

GEO 5500 Numerical Methods in the Geosciences
Computer Assignment #3:
Matrices and Linear Algebra

Assigned: January 26, 2005

Due: February 3, 2005

Reading: Lindfield and Penny, Chapter 2.

1. For the simple truss system shown in Figure 1, write an m-file that solves the following problems:

- a. The forces for each truss segment assuming angles α , β , γ , and δ between the trusses are $\pi/4$. (Note: the answers are given on Figure 1).
- b. Increase and decrease the angle (i.e., the bridge assumes as a progressively lower and higher profile) and plot the force changes in each segment.

2. Several samples from a gold prospect produced the following analyses:

Sample	Total Au (ppb)	pyrite (%)	orpiment (%)	organic C (%)
1	3,000	2	2	1
2	1,500	1	0	0
3	2,000	2	5	0

- a. Write a Matlab script that reads the appropriate files and calculates the amount of gold in the pyrite, orpiment, and organic carbon. Determine the condition of the resulting matrix.
- b. Repeat part (a) when the amount of carbon in sample 2 is increased to 1%. What does this say about the necessity to do accurate analysis of mineral composition?

Sample	Total Au (ppb)	pyrite (%)	orpiment (%)	organic C (%)
4	10,000	8	8	3
5	2,000	2	5	1
6	5,000	4	4	1
7	1,000	1	0	0
8	6,000	4	4	3

- c. Produce an expanded matrix for all eight samples. Comment on the rank and condition of this new matrix and how you might determine the amount of gold in the minerals using these new data.

Example 3.7 Forces in a Simple Truss

Assuming that the weight of the structure (100 kg) is localized at node 2 (bottom center of the figure), the following linear system describes the truss:

$$\begin{array}{rcccccccc}
 V_1 & & & +F_{14} \sin \alpha & & & & = & 0 \\
 H_1 & +F_{12} & +F_{14} \cos \alpha & & & & & = & 0 \\
 & & & & +F_{24} \sin \beta & +F_{25} \sin \gamma & & = & 100 \\
 & -F_{12} & & +F_{23} & -F_{24} \cos \beta & +F_{25} \cos \gamma & & = & 0 \\
 V_3 & & & & & & +F_{35} \sin \delta & = & 0 \\
 & & & -F_{23} & & & -F_{35} \cos \delta & = & 0 \\
 & -F_{14} \sin \alpha & -F_{24} \sin \beta & & & & & = & 0 \\
 & -F_{14} \cos \alpha & +F_{24} \cos \beta & & & & +F_{45} & = & 0 \\
 & & & & & -F_{25} \sin \gamma & -F_{35} \sin \delta & = & 0 \\
 & & & & & -F_{25} \cos \gamma & +F_{35} \cos \delta - F_{45} & = & 0
 \end{array}$$

The equations, in the order written, cannot be solved without pivoting.

The results of using a simple computer program for Gaussian elimination with row pivoting show that for $\alpha = \beta = \gamma = \delta = \pi/4$, we have

$$\begin{array}{l}
 V_1 = 50, \quad H_1 = 0, \quad V_3 = 50, \\
 F_{12} = 50, \quad F_{14} = -70.7, \quad F_{23} = 50, \quad F_{24} = 70.7, \\
 F_{25} = 70.7, \quad F_{35} = -70.7, \quad F_{45} = -100.
 \end{array}$$

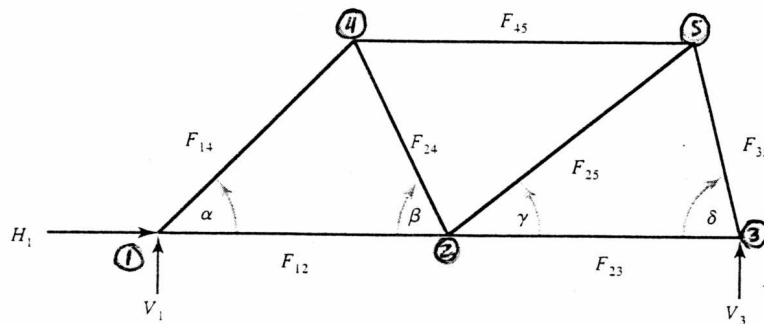


FIGURE 1 Triangular truss.