E-commerce Journey

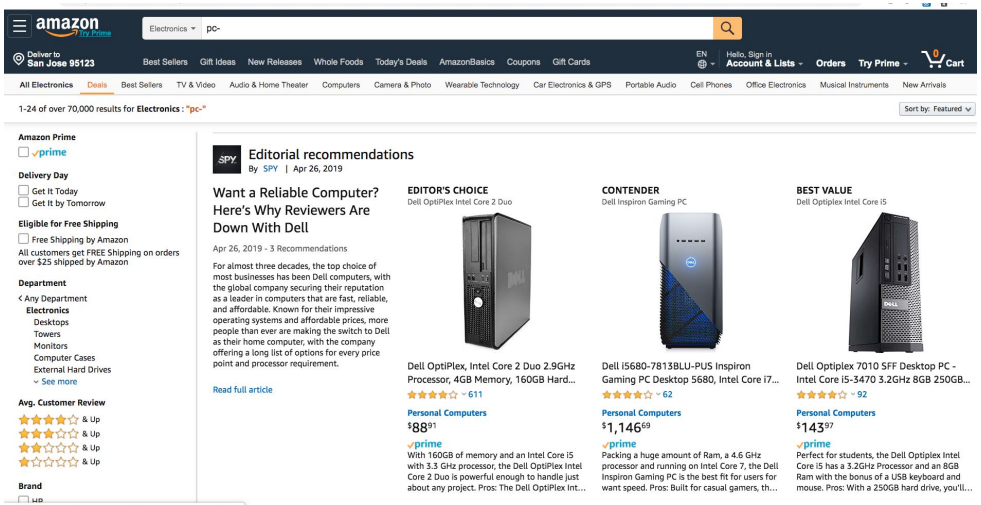
Andy && Theodore

How not to yield to dynamics...

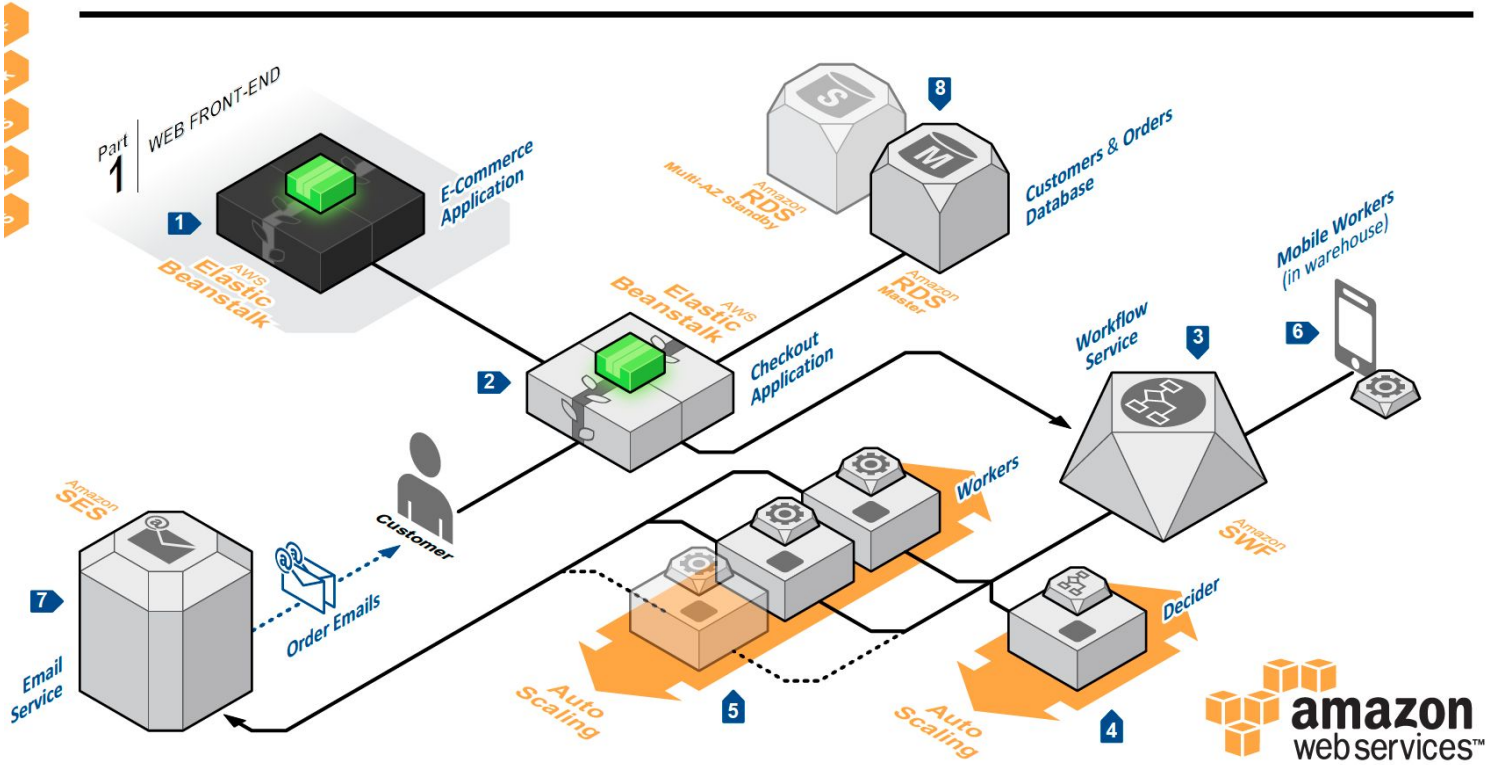
RoadMap (keypoints)

- Approach
- Business logic
- User Case
- Take away

Insights: E-commerce in 90s vs today

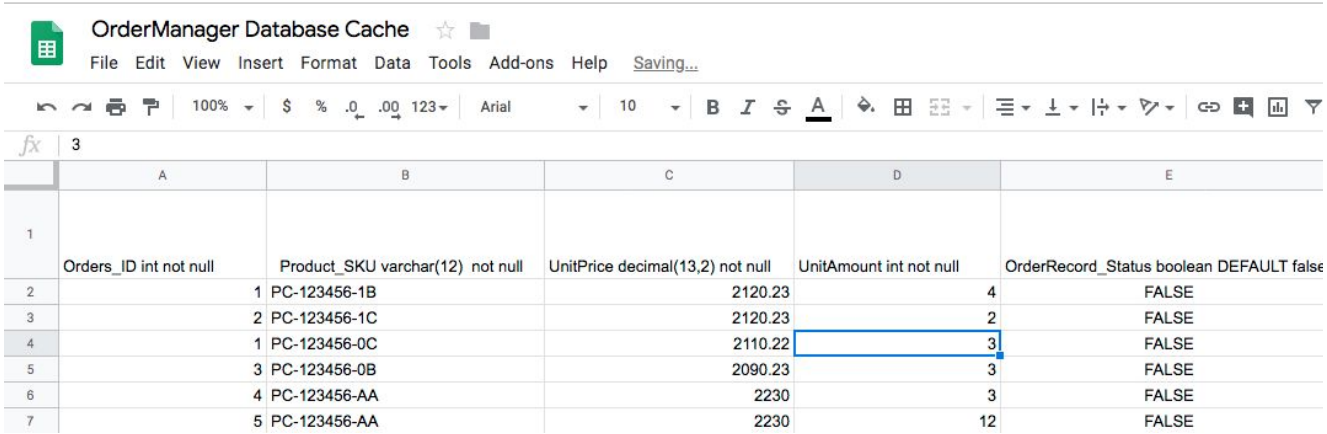


What hasn't changed.



The Workflow step 1

The Workflow step 2



OrderManager Database Cache

File Edit View Insert Format Data Tools Add-ons Help Saving...

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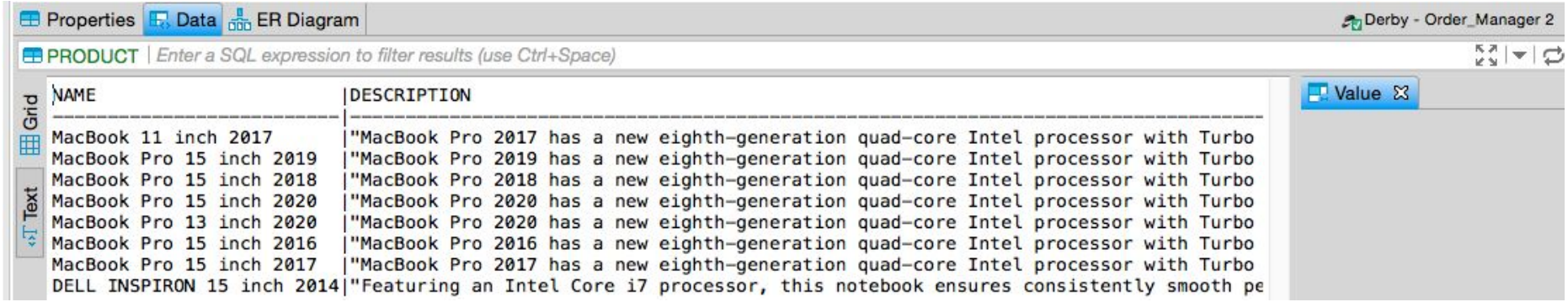
fx 3

	A	B	C	D	E
1	Orders_ID int not null	Product_SKU varchar(12) not null	UnitPrice decimal(13,2) not null	UnitAmount int not null	OrderRecord_Status boolean DEFAULT false
2	1	PC-123456-1B	2120.23	4	FALSE
3	2	PC-123456-1C	2120.23	2	FALSE
4	1	PC-123456-0C	2110.22	3	FALSE
5	3	PC-123456-0B	2090.23	3	FALSE
6	4	PC-123456-AA	2230	3	FALSE
7	5	PC-123456-AA	2230	12	FALSE

The Workflow step 3



Configured-DataTypes

Name	Precision	Min scale	Max scale	Description
BIGINT	19	0	0	BIGINT
LONG VARCHAR FOR BIT DATA	32,700	0	0	LONG VARCHAR FOR BIT DATA
VARCHAR () FOR BIT DATA	32,672	0	0	VARCHAR () FOR BIT DATA
CHAR () FOR BIT DATA	254	0	0	CHAR () FOR BIT DATA
LONG VARCHAR	32,700	0	0	LONG VARCHAR
CHAR	254	0	0	CHAR
CHAR AL	31	0	31	DECIMAL
INTEGER	10	0	0	INTEGER
SMALLINT	5	0	0	SMALLINT
FLOAT	52	0	0	FLOAT
REAL	23	0	0	REAL
DOUBLE	52	0	0	DOUBLE
VARCHAR	32,672	0	0	VARCHAR
BOOLEAN	1	0	0	BOOLEAN
DATE	10	0	0	DATE
TIME	8	0	0	TIME
TIMESTAMP	29	0	9	TIMESTAMP
OBJECT	0	0	0	OBJECT
BLOB	2,147,483,647	0	0	BLOB
CLOB	2,147,483,647	0	0	CLOB
XML	0	0	0	XML

Implemented Function For Order Manager DataBase

1. Auto Order Date
2. Auto Ship Date
3. Support Replenish of Inventory
4. Support BackOrder
5. Multiple Triggers to achieve maximum automation

```
// triggers created by this program
String dbTriggers[] = {
    "InsertUnitPriceInOrderRecord","InsufficientInventory","ChangeOrderRecordStatus",
    "AutoDeductInventory","AutoShipDate","SendEmailToCustomer","ReturnItemsToInventory",
    "NoRecordForOrder","BackOrder"

};
```

Key Design Choice

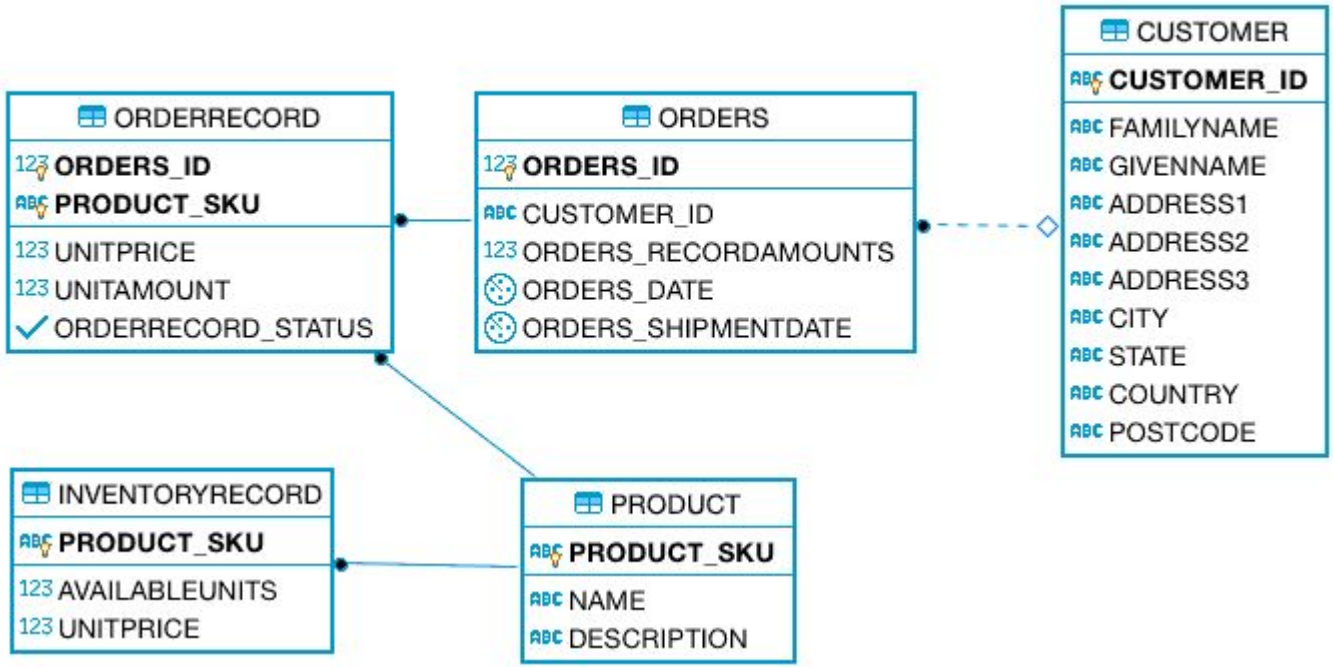
1. Primary Key in Product: SKU only (not combined with UnitPrice or no Primary Key)

2. Orders has a field “Record Amounts” (Order 1 : 2 Records)

3. OrderRecord has a field Record_Status
   False: not enough stock
   True: enough stock, but not Shipped unless every Record Under the same Order_ID has status true

4. If Available Units = 0 for SKU in Inventory Do not delete this SKU - Replenish will check OrderRecord with status = false

DDL - ER diagram



```
String createTable_Product =
          "create table Product ("
        + "  Name varchar(32) not null,"
        + "  Description varchar(255) not null unique,"
        + "  Product_SKU varchar(12) not null,"
        + "  primary key (Product_SKU),"
        + "  check(isSKU(Product_SKU))"
        + ")";
```

```
String createTable_InventoryRecord =
          "create table InventoryRecord ("
        + "  Product_SKU varchar(12) not null,"
        + "  AvailableUnits int not null,"
        + "  UnitPrice decimal(13,2) not null,"
        + "  primary key (Product_SKU)," // one Product_SKU can only have one price
        // + "   check(isRounded(UnitPrice)),"
        + "  check(AvailableUnits >= 0),"
        + "  check(UnitPrice >= 0.00)," // free item
        + "  foreign key (Product_SKU) references Product(Product_SKU) on delete cascade"
        + ")";
```

Unique / Decimal(13,2) / Free item / SKU with 0 stock

Adding On Update Restrict / *On Update Cascade* for mySQL only

```
String createTable_Customer =
            "create table Customer("
        + "  FamilyName varchar(16) not null,"
        + "  GivenName varchar(16) not null,"
        + "  Customer_ID varchar(320) not null,"
        + "  Address1 varchar(255) not null,"
        + "  Address2 varchar(255) default null," // could be null
        + "  Address3 varchar(255) default null," // could be null
        + "  City varchar(255) not null,"
        + "  State varchar(2) not null constraint State_Constraint"
        + "     check (State in ('CA','AZ','TX','KL','UP','WB','AH','GS','BJ')),"
        + "  Country varchar(3) not null constraint Country_Constraint"
        + "     check (Country in ('USA','IND','CHN')),"
        + "  PostCode varchar(11) not null,"
        + "  primary key (Customer_ID),"
        + "  check (isCustomerIDEmailAddress(Customer_ID)),"
        + "  check (isZipCode(PostCode))"
        + ")";
```

Enum / 3 Address subfields with 1 not null and 2 default null

```
String createTable_Orders =
            "create table Orders("
        + "  Orders_ID int not null GENERATED ALWAYS AS IDENTITY (START WITH 1, INCREMENT BY 1)
        + "  Customer_ID varchar(320) not null,"
        + "  Orders_RecordAmounts int not null,"
        + "  Orders_Date TIMESTAMP not null DEFAULT CURRENT_TIMESTAMP," // check format and dat
        + "  Orders_ShipmentDate TIMESTAMP default null," // could be null when not shipped
        + "  primary key (Orders_ID),"  // Orders_ID completely determines relation
        + "  check(Orders_RecordAmounts > 0),"
        + "  foreign key (Customer_ID) references Customer(Customer_ID) on delete cascade"
        + ")";
stmt.executeUpdate(createTable_Orders);
String createTable_OrderRecord =
            "create table OrderRecord("
        + "  Orders_ID int not null,"
        + "  Product_SKU varchar(12) not null,"
        + "  UnitPrice decimal(13,2) not null,"
        + "  UnitAmount int not null," //
        + "  OrderRecord_Status boolean DEFAULT false," // (meaning incomplete/pending) or
        + "  primary key (Orders_ID,Product_SKU),"
        + "  foreign key (Orders_ID) references Orders(Orders_ID) on delete cascade,"
        + "  foreign key (Product_SKU) references Product(Product_SKU) on delete cascade,'
        + "  check(UnitAmount > 0)"
        + ")";
stmt.executeUpdate(createTable_OrderRecord);
```

AUTO_INCREMENT / DEFAULT TimeStamp / DEFAULT value NULL for ShipDate

Cascading Triggers

Input Data for OrderRecord

```
1   PC-123456-1B    4
1   PC-123456-0C    3
2   PC-123456-1C    2
3   PC-123456-0B    99
4   PC-123456-1B    1
5   PC-123456-1B    1
5   PC-123456-1C    1
5   PC-123456-0B    1
6   PC-123456-00    1
```

```
( 1, PC-123456-1B, $ 2120.23,  4,  true)
( 1, PC-123456-0C, $ 2110.22,  3,  true)
( 2, PC-123456-1C, $ 2120.23,  2,  true)
( 3, PC-123456-0B, $ 2090.23, 99, false)
( 4, PC-123456-1B, $ 2120.23,  1,  true)
( 5, PC-123456-1B, $ 2120.23,  1,  true)
( 5, PC-123456-1C, $ 2120.23,  1,  true)
( 5, PC-123456-0B, $ 2090.23,  1,  true)
( 6, PC-123456-00, $ 2110.23,  1,  true)
```

Input Data for Orders

```
1 mjames@husky.neu.edu    2
2 kud@hotmail.com 1
3 prav@gmail.com  1
4 cchap@foxmail.com    1
5 andy@gmail.com  3
6 ted@hotmail.com 2
```

```
Orders_Id:   1,Email: mjames@husky.neu.edu, Record Amount: 2, OrderDate:
Orders_Id:   2,Email:      kud@hotmail.com, Record Amount: 1, OrderDate:
Orders_Id:   3,Email:       prav@gmail.com, Record Amount: 1, OrderDate:
Orders_Id:   4,Email:    cchap@foxmail.com, Record Amount: 1, OrderDate:
Orders_Id:   5,Email:      andy@gmail.com, Record Amount: 3, OrderDate:
Orders_Id:   6,Email:      ted@hotmail.com, Record Amount: 2, OrderDate:
Tables_Orders has 6 rows
```

```
2019-06-25 11:18:03.872, ShipDate:   2019-06-25 11:18:24.189
2019-06-25 11:18:03.896, ShipDate:   2019-06-25 11:18:24.195
2019-06-25 11:18:03.898, ShipDate:                        null
  2019-06-25 11:18:03.9, ShipDate:   2019-06-25 11:18:24.235
2019-06-25 11:18:03.901, ShipDate:   2019-06-25 11:18:24.253
2019-06-25 11:18:03.903, ShipDate:                        null
```

Cascading Triggers on OrderRecord

1. Auto Select Price for SKU from Inventory: Two Ways / Using Pure Trigger or Trigger Calling Stored Procedures

```
// create trigger for auto insertion of unitPrice in InventoryRecord table
String createTrigger_InsertUnitPriceInOrderRecord =
          "create trigger InsertUnitPriceInOrderRecord"
        + " after insert on OrderRecord"
        + " REFERENCING NEW ROW AS NewTuple"
        + " for each row MODE DB2SQL"
        + " UPDATE OrderRecord"
        + "   SET UnitPrice = "
        + "     (SELECT UnitPrice from InventoryRecord "
        + "     where InventoryRecord.Product_SKU = NewTuple.Product_SKU)"
        + "   where Product_SKU = newTuple.Product_SKU";
```

Cascading Triggers on OrderRecord

2. Check If Inventory Stock is not Sufficient, when = if check

```
String createTrigger_InsufficientInventory =
          "create trigger InsufficientInventory"
        + " NO CASCADE BEFORE insert on OrderRecord"
        + " REFERENCING NEW ROW AS NewTuple"
        + " for each row MODE DB2SQL"
        + " WHEN (NewTuple.UnitAmount >"
        + "     (SELECT AvailableUnits from InventoryRecord "
        + "     where InventoryRecord.Product_SKU = NewTuple.Product_SKU))"
        + " CALL InsufficientItems(NewTuple.Product_SKU, NewTuple.UnitAmount)";
```

Cascading Triggers on OrderRecord

3. Check If Inventory Stock is Sufficient, the else branch after if because there is branching conditions check in Derby Trigger

```
String createTrigger_ChangeOrderRecordStatus =
          "create trigger ChangeOrderRecordStatus"
        + " AFTER insert on OrderRecord"
        + " REFERENCING NEW ROW AS NewTuple"
        + " for each row MODE DB2SQL"
        + " WHEN (NewTuple.UnitAmount <="
        + "     (SELECT AvailableUnits from InventoryRecord "
        + "     where InventoryRecord.Product_SKU = NewTuple.Product_SKU))"
        + " UPDATE OrderRecord set OrderRecord_Status = true"
        + "     where (OrderRecord.Product_SKU = NewTuple.Product_SKU"
        + " and OrderRecord.Orders_ID = NewTuple.Orders_ID)";
```

Change status = True if enough stock, Change Trigger After Insert

Cascading Triggers on OrderRecord

4. Trigger on change of the status, if true, then deduct the items from Inventory

```
String createTrigger_AutoDeductInventory =
      "create trigger AutoDeductInventory"
    + " AFTER Update OF OrderRecord_Status"
    + " on OrderRecord"
    + " REFERENCING NEW ROW AS NewTuple"
    + " for each row MODE DB2SQL"
    + " Update InventoryRecord"
    + "     set AvailableUnits = AvailableUnits - NewTuple.UnitAmount"
    + "         where (InventoryRecord.Product_SKU = NewTuple.Product_SKU)";
stmt.executeUpdate(createTrigger_AutoDeductInventory);
System.out.println("Created trigger for AutoDeductInventory");
```

Cascading Triggers on OrderRecord

5. Yet another Trigger on change of the status, to check if the shipDate should be Set

```
String createTrigger_AutoShipDate =
         "create trigger AutoShipDate"
       + " AFTER Update OF OrderRecord_Status"
       + " on OrderRecord"
       + " REFERENCING NEW ROW AS NewTuple"
       + " for each row MODE DB2SQL"
       + " CALL AutoShipCheck(NewTuple.Orders_ID)";
stmt.executeUpdate(createTrigger_AutoShipDate);
System.out.println("Created trigger for AutoShipDate");
```

Cascading Triggers on OrderRecord

```
public static void AutoShipCheck(int Orders_ID) {
    try {
        Connection conn = DriverManager.getConnection("jdbc:default:connection");

        PreparedStatement pstmt = conn.prepareStatement("SELECT COUNT(*) FROM OrderRecord where (OrderRecord.Orders_ID = ? AND OrderRecord.OrderRecord
        pstmt.setInt(1, Orders_ID);
        pstmt.execute();
        ResultSet rs1 = pstmt.getResultSet();
        int True_Records = -1; // guard value
        if (rs1.next()) {
            True_Records = rs1.getInt(1);
        }
        System.out.printf("True_Status_Records for Orders_ID %d is %d\n",Orders_ID,True_Records);

        pstmt = conn.prepareStatement("Update Orders SET Orders_ShipmentDate = CURRENT_TIMESTAMP where (Orders.Orders_ID = ? AND ((Select Orders_Recor
        pstmt.setInt(1, Orders_ID);
        pstmt.setInt(2, Orders_ID);
        pstmt.setInt(3, True_Records);
        pstmt.execute();
        // System.out.printf("Record_Amount is %d\n",Record_Amount);
    } catch (SQLException e) {
        e.printStackTrace();
    }
}
public static BigDecimal getUnitPriceFromInventoryRecord(String Product_SKU) {
```

Functional Triggers

If Status = True, And No ShipDate yet (All records ship together), meaning there are other Records with False status
Delete record will return Items back to Inventory

```
g createTrigger_ReturnItemsToInventory =
   "create trigger ReturnItemsToInventory"
 + " AFTER DELETE "
 + " on OrderRecord"
 + " REFERENCING OLD ROW AS OldTuple"
 + " for each row MODE DB2SQL"
 + " WHEN ( (OldTuple.OrderRecord_Status = true) AND "
 + " ((Select Orders_ShipmentDate From Orders where Orders_ID = OldTuple.Orders_ID) is null))
 + " Update InventoryRecord"
 + "     set AvailableUnits = AvailableUnits + OldTuple.UnitAmount"
 + "         where (InventoryRecord.Product_SKU = OldTuple.Product_SKU)";
```

Functional Triggers

If this Record is the last Record for Order_ID (regardless of status), then that Order_ID tuple is is deleted

```
String createTrigger_NoRecordForOrder =
        "create trigger NoRecordForOrder"
      + " AFTER DELETE "
      + " on OrderRecord"
      + " REFERENCING OLD ROW AS OldTuple"
      + " for each row MODE DB2SQL"
      + " WHEN ((Select COUNT(*) FROM OrderRecord Where OrderRecord.Orders_ID = OldTuple.Orders_ID) = 0)"
      + " Delete From Orders"
      + "     where (Orders.Orders_ID = OldTuple.Orders_ID)";
stmt.executeUpdate(createTrigger_NoRecordForOrder);
System.out.println("Created trigger for NoRecordForOrder");
```

Functional Triggers

If Inventory is replenished, the check OrderRecord with status = false and that SKU, try to set the status = true
And set status = true will invoke cascading triggers (decrease stock, etc)

```
// and auto-refills
String createTrigger_BackOrder =
        "create trigger BackOrder"
      + " AFTER UPDATE OF AvailableUnits "
      + " on InventoryRecord"
      + " REFERENCING NEW ROW AS NewTuple"
      + " for each row MODE DB2SQL"
      // + " WHEN ((Select AvailableUnits FROM InventoryRecord Where InventoryRecord.Product_S
      + " UPDATE OrderRecord SET "
      + " OrderRecord.OrderRecord_Status = true "
      + " WHERE (OrderRecord.OrderRecord_Status = false AND "
      + "     (Select UnitAmount FROM OrderRecord Where "
      + " (OrderRecord.Product_SKU = NewTuple.Product_SKU)) < NewTuple.AvailableUnits)";
stmt.executeUpdate(createTrigger_BackOrder);
```

UseCases
{DQL}

Transaction Roll-back

*

API for insert/delete/update record and rollback

```
After insertion, Table InventoryRecord has 7 rows
InventoryRecords:
  PC-123456-00, cnt: 70, $2110.23
  PC-123456-0B, cnt: 40, $2090.23
  PC-123456-0C, cnt: 30, $2110.22
  PC-123456-1B, cnt: 10, $2120.23
  PC-123456-1C, cnt: 20, $2120.23
  PC-123456-1N, cnt: 12, $2130.12
  PC-123456-AA, cnt: 60, $2320.23

 executing following query: delete from InventoryRecord where Product
InventoryRecords:
  PC-123456-00, cnt: 70, $2110.23
  PC-123456-0B, cnt: 40, $2090.23
  PC-123456-0C, cnt: 30, $2110.22
  PC-123456-1B, cnt: 10, $2120.23
  PC-123456-1C, cnt: 20, $2120.23
  PC-123456-AA, cnt: 60, $2320.23
After execution, Table InventoryRecord has 6 rows
InventoryRecords:
  PC-123456-00, cnt: 70, $2110.23
  PC-123456-0B, cnt: 40, $2090.23
  PC-123456-0C, cnt: 30, $2110.22
  PC-123456-1B, cnt: 10, $2120.23
  PC-123456-1C, cnt: 20, $2120.23
  PC-123456-1N, cnt: 12, $2130.12
  PC-123456-AA, cnt: 60, $2320.23
After Roll Back, Table InventoryRecord has 7 rows
```

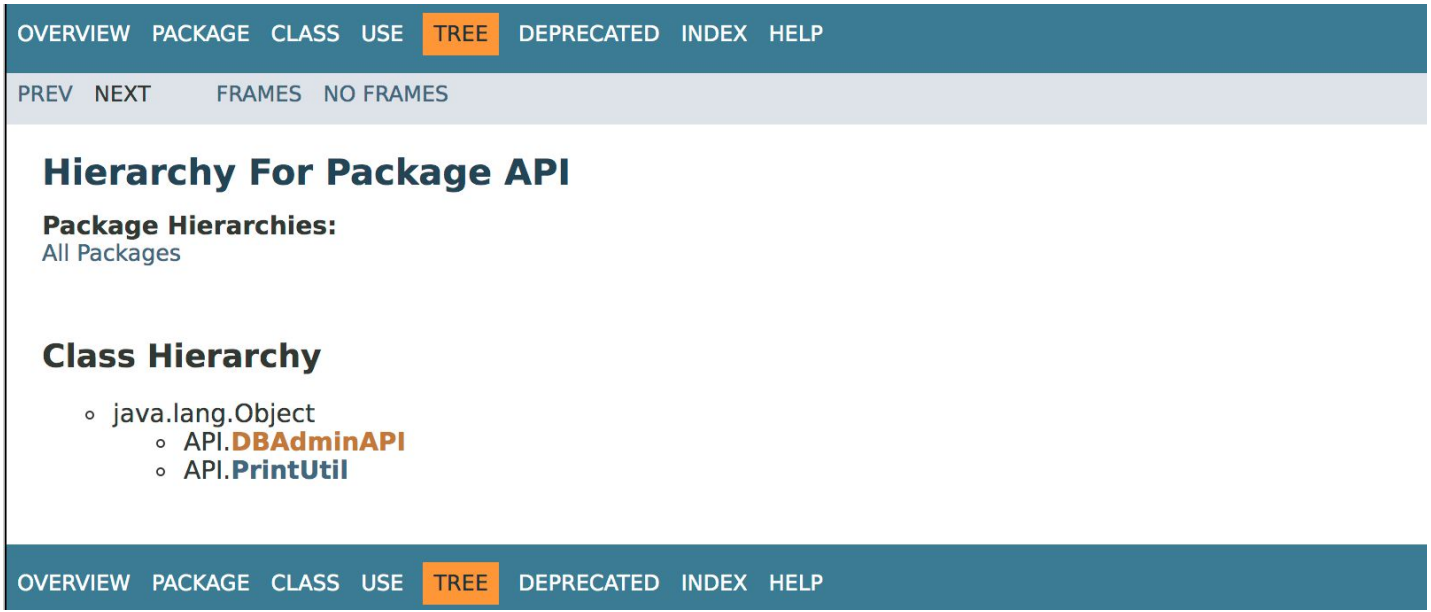
Know Thou Users

Lets run a demo ~

DQL Conclusion:

* API for Customer Orders system

* API for Data Analyst



Future Goal

* Automation (data loader sequentially)

* Encapsulations (apis -> RESTful apis)

* Scalability (single user at time -> Concurrent users)

Future Goal

* Set the UnitPrice of OrderRecord to be Sale Price
    1. Does not violate 3rd Normal Form
    2. Meet Boyce–Codd Normal Form
    3. Calculate Profit

Compare the efficieny by triggers and stored procedures

Reference

[1]. slides2 online seller's joke : https://www.kyozou.com/8-jokes-online-seller-will-love/

[2] slides 5 AWS https://aws.amazon.com/cn/blogs/aws/three-new-aws-reference-architectures-for-e-commerce/

[3] slides 6 Product sku & description
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