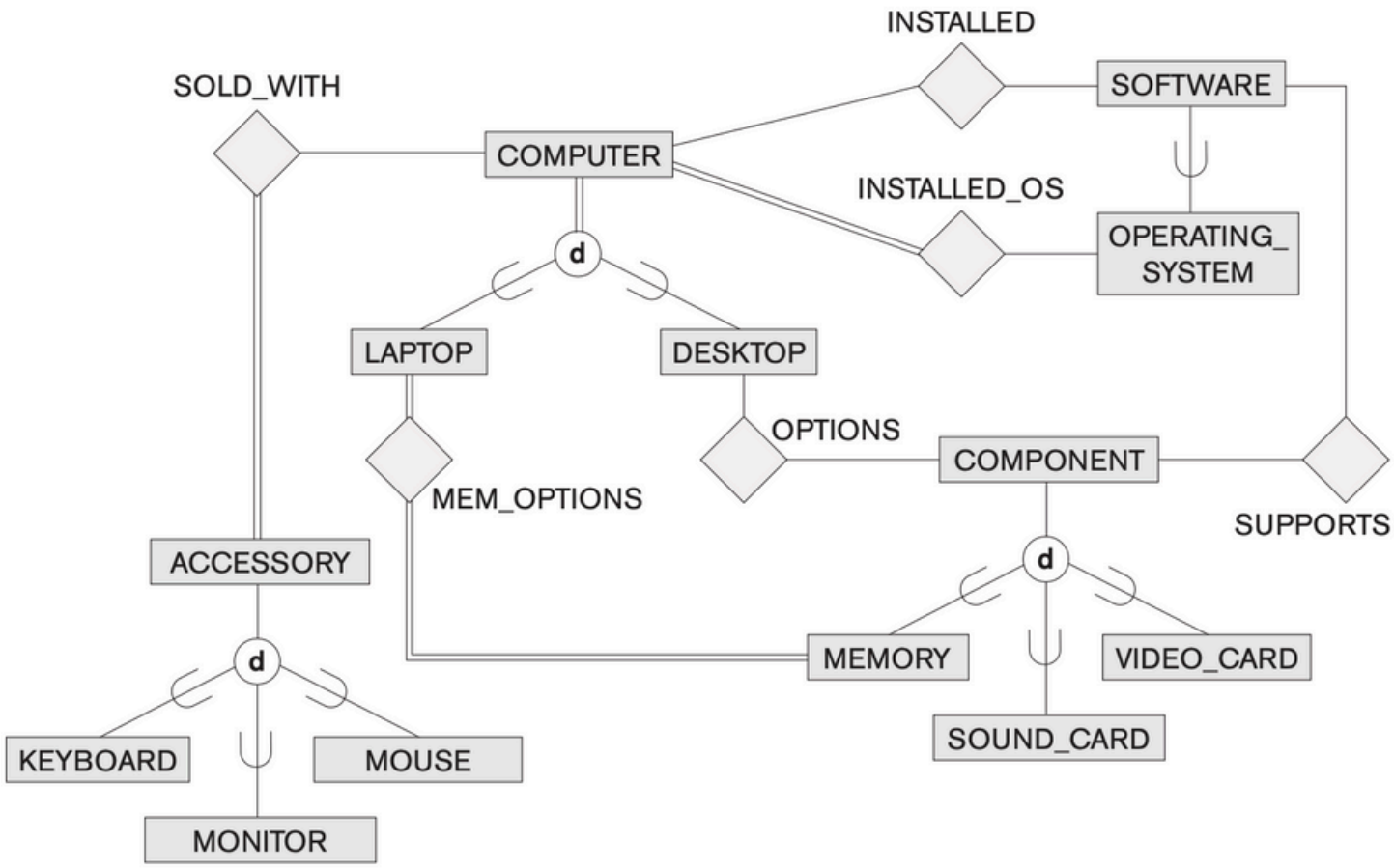
4.27. Consider the following EER diagram that describes the computer systems at a company. Provide your own attributes and key for each entity type. Supply max cardinality constraints justifying your choice. Write a complete narrative description of what this EER diagram represents.



Entity Types and Attributes

1. **COMPUTER**
   - **Attributes:** *Serial number* (Primary Key), *Brand*, *Model*, *Processor*, *RAM*, *Storage*.
   - **Justification:** The unique identifier (*Serial number*) is required for all computers, while other attributes track its specifications.
2. **LAPTOP** (Specialization of COMPUTER)
   - **Attributes:** *Serial number* (Primary Key), *Battery_life, Weight, Screen_size*.
   - **Justification:** Laptops have specific attributes such as battery life and portability-related features.
3. **DESKTOP** (Specialization of COMPUTER)
   - **Attributes:** *Serial number* (Primary Key), *Form_factor* (e.g., Tower, Mini)*, Power_supply.*
   - **Justification:** Desktops differ from laptops in power supply and form factor.
4. **ACCESSORY**
   - **Attributes:** *Serial number* (Primary Key)*, Name, Compatibility.*
   - **Justification:** Accessories need a serial number and details about their compatibility with computer systems.

5. **KEYBOARD** (Specialization of ACCESSORY)
   - **Attributes:** *Layout* (e.g., QWERTY, AZERTY)*, Type* (e.g., Mechanical, Membrane).
   - **Justification:** Keyboards have different features based on their design and use.
6. **MOUSE** (Specialization of ACCESSORY)
   - **Attributes:** *DPI, Wireless* (Yes/No).
   - **Justification:** A mouse is defined by its sensitivity (DPI) and whether it is wired or wireless.
7. **MONITOR** (Specialization of ACCESSORY)
   - **Attributes:** *Resolution, Size, Refresh_rate*.
   - **Justification:** Monitors are categorized by display-specific attributes.
8. **COMPONENT**
   - **Attributes:** *Serial number* (Primary Key), *Type*, *Compatibility*.
   - **Justification:** Components are necessary for upgrades or repairs and must have a serial number and compatibility details.
9. **MEMORY** (Specialization of COMPONENT)
   - **Attributes:** *Capacity, Type* (e.g., DDR4, DDR5).
   - **Justification:** Memory is an essential component with specifications like capacity and technology.
10. **VIDEO_CARD** (Specialization of COMPONENT)
    - **Attributes:** *VRAM, GPU_model*.
    - **Justification:** Video cards are categorized by graphical processing capabilities.
11. **SOUND_CARD** (Specialization of COMPONENT)
    - **Attributes:** *Channels* (e.g., 5.1, 7.1), *Output_quality*.
    - **Justification:** Sound cards differ based on audio output and quality features.
12. **SOFTWARE**
    - **Attributes:** *Software_id* (Primary Key), *Name, Version, License_type*.
    - **Justification:** Software needs unique identification and details like version and licensing.
13. **OPERATING_SYSTEM** (Specialization of SOFTWARE)
    - **Attributes:** *OS_type* (e.g., Windows, Linux), *Architecture* (e.g., 32-bit, 64-bit).
    - **Justification:** Operating systems are a specialized type of software with specific configurations.

Relationships and Cardinalities

1. **SOLD_WITH (COMPUTER ⇔ ACCESSORY)**
   - **Cardinality:** 1:N
   - **Justification:** A computer can be sold with multiple accessories, but each accessory is linked to a single computer.
2. **MEM_OPTIONS (LAPTOP ⇔ MEMORY)**
   - **Cardinality:** 1:N
   - **Justification:** A laptop can have multiple memory options, but each memory module is installed in a single laptop.
3. **OPTIONS (DESKTOP ⇔ COMPONENT)**
   - **Cardinality:** 1:N

    - **Justification:** A desktop can support multiple components, but each component is connected to one desktop.
4. **INSTALLED (COMPUTER ↔ SOFTWARE)**
    - **Cardinality:** 1:N
    - **Justification:** Each computer can have multiple software installed, but the software is usually associated with individual machines.
5. **INSTALLED_OS (COMPUTER ↔ OPERATING_SYSTEM)**
    - **Cardinality:** 1:1
    - **Justification:** Each computer runs a single operating system at a time.
6. **SUPPORTS (COMPONENT ↔ SOFTWARE)**
    - **Cardinality:** M:N
    - **Justification:** A component (e.g., video card) can support multiple software types, and a software type can be supported by multiple components.

Narrative Description of the Diagram

The EER diagram represents a database system designed to track computers and related items such as accessories, components, and software sold by a company. The central entity, *COMPUTER*, is specialized into *LAPTOP* and *DESKTOP* to show the differences in specifications and functionality.

- Each computer is associated with a set of ***ACCESSORIES*** such as a *KEYBOARD*, *MOUSE*, and *MONITOR*, which have different characteristics.
- ***COMPONENTS*** like *MEMORY*, *VIDEO_CARD*, and *SOUND_CARD* are tracked to show upgrades and configurations for desktops and laptops.
- The software installed on computers is represented by *SOFTWARE*, with a specialized category for operating systems (*OPERATING_SYSTEM*).
- Relationships like *SOLD_WITH*, *MEM_OPTIONS*, and *OPTIONS* allow a record of which computers are sold with specific accessories, memory options, or components.
- *SUPPORTS* shows the compatibility between components and software, making sure there are proper configurations.