FORTRAN 90

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Complex Numbers

A complex number is a number z of the form z = x + iy, where x and y are real numbers, and **i** is another number such that $\mathbf{i^2 = -1}$.

When z = x + iy as above, x is called the *real part* of z, and y is called the *imaginary part* of z. We often write yi instead of iy. For example, 3 + i2 = 3 + 2i, and the real part of 3 + 2i is **3** and the imaginary part of 3 + 2i is **2**.

Addition and Multiplication of Complex Numbers

ADDITION: Two complex numbers are added simply by adding to-gather their real parts and imaginary parts:
For example, (3 + 2i) + (4 − 6i) = (7 − 4i).

MULTIPLICATION:. For example, we will have

$$(2 + 3i)(4 + 5i) = 2(4 + 5i) + 3i(4 + 5i)$$
$$= 8 + 10i + 12i + 15i2$$
$$= 8 + 10i + 12i - 15$$
$$= -7 + 22i .$$

Complex conjugate

If z = x + iy, the complex conjugate of z is the complex number defined by $\bar{z} = x - iy$.

Complex number in fortran 90

- **Complex** : Two real number stored as a pair and treated as the real and imaginary parts of a complex number.

Examples:

(1.234,-6.5E-3)

Where in this example, 1.234 is the real part of the complex constant and -0.0065 is the imaginary component.

EXAMPLE

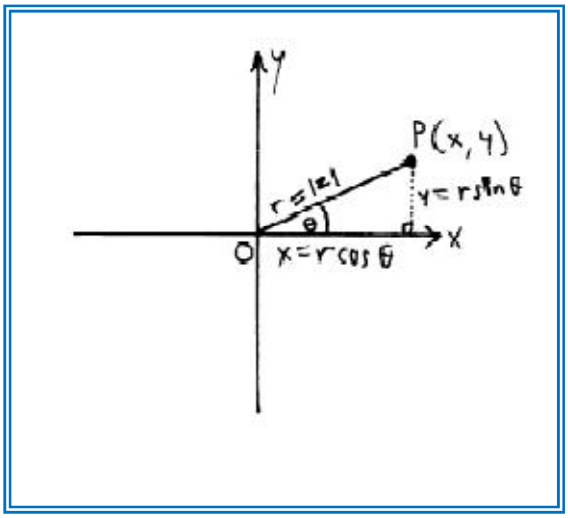
Write a fortran 90 program to addition and multiplication two complex numbers x & y, also find the conjugate of x , i*x*y, and print the real and imaginary part of y.

Assume x=1+ i , y= 1-i

```
program complex_no
implicit none
complex:: x,y,i
x=(1,1)
y=(1,-1)
i=(0,-1)
write(*,5)x+y
5 format(2x,2f9.5)
write(*,6) conjg(x),i*x*y
6 format(2x,2f9.5,2x,2f9.5)
!print real part of y by real( )
write(*,7) real(y)
7 format (2x,f9.5)
```

```
!print imaginary part of y by imag( )
write(*,7) imag(y)
end
```

Modulus (Distance OP)



Denoted by r, mod z, |z|, |x + iy|

by Pythagoras, $r^2 = x^2 + y^2$

$$r = \sqrt{x^2 + y^2}$$

$$r = |z| = |x + iy| = \sqrt{x^2 + y^2}$$

In fortran 90 the intrinsic function ***cabs (z)*** given the modulus of complex number z.

Argument (angle θ)

Denoted by θ, arg z, arg (x + iy)

for x # 0, **tan θ = y/x .**

write a fortran 90 program to calculate the modulus and argument of z=5-4i by function subprograms.

```
program complex_ma
implicit none
complex:: z
real:: ,modulus , argument
read(*,*)z
write(*,5)modulus(z)
write(*,*)"***************"
write(*,5)argument(z)
```

```
5 format(2x,f10.5)          ;       end
real function modulus (z)
implicit none
complex::z
modulus=cabs(z)
end

real function argument(z)
implicit none
real,parameter::pi=3.14159
real::theta
complex::z
theta= atan(imag(z)/real(z))
argument=(theta*180)/pi
end
```

Complex Array

$$A=\begin{vmatrix} 2+5i & 3 \\ 1-2i & 3+2i \end{vmatrix} \quad , \quad B=\begin{vmatrix} 2+5i & 3-4i \\ 1+2i & 11-7i \end{vmatrix}$$

You can add, subtract, multiply,… these two matrices

Write a fortran 90 program to add these two matrices

```
program complex_ma
implicit none
complex,dimension(2,2)::a,c,b
integer::i,j
data a/(2,5),(1,-2),(3,0),(3,2)/
read(*,*)((b(i,j),j=1,2),i=1,2)
c=a+b
write(*,5)((c(i,j),j=1,2),i=1,2)
5 format(2(2x,2f9.5))
end
```