In[1]:=
```
ClearAll["Global`*"]
coordinateList = {θ, ϕ};

(* Initialize and define Γ^μ_νρ as a rank 3 tensor *)
tmp[a_, b_, c_] := 0;
Γ = Array[tmp, {2, 2, 2}];
Γ[[1, 2, 2]] = -1/2 Sin[2 θ];
Γ[[2, 1, 2]] = Cot[θ];
Γ[[2, 2, 1]] = Cot[θ];

(* Initialize R^λ_μνκ as a rank 4 tensor *)
tmp[a_, b_, c_, d_] := 0;
R = Array[tmp, {2, 2, 2, 2}];

(* Loop over indices in R^ρ_μνκ *)
Do[
 Do[
  Do[
   Do[
    xκ = coordinateList[[κ]];
    xν = coordinateList[[ν]];

    (* R^λ_μνκ = ∂Γ^λ_μν/∂x^κ - ∂Γ^λ_μκ/∂x^ν + Γ^η_μνΓ^λ_κη - Γ^η_μκΓ^λ_νη *)
    R[[λ, μ, ν, κ]] += ∂_xν Γ[[λ, μ, κ]] - ∂_xκ Γ[[λ, μ, ν]];
    Do[
     R[[λ, μ, ν, κ]] += Γ[[η, μ, κ]] × Γ[[λ, ν, η]] - Γ[[η, μ, ν]] × Γ[[λ, κ, η]],
     {η, {1, 2}}],

    {κ, {1, 2}}],
   {ν, {1, 2}}],
  {μ, {1, 2}}],
 {λ, {1, 2}}]


Print["R^θ_θνκ = ", MatrixForm[FullSimplify[R[[1, 1]]]]]
Print["R^θ_ϕνκ = ", MatrixForm[FullSimplify[R[[1, 2]]]]]
```

```
Print["R^ϕ_θνκ = ", MatrixForm[FullSimplify[R[[2, 1]]]]]
Print["R^ϕ_ϕνκ = ", MatrixForm[FullSimplify[R[[2, 2]]]]]
```

$R^{\theta}{}_{\theta\nu\kappa} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$

$R^{\theta}{}_{\phi\nu\kappa} = \begin{pmatrix} 0 & \mathrm{Sin}[\theta]^2 \\ -\mathrm{Sin}[\theta]^2 & 0 \end{pmatrix}$

$R^{\phi}{}_{\theta\nu\kappa} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$

$R^{\phi}{}_{\phi\nu\kappa} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$

In[15]:=
```
(* Initialize Ricci^μ_ν as rank 2 tensor *)
tmp[a_, b_] := 0;
Ricci = Array[tmp, {2, 2}];

(* Loop over indices in Ricci_μν *)
Do[
 Do[
  Do[
   Ricci[[μ, ν]] += R[[σ, μ, σ, ν]],
   {σ, 1, 2}],
  {ν, 1, 2}],
 {μ, 1, 2}]

Print["Ricci_μν = ", MatrixForm[FullSimplify[Ricci]]]
```

$\mathrm{Ricci}_{\mu\nu} = \begin{pmatrix} 1 & 0 \\ 0 & \mathrm{Sin}[\theta]^2 \end{pmatrix}$

In[19]:=
```
(* Calculate curvature scalar *)
gInv = {{1, 0}, {0, 1/Sin[θ]^2}};
Print["R = ", FullSimplify[Tr[gInv.Ricci]]]
```

R = 2