System Programming
(ELEC462)

Class Introduction

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KNU

Contents

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Class Introduction

- Course name
  - System programming (ELEC0462)
- Prerequisites (Recommended)
  - Introduction to programming (COMP0204)
  - Data structure (COME0331)
- Lectures
  - Thursday 9am - 1pm (ELEC0462-003)
  - Tuesday 9am - 1pm (ELEC0462-004)
  - Office hour: Thursday 1pm - 2pm
    - Please request an appointment via email

Class Introduction (cont.)

- Instructor
  - Dukyun Nam (남덕윤)
  - Office: #402 IT-4
  - email : dynam at knu.ac.kr
- Teaching assistant (TA) & Tutors
  - 양희성 (leibniz21c at gmail.com)
  - **[ELEC0462003]** 김지은 (kjeun990806 at gmail) , 김동근 (yuy0815 at icloud)
  - **[ELEC0462004]** 백승찬 (bsc980504 at gmail) , 강경철 (cosmos041389 at gmail)

Class Introduction (cont.)

- Textbook
  - [UULP] B. Molay, *Understanding UNIX/LINUX Programming: A Guide to Theory and Practice*, Pearson, 2002
  - (Optional) [CS:APP] R.E. Bryant and D.R. O'Hallaron, *Computer Systems: A Programmer's Perspective*, Third Edition, Pearson, 2016
  - (Optional) [APUE] W.R. Stevens and S.A. Rago, *Advanced programming in the UNIX environment*, Third Edition, Addison-Wesley Progressional, 2013
    - https://learning.oreilly.com/library/view/advanced-programming-in/9780321638014/
- Grading policy
  - Midterm exam 25%, Final exam 35%, Assignment 40%
  - Lateness penalties: 20% per day

Course Schedule (Tentative)

- 1st half
  - 1 - Class introduction
  - 2 - Users, files, and the manual
  - 3 - Directories and file properties
  - 4 - Focus on file systems
  - 5 - Connection control
  - 6 - Programming for Humans
  - 7 - Event-driven programming
  - 8 - Midterm exam
- 2nd half
  - 9 - Processes and program
  - 10 - A programmable shell
  - 11 - I/O redirection and pipes
  - 12 - Connecting to processes near and far
  - 13 - Socket programs
  - 14 - Threads
  - 15 - Final exam

Simple Survey

- How many students are familiar with …
  - Operating system - Linux, Windows, …
  - Language - C, C++, Java, Python, Ruby, Scala, …
  - Editor - vim, sublime text, …
  - IDE - Visual studio code, IntelliJ, PyCharm, Eclipse, …
  - Version-control SW - git, svn, cvs, …
  - Container - Docker, Singularity, …
  - Cloud - AWS, Google cloud, MS Azure, IBM cloud, …

Course Perspective

- Most Systems Courses are Builder-Centric
  - Computer Architecture
    - Design pipelined processor in Verilog
  - Operating Systems
    - Implement sample portions of operating system
  - Compilers
    - Write compiler for simple language
  - Networking
    - Implement and simulate network protocols

*** These slides are modified from slides at http://csapp.cs.cmu.edu/3e/instructors.html**

Course Perspective (cont.)

- This Course is Programmer-Centric
  - By knowing more about the underlying system, one can be more effective as a programmer
  - Enable you to
    - Write programs that are more reliable and efficient
    - Incorporate features that require hooks into OS
      - e.g., concurrency, signal handlers

Why Linux?

- Linux is good for education and research
  - Linux is open-source and well-specified
- Linux is good for programming
  - Linux is a variant of Unix
  - Unix has GNU, a rich open-source programming environment

Exascale Era

AT LONG LAST, HPC OFFICIALLY BREAKS THE EXASCALE BARRIER

May 30, 2022 Timothy Prickett Morgan

ORNL's Frontier First to Break the Exaflop Ceiling

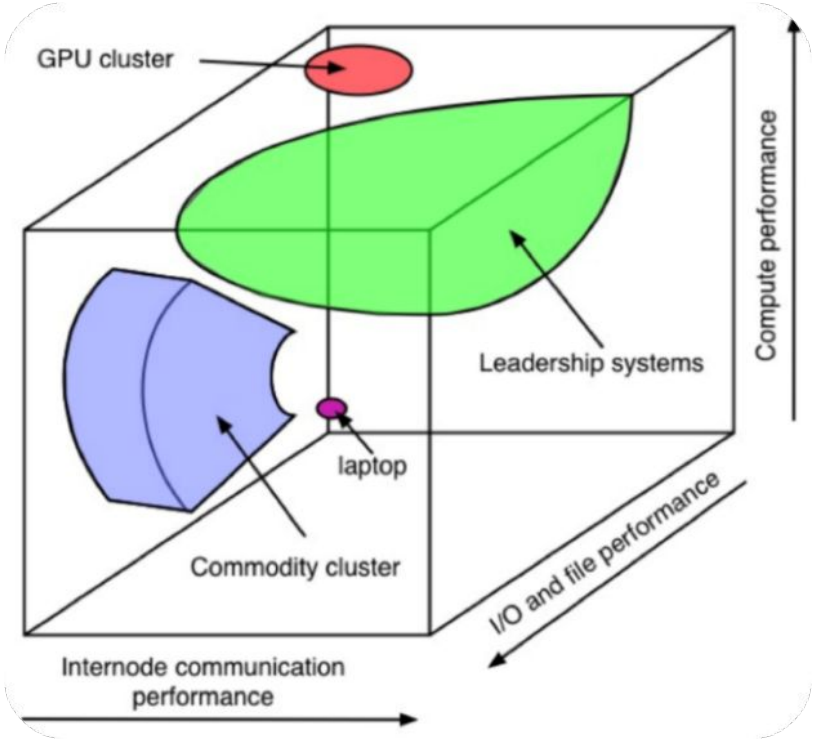
May 30, 2022

The 59th edition of the TOP500 revealed the Frontier system to be the first true exascale machine with an HPL score of 1.102 Exaflop/s.

The No. 1 spot is now held by the Frontier system at Oak Ridge National Laboratory (ORNL) in the US. Based on the latest HPE Cray EX235a architecture and equipped with AMD EPYC 64C 2GHz processors, the system has 8,730,112 total cores, a power efficiency rating of 52.23 gigaflops/watt, and relies on gigabit ethernet for data transfer.

High Performance Computing

- Supercomputer (from wikipedia)
  - “a computer with a high level of performance as compared to a general-purpose computer”
- Simplified view of HPC
  - 3 axes of compute, I/O, and communication performance



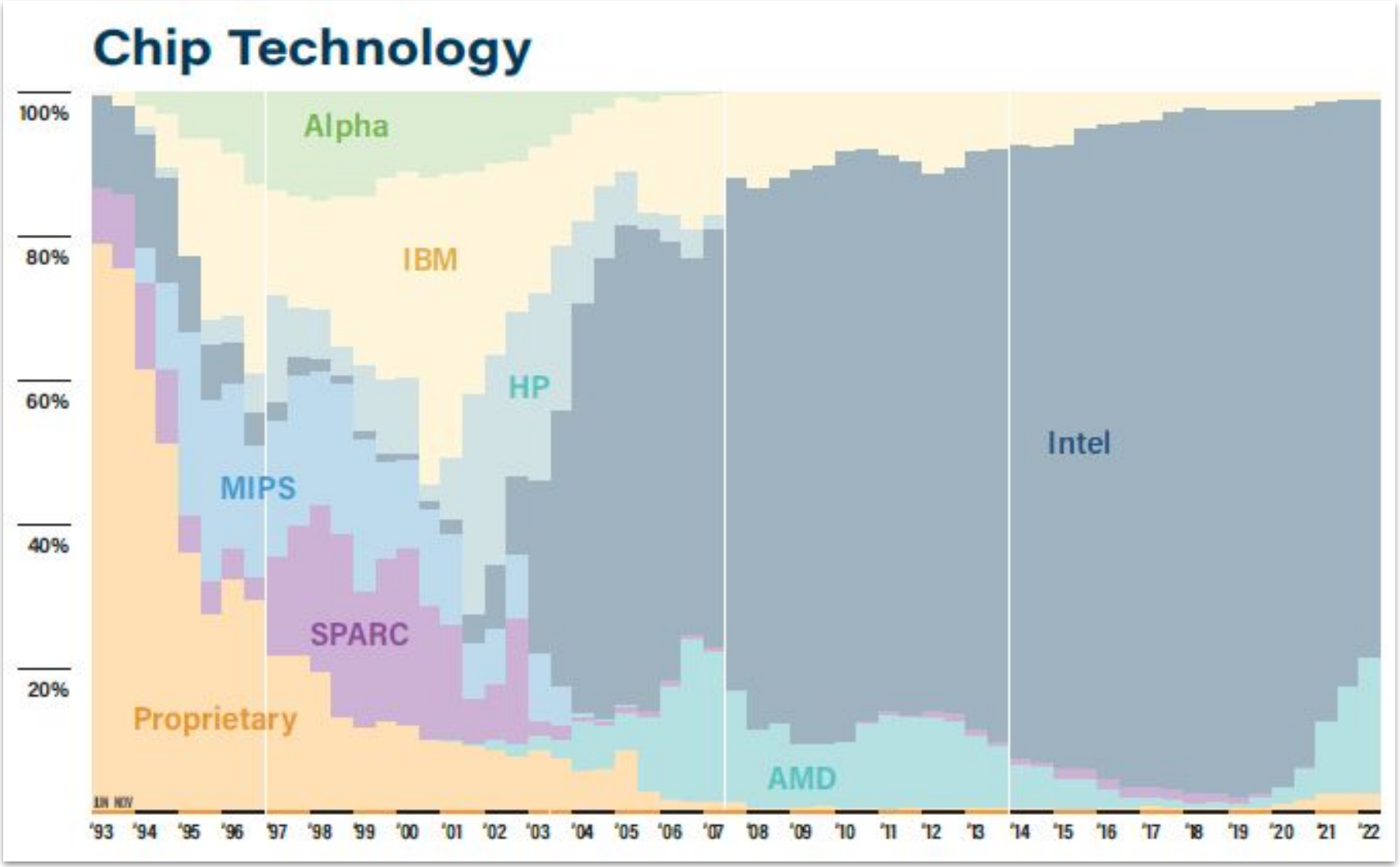
*** Future Directions for NSF Advanced Computing Infrastructure to Support U.S. Science and Engineering in 2017-2020, National Academies Press, 2016.**

Top 500

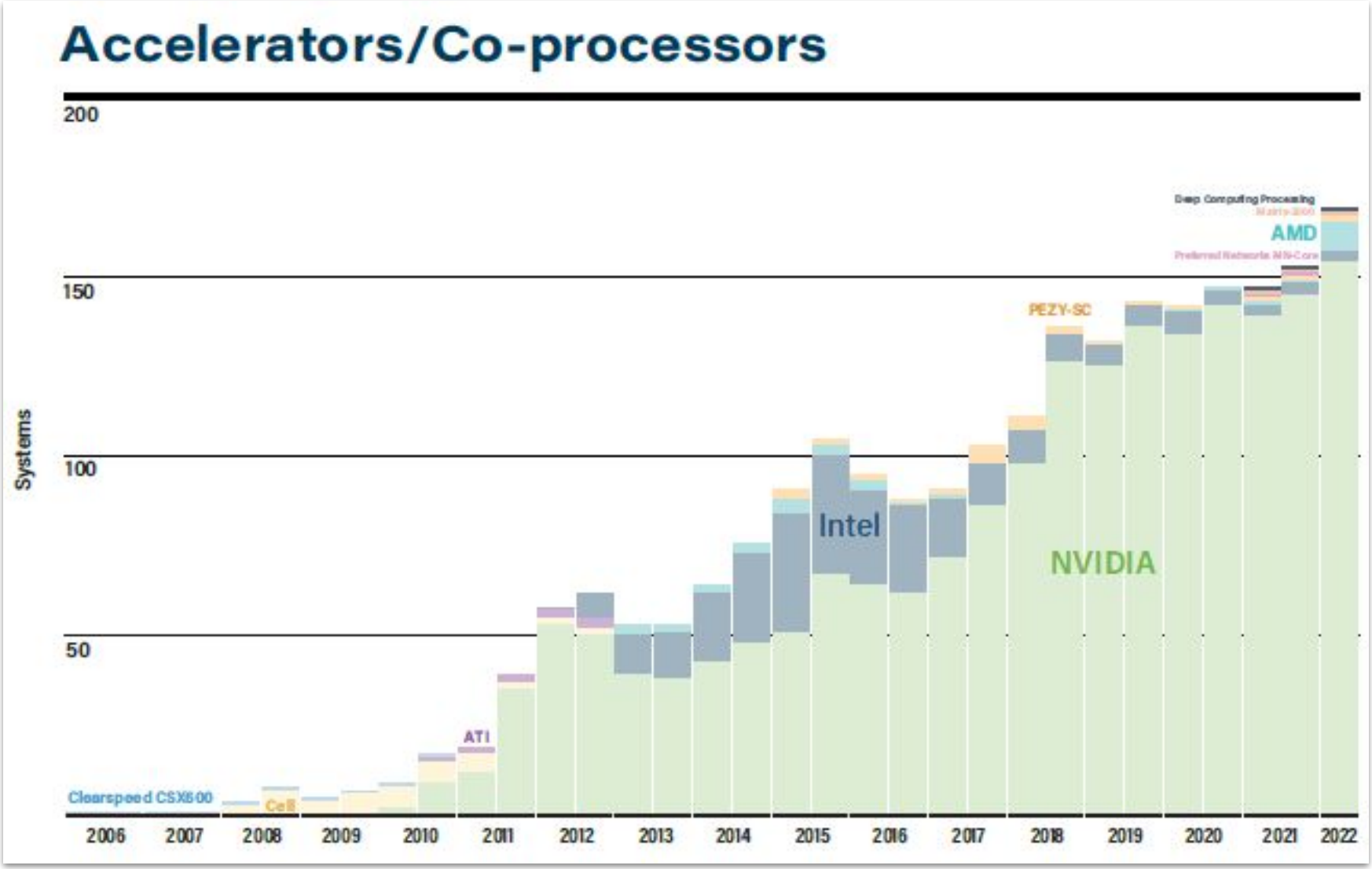
- First exascale machine (May 30, 2022)
  - Frontier, ORNL in Tennessee, USA

JUNE 2022	SYSTEM	SPECS	SITE	COUNTRY	CORES	RMAX PFLOP/S	POWER MW
1	Frontier	HPE Cray EX235a, AMD Opt 3rd Gen EPYC 64C 2GHz, AMD Instinct MI250X, Slingshot-10	DOE/SC/ORNL	USA	8,730,112	1,102.0	21.3
2	Fugaku	Fujitsu A64FX (48C, 2.2GHz), Tofu Interconnect D	RIKEN R-CCS	Japan	7,630,848	442.0	29.9
3	LUMI	HPE Cray EX235a, AMD Opt 3rd Gen EPYC 64C 2GHz, AMD Instinct MI250X, Slingshot-10	EuroHPC/CSC	Finland	1,268,736	151.9	2.94
4	Summit	IBM POWER9 (22C, 3.07GHz), NVIDIA Volta GV100 (80C), Dual-Rail Mellanox EDR Infiniband	DOE/SC/ORNL	USA	2,414,592	148.6	10.1
5	Sierra	IBM POWER9 (22C, 3.1GHz), NVIDIA Tesla V100 (80C), Dual-Rail Mellanox EDR Infiniband	DOE/NNSA/LLNL	USA	1,572,480	94.6	7.44

Top 500 (cont.)


Chip Technology
100%
80%
60%
40%
20%
Alpha
IBM
HP
MIPS
SPARC
Proprietary
AMD
Intel
'93 '94 '95 '96 '97 '98 '99 '00 '01 '02 '03 '04 '05 '06 '07 '08 '09 '10 '11 '12 '13 '14 '15 '16 '17 '18 '19 '20 '21 '22

Top 500 (cont.)


Accelerators/Co-processors
Systems
200
150
100
50
Deep Computing Processing
AMD
PEZY-SC
Intel
NVIDIA
ATI
Clearspeed CSX600
Cell
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

Top 500 (cont.)

- Operating System Share (June 2022)
  - https://www.top500.org/statistics/list/