Technology Changes

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

Does Paging Make Sense?

	1960's	2018	Change	Flash
Disk latency	80 ms	10 ms	8x	10 μs
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	25000x	160 s
Time to replace all of memory (sequential)	1 s	320 s	320x	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?)**