CS7420: Principles of Biological Vision

Programming assignment 1-Report.

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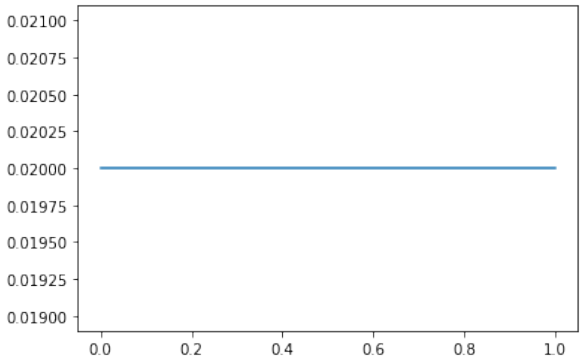
Approach :

- Assign 50 random values between 0 to 1 with equal probability to theta variable.(take uniform distribution as prior with 50 values each with prob 0.02).

```
array([0.        , 0.02040816, 0.04081633, 0.06122449,
0.08163265,
       0.10204082, 0.12244898, 0.14285714, 0.16326531,
0.18367347,
       0.20408163, 0.2244898 , 0.24489796, 0.26530612,
0.28571429,
       0.30612245, 0.32653061, 0.34693878, 0.36734694,
0.3877551 ,
       0.40816327, 0.42857143, 0.44897959, 0.46938776,
0.48979592,
       0.51020408, 0.53061224, 0.55102041, 0.57142857,
0.59183673,
       0.6122449 , 0.63265306, 0.65306122, 0.67346939,
0.69387755,
       0.71428571, 0.73469388, 0.75510204, 0.7755102 ,
0.79591837,
       0.81632653, 0.83673469, 0.85714286, 0.87755102,
0.89795918,
       0.91836735, 0.93877551, 0.95918367, 0.97959184, 1.
])
```

- Prior probaility is one because its uniform.(prior=1)



- Assign 27 values to Data as 0 and 1 (eg. 0,1,1,0,….upto 27 values) like for each value either 0 which represent vertical and 1 which represents horizontal. And the values are assigned randomly but restricted to problem which is 17 times 1's and 10 times 0's.

```
[0,
 1,
 1,
 0,
 0,
 0,
 0,
 1,
 0,
 0,
 1,
 1,
 1,
 0,
 1,
 1,
 1,
 1,
 1,
 1,
 1,
 0,
 1,
 0,
 1,
```

```
1,
1]
```

- The posterior probability is calculated for each trail and take it as prior for the next posterior probability so that the posterior got updated at each step:

Method used for posterior estimation:

->Step -1:

If Data comprises of 1's(horizontal):

p(Data/theta)= likelihood=(prob of horizontal)^ Data

If Data comprises of 0's(vertical):

p(Data/theta)= likelihood=(1-prob of horizontal)^ 1-Data

->Step-2:

After that posterior probability calculated Bay's theorem:

P(theta/Data)=P(Data/theta) * (prior)
(::prior=1 ->uniform distribution)

normailzed P(theta/Data) = P(theta/Data) / (sum of all values in P(theta/Data))

->Step-3:

Update prior -> normailzed P(theta/Data)

->Step-4

Repeat Step-1 untill all the trials will end.(27 times)

- For estimated value of theta :

Estimated Theta= Summation of (prior theta values* Estimated posterior probability)

This Summation is repeated for 50 times because I took 50 values of prior theta.

The programming language and libraries used:

Python 3.5 (did on Google Collab).
Library used(common libs):

->matplotlib (for plotting curves)

->numpy(for numeric computation)

->random (generating random values)

[implmented code from scratch]

Results:

-> Likelihood At 27th trial:

```
array([0.        , 0.02040816, 0.04081633, 0.06122449,
0.08163265,
       0.10204082, 0.12244898, 0.14285714, 0.16326531,
0.18367347,
       0.20408163, 0.2244898 , 0.24489796, 0.26530612,
0.28571429,
       0.30612245, 0.32653061, 0.34693878, 0.36734694,
0.3877551 ,
       0.40816327, 0.42857143, 0.44897959, 0.46938776,
0.48979592,
       0.51020408, 0.53061224, 0.55102041, 0.57142857,
0.59183673,
       0.6122449 , 0.63265306, 0.65306122, 0.67346939,
0.69387755,
```

```
       0.71428571, 0.73469388, 0.75510204, 0.7755102 ,
0.79591837,
       0.81632653, 0.83673469, 0.85714286, 0.87755102,
0.89795918,
       0.91836735, 0.93877551, 0.95918367, 0.97959184, 1.
])
```

->Final Posterior Estimation (the values depend on randomly generated values):

```
array([0.00000000e+00, 7.24822068e-23, 7.69675281e-18,
6.11587613e-15,
       6.53076451e-13, 2.31651903e-11, 4.08389762e-10,
4.43586804e-09,
       3.37432865e-08, 1.95227776e-07, 9.08793273e-07,
3.54266957e-06,
       1.19101562e-05, 3.53086433e-05, 9.39022684e-05,
2.27069920e-04,
       5.04659133e-04, 1.03980160e-03, 2.00017760e-03,
3.61279065e-03,
       6.15614639e-03, 9.93407324e-03, 1.52279783e-02,
2.22292969e-02,
       3.09606614e-02, 4.12013644e-02, 5.24377814e-02,
6.38601350e-02,
       7.44215162e-02, 8.29630967e-02, 8.83926946e-02,
8.98861708e-02,
       8.70678617e-02, 8.01227484e-02, 6.98028595e-02,
5.73133962e-02,
       4.40955810e-02, 3.15544637e-02, 2.08001769e-02,
1.24714616e-02,
       6.68750286e-03, 3.13360656e-03, 1.24175915e-03,
3.96547560e-04,
       9.46704796e-05, 1.48946973e-05, 1.21875025e-06,
3.04636947e-08,
       4.25520090e-11, 0.00000000e+00])
```

For normalized_posterior curve:

->Estimated Theta= 0.6206896551722364.
->Max.posterior value=0.08988617081052 54
->Variance=0.1013006867431443
-> Standard Deviation=0.318277

Final Plots: