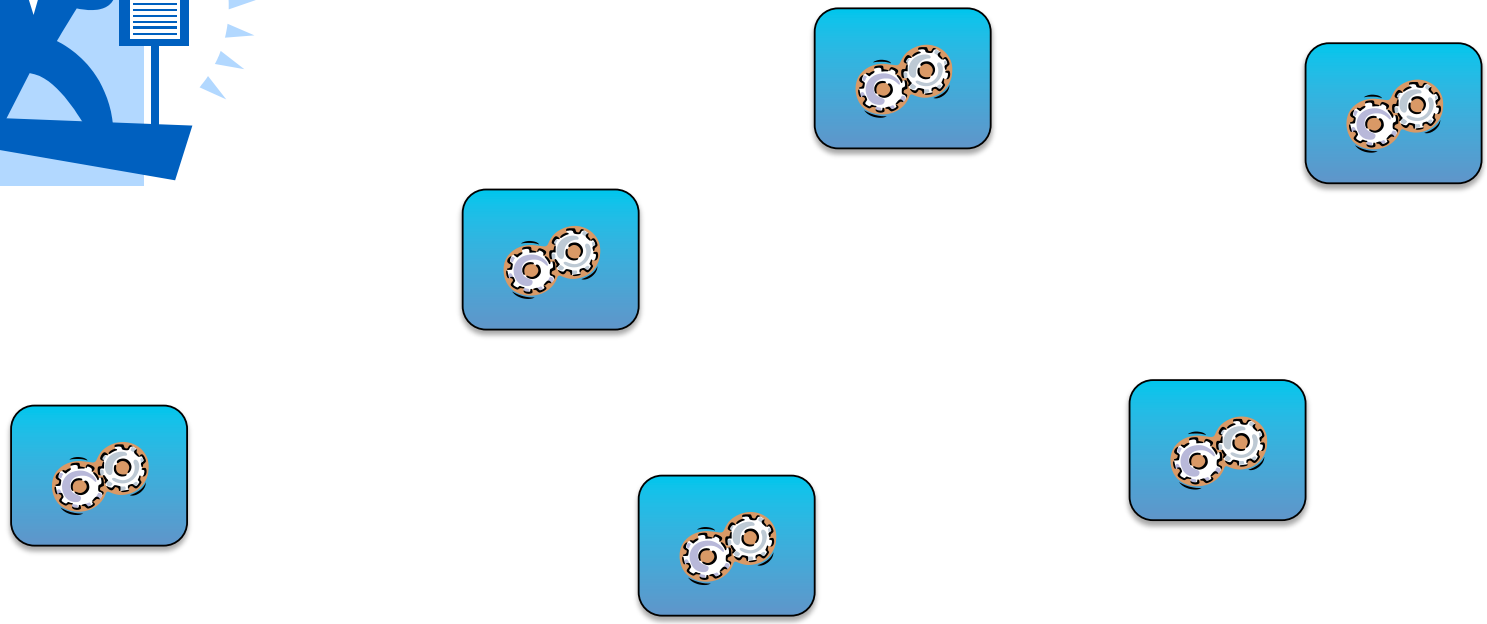
Message Driven Programming with S-Net
Methodology and Performance

Frank Penczek
S.A. Herhut, S.-B. Scholz, A. Shafarenko, J. Yang, C.Y. Chen, N. Bagherzadeh, C. Grelck

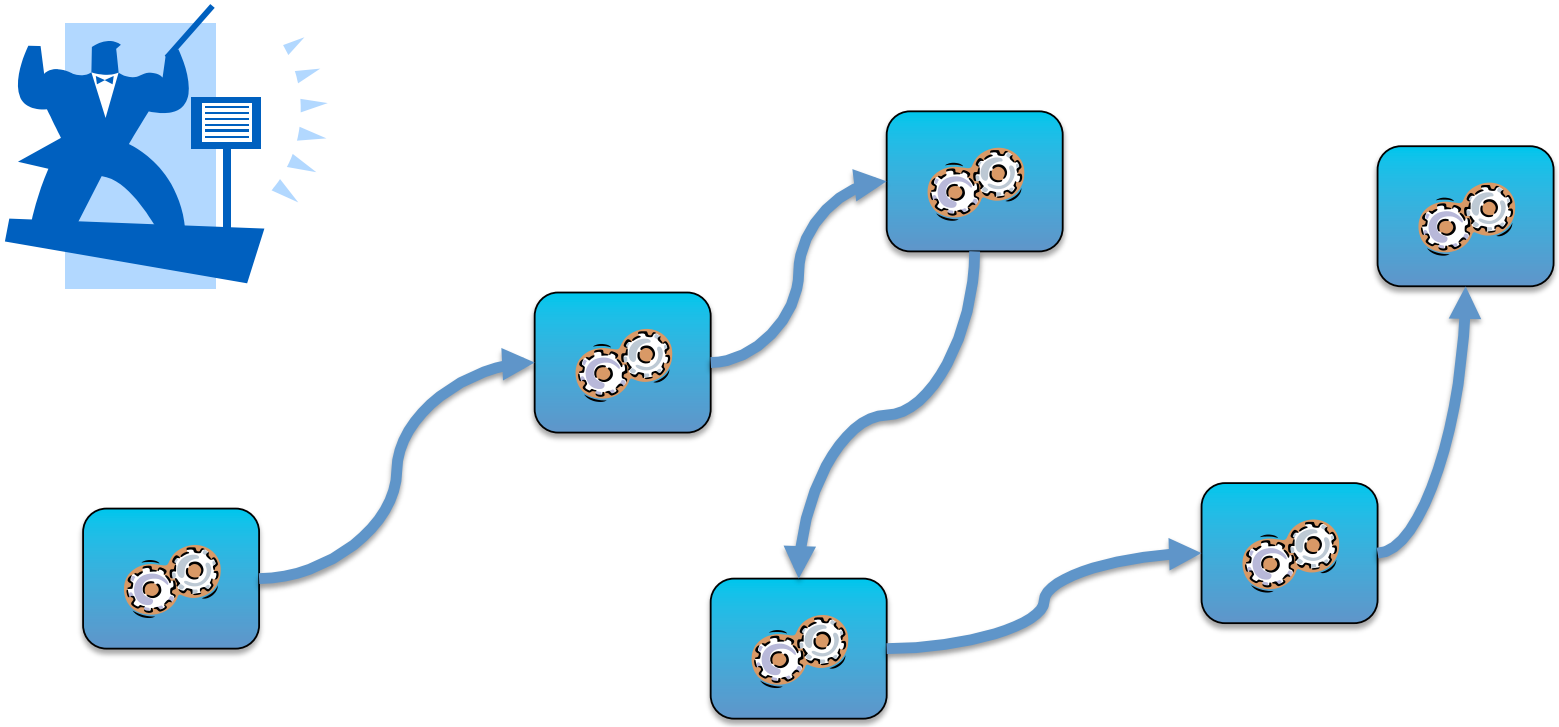
What is S-Net

Coordination & Concurrency Engineering



What is S-Net

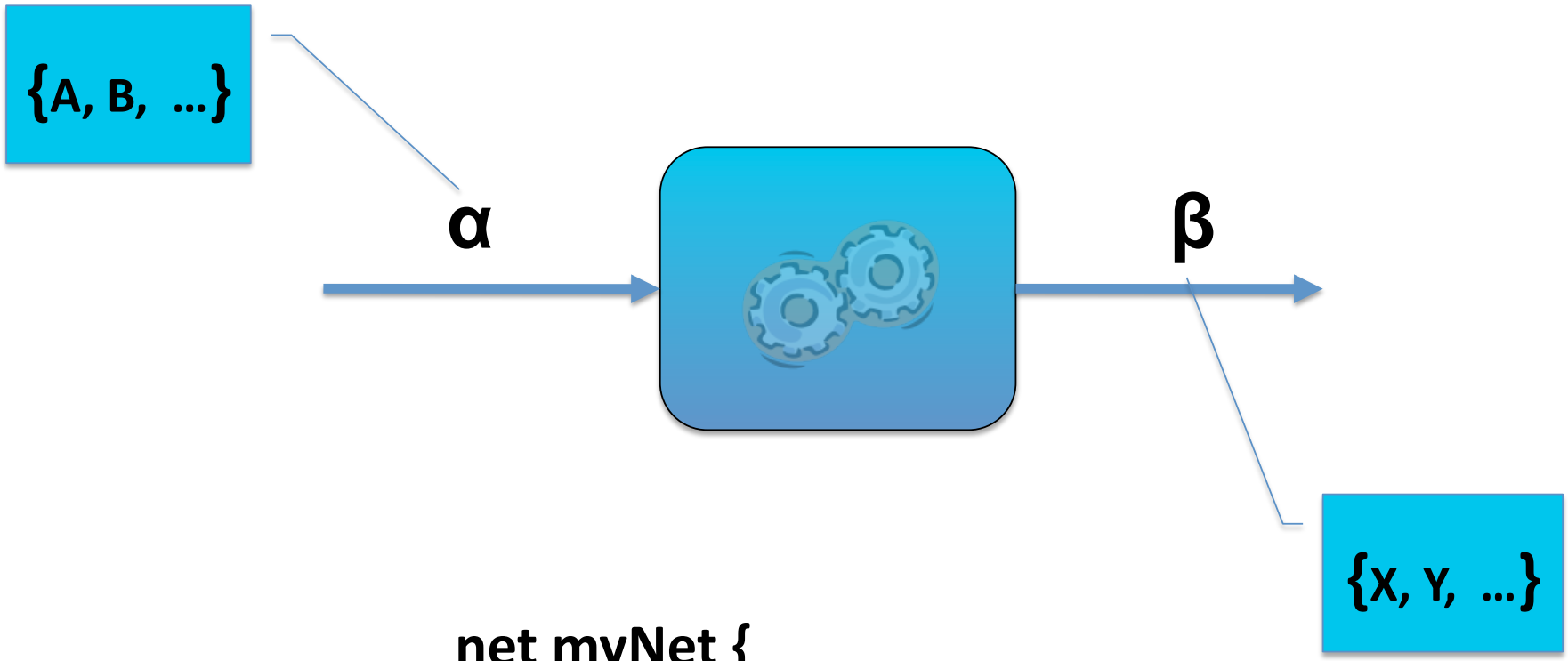
Applications as Streaming Networks



University of Hertfordshire UH

What is S-Net
Basic Building Blocks

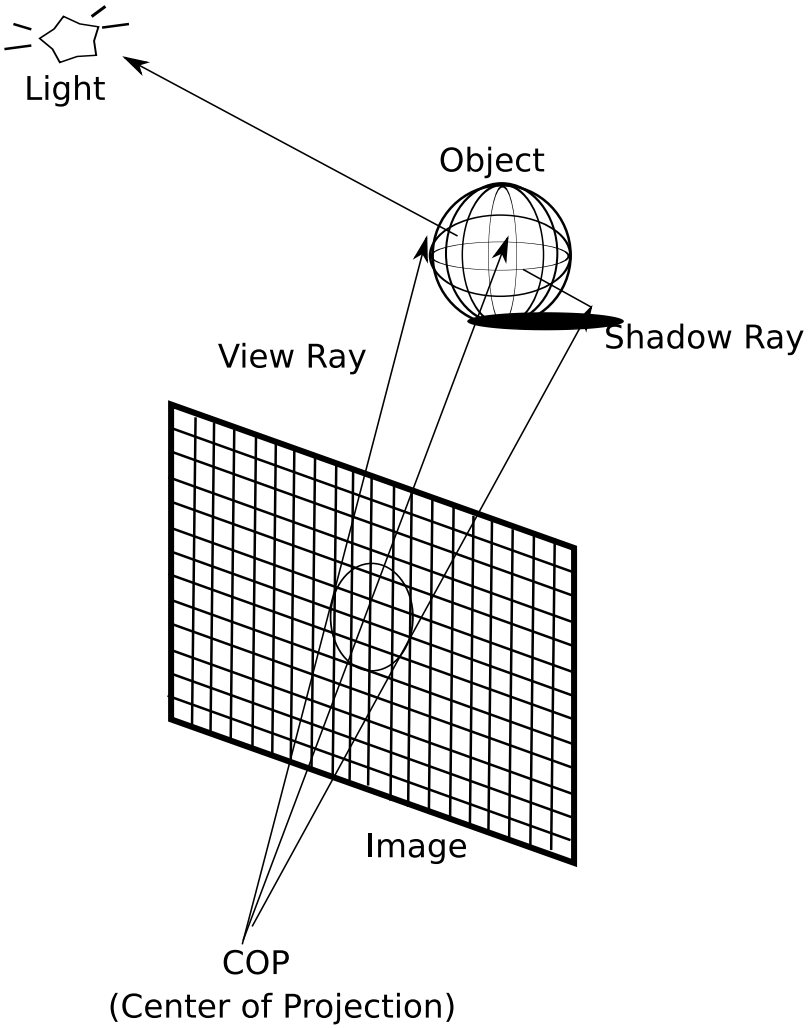
What is S-Net
Basic Building Blocks




```
net myNet {
   box MyBox( (A,B) -> (X,Y));
} connect MyBox;
```

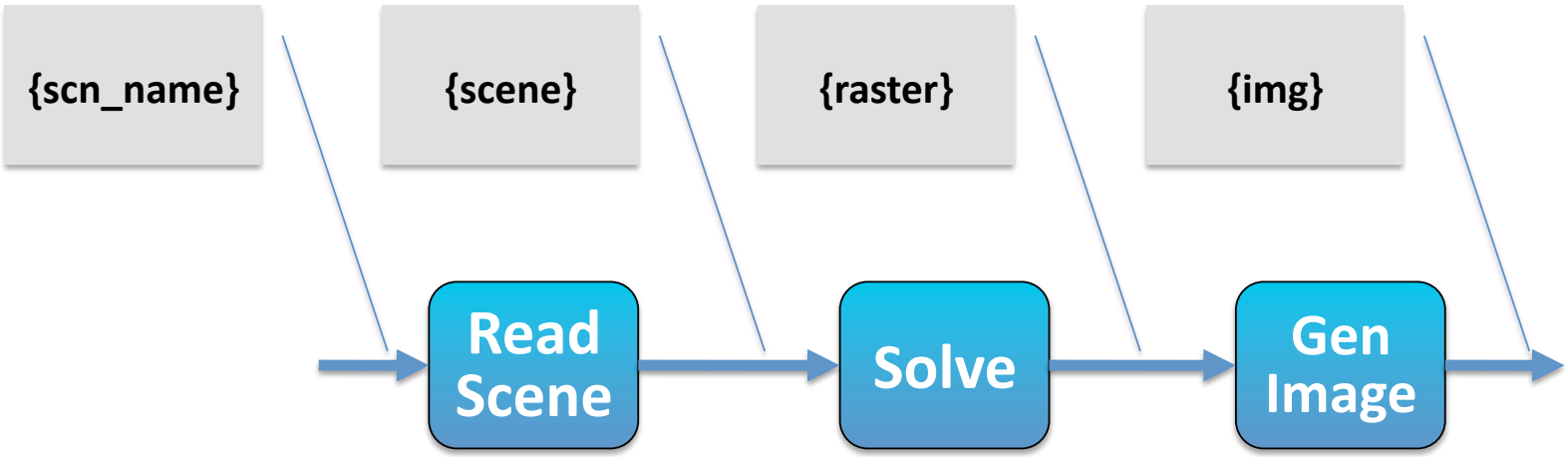
University of Hertfordshire UH

Raytracing Application
The Principle

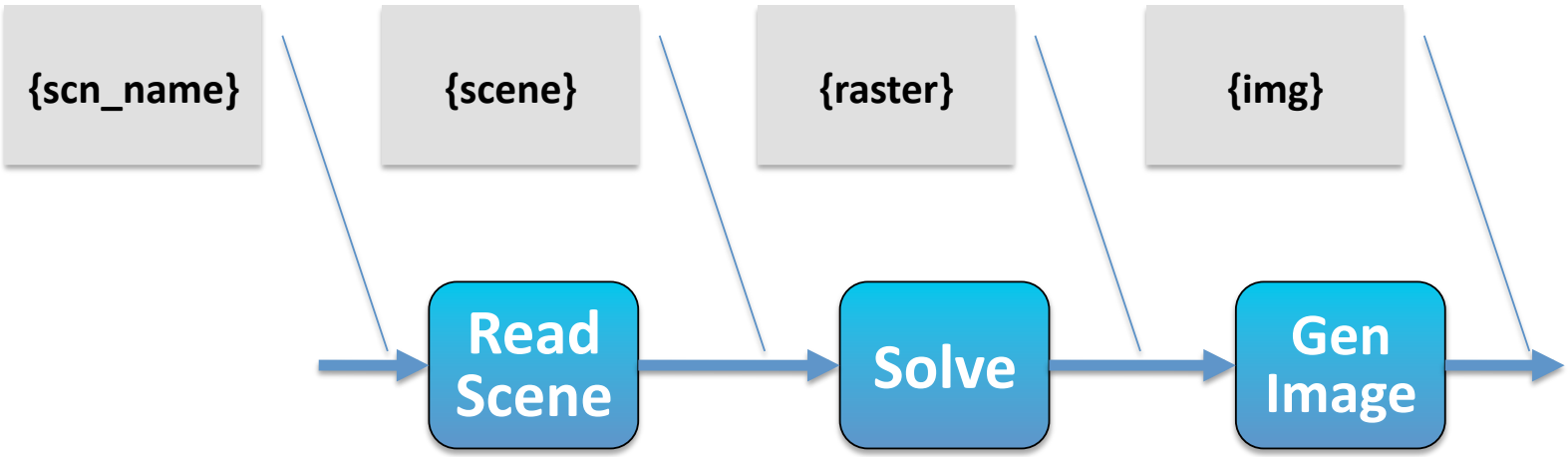


Raytracing Application
...in S-Net

Raytracing Application
...in S-Net



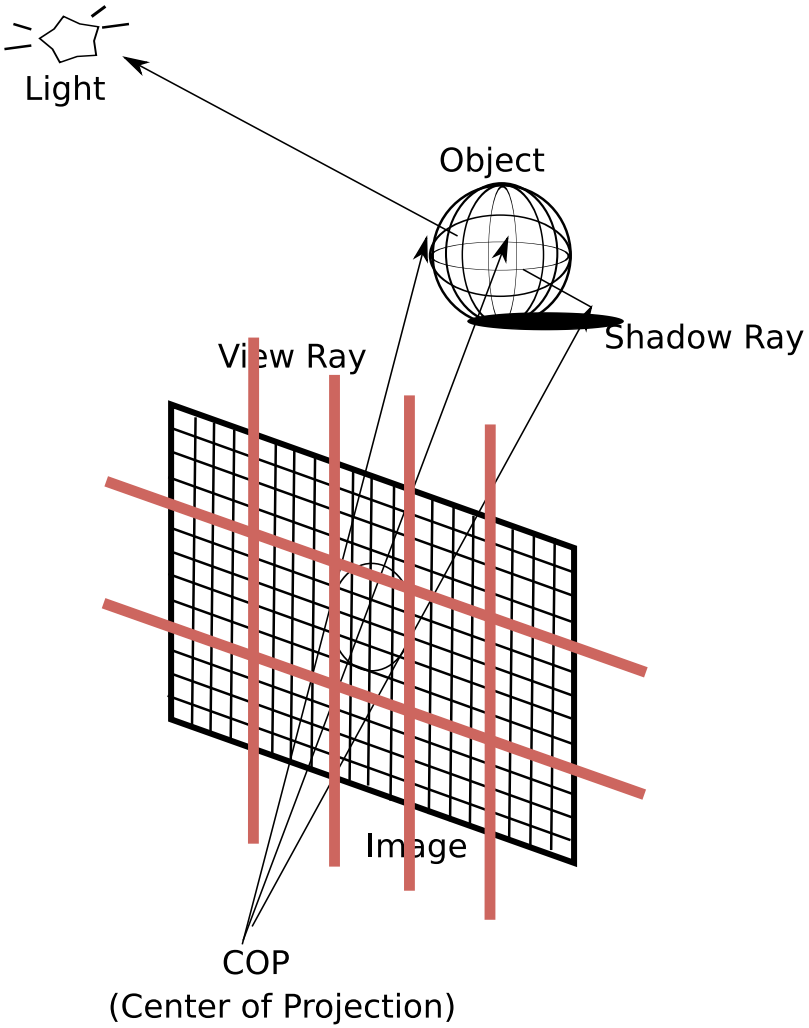
Raytracing Application
...in S-Net




```
net raytrace {

  box ReadScene( (scn_name) -> (scene));
  box Solve( (scene) -> (raster));
  box GenImage( (raster) -> (img));

} connect ReadScene .. Solve .. GenImage;
```

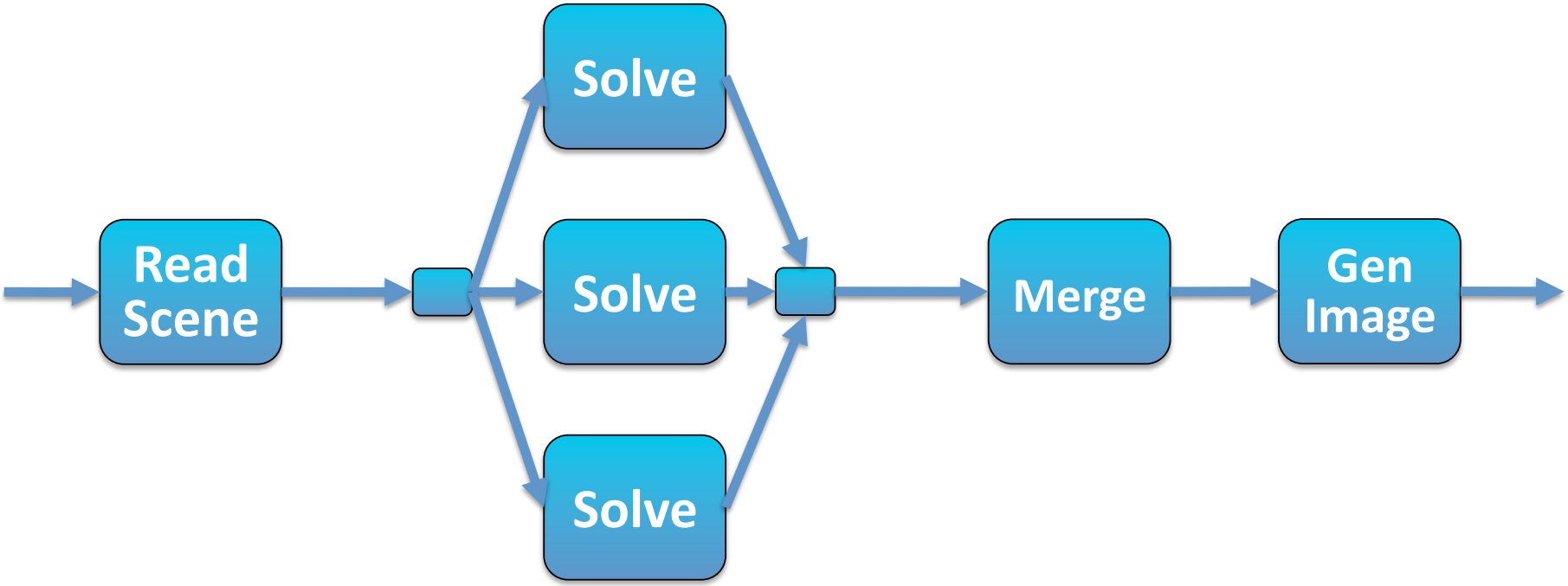
University of Hertfordshire UH

Raytracing Application
Parallelised Approach



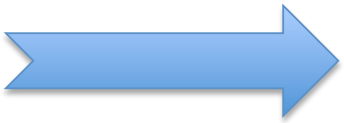
University of Hertfordshire UH

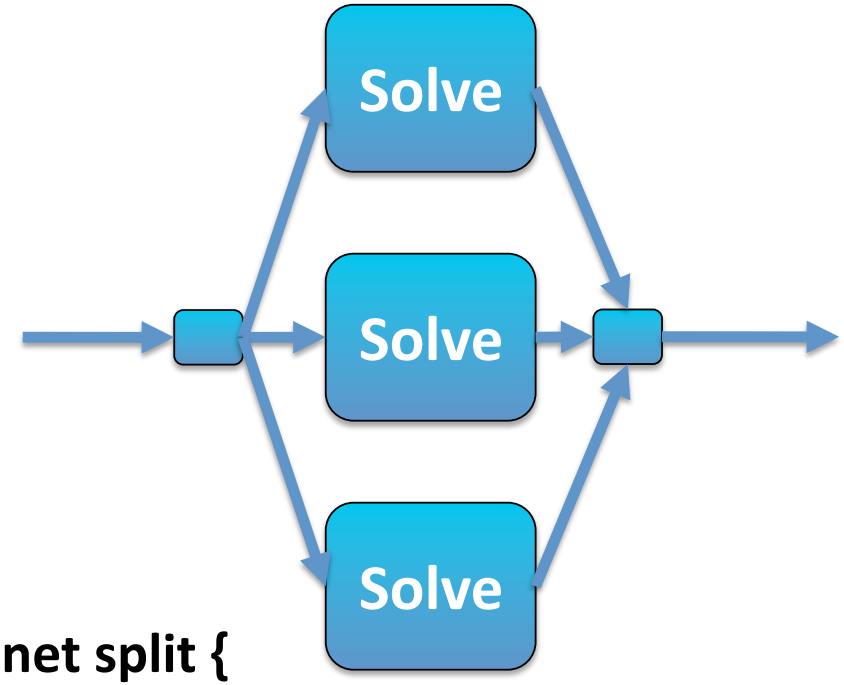
Raytracing Application
Parallelised Approach in S-Net



S-Net Combinators
Split Combinator

```
net split {

  box Solve( (scene) -> (raster));

} connect Solve;
```

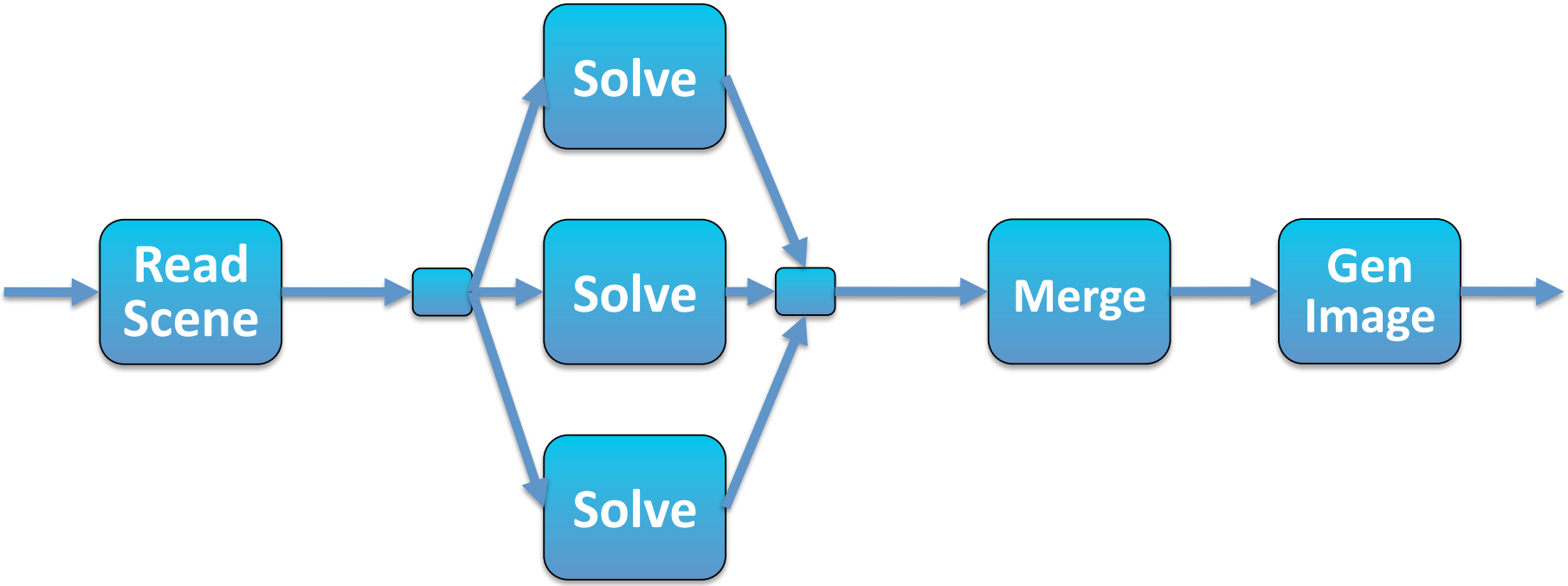




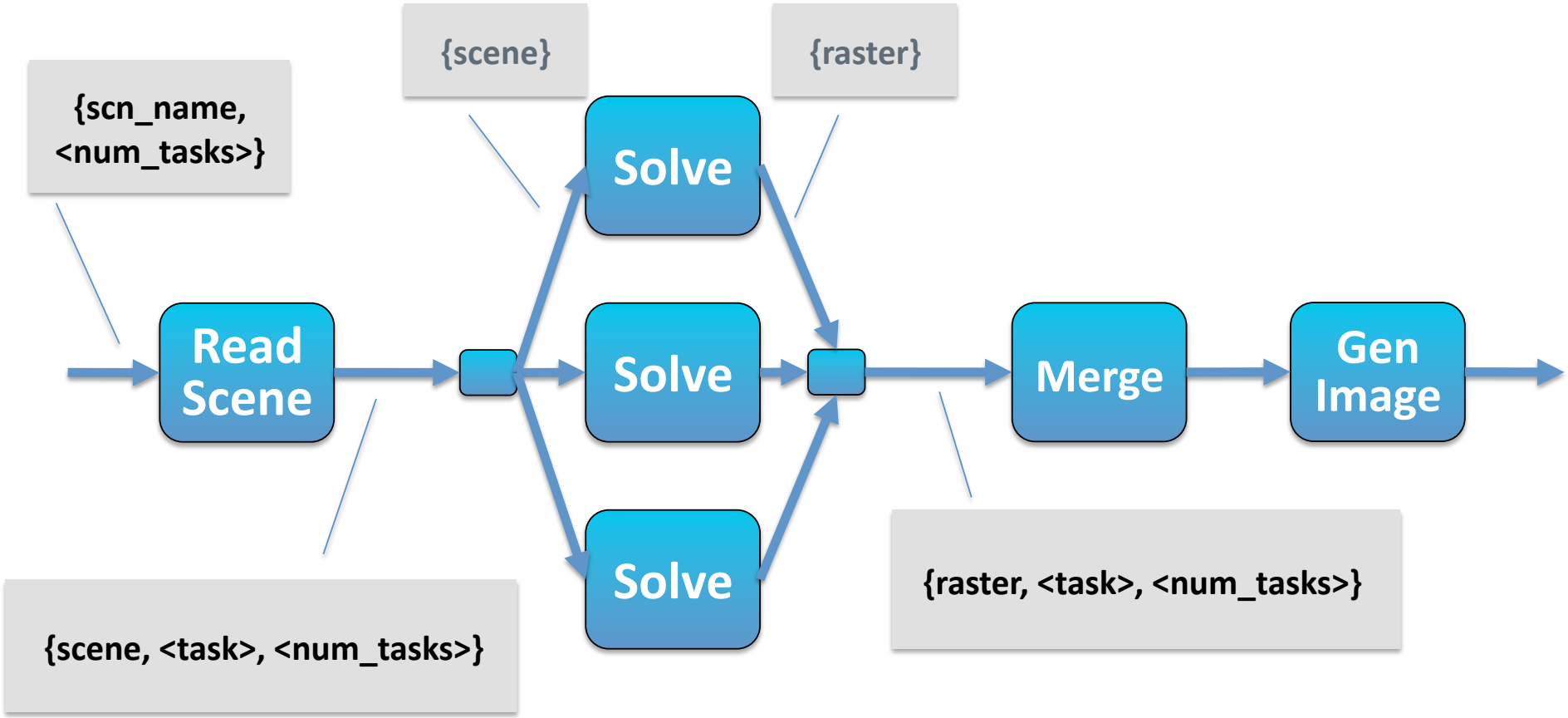

```
net split {

  box Solve( (scene) -> (raster));

} connect Solve!<task>;
```

University of Hertfordshire UH

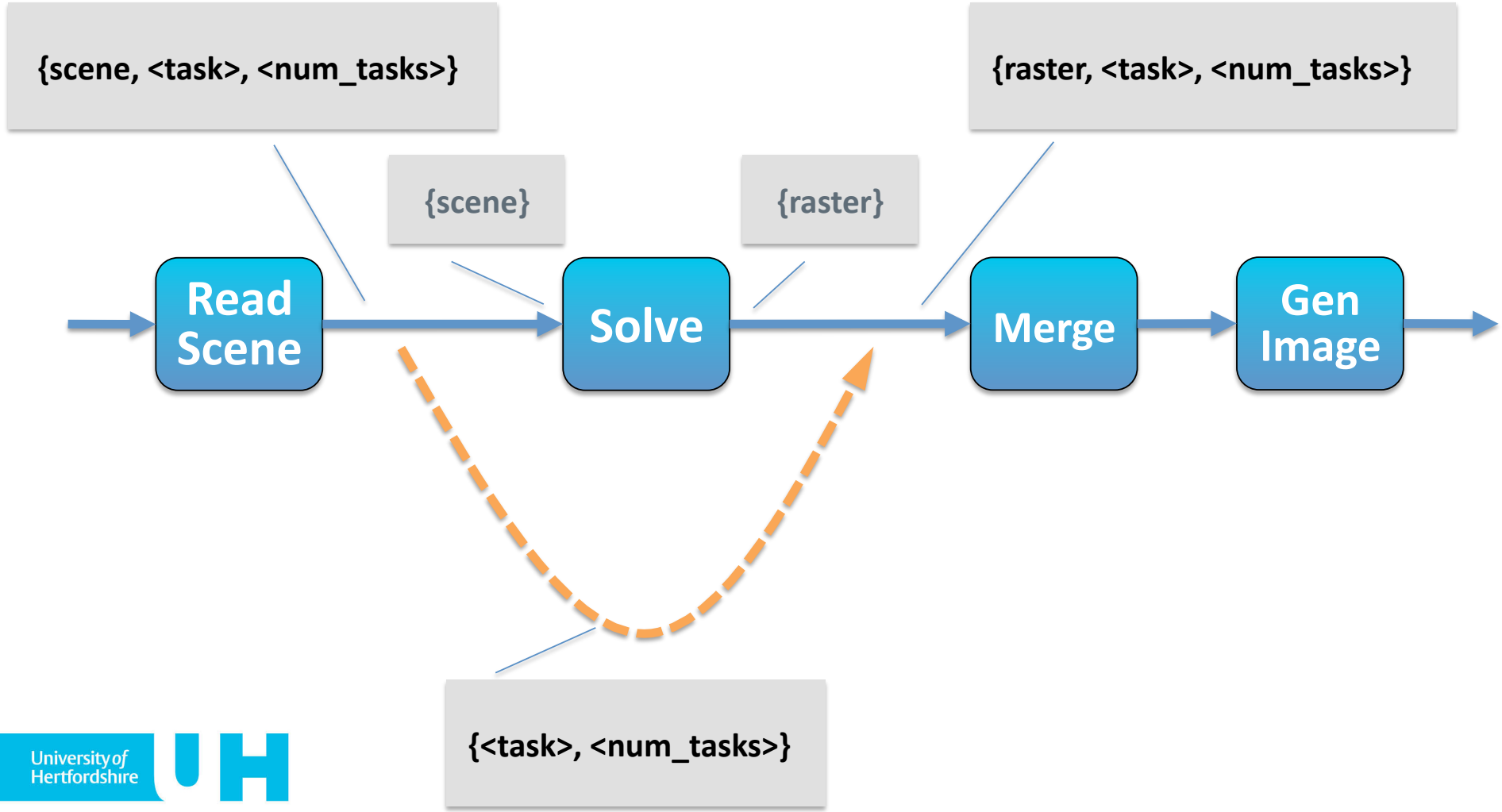
Raytracing Application
Parallelised Approach



Raytracing Application
Extended Read Scene

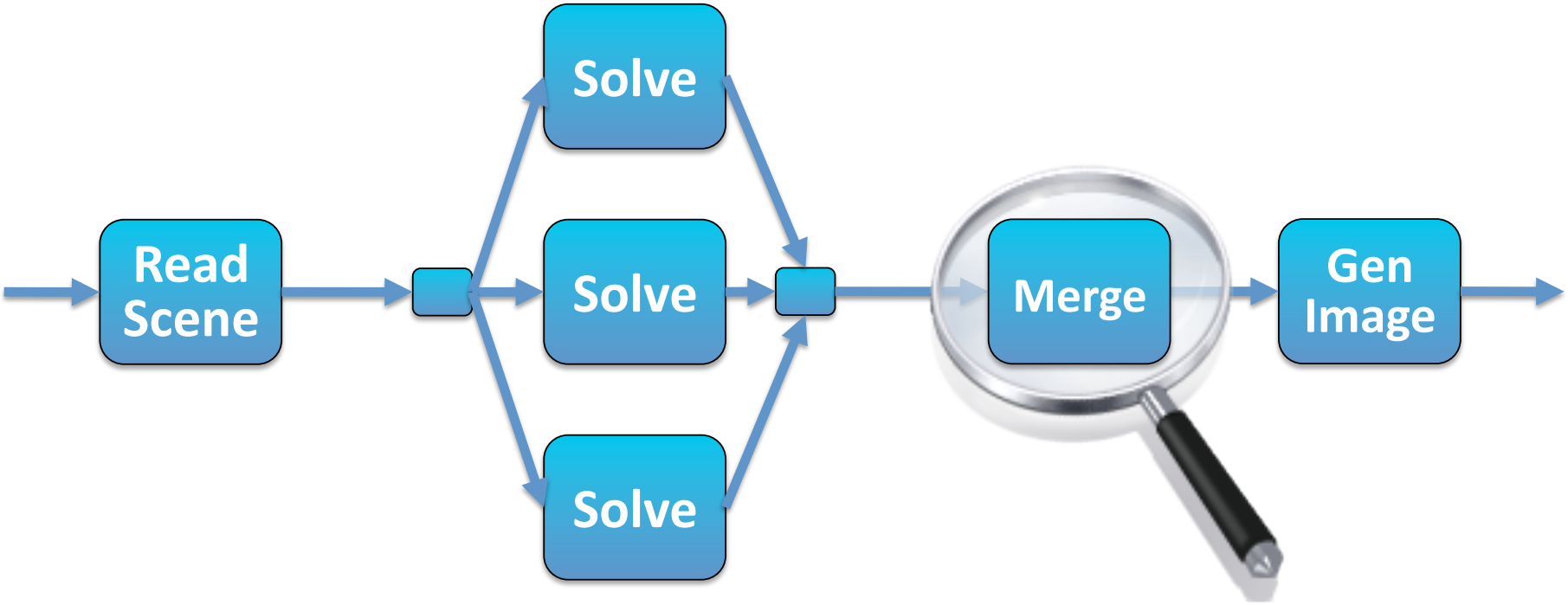


S-Net Features
Flow Inheritance

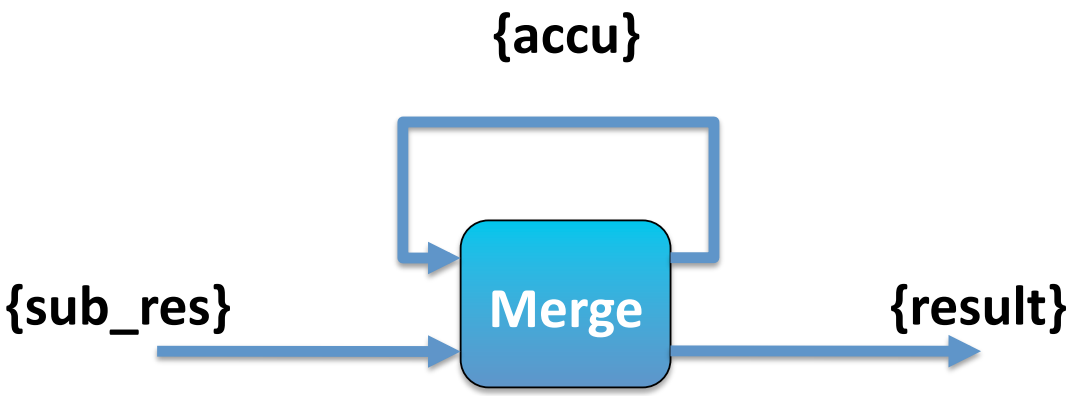


University of Hertfordshire UH

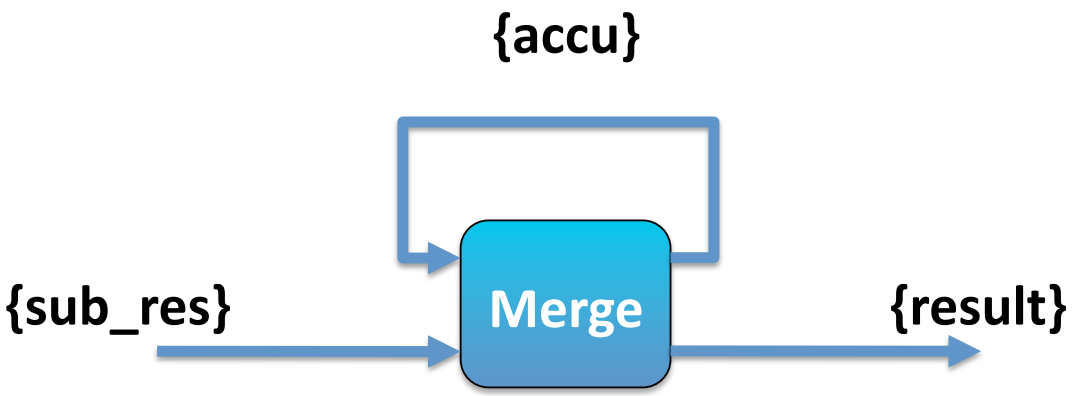
Raytracing Application
Parallelised Approach



S-Net Combinators
Iteration



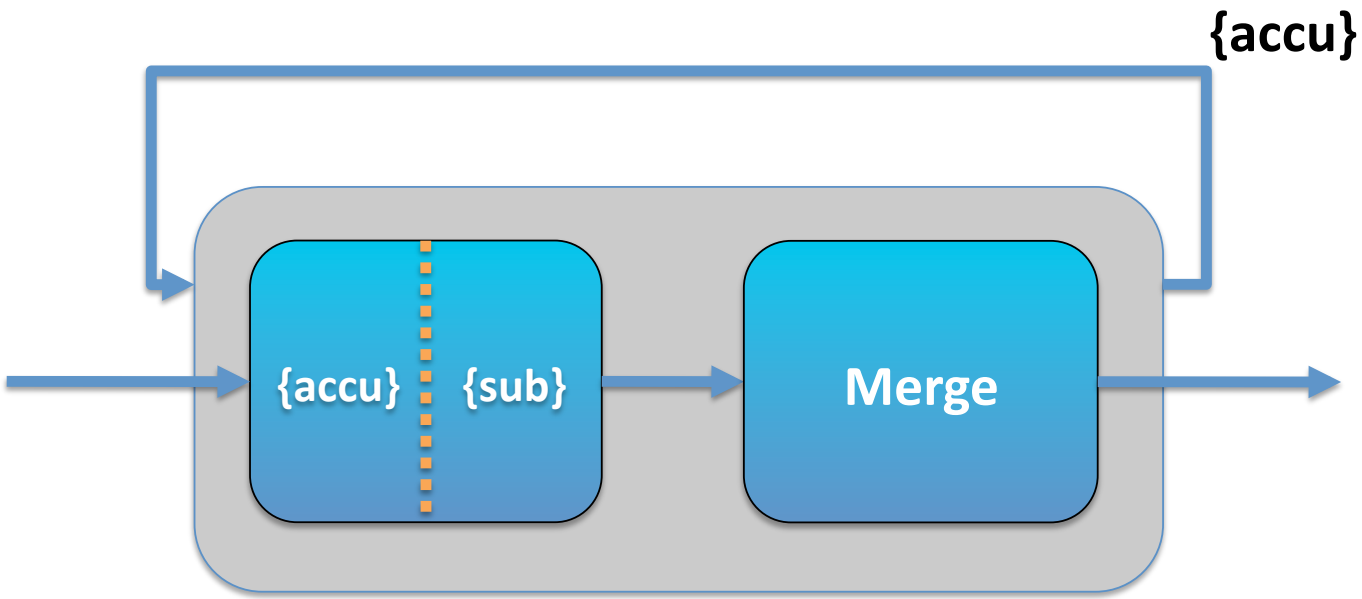
S-Net Combinators
Star Combinator




```
net merge {

  box Merge( (accu, sub_res) ->    (accu)
                                 | (result));
} connect Merge*{result};
```

University of Hertfordshire UH

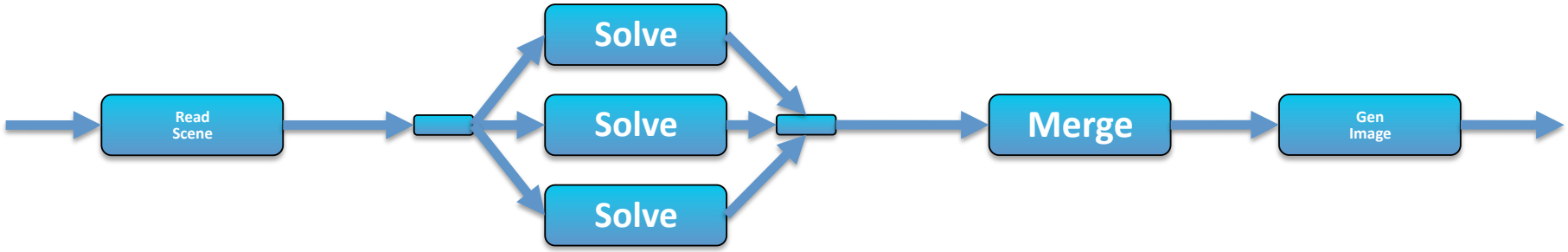
S-Net Features
Synchronisation

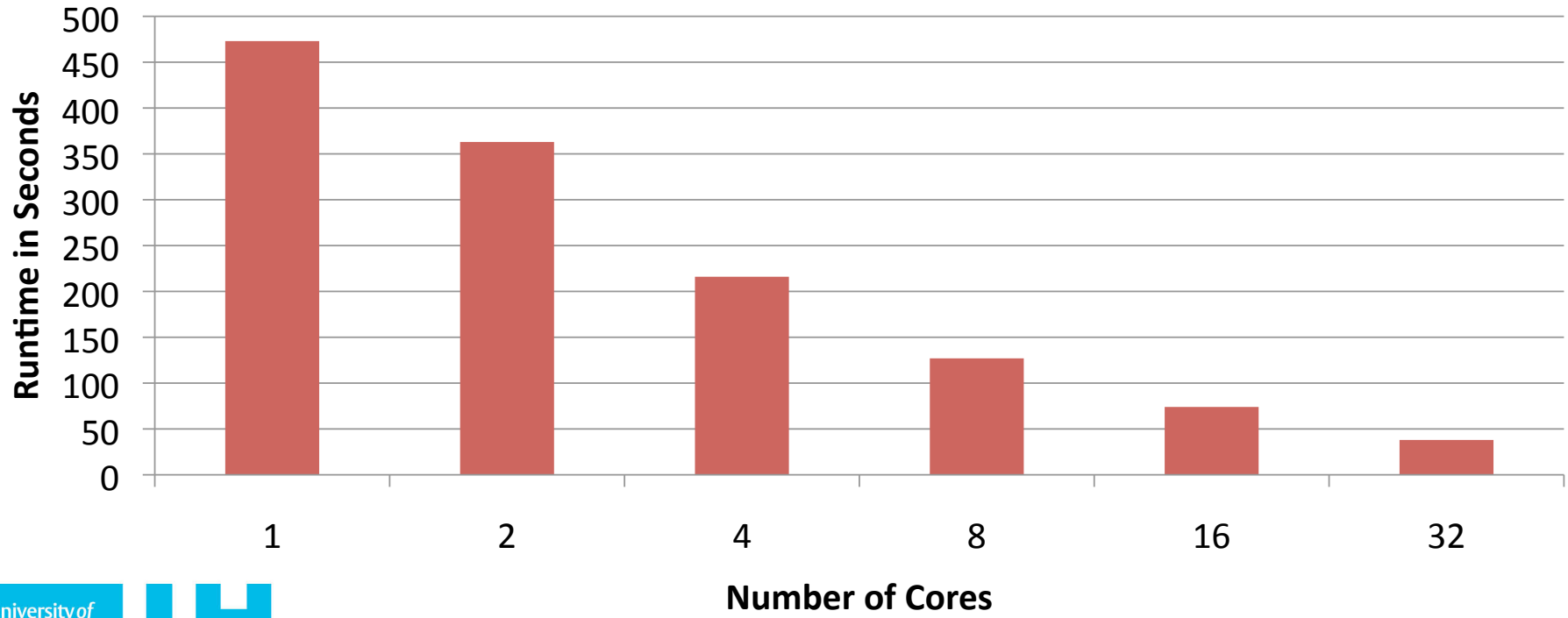



```
net merge {

  box Merge( (accu, sub_res) ->    (accu) | (result));

} connect ( [|{accu}, {sub_res} |] .. Merge)*{result};
```

University of Hertfordshire UH

Raytracing Application
Runtime on Shared Memory

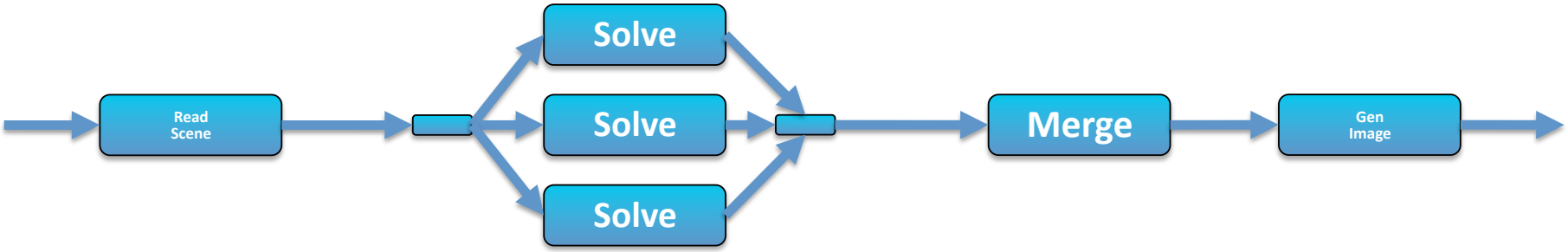


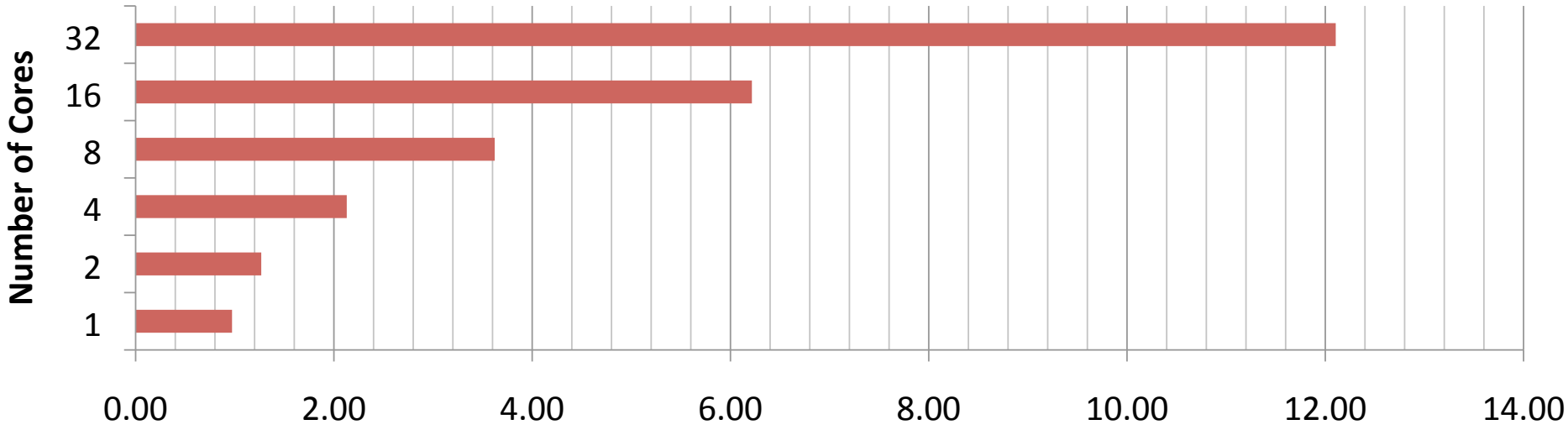


University of Hertfordshire

Raytracing Application

Speed-Up vs. original C Code



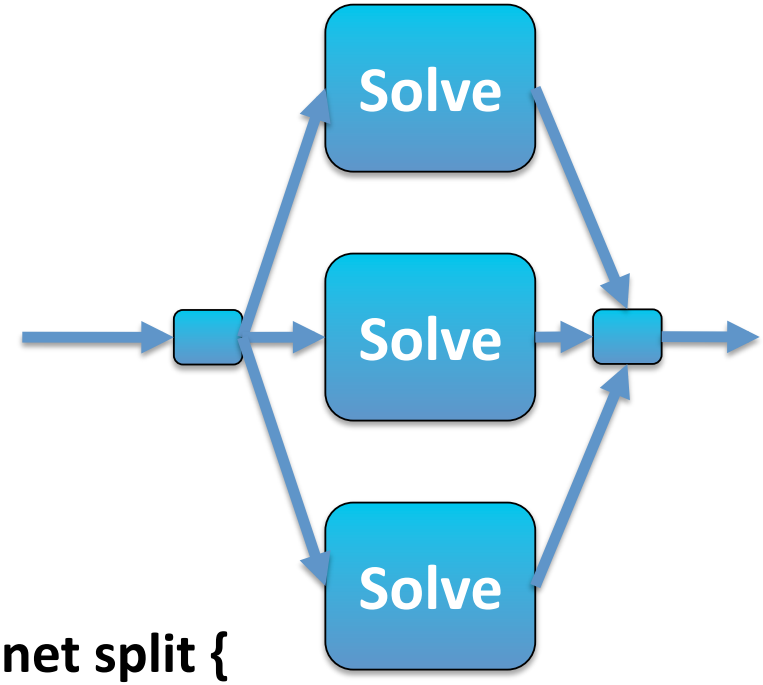


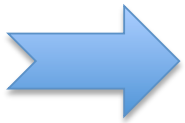
	1	2	4	8	16	32
SpeedUp	0.97	1.27	2.13	3.62	6.22	12.11

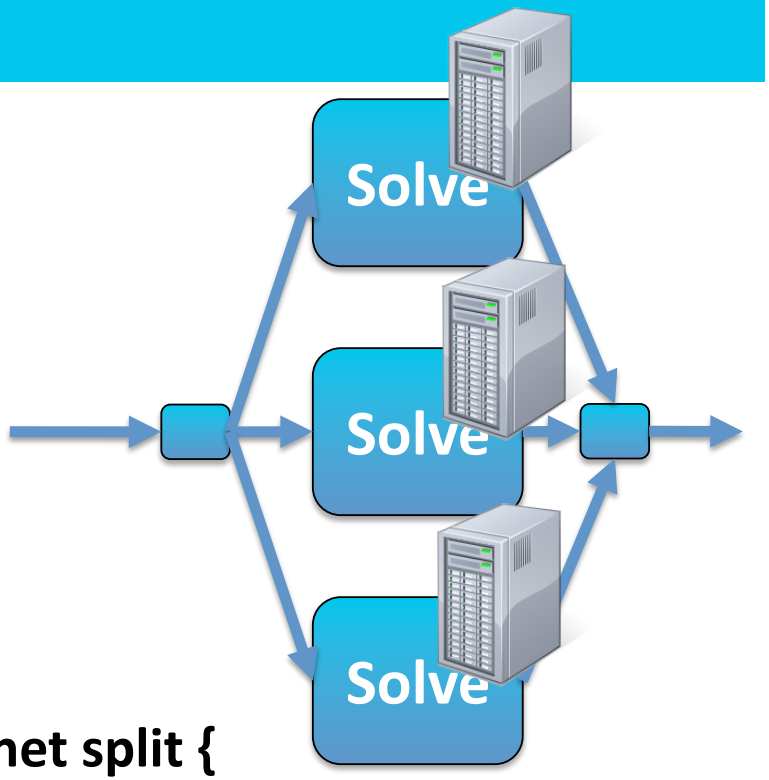
University of Hertfordshire UH

S-Net Features

Splitting using Distributed Memory





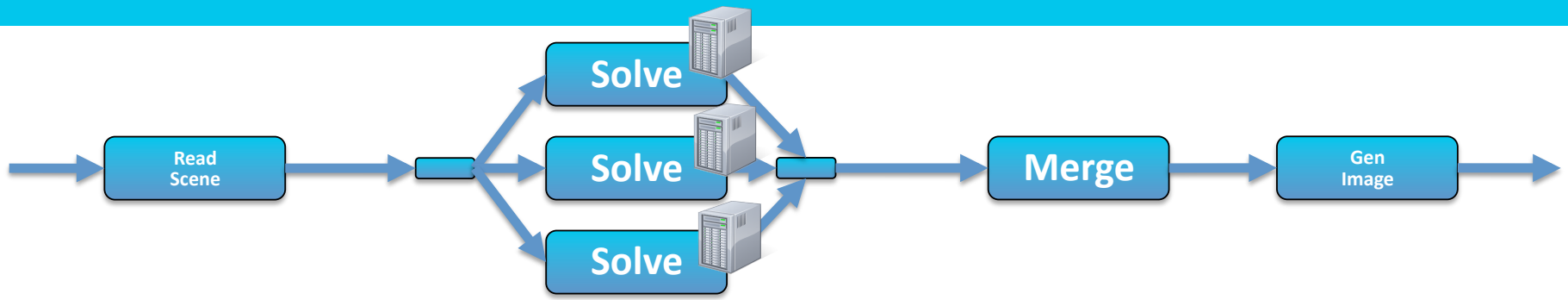


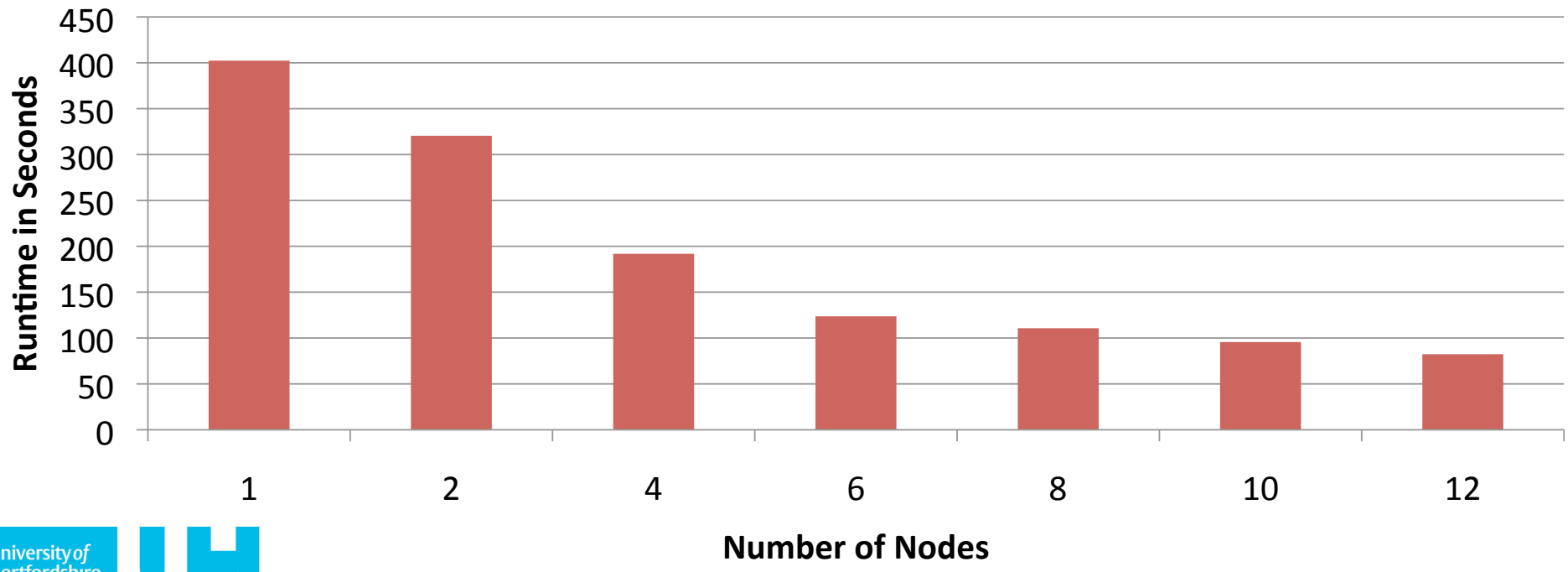

```
net split {

  box Solve( (scene) -> (raster));

} connect Solve!<task>;
```

```
net split {

  box Solve( (scene) -> (raster));

} connect Solve!@<task>;
```

University of Hertfordshire UH

Raytracing Application
Runtime on Cluster

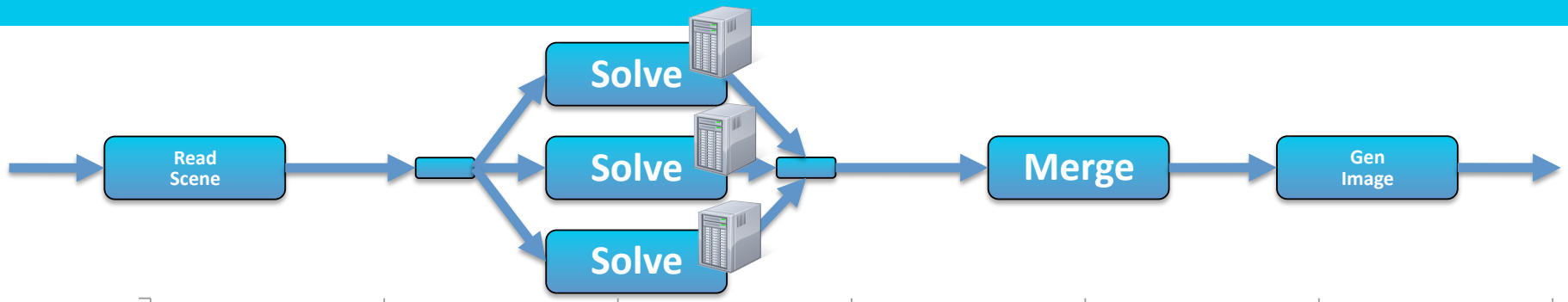


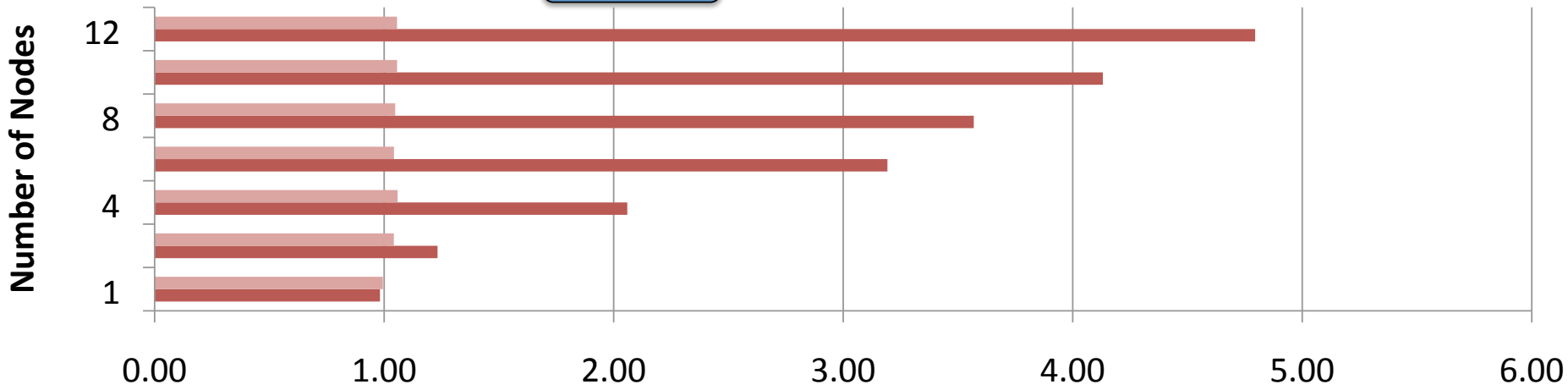


University of Hertfordshire

Raytracing Application

Speed-Up vs. original C Code and MPI



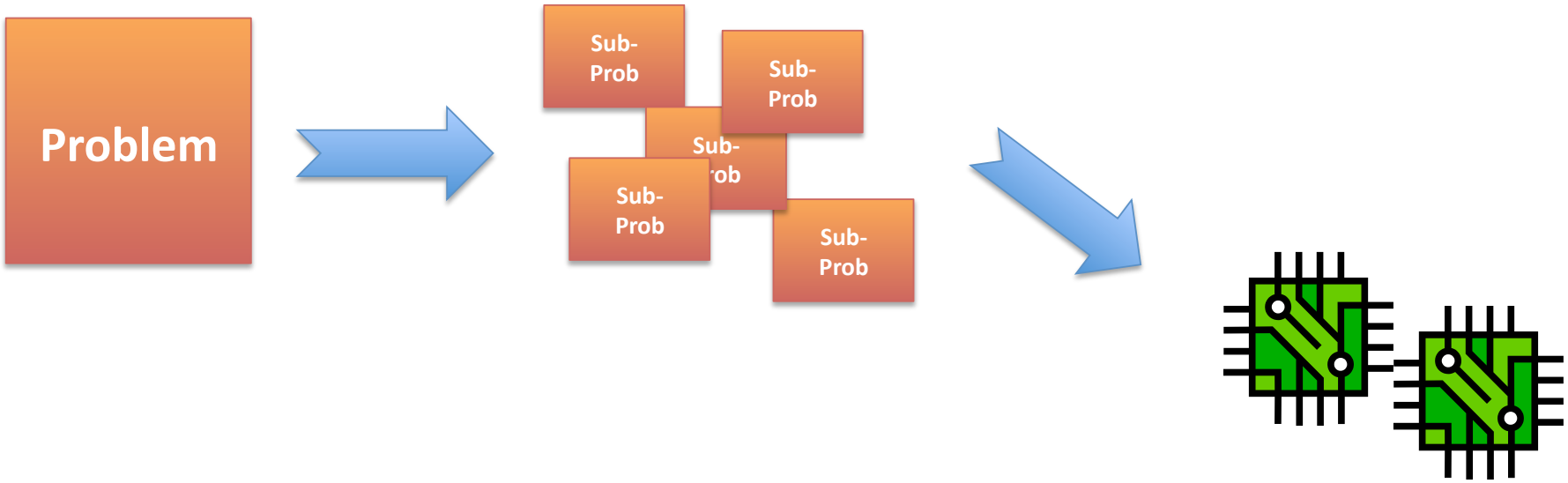


	1	2	4	6	8	10	12
MPI/SN	0.99	1.04	1.06	1.04	1.05	1.06	1.06
Seq/SN	0.98	1.23	2.06	3.19	3.57	4.13	4.79

University of Hertfordshire UH

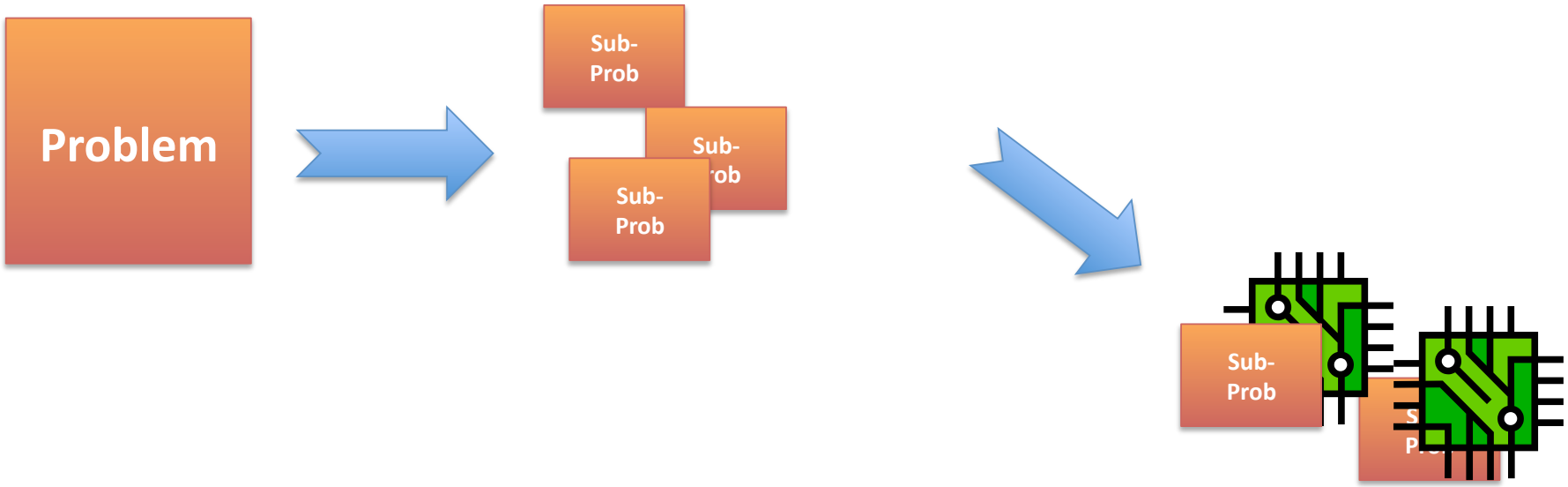
Utilising Resources Efficiently

Dynamic Load Scheduling



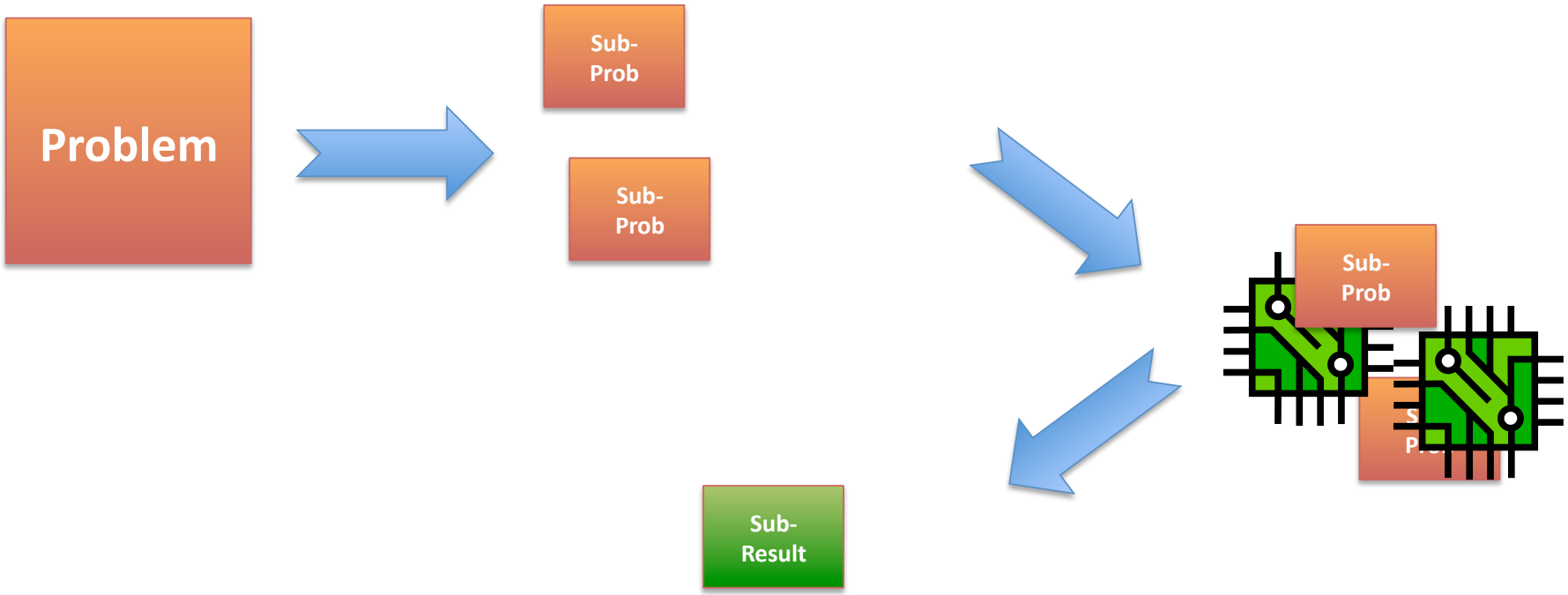
Utilising Resources Efficiently

Dynamic Load Scheduling



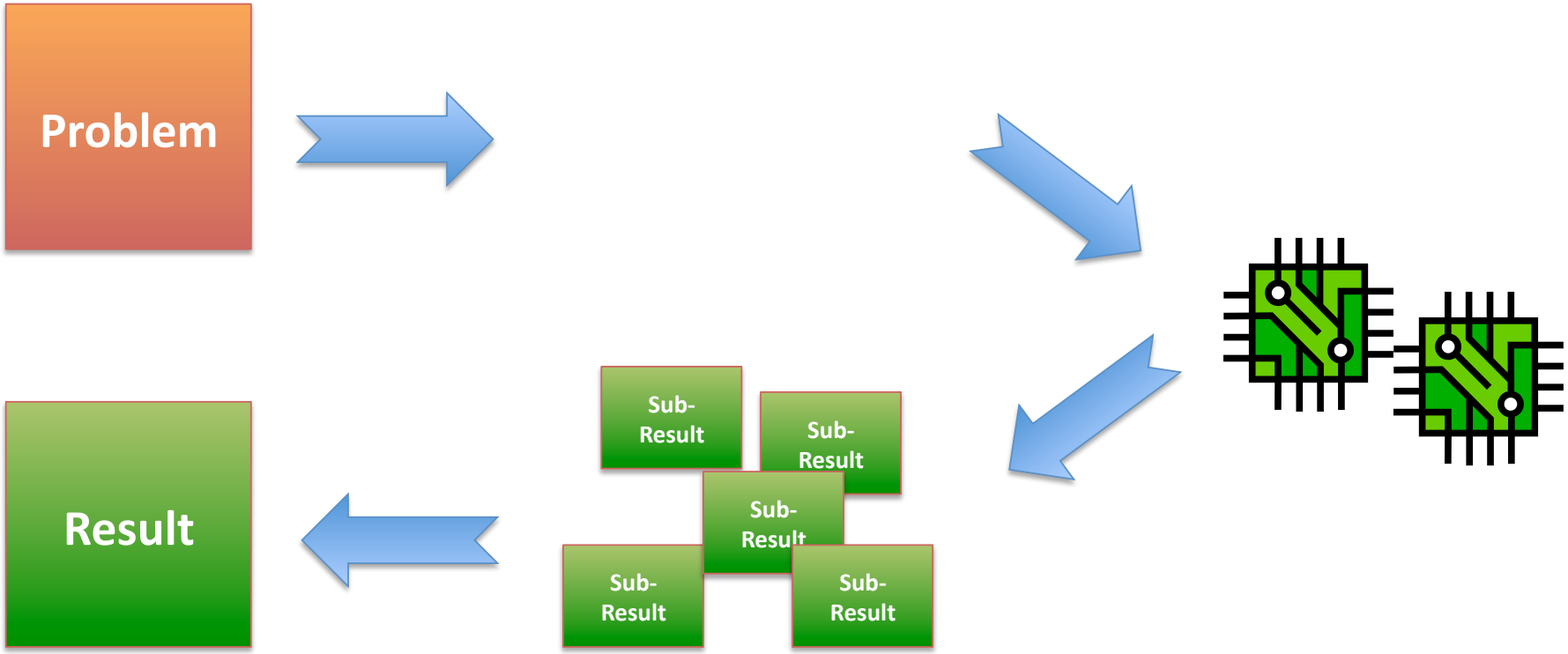
Utilising Resources Efficiently

Dynamic Load Scheduling



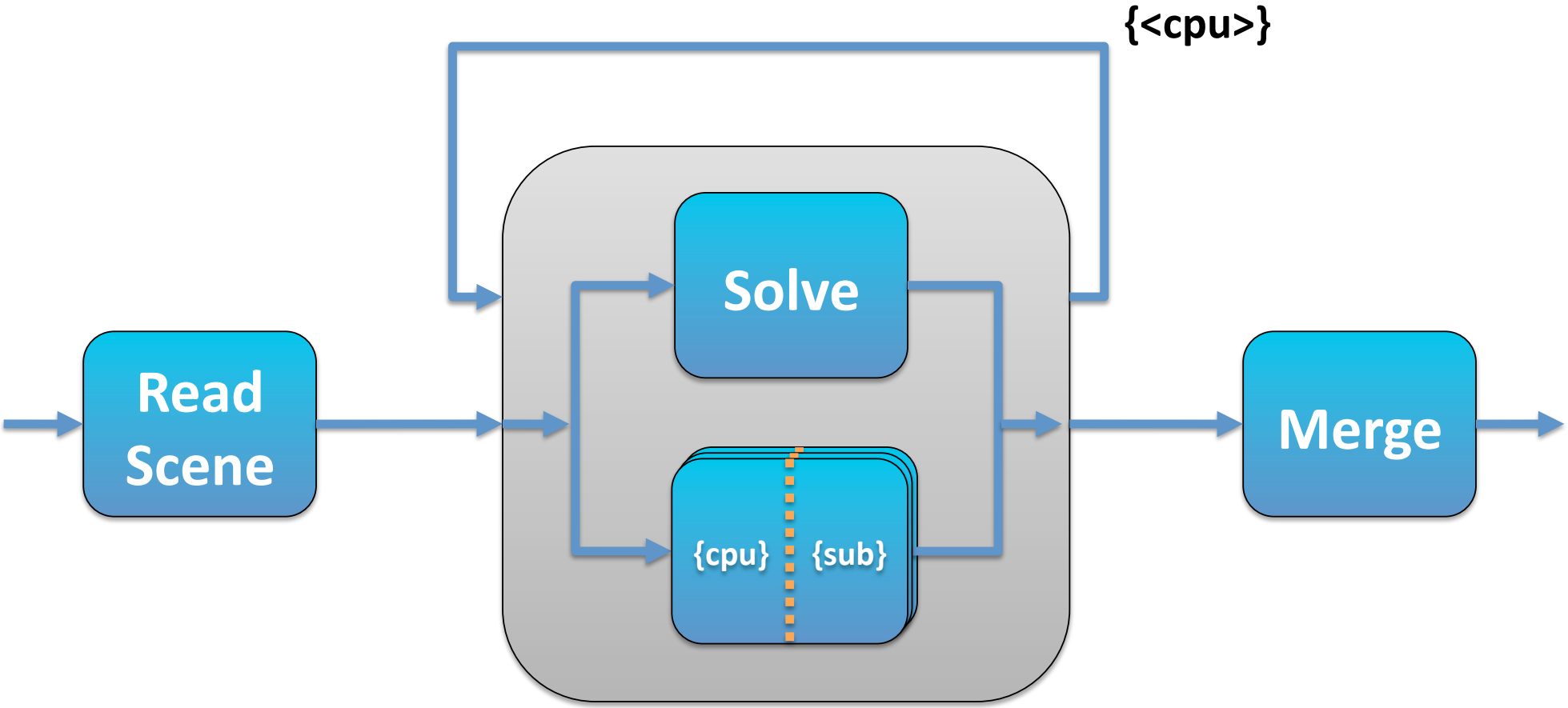
Utilising Resources Efficiently

Dynamic Load Scheduling



Utilising Resources Efficiently

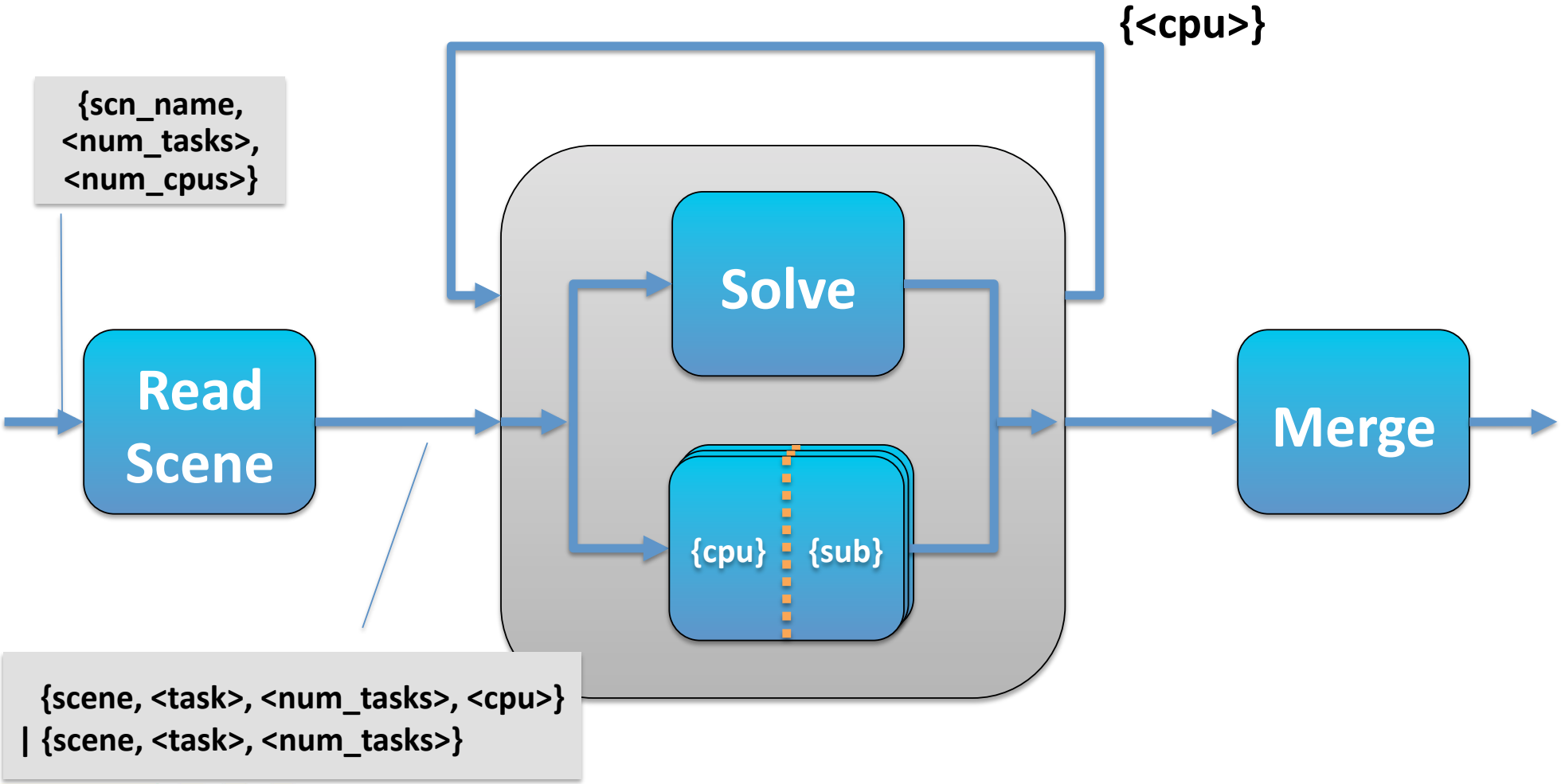
Dynamic Load Scheduling in S-Net



University of Hertfordshire UH

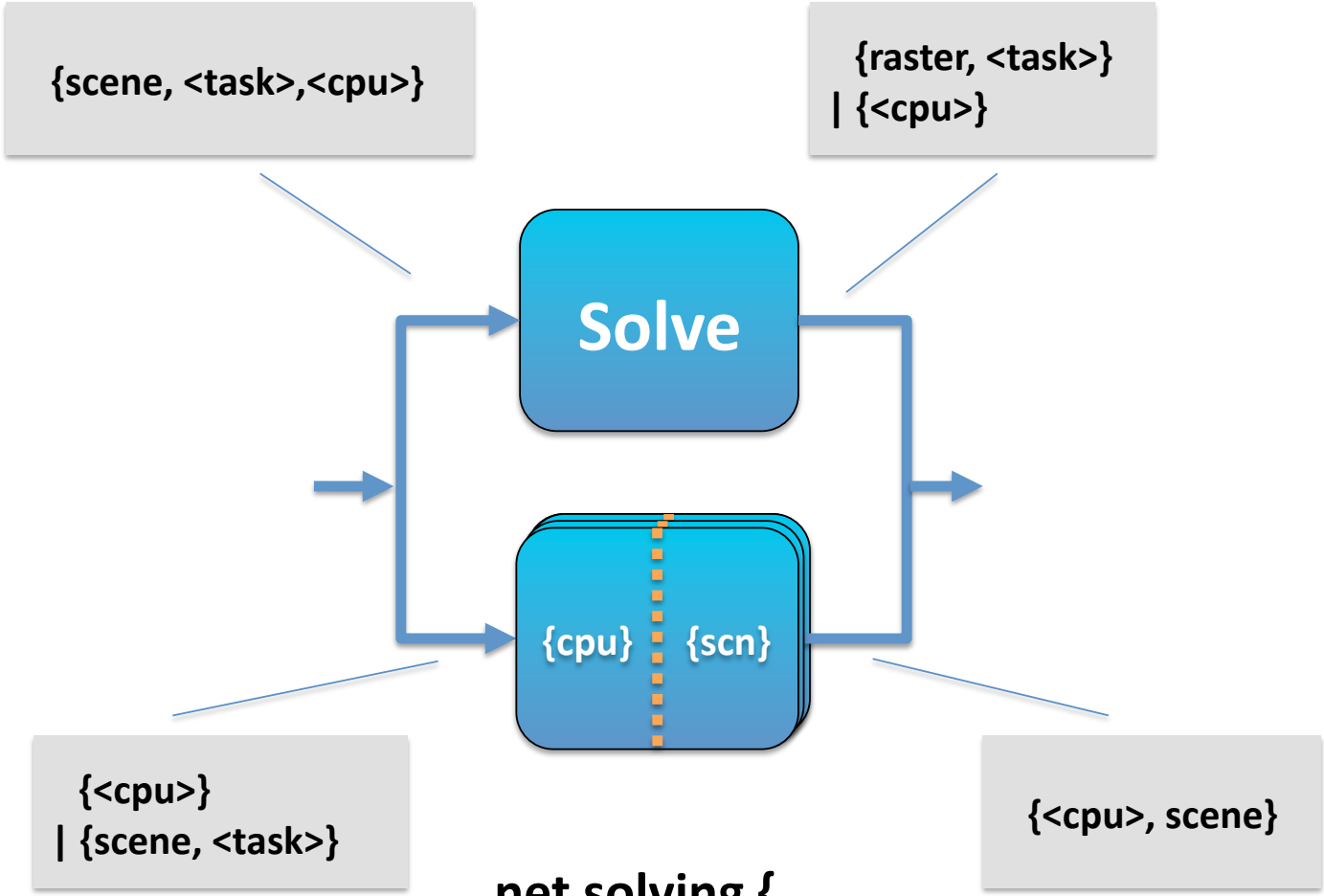
Utilising Resources Efficiently

Dynamic Load Scheduling in S-Net



University of Hertfordshire UH

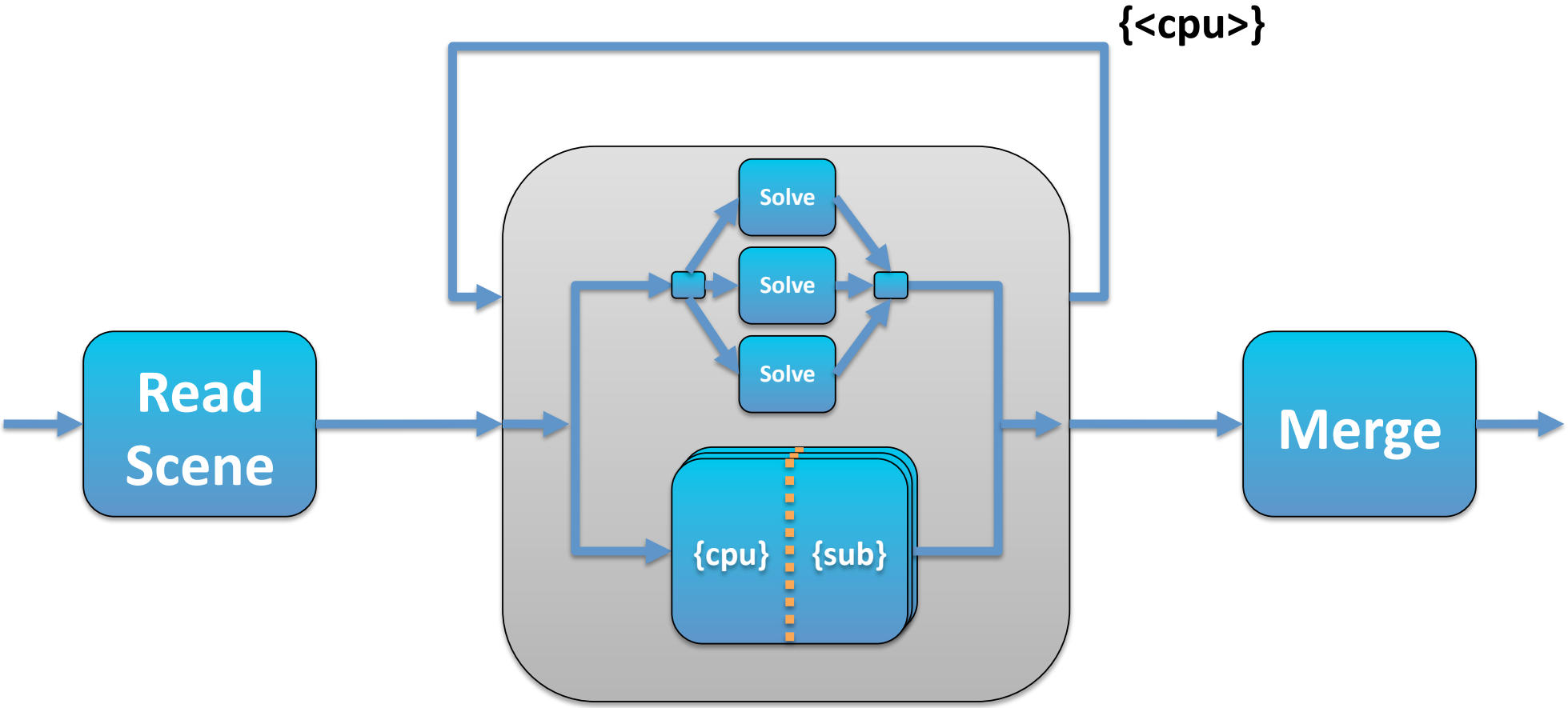
S-Net Combinators
Choice



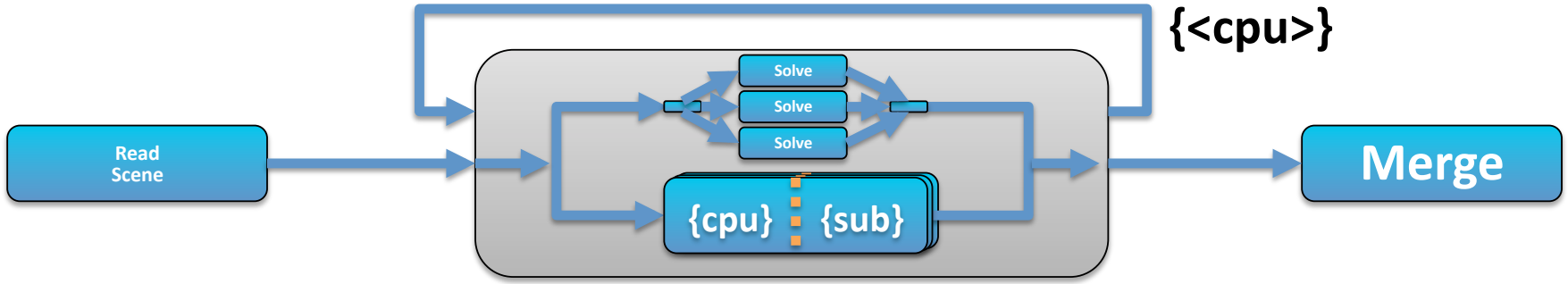

```
net solving {
   ...
} connect (Solve | [|{cpu},{scene}|]) *{raster};
```

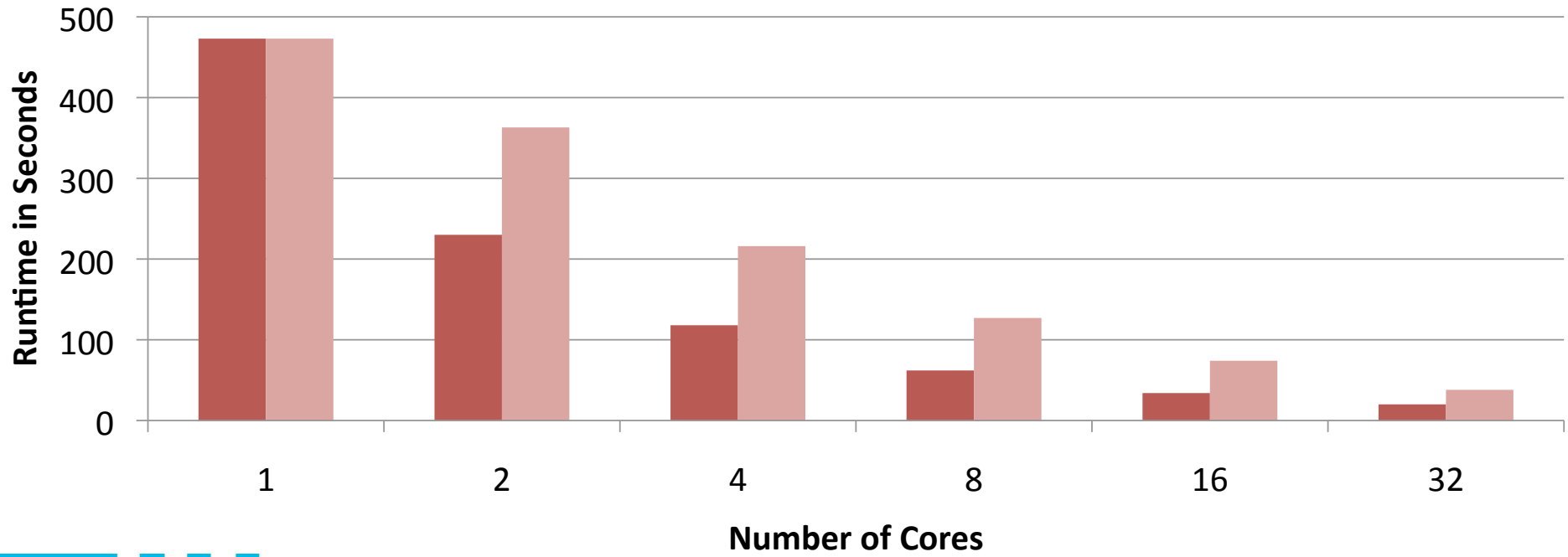
University of Hertfordshire UH

Raytracing Application
Parallelised Approach



Raytracing Application
Runtime in Shared Memory

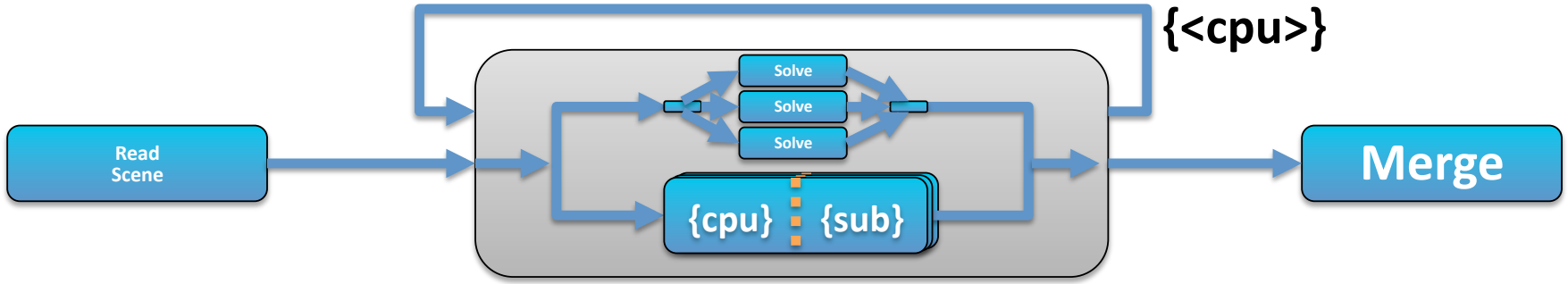


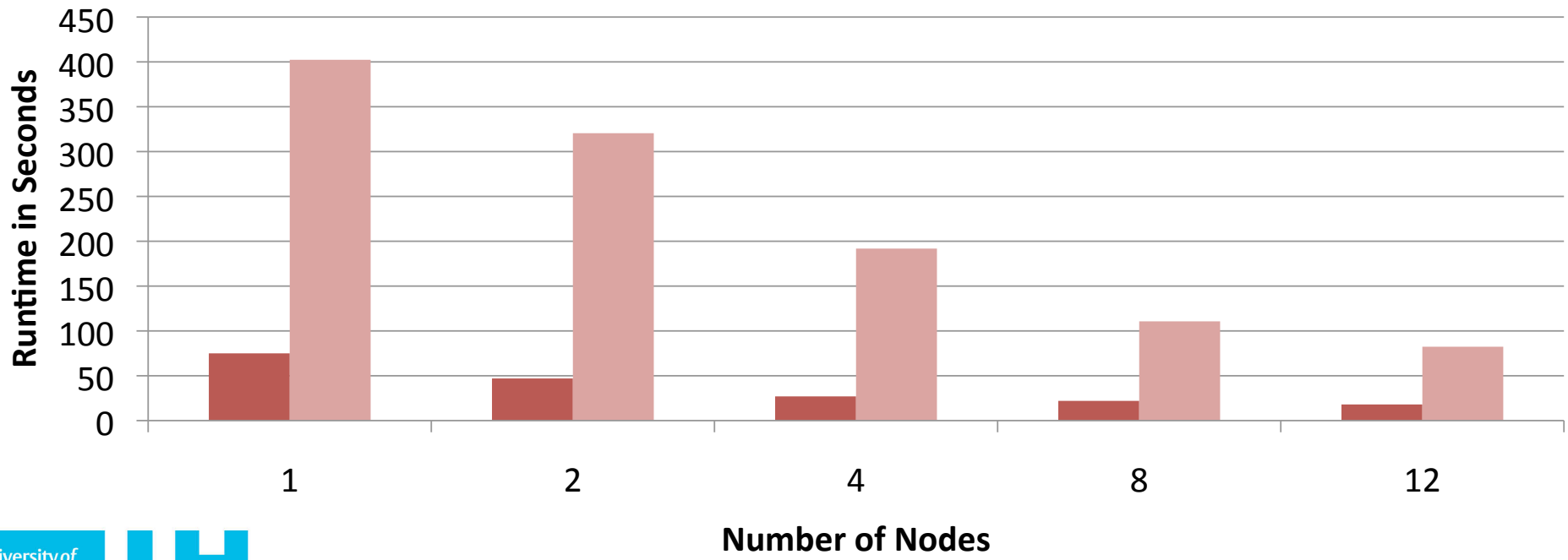


University of Hertfordshire UH

Raytracing Application

Runtime on Cluster + Shared Memory

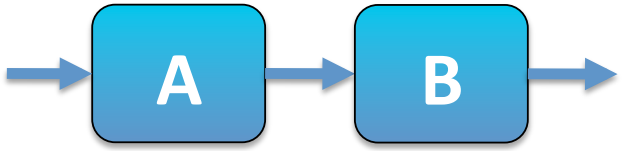




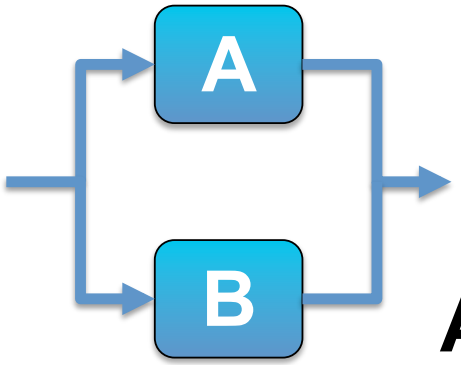
University of Hertfordshire UH

S-Net on one Slide

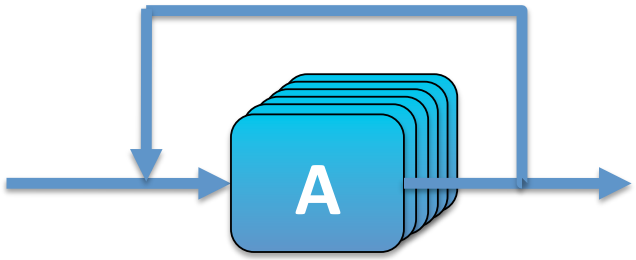
Combinators



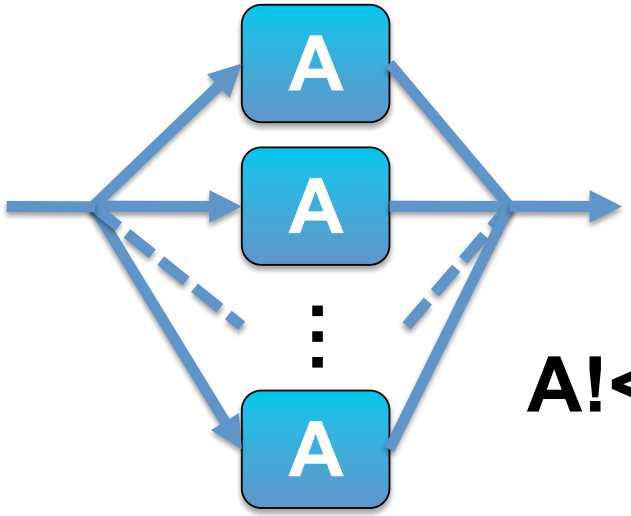
A .. B



A | B



A*{p}



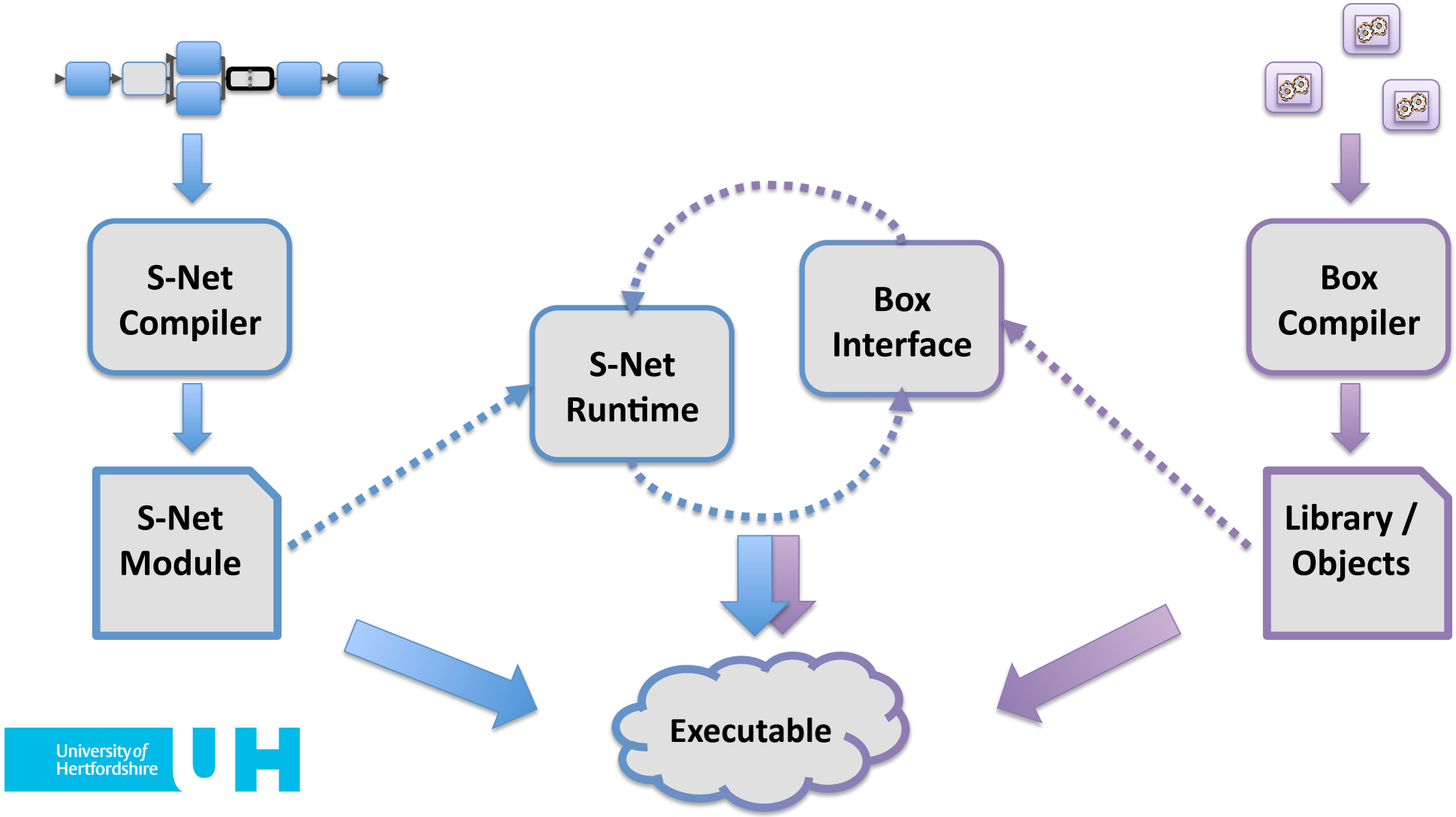
A!<t>

University of Hertfordshire UH

Thank you!

End.

S-Net Tool-Chain
Overview



University of Hertfordshire UH