Computer Systems

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Introduction

- Course designed to play a dual role:
  - ensure every CS graduate has basic knowledge about computer systems
  - prepare students who want to specialize in Systems & Networking track
- Course adopts the perspective of a *programmer* using computer systems, rather than a *designer* of operating systems
- Also the perspective taken by Bryant & O'Hallaron in textbook

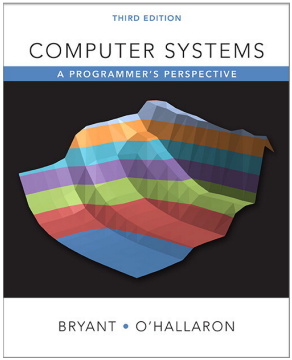

Figure 1: CSApp Book[1]

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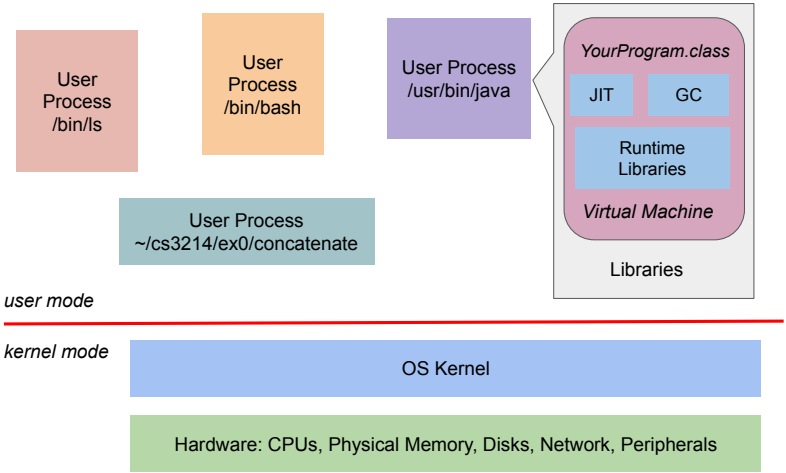
Typical System Architecture



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Functions of a OS Kernel

- is a software layer that sits between applications and hardware
- abstracts hardware through interfaces
  - User processes make **system calls**, trapping into kernel to execute kernel code, return (like a library call)

Hello World

```c
#include <stdio.h>


int main(int argc, char** argv)
{
  // Invokes write syscall underneath
  printf("Welcome to CS3214");
}
```

```
<+4>:     mov    %fs:0x18,%eax
<+12>:    test   %eax,%eax
<+14>:    jne    0x7ffff7ed51f0
<+16>:    mov    $0x1,%eax
<+21>:    syscall
```

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Functions of a OS Kernel

- provides protection
  - via preemption (ability to take a resource away)
  - via interposition (e.g. indirection)
  - via privilege (user mode vs kernel mode)
- manages resources
  - via virtualization
  - via scheduling

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Many many OSes exist in the outside world

- From a normal desktop to the car's ECU

- Each with their own end-goal designs depending on their underlying hardware capabilities, and the sensitivity of their tasks.
  - OSes for Embedded Systems are usually designed for a specific types of programs, not an arbitrary program, while desktop OSes have to support arbitrary programs.
  - Real-time OSes must use dedicated schedulers to make the task deadlines
  - Special-purpose OS exist for cloud and container workloads
  - ...

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References

[1] Randal E. Bryant and David R. O'Hallaron.
Computer Systems: A Programmer's Perspective.
Pearson, 3rd edition, 2015.

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