(T24)討論 Concurrent(同時進行的)Transactions
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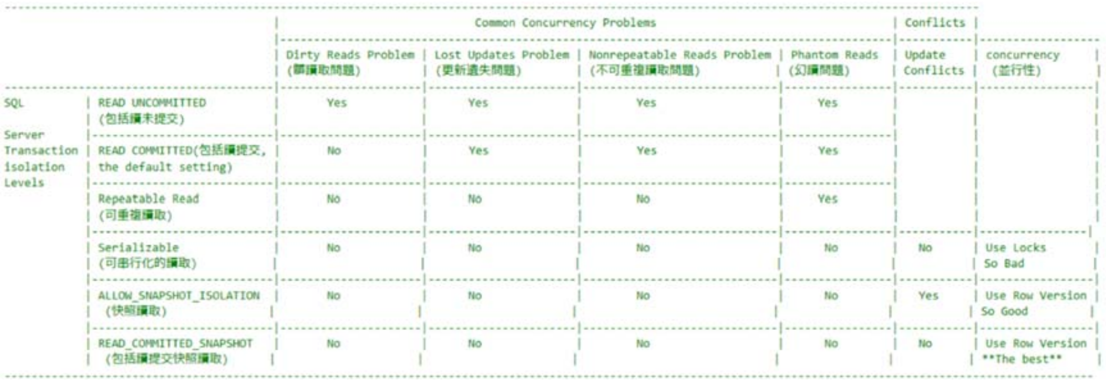
0. Summary

0.1. Concurrent Transactions



		Common Concurrency Problems				Conflicts	
		Dirty Reads Problem (髒讀取問題)	Lost Updates Problem (更新遺失問題)	Nonrepeatable Reads Problem (不可重複讀取問題)	Phantom Reads (幻讀問題)	Update Conflicts	concurrency (並行性)
SQL Server Transaction isolation Levels	READ UNCOMMITTED (包括讀未提交)	Yes	Yes	Yes	Yes		
	READ COMMITTED(包括讀提交, the default setting)	No	Yes	Yes	Yes		
	Repeatable Read (可重複讀取)	No	No	No	Yes		
	Serializable (可串行化的讀取)	No	No	No	No	No	Use Locks So Bad
	ALLOW_SNAPSHOT_ISOLATION (快照讀取)	No	No	No	No	Yes	Use Row Version So Good
	READ_COMMITTED_SNAPSHOT (包括讀提交快照讀取)	No	No	No	No	No	Use Row Version **The best**

0.2. Summary

/*
Transaction Revise :
1.
ErrorHandling_Transaction_@@Error_TryCatch
1.1.
We have to ensure a group of sql statement
can perform successfully together or unsuccessfully together.
Thus, we need SQL Transaction.
--BEGIN TRANSACTION;
BEGIN TRAN
...
--ROLLBACK TRANSACTION;
COMMIT TRAN;
1.2.
Prohibit to ROLLBACK any inner Transaction
No matter inner Transaction has name or not.
If you really want to roll back inner Transaction,
don't use inner Transaction, Use Savepoint with SavepointName
--BEGIN TRAN Tranl;
--PRINT @@TRANCOUNT;   --1st TRANCOUNT, 1
--SAVE TRAN SavePoint;
--PRINT @@TRANCOUNT;   --2nd TRANCOUNT, 1
--...
--ROLLBACK TRAN SavePoint;
--PRINT @@TRANCOUNT;   --3rd TRANCOUNT, 1
----ROLLBACK TRAN Tranl
--COMMIT TRAN Tranl;
1.3.
When ROLLBACK Outter Transaction
No matter you have commit inner Transaction or not,
the inner Transaction will be forced to rollback too.
1.4.
--SELECT ERROR_NUMBER() AS [ERROR_NUMBER()] , --245
--   ERROR_MESSAGE() AS [ERROR_MESSAGE()] ,   --Conversion failed when converting the varchar value 'Account1' to data type int.
--   ERROR_PROCEDURE() AS [ERROR_PROCEDURE()] ,   --NULL
--   ERROR_STATE() AS [ERROR_STATE()] ,   --1
--   ERROR_SEVERITY() AS [ERROR_SEVERITY()] , --16
--   ERROR_LINE() AS [ERROR_LINE()]   --9
Reference:
https://docs.microsoft.com/en-us/sql/t-sql/functions/error-procedure-transact-sql
https://docs.microsoft.com/en-us/sql/t-sql/functions/error-state-transact-sql
1.4.1.
Each kind of Error has ONE Error number just like and id, and ONE ERROR_MESSAGE
In this case, ERROR_NUMBER is 245.

```
ERROR_MESSAGE is 'Conversion failed when converting the varchar value 'Account1' to data type int.'
1.4.2.
ERROR_PROCEDURE() returns the name of the stored procedure or trigger
where an error occurred that caused the CATCH block of a TRY…CATCH.
In this case, ERROR_PROCEDURE is NULL, because this is not stored procedure or trigger.
1.4.3.
ERROR_STATE is kind of flat for debugging.
Each specific condition that raises the error assigns a unique state code.
A SQL Server support engineer can also use the state code from an error to find the location
in the source code where that error is being raised,
which may provide additional ideas on how to diagnose the problem.
1.4.4.
ERROR_SEVERITY 16 means a general error.
This is kind of the category of error message.
1.4.5.
ERROR_LINE returns the lind number where an error occurred.
1.5.
We have to ensure a group of sql statement
can perform successfully together or unsuccessfully together.
Thus, we need SQL Transaction and try catch
--BEGIN TRY
--    --BEGIN TRANSACTION;
--       BEGIN TRAN
--       ...
--       --ROLLBACK TRANSACTION;
--       COMMIT TRAN;
--END TRY
--BEGIN CATCH
--     ...
--END CATCH
1.5.1.
--INSERT  INTO [dbo].[BankTransaction]
--     (      [FromBankAccountID] ,
--            [ToBankAccountID] ,
--            [Amount]
--     )
--VALUES  ('Account1' ,    -- datatype Error
--            'Account2' , --datatype Error
--            @TransferAmount
--     );
FromBankAccountID and ToBankAccountID need int type parameter,
but the input is character string.
This will raise an error and automaticly "ROLLBACK" to beginning of transaction.
and then jump to   BEGIN CATCH clause.
*/
--==========================================================================================================================
/*
--------------------------------------------------------------------------------------------------------------------------------------------------------
                              |                         Common Concurrency Problems                              | Conflicts |
                              |------------------------------------------------------------------------------------------|-----------|------------------
                              | Dirty Reads Problem | Lost Updates Problem | Nonrepeatable Reads Problem | Phantom Reads  | Update    |
concurrency     |
                              | (髒讀取問題)        | (更新遺失問題)        | (不可重複讀取問題)          | (幻讀問題)     | Conflicts |  (並行性)       |
---------------------------------------|---------------------|----------------------|----------------------------|----------------|-----------|-----------------|
SQL        | READ UNCOMMITTED        |       Yes          |      Yes           |       Yes              |     Yes       |           |               |
          | (包括讀未提交)           |                 |                 |                     |             |         |              |
Server      |--------------------------|---------------------|----------------------|----------------------------|----------------|          |              |
Transaction | READ COMMITTED(包括讀提交, |      No          |     Yes           |       Yes              |    Yes        |          |              |
isolation   | the default setting)      |                 |                 |                     |             |         |              |
Levels      |--------------------------|---------------------|----------------------|----------------------------|----------------|          |              |
          | Repeatable Read         |      No          |      No           |       No               |     Yes       |          |              |
          | (可重複讀取)             |                 |                 |                     |             |         |              |
          |--------------------------|---------------------|----------------------|----------------------------|----------------|-----------|----------------|
          | Serializable            |      No          |      No           |       No               |     No       |  No     | Use Locks      |
        | (可串行化的讀取)         |                  |                  |                      |              |          | So Bad         |
        |---------------------------|---------------------|----------------------|-----------------------------|----------------|-----------|-----------------|
        | ALLOW_SNAPSHOT_ISOLATION  |       No          |      No           |        No                |      No        |   Yes     | Use Row Version |
        |  (快照讀取)           |                  |                  |                      |              |          | So Good        |
        |---------------------------|---------------------|----------------------|-----------------------------|----------------|-----------|-----------------|
        | READ_COMMITTED_SNAPSHOT   |       No          |      No           |        No                |      No        |   No      | Use Row Version |
        |  (包括讀提交快照讀取)     |                  |                  |                      |              |          | **The best**    |
--------------------------------------------------------------------------------------------------------------------------------------------------------------------
*/
```

1.
Transaction Concurrency Problems : Dirty Reads Problem (髒讀取問題)

1.1.
A Dirty Reads Problem (髒讀取問題) happens
when Transaction01 has been permitted to read the data
that has been modified by Transaction02 that has not yet been committed.
If the Transaction01 is rolled back after the second reads the data,
the Transaction02 has dirty data that does not exist anymore.

1.2.
E.g.1
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
Transaction1 read the ColumnA which stored value1 from database.
Transaction1 updated the ColumnA from value1 to value2
but has not committed yet.
In the mean time,
Transaction2 TRANSACTION ISOLATION LEVEL is "READ UNCOMMITTED"(包括讀未提交),
hence, Transaction2 read the ColumnA uncommitted value2.
Afterwards, Transaction1 met the Error and rollback.
Thus, the ColumnA will ROLLBACK from value2 back to value1.
However, Transaction2 was still using the
uncommitted value2 of ColumnA and doing its tasks.
The value2 is dirty data which does not exist anymore.
This is Dirty Reads Problem (髒讀取問題).

1.3.
E.g.2
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
READ COMMITTED can fix Dirty Reads Problem (髒讀取問題)
Transaction1 read the ColumnA which stored value1 from database.
Transaction1 updated the ColumnA from value1 to value2
but has not committed yet.
In the mean time,
Transaction2 also try to read ColumnA.
Transaction2 TRANSACTION ISOLATION LEVEL is "READ COMMITTED"(包括讀提交),
hence, Transaction1 blocks the Transaction2 to read ColumnA
until Transaction1 has committed.
Afterwards, Transaction1 met the Error and rollback.
Thus, the ColumnA will ROLLBACK from value2 back to value1 and committed.
Therefore, Transaction2 finally can read the ColumnA committed value1.

1.4.
Transaction isolation Level :
--SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
V.S.
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;

1.4.1.
--SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
ReadUncommitted(包括讀未提交) has DirtyReadProblem (髒讀取問題)

1.4.2.
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;

1.4.2.1.
ReadCommitted(包括讀提交 the default setting),
can fix DirtyReadProblem(髒讀取問題),
but ReadCommitted has LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).

1.4.2.1.
READ COMMITTED is the default isolation level for SQL Server.
It prevents dirty reads(髒讀取問題) by locking the uncommitted data.

2.
Transaction Concurrency Problems : Lost Updates Problem (更新遺失問題).

2.1.
Lost update problem happens when 2 transactions
read and update the same data.

2.2.
E.g.1
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
By default,
Transaction1 and Transaction2 Transaction isolation Levels
are both Read Committed (包括讀提交).
Transaction1 read the ColumnA which stored value1 from database.
In the mean time,
Transaction2 also read the ColumnA which stored value1 from database.
After 1 seconds, Transaction2 update the ColumnA from value1 to value2 and commit.
After Transaction2 COMMIT TRANSACTION,
then Transaction1 finally updated ColumnA from value1 to value3 and commit.
Thus, the ColumnA will actually store value3.
value2 does not exist any more, it is Lost Updates Problem (更新遺失問題).

2.3.
E.g.2
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
REPEATABLE READ can fix Lost Updates Problem (更新遺失問題).
Transaction1 read the ColumnA which stored value1 from database.
In the mean time,
Transaction2 also read the ColumnA which stored value1 from database.
Transaction1 REPEATABLE READ level use locks on ColumnA to prevent
Transaction2 from "updating" the ColumnA from value1 to value2.
Then it makes Transaction2 return errors and discards the value2.
Transaction1 finally updated ColumnA from value1 to value3 and commit.
Thus, the ColumnA will actually store value3.

2.4.
Transaction isolation Level :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
V.S.
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;

2.4.1.
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;

2.4.1.1.
ReadCommitted(包括讀提交 the default setting),
can fix DirtyReadProblem(髒讀取問題),
but ReadCommitted has LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).

2.4.1.2.
READ COMMITTED is the default isolation level for SQL Server.
It prevents dirty reads(髒讀取問題) by locking the uncommitted data.

2.4.2.
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;

2.4.2.1.
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題),
but ReadCommitted has PhantomReadsProblem(幻讀).

2.4.2.2.
"Repeatable Read" (可重複讀取) isolation level ensures
that the data that one transaction has read,
will be prevented from being "updated" or "deleted" by any other transaction.
Therefore,
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
However, "Repeatable Read" (可重複讀取) isolation level
does not prevent new rows from being "inserted" by other transactions.
Thus, "Repeatable Read" (可重複讀取) CAN NOT fix PhantomReadProblem (幻讀問題).

3.
Transaction Concurrency Problems : Non-Repeatable Read Problem (不可重複讀取問題)

3.1.
Non-Repeatable Read Problem (不可重複讀取問題)
when Transaction1 reads the same data twice,
and Transaction2 updates that data
in between the first and second read of Transaction1.
Thus, Transaction1 first read and
Transaction1 second read became differenct value.
This is Non-Repeatable Read Problem (不可重複讀取問題)

3.2.
E.g.1
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
By default,
Transaction1 and Transaction2 Transaction isolation Levels
are both Read Committed (包括讀提交).
Transaction1 do the "First Read" for the ColumnA
which stored value1 from database.
During Transaction1 spends 5 seconds to do some tasks,
Transaction2 updates the ColumnA from value1 to value2 and commit.
After Transaction1 finished that some tasks,
and do the "Second Read" for the ColumnA
which stored value2 from database now.
Thus, Transaction1 first read(value1) and

Transaction1 second read(value2) became differenct value.
This is Non-Repeatable Read Problem (不可重複讀取問題).

3.3.
E.g.2
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
REPEATABLE READ can fix Non-Repeatable Read Problem (不可重複讀取問題)
Transaction1 do the "First Read" for the ColumnA
which stored value1 from database.
Transaction1 REPEATABLE READ level use locks to prevent
Transaction2 from "updating" the ColumnA from value1 to value2.
Therefore, when Transaction1 finally read the ColumnA again
which will store value1 from database again.
Afterwards, Transaction1 REPEATABLE READ level release its locks on ColumnA.
Therefore, Transaction2 can finally update the ColumnA from value1 to value2.

3.4.
Transaction isolation Level :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
V.S.
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;

3.4.1.
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;

3.4.1.1.
ReadCommitted(包括讀提交 the default setting),
can fix DirtyReadProblem(髒讀取問題),
but ReadCommitted has LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).

3.4.1.2.
READ COMMITTED is the default isolation level for SQL Server.
It prevents dirty reads(髒讀取問題) by locking the uncommitted data.

3.4.2.
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;

3.4.2.1.
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題),
but ReadCommitted has PhantomReadsProblem(幻讀).

3.4.2.2.
"Repeatable Read" (可重複讀取) isolation level ensures
that the data that one transaction has read,
will be prevented from being "updated" or "deleted" by any other transaction.
Therefore,
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
However, "Repeatable Read" (可重複讀取) isolation level
does not prevent new rows from being "inserted" by other transactions.
Thus, "Repeatable Read" (可重複讀取) CAN NOT fix PhantomReadProblem (幻讀問題).

4.
Transaction Concurrency Problems : Phantom Read Problem (幻讀問題)

4.1.

when Transaction1 executes the same select query twice,
and Transaction2 insert a new data row
in between the first and second execution of Transaction1.
The new data row, which was added by Transaction2, matches
the WHERE clause of the query executed by the Transaction1.
Thus, Transaction1 gets a different number of rows
in the result set each time.

4.2.
E.g.1
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Transaction1 do the "1st Read"
and get "N1" rows in return.
During Transaction1 spends 5 seconds to do some tasks,
Transaction2 "inserted" 1 row and committed.
Thus, when Transaction1 do the "2nd Read"
and get "N1+1" rows in return.
"RepeatableRead"(可重複讀取)) has PhantomReadsProblem(幻讀).

4.3.
E.g.2
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction1 do the "1st Read"
and get "N1" rows in return.
During Transaction1 spends 5 seconds to do some tasks,
Transaction2 "inserted" 1 row and committed.
Transaction1 SERIALIZABLE use locks to lock on table
and prevent Transaction2 from
"updating", "deleting", or "inserting" to the table.
When Transaction1 finished "2nd Read"
and still get "N1" rows in return,
Transaction2 finally can "insert" a new row
and make the table become "N1+1" rows.
"serializableRead" (可串行化的讀取) can fix PhantomReadsProblem(幻讀).

4.4.
Transaction isolation Level :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
V.S.
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;

4.4.1.
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;

4.4.1.1.
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題),
but ReadCommitted has PhantomReadsProblem(幻讀).

4.4.1.2.
"Repeatable Read" (可重複讀取) isolation level ensures
that the data that one transaction has read,
will be prevented from being "updated" or "deleted" by any other transaction.
Therefore,
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).

However, "Repeatable Read" (可重複讀取) isolation level
does not prevent new rows from being "inserted" by other transactions.
Thus, "Repeatable Read" (可重複讀取) CAN NOT fix PhantomReadProblem (幻讀問題).

4.4.2.
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;

4.4.2.1.
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
, NonrepeatableReadsProblem(不可重複讀取問題),
and ReadCommitted has PhantomReadsProblem(幻讀).

4.4.2.2.
"serializable Read" (可串行化的讀取) isolation level ensures
that the data that one transaction has read,
will be prevented from being "updated" or "deleted" by any other transaction.
Therefore,
SerializableRead(可串行化的讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
In addition, SerializableRead(可串行化的讀取) isolation level
prevent new rows from being "inserted" by other transactions.
Thus, "serializable Read" (可串行化的讀取) CAN fix Phantom Read Problem (幻讀問題).

5.
SerializableRead(可串行化的讀取) V.S.
ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) V.S.
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)

5.0.

5.0.1.
All these 3 isolation levels can fix
DirtyReadsProblem (髒讀取問題)
LostUpdateProblem(更新遺失問題),
NonrepeatableReadsProblem(不可重複讀取問題),
and PhantomReadsProblem(幻讀問題)

5.0.2.
SerializableRead(可串行化的讀取) uses locks to
block all other transactions.
Therefore, its concurrency(並行性) of transaction is bad.

5.0.3.
ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) and
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level copy the resource and maintains row versioning in Tempdb.
Row version is a unique transaction sequence number identifies each transaction,
and it determine the sequence of executing transactions.
Because it does not use locks.
Thus, other transactions still can use the resource.
Therefore, concurrency(並行性) of transaction is good.

5.0.4.

5.0.4.1.
ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)
is vulnerable to update conflicts.
When both Transaction1 and Transaction2 are
using ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取),
and both Transaction1 and Transaction2 are updating the same column value,
One of Transaction will return Error as update conflicts.

5.0.4.2.
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
has no update conflicts problems, because
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
uses row version to perform whatever ReadCommitted(包括讀提交) can do, plus
whatever ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) can do.
whatever ReadCommitted(包括讀提交) can do is to prevent update conflicts.
When both Transaction1 and Transaction2 are
using READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取),
and both Transaction1 and Transaction2 are updating the same column value,
one Transaction will wait another Transaction to finish,
then it will start to execute.
One of Transaction will NOT return Error as update conflicts.

5.0.5.
Using READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
is so much easier than using ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取).
When using ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)
might need to change some existing code.
However, using ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) is much easier.
All you need is to add this line.
--ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT ON;
In addition, by default,
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Thus, you don't need to do anything else.

5.0.6.
Consider the following example,
More details will be discussed later.

5.0.6.1.
E.g.
Transaction1 use SERIALIZABLE(可串行化的讀取) level : Update Data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 use SERIALIZABLE(可串行化的讀取) level : Select data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;

5.0.6.2.
E.g.
Transaction1 use SERIALIZABLE(可串行化的讀取) level : Update Data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level : Select data
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;

5.0.6.3.
E.g.
Transaction1 use SERIALIZABLE(可串行化的讀取) level : Update Data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level : Update same data
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;

5.0.6.4.
E.g.
Transaction1 use ReadCommitted(包括讀提交) level : Update Data
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use ReadCommitted(包括讀提交) level : Select data
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;

5.0.6.5.
E.g.

Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Select data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;

5.0.6.6.
E.g.
Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update same data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;

5.0.6.7.
E.g.
Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level :
1st select before update, 2nd select after update
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;

5.0.6.8.
E.g.
Transaction1 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level : Update Data
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
Transaction2 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level :
1st select before update, 2nd select after update
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
This is the logic error and hard to debug.

5.1.
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;

5.1.1.
SerializableRead(可串行化的讀取) isolation level use locks
to block all other transactions,
so all other transactions can not insert, update, delete any thing.
Therefore,
SerializableRead(可串行化的讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
In addition, SerializableRead(可串行化的讀取) isolation level
prevent new rows from being "inserted" by other transactions.
Thus, "serializable Read" (可串行化的讀取) CAN fix Phantom Read Problem (幻讀問題).
Because of using locks, concurrency(並行性) of transaction is bad.

5.2.
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
...
--SET TRANSACTION ISOLATION LEVEL OFF;

5.2.1.
ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) and
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level copy the resource and maintains row versioning in Tempdb.

Row version is a unique transaction sequence number identifies each transaction,
and it determine the sequence of executing transactions.
Because it does not use locks.
Thus, other transactions still can use the resource.
Therefore, concurrency(並行性) of transaction is good.

5.2.2.
ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)
is vulnerable to update conflicts.

5.2.3.
Reference:
https://stackoverflow.com/questions/232333/how-long-should-set-read-committed-snapshot-on-take
Firstly,
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION ON;
Secondly, you may
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
If it take too long to enable SNAPSHOT,
close all ssms session, and re-open ssms, re-open the query.
execute the fillowing.
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION ON WITH ROLLBACK IMMEDIATE
it will immediately rollback any open transactions before starting the ALTER DATABASE statement.
Remember to disable it when you finished
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION OFF;

5.3.
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
...
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT OFF;

5.3.1.
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
...
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT OFF;
V.S.
ReadCommitted(包括讀提交 the default setting).
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level is very similar to
ReadCommitted(包括讀提交 the default setting).
The differenct is the following.

5.3.2.
ReadCommitted(包括讀提交 the default setting) use locks,
and it can fix DirtyReadsProblem(髒讀取問題).
It has LostUpdatesProblem(更新遺失問題),
NonrepeatableReadsProblem(不可重複讀取問題),
and PhantomReadsProblem(幻讀問題).
Because of locks, concurrency(並行性) of transaction is bad.

5.3.3.
ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) and
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level copy the resource and maintains row versioning in Tempdb.
Row version is a unique transaction sequence number identifies each transaction,
and it determine the sequence of executing transactions.
Because it does not use locks.
Thus, other transactions still can use the resource.
Therefore, concurrency(並行性) of transaction is good.

5.3.4.

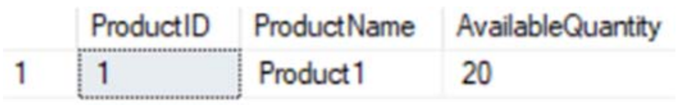
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
has no update conflicts problems, because
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
uses row version to perform whatever ReadCommitted(包括讀提交) can do, plus
whatever ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) can do.
whatever ReadCommitted(包括讀提交) can do is to prevent update conflicts.

5.3.5.
Reference:
https://stackoverflow.com/questions/232333/how-long-should-set-read-committed-snapshot-on-take
Firstly,
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
Secondly, you may
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
If it take too long to enable SNAPSHOT,
close all ssms session, and re-open ssms, re-open the query.
execute the fillowing.
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON WITH ROLLBACK IMMEDIATE
it will immediately rollback any open transactions before starting the ALTER DATABASE statement.
Remember to disable it when you finished
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT OFF;

==

1. Create Sample Data

```
--==============================================================================
--T024_01_Create Sample Data
--==============================================================================
--**** Changeable variable
--Ctrl + F --> Search '@Product1AvailableQuantity',
--then update its stock if you want.
DECLARE @Product1AvailableQuantity INT = 20;
IF ( EXISTS ( SELECT    *
              FROM      INFORMATION_SCHEMA.TABLES
              WHERE     TABLE_NAME = 'Product2' ) )
    BEGIN
        DROP TABLE Product2;
    END;
CREATE TABLE Product2
    (
      ProductID INT IDENTITY(1, 1)
                    PRIMARY KEY
                    NOT NULL ,
      ProductName NVARCHAR(100) ,
      AvailableQuantity INT
    );
INSERT  INTO Product2
VALUES  ( 'Product1', @Product1AvailableQuantity );
GO -- Run the previous command and begins new batch

SELECT  *
FROM    dbo.Product2;
GO -- Run the previous command and begins new batch
```



	ProductID	ProductName	AvailableQuantity
1	1	Product1	20

==

2. Transaction and Error Handling

```
--==============================================================================
--T024_02_Transaction and Error Handling
--==============================================================================
```

2.1. Transaction and Error Handling

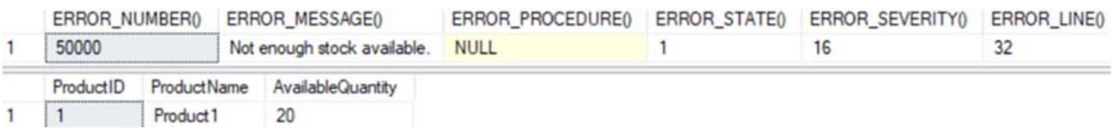
```
--==============================================================================
--T024_02_01
--Transaction and Error Handling
DECLARE @ProductID INT= 1;
--**** Changeable variable
DECLARE @OrderedQuantity INT= 100;
--DECLARE @OrderedQuantity INT= 2;
/*
if ( @Product1AvailableQuantity < @OrderedQuantity ) then return Error.
In this case, IF(100 < 20), return Error, because 'Not enough stock available.'
Please try
--DECLARE @OrderedQuantity INT= 100;
Then Try
--DECLARE @OrderedQuantity INT= 2;
*/
BEGIN TRY
    BEGIN TRAN;
        --Find the [AvailableQuantity]
    DECLARE @AvailableQuantity INT;
    SELECT  @AvailableQuantity = [AvailableQuantity]
    FROM    [dbo].[Product2]
    WHERE   [ProductID] = @ProductID;

        -- 1. Throw an error if Not enough stock available.
    IF ( @AvailableQuantity < @OrderedQuantity )
        BEGIN
            RAISERROR('Not enough stock available.',16,1);
        END;
        ----2. Adding new records to [Order] table
        --INSERT  INTO [dbo].[Order]
    --VALUES  ( ...);
        -- 3. Updating existing records
    UPDATE  [dbo].[Product2]
    SET     [AvailableQuantity] -= @OrderedQuantity
    WHERE   [ProductID] = @ProductID;
        -- 4. COMMIT TRANSACTION;
    COMMIT TRAN;
    PRINT 'Transaction Committed';
END TRY
BEGIN CATCH
    SELECT  ERROR_NUMBER() AS [ERROR_NUMBER()] ,
            ERROR_MESSAGE() AS [ERROR_MESSAGE()] ,
            ERROR_PROCEDURE() AS [ERROR_PROCEDURE()] ,
            ERROR_STATE() AS [ERROR_STATE()] ,
            ERROR_SEVERITY() AS [ERROR_SEVERITY()] ,
            ERROR_LINE() AS [ERROR_LINE()];
```

```
END CATCH;
--See the stock.
SELECT  *
FROM    Product2
WHERE   [ProductID] = @ProductID;
/*
1.
--SELECT  ERROR_NUMBER() AS [ERROR_NUMBER()] , --50000
--     ERROR_MESSAGE() AS [ERROR_MESSAGE()] ,         --Not enough stock available.
--     ERROR_PROCEDURE() AS [ERROR_PROCEDURE()] ,     --NULL
--     ERROR_STATE() AS [ERROR_STATE()] ,                    --1
--     ERROR_SEVERITY() AS [ERROR_SEVERITY()] , --16
--     ERROR_LINE() AS [ERROR_LINE()]                        --23
Reference:
https://docs.microsoft.com/en-us/sql/t-sql/functions/error-procedure-transact-sql
https://docs.microsoft.com/en-us/sql/t-sql/functions/error-state-transact-sql
1.1.
Each kind of Error has ONE Error number just like and id, and ONE ERROR_MESSAGE
In this case, ERROR_NUMBER is 50000.
ERROR_MESSAGE is 'Not enough stock available.'
1.2.
ERROR_PROCEDURE() returns the name of the stored procedure or trigger
where an error occurred that caused the CATCH block of a TRY…CATCH.
In this case, ERROR_PROCEDURE is NULL, because this is not stored procedure or trigger.
1.3.
ERROR_STATE is kind of flat for debugging.
Each specific condition that raises the error assigns a unique state code.
A SQL Server support engineer can also use the state code from an error to find the location
in the source code where that error is being raised,
which may provide additional ideas on how to diagnose the problem.
1.4.
ERROR_SEVERITY 16 means a general error.
This is kind of the category of error message.
1.5.
ERROR_LINE returns the lind number where an error occurred.
2.
We have to ensure a group of sql statement
can perform successfully together or unsuccessfully together.
Thus, we need SQL Transaction and try catch
When transaction failed, it rollback that transaction and raise Error,
then Perform Catch cluase.
Otherwise, commit the transaction.
--BEGIN TRY
--     --BEGIN TRANSACTION;
--        BEGIN TRAN
--        ...
--        --ROLLBACK TRANSACTION;
--        COMMIT TRAN;
--END TRY
--BEGIN CATCH
--      ...
--END CATCH
*/
```

When

```
DECLARE @OrderedQuantity INT= 100;
```

Returns ...



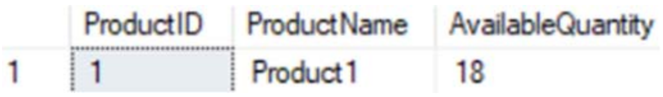
	ERROR_NUMBER()	ERROR_MESSAGE()	ERROR_PROCEDURE()	ERROR_STATE()	ERROR_SEVERITY()	ERROR_LINE()
1	50000	Not enough stock available.	NULL	1	16	32

	ProductID	ProductName	AvailableQuantity
1	1	Product1	20

When

```
DECLARE @OrderedQuantity INT= 2;
```

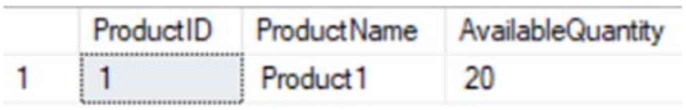
Returns ...



	ProductID	ProductName	AvailableQuantity
1	1	Product1	18

2.2. Transaction and Error Handling

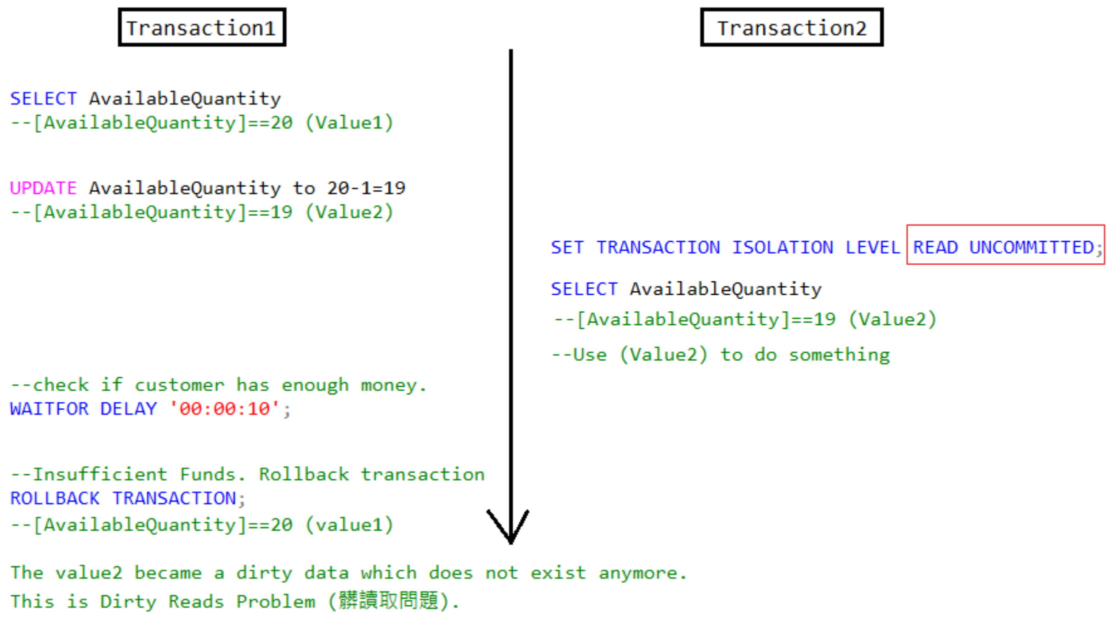
```
--==============================================================================
--T024_02_02
--Clean up
--**** Changeable variable
DECLARE @Product1AvailableQuantity INT= 20;
DECLARE @ProductID INT= 1;
UPDATE  [dbo].[Product2]
SET     [AvailableQuantity] = @Product1AvailableQuantity
WHERE   [ProductID] = @ProductID;
--See the stock.
SELECT  *
FROM    Product2
WHERE   [ProductID] = @ProductID;
GO -- Run the previous command and begins new batch
```



	ProductID	ProductName	AvailableQuantity
1	1	Product1	20

==

3. Concurrent Transactions DirtyReadProblem(髒讀取問題)



Transaction1:

```
SELECT AvailableQuantity
--[AvailableQuantity]==20 (Value1)

UPDATE AvailableQuantity to 20-1=19
--[AvailableQuantity]==19 (Value2)

--check if customer has enough money.
WAITFOR DELAY '00:00:10';

--Insufficient Funds. Rollback transaction
ROLLBACK TRANSACTION;
--[AvailableQuantity]==20 (value1)
```

Transaction2:

```
SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
SELECT AvailableQuantity
--[AvailableQuantity]==19 (Value2)
--Use (Value2) to do something
```

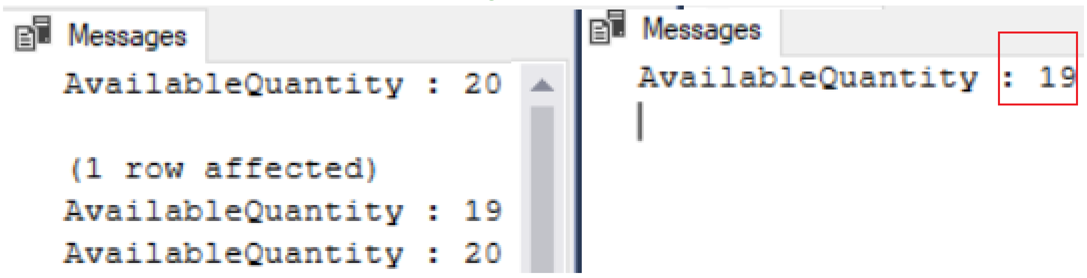
The value2 became a dirty data which does not exist anymore.
This is Dirty Reads Problem (髒讀取問題).

```
--==============================================================================
--T024_03_Concurrent Transactions DirtyReadProblem(髒讀取問題)
--=============================================================================
/*
1.
Transaction Concurrency Problems : Dirty Reads Problem (髒讀取問題)
--------------------------------------------------------
1.1.
A Dirty Reads Problem (髒讀取問題) happens
when Transaction01 has been permitted to read the data
that has been modified by Transaction02 that has not yet been committed.
If the Transaction01 is rolled back after the second reads the data,
the Transaction02 has dirty data that does not exist anymore.
--------------------------------------------------------
1.2.
E.g.1
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
Transaction1 read the ColumnA which stored value1 from database.
Transaction1 updated the ColumnA from value1 to value2
but has not committed yet.
In the mean time,
Transaction2 TRANSACTION ISOLATION LEVEL is "READ UNCOMMITTED"(包括讀未提交),
hence, Transaction2 read the ColumnA uncommitted value2.
Afterwards, Transaction1 met the Error and rollback.
Thus, the ColumnA will ROLLBACK from value2 back to value1.
However, Transaction2 was still using the
uncommitted value2 of ColumnA and doing its tasks.
The value2 is dirty data which does not exist anymore.
This is Dirty Reads Problem (髒讀取問題).
--------------------------------------------------------
1.3.
E.g.2
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
READ COMMITTED can fix Dirty Reads Problem (髒讀取問題)
Transaction1 read the ColumnA which stored value1 from database.
Transaction1 updated the ColumnA from value1 to value2
but has not committed yet.
In the mean time,
Transaction2 also try to read ColumnA.
Transaction2 TRANSACTION ISOLATION LEVEL is "READ COMMITTED"(包括讀提交),
hence, Transaction1 blocks the Transaction2 to read ColumnA
until Transaction1 has committed.
Afterwards, Transaction1 met the Error and rollback.
Thus, the ColumnA will ROLLBACK from value2 back to value1 and committed.
Therefore, Transaction2 finally can read the ColumnA committed value1.
--------------------------------------------------------
1.4.
Transaction isolation Level :
--SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
V.S.
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
----------------------------------------
1.4.1.
--SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
ReadUncommitted(包括讀未提交) has DirtyReadProblem (髒讀取問題)
----------------------------------------
1.4.2.
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
-----------------------
1.4.2.1.
ReadCommitted(包括讀提交 the default setting),
can fix DirtyReadProblem(髒讀取問題),
but ReadCommitted has LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
-----------------------
1.4.2.1.
READ COMMITTED is the default isolation level for SQL Server.
It prevents dirty reads(髒讀取問題) by locking the uncommitted data.
*/
```

3.1. ReadUncommitted(包括讀未提交) has DirtyReadProblem (髒讀取問題)

```
--============================================================================
--T024_03_01
--ReadUncommitted(包括讀未提交) has DirtyReadProblem (髒讀取問題)
/*
1.
--SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
ReadUncommitted(包括讀未提交) has DirtyReadProblem (髒讀取問題)
2.
E.g.
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
*/

----------------------------------------------------------------------------
--T024_03_01_01
--Transaction1 : READ COMMITTED
--**
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
DECLARE @AvailableQuantity INT;
BEGIN TRAN;
--Find the [AvailableQuantity]
SELECT  @AvailableQuantity = [AvailableQuantity]
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--1.
--Check if [AvailableQuantity] > orderedQuantity
--Other wise raise Error and roll back.
--2. Update AvailableQuantity
SET @AvailableQuantity -= 1;
UPDATE  dbo.Product2
SET     AvailableQuantity = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--3. check if customer has enough money to pay.
--...
WAITFOR DELAY '00:00:10';
--4. Insufficient Funds. Rollback transaction
ROLLBACK TRANSACTION;
SELECT  @AvailableQuantity = [AvailableQuantity]
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
GO -- Run the previous command and begins new batch
```

```
----------------------------------------------------------------------------
--T024_03_01_02
--Transaction2 : READ UNCOMMITTED
DECLARE @AvailableQuantity INT;
--**
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
--Find the [AvailableQuantity]
SELECT  @AvailableQuantity = [AvailableQuantity]
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Transaction2 is still using dirty data that does not exist anymore.
--1.
--Check if [AvailableQuantity] > orderedQuantity
--Other wise raise Error and roll back.
--2. Update AvailableQuantity
--3. check if customer has enough money to pay.
--...
GO -- Run the previous command and begins new batch

----------------------------------------------------------------------------
--T024_03_01_03
--Transaction3 :   FROM dbo.Product2 (NOLOCK)
--Transaction3 can replaced Transaction2
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = [AvailableQuantity]
FROM    dbo.Product2 (NOLOCK)
WHERE   ProductID = 1;
--Transaction2 is still using dirty data that does not exist anymore.
--1.
--Check if [AvailableQuantity] > orderedQuantity
--Other wise raise Error and roll back.
--2. Update AvailableQuantity
--3. check if customer has enough money to pay.
--...
GO -- Run the previous command and begins new batch
```



```
Messages
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 19
AvailableQuantity : 20
```

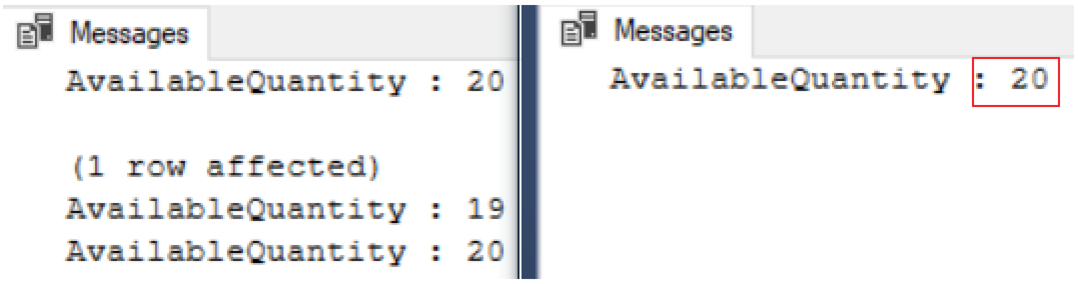
```
Messages
AvailableQuantity : 19
```

```
/*
1.
1.1.
If Transaction1 using
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
If Transaction2 using
--SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
1.2.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 19
--AvailableQuantity : 20
Transaction2 [AvailableQuantity] will return ...
--AvailableQuantity : 19
The AvailableQuantity will be 20,
and 19 does not exist any more.
ReadUncommitted(包括讀未提交) has DirtyReadProblem (髒讀取問題)
*/

--------------------------------------------------------------------------
--T024_03_01_04
--Clean up.
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
--AvailableQuantity : 20
UPDATE  dbo.Product2
SET     [AvailableQuantity] = 20
WHERE   ProductID = 1;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
GO -- Run the previous command and begins new batch
--AvailableQuantity : 20

----------------------------------------------------------------------------------
```

3.2. ReadCommitted(包括讀提交) fix DirtyReadProblem (髒讀取問題)

```
--============================================================================
--T024_03_02
--ReadCommitted(包括讀提交) fix DirtyReadProblem (髒讀取問題)
/*
1.
--SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
ReadUncommitted(包括讀未提交) has DirtyReadProblem (髒讀取問題)
2.
READ COMMITTED is the default isolation level for SQL Server.
READ COMMITTED can fix Dirty Reads Problem (髒讀取問題)
It prevents dirty reads(髒讀取問題) by locking the uncommitted data.
3.
E.g.
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
*/

--------------------------------------------------------------------------
--T024_03_02_01
--Transaction1 : READ COMMITTED
--**
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
DECLARE @AvailableQuantity INT;
BEGIN TRAN;
--Find the [AvailableQuantity]
SELECT  @AvailableQuantity = [AvailableQuantity]
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--1.
--Check if [AvailableQuantity] > orderedQuantity
--Other wise raise Error and roll back.
--2. Update AvailableQuantity
SET @AvailableQuantity -= 1;
UPDATE  dbo.Product2
```

```sql
SET     AvailableQuantity = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--3. check if customer has enough money to pay.
--...
WAITFOR DELAY '00:00:10';
--4. Insufficient Funds. Rollback transaction
ROLLBACK TRANSACTION;
SELECT  @AvailableQuantity = [AvailableQuantity]
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
GO -- Run the previous command and begins new batch

---------------------------------------------------------------------------
--T024_03_02_02
--Transaction2 : READ COMMITTED
DECLARE @AvailableQuantity INT;
--**
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
--SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
--Find the [AvailableQuantity]
SELECT  @AvailableQuantity = [AvailableQuantity]
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Transaction2 is still using dirty data that does not exist anymore.
--1.
--Check if [AvailableQuantity] > orderedQuantity
--Other wise raise Error and roll back.
--2. Update AvailableQuantity
--3. check if customer has enough money to pay.
--...
GO -- Run the previous command and begins new batch
```



```
Messages
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 19
AvailableQuantity : 20
```

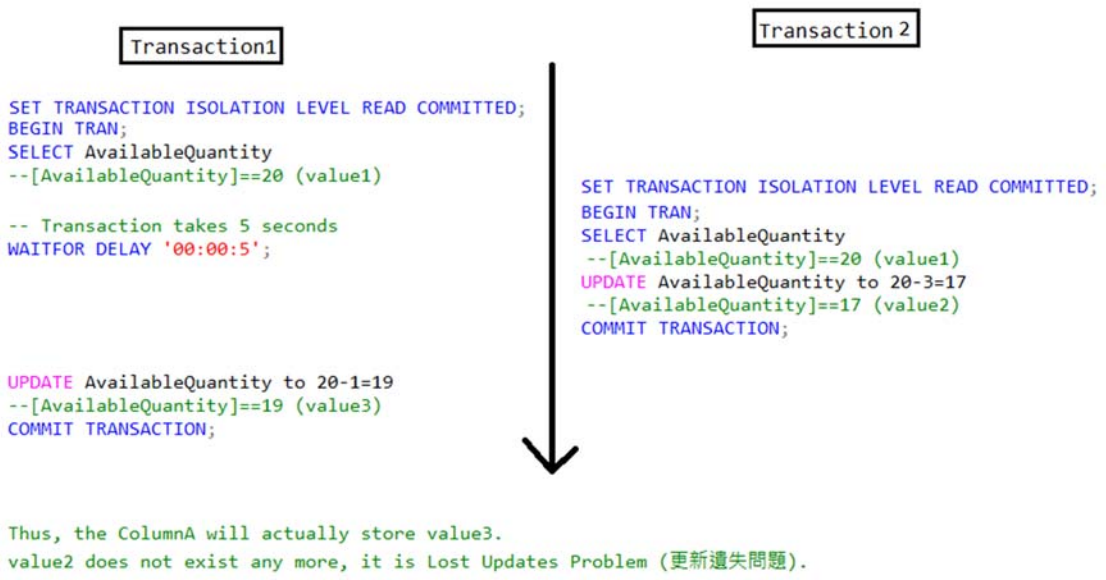
```
Messages
AvailableQuantity : 20
```

```sql
/*
1.
1.1.
If Transaction1 using
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
If Transaction2 using
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
1.2.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 19
--AvailableQuantity : 20
Transaction2 [AvailableQuantity] will return ...
--AvailableQuantity : 20
READ COMMITTED is the default isolation level for SQL Server.
It prevents dirty reads(髒讀取問題) by locking the uncommitted data.
*/
```

```
------------------------------------------------------------------------------
--T024_03_02_03
--Clean up.
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
--AvailableQuantity : 20
UPDATE  dbo.Product2
SET     [AvailableQuantity] = 20
WHERE   ProductID = 1;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
GO -- Run the previous command and begins new batch
--AvailableQuantity : 20
```

==

4. Concurrent Transactions LostUpdateProblem(更新遺失問題)


Transaction1

```
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRAN;
SELECT AvailableQuantity
--[AvailableQuantity]==20 (value1)

-- Transaction takes 5 seconds
WAITFOR DELAY '00:00:5';
```

Transaction 2

```
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRAN;
SELECT AvailableQuantity
 --[AvailableQuantity]==20 (value1)
UPDATE AvailableQuantity to 20-3=17
 --[AvailableQuantity]==17 (value2)
COMMIT TRANSACTION;
```

```
UPDATE AvailableQuantity to 20-1=19
--[AvailableQuantity]==19 (value3)
COMMIT TRANSACTION;
```

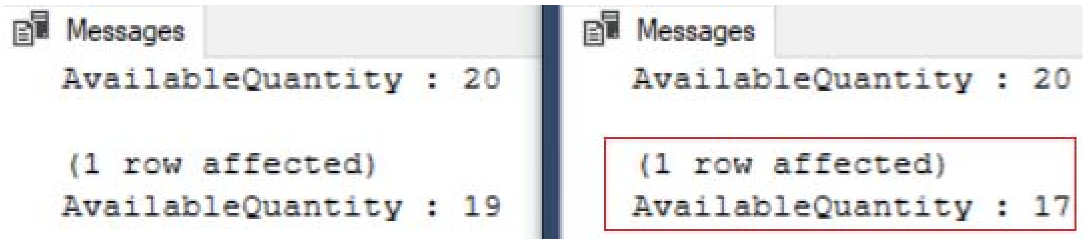
Thus, the ColumnA will actually store value3.
value2 does not exist any more, it is Lost Updates Problem (更新遺失問題).

```
/*
2.
Transaction Concurrency Problems : Lost Updates Problem (更新遺失問題).
---------------------------------------------------------
2.1.
Lost update problem happens when 2 transactions
read and update the same data.
---------------------------------------------------------
2.2.
E.g.1
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
By default,
Transaction1 and Transaction2 Transaction isolation Levels
are both Read Committed (包括讀提交).
Transaction1 read the ColumnA which stored value1 from database.
In the mean time,
Transaction2 also read the ColumnA which stored value1 from database.
After 1 seconds, Transaction2 update the ColumnA from value1 to value2 and commit.
After Transaction2 COMMIT TRANSACTION,
then Transaction1 finally updated ColumnA from value1 to value3 and commit.
Thus, the ColumnA will actually store value3.
value2 does not exist any more, it is Lost Updates Problem (更新遺失問題).
--------------------------------------------------------
2.3.
E.g.2
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
REPEATABLE READ can fix Lost Updates Problem (更新遺失問題).
Transaction1 read the ColumnA which stored value1 from database.
In the mean time,
Transaction2 also read the ColumnA which stored value1 from database.
Transaction1 REPEATABLE READ level use locks on ColumnA to prevent
Transaction2 from "updating" the ColumnA from value1 to value2.
Then it makes Transaction2 return errors and discards the value2.
Transaction1 finally updated ColumnA from value1 to value3 and commit.
Thus, the ColumnA will actually store value3.
--------------------------------------------------------
2.4.
Transaction isolation Level :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
V.S.
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
----------------------------------------
2.4.1.
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
-----------------------
2.4.1.1.
ReadCommitted(包括讀提交 the default setting),
can fix DirtyReadProblem(髒讀取問題),
but ReadCommitted has LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
-----------------------
2.4.1.2.
READ COMMITTED is the default isolation level for SQL Server.
It prevents dirty reads(髒讀取問題) by locking the uncommitted data.
----------------------------------------
2.4.2.
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
-----------------------
2.4.2.1.
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題),
but ReadCommitted has PhantomReadsProblem(幻讀).
-----------------------
2.4.2.2.
"Repeatable Read" (可重複讀取) isolation level ensures
that the data that one transaction has read,
will be prevented from being "updated" or "deleted" by any other transaction.
Therefore,
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
However, "Repeatable Read" (可重複讀取) isolation level
does not prevent new rows from being "inserted" by other transactions.
Thus, "Repeatable Read" (可重複讀取) CAN NOT fix PhantomReadProblem (幻讀問題).
*/

--------------------------------------------------------------------------------------
```

4.1. ReadCommitted(包括讀提交) has LostUpdateProblem(更新遺失問題)

```
--==============================================================================
--T024_04_01
--ReadCommitted(包括讀提交) has LostUpdateProblem(更新遺失問題)
/*
1.
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
ReadCommitted(包括讀提交 the default setting),
can fix DirtyReadProblem(髒讀取問題),
but ReadCommitted has LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
2.
E.g.1
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
*/

-----------------------------------------------------------------------------
--T024_04_01_01
--Transaction1 : READ COMMITTED
--**
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRAN;
--Find the [AvailableQuantity]
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = [AvailableQuantity]
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
-- Transaction takes 5 seconds
WAITFOR DELAY '00:00:5';
--1.
--Check if [AvailableQuantity] > orderedQuantity
--Other wise raise Error and roll back.
--2. check if customer has enough money to pay.
--3. Add new record to Order Table.
--...
--4. Update AvailableQuantity
SET @AvailableQuantity = @AvailableQuantity - 1;
UPDATE  dbo.Product2
SET     [AvailableQuantity] = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
-----------------------------------------------------------------------------
--T024_04_01_02
--Transaction2 : READ COMMITTED
--**
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRAN;
--Find the [AvailableQuantity]
```

```sql
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = [AvailableQuantity]
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
-- Transaction takes 1 seconds
WAITFOR DELAY '00:00:1';
--1.
--Check if [AvailableQuantity] > orderedQuantity
--Other wise raise Error and roll back.
--2. check if customer has enough money to pay.
--3. Add new record to Order Table.
--...
--4. Update AvailableQuantity
SET @AvailableQuantity = @AvailableQuantity - 3;
UPDATE  dbo.Product2
SET     [AvailableQuantity] = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
```



```
Messages
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 19
```

```
Messages
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 17
```

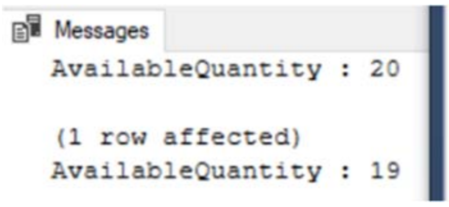
```sql
/*
1.
1.1.
If Transaction1 using
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
If Transaction2 using
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
1.2.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 19
Transaction2 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 17
The AvailableQuantity will be finally 19,
and 17 does not exist any more.
ReadCommitted has LostUpdateProblem(更新遺失問題)
*/

---------------------------------------------------------------------------
--T024_04_01_03
--Clean up :
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
--AvailableQuantity : 19
--Clean up the changes. Rollback the the AvailableQuantity
UPDATE  dbo.Product2
SET     [AvailableQuantity] = 20
WHERE   ProductID = 1;
```

```
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
GO -- Run the previous command and begins new batch
--AvailableQuantity : 20

--------------------------------------------------------------------------------------
```

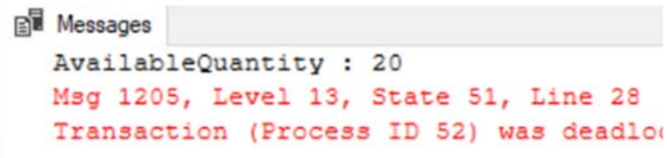
4.2. "RepeatableRead"(可重複讀取) can fix LostUpdateProblem(更新遺失問題)

```
--==============================================================================
--T024_04_02
--"RepeatableRead"(可重複讀取) can fix LostUpdateProblem(更新遺失問題)
/*
1.
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
ReadCommitted(包括讀提交 the default setting),
can fix DirtyReadProblem(髒讀取問題),
but ReadCommitted has LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
2.
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
"Repeatable Read" (可重複讀取) isolation level ensures
that the data that one transaction has read,
will be prevented from being "updated" or "deleted" by any other transaction.
Therefore,
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
However, "Repeatable Read" (可重複讀取) isolation level
does not prevent new rows from being "inserted" by other transactions.
Thus, "Repeatable Read" (可重複讀取) CAN NOT fix PhantomReadProblem (幻讀問題).
3.
E.g.2
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
REPEATABLE READ can fix Lost Updates Problem (更新遺失問題).
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
*/
----------------------------------------------------------------------------
--T024_04_02_01
--Transaction1 : READ COMMITTED
--**
SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRAN;
--Find the [AvailableQuantity]
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = [AvailableQuantity]
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
-- Transaction takes 5 seconds
WAITFOR DELAY '00:00:5';
--1.
--Check if [AvailableQuantity] > orderedQuantity
--Other wise raise Error and roll back.
--2. check if customer has enough money to pay.
```

```sql
--3. Add new record to Order Table.
--...
--4. Update AvailableQuantity
SET @AvailableQuantity = @AvailableQuantity - 1;
UPDATE  dbo.Product2
SET     [AvailableQuantity] = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
-----------------------------------------------------------------------------
--T024_04_02_02
--Transaction2 : READ COMMITTED
--**
SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRAN;
--Find the [AvailableQuantity]
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = [AvailableQuantity]
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
-- Transaction takes 1 seconds
WAITFOR DELAY '00:00:1';
--1.
--Check if [AvailableQuantity] > orderedQuantity
--Other wise raise Error and roll back.
--2. check if customer has enough money to pay.
--3. Add new record to Order Table.
--...
--4. Update AvailableQuantity
SET @AvailableQuantity = @AvailableQuantity - 3;
UPDATE  dbo.Product2
SET     [AvailableQuantity] = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
```



```
Messages
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 19
```



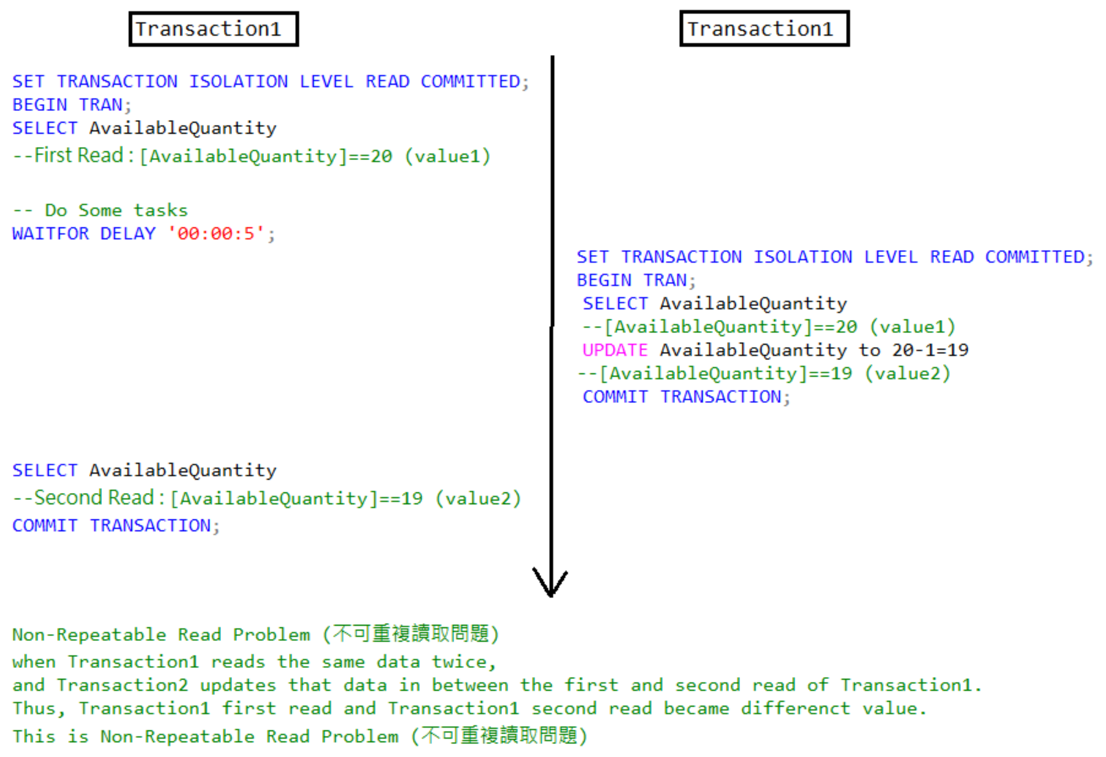
```
Messages
AvailableQuantity : 20
Msg 1205, Level 13, State 51, Line 28
Transaction (Process ID 52) was deadlo
```

```
/*
1.
1.1.
If Transaction1 using
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
If Transaction2 using
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
1.2.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 19
Transaction2 [AvailableQuantity] will return ...
--AvailableQuantity : 20
```

```
When update AvailableQuantity, it will return error.
The AvailableQuantity will be finally 19.
REPEATABLE READ can fix LostUpdateProblem(更新遺失問題)
*/
---------------------------------------------------------------------------
--T024_04_02_03
--Clean up :
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
--AvailableQuantity : 19
--Clean up the changes. Rollback the the AvailableQuantity
UPDATE  dbo.Product2
SET     [AvailableQuantity] = 20
WHERE   ProductID = 1;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
GO -- Run the previous command and begins new batch
--AvailableQuantity : 20
```

===

5. Concurrent Transactions NonRepeatableReadProblem(不可重複讀取問題)



```
Transaction1

SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRAN;
SELECT AvailableQuantity
--First Read : [AvailableQuantity]==20 (value1)

-- Do Some tasks
WAITFOR DELAY '00:00:5';
```

```
Transaction1

SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRAN;
 SELECT AvailableQuantity
 --[AvailableQuantity]==20 (value1)
 UPDATE AvailableQuantity to 20-1=19
--[AvailableQuantity]==19 (value2)
 COMMIT TRANSACTION;
```

```
SELECT AvailableQuantity
--Second Read : [AvailableQuantity]==19 (value2)
COMMIT TRANSACTION;
```

```
Non-Repeatable Read Problem (不可重複讀取問題)
when Transaction1 reads the same data twice,
and Transaction2 updates that data in between the first and second read of Transaction1.
Thus, Transaction1 first read and Transaction1 second read became differenct value.
This is Non-Repeatable Read Problem (不可重複讀取問題)
```

```
--==============================================================================
--T024_05_Concurrent Transactions NonRepeatableReadProblem(不可重複讀取問題)
--==============================================================================
/*
3.
Transaction Concurrency Problems : Non-Repeatable Read Problem (不可重複讀取問題)
-----------------------------------------------------------
```

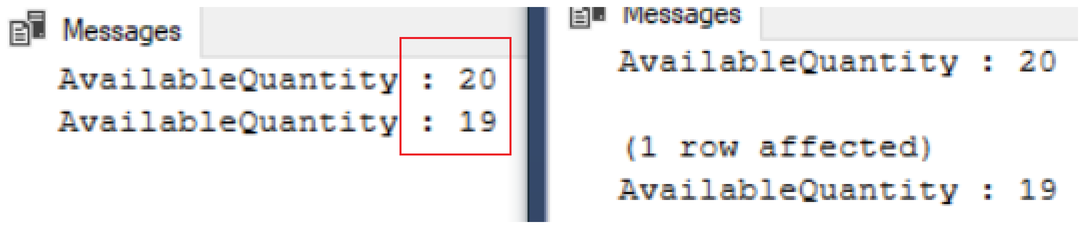
```
3.1.
Non-Repeatable Read Problem (不可重複讀取問題)
when Transaction1 reads the same data twice,
and Transaction2 updates that data
in between the first and second read of Transaction1.
Thus, Transaction1 first read and
Transaction1 second read became differenct value.
This is Non-Repeatable Read Problem (不可重複讀取問題)
--------------------------------------------------------
3.2.
E.g.1
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
By default,
Transaction1 and Transaction2 Transaction isolation Levels
are both Read Committed (包括讀提交).
Transaction1 do the "First Read" for the ColumnA
which stored value1 from database.
During Transaction1 spends 5 seconds to do some tasks,
Transaction2 updates the ColumnA from value1 to value2 and commit.
After Transaction1 finished that some tasks,
and do the "Second Read" for the ColumnA
which stored value2 from database now.
Thus, Transaction1 first read(value1) and
Transaction1 second read(value2) became differenct value.
This is Non-Repeatable Read Problem (不可重複讀取問題).
--------------------------------------------------------
3.3.
E.g.2
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
REPEATABLE READ can fix Non-Repeatable Read Problem (不可重複讀取問題)
Transaction1 do the "First Read" for the ColumnA
which stored value1 from database.
Transaction1 REPEATABLE READ level use locks to prevent
Transaction2 from "updating" the ColumnA from value1 to value2.
Therefore, when Transaction1 finally read the ColumnA again
which will store value1 from database again.
Afterwards, Transaction1 REPEATABLE READ level release its locks on ColumnA.
Therefore, Transaction2 can finally update the ColumnA from value1 to value2.
--------------------------------------------------------
3.4.
Transaction isolation Level :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
V.S.
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
----------------------------------------
3.4.1.
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
-----------------------
3.4.1.1.
ReadCommitted(包括讀提交 the default setting),
can fix DirtyReadProblem(髒讀取問題),
but ReadCommitted has LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
-----------------------
3.4.1.2.
READ COMMITTED is the default isolation level for SQL Server.
It prevents dirty reads(髒讀取問題) by locking the uncommitted data.
----------------------------------------
3.4.2.
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
```

```
-----------------------
3.4.2.1.
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題),
but ReadCommitted has PhantomReadsProblem(幻讀).
-----------------------
3.4.2.2.
"Repeatable Read" (可重複讀取) isolation level ensures
that the data that one transaction has read,
will be prevented from being "updated" or "deleted" by any other transaction.
Therefore,
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
However, "Repeatable Read" (可重複讀取) isolation level
does not prevent new rows from being "inserted" by other transactions.
Thus, "Repeatable Read" (可重複讀取) CAN NOT fix PhantomReadProblem (幻讀問題).
*/
```

5.1. ReadCommitted(包括讀未提交) has NonRepeatableReadProblem(不可重複讀取問題)

```
--=============================================================================
--T024_05_01
--ReadCommitted(包括讀未提交) has NonRepeatableReadProblem(不可重複讀取問題)
/*
1.
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
ReadCommitted(包括讀提交 the default setting),
can fix DirtyReadProblem(髒讀取問題),
but ReadCommitted has LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
2.
E.g.1
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
*/
-----------------------------------------------------------------------------
--T024_05_01_01
--Transaction1 : READ COMMITTED
--**
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;
DECLARE @AvailableQuantity INT;
--First read.
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
-- Do Some tasks
WAITFOR DELAY '00:00:5';
--Second read.
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
```

```sql
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
----------------------------------------------------------------------------
--T024_05_01_02
--Transaction2 : READ COMMITTED
--**
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;
DECLARE @AvailableQuantity INT;
--First read.
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Update
SET @AvailableQuantity -= 1;
UPDATE  dbo.Product2
SET     AvailableQuantity = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
```



```
AvailableQuantity : 20
AvailableQuantity : 19
```

```
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 19
```

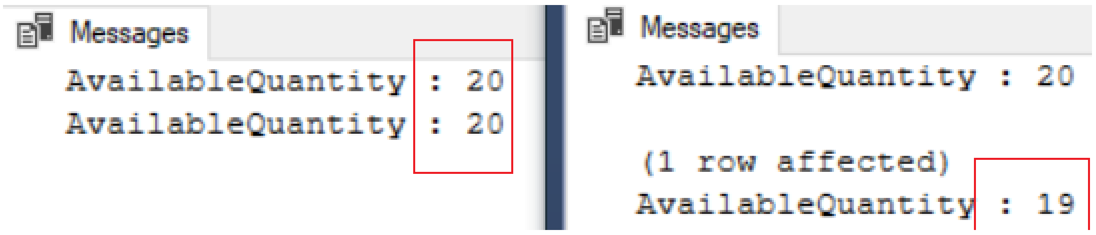
```sql
/*
1.
1.1.
If Transaction1 using
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
If Transaction2 using
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
1.2.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 19
Transaction2 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 19
Transaction1 didn't update the AvailableQuantity,
but the 1st read and 2nd read value are different.
ReadUncommitted(包括讀未提交) has NonrepeatableReadsProblem(不可重複讀取問題)
*/

----------------------------------------------------------------------------
--T024_05_01_03
--Clean up :
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
--AvailableQuantity : 19
```

```
--Clean up the changes. Rollback the the AvailableQuantity
UPDATE  dbo.Product2
SET     [AvailableQuantity] = 20
WHERE   ProductID = 1;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
GO -- Run the previous command and begins new batch
--AvailableQuantity : 20
```

5.2. RepeatableRead(可重複讀取) can fix NonRepeatableReadProblem(不可重複讀取問題)

```
--=============================================================================
--T024_05_02
--RepeatableRead(可重複讀取) can fix NonRepeatableReadProblem(不可重複讀取問題)
/*
1.
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
ReadCommitted(包括讀提交 the default setting),
can fix DirtyReadProblem(髒讀取問題),
but ReadCommitted has LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
2.
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
"Repeatable Read" (可重複讀取) isolation level ensures
that the data that one transaction has read,
will be prevented from being "updated" or "deleted" by any other transaction.
Therefore,
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
However, "Repeatable Read" (可重複讀取) isolation level
does not prevent new rows from being "inserted" by other transactions.
Thus, "Repeatable Read" (可重複讀取) CAN NOT fix PhantomReadProblem (幻讀問題).
3.
E.g.1
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
*/

----------------------------------------------------------------------------
--T024_05_02_01
--Transaction1 : READ COMMITTED
--**
SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;
DECLARE @AvailableQuantity INT;
--First read.
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
-- Do Some tasks
WAITFOR DELAY '00:00:5';
```

```sql
--Second read.
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
----------------------------------------------------------------------------
--T024_05_02_02
--Transaction2 : READ COMMITTED
--**
SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;
DECLARE @AvailableQuantity INT;
--First read.
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Update
SET @AvailableQuantity -= 1;
UPDATE  dbo.Product2
SET     AvailableQuantity = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
```



Messages

```
AvailableQuantity : 20
AvailableQuantity : 20
```

Messages

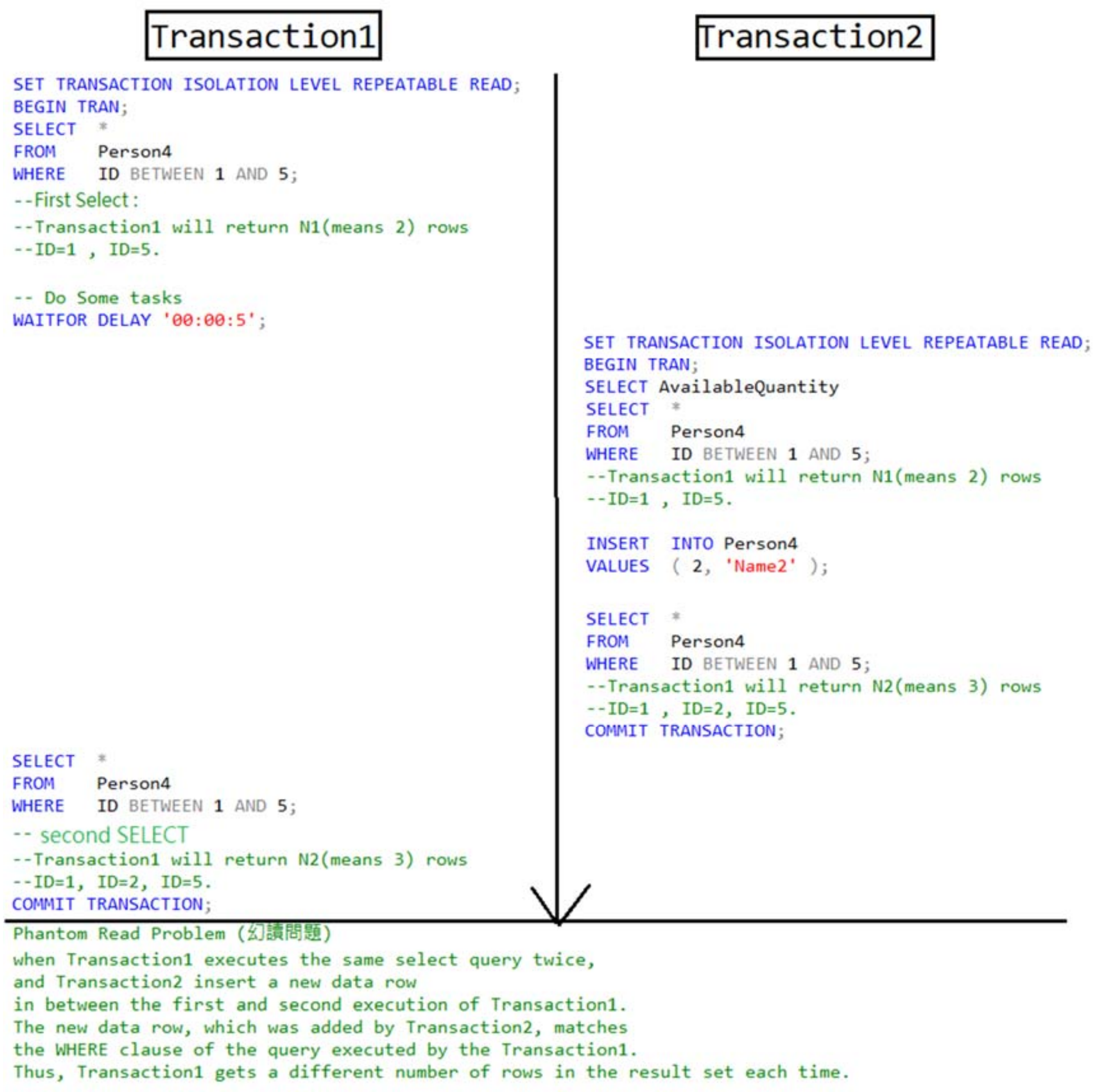
```
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 19
```

```
/*
1.
1.1.
If Transaction1 using
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
If Transaction2 using
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
1.2.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 20
Transaction2 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 19
Transaction1 REPEATABLE READ use locks on AvailableQuantity to prevent
Transaction2 from "updating" from 20 to 19.
After Transaction1 finished and release the locks, then
Transaction2 can finally update AvailableQuantity from 20 to 19.
Repeatable Read(可重複讀取) can fix NonrepeatableReadsProblem(不可重複讀取問題)
*/

----------------------------------------------------------------------------
--T024_05_02_03
```

```
--Clean up :
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
--AvailableQuantity : 19
--Clean up the changes. Rollback the the AvailableQuantity
UPDATE  dbo.Product2
SET     [AvailableQuantity] = 20
WHERE   ProductID = 1;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
GO -- Run the previous command and begins new batch
--AvailableQuantity : 20
```

===

6. Concurrent Transactions PhantomReadProblem(幻讀問題)



Transaction1

```
SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
BEGIN TRAN;
SELECT  *
FROM    Person4
WHERE   ID BETWEEN 1 AND 5;
--First Select :
--Transaction1 will return N1(means 2) rows
--ID=1 , ID=5.

-- Do Some tasks
WAITFOR DELAY '00:00:5';
```

Transaction2

```
SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
BEGIN TRAN;
SELECT AvailableQuantity
SELECT  *
FROM    Person4
WHERE   ID BETWEEN 1 AND 5;
--Transaction1 will return N1(means 2) rows
--ID=1 , ID=5.

INSERT  INTO Person4
VALUES  ( 2, 'Name2' );

SELECT  *
FROM    Person4
WHERE   ID BETWEEN 1 AND 5;
--Transaction1 will return N2(means 3) rows
--ID=1 , ID=2, ID=5.
COMMIT TRANSACTION;
```

```
SELECT  *
FROM    Person4
WHERE   ID BETWEEN 1 AND 5;
-- second SELECT
--Transaction1 will return N2(means 3) rows
--ID=1, ID=2, ID=5.
COMMIT TRANSACTION;
```

```
Phantom Read Problem (幻讀問題)
when Transaction1 executes the same select query twice,
and Transaction2 insert a new data row
in between the first and second execution of Transaction1.
The new data row, which was added by Transaction2, matches
the WHERE clause of the query executed by the Transaction1.
Thus, Transaction1 gets a different number of rows in the result set each time.
```

```
--==============================================================================
--T024_06_Concurrent Transactions PhantomReadProblem(幻讀問題)
--==============================================================================
/*
4.
```

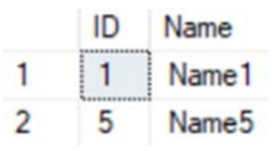
```
Transaction Concurrency Problems : Phantom Read Problem (幻讀問題)
--------------------------------------------------------
4.1.
when Transaction1 executes the same select query twice,
and Transaction2 insert a new data row
in between the first and second execution of Transaction1.
The new data row, which was added by Transaction2, matches
the WHERE clause of the query executed by the Transaction1.
Thus, Transaction1 gets a different number of rows
in the result set each time.
--------------------------------------------------------
4.2.
E.g.1
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Transaction1 do the "1st Read"
and get "N1" rows in return.
During Transaction1 spends 5 seconds to do some tasks,
Transaction2 "inserted" 1 row and committed.
Thus, when Transaction1 do the "2nd Read"
and get "N1+1" rows in return.
"RepeatableRead"(可重複讀取)) has PhantomReadsProblem(幻讀).
--------------------------------------------------------
4.3.
E.g.2
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction1 do the "1st Read"
and get "N1" rows in return.
During Transaction1 spends 5 seconds to do some tasks,
Transaction2 "inserted" 1 row and committed.
Transaction1 SERIALIZABLE use locks to lock on table
and prevent Transaction2 from
"updating", "deleting", or "inserting" to the table.
When Transaction1 finished "2nd Read"
and still get "N1" rows in return,
Transaction2 finally can "insert" a new row
and make the table become "N1+1" rows.
"serializableRead" (可串行化的讀取) can fix PhantomReadsProblem(幻讀).
--------------------------------------------------------
4.4.
Transaction isolation Level :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
V.S.
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
----------------------------------------
4.4.1.
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
-----------------------
4.4.1.1.
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題),
but ReadCommitted has PhantomReadsProblem(幻讀).
-----------------------
4.4.1.2.
"Repeatable Read" (可重複讀取) isolation level ensures
that the data that one transaction has read,
will be prevented from being "updated" or "deleted" by any other transaction.
Therefore,
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
```

```
and NonrepeatableReadsProblem(不可重複讀取問題).
However, "Repeatable Read" (可重複讀取) isolation level
does not prevent new rows from being "inserted" by other transactions.
Thus, "Repeatable Read" (可重複讀取) has PhantomReadProblem (幻讀問題).
----------------------------------------
4.4.2.
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
-----------------------
4.4.2.1.
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
, NonrepeatableReadsProblem(不可重複讀取問題),
and ReadCommitted has PhantomReadsProblem(幻讀).
-----------------------
4.4.2.2.
"serializable Read" (可串行化的讀取) isolation level ensures
that the data that one transaction has read,
will be prevented from being "updated" or "deleted" by any other transaction.
Therefore,
SerializableRead(可串行化的讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
In addition, SerializableRead(可串行化的讀取) isolation level
prevent new rows from being "inserted" by other transactions.
Thus, "serializable Read" (可串行化的讀取) CAN fix Phantom Read Problem (幻讀問題).
*/
```

6.1. "RepeatableRead"(可重複讀取) has PhantomReadProblem (幻讀問題)

```
--==============================================================================
--T024_06_01
--"RepeatableRead" (可重複讀取) has PhantomReadProblem (幻讀問題)
/*
1.
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
"Repeatable Read" (可重複讀取) isolation level ensures
that the data that one transaction has read,
will be prevented from being "updated" or "deleted" by any other transaction.
Therefore,
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
However, "Repeatable Read" (可重複讀取) isolation level
does not prevent new rows from being "inserted" by other transactions.
Thus, "Repeatable Read" (可重複讀取) CAN NOT fix PhantomReadProblem (幻讀問題).
2.
E.g.1
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
*/

----------------------------------------------------------------------------
--T024_06_01_01
--Create Sample Data
IF ( EXISTS ( SELECT    *
              FROM      INFORMATION_SCHEMA.TABLES
```

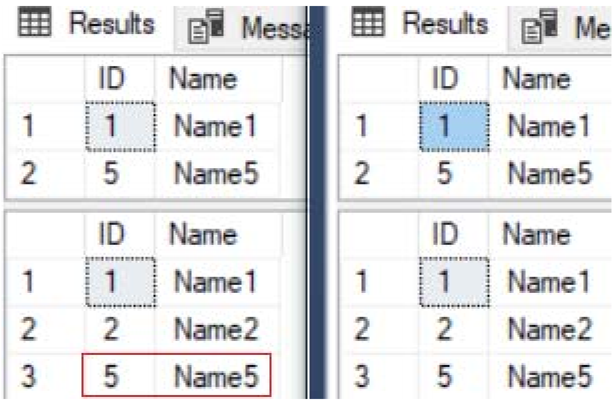
```
                WHERE     TABLE_NAME = 'Person4' ) )
    BEGIN
        TRUNCATE TABLE dbo.Person4;
        DROP TABLE Person4;
    END;
GO -- Run the previous command and begins new batch
CREATE TABLE Person4
    (
      ID INT PRIMARY KEY
             NOT NULL ,
      [Name] NVARCHAR(50)
    );
GO -- Run the previous command and begins new batch
INSERT  INTO Person4
VALUES  ( 1, 'Name1' );
INSERT  INTO Person4
VALUES  ( 5, 'Name5' );
GO -- Run the previous command and begins new batch
SELECT  *
FROM    Person4;
GO -- Run the previous command and begins new batch
```



	ID	Name
1	1	Name1
2	5	Name5

```
----------------------------------------------------------------------------
--T024_06_01_02
--Transaction1 : REPEATABLE READ
--"Repeatable Read" (可重複讀取) has PhantomReadProblem (幻讀問題).
--"serializable Read" (可串行化的讀取) CAN fix Phantom Read Problem (幻讀問題).
--**
SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
BEGIN TRANSACTION;
SELECT  *
FROM    Person4
WHERE   ID BETWEEN 1 AND 5;
-- Do Some work
WAITFOR DELAY '00:00:5';
SELECT  *
FROM    Person4
WHERE   ID BETWEEN 1 AND 5;
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
----------------------------------------------------------------------------
--T024_06_01_03
--Transaction2 : REPEATABLE READ
--"Repeatable Read" (可重複讀取) has PhantomReadProblem (幻讀問題).
--"serializable Read" (可串行化的讀取) CAN fix Phantom Read Problem (幻讀問題).
--**
SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
BEGIN TRANSACTION;
SELECT  *
FROM    Person4
```

```
WHERE    ID BETWEEN 1 AND 5;
INSERT  INTO Person4
VALUES  ( 2, 'Name2' );
SELECT  *
FROM     Person4
WHERE    ID BETWEEN 1 AND 5;
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
```



```
   ID  Name          ID  Name
1  1   Name1      1  1   Name1
2  5   Name5      2  5   Name5

   ID  Name          ID  Name
1  1   Name1      1  1   Name1
2  2   Name2      2  2   Name2
3  5   Name5      3  5   Name5
```

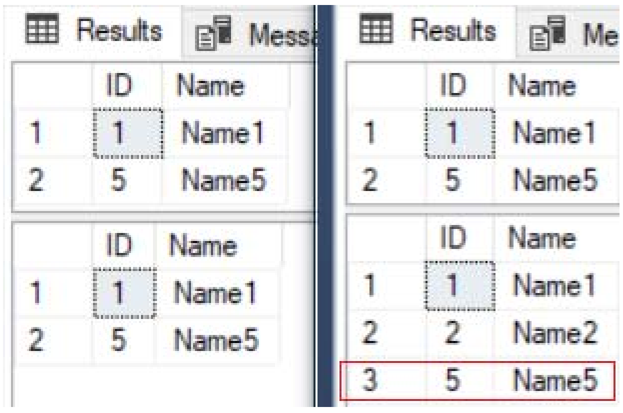
```
/*
1.
1.1.
If Transaction1 using
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
If Transaction2 using
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
1.2.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 do the "1st Read"
and get "2" rows in return.
During Transaction1 spends 5 seconds to do some tasks,
Transaction2 "inserted" 1 row and committed.
Thus, when Transaction1 do the "2nd Read"
and get "2+1" rows in return.
"RepeatableRead"(可重複讀取)) has PhantomReadsProblem(幻讀).
*/

----------------------------------------------------------------------------
--T024_06_01_04
--Clean up :
IF ( EXISTS ( SELECT    *
              FROM      INFORMATION_SCHEMA.TABLES
              WHERE     TABLE_NAME = 'Person4' ) )
    BEGIN
        TRUNCATE TABLE dbo.Person4;
        DROP TABLE Person4;
    END;
GO -- Run the previous command and begins new batch
CREATE TABLE Person4
    (
      ID INT PRIMARY KEY
             NOT NULL ,
      [Name] NVARCHAR(50)
    );
GO -- Run the previous command and begins new batch
INSERT  INTO Person4
```

```
VALUES  ( 1, 'Name1' );
INSERT  INTO Person4
VALUES  ( 5, 'Name5' );
GO -- Run the previous command and begins new batch
SELECT  *
FROM    Person4
GO -- Run the previous command and begins new batch
```

6.2. "SerializableRead"(可串行化的讀取) can fix PhantomReadProblem (幻讀問題)

```
--==============================================================================
--T024_06_02
--"SerializableRead"(可串行化的讀取) can fix PhantomReadProblem (幻讀問題)
/*
1.
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
"Repeatable Read" (可重複讀取) isolation level ensures
that the data that one transaction has read,
will be prevented from being "updated" or "deleted" by any other transaction.
Therefore,
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
However, "Repeatable Read" (可重複讀取) isolation level
does not prevent new rows from being "inserted" by other transactions.
Thus, "Repeatable Read" (可重複讀取) has PhantomReadProblem (幻讀問題).
2.
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
"serializable Read" (可串行化的讀取) isolation level ensures
that the data that one transaction has read,
will be prevented from being "updated" or "deleted" by any other transaction.
Therefore,
Repeatable Read(可重複讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
In addition, "serializable Read" (可串行化的讀取) isolation level
prevent new rows from being "inserted" by other transactions.
Thus, "serializable Read" (可串行化的讀取) CAN fix Phantom Read Problem (幻讀問題).
3.
E.g.1
Transaction1 :
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 :
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
*/

-----------------------------------------------------------------------------
--T024_06_02_01
--Transaction1 : REPEATABLE READ
--"Repeatable Read" (可重複讀取) has PhantomReadProblem (幻讀問題).
--"serializable Read" (可串行化的讀取) CAN fix Phantom Read Problem (幻讀問題).
--**
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
BEGIN TRANSACTION;
SELECT  *
FROM    Person4
```

```
WHERE   ID BETWEEN 1 AND 5;
-- Do Some work
WAITFOR DELAY '00:00:5';
SELECT  *
FROM    Person4
WHERE   ID BETWEEN 1 AND 5;
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
-----------------------------------------------------------------------------
--T024_06_02_02
--Transaction2 : REPEATABLE READ
--"Repeatable Read" (可重複讀取) has PhantomReadProblem (幻讀問題).
--"serializable Read" (可串行化的讀取) CAN fix Phantom Read Problem (幻讀問題).
--**
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
BEGIN TRANSACTION;
SELECT  *
FROM    Person4
WHERE   ID BETWEEN 1 AND 5;
INSERT  INTO Person4
VALUES  ( 2, 'Name2' );
SELECT  *
FROM    Person4
WHERE   ID BETWEEN 1 AND 5;
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
```



	ID	Name
1	1	Name1
2	5	Name5

	ID	Name
1	1	Name1
2	5	Name5

	ID	Name
1	1	Name1
2	5	Name5

	ID	Name
1	1	Name1
2	2	Name2
3	5	Name5

```
/*
1.
1.1.
If Transaction1 using
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
If Transaction2 using
--SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
1.2.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 do the "1st Read"
and get "2" rows in return.
During Transaction1 spends 5 seconds to do some tasks,
Transaction2 "inserted" 1 row and committed.
Transaction1 SERIALIZABLE use locks to lock on table
and prevent Transaction2 from
"updating", "deleting", or "inserting" to the table.
When Transaction1 finished "2nd Read"
and still get "2" rows in return,
Transaction2 finally can "insert" a new row
```

```
and make the table become "2+1" rows.
"serializableRead" (可串行化的讀取) can fix PhantomReadsProblem(幻讀).
*/
-----------------------------------------------------------------------------
--T024_06_02_03
--Clean up :
IF ( EXISTS ( SELECT    *
              FROM      INFORMATION_SCHEMA.TABLES
              WHERE     TABLE_NAME = 'Person4' ) )
    BEGIN
        TRUNCATE TABLE dbo.Person4;
        DROP TABLE Person4;
    END;
GO -- Run the previous command and begins new batch
CREATE TABLE Person4
    (
      ID INT PRIMARY KEY
             NOT NULL ,
      [Name] NVARCHAR(50)
    );
GO -- Run the previous command and begins new batch
INSERT  INTO Person4
VALUES  ( 1, 'Name1' );
INSERT  INTO Person4
VALUES  ( 5, 'Name5' );
GO -- Run the previous command and begins new batch
SELECT  *
FROM    Person4
GO -- Run the previous command and begins new batch
```

7. SerializableRead(可串行化的讀取) V.S. ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) V.S. READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)

```
--==========================================================================
--T024_07_SerializableRead(可串行化的讀取)
--V.S. ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)
--V.S. READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
--==========================================================================
/*
5.
SerializableRead(可串行化的讀取) V.S.
ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) V.S.
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
```

5.0.

5.0.1.
All these 3 isolation levels can fix
DirtyReadsProblem (髒讀取問題)
LostUpdateProblem(更新遺失問題),
NonrepeatableReadsProblem(不可重複讀取問題),
and PhantomReadsProblem(幻讀問題)

5.0.2.
SerializableRead(可串行化的讀取) uses locks to
block all other transactions.
Therefore, its concurrency(並行性) of transaction is bad.

5.0.3.
ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) and
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level copy the resource and maintains row versioning in Tempdb.
Row version is a unique transaction sequence number identifies each transaction,
and it determine the sequence of executing transactions.
Because it does not use locks.
Thus, other transactions still can use the resource.
Therefore, concurrency(並行性) of transaction is good.

5.0.4.
ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)
is vulnerable to update conflicts.
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
has no update conflicts problems, because
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
uses row version to perform whatever ReadCommitted(包括讀提交) can do, plus
whatever ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) can do.
whatever ReadCommitted(包括讀提交) can do is to prevent update conflicts.

5.0.5.
Using READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
is so much easier than using ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取).
When using ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)
might need to change some existing code.
However, using ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) is much easier.
All you need is to add this line.
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION ON;
In addition, by default,
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Thus, you don't need to do anything else.

5.0.6.
Consider the following example,
More details will be discussed later.

5.0.6.1.
E.g.
Transaction1 use SERIALIZABLE(可串行化的讀取) level : Update Data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 use SERIALIZABLE(可串行化的讀取) level : Select data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;

5.0.6.2.
E.g.
Transaction1 use SERIALIZABLE(可串行化的讀取) level : Update Data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level : Select data

--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;

5.0.6.3.
E.g.
Transaction1 use SERIALIZABLE(可串行化的讀取) level : Update Data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level : Update same data
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;

5.0.6.4.
E.g.
Transaction1 use ReadCommitted(包括讀提交) level : Update Data
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use ReadCommitted(包括讀提交) level : Select data
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;

5.0.6.5.
E.g.
Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Select data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;

5.0.6.6.
E.g.
Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update same data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;

5.0.6.7.
E.g.
Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level :
1st select before update, 2nd select after update
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;

5.0.6.8.
E.g.
Transaction1 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level : Update Data
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
Transaction2 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level :
1st select before update, 2nd select after update
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
This is the logic error and hard to debug.

5.1.
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;

5.1.1.
SerializableRead(可串行化的讀取) isolation level use locks
to block all other transactions,
so all other transactions can not insert, update, delete any thing.

Therefore,
SerializableRead(可串行化的讀取)
can fix LostUpdateProblem(更新遺失問題)
and NonrepeatableReadsProblem(不可重複讀取問題).
In addition, SerializableRead(可串行化的讀取) isolation level
prevent new rows from being "inserted" by other transactions.
Thus, "serializable Read" (可串行化的讀取) CAN fix Phantom Read Problem (幻讀問題).
Because of using locks, concurrency(並行性) of transaction is bad.

5.2.
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
...
--SET TRANSACTION ISOLATION LEVEL OFF;

5.2.1.
ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) and
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level copy the resource and maintains row versioning in Tempdb.
Row version is a unique transaction sequence number identifies each transaction,
and it determine the sequence of executing transactions.
Because it does not use locks.
Thus, other transactions still can use the resource.
Therefore, concurrency(並行性) of transaction is good.

5.2.2.
ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)
is vulnerable to update conflicts.

5.2.3.
Reference:
https://stackoverflow.com/questions/232333/how-long-should-set-read-committed-snapshot-on-take
Firstly,
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION ON;
Secondly, you may
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
If it take too long to enable SNAPSHOT,
close all ssms session, and re-open ssms, re-open the query.
execute the fillowing.
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION ON WITH ROLLBACK IMMEDIATE
it will immediately rollback any open transactions before starting the ALTER DATABASE statement.
Remember to disable it when you finished
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION OFF;

5.3.
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
...
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT OFF;

5.3.1.
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
...
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT OFF;
V.S.
ReadCommitted(包括讀提交 the default setting).
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level is very similar to
ReadCommitted(包括讀提交 the default setting).
The differenct is the following.

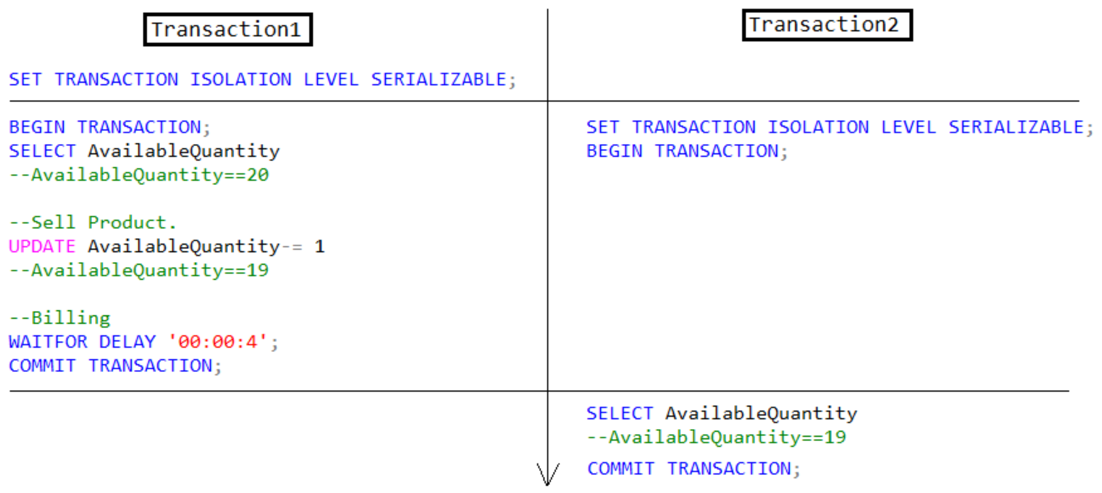
5.3.2.
ReadCommitted(包括讀提交 the default setting) use locks,
and it can fix DirtyReadsProblem(髒讀取問題).
It has LostUpdatesProblem(更新遺失問題),
NonrepeatableReadsProblem(不可重複讀取問題),
and PhantomReadsProblem(幻讀問題).
Because of locks, concurrency(並行性) of transaction is bad.

5.3.3.
ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) and
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level copy the resource and maintains row versioning in Tempdb.
Row version is a unique transaction sequence number identifies each transaction,
and it determine the sequence of executing transactions.
Because it does not use locks.
Thus, other transactions still can use the resource.
Therefore, concurrency(並行性) of transaction is good.

5.3.4.
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
has no update conflicts problems, because
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
uses row version to perform whatever ReadCommitted(包括讀提交) can do, plus
whatever ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) can do.
whatever ReadCommitted(包括讀提交) can do is to prevent update conflicts.

5.3.5.
Reference:
https://stackoverflow.com/questions/232333/how-long-should-set-read-committed-snapshot-on-take
Firstly,
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
Secondly, you may
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
If it take too long to enable SNAPSHOT,
close all ssms session, and re-open ssms, re-open the query.
execute the fillowing.
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON WITH ROLLBACK IMMEDIATE
it will immediately rollback any open transactions before starting the ALTER DATABASE statement.
Remember to disable it when you finished
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT OFF;
*/

7.1. SerializableRead(可串行化的讀取)



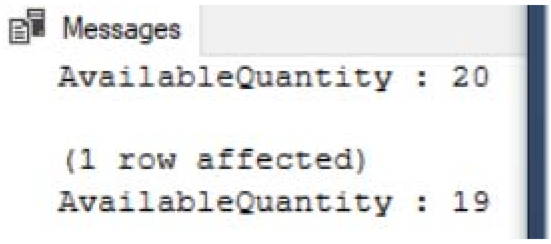
```
SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;

BEGIN TRANSACTION;
SELECT AvailableQuantity
--AvailableQuantity==20

--Sell Product.
UPDATE AvailableQuantity-= 1
--AvailableQuantity==19

--Billing
WAITFOR DELAY '00:00:4';
COMMIT TRANSACTION;
```

```
SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
BEGIN TRANSACTION;

SELECT AvailableQuantity
--AvailableQuantity==19
COMMIT TRANSACTION;
```

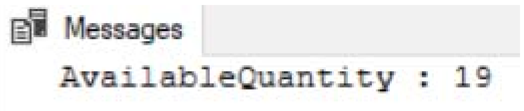
```
Transaction1 SERIALIZABLE isolation level(可串行化的讀取)
will block all other transaction until it finishes.
Thus, Transaction1 will update
the AvailableQuantity from 20 to 19.
Then Transaction2 can finally read that 19.
```

```
--==============================================================================
--T024_07_01
--SerializableRead(可串行化的讀取)
/*
Transaction1 use SERIALIZABLE(可串行化的讀取) level : Update Data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 use SERIALIZABLE(可串行化的讀取) level : Select data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
*/
--------------------------------------------------------------------------------
--T024_07_01_01
--Transaction1 use SERIALIZABLE level : Update Data
/*
SERIALIZABLE transaction isolation level will
block all other transaction until it finishes.
*/
SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
BEGIN TRANSACTION;
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Sell One Product.
SET @AvailableQuantity -= 1;
UPDATE  dbo.Product2
SET     AvailableQuantity = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
WAITFOR DELAY '00:00:4';
--Billing to customer...
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
--------------------------------------------------------------------------------
--T024_07_01_02
--Transaction2 use SERIALIZABLE level : Select data
SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
BEGIN TRANSACTION;
DECLARE @AvailableQuantity INT;
```

```
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
```



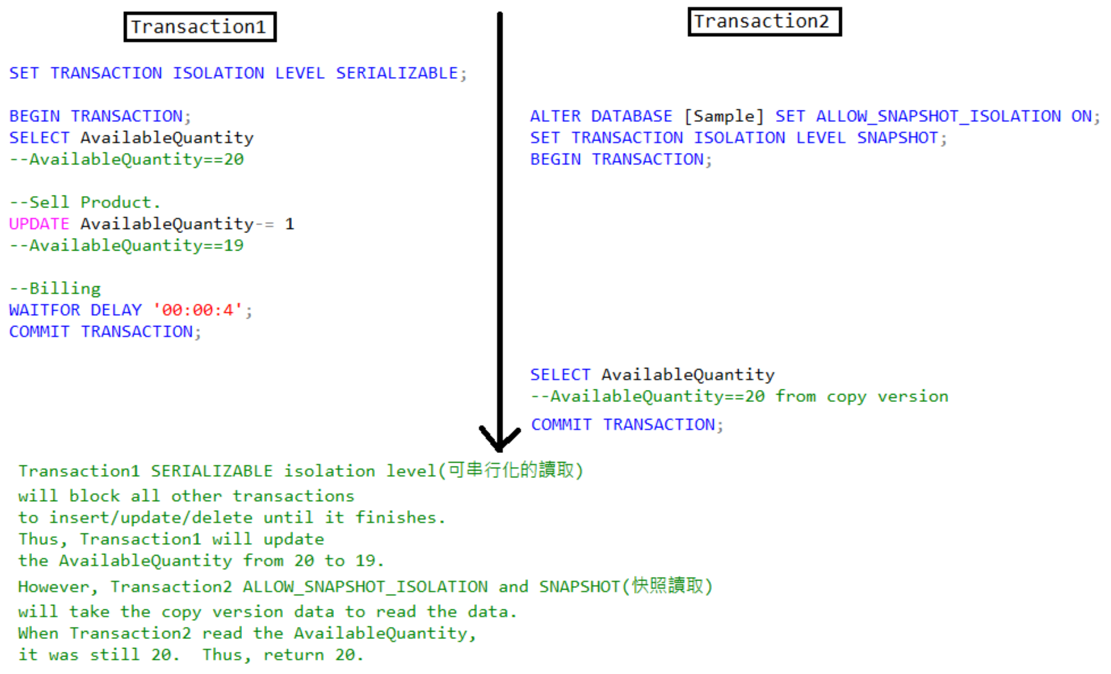
```
Messages
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 19
```



```
Messages
AvailableQuantity : 19
```

```
/*
1.
1.1.
Transaction1 use SERIALIZABLE(可串行化的讀取) level : Update Data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 use SERIALIZABLE(可串行化的讀取) level : Select data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
1.2.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 19
Transaction2 [AvailableQuantity] will return ...
--AvailableQuantity : 19
Transaction1 SERIALIZABLE isolation level(可串行化的讀取)
will block all other transaction until it finishes.
Thus, Transaction1 will update
the AvailableQuantity from 20 to 19.
Then Transaction2 can finally read that 19.
*/
-----------------------------------------------------------------------------
--T024_07_01_03
--Clean up:
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
--AvailableQuantity : 19
UPDATE  dbo.Product2
SET     [AvailableQuantity] = 20
WHERE   ProductID = 1;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
GO -- Run the previous command and begins new batch
--AvailableQuantity : 20

--------------------------------------------------------------------------------------
```

7.2. ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)



Transaction1

```
SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;

BEGIN TRANSACTION;
SELECT AvailableQuantity
--AvailableQuantity==20

--Sell Product.
UPDATE AvailableQuantity-= 1
--AvailableQuantity==19

--Billing
WAITFOR DELAY '00:00:4';
COMMIT TRANSACTION;
```

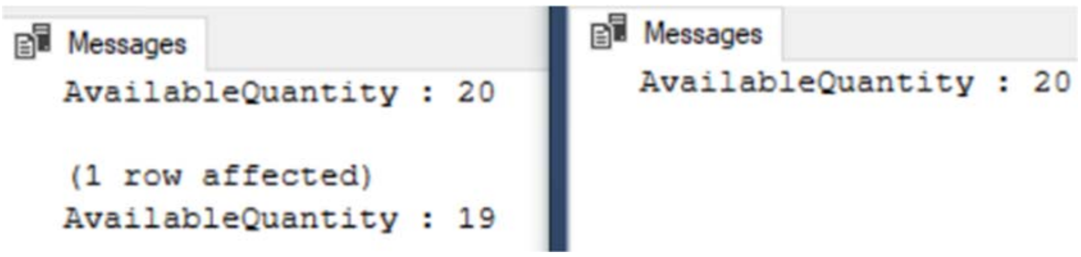
Transaction2

```
ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
BEGIN TRANSACTION;

SELECT AvailableQuantity
--AvailableQuantity==20 from copy version
COMMIT TRANSACTION;
```

```
Transaction1 SERIALIZABLE isolation level(可串行化的讀取)
will block all other transactions
to insert/update/delete until it finishes.
Thus, Transaction1 will update
the AvailableQuantity from 20 to 19.
However, Transaction2 ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)
will take the copy version data to read the data.
When Transaction2 read the AvailableQuantity,
it was still 20.  Thus, return 20.
```

```
--==============================================================================
--T024_07_02
--ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)
/*
Transaction1 use SERIALIZABLE(可串行化的讀取) level : Update Data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level : Select data
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
*/

--------------------------------------------------------
--T024_07_02_01
ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
/*
Reference:
https://stackoverflow.com/questions/232333/how-long-should-set-read-committed-snapshot-on-take
Firstly,
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION ON;
Secondly, you may
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
If it take too long to enable SNAPSHOT,
close all ssms session, and re-open ssms, re-open the query.
execute the fillowing.
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION ON WITH ROLLBACK IMMEDIATE
it will immediately rollback any open transactions before starting the ALTER DATABASE statement.
Remember to disable it when you finished
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION OFF;
*/
--------------------------------------------------------
--T024_07_02_02
--Transaction1 use SERIALIZABLE level : Update Data
SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
BEGIN TRANSACTION;
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Sell One Product.
SET @AvailableQuantity -= 1;
```

```
UPDATE  dbo.Product2
SET     AvailableQuantity = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
WAITFOR DELAY '00:00:4';
--Billing to customer...
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
----------------------------------------------------
--T024_07_02_03
--Transaction2 use SNAPSHOT level : Select data
SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
BEGIN TRANSACTION;
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
```

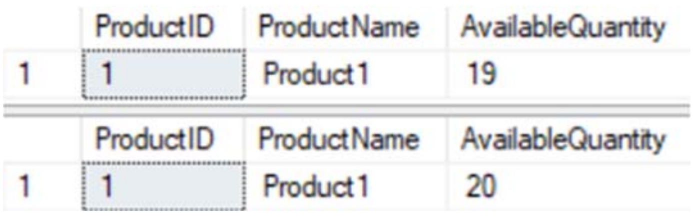


```
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 19
```

```
AvailableQuantity : 20
```

```
/*
1.
1.1.
Transaction1 use SERIALIZABLE(可串行化的讀取) level : Update Data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level : Select data
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
1.2.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 19
Transaction2 [AvailableQuantity] will return ...
--AvailableQuantity : 20
Transaction1 SERIALIZABLE isolation level(可串行化的讀取)
will block all other transactions
to insert/update/delete until it finishes.
Thus, Transaction1 will update
the AvailableQuantity from 20 to 19.
However, Transaction2 ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)
will take the copy version data to read the data.
When Transaction2 read the AvailableQuantity,
it was still 20.  Thus, return 20.
*/
----------------------------------------------------
--T024_07_02_04
--Clean up.
ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION OFF;
SELECT  *
FROM    dbo.Product2
```

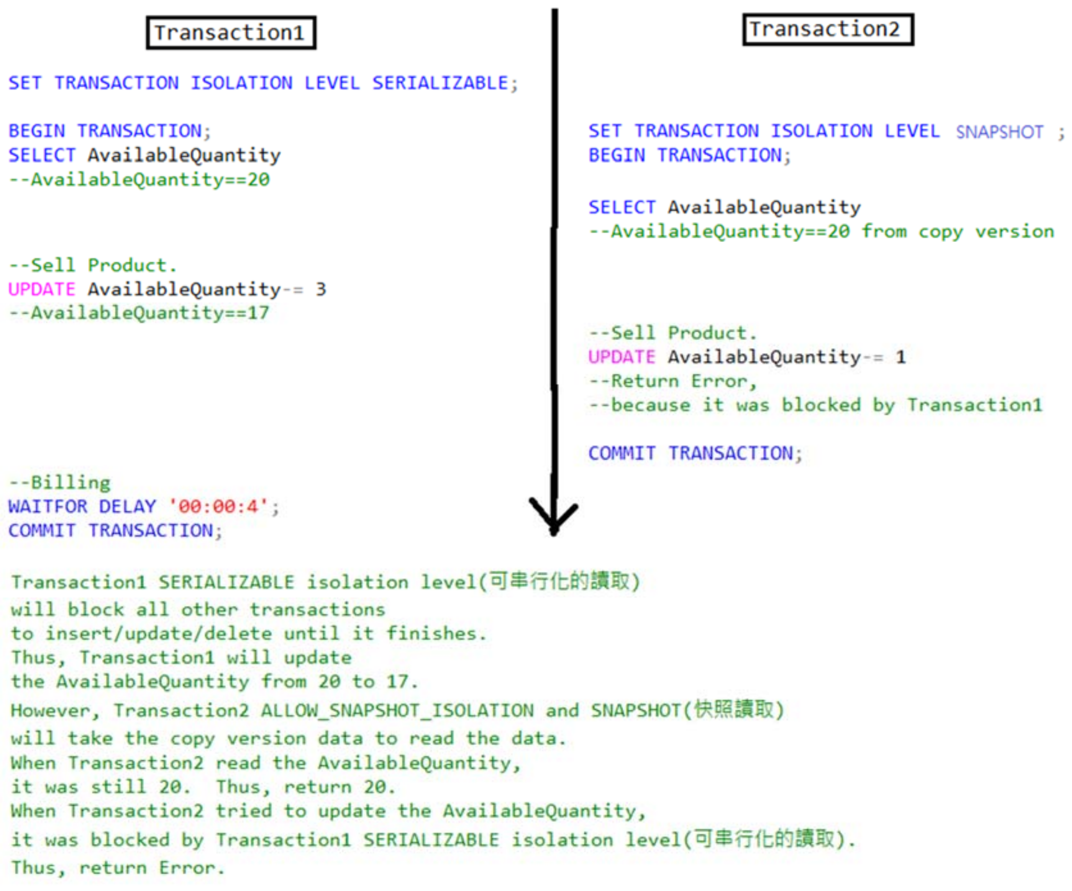
```
WHERE   ProductID = 1;
--AvailableQuantity : 19
UPDATE  dbo.Product2
SET     [AvailableQuantity] = 20
WHERE   ProductID = 1;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
GO -- Run the previous command and begins new batch
--AvailableQuantity : 20
```



	ProductID	ProductName	AvailableQuantity
1	1	Product1	19

	ProductID	ProductName	AvailableQuantity
1	1	Product1	20

7.3. ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)



Transaction1

```
SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;

BEGIN TRANSACTION;
SELECT AvailableQuantity
--AvailableQuantity==20


--Sell Product.
UPDATE AvailableQuantity-= 3
--AvailableQuantity==17


--Billing
WAITFOR DELAY '00:00:4';
COMMIT TRANSACTION;
```

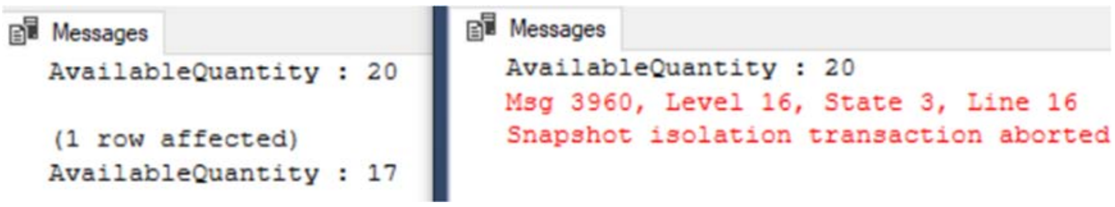
Transaction2

```
SET TRANSACTION ISOLATION LEVEL SNAPSHOT ;
BEGIN TRANSACTION;

SELECT AvailableQuantity
--AvailableQuantity==20 from copy version


--Sell Product.
UPDATE AvailableQuantity-= 1
--Return Error,
--because it was blocked by Transaction1

COMMIT TRANSACTION;
```

```
Transaction1 SERIALIZABLE isolation level(可串行化的讀取)
will block all other transactions
to insert/update/delete until it finishes.
Thus, Transaction1 will update
the AvailableQuantity from 20 to 17.
However, Transaction2 ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)
will take the copy version data to read the data.
When Transaction2 read the AvailableQuantity,
it was still 20.  Thus, return 20.
When Transaction2 tried to update the AvailableQuantity,
it was blocked by Transaction1 SERIALIZABLE isolation level(可串行化的讀取).
Thus, return Error.
```

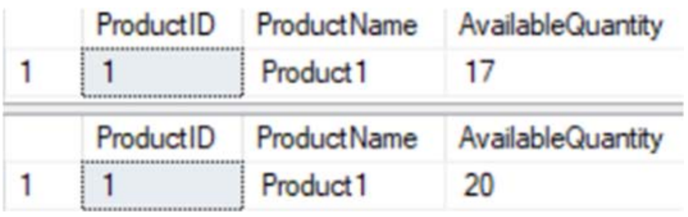
```
--==============================================================================
--T024_07_03
--ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)
/*
Transaction1 use SERIALIZABLE(可串行化的讀取) level : Update Data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level : Update same data
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
*/
-------------------------------------------------------
```

```sql
--T024_07_03_01
ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
/*
Reference:
https://stackoverflow.com/questions/232333/how-long-should-set-read-committed-snapshot-on-take
Firstly,
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION ON;
Secondly, you may
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
If it take too long to enable SNAPSHOT,
close all ssms session, and re-open ssms, re-open the query.
execute the fillowing.
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION ON WITH ROLLBACK IMMEDIATE
it will immediately rollback any open transactions before starting the ALTER DATABASE statement.
Remember to disable it when you finished
--ALTER DATABASE Sample3 SET ALLOW_SNAPSHOT_ISOLATION OFF;
*/
-------------------------------------------------------------------------------
--T024_07_03_02
--Transaction1 use SERIALIZABLE level : Update Data
SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
BEGIN TRANSACTION;
--Get the stock quanty
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Deduct the quantity.
SET @AvailableQuantity -= 3;
UPDATE  dbo.Product2
SET     AvailableQuantity = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Do some tasks.
--E.g. Billing to customers
WAITFOR DELAY '00:00:4';
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
-------------------------------------------------------------------------------
--T024_07_03_03
--Transaction2 use SNAPSHOT level : Update same data
SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
BEGIN TRANSACTION;
--Get the stock quanty
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Deduct the quantity.
SET @AvailableQuantity -= 1;
UPDATE  dbo.Product2
SET     AvailableQuantity = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
```


```
Messages
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 17
```

```
Messages
AvailableQuantity : 20
Msg 3960, Level 16, State 3, Line 16
Snapshot isolation transaction aborted
```

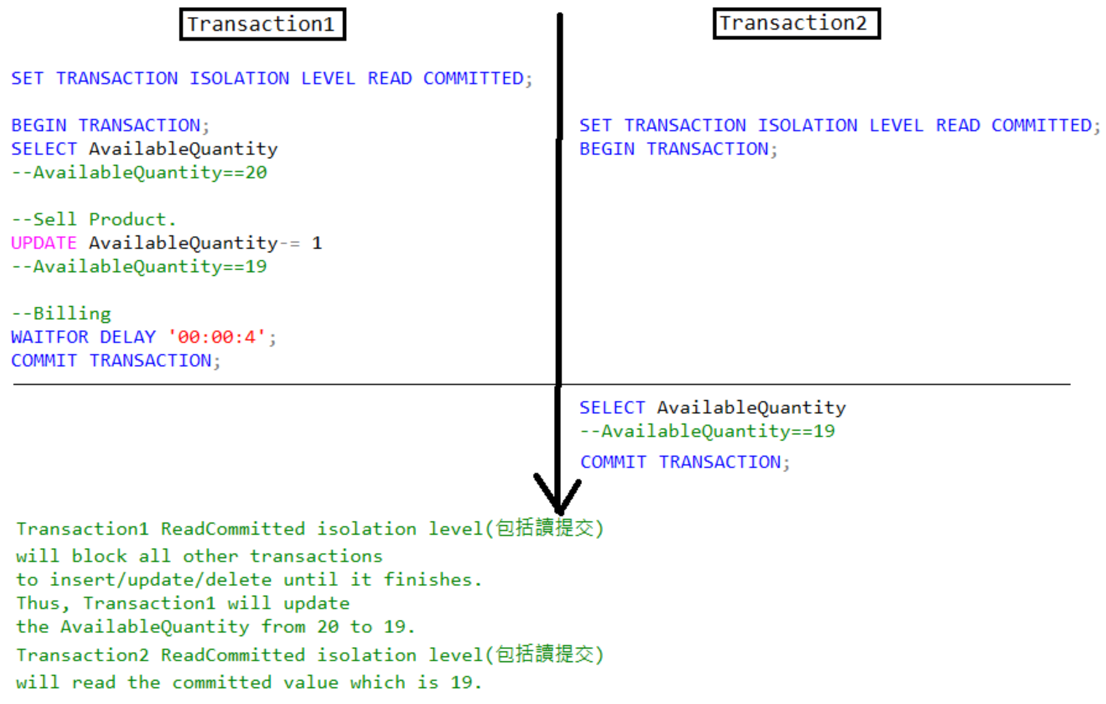
```
/*
1.
1.1.
Transaction1 use SERIALIZABLE(可串行化的讀取) level : Update Data
--SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
Transaction2 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level : Update same data
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
1.2.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 17
Transaction2 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--Then return Error when update same data.
Transaction1 SERIALIZABLE isolation level(可串行化的讀取)
will block all other transactions
to insert/update/delete until it finishes.
Thus, Transaction1 will update
the AvailableQuantity from 20 to 17.
However, Transaction2 ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)
will take the copy version data to read the data.
When Transaction2 read the AvailableQuantity,
it was still 20.  Thus, return 20.
When Transaction2 tried to update the AvailableQuantity,
it was blocked by Transaction1 SERIALIZABLE isolation level(可串行化的讀取).
Thus, return Error.
*/
-------------------------------------------------------
--T024_07_03_04
--Clean up
ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION OFF;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
--AvailableQuantity : 17
UPDATE  dbo.Product2
SET     [AvailableQuantity] = 20
WHERE   ProductID = 1;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
GO -- Run the previous command and begins new batch
--AvailableQuantity : 20
```



	ProductID	ProductName	AvailableQuantity
1	1	Product1	17

	ProductID	ProductName	AvailableQuantity
1	1	Product1	20

7.4. ReadCommitted(包括讀提交)



Transaction1

```
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;

BEGIN TRANSACTION;
SELECT AvailableQuantity
--AvailableQuantity==20

--Sell Product.
UPDATE AvailableQuantity-= 1
--AvailableQuantity==19

--Billing
WAITFOR DELAY '00:00:4';
COMMIT TRANSACTION;
```

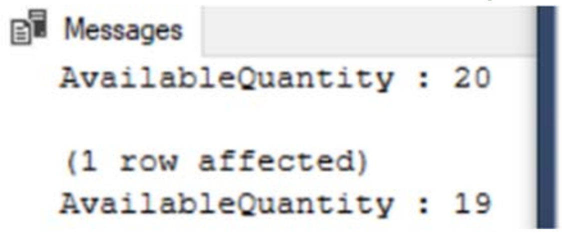
Transaction2

```
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;

SELECT AvailableQuantity
--AvailableQuantity==19
COMMIT TRANSACTION;
```

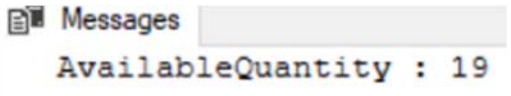
```
Transaction1 ReadCommitted isolation level(包括讀提交)
will block all other transactions
to insert/update/delete until it finishes.
Thus, Transaction1 will update
the AvailableQuantity from 20 to 19.
Transaction2 ReadCommitted isolation level(包括讀提交)
will read the committed value which is 19.
```

```
--==============================================================================
--T024_07_04
--ReadCommitted(包括讀提交)

/*
Transaction1 use ReadCommitted(包括讀提交) level : Update Data
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use ReadCommitted(包括讀提交) level : Select data
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
*/

-----------------------------------------
--T024_07_04_01
--Transaction1 use ReadCommitted(包括讀提交) level : Update Data
--Alter database [Sample] SET READ_COMMITTED_SNAPSHOT OFF
/*
Remember to disable READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
We use normal ReadCommitted(包括讀提交) in this example.
*/
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;
--Get the stock quantity
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Sell the product
SET @AvailableQuantity -= 1;
UPDATE  dbo.Product2
SET     AvailableQuantity = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
```

```sql
--Billing to Customer
WAITFOR DELAY '00:00:4';
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
-----------------------------------------
--T024_07_04_02
--Transaction2 use ReadCommitted(包括讀提交) level : Select data
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;
--Get the stock quantity
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
```

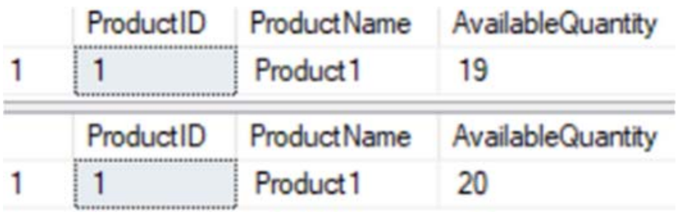


```
Messages
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 19
```



```
Messages
AvailableQuantity : 19
```

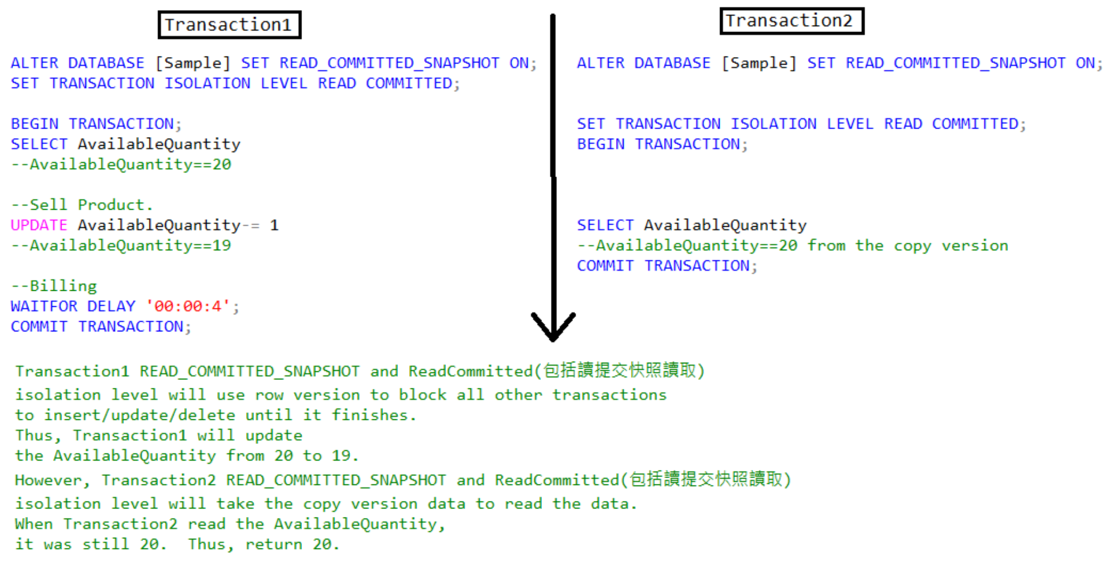
```sql
/*
1.
1.1.
Transaction1 use ReadCommitted(包括讀提交) level : Update Data
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use ReadCommitted(包括讀提交) level : Select data
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
1.2.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 19
Transaction2 [AvailableQuantity] will return ...
--AvailableQuantity : 19
Transaction1 ReadCommitted isolation level(包括讀提交)
will block all other transactions
to insert/update/delete until it finishes.
Thus, Transaction1 will update
the AvailableQuantity from 20 to 19.
Transaction2 ReadCommitted isolation level(包括讀提交)
will read the committed value which is 19.
*/
----------------------------------------------------
--T024_07_04_03
--Clean up the changes. Rollback the the AvailableQuantity
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
UPDATE  dbo.Product2
SET     [AvailableQuantity] = 20
WHERE   ProductID = 1;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
GO -- Run the previous command and begins new batch
```



	ProductID	ProductName	AvailableQuantity
1	1	Product1	19

	ProductID	ProductName	AvailableQuantity
1	1	Product1	20

7.5. READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)

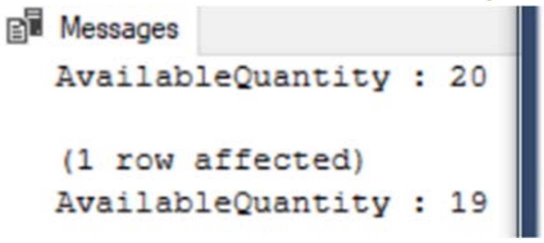


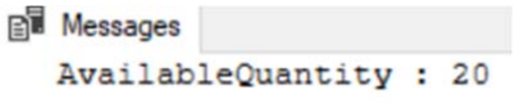
```
Transaction1
ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT ON;
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;

BEGIN TRANSACTION;
SELECT AvailableQuantity
--AvailableQuantity==20

--Sell Product.
UPDATE AvailableQuantity-= 1
--AvailableQuantity==19

--Billing
WAITFOR DELAY '00:00:4';
COMMIT TRANSACTION;
```

```
Transaction2
ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT ON;

SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;


SELECT AvailableQuantity
--AvailableQuantity==20 from the copy version
COMMIT TRANSACTION;
```

```
Transaction1 READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level will use row version to block all other transactions
to insert/update/delete until it finishes.
Thus, Transaction1 will update
the AvailableQuantity from 20 to 19.
However, Transaction2 READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level will take the copy version data to read the data.
When Transaction2 read the AvailableQuantity,
it was still 20.  Thus, return 20.
```

```
--==============================================================================
--T024_07_05
--READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
/*
Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Select data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
*/
----------------------------------------
--T024_07_05_01
ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT ON;
/*
Reference:
https://stackoverflow.com/questions/232333/how-long-should-set-read-committed-snapshot-on-take
Firstly,
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
Secondly, you may
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
If it take too long to enable SNAPSHOT,
close all ssms session, and re-open ssms, re-open the query.
execute the filllowing.
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON WITH ROLLBACK IMMEDIATE
it will immediately rollback any open transactions before starting the ALTER DATABASE statement.
Remember to disable it when you finished
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT OFF;
*/
----------------------------------------
--T024_07_05_02
```

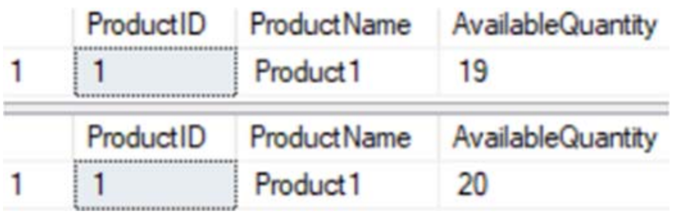
```
--Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;
--Get the stock quantity
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Sell the product
SET @AvailableQuantity -= 1;
UPDATE  dbo.Product2
SET     AvailableQuantity = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Billing to Customer
WAITFOR DELAY '00:00:4';
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
----------------------------------------
--T024_07_05_03
--Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Select data
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;
--Get the stock quantity
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
```


```
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 19
```


```
AvailableQuantity : 20
```

```
/*
1.
1.1.
Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Select data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
1.2.
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
has no update conflicts problems, because
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
uses row version to perform whatever ReadCommitted(包括讀提交) can do, plus
whatever ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) can do.
whatever ReadCommitted(包括讀提交) can do is to prevent update conflicts.
1.3.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
```

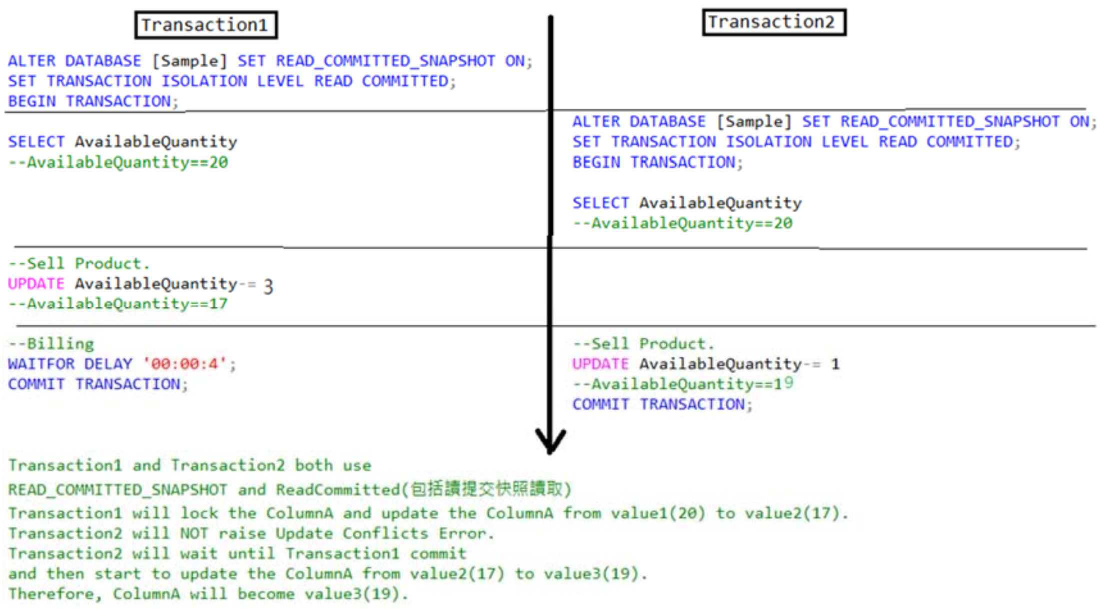
```
Transaction1 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 19
Transaction2 [AvailableQuantity] will return ...
--AvailableQuantity : 20
Transaction1 READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level will use row version to block all other transactions
to insert/update/delete until it finishes.
Thus, Transaction1 will update
the AvailableQuantity from 20 to 19.
However, Transaction2 READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level will take the copy version data to read the data.
When Transaction2 read the AvailableQuantity,
it was still 20.  Thus, return 20.
*/
----------------------------------------------------
--T024_07_05_04
--Clean up.
ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT OFF;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
--AvailableQuantity : 19
UPDATE  dbo.Product2
SET     [AvailableQuantity] = 20
WHERE   ProductID = 1;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
GO -- Run the previous command and begins new batch
--AvailableQuantity : 20
```



	ProductID	ProductName	AvailableQuantity
1	1	Product1	19

	ProductID	ProductName	AvailableQuantity
1	1	Product1	20

7.6. READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)

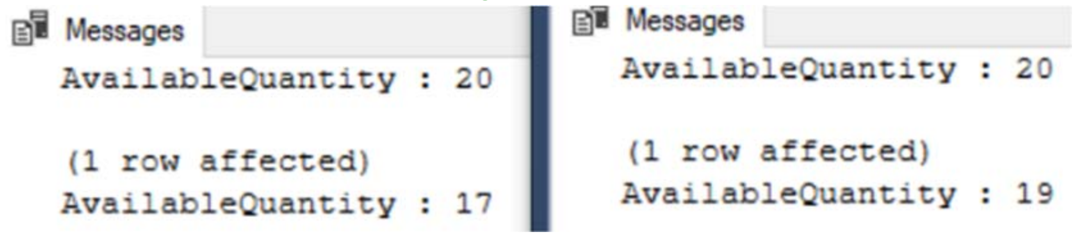


```
Transaction1
ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT ON;
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;

SELECT AvailableQuantity
--AvailableQuantity==20

--Sell Product.
UPDATE AvailableQuantity-= 3
--AvailableQuantity==17

--Billing
WAITFOR DELAY '00:00:4';
COMMIT TRANSACTION;
```

```
Transaction2
ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT ON;
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;

SELECT AvailableQuantity
--AvailableQuantity==20

--Sell Product.
UPDATE AvailableQuantity-= 1
--AvailableQuantity==19
COMMIT TRANSACTION;
```

```
Transaction1 and Transaction2 both use
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
Transaction1 will lock the ColumnA and update the ColumnA from value1(20) to value2(17).
Transaction2 will NOT raise Update Conflicts Error.
Transaction2 will wait until Transaction1 commit
and then start to update the ColumnA from value2(17) to value3(19).
Therefore, ColumnA will become value3(19).
```

```
--==============================================================================
--T024_07_06
--READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
/*
Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update same data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
*/
----------------------------------------
--T024_07_06_01
ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT ON;
/*
Reference:
https://stackoverflow.com/questions/232333/how-long-should-set-read-committed-snapshot-on-take
Firstly,
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
Secondly, you may
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
If it take too long to enable SNAPSHOT,
close all ssms session, and re-open ssms, re-open the query.
execute the fillowing.
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON WITH ROLLBACK IMMEDIATE
it will immediately rollback any open transactions before starting the ALTER DATABASE statement.
Remember to disable it when you finished
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT OFF;
*/
----------------------------------------
--T024_07_06_02
--Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
--ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT ON;
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;
--Get the stock quantity
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Sell the product
SET @AvailableQuantity -= 3;
```

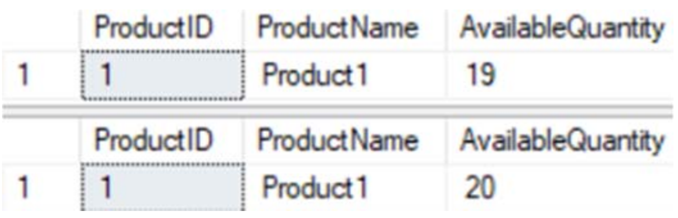
```sql
UPDATE  dbo.Product2
SET     AvailableQuantity = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Billing to Customer
WAITFOR DELAY '00:00:4';
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
----------------------------------------------------
--T024_07_06_03
--Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update same data
--ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT ON;
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Sell One Product.
SET @AvailableQuantity -= 1;
UPDATE  dbo.Product2
SET     AvailableQuantity = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
```


```
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 17
```

```
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 19
```

```
/*
1.
1.1.
Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update same data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
1.2.
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
has no update conflicts problems, because
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
uses row version to perform whatever ReadCommitted(包括讀提交) can do, plus
whatever ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) can do.
whatever ReadCommitted(包括讀提交) can do is to prevent update conflicts.
1.3.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 17
Transaction2 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 19
Transaction1 and Transaction2 both use
```

```
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
Transaction1 will lock the ColumnA and update the ColumnA from value1(20) to value2(17).
Transaction2 will NOT raise Update Conflicts Error.
Transaction2 will wait until Transaction1 commit
and then start to update the ColumnA from value2(17) to value3(19).
Therefore, ColumnA will become value3(19).
*/
----------------------------------------------------
--T024_07_06_04
--Clean up
ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT OFF;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
UPDATE  dbo.Product2
SET     [AvailableQuantity] = 20
WHERE   ProductID = 1;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
GO -- Run the previous command and begins new batch
```

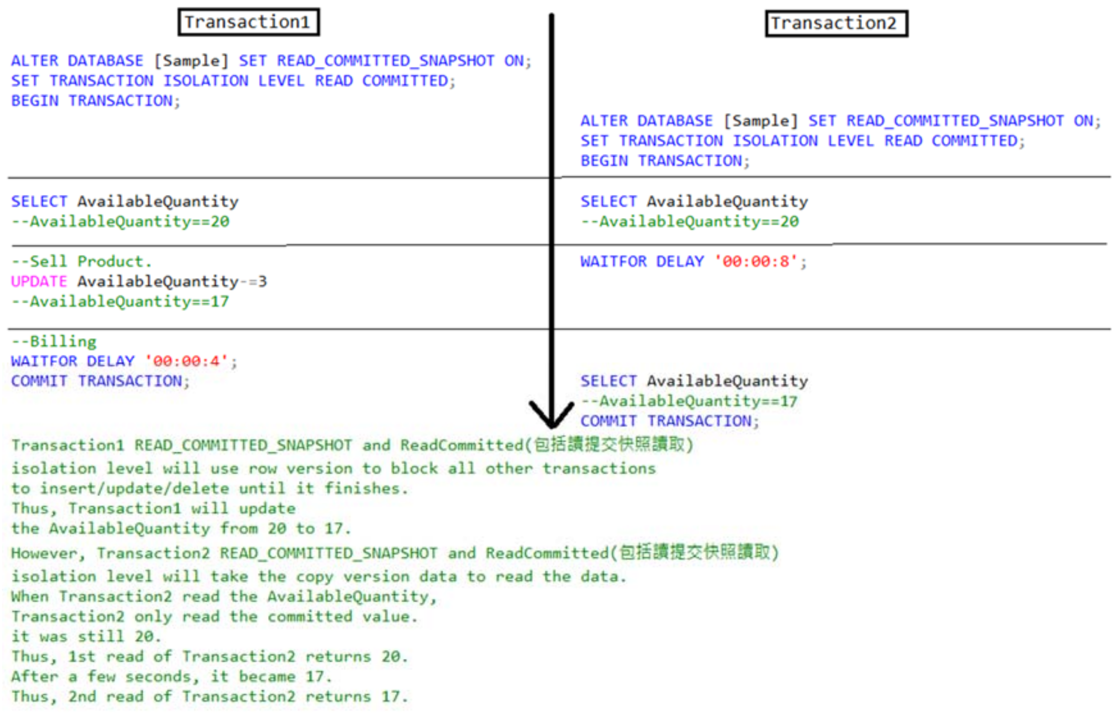


	ProductID	ProductName	AvailableQuantity
1	1	Product1	19

	ProductID	ProductName	AvailableQuantity
1	1	Product1	20

```
--------------------------------------------------------------------------------
```

7.7. READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)



Transaction1

```
ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT ON;
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;

SELECT AvailableQuantity
--AvailableQuantity==20

--Sell Product.
UPDATE AvailableQuantity-=3
--AvailableQuantity==17

--Billing
WAITFOR DELAY '00:00:4';
COMMIT TRANSACTION;
```

Transaction2

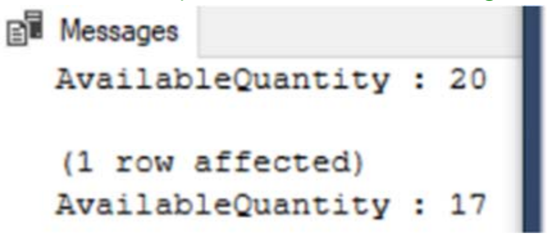
```
ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT ON;
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;

SELECT AvailableQuantity
--AvailableQuantity==20

WAITFOR DELAY '00:00:8';

SELECT AvailableQuantity
--AvailableQuantity==17
COMMIT TRANSACTION;
```

```
Transaction1 READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level will use row version to block all other transactions
to insert/update/delete until it finishes.
Thus, Transaction1 will update
the AvailableQuantity from 20 to 17.
However, Transaction2 READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level will take the copy version data to read the data.
When Transaction2 read the AvailableQuantity,
Transaction2 only read the committed value.
it was still 20.
Thus, 1st read of Transaction2 returns 20.
After a few seconds, it became 17.
Thus, 2nd read of Transaction2 returns 17.
```

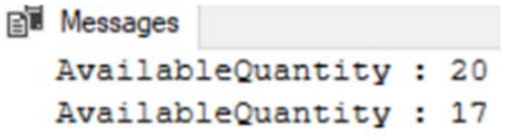
```
--==============================================================================
--T024_07_07
--READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
```

```sql
/*
Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level :
1st select before update, 2nd select after update
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
*/
----------------------------------------
--T024_07_07_01
ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT ON;
/*
Reference:
https://stackoverflow.com/questions/232333/how-long-should-set-read-committed-snapshot-on-take
Firstly,
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
Secondly, you may
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
If it take too long to enable SNAPSHOT,
close all ssms session, and re-open ssms, re-open the query.
execute the fillowing.
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON WITH ROLLBACK IMMEDIATE
it will immediately rollback any open transactions before starting the ALTER DATABASE statement.
Remember to disable it when you finished
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT OFF;
*/
----------------------------------------
--T024_07_07_02
--Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;
--Get the stock quantity
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Sell the product
SET @AvailableQuantity -= 3;
UPDATE  dbo.Product2
SET     AvailableQuantity = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Billing to Customer
WAITFOR DELAY '00:00:4';
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
----------------------------------------
--T024_07_07_03
--Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level :
--1st select before update, 2nd select after update
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
BEGIN TRANSACTION;
--Check stock
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
```

```
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Do something
WAITFOR DELAY '00:00:8';
--Check stock again
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
```



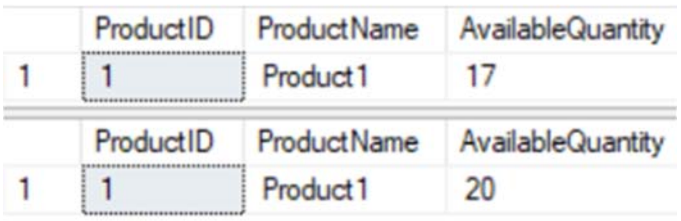
```
Messages
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 17
```



```
Messages
AvailableQuantity : 20
AvailableQuantity : 17
```

```
/*
1.
1.1.
Transaction1 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update Data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
Transaction2 use READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取) level : Update same data
--ALTER DATABASE Sample3 SET READ_COMMITTED_SNAPSHOT ON;
--SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
1.2.
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
has no update conflicts problems, because
READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
uses row version to perform whatever ReadCommitted(包括讀提交) can do, plus
whatever ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) can do.
whatever ReadCommitted(包括讀提交) can do is to prevent update conflicts.
1.3.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 17
Transaction2 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 17
Transaction1 READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level will use row version to block all other transactions
to insert/update/delete until it finishes.
Thus, Transaction1 will update
the AvailableQuantity from 20 to 17.
However, Transaction2 READ_COMMITTED_SNAPSHOT and ReadCommitted(包括讀提交快照讀取)
isolation level will take the copy version data to read the data.
When Transaction2 read the AvailableQuantity,
Transaction2 only read the committed value.
it was still 20.
Thus, 1st read of Transaction2 returns 20.
After a few seconds, it became 17.
Thus, 2nd read of Transaction2 returns 17.
*/
----------------------------------------
--T024_07_07_04
--Clean up
ALTER DATABASE [Sample] SET READ_COMMITTED_SNAPSHOT OFF;
SELECT  *
FROM    dbo.Product2
```

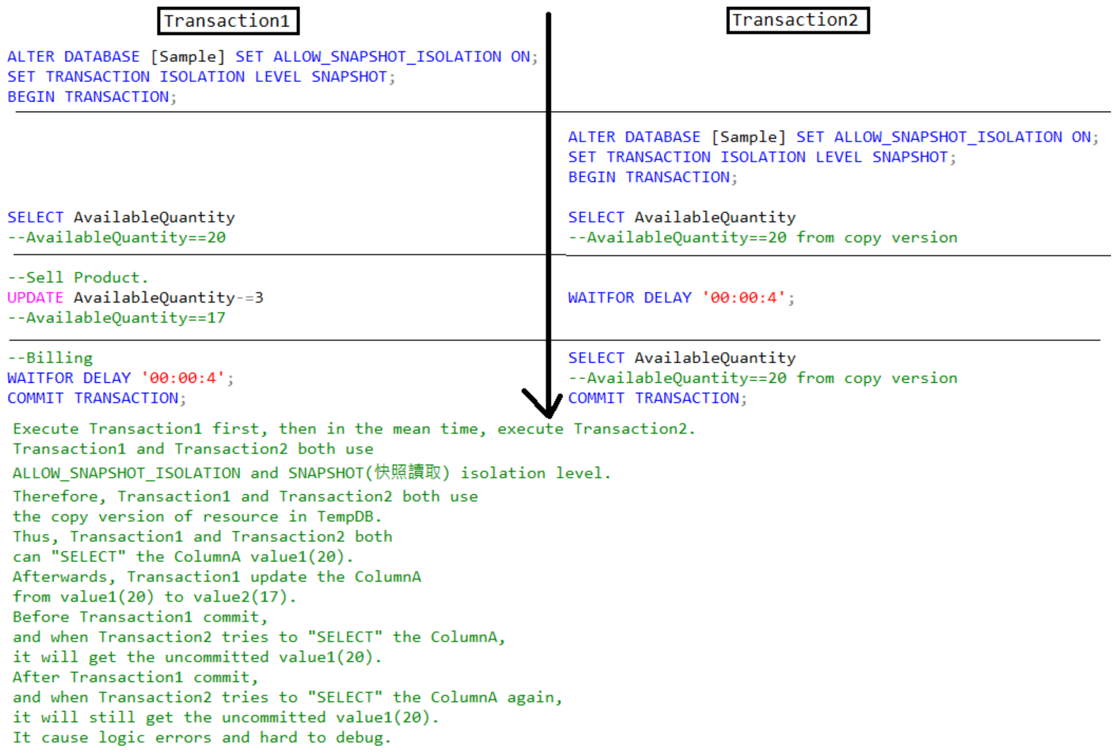
```
WHERE   ProductID = 1;
--AvailableQuantity : 17
UPDATE  dbo.Product2
SET     [AvailableQuantity] = 20
WHERE   ProductID = 1;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
GO -- Run the previous command and begins new batch
--AvailableQuantity : 20
```



	ProductID	ProductName	AvailableQuantity
1	1	Product1	17

	ProductID	ProductName	AvailableQuantity
1	1	Product1	20

7.8. ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)



Transaction1	Transaction2

ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
BEGIN TRANSACTION;	

	ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
	SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
	BEGIN TRANSACTION;

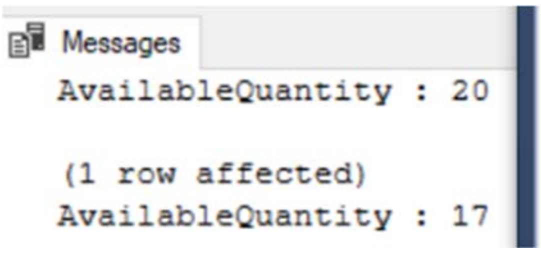
SELECT AvailableQuantity --AvailableQuantity==20	SELECT AvailableQuantity --AvailableQuantity==20 from copy version
--Sell Product. UPDATE AvailableQuantity-=3 --AvailableQuantity==17	WAITFOR DELAY '00:00:4';

--Billing
WAITFOR DELAY '00:00:4';
COMMIT TRANSACTION;
	SELECT AvailableQuantity
	--AvailableQuantity==20 from copy version
	COMMIT TRANSACTION;

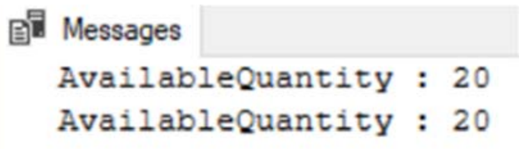
```
Execute Transaction1 first, then in the mean time, execute Transaction2.
Transaction1 and Transaction2 both use
ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) isolation level.
Therefore, Transaction1 and Transaction2 both use
the copy version of resource in TempDB.
Thus, Transaction1 and Transaction2 both
can "SELECT" the ColumnA value1(20).
Afterwards, Transaction1 update the ColumnA
from value1(20) to value2(17).
Before Transaction1 commit,
and when Transaction2 tries to "SELECT" the ColumnA,
it will get the uncommitted value1(20).
After Transaction1 commit,
and when Transaction2 tries to "SELECT" the ColumnA again,
it will still get the uncommitted value1(20).
It cause logic errors and hard to debug.
```

```
--==============================================================================
--T024_07_08
--ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取)
/*
Transaction1 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level : Update Data
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
Transaction2 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level :
1st select before update, 2nd select after update
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
This is the logic error and hard to debug.
*/
-----------------------------------------
--T024_07_08_01
```

```
ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
/*
Reference:
https://stackoverflow.com/questions/232333/how-long-should-set-read-committed-snapshot-on-take
Firstly,
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
Secondly, you may
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
If it take too long to enable SNAPSHOT,
close all ssms session, and re-open ssms, re-open the query.
execute the fillowing.
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON WITH ROLLBACK IMMEDIATE
it will immediately rollback any open transactions before starting the ALTER DATABASE statement.
Remember to disable it when you finished
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION OFF;
*/
----------------------------------------
--T024_07_08_02
--Transaction1 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level : Update Data
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
BEGIN TRANSACTION;
--Get the stock quantity
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Sell the product
SET @AvailableQuantity -= 3;
UPDATE  dbo.Product2
SET     AvailableQuantity = @AvailableQuantity
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Billing to Customer
WAITFOR DELAY '00:00:4';
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
----------------------------------------------------
--T024_07_08_03
--Transaction2 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level :
--1st select before update, 2nd select after update
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
BEGIN TRANSACTION;
--Check stock
DECLARE @AvailableQuantity INT;
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
--Do something
WAITFOR DELAY '00:00:8';
--Check stock again
SELECT  @AvailableQuantity = AvailableQuantity
FROM    dbo.Product2
WHERE   ProductID = 1;
PRINT 'AvailableQuantity : ' + CONVERT(NVARCHAR, @AvailableQuantity);
COMMIT TRANSACTION;
GO -- Run the previous command and begins new batch
```

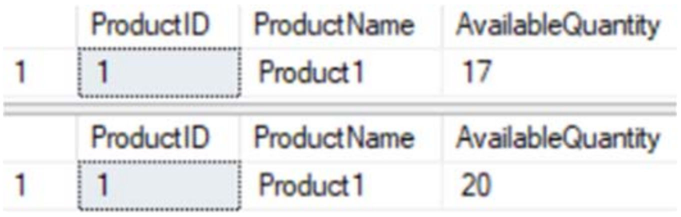


```
Messages
AvailableQuantity : 20

(1 row affected)
AvailableQuantity : 17
```



```
Messages
AvailableQuantity : 20
AvailableQuantity : 20
```

```
/*
1.
1.1.
Transaction1 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level : Update Data
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
Transaction2 use ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) level :
1st select before update, 2nd select after update
--ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION ON;
--SET TRANSACTION ISOLATION LEVEL SNAPSHOT;
1.2.
Execute Transaction1,
then during Transaction1 is still running, execute Transaction2
Transaction1 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 17
Transaction2 [AvailableQuantity] will return ...
--AvailableQuantity : 20
--AvailableQuantity : 20
Execute Transaction1 first, then in the mean time, execute Transaction2.
Transaction1 and Transaction2 both use
ALLOW_SNAPSHOT_ISOLATION and SNAPSHOT(快照讀取) isolation level.
Therefore, Transaction1 and Transaction2 both use
the copy version of resource in TempDB.
Thus, Transaction1 and Transaction2 both
can "SELECT" the ColumnA value1(20).
Afterwards, Transaction1 update the ColumnA
from value1(20) to value2(17).
Before Transaction1 commit,
and when Transaction2 tries to "SELECT" the ColumnA,
it will get the uncommitted value1(20).
After Transaction1 commit,
and when Transaction2 tries to "SELECT" the ColumnA again,
it will still get the uncommitted value1(20).
It cause logic errors and hard to debug.
*/
----------------------------------------------------
--T024_07_08_04
--Clean up
ALTER DATABASE [Sample] SET ALLOW_SNAPSHOT_ISOLATION OFF;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
--AvailableQuantity : 17
UPDATE  dbo.Product2
SET     [AvailableQuantity] = 20
WHERE   ProductID = 1;
SELECT  *
FROM    dbo.Product2
WHERE   ProductID = 1;
GO -- Run the previous command and begins new batch
--AvailableQuantity : 20
```



	ProductID	ProductName	AvailableQuantity
1	1	Product1	17

	ProductID	ProductName	AvailableQuantity
1	1	Product1	20

===

8. Clean up

```
IF ( EXISTS ( SELECT    *
             FROM      INFORMATION_SCHEMA.TABLES
             WHERE     TABLE_NAME = 'Product2' ) )
   BEGIN
       DROP TABLE Product2;
   END;
GO -- Run the previous command and begins new batch
IF ( EXISTS ( SELECT    *
             FROM      INFORMATION_SCHEMA.TABLES
             WHERE     TABLE_NAME = 'Person4' ) )
   BEGIN
       TRUNCATE TABLE dbo.Person4;
       DROP TABLE Person4;
   END;
GO -- Run the previous command and begins new batch
```