Benchmark tests of certain diagrams

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When doing tensor contractions, we always make a choice of the order in which the indices are contracted. This choice can have a large impact on the runtime of the contraction code. The intent of this paper is to show the runtime of all possible (albeit topologically distinct) choices for all the distinct diagrams that we need for hadron spectroscopy. Note that we restrict ourselves here to contractions of up to four tensors and only tensors with rank 2 or 3 (mesons and baryons).

The result of the benchmark tests are shown in tables 1 and 2. In the diagrams, an oval is a rank 2 tensor and a triangle is a rank 3 tensor, and each vertex is an index. The dotted lines indicate which indices are contracted with which. The contraction pattern column shows the order of the contractions along with any temporary tensors needed. Every line in the contraction pattern is a single pichioperation. The last column shows an estimate of the time it takes to perform the complete contraction operation on some machine.

For diagrams 0 through 4 there is only one distinct way to perform the contractions. For the rest of the diagrams there are at least two.

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Table 1:

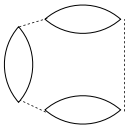
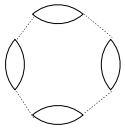
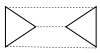
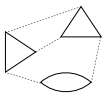
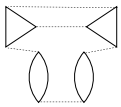
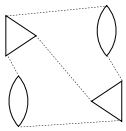
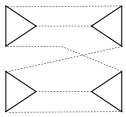
Diagram	#	Character rep.	Contraction pattern	Time
	0	A_{aa}	A_{aa}	53(9) µs
	1	$A_{ab}B_{ab}$	$A_{ab}B_{ab}$	0.37(10) ms
	2	$A_{ab}B_{bc}C_{ac}$	$A_{ab}B_{bc} \to D_{ac}$ $D_{ac}C_{ac}$	1.3(13) ms
	3	$A_{ab}B_{bc}C_{cd}D_{ad}$	$A_{ab}B_{bc} \to E_{ac}$ $E_{ac}C_{cd} \to F_{ad}$ $F_{ad}D_{ad}$	1.5(9) ms
	4	$A_{abc}B_{abc}$	$A_{abc}B_{abc}$	13.2(7) ms
	5	$A_{abc}B_{abd}C_{cd}$	$A_{abc}B_{abd} \to D_{cd}$ $D_{cd}C_{cd}$	0.739(5) s
			$A_{abc}C_{cd} \to D_{abd}$ $D_{abd}B_{abd}$	65(5) ms

Table 2:

Diagram	#	Character rep.	Contraction pattern	Time
	6	$A_{abc}B_{abd}C_{ce}D_{de}$	$A_{abc}B_{abd} \to E_{cd}$ $E_{cd}C_{ce} \to F_{de}$ $F_{de}D_{de}$	0.738(5) s
			$A_{abc}C_{ce} \to E_{abe}$ $B_{abd}D_{de} \to F_{abe}$ $E_{abe}F_{abe}$	0.119(16) s
			$C_{ce}D_{de} \to E_{cd}$ $A_{abc}E_{cd} \to F_{abd}$ $F_{abd}B_{abd}$	68.5(17) ms
	7	$A_{abc}B_{ade}C_{bd}D_{ce}$	$A_{abc}B_{ade} \to E_{bcde}$ $E_{bcde}C_{bd} \to F_{ce}$ $F_{ce}D_{ce}$	1.88(9) s
			$A_{abc}C_{bd} \to E_{acd}$ $E_{acd}B_{ade} \to F_{ce}$ $F_{ce}D_{ce}$	0.779(6) s
			$A_{abc}C_{bd} \to E_{acd}$ $B_{ade}D_{ce} \to F_{adc}$ $E_{acd}F_{adc}$	87(8) ms
			$A_{abc}C_{bd} \to E_{acd}$ $E_{acd}D_{ce} \to F_{ade}$ $F_{ade}B_{ade}$	87(3) ms
	8	$A_{abc}B_{abd}C_{def}D_{cef}$	$A_{abc}B_{abd} \to E_{cd}$ $E_{cd}C_{def} \to F_{cef}$ $F_{cef}D_{cef}$	0.762(9) s
			$A_{abc}B_{abd} \to E_{cd}$ $C_{def}D_{cef} \to F_{dc}$ $E_{cd}F_{dc}$	1.500(4) s
			$A_{abc}D_{cef} \to E_{abef}$ $B_{abd}C_{def} \to F_{abef}$ $E_{abef}F_{abef}$	4.55(4) s
			$A_{abc}D_{cef} \to E_{abef}$ $E_{abef}B_{abd} \to F_{efd}$ $E_{efd}C_{def}$	48.4(2) s