Page Size: 4 KB

Physical RAM

Stack

P1 Virtual Memory Space

... 

Phys. Page: [0xfff]

Page Table For P1

Index: [0x39]

Offset: 0x3ac

Heap

0x393ac 

... 

0xfff3ac 

Used

Used

Used

Used
Page Eviction

Virtual Page #: 17
Virtual Page #: 33
Virtual Page #: 40
Virtual Page #: 17
Virtual Page #: 43
Virtual Page #: 8
Virtual Page #: 99
Virtual Page #: 99
Virtual Page #: 33
Virtual Page #: 99
Virtual Page #: 17
Page Eviction Strategies

• Optimal (OPT)

• Least Recently Used (LRU)

• Least Frequently used (LFU)

• Not Recently Used (NRU) / Access Bit

• Working Set
Page Eviction

Virtual Page #: 17
Virtual Page #: 33
Virtual Page #: 40
Virtual Page #: 17
Virtual Page #: 43
Virtual Page #: 8
Virtual Page #: 99
Virtual Page #: 99
Virtual Page #: 33
Virtual Page #: 99
Virtual Page #: 17
Page Eviction

Virtual Page #: 17 →
Virtual Page #: 33 →
Virtual Page #: 40 →
Virtual Page #: 17 →
Virtual Page #: 43 →
Virtual Page #: 8 →
Virtual Page #: 99 →
Virtual Page #: 99 →
Virtual Page #: 33 →
Virtual Page #: 99 →
Virtual Page #: 17 →
Page Eviction

Virtual Page #: 17
Virtual Page #: 33
Virtual Page #: 40
Virtual Page #: 17
Virtual Page #: 43
Virtual Page #: 8
Virtual Page #: 99
Virtual Page #: 99
Virtual Page #: 33
Virtual Page #: 99
Virtual Page #: 17
Page Eviction

Virtual Page #: 17
Virtual Page #: 33
Virtual Page #: 40
Virtual Page #: 17
Virtual Page #: 43
Virtual Page #: 8
Virtual Page #: 99
Virtual Page #: 99
Virtual Page #: 33
Virtual Page #: 99
Virtual Page #: 17
Status Bit #2

• **Accessed (A) Bit:**
  
  – This bit denotes if the page has been recently accessed.

  – **A=1**: The page has been recently accessed.
  
  – **A=0**: The page has not been recently accessed.

  • When the PTE is accessed, the R bit is set to 1. The MMU will scan page tables when memory is needed. When the MMU scans the memory:
    
    – If R=1, R is set to 0.
    
    – If R=0, page is evicted.
Status Bit #3

• **Dirty (D) Bit:**
  
  – Denotes if the page has been written to, and needs to be updated on disk when paged out.

  – **D=1:** The page is “dirty” and needs to be written to disk when paged out.

  – **D=0:** The page is “clean” and does not need to be written to disk when paged out.
Status Bit #4

• **Read/Write (R) Bit:**
  – Denotes if the page is read-only or read/write.

  – **R=1**: The page is read/write.
  – **R=0**: The page is read-only.

• Areas of memory when the binary source of the process is located would be read-only.
• **Never eXecute (NX) Bit:**
  
  – Denotes if the page’s content should never execute code.
  
  – **NX=1**: The content of the page should never be executed
  
  – **NX=0**: The content of the may be executed
    
    • Areas such as heap and stack memory, that should never contain executable code, would have NX=1.
int subtract(int a, int *b) {
    int c = a - *b;
    return c;
}

int add(int a, int *b) {
    int c = a + *b;
    return c;
}

void main() {
    int a = 4;
    int *b = malloc(sizeof(int));
    *b = 7;
    int c = add(a, b);
    int d = subtract(c, b);
}