

# Technology Changes

	Mid-1980's	2015	Change
<b>CPU speed</b>	<b>15 MHz</b>	<b>2.5 GHz</b>	<b>167x</b>
<b>Memory size</b>	<b>8 MB</b>	<b>16 GB</b>	<b>2000x</b>
<b>Disk capacity</b>	<b>30 MB</b>	<b>2 TB</b>	<b>66667x</b>
<b>Disk transfer rate</b>	<b>2 MB/s</b>	<b>200 MB/s</b>	<b>100x</b>
<b>Network speed</b>	<b>10 Mb/s</b>	<b>10 Gb/s</b>	<b>1000x</b>

# Does Paging Make Sense?

	1960's	2018	Change	Flash
Disk latency	80 ms	10 ms	8x	10 $\mu$ s
Disk transfer rate	250 KB/s	200 MB/s	800x	2 GB/s
Memory size	256 KB	64 GB	250,000x	64 GB
Time to replace all of memory (random)	6.4 s	44 hrs	<b>25000x</b>	160 s
Time to replace all of memory (sequential)	1 s	320 s	<b>320x</b>	32 s

Can't afford to page out unless idle for a long time

# Role of Disks

Disk access rate not keeping up with capacity:

	Mid-1980's	2018	Change
Disk capacity	30 MB	5 TB	166667x
Max. transfer rate	2 MB/s	200 MB/s	100x
Latency (seek & rotate)	20 ms	10 ms	2x
Capacity/bandwidth (large blocks)	15 s	25000 s	1667x
Capacity/bandwidth (1KB blocks)	600 s	579 days	83333x

- Disks must become more archival
- Frequently accessed information must be stored elsewhere (Flash? DRAM?)