Effective Visualization of File System Access-Control

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CS 167/9 Guest Lecture

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Discretionary Access Control

- Users can protect what they own.
- The owner may grant access to others.
- The owner may define the type of access (read/write/execute) given to others.
- This is the standard model used in many operating systems
- Alternative model (not covered): Mandatory Access Control (MAC)

Closed Policy

- Give Tom read access to “foo”
- Give Bob r/w access to “bar”
  - Tom: I would like to read “foo”
    - Access allowed
  - Tom: I would like to read “bar”
    - Access denied
- This policy is also called “default secure”

Open Policy

- Deny Tom read access to “foo”
- Deny Bob r/w access to “bar”
  - Tom: I would like to read “foo”
    - Access denied
  - Tom: I would like to read “bar”
    - Access allowed
- Windows uses also this kind of policy

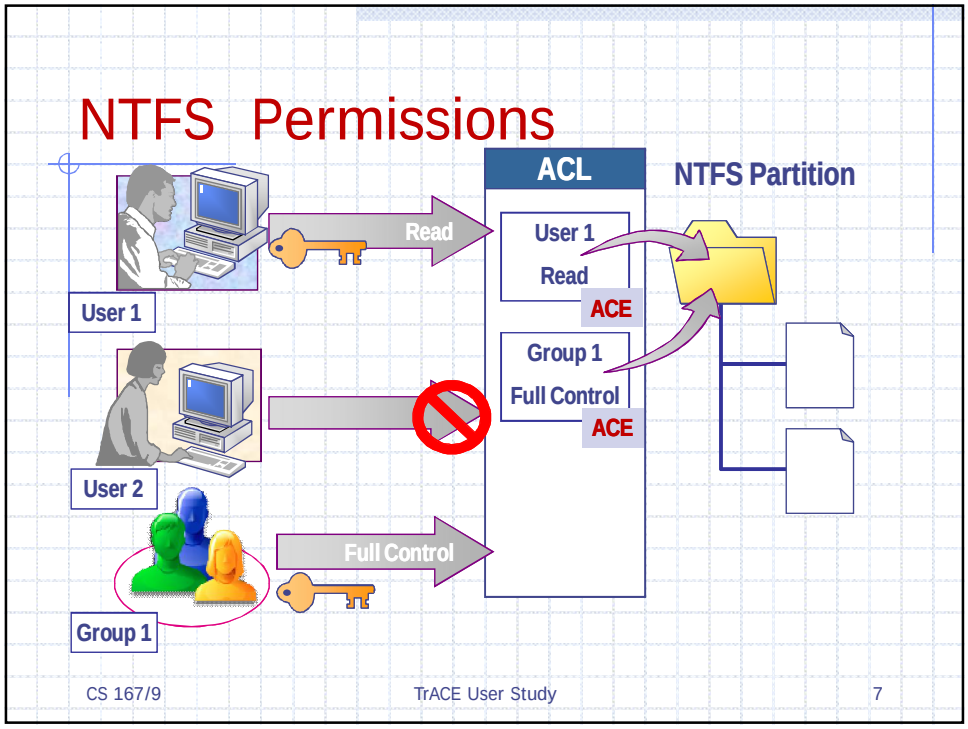
Closed Policy with Negative Authorizations and Deny Priority

- Give Tom r/w access to “bar”
- Deny Tom write access to “bar”

  Tom: I would like to read “bar”
  - Access allowed
  - Tom: I would like to write “bar”
    - Access denied
- This policy is used by Windows to manage access control

Access Control Entries and Lists

- A Discretionary Access Control List (DACL) for a resource (e.g., a file or folder) is a sorted list of zero or more Access Control Entries (ACEs)
- An ACE refers specifies that a certain set of accesses (e.g., read, execute and write) to the resources is allowed or denied for a user or group
- Examples of ACEs for folder “Bob’s CS167 Grades”
  - Bob; Read; Allow
  - TAs; Read; Allow
  - TWD; Read, Write; Allow
  - Bob; Write; Deny
  - TAs; Write; Allow


NTFS Permissions
ACL
NTFS Partition
Read
User 1
Read
ACE
Group 1
Full Control
ACE
User 1
User 2
Full Control
Group 1
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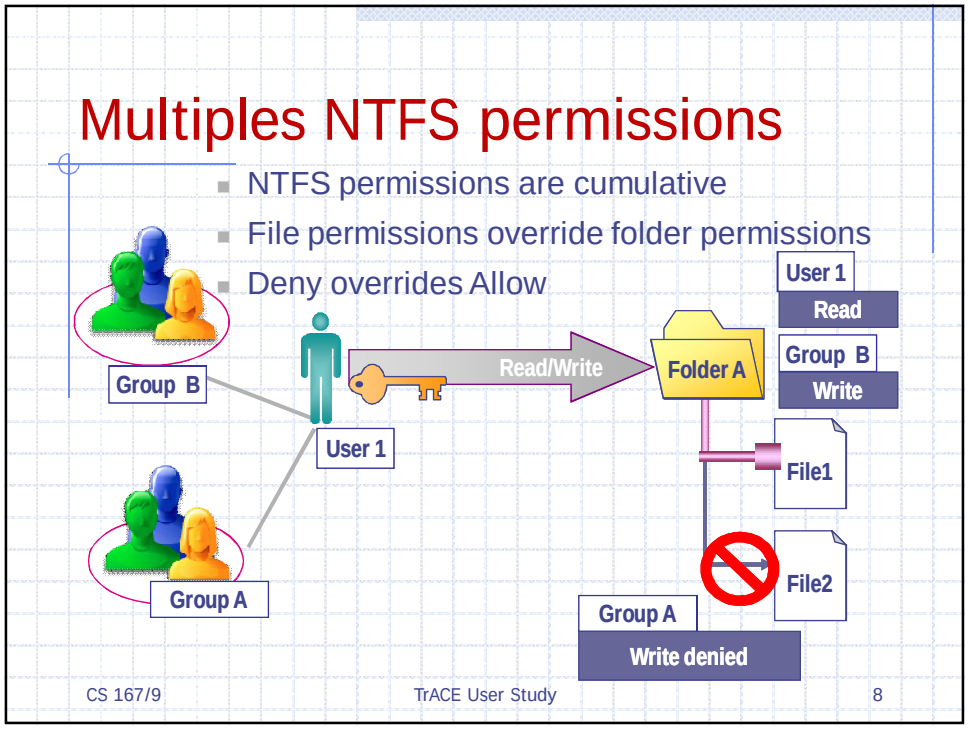
Multiples NTFS permissions
NTFS permissions are cumulative
File permissions override folder permissions
Deny overrides Allow
User 1
Read
Group B
Write
Read/Write
Folder A
Group B
User 1
File1
File2
Group A
Group A
Write denied
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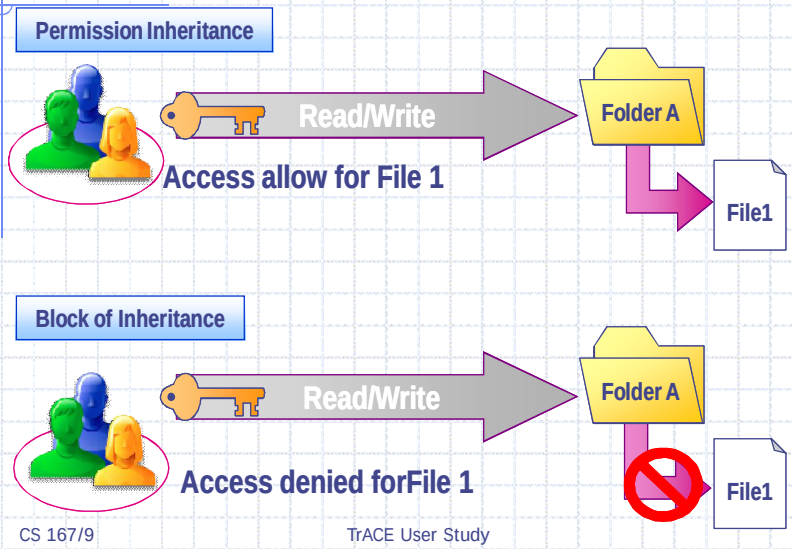
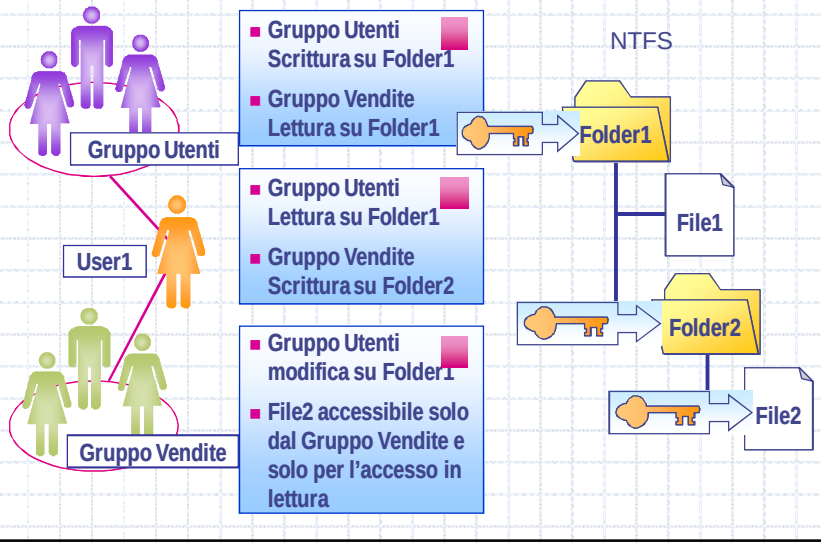
NTFS: permission inheritance



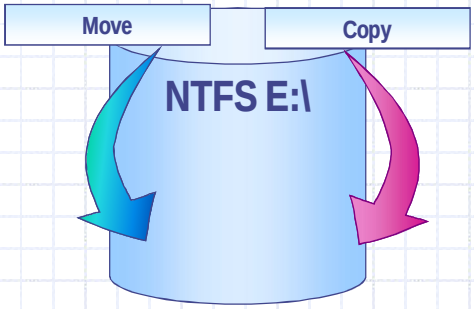
Access Control Algorithm

- The DACL of a file or folder is a sorted list of ACEs
  - Local ACEs precede inherited ACEs
  - ACEs inherited from folder F precede those inherited from parent of F
  - Among those with same source, Deny ACEs precede Allow ACEs
- Algorithm for granting access request (e.g., read and execute):
  - ACEs in the DACL are examined in order
  - Does the ACE refer to the user or a group containing the user?
  - If so, do any of the accesses in the ACE match those of the request?
  - If so, what type of ACE is it?
    - **Deny**: return ACCESS_DENIED
    - **Allow**: grant the specified accesses and if there are no remaining accesses to grant, return ACCESS_ALLOWED
  - If we reach the end of the DACL and there are remaining requested accesses that have not been granted yet, return ACCESS_DENIED

Esempi: permessi NTFS

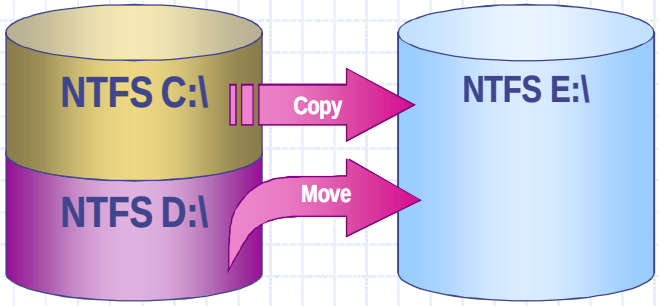


NTFS: move or copy a file within the same volume



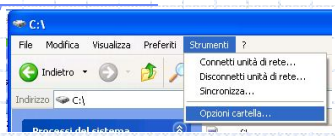
- If you **move** a file or a folder inside the same volume your permission will be the same of the **source** folder
- If you **copy** a file or a folder inside the same volume your permission will be the same of the **destination** folder

NTFS: move or copy a file across different volumes



- If you **copy** or **move** a file or a folder on different volumes your permission will be the same of the **destination** folder

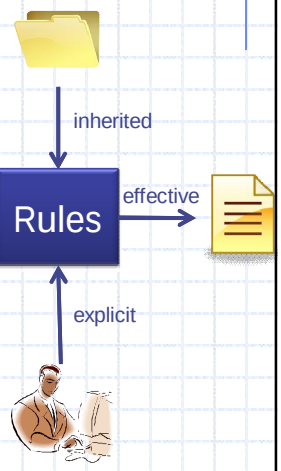
How activate NTFS permissions in Windows XP Pro



- NTFS permissions in Windows XP Pro are disabled by default.
- Using **Folder Options…** from **Tools** menu inside **Windows Explorer** is possible to activate NTFS permission in windows by unchecking **Use simple file sharing**

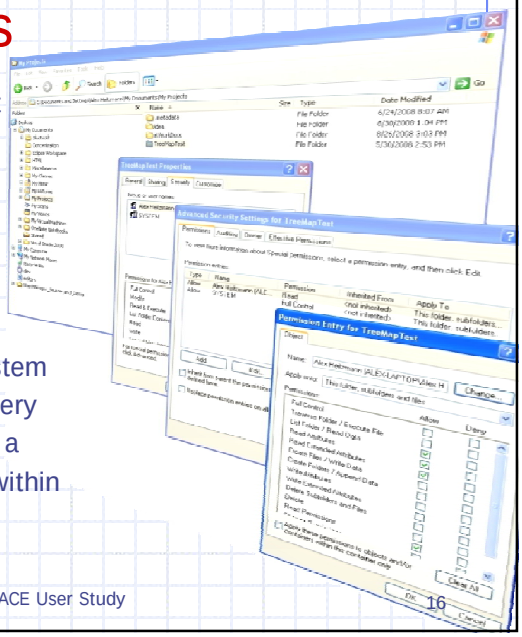
NTFS file permissions

- **Explicit**: set by the *owner* for each user/group.
- **Inherited**: dynamically inherited from the explicit permissions of ancestor folders.
- **Effective**: obtained by combining the explicit and inherited permission.
- Determining effective permissions:
  - By default, a user/group has no privileges.
  - Explicit permissions override conflicting inherited permissions.
  - Denied permissions override conflicting allowed permissions.

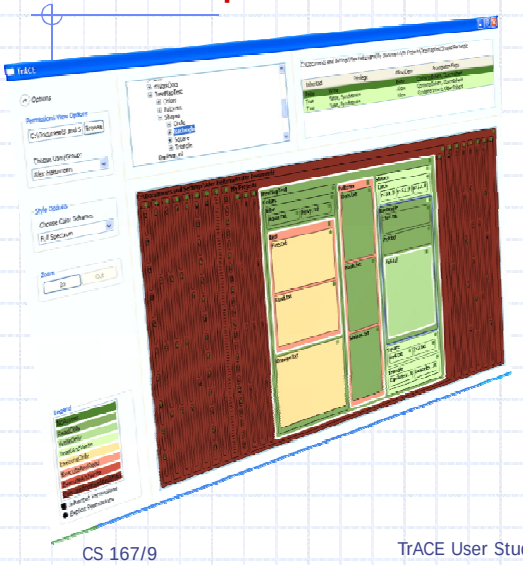


Windows Tools

- Access control management tools provide detailed information and controls, across multiple dialogs.
- Focus on single file/folders.
- It is challenging for an inexperienced user, or a system administrator dealing with very large file structures, to gain a global view of permissions within the file system .



Enter TrACE:
Treemap Access Control Evaluator



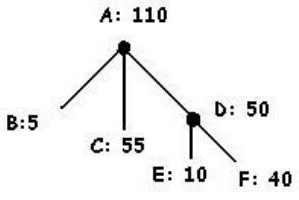
TrACE allows the user to:

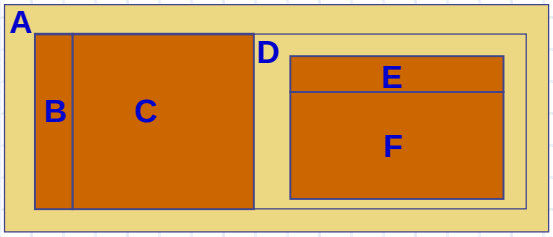
- At a glance, determine the explicit, inherited, and effective permissions of files and folders.
- Understand access control relationships between files and their ancestors.
- Quickly evaluate large directory structures and find problem areas.

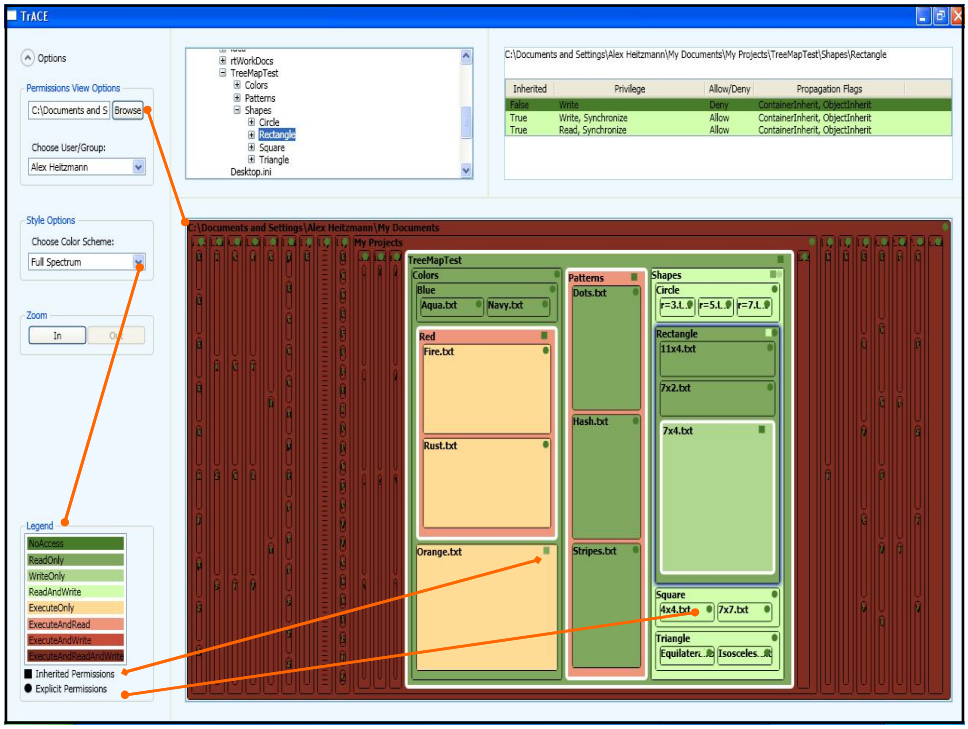
TrACE uses treemaps.

What is a Treemap?

- A visualization method to display large hierarchical data structures (trees)
- Layout based on nested rectangles.
- Treemaps were introduced by Ben Shneiderman in "Tree visualization with tree-maps: 2-d space-filling approach"; TOG 1991



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TreeMapTest
Colors
Patterns
Shapes
Circle
Rectangle
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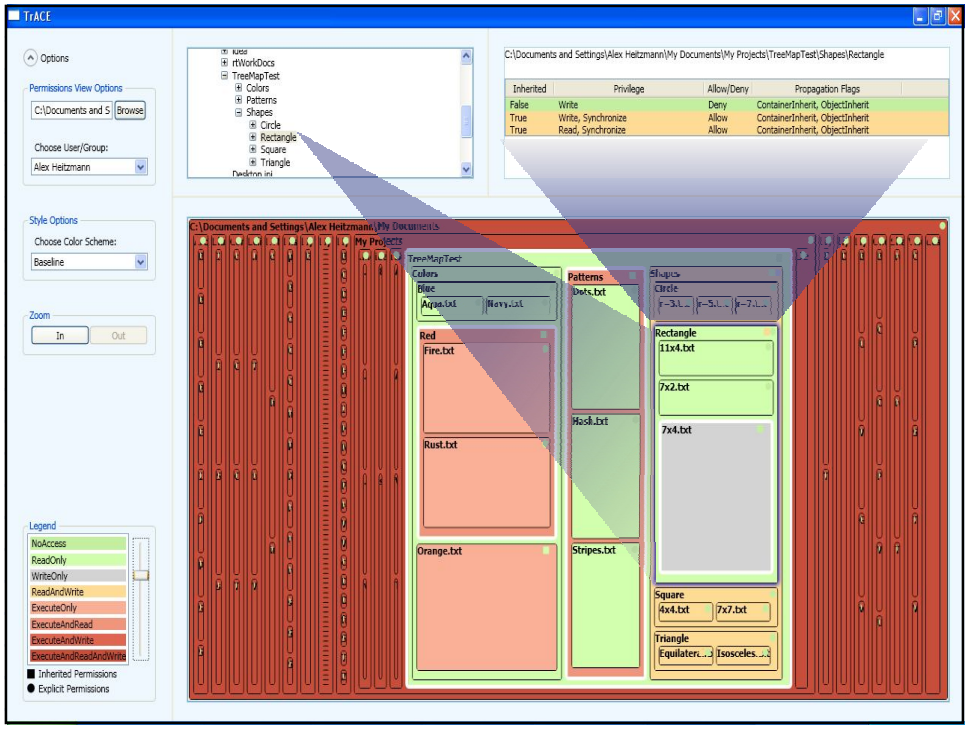
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Privilege
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Propagation Flags
False
Write
Deny
ContainerInherit, ObjectInherit
True
Write, Synchronize
Allow
ContainerInherit, ObjectInherit
Read, Synchronize
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Fire.txt
Rust.txt
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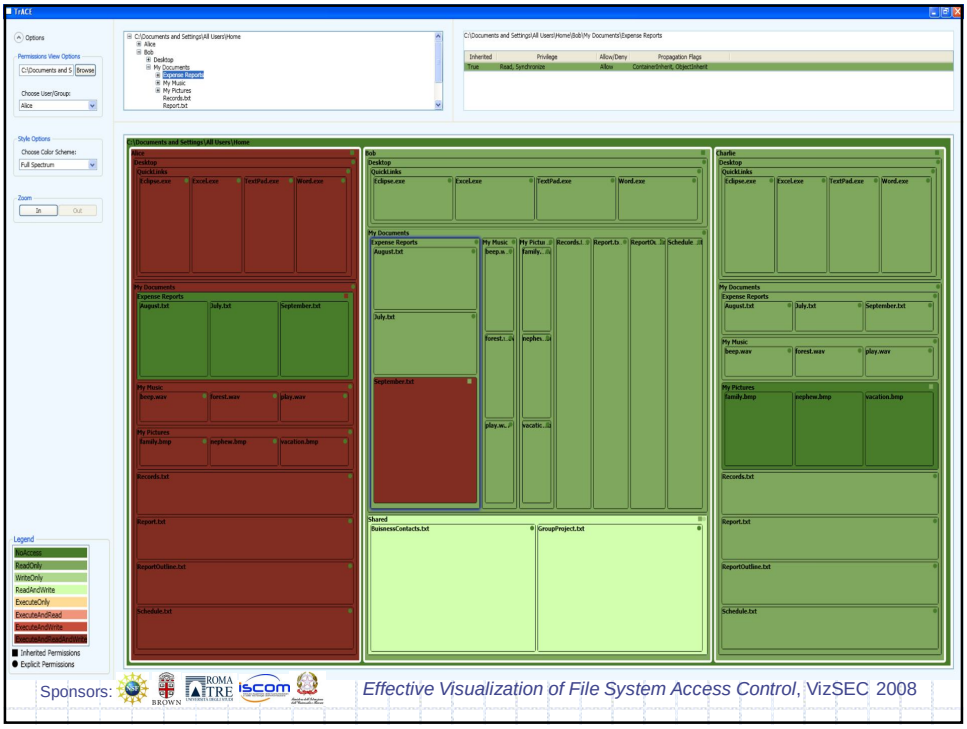
7x7.txt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WriteOnly
ReadAndWrite
ExecuteOnly
ExecuteAndRead
ExecuteAndWrite
Inherited Permissions
Explicit Permissions
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