Assignment 8 - Capstone Project
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1. Description

The project aims to build a database for a mutual fund company to record its stock investment activities, as well as the activities of its employees and investors. The goal of the database is to provide convince when querying related activities and help catching up how things flow within the company. A mutual fund company is a company that pools money from investors and then invests the money in securities such as stocks, bonds, etc. To make sure the project is in the appropriate scope, some scenarios in this project are simplified.

We only consider the individual investors here. The important information about an investor is the name, bank information (account and routine number for paying/receiving money), phone number, email and address. An investor can invest in one fund multiple times in one day. But the company only confirms those investments at the end of each business day for each investor. So the database will only record the total investment amount for that day of each investor.

Diverse types of funds are issued to meet the interests of different Investors. For each fund, its name, risk level and description are recorded. To quantify the risk level, we define it on a scale of 1-5, where 1 is lowest and 5 is highest. Investors can choose one or more funds to invest. One fund can be invested by more than one investors. If one fund has no investors, then it will be considered as issuance failure and will not be recorded in the database.

A fund has its own investing strategy. That is, the asset allocation (including cash, stock, bond, etc.) for each fund will be different. For example, money market fund is a low risk fund. To achieve its low risk, this type of funds will not be allowed to invest stocks and lower credit rated bonds. To simplify the scenario, this project will focus on tracing one asset type -stock. The database will record stocks that managed by the mutual fund company. To be specific, the stock name, issue company name, traded stock exchange and their quantity will be the interest. A fund can buy different stocks and one stock can be contained by different funds.

For employees in the mutual fund, their name, address, sex, birth date, phone, email, highest degree and certificates are recorded. Managers are responsible for managing funds' investing activities (i.e making the final investment decisions). So they usually have very rich investment experience. Several managers can manage one fund together and a manager can manage several funds. Traders are responsible for executing transaction request from managers. Analysts are responsible for analyze stocks and writing analysis reports.

Analysts can cooperate to write reports. An analyst can write multiple reports for the same stock in different time period and those reports can express same or different opinions. The reports analyze the recent news, financial statements, industries and so on. Based on that, the analyst(s) will give invest advice. The invest advice includes "buy", "sell" or "hold". For the purposes of this exercise, we will assume that only one stock is analyzed in an individual report. According to regulatory requirements (avoiding internal transaction, market manipulation, etc.), stocks bought by the company should have analysts' reports to give analysis support. But analysts can also write reports about stocks that have not been bought yet. For the reports, the database will record its title, stock name, investment advice, report date and a brief summary.

Managers need to determine buy or sell of one stock, the quantity (or quantity range) and its price (or price range). After a manager makes the decision, he will give a corresponding transaction request to a trader to complete the transaction. A transaction request can only involve one stock and be placed by one manager. One trader will be assigned to finish the transaction. The trader can choose the best trading time, and best deal price/quantity if given a price/quantity range, based on their own judgment. For the transactions, the traded stock name, transaction direction and quantity will be recorded. Each transaction will change the current stocks status. For one stock, it can be traded multiple times. The database will keep the historical information. So if one stock was sold out, it will be recorded as quantity 0 but still in the system. Assume the data entered into the database have already updated for the latest transactions.

As one of the benefits offers to the investors is: the company holds events to teach investors some investment knowledge and sharing opinion of recent news. Some of the employees (i.e managers) will give presentations during the events. This is a voluntary activity. So we assume not all of the investors/employees will participate in those events. If no one shows up, the event will be cancelled and not recorded into the system. For the events, its date, location and topic will be recorded.

2. EER diagram

The EER diagram is showed below. A clearer Visio version is also submitted.

Assumption:
1. A manager manage at least one fund. A trader made at least one transaction. A analyst write at least one report.
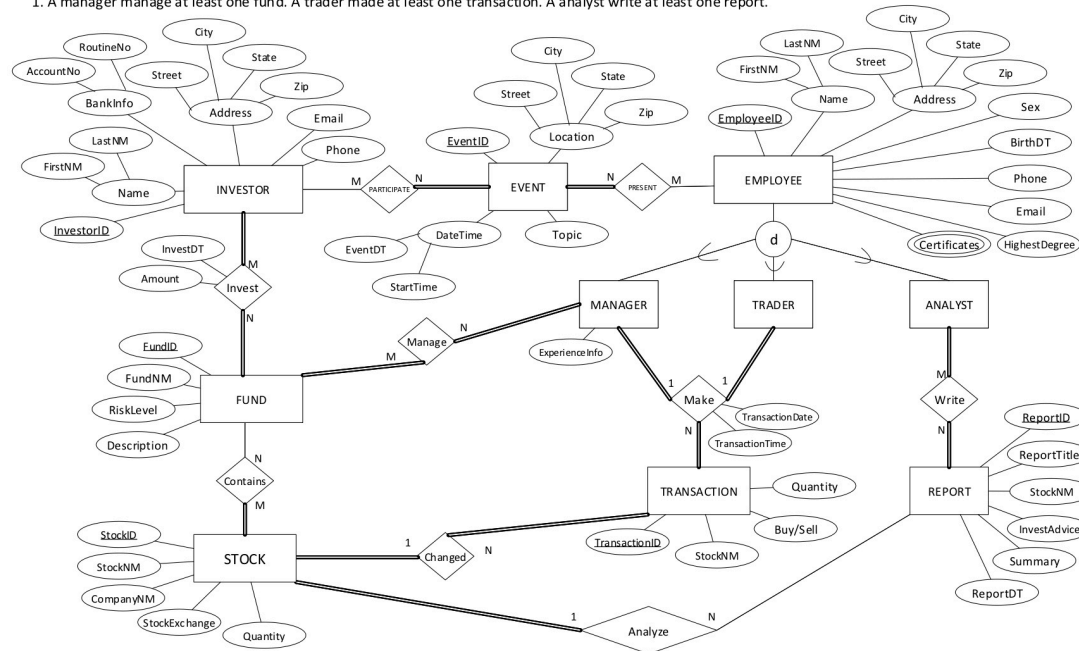
3. Relational model

Map above EER into the relational model. Note that all the tables below are showed without normalization.

TableName	Attribute(datatype)	Constraints
EMPLOYEE	EmployeeID(number)	Primary Key
EMPLOYEE	FirstNM(varchar2)	Not null
EMPLOYEE	LastNM (varchar2)	Not null
EMPLOYEE	Street (varchar2)	
EMPLOYEE	City (varchar2)	
EMPLOYEE	State (varchar2)	2 uppercase letter abbreviation
EMPLOYEE	Zip (varchar2)	5 digital zipcode
EMPLOYEE	Sex (varchar2)	Only in 'F' and 'M'
EMPLOYEE	BirthDT (date)	
EMPLOYEE	Phone(varchar2)	10 digital phone number
EMPLOYEE	Email (varchar2)	
EMPLOYEE	HighestDegree (varchar2)	Only in 'High-school', 'Undergraduate', 'Master', 'PHD' and 'Post-doctor'
CERTIFICATES	EmployeeID(number)	Primary Key Foreign key to EMPLOYEE.EmployeeID
CERTIFICATES	Certificates (varchar2)	Primary Key

MANAGER	ManagerID(number)	Primary Key Foreign key to EMPLOYEE.EmployeeID
MANAGER	ExperienceInfo(varchar2)	
TRADER	TraderID(number)	Primary Key Foreign key to EMPLOYEE.EmployeeID
ANALYST	AnalystID(number)	Primary Key Foreign key to EMPLOYEE.EmployeeID
INVESTOR	InvestorID(number)	Primary Key
INVESTOR	FirstNM(varchar2)	Not null
INVESTOR	LastNM(varchar2)	Not null
INVESTOR	AccountNo(varchar2)	Not null
INVESTOR	RoutineNo(varchar2)	Not null
INVESTOR	Street (varchar2)	
INVESTOR	City (varchar2)	
INVESTOR	State (varchar2)	2 uppercase letter abbreviation
INVESTOR	Zip (varchar2)	5 digital zipcode
INVESTOR	Email (varchar2)	
INVESTOR	Phone(varchar2)	10 digital phone number
FUND	FundID (number)	Primary Key
FUND	FundNM (varchar2)	Not null
FUND	RiskLevel(varchar2)	Only in '1', '2', '3', '4', '5'
FUND	Description (varchar2)	
MANAGE	ManagerID(number)	Primary Key Foreign key to MANAGER.ManagerID
MANAGE	FundID (number)	Primary Key Foreign key to FUND.FundID
INVEST	InvestorID(number)	Primary Key Foreign key to INVESTOR.InvestorID
INVEST	FundID(number)	Primary Key Foreign key to FUND.FundID
INVEST	InvestDT(date)	Primary Key
INVEST	Amount(number)	>0 Not null
STOCK	StockID(number)	Primary Key
STOCK	StockNM(varchar2)	Not null
STOCK	CompanyNM(varchar2)	
STOCK	StockExchange(varchar2)	
STOCK	Quantity (number)	Not null >=0
CONTAINS	FundID (number)	Primary Key Foreign key to FUND.FundID
CONTAINS	StockID(number)	Primary Key Foreign key to STOCK.StockID
REPORT	ReportID (number)	Primary Key

REPORT	ReportTitle (varchar2)	Not null
REPORT	StockNM (varchar2)	Not null
REPORT	InvestAdvice(varchar2)	Not null, Only in 'BUY','SELL','HOLD'
REPORT	Summary(varchar2)	
REPORT	ReportDT(date)	Not null
REPORT	StockID(number)	Foreign key to STOCK.StockID
WRITE	AnalystID(number)	Primary Key Foreign key to ANALYST.AnalystID
WRITE	ReportID(number)	Primary Key Foreign key to REPORT.ReportID
TRANSACTION	TransactionID(number)	Primary Key
TRANSACTION	StockNM(varchar2)	
TRANSACTION	Buy_Sell(varchar2)	Only in 'BUY', 'SELL' not null
TRANSACTION	Quantity(number)	not null >0
TRANSACTION	ManagerID(number)	Foreign key to MANAGER.ManagerID
TRANSACTION	TraderID(number)	Foreign key to TRADER.TraderID
TRANSACTION	StockID(number)	Foreign key to STOCK.StockID
TRANSACTION	TransactionDate(date)	not null
TRANSACTION	TransactionTime(varchar2)	not null
EVENT	EventID(number)	Primary Key
EVENT	Topic(varchar2)	Not null
EVENT	EventDT(date)	Not null
EVENT	StartTime(varchar2)	Not null
EVENT	Street (varchar2)	
EVENT	City (varchar2)	
EVENT	State (varchar2)	2 uppercase letter abbreviation
EVENT	Zip (varchar2)	5 digital zipcode
PARTICIPATE	EventID(number)	Primary Key Foreign key to EVENT.EventID
PARTICIPATE	InvestorID(number)	Primary Key Foreign key to INVESTOR.InvestorID
PRESENT	EventID(number)	Primary Key Foreign key to EVENT.EventID
PRESENT	EmployeeID(number)	Primary Key Foreign key to EMPLOYEE.EmployeeID

4. Functional dependencies

EMPLOYEE(EmployeeID, FirstNM, LastNM, Street, City , State, Zip, Sex, BirthDT , Phone, Email , HighestDegree)
{EmployeeID} -> {FirstNM, LastNM, Street, Zip, Sex, BirthDT, Phone, Email , HighestDegree};
{Zip} -> {City , State}

Note: {Certificates} is a mutilated attribute which indicated that the table was not be in 1NF. This attribute had already been taken care of when mapping into the relational model. We had moved it out and created a new separate relation for it. To normalize EMPLOYEE in 3NF, remove city and state out, and create a new relation for them with zip as its primary key (table is named ZIP).

INVESTOR(InvestorID, FirstNM, LastNM, AccountNo, RoutineNo, Street, City , State, Zip, Phone, Email)
{InvestorID} -> {FirstNM, LastNM, AccountNo, RoutineNo, Street, Zip, Phone, Email };
{Zip} -> {City , State}
To normalize it, remove city and state out. Since a new table has already built above, no need to create a new one.

STOCK(StockID, StockNM, CompanyNM, StockExchange, Quantity)
{StockID} -> {StockNM, Quantity};
{StockNM} -> {CompanyNM, StockExchange}
To normalize it, remove CompanyNM and StockExchange out, and create a new relation for them with StockNM as its primary key (table is named STOCKNM).

REPORT(ReportID, ReportTitle, StockNM, InvestAdvice, Summary, ReportDT, StockID)
Note: {StockID} -> {StockNM} only holds for stocks that have been bought by the company since StockID is a foreign key to Stock.StockID. However, analysts can write other stocks besides those ones. In that way, StockID will have no value. So we will not take actions for this table.

TRANSACTION (TransactionID,StockNM,Buy_Sell,Quantity,ManagerID,TraderID, StockID,TransactionDate,TransactionTime)
{TransactionID} -> {StockNM,Buy_Sell,Quantity,ManagerID,TraderID, TransactionDate, TransactionTime}
{StockID} -> {StockNM}
To normalize it, remove StockNM out, and create a new relation for it with StockID as its primary key. Note we have already had a table STOCK (StockID, StockNM, Quantity). So I think this table would be enough and no need to create one more.

EVENT (EventID, Topic, EventDT, StartTime, Street, City, State, Zip)
{EventID} -> {Topic, EventDT, StartTime, Street, Zip };
{Zip} -> {City , State}
To normalize it, remove city and state out. Since a new table have already built, no need to create new table.

For the rest of the tables, all the non-prime attributes are not functionally dependent on each other. All the attributes are dependent on the whole primary key.

After fixing the tables mentioned above, all the tables are in 3NF.

5. Write sql statements to create the normalized database
Please see the submitted SQL scripts to get the SQL statements and the submitted PDF file for relationships using the Data Modeler.

6&7 Query for the database and its results

Please see the submitted to SQL scripts get the SQL statements. Questions are listed below and its results are showed right below each question:

1. Manager X (X is the name of the manger) wants to send thank you note to those who invested his funds. List the name and address of all the investors who invest the funds managed by manager X, along with the fund name.

	FIRSTNM	LASTNM	STREET	CITY	STATE	ZIP	FUNDNM
1	Jon	Snow	1 first St.	Chicago	IL	60608	Hybrid fund 1
2	Yara	Greyjoy	1170 Main St.	Urbana	IL	61801	Hybrid fund 1
3	Stannis	Baratheon	117 St.	Savoy	IL	61874	Hybrid fund 1
4	Jorah	Mormont	107 E Healy	Champaign	IL	61820	Nasdaq fund
5	Stannis	Baratheon	117 St.	Savoy	IL	61874	Nasdaq fund
6	Ramsay	Bolton	110 E Healy	Champaign	IL	61820	Nasdaq fund

2. An investor X (X is the name of the manger) wants to know the current stocks contained by the funds he invested. List the fund name and its corresponding stock name.

	FUNDNM	STOCKNM
1	Nasdaq fund	AMZN
2	Nasdaq fund	TSLA
3	Nasdaq fund	INTC
4	Technology fund	AAPL
5	Technology fund	INTC
6	Technology fund	GOOG

3. The marketing department is responsible for planning all the events. They want to know the basic participation information during Nov, like which employee joined and how many investors joined. Give the names of employees who presented during this month. Also, for each employee, list corresponding events information, and the number of investors who joined that event.

	EMPLOYEEID	FIRSTNM	LASTNM	EVENTID	TOPIC	EVENTDT	NO_PARTICIPANT
1	2	Theon	Greyjoy	5	View after Fed increased Fed rate	30-NOV-18	5
2	3	Tyrion	Lannister	5	View after Fed increased Fed rate	30-NOV-18	5
3	1	Daenerys	Targaryen	5	View after Fed increased Fed rate	30-NOV-18	5
4	1	Daenerys	Targaryen	1	Weekly News Analysis	02-NOV-18	3
5	2	Theon	Greyjoy	1	Weekly News Analysis	02-NOV-18	3
6	1	Daenerys	Targaryen	4	Weekly News Analysis	23-NOV-18	2
7	3	Tyrion	Lannister	2	Weekly News Analysis	09-NOV-18	2
8	6	Davos	Seaworth	3	Weekly News Analysis	16-NOV-18	1

4. If a stock is traded frequently, there may be due to frequent changes in the market. It should be considered having potential high investment risk. The risk management department will monitor this issue. They want to know how frequently the stocks were traded during Nov. Select out stocks that have been traded during Nov. List the stock name, company name, stock exchange, current quantity and number of transactions.

	STOCKNM	COMPANYNM	STOCKEXCHANGE	QUANTITY	NO_TRANSACTION
1	TSLA	Tesla Inc	NASDAQ	5000	5
2	WMT	Walmart, Inc	NYSE	5000	2
3	GOOG	Alphabet, Inc	NASDAQ	20000	1

5. The company wants to reward analysts who are activity seeking valuable stocks. That is, reward analysts who analyze stocks that have not been bought yet. Given the name of the analysts and their reports information.

	FIRSTNM	LASTNM	REPORTTITLE	STOCKNM	INVESTADVICE	REPORTDT	SUMMARY
1	Davos	Seaworth	YELP develops new busniess	YELP	BUY	20-NOV-18	unexpected good news
2	Davos	Seaworth	JPM 3rd financial statement analysis	JPM	BUY	20-NOV-18	stable profit
3	Khal	Drogo	YELP develops new busniess	YELP	BUY	20-NOV-18	unexpected good news