Tools Updates

Chapel Team, Cray Inc.

Chapel version 1.12

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Outline

- chplvis: a Tool for Performance Visualization
- 'chpldoc' Improvements

chplvis: a Tool for Performance Visualization

chplvis: Background

- **Performance debugging tool support for Chapel is limited**
  - No support for tools like Tau, ParaView, and VisIt
  - Basic support for tools like valgrind and gdb
  - Parallel performance debugging is not easy

- **Chapel runtime uses tasks and locales**
  - Direct support for these features is important
  - Other tools do not support this exact paradigm
    - e.g., provide thread-based information rather than task-based

    ⇒ Challenging to integrate support for Chapel in other tools

chplvis: A Communication and Task Viewer

- **A new visualization tool for…**
  …Inter-locale communication
  …Task concurrency within a locale
  …CPU and clock time

- **Support provided via a standard module: `VisualDebug'**
  - User calls module functions to indicate program segments to visualize
    - http://chapel.cray.com/docs/latest/modules/standard/VisualDebug.html
  - Runtime collects data about runtime events, creates data files
  - Chplvis program displays data from files visually

chplvis: VisualDebug.chpl module

startVdebug("dataDirName")

- Starts collecting runtime events
- Creates named directory for data collection
- Each locale writes a separate data file

stopVdebug()

- Stops all data collection, closes all data files

tagVdebug("tagName")

- Inserts tag in the data, allows partial run visualizations
- Chplvis tool uses tag name to control displayed data

pauseVdebug()

- Temporarily suspend collection of runtime events

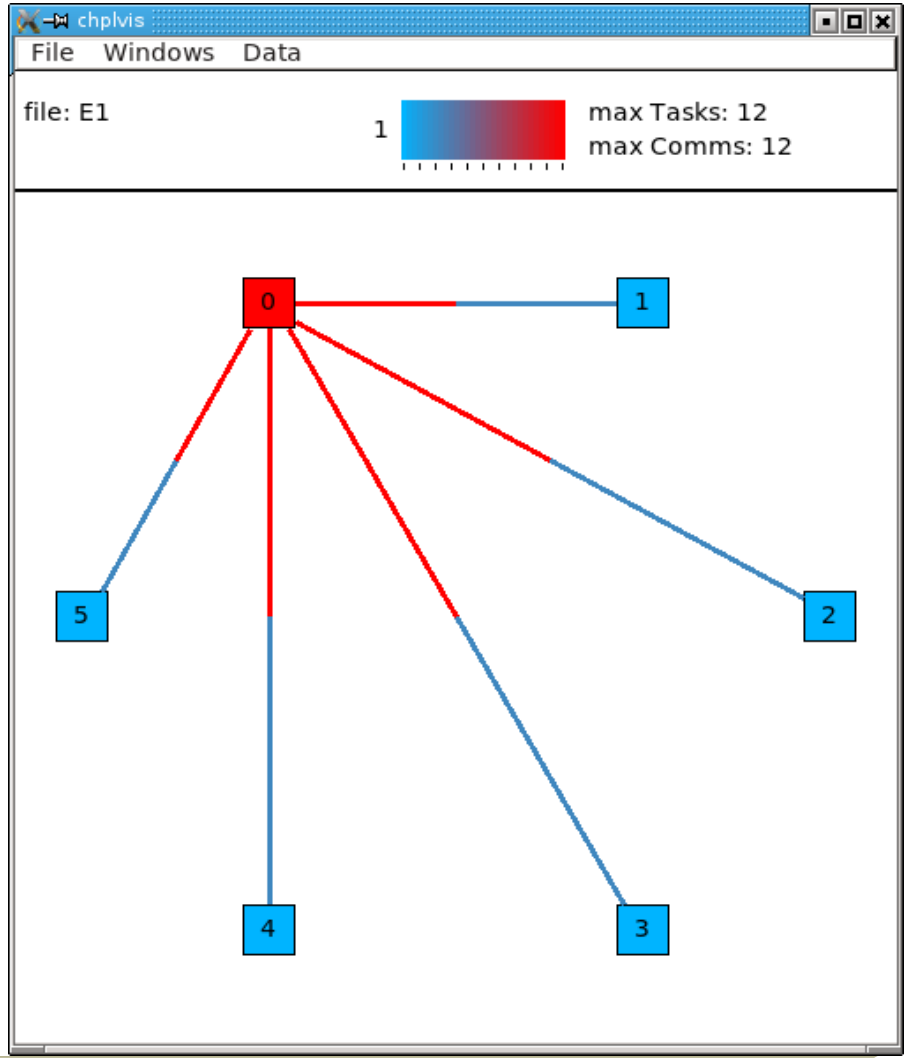
chplvis: Simple Example

Simple coforall and on clause:

```
use VisualDebug;

startVdebug("E1");

coforall loc in Locales do
   on loc do
     writeln("Hello from locale " + here.id + ".");

stopVdebug();
```

chplvis: Simple Example display

- **Simple coforall and on-clause display, 6 locales**
  - Boxes are locales
  - Lines are communication
  - Color shows data value
    - Segment adjacent to box indicates number of communications *into* locale
- **Interactive display**
  - Click on boxes
  - Click on lines
  - Data menu changes display



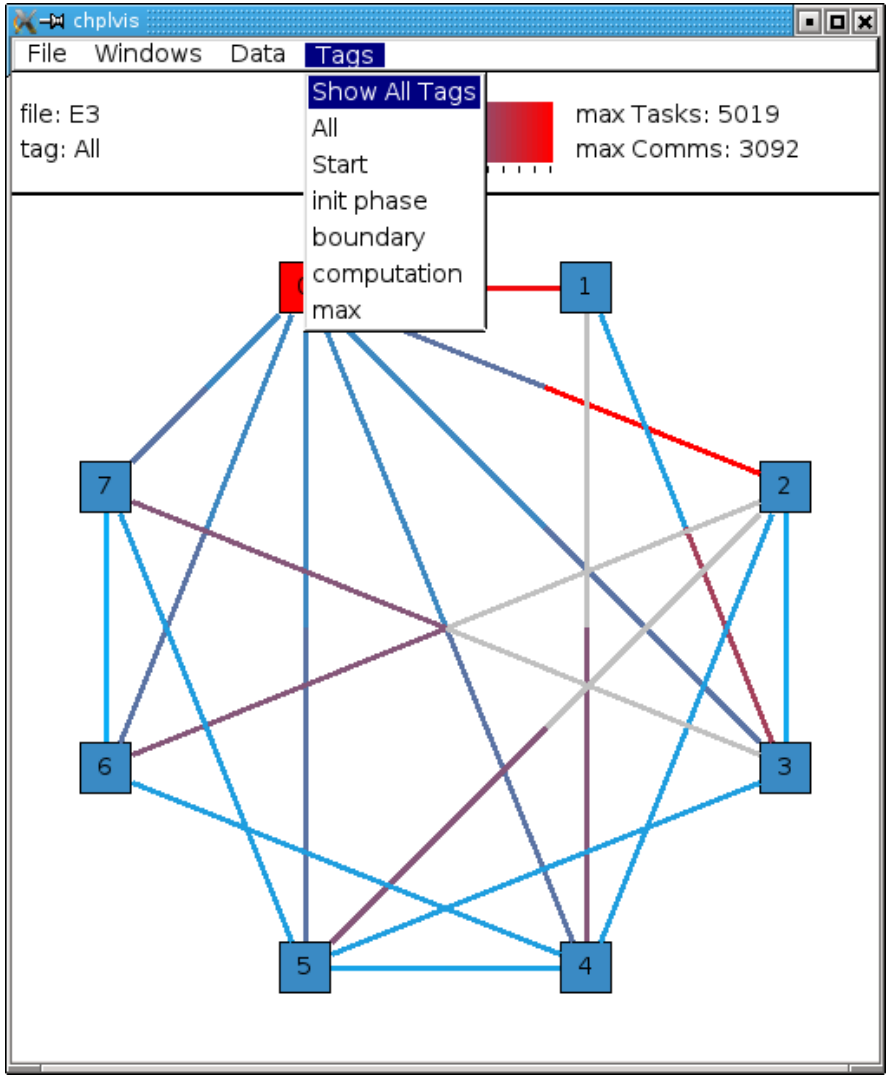
chplvis: Jacobi Example

Jacobi computation loop:

```
while (delta > epsilon) {
  tagVdebug("computation");  // Tag the computation part of this loop
   for t in 1..compLoop {
     forall (i,j) in R do A[i,j] = Temp[i,j];
     forall (i,j) in R do
       Temp[i,j] = (A[i-1,j]+A[i+1,j]+A[i,j-1]+A[i,j+1])/4;
   }

   tagVdebug("max");  // tag the reduction part of this loop.
   forall (i,j) in R do
     Diff[i,j] = abs(Temp[i,j] - A[i,j]);
   delta = max reduce Diff;

   pauseVdebug();
   iteration += compLoop;
 }
```

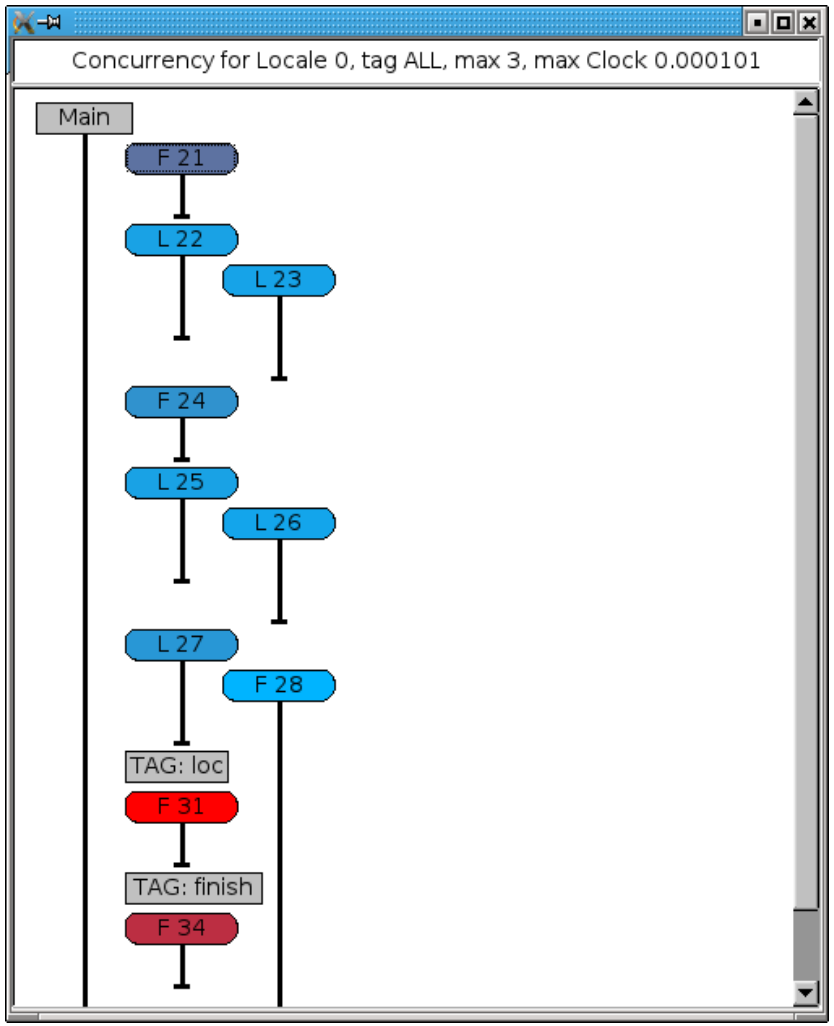
chplvis: Jacobi Example Display

- **8 locale run with tags**
  - 'All' ⇒ program start to first tag
  - Tag names taken from calls
  - Gray segments indicate no communication into that locale



chplvis: Intra-locale task example

- **Task concurrency display**
  - Ovals are tasks
  - Colors show task clock time
  - Lines show (logical) lifetime
  - Tags may be shown in task timeline
- **Display interaction**
  - Click task for list of the task's communications
  - Hover over task for summary display of times and communication counts



chplvis: Status and Next Steps

Status:

- No known bugs
- Works well up to 32 locales
- All planned features working

Next Steps:

- Get user feedback
- Improve visualization for more than 32 locales
- Longer-term: introduce more data-centric views of computation

‘chpldoc’ Improvements

Chpldoc Improvements: Background

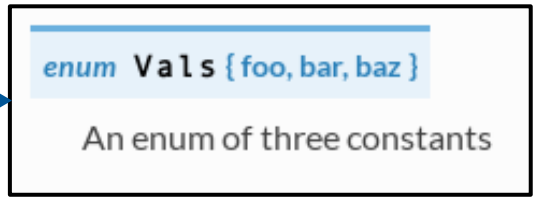
- **chpldoc was much improved in 1.11**
  - Including distinct flags from chpl binary

Chapel 1.11:

```
chpldoc -h
Usage: chpldoc [flags] [source files]

Documentation Options:
  -o, --output-dir <dirname>

      --save-sphinx <directory>

      --comment-style <indicator>

      --text-only
  -h, --help
```

- **Still some bugs to iron out**
  - Initialization expressions of certain types were handled poorly
  - Numeric enum values were dropped on the floor

```
/* An enum of three constants */
enum Vals {foo = 1, bar, baz};
```



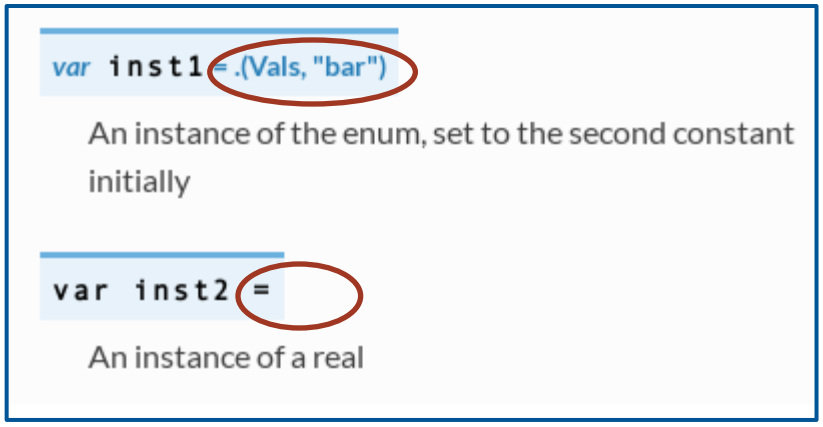
  - Needed pragma to hide symbols from output

Chpldoc Improvements: This Effort

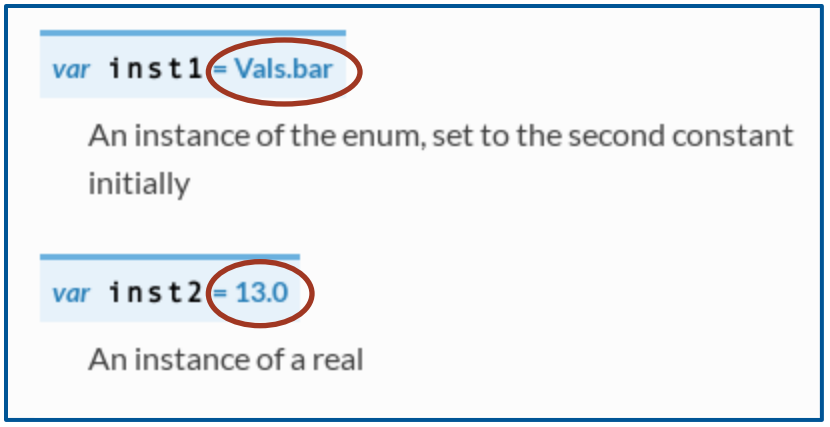
- chpldoc now shows an enum's numeric values
- fixed enum, real, imag, complex initialization expressions

```
/* An instance of the enum, set to the
second constant initially */
var inst1 = Vals.bar;
/* An instance of a real */
var inst2 = 13.0;
```

Chapel 1.11:



Chapel 1.12:



Chpldoc Improvements: This Effort

- **Previously: only ignored symbols with pragma "no doc"**

```
pragma "no doc"
var foo: int;
```

  - Pragmas aren't currently intended for end-users
  - Already wanted privacy control in namespaces
    - This was a quick fix, not a long-term solution

- **Now: private symbols are also ignored by chpldoc**
  - Still supporting "no doc" pragma
    - Not all symbols support 'private' yet
    - Even then, may not want everything 'public' to be documented

Chpldoc Improvements: This Effort

- **More flags**
  - New: --author for setting author output
  - Other flags shared with chpl binary
    - License, copyright, etc.
    - Better developer debugging

Chapel 1.11:

```
chpldoc -h
Usage: chpldoc [flags] [source files]

Documentation Options:
  -o, --output-dir <dirname>

      --save-sphinx <directory>

      --comment-style <indicator>

      --text-only
  -h, --help
```

Chapel 1.12:

```
chpldoc -h
Usage: chpldoc [flags] [source files]

Documentation Options:
  -o, --output-dir <dirname>

      --save-sphinx <directory>

      --author <author>
      --comment-style <indicator>

      --text-only
      --[no-]print-commands

Information Options:
  -h, --help
      --help-env
      --help-settings
      --version
      --copyright
      --license

Developer Flags:
      --[no-]devel
      --gdb
      --lldb
      --print-chpl-home
```

Chpldoc Improvements: Next Steps

- **More bug fixes**
- **Support testing example codes within chpldoc comments**
  - Similar to python doctests
- **Compatibility with newly converted .rst files**
- **Support class/record view, including inheritance info**
  - And add class and record index
- **Link to source code from docs**

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