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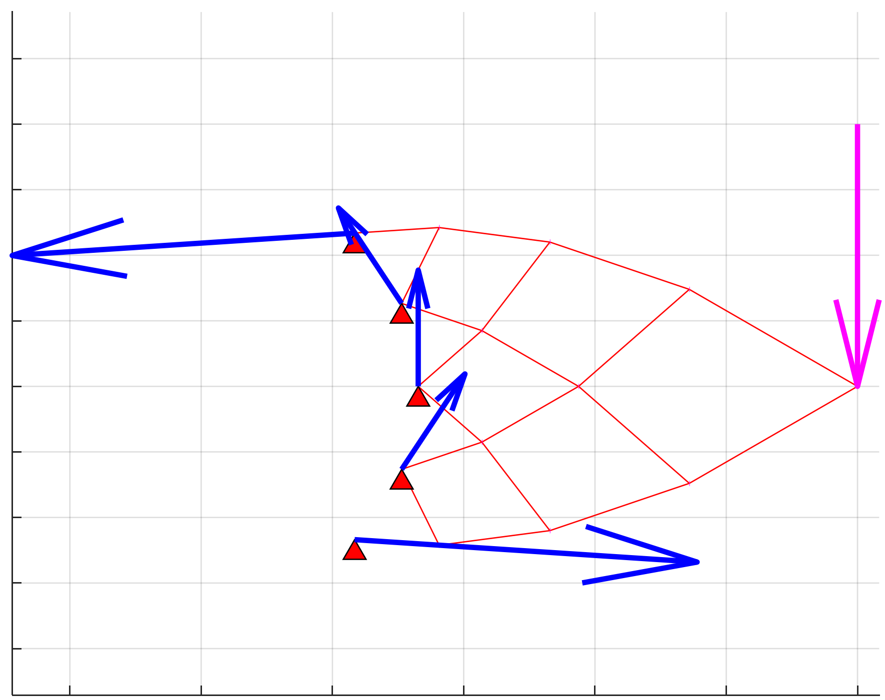
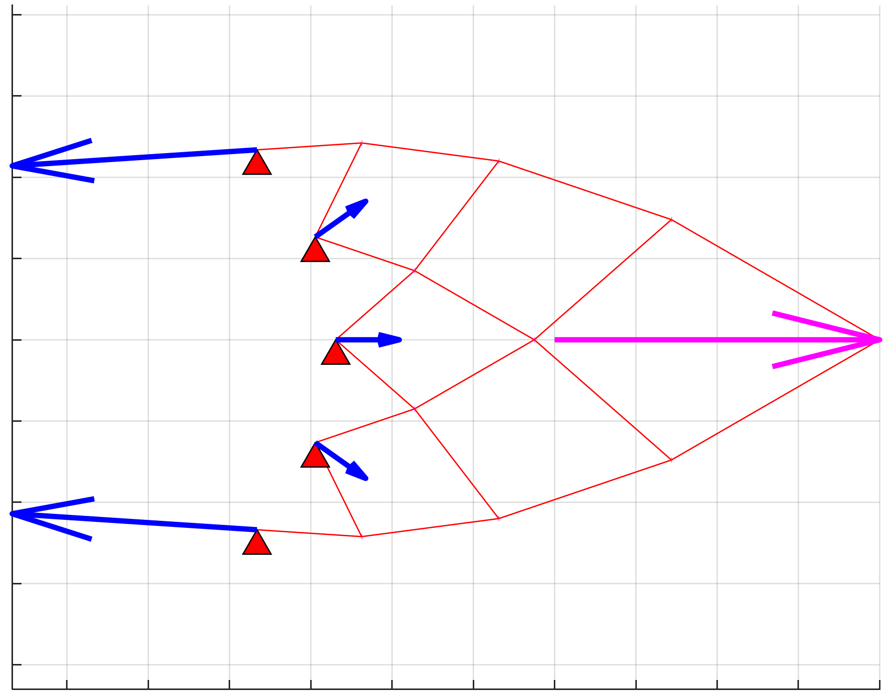
HW 1 Report

1. Mitchel Truss
   a. The structure is not potentially inconsistent. This means that there are no soft modes present in the structure.
   b. The structure is not underdetermined. This structure is statically determinant, meaning that only 1 stress distribution is possible for the given load.
   c. Discussion:

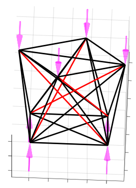
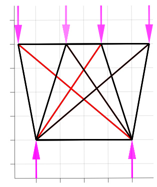
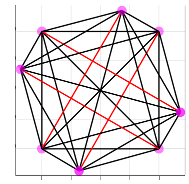


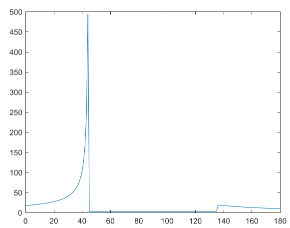
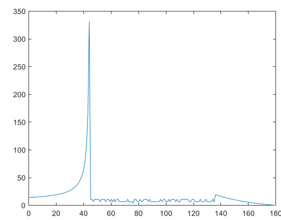
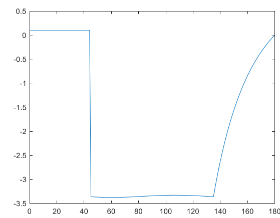
The Mitchel truss is a statically determinant design for the given input force (10 N downwards). The members in tension and in compression match that of Figure 4.6 in the book, indicating the success of the simulation. Also of note, the members on the outside of the structure bear the majority of the force (10-13 N), while the inner beams carry a significantly smaller portion (2-4 N).



With the input force in the positive x direction, the distribution of forces in the bars is more even. Load on individual beams vary from around 1 to 8 N, with the outer bars once again bearing the most force. Interestingly, the outer bars are all in tension, while the inner bars are all in tension. This distribution is once again statically determinant.

2. Nonminimal Prism
   a. With all free nodes, the structure is potentially inconsistent. This implies the presence of soft nodes, which indicate potential instability of the system with a small deviation of forces. However, when at least 3 nodes of the structure are fixed, the structure is no longer potentially inconsistent. Thus, the potential inconsistency may be due to the unconstrained spatial degrees of freedom of the structure.
   b. The structure is undetermined, meaning there are multiple different force combinations between members to counteract the input forces. These extra degrees of freedom give us flexibility to achieve a desired force distribution that meet our requirements. The structure is pretensionable, meaning under a load of 0 N on all free nodes, there is a possible force configuration where all strings are in tension.
   c. Discussion:

Nonminimal Prism (30 degree angle, compression, 80 N total)		
Profile View	Front View	Top View
		

Nonminimal Prism (0-180 degree angle, compression, 80 N total)		
Max Compression (Beams)	Max Tension (Strings)	Min Tension (Strings)
		

The performance of the Nonminimal prism is dependent on the angle between the bottom and top of the prism. From the figures above, one can see that the best performing structure is that which has a 0 degree angle between the top and bottom of the prism (all bars cross through the center). However, this configuration is not physically possible, as all of the bars pass through each other in this configuration. However, the system still performs well until around 35 degrees, where the compression in the bars and tension in the strings exponentially increase. There is instability around 42 degrees, after which maintaining tension in each of the strings is no longer possible.

Also of note, the system performs significantly better under tension than under compression. Under tension, the compression in each bar is 3.6 N (41.2 N previously), and the maximum tension in the strings is 6.4 N (26.9 N previously). These results were compared with an angle of 30 degrees.