Identify Instruction Se Architecture

Know a brief history of x86 processors

Understand the lifetime of a program

Name x86 integer registers

MACHINE PROGRAMMING

① Instruction Set Architectures

② Machine Programming

MACHINE VS. HUMAN LANGUAGE

Add 5 and 8

011000110101

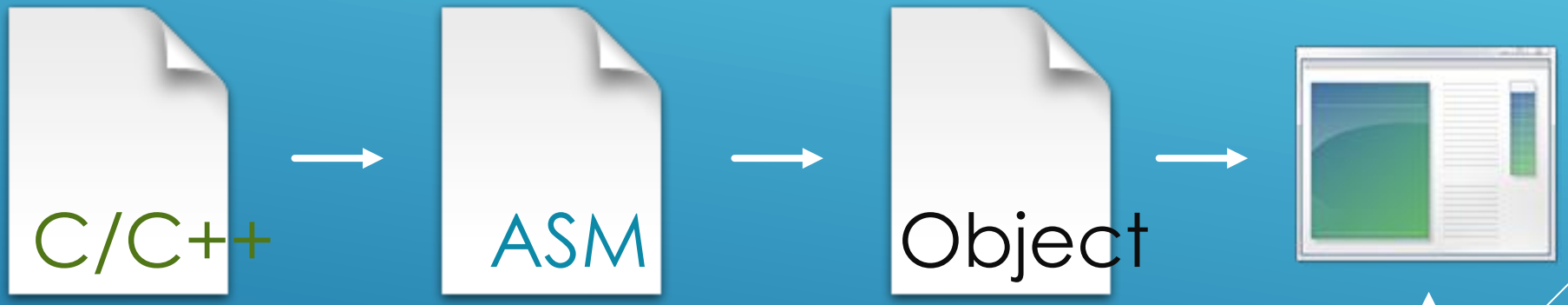
instructions	words
instruction set	vocabulary
machine language	assembly language

```
03 45 08        add 0x8(%ebp),%eax
```

Code time

Compile time

Run time

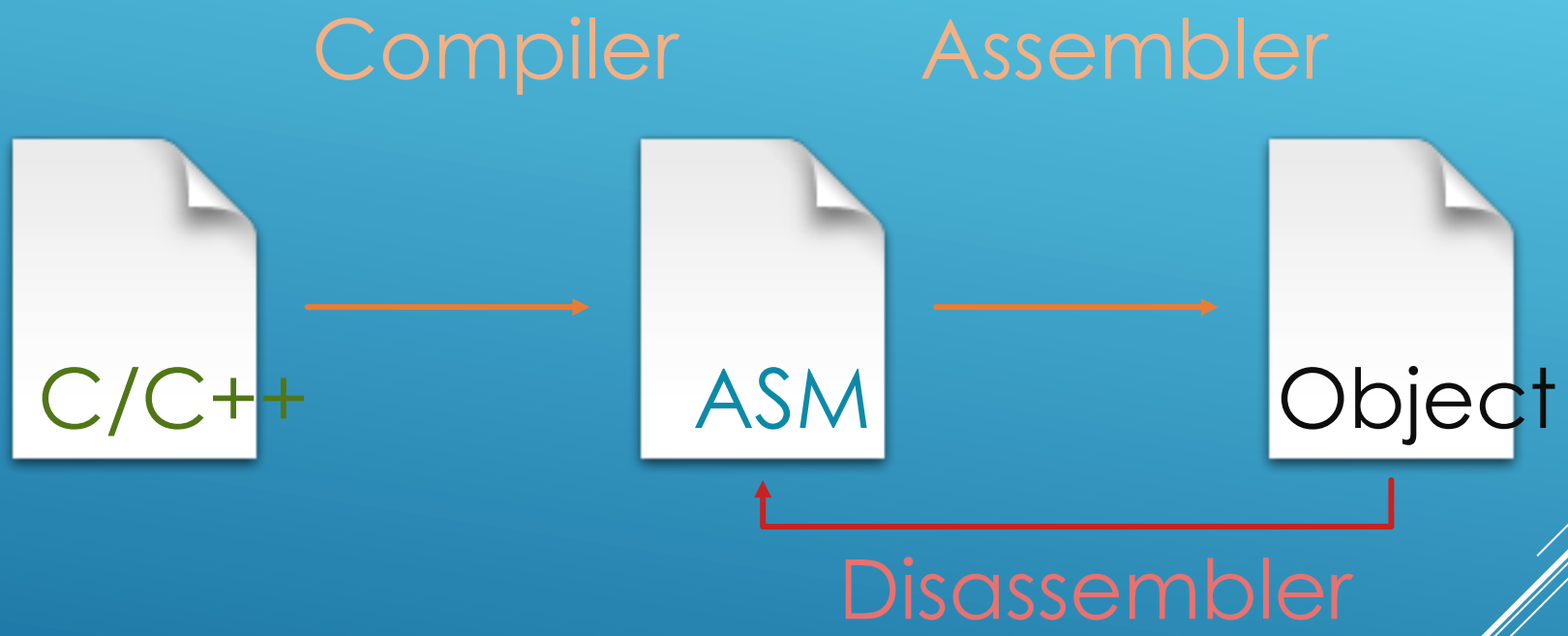


Compiler

Assembler

Linker

LIFETIME OF PROGRAM



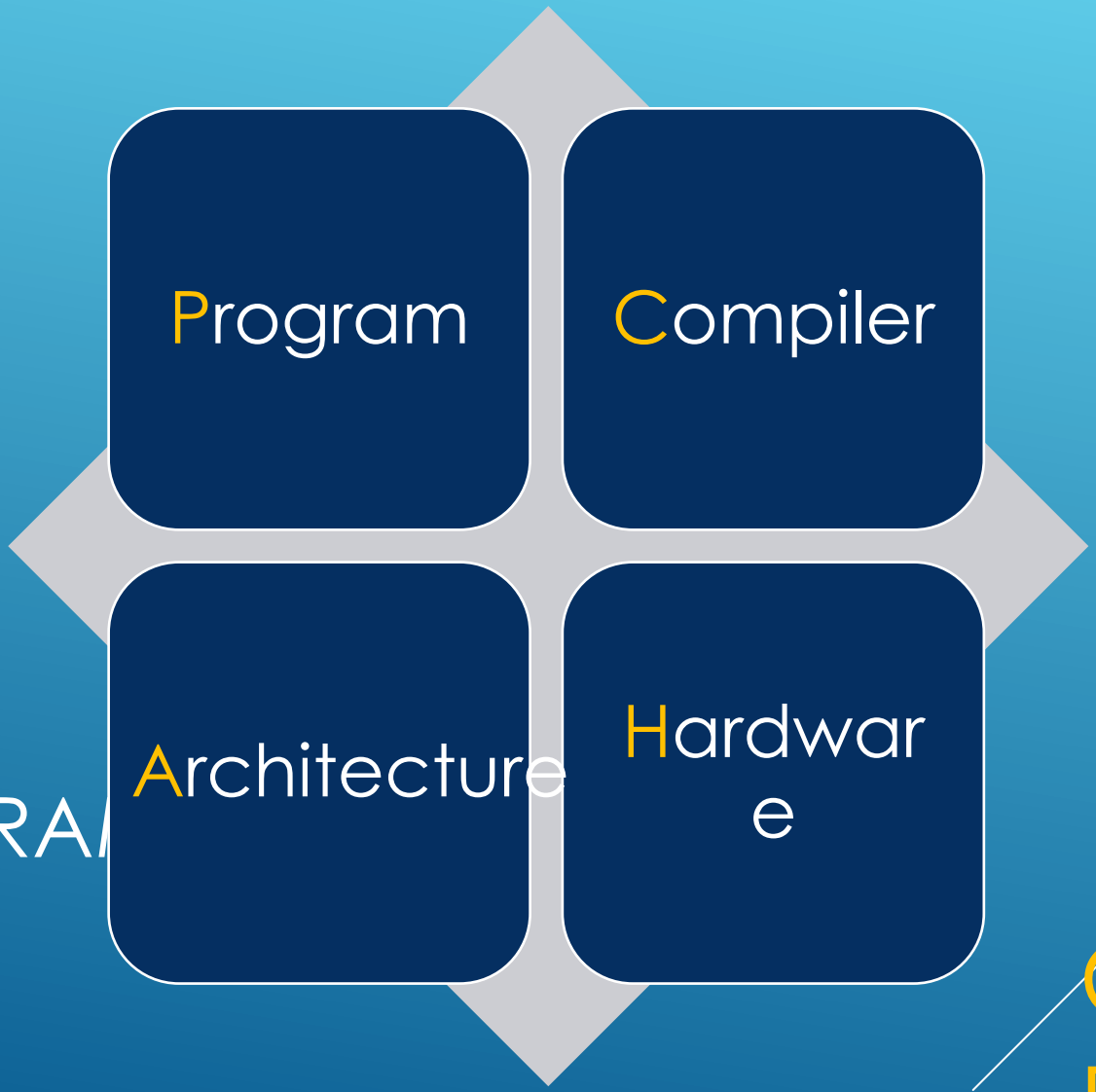
CODE EXAMPLES

```
gcc -Og -c example.c
```

```
gcc -Og -S example.c
```

```
objdump -d example.o
```

PROGRA



CHA
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① System's state

② Instructions
CPU can execute

③

Instruction
Set
Architecture

e

INSTRUCTION ARCHITECTU

x86

MIPS

SPARC

PowerPC

1968

1985

2016

1978

2005

INTEL

Transistor count

29K

275K

250M

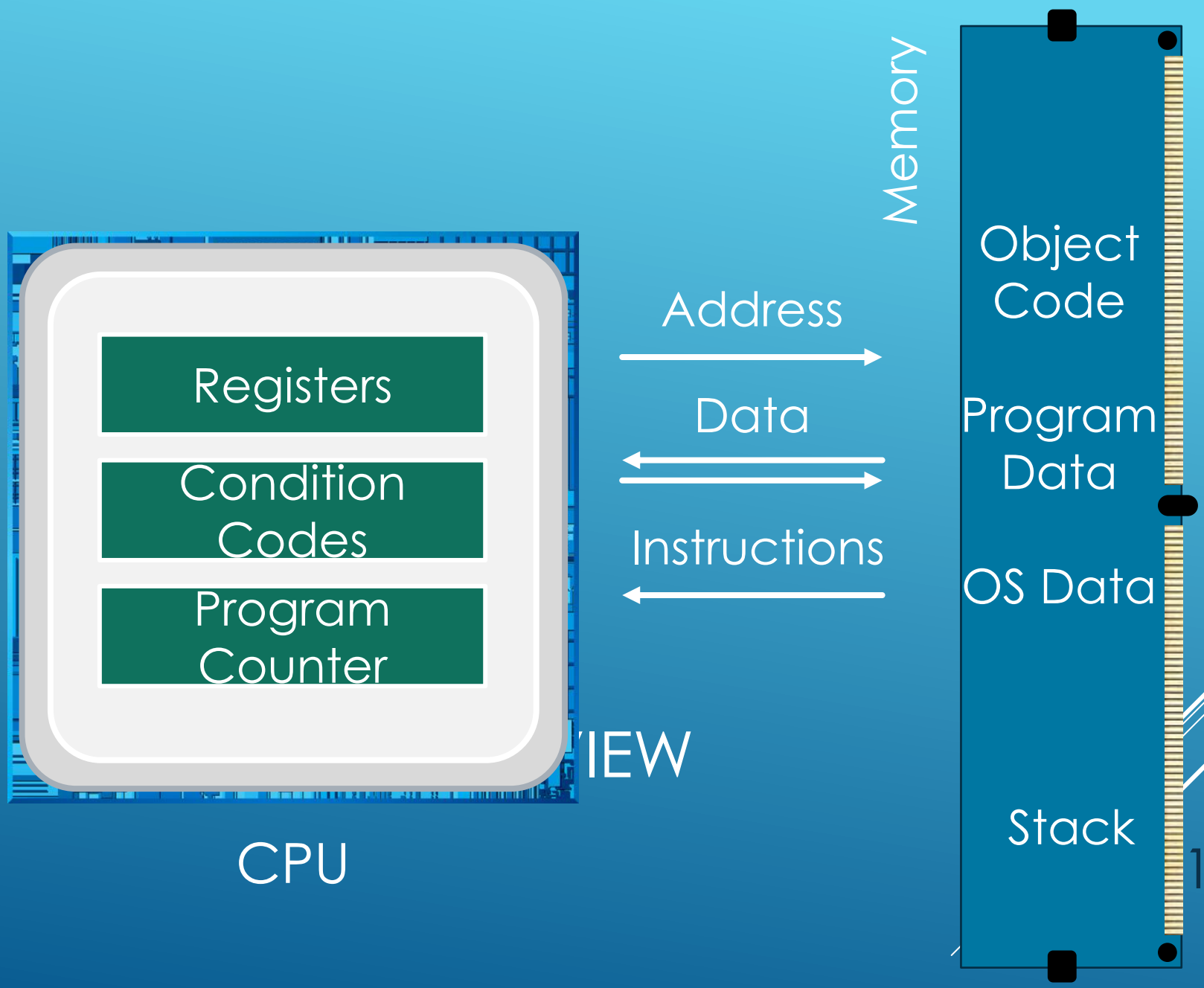
7.2B

Gordon Moore

Co-founder of Intel

> The number of transistors in a chip will approximately double every two years.

ADVANCED MICRO DEVICES


Memory
Object Code
Program Data
OS Data
Stack
Address
Data
Instructions
Registers
Condition Codes
Program Counter
CPU

IEW

```c
int sum(int x, int y)
{
   int t = x+y;
   return t;
}
```

code.c

gcc –O1 –S code.c

COMPILING

32-bit

```
sum:
push %ebp
mov %esp,%ebp
mov 12(%ebp),%eax
add 8(%ebp),%eax
mov %ebp,%esp
pop %ebp
ret
```

64-bit

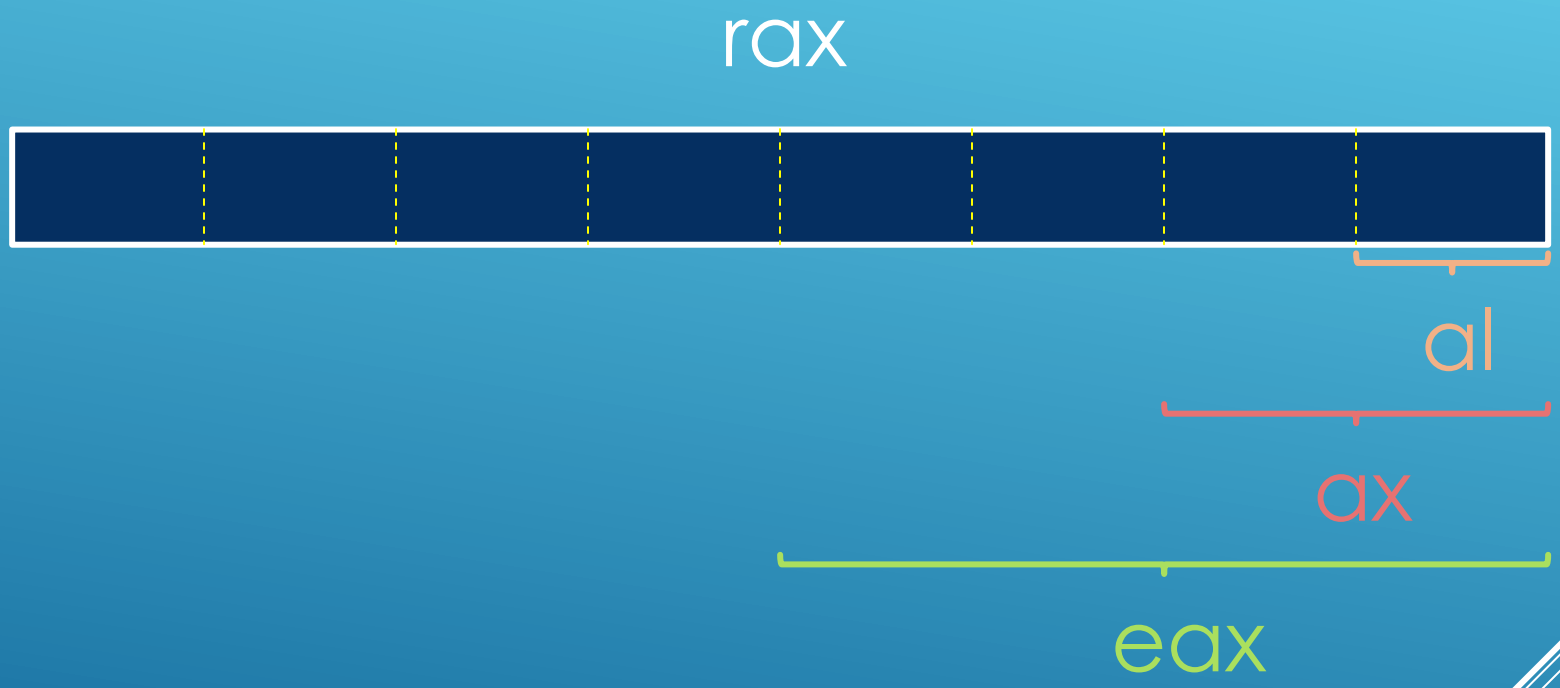
```
sum:
leal (%rdi,%rsi),%eax
ret
```

CATEGORIES OF REGISTERS

- Data
- Address
- Floating point
- Instruction
- Conditional
- Constant (zero, one, or pi)
- Vector
- Special-purpose

General purpose registers (GPRS)


IA32 Integer Registers
%rax
%eax
%ax
%rbx
%ebx
%bx
%rcx
%ecx
%cx
%rdx
%edx
%dx
%rsi
%esi
%si
%rdi
%edi
%di
%rsp
%esp
%sp
%rbp
%ebp
%bp
%r8
%r9
%r10
%r11
%r12
%r13
%r14
%r15
x86-64 Integer Registers

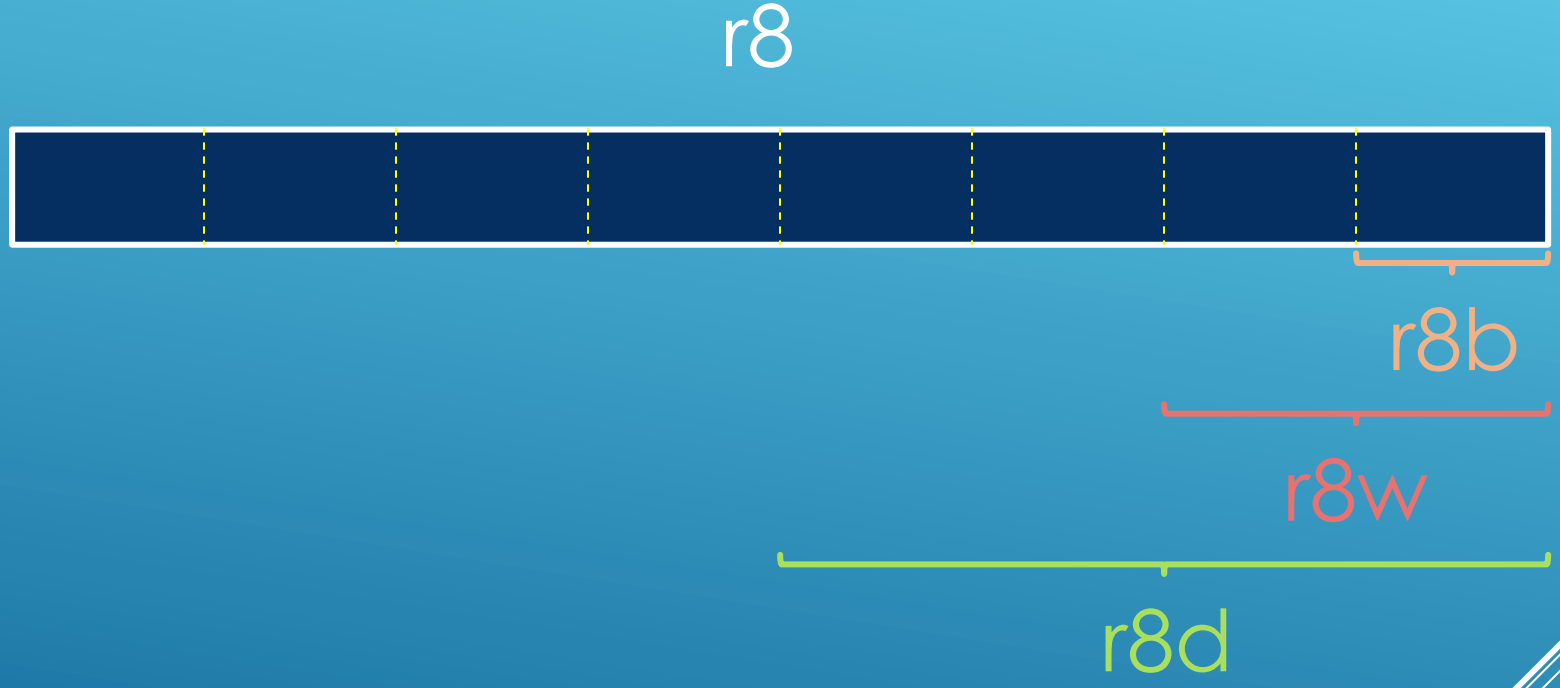


SUB-REGISTER

Same for rbx, rcx, rdx

SUB-REGISTER

Same for rdi, rbp, rsp



SUB-REGISTER

Same for r9, r10, r11, r12, r13, r14, r15

SUMMARY

- Instruction Set Architecture
- Program Performance
- Intel x86 Architecture
- x86 Registers