

# Course Summary

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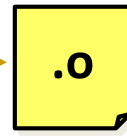
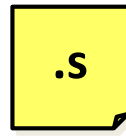
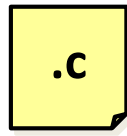


# Computer Systems

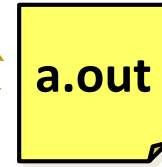
system utilities



prog. language



linker

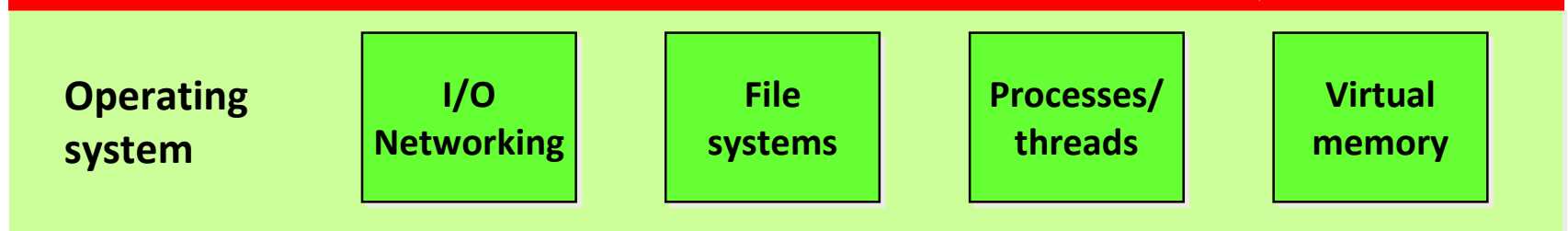


compiler

assembler

loader/dynamic linker

system call interface

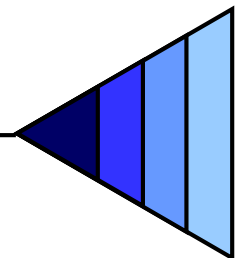


Binary representation  
Byte ordering  
Instruction Set Architecture (ISA)  
Memory Management Unit (MMU)  
Pipelining



CPU

Memory hierarchy



locality  
caching

# Computer System Issues

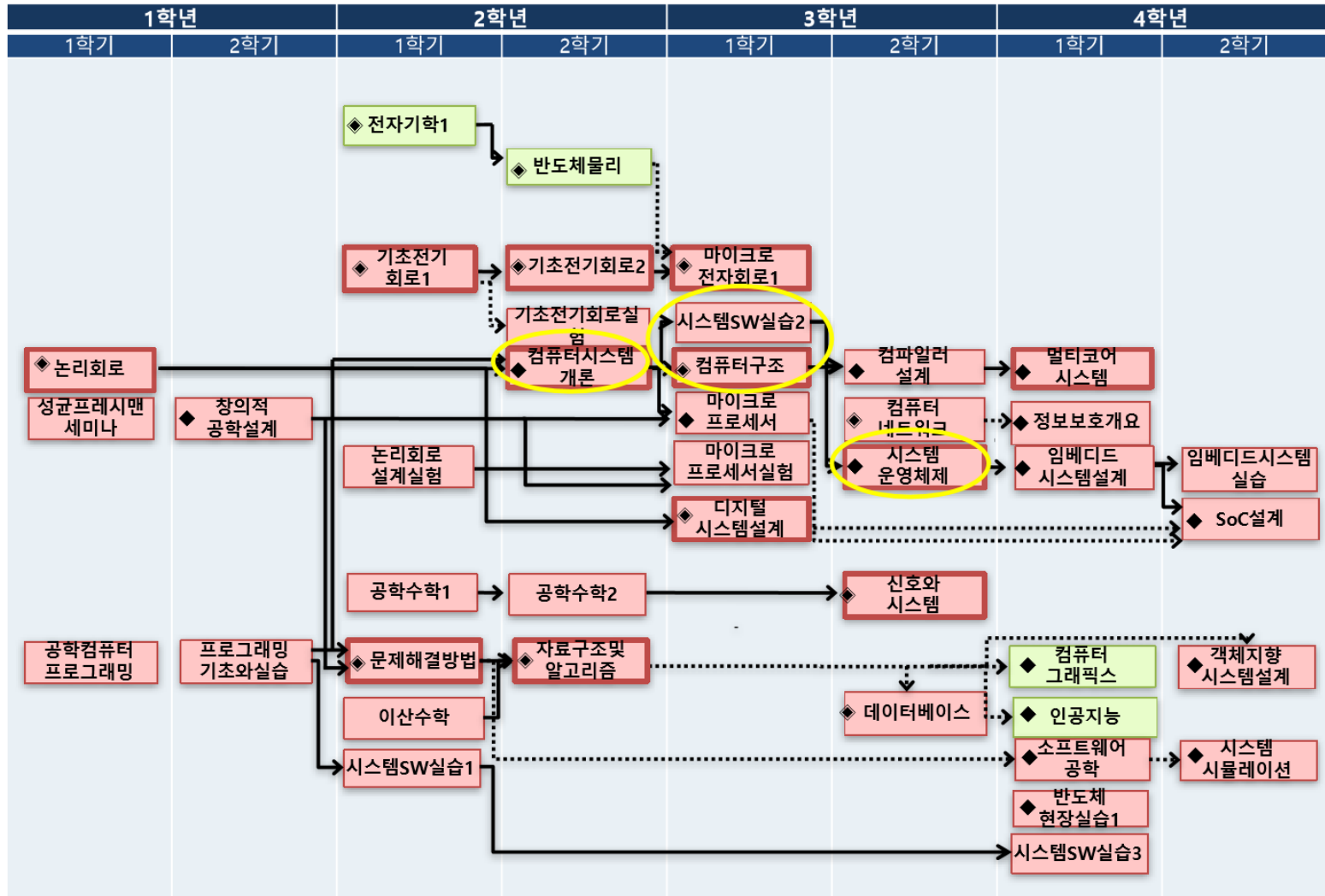
- **Asymptotic complexity? Constant factors matter too!**
  - Easily see 10:1 performance range depending on how code is written
  - Must optimize at multiple levels: algorithm, data representation, procedures, and loops
- **Must understand system to optimize performance**
  - How programs are compiled and executed
  - How to measure program performance and identify bottlenecks
  - How to improve performance without destroying code modularity and generality

# Well...

**The end ??**

**No! It is the **beginning** of many important  
courses you **MUST** take!!!**

# System Software Track (Revisited)



# Want More?

- **Computer architectures**
  - How to design an Instruction Set Architecture (ISA)?
  - How to build a high performance processor?
- **Programming languages**
  - Means for high-level programming
- **Compilers**
  - Bridging the semantic gap
  - Machine-independent optimizations
  - Machine-dependent optimizations
- **Operating systems**
  - Provides system calls for application programming
  - Resource sharing & management
- **Computer networks**
  - How to make the communication between machines work?
- **Database systems**
  - One of serious applications that needs system-level support
- **Embedded systems**
  - Special purpose
  - Limited resources
  - Low-power requirement
- **Distributed systems**
  - Applications and services that span multiple computers
- **And many more...**

# Thank You!

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