Assignment -2 : Mars Orbit

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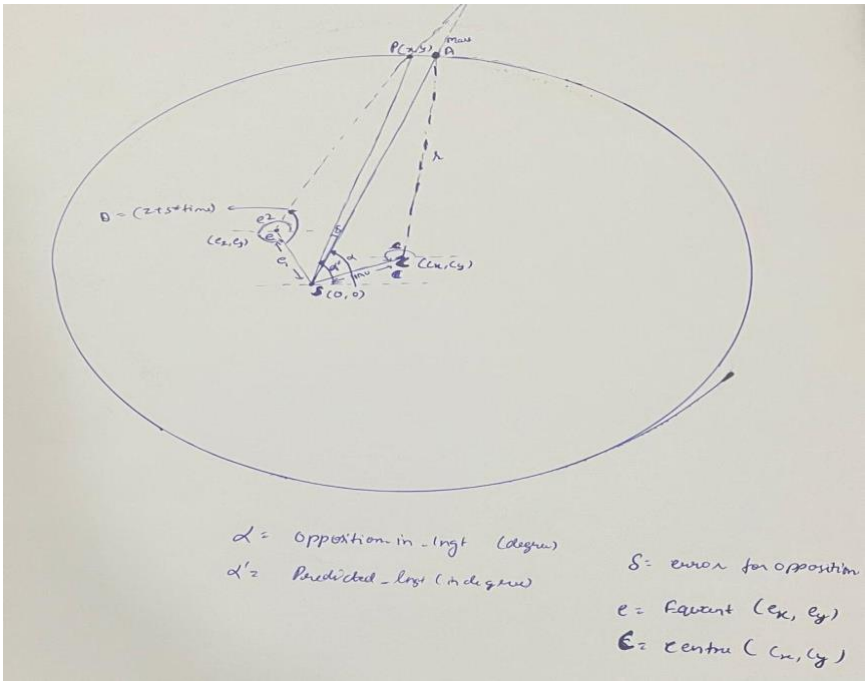
Problem 1:

Here, Is the general Diagram which give basic idea about how our picture looks like:



Main Idea:

Here we have to find pred_angle_for_opposition on the basis of certain parameters

C = centre with (cx, cy) Cartesian coordinate with distance 1 unit from sun

E = equant Point with (ex,ey) Cartesian coordinate with distance e1 from sun

To get pred_angle , we have to solve two equation then find the slope of that line

i.e. (x,y) is the intersectionPoint on Circle that followed by Mars.

So,

ex, ey = e1*cos(e2) , e1*sin(e2)

cx, cy = 1*cos(c) , 1*sin(c)

We have two equations for each opposition:

$(x-cx)^2 + (y-cy)^2 = r^2$ ---------- (i) and D = (z+ s*time)

(y- ey) = (x-ex)*tan(D) ---------- (ii)

On putting value of y from eq(ii) in eq(i) , we will get,

$$(1 + (\tan D)^2)\ x^2 + (-2 * cx + 2 * \tan D * (ey - cy - ex * \tan D))\ x + (ey - cy - ex * \tan D)^2 + cx^2 + r^2 = 0$$

On Solving this equation we will get x and y ,

Then ,

pred_angle = $\tan^{-1}(y/x)$
Error = pred_angle – actual_angle

Function :

Errors ,maxError = MarsEquantModel (c,r,e1,e2,z,s,times,oppositions)

Result:

```
c: 142,
e1: 2,
e2: 150
z: 75,
r: 4,
s: 0.5240174672489083,
Errors : [32.91337259 23.72922061 13.9227638   5.26297032  0.40114213  7.22970597
 33.43681242 35.41758935 27.19055958 17.40072236  8.05568416  1.22557743],
maxError: 35.417589346075225
```

Problem 2:

As , In this we have to find ***Best Orbit Inner Parameters*** ie. (c,e1,e2,z) for given r and s

So, I have used Exhaustive search, I have taken each value on certain range independent but in cyclic order(kind of round Robin Approach) for each parameter

After this, we have used minimize function on given loss_function to get max_error to be minimum to get these parameters.Exhaustive Search is done by fixing remaining parameter fixed ,and searching for only single parameter.

Function:

c,e1,e2,z,errors,maxError = BestOrbitInnerParams(r,s,times,oppositions)

Result:

Problem 3:

So, I have used Exhaustive search, I have taken each value on certain range independent but in cyclic order(kind of round Robin Approach) for each parameter

Here, we have searched for s in range of (360/(678+1)) to ((360/(678-1)) for about 100 of values and check for good one to give result on the basis of function that is Generated in Problem 2

Function:

s,errors,maxError = BestS(r,s,times,oppositions)

Result:

Problem 4:

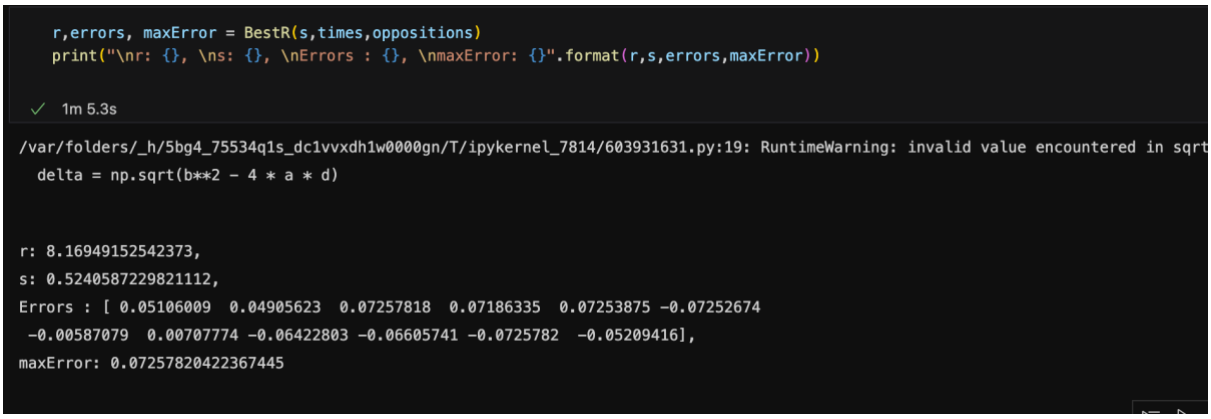
So, I have used Exhaustive search, I have taken each value on certain range independent but in cyclic order(kind of round Robin Approach) for each parameter

Here, we have searched for r in range of (4 to 10) for about 100 of values and check for good one to give result on the basis of function that is Generated in Problem 2

Function:

r,errors,maxError = BestR(s,times,oppositions)

Result:



Problem 5:

It is wrapper function, in this function, I have exhaustively searched for best values of r and s from some value in order to minimize the maximum error.

I have called BestR() and BestS() function , one after other in iterative manner to update value of r and s , break the iteration , if I get error less than 4 minute or value of r and s not updated in further iterations.

Function:

r,s,c,e1,e2,z,errors,maxError= BestMarsOrbitParams(times,oppositions)

Result:

- I am getting max_Error as ***4.35 minutes*** rounded upto 2 decimal places which is 21 seconds away from desired results.