

2025 USA-NA-AIO Round 2, Problem 2, Part 10

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Part 10 (5 points, coding task)

This question follows Part 9.

You are asked to define a function called `GQA_2_MLA` that performs the following tasks:

- Input:
 - `W_M_GQA` : A numpy array with shape (r, D) , where r is guaranteed to be a factor of D (not something you need to worry about).
- Outputs:
 - `W_DKV_MLA` : A numpy array with shape (r, D) .
 - `W_UM_MLA` : A numpy array with shape (D, r) .
- Things to do inside this function:
 - Compute `W_M_GQA_tilde` that concatenates D/r copies of `W_M_GQA` along axis 0.
 - Print the shapes of `W_UM_MLA` and `W_DKV_MLA` .
 - Print the mean-squared error between `W_M_GQA_tilde` and `W_UM_MLA @ W_DKV_MLA` .

Hints:

- You may use `np.linalg` .
- PyTorch is not allowed.

- No loop in your code.

After defining this function, test it with the input `np.random.randn(4,24)`.

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May 2025

WRITE YOUR SOLUTION HERE

```
def GQA_2_MLA(W_M_GQA):
    r = W_M_GQA.shape[0]
    D = W_M_GQA.shape[1]
    num_copies = D // r

    W_K_GQA_tilde = np.concatenate([W_M_GQA] * num_copies, axis=0)
    U, S, V = np.linalg.svd(W_K_GQA_tilde)
    W_UM_MLA = U[:, :r]
    W_DKV_MLA = S.reshape(-1,1)[:r, :] * V[:r, :]
    print(f"Shape of W_UM_MLA: {W_UM_MLA.shape}")
    print(f"Shape of W_DKV_MLA: {W_DKV_MLA.shape}")

    MSE = np.mean((W_K_GQA_tilde - W_UM_MLA @ W_DKV_MLA)**2)
    print(f"Mean-squared error: {MSE}")

    return W_DKV_MLA, W_UM_MLA

GQA_2_MLA(np.random.randn(4,24))

""" END OF THIS PART """
```

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