

Exercise 4.5 Reformatting complex expressions

```
1 {a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,q,r,s,t,u,v,w#}::Indices(position=independent).
2
3
4 \nabla{#}::Derivative.
5
6 def get_term (obj,n):
7
8     x^{a}::Weight(label=xnum).      # assign weights to x^{a}
9
10    foo := @(obj).                    # make a copy of obj
11    bah = Ex("xnum = " + str(n))    # choose a target
12    keep_weight (foo,bah)            # extract the target
13
14    return foo
15
16 def reformat (obj,scale):
17
18    {x^{a},A_{a},B_{a},A_{a b},B_{a b},C_{a b},C_{a b c},g^{a b}}::SortOrder. # choose a sort order
19
20    foo = Ex(str(scale))              # create a scale factor
21    bah := @(foo) @(obj).              # apply the scale factor, clears all fractions
22
23    distribute      (bah)              # only required if (bah) contains brackets
24    sort_product    (bah)
25    rename_dummies  (bah)
26    canonicalise    (bah)
27    factor_out      (bah,$x^{a?}$)
28
29    ans := @(bah) / @(foo).            # undo previous scaling
30
31    return ans
32
33 # -----
34
35 # a messy unformatted expression
36
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37  expr :=      (1/7) A_{e} x^{e}
38            -   (1/3) B_{f} x^{f}
39            +   (1/3) A_{a b} x^{a} x^{b}
40            +   (1/9) B_{e c} x^{c} x^{e}
41            -   (1/5) C_{p c} B_{d q} g^{c d} x^{p} x^{q}
42            +   (3/7) A_{a b c} x^{a} x^{b} x^{c}
43            -   (1/5) B_{a b} C_{c d e} g^{c d} x^{a} x^{b} x^{e}
44            +   (7/11) B_{a b} B_{c d} C_{e f g} g^{b c} g^{d f} x^{a} x^{e} x^{g}. # cdb (ex-0405.100,expr)
45
46  # split the expression into seprate terms
47
48  term1 = get_term (expr,1)      # cdb(term1.101,term1)
49  term2 = get_term (expr,2)      # cdb(term2.101,term2)
50  term3 = get_term (expr,3)      # cdb(term3.101,term3)
51
52  # reformat terms and tidy fractions
53
54  term1 = reformat (term1, 21)    # cdb(term1.102,term1)
55  term2 = reformat (term2, 45)    # cdb(term2.102,term2)
56  term3 = reformat (term3,385)    # cdb(term3.102,term3)
57
58  # rebuild the expression
59
60  expr := @(term1) + @(term2) + @(term3). # cdb (ex-0405.101,expr)

```

$$\begin{aligned}
g &= \frac{1}{7} A_e x^e - \frac{1}{3} B_f x^f + \frac{1}{3} A_{ab} x^a x^b + \frac{1}{9} B_{ec} x^c x^e - \frac{1}{5} C_{pc} B_{dq} g^{cd} x^p x^q + \frac{3}{7} A_{abc} x^a x^b x^c - \frac{1}{5} B_{ab} C_{cde} g^{cd} x^a x^b x^e + \frac{7}{11} B_{ab} B_{cd} C_{efg} g^{bc} g^{df} x^a x^e x^g \quad (\text{ex-0405.100}) \\
&= \frac{1}{21} x^a (3 A_a - 7 B_a) + \frac{1}{45} x^a x^b (15 A_{ab} + 5 B_{ab} - 9 B_{ca} C_{bd} g^{dc}) + \frac{1}{385} x^a x^b x^c (165 A_{abc} - 77 B_{ab} C_{dec} g^{de} + 245 B_{ad} B_{ef} C_{bgc} g^{de} g^{fg}) (\text{ex-0405.101})
\end{aligned}$$