Homework Assignment 2

Section___________________

Student ID_________________________Name (Print)__________________________

Review of Chap2, logical data and operators

Chapman exercise 2.22, 2.23, 2.25, and 3.1, 3.3(added on 9/17/08)
Due Sep, 19, 2008 5pm
You need to turn in:
- Source code ( or .f95 files ) for 2.22, 2.23, 2.25 and 3.3 to Tony ytian@olemiss.edu
- Hardcopies of program plans for 2.22, 2.23, 2.25, and 3.3
- Hardcopies of your answer to 3.1
- Hardcopies can be dropped off at Weir 217
Solution
2-22) **Decibels**: Engineers often measure the ratio of two power measurements in **decibels**, or dB. The equation for the ratio of two power measurements in decibels is

\[ dB = 10 \log_{10} \left( \frac{P_2}{P_1} \right) \]

where \( P_2 \) is the power level being measured, and \( P_1 \) is some reference power level. Assume that the reference power level \( P_1 \) is 1 milliwatt, and write a program that accepts an input power \( P_2 \) and converts it into dB with respect to 1-mW reference level.

a) **Program planning:**
- **Problem statement**: Convert input power in milliwatte unit to decibles unit relative to 1 mw.
- **Program input**: Power value in milliwatte, \( p_2 \)
- **Program output**: Power value in dB given user input of \( p_2 \)
- **Algorithm**
  - Get user input of \( p_2 \) from the keyboard, read(*,*) \( p_2 \)
  - Calculate the dB value of \( p_2 \) using the intrinsic function as follows
    \[ p_2dB = 10 \log_{10}(p_2) \]
  - Write the result to the monitor, write(*,*) \( p_2dB \)
- **Testing plan**
  - input \( p_2 = 1000 \), output \( p_2dB = 30 \)

b) **Source code**: 2-22.f95

```fortran
!Chapman 2-23, implement hyperbolic cosine function
! \text{cosh}(x) = \frac{\text{exp}(x) + \text{exp}(-x)}{2}
! And compare the result with that from Fortran intrinsic function cosh
!The value x is from user input
!Test on x of 3.0

program hyperbolicCosine
  implicit none
  real::x=0, myResult=0

  write(*,*) "Please enter x:"
  read(*,*) x
  myResult = (exp(x)+exp(-x))/2
  write(*,*) "myResult=", myResult
  write(*,*) "intrinsic function result is ", cosh(x)
end program
```

2-23) **Hyperbolic cosine**: The hyperbolic cosine function is defined by the equation

\[ \cosh x = \frac{\exp(x) + \exp(-x)}{2} \]

Write a Fortran program to calculate the hyperbolic cosine of a user-supplied value \( x \). Use the program to calculate the hyperbolic cosine of 3.0. Compare the answer that your program produces to the answer produced by the Fortran intrinsic function \( \text{COSH}(x) \).

a) Program planning:
- **Problem statement**
  Implement hyperbolic cosine using exponential function, and compare result to the Fortran intrinsic function result.
- **Program input**
  value of \( x \)
- **Program output**
  exponential-based implementation result of \( \cosh(x) \), \( \text{myResult} \)
  Fortran intrinsic function result, \( \text{cosh}(x) \)
- **Algorithm**
  - Get user input of \( x \) from the keyboard, \( \text{read}(\ast,x) \)
  - Calculate exponential-based \( \cosh(x) \)
    \( \text{myResult} = (\exp(x) + \exp(-x))/2 \)
  - Write the result to the monitor, \( \text{write}(\ast,x) \ \text{myResult} \)
  - Write the intrinsic function result, \( \text{write}(\ast,x) \ \text{“Intrinsic”, cosh}(x) \)
- **Testing plan**
  input \( x = 3.0 \), output \( \cosh(x) = 10.06766 \)

b) **Source code**: 2-23.f95

```fortran
! Chapman 2-23, implement hyperbolic cosine function
! cosh(x)=(exp(x)+exp(-x))/2
! And compare the result with that from Fortran intrinsic function cosh
! The value x is from user input
! Test on x of 3.0
program hyperbolicCosine
  implicit none
  real::x=0, myResult=0
  write(\ast,x) "Please enter x:"
  read(\ast,x) x
  myResult = (exp(x)+exp(-x))/2
  write(\ast,x) "myResult=", myResult
  write(\ast,x) "intrinsic function result is ", cosh(x)
end program
```

Please enter \( x \):
3
myResult = 10.06766
intrinsic function result is 10.06766
Radio Recevier: A simplified version of the front end of an AM radio receiver consists of an RLC tuned circuit containing a resistor, capacitor, and an inductor connected in series. The RLC circuit is then connected to an external antenna and ground. The tuned circuit allows the radio to select a specific station out of all the stations transmitting on the AM band. At the resonant frequency of the circuit, essentially all of the signal V0 appearing at the antenna appears across the resistor, which represents the rest of the radio. In other words, the radio receives its strongest signal at the resonant frequency. The resonant frequency of the LC circuit is given by the equation

\[ f_0 = \frac{1}{2 \pi \sqrt{LC}} \]

where \( L \) is inductance in henrys (H) and \( C \) is capacitance in farads (F). Write a program that calculates the resonant frequency of this radio set, given specific values of \( L \) and \( C \). Test your program by calculating the frequency of the radio when \( L = 0.1 \text{ mH} \) and \( C = 0.25 \text{ nF} \).

a) Program planning:
- Problem statement
  - Implement resonant frequency calculation for an RLC circuit
- Program input
  - value of \( L \) in milli-henrys
  - value of \( C \) in nano-farads
- Program output
  - The resonant frequency \( f \)
- Algorithm
  - Get user input of \( L \) and \( C \) from the keyboard, read(*,*) L,C
  - Calculate \( f \)
    \[ f = \frac{1}{2 \pi \sqrt{LC}} \]
    Needs to declare a constant \( \pi \) for this statement
  - Write the result to the monitor, write(*,*) f
- Testing plan
  - input \( L=0.1 \text{ mH} \), \( C=0.25 \text{ nF} \), output \( f=1\text{MHz} \)
b) Source code: 2-25.f95

```
!Chapman 2-25, radio receiver
! calculate resonant frequency f0 given user input of inductance L and
! capacitance C as follows
! f0 = 1/(2*pi*sqrt(L*C))

program resonantFrequency
implicit none
real,parameter::Pi=3.14159265
real::L=0,C=0,f=0

write(*,*) "Please enter inductance L in mH, &
and then capacitance C in nF:"
read(*,*) L,C
L = L / 10**3
C = C / 10**9
f = 1/(2*pi*sqrt(L*C))
write(*,*) "resonantFrequency=", f
end program
```

```
./a.out
Please enter inductance L in mH, and then capacitance C in nF:
0.1 0.25
resonantFrequency= 1006584.
```
3-1) Which of the following expressions are legal in Fortran? If an expression is legal, evaluate it.
(a) 5.5 >= 5 legal, .true.
(b) 20 > 20 legal, .true.
(c) .NOT. 6>5 legal, .false.
(d) .TRUE. > .FALSE. illegal
(e) 35 / 17. > 35 / 17 legal, .true.
(f) 7 <= 8 .EQV. 3 / 2 == 1 legal, .true.
(g) 17.5 .AND. (3.3 > 2.) illegal

3-3) Write the Fortran statements required to calculate \( y(t) \) from the equation
\[
y(t) = \begin{cases} 
-3t^2 + 5 & t \geq 0 \\
3t^2 + 5 & t < 0 
\end{cases}
\]
for a user-supplied value of \( t \).
a) Program planning:
- Problem statement
  Implement the function \( y(t) \) using branching construct
- Program input
  value of \( t \)
- Program output
  value of \( y(t) \), \( y \)
- Algorithm
  - Get user input of \( t \) from the keyboard, read(*,*) \( t \)
  - Calculate \( f \)
    - if ( \( t \geq 0 \) ) then
      \( y = -3t^2 + 5 \)
    else
      \( y = 3t^2 + 5 \)
  end if
  - Write the result to the monitor, write(*,*) \( y \)
- Testing plan
  input \( t = 1 \), output \( y = 2 \)
  input \( t = -1 \), output \( y = 8 \)
b) Source code: 3-3.f95

```fortran
! Chapman 3-3, implement function y(t)
! y(t) = | -3*t^2+5,  if t >= 0
!        | 3*t^2+5,   if t < 0
! the value of t is assigned from user input

program yoft
  implicit none
  real::y=0,t=0

  write(*,*) "Please enter the value of t:"
  read(*,*) t
  if ( t >= 0 ) then
    y = - 3*t*t+5
  else
    y =  3*t*t+5
  end if
  write(*,*) "y(t)=", y
end program
```

```
./a.out
Please enter the value of t:
1
  y(t)= 2.000000
[jxue@backus ~hw2]$ ./a.out
Please enter the value of t:
-1
  y(t)= 8.000000
```