

cse5441 - parallel computing

introduction

high performance computing

Wikipedia: "High-performance computing" redirects here (supercomputer)
A supercomputer is a computer with a very high-level computational capacity.

Intel: "... time to results, handle today's unprecedented growth in data volumes, and improve the accuracy and precision of data modeling and simulation applications."

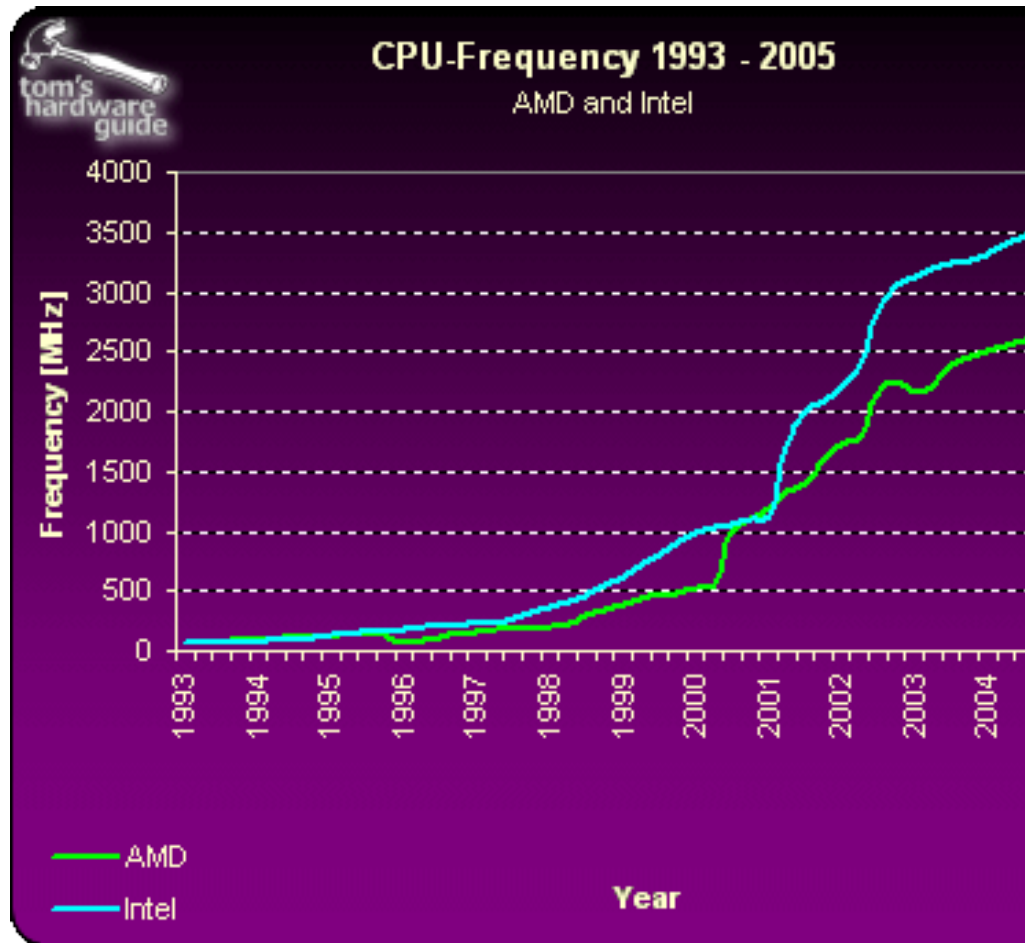
Dell: "... drive faster processing for the most demanding applications, including computational chemistry, weather forecasting, financial analytics and engineering design."

insidehpc.com: "High Performance Computing most generally refers to the practice of aggregating computing power in a way that delivers much higher performance than one could get out of a typical desktop computer or workstation in order to solve large problems in science, engineering, or business."



why parallel computing?

http://img.tomshardware.com/us/2005/11/21/the_mother_of_all_cpu_charts_2005/cpu_frequency.gif

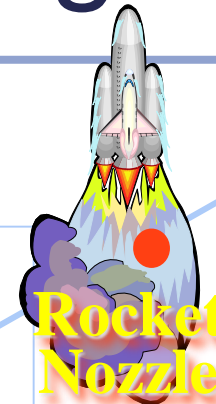


toward
a
brighter
tomorrow

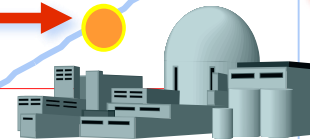
why parallel computing?



Sun's
Surface

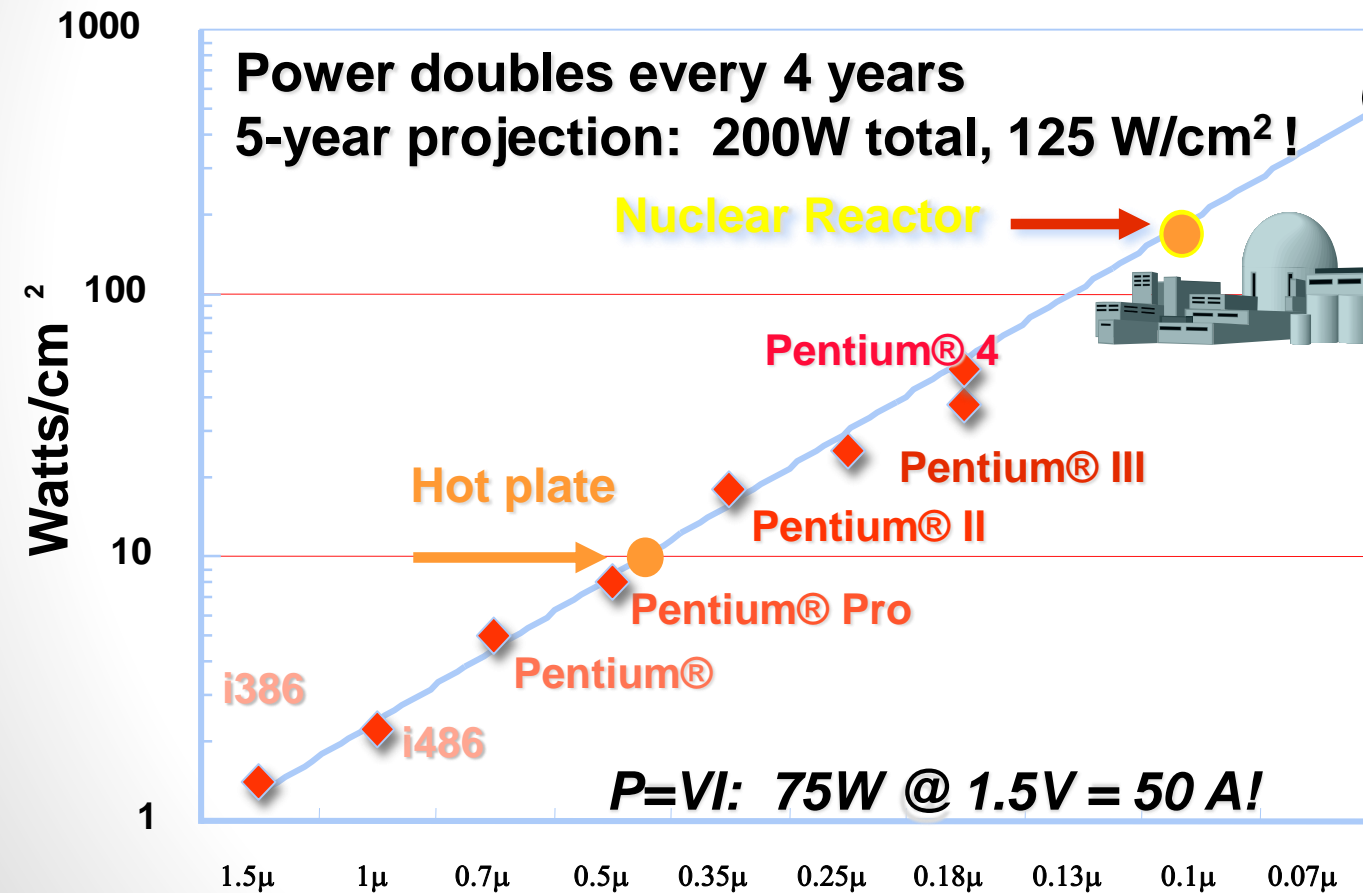


Rocket
Nozzle



Nuclear Reactor

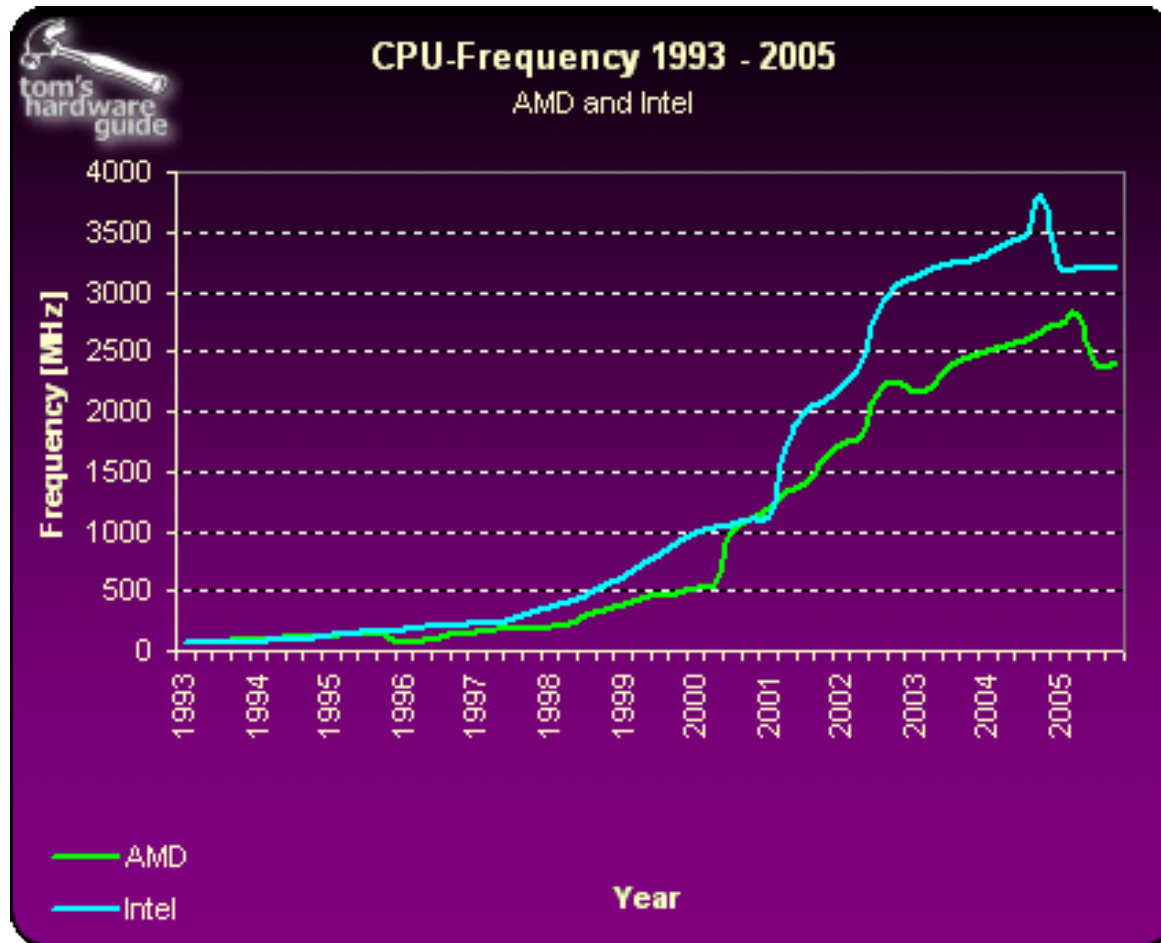
Power doubles every 4 years
5-year projection: 200W total, 125 W/cm² !



why parallel computing?

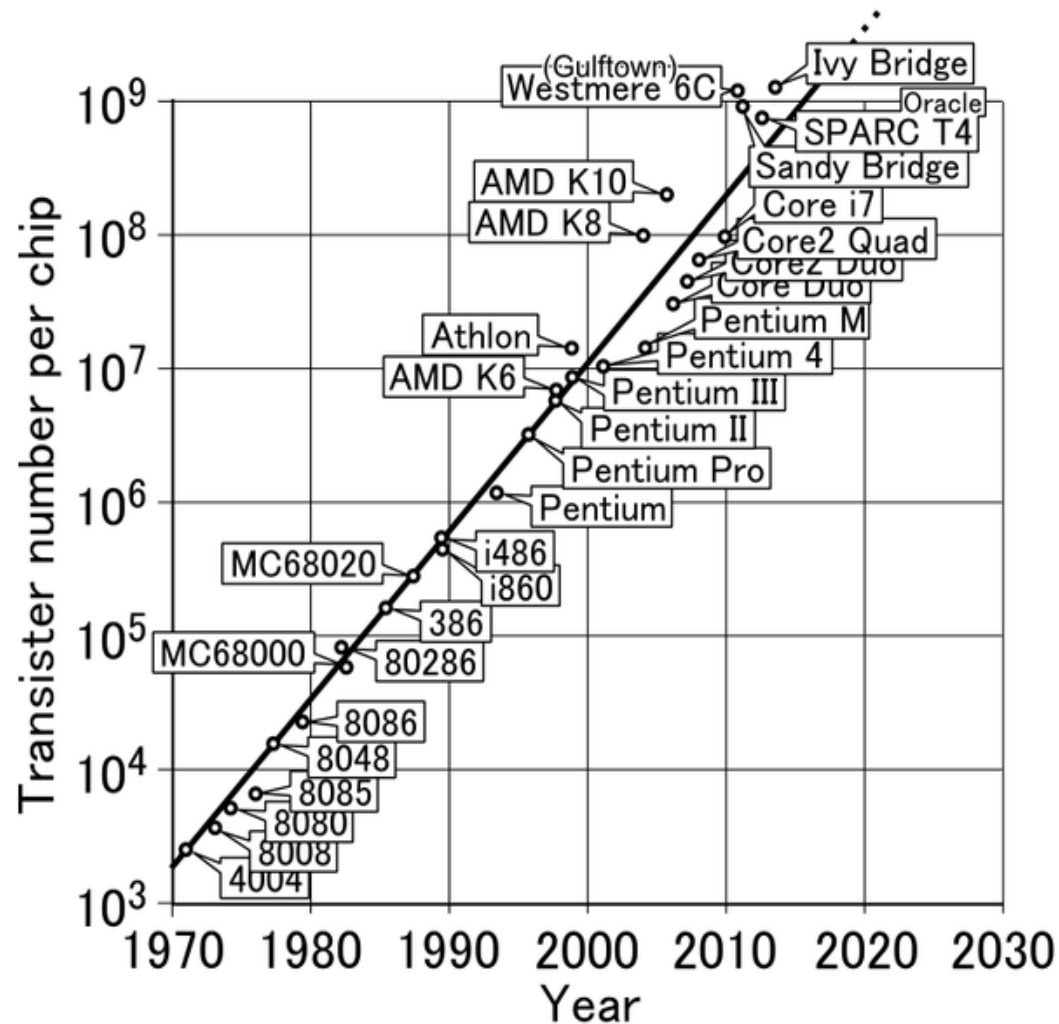
http://img.tomshardware.com/us/2005/11/21/the_mother_of_all_cpu_charts_2005/cpu_frequency.gif

http://az616578.vo.msecnd.net/files/2016/04/30/635976404052129760-1367981549_Rainy-day-savings.jpg



2004 – Intel cancels Tejas and Jayhawk due to "heat problems due to the extreme power consumption of the core ..."

Moore's law

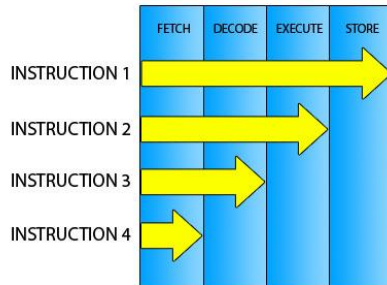


parallel everywhere

MACHINE CYCLE (without pipeline):

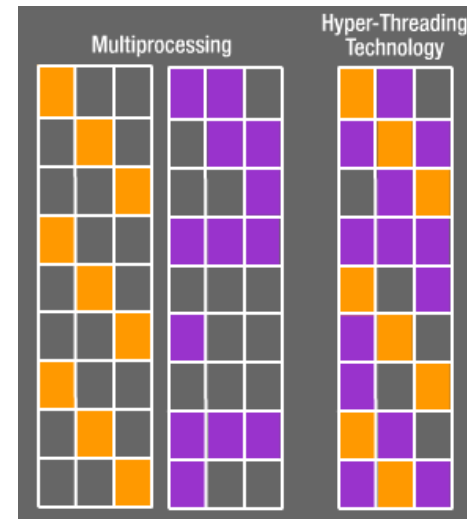


MACHINE CYCLE (with pipeline):

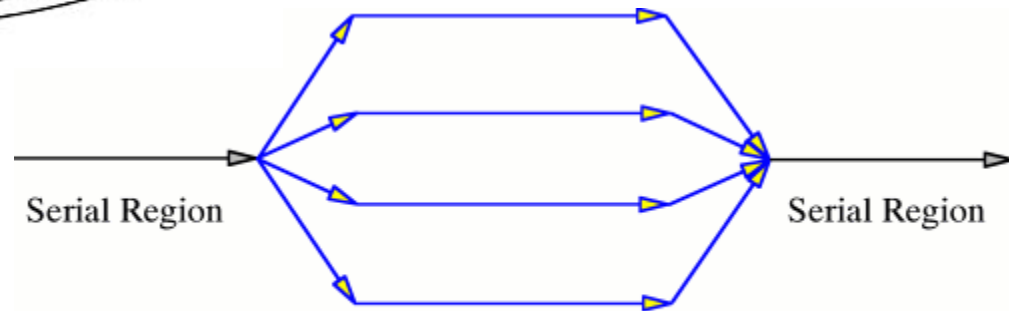
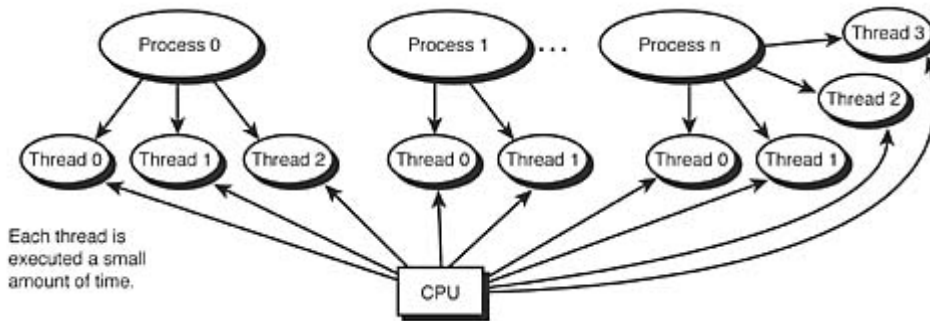


pipelining

hyper-threading



cse5441 - software focused



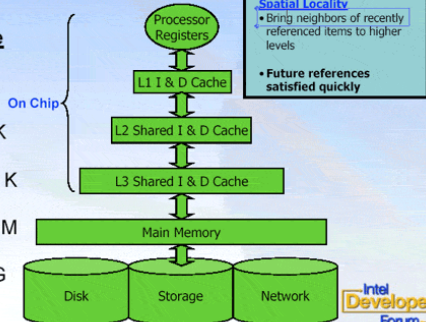
Parallel for Region
with 4 Threads

Review of Cache Architecture

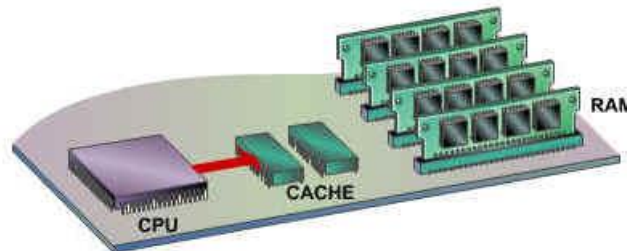
Memory Hierarchy

~Latency ~Size

1's nS	10's K
10's nS	100's K
10's nS	1000's K
100's nS	1000's M
1's mS	100's G



- Temporal Locality**
 - Keep recently referenced items at higher levels
- Spatial Locality**
 - Bring neighbors of recently referenced items to higher levels
- Future references satisfied quickly



<http://www.alf.sd83.bc.ca/courses/it11/images/proces9.jpg>
<http://www.yaldex.com/games-programming/FILES/02fig02.gif>
<http://www.senukex.co/wp-content/uploads/Multi-Threading.jpg>
http://www.nordichardware.com/skrivelser_img/372/intelgrafik.gif
<http://www.windowsnetworking.com/img/upl/image0021225707175745.gif>

cse5441 - course outline

- introduction
- single-core methods
 - cache management
 - loop analysis and transformation
 - data dependence analysis
- parallel programming methods
 - Posix threads
 - OpenMP
 - CUDA
 - Message Passing Interface (MPI)
- vectorizing compilers

cse5441 - syllabus

- organizational information
- course materials
 - text / additional readings
 - lecture presentations
 - electronic media
 - programming sessions
- course objectives
 - high-performance architectures
 - programming for high performance
 - multi-processing architectures
 - multi-processing APIs
- grading policies
- important dates
- course expectations and policies

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