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> restart, with(grtensor);
libname := "/Users/peter/maple/gitlab/GRTensorIII/lib",
          "/Library/Frameworks/Maple.framework/Versions/2017/lib"
          "GRTensor III v2.0.2+ Debug"
          "Copyright 2017, Peter Musgrave, Denis Pollney, Kayll Lake"
          "Latest version is at http://github.com/grtensor/grtensor"
          "For help ?grtensor"
[Asym, KillingCoords, PetrovReport, Sym, autoAlias, difftool, grDalias, grF_strToDef, gralter,
 grapply, grarray, grcalc, grcalc1, grcalcalter, grcalcd, grclear, grcomponent, grconstraint,
 grdata, grdebug, grdef, grdisplay, grdump, greqn2set, grinit, grload, grload_maplet,
 grmap, grmetric, grnewmetric, grnormalize, groptions, grsave, grtestinput, grtransform,
 grundef, hypersurf, join, kdelta, makeg, nprotate, nptetrad, qload, spacetime]
grOptionqloadPath := "/Users/peter/maple/gitlab/GRTensorIII/kayll/metrics"
grOptionMetricPath := "/Users/peter/maple/gitlab/grtensor/metrics"
[Asym, KillingCoords, PetrovReport, Sym, autoAlias, difftool, grDalias, grF_strToDef, gralter,
 grapply, grarray, grcalc, grcalc1, grcalcalter, grcalcd, grclear, grcomponent, grconstraint,
 grdata, grdebug, grdef, grdisplay, grdump, greqn2set, grinit, grload, grload_maplet,
 grmap, grmetric, grnewmetric, grnormalize, groptions, grsave, grtestinput, grtransform,
 grundef, hypersurf, join, kdelta, makeg, nprotate, nptetrad, qload, spacetime]

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(1)

```

> qload(schw);
Calculated ds for schw (0.000000 sec.)
      Default spacetime = schw
      For the schw spacetime:
            Coordinates
                  x(up)
            
$$x^a = \begin{bmatrix} r & \theta & \phi & t \end{bmatrix}$$

            Line element
            
$$ds^2 = \frac{dr^2}{1 - \frac{2m}{r}} + r^2 d\theta^2 + r^2 \sin(\theta)^2 d\phi^2 + \left(-1 + \frac{2m}{r}\right) dt^2$$

            The Schwarzschild metric in curvature coordinates

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(2)

```

> grdef("T{^a ^b} := rho(t)*kdelta{^a $t}*kdelta{^b $t}");
Created definition for T(up,up)
> grcalc(T(up, up));
Calculated grtensor:-kdelta(up,dn) for schw (0.000000 sec.)
Calculated T(up,up) for schw (0.001000 sec.)
      CPU Time = 0.002
> grdisplay(T(up, up));
      For the schw spacetime:

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$$T^{a\ b} = \begin{matrix} T(up, up) \\ T(up, up) \\ \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \rho(t) \end{bmatrix} \end{matrix} \quad (4)$$

```
> grdef("v^{a} := kdelta{^a $t}");
Created definition for v(up)
> grcalc(KillingTest[v]);
Created a definition for v(up,cdn)
Created definition for v(dn)
Created a definition for v(dn,cdn)
Calculated g(dn,dn,pdn) for schw (0.002000 sec.)
Calculated Chr(dn,dn,dn) for schw (0.001000 sec.)
Calculated detg for schw (0.003000 sec.)
Calculated g(up,up) for schw (0.004000 sec.)
Calculated Chr(dn,dn,up) for schw (0.001000 sec.)
Calculated v(up) for schw (0.001000 sec.)
Calculated v(up,cdn) for schw (0.000000 sec.)
Calculated expsc[v] for schw (0.000000 sec.)
Calculated conf[v] for schw (0.000000 sec.)
Calculated v(dn) for schw (0.000000 sec.)
Calculated v(dn,cdn) for schw (0.000000 sec.)
Calculated ktest(dn,dn) || `[v]` for schw (0.000000 sec.)
Calculated KillingTest[v] for schw (0.000000 sec.)
CPU Time = 0.043
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```
> grdisplay(_);
```

For the schw spacetime:

Killing Test Result

Killing Test[v] = a Killing vector.

(6)

```
> KillingCoords( );
Testing Killing coordinates for schw
Created a definition for coord1(up,cdn)
Created definition for coord1(dn)
Created a definition for coord1(dn,cdn)
Created a definition for coord2(up,cdn)
Created definition for coord2(dn)
Created a definition for coord2(dn,cdn)
Created a definition for coord3(up,cdn)
Created definition for coord3(dn)
Created a definition for coord3(dn,cdn)
Created a definition for coord4(up,cdn)
Created definition for coord4(dn)
Created a definition for coord4(dn,cdn)
Calculated coord1(up) for schw (0.001000 sec.)
Calculated coord1(up,cdn) for schw (0.000000 sec.)
Calculated expsc[coord1] for schw (0.000000 sec.)
Calculated conf[coord1] for schw (0.001000 sec.)
Calculated coord1(dn) for schw (0.000000 sec.)
Calculated coord1(dn,cdn) for schw (0.000000 sec.)
Calculated ktest(dn,dn) || `[coord1]` for schw (0.000000 sec.)
Calculated KillingTest[coord1] for schw (0.000000 sec.)
```

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Calculated coord2(up) for schw (0.000000 sec.)
Calculated coord2(up,cdn) for schw (0.001000 sec.)
Calculated expsc[coord2] for schw (0.000000 sec.)
Calculated conf[coord2] for schw (0.000000 sec.)
Calculated coord2(dn) for schw (0.000000 sec.)
Calculated coord2(dn,cdn) for schw (0.001000 sec.)
Calculated ktest(dn,dn) || `[coord2]` for schw (0.000000 sec.)
Calculated KillingTest[coord2] for schw (0.000000 sec.)
Calculated coord3(up) for schw (0.000000 sec.)
Calculated coord3(up,cdn) for schw (0.001000 sec.)
Calculated expsc[coord3] for schw (0.000000 sec.)
Calculated conf[coord3] for schw (0.000000 sec.)
Calculated coord3(dn) for schw (0.000000 sec.)
Calculated coord3(dn,cdn) for schw (0.000000 sec.)
Calculated ktest(dn,dn) || `[coord3]` for schw (0.000000 sec.)
Calculated KillingTest[coord3] for schw (0.000000 sec.)
Calculated coord4(up) for schw (0.000000 sec.)
Calculated coord4(up,cdn) for schw (0.000000 sec.)
Calculated expsc[coord4] for schw (0.001000 sec.)
Calculated conf[coord4] for schw (0.000000 sec.)
Calculated coord4(dn) for schw (0.000000 sec.)
Calculated coord4(dn,cdn) for schw (0.000000 sec.)
Calculated ktest(dn,dn) || `[coord4]` for schw (0.000000 sec.)
Calculated KillingTest[coord4] for schw (0.001000 sec.)

```

CPU Time = 0.200

Killing Coordinate Test Results

Coordinate vector = $[r, \theta, \phi, t]$

coord1(up) = $[1, 0, 0, 0]$, *not a Killing vector.*

coord2(up) = $[0, 1, 0, 0]$, *not a Killing vector.*

coord3(up) = $[0, 0, 1, 0]$, *a Killing vector.*

coord4(up) = $[0, 0, 0, 1]$, *a Killing vector.*

(7)

>