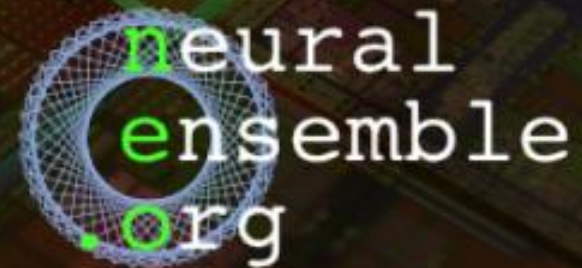


Concurrency Kung-fu: Python Style

Eilif Muller



Blue
Brain
Project



Reserve your place ...

- Login to the head node:
\$ ssh student<1..15>@asppcluster.in.waw.pl
- Schedule an interactive session on a compute node:
\$ qssh -pe smp 18 -now no

...for the concurrency revolution!

Why Concurrency? (parallelism)

The brain is a parallel machine

Asynchronous

Distributed memory

Simple messages

Agnostic to component failure

Connectivity:

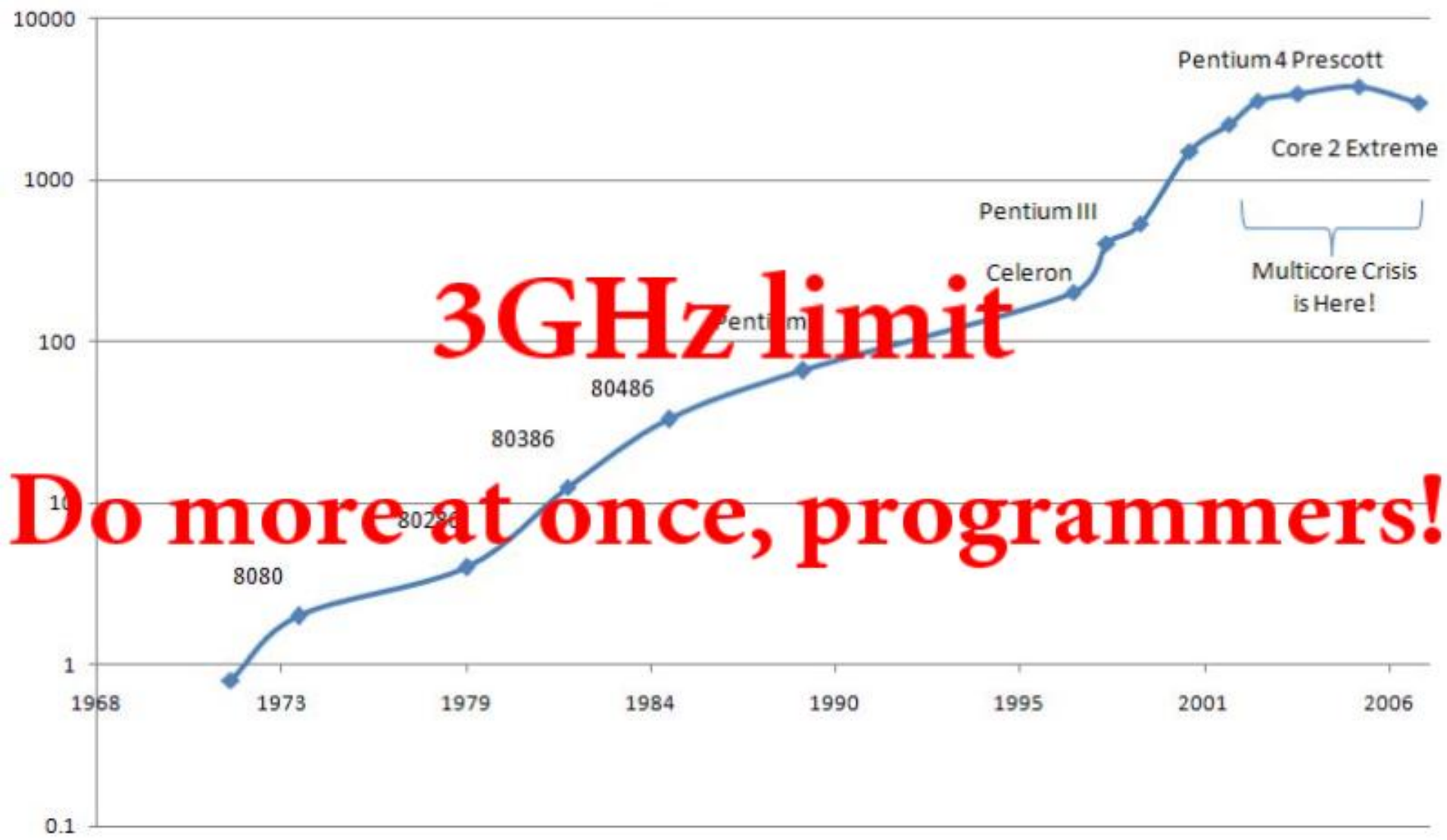
dense local, sparse global

Works with long latencies

000188

Why Concurrency? (parallelism)

Intel Processor Clock Speed (MHz)



3GHz limit

Do more at once, programmers!

Multicore Crisis is Here!

The free lunch is over

"Concurrency is the next major revolution in how we write software [after OOP]."

Herb Sutter, *The Free Lunch is Over: A Fundamental Turn Towards Concurrency in Software*, Dr.Dobb's Journal, 30(3) March 2005.

At least 3 types of Concurrency

SMP	Message passing	Stream
Shared mem. Multi-thread	MPI, sockets Linux Clusters	GPU, Cell
<8 Threads Or \$	1000's of processes over network	SIMD Stream: Kernel over arrays
threads multiprocessing	mpi4py, ipython Parallel Python	PyCUDA, PyOpenCL

Others: SSEx ...

Don't Panic!

- ◆ Writing parallel programs is easy!
 - ◆ Small and simple APIs
- ◆ Designing parallel algorithms can be **easy** or **hard**.
 - ◆ **Easy:** "embarrassingly parallel"
 - ◆ **Hard:** to find the parallelism
 - ◆ **Hardware:** e.g. the starving CPU

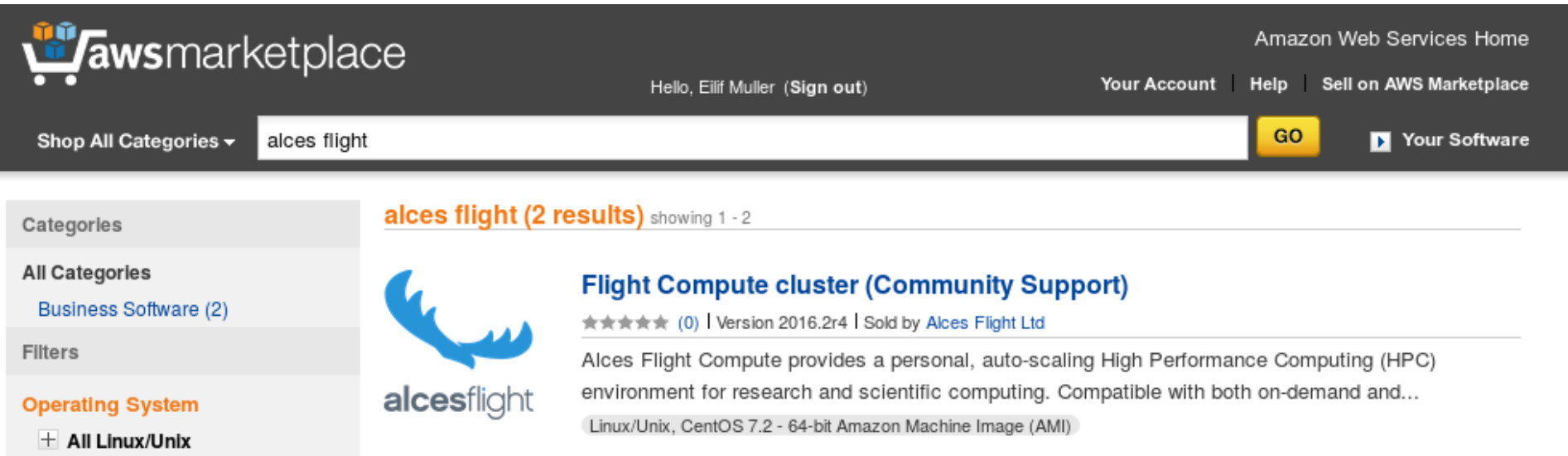
Don't Panic!

- ◆ Scientific parallel programs are easy!
 - ◆ **Parallelism:** Number crunching over large datasets
 - ◆ **Prior-art:** Many algorithms already exist
 - ◆ **Hardware:** HPC is traditionally academic

Objectives

- Hands on experience using a real HPC cluster
- Basic APIs
- Speed-ups motivate ...

And we have a toy to play with!



The screenshot shows the AWS Marketplace interface. At the top left is the 'awsmarketplace' logo. On the right, there are links for 'Amazon Web Services Home', 'Your Account', 'Help', and 'Sell on AWS Marketplace'. Below the logo, it says 'Hello, Eilif Muller (Sign out)'. A search bar contains the text 'alces flight' with a 'GO' button to its right. On the left side, there is a 'Categories' sidebar with 'All Categories' (Business Software (2)) and 'Filters' (Operating System: All Linux/Unix). The main content area shows search results for 'alces flight (2 results) showing 1 - 2'. The first result is 'Flight Compute cluster (Community Support)' by Alces Flight Ltd, version 2016.2r4. It features a blue bird-like logo and a five-star rating. The description states it provides a personal, auto-scaling HPC environment for research and scientific computing, compatible with both on-demand and reserved instances. The operating system is listed as Linux/Unix, CentOS 7.2 - 64-bit Amazon Machine Image (AMI).



AWS Cloud Credits for Research

```
ssh student<1..15>@asppcluster.in.waw.pl
```

Architecture of a cluster

Login/Head
Node



Scheduler
Job queue

Compute Nodes



(Auto-scaling in the cloud...)

ssh student<1..15>

@asppcluster.in.waw.pl





Part 1:

Easy Concurrency with IPython