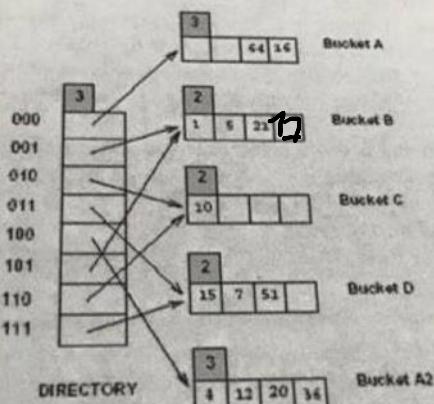


Dispersive extensibilità

B. (15%) Consider the Extendible Hashing index shown below. Show the index after inserting entries with hash values 17 and 9.



1 ↗

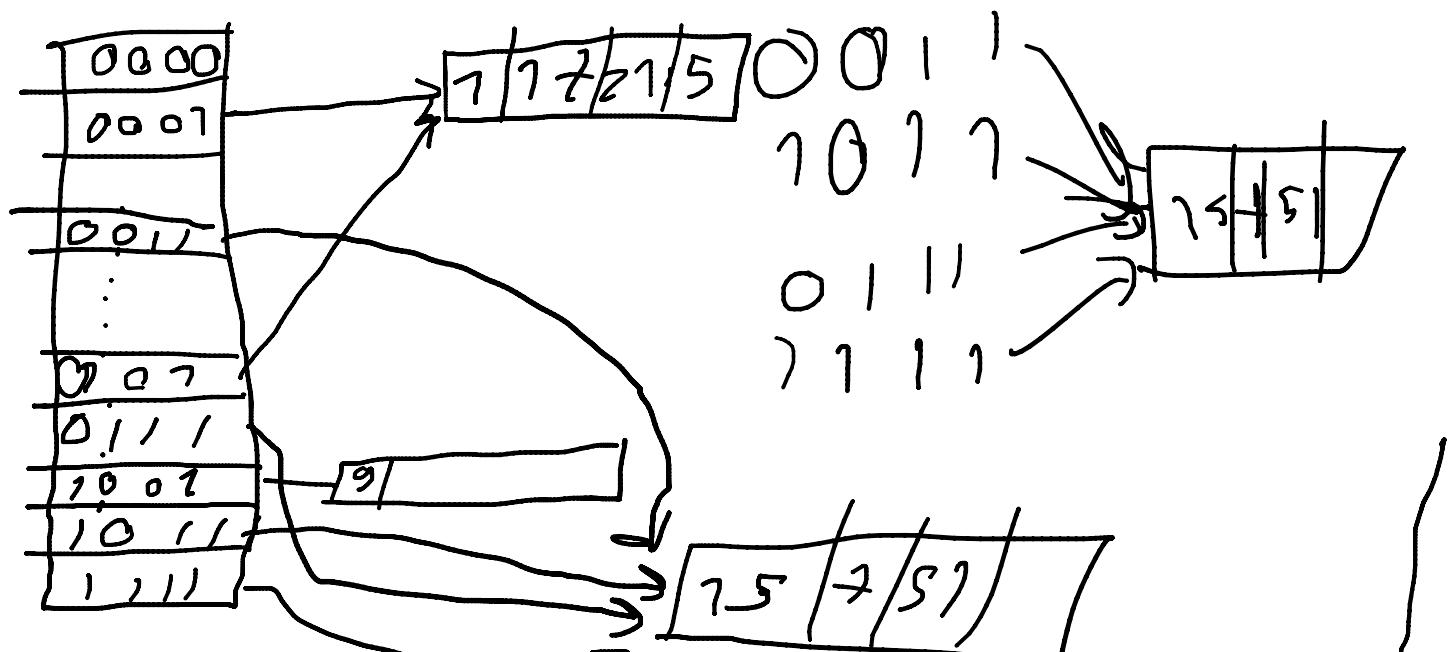
$$16 = 10000$$

$$17 \equiv 10001$$

$$9 = 10001$$

$$101$$

$$27 = 10101$$



11,111 → 75 / 751 /

C. (30%) Consider the following relation and its set of functional dependencies:

$S(A, B, C, D, E, F, G)$

$\{A \rightarrow BC, ABC \rightarrow D\}$

- List all of the candidate keys.
- Give the minimal cover of the set of functional dependencies.
- Name the strongest normal form that is not violated by the relation containing these attributes.
- Decompose S into a collection of BCNF relations if it is not in BCNF

a) $A \rightarrow BC \Rightarrow A \rightarrow ABC \rightarrow D$

AEG these candidate

b) $\{A \rightarrow B, A \rightarrow C, ABC \rightarrow D\}$

$A \rightarrow ABC \rightarrow D \Rightarrow A \rightarrow D$

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

c) 1NF, A low form
normal e violated ($A \rightarrow BC$)

$A \rightarrow B$ DF \leftarrow
DF partial \searrow reprim

d) $R_1(A, B, C, D)$ $R_2(A, B, C, E, F, G)$

$R_3(A, E, F, G)$ $R_4(A, B, C)$

R_4 redundant ($R_4 \subset R_{11}$)

$\Rightarrow R_7(A, B, C, D) \supseteq R_3(A, E, F, G)$

B. (15%) Fie relația $R(A,B,C)$ și dependența funcțională $A \rightarrow B$ ce este satisfăcută de R . Presupunând că decidem să descompunem relația în $R_1(A,B)$ și $R_2(B,C)$, dați un exemplu de instanță a relației R pentru care joncțiunea (join-ul) proiecțiilor pe R_1 și R_2 nu conduce la aceeași instanță inițială.

C. (20%) Se dă următoarea relație și mulțimea de dependențe funcționale ce sunt respectate de relație:

$$S(A, B, C, D) \quad F = \{B \rightarrow C, D \rightarrow A\}$$

- a) Determinați cheile relației S .
- b) Determinați care este cea mai puternică formă normală în care se află S .
- c) Dacă S nu este în forma normală a lui Boyce-Codd, determinați o descompunere BCNF a lui S cu joncțiuni fără pierderi și cu păstrarea dependențelor.

R			$R_1 \bowtie R_2$		
A	B	C	A	B	C
1	2	3	1	2	3
1	2	1	2	3	4
2	3	5	4	2	5
4	2	3			

A	B	C
1	2	3
1	2	4
2	3	5
4	2	3
4	2	4

C. $S(A, B, C, D)$, $\{B \rightarrow C, D \rightarrow A\}$

- a) $BD^+ = ABCD$
- b) 1NF (2NF is violated)

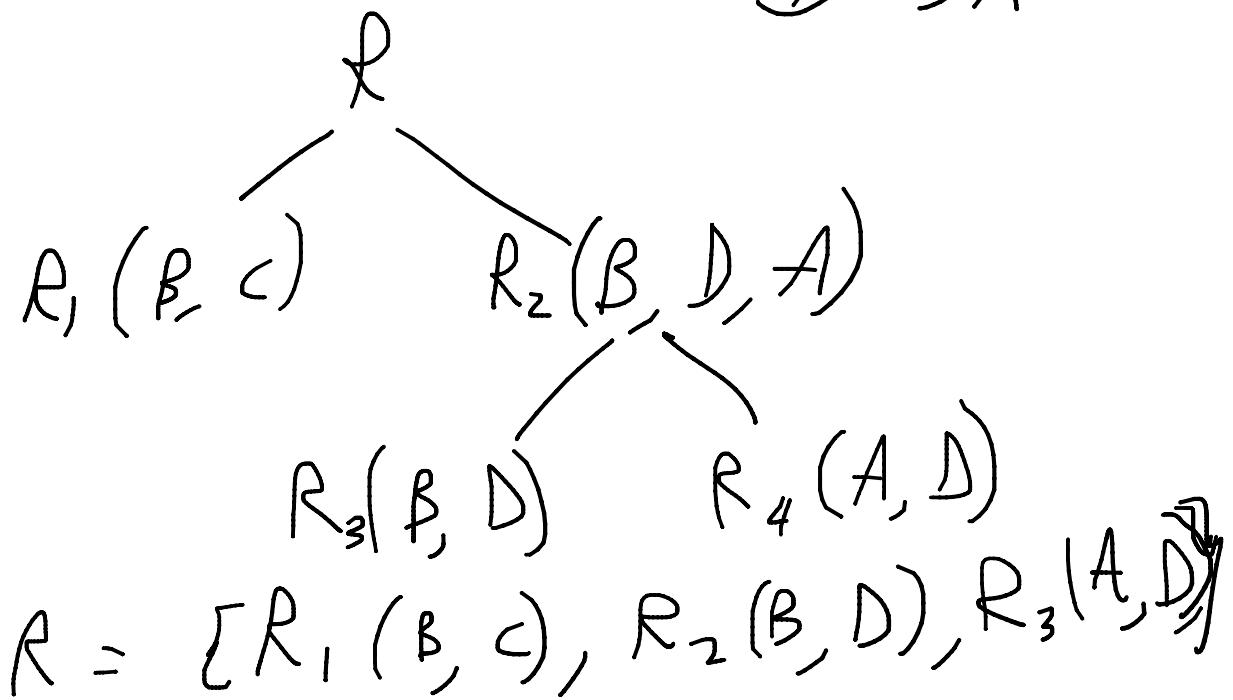
$D \rightarrow A$
 DF partiali
 attribut neprim

a)

$$\begin{aligned}
 & B \rightarrow C \quad \left. \begin{array}{l} B \rightarrow B \\ D \rightarrow A \end{array} \right\} \Rightarrow B \rightarrow BC \quad \left. \begin{array}{l} D \rightarrow AD \\ D \rightarrow D \end{array} \right\} \Rightarrow \\
 & \Rightarrow BD \rightarrow ABCD \Rightarrow BD \neq ABCD
 \end{aligned}$$

$R(A, B, C, D)$

$B \rightarrow C$
 $D \rightarrow A$

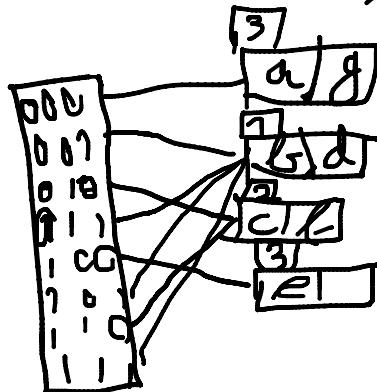
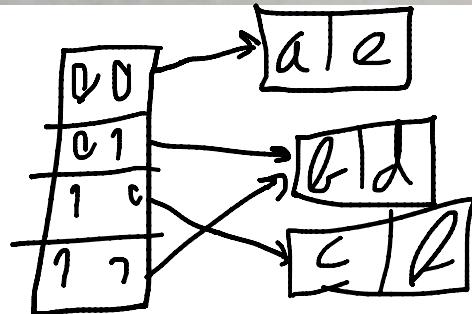
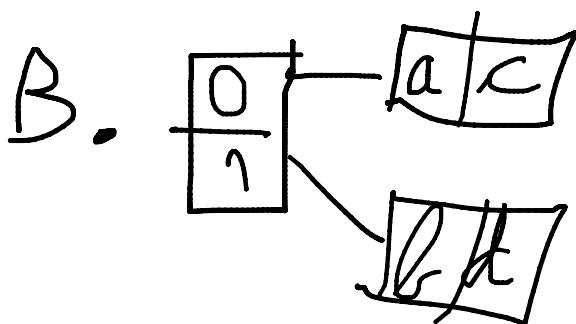


B. (15%) Presupunând că fiecare pagină de memorie a unui index cu acces direct necesită (Extensible Hash File) poate stoca cel mult 2 intrări, desenati configurația indexului după inserarea în ordine a următoarelor valori:

Key	Hash key
a	0000
b	0001
c	0010
d	0011
e	0100
f	0110
g	1000

C. (20%) Fie următoarea relație și multimea de dependențe funcționale satisfăcute de ea:
 $S(A, B, C, D) \quad (C \rightarrow D; C \rightarrow A, B \rightarrow C)$

- Determinați cheile candidat.
- Determinați care este cea mai puternică formă normală în care se află S (3NF, 2NF sau BCNF).
- Dacă S nu este în forma normală a lui Boyce-Codd, determinați o descompunere BCNF a lui S cu juncții fără pierderi și cu păstrarea dependențelor.



0 0 0 - a | a

1 0 * 0 - e

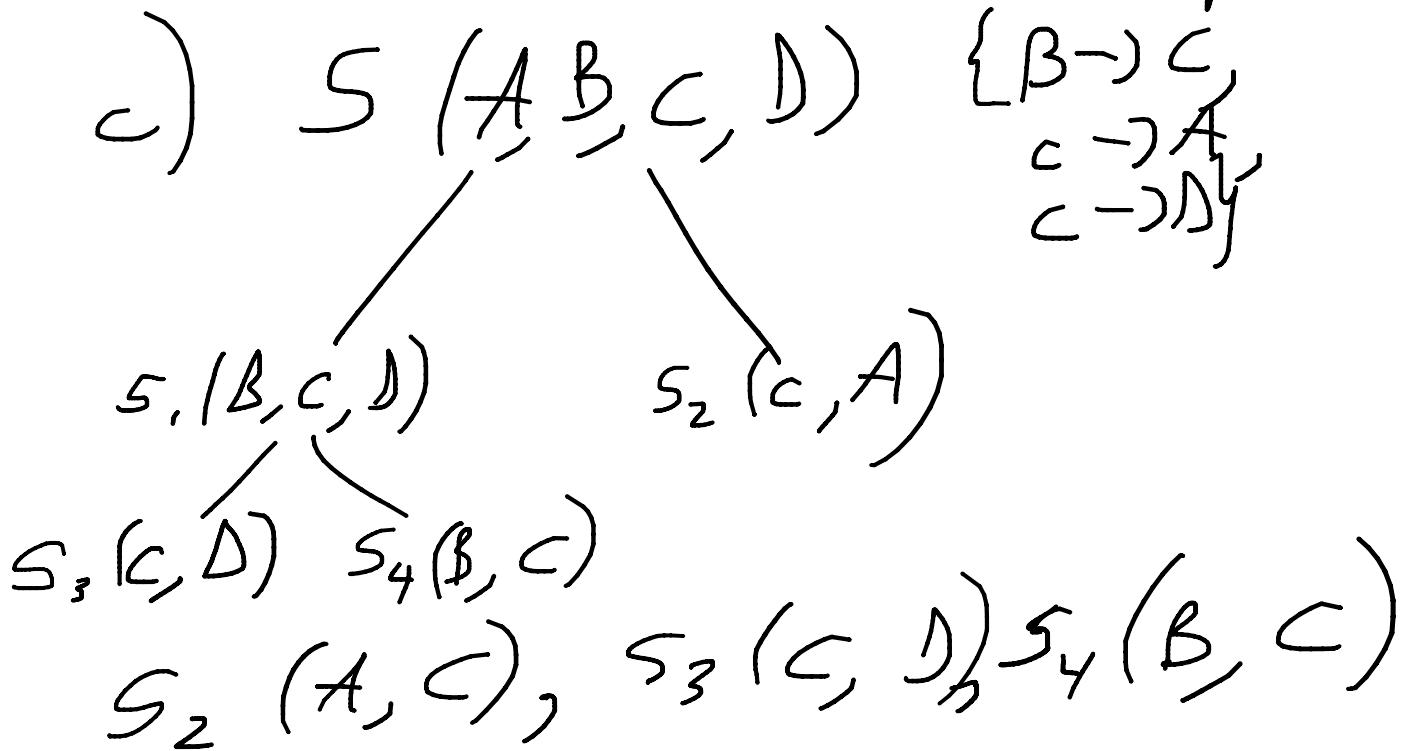
C. $S(A, B, C, D) \quad \{C \rightarrow D, C \rightarrow A, B \rightarrow C\}$

a) $B \rightarrow C$
 $C \rightarrow D$
 $C \rightarrow A$
 $R \rightarrow A$

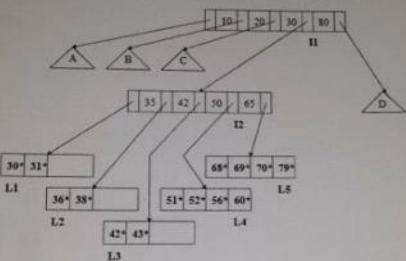
$$\Rightarrow B^+ = A B C D$$

b) 1NF 2NF

Nu aparține 3NF deoarece: $C \rightarrow A$
at. nepri at. nepri



B. Consider the following B+ tree index of order 5 (A,B,C and D are sub-trees). Show the B+ tree that would result from inserting a record with search key '64'.



C. Consider a relation with four attributes ABCD and the following functional dependencies: $BC \rightarrow D$, $BC \rightarrow A$, $D \rightarrow B$, $A \rightarrow C$

a) Identify the key(s) for the relation

b) Explain why the relation is not in BCNF but in 3NF.

c) Decompose it into a set of BCNF relations.

$$C. S(A, B, C, D)$$

$$\{ BC \rightarrow D, BC \rightarrow A, D \rightarrow B, A \rightarrow C \}$$

a) $\begin{array}{l} BC \rightarrow D \\ BC \rightarrow A \\ BC \rightarrow BC \end{array} \Rightarrow BC^+ = ABCD$

$\begin{array}{l} D \rightarrow B \\ A \rightarrow C \\ D \rightarrow D \end{array} \Rightarrow AD^+ = ABCD$

$\begin{array}{l} D \rightarrow B \Rightarrow DC \rightarrow BC \\ BC \rightarrow A \\ D \subset DC \end{array} \Rightarrow CD^+ = ABCD$

$\begin{array}{l} A \rightarrow C \\ A \rightarrow A \\ BC \rightarrow D \\ AB \rightarrow AB \end{array} \Rightarrow AB^+ = ABCD$

(Q) 1 NF evident

2 NF evident

3 NF $\not\exists$ attribute non-prime

~~BCNF~~ $A \rightarrow C$ in C there

$$C. S(A, B, C, D) \quad \swarrow \quad \nwarrow$$

$$\{ BC \rightarrow D, BC \rightarrow A, D \rightarrow B, A \rightarrow C \}$$

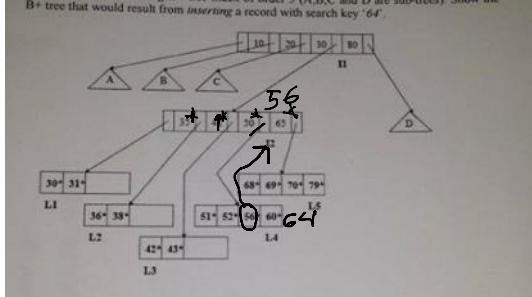
$$S_1(A, C, D) \quad S_2(B, D)$$

$$S_3(A, D) \quad S_4(A, C)$$

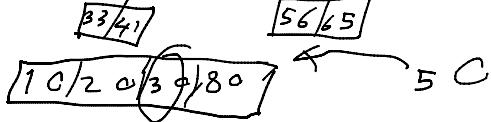
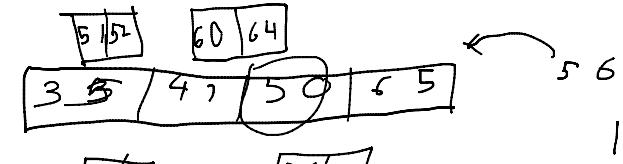
$$S_2(B, D) \quad S_3(A, D) \quad S_4(A, C)$$

B.

B. Consider the following B+ tree index of order 5 (A,B,C and D are sub-trees). Show the B+ tree that would result from inserting a record with search key '64'.
B+ tree index of order 5

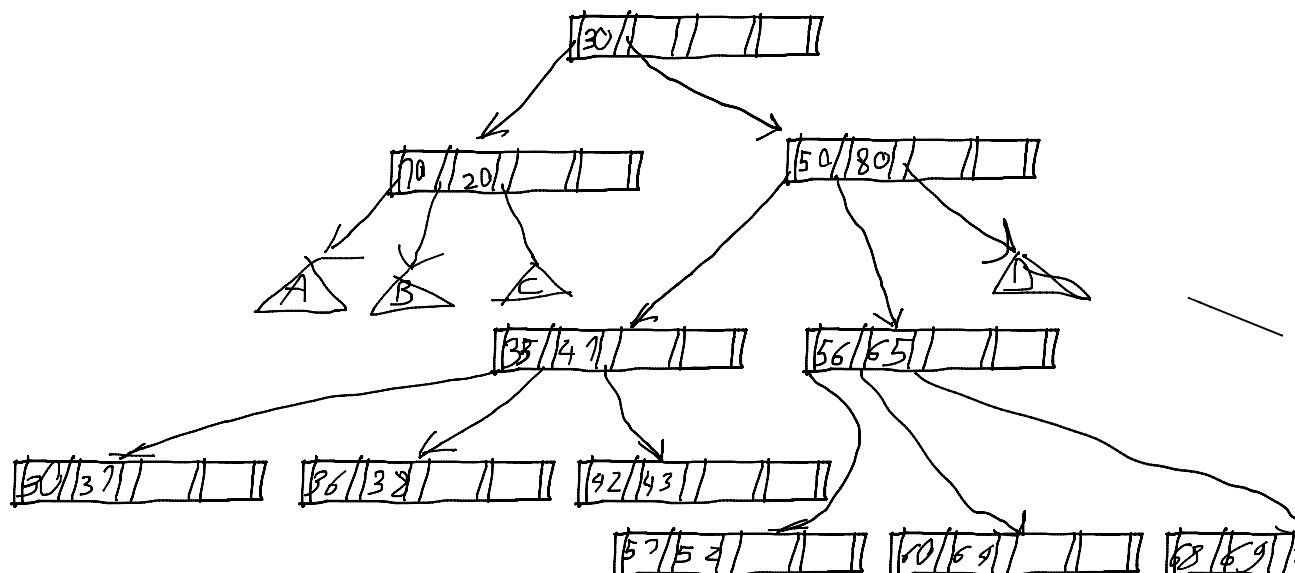


5 1 5 2 5 4 0 6 4



10 20

50 80

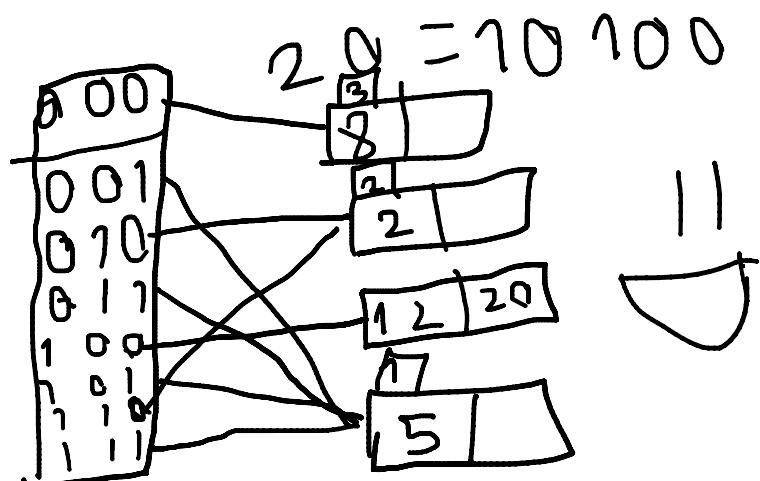
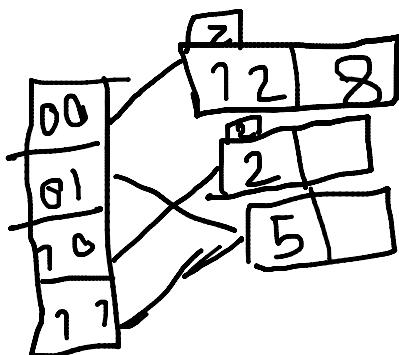


70112911

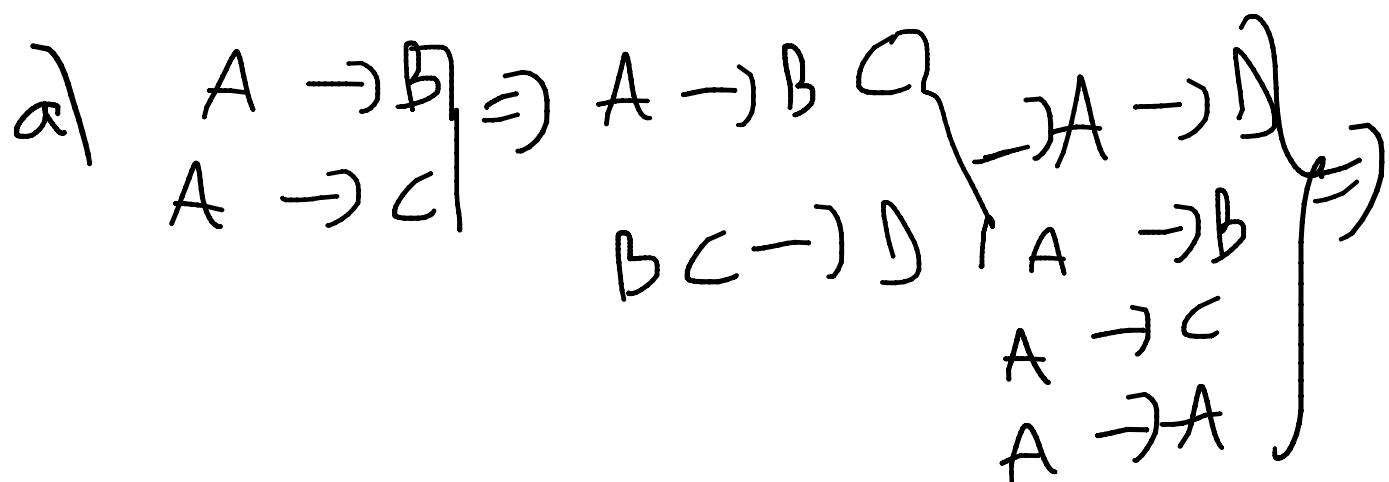
B. (15%) Give an example of an Extendible Hashing index file for which it is necessary to increase the global depth from 2 to 3 when the value '20' is inserted. Show your structure before and after the insertion.

C. (30%) Consider the following relation and the set of functional dependencies:
 $R(A,C,B,D)$, $\{A \rightarrow B, BC \rightarrow D, A \rightarrow C\}$

- a) Identify the key(s) for the relation.
- b) State the strongest normal form that the relation is in.
- c) If R is not in BCNF, decompose it into a set of BCNF relations that preserve the dependencies



$\subset R(A, B, C, D)$ $A \rightarrow B, B \leftarrow D, A \rightarrow C$



$$\Rightarrow A^+ = ABCD$$

b) 1NF evident

2NF evident

3NF $BC \rightarrow D$

grup de dr.
reprime

at. reprime

c) $BC \rightarrow D$

$S(A, B, C, D)$

$S_1(A, B, C) \xrightarrow{A \rightarrow BC} S_2(B, C, D)$

C. Este urm. relație și multimea de dependențe funcționale

$$R(A, B, C, D, E), \{ A \rightarrow B, C \rightarrow D \}$$

- a) Set. cheile candidat
- b) Care este rea mai mare formă normală în care se află relația? Explicați.
- c) Dacă relația nu se află în forma normală Boyce-Codd, determinați o descompunere a se află în forma normală Boyce-Codd cu păstrarea dependențelor

a) $A \subset E^+ = AB \subset \underline{D}E$

b) 1NF \rightarrow 2NF - $\boxed{A \rightarrow B}$
 ΔF partial

c) $A \rightarrow B$ $C \rightarrow D$

$$S(A, B, C, D, E)$$

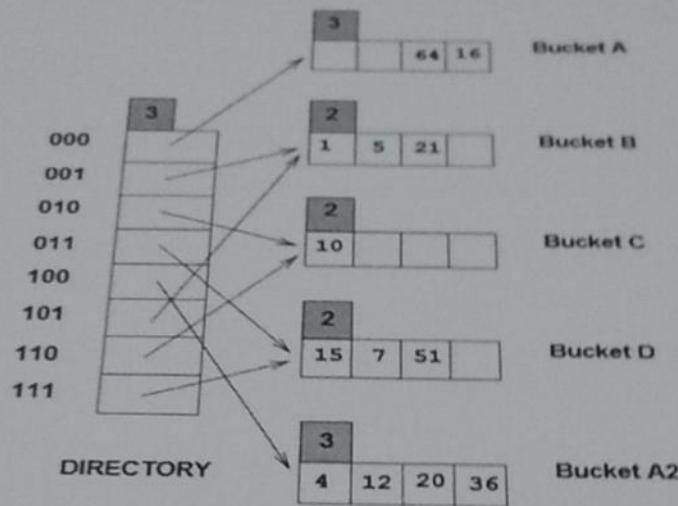
$$S_1(A, B)$$

$$S_2(A, C, D, E)$$

$$S_3(C, D)$$

$$S_4(A, C, E)$$

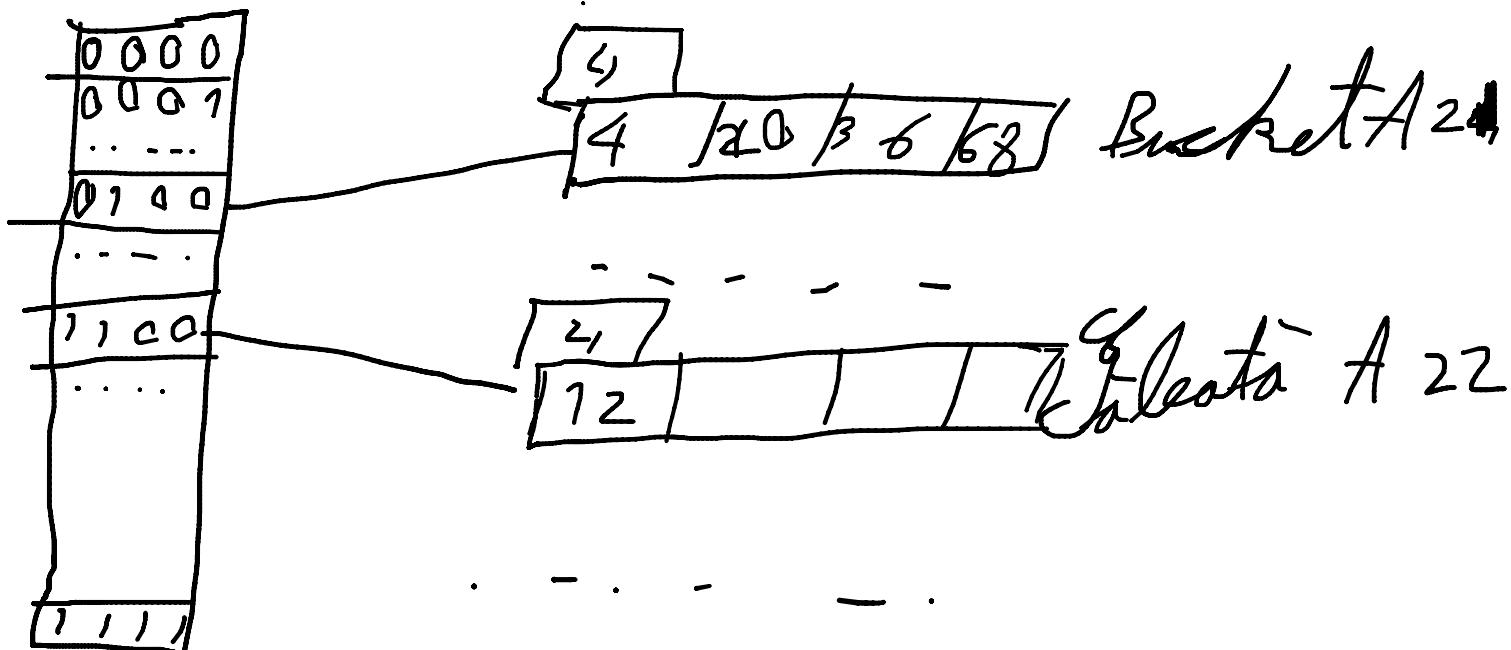
B. Consider the following Extendible Hashing index. Show the index after inserting an entry with hash value 68.



C. Consider the following relation and the set of functional dependencies:

$$R(A, C, B, D, E), \{A \rightarrow B, C \rightarrow D\}$$

- a) Identify the key(s) for the relation.
- b) State the strongest normal form that the relation is in.
- c) If it is not in BCNF, decompose it into a collection of BCNF relations.



C.