

# UPC: Beowulf to the X1

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# History

- UPC is a new language (we have been saying that for 4-5 years)
- Developed by Carlson and Draper on the T3E
- Unified += Culler, Yelick, Brooks & Warren
- UPC group = CCS, GWU, MTU, UCB, ... Cray Inc, HP,.....
- UPC and CoArray are locally popular
- A few that care a lot, not a lot that care at all

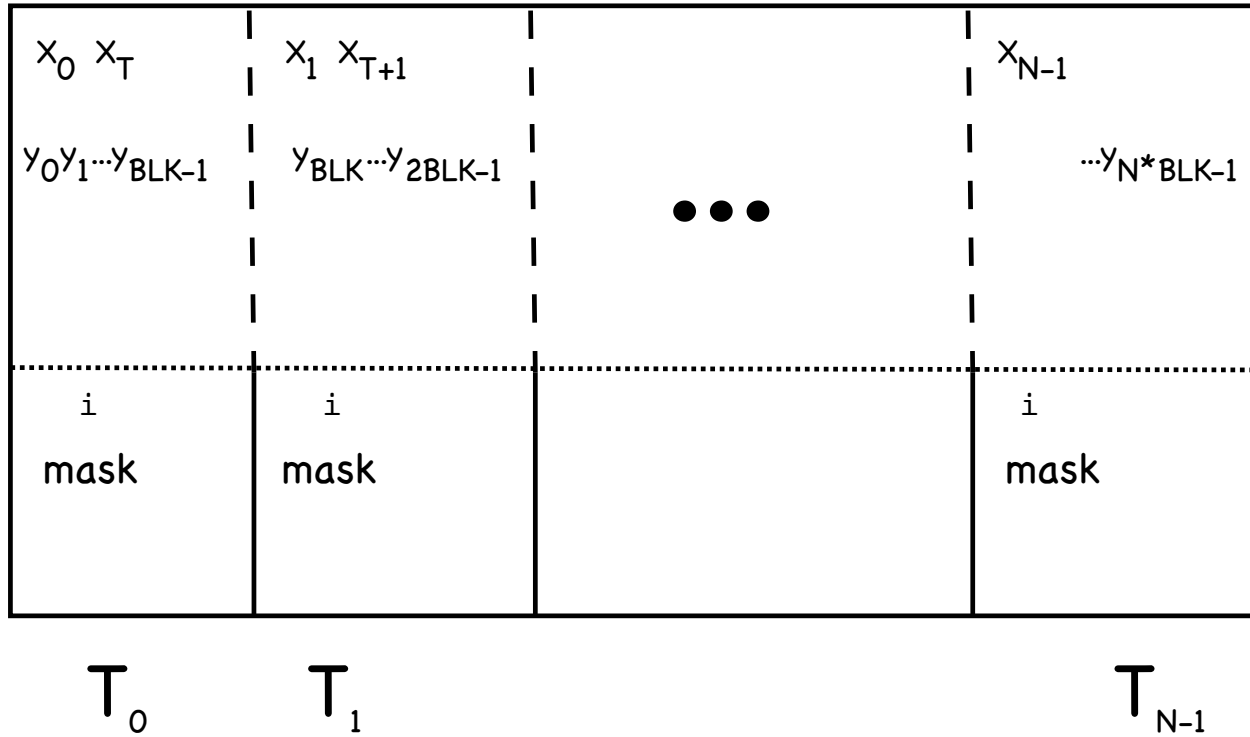
# UPC

- ④ SPMD programming language
  - ④ THREADS, MYTHREAD
  - ④ No spawn command
  - ④ talking about subsets
- ④ Partitioned Shared Memory
  - ④ Affinity
  - ④ Memory Models

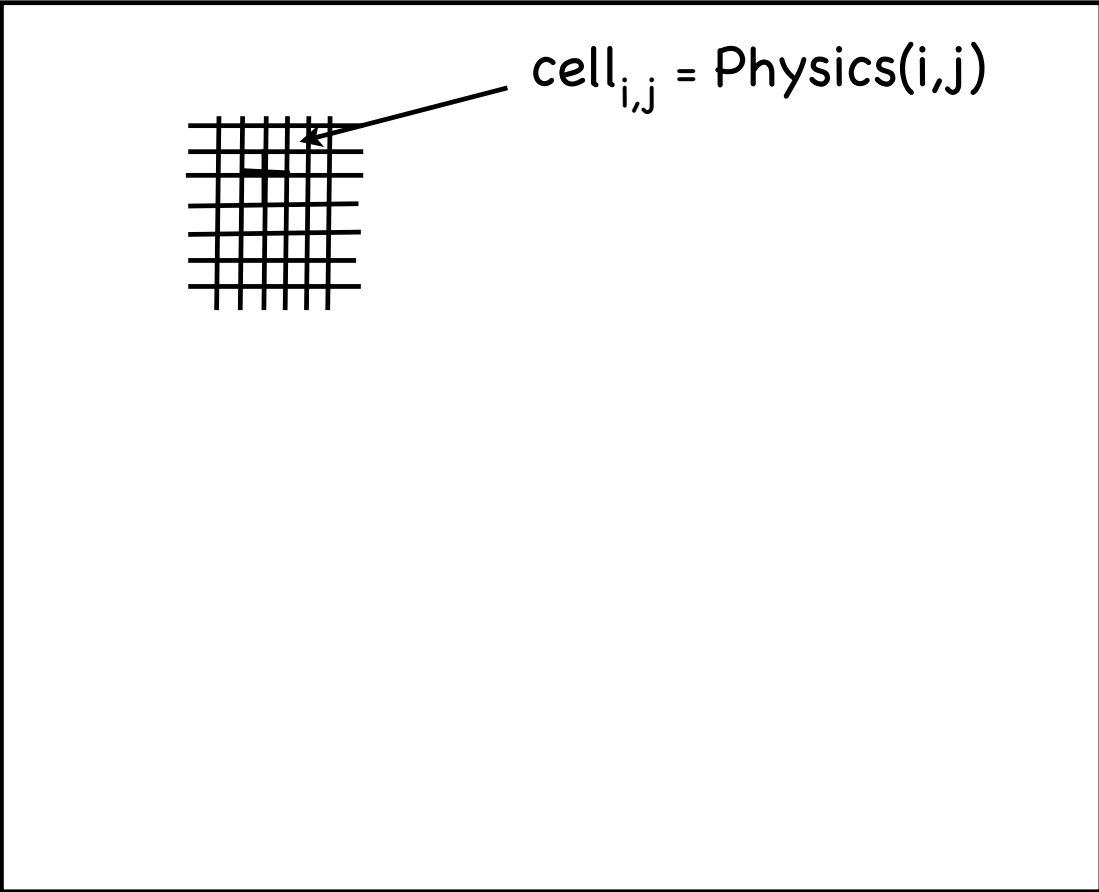
# Affinity

- ④ Affinity is relation (a partition) from shared memory addresses to threads
- ④ Usually maps memory on a node to the thread on the node
- ④ Makes sense even if you have a real shared memory system
  - ④ `upc_forall == do_mine`

# Affinity and Blocking



```
shared [1] float x[MaxN];
shared [BLK] float y[MaxN];
```



```
//Standard grid based algorithm
```

```
double cell[N][N], newcell[N][N];  
.....
```

```
for(i=0;i<N;i++)
```

```
    for(j=0;j<N;j++)
```

```
        newcell[i][j] = Physics(i,j);
```

```
//Standard grid based algorithm in UPC
```

```
#define BLK (N*N/THREAD)
```

```
shared [BLK] double cell[N][N];
```

```
shared [BLK] double newcell[N][N];
```

```
• • •
```

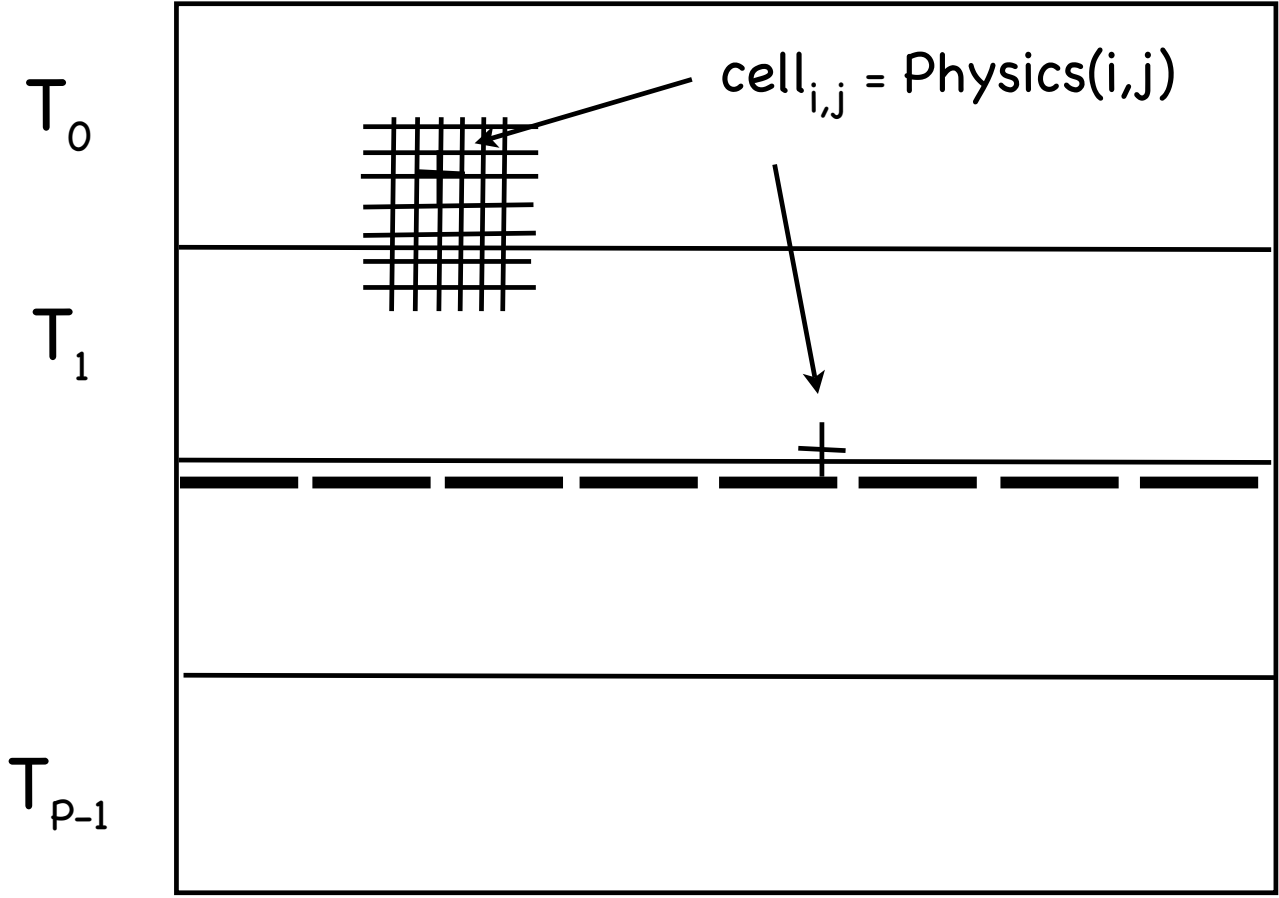
```
for(i=0;i<N;i++)
```

```
    if( upc_threadof(&cell[i][0]) == MYTHREAD)
```

```
        for(j=0;j<N;j++)
```

```
            newcell[i][j] = Physics(i,j);
```





# Memory Models

- ⊗ strict  $\sim$  = sequential consistency (every thread sees memory operation in program order)
- ⊗ relaxed  $\sim$  = weak (full C optimization is allowed between strict references)
- ⊗ Important Issue to implementors
  - ⊗ legal issues
  - ⊗ performance issues
- ⊗ Interaction with I/O and Collectives

# Memory Models and Programmers

Say `cell[i][j] = { u, v, w, ...}`

.....

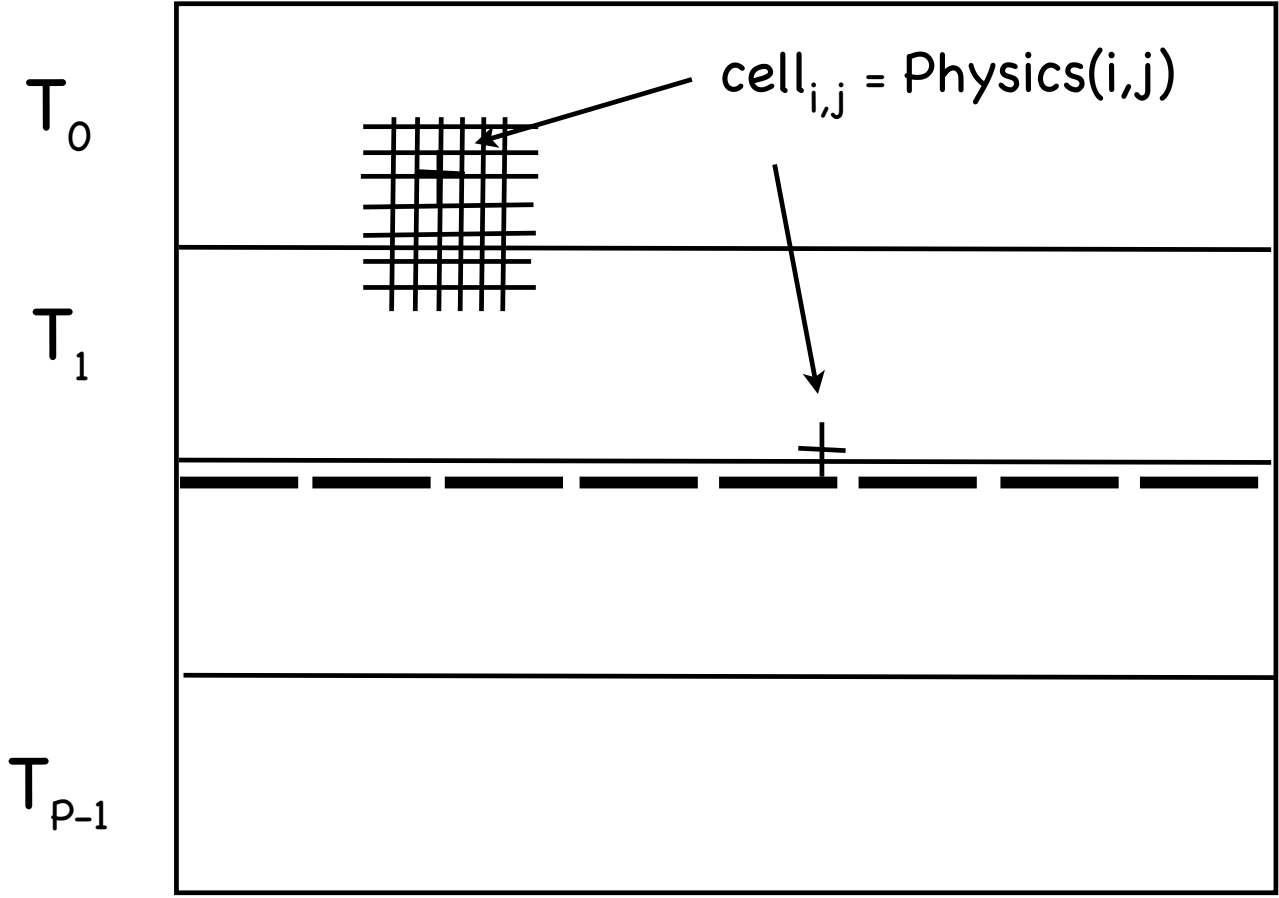
```
for(j=0; j<N; j++)
```

```
    u[i][j] = ...    // strict consistency kill caching
```

```
    v[i][j] = ...
```

```
    w[i][j] = ...    // but, it's not a big deal
```

.....

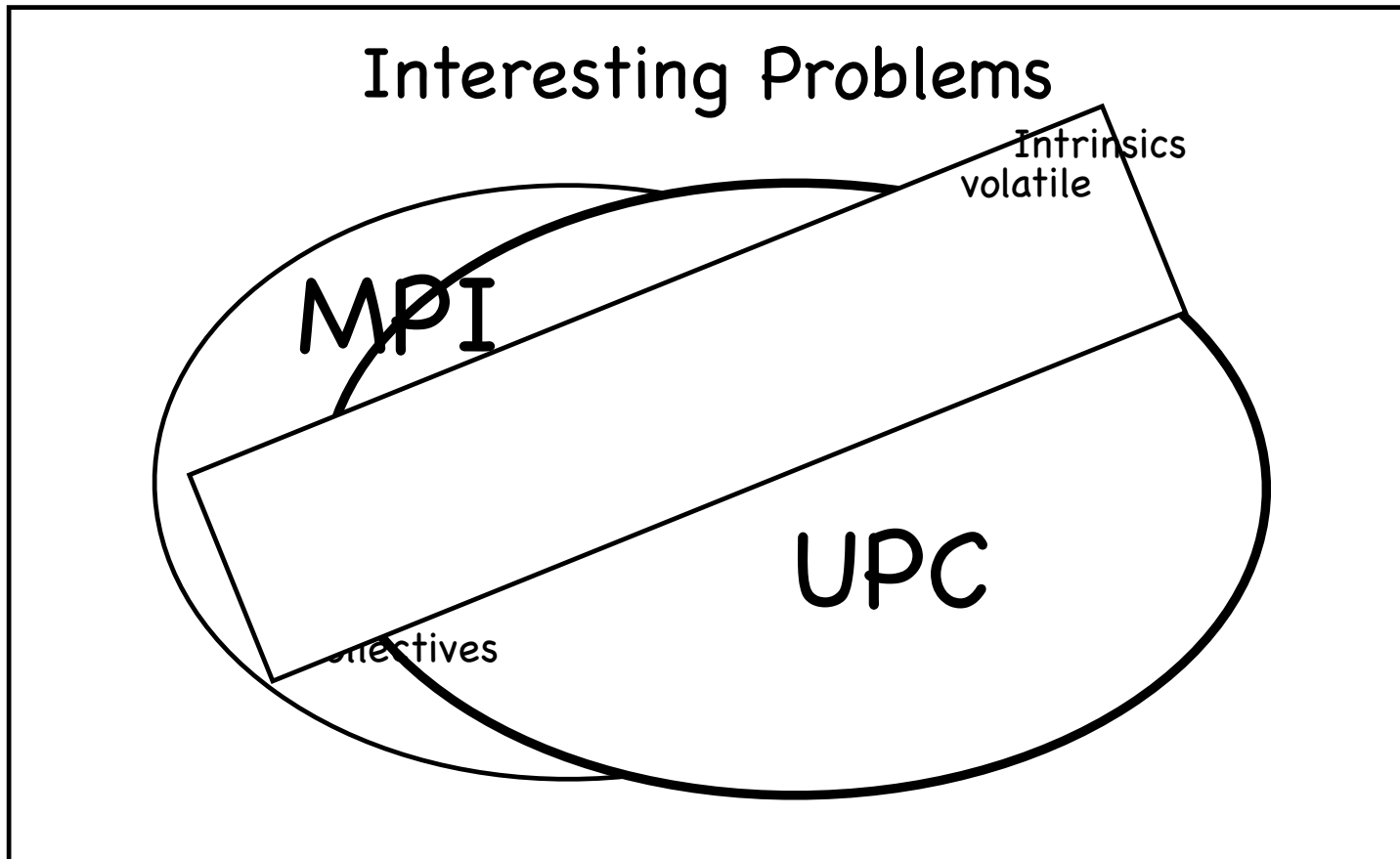


# Memory Models and Programmers

Another cache related example

```
forevery (pixel) {  
    Histo[ color(pixel) ]++;  
}
```

# Applications Across Platforms



# Where are the Number?

- ① Circle the wagons and .....
- ① MuPC, GCC/GASNet work and publicly available
  - ① Can't write a real world application yet
  - ① Works fine for teaching
  - ① Good for research (simulated performance)
- ① Multicomputers with Integrated Networks (no killer app yet, but reasonable performance)
- ① T3E and X1 (not a UPC issue)

# Summary

- ④ UPC and Titanium (java) are widely available
- ④ Co-Array is increasing its platform base
- ④ UPC can run across multiple platforms
- ④ UPC runs better on better hardware
- ④ Incremental Parallelism & Performance Tuning
  - ④ Makes the X1 a development platform
  - ④ UPC is a TOOL for High Productivity