Databases Autumn 2025

Hand-In Exercise 1

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Total Points	

Task	**Points**

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This template showcases various useful latex commands and setups. Remove this for your actual hand-in.

Task 1

Relational algebra is a treat with LaTeX, as can be seen in Equation (1):

$$\pi\left[Attribute1, Attribute2\right]\left(\sigma\left[Attribute = Something\right]\left(Entity1\right) \bowtie Entity2\right) \tag{1}$$

Task 2

(a) Person on Name:

$$\sigma\left[Name =' ChristopherNolan'\right]\left(Person\right) \tag{2}$$

Activity on SceneAuthor:

$$\sigma\left[Activity =' director'\right]\left(SceneAuthor\right) \tag{3}$$

Add join on both:

$$\pi\left[MovieID, SceneID\right]\left(\sigma\left[Name =' ChristopherNolan' \wedge Activity =' director'\right] \left(Person \bowtie SceneAuthor\right)\right) \tag{4}$$

(b) Movie on Title:

$$\sigma[MovieTitle =' Inception'](Movie) \tag{5}$$

Hans Zimmer as composer (within that movie):

$$\pi\left[MovieID, SceneID\right] \left(\sigma\left[MovieTitle =' Inception' \wedge Name =' HansZimmer' \wedge Activity =' composer'\right] \left(Movie \bowtie SceneAuthor \bowtie Person\right)\right) \tag{6}$$

Christopher Nolan as screenwriter (within that movie):

$$\pi\left[MovieID, SceneID\right] \left(\sigma\left[MovieTitle =' Inception' \wedge Name =' ChristopherNolan' \wedge Activity =' screenwriter'\right] \left(Movie \bowtie SceneAuthor \bowtie Person\right)\right) \tag{7}$$

Intersect on scene key then output SceneID:

$$\pi\left[SceneID\right] \\ ((\pi\left[MovieID, SceneID\right] \\ (\sigma\left[MovieTitle =' Inception' \wedge Name =' HansZimmer' \wedge Activity =' composer'\right] \\ (Movie \bowtie SceneAuthor \bowtie Person))) \cap \\ (\pi\left[MovieID, SceneID\right] \\ (\sigma\left[MovieTitle =' Inception' \wedge Name =' ChristopherNolan' \wedge Activity =' screenwriter'\right] \\ (Movie \bowtie SceneAuthor \bowtie Person)))) \quad (8)$$

(c) Person on Name:

$$\sigma\left[Name =' QuentinTarantino'\right](Person) \quad (9)$$

Actor role on ScenePerformer:

$$\sigma\left[Role =' actor'\right](ScenePerformer) \quad (10)$$

Director activity on SceneAuthor:

$$\sigma\left[Activity =' director'\right](SceneAuthor) \quad (11)$$

Combine and output scene Titles:

$$\pi\left[Title\right](\sigma\left[Name =' QuentinTarantino' \wedge Role =' actor' \wedge Activity =' director'\right] \\ (Scene \bowtie ScenePerformer \bowtie SceneAuthor \bowtie Person)) \quad (12)$$

(d) Actor on ScenePerformer:

$$\sigma\left[Name =' RobertDowneyJr.' \wedge Role =' actor'\right](ScenePerformer \bowtie Person) \quad (13)$$

Author on SceneAuthor:

$$\sigma\left[Name =' RobertDowneyJr.'\right](SceneAuthor \bowtie Person) \quad (14)$$

Union on MovieID, then output MovieTitle:

$$\pi\left[MovieTitle\right] \\ ((\pi\left[MovieID\right](\sigma\left[Name =' RobertDowneyJr.' \wedge Role =' actor'\right](ScenePerformer \bowtie Person)) \\ \cup \pi\left[MovieID\right](\sigma\left[Name =' RobertDowneyJr.'\right](SceneAuthor \bowtie Person))) \bowtie Movie) \quad (15)$$

(e) Actor on ScenePerformer:

$$\sigma\left[Name =' ScarlettJohansson' \wedge Role =' actor'\right](ScenePerformer \bowtie Person) \quad (16)$$

Stunt double on ScenePerformer:

$$\sigma\left[Name =' ScarlettJohansson' \wedge Role =' stuntdouble'\right](ScenePerformer \bowtie Person) \quad (17)$$

Intersect on scene key, then output Titles:

$$\begin{aligned}&\pi\left[Title\right]\\&\quad((\pi\left[MovieID, SceneID\right](\sigma\left[Name =' ScarlettJohansson' \wedge Role =' actor'\right]\\&\qquad(ScenePerformer \bowtie Person)) \cap \pi\left[MovieID, SceneID\right]\\&\qquad(\sigma\left[Name =' ScarlettJohansson' \wedge Role =' stuntdouble'\right]\\&\qquad\qquad(ScenePerformer \bowtie Person))) \bowtie Scene)\end{aligned} \quad (18)$$

(f) Person on Name (subset of Person):

$$F_{1.1} = \{p | p \in Person \wedge p.Name =' ChristopherNolan'\} \quad (19)$$

Activity on SceneAuthor (subset of SceneAuthor):

$$F_{1.2} = \{sa | sa \in SceneAuthor \wedge sa.Activity =' director'\} \quad (20)$$

Join by PID, output (MovieID,SceneID) without Person:

$$\{\langle sa.MovieID, sa.SceneID\rangle | sa \in F_{1.2} \wedge \exists p(p \in F_{1.1} \wedge p.PID = sa.PID)\} \quad (21)$$

(g) Movie on Title:

$$G_{2.1} = \{m | m \in Movie \wedge m.MovieTitle =' Inception'\} \quad (22)$$

Hans Zimmer as composer (within that movie):

$$\begin{aligned}G_{2.2} = \{sa | &sa \in SceneAuthor \wedge sa.Activity =' composer' \wedge\\&\exists p(p \in Person \wedge p.PID = sa.PID \wedge p.Name =' HansZimmer') \wedge\\&\exists m(m \in G_{2.1} \wedge m.MovieID = sa.MovieID)\}\end{aligned} \quad (23)$$

Christopher Nolan as screenwriter (within that movie):

$$\begin{aligned}G_{2.3} = \{sa | &sa \in SceneAuthor \wedge sa.Activity =' screenwriter' \wedge\\&\exists p(p \in Person \wedge p.PID = sa.PID \wedge p.Name =' ChristopherNolan') \wedge\\&\exists m(m \in G_{2.1} \wedge m.MovieID = sa.MovieID)\}\end{aligned} \quad (24)$$

Intersect on full scene key, then output SceneID:

$$\{\langle x.SceneID\rangle | x \in G_{2.2} \wedge \exists y(y \in G_{2.3} \wedge y.MovieID = x.MovieID \wedge y.SceneID = x.SceneID)\} \quad (25)$$

(h) Person on Name (subset of Person):

$$H_{3.1} = \{p | p \in Person \wedge p.Name =' QuentinTarantino'\} \tag{26}$$

Actor role on ScenePerformer:

$$H_{3.2} = \{sp | sp \in ScenePerformer \wedge sp.Role =' actor'\} \tag{27}$$

Director activity on SceneAuthor:

$$H_{3.3} = \{sa | sa \in SceneAuthor \wedge sa.Activity =' director'\} \tag{28}$$

Join on person and scene, then output Title:

$$\begin{aligned}\{\langle s.Title\rangle | s \in Scene \wedge \exists p \exists sp \exists sa (p \in H_{3.1} \wedge sp \in H_{3.2} \wedge sa \in H_{3.3} \wedge \\ sp.PID = p.PID \wedge sa.PID = p.PID \wedge \\ sp.MovieID = sa.MovieID \wedge sp.SceneID = sa.SceneID \wedge \\ s.MovieID = sp.MovieID \wedge s.SceneID = sp.SceneID)\}\end{aligned} \tag{29}$$

(i) Person on Name (subset of Person):

$$I_{4.1} = \{p | p \in Person \wedge p.Name =' RobertDowneyJr.'\} \tag{30}$$

Actor role on ScenePerformer:

$$I_{4.2} = \{sp | sp \in ScenePerformer \wedge sp.Role =' actor'\} \tag{31}$$

Any author activity on SceneAuthor:

$$I_{4.3} = \{sa | sa \in SceneAuthor\} \tag{32}$$

Actor or author in the same movie, then output MovieTitle:

$$\begin{aligned}\{\langle m.MovieTitle\rangle | m \in Movie \wedge (\exists p \exists sp (p \in I_{4.1} \wedge sp \in I_{4.2} \wedge \\ sp.PID = p.PID \wedge sp.MovieID = m.MovieID) \vee \\ \exists q \exists sa (q \in I_{4.1} \wedge sa \in I_{4.3} \wedge sa.PID = q.PID \wedge sa.MovieID = m.MovieID))\}\end{aligned} \tag{33}$$

(j) Person on Name (subset of Person):

$$J_{5.1} = \{p | p \in Person \wedge p.Name =' ScarlettJohansson'\} \tag{34}$$

Actor role on ScenePerformer:

$$J_{5.2} = \{spA | spA \in ScenePerformer \wedge spA.Role =' actor'\} \tag{35}$$

Stunt double role on ScenePerformer:

$$J_{5.3} = \{spS | spS \in ScenePerformer \wedge spS.Role =' stuntdouble'\} \tag{36}$$

Same person, same scene, then output Title:

$$\begin{aligned}\{\langle s.Title\rangle | s \in Scene \wedge \exists p \exists spA \exists spS (p \in J_{5.1} \wedge spA \in J_{5.2} \wedge spS \in J_{5.3} \wedge \\ spA.PID = p.PID \wedge spS.PID = p.PID \wedge \\ spA.MovieID = spS.MovieID \wedge spA.SceneID = spS.SceneID \wedge \\ s.MovieID = spA.MovieID \wedge s.SceneID = spA.SceneID)\}\end{aligned} \tag{37}$$