

### Answers of Problem 1:

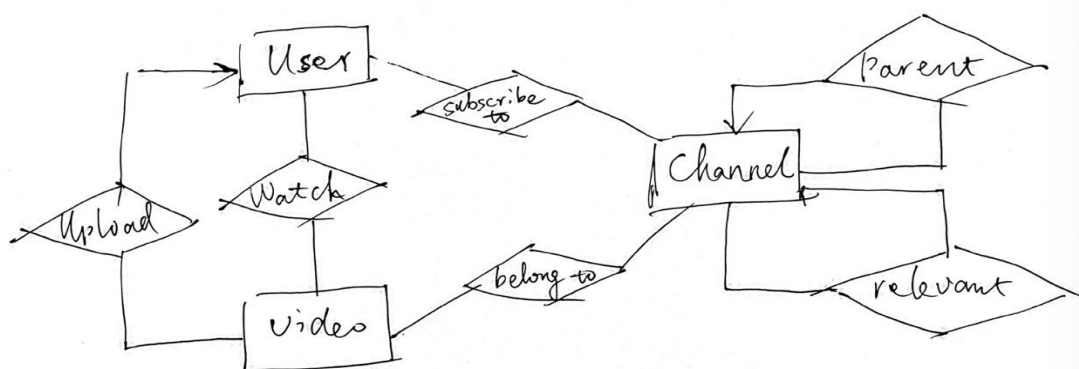
- (1)  $\Pi_{pname}(\text{project} \bowtie (\sigma_{cname="X Bank"}(\text{client})))$
- (2) Create table participate (  
    eId char(12),  
    pId char(12),  
    role char(24),  
    primary key (eId,pId),  
    foreign key (eId) references employee,  
    foreign key (pId) references project,  
    check role in ("project manager", "developer", "tester"))
- (3) select eName from employee where eId in (select eId from participate group by eId having count(distinct role) = 3)
- (4) select eName from employee natural join participate where pId = "p1102" and eSalary in (select max(salary) from employee natural join participate where pId = "p1102")

or

with pemmployee(eId, eName, salary) as (select eId,eName, salary from employee where eId in (select eId from participate where pId = "p1102"))  
select eName from pemmployee where salary in (select max(salary) from pemmployee)

- (5) participate (eId, pId, roleId)  
    role (roleId, roleName)

### Answers of Problem 2:

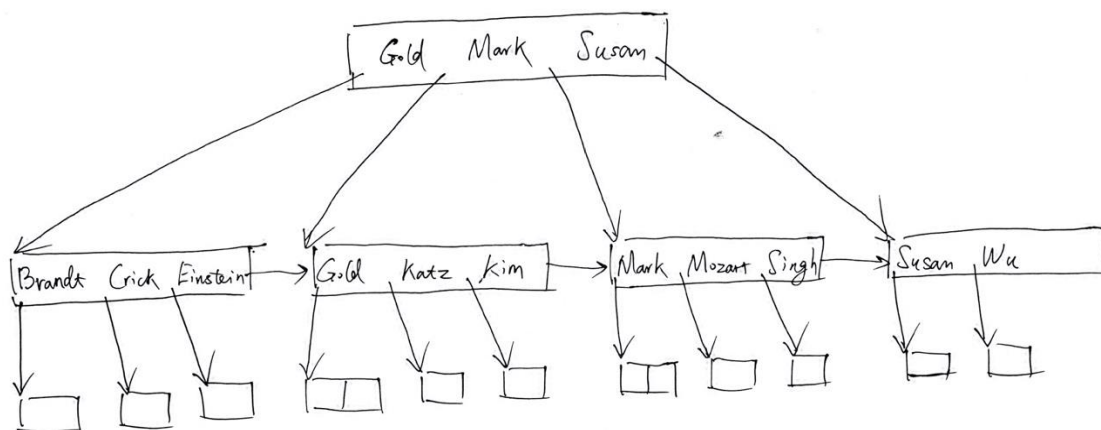


### Answers of Problem 3:

- (1) ABI
- (2)  $F_c = \{B \rightarrow CH, AC \rightarrow D\}$
- (3) (ACD, BCH, ABI) : dependency preserving; or (BCH, ABD, ABI): not dependency preserving

### Answers of Problem 5:

- (1)



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(2) max entries per node :  $\lfloor (4096-4)/(32+4) \rfloor = 113$ ,  $n = 114$ ; B+-tree max height =  $\lfloor \log_{57} 9000 + 1 \rfloor = 3$ ; worst case blocks to read:  $3(\text{B+-tree blocks}) + 1(\text{bucket block}) + 5(\text{one block for each employee}) = 9$

### **Answers of Problem 6:**

- (1) a. Shanghai client number:  $500/100 = 5$   
b. estimated size =  $5 * 40000 / V(cId, project) = 500$   
(2) blocks of employee:  $30000/40 = 750$ ; blocks of participate:  $40000/100 = 400$   
(3) most optimistic:  $M = 50$ ,  $n = 400/50 = 8$ ,  $b_b = \lfloor 50 / (8+1) \rfloor = \lfloor 50/9 \rfloor = 5$   
Transfers:  $3(b_r + b_s) + 4n = 3*(1150) + 32 = 3450 + 32$   
Seeks:  $2(\lceil b_r / b_b \rceil + \lceil b_s / b_b \rceil) + 2n = 2(\lceil 750/5 \rceil + \lceil 400/5 \rceil) + 16 = 460 + 16$

or

considering fudge factor = 1.2:

$$M = 50, n = \lceil 8 * 1.2 \rceil = 10, b_b = \lfloor 50 / (10+1) \rfloor = \lfloor 50/11 \rfloor = 4$$

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### **Answers of Problem 7:**

- (1) normal: 250000; 250000+800; 250000+1500; 250000+2300; extra: 250000+1000 (there is no "190012"); 250000+500; 250000+1300 (there is no "181020").  
(2) Yes. T1 read "181020"; T3 write "190012"; T1 read "190012"; T3 write "181020"  
(3) No

### **Answers of Problem 8:**

- (1) t1: write <checkpoint LTransactions> to log buffer; output log buffer to log file;  
t3: output log buffer to log file; output B1 to disk;  
t7: do nothing for log or data. (save pointer of <checkpoint L> to a save place)  
(2) t2: write a data modification log to log buffer; modify B1; do nothing to others  
(3) redo: T2, T4; undo: T3  
(4) redo start: t1; undo end: beginning of T3