

Basics of Computers

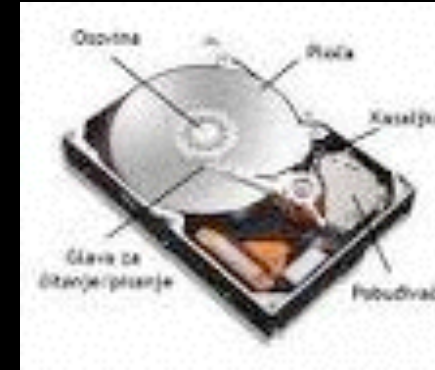
I-Introduction

Desktop computer

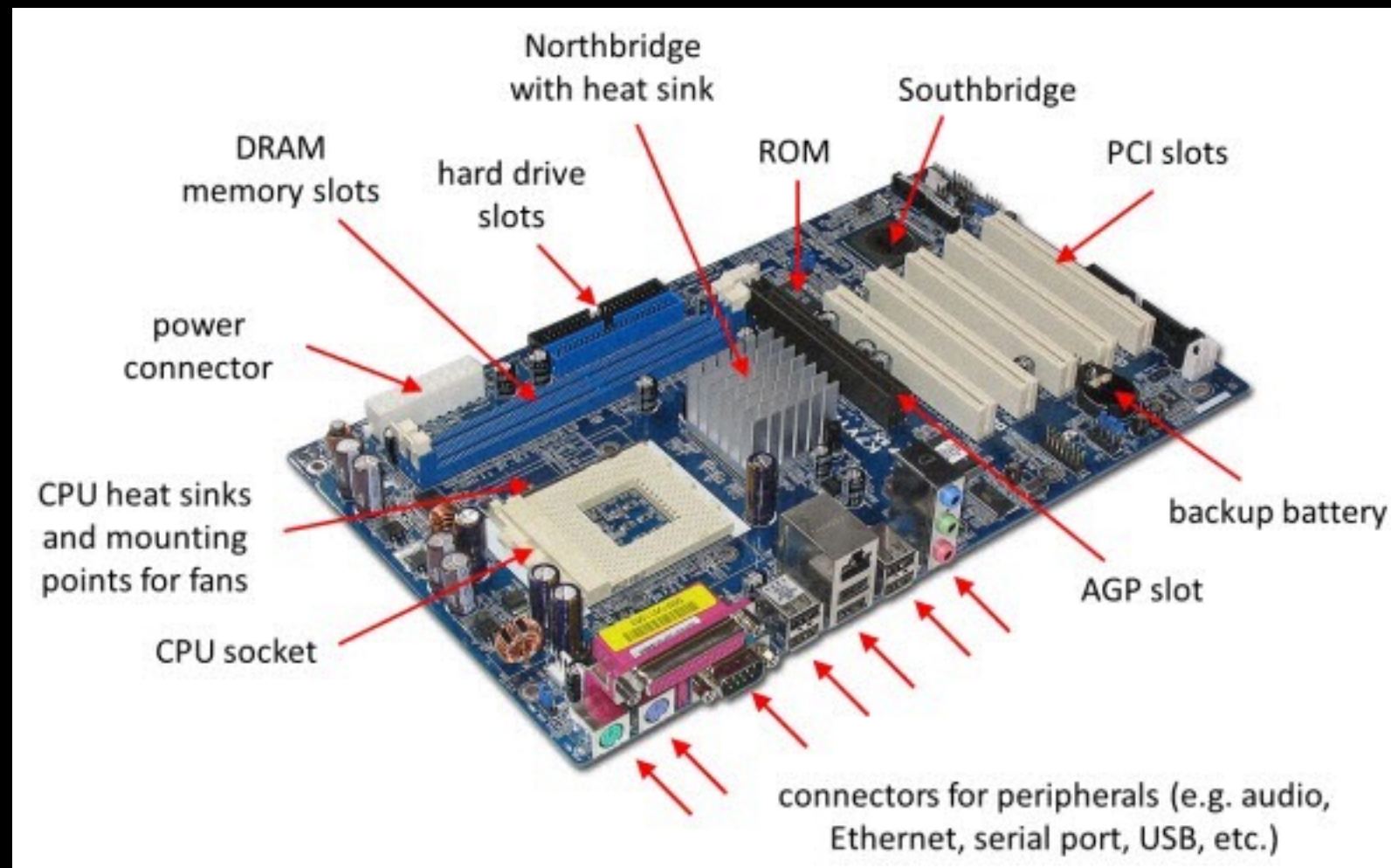
- ★ Computational unit
- ★ Memory
- ★ Input/Output



Random
Access
Memory
(RAM)

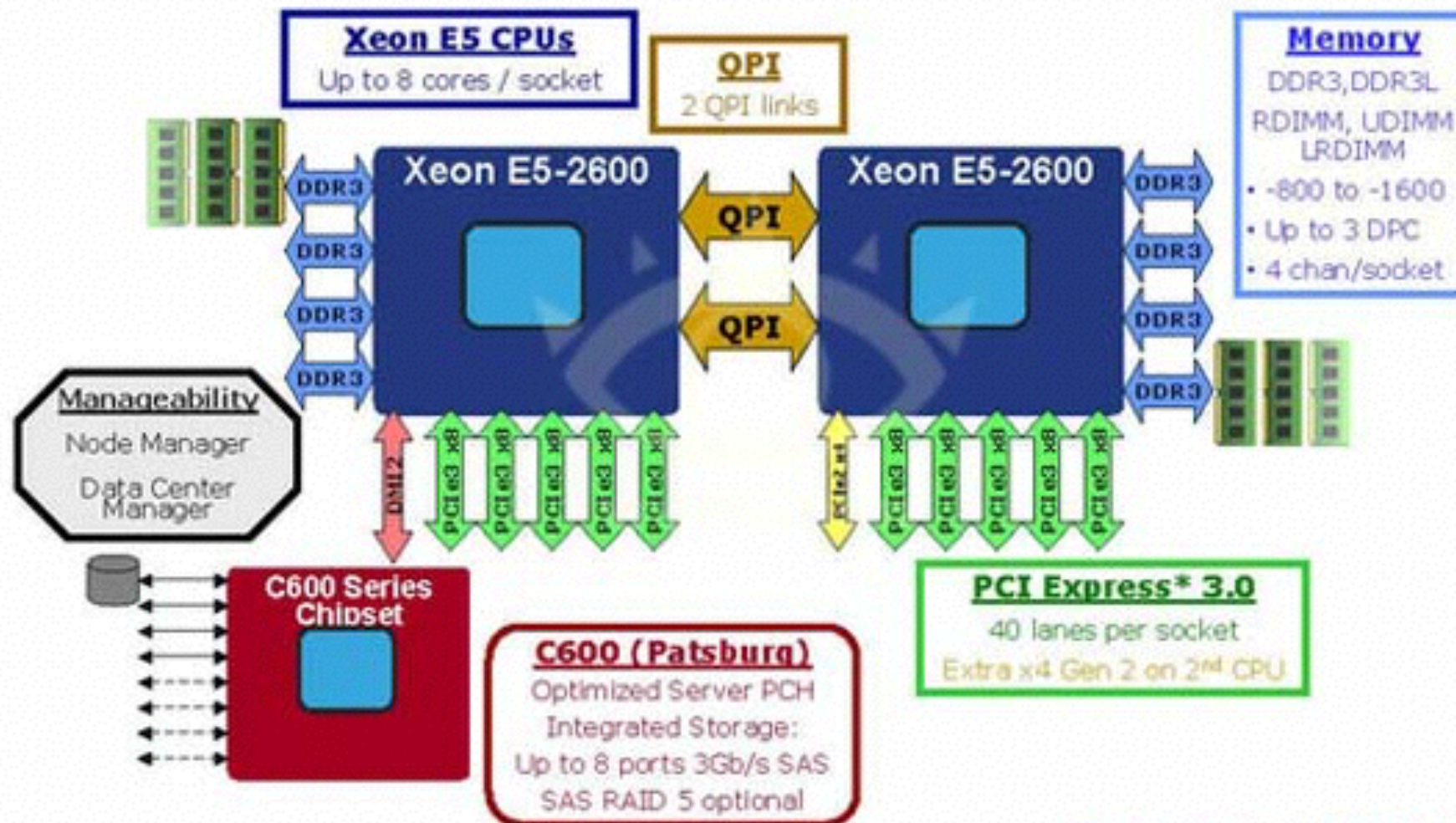


Harddisk



Motherboard

Romley EP Platforms

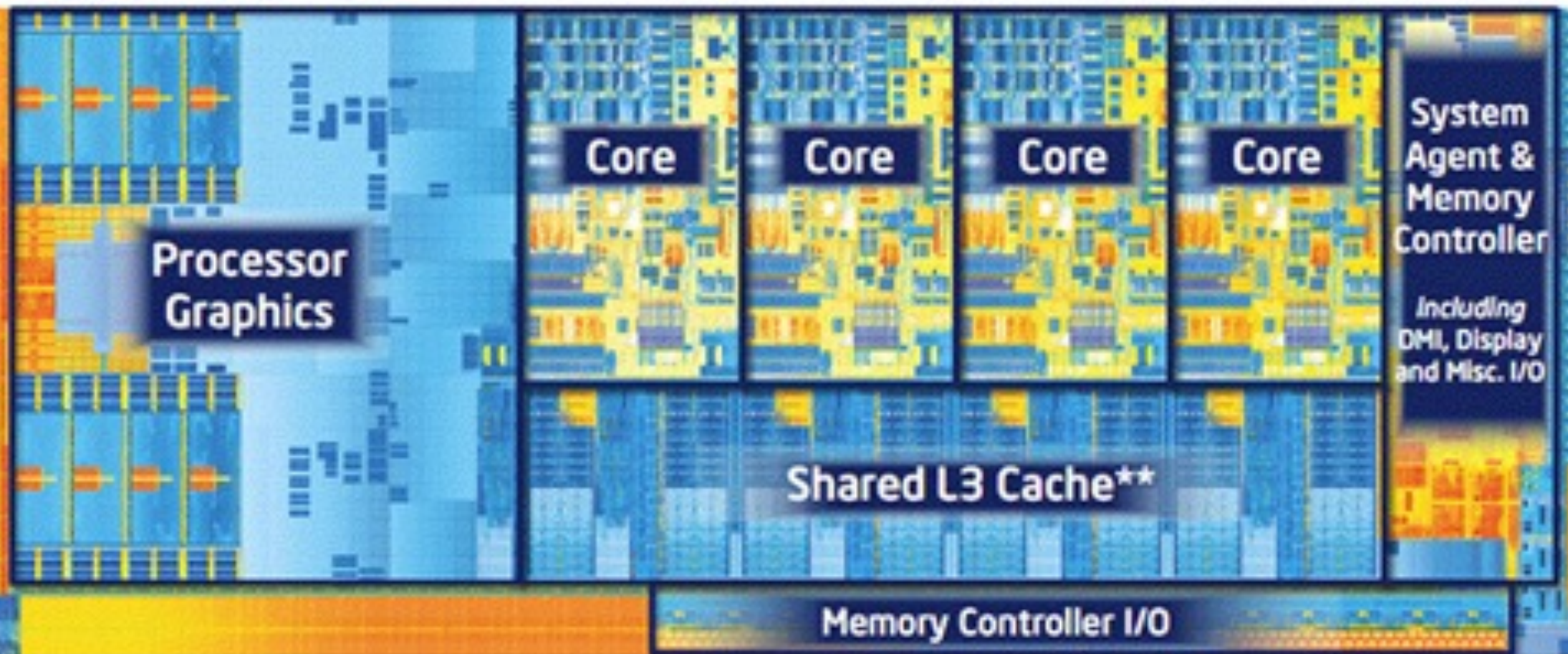


Under Embargo Until March 6, 2012 9am PST



Competitor
AMD

3rd Generation Intel® Core™ Processor: 22nm Process



New architecture with shared cache delivering more performance and energy efficiency

Quad Core die with Intel® HD Graphics 4000 shown above
Transistor count: 1.4Billion Die size: 160mm²

** Cache is shared across all 4 cores and processor graphics



size = 13 mm x 13 mm

- ★ 8 floating point operations/cycle.
- ★ $2.5 \text{ GHz} \times 8 \text{ ops} = 20 \text{ GigaFlop/core}$ processing power
- ★ with 4 cores/processor = 80 GF/processor
- ★ Workstations have more RAMs, several 6/8/10-core processors
- ★ This is not enough for big computations.

Memory

- ★ Bit (0/1) a basic unit
- ★ Byte = 8 bits
- ★ Typical RAM in a PC = 4,8,16 GB
- ★ DDR (double data rate)
- ★ SDRAM (synchronous dynamic random access memory)

	Description	Size	Range
char	Character	1 byte	0 to 255
C-int	integer	4 bytes	$-2,147,483,648$ to $2,147,483,647$, [-2^{31} to $2^{31} - 1$]
C-long	Integer	8 bytes	-9223372036854775808 to 9223372036854775807 , [-2^{63} to $2^{63} - 1$]
bool	Boolean value	1 byte	0/1
C-float	real	4 bytes	$\pm 3.4e(\pm 38)$ ~7 digits
double	real	8 bytes	$\pm 1.7e(\pm 308)$ 15 digits

Estimates

- ★ Typical desktop has 4 to 8 Gigabytes of RAM.
- ★ To save a matrix $A(N,N)$ with $N=10^3$, we need
- ★ 8×10^6 bytes for double, and 4×10^6 bytes for float
- ★ We deal with 4096^3 array. Memory requirement is $8 \times 64 \times 10^9 = (1/4)$ Terabytes.

High performance computing (HPC) clusters

Connect many machines
and work together

IITK HPC

- ★ 901 nodes with FDR infiband switch (56 Gbps) and 500 TB of disk space. Each node contains
 - Intel Xeon E5-2670V 2.5GHz 2 CPU-Ivybridge
 - 128 GB RAM/node
- ★ No of cores = 17980
- ★ Total RAM= 115TB; Hard disk = 500 TB
- ★ Performance: $20 \times 20 \times 901 = 360.4$ Teraflop peak
- ★ Power = 370 KW
- ★ Ranked 118 in June 2014 ranking

Top 10 HPC systems

RANK	SITE	SYSTEM	CORES	RMAX (TFLOP/S)	RPEAK (TFLOP/S)	POWER (KW)
1	National Super Computer Center in Guangzhou China	Tianhe-2 (MilkyWay-2) - TH-IVB-FEP Cluster, Intel Xeon E5-2692 12C 2.200GHz, TH Express-2, Intel Xeon Phi 31S1P NUDT	3,120,000	33,862.7	54,902.4	17,808
2	DOE/SC/Oak Ridge National Laboratory United States	Titan - Cray XK7 , Opteron 6274 16C 2.200GHz, Cray Gemini interconnect, NVIDIA K20x Cray Inc.	560,640	17,590.0	27,112.5	8,209
3	DOE/NNSA/LLNL United States	Sequoia - BlueGene/Q, Power BQC 16C 1.60 GHz, Custom IBM	1,572,864	17,173.2	20,132.7	7,890
4	RIKEN Advanced Institute for Computational Science (AICS) Japan	K computer, SPARC64 VIIIfx 2.0GHz, Tofu interconnect Fujitsu	705,024	10,510.0	11,280.4	12,660
5	DOE/SC/Argonne National Laboratory United States	Mira - BlueGene/Q, Power BQC 16C 1.60GHz, Custom IBM	786,432	8,586.6	10,066.3	3,945

top500.org as of Jan 2016

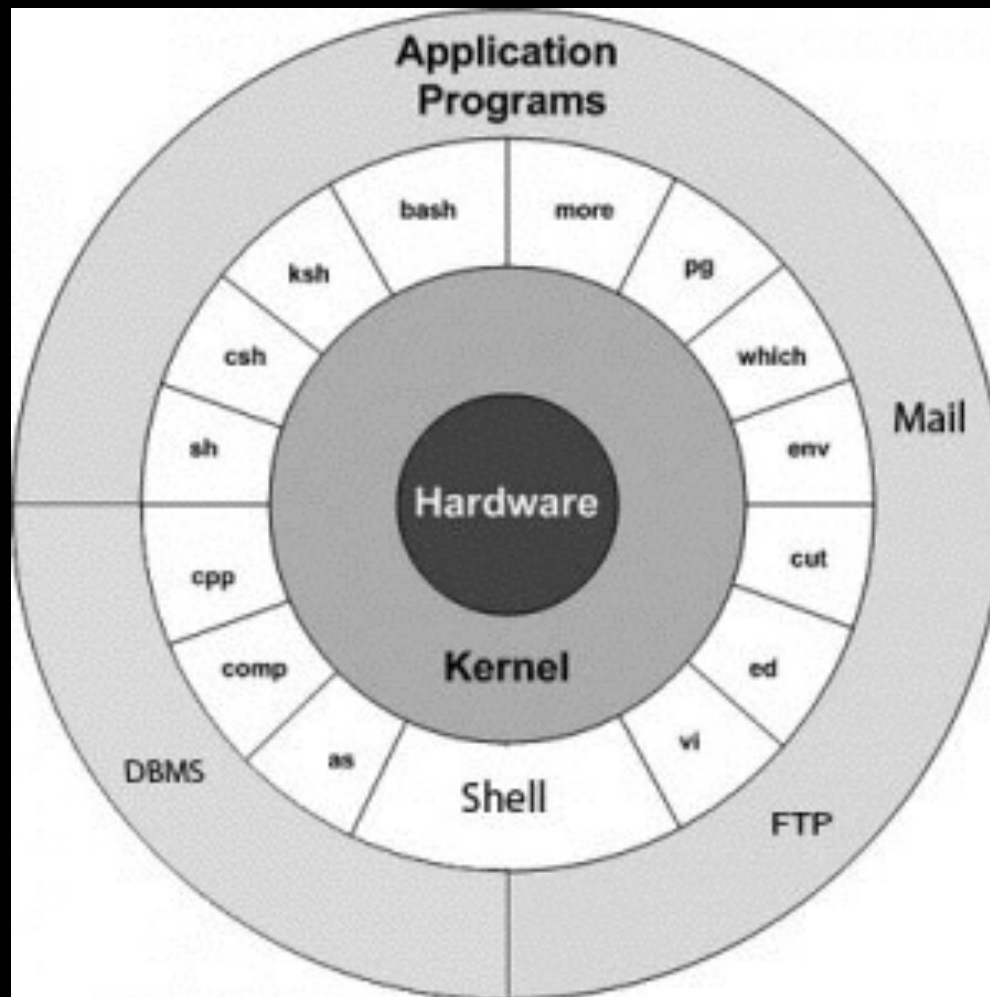
Refer top500.org for present list

6	DOE/NNSA/LANL/SNL United States	Trinity - Cray XC40, Xeon E5-2698v3 16C 2.3GHz, Aries interconnect Cray Inc.	301,056	8,100.9	11,078.9	
7	Swiss National Supercomputing Centre (CSCS) Switzerland	Piz Daint - Cray XC30, Xeon E5-2670 8C 2.600GHz, Aries interconnect , NVIDIA K20x Cray Inc.	115,984	6,271.0	7,788.9	2,325
8	HLRS - Höchstleistungsrechenzentrum Stuttgart Germany	Hazel Hen - Cray XC40, Xeon E5-2680v3 12C 2.5GHz, Aries interconnect Cray Inc.	185,088	5,640.2	7,403.5	
9	King Abdullah University of Science and Technology Saudi Arabia	Shaheen II - Cray XC40, Xeon E5-2698v3 16C 2.3GHz, Aries interconnect Cray Inc.	196,608	5,537.0	7,235.2	2,834
10	Texas Advanced Computing Center/Univ. of Texas United States	Stampede - PowerEdge C8220, Xeon E5-2680 8C 2.700GHz, Infiniband FDR, Intel Xeon Phi SE10P Dell	462,462	5,168.1	8,520.1	4,510

top500.org as of Jan 2016

Software

Unix OS



Apps:
Python,
Matlab

compiler converts higher
level codes to lower-level
(kernel level programs)

<http://unixlinuxtesting.h2kinfosys.com>

- Directory structure
- Shell?
- Important commands you should know: ls, cd, pwd, cp, mv, etc. Go through the commands given in the tutorial. Eg., <http://www.ee.surrey.ac.uk/Teaching/Unix/unixintro.html>
- Learn an editor (say gedit).

Other OS

Windows
OS X

Mobile OS
iOS
Android

Programming Languages

C, C++, Fortran, Java: Compiler

Python, matlab, maple: Interpreter language

Interpreter languages slower than compiler
languages...

But faster to code

INSTALLING PYTHON

Install Anaconda

Python 3

Much easier to use

```
$ipython - -pylab
```

Video corrections

- 07:30 — 13mm x 13mm
- 31:57 — The list is of Nov 2015. See the website top500.org for the new list.
- In the present course, we will use Python 2/7