

Assignment 2:

Access Control



Information and Communications Security (SS22)

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Exercise 1: Access Control Matrix

Exercise 2: Access Control Lists and Capability Lists

Exercise 3: Bell-LaPadula Model

Exercise 4: Role Based Access Control

Exercise 5: Chinese Wall Model

Exercise 1: Access Control Matrix

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Exercise 4: Role Based Access Control

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Exercise 1: Access Control Matrix

Alice can read file X, can append to file Y, and can write to file Z. Bob can append to file X, can write to file Y, and cannot access file Z.

Write the access control matrix M that specifies the described set of access rights for subjects Alice and Bob to objects file X, file Y and file Z.

Alice can read file X, can append to file Y, and can write to file Z.
Bob can append to file X, can write to file Y, and cannot access file Z.

Alice can read file X, can append to file Y, and can write to file Z.
 Bob can append to file X, can write to file Y, and cannot access file Z.

Alice can read file X, can append to file Y, and can write to file Z.
Bob can append to file X, can write to file Y, and cannot access file Z.

Alice			
Bob			

Alice can read file X, can append to file Y, and can write to file Z.
Bob can append to file X, can write to file Y, and cannot access file Z.

	file X	file Y	file Z
Alice			
Bob			

Alice can read file X, can append to file Y, and can write to file Z.
Bob can append to file X, can write to file Y, and cannot access file Z.

	file X	file Y	file Z
Alice	{read}		
Bob			

Alice can read file X, can append to file Y, and can write to file Z.
Bob can append to file X, can write to file Y, and cannot access file Z.

	file X	file Y	file Z
Alice	{read}	{append}	
Bob			

Alice can read file X, can append to file Y, and can write to file Z.
Bob can append to file X, can write to file Y, and cannot access file Z.

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob			

Alice can read file X, can append to file Y, and can write to file Z.
Bob can append to file X, can write to file Y, and cannot access file Z.

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}		

Alice can read file X, can append to file Y, and can write to file Z.
Bob can append to file X, can write to file Y, and cannot access file Z.

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	

Alice can read file X, can append to file Y, and can write to file Z.
Bob can append to file X, can write to file Y, and cannot access file Z.

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 1: Access Control Matrix

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Exercise 5: Chinese Wall Model

2 a) What are the basic differences between **access control lists (ACL)** and **capability lists (CLists)**? Compare these approaches in terms of revocation of a user's access to a particular set of files.

- **Capability lists** are subject-focused:
 - For each subject, there is a list of objects
- **Access control lists** are object-focused.
 - For each object, there is a list of subjects

2 a) What are the basic differences between **access control lists (ACL)** and **capability lists (CLists)**? Compare these approaches in terms of revocation of a user's access to a particular set of files.

- **Capability lists** are subject-focused:
 - For each subject, there is a list of objects
 - **Access control lists** are object-focused.
 - For each object, there is a list of subjects
- Therefore, a user's access right to a particular file can easily be revoked when capability lists are used

2 b) Write a set of **access control lists** for the situation given in exercise 1.

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

- **ACL(file X) =** Alice: {read}, Bob: {append}
- **ACL(file Y) =** Alice: {append}, Bob: {write}
- **ACL(file Z) =** Alice: {write}, Bob: { }

2 b) Write a set of **capability lists** for the situation given in exercise 1.

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

- **CList(Alice)** = file X: {read}, file Y: {append}, file Z: {write}
- **CList(Bob)** = file X: {append}, file Y: {write}, file Z: { }

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Exercise 3: Bell-LaPadula Model

Given the access rights defined in exercise 1, the subject's security levels are

L_{Alice} = Confidential and
 L_{Bob} = Secret,

the object's security levels are

$L_{\text{file X}}$ = Unclassified,
 $L_{\text{file Y}}$ = Secret,
 $L_{\text{file Z}}$ = Top Secret.

(Top Secret > Secret > Confidential > Unclassified)

3 a) Draw a Bell-LaPadula model which visualizes the access rights defined in access control matrix M .

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

3 a) Draw a Bell-LaPadula model which visualizes the access rights defined in access control matrix M.

Security Level:
Top Secret

Security Level:
Secret

Security Level:
Confidential

Security Level:
Unclassified

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

3 a) Draw a Bell-LaPadula model which visualizes the access rights defined in access control matrix M.

Security Level:
Top Secret

Security Level:
Secret

Security Level:
Confidential



Security Level:
Unclassified

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

3 a) Draw a Bell-LaPadula model which visualizes the access rights defined in access control matrix M.

Security Level:
Top Secret

Security Level:
Secret



Security Level:
Confidential



Security Level:
Unclassified

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

3 a) Draw a Bell-LaPadula model which visualizes the access rights defined in access control matrix M.

Security Level:
Top Secret

Security Level:
Secret



Security Level:
Confidential



Security Level:
Unclassified



Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

3 a) Draw a Bell-LaPadula model which visualizes the access rights defined in access control matrix M.

Security Level:
Top Secret

Security Level:
Secret

Security Level:
Confidential

Security Level:
Unclassified



Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

3 a) Draw a Bell-LaPadula model which visualizes the access rights defined in access control matrix M.

Security Level:
Top Secret



Security Level:
Secret



Security Level:
Confidential



Security Level:
Unclassified



	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

3 a) Draw a Bell-LaPadula model which visualizes the access rights defined in access control matrix M.

Security Level:
Top Secret



Security Level:
Secret



Security Level:
Confidential



Security Level:
Unclassified



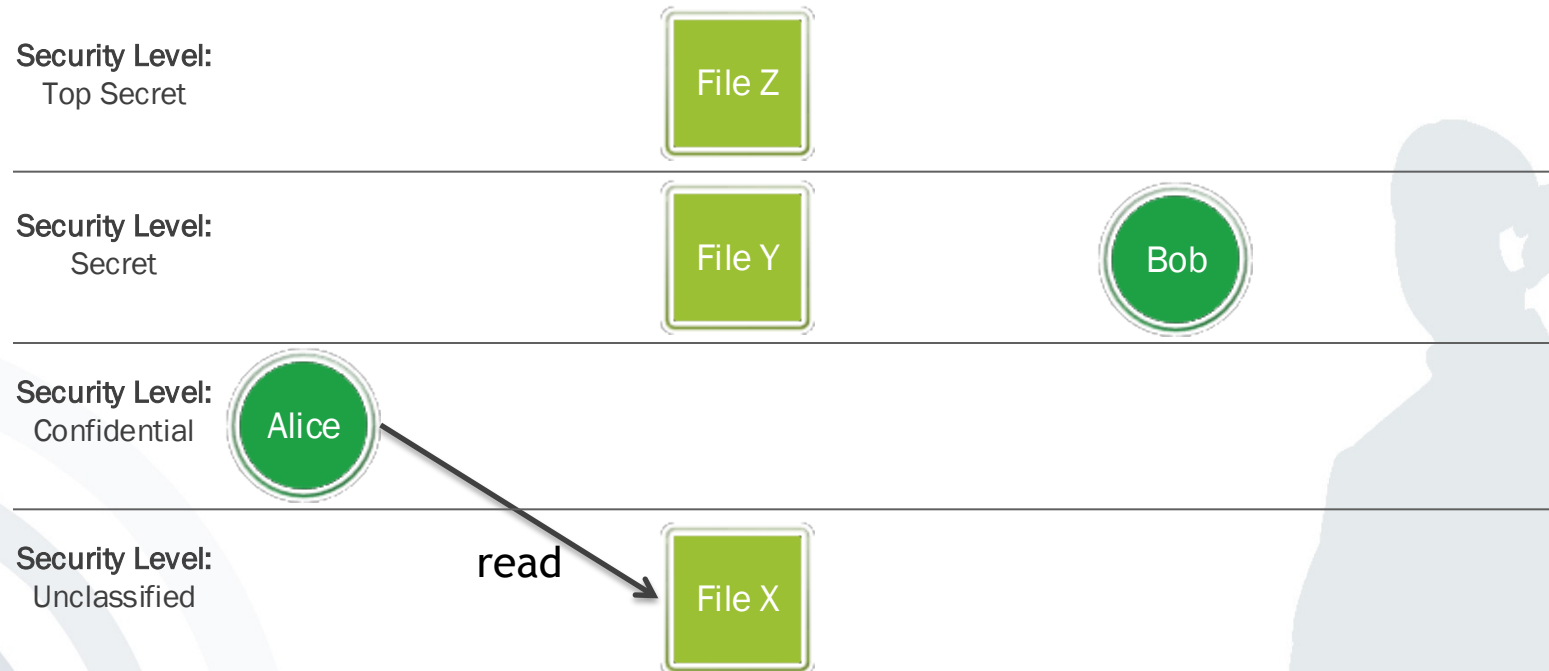
	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

3 a) Draw a Bell-LaPadula model which visualizes the access rights defined in access control matrix M.



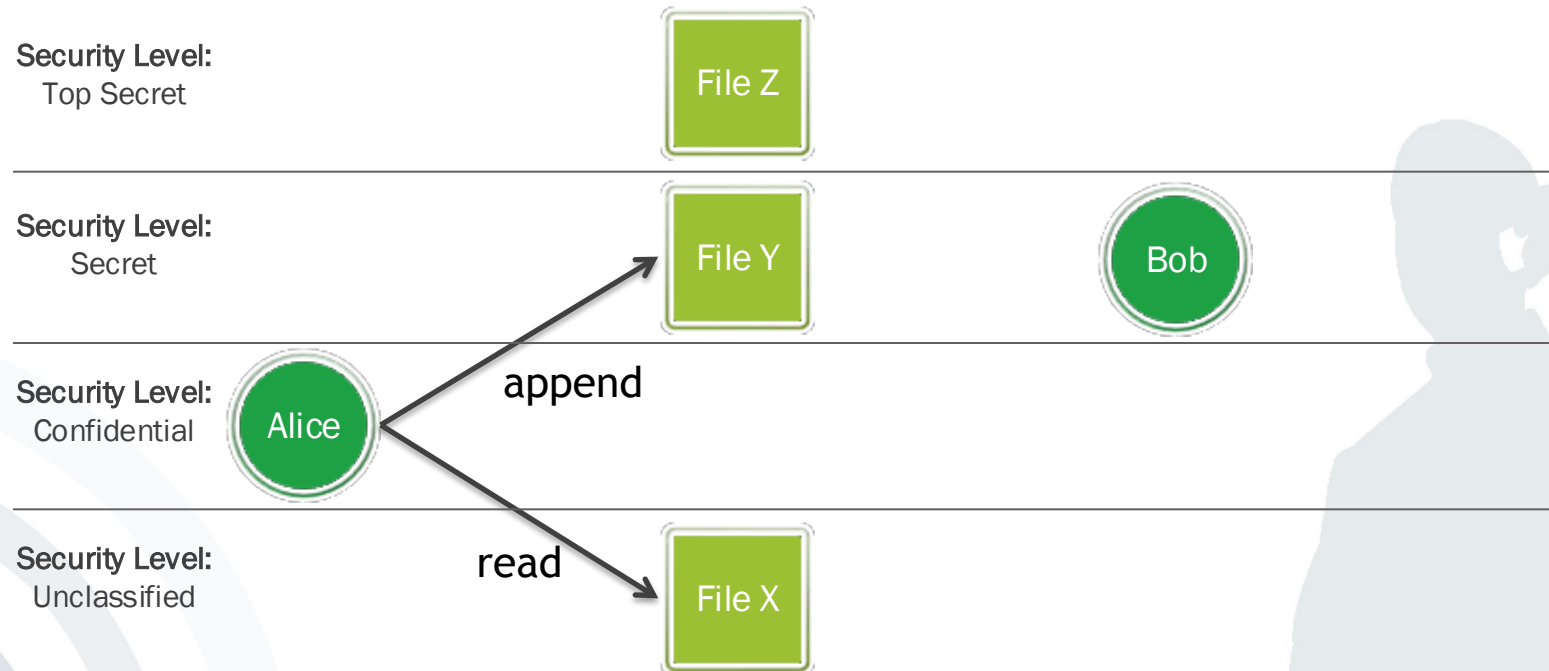
	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

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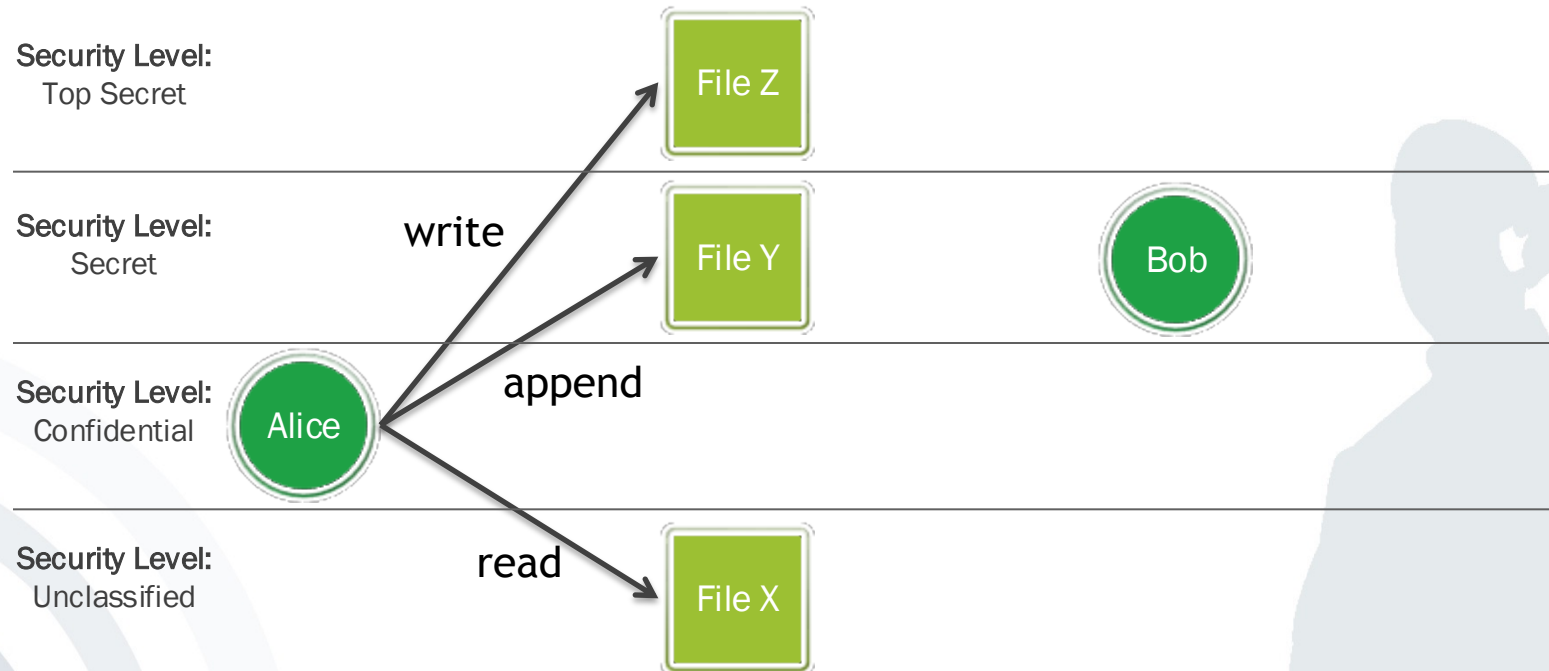
	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

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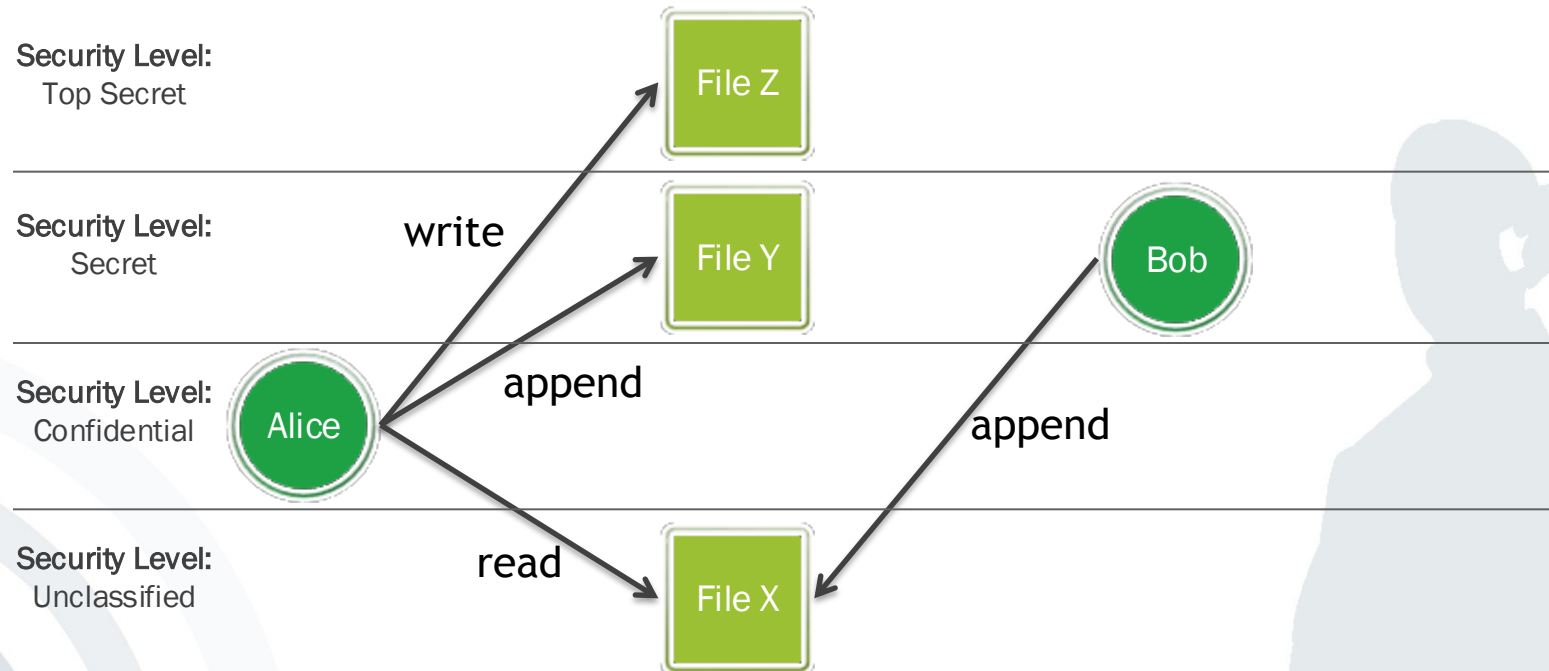
	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

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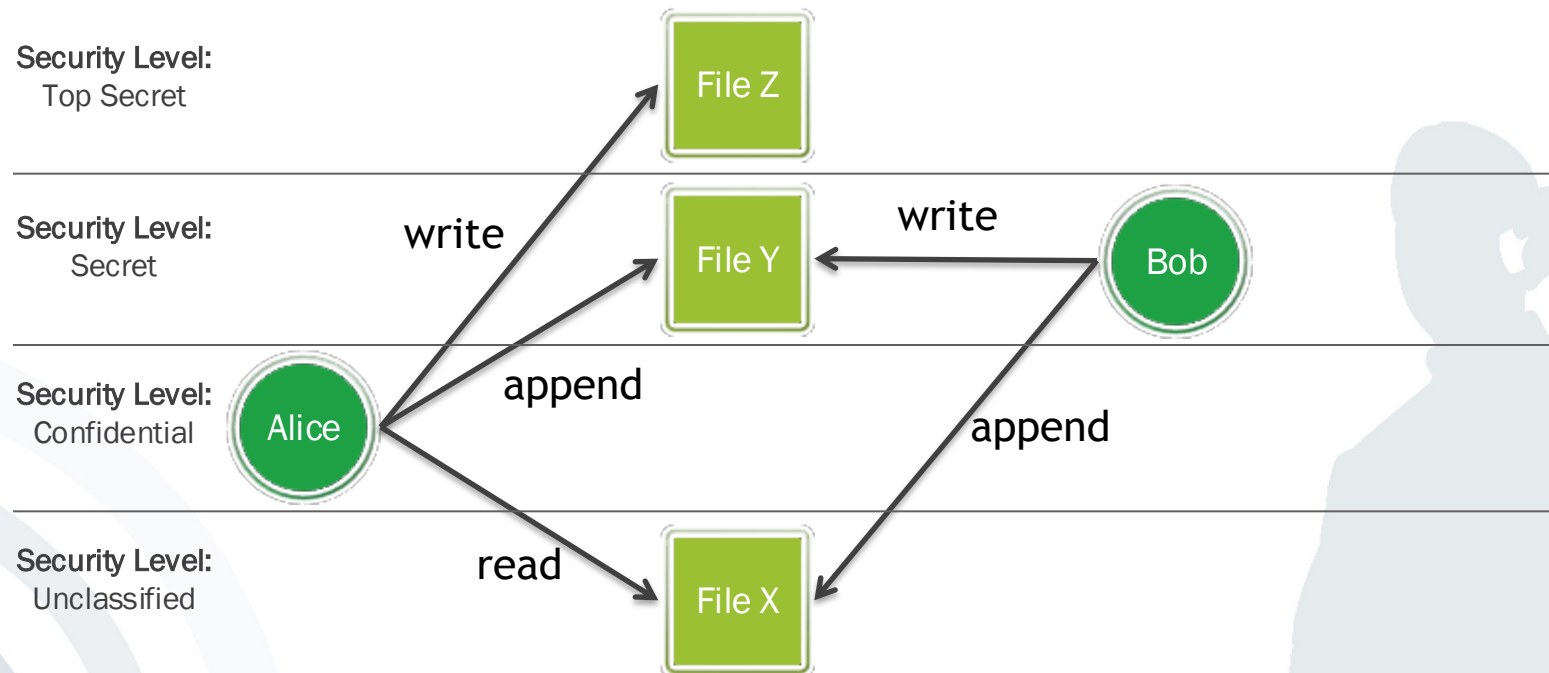
	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

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3 a) Draw a Bell-LaPadula model which visualizes the access rights defined in access control matrix M.



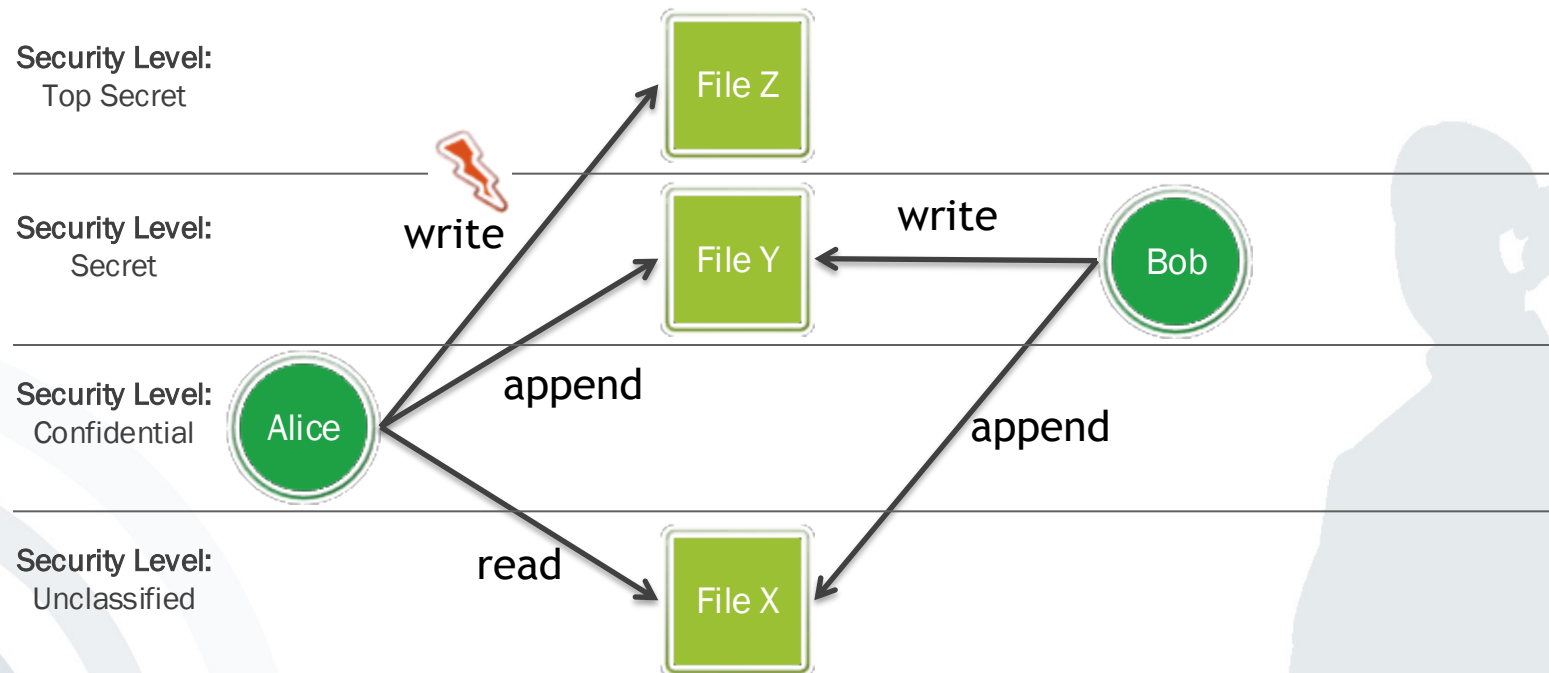
	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

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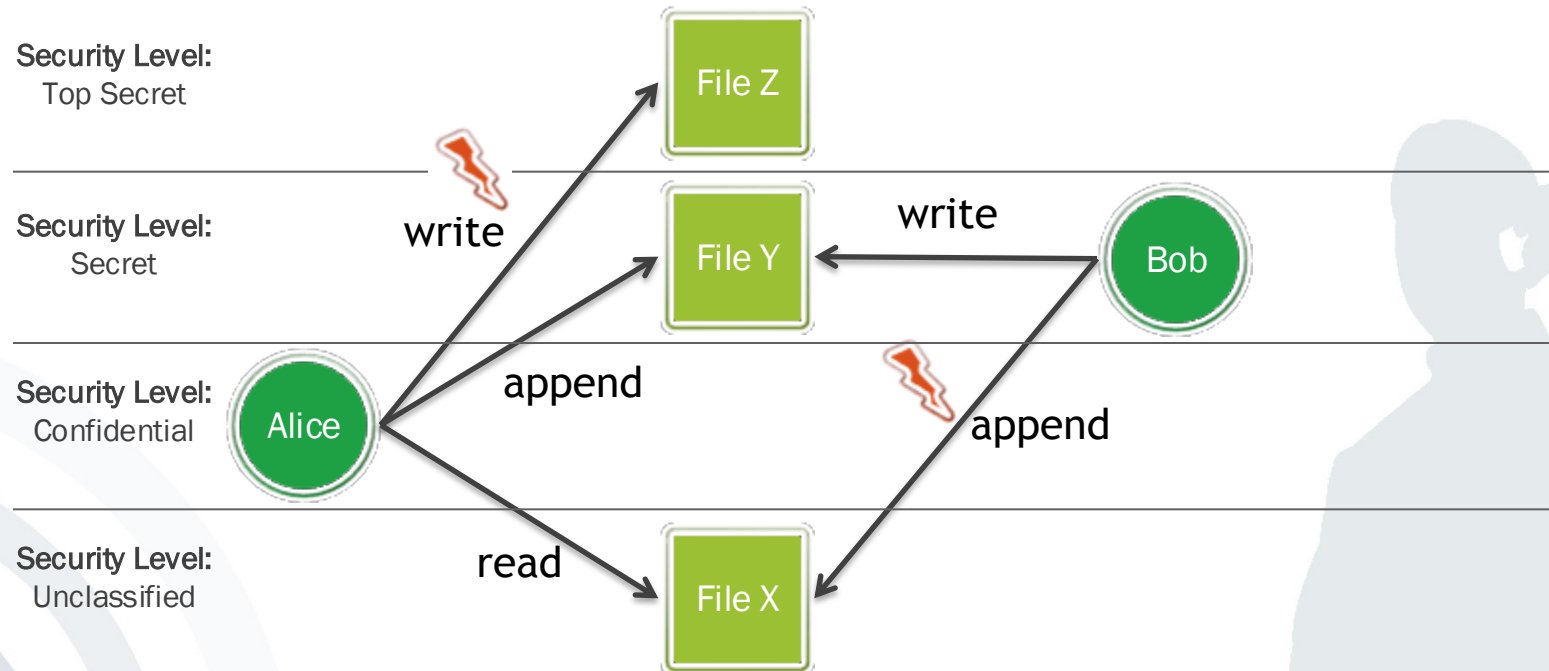
	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

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	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level : $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

3 b) Which of the following actions are allowed? Explain and justify your answer.

1. Alice reads file X
2. Alice reads file Y
3. Bob appends to file X
4. Bob appends to file Z

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

1. Alice reads file X

- Access Control Matrix:

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Condition: $\text{read} \in M(\text{Alice}, \text{file X}) \rightarrow \checkmark$

- Security Levels:

Condition: $L_{\text{Alice}} \geq L_{\text{file X}} \rightarrow \checkmark$

$L_{\text{Alice}} = \text{Confidential}$, $L_{\text{file X}} = \text{Unclassified}$

→ Grant access \checkmark

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

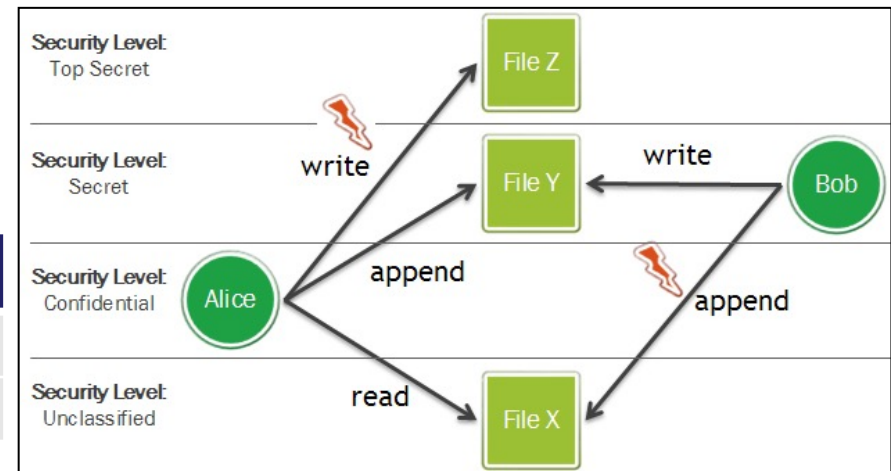
Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

1. Alice reads file X

- Access Control Matrix:

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }



Condition: $\text{read} \in M(\text{Alice}, \text{file X}) \rightarrow \checkmark$

- Security Levels:

Condition: $L_{\text{Alice}} \geq L_{\text{file X}} \rightarrow \checkmark$

$L_{\text{Alice}} = \text{Confidential}$, $L_{\text{file X}} = \text{Unclassified}$

→ Grant access \checkmark

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

2. Alice reads file Y

- Access Control Matrix:

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Condition: $\text{read} \in M(\text{Alice}, \text{file Y}) \rightarrow \text{X}$

- Security Levels:

Condition: $L_{\text{Alice}} \geq L_{\text{file Y}} \rightarrow \text{X}$

$L_{\text{Alice}} = \text{Confidential}$, $L_{\text{file Y}} = \text{Secret}$

→ Deny access **X**

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

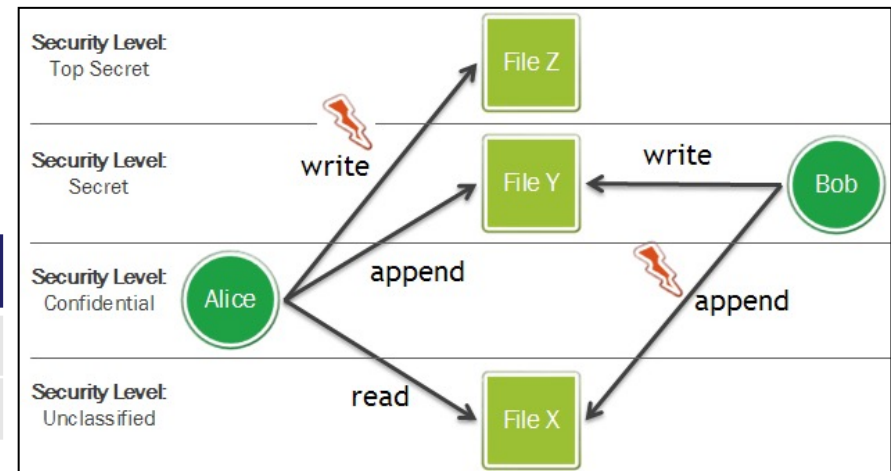
Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

2. Alice reads file Y

- Access Control Matrix:

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }



Condition: $\text{read} \in M(\text{Alice}, \text{file Y}) \rightarrow \text{X}$

- Security Levels:

Condition: $L_{\text{Alice}} \geq L_{\text{file Y}} \rightarrow \text{X}$

$L_{\text{Alice}} = \text{Confidential}$, $L_{\text{file Y}} = \text{Secret}$

→ Deny access **X**

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

3. Bob appends to file X

- Access Control Matrix:

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Condition: $\text{append} \in M(\text{Bob}, \text{file X}) \rightarrow \checkmark$

- Security Levels:

Condition: $L_{\text{Bob}} \leq L_{\text{file X}} \rightarrow \times$

$L_{\text{Bob}} = \text{Secret}$, $L_{\text{file X}} = \text{Unclassified}$

\rightarrow Deny access \times

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

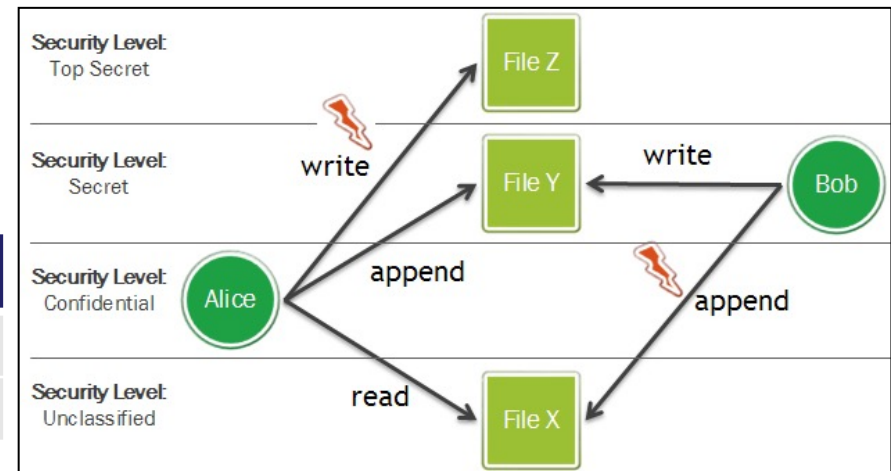
Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

3. Bob appends to file X

- Access Control Matrix:

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }



Condition: $\text{append} \in M(\text{Bob}, \text{file X}) \rightarrow \checkmark$

- Security Levels:

Condition: $L_{\text{Bob}} \leq L_{\text{file X}} \rightarrow \times$

$L_{\text{Bob}} = \text{Secret}, L_{\text{file X}} = \text{Unclassified}$

→ Deny access \times

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

4. Bob appends to file Z

- Access Control Matrix:

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Condition: $\text{append} \in M(\text{Bob}, \text{file Z}) \rightarrow \text{X}$

- Security Levels:

Condition: $L_{\text{Bob}} \leq L_{\text{file Z}} \rightarrow \checkmark$

$L_{\text{Bob}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

\rightarrow Deny access X

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }

Exercise 3

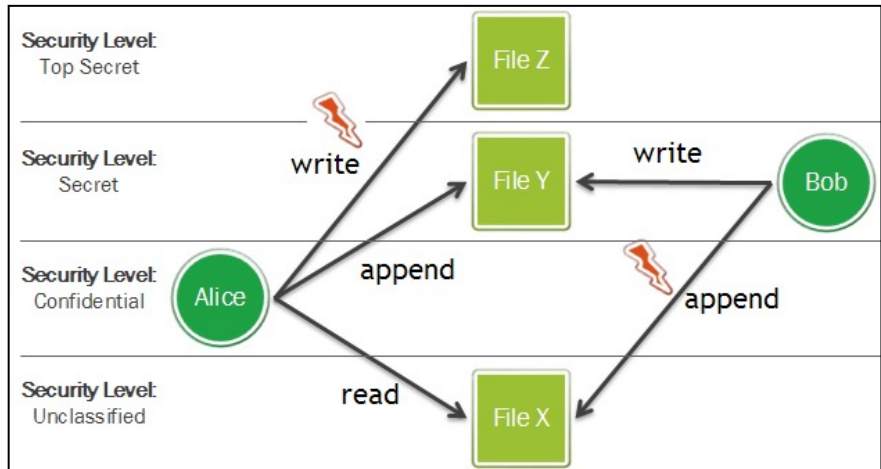
Subjects' Level: $L_{\text{Alice}} = \text{Confidential}$, $L_{\text{Bob}} = \text{Secret}$

Objects' Level: $L_{\text{file X}} = \text{Unclassified}$, $L_{\text{file Y}} = \text{Secret}$, $L_{\text{file Z}} = \text{Top Secret}$

4. Bob appends to file Z

- Access Control Matrix:

	file X	file Y	file Z
Alice	{read}	{append}	{write}
Bob	{append}	{write}	{ }



Condition: $\text{append} \in M(\text{Bob}, \text{file Z}) \rightarrow \text{X}$

- Security Levels:

Condition: $L_{\text{Bob}} \leq L_{\text{file Z}} \rightarrow \checkmark$

$L_{\text{Bob}} = \text{Secret}, L_{\text{file Z}} = \text{Top Secret}$

→ Deny access **X**

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Exercise 4: Role Based Access Control (RBAC)

Consider a simplified scenario in a bank and the concept of RBAC. In order to perform a change (transaction) on an account (to mandate deposits and withdrawals), a **customer uses his card to authorize the transaction.** He can do this by being registered in the bank in the role of a “client” by using a card reader. **The account of this customer is then authorized** for the duration of this session, and **authorized subjects can perform changes to this account.**

The following roles and rights are defined in this scenario:

Role	Rights
Bank employee	Read all account data
Base	Read Terms of Use
Auditor	Perform audit
Branch Manager	Open and authorize account(s)' transactions (even without a chip card)
Cashier	Change an authorized account
Client Advisor	Open bank account
Client	Authorize own account

Roles: Bank employee, Base, Auditor, Branch Manager, Cashier, Client Advisor, Client.

a) Draw an RBAC diagram for this scenario.

Role

R1 → R2: R2 has
also the rights of R1

Roles: Bank employee, Base, Auditor, Branch Manager, Cashier, Client Advisor, Client.

a) Draw an RBAC diagram for this scenario.

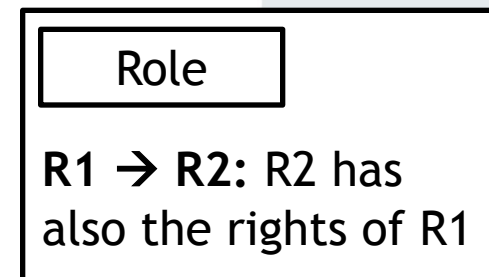
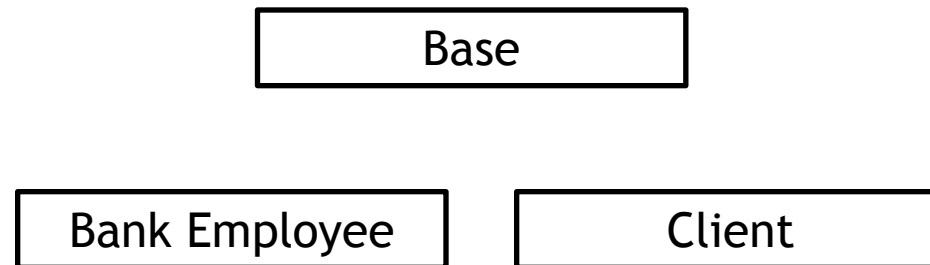
Base

Role

R1 → R2: R2 has
also the rights of R1

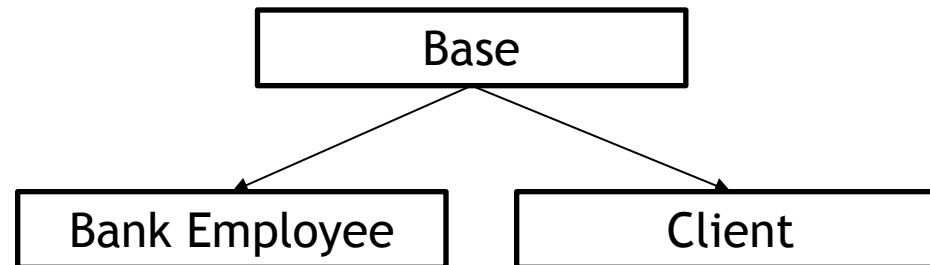
Roles: Bank employee, Base, Auditor, Branch Manager, Cashier, Client Advisor, Client.

a) Draw an RBAC diagram for this scenario.



Roles: Bank employee, Base, Auditor, Branch Manager, Cashier, Client Advisor, Client.

a) Draw an RBAC diagram for this scenario.

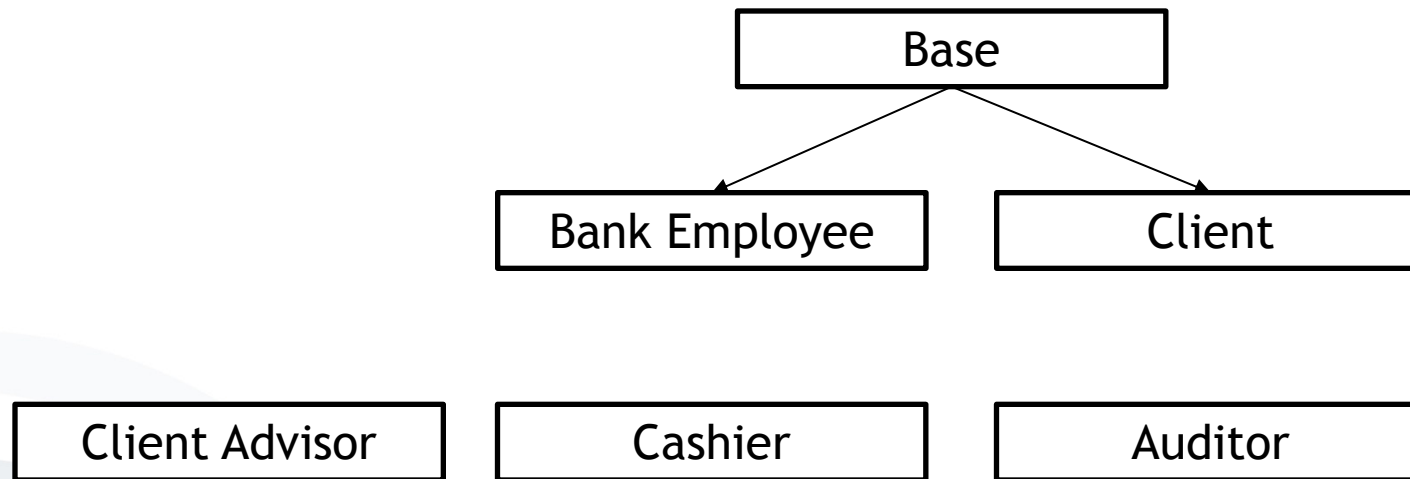


Role

R1 → R2: R2 has also the rights of R1

Roles: Bank employee, Base, Auditor, Branch Manager, Cashier, Client Advisor, Client.

a) Draw an RBAC diagram for this scenario.

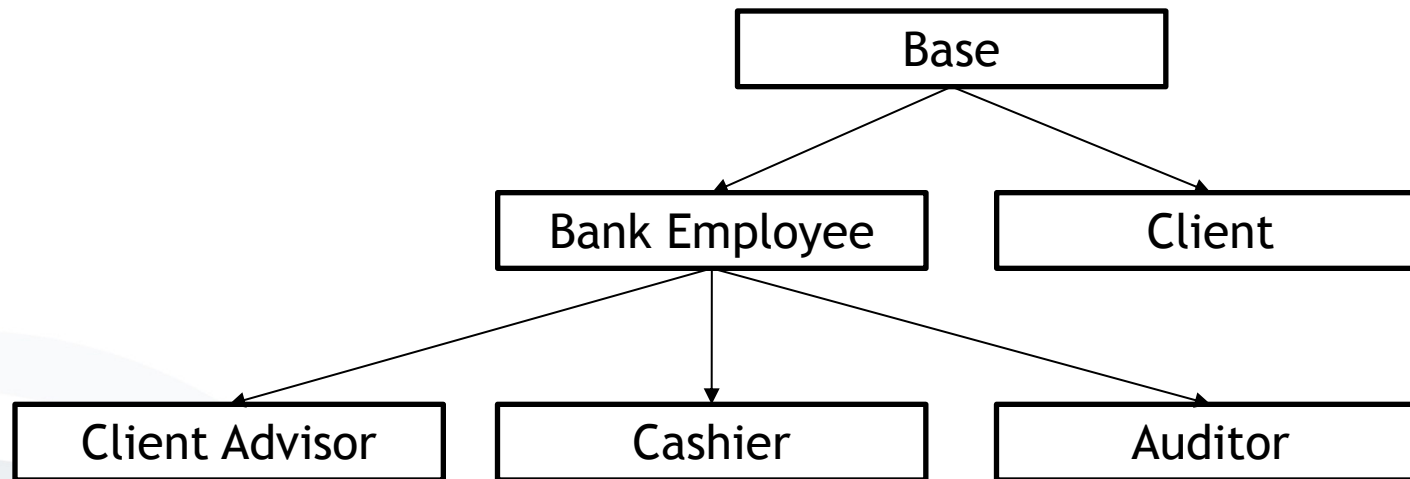


Role

R1 → R2: R2 has also the rights of R1

Roles: Bank employee, Base, Auditor, Branch Manager, Cashier, Client Advisor, Client.

a) Draw an RBAC diagram for this scenario.

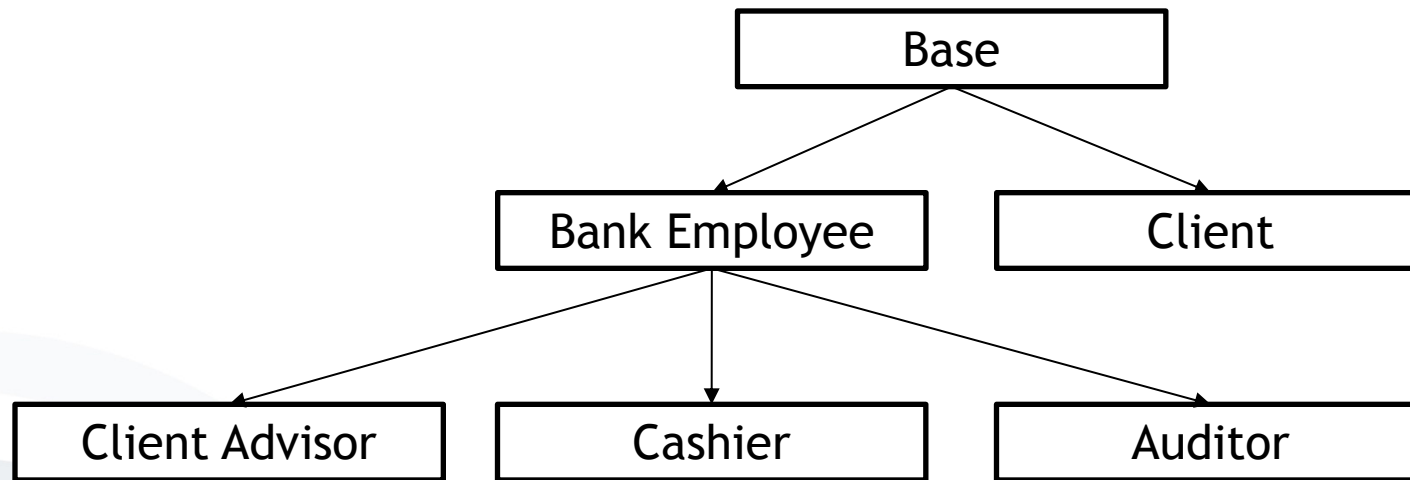


Role

$R1 \rightarrow R2$: R2 has also the rights of R1

Roles: Bank employee, Base, Auditor, Branch Manager, Cashier, Client Advisor, Client.

a) Draw an RBAC diagram for this scenario.



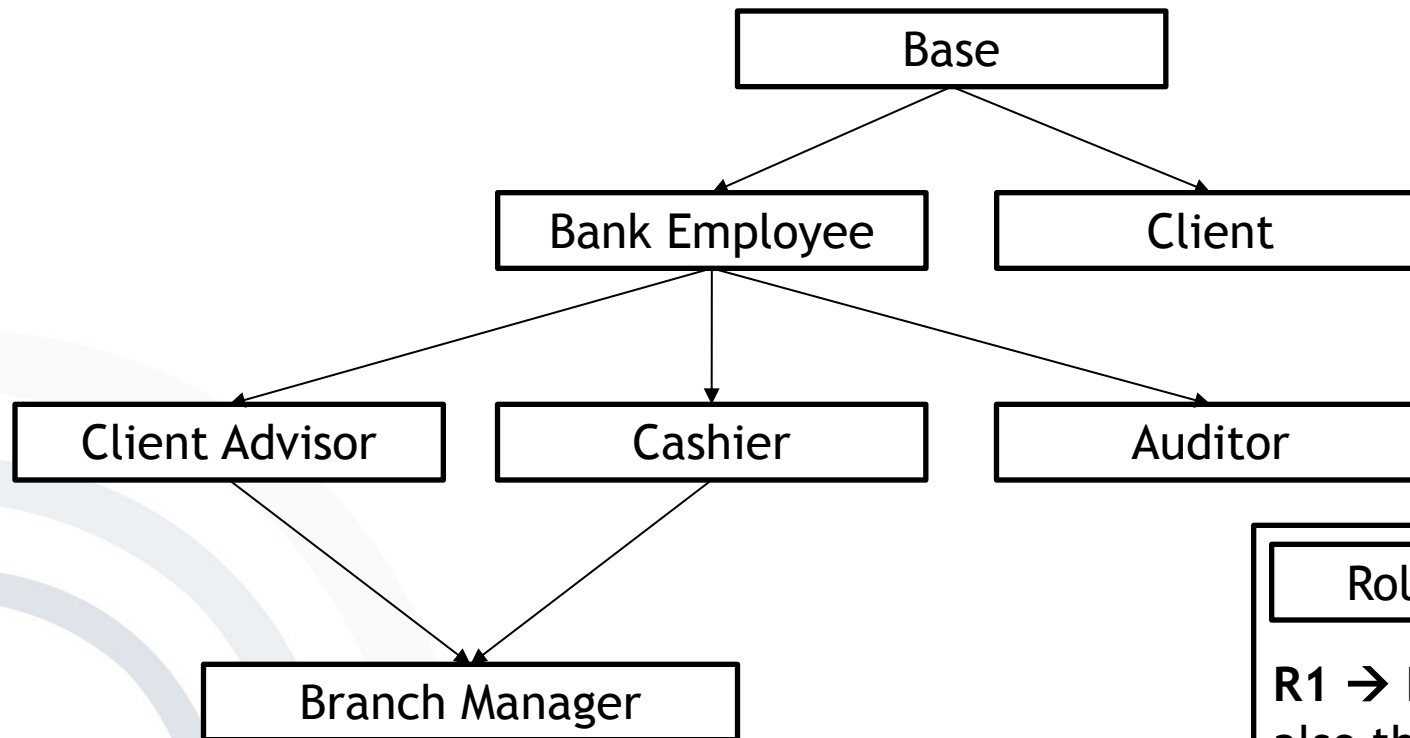
Branch Manager

Role

$R1 \rightarrow R2$: R2 has also the rights of R1

Roles: Bank employee, Base, Auditor, Branch Manager, Cashier, Client Advisor, Client.

a) Draw an RBAC diagram for this scenario.



Role

R1 → R2: R2 has also the rights of R1

Roles: Bank employee, Base, Auditor, Branch Manager, Cashier, Client Advisor, Client.

b) The subject cash machine (ATM) has the role cashier. Can it perform the following actions?

- (1) Withdraw cash from an authorized account
- (2) Withdraw cash from an unauthorized account

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b) The subject cash machine (ATM) has the role cashier. Can it perform the following actions?

- (1) Withdraw cash from an authorized account → ✓
- (2) Withdraw cash from an unauthorized account → ✗

Exercise 1: Access Control Matrix

Exercise 2: Access Control Lists and Capability Lists

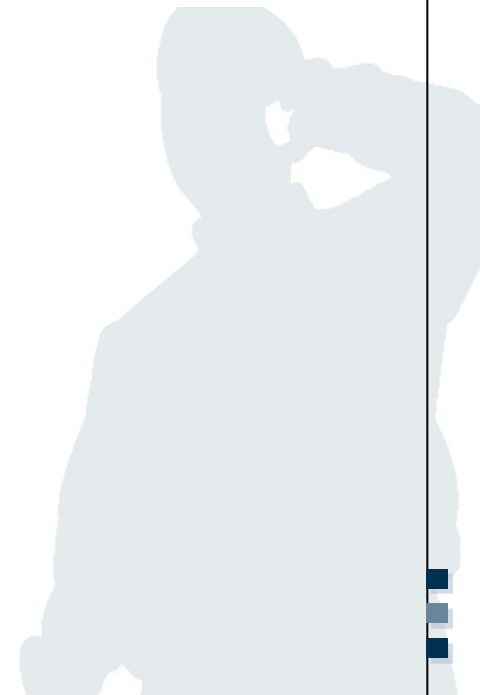
Exercise 3: Bell-LaPadula Model

Exercise 4: Role Based Access Control

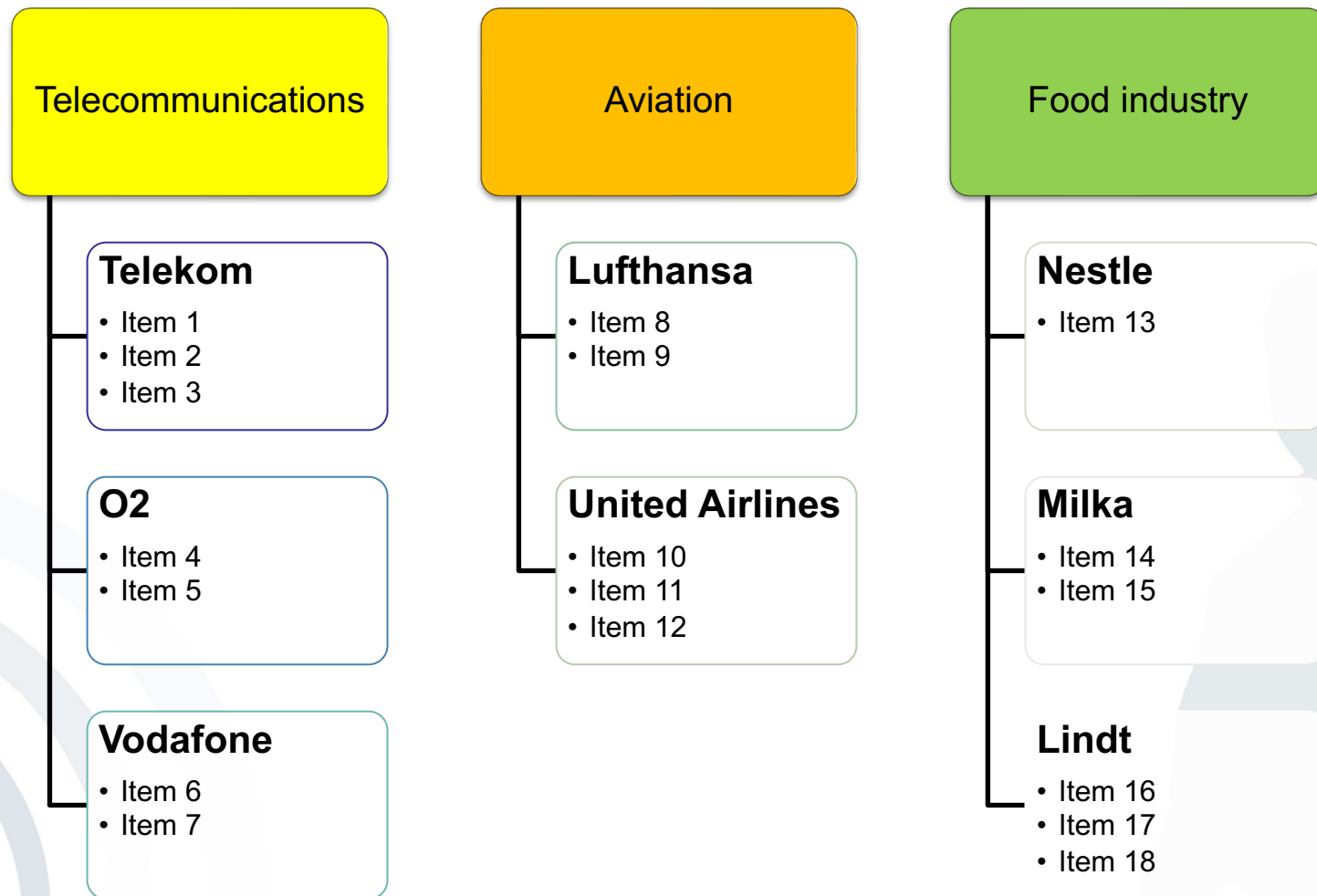
Exercise 5: Chinese Wall Model

Exercise 5: Chinese Wall Model

Take the Chinese Wall Model and the COI classes for three different industries: telecommunications, aviation, and food industry.



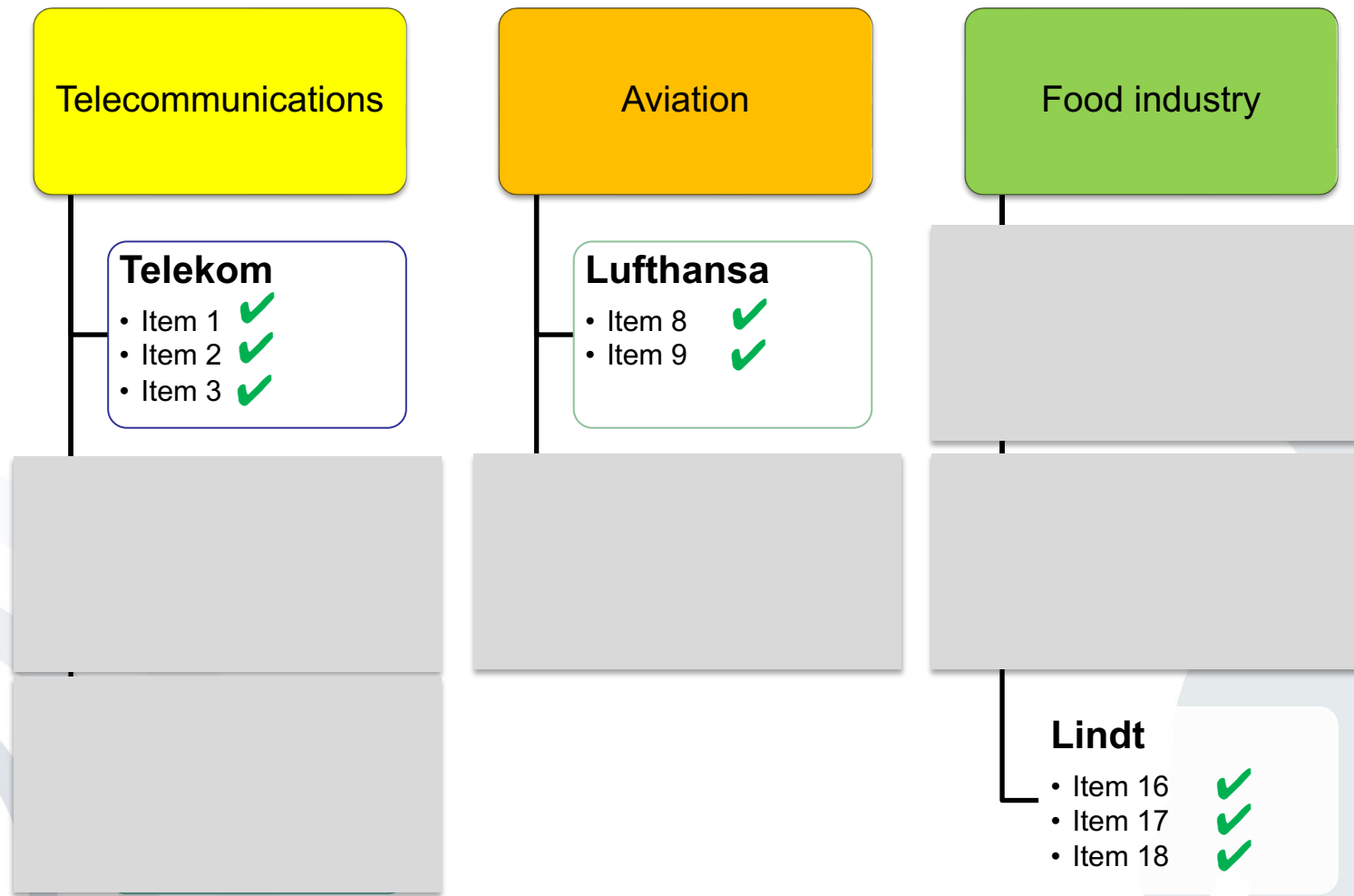
a) Which COI classes do you have access to in the beginning?



a) Which COI classes do you have access to in the beginning?



b) You are assigned to consult and given access to the company datasets of **Telekom**, **Lufthansa**, and **Lindt**. Which individual company files do you have access to now and which not?



Open Questions?

