Database Design:
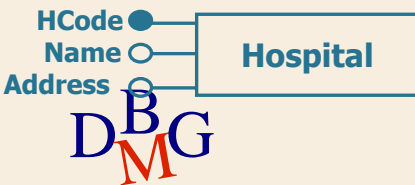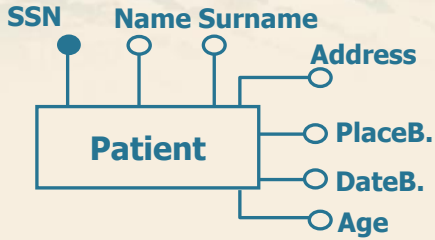# Use case requirements
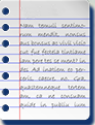
DBMG
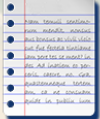
It is needed to design a database for the management of a system of booking medical examinations within a Local Health Company (LHC), taking into account the following information.
Each patient is characterized by a Social Secure Number (SSN), first name, last name, address, date of birth, place of birth and age.
Each hospital is characterized by a numeric code, a name and an address.

SSN   Name Surname
                    Address

┌─────────────────┐   ○ PlaceB.
│   Patient   │
│   │   ○ DateB.
└─────────────────┘   ○ Age

HCode ●
Name ○   ┌──────────────┐
Address ○ │   Hospital   │
          └──────────────┘
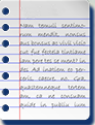
Each hospital is organized in wards identified by a numeric code unique within the hospital. Each ward is also characterized by the name and phone number.
The ward's staff is identified through the SSN. The first name, last name and home address are also known. Among the staff, in the case of the doctors, the list of specializations achieved is known, while for the volunteer staff the name of the association of belonging is known (if available).
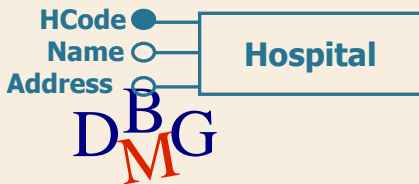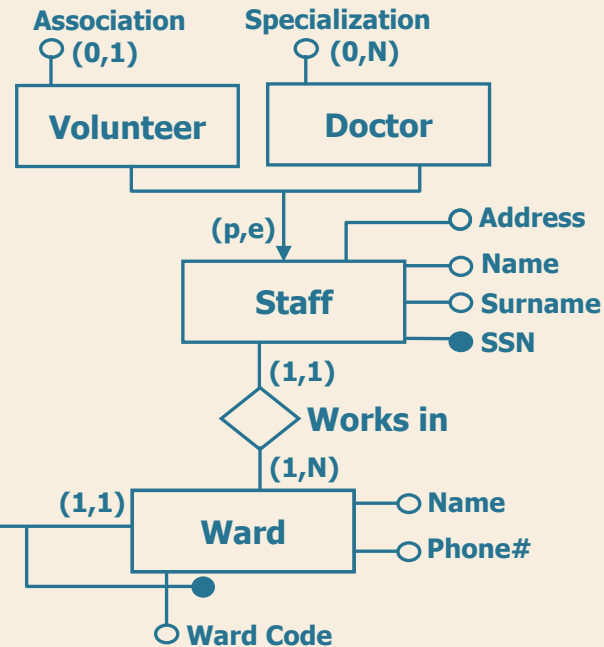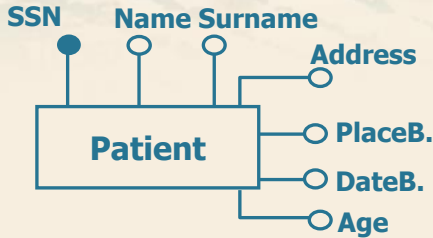
Medical examinations that can be performed are characterized by a numeric code and a textual description (e.g. X-ray, etc.). In the case of specialist examinations, the doctor who makes the visit and the description of the diet to be followed (if necessary) is also stored.
The laboratories that perform the examinations are identified by a code unique within the hospital and are characterized by the laboratory name, location plan and room number.

Patient — SSN, Name, Surname, Address, PlaceB., DateB., Age

Exam — ExamCode, Description

Specialistic Exam — Diet description (0,1)

Exam (p,e) Specialistic Exam (1,1) Made by (0,N) Doctor

Volunteer — Association (0,1)
Doctor — Specialization (0,N)

Volunteer / Doctor (p,e) Staff

Staff — Address, Name, Surname, SSN

Laboratory — Room#, Floor, LabName, LabCod

Laboratory (1,1) Has (0,N) Hospital

Staff (1,1) Works in (1,N) Ward

Hospital — HCode, Name, Address

Ward — Name, Phone#, Ward Code

Hospital (1,N) Has (1,1) Ward

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For each member of the laboratory staff, the days and laboratories in which he/she serves are stored. Keep in mind that each member of staff can serve in multiple laboratories during the same day.

A reservation is required to make an examination. For each booking of an examination done by a patient, the database stores the date and time of the examination, the laboratory where it is performed, the cost of the ticket and whether such an examination is prescribed urgently. Keep in mind that each patient can make multiple bookings of the same exam on different dates. Also note that the same examination cannot be repeated on the same day by the same patient, even in different laboratories.

Problem requirements (time representation)

Each doctor can take on different roles during his career (e.g. assistant, primary, etc.). You want to keep track of the roles taken by each doctor throughout their career and the time periods in which they took on those roles (start date, end date). Keep in mind that each doctor cannot take on multiple roles at the same time, while he can assume the same role at different time periods.

Design example:
time representation

- It is necessary to explicitly represent the elapsing of time in the case of
  - representation of events
  - variation of entity or attribute information over time
- Several representations are possible
  - N-ary relationship with a time entity
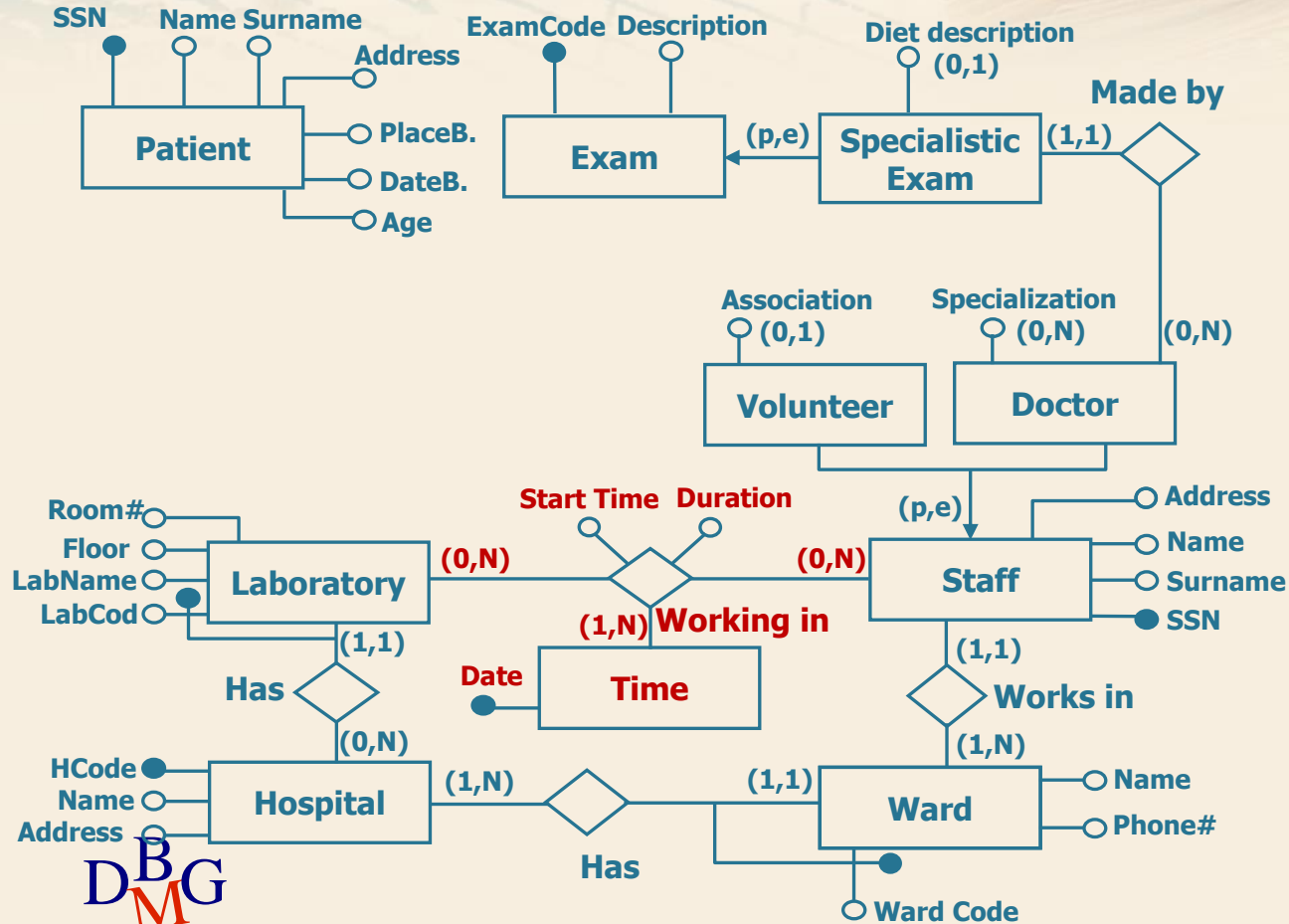 - A time history entity
  - binary relationship with a time entity

Design example:
Time representation (I)
N-ary relationship with a time entity

Problem requirements (time representation)

For each member of the laboratory staff, the days and laboratories in which he/she serves are stored. Keep in mind that each member of staff can serve in multiple laboratories during the same day.

Entity-Relationship diagram containing the following entities and relationships:

Patient with attributes: SSN (key), Name, Surname, Address, PlaceB., DateB., Age

Exam with attributes: ExamCode (key), Description

Specialistic Exam with attribute: Diet description (0,1); connected to Exam via (p,e) generalization

Made by relationship (1,1) — (0,N) connecting Specialistic Exam to Doctor

Volunteer with attribute: Association (0,1)

Doctor with attribute: Specialization (0,N)

Volunteer and Doctor connected to **Staff** via (p,e) generalization

Staff with attributes: Address, Name, Surname, SSN (key)

Working in relationship with attributes: Start Time, Duration; connecting Laboratory (0,N) and Staff (0,N) and Time (1,N)

Time with attribute: Date (key)

Laboratory with attributes: Room#, Floor, LabName, LabCod (key)

Has relationship (1,1) — (0,N) connecting Laboratory and Hospital

Hospital with attributes: HCode (key), Name, Address

Has relationship (1,N) — (1,1) connecting Hospital and Ward

Works in relationship (1,1) — (1,N) connecting Staff and Ward

Ward with attributes: Name, Phone#, Ward Code (key)

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Design example:
Time representation (II)
Time history entity
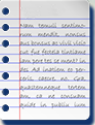
A reservation is required to make an examination. For each booking of an examination done by a patient, the database stores the date and time of the examination, the laboratory where it is performed, the cost of the ticket and whether such an examination is prescribed urgently. Keep in mind that each patient can make multiple bookings of the same exam on different dates. Also note that the same examination cannot be repeated on the same day by the same patient, even in different laboratories.

Cardinality of relationship Books
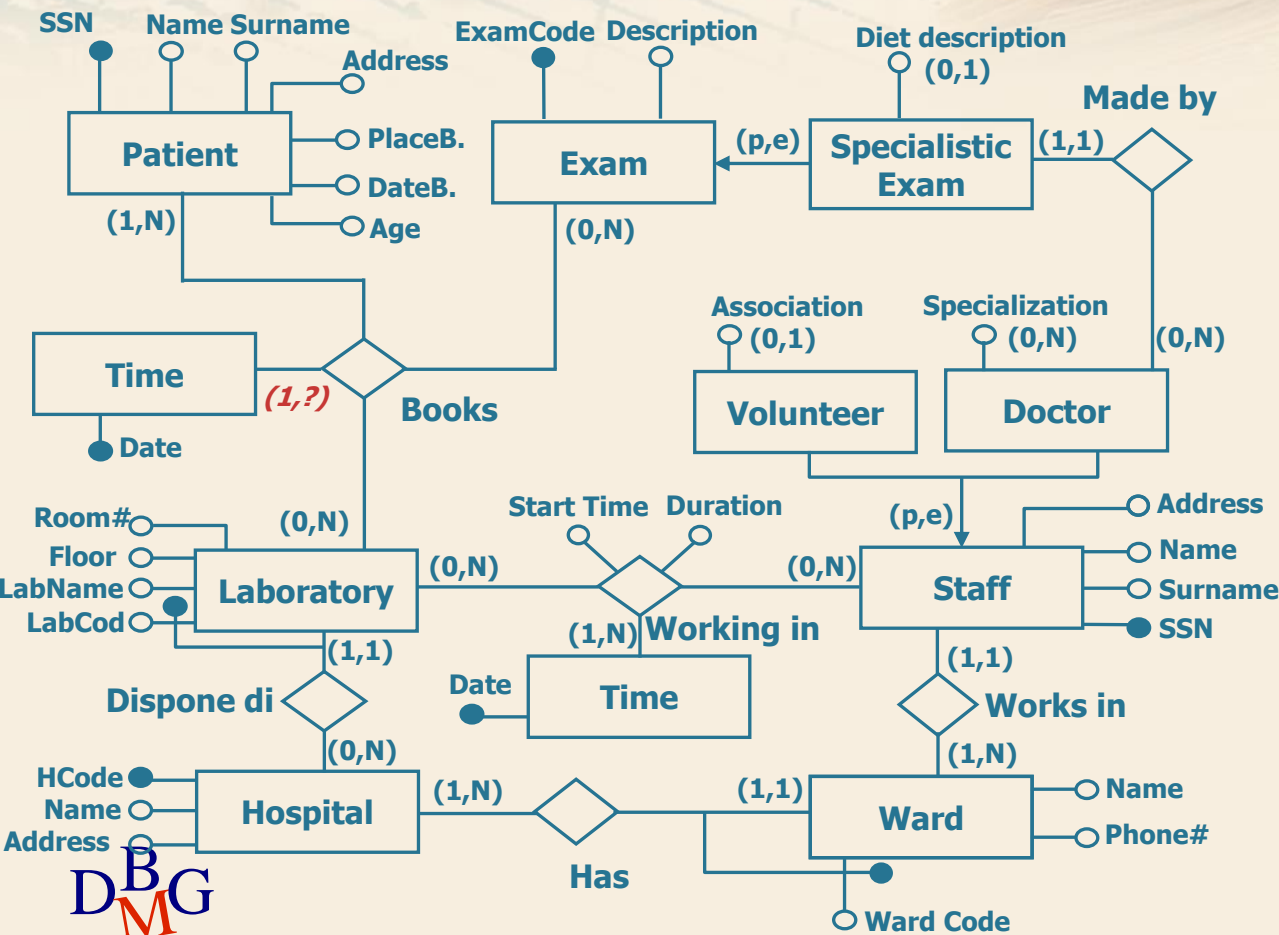
Constraints on booking

A reservation is required to make an examination. For each booking of an examination by a patient you want to store the date and time of the examination, the laboratory where it is performed, the cost of the ticket and whether such an examination is prescribed urgently. Keep in mind that each patient can make multiple bookings of the same exam on different dates. *Also note that the same examination cannot be repeated on the same day by the same patient, even in different laboratories.*
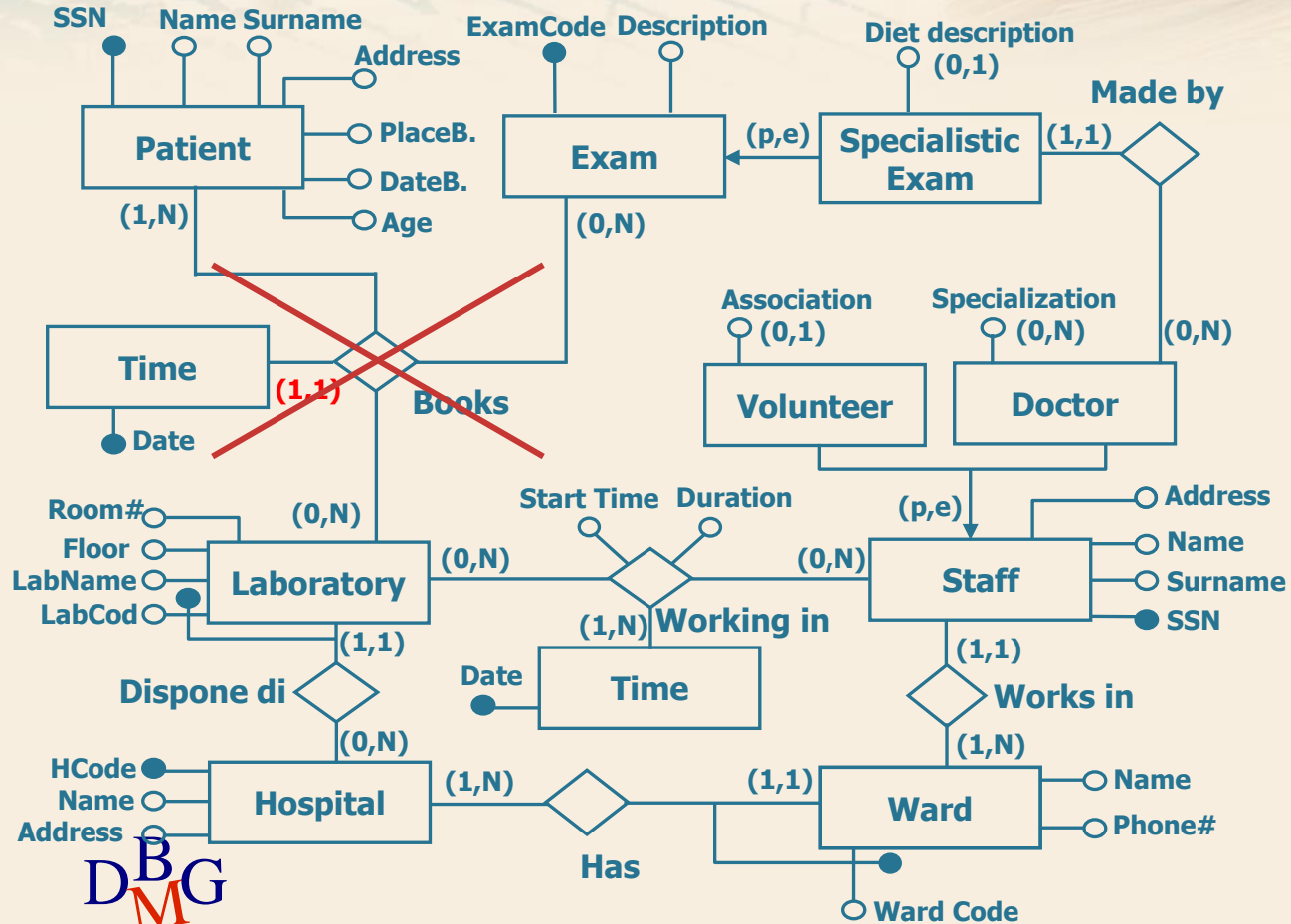
Entity-Relationship diagram of the booking representation:
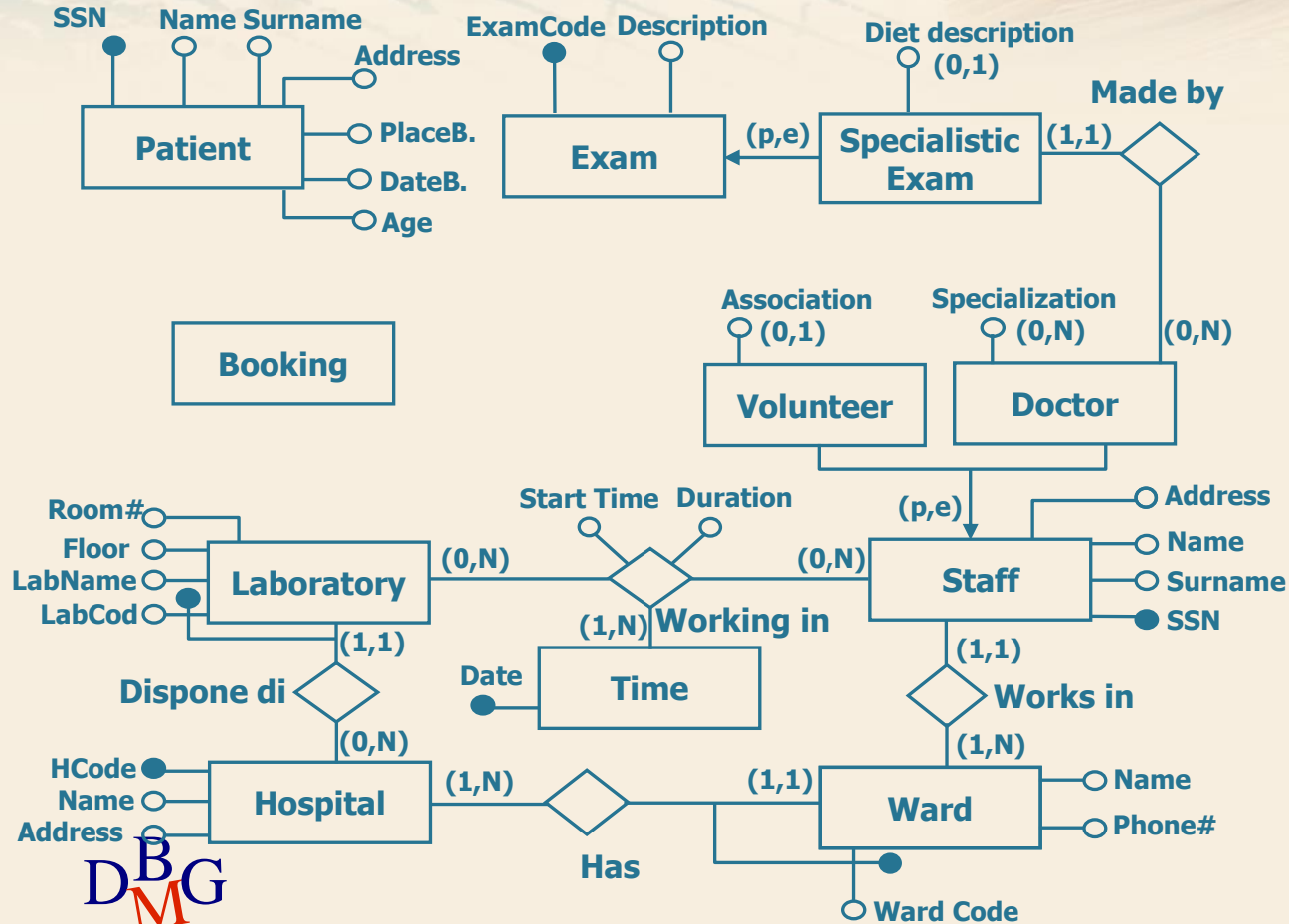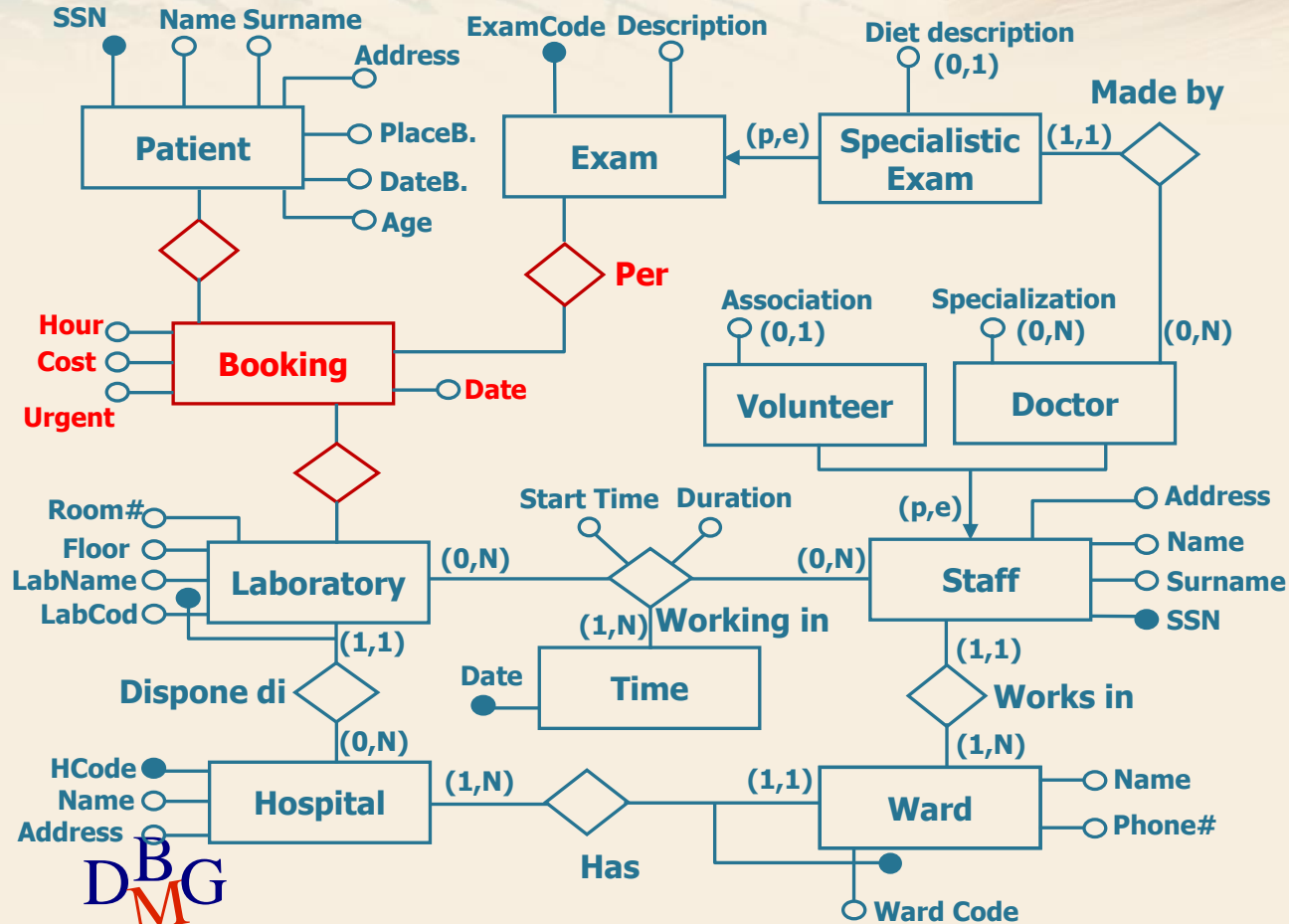
- **Patient** entity with attributes: SSN (key), Name, Surname, Address, PlaceB., DateB., Age
- **Exam** entity with attributes: ExamCode (key), Description
- **Specialistic Exam** entity with attribute: Diet description (0,1), connected to Exam via (p,e) generalization
- **Made by** relationship (1,1) / (0,N) connecting Specialistic Exam and Doctor
- **Time** entity with attribute: Date (key)
- **Books** relationship (crossed out) connecting Patient (1,N), Exam (0,N), Time (1,1)
- **Volunteer** entity with attribute: Association (0,1)
- **Doctor** entity with attribute: Specialization (0,N)
- **Staff** entity with attributes: Address, Name, Surname, SSN (key); generalization (p,e) from Volunteer and Doctor
- **Laboratory** entity with attributes: Room#, Floor, LabName, LabCod (key)
- **Working in** relationship with attributes Start Time, Duration; connecting Laboratory (0,N), Staff (0,N), Time (1,N)
- **Time** entity with attribute: Date (key)
- **Dispone di** relationship (1,1) / (0,N) connecting Laboratory and Hospital
- **Works in** relationship (1,1) / (1,N) connecting Staff and Ward
- **Hospital** entity with attributes: HCode (key), Name, Address
- **Ward** entity with attributes: Name, Phone#, Ward Code (key)
- **Has** relationship (1,N) / (1,1) connecting Hospital and Ward

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Introduction of the entity Booking

Patient — SSN, Name, Surname, Address, PlaceB., DateB., Age

Exam — ExamCode, Description

Specialistic Exam — Diet description (0,1)

Exam ← (p,e) — Specialistic Exam

Specialistic Exam — (1,1) **Made by** — (0,N) Doctor

Booking

Volunteer — Association (0,1)

Doctor — Specialization (0,N)

Volunteer / Doctor — (p,e) — **Staff**

Staff — Address, Name, Surname, SSN

Laboratory — Room#, Floor, LabName, LabCod

Laboratory (0,N) — **Working in** — (0,N) Staff

Working in — Start Time, Duration

Working in (1,N) — **Time** — Date

Laboratory (1,1) — **Dispone di** — (0,N) Hospital

Hospital — HCode, Name, Address

Staff (1,1) — **Works in** — (1,N) Ward

Ward — Name, Phone#, Ward Code

Hospital (1,N) — **Has** — (1,1) Ward

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# Refinement of the entity Booking

Refinement of the entity Booking

Design example:
Time representation (III)
Binary relationship with a time entity

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Each doctor can take on different roles during his career (e.g. assistant, primary, etc.). The database keeps track of the roles taken by each doctor throughout their career and the time periods in which the doctor took on each role (start date, end date). Keep in mind that each doctor cannot take on multiple roles at the same time, while he can assume the same role at different time periods.
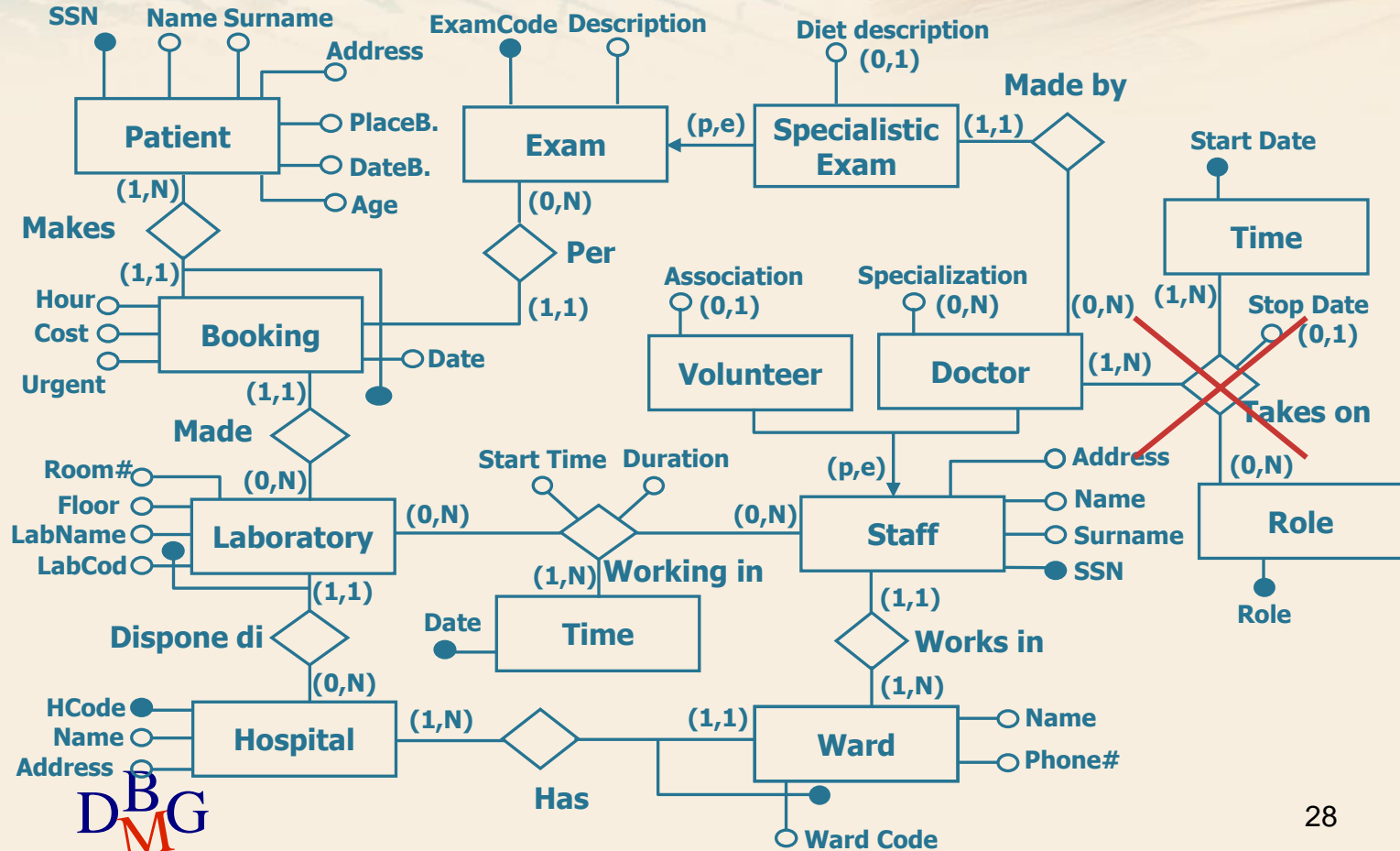
Refinement of relationship Take on
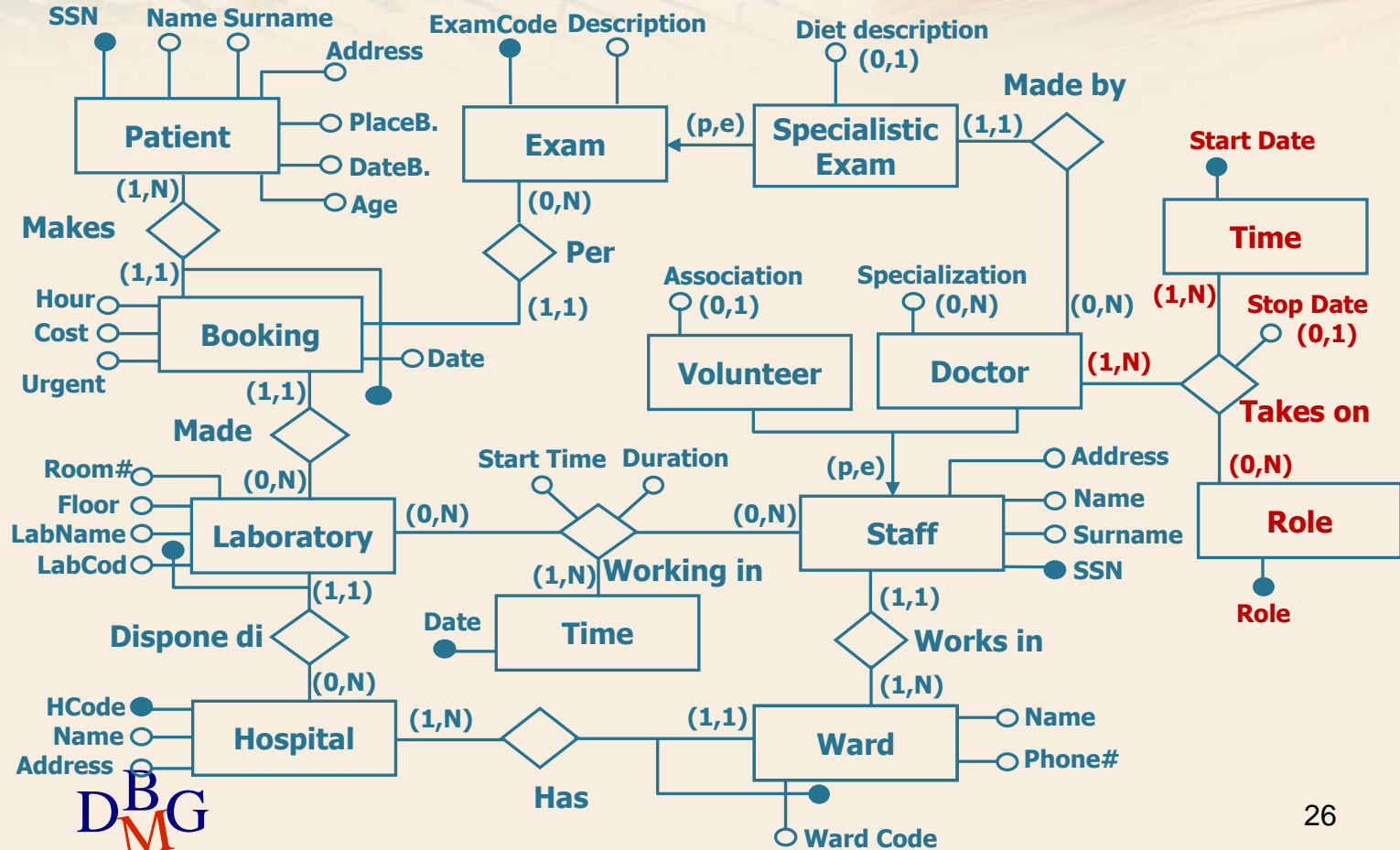
Each doctor can take on different roles during his career (e.g. assistant, primary, etc.). You want to keep track of the roles taken by each doctor throughout their career and the time periods in which they took on those roles (start date, end date). *Keep in mind that each doctor cannot take on multiple roles at the same time, while he can assume the same role at different time periods.*

Data history of relationship Take on

Refinement of relationship Take on