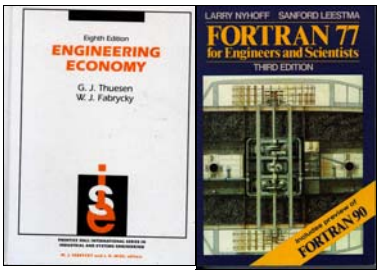
University of Maryland, College Park
Department of Civil and Environmental Engineering
ENCE 202 – Computation Methods in Civil Engineering I



Final Exam
Closed Book & Notes Exam for two hours (120 minutes)

Tuesday, May 23, 2000
8:00 am – 10:00 am, EGN 1202

Instructor: Dr. Ibrahim Assakkaf

Student Name:_____

SSN:_____

Grade:_____

Problem 1 (C Programming) (20 points)

Answer the following short-answer questions for the C program on the next page:

a. What quantity is stored in the integer variable **n**? Describe in words and write the particular value for **n** given the DATA.IN file shown on the next page.

b. Mathematically, what value is represented by the structure element **quantity**? You may describe **quantity** with mathematical equation(s), words, or both.

c. What is the first line output to the screen when running this C program with the DATA.IN file shown on the next page?

d. Explain in 1-2 sentences why we use dynamic memory allocation for both the **varray** variable and the **v** *my_vector* structure element.

e. Debugging is an important part of programming in any language. What error do you see if you have mistakenly typed the line fscanf(inptr,"%d",&n); as fscanf(inptr,"%d",n); ? When does this error occur, during compilation (with *gcc*) or program execution?

Example DATA.IN File for Problem #1:

```
3
4  1.0  1.0  1.0  1.0
5  1.2  -1.9 2.1  4.0 2.2
3  –0.1  0.2  0.4
```

Problem #1 C Program:

```
#include <stdio.h>
#include <math.h>

struct my_vector
{
  int length;
  float *v;
  float quantity;
};

main()
{
  FILE *inptr;
  int i, j, n;
  struct my_vector *varray;

  inptr = fopen("DATA.IN","r");
  fscanf(inptr,"%d",&n);
  varray = (struct my_vector *) malloc(n * sizeof(struct my_vector));

  for (i=0;i<n;i++) {
    fscanf(inptr,"%d", &(varray[i].length));
    varray[i].v = (float *) malloc(varray[i].length * sizeof(float));

    varray[i].quantity = 0.0;
    for (j=0;j<varray[i].length;j++) {
      fscanf(inptr,"%f", &(varray[i].v[j]));
      varray[i].quantity += varray[i].v[j] * varray[i].v[j];
    }
    varray[i].quantity = sqrt(varray[i].quantity);
    printf("quantity[%d] = %7.3f\n", i, varray[i].quantity);
  }

  fclose(inptr);
}
```

Problem 2 (MATLAB) (20 points)

In the structure shown in Figure 1 below, six wires support three beams. Wires 1 and 2 can support no more than 1200 newtons each, wires 3 and 4 can support no more than 400 newtons each, and wires 5 and 6 no more than 200 newtons each. Three equal weights W are attached at the points shown. Assuming that the structure is stationary and that the weights of the wires and the beams are very small compared to W, the principles of statics applied to a particular beam state that the sum of vertical forces is zero and that the sum of moments about any point is also zero. Applying these principles to each beam using the free body diagrams shown in Figure 2, we obtain the following equations. Let the tension force in wire *i* be T_i.

For beam 1

$$T_1 + T_2 = T_3 + T_4 + W + T_6$$
$$-T_3 - 4T_4 - 5W - 6T_6 + 7T_2 = 0$$

For beam 2

$$T_3 + T_4 = W + T_5$$
$$-W - 2T_5 + 3T_4 = 0$$

For beam 3

$$T_5 + T_6 = W$$
$$-W + 3T_6 = 0$$

Write a Matlab program to find the maximum value of the weight W the structure can support. Remember that the wires cannot support compression, so T_i must not be negative

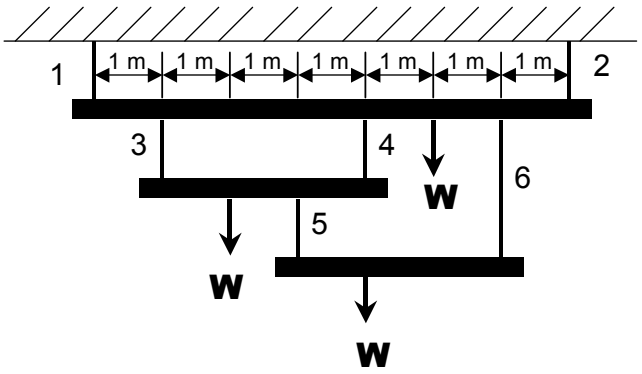


Figure 1. Structure for MATLAB Problem #2

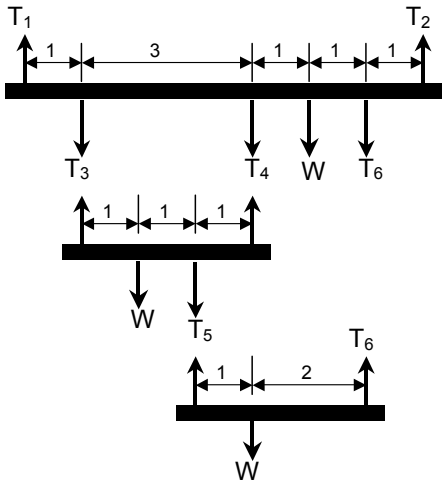


Figure 2. Free-body Diagram for MATLAB Problem #2

Problem 3 (**FORTRAN**) (20 points)

Part A: TRUE or FALSE

1. The condition in an IF statement must consist of three variables. _____
2. DO 1000 I = 1500, 6000, 1500 is a valid DO statement. _____
3. Subroutine subprograms are called with a CALL statement. _____
4. A subroutine normally returns a single value. _____
5. A GO TO statement may only jump backward in the program. _____
6. The English meaning of the variable name determines how the variable is used in the program. _____
7. The condition in an IF statement must be a relationship that can be evaluated as either true or false. _____
8. You must not leave room for minus sign in an output field. _____
9. In Fortran, REAL and INTEGER are the only types of data. _____
10. In FORTRAN, the equal sign means that the quantities to its left and right are identical. _____

Part B: Multiple Choice

1. What is the output of this program segment?

```
I = 1
IF (I .GT. 0) THEN
PRINT *, ` CD`
ELSE
PRINT *, ` DC`
END IF
```

Answer: _____

(a) CD (b) DC (c) CDCD (d) CDDC

2. After the assignment statement A = 2**2 / SQRT(4) is executed, the value of A will be

Answer: _____

(a) 4 (b) 8 (c) 2 (d) 1

3. Which of the following are valid words in FORTRAN Language?

I. DISCARD
II. READ
III. EXECUTE

Answer: _____

(a) I only (b) II only (c) III only (d) I, II, and III

4. The statements in the following program segment result in reading X column-wise. If we read 13, 14, 18, 19, 21, and 25 the result will be the following matrix:

```
INTEGER X(2,3)
READ *, X
```

Answer: _____

(a) $\begin{bmatrix} 21 & 18 & 13 \\ 25 & 19 & 14 \end{bmatrix}$ (b) $\begin{bmatrix} 13 & 18 & 21 \\ 14 & 19 & 25 \end{bmatrix}$ (c) $\begin{bmatrix} 13 & 19 \\ 14 & 21 \\ 18 & 25 \end{bmatrix}$ (d) $\begin{bmatrix} 19 & 13 \\ 21 & 14 \\ 25 & 18 \end{bmatrix}$

5. Which of the following can be used to declare an array capable of storing a total of 18 values?

Answer: _____

(a) A(12) (b) B (3,4) (c) C (2,3,3) (d) D (2,2,2,2)

Problem 4 (FORTRAN) (20 points)

(1) Identify and correct errors (if any) in the following program:

```
PROGRAM SUM
READ *, A,B
X = SUM (A,B)
Y =  SUM (A**2, B**2)
PRINT *, A, B, X, Y
END
SUBROUTINE SUM (T, V)
RETURN
END
```

(2) What would be the values of X, Y, XVAL, YVAL, and XPRIME after the CALL statement is executed in the following program?

```
PROGRAM FINAL
X = 3.0
Y = 5.0
CALL POLY (X, Y, XVAL, YVAL, XPRIME)
.
.
END
SUBROUTINE POLY (A, B, C, D, E)
C = A**2+4.0*A-5.0
D = SQRT(B) + 3.0
E = 2.0*A+4.0
A = C/E
RETURN
END
```

Problem 5 (Engineering Economics) (20 points)

(1) A construction company is considering the purchase of either a new scraper for $185,400, which has an 8-year life with an estimated net annual income of $58,000 and a salvage value of 10% of the purchase price, or a used excavator for $65,200, with an estimated life of 4 years and no salvage value and an estimated net annual income of $35,000. Major repairs of $14,000 for the used scraper are expected after two years of use. Based on the net present worth (NPW) analysis and equal replacement conditions (costs and incomes), which scraper should the company choose if its MARR is 20%? Draw the cash flow diagrams and justify your answer.

(2) A piece of equipment is available for purchase for $12,000, has an estimated useful life of 5 years, and has an estimated salvage value of $2,000. Determine the depreciation and the book value for each of the five years using the straight line (SL) method. (NOTE: construct a table showing the values for depreciation and book value for each year)