Modelo Lógico (Entidades y Relaciones)

Entidades Principales

- **User** (userId, nombre, email, hashPassword, rol, estado, createdAt, updatedAt)
- **Document** (docId, userId→User, título, autores, año, doi/url, resumen, palabrasClave, archivoPDF, estado, createdAt, updatedAt)
- **Question** (questionId, docId→Document, userId→User, pregunta, respuesta, tokensUtilizados, createdAt)
- **Session** (sessionId, userId→User, documentos[docId→Document], createdAt, updatedAt)
- **MetricEvent** (eventId, userId→User, tipo, metadata, ts)
- **AuditLog** (auditId, actorId→User, acción, recurso(tipo, id), detalle, ts)

Relaciones (Cardinalidad Esencial)

- User 1..* Document (como propietario)
- User 1..* Question
- User 1..* Session
- Document 1..* Question
- Session N..M Document (colección de documentos)
- Todo genera **MetricEvent** y **AuditLog** para seguimiento

Modelo Físico (MongoDB - Colecciones, Campos e Índices)

1. Users

```
{
  "_id": ObjectId,
  "email": String, // único
  "passwordHash": String,
  "name": String,
  "role": {
    "type": "enum",
    "values": ["admin", "user"]
  },
  "status": {
    "type": "enum",
    "values": ["active", "inactive", "suspended"]
  },
  "createdAt": Date,
  "updatedAt": Date
}
```

Índices:

- { "email": 1 } (único)
- { "status": 1 }
- { "createdAt": -1 }

2. Documents

```json
{
  "_id": ObjectId,
  "userId": ObjectId, // users._id
  "title": String,
  "authors": [String],
  "year": Number,
  "doi": String,
  "url": String,
  "summary": String,
  "keywords": [String],
  "pdf": {
    "filename": String,
    "url": String,
    "sizeKB": Number,
    "pages": Number
  },
  "status": {
    "type": "enum",
    "values": ["uploaded", "processing", "processed", "error"]
  },
  "createdAt": Date,
  "updatedAt": Date
}
```

Índices:

- { "userId": 1 }
- { "status": 1 }
- { "keywords": 1 }
- { "createdAt": -1 }
- { "title": "text", "summary": "text" } (índice de texto)

3. Questions

```
{
  "_id": ObjectId,
  "docId": ObjectId, // documents._id
  "userId": ObjectId, // users._id
  "question": String,
  "answer": String,
  "tokensUsed": {
    "input": Number,
    "output": Number,
    "total": Number
  },
  "modelUsed": String,
  "confidenceScore": Number,
  "createdAt": Date
}
```

Índices:

- { "docId": 1 }
- { "userId": 1 }
- { "createdAt": -1 }
- { "question": "text" } (índice de texto)

4. Sessions

```
{
  "_id": ObjectId,
  "userId": ObjectId, // users._id
  "name": String,
  "description": String,
  "documents": [ObjectId], // documents._id
  "active": Boolean,
  "createdAt": Date,
  "updatedAt": Date
}
```

Índices:

- { "userId": 1 }
- { "active": 1 }

- { "createdAt": -1 }

5. metricEvents

```
{
  "_id": ObjectId,
  "userId": ObjectId, // users._id
  "type": {
    "type": "enum",
    "values": [
      "document_upload",
      "question_asked",
      "session_created",
      "user_login",
      "api_call"
    ]
  },
  "metadata": Object,
  "ts": Date
}
```

Índices:

- { "userId": 1 }
- { "type": 1 }
- { "ts": -1 }

6. auditLogs

```
{
  "_id": ObjectId,
  "actorId": ObjectId, // users._id
  "action": String, // UPLOAD_DOC, DELETE_DOC, ASK_QUESTION...
  "resource": {
    "type": String,
    "id": ObjectId
  },
  "detail": Object,
  "ip": String,
  "userAgent": String,
  "ts": Date
}
```

Índices:

- { "actorId": 1 }
- { "action": 1 }
- { "ts": -1 }
- { "resource.type": 1, "resource.id": 1 }