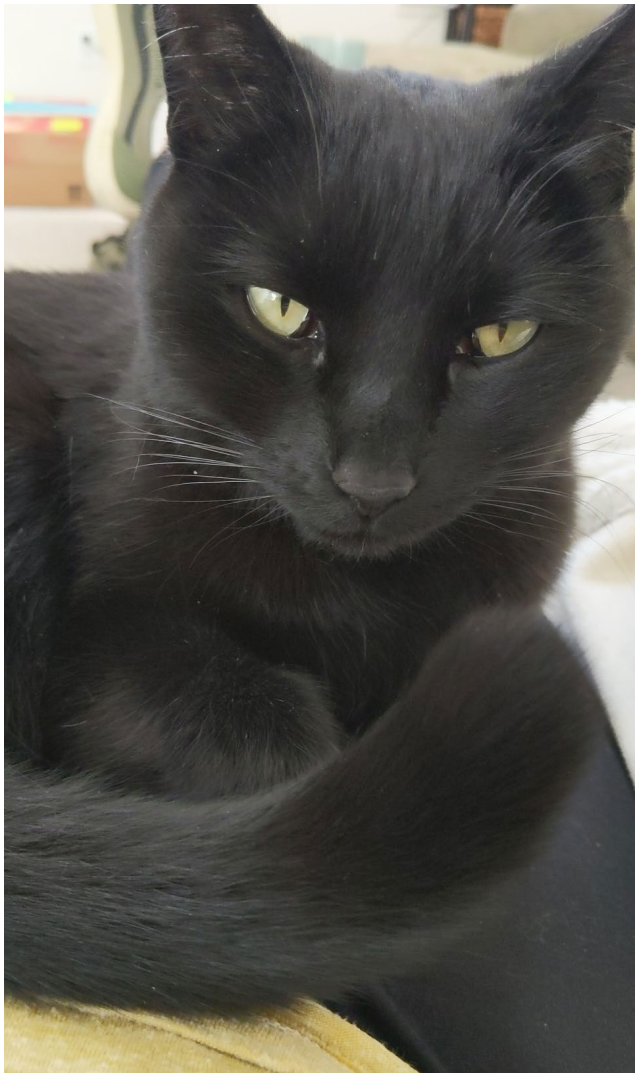

Relational Algebra

ERIN KEITH

Goals

1. Introduce Relational Algebra
2. Practice!

Relational Algebra

Selection	σ
Projection	π
Renaming	ρ
Union	$\cup$
Intersection	$\cap$
Difference	$-$
Cartesian product	$\times$
Join	$\bowtie$

Relational Algebra

Union – set of all elements in each relation (duplicates are removed)

Intersection – set of elements that are only in both relations

Difference – set of elements in one relation but not the other (order matters)

- The relations must have schemas with identical sets of attributes.
- The types (domains) and order for each attribute must be the same
  - This may require renaming of attributes in one or both relations

Relational Algebra

Projection – eliminates some columns

Selection – eliminates some rows (tuples)

Cartesian Product – pairs tuples of two relations in all possible ways

Join – selectively pairs tuples from two relations

title	*year*	*length*	*genre*	*studioName*	*producerC#*
Star Wars	1977	124	sciFi	Fox	12345
Galaxy Quest	1999	104	comedy	DreamWorks	67890
Wayne's World	1992	95	comedy	Paramount	99999

Figure 2.13: The relation Movies

Projection

- Performed on one relation
- Produces a subset of columns

$$\pi_{title,year,length}(\texttt{Movies})$$

title	*year*	*length*	*genre*	*studioName*	*producerC#*
Star Wars	1977	124	sciFi	Fox	12345
Galaxy Quest	1999	104	comedy	DreamWorks	67890
Wayne's World	1992	95	comedy	Paramount	99999

title	*year*	*length*
Star Wars	1977	124
Galaxy Quest	1999	104
Wayne's World	1992	95

Selection

- Performed on one relation
- Produces a subset of tuples

$$\sigma_{length \geq 100}(\text{Movies})$$

title	*year*	*length*	*genre*	*studioName*	*producerC#*
Star Wars	1977	124	sciFi	Fox	12345
Galaxy Quest	1999	104	comedy	DreamWorks	67890
Wayne's World	1992	95	comedy	Paramount	99999

title	*year*	*length*	*genre*	*studioName*	*producerC#*
Star Wars	1977	124	sciFi	Fox	12345
Galaxy Quest	1999	104	comedy	DreamWorks	67890

Cartesian Product

- Performed on two relations
- Produces all possible combinations of tuples

A	B
1	2
3	4

(a) Relation R

B	C	D
2	5	6
4	7	8
9	10	11

(b) Relation S

A	$R.B$	$S.B$	C	D
1	2	2	5	6
1	2	4	7	8
1	2	9	10	11
3	4	2	5	6
3	4	4	7	8
3	4	9	10	11

(c) Result $R \times S$

(natural) Joins

- Performed on two relations
- Produces combinations of tuples where values in a column match

A	B
1	2
3	4

(a) Relation R

B	C	D
2	5	6
4	7	8
9	10	11

(b) Relation S

A	B	C	D
1	2	5	6
3	4	7	8

(c) Result $R \bowtie S$

(natural) Joins

- Performed on two relations
- Produces combinations of tuples where values in a column match

A	B	C
1	2	3
6	7	8
9	7	8

(a) Relation U

B	C	D
2	3	4
2	3	5
7	8	10

(b) Relation V

A	B	C	D
1	2	3	4
1	2	3	5
6	7	8	10
9	7	8	10

(c) Result $U \bowtie V$

Figure 2.16: Natural join of relations

Practice

Provide the results for the following query on the relation below.

$$\pi_{title,\,year}\left(\sigma_{length \geq 100 \text{ AND } studioName = \text{'Fox'}}(\text{Movies})\right)$$

Selection	σ
Projection	π
Renaming	ρ
Union	$\cup$
Intersection	$\cap$
Difference	$-$
Cartesian product	$\times$
Join	$\bowtie$
Logical AND	$\wedge$
Logical OR	$\vee$
Logical NOT	$\sim$

title	*year*	*length*	*genre*	*studioName*	*producerC#*
Star Wars	1977	124	sciFi	Fox	12345
Galaxy Quest	1999	104	comedy	DreamWorks	67890
Wayne's World	1992	95	comedy	Paramount	99999

Figure 2.13: The relation Movies

Practice

Provide the results for the following query on the relation below.

$$\pi_{title,\,year}\left(\sigma_{length \geq 100 \text{ AND } studioName = \text{'Fox'}}(\text{Movies})\right)$$

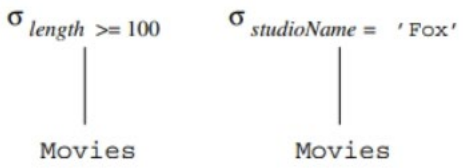

Figure 2.18: Expression tree for a relational algebra expression

title	*year*	*length*	*genre*	*studioName*	*producerC#*
Star Wars	1977	124	sciFi	Fox	12345
Galaxy Quest	1999	104	comedy	DreamWorks	67890

title	*year*	*length*	*genre*	*studioName*	*producerC#*
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Practice

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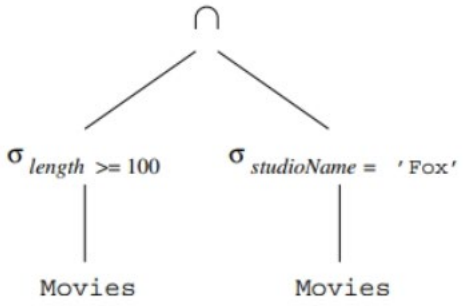
$$\pi_{title,\,year}\left(\sigma_{length \geq 100 \text{ AND } studioName = \text{'Fox'}}(\text{Movies})\right)$$



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Practice

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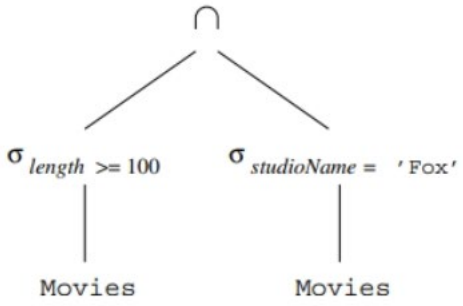

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Practice

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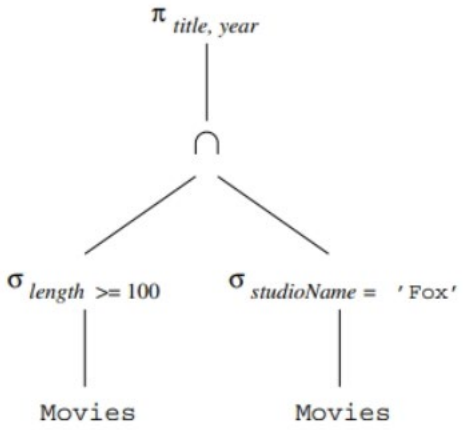


Figure 2.18: Expression tree for a relational algebra expression

title	*year*	*length*	*genre*	*studioName*	*producerC#*
Star Wars	1977	124	sciFi	Fox	12345

Practice

Provide the results for the following query on the relation below.

$$\pi_{title,\,year}\left(\sigma_{length \geq 100 \text{ AND } studioName = \text{'Fox'}}(\text{Movies})\right)$$

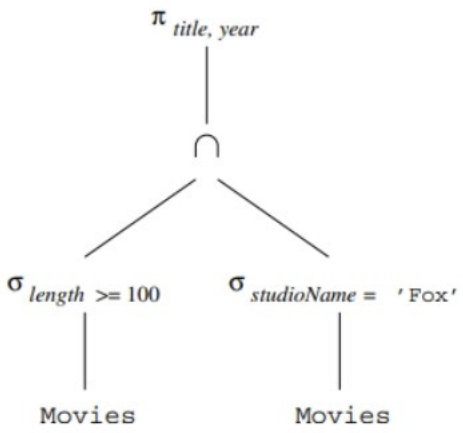


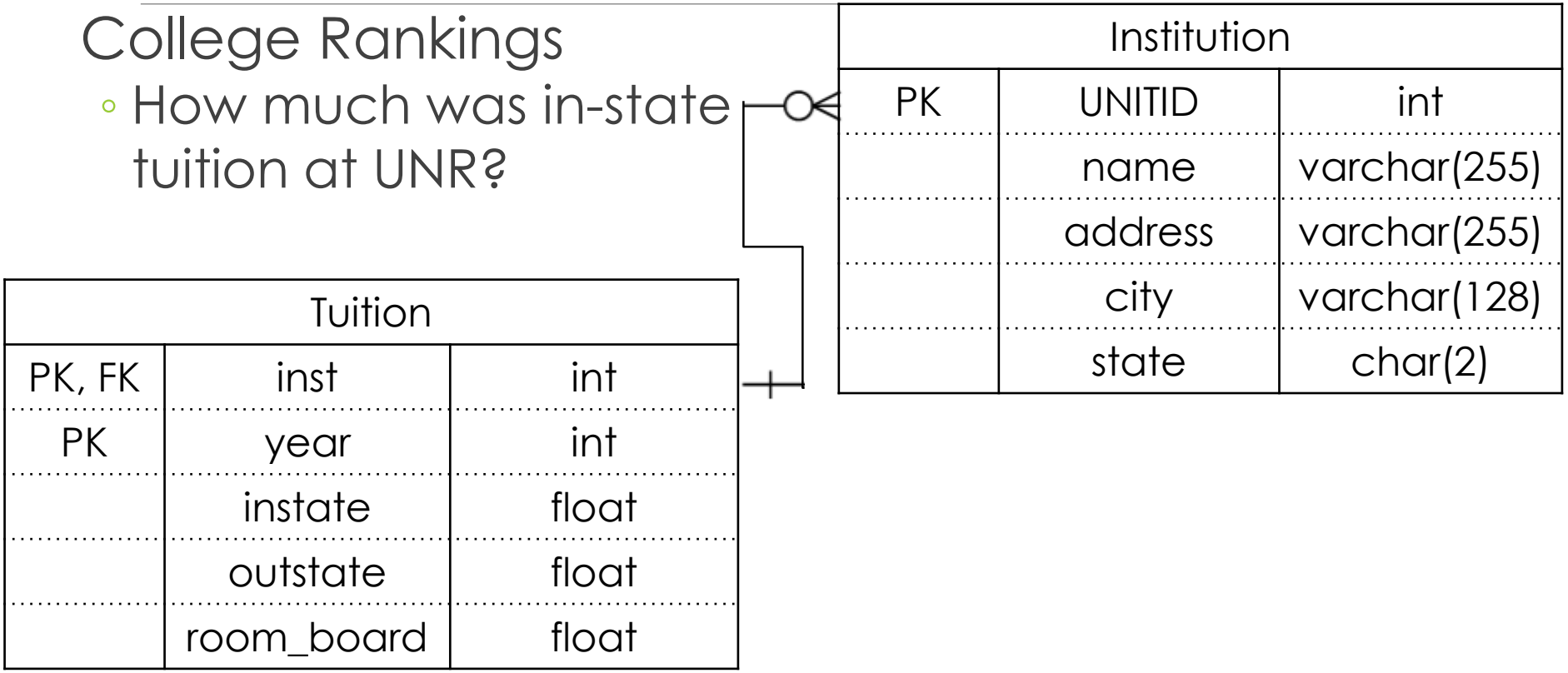
Figure 2.18: Expression tree for a relational algebra expression

title	year
Star Wars	1977

Practice

College Rankings

- How much was in-state tuition at UNR?

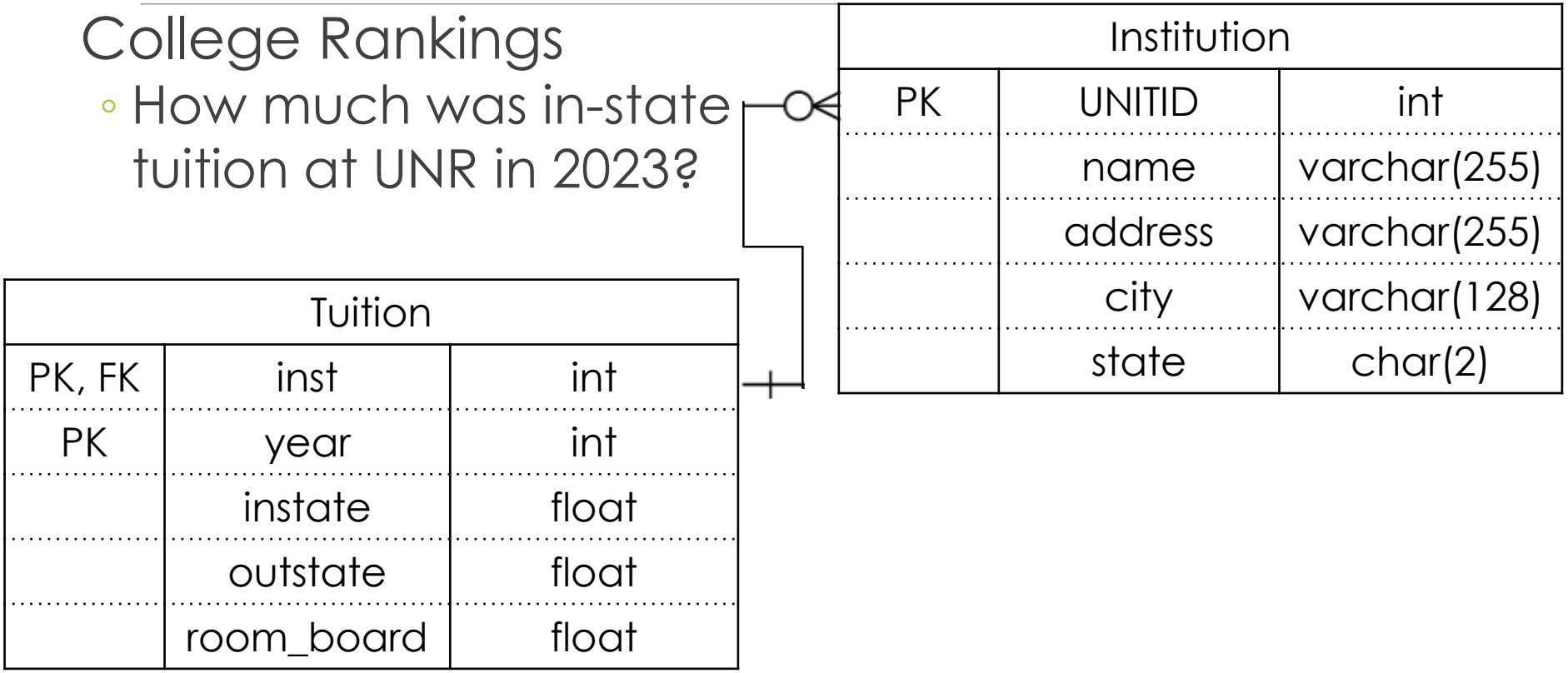


$\pi_{instate}(\sigma_{name='UNR'}(Tuition \bowtie Institution))$

Practice

College Rankings

- How much was in-state tuition at UNR in 2023?



Institution		
PK	UNITID	int
	name	varchar(255)
	address	varchar(255)
	city	varchar(128)
	state	char(2)

Tuition		
PK, FK	inst	int
PK	year	int
	instate	float
	outstate	float
	room_board	float

$\pi_{instate}(\sigma_{year=2023 \text{ AND } name='UNR'}(Tuition \bowtie Institution))$

Activity

In pairs, come up with 3 more questions you would have about this data.

Write out the corresponding relational algebra expressions.

Next Class

Module:

Week 6: Ch 5.1

Topic:

Relational Operations on Bags