Computer Modeling

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Before We Start ….
Passive vs. Active Learning

- After 2 weeks, we tend to remember

- Passive learning
  - 10% of what we read
  - 20% of what we hear
  - 30% of what we see (picture)
  - 50% of what we hear and see

- Active learning
  - 70% of what we say
  - 90% of what we say and do

Everybody! be an Active Learner

- recall prior material
- answer a question (say a lot!)
- guess the solution first (even guessing wrong will help you to remember the right approach)
- raise questions
- think of application
- imagine that you were the professor and think about how you would give a test on the subject material so that key concepts and results will be checked
- summarize a lecture, a set of homework or a lab in your own words concisely

An Active Learner will become an Independent Researcher and Engineer

Course Information

- Office Hour: Tuesday 12 - 1pm at 301-409 (Lunch will be served by appointment)
  - come to me pretty often
- Contact:
  - Chang-Gun Lee (cglee@snu.ac.kr, 880-1862, 010-6549-5605)
  - TA: JungEun Kim (deep0314@snu.ac.kr)
- Grading (Tentative)
  - Attendance: 10%
  - Homework & Projects: 30%
  - Active participation: 10%
  - Midterm: 20%
  - Final: 30% (???)

Course Philosophy

- Modeling and Analysis of Computer Systems are important
  - For graduate study
  - For professional jobs in industry
- Students will be trained with both
    - Analytic model
    - Simulation

Topics

- **Basic Queueing Theory**
- **Hands on experiences with popular simulation tools**
  - SMPL
  - OMNet++
  - NS2
- **Play with actual examples**
  - Resource management in embedded systems
  - Real-time tracking in ubiquitous environments
  - Wireless sensor network protocols
  - Flash memory software

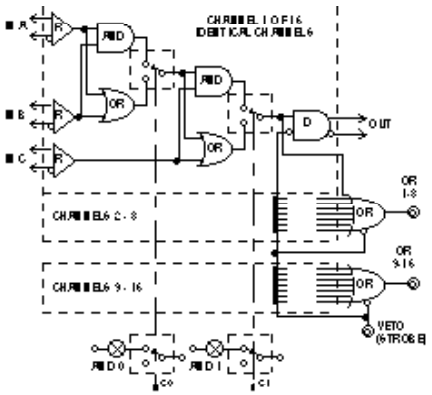
Textbook

- Lecture notes and research papers
- “Simulation Modeling and Analysis” by A. M. Law and W.D. Kelton, McGraw-Hill
- “Probability, Statistics, and Queueing Theory with Computer Science Applications” by A. O. Allen, Academic Press
- “Quantitative System Performance” by E. Lazowska, J. Zahorjan, S. Graham, K. Sevcik, Prentice-Hall
- OMNet++ Manual
- NS2 Manual

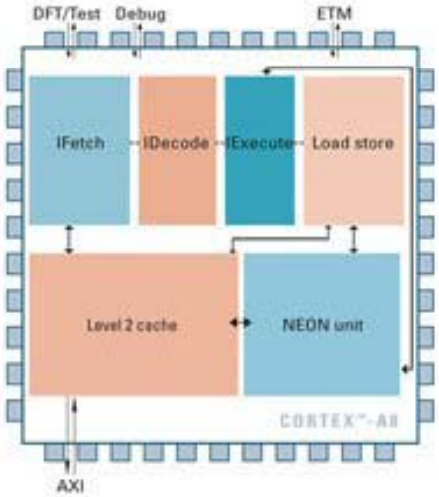
Why Computer Modeling is Important?

- Why?
  - We often make a computer-related mechanism.
  - We want to check the correctness of it
  - We want to see the performance of it
  - We want to improve it if it does not satisfy the requirements
  - My boss (in the industry and graduate school) will ask the above questions
- Why not?
  - Actually implement it and run it to see (and measure) its behavior
  - Take time to implement it
  - We need HW platform to implement it
  - We may waste the HW platform if it does not work
  - It is really painful to redo the implementation
- So, we need to check it before we actually implement it.
- For this, it is essential to MODEL it!

What to Model?

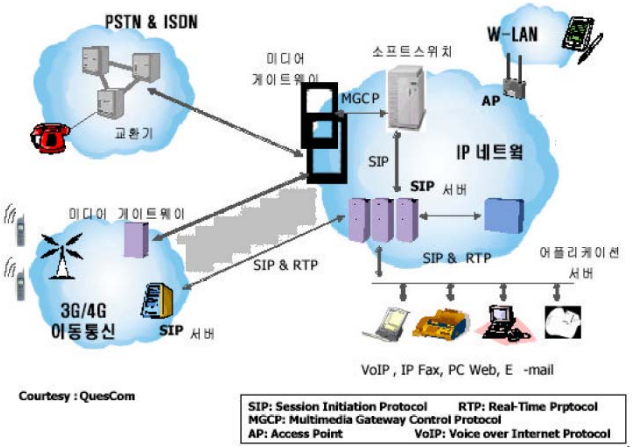


Digital Circuit

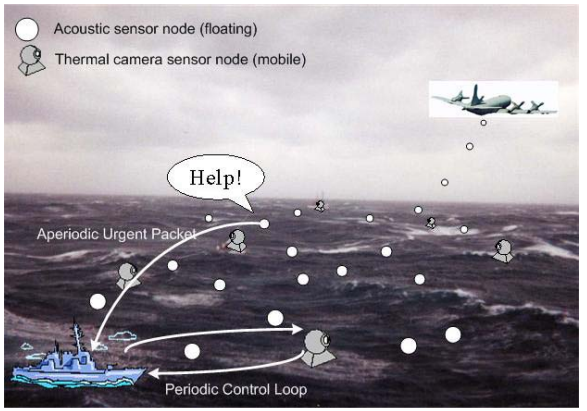


Processor Core

Embedded System



Internet



Wireless Sensor Network

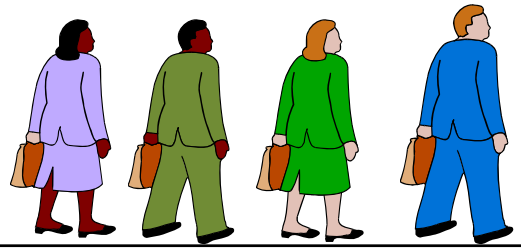
How to Model?

- Analytic method
- Simulation

Analytic method

Poisson Arrivals

$$P[Y=k]=e^{-\lambda t}\frac{(\lambda t)^k}{k!}$$



Performance

$$\#\text{ of customers}: L=\frac{\rho}{1-\rho}\ (\text{where } \rho=\frac{\lambda}{\mu})$$

$$\text{waiting time}: W=\frac{\alpha}{(1-\rho)}$$

Exponential Service Time

$$f(x)=\alpha e^{-\alpha x}\ (\text{where } \alpha=\frac{1}{\mu})$$

- Pros.
  - Closed form interpretation of the results
  - Easy to see the impacts of various parameters
- Cons.
  - Hard to apply for complicated systems
  - Often use simplifying assumptions (deviation from the reality)

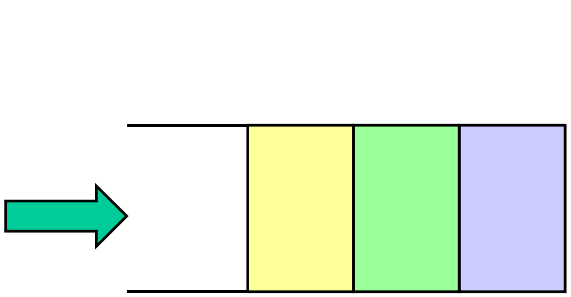
Simulation

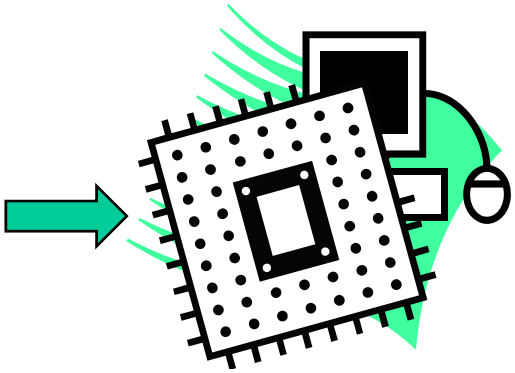
	customers	Wait time
C_1	0	3
C_2	1	6
C_3	2	8
C_4	0	3

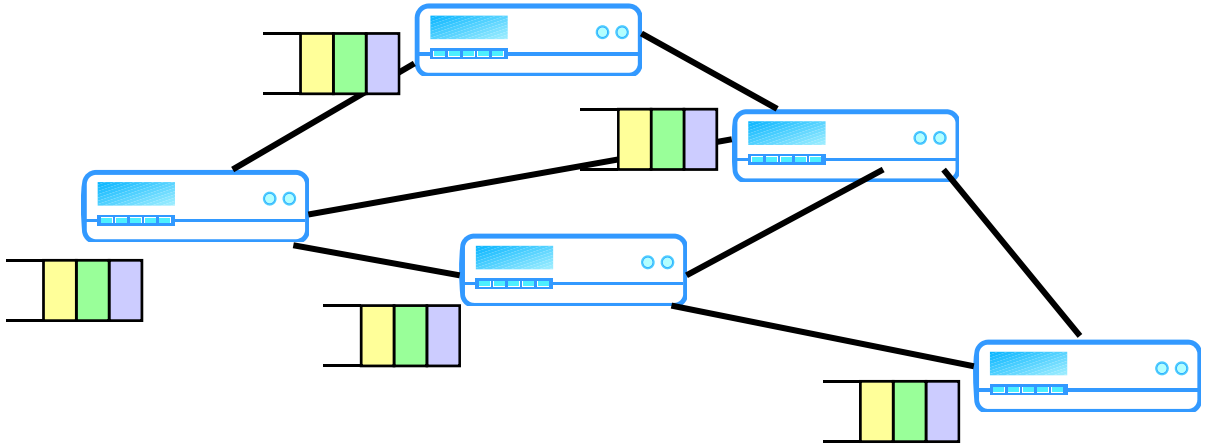
- Pros.
  - Can model any kind of complex systems
  - Can model almost the reality
- Cons.
  - No simple look of inter-parameter relations
  - Quite long simulation time

Why Hair Salon for Computer Engineers?

```
main()
{
   for(1)
        work hard;
}
```







Will it be an easy course?

- Easy for hard working guys
- Difficult for …

- At the end, you will learn a lot and realize that this course is useful for your future!