Abstract Query Languages

- Domain Relational Calculus (logic-based)
  (High-level – Declarative)
- Datalog (logic-based)
  (Mid-level – Mix of declarative/procedural)
- Relational Algebra
  (Low-level – Procedural)

Mail Order Database

CUSTOMERS(CNO,CNAME,STREET,ZIP,PHONE)

PARTS(PNO,PNAME,QOH,PRICE,OLEVEL)

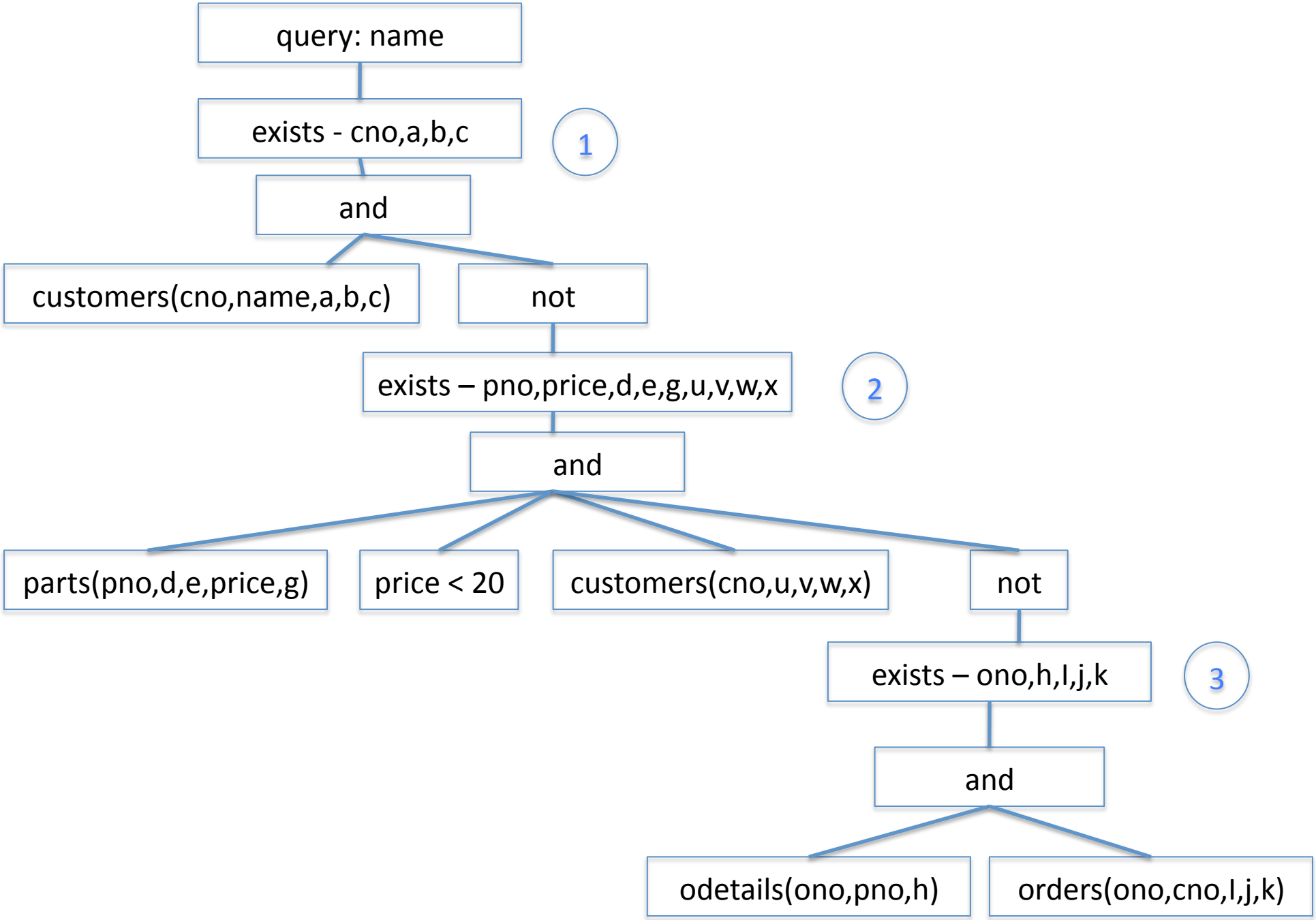
ORDERS(ONO,CNO,ENO,RECEIVED,SHIPPED)

ODETAILS(ONO,PNO,QTY)

Query - DRC

Retrieve the names of customers who have ordered ALL parts costing less than $20.00.

```
{name | (exists cno,a,b,c)(customers(cno,name,a,b,c) and
           not ((exists pno,price,d,e,g,u,v,w,x)(
                    parts(pno,d,e,price,g) and
                    price < 20 and
                    customers(cno,u,v,w,x) and
                    not ((exists ono,h,i,j,k)(
                             odetails(ono,pno,h) and
                             orders(ono,cno,i,j,k)
                         ))
                ))
        )
}
```


query: name
exists - cno,a,b,c
1
and
customers(cno,name,a,b,c)
not
exists – pno,price,d,e,g,u,v,w,x
2
and
parts(pno,d,e,price,g)
price < 20
customers(cno,u,v,w,x)
not
exists – ono,h,I,j,k
3
and
odetails(ono,pno,h)
orders(ono,cno,I,j,k)

DRC to Datalog

```
temp3(pno,cno) :-
  odetails(ono,pno,h),
  orders(ono,cno,i,j,k).

temp2(cno) :-
  parts(pno,d,e,price,g),
  price < 20,
  customers(cno,u,v,w,x),
  not temp3(pno,cno).

answer(name) :-
  customers(cno,name,a,b,c),
  not temp2(cno).
```

DRC to Relational Algebra (via Datalog)

```
temp3(pno,cno) := rename[ono,pno,h](odetails) join
                  rename[ono,cno,i,j,k](orders)

temp2(cno) :- select[price < 20](
                    rename[pno,d,e,price,g](parts) join
                    rename[cno,u,v,w,x](customers)
              )
              join
              ((project[pno](rename[pno,d,e,price,g](parts)) times
                project[cno](rename[cno,u,v,w,x](customers)))
               minus
               rename[pno,cno](temp3)
              )

answer(name) :=  project[name](
                   rename[cno,name,a,b,c](customers) join
                   ( project[cno](rename[cno,name,a,b,c](customers)
                     minus
                     temp2(cno)
                   )
                 )
```