

```

> restart
> with(plots)
[animate, animate3d, animatecurve, arrow, changecoords, complexplot, complexplot3d,
conformal, conformal3d, contourplot, contourplot3d, coordplot, coordplot3d, densityplot,
display, dualaxisplot, fieldplot, fieldplot3d, gradplot, gradplot3d, implicitplot,
implicitplot3d, inequal, interactive, interactiveparams, intersectplot, listcontplot,
listcontplot3d, listdensityplot, listplot, listplot3d, loglogplot, logplot, matrixplot, multiple,
odeplot, pareto, plotcompare, pointplot, pointplot3d, polarplot, polygonplot, polygonplot3d,
polyhedra_supported, polyhedraplot, rootlocus, semilogplot, setcolors, setoptions,
setoptions3d, shadebetween, spacecurve, sparsematrixplot, surfdata, textplot, textplot3d,
tubeplot]

```

(1)

▼ Un Phased Case

```

> NGroup := unapply( min( nHap, max( ceil(  $\frac{nPar}{nHap}$  ), nSm ) ), nHap, nPar, nSm )
NGroup := (nHap, nPar, nSm)  $\mapsto$  min( nHap, max( nSm,  $\left\lceil \frac{nPar}{nHap} \right\rceil$  ) )

```

(1.1)

▼ Num people in group needed for "sufficient" parallisum

```

> Curves := { NGroup( nHap, 71e3, 46 ), NGroup( nHap, 262e3, 128 ), NGroup( nHap,
270e3, 132 ) }
Curves := { min( nHap, max( 46,  $\left\lceil \frac{71000.}{nHap} \right\rceil$  ) ), min( nHap, max( 128,  $\left\lceil \frac{262000.}{nHap} \right\rceil$  ) ),
min( nHap, max( 132,  $\left\lceil \frac{270000.}{nHap} \right\rceil$  ) ) }

```

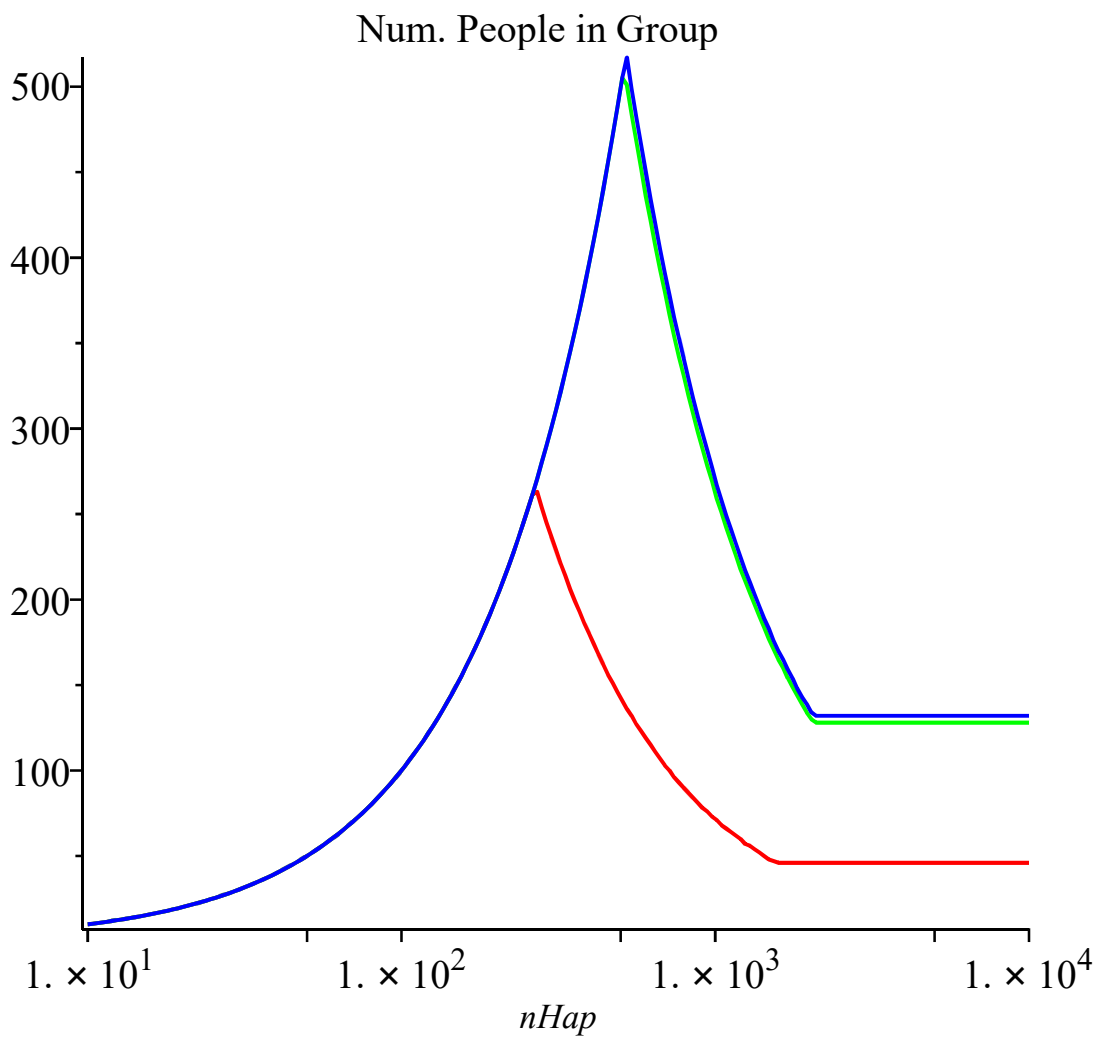
(1.1.1)

```

> PGroup := semilogplot( Curves, nHap = 10 .. 10e3, color = [red, green, blue] ) :
> PlotOpts := title = "Num. People in Group"
PlotOpts := title = "Num. People in Group"
> display( PGroup, PlotOpts )

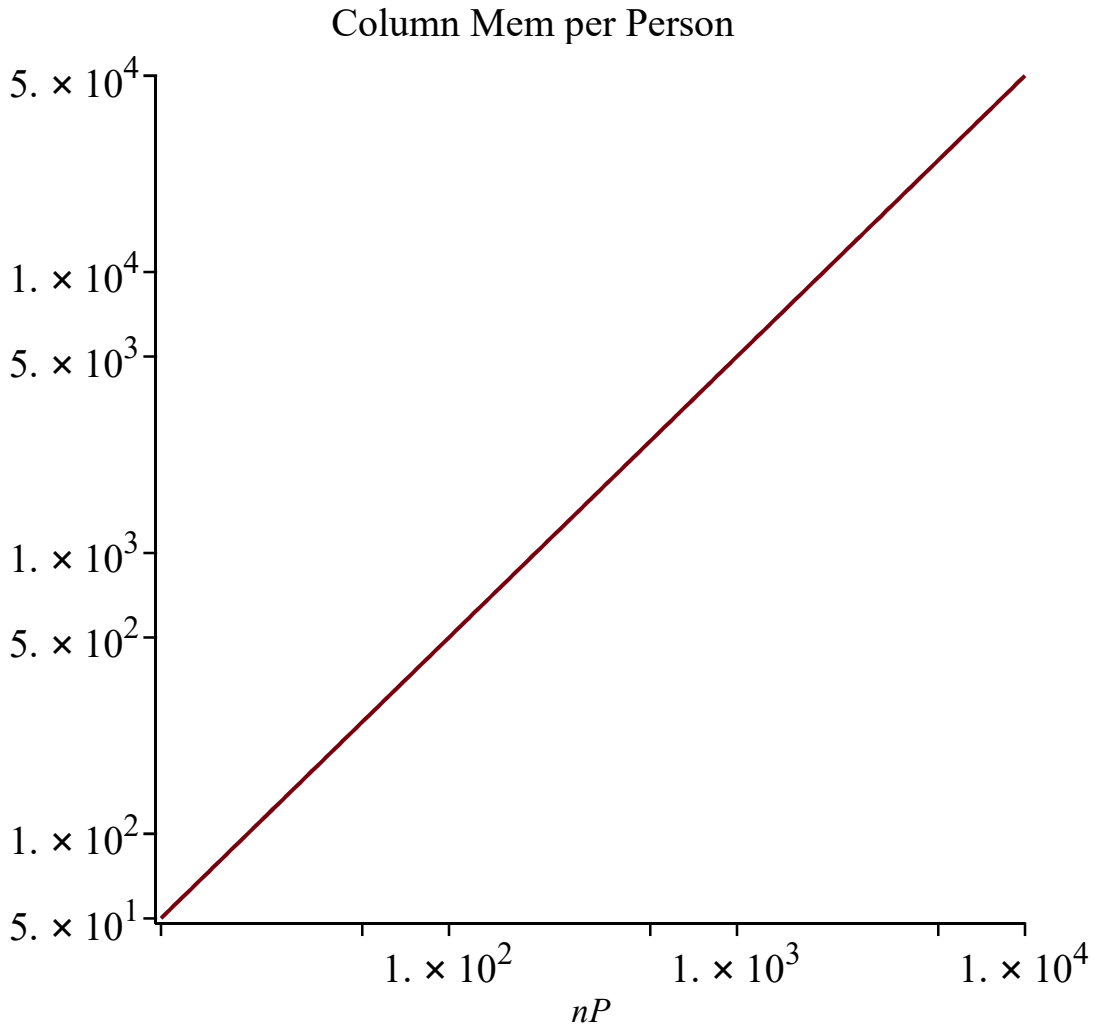
```

(1.1.2)



▼ Sheared Mem per Block

> `loglogplot(nP·5, nP = 10 .. 10e3, title = "Column Mem per Person")`

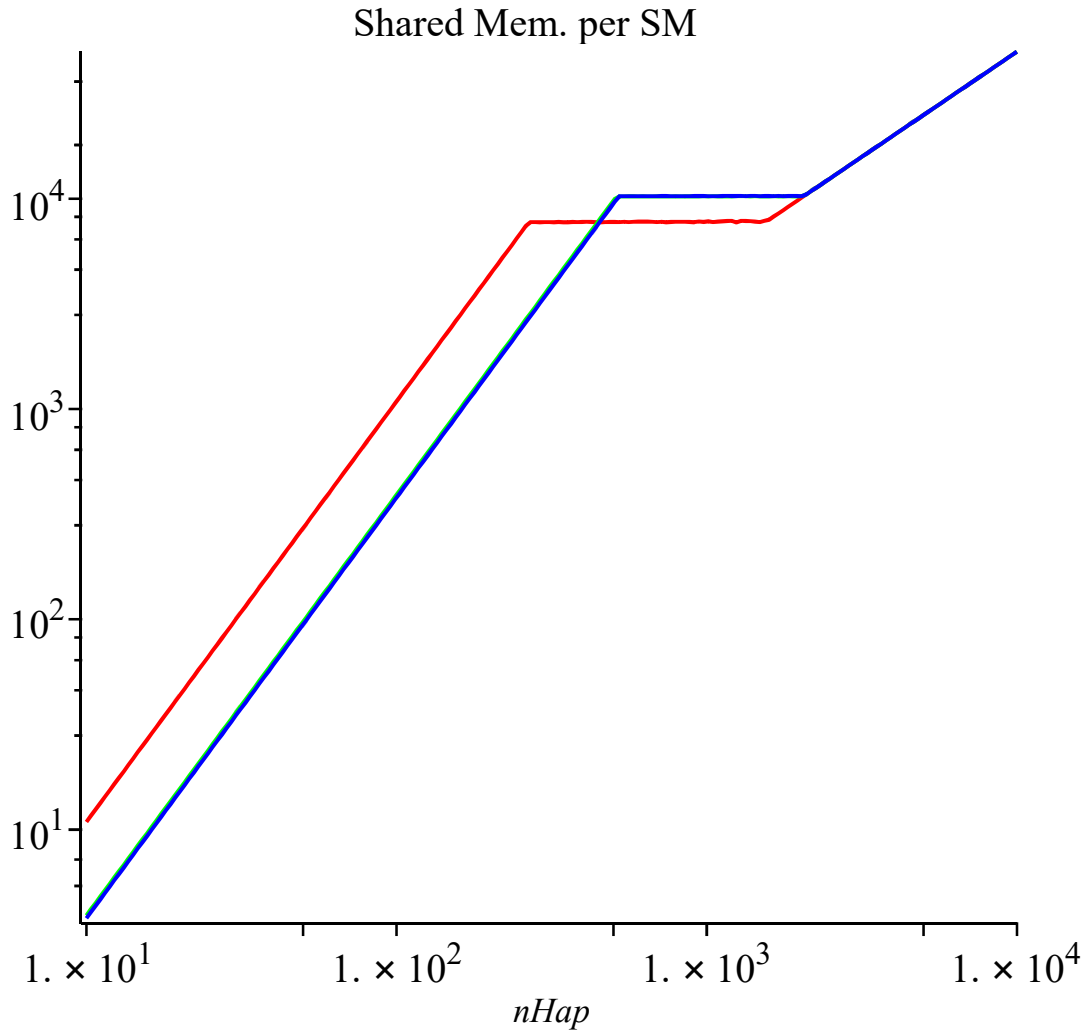


Shared Mem per SM

$$\begin{aligned} &> \text{TotalSharedMem} := \text{unapply}(\text{NGroup}(nHap, nPar, nSnp) \cdot nHap \cdot 5, nHap, nPar, nSnp) \\ &\text{TotalSharedMem} := (nHap, nPar, nSnp) \mapsto 5 \min\left(nHap, \max\left(nSnp, \left\lfloor \frac{nPar}{nHap} \right\rfloor\right)\right) nHap \quad (1.3.1) \end{aligned}$$

$$\begin{aligned} &> \text{Curves} := \left[\frac{\text{TotalSharedMem}(nHap, 71e3, 46)}{46}, \frac{\text{TotalSharedMem}(nHap, 262e3, 128)}{128}, \right. \\ &\quad \left. \frac{\text{TotalSharedMem}(nHap, 271e3, 132)}{132} \right]; \\ &\text{Curves} := \left[\frac{5 nHap \min\left(nHap, \max\left(46, \left\lfloor \frac{71000.}{nHap} \right\rfloor\right)\right)}{46}, \right. \\ &\quad \frac{5 \min\left(nHap, \max\left(128, \left\lfloor \frac{262000.}{nHap} \right\rfloor\right)\right) nHap}{128}, \\ &\quad \left. \frac{5 \min\left(nHap, \max\left(132, \left\lfloor \frac{271000.}{nHap} \right\rfloor\right)\right) nHap}{132} \right] \quad (1.3.2) \end{aligned}$$

```
> loglogplot(Curves, nHap = 10 .. 1e4, title = "Shared Mem. per SM", color = [red, green, blue])
```



Global mem per Group

```
> MemLat := unapply( 2 · nHap · nSnp, nHap, nSnp )
MemLat := (nHap, nSnp) ↦ 2 nSnp nHap (1.4.1)
```

```
> GroupGlobalMem := unapply( MemLat(nHap, nSnp) · NGroup(nHap, nPar, nSm), nHap,
nSnp, nPar, nSm )
GroupGlobalMem := (nHap, nSnp, nPar, nSm) ↦ 2 nSnp nHap min( nHap, max( nSm, (1.4.2)
⌊ nPar / nHap ⌋ ) )
```

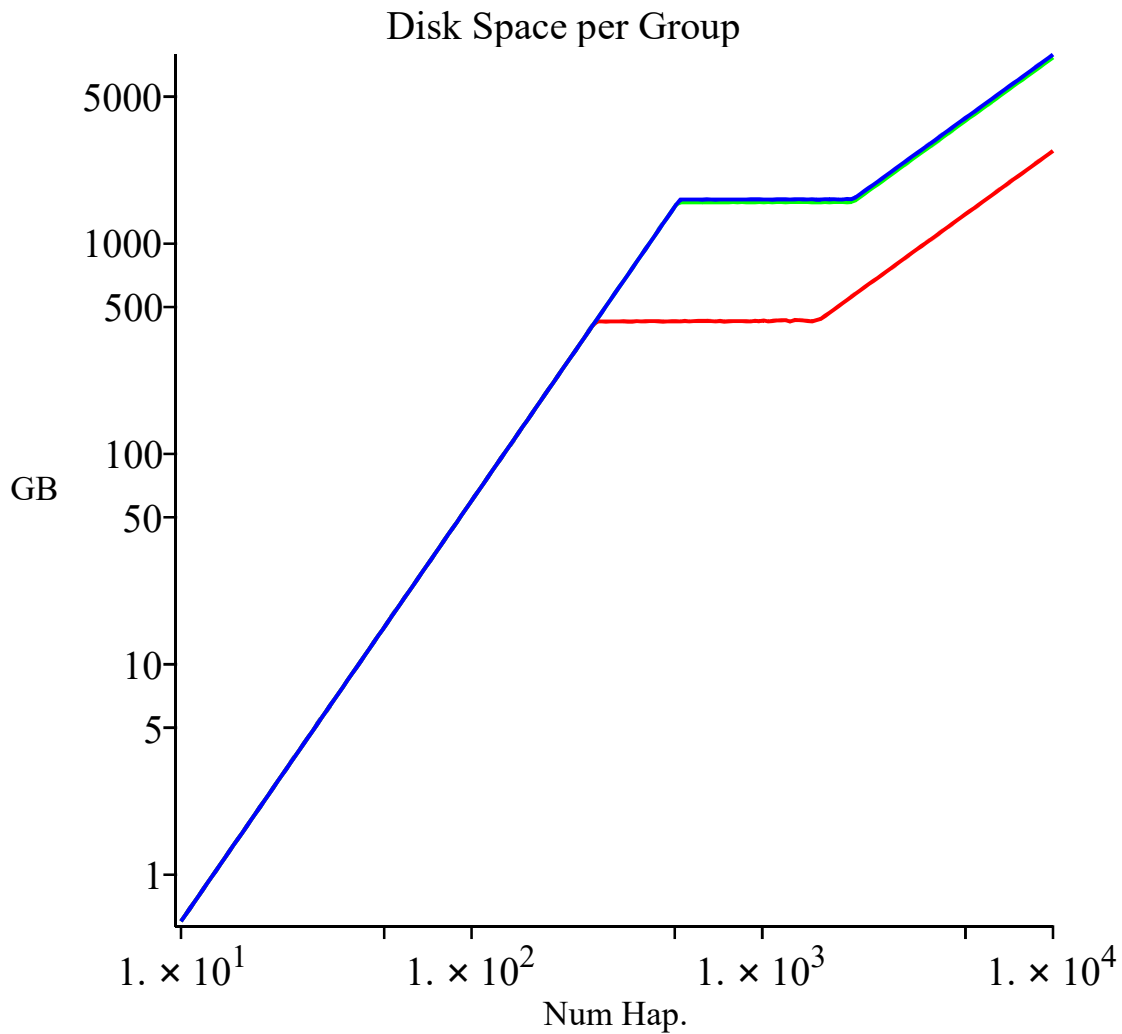
```
> PlotOpts := title = "Global Mem. for a Group of Lattices", labels = ["Num State", "GB"]
PlotOpts := title = "Global Mem. for a Group of Lattices", labels = ["Num State", "GB"] (1.4.3)
```

```
> Curve := [ GroupGlobalMem(nHap, 3e6, 71e3, 46), GroupGlobalMem(nHap, 3e6,
262e3, 128), GroupGlobalMem(nHap, 3e6, 270e3, 132) ]
Curve := [ 6 · 10^6 nHap min( nHap, max( 46, ⌊ 71000 / nHap ⌋ ) ), 6 · 10^6 min( nHap, max( 128, (1.4.4)
```

```

>  $\left\lceil \frac{262000.}{nHap} \right\rceil \right) nHap, 6. \cdot 10^6 nHap \min \left( nHap, \max \left( 132, \left\lceil \frac{270000.}{nHap} \right\rceil \right) \right) \right]$ 
> PlotOpts := title = "Disk Space per Group", labels = ["Num Hap.", "GB"]
  PlotOpts := title = "Disk Space per Group", labels = ["Num Hap.", "GB"] (1.4.5)
> loglogplot(Curve·1e−9, nHap = 10..10e3, color = [red, green, blue], PlotOpts)

```



```

> DiskSize := [ GroupGlobalMem(3e3, 3e6, 71e3, 46), GroupGlobalMem(3e3, 3e6, 262e3,
  128), GroupGlobalMem(3e3, 3e6, 270e3, 132) ]
  DiskSize := [8.28 1011, 2.304 1012, 2.376 1012] (1.2)

```

```

> IoTime :=  $\left[ \frac{DiskSize[1]}{100e6} \cdot \frac{1}{60}, \frac{DiskSize[2]}{300e6} \cdot \frac{1}{60}, \frac{DiskSize[3]}{1e9} \cdot \frac{1}{60} \right]$ 
  IoTime := [138.0000000, 128.0000000, 39.60000001] (1.3)

```

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>
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```