

## Example 7 Export to C-code

```
1 def write_code (obj,name,filename,rank):
2
3     import os
4
5     from sympy.printing.c import C99CodePrinter as printer
6     from sympy.codegen.ast import Assignment
7
8     idx=[] # indices in the form [{x, x}, {x, y} ...]
9     lst=[] # corresponding terms [termxx, termxy, ...]
10
11     for i in range( len(obj[rank]) ): # rank = number of free indices
12         idx.append( str(obj[rank][i][0]._sympy_()) ) # indices for this term
13         lst.append( str(obj[rank][i][1]._sympy_()) ) # the matching term
14
15     mat = sympy.Matrix([lst]) # row vector of terms
16     sub_exprs, simplified_rhs = sympy.cse(mat) # optimise code
17
18     with open(os.getcwd() + '/' + filename, 'w') as out:
19
20         for lhs, rhs in sub_exprs:
21             out.write(printer().doprint(Assignment(lhs, rhs))+'\n')
22
23         for index, rhs in enumerate (simplified_rhs[0]):
24             lhs = sympy.Symbol(name+' '+idx[index]).replace(', ', '[')
25             out.write(printer().doprint(Assignment(lhs, rhs))+'\n')
```

```

1  {\theta, \varphi}::Coordinate.
2  {a,b,c,d,e,f,g,h#}::Indices(values={\theta, \varphi}, position=independent).
3
4  \partial{#}::PartialDerivative.
5
6  g_{a b}::Metric.
7  g^{a b}::InverseMetric.
8
9  Gamma := \Gamma^{a}_{f g} -> 1/2 g^{a b} ( \partial_{g}{g_{b f}}
10                                     + \partial_{f}{g_{b g}}
11                                     - \partial_{b}{g_{f g}} ).
12
13  Rabcd := R^{d}_{e f g} -> \partial_{f}{\Gamma^{d}_{e g}}
14                             - \partial_{g}{\Gamma^{d}_{e f}}
15                             + \Gamma^{d}_{b f} \Gamma^{b}_{e g}
16                             - \Gamma^{d}_{b g} \Gamma^{b}_{e f}.
17
18  Rab := R_{a b} -> R^{c}_{c} {a c b}.
19
20  gab := { g_{\theta \theta} = r**2,
21           g_{\varphi \varphi} = r**2 \sin(\theta)**2 }. # cdb(ex-07.101,gab)
22
23  complete (gab, $g^{a b}$) # cdb(ex-07.102,gab)
24
25  substitute (Rabcd, Gamma)
26  substitute (Rab, Rabcd)
27
28  evaluate (Gamma, gab, rhsonly=True) # cdb(ex-07.103,Gamma)
29  evaluate (Rabcd, gab, rhsonly=True) # cdb(ex-07.104,Rabcd)
30  evaluate (Rab, gab, rhsonly=True) # cdb(ex-07.105,Rab)
31
32  write_code (Gamma[1], 'myGamma', 'example-07-gamma.c', 3)
33  write_code (Rabcd[1], 'myRabcd', 'example-07-rabcd.c', 4)
34  write_code (Rab[1], 'myRab', 'example-07-rab.c', 2)

```

$$[g_{\theta\theta} = r^2, \ g_{\varphi\varphi} = r^2(\sin \theta)^2] \quad (\text{ex-07.101})$$

$$\left[ g_{\theta\theta} = r^2, \ g_{\varphi\varphi} = r^2(\sin \theta)^2, \ g^{\theta\theta} = r^{-2}, \ g^{\varphi\varphi} = (r^2(\sin \theta)^2)^{-1} \right] \quad (\text{ex-07.102})$$

$$\Gamma^a_{fg} \rightarrow \square_{fg}^a \begin{cases} \square_{\varphi\theta}^{\varphi} = (\tan \theta)^{-1} \\ \square_{\theta\varphi}^{\varphi} = (\tan \theta)^{-1} \\ \square_{\varphi\varphi}^{\theta} = -\frac{1}{2} \sin(2\theta) \end{cases} \quad (\text{ex-07.103})$$

$$R^d_{efg} \rightarrow \square_{eg}^d \begin{cases} \square_{\varphi\varphi}^{\theta} = (\sin \theta)^2 \\ \square_{\theta\varphi}^{\varphi} = -1 \\ \square_{\varphi\theta}^{\theta} = -(\sin \theta)^2 \\ \square_{\theta\theta}^{\varphi} = 1 \end{cases} \quad (\text{ex-07.104})$$

$$R_{ab} \rightarrow \square_{ab} \begin{cases} \square_{\varphi\varphi} = (\sin \theta)^2 \\ \square_{\theta\theta} = 1 \end{cases} \quad (\text{ex-07.105})$$