

AMATH 483/583

High Performance Scientific Computing

Lecture:

Basic OS Memory Management

Andrew Lumsdaine
Northwest Institute for Advanced Computing
Pacific Northwest National Laboratory
University of Washington
Seattle, WA

You Have a Segmentation Fault, Now What?

```
$ ./a.out  
Segmentation fault
```

Access to
invalid memory

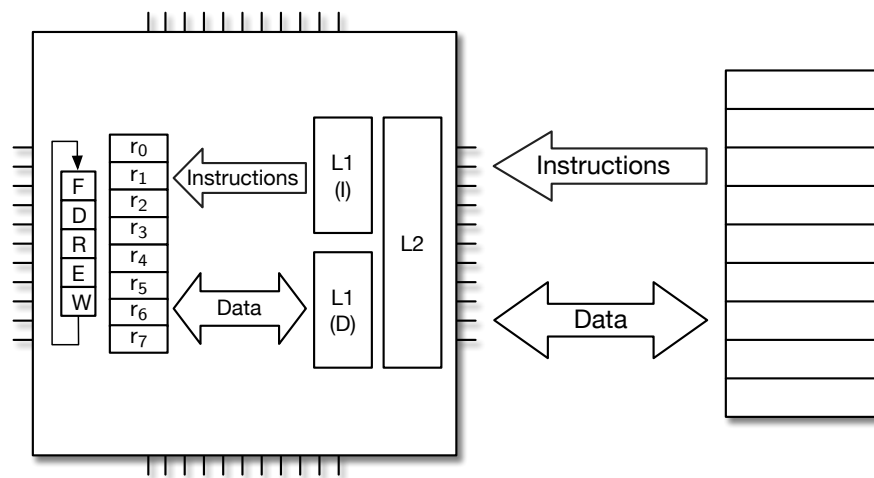
```
int main() {  
  
    int *p = 0;  
    *p = 0;  
  
    return 0;  
}
```

Pointer
(address)

Set to zero

Try to write

Over Simplified Memory Model



Two of the Same Program Running at the Same Time

```
Vector x(10);  
for (size_t i = 0; i < 10; ++i) {  
    x(i) = x(i) + i;  
}
```

```
Vector x(10);  
for (size_t i = 0; i < 10; ++i) {  
    x(i) = x(i) + i;  
}
```

Same x

Vector x

x(0)
x(1)



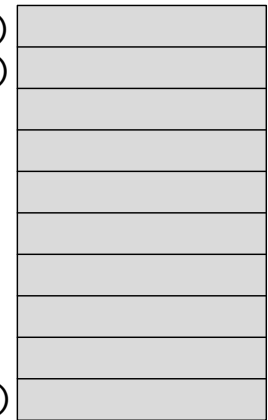
Not a race
condition

Programs are
completely
isolated

Same x

Vector x

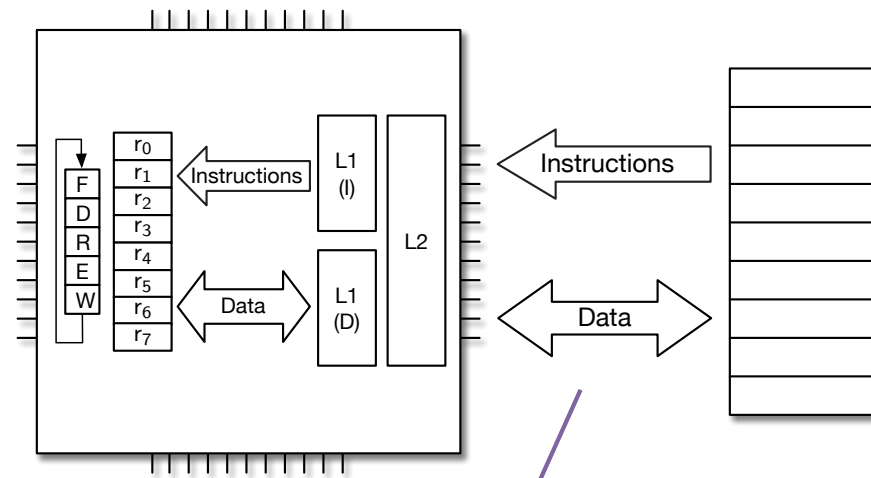
x(0)
x(1)



Same
address in
memory

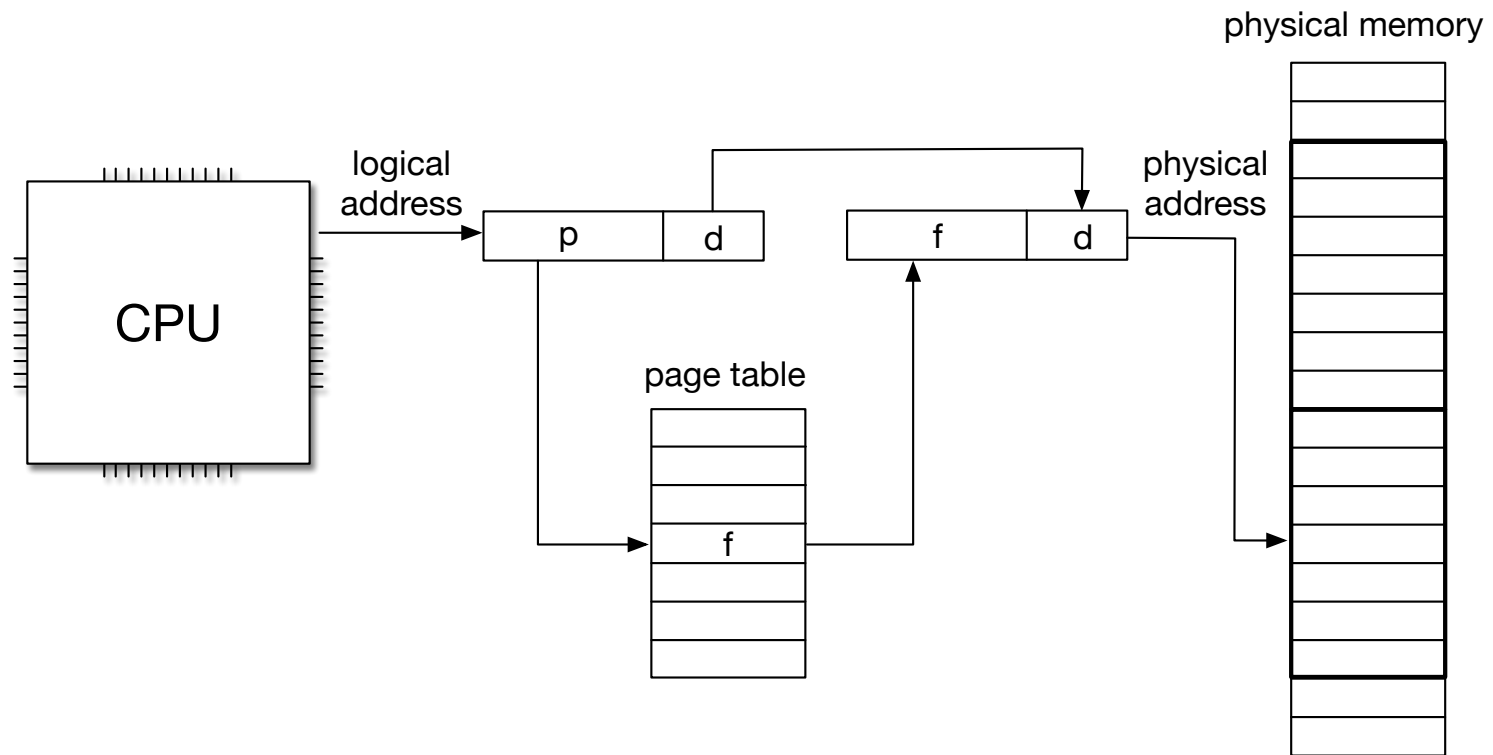
x(num_rows_ - 1)

Over Simplified Memory Model

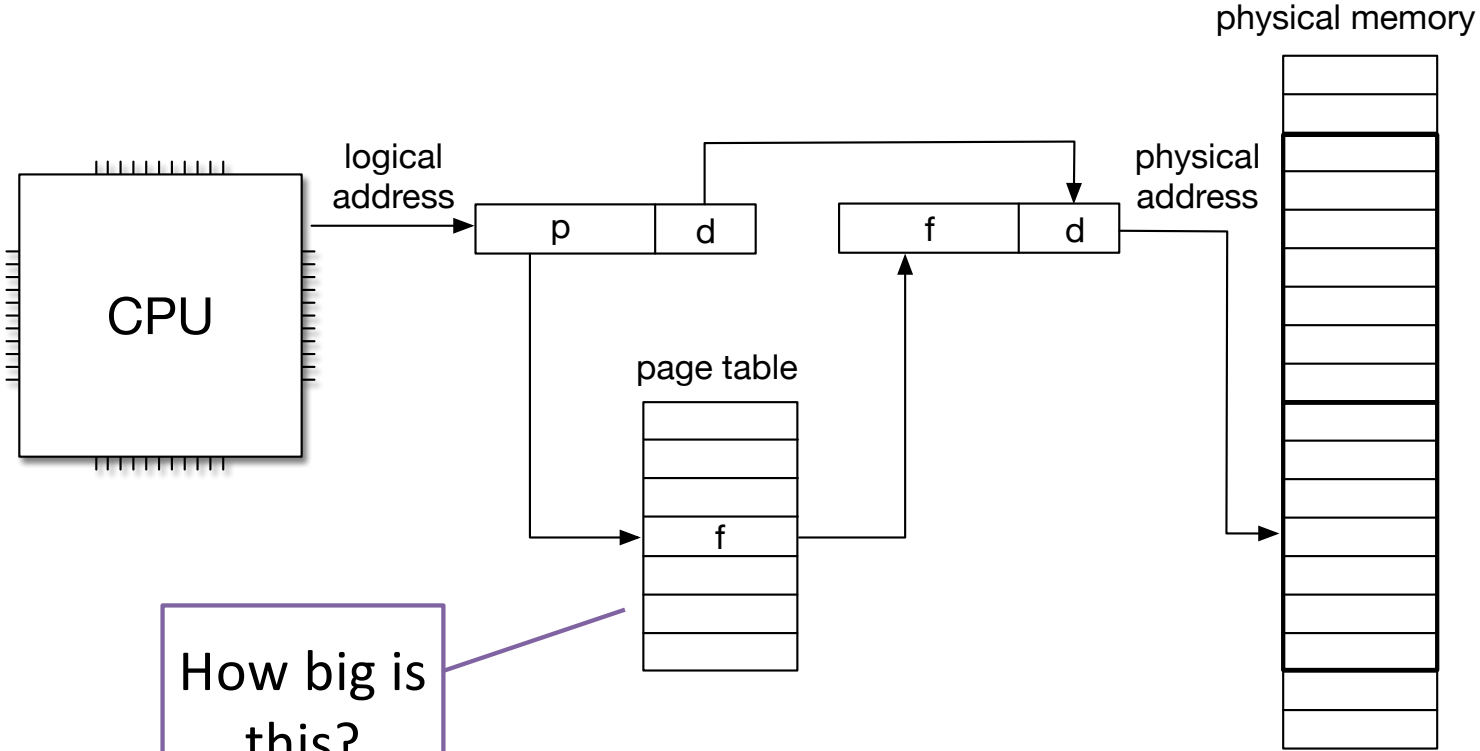


Add a layer
of
indirection

Paged Memory

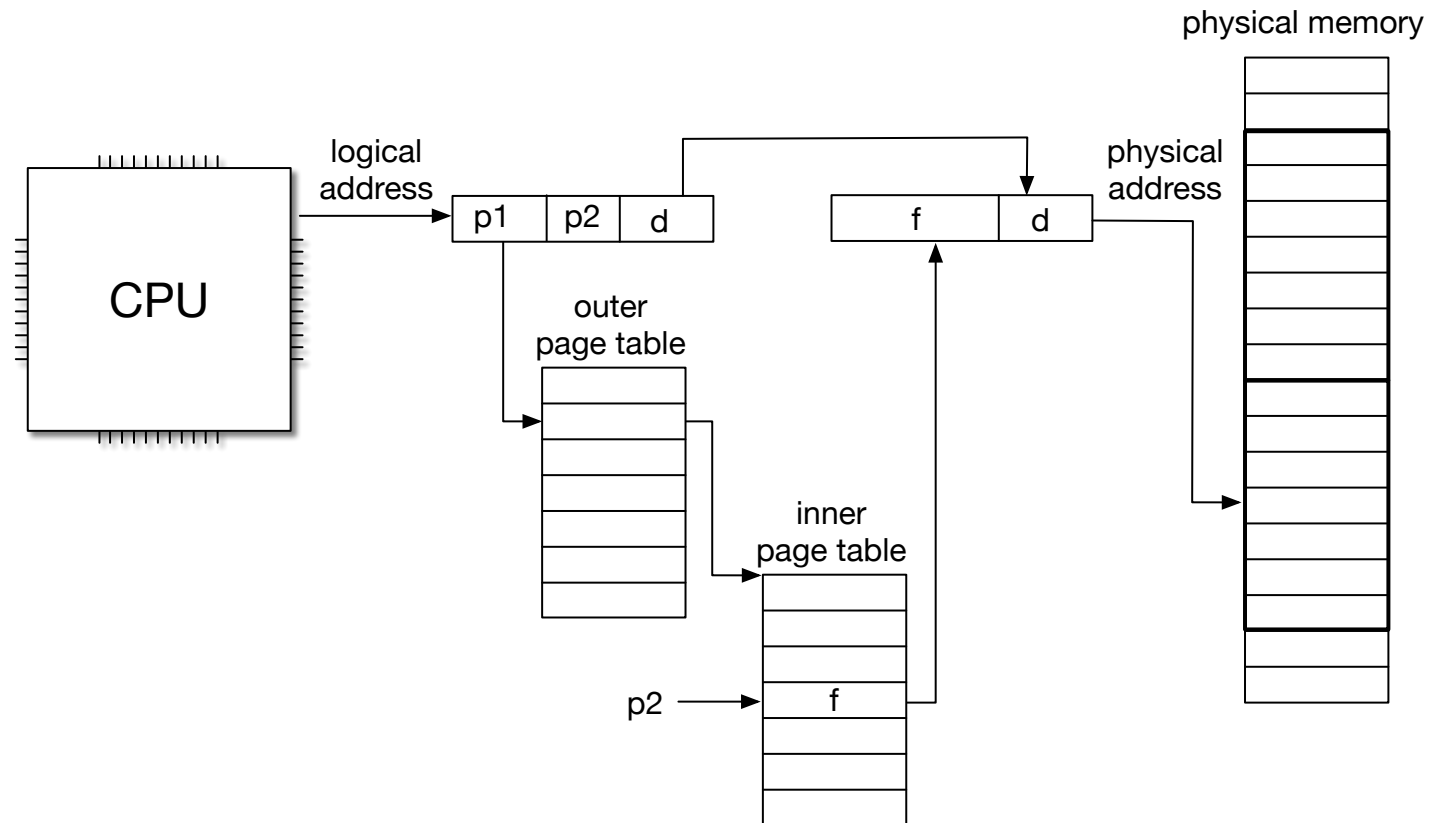


Paged Memory



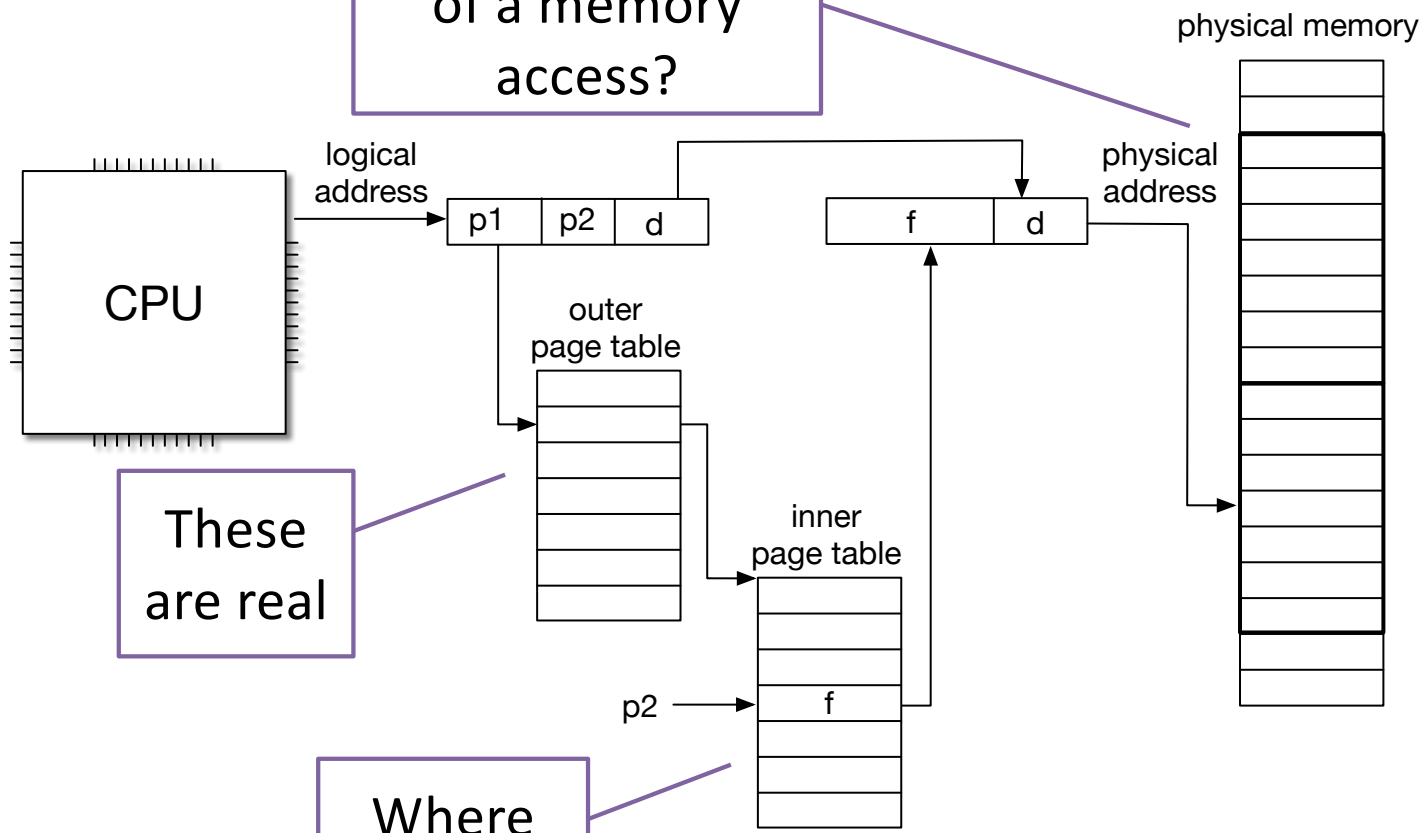
How big is this?

Two Level Page Table



Access Costs

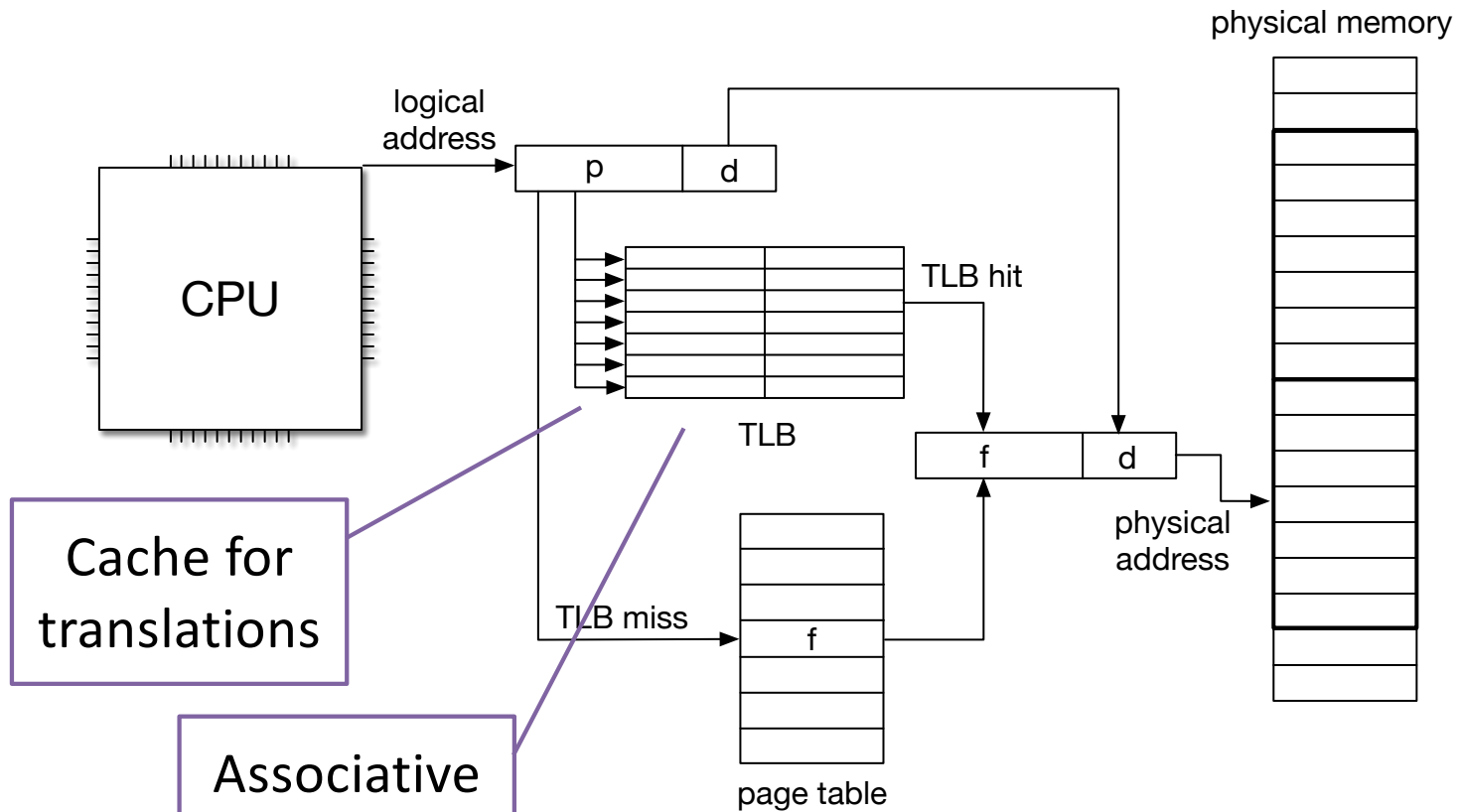
What is the cost of a memory access?



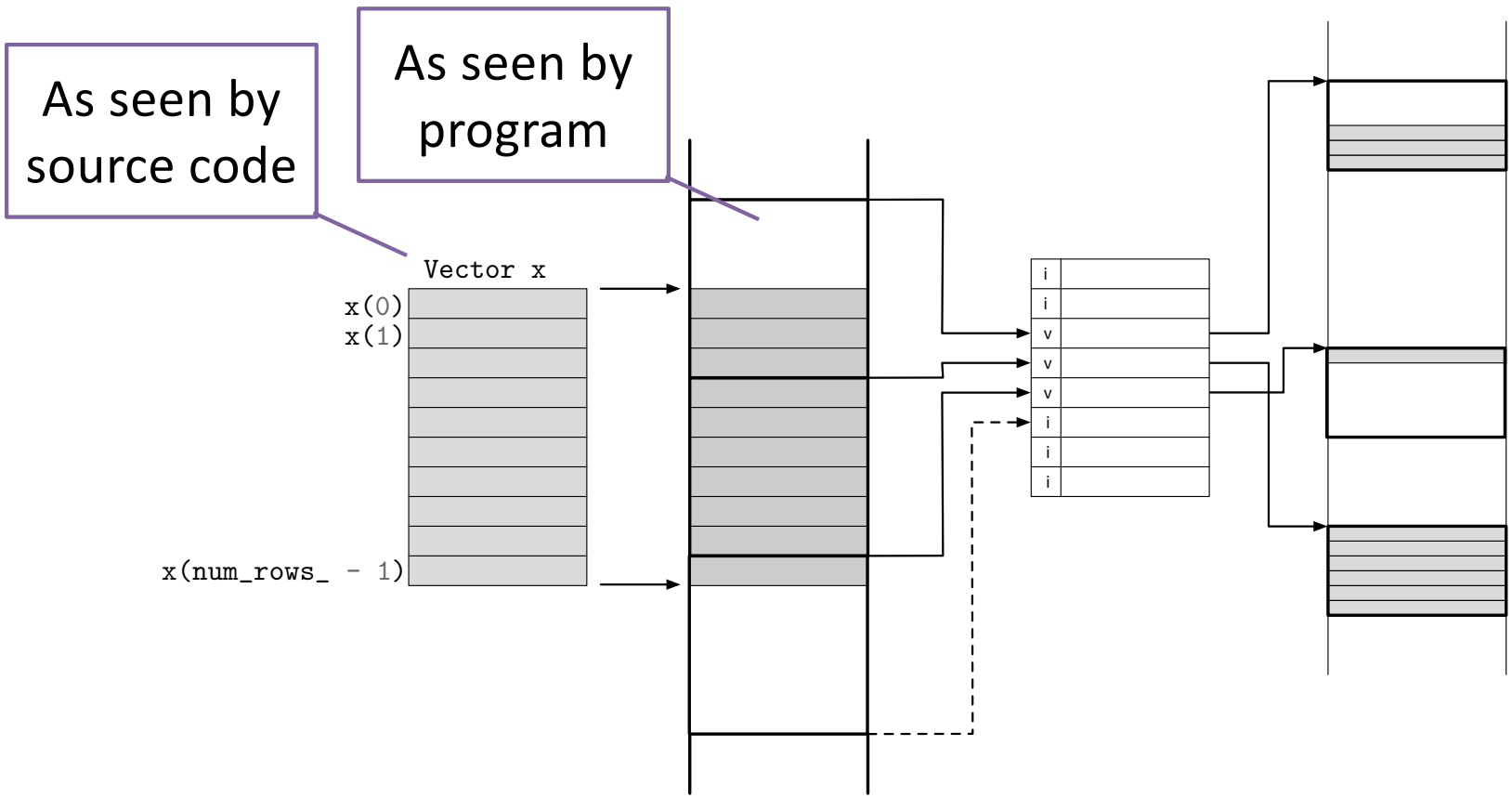
These are real

Where are they?

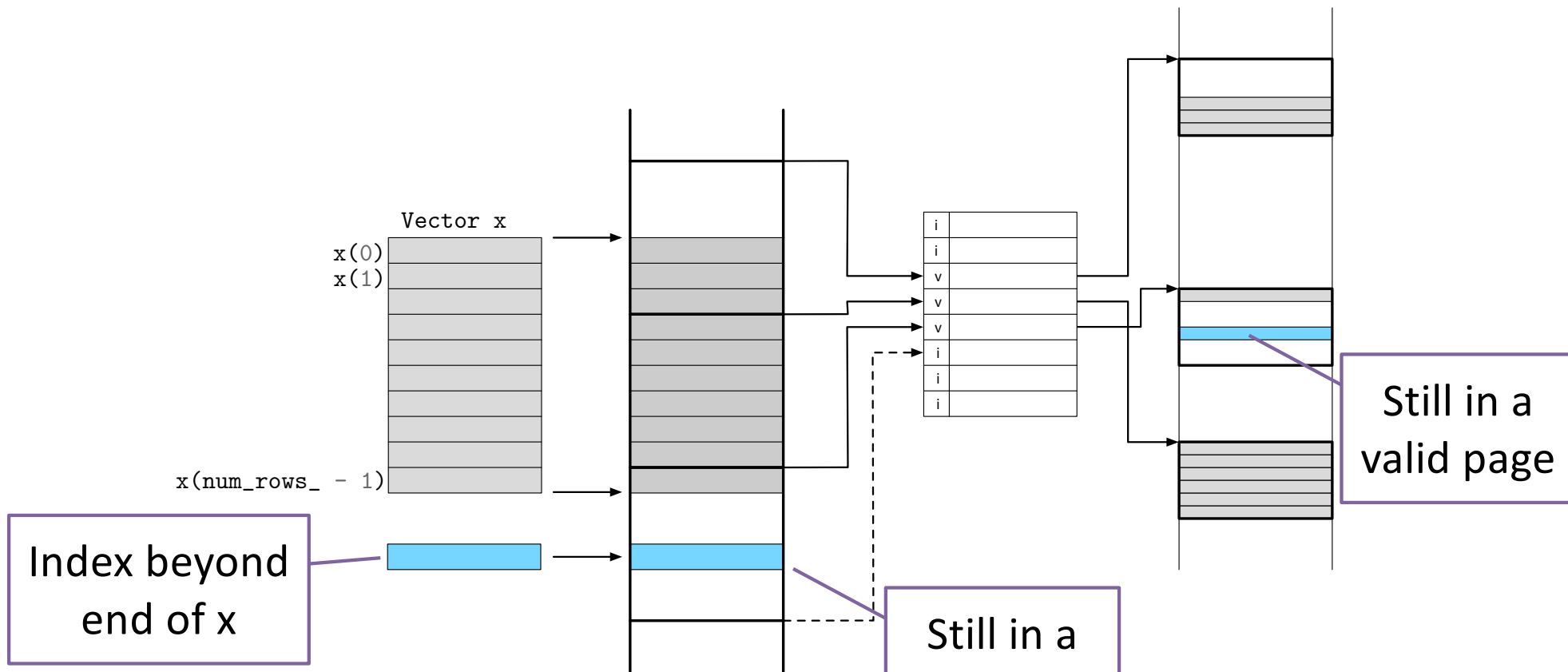
Translation Lookaside Buffer (TLB)



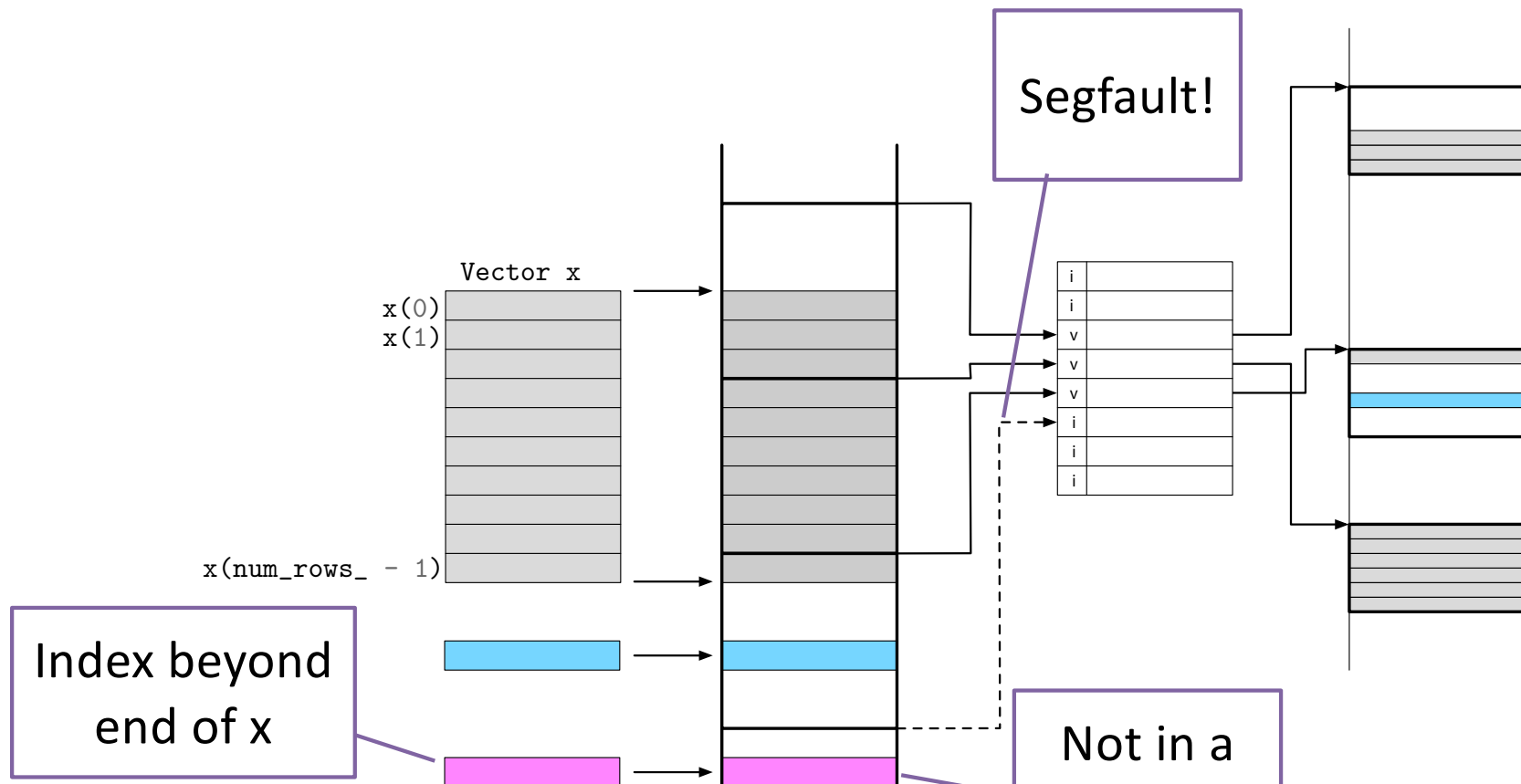
Memory Management



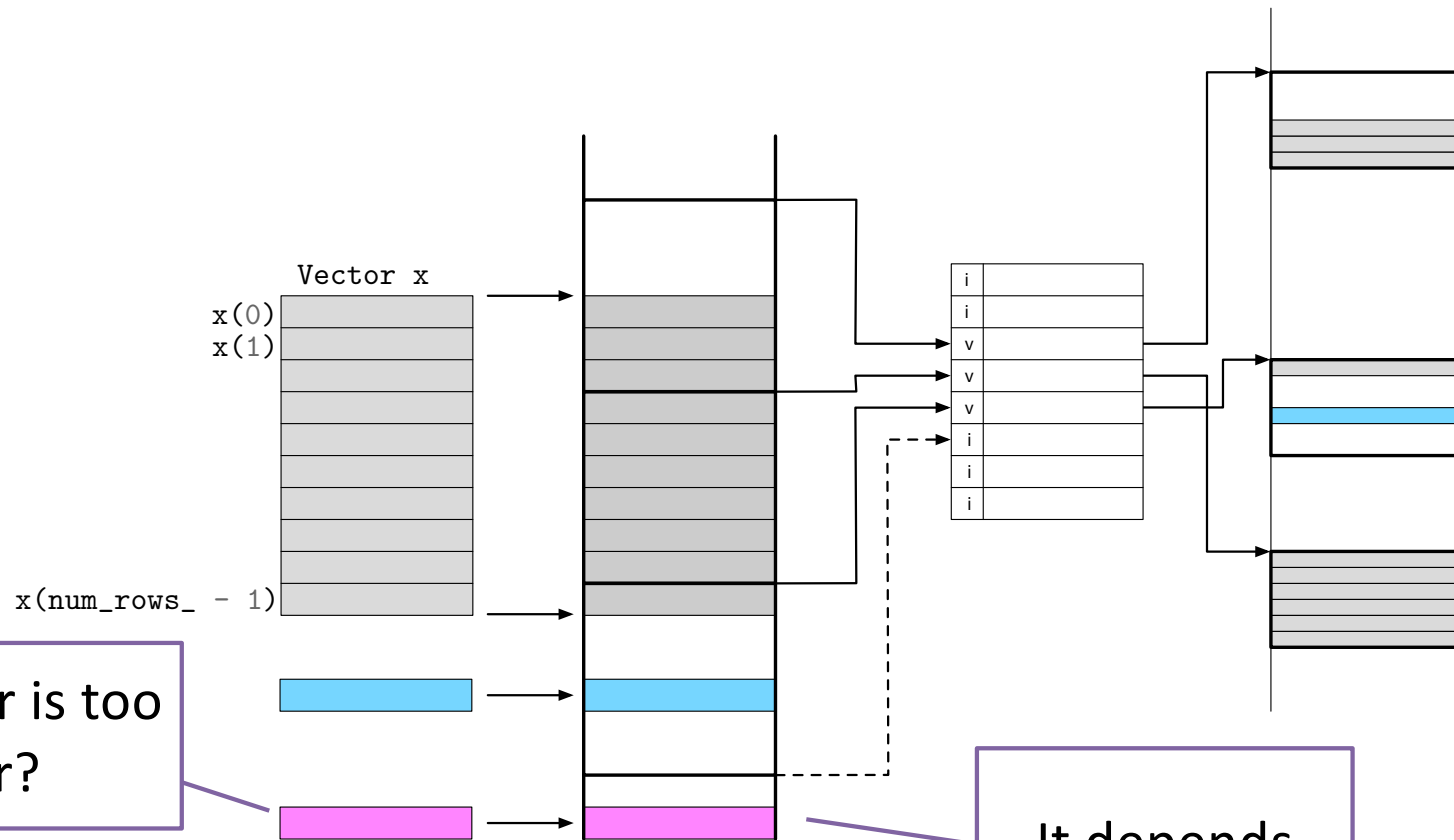
Accessing Out of Bounds Index



Accessing Unmapped Page



Accessing Unmapped Page



How far is too far?

It depends

Thank you!

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Pacific Northwest
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WASHINGTON

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