$ds^2 = -dt^2 + a^2(t)dx^2 + a^2(t)dy^2 + a^2(t)dz^2$

$\Rightarrow ds\,ds = -dt\,dt + a^2(t)(dx\,dx + dy\,dy + dz\,dz)$

i.e., $ds^2 = -dt^2 + a^2(t)\left(\sum_{i=1}^{3} dx^i dx^i\right)$ *i's are* **not** *powers.*

The convention used here is this: $dx^1 = dx$, $dx^2 = dy$ & $dx^3 = dz$

Now, I want to find the Christoffel symbols of the second kind and the Ricci tensors.

```
> restart;
> with(tensor) :
> coords := [t, x, y, z] :
> g := array(symmetric, sparse, 1..4, 1..4) :
> g[1, 1] := -1 :
> g[2, 2] := a(t)^2 :
> g[3, 3] := a(t)^2 :
> g[4, 4] := a(t)^2 :
> metric := create([-1,-1], eval(g));
```

$$metric := table\left(\left[index\_char = [-1, -1], compts = \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & a(t)^2 & 0 & 0 \\ 0 & 0 & a(t)^2 & 0 \\ 0 & 0 & 0 & a(t)^2 \end{bmatrix}\right]\right) \quad \textbf{(1)}$$

```
> tensorsGR(coords, metric, contra_metric, det_met, C1, C2, Rm, Rc, R, GEin, C) :
> displayGR(Christoffel2, C2);
```

The Christoffel Symbols of the Second Kind

non-zero components :

$$\{1,22\} = a(t)\left(\frac{d}{dt}a(t)\right)$$

$$\{1,33\} = a(t)\left(\frac{d}{dt}a(t)\right)$$

$$\{1,44\} = a(t)\left(\frac{d}{dt}a(t)\right)$$

$$\{2,12\} = \frac{\frac{d}{dt}a(t)}{a(t)}$$

$$\{3,13\} = \frac{\frac{d}{dt}a(t)}{a(t)}$$

$$\{4,14\} = \frac{\frac{d}{dt}a(t)}{a(t)} \quad \textbf{(2)}$$

> $displayGR(Ricci, Rc);$

The Ricci tensor

non-zero components :

$$R11 = \frac{3\left(\frac{d^2}{dt^2}\,a(t)\right)}{a(t)}$$

$$R22 = -2\left(\frac{d}{dt}\,a(t)\right)^2 - a(t)\left(\frac{d^2}{dt^2}\,a(t)\right)$$

$$R33 = -2\left(\frac{d}{dt}\,a(t)\right)^2 - a(t)\left(\frac{d^2}{dt^2}\,a(t)\right)$$

$$R44 = -2\left(\frac{d}{dt}\,a(t)\right)^2 - a(t)\left(\frac{d^2}{dt^2}\,a(t)\right)$$

character : [-1, -1] **(3)**

So, it is fairly straightforward. Now what I wanted is this, instead of 4 dimensions(1 temporal,3 spatial), I want to work with arbitrary dimensions, say **n**. In this case the above metric would be

$$ds^2 = -dt^2 + a^2(t)\left(\sum_{i=1}^{n-1} dx^i dx^i\right).$$

For the special case **n = 4**, we have the above solutions.

Now,in this generalized case, how can I find the Christoffel symbols of the second kind and the Ricci tensors?

The main problem, seems to me is that I don't know how can I construct the array.

Is there any other method in Maple which can work with ds^2 *directly*?

By the way, I don't want to give values to n, i.e. I want the answers in terms of n. **Not** for a particular value of n.