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ENG382 Assignment

① Using an initial guess value of $y = 0.05$, find the root of the function given below using fixed-point Iteration method.

② manually, showing workings and solutions for only five iterations,

$$f(y) = \cos(y)$$

$$\cos(y) = 0$$

$$y + \cos y = y$$

$$y = y + \cos y$$

$$y_{i+1} = y_i + \cos y_i$$

Initial guess value of $y = 0.05$

for iter 1

$$\begin{aligned} y_{i+1} &= 0.05 + \cos 0.05 \\ &= 1.0499 \end{aligned}$$

for iter 2

$$\begin{aligned} y_{i+1} &= 1.0499 + \cos 1.0499 \\ &= 2.0497 \end{aligned}$$

for iter 3

$$\begin{aligned} y_{i+1} &= 2.0497 + \cos 2.0497 \\ &= 3.0492 \end{aligned}$$

for iter 4

$$y_{i+1} = 3.0492 + \cos(3.0492) \\ = 4.0478$$

for iter 5

$$y_{i+1} = 4.0478 + \cos 4.0478 \\ = 5.0453$$

errors

for iter 1

$$\text{error} = \left| \frac{y_{i+1} - y_i}{y_{i+1}} \right| \times 100$$

$$= \left| \frac{1.0499 - 0.05}{1.0499} \right| \times 100 \\ = 95.24\%$$

for iter 2

$$\text{error} = \left| \frac{2.0498 - 1.0499}{2.0498} \right| \times 100 \\ = 48.776\%$$

for iter 3

$$\text{error} = \left| \frac{3.0492 - 2.0498}{3.0492} \right| \times 100 \\ = 32.775\%$$

for iter 4

$$\text{error} = \left| \frac{4.0478 - 3.0492}{4.0478} \right| \times 100 \\ = 24.67\%$$

for iter 5

$$\text{error} = \left| \frac{5.0453 - 4.0478}{5.0453} \right| \times 100 \\ = 19.771\%$$

iter	y	error (%)
0	0.05	95.24
1	1.0499	48.78
2	2.0497	32.78
3	3.0492	24.67
4	4.0478	19.78
5	5.0453	

③ Using the fixed-point iteration method, taking method, taking the initial guess value of z and the percentage absolute error tolerance to be 0.1 and $1e-5$ respectively, find the root of the function given in equation below using!

① manual method showing all the workings and values for just five iterations

$$f(z) = e^{-15z} - z + \cos z$$

$$e^{-15z} - z + \cos z = 0$$

$$z = e^{-15z} + \cos z$$

$$z_{i+1} = e^{-15z_i} + \cos z_i$$

initial guess value = 0.1

for iter 1

$$z_{i+1} = e^{-15(0.1)} + \cos 0.1$$

$$= 1.2231$$

for iter 2

$$z_{i+1} = e^{-15(1.2231)} + \cos 1.2231$$

$$= \cancel{0.9998} = 0.99977$$

for iter 3

$$z_{i+1} = e^{-15(0.99977)} + \cos 0.99977$$

$$= 0.999848$$

for iter 4

$$z_{i+1} = e^{-15(0.999848)} + \cos 0.999848$$

$$= 0.999848$$

for iter 5

$$z_{i+1} = e^{-15(0.999848)} + \cos 0.999848$$

$$= 0.999848$$

errors

for iter 1

$$\text{error} = \left| \frac{z_{i+1} - z_i}{z_{i+1}} \right| \times 100$$

$$\text{error} = \left| \frac{1.2231 - 0.1}{1.2231} \right| \times 100 = 91.824$$

for iter 2

$$\text{error} = \left| \frac{0.99977 - 1.2231}{0.99977} \right| \times 100 = 22.341$$

for iter 3

$$\text{error} = \left| \frac{0.999848 - 0.99977}{0.999848} \right| \times 100 = 0.0075924$$

for iter 4

$$\text{error} = \left| \frac{0.999848 - 0.999848}{0.999848} \right| \times 100 = 2.35 \times 10^{-6}$$

for iter 5

$$\text{error} = \left| \frac{0.999848 - 0.999848}{0.999848} \right| \times 100 = 7.26 \times 10^{-10}$$

iter	z	error
0	0.5151	2074
1	1.2231	91.824
2	0.99977	22.341
3	0.99985	7.5924×10^{-3}
4	0.99985	2.35×10^{-6}
5	0.99985	7.26×10^{-10}

the roots are 0 and 1