MongoDB Coding Challenge

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Relationships in MongoDB

MongoDB is a NoSQL database that offers flexible ways to model relationships between data. Unlike relational databases, MongoDB does not enforce foreign key constraints, so managing relationships is handled through data modeling strategies.

Types of Relationships

MongoDB supports two primary methods for representing relationships between documents:

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1. **Embedded Documents (Denormalization)**

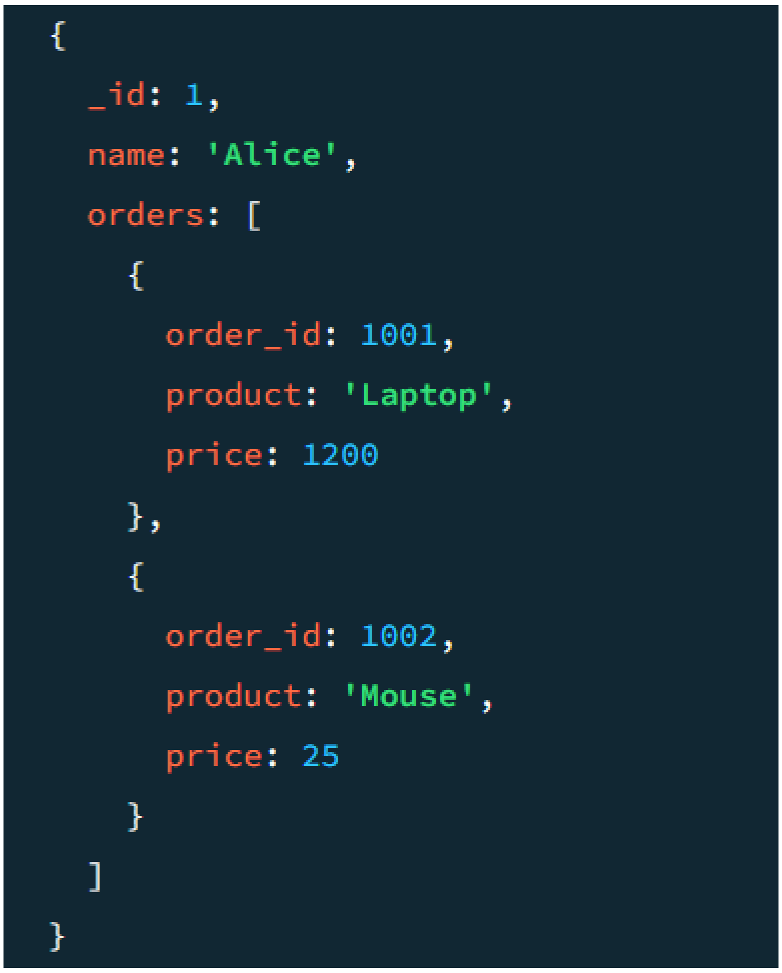
   This approach stores related data within a single document, ideal for data that is frequently accessed together. It simplifies data retrieval and ensures data locality.

Use When:

- Data is tightly coupled and accessed together.
- The relationship is one-to-few.
- Performance is more important than data redundancy.

Example:

```
{
 "_id": 1,
 "name": "Alice",
 "orders": [
  {
   "order_id": 1001,
   "product": "Laptop",
   "price": 1200
  },
  {
   "order_id": 1002,
   "product": "Mouse",
   "price": 25
  }
 ]
}
```



```
{
  _id: 1,
  name: 'Alice',
  orders: [
    {
      order_id: 1001,
      product: 'Laptop',
      price: 1200
    },
    {
      order_id: 1002,
      product: 'Mouse',
      price: 25
    }
  ]
}
```

Pros:

- Fewer queries
- Faster read performance

Cons:

- Document size can grow quickly
- Harder to update deeply nested data

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2. **Referenced Documents (Normalization)**

   This method involves storing references to related documents using unique identifiers, suitable for large or independently accessed data. It allows for normalization and maintains data consistency.

Use When:

- Data is reused across documents (e.g., users, products).
- The relationship is one-to-many or many-to-many.

- Data integrity and separation are important.

Example:

Users Collection

```
{
  "_id": ObjectId("64f0a..."),
  "name": "Bob"
}
```

Orders Collection

```
{
  "_id": ObjectId("64f0b..."),
  "user_id": ObjectId("64f0a..."),
  "product": "Keyboard",
  "price": 50
}
```

Pros:

- More flexible for complex relationships
- Easier to update data in isolation

Cons:

- Requires multiple queries or aggregation joins

Using $lookup for Joins

MongoDB supports a form of join using the $lookup aggregation stage. the $lookup stage, enabling complex many-to-many relationships.

Example:

```
db.orders.aggregate([
  {
    $lookup: {
      from: "users",
      localField: "user_id",
      foreignField: "_id",
      as: "user_info"
    }
  }
])
```

This returns each order document with a new field user_info containing the referenced user data.

Choosing Between Embedding vs Referencing

Feature	**Embedding**	**Referencing**
Simplicity	Simple	More complex
Query Speed	Faster reads	Slower (needs join)
Write Efficiency	Fewer writes	May need multiple writes
Data Integrity	Harder	Easier
Document Size	Can grow large	Smaller units

One-to-One Relationship

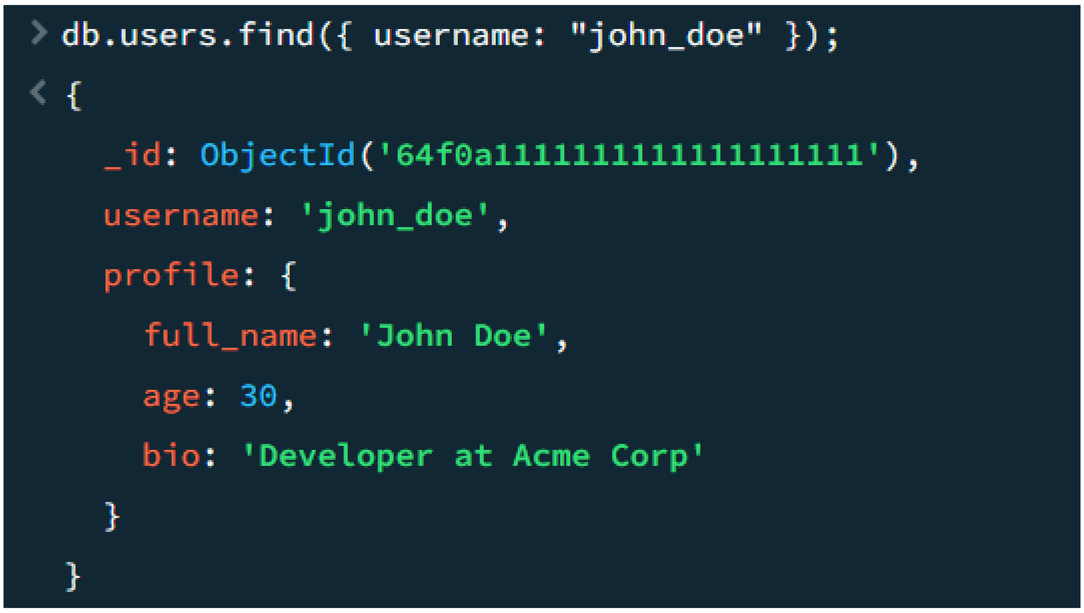
A one-to-one relationship is when one document is associated with exactly one other document.

Use Cases:

- Storing user profiles separately from user credentials
- Separating large optional fields (e.g., user settings, metadata)

Embedded Document

```
{
  "_id": ObjectId("user_id_1"),
  "username": "john_doe",
  "profile": {
    "full_name": "John Doe",
    "age": 30,
    "bio": "Developer at Acme Corp"
  }
}
```



```
> db.users.find({ username: "john_doe" });
< {
    _id: ObjectId('64f0a1111111111111111111'),
    username: 'john_doe',
    profile: {
      full_name: 'John Doe',
      age: 30,
      bio: 'Developer at Acme Corp'
    }
  }
```

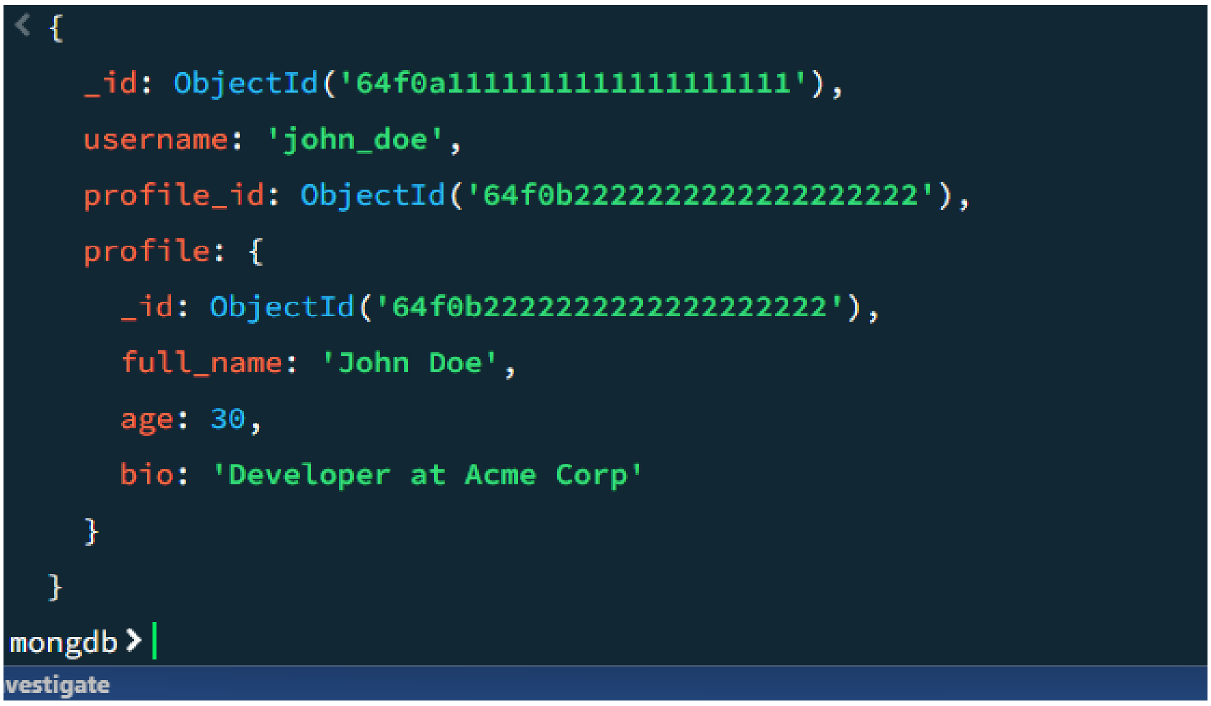
Referenced Document

Users Collection

```
{
 "_id": ObjectId("user_id_1"),
 "username": "john_doe",
 "profile_id": ObjectId("profile_id_1")
}
```

Profiles Collection

```
{
 "_id": ObjectId("profile_id_1"),
 "full_name": "John Doe",
 "age": 30,
 "bio": "Developer at Acme Corp"
}
```



```
< {
    _id: ObjectId('64f0a111111111111111111'),
    username: 'john_doe',
    profile_id: ObjectId('64f0b222222222222222222'),
    profile: {
      _id: ObjectId('64f0b222222222222222222'),
      full_name: 'John Doe',
      age: 30,
      bio: 'Developer at Acme Corp'
    }
  }
mongdb >
```

One-to-Many Relationship with Embedded Documents

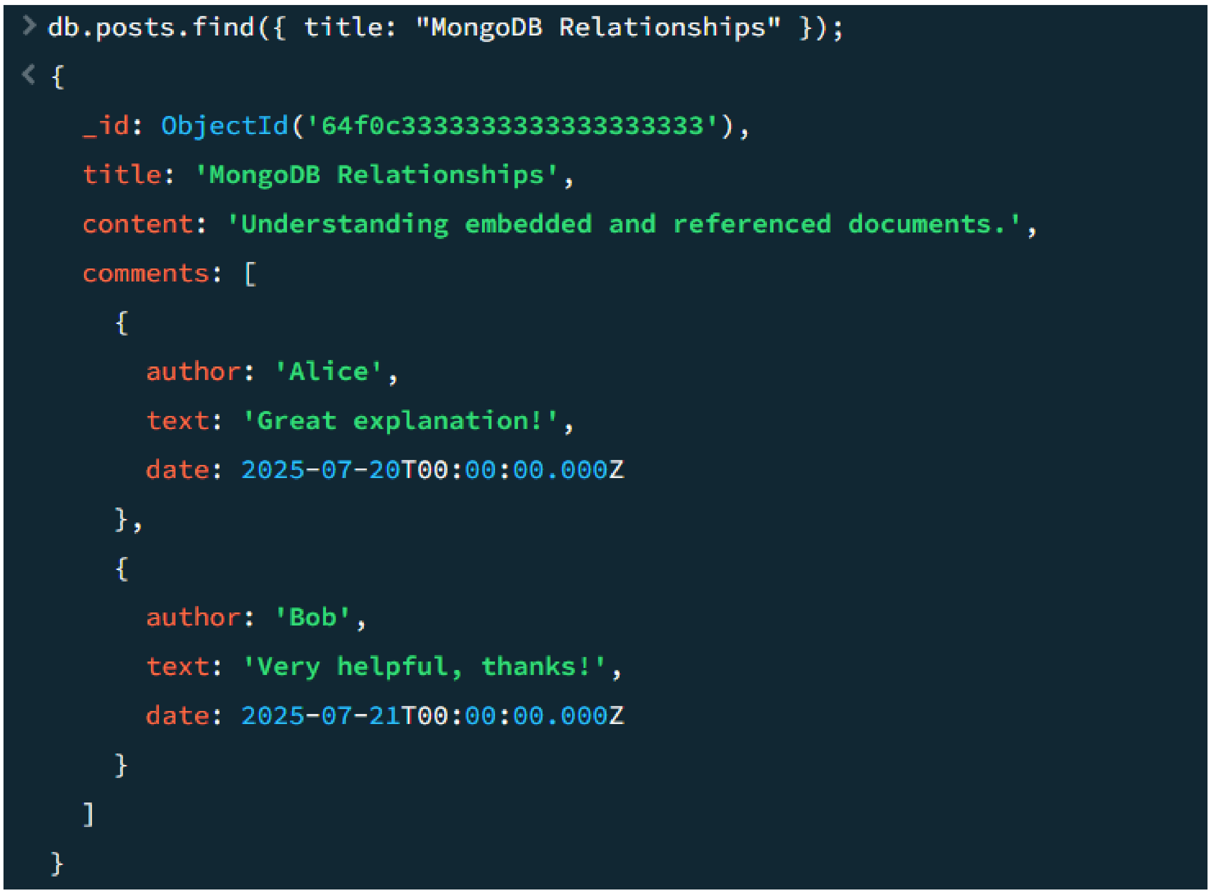
A one-to-many relationship is when one document contains many related sub-documents. Embedding works best when the related items are limited in number and used together.

Use Cases:

- A blog post with comments
- A product with specifications
- A user with a list of saved items

Example: Blog Post with Embedded Comments

```
{
 "_id": ObjectId("post_id_1"),
 "title": "MongoDB Relationships",
 "content": "Understanding embedded and referenced documents.",
 "comments": [
   {
    "author": "Alice",
    "text": "Great explanation!",
    "date": "2025-07-20"
   },
   {
      "author": "Bob",
      "text": "Very helpful, thanks!",
      "date": "2025-07-21"
    }
  ]
}
```



```
> db.posts.find({ title: "MongoDB Relationships" });
< {
    _id: ObjectId('64f0c3333333333333333333'),
    title: 'MongoDB Relationships',
    content: 'Understanding embedded and referenced documents.',
    comments: [
      {
        author: 'Alice',
        text: 'Great explanation!',
        date: 2025-07-20T00:00:00.000Z
      },
      {
        author: 'Bob',
        text: 'Very helpful, thanks!',
        date: 2025-07-21T00:00:00.000Z
      }
    ]
  }
```

One-to-Many Relationship with Document References

Referencing is ideal when the number of related documents is large or when sub-documents are accessed independently.

Use Cases:

- Users and their orders
- Authors and their books
- Categories and products

Example: User and Orders (Referenced)

Users Collection

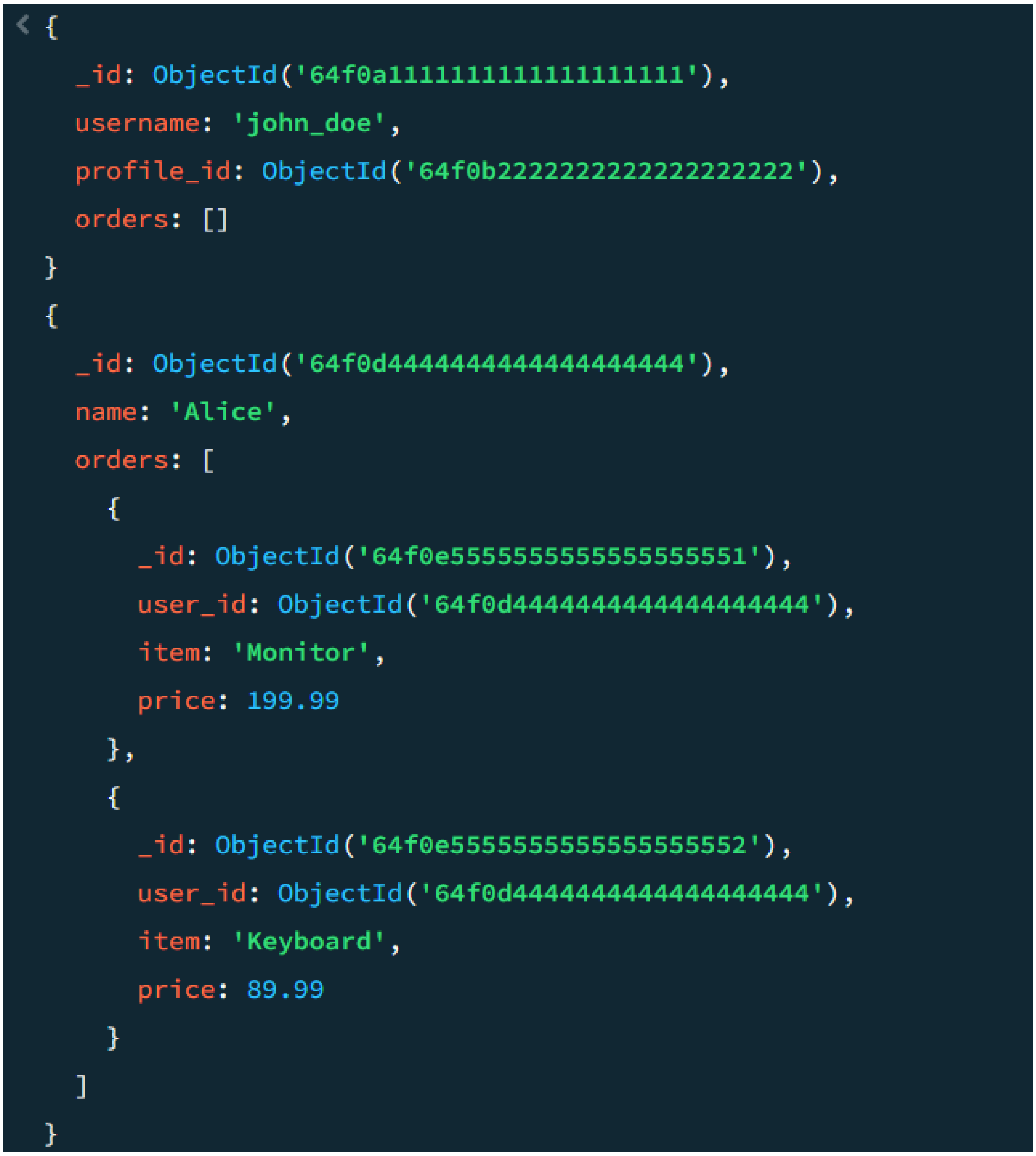
```
{
  "_id": ObjectId("user_id_1"),
  "name": "Alice"
}
```

Orders Collection

```
{
  "_id": ObjectId("order_id_1"),
  "user_id": ObjectId("user_id_1"),
  "item": "Monitor",
  "price": 199.99
}
```

Fetching Related Data with $lookup

```
db.users.aggregate([
  {
    $lookup: {
      from: "orders",
      localField: "_id",
      foreignField: "user_id",
      as: "orders"
    }
  }
])
```



```
{
  _id: ObjectId('64f0a1111111111111111111'),
  username: 'john_doe',
  profile_id: ObjectId('64f0b2222222222222222222'),
  orders: []
}
{
  _id: ObjectId('64f0d4444444444444444444'),
  name: 'Alice',
  orders: [
    {
      _id: ObjectId('64f0e5555555555555555551'),
      user_id: ObjectId('64f0d4444444444444444444'),
      item: 'Monitor',
      price: 199.99
    },
    {
      _id: ObjectId('64f0e5555555555555555552'),
      user_id: ObjectId('64f0d4444444444444444444'),
      item: 'Keyboard',
      price: 89.99
    }
  ]
}
```

Relationship Type	Embedding	Referencing
One-to-One	Small, always together	Large, separate lifecycle
One-to-Many	Few items, read together	Many items, queried separately