# Fall 2022 B561 Assignment 1
# Relational Databases, Expressing Constraints and Queries in SQL, Python, and in Safe Tuple Relational Calculus (safe TRC)

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Discussed with Yu Mo

**Problem 20.(a)**

1. Find each pair $(d, m)$ where $d$ is the name of a department and $m$ is a major of a student who is employed by that department and who earns a salary of at least 20000.

$$\{(d.department, j.major) \mid department(d) \wedge studentMajor(j) \wedge \\ \exists e \in employedBy(e)(d.deptName = e.deptName \wedge e.sid = j.sid \wedge e.salary >= 20000)\}.$$

**Problem 20.(b)**

2. Find each pair $(d, m)$ where $d$ is the name of a department and $m$ is a major of a student who is employed by that department and who earns a salary of at least 20000.

$$\{(s1.sid, s2.sid) \mid Student(s1) \wedge Student(s2) \wedge s1.sid \neq s2.sid \wedge \\ (\forall f1 \in hasFriend(f1.sid1 = s1.sid \rightarrow \exists e1 \in employedBy(e1)(e1.sid = f1.sid2 \wedge e1.deptName =' CS'))) \wedge \\ (\forall f2 \in hasFriend(f2.sid1 = s2.sid \rightarrow \exists e2 \in employedBy(e2)(e2.sid = f2.sid2 \wedge e2.deptName =' CS'))).$$

**Problem 20.(c)**

3. Find each major for which there exists a student with that major and who does not only have friends who also have that major.

$$\{(j.major) \mid studentMajor(j) \wedge \exists hf \in hasFriend(hf.sid1, hf.sid2) \\ (hf.sid1 = j.sid1 \wedge (\exists j_1 \in studentMajor(j_1.sid = hf.sid2 \wedge j.sid \neq j_1.sid \wedge j_1.major \neq j.major))\}.$$

Problem 22.(a)

Some major has fewer than 2 students with that major

$$\exists m \;\; Major(m) \rightarrow count(\exists sm \;\; (studentMajor(sm) \wedge sm.major = m.major)) < 2$$

Problem 23.(a)

Each student who works for a department has a friend who also works for that department and who earns the same salary

$$\forall e \;\; employedBy(e) \rightarrow \exists hf \;\; (hasFriend(hf) \wedge hf.sid1 = e.sid \wedge$$
$$(\exists e2 \;\; (employedBy(e2) \wedge e2.deptName = e.deptName \wedge e.salary = e2.salary \wedge e2.sid = hf.sid2)))$$

Problem 24.(a)

All students working in a same department share a major and earn the same salary

$$\forall e1 \in employedBy \forall e2 \in employedBy(e1.deptName = e2.deptName \wedge e1.sid \neq e2.sid \rightarrow$$
$$\exists j_1 \in studentMajor \exists j_2 \in studentMajor(j_1.sid = e_1.sid \wedge e_1.salary = e_2.salary$$
$$j_2.sid = e_2.sid \wedge j_1.sid \neq j_2.sid \wedge j_1.major = j_2.major))$$