What the hell is a “whiteout” file?
struct stat

struct stat {
    dev_t st_dev;    /* device number (filesystem) */
    ino_t st_ino;    /* i-node number (serial number) */
    mod_t st_mode;   /* file type & mode (permissions) */
    dev_t st_rdev;   /* device number for special files */
    nlink_t st_nlink; /* number of links */
    uid_t st_uid;    /* user ID of owner */
    gid_t st_gid;    /* group ID of owner */
    off_t st_size;   /* size in bytes, for regular files */
    time_t st_atime; /* time of last access */
    time_t st_mtime; /* time of last modification */
    time_t st_ctime; /* time of last file status change */
    long st_blocks;  /* number of 512-byte blocks allocated */
    long st_blksize; /* optimal I/O block size */
}

Additional fields may be defined; check your system's manual page.
struct stat: st_mode

The st_mode field of the struct stat encodes the type of file:

• **regular** – most common, interpretation of data is up to application
• **directory** – contains names of other files and pointer to information on those files
• **character special** – used for certain types of devices, e.g., terminal
• **block special** – used for disk devices (typically)
• **FIFO** – used for interprocess communication (sometimes called a "named pipe")
• **socket** – used for network communication and non-network communication (same host)
• **symbolic link** – points to another file
• **whiteout** – uhm… what?
What is a “whiteout” file?

A "whiteout" file is used to hide a lower layer file when the corresponding upper layer file in a union mount has been removed.
Union Mounts

Directory1
- Subdirectory
  - File1
  - File2
- File3
- File4

Directory2
- Subdirectory2
  - File5
  - File6
- File7
- File8
- Subdirectory3
  - File9
Union Mounts

Directory 1
- Subdirectory
  - File 1
  - File 2
- File 3
- File 4

Directory 2
- Subdirectory
  - File 5
- File 3
- File 6
Union Mounts

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Directory1
  - Subdirectory
    - File1
    - File2
  - File3
  - File4

Subdirectory
  - File1
  - File2
  - File3
  - File4
  - File5
  - File6

Directory2
  - Subdirectory
    - File5
  - File3
  - File6
Union Mounts

Directory1
  └── Subdirectory
      ├── File1
      ├── File2
      └── File3
      └── File4

Directory2
  └── Subdirectory
      ├── File1
      └── File2

Directory1
  └── File3
      └── File4
      └── File6

Directory2
  └── Subdirectory
      └── File5
      └── File3
      └── File6

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Union Mounts

Directory1
- Subdirectory
  - File1
  - File2
- File3
- File4

Directory2
- Subdirectory
  - File1
  - File2
  - File3
  - File4
  - File5
- File6

Directory1
- Directory1
- Directory2

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Union Mounts

- Directory1
  - Subdirectory
    - File1
    - File2
  - File3
  - File4

- Directory2
  - Subdirectory
    - File1
    - File2
  - File3
  - File4
  - File5
  - File6
Union Mounts

Directory1
  └ Subdirectory
    ├── File1
    │    └ File4
    └ File2
  └ File3

Directory2
  └ Subdirectory
    └ File5
  └ File4

Directory1
  └ Subdirectory
    └ File2
    └ File5
    └ File6
Union Mounts

Directory1
  - Subdirectory
    - File1
    - File2
  - File3
  - File4

Directory2
  - Subdirectory
    - File5
  - File6
Union Mounts and Whiteout Files

- Union mounts allow you to “combine” directories as if layering one directory on top of the other.
- Directories present in the lower layer but not in the upper layer lead to the creation of an empty “shadow” directory in the upper layer.
- If a file is present in both directories, the upper layer file “covers” the one in the lower layer.
- Removing such a file then leads to the creation of a “whiteout” file in the union mount to cover the (still existing) file in the lower layer.
- `ls -W` shows whiteout files; use `S_ISWHT(st_mode)` to test yourself.
Links

- `mount_union(8)`
- https://lwn.net/Articles/265240/
- https://docs.kernel.org/filesystems/overlayfs.html