# DESIGN METHODS

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# Logic

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# DIVISIONS OF LOGIC:

## 1. Material Logic:

This focuses on the study of the main philosophical problems addressed in logic such as problems of postulates, abstractions, or inferences.

## 2. Formal Logic:

This focuses on operating the mind from the point of view of correct thinking.

## 2. Formal Logic:

**Levels of Expression**

- *Inference:*

Inference is a process by which the mind extracts new knowledge or insight from any given proposition or a set of propositions.

Inference must follow the valid sequence of premises.

- **Inference**

**Is the mechanism for arriving at judgments.**

**It is either:**

- **Direct from the issues that include linking the boundaries with each other to derive/extract complex issues from them,**

- **Or, it is indirect, and then it generally consists of three components: (introduction, result, logical relationship).**

## 2. *Formal Logic:*

**Levels of Expression**

*Inference* may be "immediate" if only one premise is relied upon, or "mediate" if more than one premise is relied upon.

*Inferences* are implications, and part of logic; is understanding the meaning of the statement and what it does not include...

**(Implications: are conclusions that can be drawn from something, although it is not explicitly stated).**

# Elements of Mediate Inference :

1- Premises.

2- Conclusions.

3- Logical Relationships.

# The basic Mechanisms of Inference :

**1- Deduction:** The process of reaching a decision or answer by thinking about the known facts, or the decision that is reached.

**2- Induction:** Inductive reasoning, in logic, inferences from particular cases to the general case

**3- Analogy:** Inference that if two or more things agree with one another in some respects they will probably agree in others…A comparison of two different things based on the similarity of a particular aspect

**4- Abduction:** The act of making a person go somewhere with you, especially using threats or violence.

## 1 - Deduction:

It is the inference of a *particular situation* by reference to a *general law* or *principle*.

Deduction is the method of reasoning by inference from premises, which Aristotle describes in the (Prior Analytics).

Its mechanism is the **syllogism** of a formal statement consisting of two propositions from that a third one naturally follows.

All men are mortal                    (major premise)
Socrates is a man                     (minor premise)
Therefore, Socrates is mortal (conclusion)

## 1 - *Deduction:*

Deductive logic starts from *general* to *specific*.

- The major premise is generally true (at least there is no known case of a man who was not mortal);

- The minor premise is true of the particular case (i.e. Socrates) and the conclusion too is specific to that case.

All animals have four legs.
Dogs are animals                    (correct)
Therefore, dogs have four legs        (correct)

# 1 - Deduction:

Although the conclusion in this syllogism is correct yet we cannot be <u>absolutely</u> sure of the validity of the major premise ... **we are not certain of facts and we must be very worried of our extremely claims.**

|  |  |
|---|---|
| All fungi are poisonous | wrong |
| Truffles are fungi | correct |
| Therefore, truffles are poisonous | wrong |

In this syllogism, the major premise is *wrong* leading to *wrong conclusion*.

## 1- Deduction:

Accordingly, we should avoid *general statements* in arguments because this will teach us to be accurate;

To be careful of what we are saying and how to say it and **not give statements which are not based on certain facts.**

*For example:*

the effect of *weather* on building:
a student may learn or conclude the *desirability* of sunlight in interior spaces.

This is a common fact, but spaces with no sunlight are desirable for artists for example!!!

*Example:*

All rooms without sunlight are undesirable (1)   wrong
A room facing north doesn't get sunlight    (2)   correct
All northern rooms are undesirable          (3)   wrong

**The final statement (3) is conclusion of statement (1)  and (2).**

**by analysis** we realize that the conclusion is *wrong* because northern spaces are desirable in some cases (e.g. for artists – studios – laboratories, chemical stores, cooling systems ...etc.) where sunlight and sun glare should be avoided, so northern rooms are useful.

As a result, such kind of arguments could lead to false conclusion which we call "*fallacy*": Misconception, especially on the basis of an incorrect argument (based on *unsound reasoning*).

Therefore it is better to avoid such extremely *general statements* in argument.

In spite of these defects, deduction has its uses. **We might define it for our purpose**, as inference by reasoning from general rule to a particular solution.

This clearly has *application in design*. In some ways, for instance, it is the mechanism of building systems. **One makes a system of general rules and deduces from it a specific solution.**
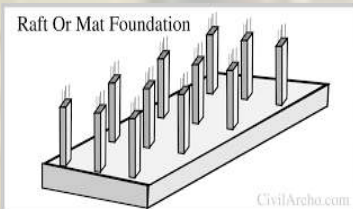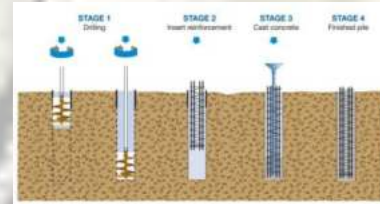
## 2- *Induction:*

It is the inference of *general law* from *particular* instances.

Induction has an opposite meaning to deductive logic, starting from *particular* to *general.* Inductive reasoning is concerned with creating a uniform pattern; given some facts, we assume that some general principles unite them.

Strip foundation rests on ground

Pile foundation rests on ground

Raft foundation rests on ground

Therefore, all foundations rest on ground (conclusion)

## 2- Induction:

Inductive logic is very important in design. By observation and research, we try to organize facts that, taken individually, seem isolated, fragmented, and opposite to each other.

**By induction we conclude things, but this conclusion is a "*probability*".**

Basically, in inductive reasoning, we have two cases:

A- *Perfect inductive reasoning*:
The premises are required to be correct and certain and all cases must be similar
( All humans have heads )

## 2- Induction:

B- *Imperfect induction reasoning* :
   Does not require all premises to be accurate or all cases similar and basically induction is usually imperfect,

   ( All boats rest on water )
   This is imperfect, because of technical development; there could be some kinds of boats that do not rest on water.

   Also, all cases that maybe perfect one day could be changed in the future.

## 3- Analogy:

It is a *cognitive* process of transferring information or meaning from a particular subject (*the analogue or source*) to another (*the target*), or the corresponding linguistic expression for such an operation.

In a narrower sense, analogy is an inference from one particular to another particular where at least one of the premises or the conclusion is general.

**The word analogy can also refer to the relationship between the source and the target itself.**

## 3- Analogy:

The measurement of the source depends on the **similarity** between the two parts. If we know that one of them is characterized by (**an attribute**), it is possible to conclude that the other is characterized by it.

Knowledge here is the possibility of assumption, because the process tends to *access* knowledge through *parts*, not the *whole*.

Analogy plays a significant role in *problem solving*, as well as decision making, and commonly used to reach the problem solving in design process.

# 4- Abduction:

Is a form of logical inference which starts with an **observation** or set of observations and then seeks to find the simplest and most likely **explanation** for the observations.

In abduction, the premises do not guarantee the conclusion. One can understand abductive reasoning as "inference to the best explanation".

If there is rain, the land will be wetted    (Rules)
The Land is wet                                         (premise)
It was raining                                            (Conclusion)

# *Laws of Logic:*

1. The law of Identity.

2. The law of Non-Contradiction.

3. The law of Excluded Middle.

# Laws of Logic:

## 1. The law of Identity:

It states that "each thing is the same with itself and different from another".

Consequently, things that have the same essence are the same thing, while things that have different essences are different things.

**A is A. An Apple is an Apple**

In other words, something is what it is, if something exists, it has a nature, an essence. For example, a book has a front and back cover with pages. This also means that anything that exists has characteristics.

# Laws of Logic:

## 1. The law of Identity:

We recognize what something is by observing its characteristics.

Also, if something has an identity, it has a single identity. It does not have more than one identity.

In other words, if something exists it has a set of attributes that are consistent with its own existence. It does not have a set of attributes that are inconsistent with itself.

**Therefore we can easily conclude that a cat is not a parachute. An Apple is not a race car. A tree is not a movie.**

## Laws of Logic:

**2. The law of Non-Contradiction:**

A statement such as "It is raining" cannot be both **true** and **false** in the same **sense**.

Of course, it could be raining in one place and not raining in another, but the principle says that it cannot be raining and not raining at the same time in the same place.

**at the same time and in the same sense.**

In other words, something (a statement) cannot be both true and false at the same time and in the same way.

## *Laws of Logic:*
## 2. The law of Non-Contradiction:

If I wanted to let you know that I went shopping yesterday, and later told you that I did not go shopping yesterday, you would be right in saying there is a contradiction.

A contradiction happens when one statement excludes the possibility of another but both claim to be true. Since we know that both cannot be true, we see a contradiction.

From this principle, we can conclude that **truth** is not **self-contradictory**.

This is a very important concept. Let me repeat it. **Truth is not self-contradictory**.

## *Laws of Logic:*

## 3. The law of Excluded Middle

A statement is either **true** or **false**.

For example, my hair is brown. It is either true or false that my hair is brown.

Another example: I am pregnant. The statement is either true or false. Since I am a male, it is not possible for me to be pregnant.

Therefore, the statement is false.

If I were a female, it would be possible for me to be pregnant (under normal physical conditions).

## *Laws of Logic:*
## 3. The law of Excluded Middle

A woman is not "kind-of/to some extent" pregnant. She either is or is not pregnant - there is no middle position.

The law of excluded middle is important because it helps us deal in absolute terms.

This is particularly important in a society where relativism is promoted and truth statements are denied………