Interfacing Chapel with traditional HPC programming languages[1]

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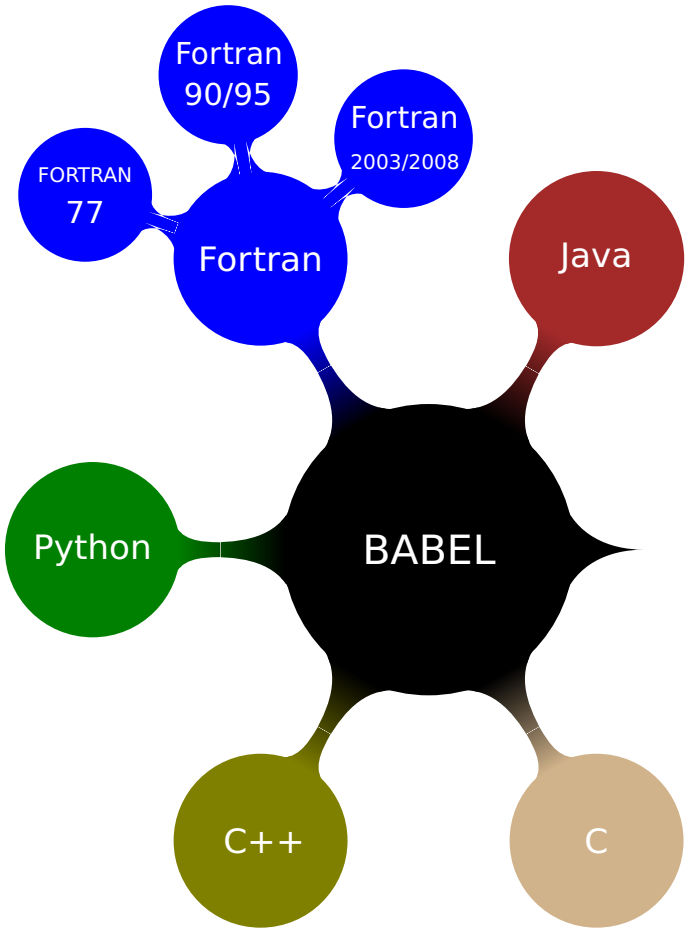
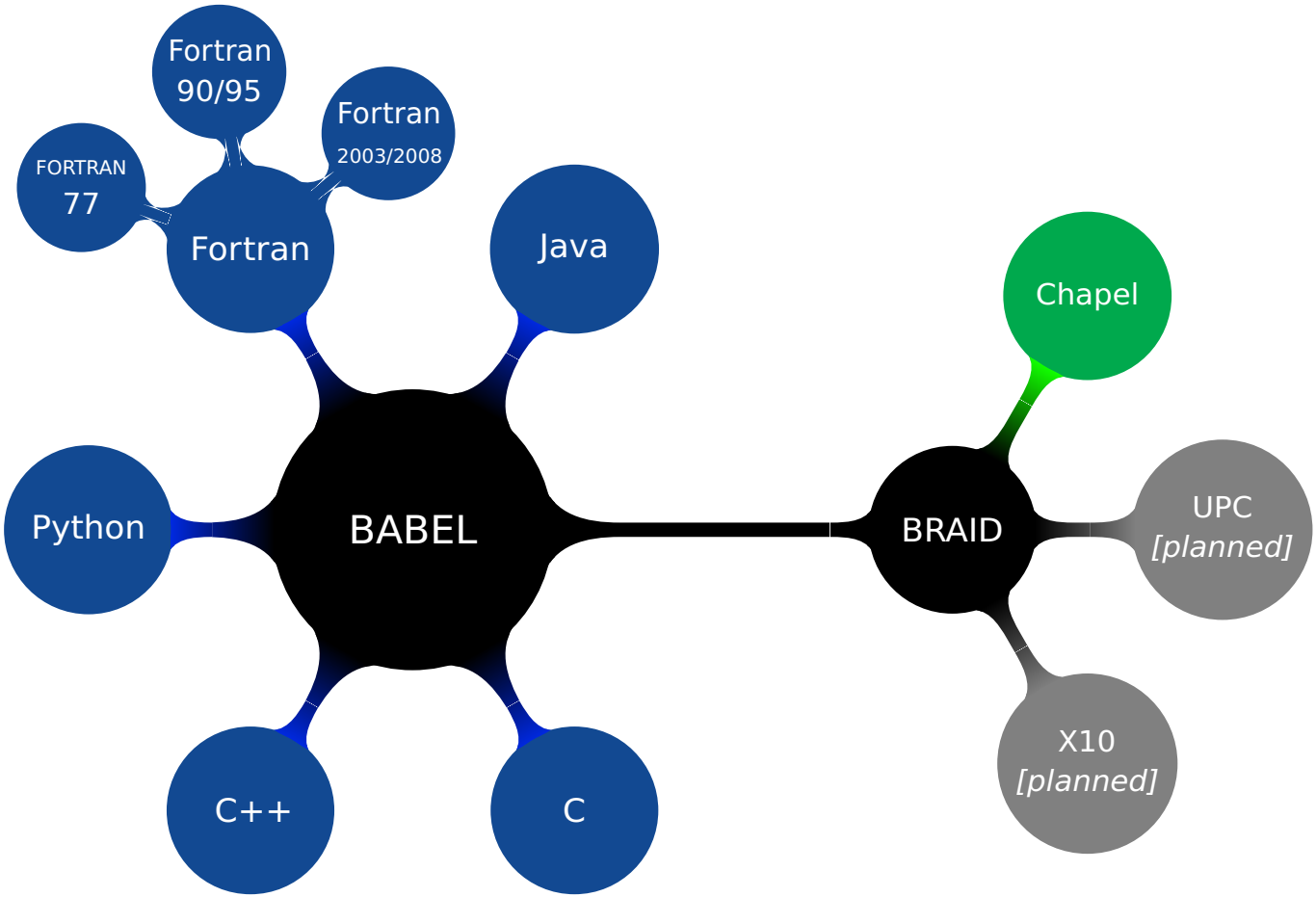
Related work



Babel

- LLNL's language interoperability toolkit for high-performance computing
- Designed for fast in-process communication
- Handles generation of all glue-code
- Features multi-dim. arrays, OOP, RMI, . . .

BRAID connects Babel with PGAS languages



How does it work

Programming-language-neutral **interface specification**

Scientific Interface Definition Language (SIDL)

SIDL supporting

- fundamental data types
- object-oriented programming (user-defined types)
- interface inheritance
- exception handling
- dynamic multi-dimensional arrays

Using Chapel with BRAID — I

first, define the interface in SIDL

Example

```
import hplsupport;
package hpcc version 1.0 {
  class ParallelTranspose {
    // C[i,j] = A[j,i] + beta * C[i,j]
    static void ptransCompute(
        in hplsupport.Array2dDouble a,
        in hplsupport.Array2dDouble c,
        in double beta,
        in int i,
        in int j);
  }
}
```

Using Chapel with BRAID — II

- use Babel compiler for server/callee glue code:
  `~/cxxLib> babel --server=cxx hpcc.sidl`
  - generates code for **skeleton** and Intermediate Object Representation (IOR)
  - generates **splicer blocks** for **user code**
- use BRAID compiler for client/caller glue code:
  `~/chplClient> braid --client=chapel hpcc.sidl`
  - generates a Chapel **stub** that implements our interface

  ➥ link to server code and SIDL runtime library during compilation and run the executable!
- Babel/BRAID bindings take care of interoperability!

Distributed data types

BRAID provides two options for distributed arrays:

Transparent

Distr. arrays are automatically converted to/from a local array

- re-use your existing Fortran lib without modification

Via `DistributedArray` Interface

Exposes the Chapel runtime to legacy programming languages

- use `get()` and `set()` methods for element access
- copy only what you need

Summary and Future Work

- Achieved interoperability between Chapel and
  1. C
  2. C++
  3. FORTRAN 77, Fortran 90/95
  4. Fortran 2003/2008
  5. Java
  6. Python

➡ including support for distributed arrays

Future work

- Chapel as a server language
- Parallel-Parallel interoperability (Chapel↔MPI/UPC/. . .)

Try it!

- BRAID preview is included in Babel 2.0 release:
  http://www.llnl.gov/CASC/components/
- Development snapshots at:
  http://compose-hpc.sourceforge.net (BSD licensed)

For more details

- "Connecting PGAS and traditional HPC languages"
  ➡at SC'11 **poster session**!
- "Interfacing Chapel with Traditional HPC Programming Languages"
  Adrian Prantl, Thomas Epperly, Shams Imam, Vivek Sarkar
  Fifth Conference on Partitioned Global Address Space Programming Models (PGAS 2011)