Tutorial on Relational Algebra

Actor

actorId	name	nationality	age
LDC21	Leonardo DiCaprio	American	40
KW871	Kate Winslet	British	39
CB379	Christian Bale	British	40
MKE12	Michael Keaton	American	63
JGL81	Joseph Gordon-Levitt	American	33
EMG32	Ewan McGregor	British	43
HBC54	Helena Bonham Carter	British	48

Film

filmId	title	year	directorId
INC10	Inception	2010	CN345
TIT97	Titanic	1997	JC212
RR008	Revolutionary Road	2008	SM521
SKF12	Skyfall	2012	SM521
SHI10	Shutter Island	2010	SCO78
DK008	The Dark Knight	2008	CN345
DKR12	The Dark Knight Rises	2012	CN345
BAT92	Batman Returns	1992	BUR34
FISH4	Big Fish	2003	BUR34

Performance

actorId	filmId	character
LDC21	INC10	Dominic Cobb
LDC21	TIT97	Jack Dawson
KW871	TIT97	Rose DeWitt Bukater
LDC21	RR008	Frank Wheeler
KW871	RR008	April Wheeler
LDC21	SHI10	Teddy Daniels
CB379	DK008	Bruce Wayne
CB379	DKR12	Bruce Wayne
JGL81	INC10	Arthur
MKE12	BAT92	Bruce Wayne
EMG32	FISH4	Ed Bloom
HBC54	FISH4	Jenny

Director

directorId	name	nationality
CN345	Christopher Nolan	British
JC212	James Cameron	Canadian
SM521	Sam Mendes	British
SCO78	Martin Scorsese	American
BUR34	Tim Burton	American

Write the output of following Relational Algebra:

(a) $\sigma_{\text{age}>45}(\text{Actor})$

(b) $\pi_{\text{title}}(\text{Film})$

(c) $\pi_{\text{title}}(\sigma_{\text{year}<2000}(\text{Film}))$

(d) $\sigma_{\text{year}=2012}(\text{Film}) \times \sigma_{\text{nationality}\neq\text{'American'}}(\text{Director})$

(e) $\sigma_{\text{year}=2012}(\text{Film}) \bowtie \sigma_{\text{nationality}\neq\text{'American'}}(\text{Director})$

(f) $\pi_{\text{title}}(\text{Film} \bowtie \sigma_{\text{nationality}=\text{'British'}}(\text{Director}))$

(g) $\sigma_{\text{year}<2000}(\text{Film}) \cup \sigma_{\text{year}>2010}(\text{Film})$

(h) $\sigma_{\text{year}\geq2000}(\text{Film}) \cap \sigma_{\text{year}\leq2010}(\text{Film})$

Solution:

(a) $\sigma_{age>45}(\text{Actor})$

Retrieves details of all actors above the age of 45. The output table is as follows:

actorId	name	nationality	age
MKE12	Michael Keaton	American	63
HBC54	Helena Bonham Carter	British	48

(b) $\pi_{title}(\text{Film})$

Retrieves all distinct film titles. The output table is as follows:

title
Inception
Titanic
Revolutionary Road
Skyfall
Shutter Island
The Dark Knight
The Dark Knight Rises
Batman Returns
Big Fish

(c) $\pi_{title}(\sigma_{year<2000}(\text{Film}))$

Retrieves all distinct titles of films that were released before 2000. The output table is as follows:

title
Titanic
Batman Returns

(d) $\sigma_{year=2012}(\text{Film}) \times \sigma_{nationality \neq \text{'American'}}(\text{Director})$

Retrieves all information about all combinations of films released in 2012 and non-American directors. The output table is as follows:

filmId	title	year	directorId	directorId	name	nationality
SKF12	Skyfall	2012	SM521	CN345	Christopher Nolan	British
SKF12	Skyfall	2012	SM521	JC212	James Cameron	Canadian
SKF12	Skyfall	2012	SM521	SM521	Sam Mendes	British
DKR12	The Dark Knight Rises	2012	CN345	CN345	Christopher Nolan	British
DKR12	The Dark Knight Rises	2012	CN345	JC212	James Cameron	Canadian
DKR12	The Dark Knight Rises	2012	CN345	SM521	Sam Mendes	British

(e) $\sigma_{year=2012}(\text{Film}) \bowtie \sigma_{nationality \neq \text{'American'}}(\text{Director})$

Retrieves the details of all films released in 2012 and directed by a non-American director, along with the details of the corresponding director. The output table is as follows:

filmId	title	year	directorId	name	nationality
SKF12	Skyfall	2012	SM521	Sam Mendes	British
DKR12	The Dark Knight Rises	2012	CN345	Christopher Nolan	British

(f) $\pi_{\text{title}}(\text{Film} \bowtie \sigma_{\text{nationality}=\text{'British'}}(\text{Director}))$

Retrieves all distinct titles of films directed by a British director. The output table is as follows:

title
Inception
Revolutionary Road
Skyfall
The Dark Knight
The Dark Knight Rises

(g) $\sigma_{\text{year}<2000}(\text{Film}) \cup \sigma_{\text{year}>2010}(\text{Film})$

Retrieves details of all films released before 2000 or after 2010. The output table is as follows:

filmId	title	year	directorId
TIT97	Titanic	1997	JC212
SKF12	Skyfall	2012	SM521
DKR12	The Dark Knight Rises	2012	CN345
BAT92	Batman Returns	1992	BUR34

(h) $\sigma_{\text{year}\geq 2000}(\text{Film}) \cap \sigma_{\text{year}\leq 2010}(\text{Film})$

Retrieves details of all films released between 2000 and 2010. The output table is as follows:

filmId	title	year	directorId
INC10	Inception	2010	CN345
RR008	Revolutionary Road	2008	SM521
SHI10	Shutter Island	2010	SCO78
DK008	The Dark Knight	2008	CN345
FISH4	Big Fish	2003	BUR34

Airport

airportId	name	city
LHR	Heathrow	London
LGW	Gatwick	London
CDG	Charles de Gaulle	Paris
ORY	Orly	Paris

flightNo	flightCompany	depAirport	arrAirport
AF1231	Air France	LHR	CDG
AF1232	Air France	CDG	LHR
AF1234	Air France	LGW	CDG
AF1235	Air France	CDG	LGW
BA2943	British Airways	LGW	ORY
BA2944	British Airways	ORY	LGW
BA4059	British Airways	LHR	CDG
BA4060	British Airways	CDG	LHR

Booking

ticketNo	name	nationality	flightNo	seatNo
EAG129489	John Jones	British	AF1232	12D
EAF123456	Fraser McEwan	British	AF1232	30E
ABS958332	Mathilde Duval	French	BA2944	10A
ORE394895	Fiona Stewart	British	BA4060	5D
EYR149583	Karen Woods	British	BA4059	14B
EAG348595	Pierre Fontaine	French	BA2944	30D

Seat

seatNo	flightNo	class
12D	AF1232	Business
30E	AF1232	Economy
10A	BA2944	Business
5D	BA4060	Business
14B	BA4059	Economy
30D	BA2944	Economy

Find the output of following Relational Algebraic Expression:

(a) $\sigma_{\text{class='Business'}}(\text{Seat})$

(b) $\pi_{\text{nationality}}(\text{Booking})$

(c) $\sigma_{\text{nationality='French'}}(\text{Booking}) \times \sigma_{\text{class='Business'}}(\text{Seat})$

(d) $\text{Booking} \bowtie \text{Seat}$

(e) $\pi_{\text{name}}(\sigma_{\text{class='Business'}}(\text{Booking} \bowtie \text{Seat}))$

(f) $\text{Airport} \cup \text{Seat}$

Do by yourself.