Asp Specializers & Recent Results
Shoaib Kamil, Armando Fox, David Patterson, Katherine Yelick, and many others

SEJITS Overview

Specializer == pattern-specific JIT compiler
- Code templates hand-authored by efficiency programmers in efficiency language (eg C++)
- AST transformation of VHLL code to instantiate templates
- Compile & run specialized code, return results to PLL
- Occurs invisibly to programmer

Asp: A SEJITS Implementation for Python
- Users write their apps in Python
- Supports code generation in C/C+/CUDA/Cilk+
- Under rapid development (patches welcome!)
- Public source repo: git://github.com/shoaibkamil/asp.git
- Wiki: http://github.com/shoaibkamil/asp/wiki
- Get involved
  - Pre-built VM environment using Vagrant
  - Build your own specializers and help us improve design/usability of Asp

Recent Goings-on in Asp
- Multiple specializers in development
- Two support multiple backends already
- Productivity programmers adopting specializers
- Summer students will be working on new specializers
- Aspdb, the global db for timings, now running on Google Appengine
- Machine learning already giving insight into recorded specializer run results
- Presenting at SciPy conference in July
  - Developer preview release planned to coincide

Stencil Specializer Results: Laplacian

```python
class Heat3D(StencilKernel):
    def kernel(self, in_grid, out_grid):
        for x in in_grid.interior_points():
            for y in in_grid.neighbors(x, 1):
                out_grid[x] = out_grid[x] + (1.0/6.0)*in_grid[y]
```
- Standard Laplacian heat equation benchmark
- Specializer outputs both OpenMP and Cilk+
- >65% of peak on Core i7 machine
- 3 orders of magnitude faster than pure Python
- Very few optimizations implemented so far
- Believe we can approach 95% of peak

Stencil Specializer App: Brain Imaging
- 3D MRI brain data is noisy
- Bilateral filter applied to bring out varying features
- Different features appear at different filter radii
- Memory bound at small radii, computation bound at large radii

```python
class BilatKernel(StencilKernel):
def kernel(self, in_img, out_img, filter):
    for x in in_img.neighbors(x, r):
        out_img[x] = in_img[x] + filter[abs(int(in_img[x] - in_img[y]))%255] * in_img[y]
```

Asp Infrastructure

Other Asp/SEJITS Posters
- Implementing a Specializer (Derrick Coetzee)
- Matrix Powers in Asp (Jeffrey Moran)
- Gaussian Mixture Modeling (Katya Gonia and Henry Cook)
- Using Machine Learning for Auto-tuning Multi-coreStencil (Orianna DeMasi)

Original imagery courtesy Prof. Owen Carlinchael, Dept. of Neurology, UCD and the UCD Alzheimer's Center.