Example 1 The metric connection

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{a,b,c,d,e,f,h,i,j,k,l,m,n,o,p,q,r,s,t,u#}::Indices.

g_{a b}::Metric.
g_{a}^{b}::KroneckerDelta.

\partial{#}::PartialDerivative.

Gamma := \Gamma^{a}_{b c} -> (1/2) g^{a d} (  \partial_{b}{g_{d c}}
                                            + \partial_{c}{g_{b d}}
                                            - \partial_{d}{g_{b c}} ).   # cdb (ex-01.101,Gamma)

cderiv := \partial_{c}{g_{a b}} - g_{a d}\Gamma^{d}_{b c}
                                - g_{d b}\Gamma^{d}_{a c}.               # cdb (ex-01.102,cderiv)

substitute          (cderiv, Gamma)                                      # cdb (ex-01.103,cderiv)
distribute          (cderiv)                                             # cdb (ex-01.104,cderiv)
eliminate_metric    (cderiv)                                             # cdb (ex-01.105,cderiv)
eliminate_kronecker (cderiv)                                             # cdb (ex-01.106,cderiv)
canonicalise        (cderiv)                                             # cdb (ex-01.107,cderiv)

checkpoint.append (cderiv)
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$$\Gamma = {\Gamma^a}_{bc} \to \frac{1}{2} g^{ad} \left(\partial_b g_{dc} + \partial_c g_{bd} - \partial_d g_{bc} \right) \tag{ex-01.101}$$

$$g_{ab;c} = \partial_c g_{ab} - g_{ad} {\Gamma^d}_{bc} - g_{db} {\Gamma^d}_{ac} \tag{ex-01.102}$$

$$= \partial_c g_{ab} - \frac{1}{2} g_{ad} g^{de} \left(\partial_b g_{ec} + \partial_c g_{be} - \partial_e g_{bc} \right) - \frac{1}{2} g_{db} g^{de} \left(\partial_a g_{ec} + \partial_c g_{ae} - \partial_e g_{ac} \right) \tag{ex-01.103}$$

$$= \partial_c g_{ab} - \frac{1}{2} g_{ad} g^{de} \partial_b g_{ec} - \frac{1}{2} g_{ad} g^{de} \partial_c g_{be} + \frac{1}{2} g_{ad} g^{de} \partial_e g_{bc} - \frac{1}{2} g_{db} g^{de} \partial_a g_{ec} - \frac{1}{2} g_{db} g^{de} \partial_c g_{ae} + \frac{1}{2} g_{db} g^{de} \partial_e g_{ac} \tag{ex-01.104}$$

$$= \partial_c g_{ab} - \frac{1}{2} {g_a}^e \partial_b g_{ec} - \frac{1}{2} {g_a}^e \partial_c g_{be} + \frac{1}{2} {g_a}^e \partial_e g_{bc} - \frac{1}{2} {g_b}^e \partial_a g_{ec} - \frac{1}{2} {g_b}^e \partial_c g_{ae} + \frac{1}{2} {g_b}^e \partial_e g_{ac} \tag{ex-01.105}$$

$$= \frac{1}{2} \partial_c g_{ab} - \frac{1}{2} \partial_c g_{ba} \tag{ex-01.106}$$

$$= 0 \tag{ex-01.107}$$