

0.12 Candidate Keys

you-said

$x(\text{genreid}, \text{genre}, \text{runtime}, \text{title}, \text{movieid}, \text{isadult}, \text{year})$; $F = \{\{\text{genreid}, \text{title}\} \Rightarrow \{\text{runtime}\}, \{\text{genre}\} \Rightarrow \{\text{genreid}\}, \{\text{movieid}\} \Rightarrow \{\text{isadult}\}, \{\text{movieid}\} \Rightarrow \{\text{title}\}, \{\text{movieid}\} \Rightarrow \{\text{runtime}\}, \{\text{genreid}\} \Rightarrow \{\text{genre}\}, \{\text{runtime}, \text{title}\} \Rightarrow \{\text{year}\}, \{\text{movieid}\} \Rightarrow \{\text{year}\}, \{\text{genre}, \text{title}\} \Rightarrow \{\text{runtime}\}, \{\text{title}\} \Rightarrow \{\text{isadult}\}\}$. apply this algorithm to the above set of functional dependencies: functional_dependencies (FD) of type \rightarrow for ith functional dependency. left = Union of all in FD right = Union of all in FD Initialize case_1, case_2, case_3, case_4 as empty sets. For x in attributes: if x left & x right: case_1.add(x) if x left & x right: case_2.add(x) if x left & x right: case_3.add(x) if x left & x right: case_4.add(x) return attributes in case_1, case_2, case_3, case_4

ChatGPT said:

Let's go through the algorithm step-by-step with the relation $x(\text{genreid}, \text{genre}, \text{runtime}, \text{title}, \text{movieid}, \text{isadult}, \text{year})$ and the given functional dependencies:

step-1-identify-left-and-right-sets

Step 1: Identify Left and Right Sets

Functional Dependencies (FDs):

1. $\{\text{genreid}, \text{title}\} \rightarrow \{\text{runtime}\}$ $\{\text{genreid}, \text{title}\} \rightarrow \{\text{runtime}\}$
2. $\{\text{genre}\} \rightarrow \{\text{genreid}\}$ $\{\text{genre}\} \rightarrow \{\text{genreid}\}$
3. $\{\text{movieid}\} \rightarrow \{\text{isadult}\}$ $\{\text{movieid}\} \rightarrow \{\text{isadult}\}$
4. $\{\text{movieid}\} \rightarrow \{\text{title}\}$ $\{\text{movieid}\} \rightarrow \{\text{title}\}$
5. $\{\text{movieid}\} \rightarrow \{\text{runtime}\}$ $\{\text{movieid}\} \rightarrow \{\text{runtime}\}$
6. $\{\text{genreid}\} \rightarrow \{\text{genre}\}$ $\{\text{genreid}\} \rightarrow \{\text{genre}\}$
7. $\{\text{runtime}, \text{title}\} \rightarrow \{\text{year}\}$ $\{\text{runtime}, \text{title}\} \rightarrow \{\text{year}\}$
8. $\{\text{movieid}\} \rightarrow \{\text{year}\}$ $\{\text{movieid}\} \rightarrow \{\text{year}\}$
9. $\{\text{genre}, \text{title}\} \rightarrow \{\text{runtime}\}$ $\{\text{genre}, \text{title}\} \rightarrow \{\text{runtime}\}$
10. $\{\text{title}\} \rightarrow \{\text{isadult}\}$ $\{\text{title}\} \rightarrow \{\text{isadult}\}$

Now, find the union of all left-hand sides (α) and right-hand sides (β):

- **Left (Union of α):**

genreid, title, genre, movieid, runtimegenreid,title,genre,movieid,runtime

- **Right (Union of β):**

runtime, genreid, isadult, title, year, genreruntime,genreid,isadult,title,year,genre

step-2-classify-the-attributes

Step 2: Classify the Attributes

Now we classify the attributes based on their membership in the "Left" and "Right" sets:

attributes-in-x-textgenreidtextgenretextruntimetexttitletextmovieidtextisadulttextyearxgenreidgenreruntin

1. **genreid**

In Left: Yes

In Right: Yes

Case 4

2. **genre**

In Left: Yes

In Right: Yes

Case 4

3. **runtime**

In Left: Yes

In Right: Yes

Case 4

4. **title**

In Left: Yes

In Right: Yes

Case 4

5. **movieid**

In Left: Yes

In Right: Yes

Case 4

6. **isadult**

In Left: No

In Right: Yes

Case 2

7. **year**

In Left: No

In Right: Yes

Case 2

step-3-final-output

Step 3: Final Output• **Case 1 (not in Left, not in Right):**

None

• **Case 2 (not in Left, but in Right):**

{isadult, year}{isadult, year}

• **Case 3 (in Left, but not in Right):**

None

• **Case 4 (in Left and in Right):**

{genreid, genre, runtime, title, movieid}{genreid, genre, runtime, title, movieid}

result

Result:

• Case 1: None

• Case 2: {isadult, year}{isadult, year}

• Case 3: None

• Case 4: {genreid, genre, runtime, title, movieid}{genreid, genre, runtime, title, movieid}

you-said-1

movieid is not in right

ChatGPT said:

You're right! I mistakenly included **movieid** in the right set, but it doesn't actually appear on the right-hand side of any functional dependency. Let's correct the solution accordingly.

step-1-identify-left-and-right-sets-1

Step 1: Identify Left and Right Sets

Functional Dependencies (FDs):

1. $\{\text{genreid}, \text{title}\} \rightarrow \{\text{runtime}\} \quad \{\text{genreid}, \text{title}\} \rightarrow \{\text{runtime}\}$
2. $\{\text{genre}\} \rightarrow \{\text{genreid}\} \quad \{\text{genre}\} \rightarrow \{\text{genreid}\}$
3. $\{\text{movieid}\} \rightarrow \{\text{isadult}\} \quad \{\text{movieid}\} \rightarrow \{\text{isadult}\}$
4. $\{\text{movieid}\} \rightarrow \{\text{title}\} \quad \{\text{movieid}\} \rightarrow \{\text{title}\}$
5. $\{\text{movieid}\} \rightarrow \{\text{runtime}\} \quad \{\text{movieid}\} \rightarrow \{\text{runtime}\}$
6. $\{\text{genreid}\} \rightarrow \{\text{genre}\} \quad \{\text{genreid}\} \rightarrow \{\text{genre}\}$
7. $\{\text{runtime}, \text{title}\} \rightarrow \{\text{year}\} \quad \{\text{runtime}, \text{title}\} \rightarrow \{\text{year}\}$
8. $\{\text{movieid}\} \rightarrow \{\text{year}\} \quad \{\text{movieid}\} \rightarrow \{\text{year}\}$
9. $\{\text{genre}, \text{title}\} \rightarrow \{\text{runtime}\} \quad \{\text{genre}, \text{title}\} \rightarrow \{\text{runtime}\}$
10. $\{\text{title}\} \rightarrow \{\text{isadult}\} \quad \{\text{title}\} \rightarrow \{\text{isadult}\}$

- **Left (Union of α):**

genreid, title, genre, movieid, runtime, genreid, title, genre, movieid, runtime

- **Right (Union of β):**

runtime, genreid, isadult, title, year, genre, runtime, genreid, isadult, title, year, genre

step-2-classify-the-attributes-1

Step 2: Classify the Attributes

Now we classify the attributes based on their membership in the "Left" and "Right" sets:

attributes-in-x-textgenreidtextgenreidtextruntimetexttitletextmovieidtextisadulttextyearxgenreidgenreid

1

1. **genreid**

In Left: Yes

In Right: Yes

Case 4

2. **genre**
In Left: Yes
In Right: Yes
Case 4
3. **runtime**
In Left: Yes
In Right: Yes
Case 4
4. **title**
In Left: Yes
In Right: Yes
Case 4
5. **movieid**
In Left: Yes
In Right: No
Case 3
6. **isadult**
In Left: No
In Right: Yes
Case 2
7. **year**
In Left: No
In Right: Yes
Case 2

step-3-final-output-1

Step 3: Final Output

- **Case 1 (not in Left, not in Right):**
None
- **Case 2 (not in Left, but in Right):**
{isadult, year}{isadult, year}
- **Case 3 (in Left, but not in Right):**
{movieid}{movieid}

- **Case 4 (in Left and in Right):**

$\{\text{genreid}, \text{genre}, \text{runtime}, \text{title}\} \{\text{genreid}, \text{genre}, \text{runtime}, \text{title}\}$

corrected-result

Corrected Result:

- **Case 1:** None

- **Case 2:** $\{\text{isadult}, \text{year}\} \{\text{isadult}, \text{year}\}$

- **Case 3:** $\{\text{movieid}\} \{\text{movieid}\}$

- **Case 4:** $\{\text{genreid}, \text{genre}, \text{runtime}, \text{title}\} \{\text{genreid}, \text{genre}, \text{runtime}, \text{title}\}$

you-said-2

use this formula for closure: Closure of beta under F (beta+) result := beta Do For each gama \rightarrow delta in F: If (gema result): result := result Union delta While (result does not change) Return result give closure of case 3

ChatGPT said:

Let's apply the closure algorithm for **Case 3**, where the attribute is $\{\text{movieid}\} \{\text{movieid}\}$.
given-functional-dependencies-fds

Given Functional Dependencies (FDs):

1. $\{\text{genreid}, \text{title}\} \rightarrow \{\text{runtime}\} \{\text{genreid}, \text{title}\} \rightarrow \{\text{runtime}\}$
2. $\{\text{genre}\} \rightarrow \{\text{genreid}\} \{\text{genre}\} \rightarrow \{\text{genreid}\}$
3. $\{\text{movieid}\} \rightarrow \{\text{isadult}\} \{\text{movieid}\} \rightarrow \{\text{isadult}\}$
4. $\{\text{movieid}\} \rightarrow \{\text{title}\} \{\text{movieid}\} \rightarrow \{\text{title}\}$
5. $\{\text{movieid}\} \rightarrow \{\text{runtime}\} \{\text{movieid}\} \rightarrow \{\text{runtime}\}$
6. $\{\text{genreid}\} \rightarrow \{\text{genre}\} \{\text{genreid}\} \rightarrow \{\text{genre}\}$
7. $\{\text{runtime}, \text{title}\} \rightarrow \{\text{year}\} \{\text{runtime}, \text{title}\} \rightarrow \{\text{year}\}$
8. $\{\text{movieid}\} \rightarrow \{\text{year}\} \{\text{movieid}\} \rightarrow \{\text{year}\}$
9. $\{\text{genre}, \text{title}\} \rightarrow \{\text{runtime}\} \{\text{genre}, \text{title}\} \rightarrow \{\text{runtime}\}$
10. $\{\text{title}\} \rightarrow \{\text{isadult}\} \{\text{title}\} \rightarrow \{\text{isadult}\}$

step-by-step-process-to-find-the-closure-of-textmovieidmovieid-denoted-betaux3b2

Step-by-Step Process to Find the Closure of $\{movieid\}$ (denoted β^{++}): Step-by-Step Process to Find the Closure of $\{\{movieid\}\}$ (denoted $\beta^{\{++\}}$):

1. **Initialize:**

$$result := \{movieid\}$$

$$result := \{movieid\}$$

2. **Iterate through FDs:**

FD 3:

$$\{movieid\} \rightarrow \{isadult\} \quad \{movieid\} \rightarrow \{isadult\}$$

Since $\{movieid\} \subseteq result$, update result:

$$result := \{movieid, isadult\}$$

$$result := \{movieid, isadult\}$$

FD 4:

$$\{movieid\} \rightarrow \{title\} \quad \{movieid\} \rightarrow \{title\}$$

Since $\{movieid\} \subseteq result$, update result:

$$result := \{movieid, isadult, title\}$$

$$result := \{movieid, isadult, title\}$$

FD 5:

$$\{movieid\} \rightarrow \{runtime\} \quad \{movieid\} \rightarrow \{runtime\}$$

Since $\{movieid\} \subseteq result$, update result:

$$result := \{movieid, isadult, title, runtime\}$$

$$result := \{movieid, isadult, title, runtime\}$$

FD 8:

$$\{movieid\} \rightarrow \{year\} \quad \{movieid\} \rightarrow \{year\}$$

Since $\{movieid\} \subseteq result$, update result:

$$result := \{movieid, isadult, title, runtime, year\}$$

$$result := \{movieid, isadult, title, runtime, year\}$$

3. **No More Changes:** At this point, applying other FDs does not add any new attributes to the result. So, the closure process terminates.

final-closure-of-textmovieidmovieid

Final Closure of $\{\text{movieid}\}$:

$$\{\text{movieid}\}^+ = \{\text{movieid}, \text{isadult}, \text{title}, \text{runtime}, \text{year}\}$$

$$\{\text{movieid}\}^+ = \{\text{movieid}, \text{isadult}, \text{title}, \text{runtime}, \text{year}\}$$

This is the full closure of **movieid** under the given set of functional dependencies.

you-said-3

use this formula for closure: Closure of beta under F (beta+) result := beta Do For each $\text{gema} \rightarrow \text{delta}$ in F: If ($\text{gema} \rightarrow \text{result}$): result := result Union delta While (result does not change) Return result give closures of $\{\text{movieid}, \text{genreid}\}$, $\{\text{movieid}, \text{genre}\}$, $\{\text{movieid}, \text{runtime}\}$, $\{\text{movieid}, \text{title}\}$

ChatGPT said:

Let's apply the closure formula to the sets $\{\text{movieid}, \text{genreid}\}$, $\{\text{movieid}, \text{genre}\}$, $\{\text{movieid}, \text{runtime}\}$, and $\{\text{movieid}, \text{title}\}$.

given-functional-dependencies-fds-1

Given Functional Dependencies (FDs):

1. $\{\text{genreid}, \text{title}\} \rightarrow \{\text{runtime}\}$
2. $\{\text{genre}\} \rightarrow \{\text{genreid}\}$
3. $\{\text{movieid}\} \rightarrow \{\text{isadult}\}$
4. $\{\text{movieid}\} \rightarrow \{\text{title}\}$
5. $\{\text{movieid}\} \rightarrow \{\text{runtime}\}$
6. $\{\text{genreid}\} \rightarrow \{\text{genre}\}$
7. $\{\text{runtime}, \text{title}\} \rightarrow \{\text{year}\}$
8. $\{\text{movieid}\} \rightarrow \{\text{year}\}$
9. $\{\text{genre}, \text{title}\} \rightarrow \{\text{runtime}\}$
10. $\{\text{title}\} \rightarrow \{\text{isadult}\}$

closure-of-textmovieidtextgenreidmovieidgenreid

1. Closure of $\{\text{movieid}, \text{genreid}\}$: 1. Closure of $\{\text{movieid}, \text{genreid}\}$:
step-by-step-process

1. **Initialize:**

$$\text{result} := \{\text{movieid}, \text{genreid}\}$$

$$\text{result} := \{\text{movieid}, \text{genreid}\}$$

2. **Iterate through FDs:**

FD 6:

$$\{\text{genreid}\} \rightarrow \{\text{genre}\} \quad \{\text{genreid}\} \rightarrow \{\text{genre}\}$$

Since $\{\text{genreid}\} \subseteq \text{result}$, update result:

$$\text{result} := \{\text{movieid}, \text{genreid}, \text{genre}\}$$

$$\text{result} := \{\text{movieid}, \text{genreid}, \text{genre}\}$$

FD 3:

$$\{\text{movieid}\} \rightarrow \{\text{isadult}\} \quad \{\text{movieid}\} \rightarrow \{\text{isadult}\}$$

Since $\{\text{movieid}\} \subseteq \text{result}$, update result:

$$\text{result} := \{\text{movieid}, \text{genreid}, \text{genre}, \text{isadult}\}$$

$$\text{result} := \{\text{movieid}, \text{genreid}, \text{genre}, \text{isadult}\}$$

FD 4:

$$\{\text{movieid}\} \rightarrow \{\text{title}\} \quad \{\text{movieid}\} \rightarrow \{\text{title}\}$$

Since $\{\text{movieid}\} \subseteq \text{result}$, update result:

$$\text{result} := \{\text{movieid}, \text{genreid}, \text{genre}, \text{isadult}, \text{title}\}$$

$$\text{result} := \{\text{movieid}, \text{genreid}, \text{genre}, \text{isadult}, \text{title}\}$$

FD 5:

$$\{\text{movieid}\} \rightarrow \{\text{runtime}\} \quad \{\text{movieid}\} \rightarrow \{\text{runtime}\}$$

Since $\{\text{movieid}\} \subseteq \text{result}$, update result:

$$\text{result} := \{\text{movieid}, \text{genreid}, \text{genre}, \text{isadult}, \text{title}, \text{runtime}\}$$

result:= {movieid,genreid,genre,isadult,title,runtime}

FD 8:

$\{movieid\} \rightarrow \{year\}$ $\{movieid\} \rightarrow \{year\}$

Since $\{movieid\} \subseteq result$, update result:

result := {movieid, genreid, genre, isadult, title, runtime, year}

result:= {movieid,genreid,genre,isadult,title,runtime,year}

3. **No More Changes:** At this point, applying other FDs does not add new attributes to the result.

final-closure-of-textmovieidtextgenreidmovieidgenreid

Final Closure of {movieid, genreid} **Final Closure of {movieid, genreid}**

$\{movieid, genreid\}^+ = \{movieid, genreid, genre, isadult, title, runtime, year\}$

$\{movieid, genreid\}^+ = \{movieid, genreid, genre, isadult, title, runtime, year\}$

closure-of-textmovieidtextgenreidmovieidgenre

2. **Closure of {movieid, genre}** **Closure of {movieid, genre}**
step-by-step-process-1

1. **Initialize:**

result := {movieid, genre}

result:= {movieid,genre}

2. **Iterate through FDs:**

FD 2:

$\{genre\} \rightarrow \{genreid\}$ $\{genre\} \rightarrow \{genreid\}$

Since $\{genre\} \subseteq result$, update result:

result := {movieid, genre, genreid}

result:= {movieid,genre,genreid}

FD 6:

$\{\text{genreid}\} \rightarrow \{\text{genre}\} \quad \{\text{genreid}\} \rightarrow \{\text{genre}\}$

(Already covered, no new updates)

FD 3:

$\{\text{movieid}\} \rightarrow \{\text{isadult}\} \quad \{\text{movieid}\} \rightarrow \{\text{isadult}\}$

Since $\{\text{movieid}\} \subseteq \text{result}\{\text{movieid}\}$ result, update result:

result := {movieid, genre, genreid, isadult}

result:= {movieid,genre,genreid,isadult}

FD 4:

$\{\text{movieid}\} \rightarrow \{\text{title}\} \quad \{\text{movieid}\} \rightarrow \{\text{title}\}$

Since $\{\text{movieid}\} \subseteq \text{result}\{\text{movieid}\}$ result, update result:

result := {movieid, genre, genreid, isadult, title}

result:= {movieid,genre,genreid,isadult,title}

FD 5:

$\{\text{movieid}\} \rightarrow \{\text{runtime}\} \quad \{\text{movieid}\} \rightarrow \{\text{runtime}\}$

Since $\{\text{movieid}\} \subseteq \text{result}\{\text{movieid}\}$ result, update result:

result := {movieid, genre, genreid, isadult, title, runtime}

result:= {movieid,genre,genreid,isadult,title,runtime}

FD 8:

$\{\text{movieid}\} \rightarrow \{\text{year}\} \quad \{\text{movieid}\} \rightarrow \{\text{year}\}$

Since $\{\text{movieid}\} \subseteq \text{result}\{\text{movieid}\}$ result, update result:

result := {movieid, genre, genreid, isadult, title, runtime, year}

result:= {movieid,genre,genreid,isadult,title,runtime,year}

3. **No More Changes:** At this point, applying other FDs does not add new attributes to the result.

final-closure-of-textmovieidtextgenremovieidgenre

Final Closure of $\{\text{movieid}, \text{genre}\}$:Final Closure of $\{\text{movieid}, \text{genre}\}$

$$\begin{aligned} \{\text{movieid}, \text{genre}\}^+ &= \{\text{movieid}, \text{genre}, \text{genreid}, \text{isadult}, \text{title}, \text{runtime}, \text{year}\} \\ \{\text{movieid}, \text{genre}\}^+ &= \{\text{movieid}, \text{genre}, \text{genreid}, \text{isadult}, \text{title}, \text{runtime}, \text{year}\} \end{aligned}$$

closure-of-textmovieidtextruntime

3. Closure of $\{\text{movieid}, \text{runtime}\}$:3. Closure of $\{\text{movieid}, \text{runtime}\}$

step-by-step-process-2

1. **Initialize:**

$$\begin{aligned} \text{result} &:= \{\text{movieid}, \text{runtime}\} \\ \text{result} &:= \{\text{movieid}, \text{runtime}\} \end{aligned}$$

2. **Iterate through FDs:**

FD 3:

$$\begin{aligned} \{\text{movieid}\} &\rightarrow \{\text{isadult}\} \{\text{movieid}\} \rightarrow \{\text{isadult}\} \\ \text{Since } \{\text{movieid}\} &\subseteq \text{result}\{\text{movieid}\} \text{result, update result:} \end{aligned}$$

$$\begin{aligned} \text{result} &:= \{\text{movieid}, \text{runtime}, \text{isadult}\} \\ \text{result} &:= \{\text{movieid}, \text{runtime}, \text{isadult}\} \end{aligned}$$

FD 4:

$$\begin{aligned} \{\text{movieid}\} &\rightarrow \{\text{title}\} \{\text{movieid}\} \rightarrow \{\text{title}\} \\ \text{Since } \{\text{movieid}\} &\subseteq \text{result}\{\text{movieid}\} \text{result, update result:} \end{aligned}$$

$$\begin{aligned} \text{result} &:= \{\text{movieid}, \text{runtime}, \text{isadult}, \text{title}\} \\ \text{result} &:= \{\text{movieid}, \text{runtime}, \text{isadult}, \text{title}\} \end{aligned}$$

FD 8:

$$\begin{aligned} \{\text{movieid}\} &\rightarrow \{\text{year}\} \{\text{movieid}\} \rightarrow \{\text{year}\} \\ \text{Since } \{\text{movieid}\} &\subseteq \text{result}\{\text{movieid}\} \text{result, update result:} \end{aligned}$$

$$\begin{aligned} \text{result} &:= \{\text{movieid}, \text{runtime}, \text{isadult}, \text{title}, \text{year}\} \\ \text{result} &:= \{\text{movieid}, \text{runtime}, \text{isadult}, \text{title}, \text{year}\} \end{aligned}$$

3. **No More Changes:** At this point, applying other FDs does not add new attributes to the result.

final-closure-of-textmovieidtextruntimemovieidruntime

Final Closure of $\{\text{movieid}, \text{runtime}\}$: Final Closure of $\{\text{movieid}, \text{runtime}\}$

$$\{\text{movieid}, \text{runtime}\}^+ = \{\text{movieid}, \text{runtime}, \text{isadult}, \text{title}, \text{year}\}$$

$$\{\text{movieid}, \text{runtime}\}^+ = \{\text{movieid}, \text{runtime}, \text{isadult}, \text{title}, \text{year}\}$$

closure-of-textmovieidtexttitlemovieidtitle

4. **Closure of $\{\text{movieid}, \text{title}\}$:** 4. Closure of $\{\text{movieid}, \text{title}\}$

step-by-step-process-3

1. **Initialize:**

$$\text{result} := \{\text{movieid}, \text{title}\}$$

$$\text{result} := \{\text{movieid}, \text{title}\}$$

2. **Iterate through FDs:**

FD 3:

$$\{\text{movieid}\} \rightarrow \{\text{isadult}\} \quad \{\text{movieid}\} \rightarrow \{\text{isadult}\}$$

Since $\{\text{movieid}\} \subseteq \text{result}$, update result:

$$\text{result} := \{\text{movieid}, \text{title}, \text{isadult}\}$$

$$\text{result} := \{\text{movieid}, \text{title}, \text{isadult}\}$$

FD 5:

$$\{\text{movieid}\} \rightarrow \{\text{runtime}\} \quad \{\text{movieid}\} \rightarrow \{\text{runtime}\}$$

Since $\{\text{movieid}\} \subseteq \text{result}$, update result:

$$\text{result} := \{\text{movieid}, \text{title}, \text{isadult}, \text{runtime}\}$$

$$\text{result} := \{\text{movieid}, \text{title}, \text{isadult}, \text{runtime}\}$$

FD 8:

$\{\text{movieid}\} \rightarrow \{\text{year}\}$ $\{\text{movieid}\} \rightarrow \{\text{year}\}$

Since $\{\text{movieid}\} \subseteq \text{result}$, update result:

$\text{result} := \{\text{movieid}, \text{title}, \text{isadult}, \text{runtime}, \text{year}\}$

$\text{result} := \{\text{movieid}, \text{title}, \text{isadult}, \text{runtime}, \text{year}\}$

3. **No More Changes:** At this point, applying other FDs does not add new attributes to the result.

final-closure-of-textmovieidtexttitlemovieidtitle

Final Closure of $\{\text{movieid}, \text{title}\}$: Final Closure of $\{\text{movieid}, \text{title}\}$

$\{\text{movieid}, \text{title}\}^+ = \{\text{movieid}, \text{title}, \text{isadult}, \text{runtime}, \text{year}\}$

$\{\text{movieid}, \text{title}\}^+ = \{\text{movieid}, \text{title}, \text{isadult}, \text{runtime}, \text{year}\}$

summary-of-closures

Summary of Closures:

1. $\{\text{movieid}, \text{genreid}\}^+ = \{\text{movieid}, \text{genreid}, \text{genre}, \text{isadult}, \text{title}, \text{runtime}, \text{year}\}$ $\{\text{movieid}, \text{genreid}\}^+ = \{\text{movieid}, \text{genreid}, \text{genre}, \text{isadult}, \text{title}, \text{runtime}, \text{year}\}$
2. $\{\text{movieid}, \text{genre}\}^+ = \{\text{movieid}, \text{genre}, \text{genreid}, \text{isadult}, \text{title}, \text{runtime}, \text{year}\}$ $\{\text{movieid}, \text{genre}\}^+ = \{\text{movieid}, \text{genre}, \text{genreid}, \text{isadult}, \text{title}, \text{runtime}, \text{year}\}$
3. $\{\text{movieid}, \text{runtime}\}^+ = \{\text{movieid}, \text{runtime}, \text{isadult}, \text{title}, \text{year}\}$ $\{\text{movieid}, \text{runtime}\}^+ = \{\text{movieid}, \text{runtime}, \text{isadult}, \text{title}, \text{year}\}$
4. $\{\text{movieid}, \text{title}\}^+ = \{\text{movieid}, \text{title}, \text{isadult}, \text{runtime}, \text{year}\}$ $\{\text{movieid}, \text{title}\}^+ = \{\text{movieid}, \text{title}, \text{isadult}, \text{runtime}, \text{year}\}$

you-said-4

use this algorithm completely for closure: Closure of beta under F (beta+) result := beta Do For each gema \rightarrow delta in F: If (gema result): result := result Union delta While (result does not change) Return result give closure of $\{\text{movieid}, \text{runtime}, \text{title}\}$

ChatGPT said:

Let's apply the closure algorithm step by step for the set $\{\text{movieid}, \text{runtime}, \text{title}\}$ under the given set of functional dependencies (FDs).

given-functional-dependencies-fds-2

Given Functional Dependencies (FDs):

1. $\{\text{genreid}, \text{title}\} \rightarrow \{\text{runtime}\}$ $\{\text{genreid}, \text{title}\} \rightarrow \{\text{runtime}\}$
2. $\{\text{genre}\} \rightarrow \{\text{genreid}\}$ $\{\text{genre}\} \rightarrow \{\text{genreid}\}$
3. $\{\text{movieid}\} \rightarrow \{\text{isadult}\}$ $\{\text{movieid}\} \rightarrow \{\text{isadult}\}$
4. $\{\text{movieid}\} \rightarrow \{\text{title}\}$ $\{\text{movieid}\} \rightarrow \{\text{title}\}$
5. $\{\text{movieid}\} \rightarrow \{\text{runtime}\}$ $\{\text{movieid}\} \rightarrow \{\text{runtime}\}$
6. $\{\text{genreid}\} \rightarrow \{\text{genre}\}$ $\{\text{genreid}\} \rightarrow \{\text{genre}\}$
7. $\{\text{runtime}, \text{title}\} \rightarrow \{\text{year}\}$ $\{\text{runtime}, \text{title}\} \rightarrow \{\text{year}\}$
8. $\{\text{movieid}\} \rightarrow \{\text{year}\}$ $\{\text{movieid}\} \rightarrow \{\text{year}\}$
9. $\{\text{genre}, \text{title}\} \rightarrow \{\text{runtime}\}$ $\{\text{genre}, \text{title}\} \rightarrow \{\text{runtime}\}$
10. $\{\text{title}\} \rightarrow \{\text{isadult}\}$ $\{\text{title}\} \rightarrow \{\text{isadult}\}$

step-by-step-process-4

Step-by-Step Process:

step-1-initialize

$\text{result} := \{\text{movieid}, \text{runtime}, \text{title}\}$

$\text{result} := \{\text{movieid}, \text{runtime}, \text{title}\}$

step-2-apply-functional-dependencies-iteratively

1. **FD 3:** $\{\text{movieid}\} \rightarrow \{\text{isadult}\}$ $\{\text{movieid}\} \rightarrow \{\text{isadult}\}$
 $\{\text{movieid}\} \subseteq \text{result}$ $\{\text{movieid}\} \rightarrow \text{result}$, so:

$\text{result} := \{\text{movieid}, \text{runtime}, \text{title}, \text{isadult}\}$

$\text{result} := \{\text{movieid}, \text{runtime}, \text{title}, \text{isadult}\}$

2. **FD 4:** $\{\text{movieid}\} \rightarrow \{\text{title}\}$ $\{\text{movieid}\} \rightarrow \{\text{title}\}$
 (Already in result, no change)

3. **FD 5:** $\{\text{movieid}\} \rightarrow \{\text{runtime}\}$ $\{\text{movieid}\} \rightarrow \{\text{runtime}\}$
 (Already in resultresult, no change)
4. **FD 7:** $\{\text{runtime}, \text{title}\} \rightarrow \{\text{year}\}$ $\{\text{runtime}, \text{title}\} \rightarrow \{\text{year}\}$
 $\{\text{runtime}, \text{title}\} \subseteq \text{result}\{\text{runtime}, \text{title}\}\text{result}$, so:

$$\text{result} := \{\text{movieid}, \text{runtime}, \text{title}, \text{isadult}, \text{year}\}$$

$$\text{result} := \{\text{movieid}, \text{runtime}, \text{title}, \text{isadult}, \text{year}\}$$

5. **FD 8:** $\{\text{movieid}\} \rightarrow \{\text{year}\}$ $\{\text{movieid}\} \rightarrow \{\text{year}\}$
 (Already in resultresult, no change)
6. **FD 10:** $\{\text{title}\} \rightarrow \{\text{isadult}\}$ $\{\text{title}\} \rightarrow \{\text{isadult}\}$
 (Already in resultresult, no change)

step-3-no-more-changes

At this point, no other functional dependency adds new attributes to the result.
 final-closure-of-textmovieidtextruntimegettexttitlemovieidruntime

Final Closure of $\{\text{movieid}, \text{runtime}, \text{title}\}$: Final Closure of $\{\text{movieid}, \text{runtime}, \text{title}\}$:

$$\{\text{movieid}, \text{runtime}, \text{title}\}^+ = \{\text{movieid}, \text{runtime}, \text{title}, \text{isadult}, \text{year}\}$$

$$\{\text{movieid}, \text{runtime}, \text{title}\}^+ = \{\text{movieid}, \text{runtime}, \text{title}, \text{isadult}, \text{year}\}$$

This is the closure of the set $\{\text{movieid}, \text{runtime}, \text{title}\}$.

you-said-5

So the candidate keys are the ones whose closure contained all the attributes. Here the candidate keys are $\{\text{genre}, \text{movieid}\}$, $\{\text{genreid}, \text{movieid}\}$

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ChatGPT said:

Yes, you're correct! The candidate keys are those attribute sets whose closure contains all the attributes of the relation. In this case, the closure of both $\{\text{genre}, \text{movieid}\}$ and $\{\text{genreid}, \text{movieid}\}$ includes all the attributes of the relation:

attributes-in-the-relation

Attributes in the relation:

$$\{\text{genreid, genre, runtime, title, movieid, isadult, year}\}$$

$$\{\text{genreid, genre, runtime, title, movieid, isadult, year}\}$$

lets-check-the-closures

Let's check the closures:**1. Closure of {genre, movieid}{genre, movieid}:**

- Using the closure algorithm, the closure of {genre, movieid}{genre, movieid} results in all the attributes:

$$\{\text{genre, movieid}\}^+ = \{\text{genre, movieid, genreid, isadult, title, runtime, year}\}$$

$$\{\text{genre, movieid}\}^+ = \{\text{genre, movieid, genreid, isadult, title, runtime, year}\}$$
2. Closure of {genreid, movieid}{genreid, movieid}:

- Similarly, the closure of {genreid, movieid}{genreid, movieid} also results in all the attributes:

$$\{\text{genreid, movieid}\}^+ = \{\text{genreid, movieid, genre, isadult, title, runtime, year}\}$$

$$\{\text{genreid, movieid}\}^+ = \{\text{genreid, movieid, genre, isadult, title, runtime, year}\}$$

therefore-the-candidate-keys-are

Therefore, the candidate keys are:

$$\{\text{genre, movieid}\}, \{\text{genreid, movieid}\}$$

$$\{\text{genre, movieid}\}, \{\text{genreid, movieid}\}$$

These are the minimal sets of attributes whose closures contain all the attributes of the relation, making them the candidate keys.

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