

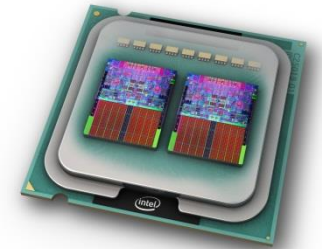


Storskaliga Distribuerade System och Nätverk (Large-scale Distributed Systems and Networks)

Slides by Niklas Carlsson

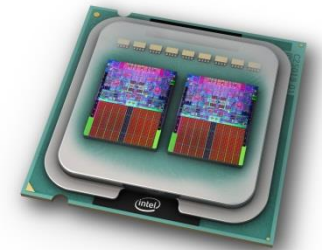
Systems thinking

- We want to understand the full system and the ecosystem it operates within; e.g.,
 - Understanding the full system
 - Looking at the parts and how they interact
- This course provide many examples ...



Components, overall system, service(s)

- Components together provide some service(s)
 - Typically want good overall performance
- Data storage and processing often distributed
 - Data/information stored and moving between components
 - Processing in different components
- How do we best design, utilize, and run systems?

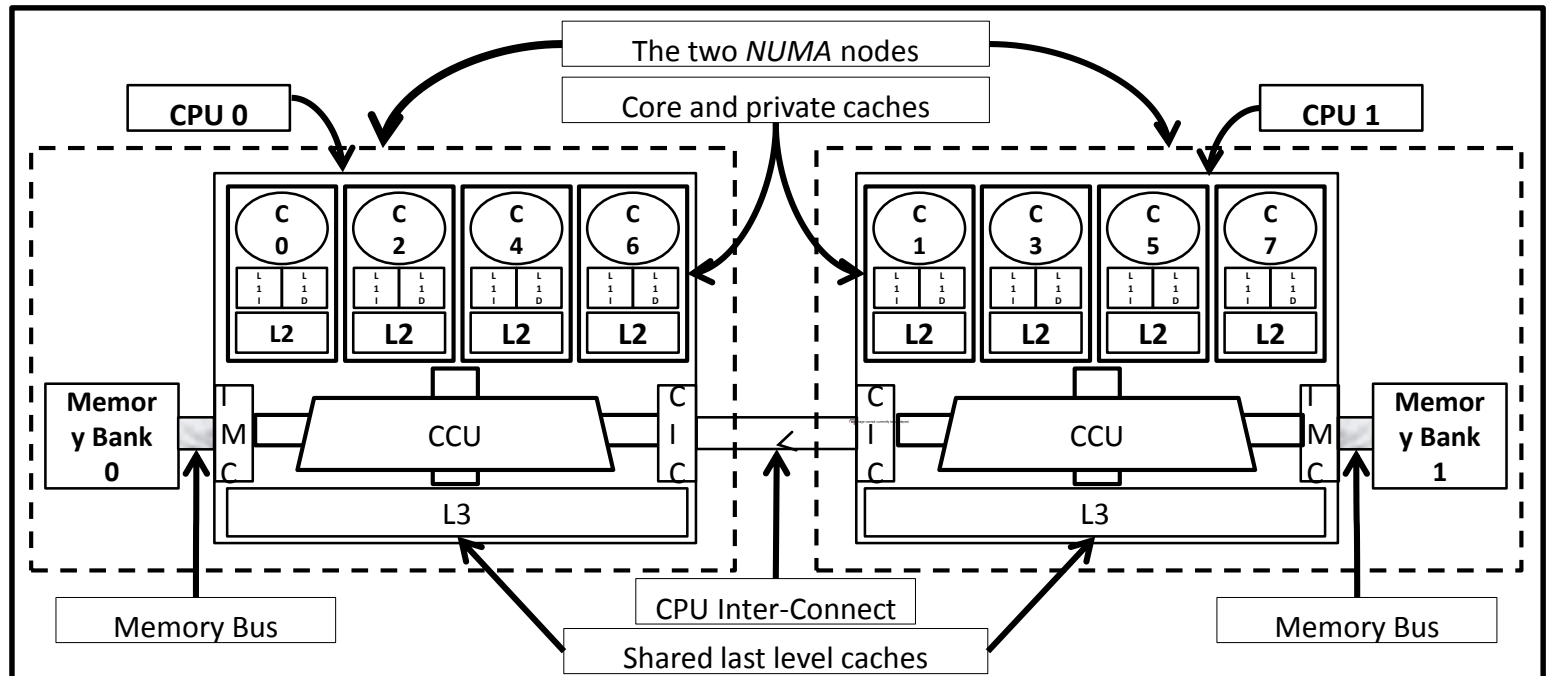
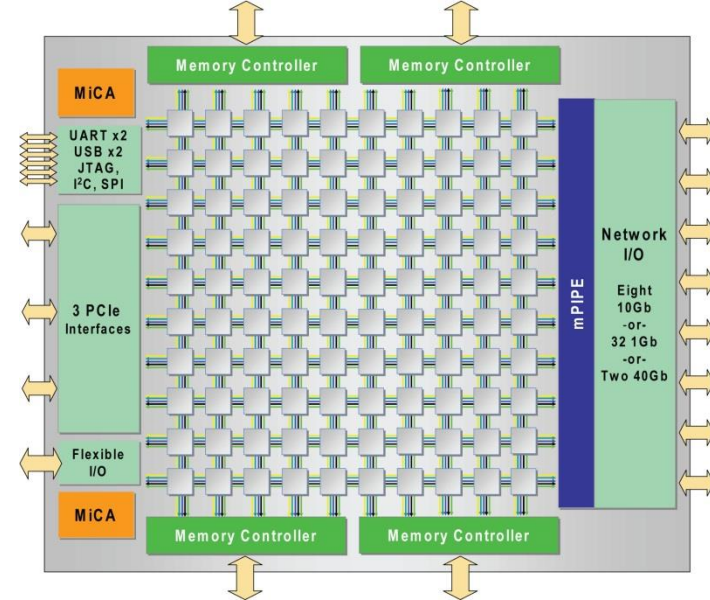


Embedded Systems

- We find microprocessors everywhere ...

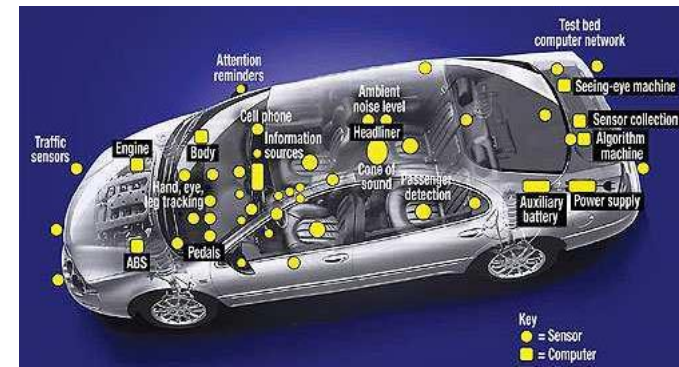
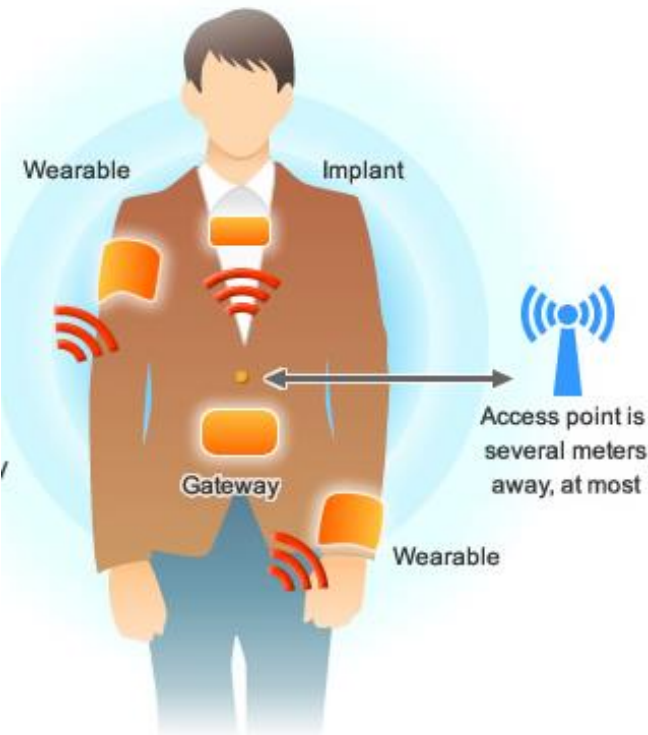


Multicore and Manycore Systems

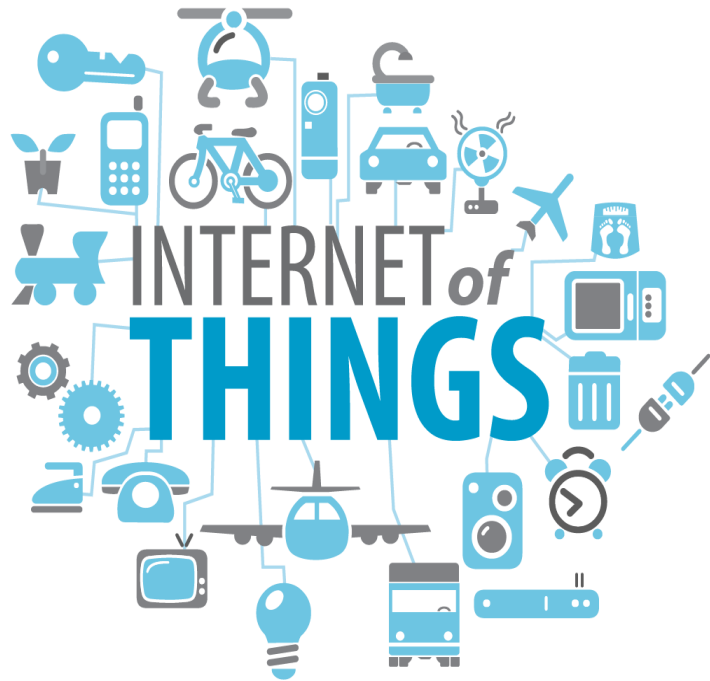


Distributed Systems

- Everything is connected ...

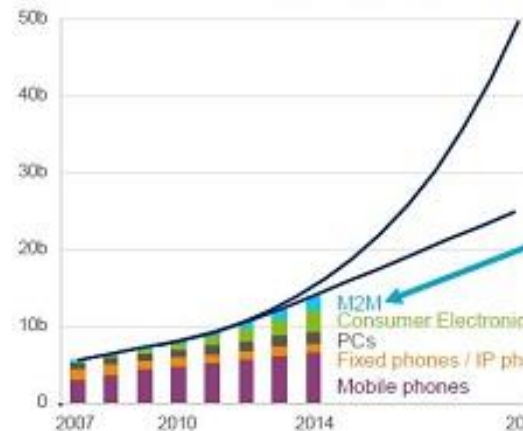


... looking towards the future ...



NEW DEVICES AND NEW INDUSTRIES BRING NEW BUSINESS OPPORTUNITIES

Connected Devices Worldwide



Addressing Industries

Traffic systems, Automotive
Transport and logistics
Utilities – smart grid
Security – connected buildings
Home appliances
Medical automation, Remote healthcare
ATM, Point of sale, Vending
Critical infrastructures
Monitoring and control

More devices per person

eBook readers, Music players, DVD players, Gaming devices, Cameras, Home appliances, In-vehicle entertainment etc.

New telecom cycle: 10x devices, 10x industries

The 2020 vision

- ❑ Everything that can be connected will be connected
 - 50B devices (perhaps more like 500B ...)
- ❑ IoT and smart cities
 - Machine-to-machine
- ❑ High-definition 3D streaming/games to heterogeneous clients



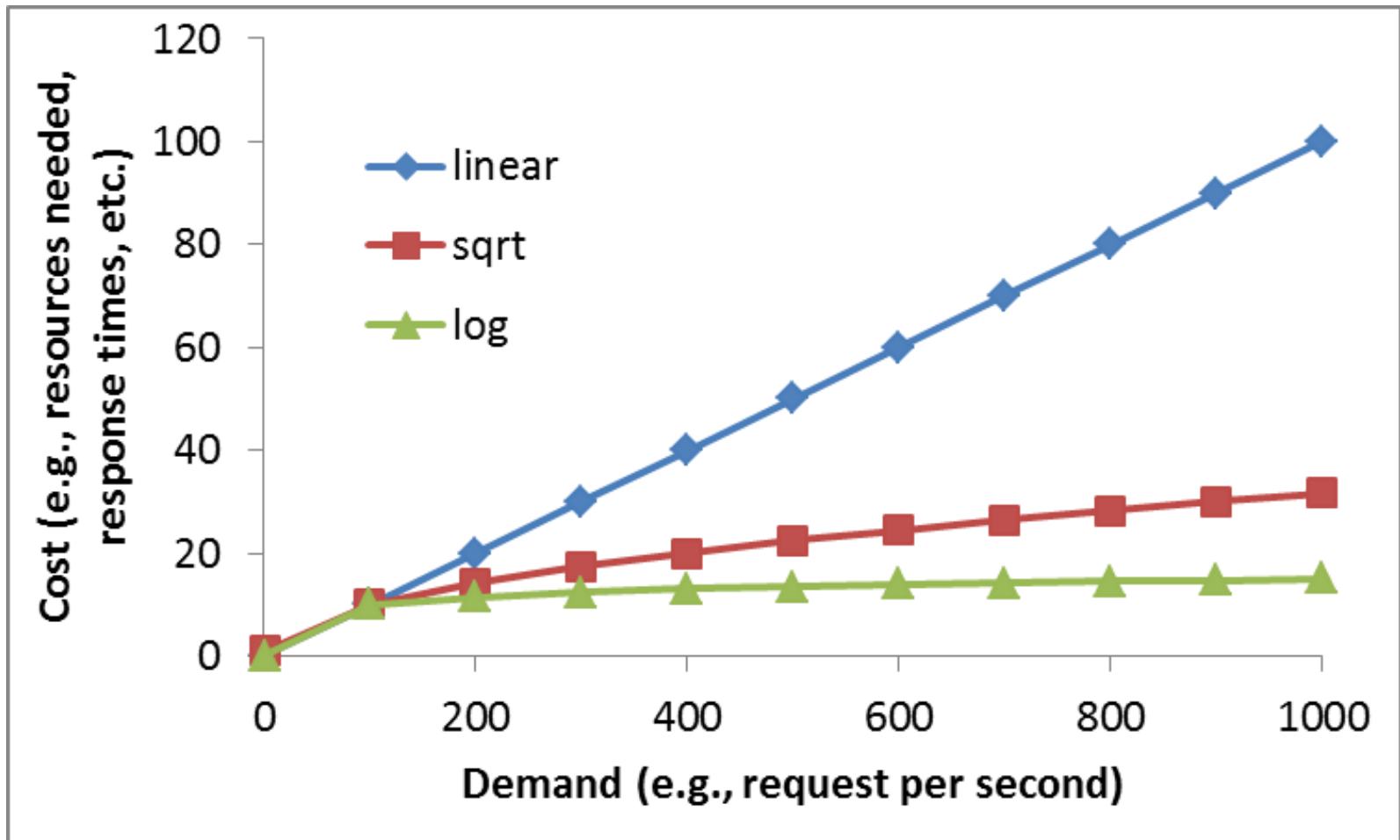
Personalized service and personal footprints in a connected world ...



Scalability

- Typically want solutions that “scales”
 - Ability of a system, network, or process to handle a growing amount of work effectively
 - Capability to increase its total output under an increased load when resources are added
- Typically want the costs or resource capacity needed to scale sub-linearly with demand OR the performance to improve at least proportionally to the capacity added

Scalability examples



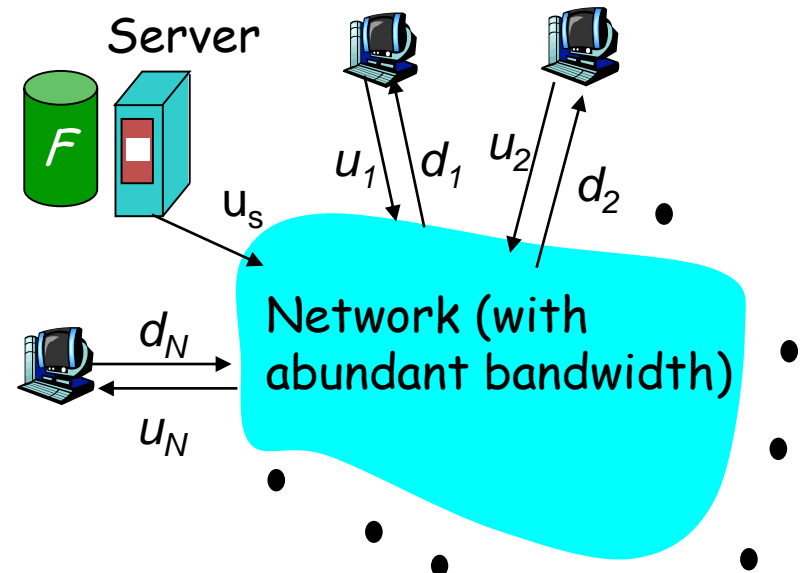
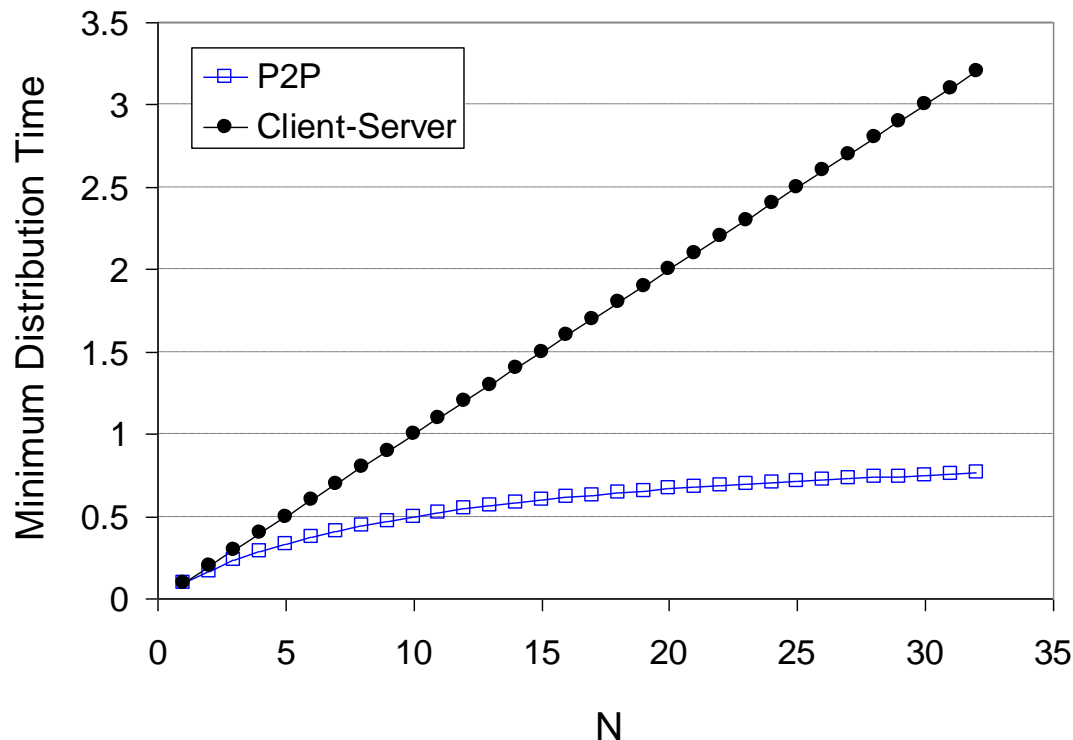
Server-client vs. P2P: example

Time to distribute F to N clients,
using client/server approach

$$d_{cs} = \max \left\{ NF/u_s, F/\min(d_i) \right\}$$

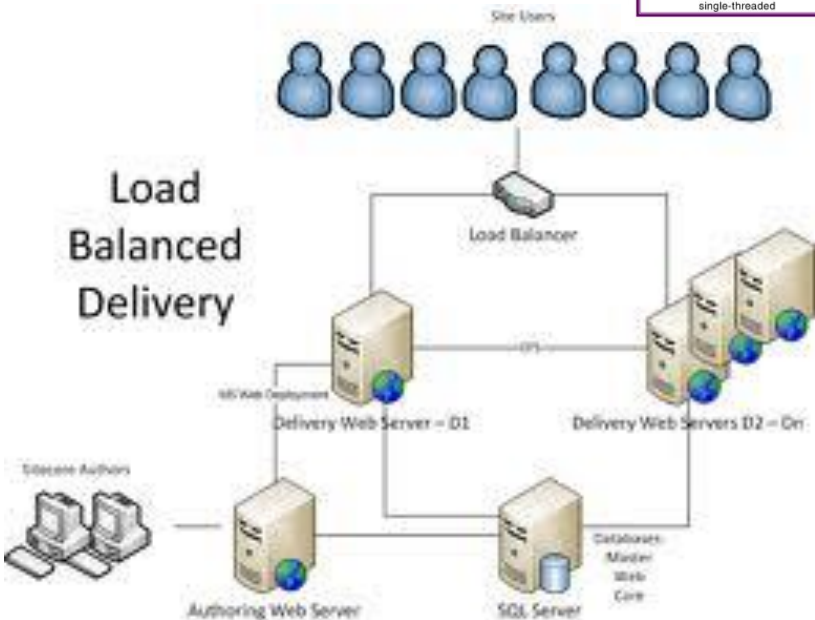
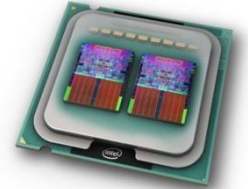
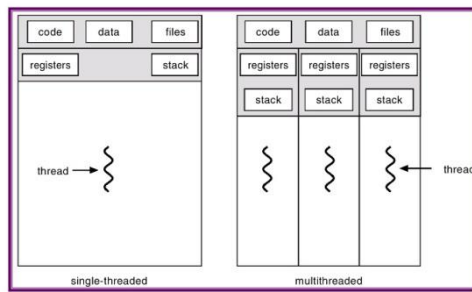
... and using a P2P approach

$$d_{p2p} = \max \left\{ F/u_s, F/\min(d_i), NF/(u_s + \sum u_i) \right\}$$



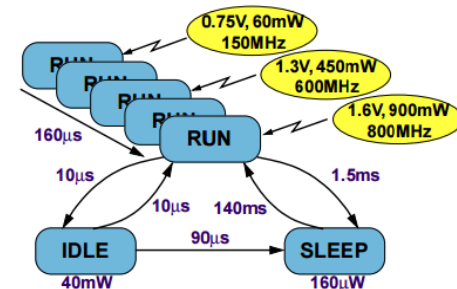
Client upload rate = u ,
 $F/u = 1$ hour, $u_s = 10u$, $d_{\min} \geq u_s$

Parallelism



How do we understand these tradeoffs?

- There are three main methods used in the design of performance evaluation studies:
- Analytic approaches
 - the use of mathematics, Markov chains, queueing theory, Petri Nets, abstract models...
- Simulation approaches
 - design and use of computer simulations and simplified models to assess performance
- Experimental approaches
 - measurement and use of a real system



Recommended follow up courses

- TDTS21 Advanced Networking (6hp)
- TDDD25 Distributed Systems (6hp)
- TDDI08 Embedded Systems Design (4hp)
- TDDI11 Embedded Software, 6 credits (6hp)
- TDDC78 Programming Parallel Computers (6hp)
- TDDD56 Multicore and GPU Programming (6hp)
- ... and lots of interesting thesis projects, of course!

(Other projects are also possible; e.g., on individual basis ...)

The exam

- Tuesday June 4, 2019
- Closed book
- Some example and practice questions online
 - Four parts: each worth a $1/4^{\text{th}}$ of the points ...
 - Bonus question (only on original May/June exam)
- Bonus points from project will be assigned during the exam (not before)
 - Details on website (only on original May/June exam)

... more exam ...

- Read all instructions carefully
- Please explain how you derived your answers. Your final answers should be clearly stated.
- Write answers legibly; no marks will be given for answers that cannot be read easily.
- Where a discourse or discussion is called for, be concise and precise.
- No assistance: closed book, closed notes, and no electronics ...

... yet more exam ...

- If necessary, state any assumptions you made in answering a question. However, remember to read the instructions for each question carefully and answer the questions as precisely as possible. Solving the *wrong question may result in deductions!* It is better to solve the *right question incorrectly, than the wrong question correctly.*
- Please use English. (If needed, feel free to bring a dictionary from an official publisher. Hardcopy, not electronic!! Also, your dictionary is not allowed to contain any notes; only the printed text by the publisher.)

Good luck on the exam!!