

Preface

“There is no substitute for true understanding”

Kai Lai Chung

If you want to cope with science, you have to understand it – truly understand it. This holds in particular for astronautics. “To understand” means that you have a network of relationships in your mind, which permits you to deduce an unknown fact from a well-known fact. The evolution of a human being from birth to adulthood and beyond consists of building up a comprehensive knowledge network of the world, which makes it possible to cope with it. That you are intelligent just means that you are able to do that – sometimes you can do it better, and sometimes worse.

True understanding is the basis of everything. There is nothing that would be able to substitute true understanding. Computers do not understand – they merely carry out programmed deterministic orders. They do not have any understanding of the world. This is why even a large language computer will always render a false translation of the phrase: “It is the horse which rides the child.” It won’t be able to understand what riding means, and thus not know who is riding on what or whom. Most probably, and according to the word sequence, it would translate it as if the horse is riding the child. No computer program in the world is able to substitute understanding. You have to understand yourself. Only when you understand are you able to solve problems by designing excellent computer programs. Nowadays, real problems are only solved on computers – written by bright engineers and scientists.

The goal of this book is to build up a network of astronautic relationships in the mind of the reader. If you don’t understand something while reading this book, I made a mistake. The problem of a relational network, though, is that the underlying logic can be very complex, and sometimes it seems that our brains are not suitable for even the simplest logic. If I asked you, “You are not stupid, are you?”, you would normally answer, “No!” From a logical point of view, a double negation of an attribute is the attribute itself. So your “No!” means that you consider yourself stupid. You, and also we scientists

and engineers, do not want this embarrassing mistake to happen time and time again, and so we use mathematics. Mathematical logic is the guardrail of human thinking. Physics, on the other hand, is the art of applying this logic consistently to nature in order to be able to understand how it works. So it comes as no surprise to find a huge amount of formulas and a lot of physics in this book.

Some might think this is sheer horror. But now comes the good news. You don't need to remember most of the formulas – neither for exams nor for later. To understand astronautics, you just need to know the formulas shaded gray and to remember those bordered black. They are all you require to tell you the essential story. There you should pause and try to understand their meaning and lift the secrets of nature. You don't need to remember all the other formulas, but you should be able to derive these stepping stones for yourself. Thereby you will always be able to link nodes in your relational network whenever you deem it necessary. To treat formulas requires knowing a lot of tricks. You will learn them only by watching others doing such “manipulation” and, most importantly, by doing it yourself. Sometimes you will see the word “exercise” in brackets. This indicates that the said calculation would be a good exercise for you to prove to yourself that you know the tricks. Sometimes it might denote that there is not the space to fully lay out the needed calculation because it is too lengthy or quite tricky. So, you have to guess for yourself whether or not you should do the exercise. Nonetheless, only very few of you will have to derive formulas professionally later. For the rest of you: just try to follow the story and understand how consistent and wonderful nature is. Those who succeed will understand the words of Richard Feynman, the great physicist, who once expressed his joy about this by saying: “The pleasure of finding things out.”

Take the pleasure to find out about astronautics.

April 2007

Ulrich Walter