

OZVĚNY SC18

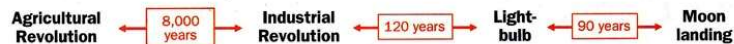
19. PROSINEC 2018

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RAYE KURZWEIL: CESTA K SINGULARITĚ

1 The accelerating pace of change ...

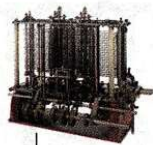


2 ... and exponential growth in computing power ...

Computer technology, shown here climbing dramatically by powers of 10, is now progressing more each hour than it did in its entire first 90 years

COMPUTER RANKINGS

By calculations per second per \$1,000



Analytical engine
Never fully built, Charles Babbage's invention was designed to solve computational and logical problems



Colossus
The electronic computer, with 1,500 vacuum tubes, helped the British crack German codes during WW II



UNIVAC I
The first commercially marketed computer, used to tabulate the U.S. Census, occupied 943 cu. ft.

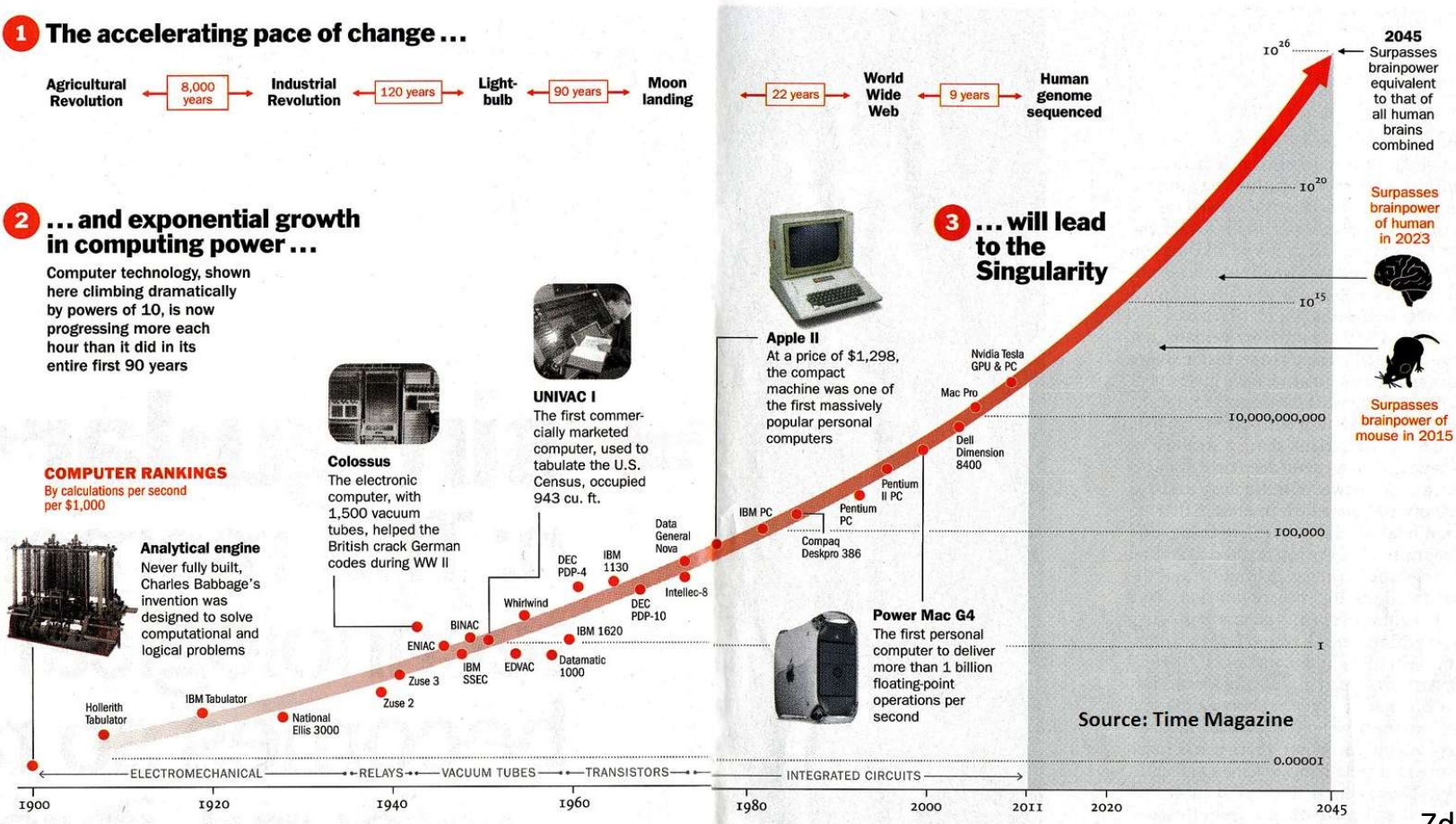


Apple II
At a price of \$1,298, the compact machine was one of the first massively popular personal computers



Power Mac G4
The first personal computer to deliver more than 1 billion floating-point operations per second

3 ... will lead to the Singularity

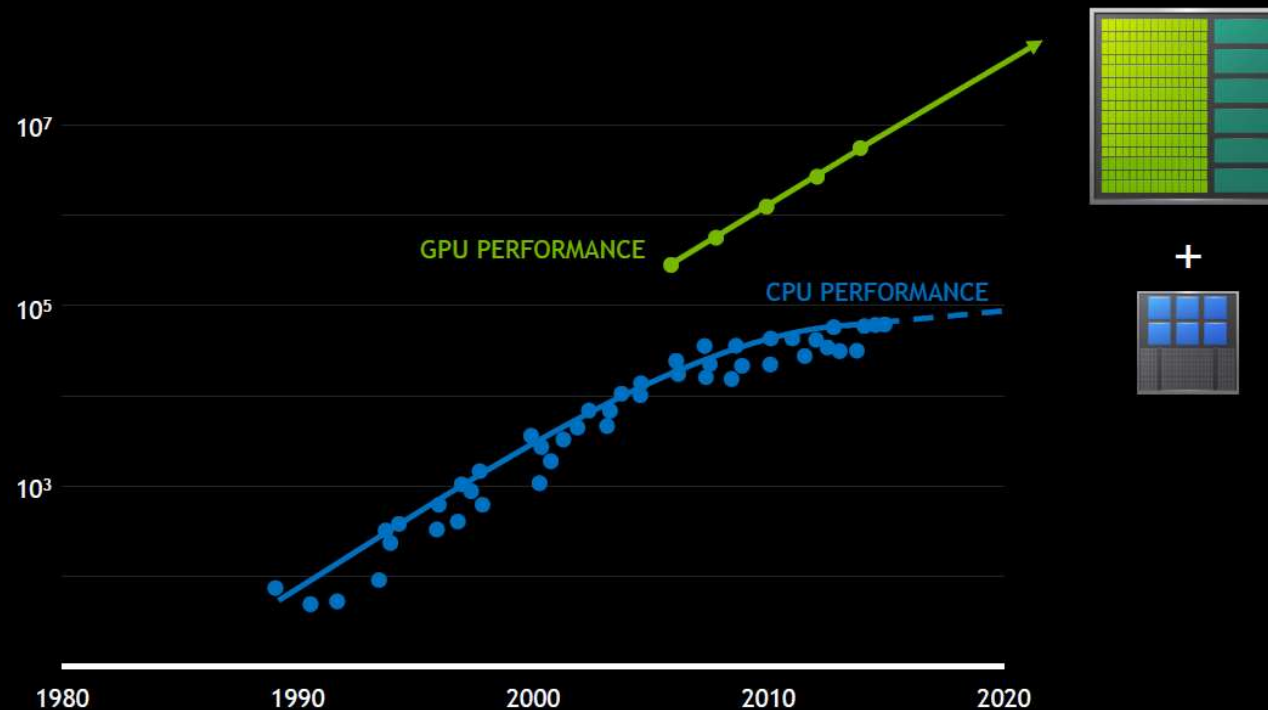


Zdroj: Time Magazine

<https://www.medicaldesignandoutsourcing.com/futurist-ray-kurzweil-predicts-printed-organs-nanorobots-connecting-brains-computers-cloud/>

CPU VS. GPU PERFORMANCE

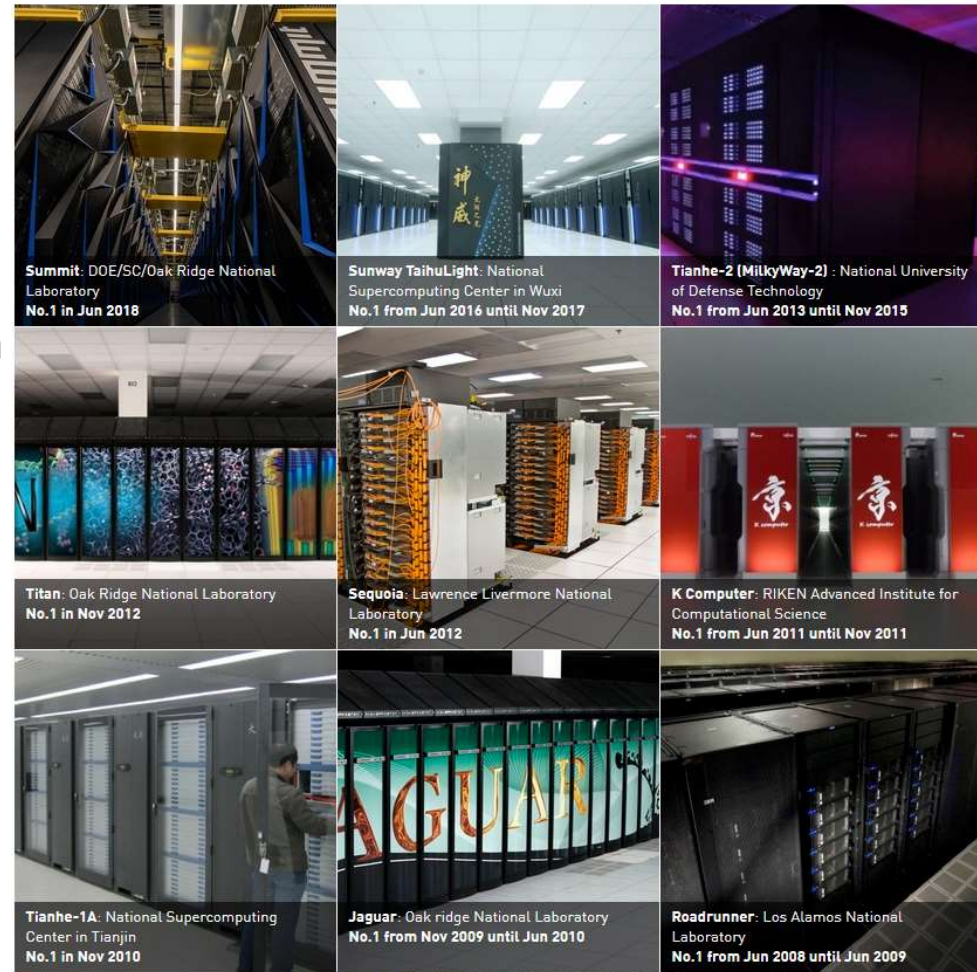
ACCELERATED COMPUTING 1000X EVERY 10 YEARS



Zdroj: NVIDIA

TOP500

- 1979 – první seznam serverů podle Linpacku
- 1993 – první seznam TOP500
- 1997 – ASCI Red – první teraflops system
- 2008 – IBM Roadrunner – první petaflops systém
- 2010 – Tianhe-1A – Čína obsadila #1
- 2013–2016 – Tianhe-2 – Čína pokračuje...
- 2016 – 2017 – Sunway, Čína
- 2018 – IBM Summit, USA: 122->143 petaflops



Zdroj: <https://www.top500.org/>

TOP500 – LISTOPAD 2018



Zpomalení, stárnutí, koncentrace
DOE/USA má 5 systémů v TOP10
Intel má podíl přes 95%
138 systémů je akcelerovaných (99% je NVIDIA)

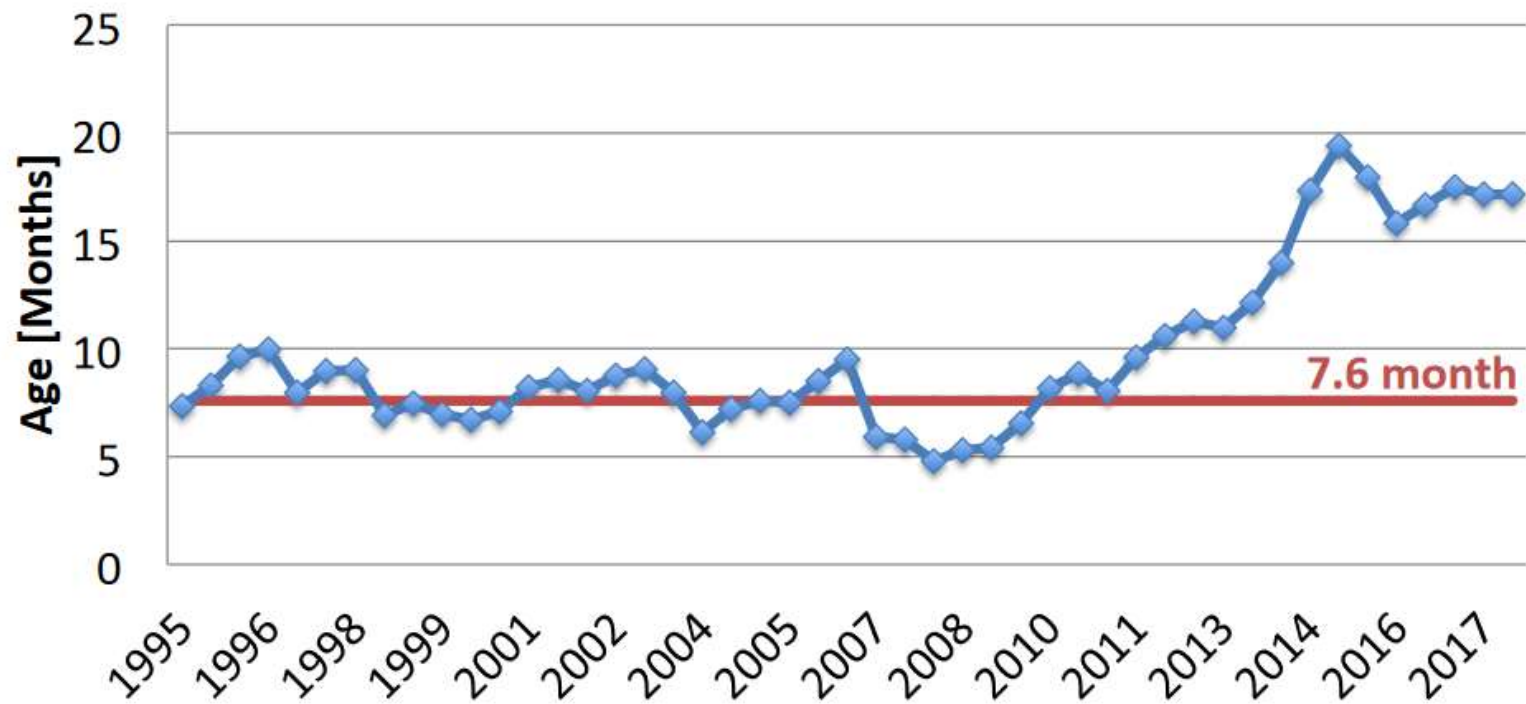
Čína má na počet 45% systémů vs. USA 22%
ale celkový výkon: Čína 31% vs. USA 38%
Výrobci podle počtu systémů:
Lenovo (23->28%), Inspur (13%->17%),
Sugon (11%), Cray (10%), HPE (9%)

Rank	Site	System	Cores	Rmax (TFlop/s)	Rpeak (TFlop/s)	Power (kW)
1	DOE/SC/Oak Ridge National Laboratory United States	Summit - IBM Power System AC922, IBM POWER9 22C 3.07GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband IBM	2,397,824	143,500.0	200,794.9	9,783
			122 Pflops -> 143 Pflops			
2	DOE/NNSA/LLNL United States	Sierra - IBM Power System S922LC, IBM POWER9 22C 3.1GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband IBM / NVIDIA / Mellanox	1,572,480	94,640.0	125,712.0	7,438
			71.6 Pflops -> 94.6 Pflops			
3	National Supercomputing Center in Wuxi China	Sunway TaihuLight - Sunway MPP, Sunway SW26010 260C 1.45GHz, Sunway NRCP	10,649,600	93,014.6	125,435.9	15,371
			#1 v letech 2016--2017			
4	National Super Computer Center in Guangzhou China	Tianhe-2A - TH-IVB-FEP Cluster, Intel Xeon E5-2692v2 12C 2.2GHz, TH Express-2, Matrix-2000 NUDT	4,981,760	61,444.5	100,678.7	18,482
			Intel Xeon Phi -> Matrix-2000			
5	Swiss National Supercomputing Centre (CSCS) Switzerland	Piz Daint - Cray XC50, Xeon E5-2690v3 12C 2.6GHz, Aries interconnect, NVIDIA Tesla P100 Cray Inc.	387,872	21,230.0	27,154.3	2,384
			#1 v Evropě			

6	DOE/NNSA/LANL/SNL United States	Trinity - Cray XC40, Xeon E5-2698v3 16C 2.3GHz, Intel Xeon Phi 7250 68C 1.4GHz, Aries interconnect Cray Inc.	979,072	20,158.7	41,461.2	7,578
7	National Institute of Advanced Industrial Science and Technology (AIST) Japan	AI Bridging Cloud Infrastructure (ABCI) - PRIMERGY CX2570 M4, Xeon Gold 6148 20C 2.4GHz, NVIDIA Tesla V100 SXM2, Infiniband EDR Fujitsu	391,680	19,880.0	32,576.6	1,649
8	Leibniz Rechenzentrum Germany	SuperMUC-NG - ThinkSystem SD530, Xeon Platinum 8174 24C 3.1GHz, Intel Omni-Path Lenovo	305,856	19,476.6	26,873.9	
			nový systém			
9	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
			od roku 2012			
10	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
			od roku 2011			

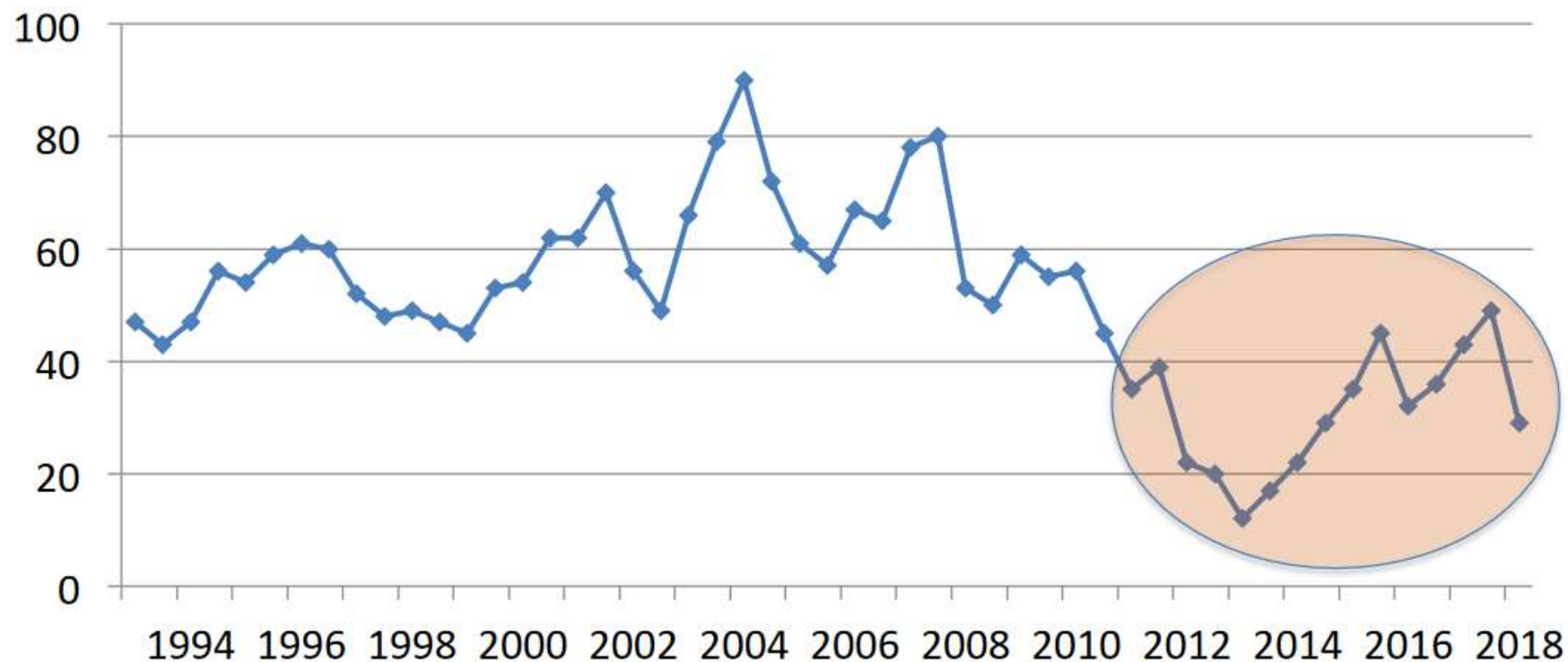
Zdroj: <https://www.top500.org/>

PRŮMĚRNÁ DOBA SYSTÉMU V TOP500



Zdroj: <https://www.top500.org/>

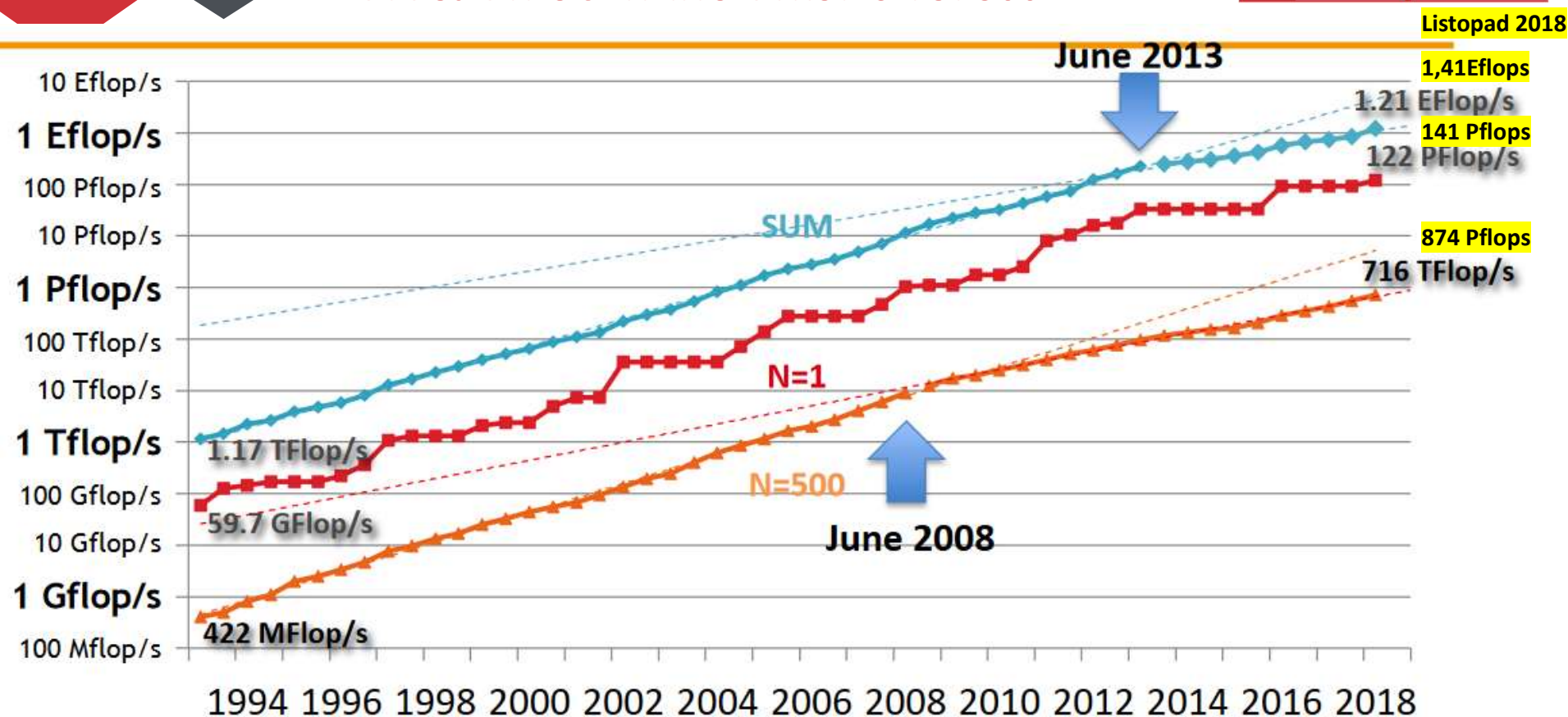
POŘADÍ V TOP500, KTERÉ ROZDĚLUJE ŽEBŘÍČEK NA
POLOVINY CELKOVÉHO VÝKONU



Zdroj: <https://www.top500.org/>

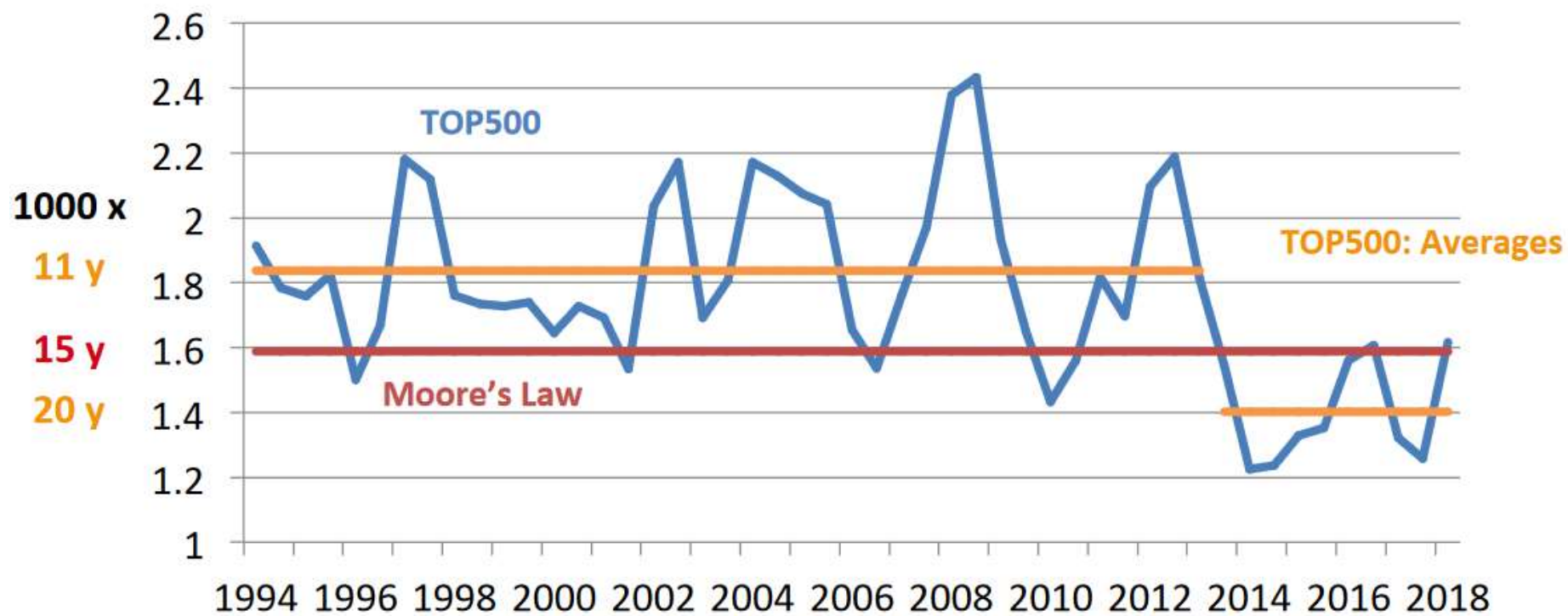
VÝVOJ VÝPOČETNÍHO VÝKONU TOP500

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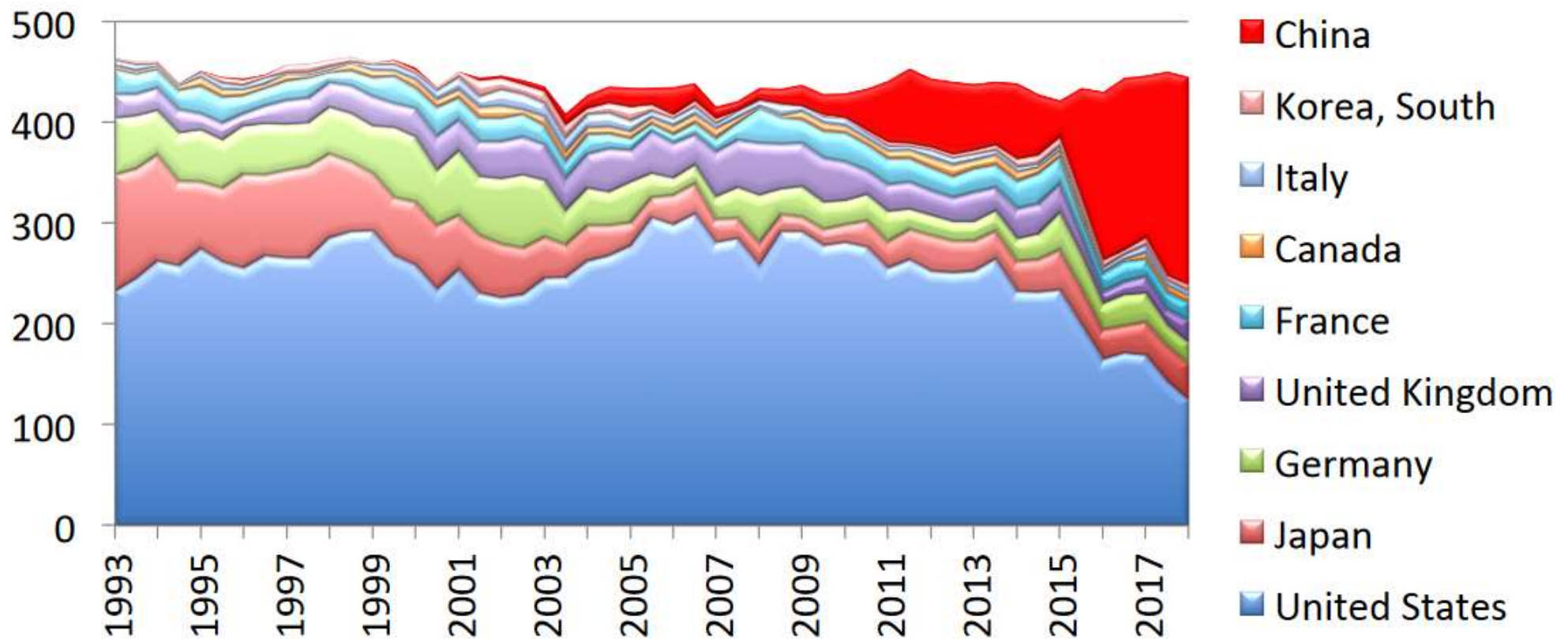
Zdroj: <https://www.top500.org/>

NÁRŮST VÝKONNOSTI SYSTÉMU V TOP500



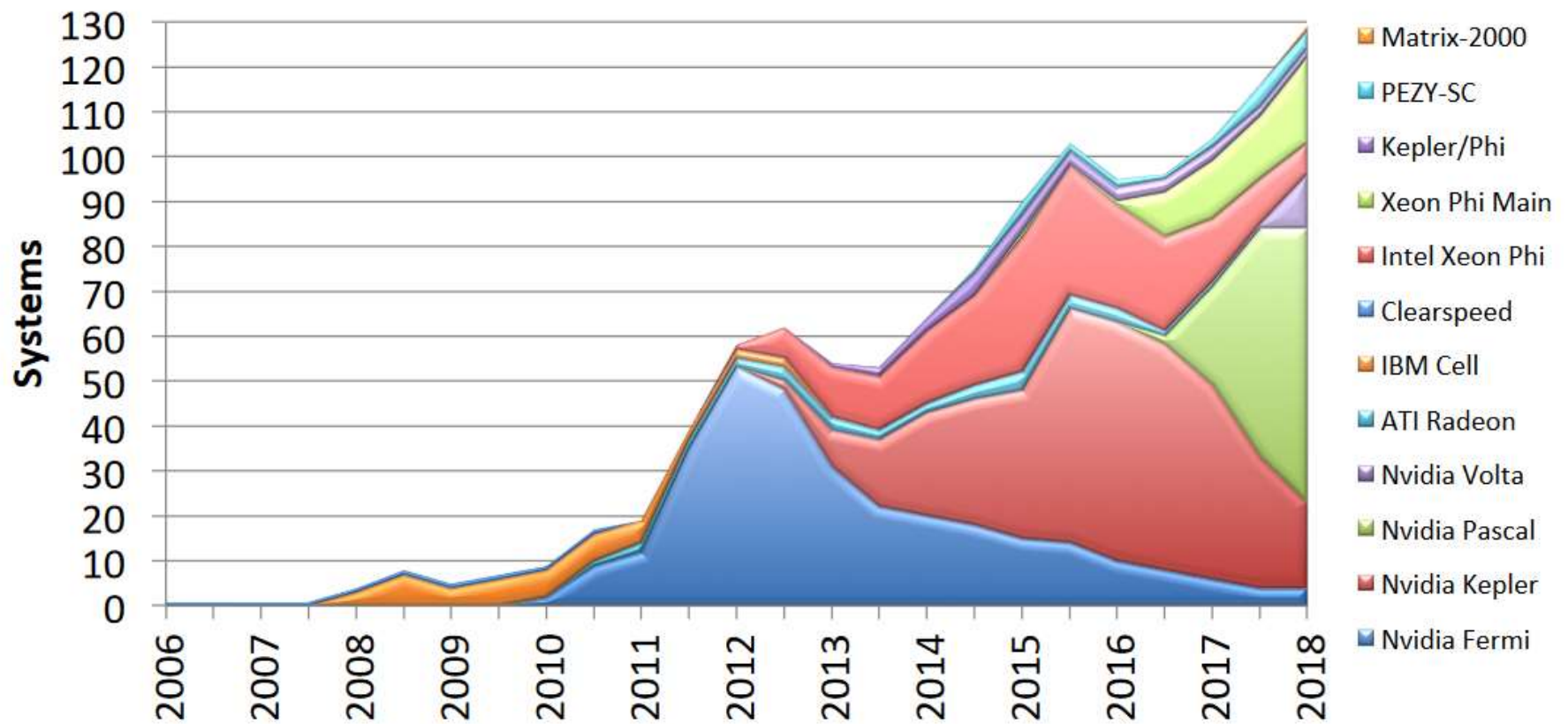
Zdroj: <https://www.top500.org/>

POČET SYSTÉMŮ V TOP500 PODLE ZEMÍ



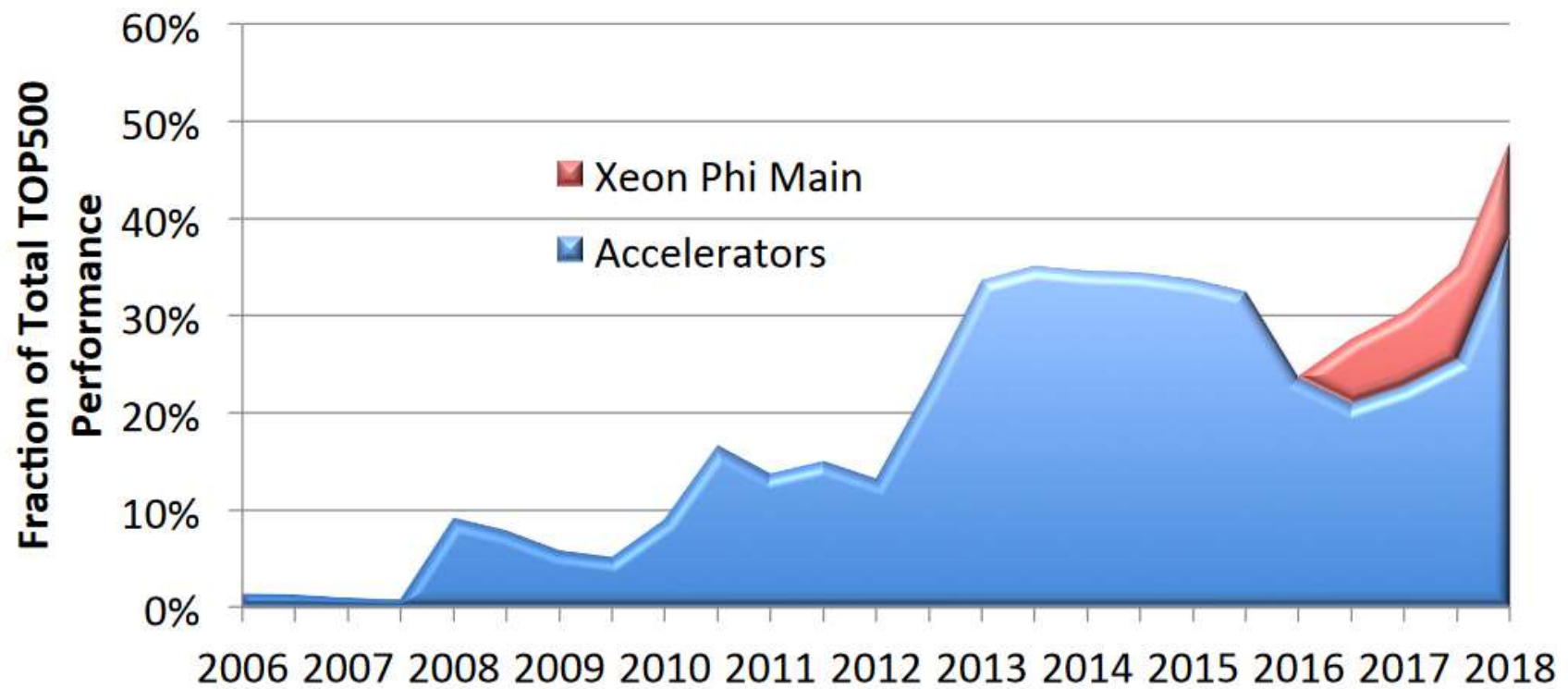
Zdroj: <https://www.top500.org/>

PODÍL AKCELERÁTORŮ V TOP500



Zdroj: <https://www.top500.org/>

PODÍL AKCELERÁTORŮ NA CELKOVÉM VÝKONU



Zdroj: <https://www.top500.org/>

Exaflops (10^{18})– 2022?

Zetaflops (10^{21}) – 2035?

SOFTWARE!!!

Procesory

- Intel, AMD, IBM POWER, ARM

GP GPU/ML akcelerátory

- NVIDIA, ..., AMD, Google, Huawei

FPGA:

- Xilinx, Altera

Speciální koprocesory

- NEC Aurora (vector), ...

3D technologie pro CPU?

Kvantové počítače?

- IBM, D-Wave, Google, Microsoft, ...

Dataflow počítače?

- Intel Configurable Spatial Accelerator

Neuromorfické čipy?

...

*„NAŠE ŘEŠENÍ
VÁS BUDOU BAVIT“*

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