For the planar grasp with two hard finger contacts, do the following:

$$g = \begin{bmatrix} 0 \\ -1 \\ 0 \end{bmatrix}$$
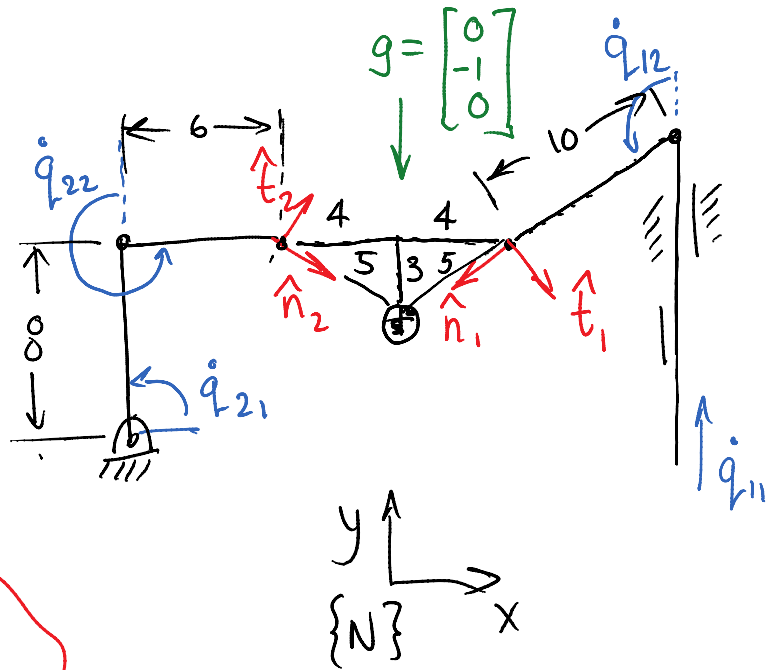
It will be helpful to use matlab for parts C, D, E, F, G, H, & I.

A. Construct G & J using the formulas given in class

B. Construct G & J by writing position kinematic equations and differentiating them w.r.t. time.

C. Draw the mapping diagram showing the 8 subspaces of G and J.   Hint: Compute Rank(G) and Rank (J)

D. Ignoring the finger kinematics, do the contacts provide enough constraint to move the object with any desired twist in $\mathbb{R}^3$?

Relate your answer to the mapping diagram.

E. $\mathcal{N}(G)$ tells us what finger tip velocities are impossible. Plot a vector of $\mathcal{N}(G)$ on the picture of the grasp and explain why such finger motions are impossible.

Relate your answer to the mapping diagram.

F. Find a set of joint efforts such that the contact forces balance the external force

AND $|\lambda_{it}| < \mu \lambda_{in}$

AND $\lambda_{in} > 0$

$\Big\}$ for $i = 1, 2$

where $\mu = 1.0$ $\longleftarrow$ μ is the friction coefficient.

G. Remove joint $(1,2)$ and repeat parts C, D, E, & F.

H. Remove joints $(1,2)$ and $(2,1)$ and repeat C, D, E, F, & G.