CSE320 System Fundamentals II

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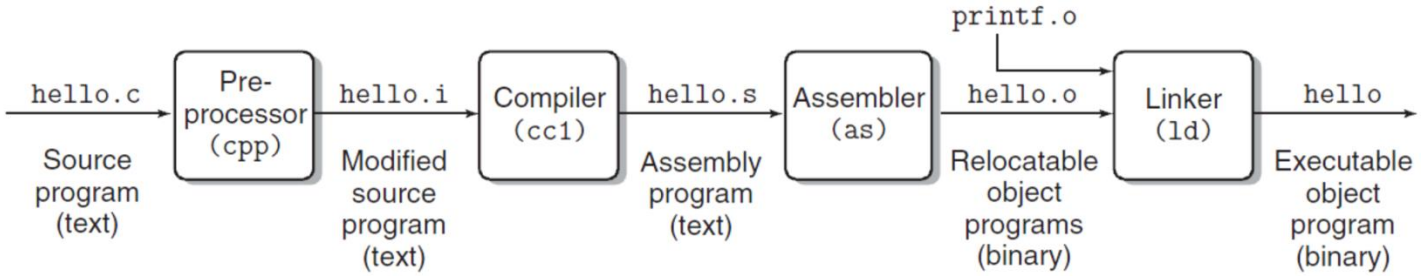
Compilation



- `gcc hello.c`
- `gcc -E hello.c -o hello.i`
- `gcc -S hello.c`
- `gcc hello.s`

C Programming & Run-time Environments

Variables

Flow control

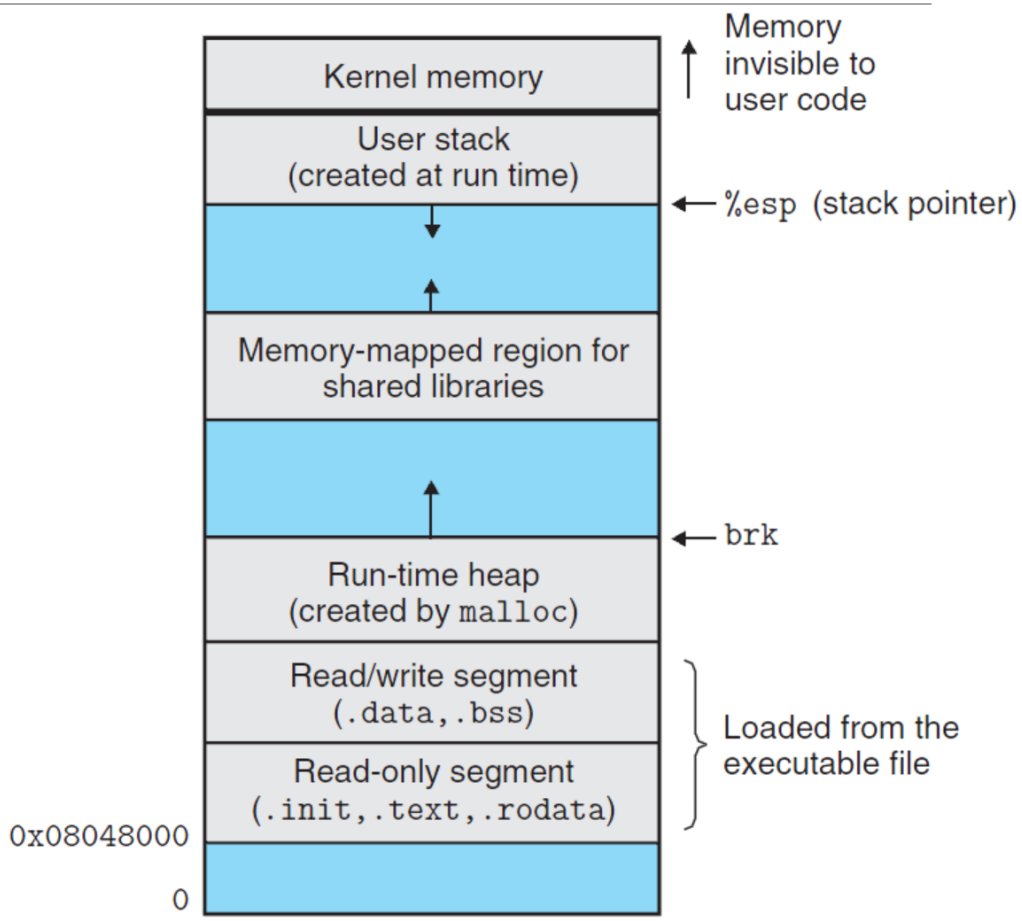
Function calls

Structures

Pointers

Dynamic memory allocation

Runtime env.

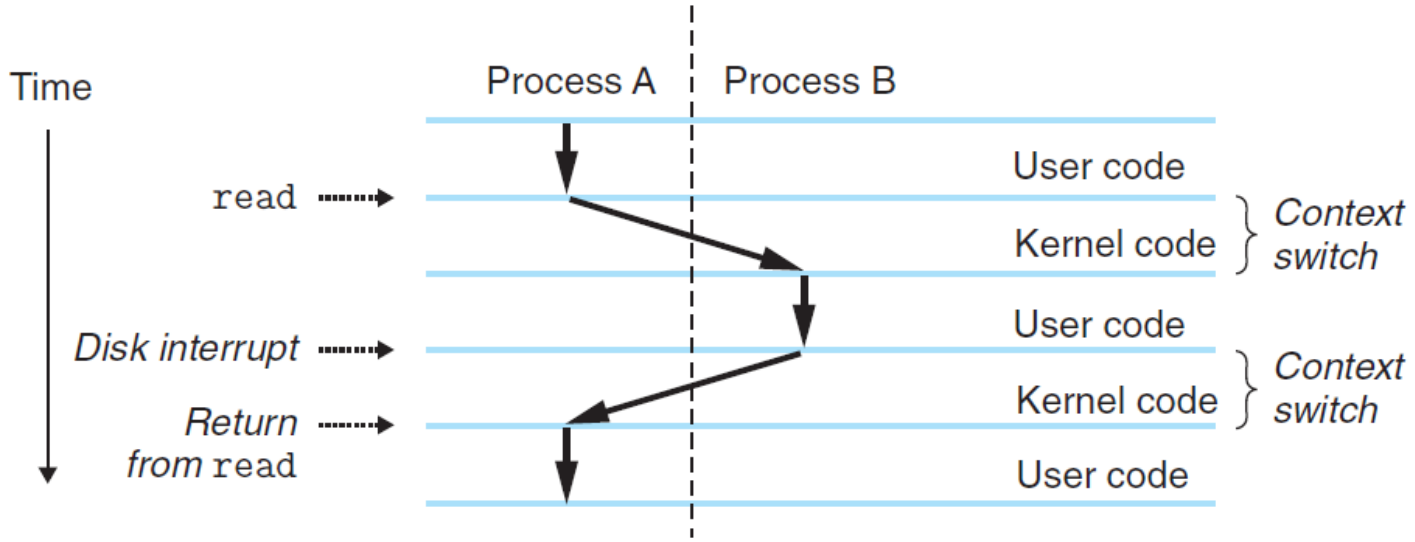


```c
#include <stdio.h>
void foo(
    char* msg)
{
    int a = 100;
    printf(
        "%s %d\n",
        msg,
        a);
}

int main(
    int argc,
    char** argv)
{
    foo("Hello World");
    return 0;
}
```

```
    .section    .rodata
.LC0: .string   "%s %d\n"
.LC1: .string   "Hello World"
    .text
    .globl  foo, main
foo:
    pushq   %rbp
    movq    %rsp, %rbp
    subq    $32, %rsp
    movq    %rdi, -24(%rbp)
    movl    $100, -4(%rbp)
    movl    -4(%rbp), %edx
    movq    -24(%rbp), %rax
    movq    %rax, %rsi
    movl    $.LC0, %edi
    movl    $0, %eax
    call    printf
    leave
    ret
```

```
main:
    pushq   %rbp
    movq    %rsp, %rbp
    subq    $16, %rsp
    movl    %edi, -4(%rbp)
    movq    %rsi, -
16(%rbp)
    movl    $.LC1, %edi
    call    foo
    movl    $0, %eax
    leave
    ret
```

System Calls



User mode code cannot access resources directly

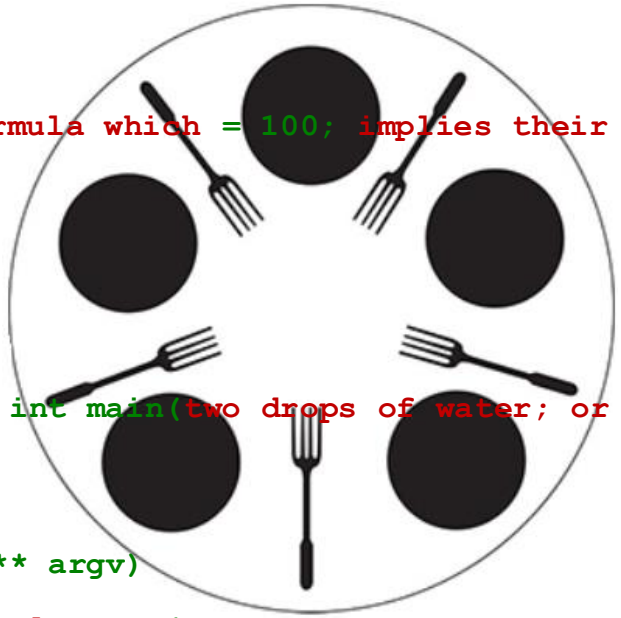
Ask the OS to handle the request

`read, write, fork, execv, _exit, …`

Threads and Locks

If two processes are printing together at the same time…

```
#include <stdio.h>

void foo(Repetition Is not generality. Repetition and generality

    char* msg)

{

    int amust be distinguished in several ways. Every formula which = 100; implies their

printf("%s %d\n", confusion is regrettable:

msg, a);

}

for example, when we say that two things are as alike as int main(two drops of water; or
when we identify 'there is only a science of the general'

 int with argc,

'there is only a science of that which is repeated.'char** argv)

Repetition and resemblance are different in kind - extremely so. {

    foo("Hello World");

    return 0;

}
```



Performance

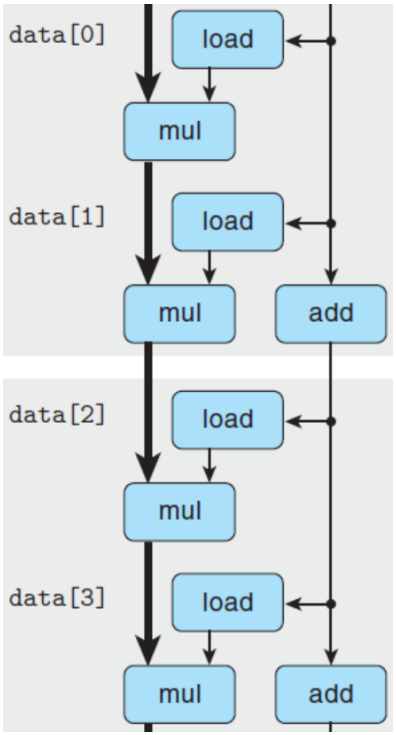
Which of the two programs will run faster?

```
int a[100][100];
for (i = 0; i<100; i++)
    for (j = 0; j<100; j++)
        s += a[i][j];
```

```
int a[100][100];
for (i = 0; i<100; i++)
    for (j = 0; j<100; j++)
        s += a[j][i];
```

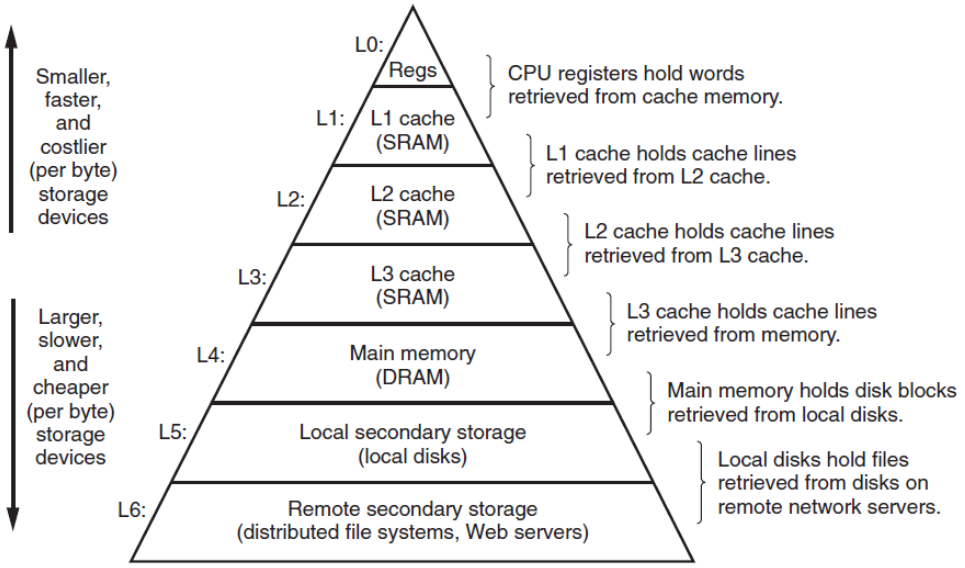
```
for (i = 0; i<100; i += 2)
    acc = (acc * data[i]) * data[i + 1];
```

```
for (i = 0; i<100; i += 2)
    acc = acc * (data[i] * data[i + 1]);
```



Memory Hierarchy, Locality, Virtual memory

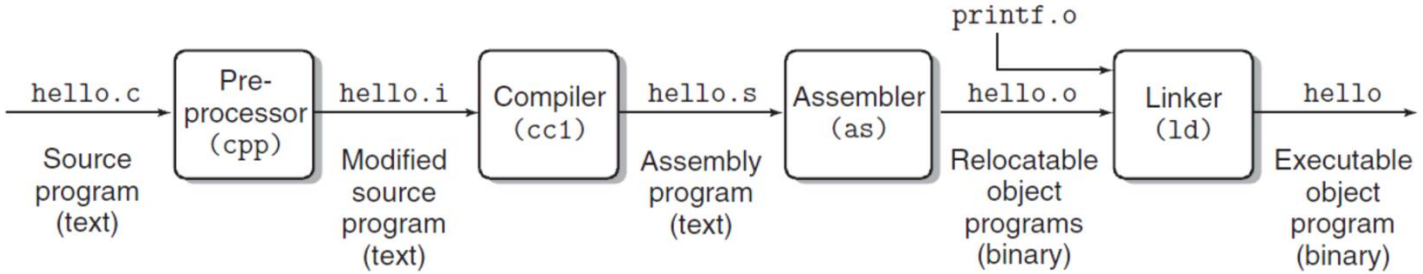
Memory Hierarchy

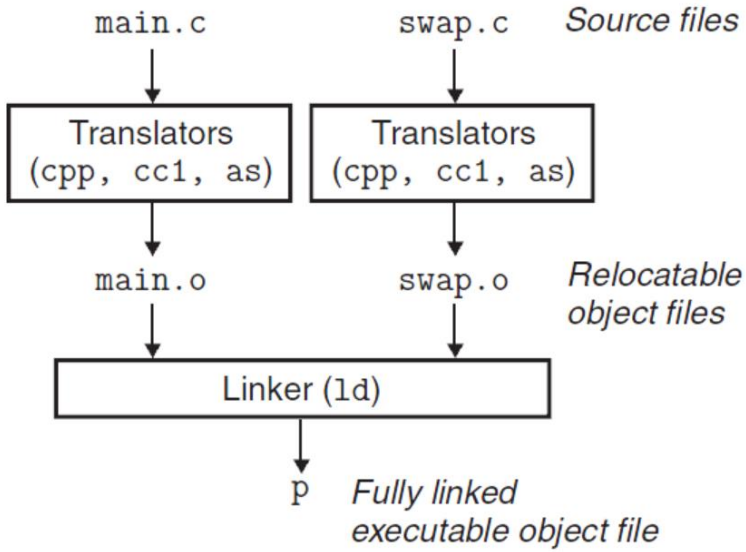


Magic?

- I bought a PC with 8GB of memory, but I got 100 processes running each with 4GB of memory.

Memory Mapping and Linking





Questions?