

Databases Autumn 2025

Hand-In Exercise 1

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Aiysha Frutiger
Jannick Seper
Luis Tritschler

Total Points	
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Task 1

- a) $AHV \rightarrow (FullName, Birthday, Zip, country)$

$FullName \rightarrow (FirstName, LastName)$

$Birthday \rightarrow YearOfBirth$

$(County, Zip) \rightarrow City$

The AHV uniquely identifies each resident. From these attributes, all others can be derived transitively: $FullName$ determines $(FirstName, LastName)$, $Birthday$ determines $YearOfBirth$, and $(Country, Zip)$ determines $City$. We thought about including $(Country, City) \rightarrow Zip$ but there are cities with multiple zips (Zürich for example) and that's why we did not include this dependency.

- b) With this functional dependencies we compute the attribute closure for AHV. F^+ is $(AHV, FullName, Birthday, Zip, Country, FirstName, LastName, YearOfBirth, City)$ = $sch(Resident)$. Since no subset of AHV determines all attributes, AHV is minimal and therefore the only candidate key.

- c) The relation Resident is in 2NF, since the only candidate key is AHV and therefore no partial dependencies on a subset of a composite key can exist. It is not in Third Normal Form, because there are several transitive dependencies. For example: $AHV \rightarrow (Zip, country)$ and $(Country, Zip) \rightarrow City$, hence $City$ is transitively dependent on AHV. Version in 3NF:

Resident(AHV, FullName, Birthday, Zip, Country)

Name(FullName, FirstName, LastName)

Birthday(Birthday, YearOfBirth)

Location(Zip, Country, City)

Task 2

- a) $\{\{A, B, C\}, \{A, C, D\}\}$

- b) i Because for FD2 B on the left is not a superkey, R is not in BCNF.
ii Because for FD3 E on the right which is not part of a primary key, R is not in 3NF.
iii Because in FD3, E (non-prime attribute) is dependent on C,D which is a subset of a candidate key, R is not in 2NF

R is only in 1NF.

Task 3

- a) $\{\{A, C\}, \{A, B\}\}$

- b) i S is in 2NF because in FD1, neither A nor B alone determine D and C is in the candidate keys. Also in FD2, although C is a proper subset of a candidate key, B is a primary key and therefore all rules for 2NF hold true.

- ii S is also in 2NF because in FD1, A, B is a candidate key and therefore a superkey and therefore 2NF is satisfied. Because C alone is not a superkey, but B is a prime key, this FD also satisfies 3NF.
- iii However, because C alone is not a superkey, it does not satisfy FD2 and therefore is not a BCNF.

Task 4

Task 5