Basi di Dati

Il linguaggio SQL
(prima parte)

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21 Novembre 2025

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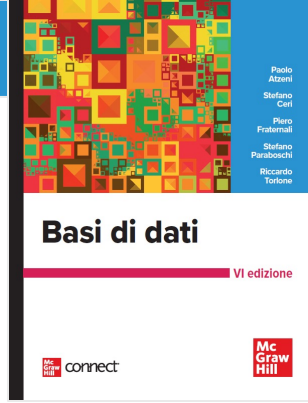

SQL

- originariamente "Structured Query Language", ora "nome proprio"
- linguaggio con varie funzionalità:
  - contiene sia il DDL sia il DML
- ne esistono varie versioni
- vediamo gli aspetti essenziali, non i dettagli

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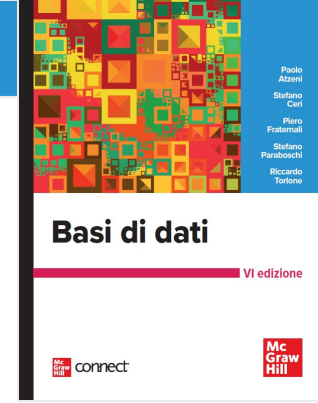

SQL: "storia"

- prima proposta SEQUEL (1974);
- prime implementazioni in SQL/DS e Oracle (1981)
- dal 1983 ca. "standard di fatto"
- standard (1986, poi 1989, 1992, 1999, 2003, 2006, 2008, 2011, 2016 …)
  - recepito solo in parte (!! Vedi http://troels.arvin.dk/db/rdbms/ per un confronto)

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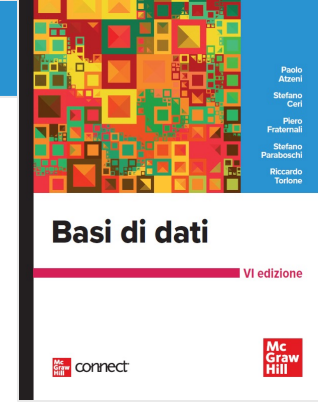

Definizione dei dati in SQL

- Istruzione CREATE TABLE:
  - definisce uno schema di relazione e ne crea un'istanza vuota
  - specifica attributi, domini e vincoli

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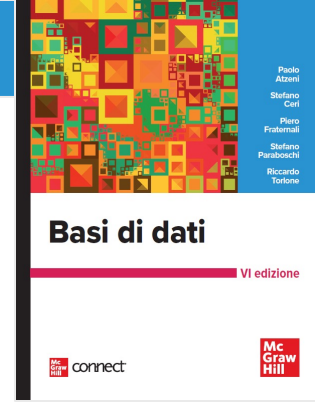

CREATE TABLE, esempio

```
CREATE TABLE Impiegato(
   Matricola CHAR(6) PRIMARY KEY,
   Nome CHAR(20) NOT NULL,
   Cognome CHAR(20) NOT NULL,
   Dipart CHAR(15),
   Stipendio NUMERIC(9) DEFAULT 0,
   FOREIGN KEY(Dipart) REFERENCES
         Dipartimento(NomeDip),
   UNIQUE (Cognome,Nome)
 )
```

- DB2 vuole NOT NULL per la chiave primaria

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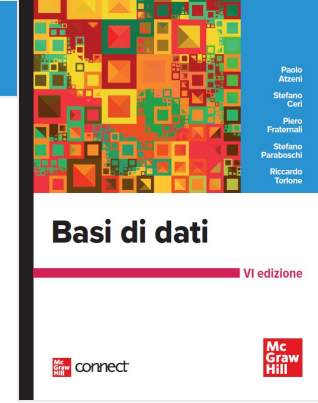

Domini

- Domini elementari (predefiniti)
- Domini definiti dall'utente (semplici, ma riutilizzabili)

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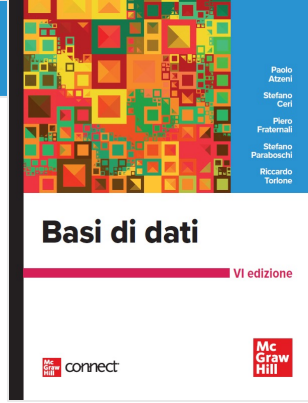

Domini elementari

- Carattere: singoli caratteri o stringhe, anche di lunghezza variabile
- Numerici, esatti e approssimati
- Data, ora, intervalli di tempo
- Introdotti in SQL:1999:
  - Boolean
  - BLOB, CLOB (binary/character large object): per grandi immagini e testi

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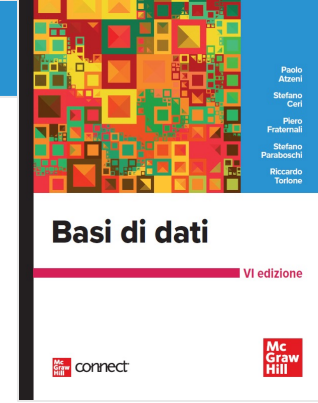

Definizione di domini

- Istruzione CREATE DOMAIN:
  - definisce un dominio (semplice), utilizzabile in definizioni di relazioni, anche con vincoli e valori di default

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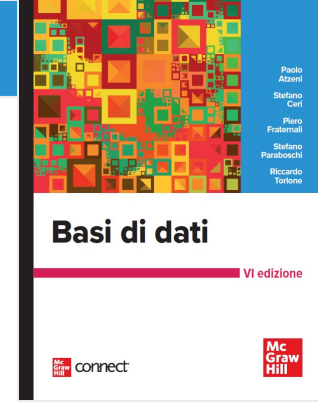

CREATE DOMAIN, esempio

```
CREATE DOMAIN Voto
  AS SMALLINT DEFAULT NULL
  CHECK ( value >=18 AND value <= 30 )
```


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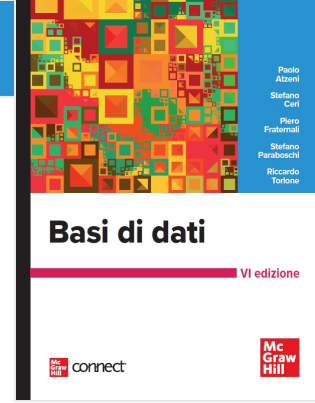

Vincoli intrarelazionali

- NOT NULL
- UNIQUE definisce chiavi candidate
- PRIMARY KEY: chiave primaria (una sola, implica NOT NULL; DB2 non rispetta lo standard)
- CHECK

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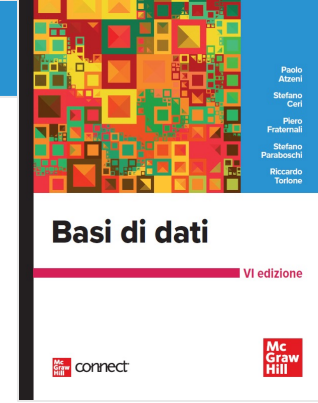

UNIQUE e PRIMARY KEY

- due forme:
  - nella definzione di un attributo, se forma da solo la chiave
  - come elemento separato

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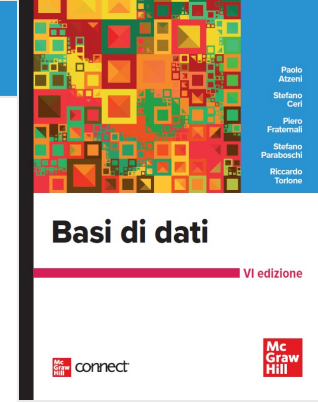

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   Cognome CHAR(20) NOT NULL,
   Dipart CHAR(15),
   Stipendio NUMERIC(9) DEFAULT 0,
   FOREIGN KEY(Dipart) REFERENCES
         Dipartimento(NomeDip),
   UNIQUE (Cognome,Nome)
 )
```


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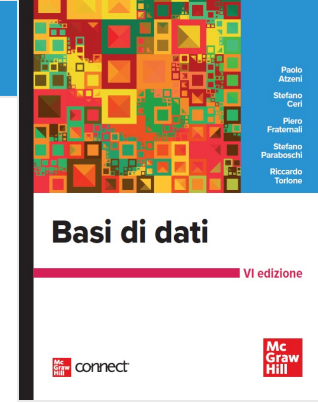

PRIMARY KEY, alternative

```
Matricola CHAR(6) PRIMARY KEY
```

oppure

```
Matricola CHAR(6),
…,
PRIMARY KEY (Matricola)
```


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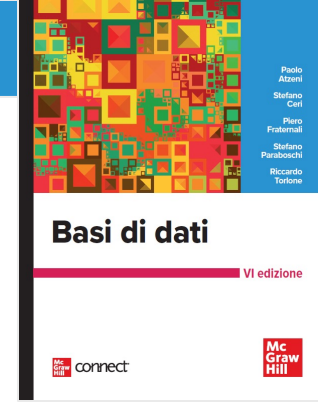

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   Cognome CHAR(20) NOT NULL,
   Dipart CHAR(15),
   Stipendio NUMERIC(9) DEFAULT 0,
   FOREIGN KEY(Dipart) REFERENCES
         Dipartimento(NomeDip),
   UNIQUE (Cognome,Nome)
 )
```


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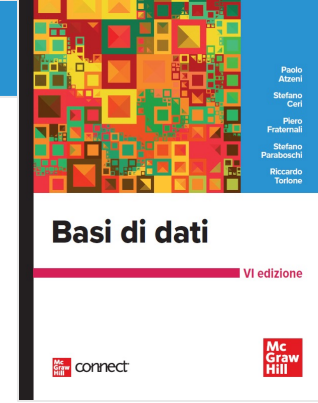

Chiavi su più attributi, attenzione

```
Nome            CHAR(20) NOT NULL,
Cognome         CHAR(20) NOT NULL,
UNIQUE (Cognome,Nome),
```

```
Nome            CHAR(20) NOT NULL UNIQUE,
Cognome         CHAR(20) NOT NULL UNIQUE,
```

- Non è la stessa cosa! Stessa cosa con le PRIMARY KEY

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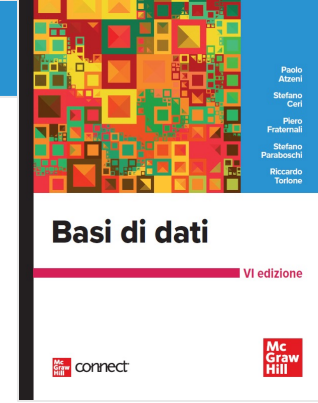

Vincoli interrelazionali

- CHECK, rivedremo più avanti
- REFERENCES e FOREIGN KEY permettono di definire vincoli di integrità referenziale
- di nuovo due sintassi
  - per singoli attributi
  - su più attributi
- E' possibile definire politiche di reazione alla violazione

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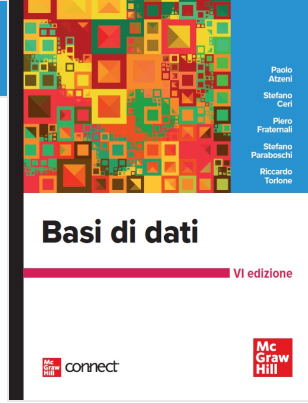

Infrazioni

Codice	Data	Vigile	Prov	Numero
34321	1/2/95	3987	MI	39548K
53524	4/3/95	3295	TO	E39548
64521	5/4/96	3295	PR	839548
73321	5/2/98	9345	PR	839548

Vigili

Matricola	Cognome	Nome
3987	Rossi	Luca
3295	Neri	Piero
9345	Neri	Mario
7543	Mori	Gino

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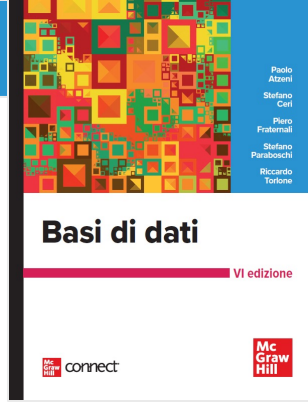

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53524	4/3/95	3295	TO	E39548
64521	5/4/96	3295	PR	839548
73321	5/2/98	9345	PR	839548

Auto

Prov	Numero	Cognome	Nome
MI	39548K	Rossi	Mario
TO	E39548	Rossi	Mario
PR	839548	Neri	Luca

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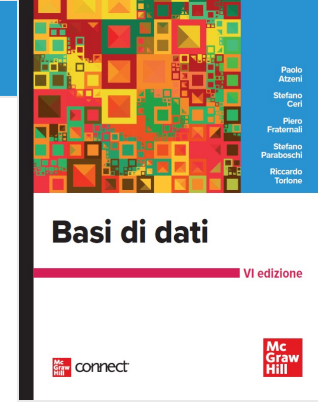

CREATE TABLE, esempio

```
CREATE TABLE Infrazioni(
   Codice CHAR(6) PRIMARY KEY,
   Data DATE NOT NULL,
   Vigile INTEGER NOT NULL
                REFERENCES Vigili(Matricola),
   Provincia CHAR(2),
   Numero CHAR(6) ,
   FOREIGN KEY(Provincia, Numero)
                REFERENCES Auto(Provincia, Numero)
 )
```


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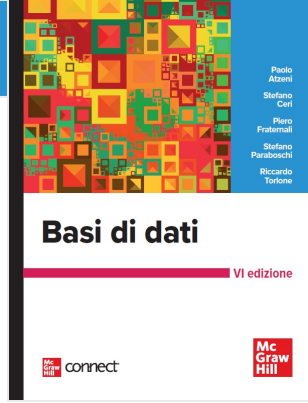

Modifiche degli schemi

ALTER DOMAIN
ALTER TABLE
DROP DOMAIN
DROP TABLE
...

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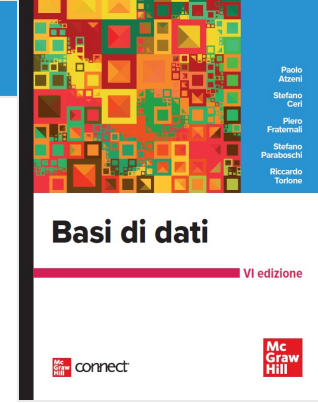

Definizione degli indici

- è rilevante dal punto di vista delle prestazioni
- ma è a livello fisico e non logico
- in passato era importante perché in alcuni sistemi era l'unico mezzo per definire chiavi
- CREATE INDEX

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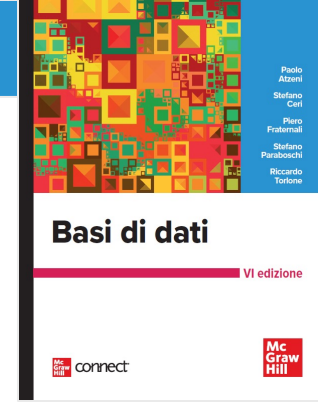

Operazioni di aggiornamento

- operazioni di
  - inserimento: insert
  - eliminazione: delete
  - modifica: update
- di una o più ennuple di una relazione
- sulla base di una condizione che può coinvolgere anche altre relazioni

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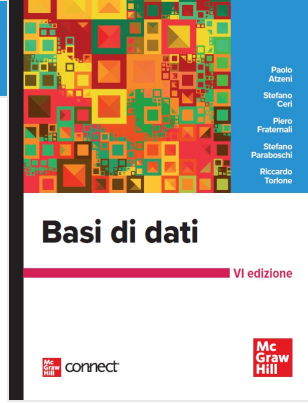

Inserimento

```
INSERT INTO Tabella [ ( Attributi ) ]
       VALUES( Valori )
```

oppure

```
INSERT INTO Tabella [ ( Attributi )]
       SELECT ...
```


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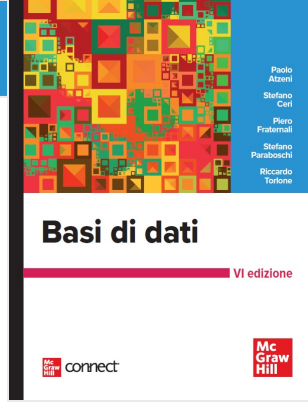


```
INSERT INTO Persone VALUES ('Mario',25,52)

INSERT INTO Persone(Nome, Eta, Reddito)
       VALUES('Pino',25,52)

INSERT INTO Persone(Nome, Reddito)
       VALUES('Lino',55)

INSERT INTO Persone ( Nome )
SELECT Padre
FROM Paternita
WHERE Padre NOT IN (SELECT Nome
                    FROM Persone)
```


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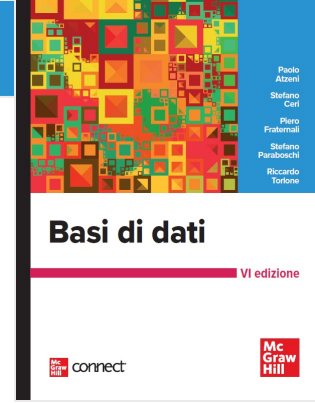

Inserimento, commenti

- l'ordinamento degli attributi (se presente) e dei valori è significativo
- le due liste debbono avere lo stesso numero di elementi
- se la lista di attributi è omessa, si fa riferimento a tutti gli attributi della relazione, secondo l'ordine con cui sono stati definiti
- se la lista di attributi non contiene tutti gli attributi della relazione, per gli altri viene inserito un valore nullo (che deve essere permesso) o un valore di default

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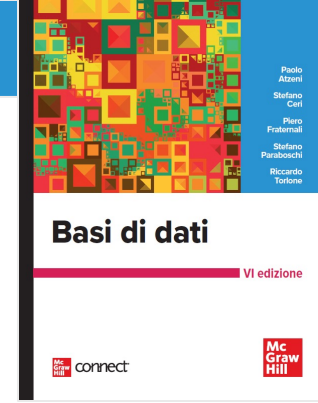

Eliminazione di ennuple

```
DELETE FROM Tabella
  [ WHERE Condizione ]
```


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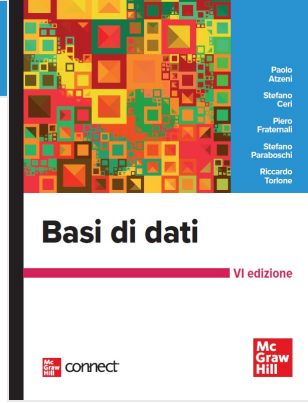


```
DELETE FROM Persone
WHERE Eta < 35
```

```
DELETE FROM Paternita
WHERE Figlio NOT in (       SELECT Nome
                            FROM Persone)
```

```
DELETE FROM Paternita
```


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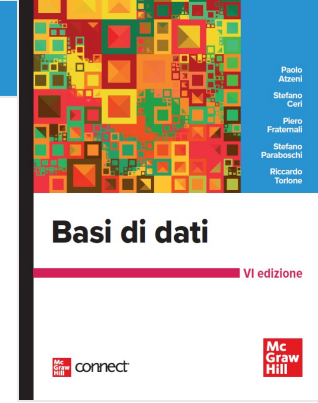

Eliminazione, commenti

- elimina le ennuple che soddisfano la condizione
- può causare (se i vincoli di integrità referenziale sono definiti con politiche di reazione cascade) eliminazioni da altre relazioni
- ricordare: se la where viene omessa, si intende where true

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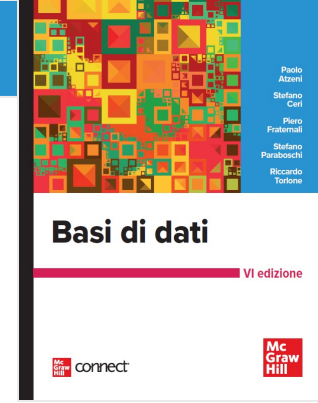

Modifica di ennuple

```
UPDATE NomeTabella
SET  Attributo = < Espressione |
                   SELECT … |
                   NULL |
                   DEFAULT >
     [ WHERE Condizione ]
```


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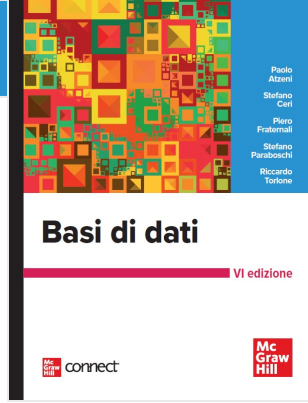


```
UPDATE Persone SET Reddito = 45
  WHERE Nome = 'Piero'

UPDATE Persone
  SET Reddito = Reddito * 1.1
  WHERE Eta < 30
```


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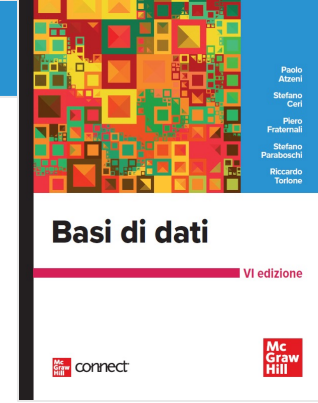

SQL, operazioni sui dati

- interrogazione:
  - SELECT
- modifica:
  - INSERT, DELETE, UPDATE

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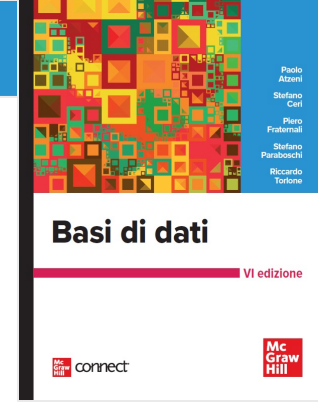

Istruzione SELECT (versione base)

```
SELECT ListaAttributi
FROM ListaTabelle
[ WHERE Condizione ]
```

- clausola SELECT (chiamata *target list*)
- clausola FROM
- clausola WHERE

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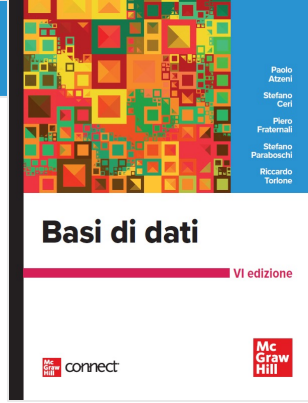

Maternità

Madre	Figlio
Luisa	Maria
Luisa	Luigi
Anna	Olga
Anna	Filippo
Maria	Andrea
Maria	Aldo

Paternità

Padre	Figlio
Sergio	Franco
Luigi	Olga
Luigi	Filippo
Franco	Andrea
Franco	Aldo

Persone

Nome	Età	Reddito
Andrea	27	21
Aldo	25	15
Maria	55	42
Anna	50	35
Filippo	26	30
Luigi	50	40
Franco	60	20
Olga	30	41
Sergio	85	35
Luisa	75	87

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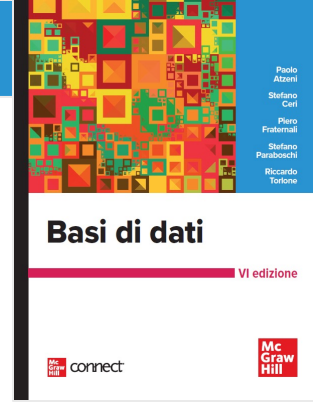

Selezione e proiezione

- Nome e reddito delle persone con meno di trenta anni

$$PROJ_{Nome,\ Reddito}(SEL_{Eta<30}(Persone))$$

```
select Nome, Reddito
from Persone
where Eta < 30
```


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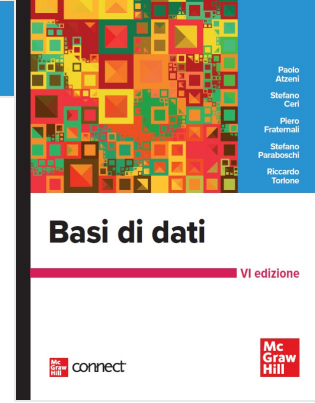

SELECT, abbreviazioni

```
select Nome, Reddito
from Persone
where eta < 30
```

```
select P.Nome as Nome,
                P.Reddito as Reddito
from Persone as P
where P.Eta < 30
```


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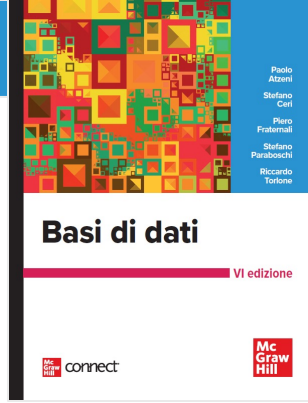

Selezione, senza proiezione

- Nome, età e reddito delle persone con meno di trenta anni

$$SEL_{Eta<30}(Persone)$$

```
select *
from Persone
where Eta < 30
```


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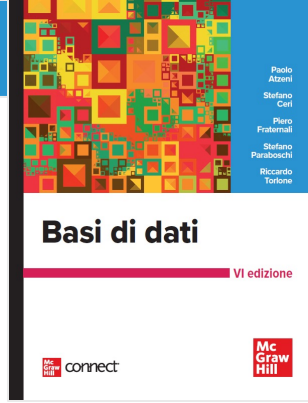

SELECT, abbreviazioni

```
select *
from Persone
where Eta < 30
```

```
select Nome, Eta, Reddito
from Persone
where Eta < 30
```


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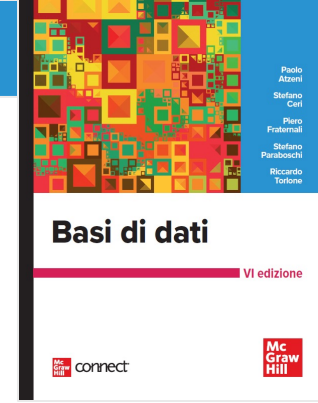

Proiezione, senza selezione

- Nome e reddito di tutte le persone

$$PROJ_{Nome,\ Reddito}(Persone)$$

```
select Nome, Reddito
from Persone
```


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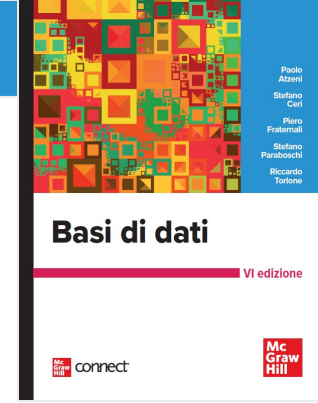

SELECT, abbreviazioni

- R(A,B)

```
select  *
from R
```

equivale (intuitivamente) a

```
select X.A as A, X.B as B
from R X
where true
```


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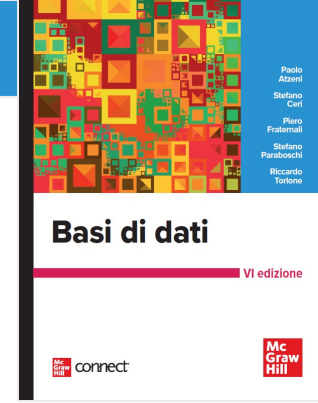

Espressioni nella target list

```
select Reddito/2 as RedditoSemestrale
from Persone
where Nome = 'Luigi'
```


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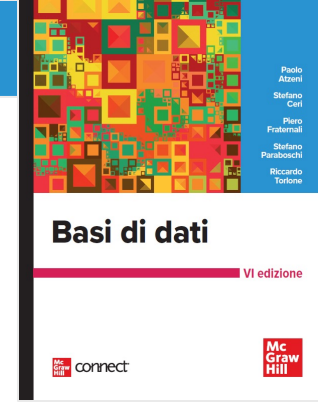

Condizione complessa

```
select *
from Persone
where Reddito > 25
      and (Eta < 30 or Eta > 60)
```


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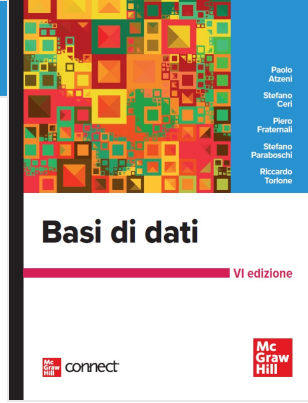

Condizione “LIKE”

- Le persone che hanno un nome che inizia per 'A' e ha una 'd' come terza lettera

```
select *
from Persone
where Nome like 'A_d%'
```


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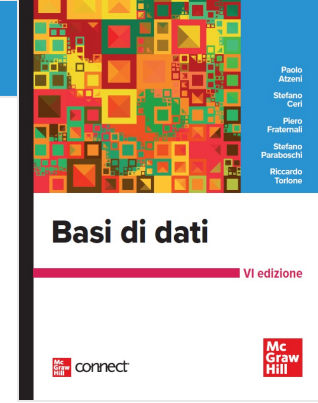

Gestione dei valori nulli

Impiegati

Matricola	Cognome	Filiale	Età
5998	Neri	Milano	45
9553	Bruni	Milano	NULL

- Gli impiegati la cui età è o potrebbe essere maggiore di 40

SEL (Età > 40) OR (Età IS NULL) (Impiegati)

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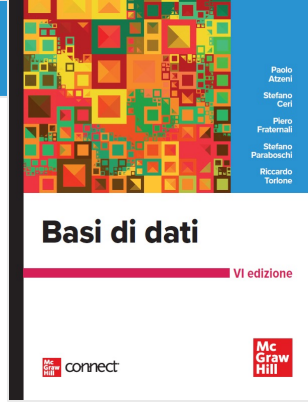

- Gli impiegati la cui età è o potrebbe essere maggiore di 40

SEL Età > 40 OR Età IS NULL (Impiegati)

```
select *
from Impiegati
where Eta > 40 or Eta is null
```


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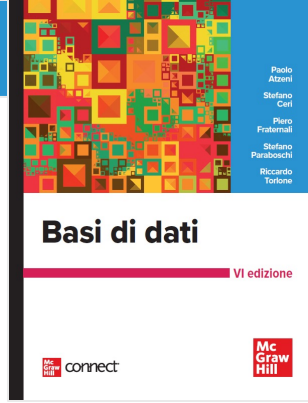

Proiezione, attenzione

- cognome e filiale di tutti gli impiegati

Cognome	Filiale
Neri	Napoli
Neri	Milano
Rossi	Roma

PROJ $_{\text{Cognome, Filiale}}$ (Impiegati)

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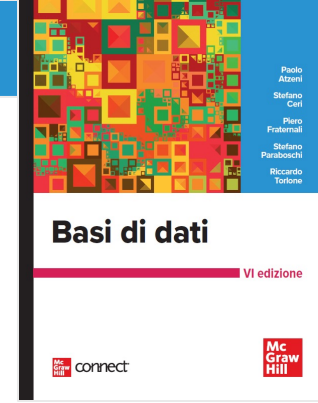


```
select
    Cognome, Filiale
from Impiegati
```

Cognome	Filiale
Neri	Napoli
Neri	Milano
Rossi	Roma
Rossi	Roma

```
select distinct
    Cognome,Filiale
from Impiegati
```

Cognome	Filiale
Neri	Napoli
Neri	Milano
Rossi	Roma

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