Supplementary material: Efficient Computation Discovery for Polynomial Expressions

1. Computations

In the following sections we present computation for various expressions. These results are automatically generated by our software. As it is really hard to format it into human readable form, so we have left them in native Matlab format.

1.1. $\sum \mathbf{ABC}$

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sum(A, 1) * (B * sum(C, 2))
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1.2. $\sum \mathbf{AA^T}$

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sum(sum(A .* repmat(sum(A, 2), [1, m])'))
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1.3. $\sum \mathbf{AA^TA}$

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sum(sum(((repmat(sum(A, 2), [1, m]) .* repmat(sum(A, 1), [n, 1])) .* A), 2), 1)
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1.4. $\mathbf{g(x \to x^4, W)}$

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2^(n+m)*(((((( sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* ( sum(sum(W, 2), 1) .* sum(sum(W, 2), 1))) .* 1) + ( sum((( sum(W, 1) .* sum(W, 1)) .* ( sum(W, 1) .* sum(W, 1))), 2) .* -2) + ( ( sum(( sum(W, 1) .* sum(W, 1)), 2) .* sum(( sum(W, 1) .* sum(W, 1)), 2)) .* 3) + ( sum(( ( sum(W, 1) .* sum(W, 1)) .* sum(( W .* W), 1)), 2) .* -12) + ( ( sum(( sum(W, 1) .* sum(W, 1)), 2) .* sum(sum(( W .* W), 2), 1)) .* 6) + (sum((repmat(sum(sum(W, 2), 1), [n, 1]) .* sum(( ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* W), 2)), 1) .* 24) + (( ( sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* sum(( sum(W, 1) .* sum(W, 1)), 2)) .* 6) + ( sum(( ( sum(W, 2) .* sum(W, 2)) .* ( sum(W, 2) .* sum(W, 2))), 1) .* -2) + ( ( sum(( sum(W, 2) .* sum(W, 2)), 1) .* sum(( sum(W, 2) .* sum(W, 2)), 1)) .* 3) + ( ( (sum(W, 2)') * ( ( W * (W')) * sum(W, 2))) .* 12) + ( ( ( sum(W, 1) * (W')) * ( W * (sum(W, 1)'))) .* 12) + (( ( sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* sum(( sum(W, 2) .* sum(W, 2)), 1)) .* 6) + ( sum(( ( sum(W, 2) .* sum(W, 2)) .* sum(( W .* W), 2)), 1) .* -12) + ( ( sum(( sum(W, 1) .* sum(W, 1)), 2) .* sum(( sum(W, 2) .* sum(W, 2)), 1)) .* 6) + ( sum(sum(( ( W .* W) .* ( W .* W)), 2), 1) .* 4) + ( ( ( sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* sum(sum(( W .* W), 2), 1)) .* 6) + ( ( sum(( sum(W, 2) .* sum(W, 2)), 1) .* sum(sum(( W .* W), 2), 1)) .* 6) + ( ( sum(sum(( W .* W), 2), 1) .* sum(sum(( W .* W), 2), 1)) .* 3) + ( sum(( sum(( W .* W), 1) .* sum(( W .* W), 1)), 2) .* -6) + ( sum(( sum(( W .* W), 2) .* sum(( W .* W), 2)), 1) .* -6) + ( sum(sum(( ( W * (W')) .* ( W * (W'))), 1), 2) .* 6))) / 256;
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1.5. $\mathbf{g(x \to x^5, W)}$

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2^(n+m)*(((sum(sum((repmat(( sum(W, 1) .* sum(W, 1)), [n, 1]) .* ( ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* W)), 2), 1) .* -40) + (sum((( sum(W, 1) .* sum(W, 1)) .* sum((repmat(sum(W, 1), [n, 1]) .* ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1]))), 1)), 2) .* -10) + (( sum(sum(W, 2), 1) .* sum(( ( sum(W, 2) .* sum(W, 2)) .* sum(( W .* W), 2)), 1)) .* -60) + (sum((repmat(sum(sum(W, 2), 1), [n, 1]) .* (repmat(sum(sum(W, 2), 1), [n, 1]) .* sum(( ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* W), 2))), 1) .* 60) + (sum((sum(( W .* repmat(sum(W, 1), [n, 1])), 2) .* sum((repmat(sum(W, 1), [n, 1]) .* ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1]))), 2)), 1) .* 60) + (sum(sum(( ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* ( W .* ( W .* W))), 2), 1) .* 80) + (sum((sum(W, 2) .* (sum(W, 2) .* sum(( ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* W), 2))), 1) .* -40) + (sum((repmat(sum(( sum(W, 2) .* sum(W, 2)), 1), [n, 1]) .* sum(( ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* W), 2)), 1) .* 60) + ( ( ( sum(W, 1) * (W')) * ( ( W * (W')) * sum(W, 2))) .* 120) + (sum((( sum(W, 2) .* sum(W, 2)) .* sum((repmat(sum(W, 2), [1, m]) .* ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1]))), 2)), 1) .* -10) + (( sum(sum(W, 2), 1) .* sum(( ( sum(W, 1) .* sum(W, 1)) .* sum(( W .* W), 1)), 2)) .* -60) + (sum((sum(repmat(( sum(W, 2) .* sum(W, 2)), [1, m]), 1) .* sum((repmat(sum(W, 2), [1, m]) .* ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1]))), 1)), 2) .* 15) + ( ( ( sum(sum(W, 2), 1) * (sum(W, 2)')) * ( ( W * (W')) * sum(W, 2))) .* 60) + ( ( ( sum(sum(W, 2), 1) * ( sum(W, 1) * (W'))) * ( W * (sum(W, 1)'))) .* 60) + ((sum(sum(W, 2), 1) .* ( sum(( sum(W, 1) .* sum(W, 1)), 2) .* sum(( sum(W, 1) .* sum(W, 1)), 2))) .* 15) + ((sum(sum(W, 2), 1) .* (( sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* ( sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)))) .* 1) + ((sum(( sum(W, 1) .* sum(W, 1)), 2) .* ( sum(sum(W, 2), 1) .* ( sum(sum(W, 2),
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1) .* sum(sum(W, 2), 1)))) .* 10) + (sum((sum(((repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* W), 2) .* repmat(sum(sum(((W .* W), 2), 1), [n, 1])), 1) .* 60) + ((sum((sum(W, 2) .* sum(W, 2)), 1) .* (sum(sum(W, 2), 1) .* (sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)))) .* 10) + ((sum(sum((W .* W), 2), 1) .* (sum(sum(W, 2), 1) .* (sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)))) .* 10) + (sum((sum(repmat((sum(W, 1) .* sum(W, 1)), [n, 1]), 2) .* sum((repmat(sum(W, 2), [1, m]) .* (repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])))), 2)), 1) .* 30) + (sum(sum((((repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* W) .* repmat(sum((W .* W), 1), [n, 1])), 2), 1) .* -120) + ((sum(sum(W, 2), 1) .* (sum((sum(W, 1) .* sum(W, 1)), 2) .* sum(sum((W .* W), 2), 1))) .* 30) + (sum(sum(((repmat(sum(W, 2), [1, m]) .* repmat(sum((W .* W), 1), [n, 1])) .* repmat(sum((W .* W), 1), [n, 1])), 2), 1) .* -30) + ((sum(sum(W, 2), 1) .* (sum((sum(W, 2) .* sum(W, 2)), 1) .* sum(sum((W .* W), 2), 1))) .* 30) + (sum(((repmat(sum(sum(W, 2), 1), [n, 1]) .* (sum((W .* W), 2) .* sum((W .* W), 2))), 1) .* -30) + (sum(((repmat(sum(sum(W, 2), 1), [n, 1]) .* sum(((W .* W) .* (W .* W)), 2)), 1) .* 20) + ((sum(sum(W, 2), 1) .* (sum(sum((W .* W), 2), 1) .* sum(sum((W .* W), 2), 1))) .* 15) + (sum((sum((W .* W), 2) .* sum(((repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* W), 2)), 1) .* -120) + (sum((((W * (W')) .* (W * (W'))) * repmat(sum(sum(W, 2), 1), [n, 1])), 1) .* 30))) / 1024;

1.6. $\mathbf{g}(\mathbf{x} \to \mathbf{x^6}, \mathbf{W})$

2^(n+m)*(((sum(sum(((W .* W) .* ((repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* (repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1]))))), 2), 1) .* 360) + (sum(sum(((W .* repmat(sum(W, 2), [1, m])) .* ((W .* repmat(sum(W, 2), [1, m])) .* repmat(sum((W .* W), 1), [n, 1]))), 2), 1) .* 360) + (sum(((sum(W, 1) .* sum(W, 1)) .* ((sum(W, 1) .* sum(W, 1)) .* (sum(W, 1) .* sum(W, 1))))), 2) .* 16) + ((sum((sum(W, 1) .* sum(W, 1)), 2) .* sum(((sum(W, 1) .* sum(W, 1)) .* (sum(W, 1) .* sum(W, 1))), 2)) .* -30) + ((((sum(W, 1) * ((W') * sum(W, 2))) * (sum(W, 1) * ((W') * sum(W, 2)))) .* 360) + (((sum(W, 1) * (W')) * ((W .* (W .* W)) * (sum(W, 1)'))) .* 480) + (sum(((sum(W, 2) .* sum(W, 2)) .* ((sum(W, 2) .* sum(W, 2)) .* (sum(W, 2) .* sum(W, 2)))), 1) .* 16) + (sum(sum(((W .* repmat(sum(W, 1), [n, 1])) .* ((W .* repmat(sum(W, 1), [n, 1])) .* repmat(sum((W .* W), 2), [1, m]))), 2), 1) .* 360) + ((sum((sum(W, 1) .* sum(W, 1)), 2) .* sum(((sum(W, 1) .* sum(W, 1)) .* sum((W .* W), 1)), 2)) .* -180) + (sum((repmat(sum(sum(W, 2), 1), [n, 1]) .* sum(((repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* (W .* (W .* W))), 2)), 1) .* 480) + (sum((repmat(sum(sum(W, 2), 1), [n, 1]) .* (sum(W, 2) .* (sum(W, 2) .* sum(((repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* W), 2)))), 1) .* -240) + (sum((sum((W .* repmat(sum(W, 1), [n, 1])), 2) .* (sum(W, 2) .* sum(repmat(sum((repmat(sum(W, 2), [1, m]) .* (repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])))), 1), [n, 1]), 2))), 1) .* 360) + (((sum(sum(W, 2), 1) * (sum(W, 1) * (W'))) * ((W * (W')) * sum(W, 2))) .* 720) + (((sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* ((sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* (sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)))) .* 1) + ((sum((sum(W, 1) .* sum(W, 1)), 2) .* ((sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* (sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)))) .* 15) + (sum((sum((W .* repmat(sum(W, 1), [n, 1])), 2) .* (sum(W, 2) .* repmat((sum(sum(W, 2), 1) .* (sum(sum(W, 2), 1) .* sum(sum(W, 2), 1))), [n, 1])))), 1) .* 120) + ((sum((sum(W, 2) .* sum(W, 2)), 1) .* ((sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* (sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)))) .* 15) + ((sum(sum((W .* W), 2), 1) .* ((sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* (sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)))) .* 15) + (sum(sum((repmat((sum(W, 2) .* sum(W, 2)), [1, m]) .* ((repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* (repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])))), 1), 2) .* -30) + (sum((sum((repmat(sum(W, 2), [1, m]) .* (repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])))), 1) .* sum((repmat(sum(W, 2), [1, m]) .* (repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1]))), 1)), 2) .* 45) + (sum((sum((W .* repmat(sum(W, 2), [1, m])), 1) .* (sum((W .* repmat(sum(W, 2), [1, m])), 1) .* repmat(sum((sum(W, 1) .* sum(W, 1)), 2), [1, m]))), 2) .* 180) + (sum((sum((W .* repmat(sum(W, 2), [1, m])), 1) .* (sum(W, 1) .* sum(((repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* W), 1))), 2) .* -360) + ((sum((sum(W, 1) .* sum(W, 1)), 2) .* (sum((sum(W, 1) .* sum(W, 1)), 2) .* sum((sum(W, 1) .* sum(W, 1)), 2))) .* 15) + (sum((sum((repmat(sum(W, 1), [n, 1]) .* (repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1]))), 1) .* sum((repmat(sum(W, 1), [n, 1]) .* (repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1]))), 1)), 2) .* -30) + ((sum(sum(W, 2), 1) .* (sum(sum(W, 2), 1) .* (sum((sum(W, 1) .* sum(W, 1)), 2) .* sum((sum(W, 1) .* sum(W, 1)), 2)))) .* 45) + (((sum(W, 1) .* sum(W, 1)) * ((repmat(sum(W, 1), [m, 1]) * (W')) * (W * (sum(W, 1)')))) .* 180) + (sum((sum((W .* repmat(sum(W, 1), [n, 1])), 2) .* ((sum(W, 2) .* repmat(sum(sum(W, 2), 1), [n, 1])) .* sum(repmat((

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sum(W, 1) .* sum(W, 1)), [n, 1]), 2))), 1) .* 360) + ( ( sum(( W .* W), 1) * ( ( (W') * sum(W, 2)) .* ( (W') * sum(W, 2)))) .* -360) + (sum(( sum(( W .* W), 1) .* ( ( sum(W, 1) .* sum(W, 1)) .* ( sum(W, 1) .* sum(W, 1)))), 2) .* 240) + ((sum(sum(( W .* W), 2), 1) .* sum(( ( sum(W, 1) .* sum(W, 1)) .* ( sum(W, 1) .* sum(W, 1))), 2)) .* -30) + ((sum(( sum(W, 1) .* sum(W, 1)), 2) .* ( sum(( sum(W, 1) .* sum(W, 1)), 2) .* sum(sum(( W .* W), 2), 1))) .* 45) + ((sum(sum(W, 2), 1) .* ( sum(sum(W, 2), 1) .* sum(( ( sum(W, 1) .* sum(W, 1)) .* sum(( W .* W), 1)), 2))) .* -180) + (((sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* ( sum(( sum(W, 1) .* sum(W, 1)), 2) .* sum(sum(( W .* W), 2), 1))) .* 90) + (sum(sum((( repmat(sum(( W .* W), 2), [1, m]) .* repmat(sum(( W .* W), 1), [n, 1])) .* ( W .* W)), 2), 1) .* 360) + (sum((sum(( W .* W), 1) .* ( sum(( W .* W), 1) .* repmat(sum(( sum(W, 1) .* sum(W, 1)), 2), [1, m]))), 2) .* -90) + ((sum(sum(( W .* W), 2), 1) .* sum(( ( sum(W, 2) .* sum(W, 2)) .* ( sum(W, 2) .* sum(W, 2))), 1)) .* -30) + ((sum(( sum(W, 2) .* sum(W, 2)), 1) .* ( sum(( sum(W, 2) .* sum(W, 2)), 1) .* sum(sum(( W .* W), 2), 1))) .* 45) + (sum((sum(( W .* repmat(sum(W, 2), [1, m])), 1) .* (sum(( W .* repmat(sum(W, 2), [1, m])), 1) .* repmat(sum(sum(( W .* W), 2), 1), [1, m]))), 2) .* 180) + (sum((sum(( W .* repmat(sum(W, 1), [n, 1])), 2) .* (sum(( W .* repmat(sum(W, 1), [n, 1])), 2) .* repmat(sum(sum(( W .* W), 2), 1), [n, 1]))), 1) .* 180) + (sum(((sum(W, 2) .* repmat(sum(sum(W, 2), 1), [n, 1])) .* (sum(( W .* repmat(sum(W, 1), [n, 1])), 2) .* repmat(sum(sum(( W .* W), 2), 1), [n, 1]))), 1) .* 360) + (sum((sum(( W .* repmat(sum(W, 1), [n, 1])), 2) .* sum(( repmat(( sum(W, 1) .* sum(W, 1)), [n, 1]) .* ( W .* repmat(sum(W, 1), [n, 1]))), 2)), 1) .* -240) + (sum(sum((W .* repmat((repmat(sum(sum(W, 2), 1), [1, m]) .* (sum(W, 1) .* sum(( ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* W), 1))), [n, 1])), 2), 1) .* -240) + ((sum(( sum(W, 2) .* sum(W, 2)), 1) .* sum(( ( sum(W, 1) .* sum(W, 1)) .* ( sum(W, 1) .* sum(W, 1))), 2)) .* -30) + (((sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* sum(( ( sum(W, 2) .* sum(W, 2)) .* sum(( W .* W), 2)), 1)) .* -180) + (((sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* sum(sum(( ( W .* W) .* ( W .* W)), 2), 1)) .* 60) + (sum((sum((repmat(sum(W, 2), [1, m]) .* ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1]))), 2) .* sum((repmat(sum(W, 2), [1, m]) .* ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1]))), 2)), 1) .* -30) + ((sum(sum(W, 2), 1) .* sum((sum(repmat(( sum(W, 2) .* sum(W, 2)), [1, m]), 1) .* sum((repmat(sum(W, 2), [1, m]) .* ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1]))), 1)), 2)) .* 45) + (sum((sum(( W .* repmat(sum(W, 2), [1, m])), 1) .* (sum(( W .* repmat(sum(W, 2), [1, m])), 1) .* repmat(( sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)), [1, m]))), 2) .* 180) + (((sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* ( sum(( sum(W, 1) .* sum(W, 1)), 2) .* sum(( sum(W, 2) .* sum(W, 2)), 1))) .* 90) + (sum((sum(( W .* repmat(sum(W, 1), [n, 1])), 2) .* (sum(( W .* repmat(sum(W, 1), [n, 1])), 2) .* repmat(( sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)), [n, 1]))), 2) .* 180) + ( ( ( sum(W, 1) * ( (W') * W)) * ( ( (W') * W) * (sum(W, 1)'))) .* 360) + (sum((sum(( W .* repmat(sum(W, 1), [n, 1])), 2) .* (sum(( W .* repmat(sum(W, 1), [n, 1])), 2) .* repmat(sum(( sum(W, 2) .* sum(W, 2)), 1), [n, 1]))), 1) .* 180) + ((sum(( sum(W, 1) .* sum(W, 1)), 2) .* ( sum(( sum(W, 1) .* sum(W, 1)), 2) .* sum(( sum(W, 2) .* sum(W, 2)), 1))) .* 45) + ( ( ( (sum(W, 2)') * W) * ( ( (W') * W) * ( (W') * sum(W, 2)))) .* 360) + (sum((sum(( W .* repmat(sum(W, 2), [1, m])), 1) .* sum(( repmat(( sum(W, 2) .* sum(W, 2)), [1, m]) .* ( W .* repmat(sum(W, 2), [1, m]))), 1)), 2) .* -240) + ((( (sum(W, 2)') * W) * ( (W') * ( repmat(sum(W, 2), [1, n]) * ( sum(W, 2) .* sum(W, 2))))) .* 180) + ( ( ( ( (sum(W, 2)') * W) * ( ((( W .* ( W .* W))')' * sum(W, 2))) .* 480) + ((sum(( sum(W, 2) .* sum(W, 2)), 1) .* sum(( ( sum(W, 2) .* sum(W, 2)) .* ( sum(W, 2) .* sum(W, 2))), 1)) .* -30) + ((sum(( sum(W, 2) .* sum(W, 2)), 1) .* ( sum(( sum(W, 2) .* sum(W, 2)), 1) .* sum(( sum(W, 2) .* sum(W, 2)), 1))) .* 15) + ((sum(( sum(W, 2) .* sum(W, 2)), 1) .* sum(( ( sum(W, 2) .* sum(W, 2)) .* sum(( W .* W), 2)), 1)) .* -180) + (sum((( sum(( W .* W), 2) .* sum(( W .* W), 2)) .* repmat(sum(( sum(W, 2) .* sum(W, 2)), 1), [n, 1])), 1) .* -90) + ((sum(( sum(W, 1) .* sum(W, 1)), 2) .* ( sum(( sum(W, 2) .* sum(W, 2)), 1) .* sum(sum(( W .* W), 2), 1))) .* 90) + ( sum(( ( sum(W, 1) .* sum(W, 1)) .* sum(( ( W .* W) .* ( W .* W)), 1)), 2) .* -480) + (( sum(( sum(W, 1) .* sum(W, 1)), 2) .* sum(sum(( ( W .* W) .* ( W .* W)), 2), 1)) .* 60) + ( sum(( sum(( W .* W), 1) .* sum(( ( W .* W) .* ( W .* W)), 1)), 2) .* -480) + (sum((sum(repmat(( sum(W, 2) .* sum(W, 2)), [1, m]), 1) .* sum(( ( W .* W) .* ( W .* W)), 1)), 2) .* 60) + ( ( ( sum(W, 1) .* sum(( W .* W), 1)) * ( ( (W') * W) * (sum(W, 1)'))) .* -720) + ((sum(sum(W, 2), 1) .* sum(sum((( ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* W) .* repmat(sum(( W .* W), 1), [n, 1])), 2), 1)) .* -720) + ((sum(( sum(W, 2) .* sum(W, 2)), 1) .* sum(( ( sum(W, 1) .* sum(W, 1)) .* sum(( W .* W), 1)), 2)) .* -180) + ((sum(sum(( W .* W), 2), 1) .* sum(( ( sum(W, 1) .* sum(W, 1)) .* sum(( W .* W), 1)), 2)) .* -180) + (sum(( ( sum(W, 1) .* sum(W, 1)) .* ( sum(( W .* W), 1) .* sum(( W .* W), 1))), 2) .* 720) + ( sum(( sum(( W .* W), 1) .* ( sum(( W .* W), 1) .* sum(( W .* W), 1))), 2) .* 240) + (sum(sum((repmat(sum(( W .* W), 1), [n, 1]) .* (repmat(( sum(W, 2) .* repmat(sum(sum(W, 2),
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1), [n, 1])), [1, m]) .* repmat(sum(( W .* W), 1), [n, 1]))), 2), 1) .* -90) + (sum((sum(repmat(( sum(W, 2) .* sum(W, 2)), [1, m]), 1) .* ( sum(( W .* W), 1) .* sum(( W .* W), 1))), 2) .* -90) + (sum((sum(( W .* W), 2) .* ( sum(( W .* W), 2) .* repmat(( sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)), [n, 1]))), 1) .* -90) + ((sum(( sum(W, 1) .* sum(W, 1)), 2) .* ( sum(sum(( W .* W), 2), 1) .* sum(sum(( W .* W), 2), 1))) .* 45) + ((( sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* ( sum(sum(( W .* W), 2), 1) .* sum(sum(( W .* W), 2), 1))) .* 45) + ((( sum(sum(W, 2), 1) .* sum(sum(W, 2), 1)) .* ( sum(( sum(W, 2) .* sum(W, 2)), 1) .* sum(sum(( W .* W), 2), 1))) .* 90) + (sum(( sum(( W .* W), 2) .* ( ( sum(W, 2) .* sum(W, 2)) .* ( sum(W, 2) .* sum(W, 2)))), 1) .* 240) + ( sum(( ( sum(W, 2) .* sum(W, 2)) .* sum(( ( W .* W) .* ( W .* W)), 2)), 1) .* -480) + (sum(( ( sum(W, 2) .* sum(W, 2)) .* ( sum(( W .* W), 2) .* sum(( W .* W), 2))), 1) .* 720) + ((sum(sum(W, 2), 1) .* sum((sum(( W .* W), 2) .* sum(( ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* W), 2)), 1)) .* -720) + ( ( ( (sum(W, 2)') * ( W * (W'))) * ( sum(W, 2) .* sum(( W .* W), 2))) .* -720) + ( sum(( sum(( W .* W), 2) .* sum(( ( W .* W) .* ( W .* W)), 2)), 1) .* -480) + ( sum(( sum(( W .* W), 2) .* ( sum(( W .* W), 2) .* sum(( W .* W), 2))), 1) .* 240) + ((sum(( sum(W, 1) .* sum(W, 1)), 2) .* sum(( ( sum(W, 2) .* sum(W, 2)) .* sum(( W .* W), 2)), 1)) .* -180) + ((sum(sum(( W .* W), 2), 1) .* sum(( ( sum(W, 2) .* sum(W, 2)) .* sum(( W .* W), 2)), 1)) .* -180) + (sum((sum(( W .* repmat(sum(W, 1), [n, 1])), 2) .* (sum(W, 2) .* sum(( ( repmat(sum(W, 2), [1, m]) .* repmat(sum(W, 1), [n, 1])) .* W), 2))), 1) .* -360) + ( ( ( ( sum(W, 1) * (W')) .* ( sum(W, 1) * (W'))) * sum(( W .* W), 2)) .* -360) + (sum((sum(repmat(( sum(W, 1) .* sum(W, 1)), [n, 1]), 2) .* ( sum(( W .* W), 2) .* sum(( W .* W), 2))), 1) .* -90) + ((sum(( sum(W, 2) .* sum(W, 2)), 1) .* ( sum(sum(( W .* W), 2), 1) .* sum(sum(( W .* W), 2), 1))) .* 45) + ( sum(sum(( ( W .* W) .* ( ( W .* W) .* ( W .* W))), 2), 1) .* 256) + ( ( sum(sum(( W .* W), 2), 1) .* sum(sum(( ( W .* W) .* ( W .* W)), 2), 1)) .* 60) + ((sum(sum(( W .* W), 2), 1) .* ( sum(sum(( W .* W), 2), 1) .* sum(sum(( W .* W), 2), 1))) .* 15) + (sum(sum((repmat(sum(( W .* W), 1), [n, 1]) .* ( repmat(sum(( W .* W), 2), [1, m]) .* repmat(sum(( W .* W), 1), [n, 1]))), 1), 2) .* -90) + ((repmat(sum(sum(W, 2), 1), [1, m]) * ( ( ( (W') * W) .* ( (W') * W)) * repmat(sum(sum(W, 2), 1), [m, 1]))) .* 90) + (sum(sum((repmat(sum(( W .* W), 2), [1, m]) .* ( repmat(sum(( W .* W), 2), [1, m]) .* repmat(sum(( W .* W), 1), [n, 1]))), 2), 1) .* -90) + ( sum(( ( ( W * (W')) .* ( W * (W'))) * ( sum(W, 2) .* sum(W, 2))), 1) .* -360) + ( sum(( ( ( W * (W')) .* ( W * (W'))) * sum(( W .* W), 2)), 1) .* -360) + (sum(( ( ( W * (W')) .* ( W * (W'))) * sum(repmat(( sum(W, 1) .* sum(W, 1)), [n, 1]), 2)), 1) .* 90) + (sum(( ( ( W * (W')) .* ( W * (W'))) * repmat(sum(( sum(W, 2) .* sum(W, 2)), 1), [n, 1])), 1) .* 90) + ( sum(( ( sum(W, 1) .* sum(W, 1)) * ( ( (W') * W) .* ( (W') * W))), 2) .* -360) + ( sum(( sum(( W .* W), 1) * ( ( (W') * W) .* ( (W') * W))), 2) .* -360) + (( repmat(sum(sum(( W .* W), 2), 1), [1, m]) * sum(( ( (W') * W) .* ( (W') * W)), 2)) .* 90) + ( sum(sum(( W .* ( ( W * (W')) * ( W .* ( W .* W)))), 2), 1) .* 480) + ( sum(sum(( ( ( W * (W')) * W) .* ( ( W * (W')) * W)), 2), 1) .* 120))) / 4096;
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