# Tutorial 5: Logical Database Design

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`StudentInfo(S, N, M, A, C, T, I, L, G)`

with the following FDs:

1. `S -> N`
2. `C -> T, I`
3. `I -> L`
4. `S, C, M -> G`
5. `S, M -> A`
6. `A -> M`

## 1 Find all keys and prove that you have found them all.

Since `S` and `C` do not appear in any RHS of the FDs,
`S` and `C` must be part of every key.
`(S C)`$^+$ = `S C N T I L` so `(S C)` is not a key.

Guess `(S C M)` and `(S C A)` are keys.
`(S C M)`$^+$ = `(S C M N T I L G A)` = `SI` so `(S C M)` is a superkey.
`(S C A)`$^+$ = `(S C A N T I L G M)` = `SI` so `(S C A)` is a superkey.
Since `(S C)` is not a key, so `(S C M)` and `(S C A)` are minimal, so they are keys.

Consider the maximal set `X` $\subseteq$ `(S N M A C T I L G)` such that `(S C)` $\subset$ `X` and `A, M` $\notin$ `X`. The maximal such `X` is `(S N C T I L G)`
`X`$^+$ = `(S N C T I L G)`$^+$ = `(S N C T I L G)` $\neq$ `SI`

Therefore, `(S C M)` and `(S C A)` are the only keys.

2 **Find a minimal cover for this set of FDs.**

3 **Obtain a lossless-join, BCNF decomposition of StudentInfo.**

4 **Obtain a lossless-join, dependency-preserving, 3NF decomposition of StudentInfo by making use of the BCNF decomposition in Question (f).**

5 **Obtain a lossless-join, dependency-preserving, 3NF decomposition of StudentInfo via synthesis by making use of your minimal cover in Question (e).**

6 **Comment on the differences, if any, between your answers to Questions (g) and (h).**