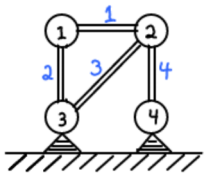
Benjamin Walter **math210**
Assignment Truss_System_Rowsp_and_Nullsp due 12/10/2021 at 02:06pm EET

Problem 1. **(1 point)** METUNCC/Applied_Math/trusses/truss-2node-4bar.pg

Consider the following truss system.



All bars are either vertical, horizontal, or at 45° from horizontal.

Enter the elongation matrix ($A = B^{\mathrm{T}}$):
(in the form "node 1 horiz", "node 1 vert", "node 2 horiz" etc.)

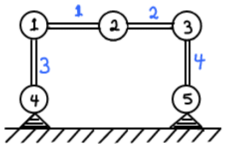
$$A = \begin{bmatrix} \_\_ & \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ & \_\_ \end{bmatrix}$$

(Remember that webwork uses **radians** for computations.)

This truss system should be stable. The matrix is square, which is good. However, you should be able to verify that A has a pivot in each column of its LU decomposition. This means that it has no nullspace.

Problem 2. **(1 point)** METUNCC/Applied_Math/trusses/truss-3node-4bar.pg

Consider the following truss system.



All bars are vertical or horizontal.

Enter the elongation matrix ($A = B^{\mathrm{T}}$):
(in the form "node 1: horiz", "node 1: vert", "node 2: horiz" etc.)

$$A = \begin{bmatrix} \_\_ & \_\_ & \_\_ & \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ & \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ & \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ & \_\_ & \_\_ & \_\_ \end{bmatrix}$$

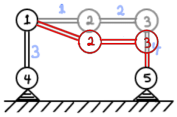
Compute a basis for the nullspace of A.

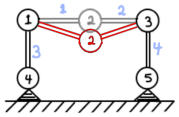
$$\text{Basis} = \left\{ \begin{bmatrix} \_\_ \\ \_\_ \\ \_\_ \\ \_\_ \\ \_\_ \\ \_\_ \end{bmatrix}, \begin{bmatrix} \_\_ \\ \_\_ \\ \_\_ \\ \_\_ \\ \_\_ \\ \_\_ \end{bmatrix} \right\}$$

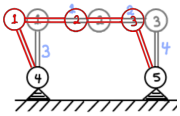
Match the following force vectors f_m with the motions they would induce and state whether they are in the nullspace of A

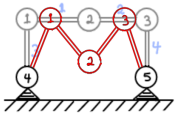
$\begin{bmatrix} 1 \\ 0 \\ 0 \\ -2 \\ -1 \\ 0 \end{bmatrix}$ Motion: [?/A/B/C/D]In nullspace? [?/Yes/No]

$\begin{bmatrix} 0 \\ 0 \\ 0 \\ -1 \\ 0 \\ -1 \end{bmatrix}$ Motion: [?/A/B/C/D]In nullspace? [?/Yes/No]


A


B

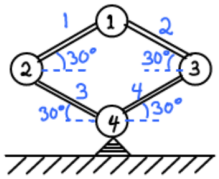

C


D

(Click on a figure to enlarge it)

Problem 3. **(1 point)** METUNCC/Applied_Math/trusses/truss-3node-4bar_diamond.pg

Consider the following truss system.



All angles are as marked.

Enter the elongation matrix ($A = B^{\mathrm{T}}$):
(in the form "node 1 horiz", "node 1 vert", "node 2 horiz" etc.)

$$A = \begin{bmatrix} \_\_ & \_\_ & \_\_ & \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ & \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ & \_\_ & \_\_ & \_\_ \\ \_\_ & \_\_ & \_\_ & \_\_ & \_\_ & \_\_ \end{bmatrix}$$

(Remember that webwork uses **radians** for computations.)

Compute a basis for the nullspace of A.

$$\text{Basis} = \left\{ \begin{bmatrix} \_\_ \\ \_\_ \\ \_\_ \\ \_\_ \\ \_\_ \\ \_\_ \end{bmatrix}, \begin{bmatrix} \_\_ \\ \_\_ \\ \_\_ \\ \_\_ \\ \_\_ \\ \_\_ \end{bmatrix} \right\}$$

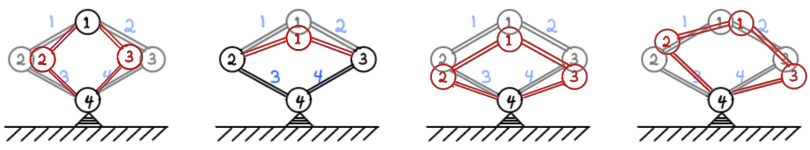
Match the following force vectors f_m the motions they would induce and state whether they are in the nullspace of A

$$\begin{bmatrix} 0 \\ -1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

Motion: [?/A/B/C/D]In nullspace? [?/Yes/No]

$$\begin{bmatrix} 0 \\ -1 \\ 0 \\ -1 \\ 0 \\ -1 \end{bmatrix}$$

Motion: [?/A/B/C/D]In nullspace? [?/Yes/No]



A B C D

(Click on a figure to enlarge it)

Problem 4. **(1 point)** METUNCC/Linear_Algebra/fund_spaces.pg

The matrix $\begin{bmatrix} 0 & 2 & 2 & 1 & 3 \\ 0 & 4 & 4 & 0 & 8 \\ 0 & -4 & -4 & 4 & -12 \end{bmatrix}$ reduces to $\begin{bmatrix} 0 & 2 & 2 & 1 & 3 \\ 0 & 0 & 0 & -2 & 2 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$.

Give bases for the following.

$$\text{Row Space} = \text{Span}\left\{ \begin{bmatrix} \_\_ & \_ & \_ & \_ & \_ \end{bmatrix}, \quad \begin{bmatrix} \_ & \_ & \_ & \_ & \_ \end{bmatrix} \right\}$$

$$\text{Column Space} = \text{Span}\left\{ \begin{bmatrix} \_\_ \\ \_ \\ \_ \end{bmatrix}, \begin{bmatrix} \_ \\ \_ \\ \_ \end{bmatrix} \right\}$$

$$\text{Nullspace} = \text{Span}\left\{ \begin{bmatrix} \_\_ \\ \_ \\ \_ \\ \_ \\ \_ \end{bmatrix}, \begin{bmatrix} \_ \\ \_ \\ \_ \\ \_ \\ \_ \end{bmatrix}, \begin{bmatrix} \_ \\ \_ \\ \_ \\ \_ \\ \_ \end{bmatrix} \right\}$$