

## 24-311 NUMERICAL METHODS Fall 03

Carnegie Mellon University

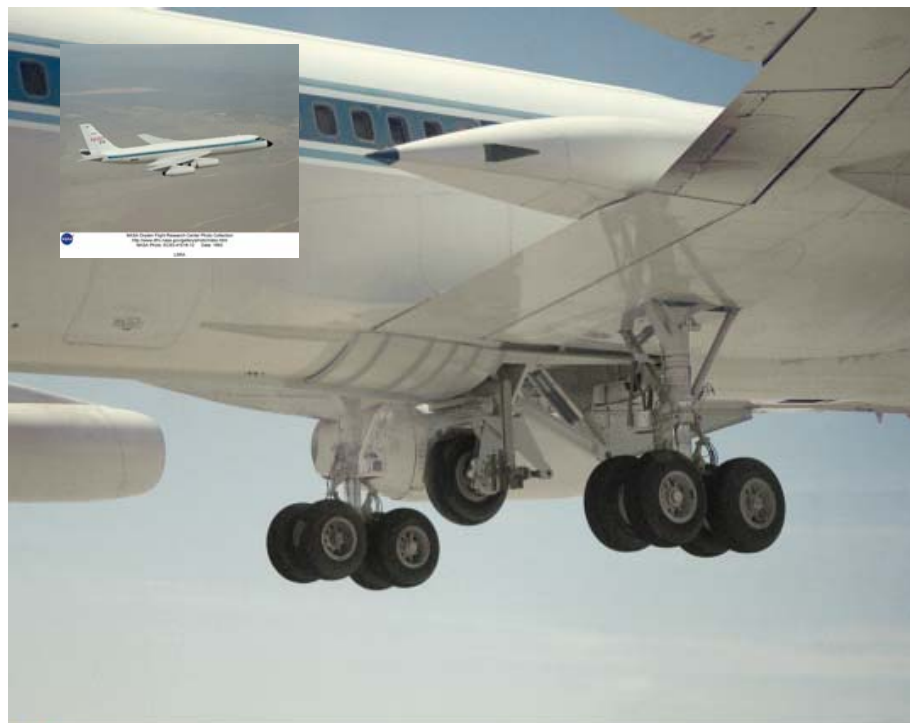
### PROBLEM SET 5

**Issued:** 9/26/03  
**Due:** 10/3/03 Friday 1:00PM @ HH B127  
**Weight:** 4% of total grade

#### PS5-1 Programming: Gauss Jordan with Partial Pivoting

You are an analysis engineer at NASA working on a new airplane landing gear, which can be modeled as a space truss. Your boss has asked you to calculate the force in each of the space truss members.

(1) Assuming that the landing gear can be modeled as a simple space truss shown in Figure 2, identify all the unknown forces, write a set of force balance equations for each of the ball joints, derive a matrix equation. The force exerted at the ball joint A by the wheel is  $F=100$  (kN). Show all the derivation process for full credit.



NASA Dryden Flight Research Center Photo Collection  
<http://www.dfrc.nasa.gov/gallery/photo/index.html>  
NASA Photo: EC93-41018-18 Date: Apr 1993

Close-up of LSRA Shuttle main gear

Figure 1: Airplane landing gear

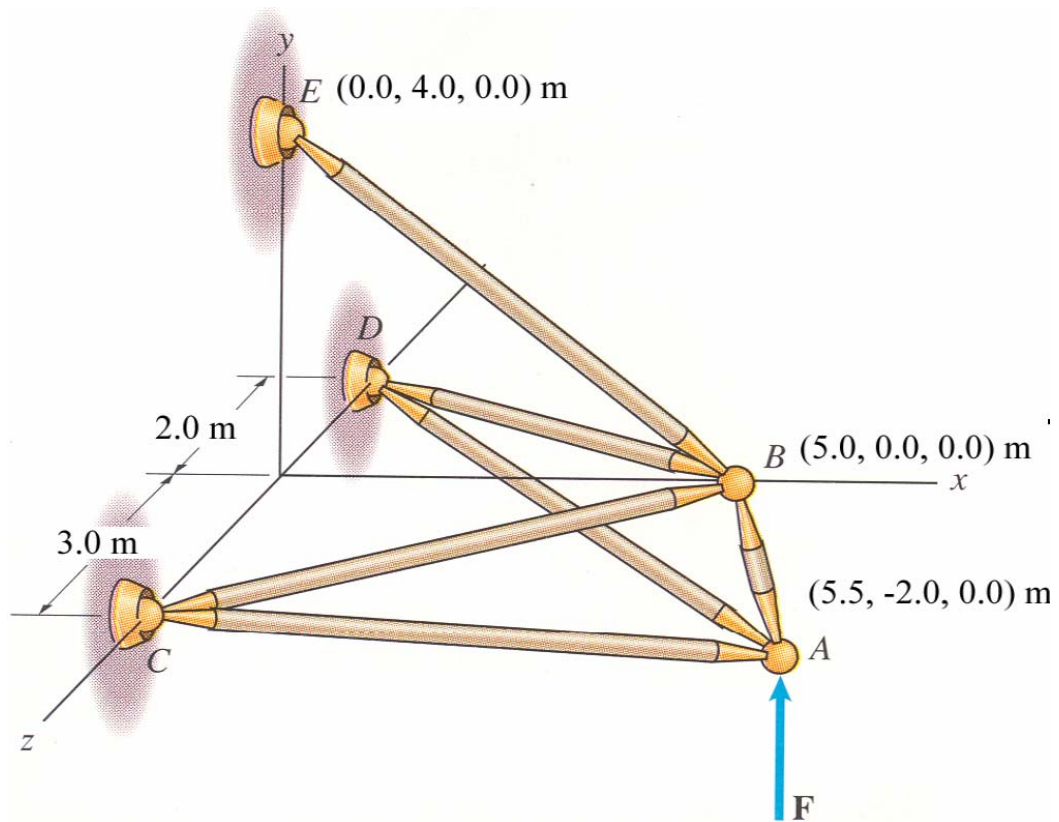


Figure 2: Space truss model of airplane landing gear

(2) Write a computer program that determines the force in each member of the truss shown in Figure 2. Use the Gauss Jordan elimination method with partial pivoting to solve the matrix equation.

To show that your program is properly implemented, the program has to generate a VRML file `output.wrl` that shows the spatial truss structure and the forces in members. Your `output.wrl` should look something like Figure 3, but the forces shown in the figure are not correct. To minimize your work to generate a VRML output, sample codes (C++ and Java) are provided on the class web. In your hand-in directory on AFS, make a new directory called `ps5` (in lower case). Hand in the following in your hand-in directory on AFS. Don't copy object files (`*.obj`, `*.o`).

- Source code files (and header file)
- Executable file
- Output VRML file named `output.wrl`

Also hand in a printout of the following:

- Source code files (and header files)
- Output VRML file
- An image of the VRML file that looks like Figure 3 (Make sure that we can read the magnitudes of the forces from these images.)

**24-311: Numerical Methods**  
**Gauss Jordan with Partial Pivoting**  
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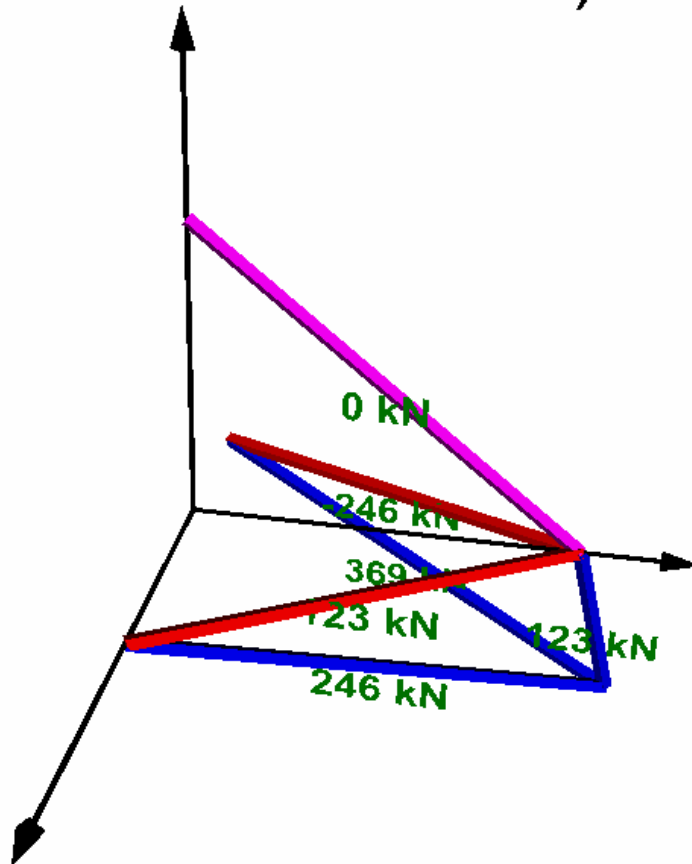


Figure 3: VRML file showing loads in truss members  
(Note: the forces shown in the figure are not correct.)

**PS5**



The first letter of  
your LAST name

\_\_\_\_\_ First Name

\_\_\_\_\_ Last Name

PS5-1 (1) (30 pts)	PS5-1 (2) (70 pts)	Total (100 pts)

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