Algorithms

After identifying and fully understanding a problem, you will set up a number of steps that need to be followed logically to reach an answer. This arrangement of steps/actions/statements is an algorithm. One usually writes this on pen and paper.

Example:
Imagine you have a picture of stars and you would like to know how the vertical and horizontal positions on the paper (i.e. the Cartesian coordinates x,y) are mapped onto the sky in RA and DEC.

Algorithm:

1) Get the stars x and y positions
2) Identify a few reference stars (more than 2) that you know their RA and DEC from catalogs.
3) Using the reference stars to find the coefficients a, b, c, d, e, f that transform x,y into RA,DEC:
   a. RA = x + ax + by + c
   b. DEC = y + dx + ey + f
      This is a matrix multiplication:

$$\begin{bmatrix} RA \\ DEC \end{bmatrix} = \begin{bmatrix} a & b \\ d & e \end{bmatrix} \times \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} c \\ f \end{bmatrix}$$

4) Apply the transformation to all the stars in your image.

IF and WHILE conditional statements

IF: Say you want to perform a calculation only when a condition is met, e.g. when x>0.5. In this case, use the "if" statement.

```
x = int(input("Enter a whole number no greater than ten: "))

if  x>10:
        print("ERROR: You entered a number greater than ten.")

print("Your number is ",x)
```

ALTERNATIVELY:

```
x = int(input("Enter a whole number no greater than ten: "))

if  x>10:
        print("ERROR: You entered a number greater than ten.")
elif  x<0:
        print("ERROR: You entered a number is not whole.")

print("Your number is ",x)
```

ALTERNATIVELY:

```
x = int(input("Enter a whole number no greater than ten: "))

if  x>10:
        print("ERROR: You entered a number greater than ten.")
elif  x<0:
        print("ERROR: You entered a number is not whole.")
else:
        print("Your number is ",x)
```

ALTERNATIVELY:

```
x = int(input("Enter a whole number no greater than ten: "))

if  x>10 or x<0:
        print("ERROR: You entered an incorrect number.")

print("Your number is ",x)
```

Try the above examples.

A word on indentation!

WHILE:

Let's say you want to get from the user a number between 0 and 10 (same as last problem) but you will not quit until he/she enters a correct one. In this case, you could use a loop that keeps on asking the same question until done.

```
x = int(input("Enter a whole number no greater than 10: "))
while x>10:
      print("Wrong number")
      x = int(input("Enter a whole number no greater than 10: "))
print("Your lucky number is ",x)
```

Getting out of the loop – break and continue

To get out of a while loop, you can use the break statement:

```
x=int(input("Enter a whole number no greater than 10: "))
while x>10 or x<0:
    print("ERROR")
    x=int(input("enter :"))
    break
    print("New chance")
print(x)
```

To get out of a while loop, you can use the break statement:

```
x=int(input("Enter a whole number no greater than 10: "))
while x>10 or x<0:
    print("ERROR")
    x=int(input("enter :"))
    continue
    print("New chance")
print(x)
```

Test the behavior of the above code by checking what happens when you enter correct and incorrect numbers.

```
x=int(input("Enter a whole number no greater than 10: "))
while x>10 or x<0:
    print("ERROR")
    x=int(input("enter :"))
    print("New chance")
print(x)
```

Test the behavior of the above codes by checking what happens when you enter correct and incorrect numbers.