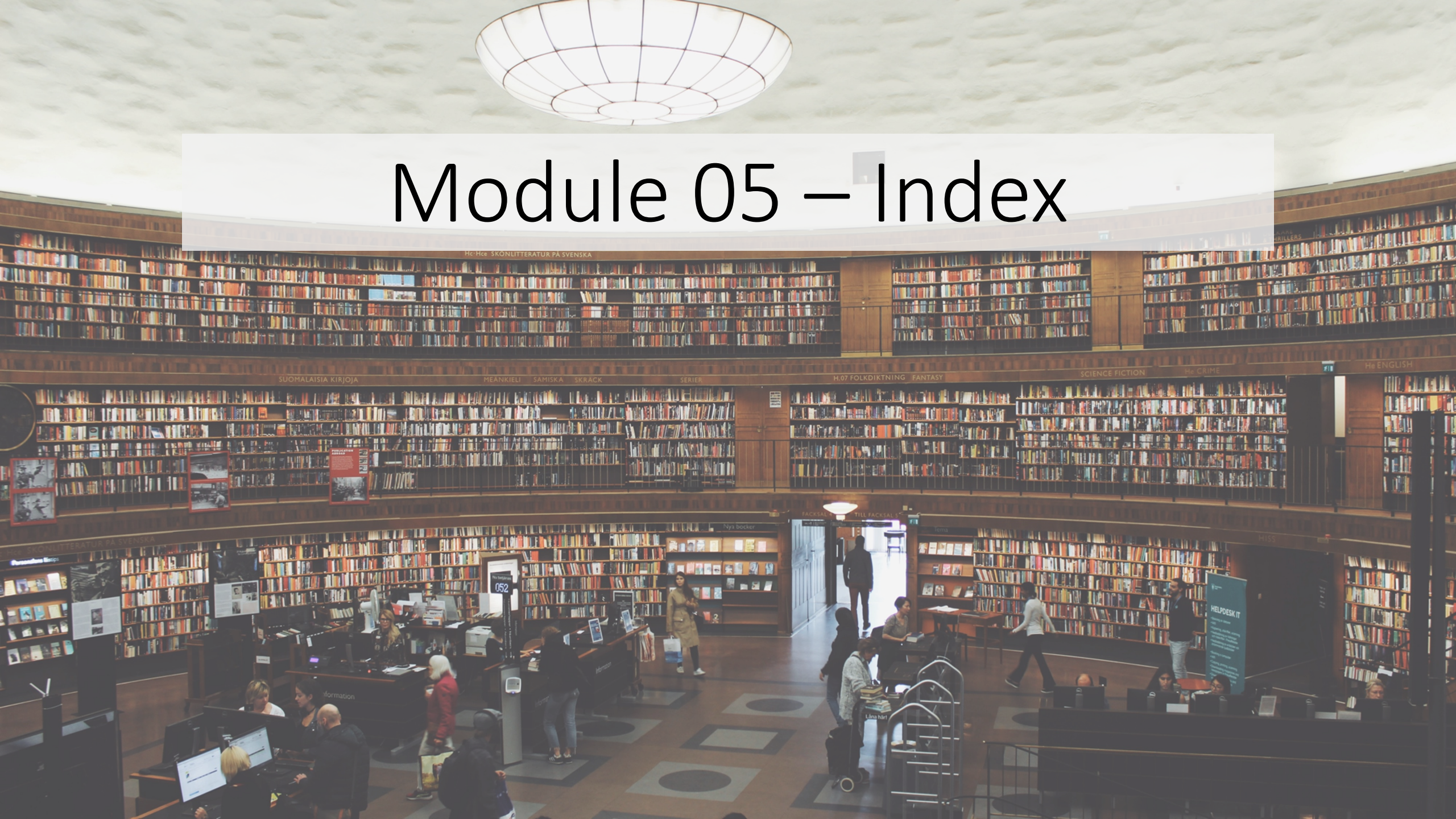
Module 05 – Index



Objectifs

- Les index
- Plan d’exécution

Index

- Un index permet d'accélérer les **recherches** en utilisant une structure de données spécialisée
- L'utilisation d'index a un influence sur toutes les opérations du DML : l'ajout ou la modification de lignes force la mise à jour des index
  - Plus vous avez d'index, plus ces opérations seront ralenties

Index SQL Server

Type	Description
CLUSTERED INDEX	Un par table. Les lignes de la table sont enregistrées dans l'ordre de l'index. Généralement, on utilise la clef primaire. SQL Server utilise la structure de données B+-Tree.
NON CLUSTERED INDEX	Autant que vous voulez. Séparés de la structure des données. Chaque clef contient un pointeur vers les données.
…	…

https://learn.microsoft.com/en-us/sql/relational-databases/indexes/indexes

https://en.wikipedia.org/wiki/B%2B_tree

Création d'index en SQL Server

- Utilisez un nom qui suit la nomenclature suivante :
  - IX_<NomTable>_<Champs>
  - FK_<NomTable>_<ClefEtrangère>

```
CREATE [ UNIQUE ] [ CLUSTERED | NONCLUSTERED ] INDEX index_name
    ON <object> ( column [ ASC | DESC ] [ ,...n ] )
    [ INCLUDE ( column_name [ ,...n ] ) ]
    [ WHERE <filter_predicate> ]
    [ WITH ( <relational_index_option> [ ,...n ] ) ]
    [ ON { partition_scheme_name ( column_name )
         | filegroup_name
         | default
         }
    ]
    [ FILESTREAM_ON { filestream_filegroup_name | partition_scheme_name | "NULL

[ ; ]
```

https://learn.microsoft.com/en-us/sql/t-sql/statements/create-index-transact-sql

Quand créer des index ?

- Les clefs primaires sont généralement indexées (CLUSTERED INDEX) et les enregistrements sont donc dans l'ordre de la clef
- Les clefs étrangères ne sont pas indexées par défaut => cela peut être une bonne pratique de le faire dans la plupart des cas
- Champs souvent recherchés
  - Recherche sur des nombres, des dates, des débuts de champs, etc.
  - Attention aux champs de type « Text » : il faut utiliser un index de type « Full-text » optimisé pour la recherche de texte
- Éviter d'indexer des champs de tables qui ne sont pas beaucoup utilisées dans des jointures / recherches comme des tables de journaux (beaucoup d'insertions, peu/pas de lectures)

Plan d’exécution

- Une requête est déclarative : l’ordre d’exécution n’est pas imposé
- On peut forcer cette ordre d’exécution (comme l’ordre des jointures par exemple) en passant des options (Ex. : OPTION (FORCE ORDER)) ou en utilisant des sous-requêtes ou des tables temporaires
- Avant d’exécuter une requête, SQL Server va estimer la meilleure façon d’exécuter votre requête en se basant sur les statistiques des tables et des précédentes exécutions
- « Estimated Query Plan » : Plan d’exécution estimé

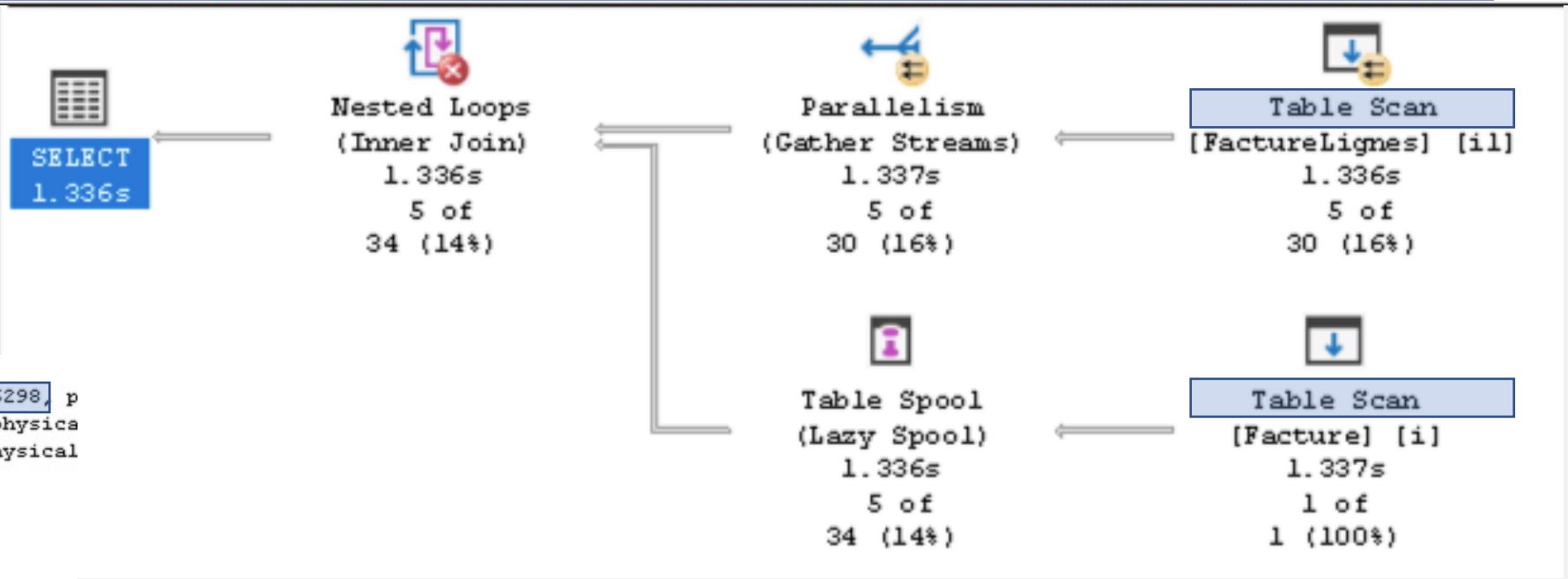
https://learn.microsoft.com/en-us/sql/t-sql/queries/hints-transact-sql-query

```
SELECT *
INTO Facture
FROM Sales.Invoices

SELECT *
INTO FactureLignes
FROM Sales.InvoiceLines

SET STATISTICS IO ON
SET STATISTICS TIME ON
```

Plan d'exécution sans index

```
SELECT *
FROM Facture i
INNER JOIN FactureLignes il ON il.InvoiceID = i.InvoiceID
WHERE i.InvoiceID = 126
ORDER BY i.InvoiceID
```

```
Estimated query progress:100%
Query 1: Query cost (relative to the batch): 100%
SELECT * FROM Facture i INNER JOIN dbo.FactureLignes il ON il.InvoiceID = i.InvoiceID WHERE i.InvoiceID = 126 ORDER BY i.InvoiceID
Missing Index (Impact 60.5032): CREATE NONCLUSTERED INDEX [<Name of Missing Index, sysname,>] ON [dbo].[Facture] ([InvoiceID])
```

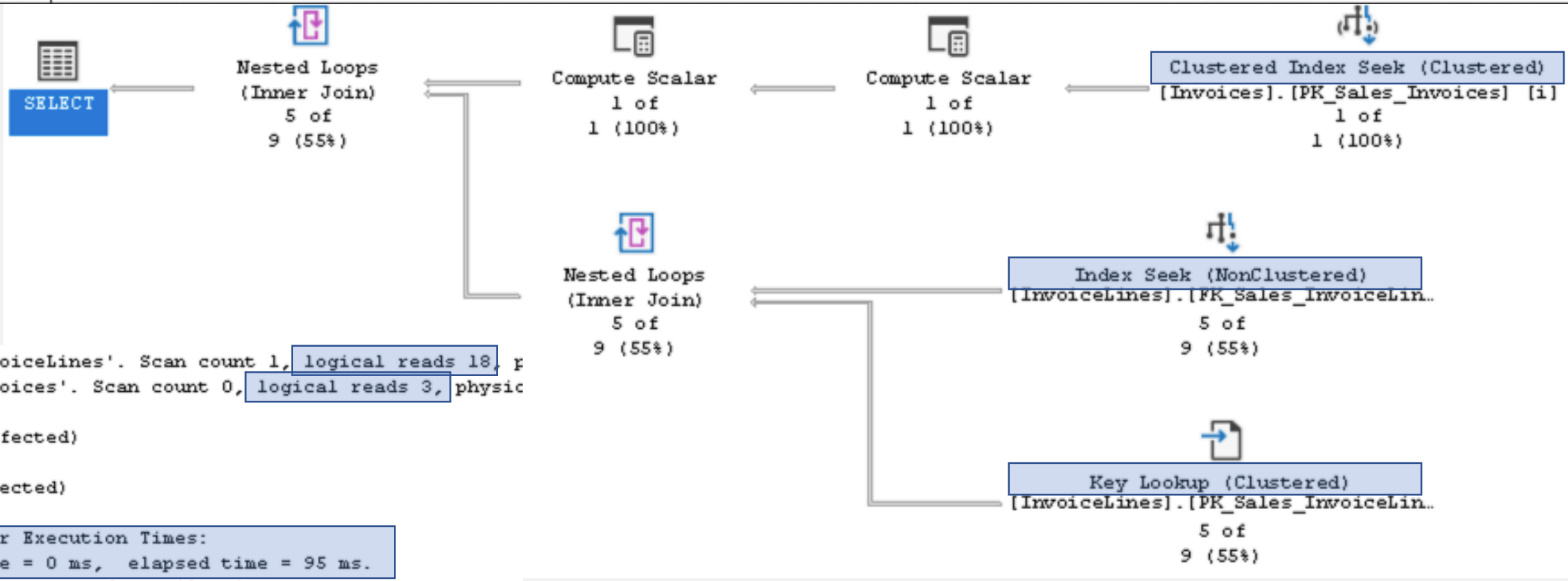



```
(5 rows affected)
Table 'FactureLignes'. Scan count 3, logical reads 15298, p
Table 'Facture'. Scan count 1, logical reads 24229, physica
Table 'Worktable'. Scan count 1, logical reads 11, physical

(6 rows affected)

(1 row affected)

SQL Server Execution Times:
   CPU time = 249 ms,  elapsed time = 485 ms.
SQL Server parse and compile time:
   CPU time = 0 ms, elapsed time = 0 ms.
```

Plan d'exécution avec index

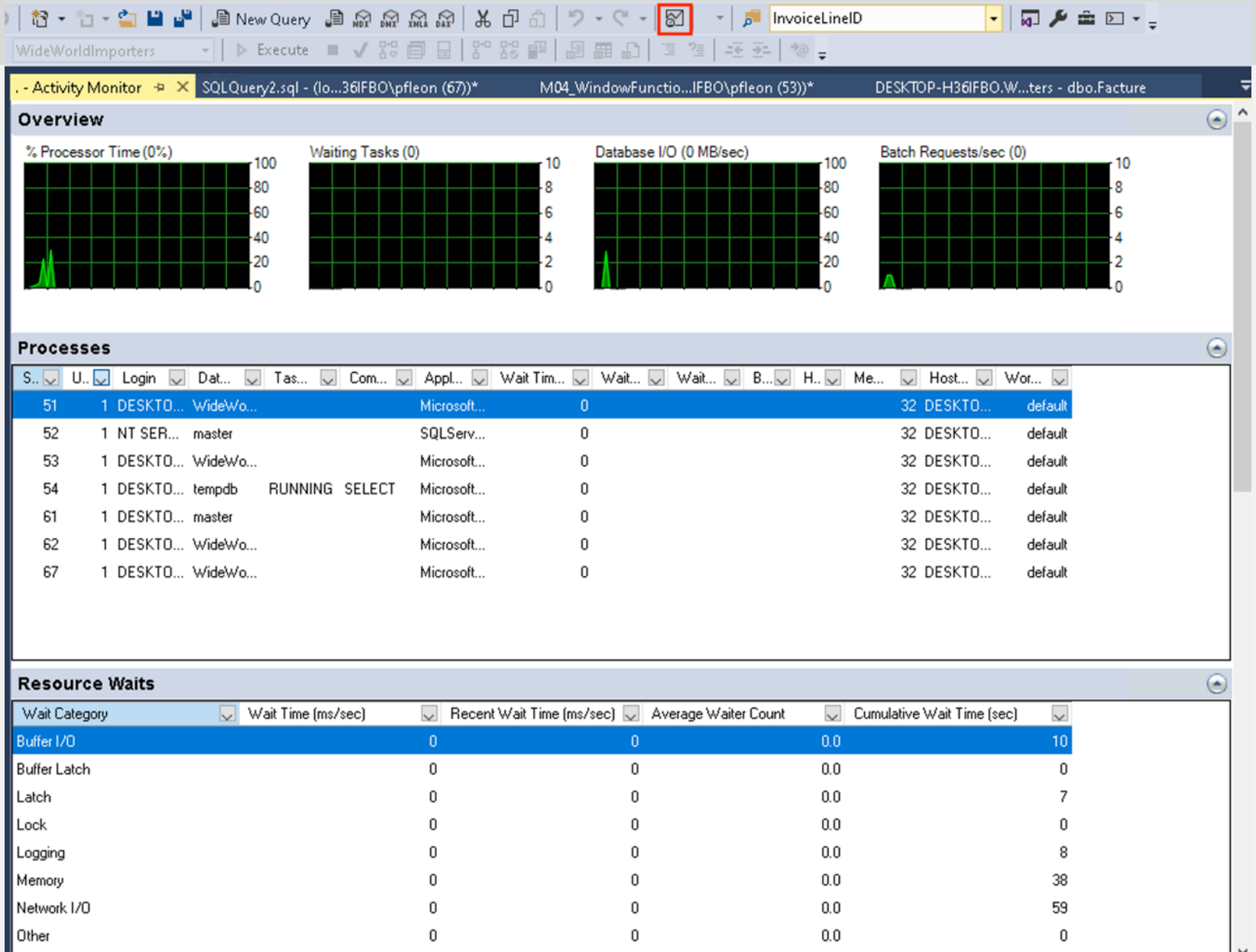
```
SELECT *
FROM Sales.Invoices i
INNER JOIN Sales.InvoiceLines il ON il.InvoiceID = i.InvoiceID
WHERE i.InvoiceID = 126
ORDER BY i.InvoiceID
```

Estimated query progress:100%	Query 1: Query cost (relative to the batch): 100% SELECT * FROM Sales.Invoices i INNER JOIN Sales.InvoiceLines il ON il.InvoiceID = i.InvoiceID WHERE i.InvoiceID = 126 ORDER BY i.InvoiceID

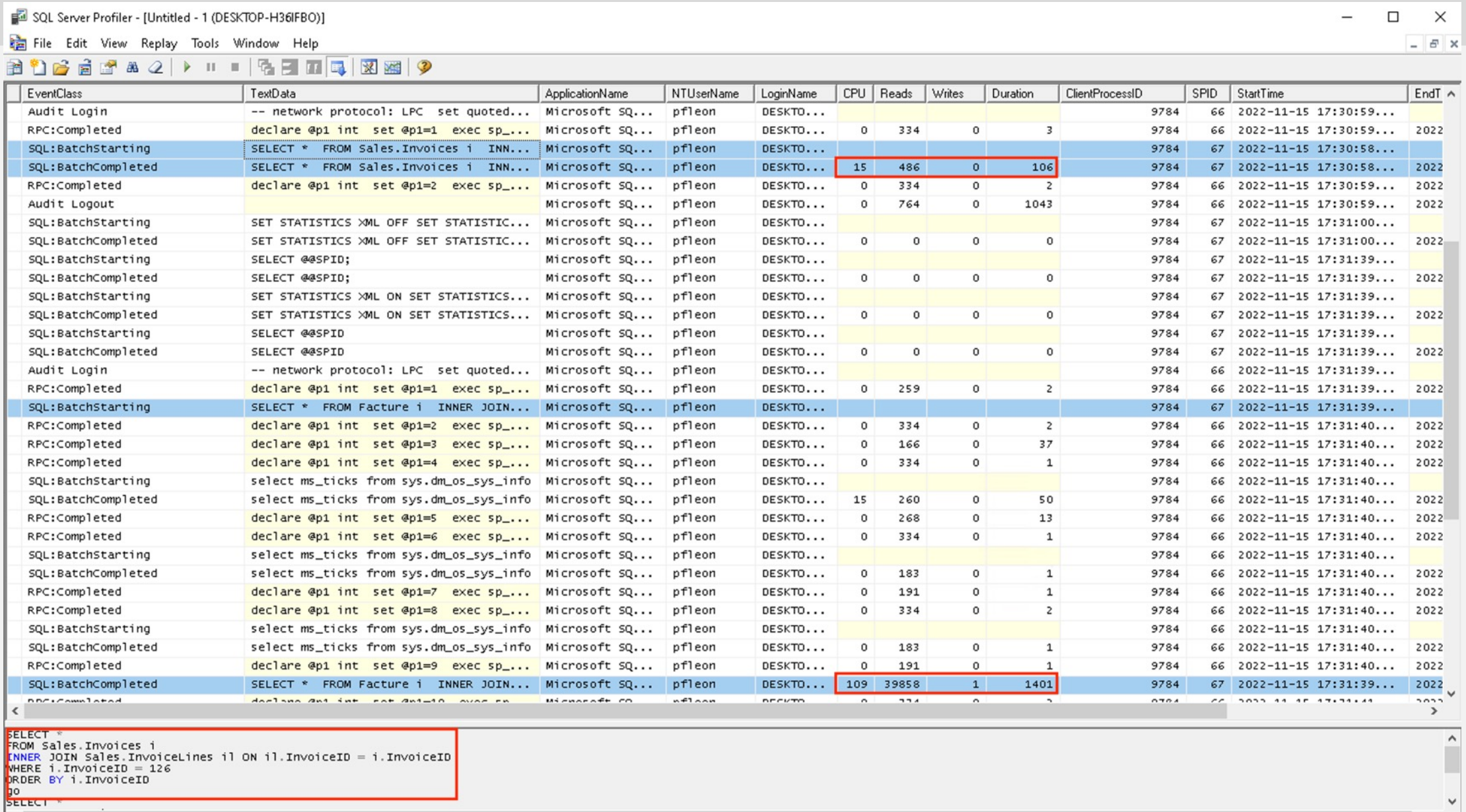



```
Table 'InvoiceLines'. Scan count 1, logical reads 18, p
Table 'Invoices'. Scan count 0, logical reads 3, physic

(8 rows affected)

(1 row affected)

SQL Server Execution Times:
   CPU time = 0 ms,  elapsed time = 95 ms.
SQL Server parse and compile time:
   CPU time = 0 ms, elapsed time = 0 ms.
```

Moniteur d'activités



SQL Server Profiler



EventClass	TextData	ApplicationName	NTUserName	LoginName	CPU	Reads	Writes	Duration	ClientProcessID	SPID	StartTime	EndT
Audit Login	-- network protocol: LPC set quoted...	Microsoft SQ...	pfleon	DESKTO...					9784	66	2022-11-15 17:30:59...	
RPC:Completed	declare @p1 int set @p1=1 exec sp_...	Microsoft SQ...	pfleon	DESKTO...	0	334	0	3	9784	66	2022-11-15 17:30:59...	2022
SQL:BatchStarting	SELECT * FROM Sales.Invoices i INN...	Microsoft SQ...	pfleon	DESKTO...					9784	67	2022-11-15 17:30:58...	
SQL:BatchCompleted	SELECT * FROM Sales.Invoices i INN...	Microsoft SQ...	pfleon	DESKTO...	15	486	0	106	9784	67	2022-11-15 17:30:58...	2022
RPC:Completed	declare @p1 int set @p1=2 exec sp_...	Microsoft SQ...	pfleon	DESKTO...	0	334	0	2	9784	66	2022-11-15 17:30:59...	2022
Audit Logout		Microsoft SQ...	pfleon	DESKTO...	0	764	0	1043	9784	66	2022-11-15 17:30:59...	2022
SQL:BatchStarting	SET STATISTICS XML OFF SET STATISTIC...	Microsoft SQ...	pfleon	DESKTO...					9784	67	2022-11-15 17:31:00...	
SQL:BatchCompleted	SET STATISTICS XML OFF SET STATISTIC...	Microsoft SQ...	pfleon	DESKTO...	0	0	0	0	9784	67	2022-11-15 17:31:00...	2022
SQL:BatchStarting	SELECT @@SPID;	Microsoft SQ...	pfleon	DESKTO...					9784	67	2022-11-15 17:31:39...	
SQL:BatchCompleted	SELECT @@SPID;	Microsoft SQ...	pfleon	DESKTO...	0	0	0	0	9784	67	2022-11-15 17:31:39...	2022
SQL:BatchStarting	SET STATISTICS XML ON SET STATISTICS...	Microsoft SQ...	pfleon	DESKTO...					9784	67	2022-11-15 17:31:39...	
SQL:BatchCompleted	SET STATISTICS XML ON SET STATISTICS...	Microsoft SQ...	pfleon	DESKTO...	0	0	0	0	9784	67	2022-11-15 17:31:39...	2022
SQL:BatchStarting	SELECT @@SPID	Microsoft SQ...	pfleon	DESKTO...					9784	67	2022-11-15 17:31:39...	
SQL:BatchCompleted	SELECT @@SPID	Microsoft SQ...	pfleon	DESKTO...	0	0	0	0	9784	67	2022-11-15 17:31:39...	2022
Audit Login	-- network protocol: LPC set quoted...	Microsoft SQ...	pfleon	DESKTO...					9784	66	2022-11-15 17:31:39...	
RPC:Completed	declare @p1 int set @p1=1 exec sp_...	Microsoft SQ...	pfleon	DESKTO...	0	259	0	2	9784	66	2022-11-15 17:31:39...	2022
SQL:BatchStarting	SELECT * FROM Facture i INNER JOIN...	Microsoft SQ...	pfleon	DESKTO...					9784	67	2022-11-15 17:31:39...	
RPC:Completed	declare @p1 int set @p1=2 exec sp_...	Microsoft SQ...	pfleon	DESKTO...	0	334	0	2	9784	66	2022-11-15 17:31:40...	2022
RPC:Completed	declare @p1 int set @p1=3 exec sp_...	Microsoft SQ...	pfleon	DESKTO...	0	166	0	37	9784	66	2022-11-15 17:31:40...	2022
RPC:Completed	declare @p1 int set @p1=4 exec sp_...	Microsoft SQ...	pfleon	DESKTO...	0	334	0	1	9784	66	2022-11-15 17:31:40...	2022
SQL:BatchStarting	select ms_ticks from sys.dm_os_sys_info	Microsoft SQ...	pfleon	DESKTO...					9784	66	2022-11-15 17:31:40...	
SQL:BatchCompleted	select ms_ticks from sys.dm_os_sys_info	Microsoft SQ...	pfleon	DESKTO...	15	260	0	50	9784	66	2022-11-15 17:31:40...	2022
RPC:Completed	declare @p1 int set @p1=5 exec sp_...	Microsoft SQ...	pfleon	DESKTO...	0	268	0	13	9784	66	2022-11-15 17:31:40...	2022
RPC:Completed	declare @p1 int set @p1=6 exec sp_...	Microsoft SQ...	pfleon	DESKTO...	0	334	0	1	9784	66	2022-11-15 17:31:40...	2022
SQL:BatchStarting	select ms_ticks from sys.dm_os_sys_info	Microsoft SQ...	pfleon	DESKTO...					9784	66	2022-11-15 17:31:40...	
SQL:BatchCompleted	select ms_ticks from sys.dm_os_sys_info	Microsoft SQ...	pfleon	DESKTO...	0	183	0	1	9784	66	2022-11-15 17:31:40...	2022
RPC:Completed	declare @p1 int set @p1=7 exec sp_...	Microsoft SQ...	pfleon	DESKTO...	0	191	0	1	9784	66	2022-11-15 17:31:40...	2022
RPC:Completed	declare @p1 int set @p1=8 exec sp_...	Microsoft SQ...	pfleon	DESKTO...	0	334	0	2	9784	66	2022-11-15 17:31:40...	2022
SQL:BatchStarting	select ms_ticks from sys.dm_os_sys_info	Microsoft SQ...	pfleon	DESKTO...					9784	66	2022-11-15 17:31:40...	
SQL:BatchCompleted	select ms_ticks from sys.dm_os_sys_info	Microsoft SQ...	pfleon	DESKTO...	0	183	0	1	9784	66	2022-11-15 17:31:40...	2022
RPC:Completed	declare @p1 int set @p1=9 exec sp_...	Microsoft SQ...	pfleon	DESKTO...	0	191	0	1	9784	66	2022-11-15 17:31:40...	2022
SQL:BatchCompleted	SELECT * FROM Facture i INNER JOIN...	Microsoft SQ...	pfleon	DESKTO...	109	39858	1	1401	9784	67	2022-11-15 17:31:39...	2022

```
SELECT *
FROM Sales.Invoices i
INNER JOIN Sales.InvoiceLines il ON il.InvoiceID = i.InvoiceID
WHERE i.InvoiceID = 126
ORDER BY i.InvoiceID
go
SELECT *
```