

ER to 3NF to DDL

The Entities:

- Customer – One account per customer. The attribute is:
  - ID- customer Identifier for the account.
- Order – Linked from the *Customer* entity through the *Allocates* relationship.

The attributes for this entity are:

- Order ID – Helps identify the order
  - Buying Price – Helps notify the customer about the Buying Price
  - Selling Price – Helps notify the customer about the Selling Price
- Market Order – Linked from the *Order* entity through the *Buy/Sell* relationship.

The attribute is:

- Amount – Displays the price the Market is trying to sell at
- Limit Order – Linked from the *Order* entity through the *Buy/Sell* relationship.

The attribute is:

- Quantity - Displays the price according to the Limit the Market is trying to sell at
- Stock Transaction – Linked from the *Market Order and Limit Order* entities through the *receiving* relationship. The attributes are:
  - Symbol – Acts as the identifier for this entity and displays the Company's Stock Name
  - Company Name – Displays the actual Company's Name
  - Amount – Displays the Amount the Company is being marketed for
- Exchange – Linked from *Stock Transaction* entity through the *Holds* relationship. The attribute for this entity is:

- Exchange ID – Acts as the identifier Identifies the Exchange
- Customer Account – Linked from *Exchange, Stock Transactions and Customer* entities through the *Owns, Proceeds, and Selects* Relationship. The attributes for this entity are:

- Account Number – Act's as the Identifier for this entity and helps the customer locate their Account Number.
- Routing Number – Helps the customer to locate their Routing Number.
- Bank - Linked from *Customer Account* entity through the *Deals With* Relationship. The attributes for this entity are:
  - Account – Act's as the Identifier for this entity and helps the Customer to access their Account for easy banking needs
  - Deposit – In case the Customer wants to Deposit money, this is the place they would visit to do so
  - Withdraw - In case the Customer wants to Withdraw money, this is the place they would visit to do so
- Bank Transactions - Linked from *Bank* entity through the *Revenues* Relationship. The attributes for this entity are:
  - Credentials - Act's as the Identifier for this entity and helps the Customer to view their Bank Credentials.
  - Cancelled – Tells the Customer if their Transaction was Cancelled
  - Pending - Tells the Customer if their Transaction is Pending
  - Approved - Tells the Customer if their Transaction was Approved

#### The Relationships:

- Allocates – Linked from Customer to Order, this is a relationship that helps us understand whether the Customer has Allocated their Order.
  - The Cardinality:
    - Customer – Only one customer can be linked to an order. Therefore, the data range will be (1,1).

- Order – Although there can be one customer to order, the one customer can still allocate multiple orders. Therefore, the data range will be (1, m).
- Buy/Sell – Linked from Order to Market Order and Limit Order, this is a relationship that deals with the Amount of Buying and Selling of the Orders that were allocated by the customer. This relationship also carries an attribute called *Records*. This is where the data from the relationship get's recorded.
  - The Cardinality:
    - Order – There could be multiple Orders allocated by the customer but there could multiple ways for the Market to Order or there could be Limits as to how many Orders can be allocated. Therefore, the data range will be (1,m).
    - Market Order – There could be multiple Market Orders. Therefore, the data range will be (1, m).
    - Limit Order – There could be multiple Limit Orders when it comes to Buying and Selling. Therefore, the data range will be (1, m).
- Receiving – Linked from Order to Stock Transaction, this is a relationship where stocks can also receive many Orders. This relationship also carries an attribute called *Records*. This is where the data from the relationship get's recorded.
  - The Cardinality:
    - Order – There could be multiple Orders when it comes to Buying and Selling. Therefore, the data range will be (1, m).
    - Stock Transaction – The Orders can receive many stock transaction. Therefore, the data range will be (1,m).
- Holds– Linked from Stock Transaction to Exchange, this is a relationship that has to do with all the holds happening between the stock transaction and

exchange. This relationship also carries an attribute called *Records*. This is where the data from the relationship gets recorded.

- The Cardinality:
  - Stock Transaction – There could be many Stock Transaction Holds for it to be Exchanged. Therefore, the data range will be (1, m).
  - Exchange – Stock Transaction can Exchange many times. Therefore, the data range will be (1, m).
- Owns – Linked from Exchange to Customer Account, this is a relationship that shows that the Customer Account can own the Exchanges the customer has made.
  - The Cardinality:
    - Exchange – There could be multiple Exchanges that have been owned by the Customer and can all be found in their Customer Account. Therefore, the data range will be (1, m).
    - Customer Account – Can display multiple Exchanges the Customer has made through their account. Therefore, the data range will be (1, m).
- Proceeds – Linked from Stock Transaction to Customer Account, this is a relationship that shows the stock related transaction the Customer has made on their Customer Account. This relationship also carries an attribute called *Records*. This is where the data from the relationship gets recorded.
  - The Cardinality:
    - Stock Transaction – The multiple Stock Transactions made by the Customer on their account. Therefore, the data range will be (1, m)

- Customer Account – Although, the Customer can make multiple Transactions, they can only do it on their one account. Therefore, the data range will be (1, 1).
- Selects – Linked from Customer to Customer Account, this is a relationship that shows that the Customer has Selected their Customer Account.
  - The Cardinality:
    - Customer – Since only one Customer can Select a Customer Account, therefore, the data range will be (1, 1).
    - Customer Account – Even though only one Customer can select the Account, there could be multiple accounts they select. For example, they could select a checking and a saving account. Therefore, the data range will be (1, m).
- Deals with – Linked from Customer Account to Bank, this is a relationship that shows how the Customer Account deals with the Bank. This relationship also carries an attribute called *Records*. This is where the data from the relationship get's recorded.
  - The Cardinality:
    - Customer Account – Through their Customer Account, the customer could be wanting to deal with many things with the bank. It doesn't have to be a specific thing. Therefore, the data range will be (1, m).
    - Bank – Through the Customer Account, you could be dealing with the deposits or withdrawals, Or even just dealing with normal Account problems with the bank. Therefore, the data range will be (1, m).
- Revenues – Linked from Bank to Bank Transactions, this is a relationship that deals with revenues and basically money. This relationship also carries an

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attribute called *Records*. This is where the data from the relationship get's recorded.

- The Cardinality:
  - Bank – There could be multiple Revenues made by the Bank. Therefore, the data range will be (1, m).
  - Bank Transactions – Even though multiple Revenues are made, all that would be viewable when dealing with Bank Transactions. Bank Transaction also notifies the Customer's Account and the Bank if any transactions were Pending, Cancelled or Approved. Basically, let's them know the status of their transactions. Therefore, the data range will be (1, m).

### The Relational Schema:

#### **Handling Entities with Non-Subtypes**

Customer (ID)

Stock Transactions (Symbol, Company\_Name, Amount)

Exchange (Exchange ID)

Customer Account (Account\_Number, Routing Number)

Bank (Account, Deposit, Withdraw)

Bank Transactions (Credentials, Cancelled, Approved, Pending)

#### **Handling Entities with Subtypes**

Order (Order\_ID, Amount, Quantity, Buying\_Price, Selling\_Price)

#### **Relationships**

*(one-to-many)*

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Customer Account (Account\_Number, Routing\_Number, ID<sup>†</sup>)  
Order (Order\_ID, Buying\_Price, Selling\_Price, ID<sup>†</sup>)  
Exchange (Exchange\_ID, Account\_Number<sup>†</sup>)

*(many-to-many)*

Proceeds (Account\_Number<sup>†</sup>, Symbol<sup>†</sup>, Record)  
Deals With (Account\_Number<sup>†</sup>, Account<sup>†</sup>, Record)  
Revenues (Account<sup>†</sup>, Credentials<sup>†</sup>, Record)  
Buy/Sell (Order\_ID<sup>†</sup>, Record)  
Holds (Exchange\_ID<sup>†</sup>, Symbol<sup>†</sup>, Record)  
Receiving (Order\_ID<sup>†</sup>, Symbol<sup>†</sup>, Record)

### The Final Schema

Customer (ID)  
Stock Transactions (Symbol, Company\_Name, Amount)  
Bank (Account, Deposit, Withdraw)  
Bank Transactions (Credentials, Cancelled, Approved, Pending)  
Customer Account (Account\_Number, Routing\_Number, ID<sup>†</sup>)  
Order (Order\_ID, Buying\_Price, Selling\_Price, ID<sup>†</sup>)  
Exchange (Exchange\_ID, Account\_Number<sup>†</sup>)  
Proceeds (Account\_Number<sup>†</sup>, Symbol<sup>†</sup>, Record)  
Deals With (Account\_Number<sup>†</sup>, Account<sup>†</sup>, Record)  
Revenues (Account<sup>†</sup>, Credentials<sup>†</sup>, Record)  
Buy/Sell (Order\_ID<sup>†</sup>, Record)  
Holds (Exchange\_ID<sup>†</sup>, Symbol<sup>†</sup>, Record)  
Receiving (Order\_ID<sup>†</sup>, Symbol<sup>†</sup>, Record)