0.3 Language

I promised to talk about language in this section but *what is language?* Without going too deep into the philosophical meaning of language and semantics, we can first consider language as a communication tool pervasive in everyday experience. We all proficient on a native language at an early age. We all experience talking, listening, reading and writing each day. The tool we use to talk, to listen to, to read and to write (no matter in what format) is language.

The language we use at most of the time is called *natural language* (in the format of English at the moment), which is naturally evolved through out the entire human history. All world languages and dialects ever exists are natural languages. Language is usually perceived as a medium for *representation and presentation*, but its origin is actually rooted in *communication*, especially, among a small group (tribe size) of people [1] . We already learnt from the previous section 0.2 that even a daily decision of a wild animal is intrinsically complex and difficult(verbose) to describe. Thus, for communication in ancient days, Homo sapiens intuitively developed simplification as a tool to hide (encapsulate) most of the complexity of daily life as background knowledge. In this case, natural language as a medium of communication, has never meant to clearly and precisely represent the world, but to update the changes to the background knowledge so that everybody in the tribe is on the same basis.

Descriptions are confounding so let's take a small example. Imagine yourself as a tribe man with another tribe member stand upon your watch on your tribe. Here comes a lion and you shout out — "Lion! Run!". You and your friend then run to a safe place and set up a camp fire to warn your fellow tribe members. Both the camp fire and the words you have said are languages in this context. A camp fire itself does not mean anything. But the camp fire built upon the premise (background knowledge) of "a sign of warning" known to all tribe members is to update changes to all who sighted the fire or smoke that "something dangerous is coming". The words "Lion! Run! " have not described what lion is, what run is, what are the attributes of the lion, why a lion can be associated with running and a lot more questions. All these are kept as background knowledge of both you and your friend (the speaker and the audience) before the communication happens and language are used. To update changes, natural language is meant to be short, vague and difficult to outsiders. In short, natural language is **not effective** in representing the world.

What's worse is that the evolution of natural language from its preliminary stage to the current has brought forward notable limitations which hinder its efficiency. Though most of the earliest signs of languages are cave paintings and petroglyphs, we can logically believe that speaking language was developed earlier than written languages [3] . The physical world we live in is 3-Dimensional. The

painting on paper or any surface is 2-Dimensional. The speaking language is also 2-Dimensional but in a different way (time and amplitude) [4]. The important feature of speaking language is that it can only be sequential, which as it shows, can never reveal the next word before the current word has been brought out. Most of the existing natural language have evolved to keep the uniformity of speaking and written language. In this case, written language on paper can only be sequential and 1-Dimensional (as the pitches of speaking have lost completely). The definition of dimensionality involves some more knowledge so let us save it for a future stage. At the moment, the only understanding needed is that information kept in a higher dimension is more efficient and lower dimension less efficient. In short, natural language is **not efficient** as well.

Generally, natural language is not designed to represent the world. It is useful in communication, but neither efficient nor effective by serving this particular purpose. To serve this purpose, we need to design new representation tools. Some of them are still called languages (e.g., mathematical language, programming language); some are not (e.g., prepositional logic, tree, graph, chart). To keep our terminologies consistent with others, I will still call them languages. But we have to aware that these "languages" are different from "languages" for updating changes in small tribes. They are languages for representations, representations of the world to be understandable to large groups of audiences.

Under this premise, the language for representation needs to be effective and efficient in its context. Effectiveness means precision(unambiguity), clear(no confusion) and understandable. Efficiency means easy and short. *Number* introduced in section 0.1 is a good example of effective and efficient language. It describes the repeated patterns (e.g., repeated objects of type zebras shown in sight of a lion) precisely, clearly and understandable using easy and short representations (in the form of Arabic numerals 0, 1, 2, …).

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1. The communication over distance is only made available after electrical telecommunication system was invented in 1830s. And the modern intertwined information network of world communication (the World Wide Web as one of its form, which is familiar to most of the audience) is only available after 1965 when the first email was sent [2]. Natural language has an extremely long history but the demands of large-group communication is quite new.↵

2. History of Communication, Wikipedia, retrieved from https://en.wikipedia.org/wiki/History_of_communication↵

3. Written languages as historical evidences are much easier to preserve compared to speaking languages.↵

4. The knowledge of sound in time and frequency domain is irrelevant to this context thus can be simplified.↵