1 Relational Algebra

The database we work with:

- Knights(kid:integer, name:string, age:int, overlord:string)
- Princesses(pid:integer, name:string, age:int, overlord:string)
- Weapons(wid:integer, name:string, price:real)
- Purchases(kid:integer, wid:integer, timestamp:date, discount:bool)

$$\rho(K, \text{Knights})$$
$$\rho(Pr, \text{Princesses})$$
$$\rho(W, \text{Weapons}$$
$$\rho(P, \text{Purchases})$$

1.1 Find the name and kid of all knights who have purchased a weapon.

$$\pi_{\text{name, kid}}(P \bowtie K)$$

1.2 Find the names of all knights who are named John Fist or are older than 30.

$$\pi_{\text{name}}(\sigma_{\text{name = ``John Fist''} \vee \text{age} > 30}(K))$$

1.3 Find the names of all knights who have bought a weapon that has a listed price of more than 200 gold pieces.

$$\pi_{\text{name}}(\pi_{\text{kid}}((\pi_{\text{wid}}\sigma_{\text{price} > 200}W) \bowtie P) \bowtie K)$$

1.4 Find the names of all knights who have purchased more than one weapon and have Lord Schrapnel as overlord.

$$\rho(P1, P)$$
$$\rho(P2, P)$$
$$\pi_{\text{name}}\sigma_{\text{overlord = ``Lord Schrapnel''}}(\pi_{\text{P1.kid}}\sigma_{\text{P1.kid = P2.kid} \wedge \text{P1.wid} \neq \text{P2.wid}}((P1 \times P2) \bowtie K))$$

1.5 Find the names of all knights who are older than John Fist.

$$\rho(K1, \sigma_{\text{name = ``John Fist''}} K)$$
$$\pi_{\text{K.name}} \sigma_{\text{K.age > K1.age}} (K \times K1)$$

1.6 Find the names of all knights who have only bought discounted weapons and, in addition, have the same age and overlord as one of the princesses.

$$\rho(L, K \bowtie_{\text{overlord, age}} Pr)$$
$$\pi_{\text{name}}((\pi_{\text{kid}} P \setminus \pi_{\text{kid}} \sigma_{\text{discount = False}} P) \bowtie L)$$

1.7 Find the names of all knights who have purchased the most expensive weapon.

$$\rho(W1, W)$$
$$\rho(W2, W)$$
$$\rho(W3, (1 \to \text{wid}, 2 \to \text{name}, 3 \to \text{price}), \sigma_{\text{W1.price < W2.price}} (W1 \times W2))$$
$$\pi_{\text{name}}(\pi_{\text{kid}}((W \setminus \pi_{\text{wid, name, price}} W3) \bowtie P) \bowtie K)$$