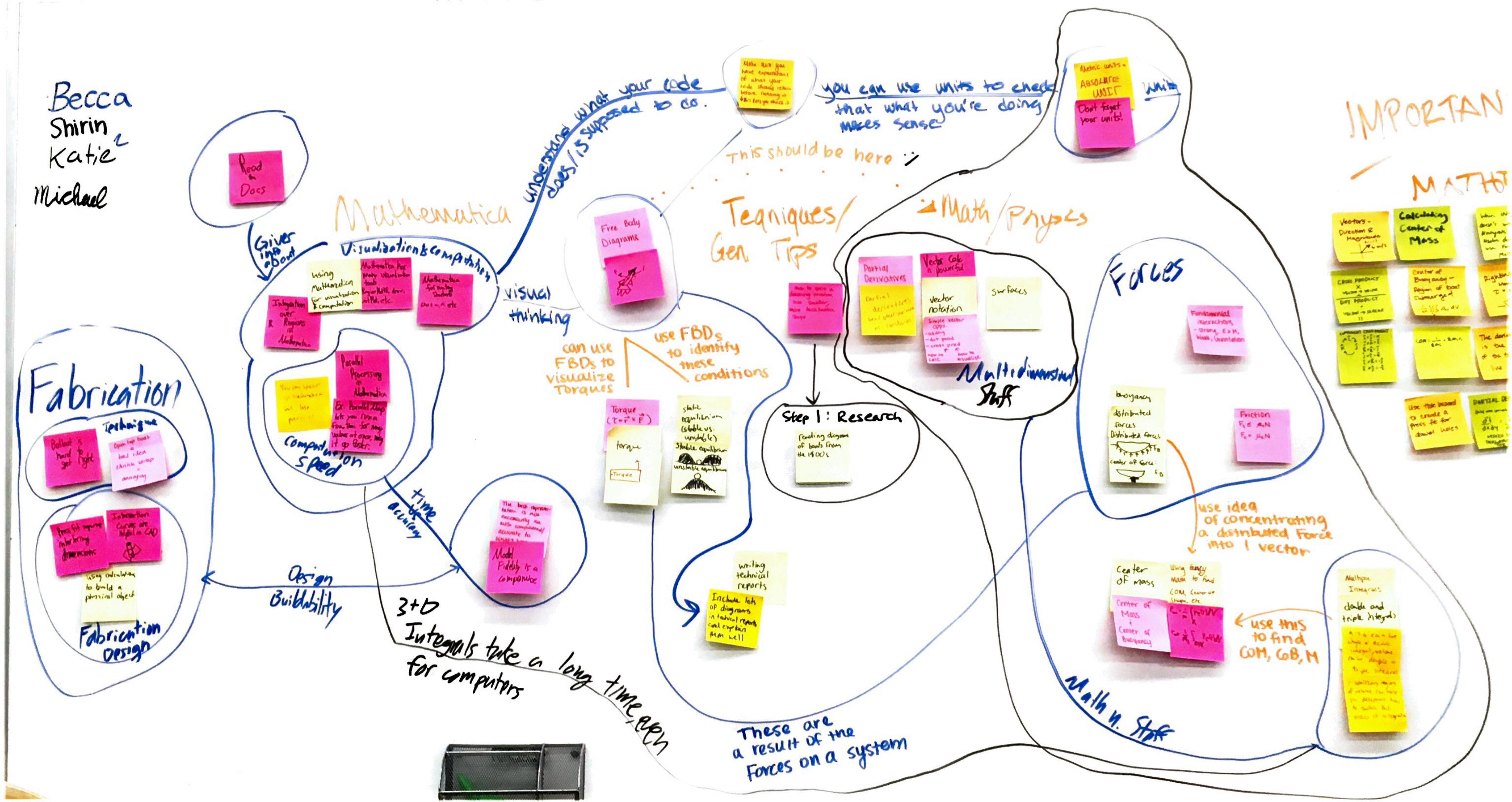
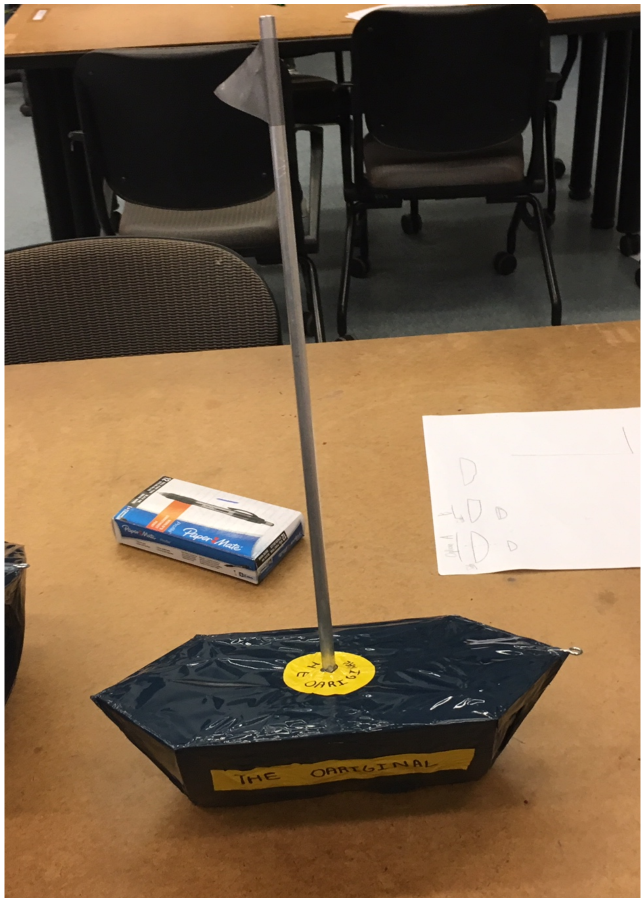


Becca
Shirin
Katie²
Michael
Read the Docs
Gives info about
Mathematica
Visualization & computation
Using Mathematica for visualization & computation
Mathematica for making Students
Integration over Regions in Mathematica
Parallel Processing in Mathematica
Computation Speed
understand what your code does / is supposed to do.
visual thinking
Free Body Diagrams
can use FBDs to visualize Torques
use FBDs to identify these conditions
Torque
torque
static equilibrium (stable vs. unstable)
stable equilibrium
unstable equilibrium
Make sure you have expectations of what your code should return before running it
you can use units to check that what you're doing makes sense
Metric units = ABSOLUTE UNIT
Don't forget your units!
Units
This should be here
Teqniques / Gen. Tips
Step 1: Research
Reading diagrams of boats from the 1900s
writing technical reports
Include lots of diagrams in technical reports and explain them well
These are a result of the Forces on a system
Math / Physics
Partial Derivatives
Vector Calc is powerful
vector notation
surfaces
Multidimensional Stuff
Forces
Fundamental interactions
buoyancy
distributed forces
Distributed Forces
center of force
Friction
use idea of concentrating a distributed Force into 1 vector
Center of mass
Using fancy Math to find COM, Center of Shape, etc.
Center of Mass + Center of Buoyancy
Multiple Integrals
double and triple integrals
use this to find COM, CB, M
Math n. Stuff
Fabrication
Technique
Ballast is hard to get right
Open top boat = bad idea
Interaction curves are helpful in CAD
Using calculation to build a physical object
Fabrication Design
Design Buildability
time vs accuracy
The best representation is not necessarily the most complicated / accurate to
Model Fidelity is a compromise
3+D Integrals take a long time, even for computers
IMPORTAN
MATH
Vectors - Direction & Magnitude
Calculating Center of Mass
CROSS PRODUCT
DOT PRODUCT
Center of Buoyancy



A) The boat’s final AVS was 180 when it was rotated in the x-y plane. We expected that AVS to be 130 degrees from our calculations in Mathematica. We think that the difference in AVS could have been due to the boat having a mass that was about 100g higher than expected. Interestingly, if the boat is rotated in the z-y plane, it has an angle of vanishing stability of about 140 degrees. At that point, it will fall over flat upside down, and then rotate in the x-y plane back up to floating upright.
B) The boat floated flat.
C) The final boat ended up being about 100-200 g heavier than we expected it to be. It also had an AVS of 180 degrees rather than 130 like the design said. It was also blue and yellow in real life, while it was not any color in the simulation.
D) We could try to plug in the measured values for the real boat into the calculations rather than trying to calculate mass and center of mass based off the boat density.