Main Goals
- Focus on programmer productivity
- Support interoperability
  - Reuse, compose existing parallel libraries and frameworks
- Behave like familiar languages
  - apparently sequential (deterministic), shared memory, imperative
- Provide reasonable per-core performance and good scalability
- For shared memory, homogeneous, manycore hardware

Motivating Applications
- Heart blood-flow simulation
- Future Parlab health code
- Multimedia

Prototype
- C based, with
  - forall over integer range
  - reduce(+)
    - locals
    - atomic add
    - upcoming: owner update
- Three runtimes
  - Intel TBB based
  - Simple SPMD-style
    - no nested parallelism
  - Sequential, with determinism checks
- Generates LLVM or C

Main Features
- Nested loop-style parallelism
  - forall, parallel composition (\(i; j\))
  - over user-defined data structures
    - Hard problem: efficient implementation of nested parallelism
- Determinism via controlled sharing
  - parallelism over independent data
  - or, declared sharing rules:

```
int reduce(+) buckets[];
forall (x in A)
  buckets[x / 100]++;
```

```
int scan(+) count = 0;
forall (x in A)
  if (x < pivot)
    B[count++] = x;
```

- Use libraries, frameworks written in other languages
  - FFTW, BLAS...
- Future Parlab

Reduction Performance

<table>
<thead>
<tr>
<th></th>
<th>seq</th>
<th>inner</th>
<th>outer</th>
<th>both</th>
</tr>
</thead>
<tbody>
<tr>
<td>col-major</td>
<td>558s</td>
<td>377s</td>
<td>115s</td>
<td>339s</td>
</tr>
<tr>
<td>row-major</td>
<td>532s</td>
<td>158s</td>
<td>118s</td>
<td>120s</td>
</tr>
</tbody>
</table>

- dual quad-core Xeon 2.8Ghz
- naïve: mark forall, rewrite outer loop
- intelligent parallelism: 18s
  - matrix-matrix multiplies
  - vs matrix-vector multiplies
- use BLAS library

Source: www.psc.org

Speech Application

- Hard problems: efficient independence checks; sharing strategies: parallel tree reduction / lock and operate / transfer to owner and operate / etc

- Hard problems: efficient cross-language calls, mixed-mode nested parallelism, maintaining determinism