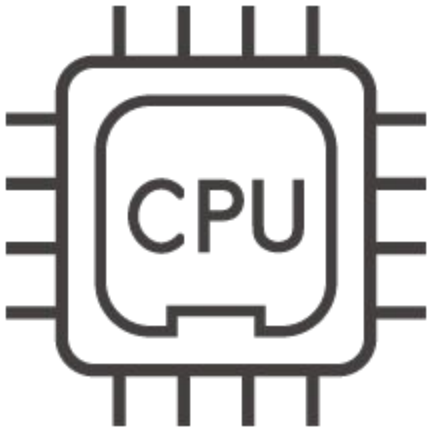
Building a Web Server

Introduction

Connor Nelson
Arizona State University

Computation

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```

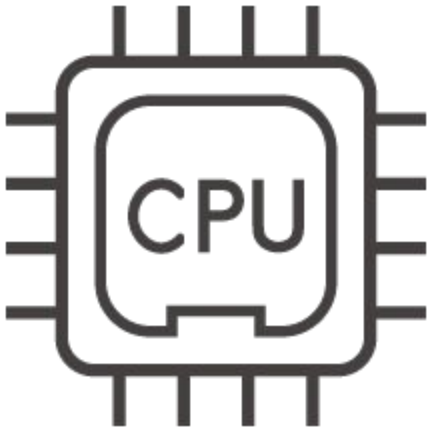


REGISTERS	
RAX	0x0000000000000000
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555000

MEMORY	
555555554000	00 00 00 00 00 00 00 00 | ....
555555554008	00 00 00 00 00 00 00 00 | ....
555555554010	00 00 00 00 00 00 00 00 | ....
...	...
555555555000	48 c7 c0 37 13 00 00 48 | H..7...H
555555555008	bb 00 40 55 55 55 55 00 | ..@UUUU.
555555555010	00 48 89 03 48 83 c0 42 | .H..H..B
555555555018	50 00 00 00 00 00 00 00 | P.......
...	...
7fffffffe000	00 00 00 00 00 00 00 00 | ....
7fffffffe008	00 00 00 00 00 00 00 00 | ....
7fffffffe010	00 00 00 00 00 00 00 00 | ....

Computation

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```



REGISTERS

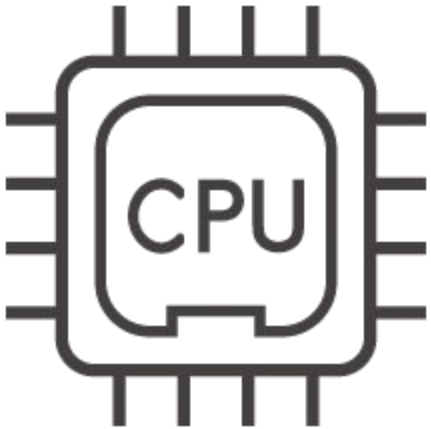
RAX	0x0000000000000000
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555000

MEMORY

```
555555554000    00 00 00 00 00 00 00 00 | ........
555555554008    00 00 00 00 00 00 00 00 | ........
555555554010    00 00 00 00 00 00 00 00 | ........
...             ...
555555555000    48 c7 c0 37 13 00 00 48 | H..7...H
555555555008    bb 00 40 55 55 55 55 00 | ..@UUUU.
555555555010    00 48 89 03 48 83 c0 42 | .H..H..B
555555555018    50 00 00 00 00 00 00 00 | P.......
...             ...
7fffffffe000    00 00 00 00 00 00 00 00 | ........
7fffffffe008    00 00 00 00 00 00 00 00 | ........
7fffffffe010    00 00 00 00 00 00 00 00 | ........
```

Computation

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```



REGISTERS

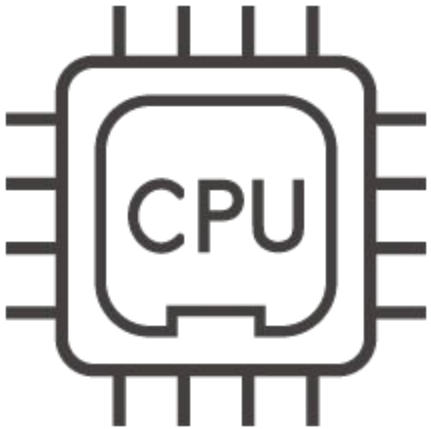
RAX	**0x0000000000001337**
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	**0x0000555555555007**

MEMORY

```
555555554000    00 00 00 00 00 00 00 00 | ........
555555554008    00 00 00 00 00 00 00 00 | ........
555555554010    00 00 00 00 00 00 00 00 | ........
...             ...
555555555000    48 c7 c0 37 13 00 00 48 | H..7...H
555555555008    bb 00 40 55 55 55 55 00 | ..@UUUU.
555555555010    00 48 89 03 48 83 c0 42 | .H..H..B
555555555018    50 00 00 00 00 00 00 00 | P.......
...             ...
7fffffffe000    00 00 00 00 00 00 00 00 | ........
7fffffffe008    00 00 00 00 00 00 00 00 | ........
7fffffffe010    00 00 00 00 00 00 00 00 | ........
```

Computation

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```



REGISTERS

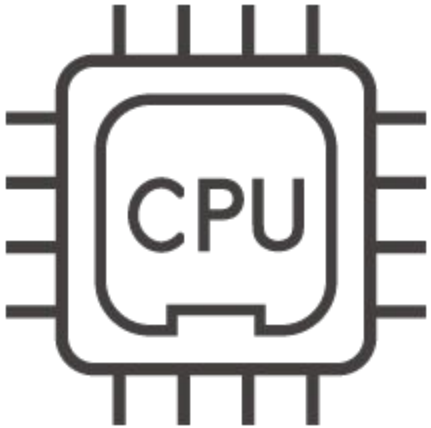
RAX	0x0000000000001337
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555007

MEMORY

```
555555554000    00 00 00 00 00 00 00 00 | ........
555555554008    00 00 00 00 00 00 00 00 | ........
555555554010    00 00 00 00 00 00 00 00 | ........
...             ...
555555555000    48 c7 c0 37 13 00 00 48 | H..7...H
555555555008    bb 00 40 55 55 55 55 00 | ..@UUUU.
555555555010    00 48 89 03 48 83 c0 42 | .H..H..B
555555555018    50 00 00 00 00 00 00 00 | P.......
...             ...
7fffffffe000    00 00 00 00 00 00 00 00 | ........
7fffffffe008    00 00 00 00 00 00 00 00 | ........
7fffffffe010    00 00 00 00 00 00 00 00 | ........
```

Computation

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```



REGISTERS

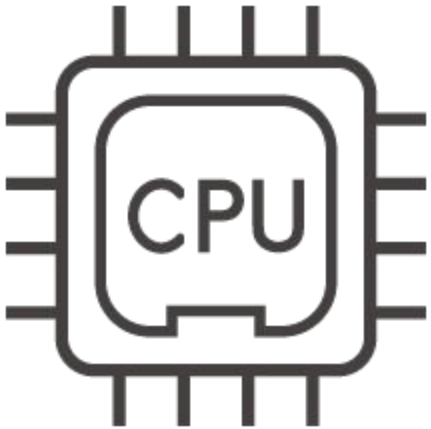
RAX	0x0000000000001337
RBX	**0x0000555555554000**
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	**0x0000555555555011**

MEMORY

```
555555554000    00 00 00 00 00 00 00 00 | ........
555555554008    00 00 00 00 00 00 00 00 | ........
555555554010    00 00 00 00 00 00 00 00 | ........
...             ...
555555555000    48 c7 c0 37 13 00 00 48 | H..7...H
555555555008    bb 00 40 55 55 55 55 00 | ..@UUUU.
555555555010    00 48 89 03 48 83 c0 42 | .H..H..B
555555555018    50 00 00 00 00 00 00 00 | P.......
...             ...
7fffffffe000    00 00 00 00 00 00 00 00 | ........
7fffffffe008    00 00 00 00 00 00 00 00 | ........
7fffffffe010    00 00 00 00 00 00 00 00 | ........
```

Computation

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```



REGISTERS

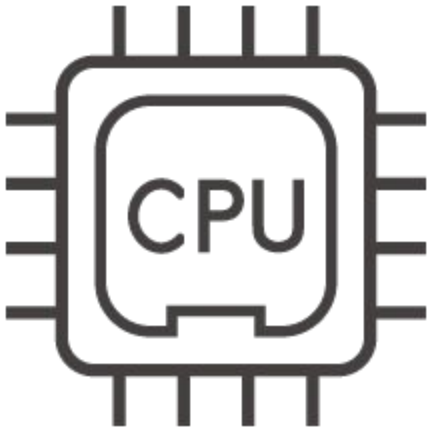
RAX	0x0000000000001337
RBX	0x0000555555554000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555011

MEMORY

```
555555554000    00 00 00 00 00 00 00 00 | ........
555555554008    00 00 00 00 00 00 00 00 | ........
555555554010    00 00 00 00 00 00 00 00 | ........
...             ...
555555555000    48 c7 c0 37 13 00 00 48 | H..7...H
555555555008    bb 00 40 55 55 55 55 00 | ..@UUUU.
555555555010    00 48 89 03 48 83 c0 42 | .H..H..B
555555555018    50 00 00 00 00 00 00 00 | P.......
...             ...
7fffffffe000    00 00 00 00 00 00 00 00 | ........
7fffffffe008    00 00 00 00 00 00 00 00 | ........
7fffffffe010    00 00 00 00 00 00 00 00 | ........
```

Computation

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```



REGISTERS

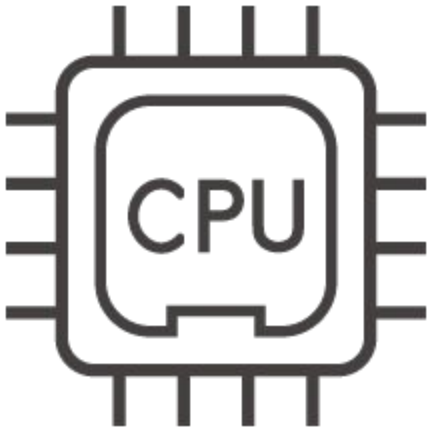
RAX	0x0000000000001337
RBX	0x0000555555554000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	**0x0000555555555014**

MEMORY

```
555555554000    37 13 00 00 00 00 00 00 | 7.......
555555554008    00 00 00 00 00 00 00 00 | ........
555555554010    00 00 00 00 00 00 00 00 | ........
...             ...
555555555000    48 c7 c0 37 13 00 00 48 | H..7...H
555555555008    bb 00 40 55 55 55 55 00 | ..@UUUU.
555555555010    00 48 89 03 48 83 c0 42 | .H..H..B
555555555018    50 00 00 00 00 00 00 00 | P.......
...             ...
7fffffffe000    00 00 00 00 00 00 00 00 | ........
7fffffffe008    00 00 00 00 00 00 00 00 | ........
7fffffffe010    00 00 00 00 00 00 00 00 | ........
```

Computation

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```



REGISTERS

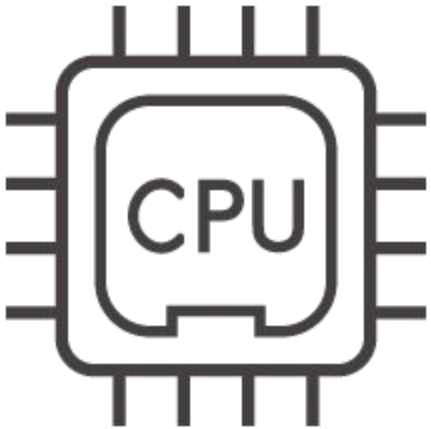
RAX	0x0000000000001337
RBX	0x0000555555554000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555014

MEMORY

```
555555554000    37 13 00 00 00 00 00 00 | 7.......
555555554008    00 00 00 00 00 00 00 00 | ........
555555554010    00 00 00 00 00 00 00 00 | ........
...             ...
555555555000    48 c7 c0 37 13 00 00 48 | H..7...H
555555555008    bb 00 40 55 55 55 55 00 | ..@UUUU.
555555555010    00 48 89 03 48 83 c0 42 | .H..H..B
555555555018    50 00 00 00 00 00 00 00 | P.......
...             ...
7fffffffe000    00 00 00 00 00 00 00 00 | ........
7fffffffe008    00 00 00 00 00 00 00 00 | ........
7fffffffe010    00 00 00 00 00 00 00 00 | ........
```

Computation

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```



REGISTERS

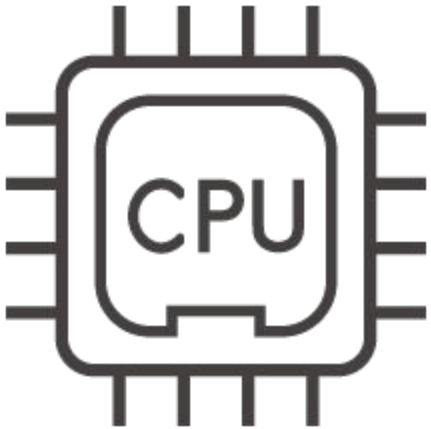
RAX	**0x0000000000001379**
RBX	0x0000555555554000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	**0x0000555555555018**

MEMORY

```
555555554000    37 13 00 00 00 00 00 00 | 7.......
555555554008    00 00 00 00 00 00 00 00 | ........
555555554010    00 00 00 00 00 00 00 00 | ........
...             ...
555555555000    48 c7 c0 37 13 00 00 48 | H..7...H
555555555008    bb 00 40 55 55 55 55 00 | ..@UUUU.
555555555010    00 48 89 03 48 83 c0 42 | .H..H..B
555555555018    50 00 00 00 00 00 00 00 | P.......
...             ...
7fffffffe000    00 00 00 00 00 00 00 00 | ........
7fffffffe008    00 00 00 00 00 00 00 00 | ........
7fffffffe010    00 00 00 00 00 00 00 00 | ........
```

Computation

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```



REGISTERS

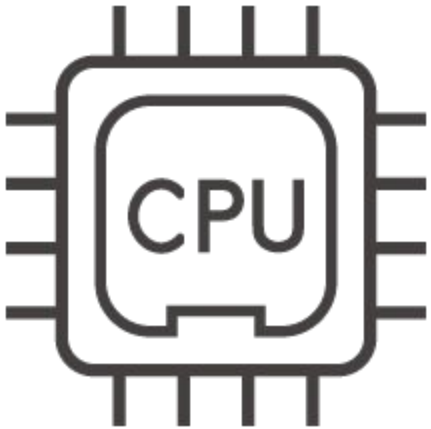
RAX	0x0000000000001379
RBX	0x0000555555554000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555018

MEMORY

```
555555554000    37 13 00 00 00 00 00 00 | 7.......
555555554008    00 00 00 00 00 00 00 00 | ........
555555554010    00 00 00 00 00 00 00 00 | ........
...             ...
555555555000    48 c7 c0 37 13 00 00 48 | H..7...H
555555555008    bb 00 40 55 55 55 55 00 | ..@UUUU.
555555555010    00 48 89 03 48 83 c0 42 | .H..H..B
555555555018    50 00 00 00 00 00 00 00 | P.......
...             ...
7fffffffe000    00 00 00 00 00 00 00 00 | ........
7fffffffe008    00 00 00 00 00 00 00 00 | ........
7fffffffe010    00 00 00 00 00 00 00 00 | ........
```

Computation

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```



REGISTERS

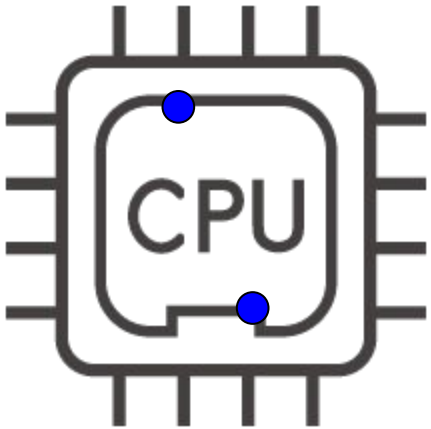
RAX	0x0000000000001379
RBX	0x0000555555554000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	**0x00007fffffffe008**
RBP	0x0000000000000000
RIP	**0x0000555555555019**

MEMORY

555555554000	37 13 00 00 00 00 00 00 | 7.......
555555554008	00 00 00 00 00 00 00 00 | ....
555555554010	00 00 00 00 00 00 00 00 | ....
...	...
555555555000	48 c7 c0 37 13 00 00 48 | H..7...H
555555555008	bb 00 40 55 55 55 55 00 | ..@UUUU.
555555555010	00 48 89 03 48 83 c0 42 | .H..H..B
555555555018	**50** 00 00 00 00 00 00 00 | **P**.......
...	...
7fffffffe000	00 00 00 00 00 00 00 00 | ....
7fffffffe008	**39 13 00 00 00 00 00 00** | **9.....**
7fffffffe010	00 00 00 00 00 00 00 00 | ....

Computation's Effects

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```



REGISTERS

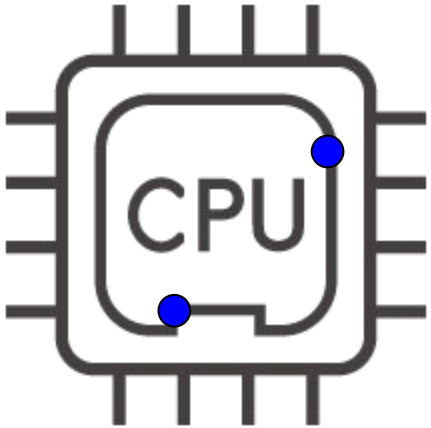
RAX	0x0000000000000000
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555000

MEMORY

```
555555554000    00 00 00 00 00 00 00 00 | ........
555555554008    00 00 00 00 00 00 00 00 | ........
555555554010    00 00 00 00 00 00 00 00 | ........
...             ...
555555555000    48 c7 c0 37 13 00 00 48 | H..7...H
555555555008    bb 00 40 55 55 55 55 00 | ..@UUUU.
555555555010    00 48 89 03 48 83 c0 42 | .H..H..B
555555555018    50 00 00 00 00 00 00 00 | P.......
...             ...
7fffffffe000    00 00 00 00 00 00 00 00 | ........
7fffffffe008    00 00 00 00 00 00 00 00 | ........
7fffffffe010    00 00 00 00 00 00 00 00 | ........
```

Computation's Effects

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```



REGISTERS

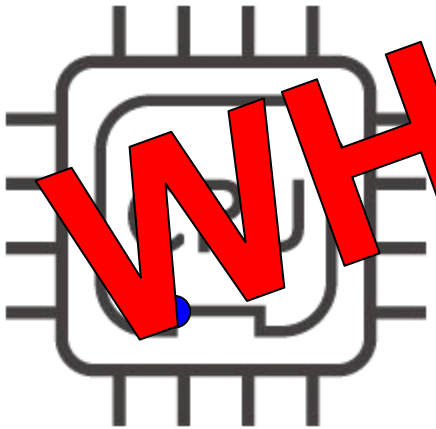
RAX	0x0000000000000000
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555000

MEMORY

```
555555554000    00 00 00 00 00 00 00 00 | ........
555555554008    00 00 00 00 00 00 00 00 | ........
555555554010    00 00 00 00 00 00 00 00 | ........
...             ...
555555555000    48 c7 c0 37 13 00 00 48 | H..7...H
555555555008    bb 00 40 55 55 55 55 00 | ..@UUUU.
555555555010    00 48 89 03 48 83 c0 42 | .H..H..B
555555555018    50 00 00 00 00 00 00 00 | P.......
...             ...
7fffffffe000    00 00 00 00 00 00 00 00 | ........
7fffffffe008    00 00 00 00 00 00 00 00 | ........
7fffffffe010    00 00 00 00 00 00 00 00 | ........
```

Computation's Effects

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```



WHO CARES?

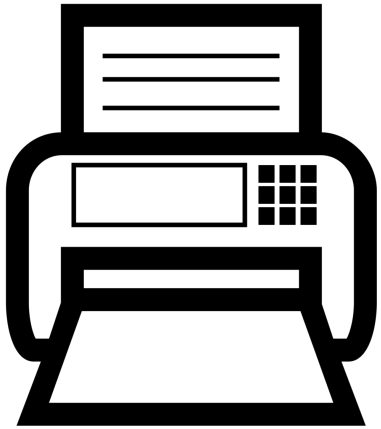
REGISTERS

RAX	0x0000000000000000
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555000

MEMORY

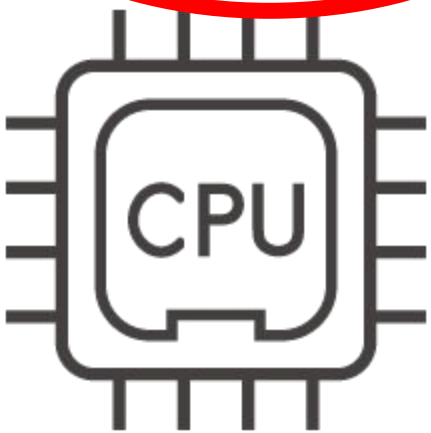
```
555555554000    00 00 00 00 00 00 00 00 | ........
555555554008    00 00 00 00 00 00 00 00 | ........
555555554010    00 00 00 00 00 00 00 00 | ........
.
555555555000    48 89 03 48 83 c0 42 50 | H..7...H
555555555008    bb 00 40 55 55 55 55 00 | ..@UUUU.
555555555010    00 48 89 03 48 83 c0 42 | .H..H..B
555555555018    50 00 00 00 00 00 00 00 | P.......
.               ...
7fffffffe000    00 00 00 00 00 00 00 00 | ........
7fffffffe008    00 00 00 00 00 00 00 00 | ........
7fffffffe010    00 00 00 00 00 00 00 00 | ........
```

Introducing: Hardware

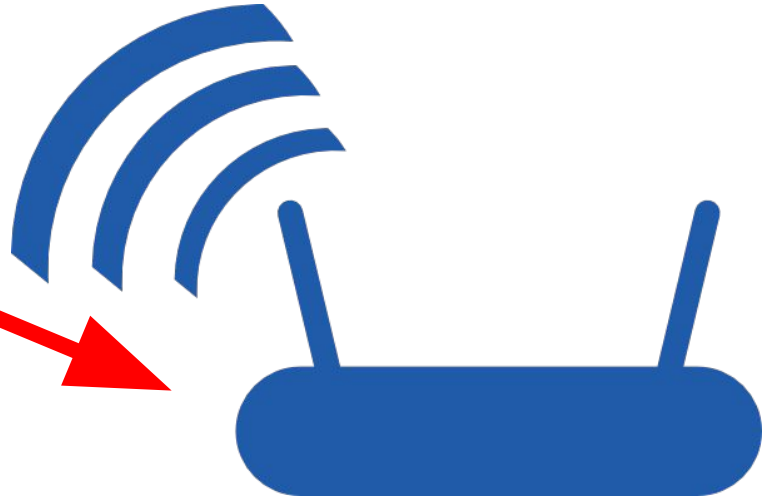


Accessing Hardware

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```

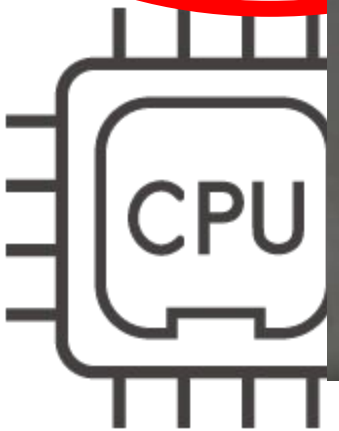


REGISTERS	
RAX	0x0000000000000000
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555000



Accessing Hardware

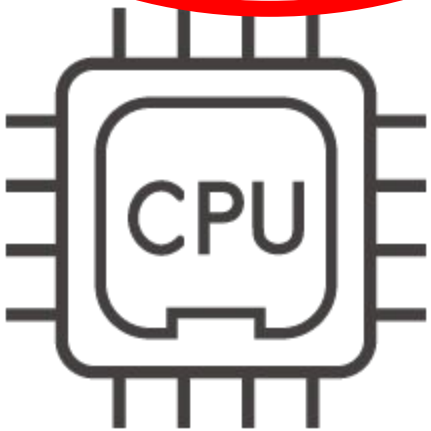
```
mov rax, 0x1337
mov rbx, 0x555
mov qword ptr
add rax, 0x42
push rax
```



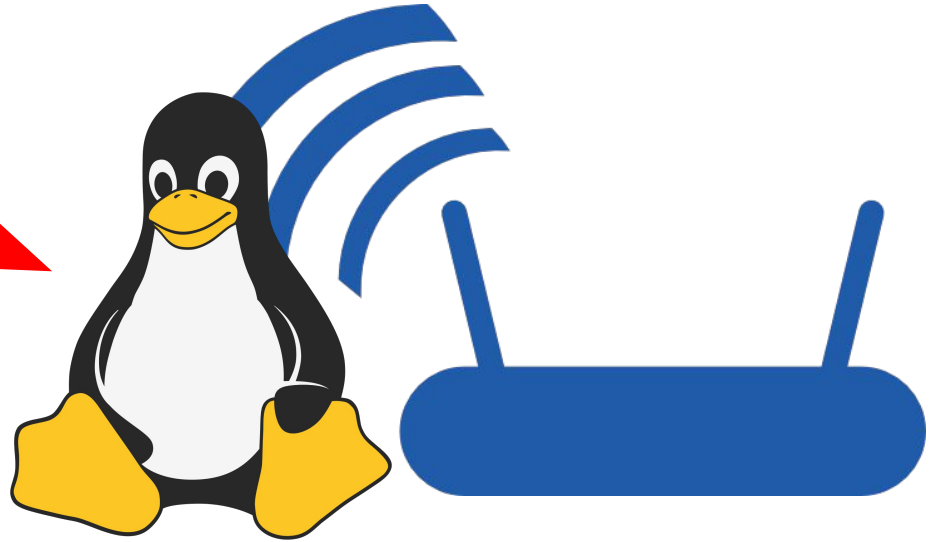
RBP	0x0000000000000000
RIP	0x0000555555555000

Accessing Hardware

```
mov rax, 0x1337
mov rbx, 0x555555554000
mov qword ptr [rbx], rax
add rax, 0x42
push rax
```

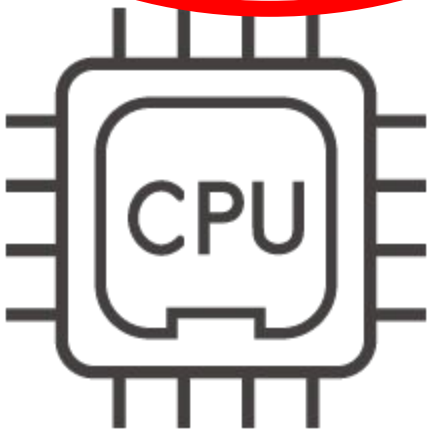


REGISTERS	
RAX	0x0000000000000000
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555000

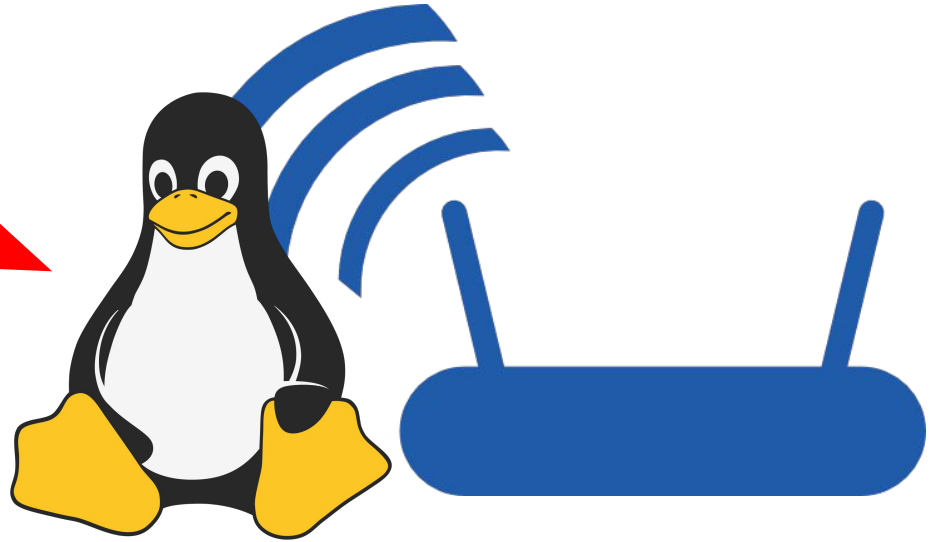


Accessing Hardware

```
mov rax, 42
syscall
```

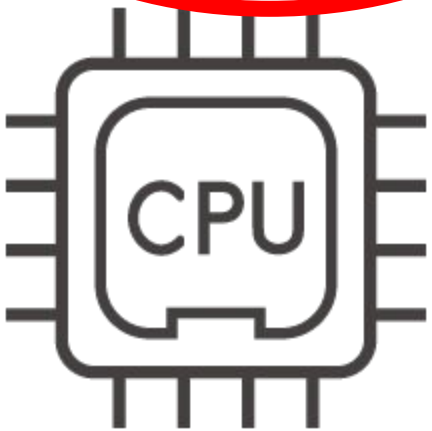


REGISTERS	
RAX	0x0000000000000000
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555000

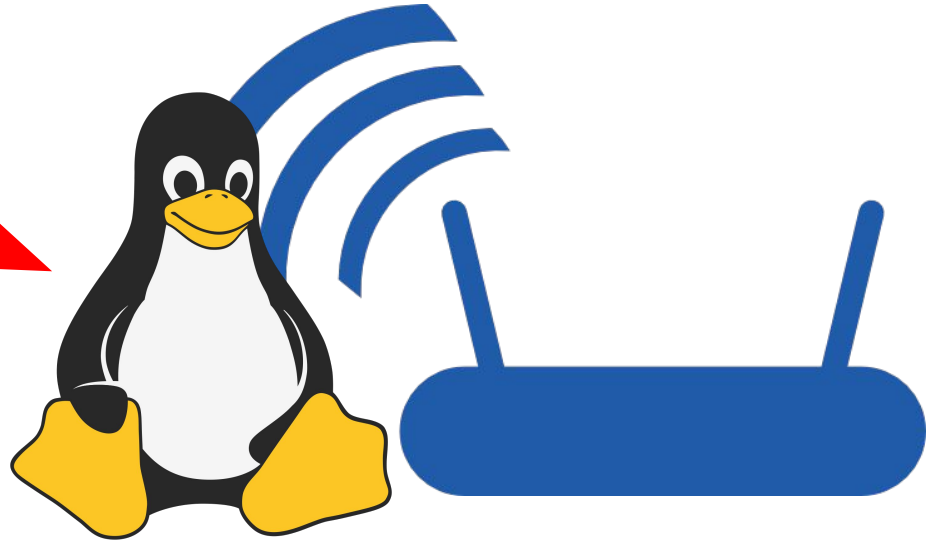


Accessing Hardware

```
mov rax, 42
syscall
```

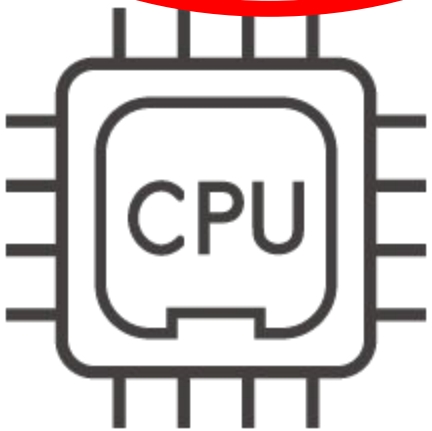


REGISTERS	
RAX	0x0000000000000000
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555000

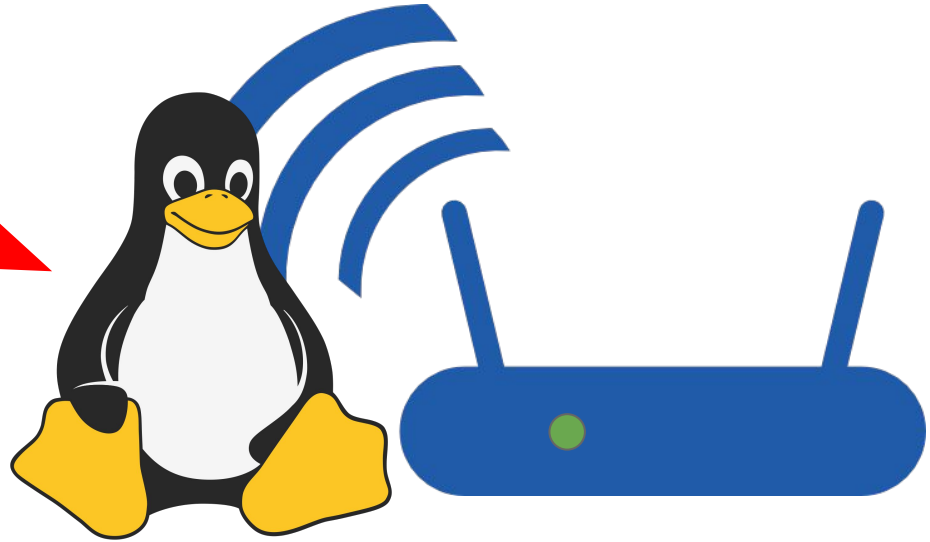


Accessing Hardware

```
mov rax, 42
syscall
```

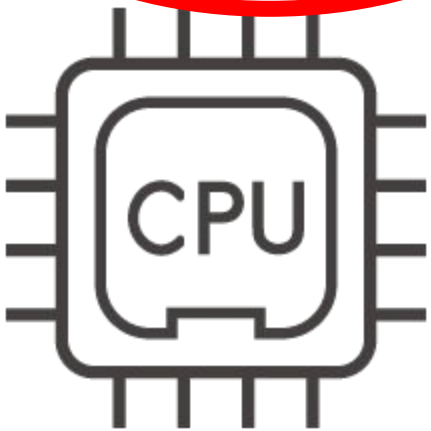


REGISTERS	
RAX	0x0000000000000000
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555000

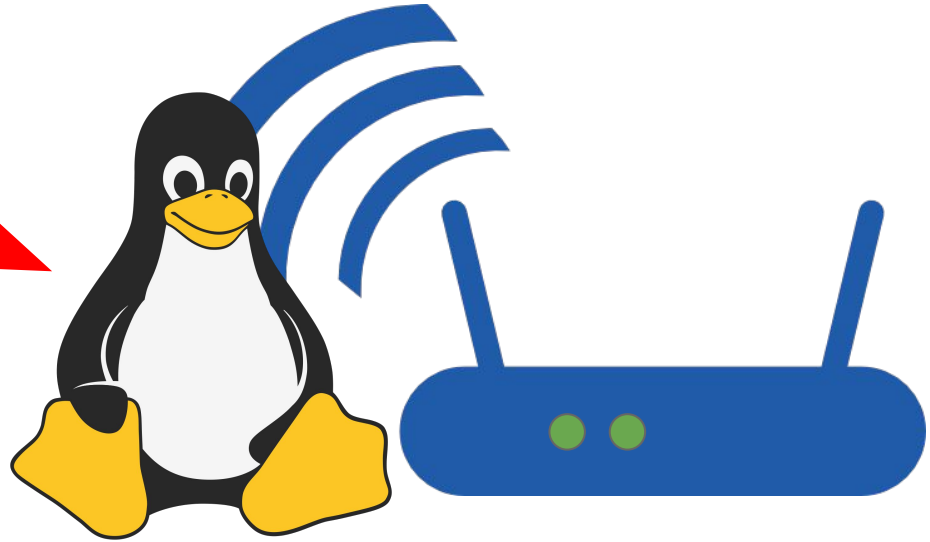


Accessing Hardware

```
mov rax, 42
syscall
```

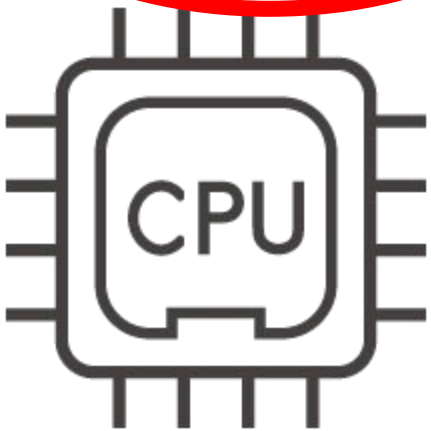


REGISTERS	
RAX	0x0000000000000000
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555000

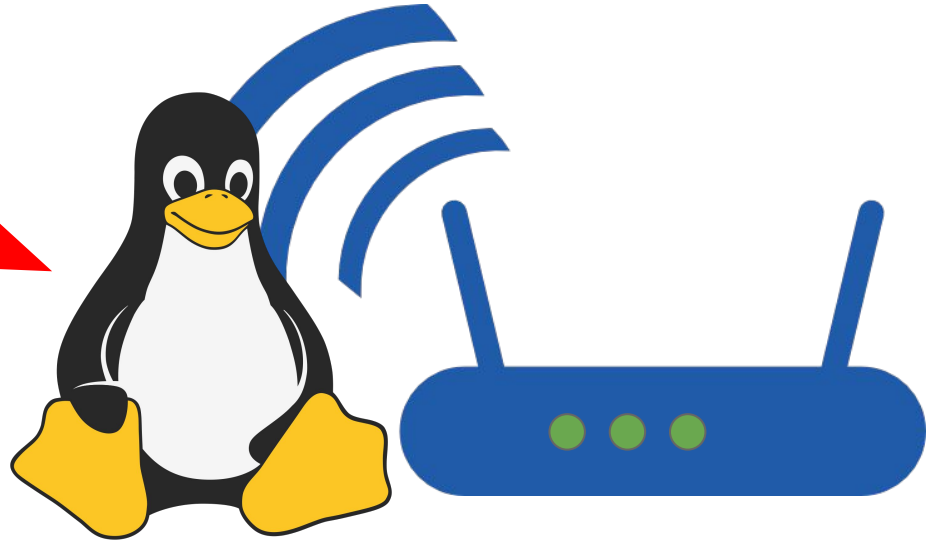


Accessing Hardware

```
mov rax, 42
syscall
```

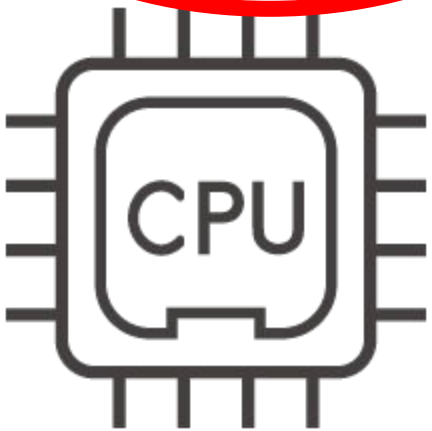
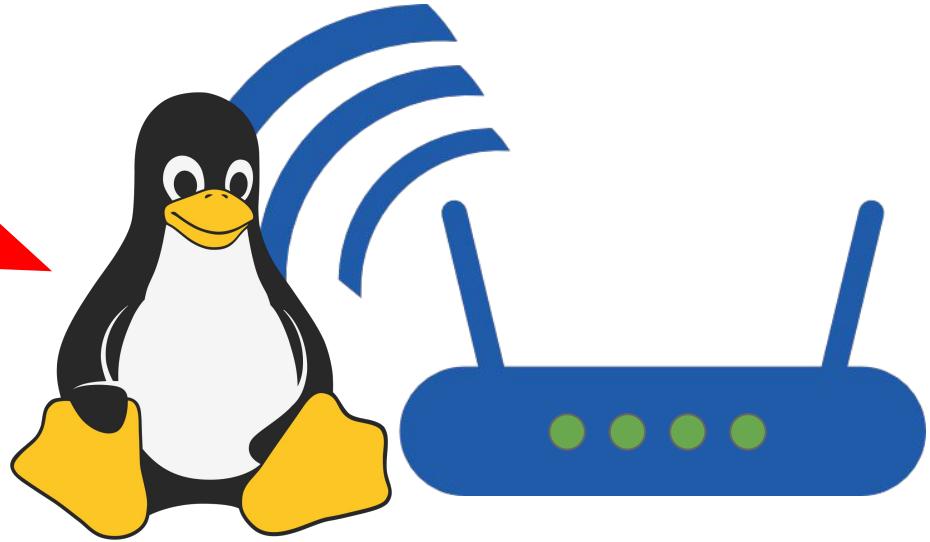


REGISTERS	
RAX	0x0000000000000000
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555000



Accessing Hardware

```
mov rax, 42
syscall
```



REGISTERS	
RAX	0x0000000000000000
RBX	0x0000000000000000
RCX	0x0000000000000000
RDX	0x0000000000000000
RDI	0x0000000000000000
RSI	0x0000000000000000
RSP	0x00007fffffffe010
RBP	0x0000000000000000
RIP	0x0000555555555000