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PYL204: Assignment 1

The Assignment is based on root finding. We have to simply find out values of α for different value of diameter of wheels of given vehicle (D) and then plot α vs D.

Given equation:-

$$A \sin\alpha \cos\alpha + B \sin 2\alpha - C \cos\alpha - E \sin\alpha = 0$$

where

$A = l \sin\beta 1$,

$B = l \cos\beta 1$,

$C = (h+0.5D)\sin\beta 1 - 0.5D \tan\beta 1$ and $E = (h+0.5D) \cos\beta 1 - 0.5D$

$l = 89$in., $h = 49$in. and $\beta 1 = 11.5^\circ$

Observations:

After trying different values, I find out that for $\alpha=30^o$ I am getting negative value and for $\alpha=34^o$,I am getting positive value for all the values of D between 30 to 100

Parameters descriptons:

* D is a list of elements {30,40,50....100}
* ε=10^-4 tolerance
* a=30^o
* b=34^o

Programming Language:

Python 3.8.6

Libraries used:

Matplotlib: Used for ploting graphs in python3
Numpy: Used for List manipulation
Math: Used for math functions like sin, cos, tan, radians

Algorithm:

I have used bisection method to solve the problem using the above parameters. Lets assume F(d,alpha) function is defined which take d and alpha as parameter, where d is elment of List D and alpha is our angle

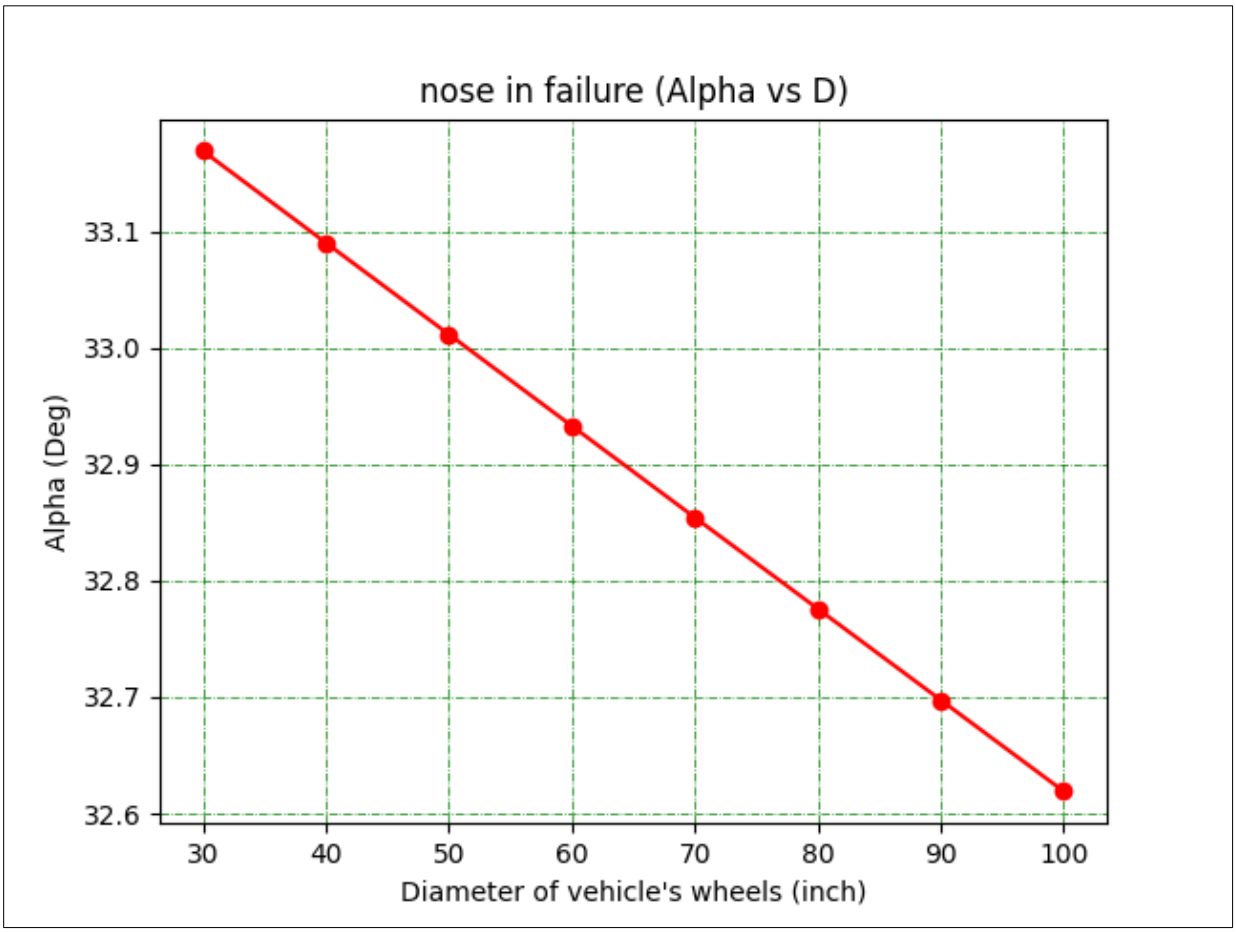
psedo code:

```
alpha=[]                                    //empy list to store output
for 0<=i<D.size(){                          // In my case D.size()=8
        p=30°
        while abs(F(D[i],p))>ε{             //bisection method
            p=a+(b-a)/2
            if F(D[i],p)*F(D[i],a)>0
                a=p
            else
                b=p
        }

        alpha.push_back(p)                  //collecting solutions
    }

    print(alpha)                            //printing alpha
    plot(D,alpha)                           //ploting the values
```

output:

D	30	40	50	60	70	80	90	100
α	33.17^0	33.09^0	33.01^0	32.93^0	32.85^0	32.78^o	32.70^o	32.62^0

Graph:



Result:

From the graph one can easy see that as the diameter of wheels of the vehicle increases. The angle by which its nose goes down decreases

Compilaton:

note: matplotlib and numpy library must we installed.

Run:

python3 ph1180830assign1.py