Supplementary Problems

1.18 Construct an algorithm and a flowchart to output the values of three variables, x, y, and z.

1.19 Construct an algorithm and a flowchart to show that for $a = 2.13$ and $b = 1.3$, the following trigonometric identity holds for the tangent function, tan (x).

$$\tan(a + b) = \frac{\tan(a) + \tan(b)}{1 - \tan(a)\tan(b)}$$

1.20 Construct an algorithm and a flowchart to calculate the apparent difference in ages between twins separated at birth. One is kept on earth while the other one is placed on a rocket ship traveling to the nearest star, Alpha Centauri, which is 4.8 light years away. Assume that the ship travels at 0.96 times the speed of light and that the trip takes 5 earth years. The age of the twin (to an earth observer) is given by

$$t_m = t_s\left[1 - \left(\frac{v}{c}\right)^2\right]^{1/2}$$

where t_m = elapsed time measured on the moving object
t_s = elapsed time measured on the earth
v = velocity of the rocket
c = speed of light.

1.21 Construct an algorithm and a flowchart to calculate the current I in a diode (an electrical device), at any applied voltage V if the diode characteristics are given by

$$I = I_0(e^{kV} - 1) \qquad \text{for } V \geq V_R$$
$$I = -I_0(e^{-kV} - 1) \qquad \text{for } V < V_R$$

where I_0, V_R, and k are constants.

1.22 Construct an algorithm and a flowchart to read in four whole numbers and determine how many of the numbers are equal to any of the other numbers in the group.

1.23 Construct an algorithm and a flowchart to issue grades to students. Use the following criteria:

if score is between 90 and 100, then grade = A
if score is between 89 and 80, then grade = B
if score is between 79 and 70, then grade = C
if score is between 69 and 60, then grade = D
if score is below 60, then grade = F.

1.24 Construct an algorithm and a flowchart to determine if a number is positive, negative or zero. Use a select case structure to make the decisions.

1.25 Construct an algorithm and a flowchart to read in two whole numbers and find the sum of all *odd* numbers between these two. Include in the sum both numbers if they are odd.

1.26 Construct an algorithm and a flowchart to compute the terms in the following series:

1 1 2 3 5 8 13 21 34 55 89 144 233 ...

The first two numbers are 1 and 1. All the other terms are determined by adding the previous two terms. Calculate n terms of this series, where n is read into the program.

1.27 Construct an algorithm and a flowchart to read in a number x and repeatedly divide it by 2 until the result is smaller than 0.001. Print out how many divisions it took.

1.28 Construct an algorithm and a flowchart to calculate the terms in this series:

$$a = 2\left[1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{5} - \cdots\right]$$

Calculate the series until any one term is less than 0.1% of the value of the sum of the previous terms. Note that the sign of each term alternates.

1.29 Construct an algorithm and a flowchart to calculate the value of a, where

$$a = \frac{x - y}{x^y} - \frac{y - x}{y^x}$$

for values of $x = 1, 2, 3, \ldots, 10$ and for values of $y = 0.1, 0.2, 0.3, \ldots, 1.0$.

1.30 Construct an algorithm and a flowchart for a main program and a module to receive two numbers and determine which one is greater.

1.31 Construct an algorithm and a flowchart for a module to approximate the sine of an angle:

$$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots$$

Then use this module to test the identity $(\sin(3a) = 3\sin(a) - 4\sin^3(a))$ for $a = 1, 2, \ldots, 5$.