BOSTON UNIVERSITY

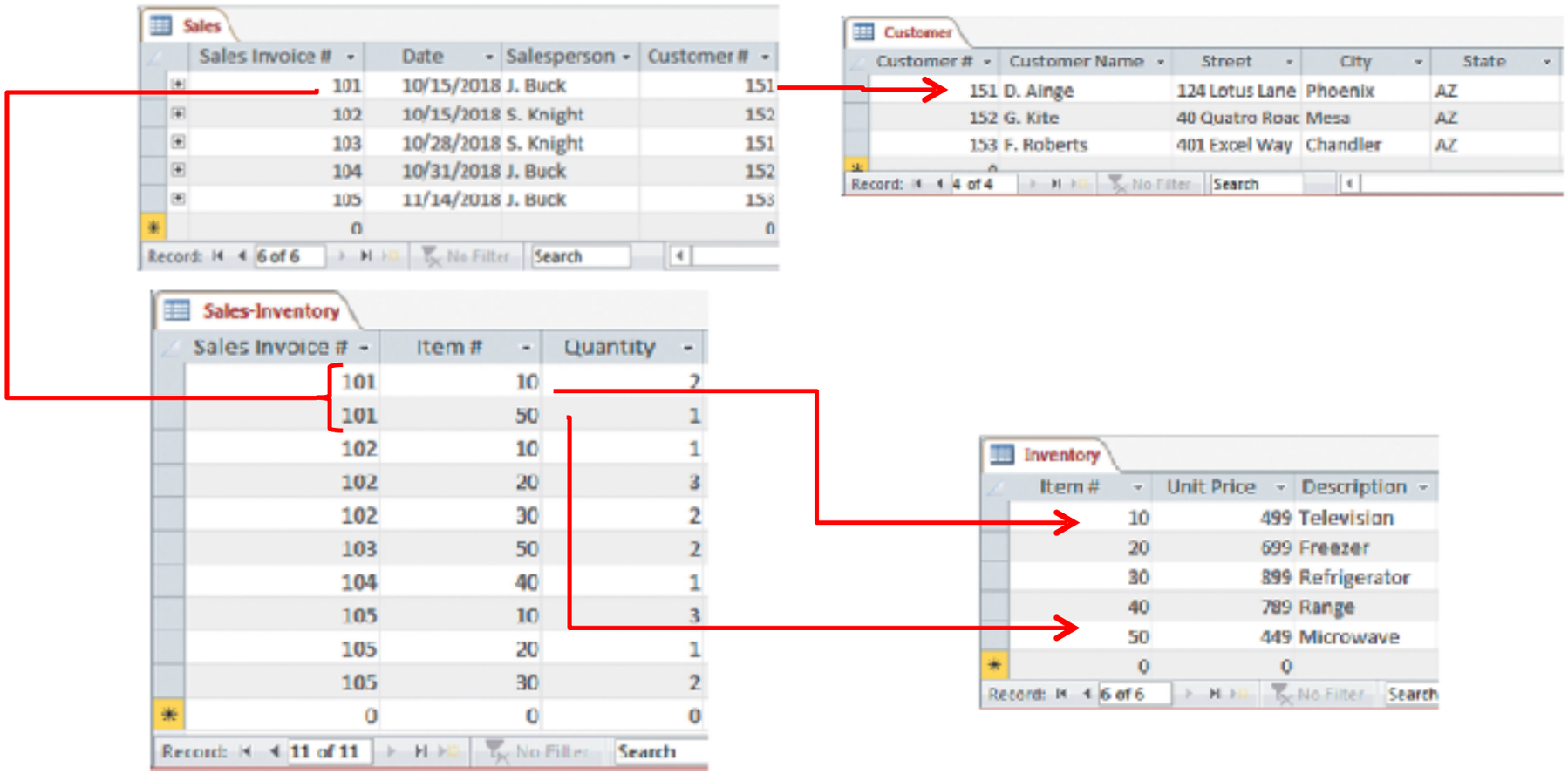
Department of Computer Science

CS591 Intro to mongoDB

@perrydBUCS

Traditional data sources: RDB

- An RDB is a relational database such as Oracle, DB2, or mySQL
- In RDBs data is stored in tables
- Each table contains a minimal amount of information and is related to other tables by a key
- For example, an Employee table and a Department table might be related by an EmployeeID
- Key values appear in each related table

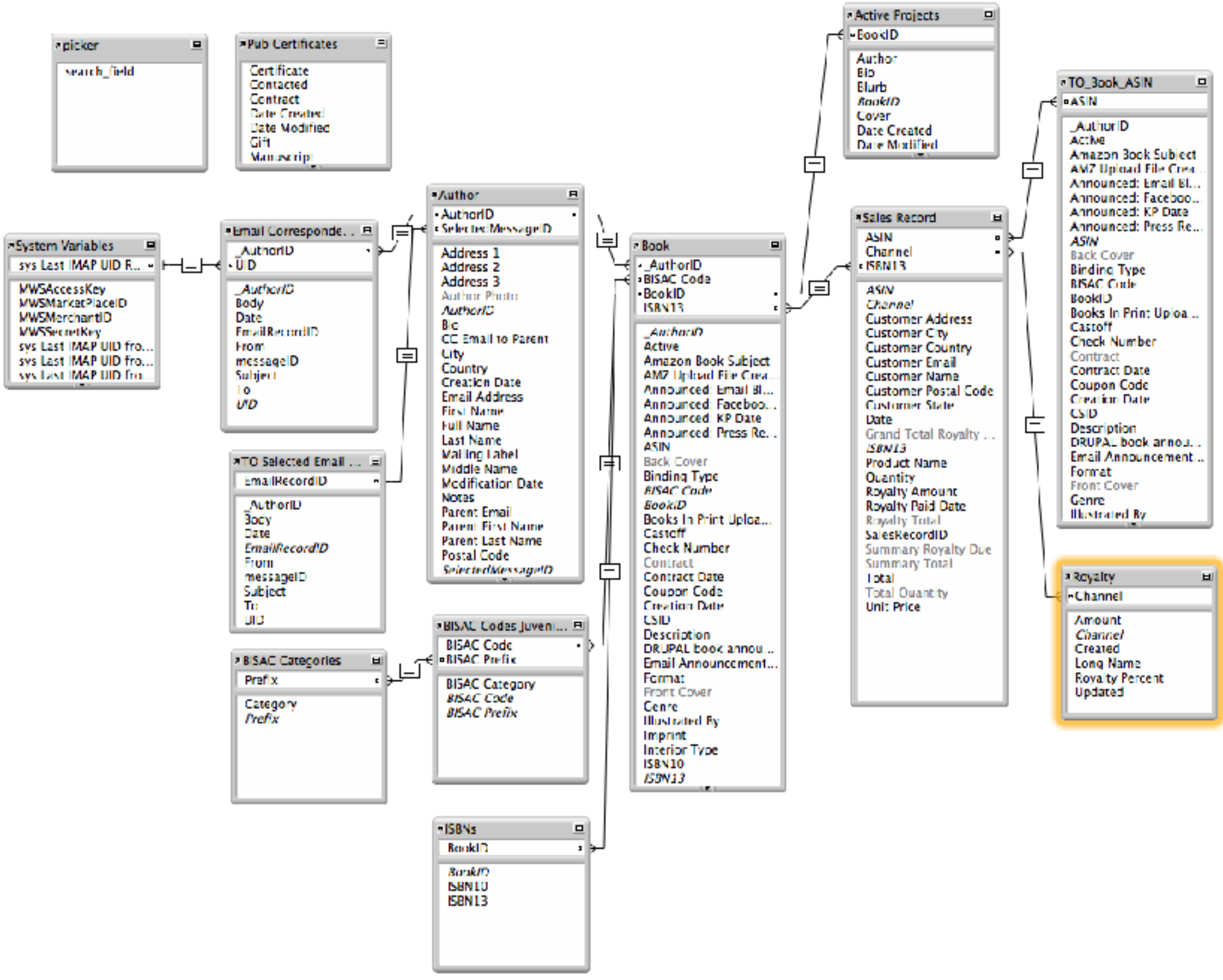


Source: Pearson Ed

- A query language (SQL: Structure Query Language) is used to manipulate data in the RDB
- For the db in the example we might write this to find all its ordered by a particular customer:

```
select customer.id, customer.name, invoice.id,
sales.invoice, sales.item, inventory.item,
inventory.description
FROM customer, invoice, sales, inventory
WHERE sales.invoice = invoice.id AND  sales.item =
inventory.item
```

- That earlier diagram is a form of ERD or *entity-relationship diagram*
- The ERD is a graphical way of showing how the tables are related
- *Related* in this case means that the tables share a common key
- Most DBs have tools to report ERDs, or you can start with an ERD and build tables from it
- Here's another, more formal ERD: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Non-relational DBs

- For web-based apps the trend has been toward non-relational DBs such as mongoDB
- The DBs are document-based rather than table based
- The term **noSQL** is used for this style…it doesn't necessarily mean '*no* SQL' but rather '*non-relational*' or '*not only SQL*'
- noSQL DBs trade simplicity for performance
- There are quite a few of them… http://nosql-database.org

- The idea behind non-relational DBs is to store all of the data necessary for a record into a single object
- Relationships are folded into that single object
- In the sales example from earlier, the invoices and items would be folded into a single customer object with arrays for invoices
- We might also just have a single invoice object that includes everything about each sale
- There can potentially be a lot of duplication
  - For example, the description of an item, or the address of a customer, might be repeated in hundreds of documents
- Do we care?

- Turns out the answer is ‘not all the time’
- In typical web-based applications the focus is on a user and his or her interaction with a site
- For this use case, a fully denormalized data store (ala noSQL) can perform better than a fully relational (highly normalized) DB
- For the corner cases where we really *do* need relational data, we take the performance hit

ORMs, ORDs, and impedance

- In most case an RDB does not map one-to-one onto the objects in the application code
- Work is required to move data from app to DB; the pattern we use is an ORM (object-relational mapping), basically a way to take RDB table info and store it in an object
- The problem is that the data types in the DB don't necessarily match the way we want to use them in the app…this is called an *impedance mismatch*

- In document-based DBs (such as mongoDB), there are few or no restrictions on data types in a record, reducing or elimination impedance
- However, this means that there are basically no filters on what goes into the mongoDB document store…the risk is GIGO
- Libraries such as Mongoose provide ODM (object-document mapping) services on top of mongoDB
- ODM is the equivalent of ORM but for non-relational DBs
- Bottom line is that ODM on top of document-based DBs provide a cleaner, more performant way to handle data in most applications

A note about ODM

- It's certainly possible to throw random, possibly unrelated JSON at a document-based DB like mongoDB, and then go and operate on it
- However, mongoDB does essentially no type checking, and the risk is that you'll be working on undefined data
- Using ODM tools such as Mongoose allow you to place schema-based constraints on types and ensures that data in the store is uniform
- We'll talk about Mongoose tomorrow!

Using noSQL DBs

- We'll use mongoDB and Javascript for our examples
- In addition, Mongoose will provide ODM services through schemas
- The TL;DL is that we map Javascript objects 1:1 to database documents
- Mapping is done through JSON

CRUD with mongoDB

CREATE	obj.save( )
READ	db.find({key: value})
UPDATE	db.findByIdAndUpdate(id, updateObj)
DELETE	db.findByIdAndRemove(id)

Quick history

- 10gen started work in 2007 on a non-relation document store to use in their PaaS business
- First public release in 2009 as open source project
- mongoDB (from ‘humongous’) grew rapidly in popularity
- 10gen changed their name to MongoDB Inc in 2013

What it is

- Non-relational
- Document store
- No SQL
- Base system written in C++
- Drivers available for most current languages
- Independent of NodeJS

Installing mongoDB

- MacOS:
  - Download and install tarball with curl
  - OR use homebrew package manager (simplest but must install home-brew first)
- Windows:
  - Download and install package from mongoDB
- http://www.mongodb.org/downloads
- https://brew.sh
- https://docs.mongodb.com/getting-started/shell/tutorial/install-mongodb-on-windows

Data directory

- By default mongoDB looks for data in /data/db
- It'll exit at start if the directory doesn't exist
- You also can point to any directory at startup, i.e.
  - mongod& —dbpath ~/data
  - Might have to fiddle with permissions depending on path

Starting mongoDB

- The database runs as a daemon and listens for connection on port 27017 by default
  - This can be changed by editing resource file
  - You might need to hunt for mongod.conf…it'll end up in the install directory
    - Useful to create an alias in /etc to make it easy to find the second time (via ln -s)
- Startup
  - mongod&
  - mongod -dbpath ~/data& (if you've moved the data directory)

!!SECURITY!!

- The base installation has authentication TURNED OFF by default
- This means anyone with access to the port has access to all databases
- (This is why there was a huge mongoDB ransomware attack a few months ago)
- Authentication is set up in mongod.conf
  - Requires definition of users and roles
  - Docs are at https://docs.mongodb.com/manual/reference/configuration-options/#security-options
  - Lots of info on the web, too, especially after the attacks
- In class we'll use defaults, but if you deploy to something other than your local machine you'll want to set up authentication

Import sample collections from mongoDB

- Grab the sample data
  - `curl https://raw.githubusercontent.com/mongodb/docs-assets/primer-dataset/primer-dataset.json > mongo-sample-collection.json`
- Import into running mongoDB instance
  - `mongoimport --db test --collection restaurants --drop --file ./mongo-sample-collection.json`

Open mongo shell

- Once mongod is running, connect to it from a command prompt
  - `mongo`
- Use `show dbs` to list available database
- Connect to a database with `use <name>`
  - `use test`
- View collections
  - `show collections`