Manisa Celal Bayar University – Department of Computer Engineering
CSE 3239 Numerical Analysis for Computer Engineers – Final Exam

Name and Surname	
Student Id	
Signature	

Question	1	2	3	4	Total
Score					

		Learning Objectives				
		L1	L2	L3	L4	L5
Questions	Q1	✓	✓			
	Q2				✓	
	Q3			✓		✓
	Q4				✓	

Questions

Q1 (25 Points) A Python function to find the root of a function with Newton Raphson method is given below. If we want to decide between the usage of roots_list (a traditional Python list) and roots_np_array (a NumPy array), which one do you prefer to get a better performance in terms of time spent to run this function. Explain your choice with details.

```
def newton_raphson(func, x0, tolerance=1e-5):
    x = x0
    roots_list = []
    roots_np_array = np.array([])
    while np.abs(func(x)) > tolerance:
        x = x - func(x)/finite_difference(func, x)
        roots_list.append(x)
        roots_np_array = np.append(roots_np_array, x)
    return x, roots_list, roots_np_array
```

Q2 (25 Points) Build a custom finite difference formula to find a derivative of a function with the points f(x-h), f(x), f(x+h), and f(x+2h).

Q3 (25 Points) Determine the root (the zero) of

$$f(x) = 5^x - 4^x + 3^x - 3$$

using Bisection Method. Use the initial limits $a = -1$ and $b = 1$. Iterate until the error falls below the tolerance 0.1 and fill the table given below. Use only the required number of rows.

	a	b	m (root)	Error
1	-1	1	0	-2
2				
3				
4				
5				
6				
7				

Q4 (25 Points) Use Simpson's 1/3 rule to approximate the integral of sin(x) from 0 to Pi with n=4 intervals.

You have 90 minutes, gl hf.
Assoc. Prof. Dr. Bora Canbula