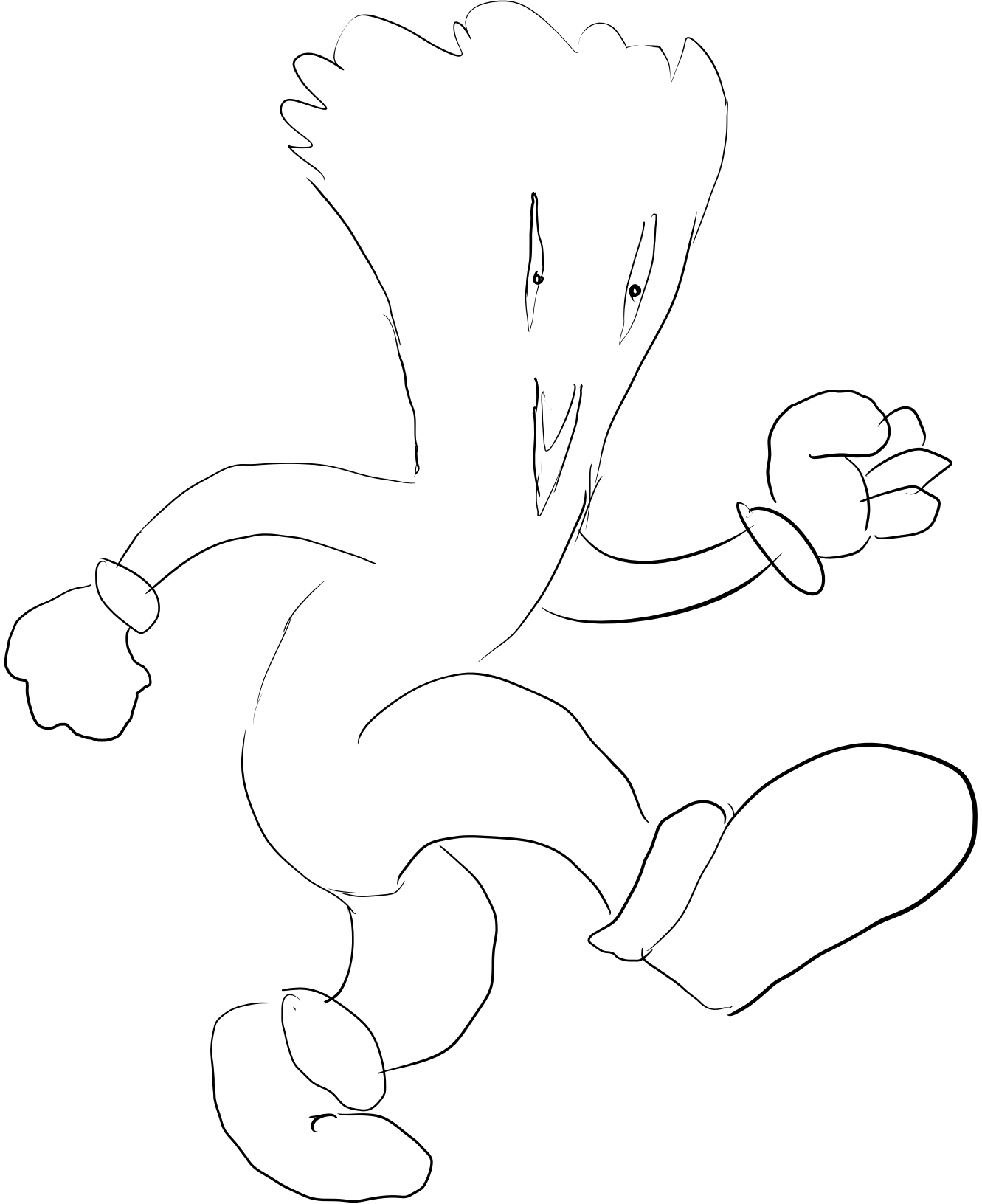
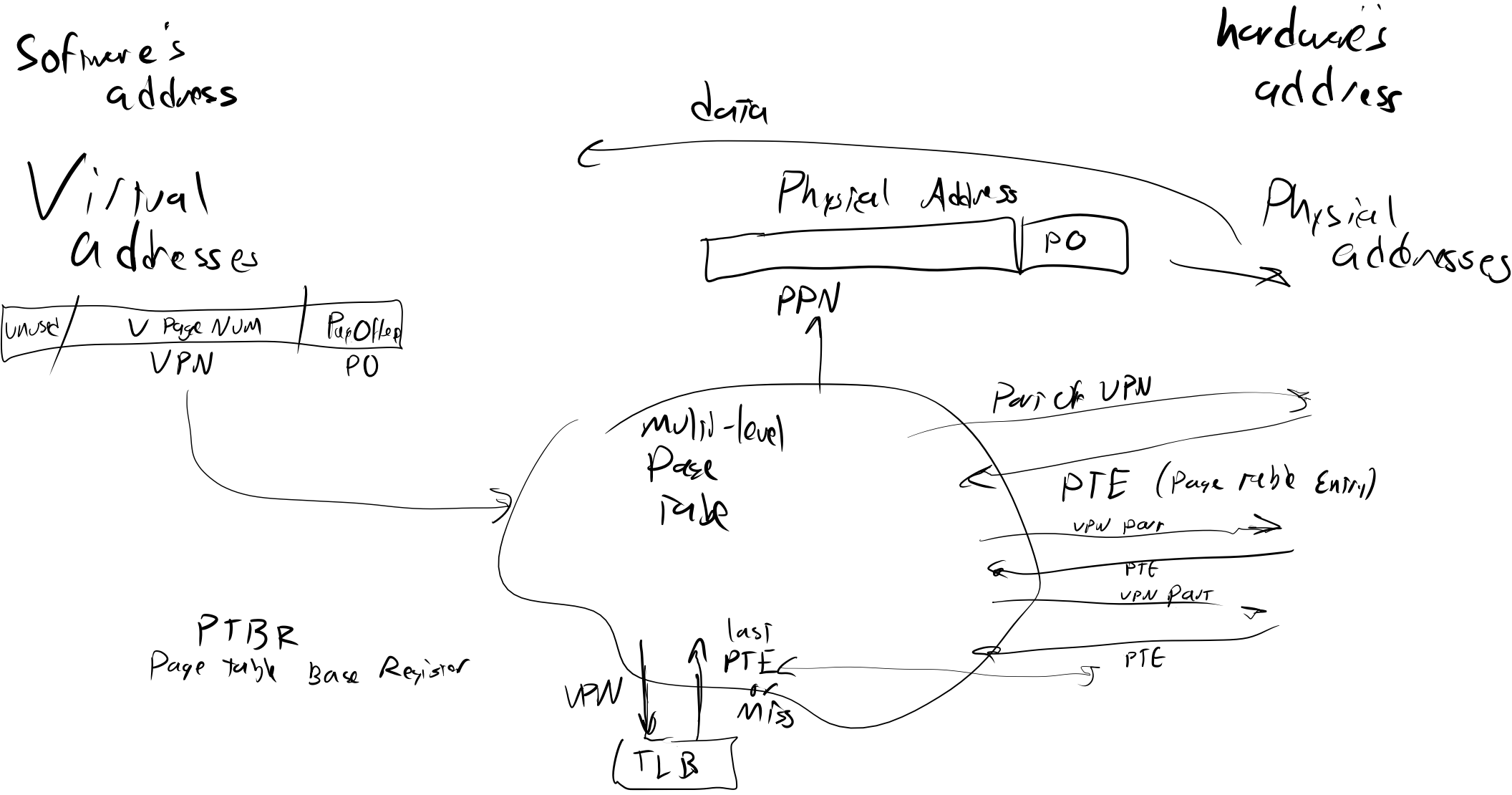


Virtual memory



Page

Continuous part
of address space
(either Physical or virtual)

Might mean
- Virtual page
- Physical page
- The pair of the two

4K = 2^{12}
PO = 12 bits
3 hex dig

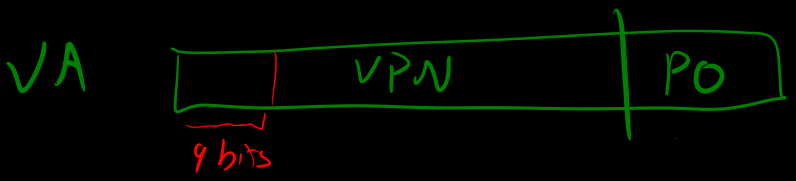
4KB pages are PN | PO
0x1234 | 567
and 0x1234 | 000
on the same page?

Page table

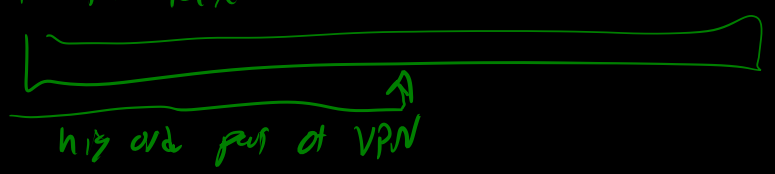
Common:
Data structure
VPN → PRN map

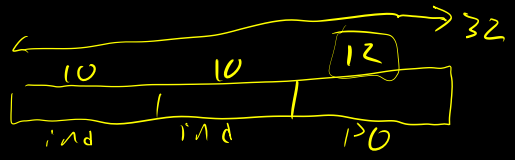
Sometimes (lazy)
1 level of a page table
i.e. 1 node in tree
i.e. 1 array
sized to be 1 page big
array of PTE

index into array

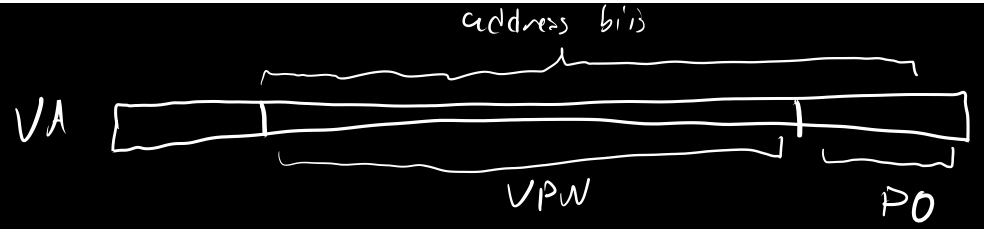


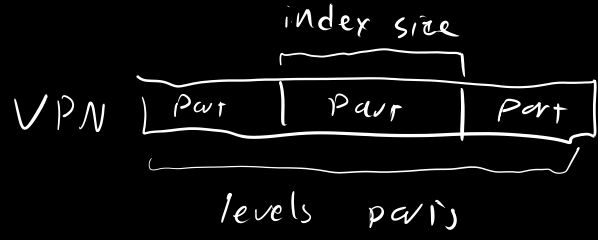
$$\frac{\#\ PTE}{array} = \frac{Size(array)}{Size(PTE)} = \frac{Size(Page)}{Size(void*)} = \frac{4kB}{8B} = 512$$





2^{12} B





ind size = Page offset size − 2

$32 = 3 * ind + 2$ $ind = 10$

$$\frac{\text{sizeof}(\text{void}^*)}{4} = \text{sizeof}(\text{PTE})$$

$$\frac{\text{1-page array of bytes}}{\text{1-page array of PTE}} = 4$$

$2^{\text{PO bits}}$

$2^{\text{VPN per bits}}$

100 in 1^s = $\frac{100 \text{ bills}}{} = 5$

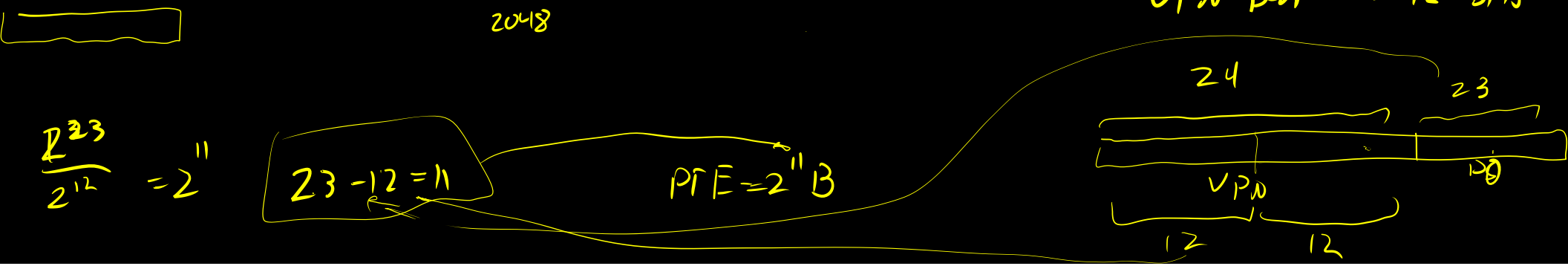
100 in 5^s = $\frac{20 \text{ bills}}{}$

$$\log\left(\frac{x}{y}\right) = \log(x) - \log(y)$$

PO = 23 bits

47 - 23 = VPN bits = 24

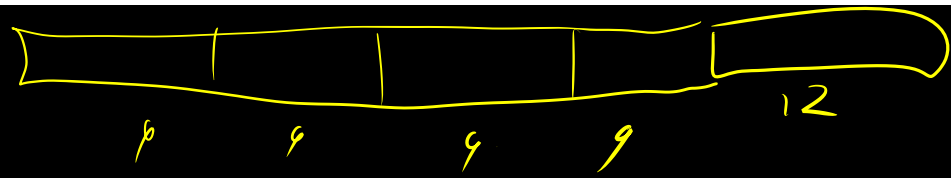
VPN part = 12 bits



PA bits = 3 + VPN Part bits

14 $\log_2(8)$ 11

level	add
0	14
1	25
2	36
3	47
4	58



48

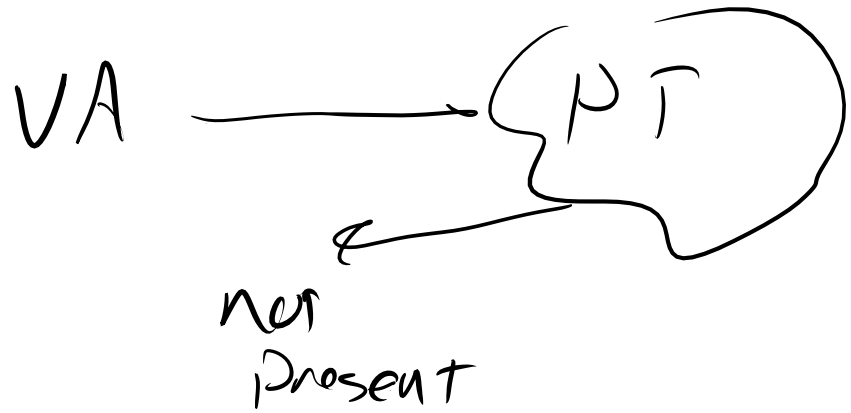
12 bit PO

VPNPB-POB = 3

VPNP = 9

Processes

kernels



Hardware:

Page fault

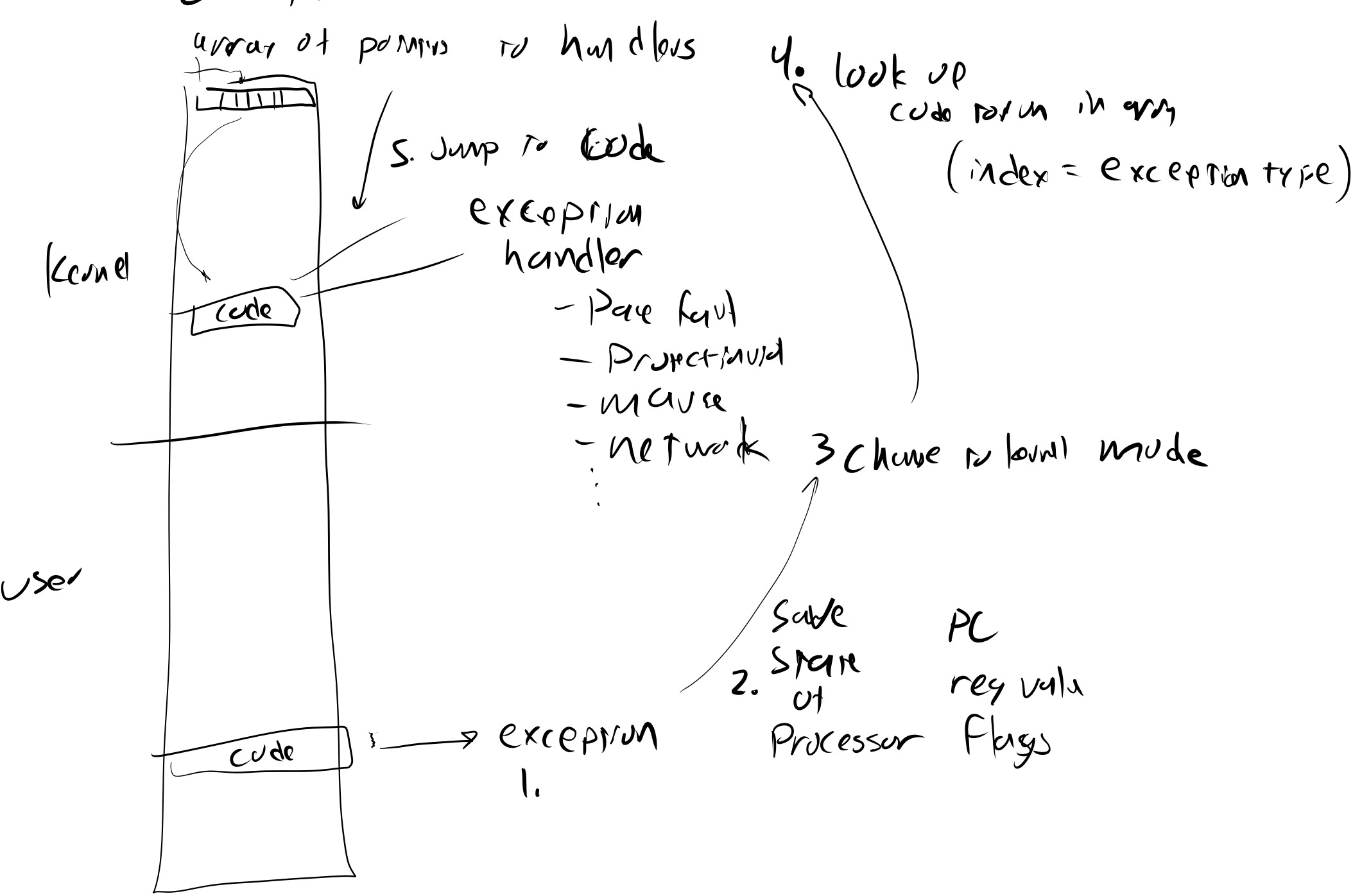
↑

a type of exception (interrupt)

what next?

1. allocate page
2. crash

Exceptions:


array of pointers to handlers
4. look up
code point in array
(index = exception type)
5. jump to code
exception
handler
- Page fault
- Protection
- Mouse
- network
:
kernel
code
3 Change to kernel mode
user
2. Save
State
of
Processor
PC
reg vals
flags
code
1. exception