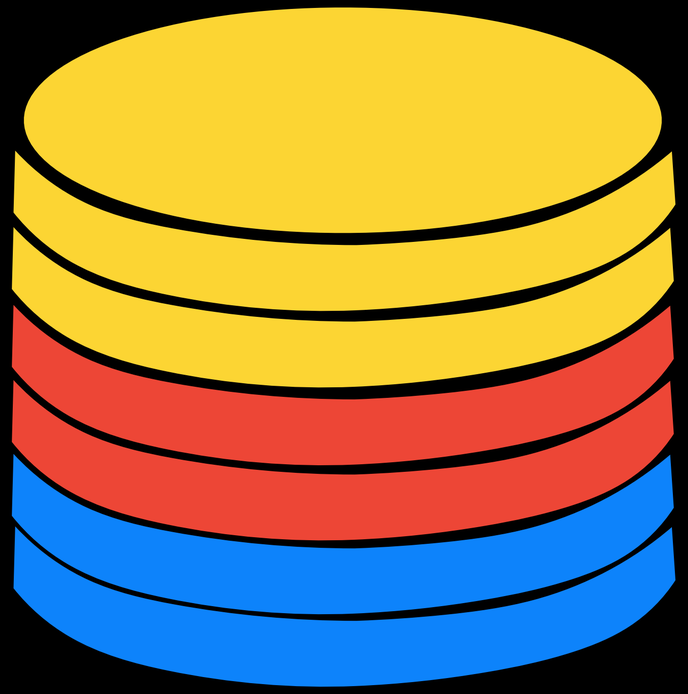
File Attributes

struct stat

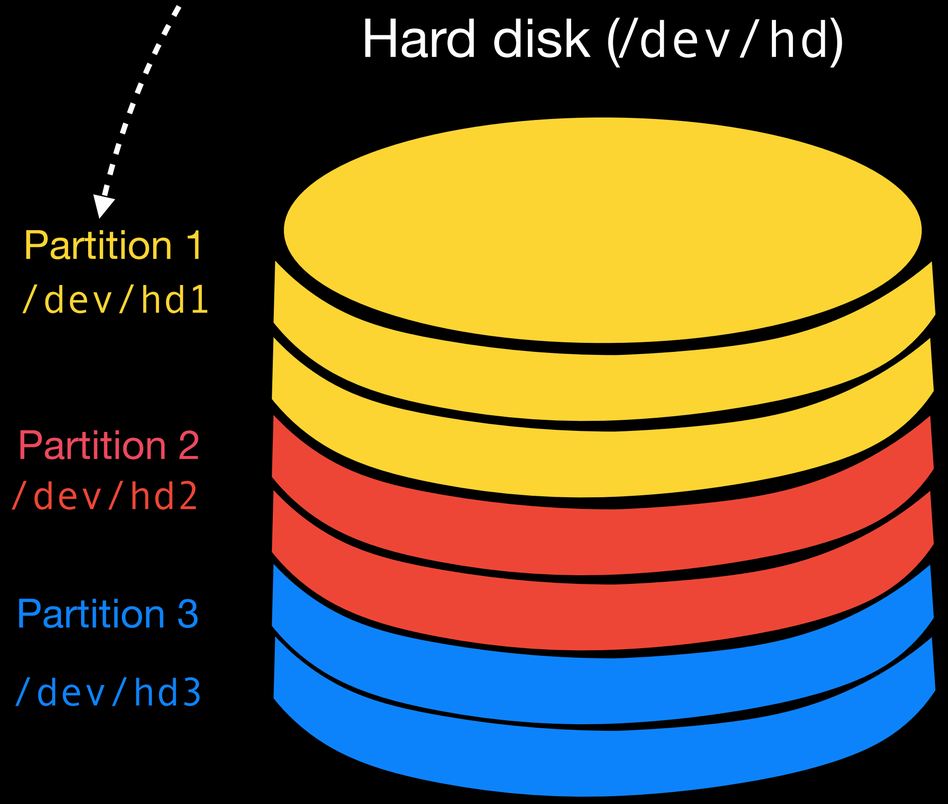
```
struct stat {
    dev_t     st_dev;     ID of device containing the file
```

```
struct stat {
    dev_t     st_dev;     ID of device containing the file
```

Hard disk (/dev/hd)



```
struct stat {
    dev_t     st_dev;     ID of device containing the file
```



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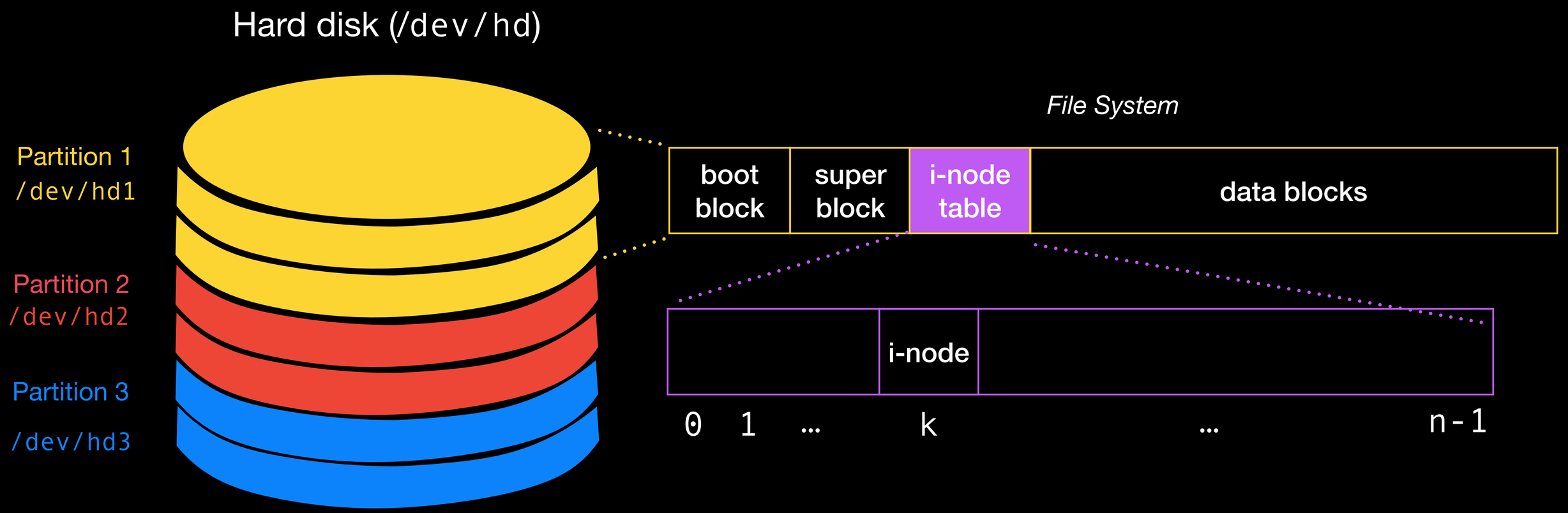
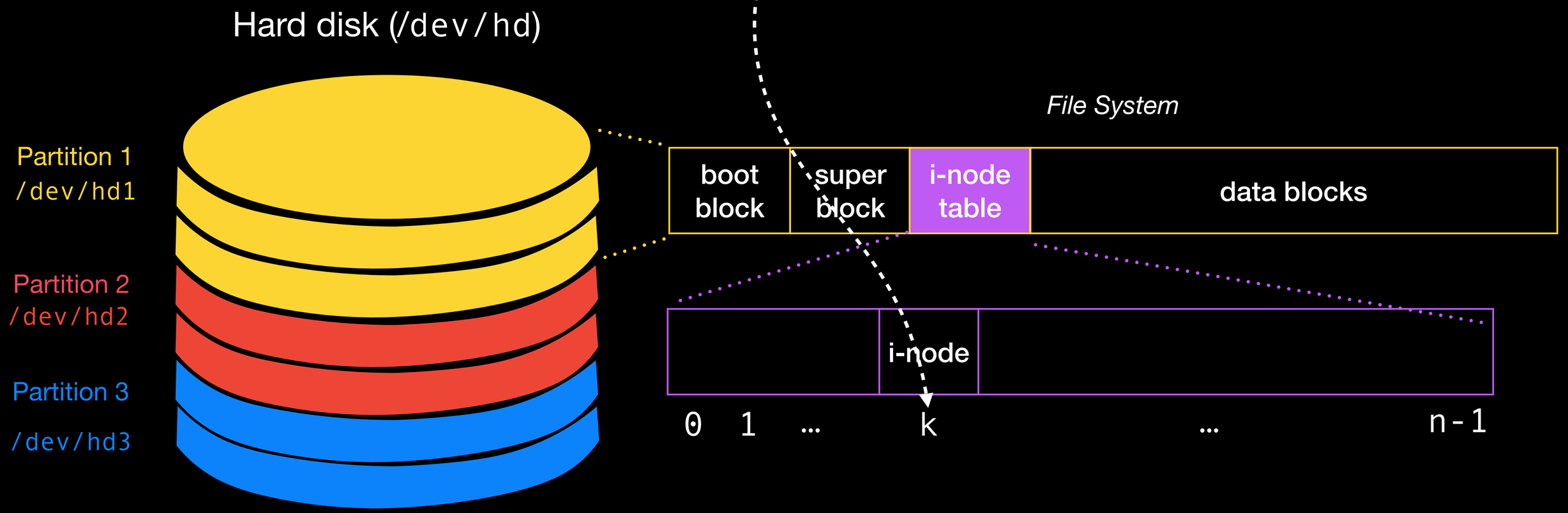
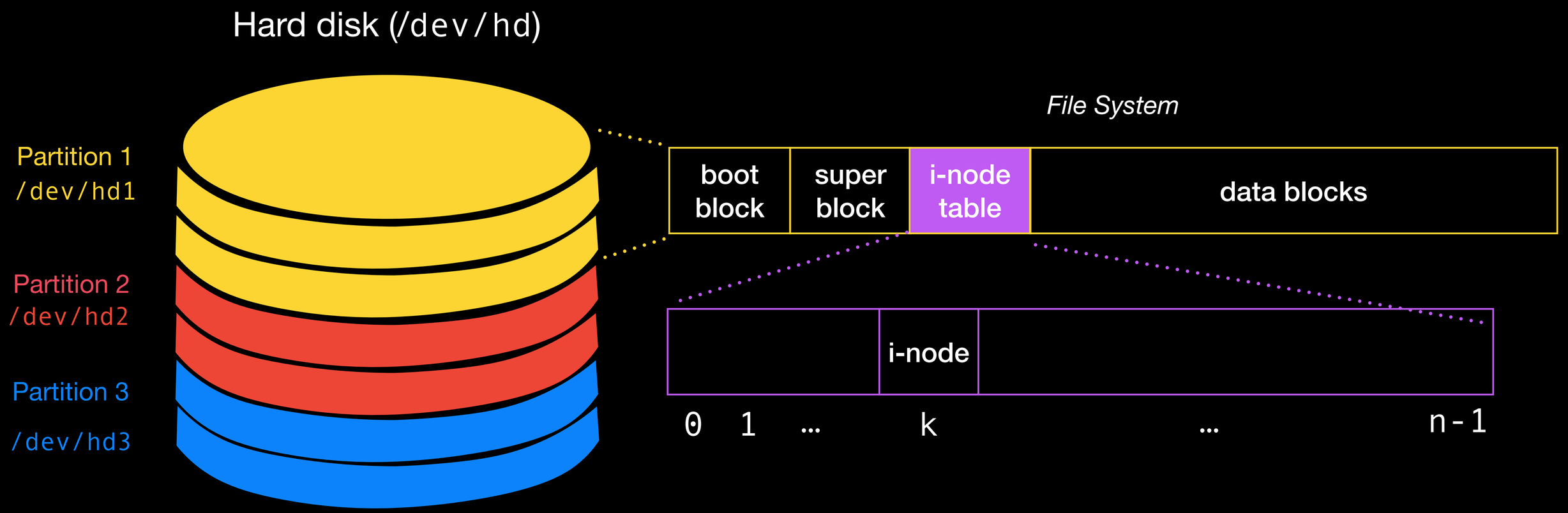
struct stat {
    dev_t     st_dev;     ID of device containing the file
```



```
struct stat {
    dev_t     st_dev;     ID of device containing the file
    ino_t     st_ino;     i-node number
```

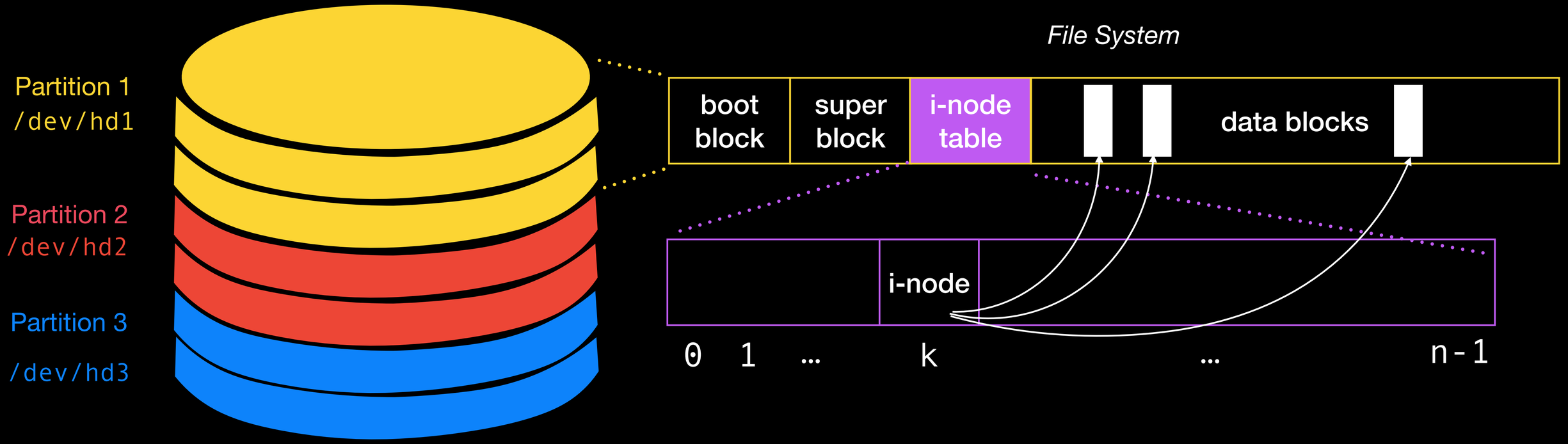


```
struct stat {
    dev_t     st_dev;     ID of device containing the file
    ino_t     st_ino;     i-node number
    off_t     st_size;    Total file size (bytes)
```



```
struct stat {
    dev_t     st_dev;     ID of device containing the file
    ino_t     st_ino;     i-node number
    off_t     st_size;    Total file size (bytes)
    blkcnt_t  st_blocks;  Number of (512B) blocks allocated
```

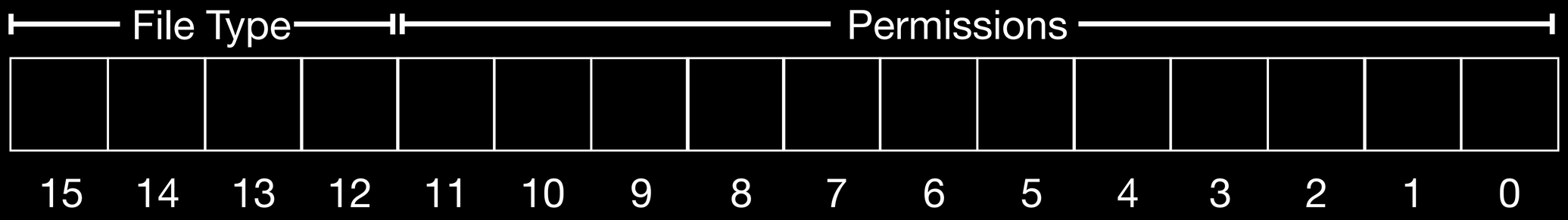
Hard disk (/dev/hd)



```
struct stat {
    …
    uid_t  st_uid;    User ID of file owner
```

```
struct stat {
    …
    uid_t  st_uid;    User ID of file owner
    gid_t  st_gid;    Group ID of file owner
```

```
struct stat {
    …
    uid_t  st_uid;    User ID of file owner
    gid_t  st_gid;    Group ID of file owner
    mode_t st_mode;   File type and mode
```



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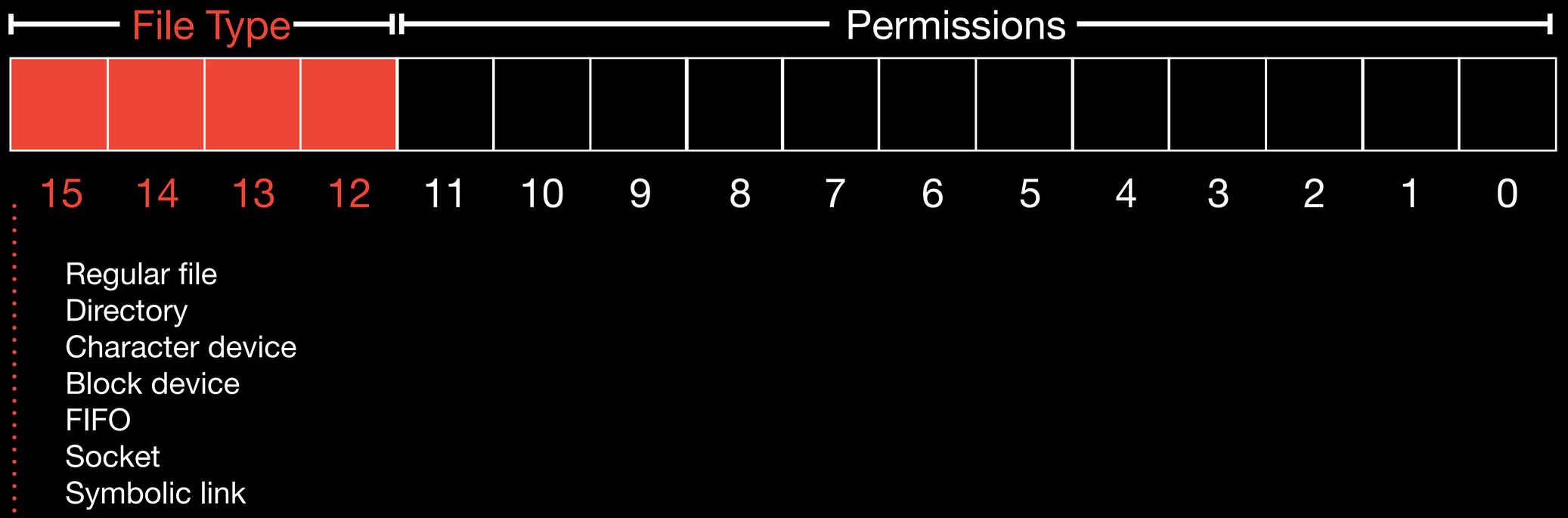
    uid_t  st_uid;    User ID of file owner
    gid_t  st_gid;    Group ID of file owner
    mode_t st_mode;   File type and mode
```



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    uid_t   st_uid;    User ID of file owner
    gid_t   st_gid;    Group ID of file owner
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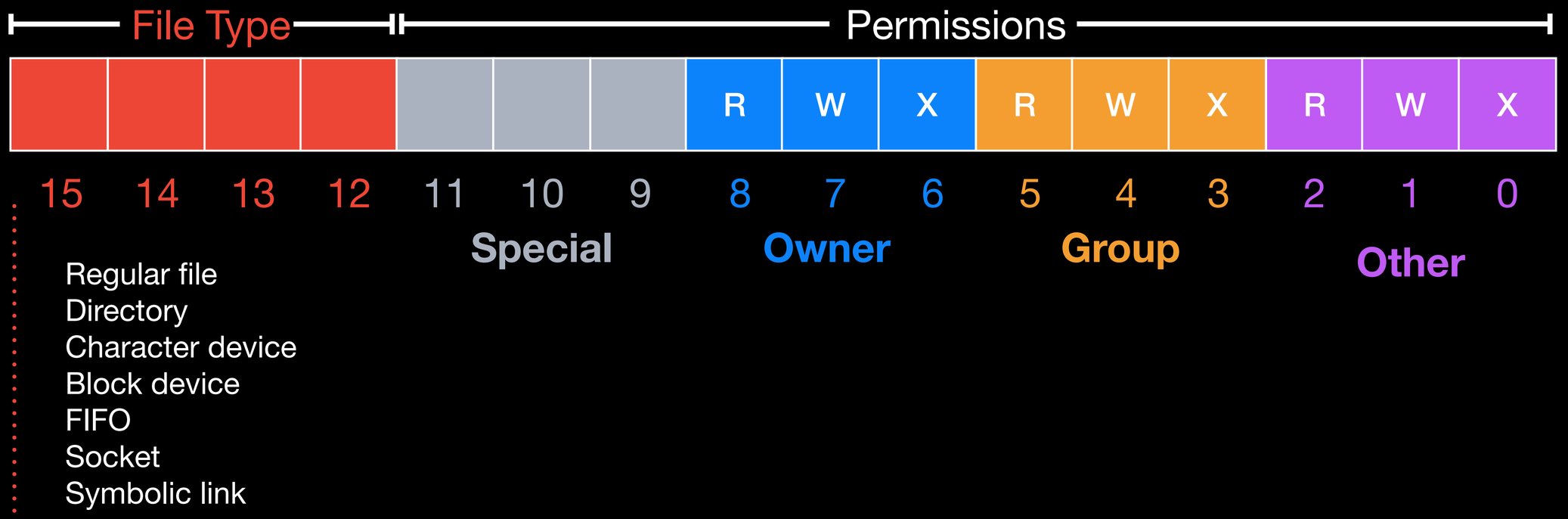

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    …
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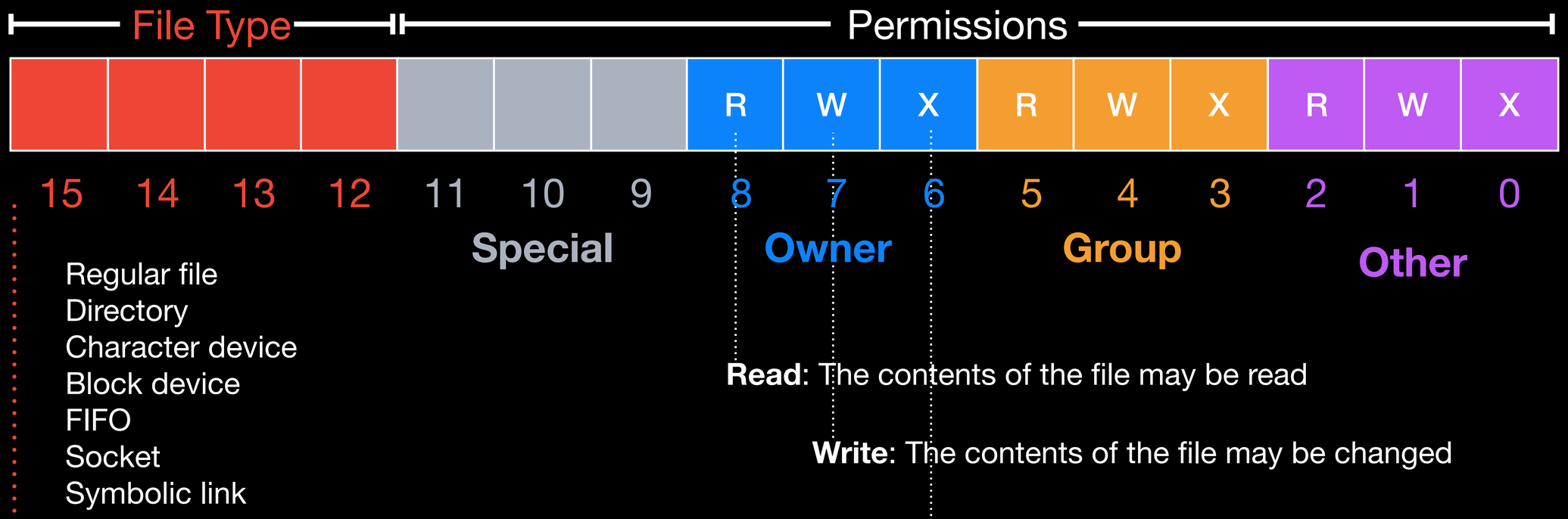
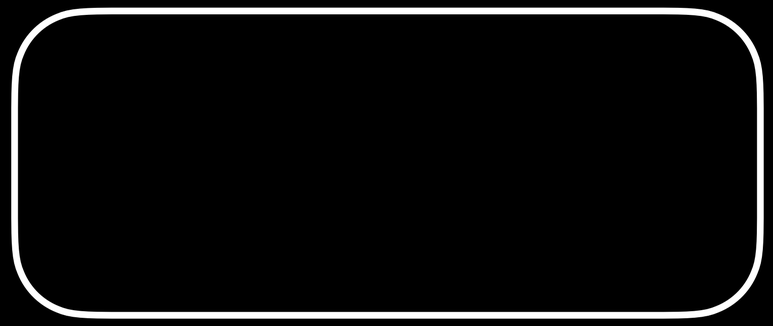
    gid_t   st_gid;    Group ID of file owner
    mode_t st_mode;    File type and mode
```



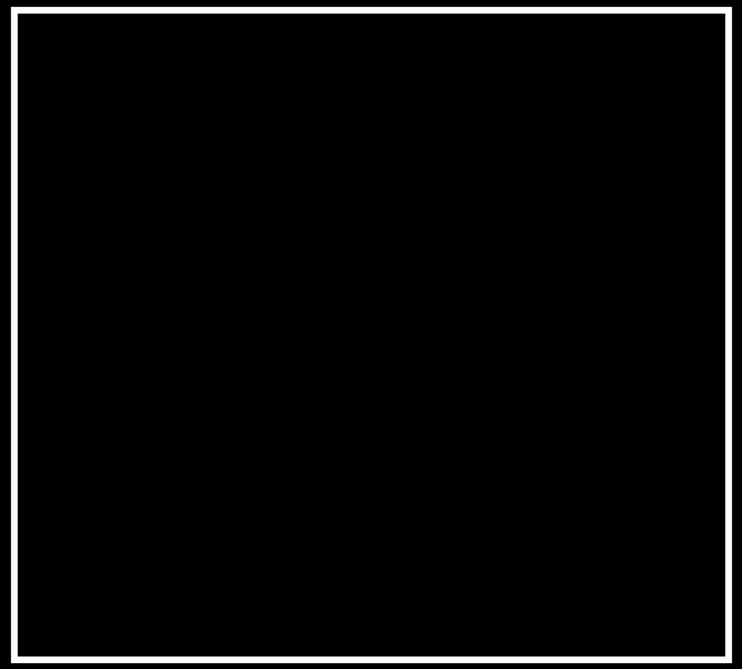
kernel space

user space

process



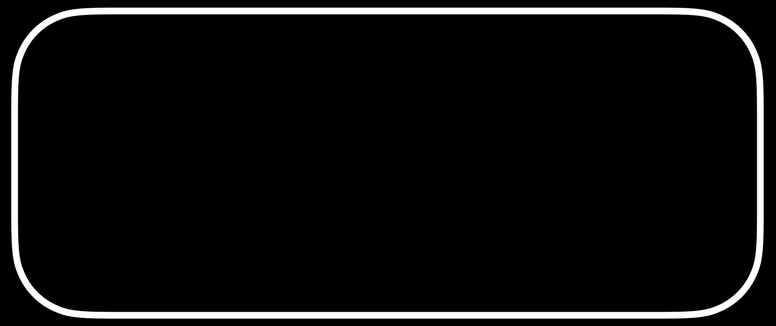
process info



kernel space

user space

process



process info

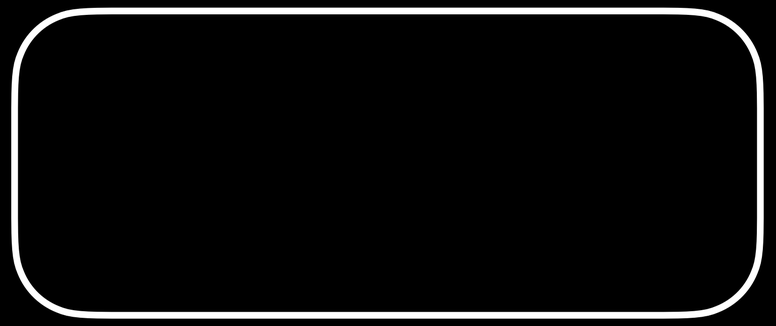
```
real UID: 100
real GID: 100

supplementary GIDS: 500, 501
```

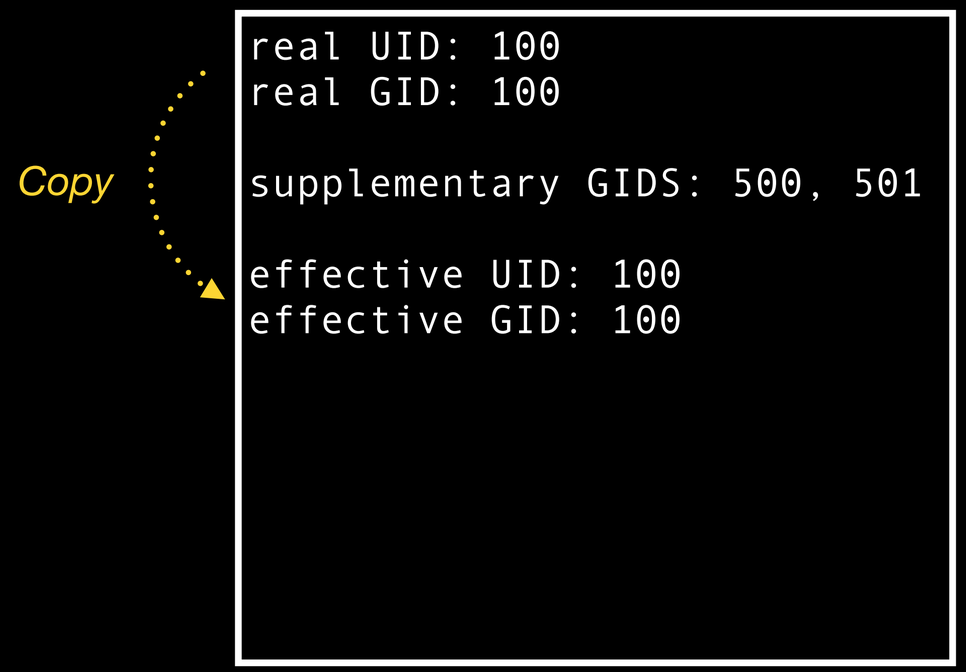
kernel space

user space

process



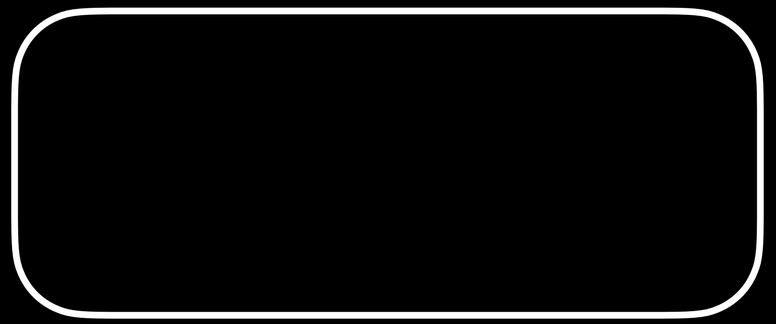
process info



kernel space

user space

process



process info

```
real UID: 100
real GID: 100

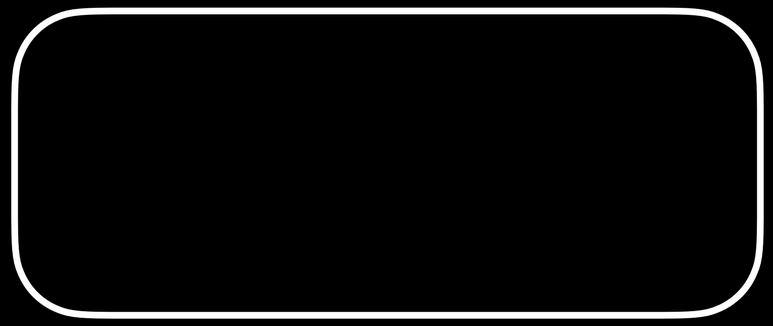
supplementary GIDS: 500, 501

effective UID: 100
effective GID: 100
```

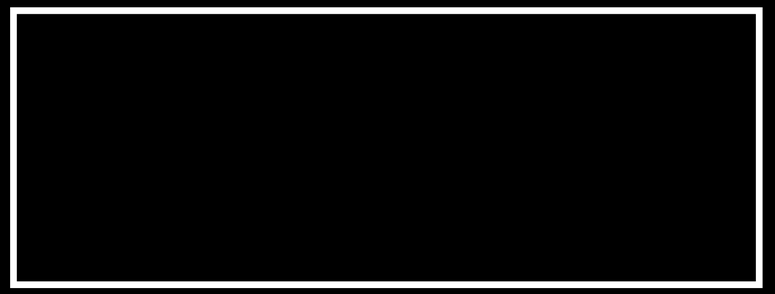
kernel space

user space

process



file



process info

```
real UID: 100
real GID: 100

supplementary GIDS: 500, 501

effective UID: 100
effective GID: 100
```

kernel space

user space

process

process info

```
real UID: 100
real GID: 100

supplementary GIDS: 500, 501

effective UID: 100
effective GID: 100
```

i-node

```
UID: …
GID: …
mode
```

			R	W	X	R	W	X	R	W	X

Special | Owner (User) | Group | Other

kernel space

user space

process

Attempt access (typically open)

file

process info

```
real UID: 100
real GID: 100

supplementary GIDS: 500, 501

effective UID: 100
effective GID: 100
```

== ?

i-node

```
UID: …
GID: …
mode
```

			R	W	X	R	W	X	R	W	X

Special | Owner (User) | Group | Other

kernel space

user space

process

Attempt access (typically open)

file

process info

```
real UID: 100
real GID: 100

supplementary GIDS: 500, 501

effective UID: 100
effective GID: 100
```

i-node

```
UID: …
GID: …
mode
```

			R	W	X	R	W	X	R	W	X
			Special			Owner (User)			Group			Other

== ?

kernel space

user space

process

Attempt access (typically open)

file

process info

```
real UID: 100
real GID: 100

supplementary GIDS: 500, 501

effective UID: 100
effective GID: 100
```

== ?

i-node

```
UID: …
GID: …
mode
```

			R	W	X	R	W	X	R	W	X

Special | Owner (User) | Group | Other

kernel space

user space

process

Attempt access (typically open)

file

process info

```
real UID: 100
real GID: 100

supplementary GIDS: 500, 501

effective UID: 100
effective GID: 100
```

== ?

i-node

```
UID: …
GID: …
mode
```

Special | Owner (User) | Group | Other

kernel space

user space

process

Attempt access (typically open)

file

process info

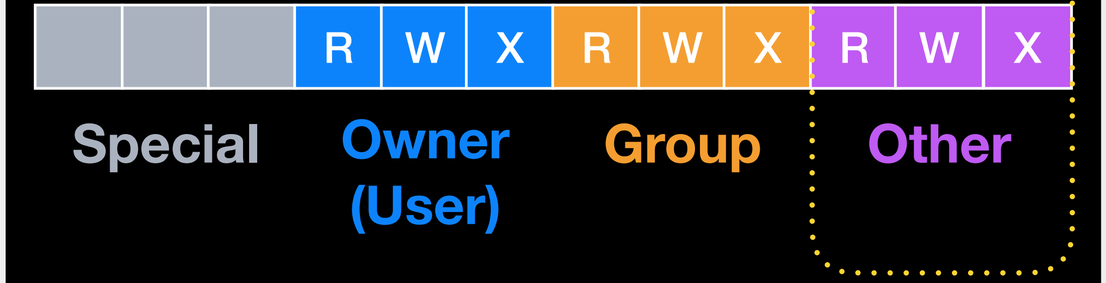
```
real UID: 100
real GID: 100

supplementary GIDS: 500, 501

effective UID: 100
effective GID: 100
```

i-node

UID: …
GID: …
mode



kernel space

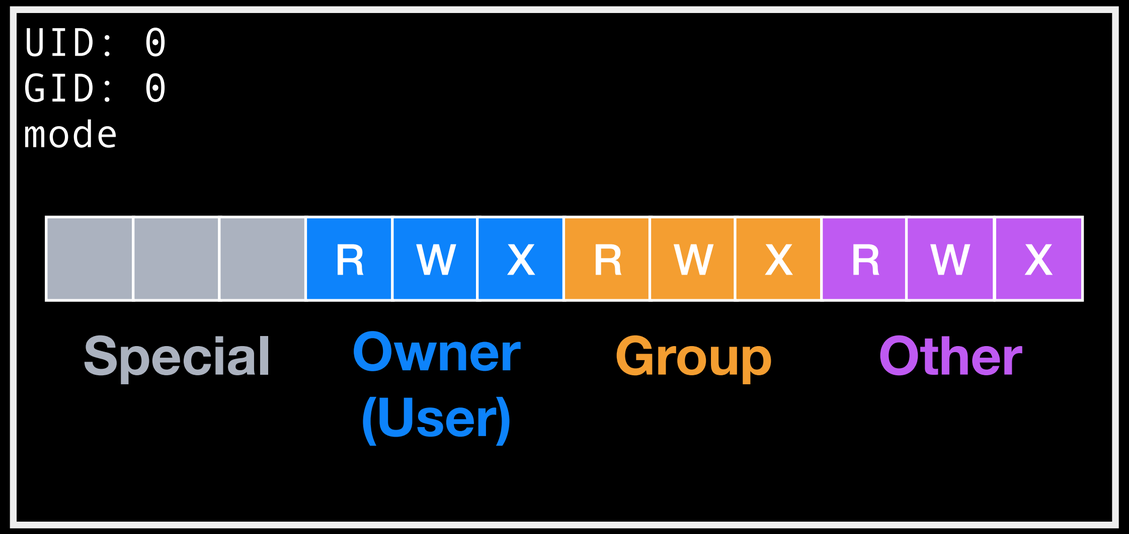
user space

process

Attempt access
(typically open)

file

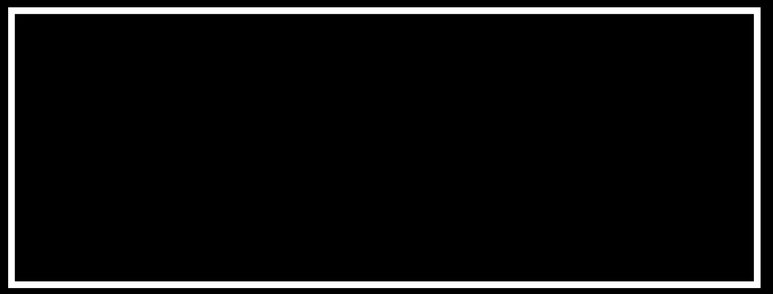
i-node



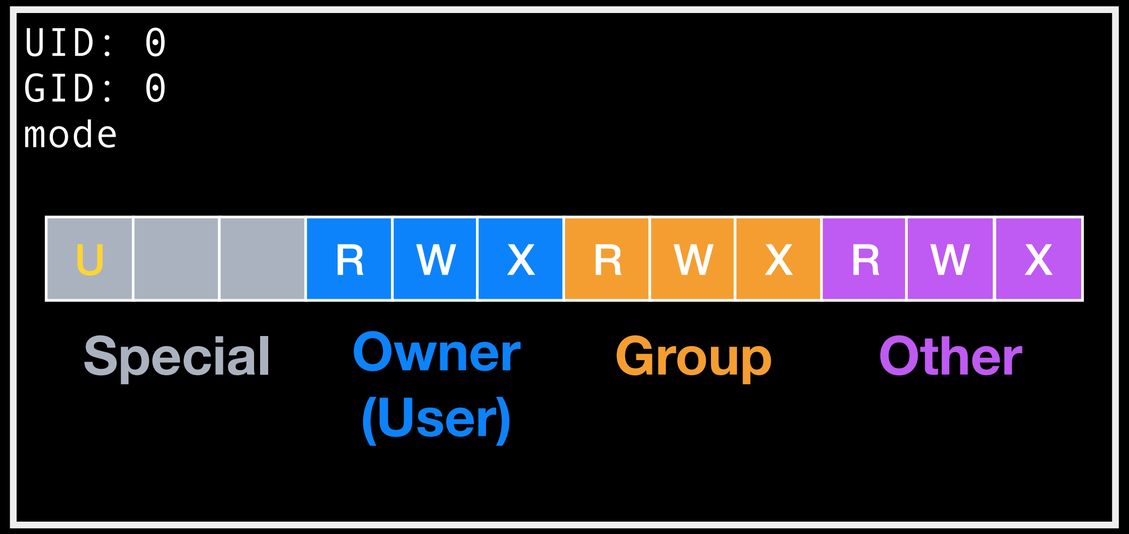
kernel space

user space

file



i-node

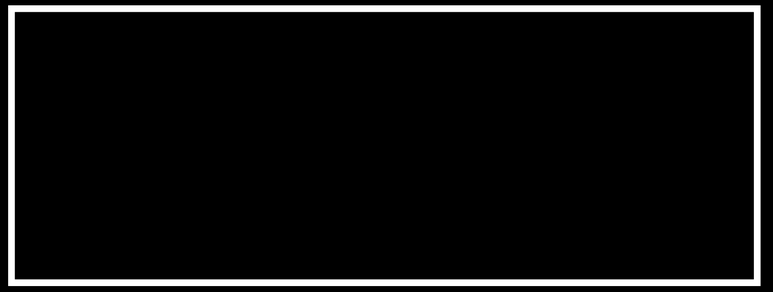


Set-user-ID

kernel space

user space

file



process info

```
real UID: 100
real GID: 100

supplementary GIDS: 500, 501
```

i-node

```
UID: 0
GID: 0
mode
```

Set-user-ID

Special **Owner (User)** **Group** **Other**

kernel space

user space

process

file

process info

```
real UID: 100
real GID: 100

supplementary GIDS: 500, 501
```

i-node

```
UID: 0
GID: 0
mode
```

Set-user-ID

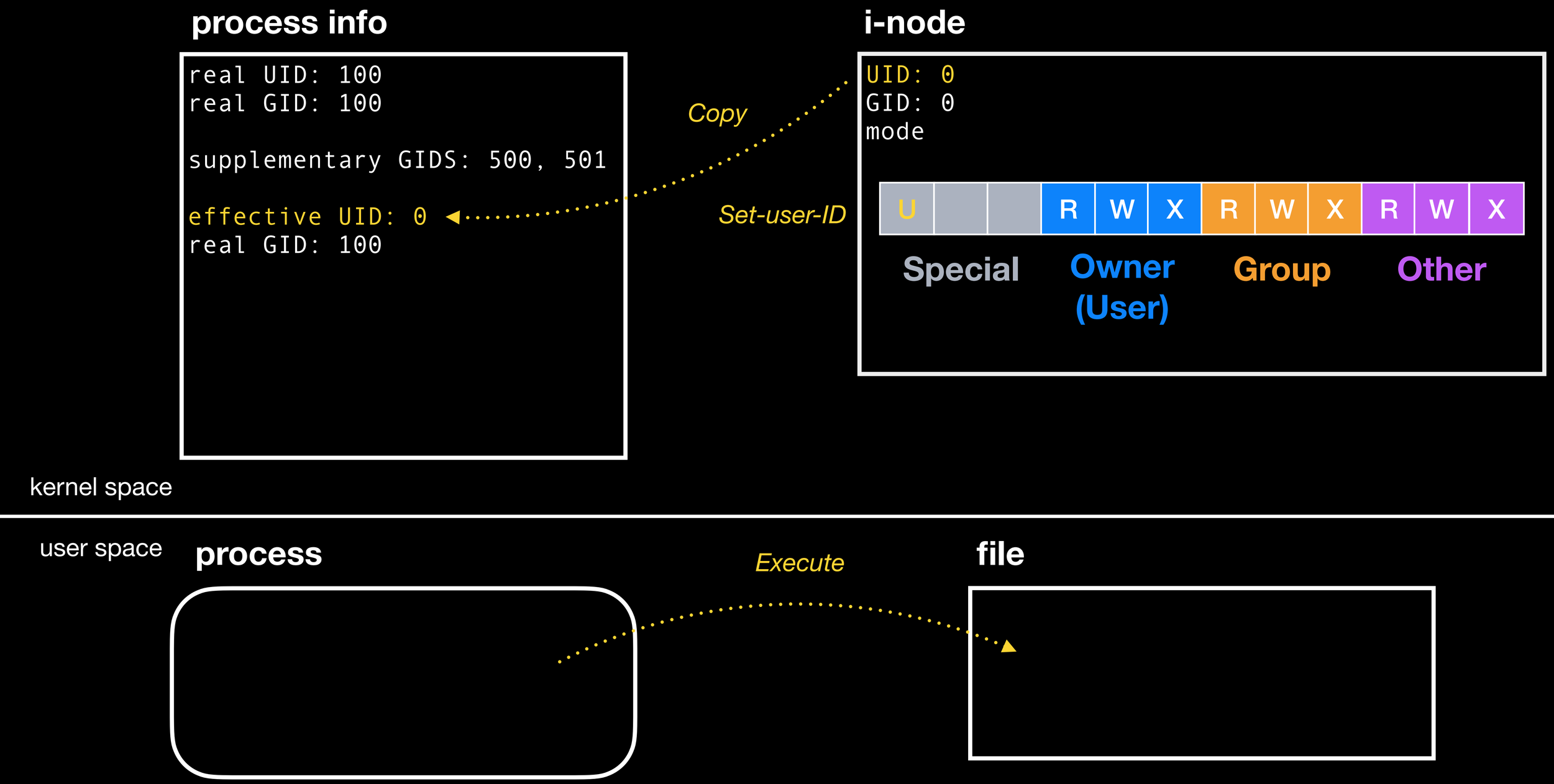
kernel space

user space

process

Execute

file


process info
real UID: 100
real GID: 100
supplementary GIDS: 500, 501
effective UID: 0
real GID: 100
Copy
Set-user-ID
i-node
UID: 0
GID: 0
mode
U
R W X R W X R W X
Special
Owner (User)
Group
Other
kernel space
user space
process
Execute
file

process info

```
real UID: 100
real GID: 100

supplementary GIDS: 500, 501
```

i-node

```
UID: 0
GID: 0
mode
```

Set-group-ID

Special

Owner (User)

Group

Other

kernel space

user space

process

file

process info

```
real UID: 100
real GID: 100

supplementary GIDS: 500, 501
```

i-node

```
UID: 0
GID: 0
mode
```

Set-group-ID

Special **Owner (User)** **Group** **Other**

kernel space

user space

process

Execute

file

process info

```
real UID: 100
real GID: 100

supplementary GIDS: 500, 501

effective UID: 100
effective GID: 0
```

Copy

Set-group-ID

i-node

```
UID: 0
GID: 0
mode
```

U	G		R	W	X	R	W	X	R	W	X
Special			Owner (User)			Group			Other		

kernel space

user space

process

Execute

file

i-node

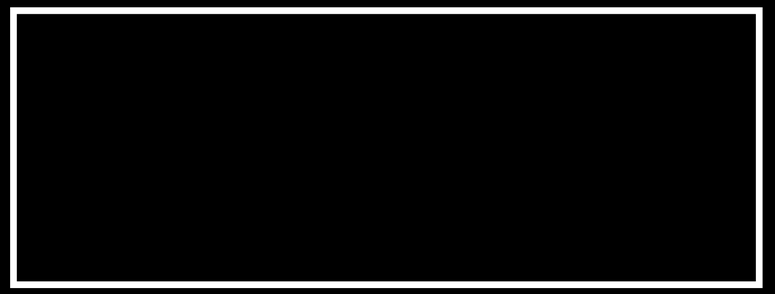
```
UID: 0
GID: 0
mode
```

Sticky bit

U	G	T	R	W	X	R	W	X	R	W	X

Special **Owner (User)** **Group** **Other**

kernel space

user space

file