Rule The Next Generation Supercomputers With X10

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Why a New Language?

❑ **Frequency Wall** – Inability to follow past frequency scaling trends.

❑ **Memory Wall** – Inability to support a coherent uniform-memory access model with reasonable performance.

❑ **Scalability Wall** – Inability to utilize all levels of available parallelism in the system[1].

What is X10?

❑ X10 is a new language developed in the IBM PERCS project as part of the DARPA program on High Productivity Computing Systems (HPCS)[2].

❑ X10 is an instance of the APGAS framework in the Java family.

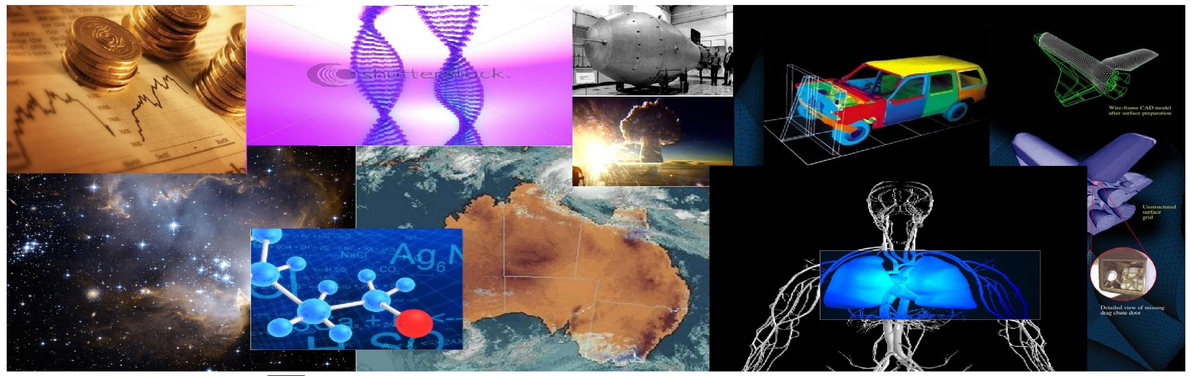
Why X10?

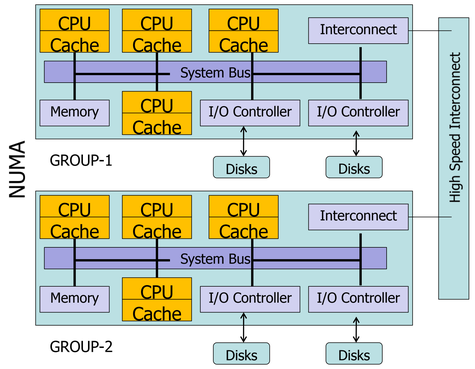
❑ Is more productive than current parallel programming models as well as more convenient and accurate than Java.

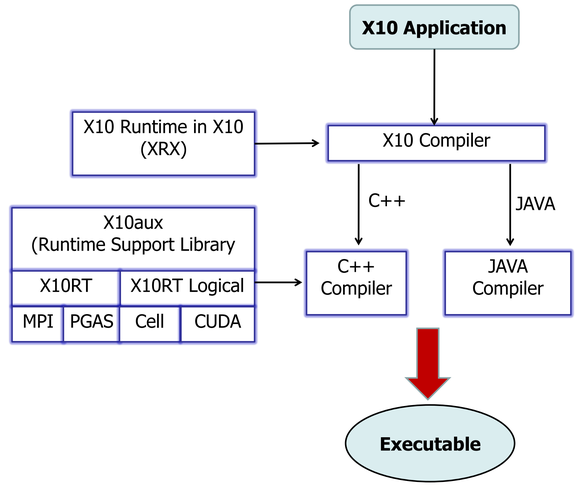
❑ Can support high levels of abstraction.

❑ Can exploit multiple levels of parallelism and non-uniform data access.

❑ Is suitable for multiple architectures, and multiple workloads.







X10 Activities (Threads)

```
public static def main(argv:Rail[String]!) {
    val sums = Rail.make[Int](2, (Int) => 0);
    finish {
        async
            { sums(0) = sum(1, 100, (i:Int) => i*i); }
        async
            { sums(1) = sum(1, 1000, (i:Int) => i); }
    }
    val t = sums(0) + sums(1);
    x10.io.Console.OUT.println("t=" + t);
}
```

Spawn an activity

Spawn another activity

Wait for finish

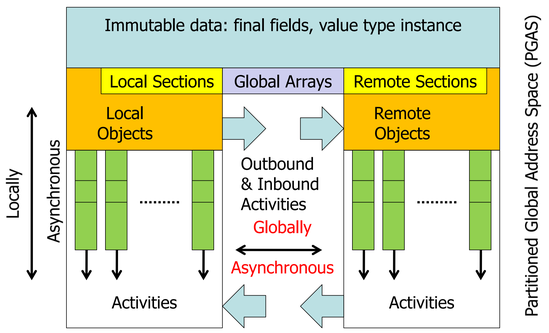
X10 Places (Processes)

```
def addTo(a:DistArray[Int], b:DistArray[Int])
{a.dist == b.dist} = {
val D = a.dist;
for(p in D.places())
    at(p) {
        for(i in D.get(p))
            a(i) += b(i);
    }
}
```

Same Distribution

One 'at' per relevant place

Local loop over points at p



Research Areas – X10 Runtime

❑ **Jikes RVM**: Jikes Research Virtual Machine[3] is implemented in the Java™ programming language, which runs on itself without requiring a second virtual machine. Ongoing work for extending Jikes RVM as X10 Java runtime.

❑ **MPI**: Runtime support for Point to point communication in X10 code existing. Ongoing work for implementation of collective communication among X10 team object comprising of threads and processes.

❑ **Cell & CUDA**: Designing and implementing X10 runtime for Cell processors and CUDA architecture is also a very promising research area.

References

[1] Kemal Ebcioglu, Vijay Saraswat, Vivek Sarkar, X10: Programming for Hierarchical Parallelism and Non-uniform data access. 3rd International Workshop on Language Runtimes, Impact of Next Generation Processor Architectures on Virtual Machine Technologies co-located with ACM OOPSLA, 2004.

[2] http://www.x10-lang.org/
[3] http://jikesrvm.org/

Supervised by Dr. Stephen Blackburn & Dr. Alistair P. Rendell