

# Odabrani koncepti relacionog modela podataka

**Baze podataka 2 (2022/2023)**

**OAS Primenjeno softversko inženjerstvo**

**Fakultet tehničkih nauka**

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# Zatvarač skupa obeležja

- ZADATAK 1

$$U_1 = \{A, B, C, D, E\}$$

$$F_1 = \{C \rightarrow D, BC \rightarrow A, B \rightarrow A, D \rightarrow E\}$$

$$(AB)^+ = ?$$

$$(CD)^+ = ?$$

$$(ABC)^+ = ?$$

$$(BC)^+ = ?$$

# Zatvarač skupa obeležja

- ZADATAK 1

$$U_1 = \{A, B, C, D, E\}$$

$$F_1 = \{C \rightarrow D, BC \rightarrow A, B \rightarrow A, D \rightarrow E\}$$

$$(AB)^+ = AB$$

$$(CD)^+ = CDE \quad [\text{primena } D \rightarrow E]$$

$$(ABC)^+ = ABCDE \quad [\text{primena } C \rightarrow D, D \rightarrow E]$$

$$(BC)^+ = BCDAE \quad [\text{primena } C \rightarrow D, BC \rightarrow A, D \rightarrow E]$$

# Zatvarač skupa obeležja

- ZADATAK 2

$$U_2 = \{A, B, C, D, E, F, G, H\}$$

$$F_2 = \{F \rightarrow C, DC \rightarrow E, H \rightarrow A, A \rightarrow H, BE \rightarrow C, E \rightarrow G\}$$

$$(EF)^+ = ?$$

$$(CD)^+ = ?$$

$$(ABF)^+ = ?$$

$$(BDF)^+ = ?$$

# Zatvarač skupa obeležja

- ZADATAK 2

$$U_2 = \{A, B, C, D, E, F, G, H\}$$

$$F_2 = \{F \rightarrow C, DC \rightarrow E, H \rightarrow A, A \rightarrow H, BE \rightarrow C, E \rightarrow G\}$$

$$(EF)^+ = EFGC$$

$$(CD)^+ = CDEG$$

$$(ABF)^+ = ABFCH$$

$$(BDF)^+ = BDFCEG$$

# Zatvarač skupa obeležja

- ZADATAK 3

$$U_3 = \{A, B, C, D, E, F, G, H\}$$

$$F_3 = \{B \rightarrow D, AC \rightarrow BD, E \rightarrow FC, FH \rightarrow A\}$$

$$(EH)^+ = ?$$

# Zatvarač skupa obeležja

- ZADATAK 3

$$U_3 = \{A, B, C, D, E, F, G, H\}$$

$$F_3 = \{B \rightarrow D, AC \rightarrow BD, E \rightarrow FC, FH \rightarrow A\}$$

$$(EH)^+ = EHFCABD$$

# Ključevi šeme relacije

- ZADATAK 1

$$R_1 = \{A, B, C, D, E\}$$

$$F_1 = \{D \rightarrow AC, C \rightarrow BE, A \rightarrow C\}$$

$$K_1 = ?$$

# Ključevi šeme relacije

- ZADATAK 1

$$R_1 = \{A, B, C, D, E\}$$

$$F_1 = \{D \rightarrow AC, C \rightarrow BE, A \rightarrow C\}$$

$$(ABCDE)^+ = ABCDE \quad [\text{uklanjanje A}]$$

$$(BCDE)^+ = BCDEA \quad [\text{uklanjanje B}]$$

$$(CDE)^+ = CDEAB \quad [\text{uklanjanje C}]$$

$$(DE)^+ = DEACB \quad [\text{uklanjanje D, E}]$$

$$E^+ = E \quad !$$

$$D^+ = DACBE \quad \text{D je ključ šeme relacije, nije moguća zamena}$$

$$K_1 = \{D\}$$

# Ključevi šeme relacije

- ZADATAK 2

$$R_2 = \{A, B, C, D, E, F\}$$

$$F_2 = \{CE \rightarrow AB, F \rightarrow D, D \rightarrow F, B \rightarrow C, E \rightarrow C\}$$

$$K_2 = ?$$

# Ključevi šeme relacije

- ZADATAK 2

$R_2 = \{A, B, C, D, E, F\}$

$F_2 = \{CE \rightarrow AB, F \rightarrow D, D \rightarrow F, B \rightarrow C, E \rightarrow C\}$

$(ABCDEF)^+ = ABCDEF$	[uklanjanje A]
$(BCDEF)^+ = BCDEFA$	[uklanjanje B]
$(CDEF)^+ = CDEFAB$	[uklanjanje C]
$(DEF)^+ = DEFCAB$	[uklanjanje D]
$(EF)^+ = EFDCAB$	[uklanjanje E, F] [EF je ključ]
$F^+ = FD$	!
$E^+ = ECAB$	!

# Ključevi šeme relacije

- ZADATAK 2

$$R_2 = \{A, B, C, D, E, F\}$$

$$F_2 = \{CE \rightarrow AB, F \rightarrow D, D \rightarrow F, B \rightarrow C, E \rightarrow C\}$$

EF je ključ, moguća zamena nad EF

EF,  $D \rightarrow F \Rightarrow$  DE mogući ključ

DE [uklanjanje D, E] [DE je ključ]

$E^+ = ECAB$  !

$D^+ = DF$  !

# Ključevi šeme relacije

- ZADATAK 2

$$R_2 = \{A, B, C, D, E, F\}$$

$$F_2 = \{CE \rightarrow AB, F \rightarrow D, D \rightarrow F, B \rightarrow C, E \rightarrow C\}$$

dodatne zamene ne daju nove ključeve

$$DE, F \rightarrow D \gg EF$$

$$K_2 = \{EF, DE\}$$

# Ključevi šeme relacije

- ZADATAK 3

$$R_3 = \{A, B, C, D, E, F, G\}$$

$$F_3 = \{F \rightarrow E, A \rightarrow B, C \rightarrow F, D \rightarrow A, E \rightarrow CFG\}$$

$$K_3 = ?$$

B nije deo ključa

B isključivo na desnim stranama FZ u  $F_3$

G nije deo ključa

G isključivo na desnim stranama FZ u  $F_3$

D jeste deo ključa

D isključivo na levim stranama FZ u  $F_3$

# Ključevi šeme relacije

- ZADATAK 3

$$R_3 = \{A, B, C, D, E, F, G\}$$

$$F_3 = \{F \rightarrow E, A \rightarrow B, C \rightarrow F, D \rightarrow A, E \rightarrow CFG\}$$

$$K_3 = ?$$

pokušaj sa D

$$D^+ = DAB$$

pokušaj sa dodavanjem F

$$(DF)^+ = DFEABCG$$

DF je ključ

# Ključevi šeme relacije

- ZADATAK 3

$$R_3 = \{A, B, C, D, E, F, G\}$$

$$F_3 = \{F \rightarrow E, A \rightarrow B, C \rightarrow F, D \rightarrow A, E \rightarrow CFG\}$$

$$K_3 = ?$$

zamenom mogu biti dobijeni dodatni ključevi

$$DF, C \rightarrow F \gg CD \dots$$

$$DF, E \rightarrow F \gg DE \dots$$

$$K_3 = \{DF, CD, DE\}$$

# Važenje funkcionalne zavisnosti

- ZADATAK 1

$$F_1 = \{A \rightarrow B, B \rightarrow A, AB \rightarrow B, AB \rightarrow AB\}$$

$A \rightarrow B$  ?

$B \rightarrow A$  ?

$AB \rightarrow B$  ?

$AB \rightarrow AB$  ?

relacija  $r_1$

<b>A</b>	<b>B</b>
a1	b1
a2	b1
a1	b2
a3	b3

# Važenje funkcionalne zavisnosti

- ZADATAK 1

$$F_1 = \{A \rightarrow B, B \rightarrow A, AB \rightarrow B, AB \rightarrow AB\}$$

$A \rightarrow B$       ne, uočiti (a1, b1) i (a1, b2)

$B \rightarrow A$       ne, uočiti (a1, b1) i (a2, b1)

$AB \rightarrow B$     da, trivijalna FZ

$AB \rightarrow AB$     da, trivijalna FZ

relacija  $r_1$

<b>A</b>	<b>B</b>
a1	b1
a2	b1
a1	b2
a3	b3

# Važenje funkcionalne zavisnosti

- ZADATAK 2

$$F_2 = \{C \rightarrow B, C \rightarrow D, AB \rightarrow C, AC \rightarrow B, D \rightarrow B, D \rightarrow C, D \rightarrow AC\}$$

$C \rightarrow B$  ?

$C \rightarrow D$  ?

$AB \rightarrow C$  ?

$AC \rightarrow B$  ?

$D \rightarrow B$  ?

$D \rightarrow C$  ?

$D \rightarrow AC$  ?

relacija  $r_2$

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
a1	b3	c1	d1
a2	b2	c1	d2
a3	b1	c2	d3
a3	b4	c2	d4

# Važenje funkcionalne zavisnosti

- ZADATAK 2

$$F_2 = \{C \rightarrow B, C \rightarrow D, AB \rightarrow C, AC \rightarrow B, D \rightarrow B, D \rightarrow C, D \rightarrow AC\}$$

$C \rightarrow B$     ne

$C \rightarrow D$     ne

$AB \rightarrow C$     da

$AC \rightarrow B$     ne

$D \rightarrow B$     da

$D \rightarrow C$     da

$D \rightarrow AC$     da

relacija  $r_2$

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
a1	b3	c1	d1
a2	b2	c1	d2
a3	b1	c2	d3
a3	b4	c2	d4

# Implikacioni problem

- ZADATAK 1

$$U_1 = \{A, B, C, D\}$$

$$F_1 = \{C \rightarrow AB, D \rightarrow B, D \rightarrow C\}$$

$$F_1 \models D \rightarrow A \quad ?$$

# Implikacioni problem

- ZADATAK 1

$$U_1 = \{A, B, C, D\}$$

$$F_1 = \{C \rightarrow AB, D \rightarrow B, D \rightarrow C\}$$

$$F_1 \models D \rightarrow A \quad ?$$

1. način

$$D^+ = DBC\underline{A}$$

$$\text{važi } F_1 \models D \rightarrow A$$

# Implikacioni problem

- ZADATAK 1

$$U_1 = \{A, B, C, D\}$$

$$F_1 = \{C \rightarrow AB, D \rightarrow B, D \rightarrow C\}$$

$$F_1 \models D \rightarrow A \quad ?$$

2. način

$$F_1 = \{C \rightarrow A, C \rightarrow B, D \rightarrow B, D \rightarrow C\}$$

$$\begin{array}{l|l} D \rightarrow C & \\ C \rightarrow A & \end{array} \quad = (A3) \Rightarrow D \rightarrow A$$

$$\text{važi } F_1 \models D \rightarrow A$$

# Implikacioni problem

- ZADATAK 2

$$U_2 = \{A, B, C, D, E\}$$

$$F_2 = \{AC \rightarrow B, DB \rightarrow A, E \rightarrow A\}$$

$$F_2 \models CDE \rightarrow A \quad ?$$

# Implikacioni problem

- ZADATAK 2

$$U_2 = \{A, B, C, D, E\}$$

$$F_2 = \{AC \rightarrow B, DB \rightarrow A, E \rightarrow A\}$$

$$F_2 \models CDE \rightarrow A \quad ?$$

1. način

$$(CDE)^+ = CDE\underline{A}B$$

$$\text{važi } F_2 \models CDE \rightarrow A$$

# Implikacioni problem

- ZADATAK 2

$$U_2 = \{A, B, C, D, E\}$$

$$F_2 = \{AC \rightarrow B, DB \rightarrow A, E \rightarrow A\}$$

$$F_2 \models CDE \rightarrow A \quad ?$$

2. način

$$\begin{array}{l|l} E \rightarrow A & \\ AC \rightarrow B & \end{array} \Rightarrow \begin{array}{l|l} CE \rightarrow B & \\ DB \rightarrow A & \end{array} \Rightarrow CDE \rightarrow A$$

važi  $F_2 \models CDE \rightarrow A$

# Implikacioni problem

- ZADATAK 3

$$U_3 = \{A, B, C, D, E, F\}$$

$$F_3 = \{CE \rightarrow D, F \rightarrow C, A \rightarrow F, AE \rightarrow C, B \rightarrow A\}$$

$$F_3 \models BE \rightarrow D \quad ?$$

# Implikacioni problem

- ZADATAK 3

$$U_3 = \{A, B, C, D, E, F\}$$

$$F_3 = \{CE \rightarrow D, F \rightarrow C, A \rightarrow F, AE \rightarrow C, B \rightarrow A\}$$

$$F_3 \models BE \rightarrow D \quad ?$$

1. način

$$(BE)^+ = BEAFCD$$

$$\text{važi } F_3 \models BE \rightarrow D$$

# Implikacioni problem

- ZADATAK 3

$$U_3 = \{A, B, C, D, E, F\}$$

$$F_3 = \{CE \rightarrow D, F \rightarrow C, A \rightarrow F, AE \rightarrow C, B \rightarrow A\}$$

$$F_3 \models BE \rightarrow D \quad ?$$

2. način

$$\begin{array}{l} B \rightarrow A \quad | \\ E \in U_3 \quad | \end{array} \Rightarrow \begin{array}{l} BE \rightarrow AE \quad | \\ AE \rightarrow C \quad | \end{array} \Rightarrow \begin{array}{l} BE \rightarrow C \quad | \\ CE \rightarrow D \quad | \end{array} \Rightarrow BE \rightarrow D$$

važi  $F_3 \models BE \rightarrow D$

# Implikacioni problem

- ZADATAK 3

$$U_3 = \{A, B, C, D, E, F\}$$

$$F_3 = \{CE \rightarrow D, F \rightarrow C, A \rightarrow F, AE \rightarrow C, B \rightarrow A\}$$

$$F_3 \models BE \rightarrow D \quad ?$$

## 3. način

$$\begin{array}{l} B \rightarrow A \mid \\ A \rightarrow F \mid \end{array} \stackrel{=A3=>}{=} \begin{array}{l} B \rightarrow F \mid \\ F \rightarrow C \mid \end{array} \stackrel{=A3=>}{=} \begin{array}{l} B \rightarrow C \mid \\ E \in U_3 \mid \end{array} \stackrel{=A2=>}{=} \begin{array}{l} BE \rightarrow CE \mid \\ CE \rightarrow D \mid \end{array} \stackrel{=A3=>}{=} BE \rightarrow D$$

$$\text{važi } F_3 \models BE \rightarrow D$$

# Projekcija skupa FZ

- ZADATAK 1

$$U_1 = \{A, B, C, D\}$$

$$F_1 = \{C \rightarrow A, B \rightarrow DC\}$$

$$F_1|_{AC} = ?$$

# Projekcija skupa FZ

- ZADATAK 1

$$U_1 = \{A, B, C, D\}$$

$$F_1 = \{C \rightarrow A, B \rightarrow DC\}$$

$$F_1|_{AC} = ?$$

$$A^+ = A$$

$$C^+ = CA$$

$$(AC)^+ = AC$$

$$F_1|_{AC} = \{A \rightarrow A, A \rightarrow \emptyset, C \rightarrow AC, C \rightarrow \emptyset, AC \rightarrow AC, AC \rightarrow \emptyset, \emptyset \rightarrow \emptyset\}$$

$$= \{A \rightarrow A, A \rightarrow \emptyset, C \rightarrow A, C \rightarrow C, C \rightarrow \emptyset, AC \rightarrow A, AC \rightarrow C, AC \rightarrow \emptyset, \emptyset \rightarrow \emptyset\}$$

$$= \{C \rightarrow A\} \cup \{\text{Trivijalne FZ nad } AC\}$$

# Projekcija skupa FZ

- ZADATAK 1

$$U_1 = \{A, B, C, D\}$$

$$F_1 = \{C \rightarrow A, B \rightarrow DC\}$$

$$F_1|_{AB} = ?$$

# Projekcija skupa FZ

- ZADATAK 1

$$U_1 = \{A, B, C, D\}$$

$$F_1 = \{C \rightarrow A, B \rightarrow DC\}$$

$$F_1|_{AB} = ?$$

$$A^+ = A$$

$$B^+ = BDCA$$

$$(AB)^+ = ABDC$$

$$F_1|_{AB} = \{A \rightarrow A, A \rightarrow \emptyset, B \rightarrow AB, B \rightarrow \emptyset, AB \rightarrow AB, AB \rightarrow \emptyset, \emptyset \rightarrow \emptyset\}$$

$$= \{A \rightarrow A, A \rightarrow \emptyset, B \rightarrow A, B \rightarrow B, B \rightarrow \emptyset, AB \rightarrow A, AB \rightarrow B, AB \rightarrow \emptyset, \emptyset \rightarrow \emptyset\}$$

$$= \{B \rightarrow A\} \cup \{\text{Trivijalne FZ nad } AB\}$$

# Projekcija skupa FZ

- ZADATAK 2

$$U_2 = \{A, B, C, D, E, F\}$$

$$F_2 = \{C \rightarrow D, B \rightarrow F, A \rightarrow EF, D \rightarrow C, FC \rightarrow E\}$$

$$F_2|_{BC} = ?$$

# Projekcija skupa FZ

- ZADATAK 2

$$U_2 = \{A, B, C, D, E, F\}$$

$$F_2 = \{C \rightarrow D, B \rightarrow F, A \rightarrow EF, D \rightarrow C, FC \rightarrow E\}$$

$$F_2|_{BC} = ?$$

$$B^+ = BF$$

$$C^+ = C\emptyset$$

$$(BC)^+ = BC\emptyset FE$$

$$F_2|_{BC} = \{\textit{Trivijalne FZ nad BC}\}$$

# Projekcija skupa FZ

- ZADATAK 2

$$U_2 = \{A, B, C, D, E, F\}$$

$$F_2 = \{C \rightarrow D, B \rightarrow F, A \rightarrow EF, D \rightarrow C, FC \rightarrow E\}$$

$$F_2|_{ADC} = ?$$

# Projekcija skupa FZ

- ZADATAK 2

$$U_2 = \{A, B, C, D, E, F\}$$

$$F_2 = \{C \rightarrow D, B \rightarrow F, A \rightarrow EF, D \rightarrow C, FC \rightarrow E\}$$

$$F_2|_{ADC} = ?$$

$$A^+ = AEF$$

$$D^+ = DC$$

$$C^+ = CD$$

$$(AD)^+ = ADEF$$

$$(AC)^+ = ACDEF$$

$$(DC)^+ = DC$$

$$(ADC)^+ = ADCEF$$

$$F_2|_{ADC} = \{D \rightarrow C, C \rightarrow D, AD \rightarrow C, AC \rightarrow D\} \cup \{\text{Trivijalne FZ nad ADC}\}$$

# Projekcija skupa FZ

- ZADATAK 2

$$U_2 = \{A, B, C, D, E, F\}$$

$$F_2 = \{C \rightarrow D, B \rightarrow F, A \rightarrow EF, D \rightarrow C, FC \rightarrow E\}$$

$$F_2|_{BDEF} = ?$$

# Ekvivalencija dva skupa FZ

- ZADATAK 1

$$U = \{A, B, C, D\}$$

$$F_1 = \{A \rightarrow B, B \rightarrow D, A \rightarrow C\}$$

$$F_2 = \{A \rightarrow B, D \rightarrow A, A \rightarrow C\}$$

$$F_1 \equiv F_2 \quad ?$$

# Ekvivalencija dva skupa FZ

- ZADATAK 1

$$U = \{A, B, C, D\}$$

$$F_1 = \{A \rightarrow B, B \rightarrow D, A \rightarrow C\}$$

$$F_2 = \{A \rightarrow B, D \rightarrow A, A \rightarrow C\}$$

$$F_1 \equiv F_2 \quad ?$$

$$F_1 \models F_2 \quad ?$$

$$F_1 \models A \rightarrow B \quad \text{važi}$$

$$A^+_{F_1} = \underline{A}BDC$$

$$F_1 \models D \rightarrow A \quad \text{ne važi}$$

$$D^+_{F_1} = D$$

ne važi  $F_1 \models F_2$

$$\Rightarrow F_1 \not\equiv F_2$$

# Ekvivalencija dva skupa FZ

- ZADATAK 2

$$U = \{A, B, C, D, E\}$$

$$F_1 = \{D \rightarrow C, E \rightarrow AC, C \rightarrow D, AB \rightarrow C\}$$

$$F_2 = \{BE \rightarrow C, E \rightarrow D, E \rightarrow A, AB \rightarrow D\}$$

$$F_1 \equiv F_2 \quad ?$$

# Ekvivalencija dva skupa FZ

- ZADATAK 2

$$U = \{A, B, C, D, E\}$$

$$F_1 = \{D \rightarrow C, E \rightarrow AC, C \rightarrow D, AB \rightarrow C\}$$

$$F_2 = \{BE \rightarrow C, E \rightarrow D, E \rightarrow A, AB \rightarrow D\}$$

$$F_1 \equiv F_2 \quad ?$$

$$F_1 \models F_2 \quad \text{važi}$$

$$F_1 \models BE \rightarrow C \quad \text{važi}$$

$$(BE)^+_{F_1} = BEA\underline{C}D$$

$$F_1 \models E \rightarrow D \quad \text{važi}$$

$$E^+_{F_1} = EA\underline{C}D$$

$$F_1 \models E \rightarrow A \quad \text{važi}$$

$$E^+_{F_1} = E\underline{A}CD$$

$$F_1 \models AB \rightarrow D \quad \text{važi}$$

$$(AB)^+_{F_1} = AB\underline{C}D$$

# Ekvivalencija dva skupa FZ

- ZADATAK 2

$$U = \{A, B, C, D, E\}$$

$$F_1 = \{D \rightarrow C, E \rightarrow AC, C \rightarrow D, AB \rightarrow C\}$$

$$F_2 = \{BE \rightarrow C, E \rightarrow D, E \rightarrow A, AB \rightarrow D\}$$

$$F_1 \equiv F_2 \quad ?$$

$$F_2 \models F_1 \quad ?$$

$$F_2 \models D \rightarrow C \quad \text{ne važi}$$

$$D^+_{F_2} = D$$

$$\text{ne važi } F_2 \models F_1$$

$$\Rightarrow F_1 \not\equiv F_2$$

# Literatura

- Pavle Mogin, Ivan Luković. Principi baza podataka. Fakultet tehničkih nauka i MP Stylos, Novi Sad. 1996.