ACADEMIC WRITING BASICS FOR REPORT WRITING

ABSTRACT

An abstract is like a movie trailer. It offers a preview, highlights key points, and helps the audience decide whether to view the entire work or not.

Parts of an Abstract (Checklist):

1. **Motivation/problem statement**: Why do we care about the problem? What practical, scientific, theoretical or artistic gap is your research filling?
2. **Methods/procedure/approach**: What did you actually do to get your results? (e.g. analysed 3 novels, completed a series of 5 oil paintings, interviewed 17 students)
3. **Results/findings/product**: As a result of completing the above procedure, what did you learn/invent/create?
4. **Conclusion/implications**: What are the larger implications of your findings, especially for the problem/gap identified in step 1?

In the below example, color code has been used to indicate each part of an abstract:

EXAMPLE:

The purpose of this study is to identify relationships between the physical and genetic characteristics of bones in mice. The physical characteristics include size, density, and the force required to break the bone, while the genetic ones are the genes of the marker loci associated with the genes that affect these qualities. This study uses strains of mice with reduced genetic variation. The two strains of mice that are the most phenotypically extreme, meaning those with the strongest and weakest bones, are crossed. The F2 generation from that cross is then analysed. The results of this analysis can be used to find which genotypes correlate with specific bone properties like size, density, and failure load. The anticipated outcome of this lab is the identification of the genotypes that affect bone strength in mice. The findings may be useful in treating medical conditions that are related to bone strength.

EXECUTIVE SUMMARY

An executive summary summarizes a longer report or proposal or a group of related reports in such a way that readers can rapidly become acquainted with a large body of material without having to read it all. It usually **contains some or all of the parts mentioned** next:

- **Statement of problem/ proposition/topic**: A brief statement of problem or proposal or topic covered in the document.
- **Background information**: A basic understanding of the research problem being investigated. Some information that can provide the reader with the essential context needed to understand the research problem and its significance.
- **Method/procedure/approach**: A summary of the methods/procedures/approaches used.
- **Key finding and its analysis**: A summary of the key findings and a concise analysis.
- **Conclusion and Recommendation**: A summary of conclusions and recommendations made.
- **Limitation:** Limitations of the report.

In the below example, color code has been used to indicate each part of an executive summary:

EXAMPLE:

This report provides an analysis and evaluation of the current and prospective profitability, liquidity and financial stability of Outdoor Equipment Ltd. Methods of analysis include trend, horizontal and vertical analyses as well as ratios such as Debt, Current and Quick ratios. Other calculations include rates of return on Shareholders' Equity and Total Assets and earnings per share to name a few. All calculations can be found in the appendices. Results of data analyzed show that all ratios are below industry averages. In particular, comparative performance is poor in the areas of profit margins, liquidity, credit control, and inventory management.

The report finds the prospects of the company in its current position are not positive. The major areas of weakness require further investigation and remedial action by management.

Recommendations discussed include:

- *Improving the average collection period for accounts receivable*
- *Improving/increasing inventory turnover·*
- *Reducing prepayments and perhaps increasing inventory levels*

The report also investigates the fact that the analysis conducted has limitations. Some of the limitations include: forecasting figures are not provided nature and type of company is not known nor the current economic conditions data limitations as not enough information is provided or enough detail i.e. monthly details not known results are based on past performances not present.

(NOTE: An executive summary differs from an abstract in that an abstract will usually be shorter and is typically intended as an overview or orientation rather than being a condensed version of the full document.)

KEYWORDS

Including appropriate keywords in your paper/thesis/report helps indexers and search engines find it, thus increase its visibility. In fact, keywords are used for indexing. **Choose 4-8 words that best define your work**.

Some guidelines that can be helpful in selecting keywords are mentioned next:

- Focus on the main topic of your research. For example, if the title of your project is "An Online Appointment Booking Web Application", the a keyword would be "**Online appointment booking**"
- Include your techniques and/or specific methodology you have used for your research/ project, i.e., the most important experimental techniques used in your report. For example, if your report uses Reinforcement learning for game playing, then a keyword would be "**Reinforcement learning**".
- Identify the words that best represent the key concept and content of your report. Be specific to the field or sub-field of your research.
- Avoid keywords that are only one word. (Refer the keywords mentioned above; they have multiple words in them, like "**Reinforcement learning**" has two words in it.
- Avoid overlapping keywords in your title and those in your keyword list, or words that convey the same meaning. For example, "**Machine learning"** and "**Reinforcement learning"** convey the same thing; thus, select only one that best define your work.

PROBLEM STATEMENT AND OBJECTIVE

A **problem statement**' is a short description of the issues that need to be addressed by a problem solving team and should be presented to them (or created by them) before they try to solve a problem. Problem statements often have three elements:

- **the problem itself**, stated clearly and with enough contextual detail to establish why it is important (that is, a clear statement that the problem exists; evidence that supports the existence of the problem)
- **the method of solving the problem**, often stated as a claim or a working thesis;
- **the purpose, statement of objective and scope** of the document the writer is preparing

On the other hand, **objective** is a claim of one or two sentences in length that outlines the problem addressed by a study. The statement of the problem should briefly address the question: What is the problem that the research will address?

EXAMPLE:

[Problem and its context] *A recent trend in the design of new aircraft is the addition of winglets, which are small fins attached to the ends of the main wing. After an aircraft has taken off and is cruising, winglets improve its performance by reducing the drag caused by the main wing. However, during the critical stages of aircraft takeoff and landing, the winglets cause two problems. First, they cause vibrations in the main wing, commonly called buffeting. Second, they cause the aircraft to lose some control of yaw, the motion of the nose right and left. In a study funded by NASA [Ref. 2], the main wing of a DC-10 transport aircraft was outfitted with winglets, and it experienced significant buffeting during takeoff and landing.*

[Approach of the current research] *In our current project, we examine winglet-induced buffeting in three wing designs. We record buffeting and yaw under experimental wind-tunnel takeoff and landing conditions for (1) a wing without winglets, (2) another wing with conventional winglets, and (3) a wing with spheroid winglets.*

Our objective is:

- *To determine the degree to which differences between load lifts on the wings and their winglets during takeoff and landing are causing the performance problems.*

[Purpose and scope of current document] *In this study, we develop theoretical models of winglet load lifts and compare these to the lifts of wings and winglets actually recorded during testing conditions.*

LITERATURE REVIEW

A literature review usually has an organizational pattern and combines both **summary** and **synthesis**. A summary is a recap of the important information of the source, whereas a **synthesis is a re-organization**, or a reshuffling, of that information. It might give a **new interpretation of old material** or **combine new with old interpretations**.

Some guidelines for literature review:

- Assess how each source relates to other research within the field. Group sources by theme, topic, or methodology and write the summary of key research.
- Evaluate how the findings of those papers can be relevant for your research
- Critically evaluate research (analyze and synthesize)

.**EXAMPLE**

Prior studies have identified many benefits for educational institutions from service-learning programs. These benefits include positive perceptions of the university by the community (Miron & Moely, 2006), enhanced student retention rates (Eyler et al., 2001), positive teaching and learning outcomes such as greater student involvement and participation in class (Caruso et al., 2007), and increased opportunities for meaningful research and scholarly activities (Strand et al., 2003).

In this study and related research, the individuals serving are university students who are collaborating with the community partner. The studied benefits to individuals serving include cultural awareness sharing (Crabtree, 2008), as well as networking opportunities and application of classroom learning to real-world issues (Bowen et al., 2009). Ultimately, service-learning stimulates student learning and engages students in their surrounding communities. Service learning creates new goals for students such as personal development, career development, moral development, academic achievement, and "reflective civic participation" (Lamb et al., 1998). These types of projects allow students to utilize material learned in the classroom to improve societal conditions.

Integrating concepts and theories learned in the classroom with everyday life makes students more capable of highlighting the importance of each course. Additionally, material learned in business courses can be applied to benefit the community through a variety of tangible services, such as business planning or marketing new programs. Service learning is an excellent way for students to apply their course lessons to real-world situations and concurrently benefit the community.

CONCLUSION

It is important to have a strong conclusion, since this is the last chance you have to make an impression on your reader. The goal of conclusion isn't to introduce any new ideas, but to sum up everything you've written.

Parts of a Conclusion (Checklist):

1. **Restate the main idea of your essay, or your thesis statement**:
    a. Restate your topic
    b. Restate your thesis statement
2. **Summarize (rather synthesize) the three sub-points of your essay**:
    a. Include a brief summary of the paper's main points, but don't simply repeat things that were in your paper.
3. **Leave the reader with an interesting final impression**:
    a. Include a provocative insight or quotation from the research or reading you did for your paper.
    b. Propose a course of action, a solution to an issue, or questions for further study.
    c. Point to broader implications.

In the below example, color code has been used to indicate each part of a conclusion:

Getting a better job is a goal that I would really like to accomplish in the next few years. Finishing school will take me a long way to meeting this goal. To meet my goal, I will also prepare my résumé and search for jobs. My goal may not be an easy one to achieve, but things that are worth doing are often not easy.

(NOTE: This is only a sample conclusion. Conclusion can be lengthy depending on report size.)

BASIC CONCEPTS OF SOFTWARE ENGINEERING FOR REPORT WRITING

REQUIREMENT ANALYSIS

The requirements for a system are the descriptions of what the system should do—the **services that it provides** and the **constraints on its operation**.

A requirement is:

- What a system must do
- A known limitation or constraint on resources or design
- How well the system must do what it does

FUNCTIONAL REQUIREMENTS

Functional requirements describe the functionality of the system that can be modelled with **use-cases.** Functional requirements usually employ the word "***shall***". For example:

Add Participant

"*The software shall display an option to add a participant*"

NON-FUNCTIONAL REQUIREMENTS

Non-functional requirements describe system properties related to:

- system performance, speed (transaction time, screen refresh time, response time), size (project, input, output) , ease of use (training time) , the "ilities" (e.g., usability, security, maintainability , availability, reliability, scalability)
- a known limitation or constraint on resources or design
- can include documentation, marketing collateral, product localization, legal compliance restrictions

They typically employ the word "**must**". For example,

Localization

"*The help file must be released in English, French and Spanish.*"

EXMPLE

Functional and non-functional requirements for VoIP can be:

Functional	Non-functional
The user shall add new participant	The audio and video quality must be high
The system shall show participants' count	The connection and service must be reliable
The main user shall be able to drop participant	The service must be easy to use
The user shall be able to summon the operator	It must be cheap to use the service
The user shall be able to mute microphone	The service must be available in the local language

FEASIBILITY ANALYSIS

A feasibility study should be relatively **cheap** and **quick.** The result should inform the decision of whether or not to go ahead with a more detailed analysis. A feasibility study leads to a decision:

- Go ahead
- Do not go ahead
- Think again

Technical feasibility

- What technologies are needed for this project? For example, during designing/modelling, development, testing, and deployment tools and technologies.
- Why did you select those technologies (for example, are those technologies free/ cheaper to use, or do you have skills/experiences to use those technologies)? Or how will they benefit your project? (or are the selected technologies best fit your problem?)
- Are all the selected technologies for this project available or achievable?
- Expenses for technical requirements should be noted in the technical feasibility study. Selecting expensive technologies may make the project economically infeasible.

Economic feasibility

- Analysis of project's costs and revenues in an effort to determine whether it is logical and possible to complete.
- Your project is a student project so the costs were mostly indirect costs unless you have spent money to buy any hardware/ software for the project. Project costs will be mainly in terms of your work hours, laptops and other resources used, and report printing. Immediate revenue is in terms of course credits but in the future you can extend the project and turn into a professional project which will generate revenue.

Operational feasibility

- Operational feasibility is the measure of how well a proposed system solves the problems, and takes advantage of the opportunities identified during scope definition. Furthermore, how it satisfies the requirements identified in the requirements analysis phase of system development.

SYSTEM DESIGN

System modelling mean representing the system using some kind of graphical notation (***A picture is worth a thousand words)***, which is now almost always based on notations in the **Unified Modelling Language (UML).**

Various UML diagrams:

- **USE CASE DIAGRAMS**, which show the interactions between a system and its environment.
- **SEQUENCE DIAGRAMS**, which show interactions between actors and the system and between system components.
- **CLASS DIAGRAMS**, which show the object classes in the system and the associations between these classes.
- **STATECHART DIAGRAMS**, which show how the system reacts to internal and external events.
- **ACTIVITY DIAGRAMS**, which show the activities involved in a process or in data processing.

Perspectives for Modelling

1. **An external perspective**, where you model the context or environment of the system. (e.g., Use-Case Diagram)
2. **An interaction perspective** where you model the interactions between a system and its environment or between the components of a system. (e.g., Sequence diagram)
3. **A structural perspective**, where you model the organization of a system or the structure of the data that is processed by the system. (e.g., Class diagram)
4. **A behavioural perspective**, where you model the dynamic behaviour of the system and how it responds to events. (For data, e.g., DFD; for event, e.g., statechart diagram)

UML principle

- Different diagrams describe various **facets** of the model.
- Several diagrams of the **same kind may co-exist**
- Each diagram shows a ***projection*** of the model
- The coherence rules between different kinds of diagrams are not fully stated. However, ***Incoherence*** between diagrams (of the same or of different kind(s)) correspond to an ***ill-formed*** **model**

USE-CASE DIAGRAM

Use case illustrates **a unit of functionality** provided by the system. Typically used to communicate the high-level functions of the system and the system's scope (i.e., diagram shows **what the system *doesn't* do**). It helps development teams visualize the **functional requirements** of a system, including the relationship of "actors". Stakeholders can easily see **if needed functionality is present or not present in the system.** Generally shows groups of use-cases:

- either all use cases for the complete system, or
- a breakout of a particular group of use cases with related functionality (e.g., all security administration related use cases)

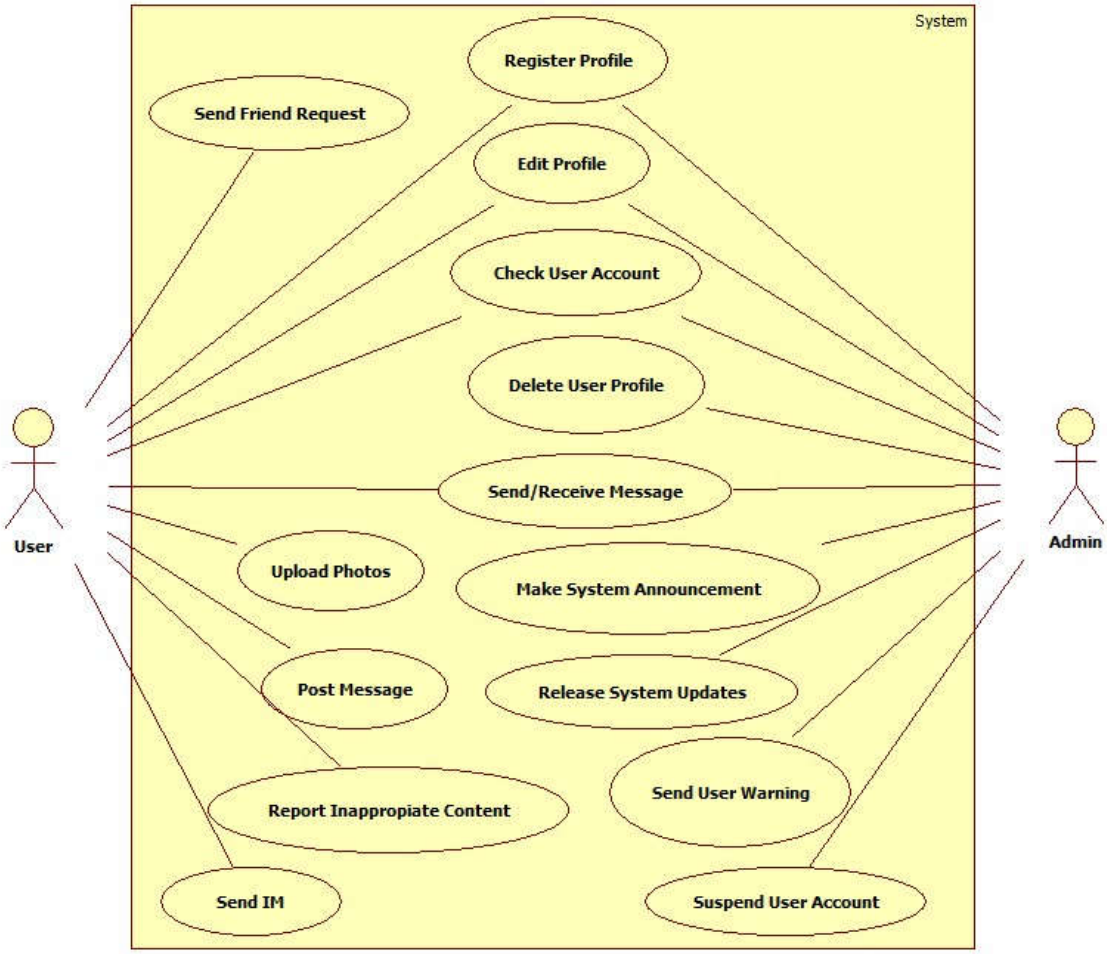

Figure 1: Use-Case Diagram of a Social Networking

SEQUENCE DIAGRAM

Sequence diagram shows **a detailed flow for a specific use case** or **even just part of a specific use case**. It describes the **flow of messages, events**, and **actions** between objects. It shows concurrent **processes** and **activations**, and **time sequences** that are not easily depicted in other diagrams. It is typically used **during analysis and design to document and understand the logical flow** of your system. (Show the calls between the different objects in their sequence and can show, at a detailed level, different calls to different objects.)

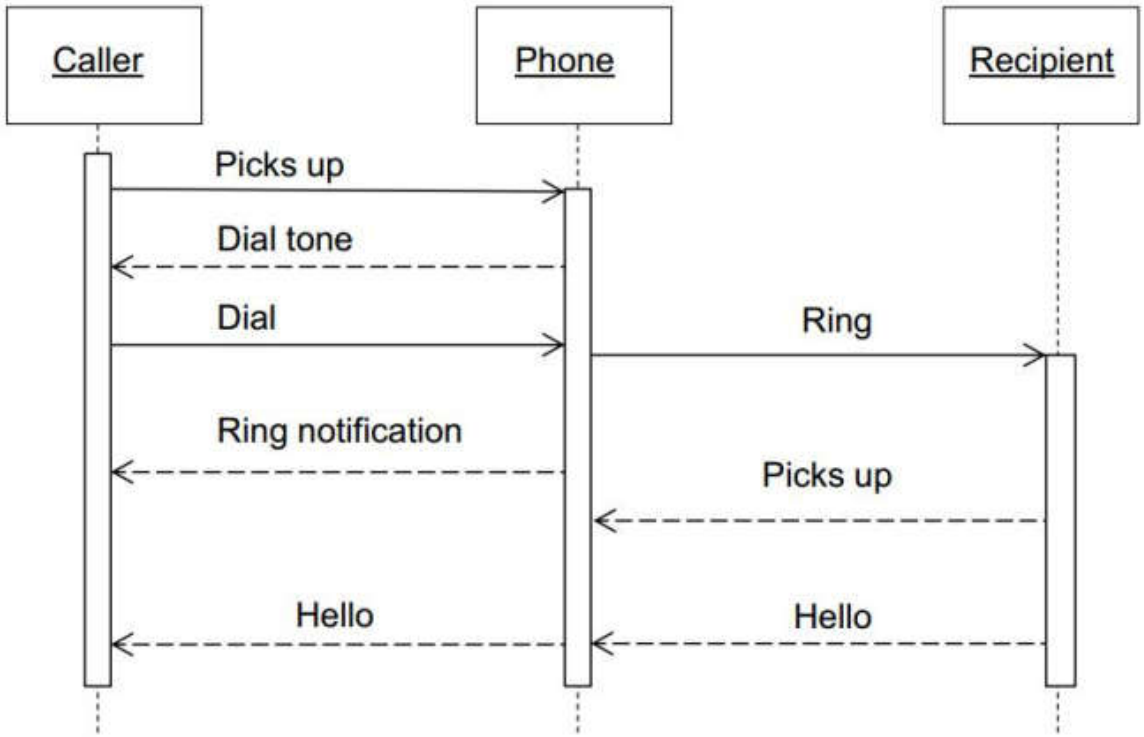

Figure 2: Sequence Diagram of a Phone Call

CLASS DIAGRAM

Class diagram shows the building blocks of any **object-orientated system**. It depicts a **static view of the model, or part of the model**, describing what attributes and behaviour it has **rather than detailing the methods for achieving operations**. Class diagrams are most useful in illustrating relationships between classes and interfaces.

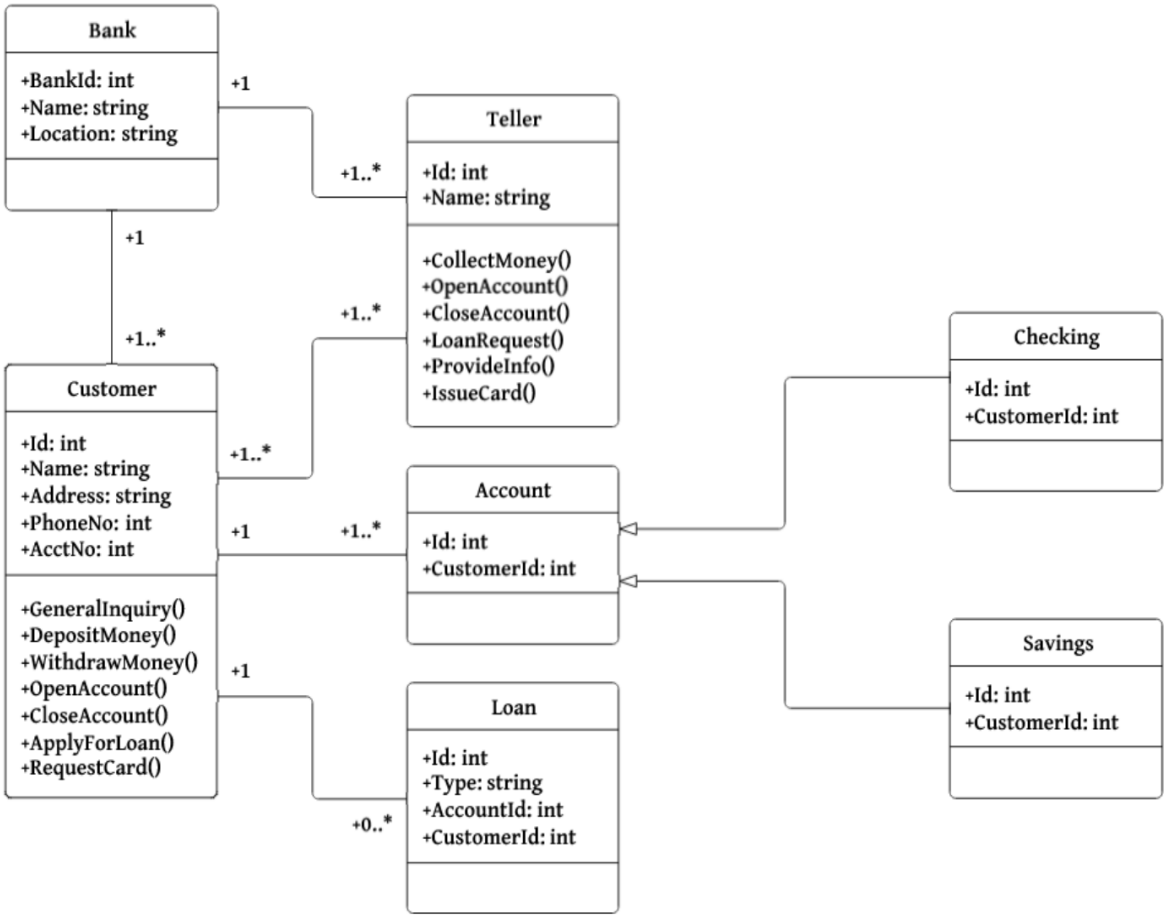

Figure 3: Class Diagram of a Banking System

ACTIVITY DIAGRAM

Activity diagrams represents the **dynamics of the system** (An application can have multiple systems. Activity diagram also captures these systems and describes the flow from one system to another. This specific usage is not available in other diagrams.) They are similar to flowchart (but have some additional capabilities, e.g., branching, parallel flow, swimlane) that are used to show the workflow of a system. They show:

- The flow of control from activity to activity in the system
- What activities can be done in
- Alternate paths through the flow

This diagram is used to model the activities which are nothing but business requirements. The diagram has more impact on business understanding rather than on implementation details. Activity diagram can be used for:

- Modelling workflow by using activities.
- Modelling business requirements.
- High level understanding of the system's functionalities.
- Investigating business requirements at a later stage.

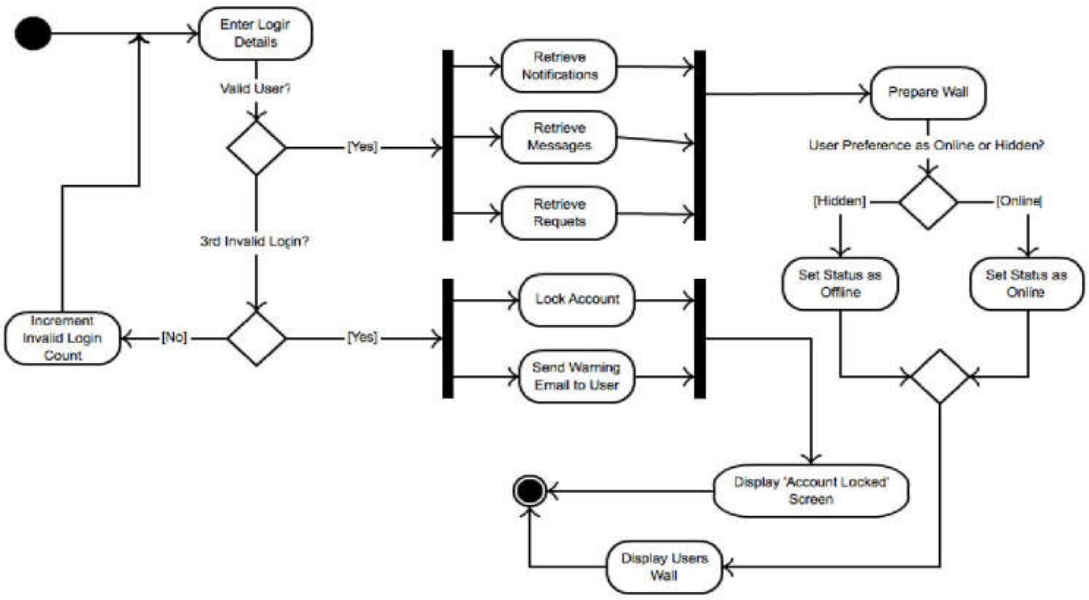

Figure 4: Activity Diagram of a Social Networking

STATECHART DIAGRAM

Statechart diagram is used to describe the states of different objects in its life cycle. Emphasis is placed on the **state changes upon some internal or external events**. These states of objects are important to analyse and implement them accurately. Statechart diagrams are used to **model the dynamic aspect of a system.**

Statechart diagram is also used for forward and reverse engineering of a system. However, the main purpose is to model **the reactive system**.

Following are the main purposes of using Statechart diagram:

- To model the dynamic aspect of a system.
- To model the life time of a reactive system.
- To describe different states of an object during its life time.
- Define a state machine to model the states of an object.

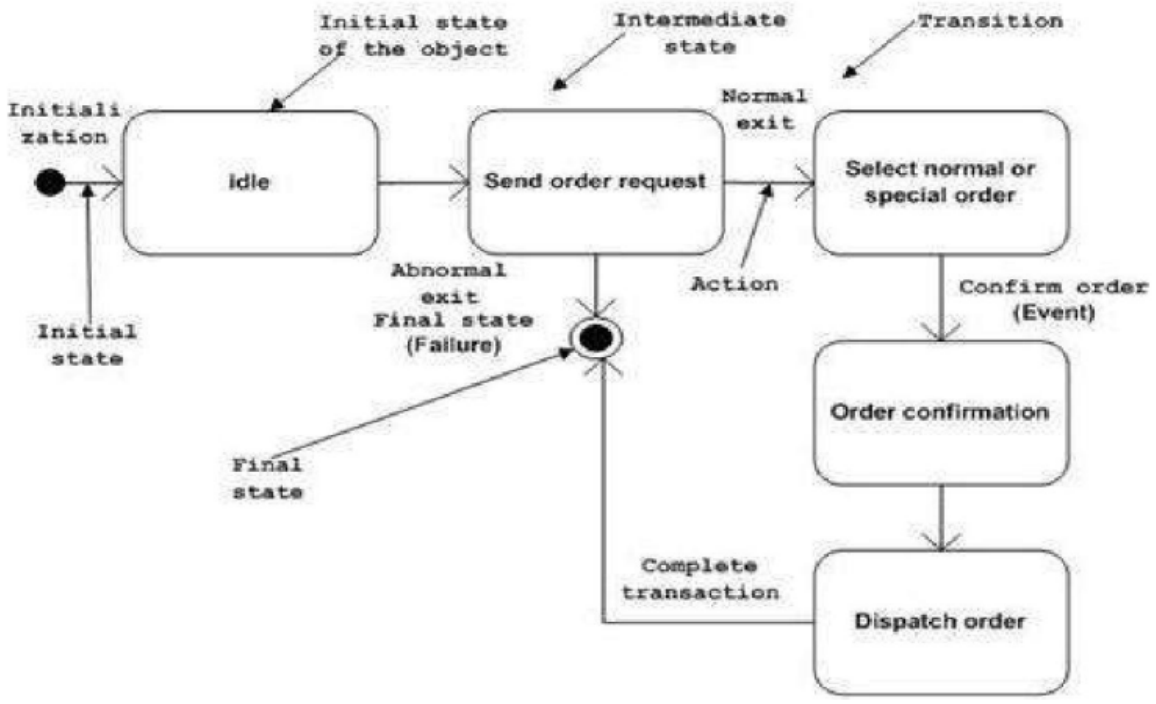

Figure 5: Statechart Diagram of a Restaurant Ordering System

DATA FLOW DIAGRAM

A DFD maps out the flow of information for any process or system. A data flow diagram can dive into progressively more detail by using **levels and layers, zeroing in on a particular piece**.

Data flow diagrams can be used to provide a clear representation of any business function. The technique starts with an overall picture of the business and continues by analysing each of the functional area of interest. This analysis can be carried out to precise the level of detail required.

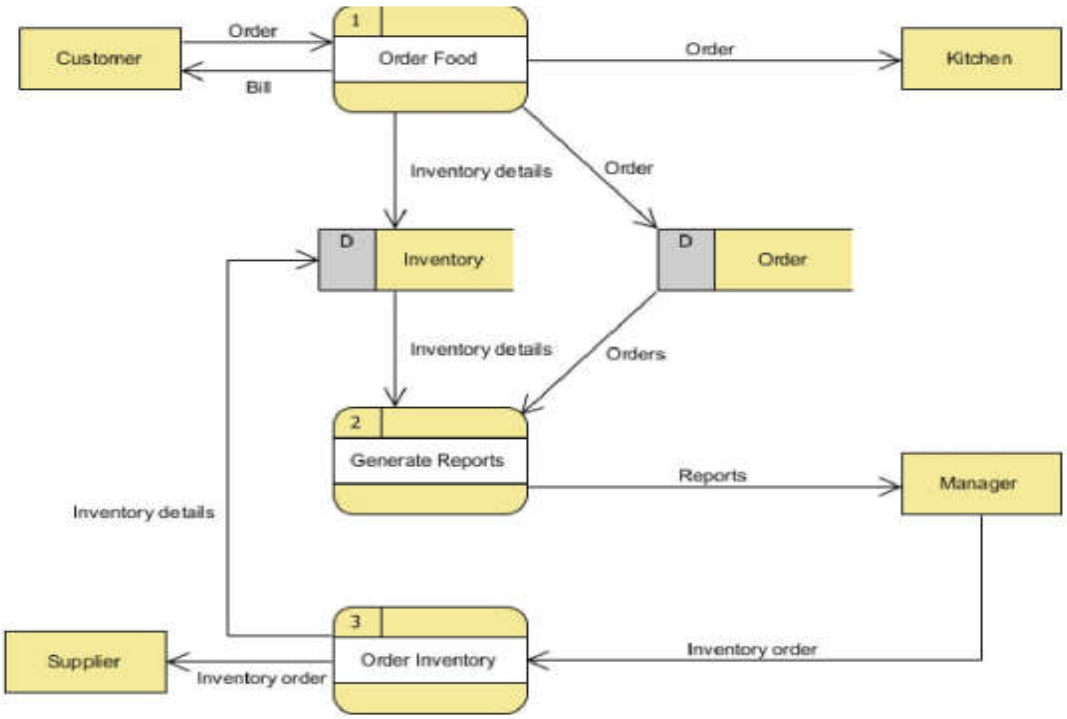

Figure 6: DFD Level 1 of a Restaurant Ordering System

ENTITYRELATIONSHIP (ER) MODEL

An ER diagram is a pictorial representation of the information that can be **captured by a database**. Serves two purposes:

- It allows database professionals to describe an overall design concisely yet accurately.
- (Most of) it can be easily transformed into the relational schema
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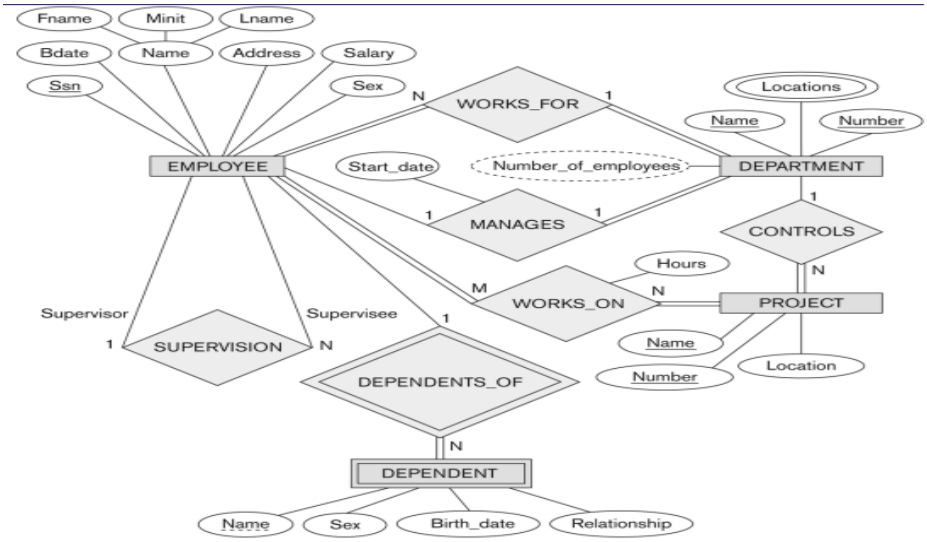

Figure 7: ER Diagram of a Company Database