实验二设计文档

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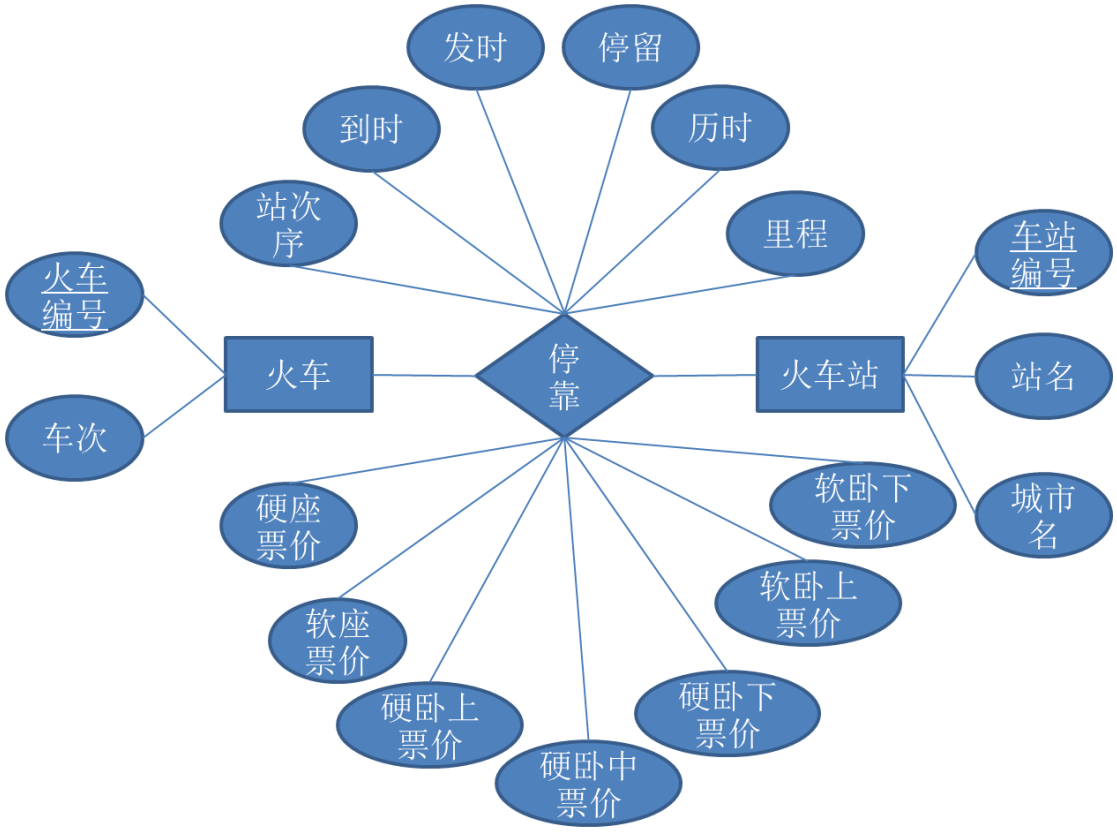
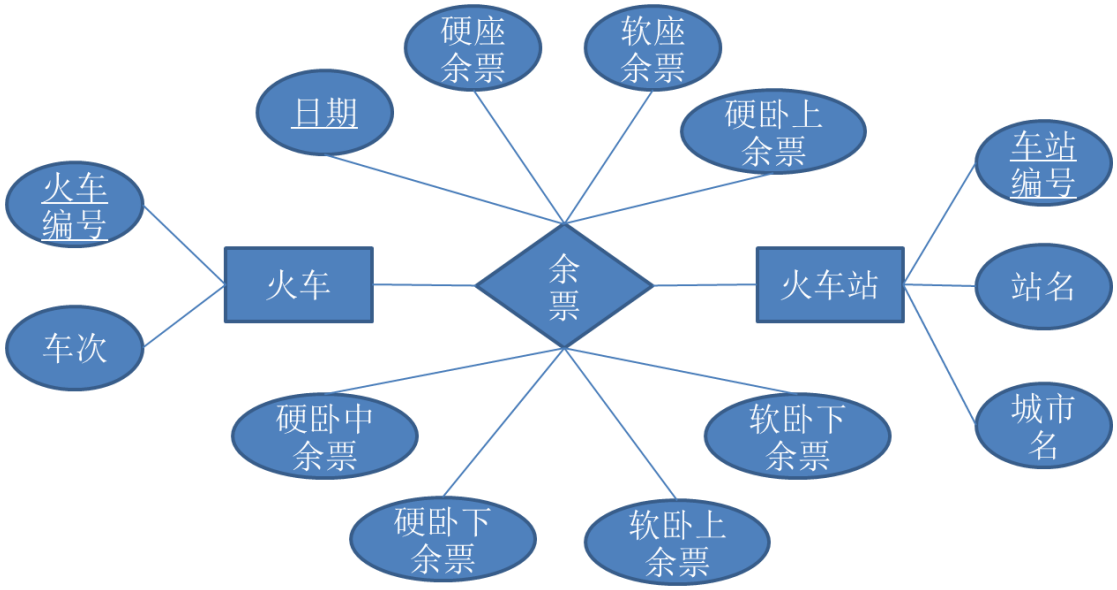
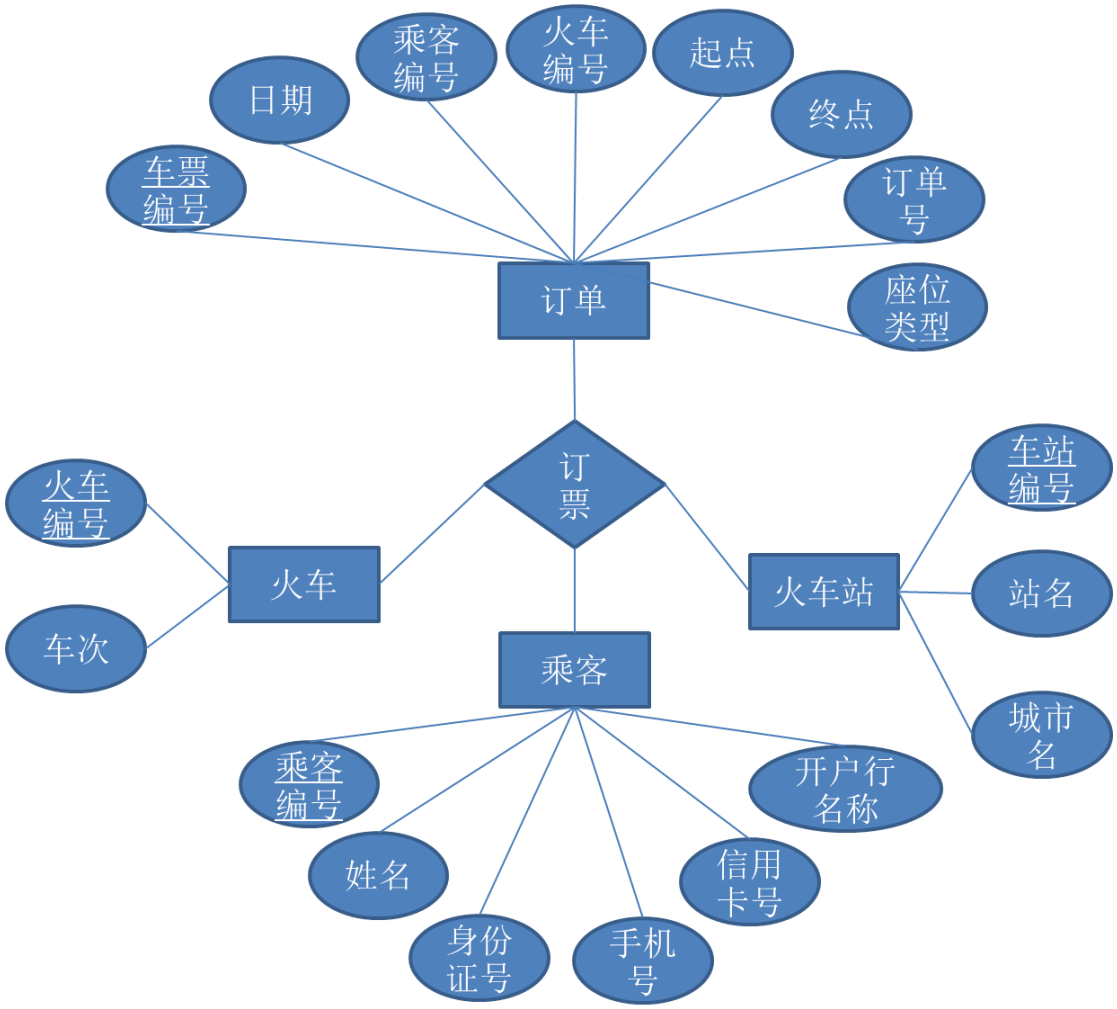
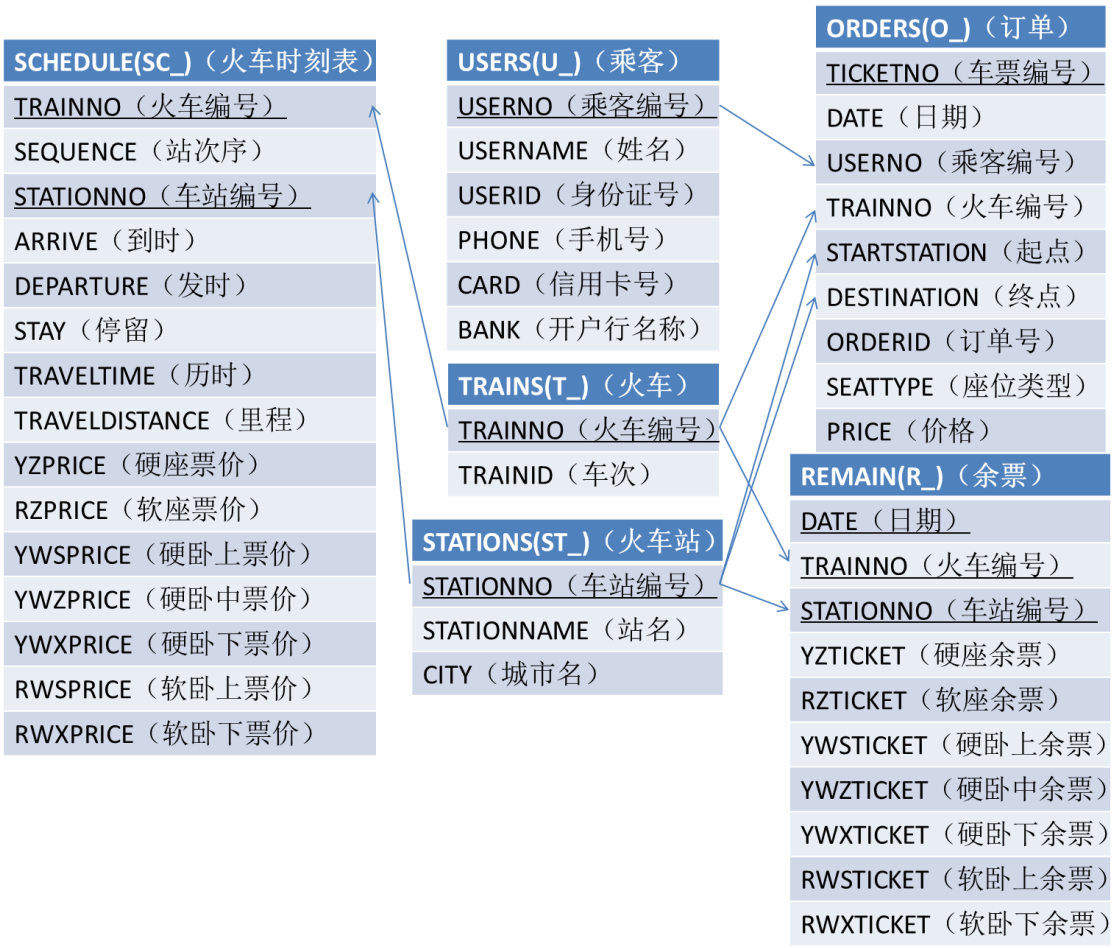
一、 ER 图






乘客编号
火车编号
起点
日期
终点
车票编号
订单号
订单
座位类型
订票
车站编号
火车编号
火车
站名
车次
火车站
乘客
城市名
乘客编号
开户行名称
姓名
信用卡号
身份证号
手机号

二、 关系模型



(train)TRAINS Table Layout

Column Sign	Column Name	Datatype Requirements	Comment
t_tid	T_TRAINNO	integer	primary key
t_name	T_TRAINID	char(32)	unique

(station)STATIONS Table Layout

Column Sign	Column Name	Datatype Requirements	Comment
s_sid	ST_STATIONNO	integer	primary key
s_name	ST_STATIONNAME	char(20)	unique
s_city	ST_CITY	char(20)	not null

(infor)SCHEDULE Table Layout

Column Sign	Column Name	Datatype Requirements	Comment
i_tid	SC_TRAINNO	integer	primary key, foreign key (T_TRAINNO)
i_sorder	SC_SEQUENCE	integer	not null
i_sid	SC_STATIONNO	integer	primary key, foreign key (ST_STATIONNO)
i_atime	SC_ARRIVE	time	
i_dtime	SC_DEPARTURE	time	
i_stay	SC_STAY	char(20)	
i_ttime	SC_TRAVELTIME	Integer	not null
i_distance	SC_TRAVELDISTANCE	Integer	not null
i_yzprice	SC_YZPRICE	decimal(15,2)	
i_rzprice	SC_RZPRICE	decimal(15,2)	
i_ywsprice	SC_YWSPRICE	decimal(15,2)	
i_ywzprice	SC_YWZPRICE	decimal(15,2)	
i_ywxprice	SC_YWXPRICE	decimal(15,2)	
i_rwsprice	SC_RWSPRICE	decimal(15,2)	
i_rwxprice	SC_RWXPRICE	decimal(15,2)	

(remaining)REMAIN Table Layout

Column Sign	Column Name	Datatype Requirements	Comment
r_time	R_DATE	date	primary key
r_tid	R_TRAINNO	integer	primary key, foreign key (T_TRAINNO)
r_sid	R_STATIONNO	integer	primary key, foreign key (ST_STATIONNO)
r_yzleft	R_YZTICKET	integer	not null
r_rzleft	R_RZTICKET	integer	not null
r_ywsleft	R_YWSTICKET	integer	not null
r_ywzleft	R_YWZTICKET	integer	not null
r_ywxleft	R_YWXTICKET	integer	not null
r_rwsleft	R_RWSTICKET	integer	not null
r_rwxleft	R_RWXTICKET	integer	not null

(passenger)USERS Table Layout

Column Sign	Column Name	Datatype Requirements	Comment
p_pid	U_USERNO	integer	primary key
p_name	U_USERNAME	char(20)	not null
p_idcard	U_USERID	char(20)	unique
p_tele	U_PHONE	char(20)	not null
p_credit	U_CARD	char(20)	not null
p_bank	U_BANK	char(20)	not null
p_password	U_PASSWORD	char(20)	not null

(orders)ORDERS Table Layout

Column Sign	Column Name	Datatype Requirements	Comment
o_tiid	O_TICKETNO	integer	primary key
o_time	O_DATE	date	not null
o_pid	O_USERNO	integer	not null, foreign key (U_USERNO)
o_tid	O_TRAINNO	integer	not null, foreign key (T_TRAINNO)
o_dsid	O_STARTSTATION	integer	not null, foreign key (ST_STATIONNO)
o_asid	O_DESTINATION	integer	not null, foreign key (ST_STATIONNO)
o_oid	O_ORDERID	integer	not null
o_type	O_SEATTYPE	char(20)	not null
o_price	O_PRICE	decimal(15,2)	not null

三、 范式细化及分析

我们认为现在的关系模型满足 BCNF，原因如下：

1. 因为所有属性都是原子类型，所以关系模型满足 1NF。
2. 因为候选键只包含一个属性的关系不存在部分依赖，又因为对于候选键包含多个属性的关系，即 SCHEDULE 中的(SC_TRAINNO, SC_SEQUENCE)和(SC_TRAINNO, SC_STATIONNO)，REMAIN 中的(R_DATE, R_TRAINNO, R_STATIONNO)，ORDERS 中的 (O_DATE, O_USERNO, O_TRAINNO, O_STARTSTATION, O_DESTINATION, O_SEATTYPE)，候选键的任意真子集都不存在非平凡的函数依赖，所以关系模型满足 2NF。您可能会认为 ORDERS 的(O_TRAINNO, O_STARTSTATION, O_DESTINATION, O_SEATTYPE)与 O_PRICE 之间存在函数依赖，我们也考虑过这个问题，结论是 O_PRICE 记录的是买票时的票价，虽然 SCHEDULE 中的可能会随发生变化，但买票时的票价是不变的。
3. 因为检查各表中的非键属性后，未发现非键传递依赖，所以关系模型满足 3NF。
4. 可能存在对于键属性的函数依赖的关系只有 SCHEDULE，因为 SCHEDULE 的两个候选键(SC_TRAINNO, SC_SEQUENCE)和(SC_TRAINNO, SC_STATIONNO)有公共的属性，但 SC_SQUENCE 与 SC_STATIONNO 之间不存在函数依赖，所以关系模型满足 BCNF。

四、 查询语句的模版

说明：因为数据库实现的时候用的列名与设计关系模型的时候不一样，所以以下的 SQL 语句中的均为数据库实现时用的列名，而非关系模型中的列名。列明的对照表请见关系模型部分。

乘客注册：

```
insert into passenger(p_name, p_idcard, p_tele, p_credit, p_bank)
    values ($1, $2, $3, $4, $5);
```

查询指定日期的指定车次：

```
select i_sorder, s_name, i_atime, i_dtime, i_yzprice, r_yzleft, i_rzprice,
    r_rzleft, i_ywsprice, r_ywsleft, i_ywzprice, r_ywzleft, i_ywxprice,
    r_ywxleft, i_rwsprice, r_rwsleft, i_rwxprice, r_rwxleft
from station, infor, remaining, train
where i_sid=r_sid and i_tid=r_tid and i_sid=s_sid and i_tid=t_tid and
    t_name=$1 and r_time=$2
order by i_sorder;
```

查询直达列车：

```
select t_name,s1.s_name,s2.s_name,i3.i_dtime,i3.i_atime,i3.i_dttime,
    i3.i_attime,i3.i_dprice,i3.i_aprice
from
    (select i1.i_tid as i_tid,i1.i_sid as i_dsid,i2.i_sid as i_asid,
        i1.i_dtime as i_dtime,i2.i_atime as i_atime, i1.i_yzprice as i_dprice,
        i1.i_ttime as i_dttime,i2.i_ttime as i_attime,i2.i_yzprice as i_aprice
    from infor as i1,infor as i2
    where i1.i_tid=i2.i_tid
        and i1.i_tid in
            ((select i_tid
            from infor
            where i_sid =$2)
            intersect
            (select i_tid
            from infor
            where i_sid =$1))
        and i1.i_sid =$2
        and i2.i_sid =$1
        and i1.i_sorder<i2.i_sorder) i3,train,station as s1,station as s2
where i3.i_tid=train.t_tid
    and i3.i_dsid=s1.s_sid
    and i3.i_asid=s2.s_sid
order by i3.i_dtime;
```

查询换乘一次的列车：

```
select td.t_name,ta.t_name,s_name
from
    (select i3.t1 as i_dtid,i3.t2 as i_atid,i3.i_sid as i_zzsid
     from
        (select i1.i_tid as t1,i2.i_tid as t2,i2.i_sid
         from
            (select *
            from infor
            where i_tid in
                (select i_tid
                from infor
                where i_sid=$1)) i1,
            (select *
            from infor
            where i_tid in
                (select i_tid
                from infor
                where i_sid=$2)) i2
        where i1.i_sid=i2.i_sid) i3
     where
        (select i_sorder
        from infor
        where i_tid=i3.t1 and i_sid=i3.i_sid)>(select i_sorder
                                               from infor
                                               where i_tid=i3.t1
                                                   and i_sid=$1)
              and (select i_sorder
                   from infor
                   where i_tid=i3.t2 and i_sid=i3.i_sid)<(select i_sorder
                                                          from infor
                                                          where i_tid=i3.t2
                                                              and i_sid=$2)
              and i3.t1!=i3.t2 and i3.i_sid!=$1 and i3.i_sid!=$2
        group by i3.t1,i3.t2,i3.i_sid) i4,train as td,train as ta,station
where td.t_tid=i4.i_dtid
        and ta.t_tid=i4.i_atid
        and s_sid=i4.i_zzsid;
```

生成订单：

```
select t_tid from train where t_name=$1;
```

```
select i_sid, i_yzprice, i_rzprice, i_ywsprice, i_ywzprice, i_ywxprice,
    i_rwsprice, i_rwxprice
from infor
where i_tid=$1 and i_sorder=$2;
```

```
select count(distinct o_oid) from orders;
```

```
select p_pid from passenger where p_idcard=$1;
```

```
insert into orders(o_time, o_pid, o_tid, o_dsid, o_asid, o_oid, o_type, o_price)
    values($1, $2, $3, $4, $5, $6, $7, $8);
```

打印订单详细信息：

```
select o_oid, t_tid, start.s_name, dest.s_name, o_type, o_price, o_time, i_dtime
from orders, train, station start, station dest, infor
where o_oid=$1 and o_tid=t_tid and o_dsid=start.s_sid and o_asid=dest.s_sid and
    o_tid=i_tid and o_dsid=i_sid;
```

查询订单：

```
select o_tiid, o_oid, o_time, i_dtime, start.s_name, dest.s_name, o_price
from orders, station start, station dest, infor
where o_time between $1 and $2 and o_tid=i_tid and o_dsid=i_sid and
    o_dsid=start.s_sid and o_asid=dest.s_sid
order by o_oid, o_tiid;
```

删除订单：

```
delete from orders where o_oid=$1;
```

管理员信息：
查询总订单数：

```
select count(distinct o_oid) from orders;
```

查询总票价：

```
select sum(o_price) from orders;
```

查询总订票费，需要知道订过的全部票数：

```
select count(*) from orders;
```

查询热点车次：

```
select t_name, count(*) as number
from train, orders
where t_tid=o_tid
group by t_name
order by number desc;
```