SCALABLE EXECUTION
Achieving high performance at any scale

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DGX-2

DGX SuperPod
**FAMILIAR & CONVENIENT NOTATION**

Program at any scale without learning new interfaces

```python
import numpy as np

def cg_solve(A, b):
    x = np.zeros(A.shape[1])
    r = b - A.dot(x)
    p = r
    rsold = r.dot(r)
    for i in xrange(b.shape[0]):
        Ap = A.dot(p)
        alpha = rsold / (p.dot(Ap))
        x = x + alpha * p
        r = r - alpha * Ap
        rsnew = r.dot(r)
        if np.sqrt(rsnew) < 1e-10:
            break
        beta = rsnew / rsold
        p = r + beta * p
        rsold = rsnew
    return x
```

- Many existing interfaces expose ample parallelism
- Data often large enough to warrant large machines
- **This code can run on a supercomputer**
import random, numpy, legate.numpy

# Code written using the NumPy interface provided by “np”:
def step1(np, n): return np.ones(n), np.ones(n)
def step2(np, x, y): return np.dot(x, y)

# Unorthodox adoption strategy:
numpy_likes = [numpy, legate.numpy]
x,y = step1(random.choice(numpy_likes), 1_000_000_000)
print( step2(random.choice(numpy_likes), x, y) )
def cg_solve(A, b, conv_iters):
    x = np.zeros_like(b)
    r = b - A.dot(x)
    p = r
    rsold = r.dot(r)
    converged = False
    max_iters = b.shape[0]

    for i in range(max_iters):
        Ap = A.dot(p)
        alpha = rsold / (p.dot(Ap))
        x = x + alpha * p
        r = r - alpha * Ap
        rsnew = r.dot(r)

        # Check convergence periodically
        if i%conv_iters == 0 and np.sqrt(rsnew) < 1e-10:
            converged = i
            break

        beta = rsnew / rsold
        p = r + beta * p
        rsold = rsnew

    return x, converged

# Use Legate NumPy if available
try:
    import legate.numpy as np
except:
    import numpy as np
```
import legate.numpy as np
for _ in range(iter):
    un = u.copy()
    vn = v.copy()
    b = build_up_b(rho, dt, dx, dy, u, v)
    p = pressure_poisson_periodic(b, nit, p, dx, dy)
    u[1:-1, 1:-1] = (  
        un[1:-1, 1:-1] * dt / dx * (un[1:-1, 1:-1] - un[1:-1, 0:-2])  
        - vn[1:-1, 1:-1] * dt / dy * (un[1:-1, 1:-1] - un[0:-2, 1:-1])  
        - dt / (2 * rho * dx) * (p[1:-1, 2:] - p[1:-1, 0:-2])  
        + nu  
        * (  
            dt  
            / dx ** 2  
            * (un[1:-1, 2:] - 2 * un[1:-1, 1:-1] + un[1:-1, 0:-2])  
            + dt  
            / dy ** 2  
            * (un[2:, 1:-1] - 2 * un[1:-1, 1:-1] + un[0:-2, 1:-1])  
        )  
        + F * dt
```
Envision an ecosystem of accelerated, distributed computing with convenient notation:

Help users program supercomputers as if they were a single processor.

Legion runtime system is the essential ingredient that makes this possible.

Legate is open source.  [http://github.com/nv-legate](http://github.com/nv-legate)