Συστήματα Υπολογιστών (Computer Systems)

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Computing infrastructure

- Typically PCs on desks
- No more! Instead:
  - Small – mobile
  - Large
    - Datacenters
Computing infrastructure

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Small devices (embedded)

- Access points
  - People, appliances, sensors
  - Machine2machine
- An interface between digital and physical world
- Need a lot of processing, memory, storage, communication
  - A simple mobile device much more powerful than the computers used by NASA to go to the moon
  - GBytes of memory, 10s Gbytes storage, Gbit speeds, many cores
  - Need more and more...
- But: Limited by energy / battery
- Goal: Performance at certain power
Devices generate a lot of data

- Most actions consume but also generate data
  - Every minute: 300H video
  - Machine2machine
- Data requires processing
  - Processing happens on servers
- How much information?
  - How much processing?

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Within these broad outlines of the digital universe are some singularities worth noting. First, while the portion of the digital universe holding potential analytic value is growing, only a tiny fraction of territory has been explored. IDC estimates that by 2020, as much as 33% of the digital universe will contain information that might be valuable if analyzed, compared with 25% today. This untapped value could be found in patterns in social media usage, correlations in scientific data from discrete studies, medical information intersected with sociological data, faces in security footage, and so on.

However, even with a generous estimate, the amount of information in the digital universe that is "tagged" accounts for only about 3% of the digital universe in 2012, and that which is analyzed is half a percent of the digital universe. Herein is the promise of "Big Data" technology—the extraction of value from the large untapped pools of data in the digital universe.

- Data grows at more than 2x/2 years
  - By 2020, 4x more data (today ~10 ZB, by 2020 ~40 ZB)
- Only 0.5% is analyzed today
  - Today, 23% of data is valuable
  - Need to process 50x more data
- In total, 200x more processing by 2020

Better servers (2x / 18months)

- Systems get better because of technology
  - E.g. faster clocks or more cores
- How much better?
  - Roughly 2x faster every ~18 months
  - Gordon Moore in the 70s
- Assuming this will continue
  - It will require a lot of research and engineering
- By 2020 systems will be ~4x faster
  - Still missing 50x improvement
Use more servers (2x / 2 years)

- Let’s buy more servers
  - “If we need more cars, let’s build them”

- Problem
  - 1. High cost – capital and operational
    - Not possible to increase by 50x datacenters
  - 2. We cannot feed them with electricity (power)
    - Typically today we place servers in data centers
    - A typical DC = electricity of a town (1000 people, 10 MW)
    - Limited by power and latency to users

- Let’s say we can have 2x new DCs by 2020
  - Still left with a factor of 25x or so
Challenge ahead (in Computer Systems)

- Achieve additional ~25x improvement in ~4 years
  - “More than Moore” era - exciting for computer systems
  - Impact on society: work, entertainment, social, science

Direction 1: Increase server utilization
- Systems today are not utilized as much they should
- E.g. one person/bus – need to run more apps per server

Direction 2: Embrace customization
- All vehicles the same – in fact, closer to planes
- Need to start customizing computers for different tasks
Systems Software

- Software that controls resources
- Central role in this transformation
Interest from Industry (chronological)

- Important problems in EU and the world
- The last few years a lot of interest from industry
- Local presence
  - OnApp
    - Virtualization, cloud management infrastructure
    - Development office in Heraklion
  - Neurocom
    - Telecom analytics
    - Development office in Heraklion/STEP-C
  - IOFabric
    - Datacenter storage
    - Startup company in North America
    - Development office in Heraklion/STEP-C
- Catalyst in all cases
  - Expertise of people in our environment

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Thank you!