the FTSA story

how not to run a project and some lessons learned

John Q. Black

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The story and information contained herein is presented as a work of fiction.

Contents

Introduction

In an essay, article, or book, an introduction (also known as a prolegomenon) is a beginning section which states the purpose and goals of the following writing. This is generally followed by the body and conclusion. The introduction typically describes the scope of the document and gives the brief explanation or summary of the document. It may also explain certain elements that are important to the essay if explanations are not part of the main text. The readers can have an idea about the following text before they actually start reading it. ln technical writing, the introduction typically includes one or more standard subsections: abstract or summary, preface, acknowledgments, and foreword. Alternatively, the section labeled introduction itself may be a brief section found side-by-side with abstract, foreword, etc. (rather than containing them). In this case the set of sections that come before the body of the book are known as the front matter. When the book is divided into numbered chapters, by convention the introduction and any other front-matter sections are unnumbered and precede chapter 1.

There is a theory which states that if ever anyone discovers exactly what the universe is for and why it is here, it will instantly disappear and be replaced by something even more bizarre and inexplicable.

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A scene transition takes characters and readers to a new location, a new time, or a new point of view. Transitions can also be used to show a characters change in heart or frame of mind.

Transitions are important in fiction because the writer cant possibly portray or account for every moment in a characters day, week, or life. A story may stretch over yearsreaders dont need to know what happened every minute of those years.

So, we use scene transitions to skip periods of time or to change to a new location in the story, glossing over events that happen between the new and old times or locations.

For a visual aid, add ***, centered on a line, to indicate a scene transition in a manuscript. (Such symbols are often changed to extra line spaces in printed books.)

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There is another theory which states that this has already happened.

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There is another theory which states that this has already happened.

Figure 1: The Universe

Prologue

A prologue is used to give readers extra information that advances the plot. It is included in the front matter and for a good reason! Authors use them for various purposes, including: Giving background information about the story. A prologue or prolog (Greek prlogos, from pro, "before" and lgos, "word") is an opening to a story that establishes the context and gives background details, often some earlier story that ties into the main one, and other miscellaneous information. The Ancient Greek prlogos included the modern meaning of prologue, but was of wider significance, more like the meaning of preface. The importance, therefore, of the prologue in Greek drama was very great; it sometimes almost took the place of a romance, to which, or to an episode in which, the play itself succeeded.

Chapter 1

how it all started

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1.2 when it started

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1.3 the name of section 3

Chapter 2

the name of chapter two

Chapter 3

the name of chapter 3

3.1 a new section

3.2 an other new section

Chapter 4

the name of chapter 4

Chapter 5

the name of chapter 5

Epilogue

“I always thought something was fundamentally wrong with the universe” [1]

AN epilogue or epilog (from Greek eplogos, ”conclusion” from - ”in addition” and lgein, ”to say”) is a piece of writing at the end of a work of literature, usually used to bring closure to the work.[1] It is presented from the perspective of within the story. When the author steps in and speaks indirectly to the reader, that is more properly considered an afterword. The opposite is a prologuea piece of writing at the beginning of a work of literature or drama, usually used to open the story and capture interest.[2] Some genres, for example television programs and video games, call the epilog an ”outro” patterned on the use of ”intro” for ”introduction”. An epilogue is the final chapter at the end of a story that often serves to reveal the fates of the characters. Some epilogues may feature scenes only tangentially related to the subject of the story. They can be used to hint at a sequel or wrap up all the loose ends. They can occur at a significant period of time after the main plot has ended. In some cases, the epilogue is used to allow the main character a chance to ”speak freely”. An epilogue can continue in the same narrative style and perspective as the preceding story, although the form of an epilogue can occasionally be drastically different from the overall story. It can also be used as a sequel.

Acknowledgments

In the creative arts and scientific literature, an acknowledgement (also spelled acknowledgment in American and Canadian English) is an expression of gratitude for assistance in creating an original work.

Glossary

A glossary, also known as a vocabulary or clavis, is an alphabetical list of terms in a particular domain of knowledge with the definitions for those terms. Traditionally, a glossary appears at the end of a book and includes terms within that book that are either newly introduced, uncommon, or specialized. While glossaries are most commonly associated with non-fiction books, in some cases, fiction novels may come with a glossary for unfamiliar terms.

List of Acronyms

An acronym is a word or name formed as an abbreviation from the initial components in a phrase or a word, usually individual letters (as in NATO or laser) and sometimes syllables (as in Benelux).

There are no universal standards of the multiple names for such abbreviations and of their orthographic styling. In English and most other languages, such abbreviations historically had limited use, but they became much more common in the 20th century. Acronyms are a type of word formation process, and they are viewed as a subtype of blending.

Bibliography

[1] D. Adams. *The Hitchhiker's Guide to the Galaxy*. San Val, 1995.

Appendices

Appendix A

Calculations for Missile Launch Acceleration

Abstract: The python code in this notebook will calculate the launch acceleration of missile launched horizontally from an aircraft.

Introduction: The launch acceleration is an important parameter for the arming environment of safe and arm devices. This notebook will calculate the launch acceleration for a rail launched missile. Acceleration at a basic level is force divided by mass. The force is supplied by the rocket motor, which is reduced by drag and the mass is the weight of the missile. This notebook will calculate the drag over a range of altitudes and Mach numbers and then calculate the launch acceleration.

As the missile leaves the launcher, its velocity will increase and so will the drag. The acceleration over the first three seconds of flight is calculated. The acceleration profile over this time interval is important because Missile acceleration after first motion from time = 0 to time = 3 seconds is also part of the arming environment.

Array variables used:
alt: altitude array, 0 to 50,000 meters
rho: pressure array in Pa, as a function of altitude
T: temperature array in C, as a function of altitude
air_density: air density array in kg/m^3, as a function of altitude

Scope: These calculations are primarily for rail launched missile. Rocket motor thrust is considered a step function at t=0. Drag coefficient versus Mach number is a educated guess. Calculations cover the following ranges: Altitude can range from 0 to 50,000 meters and mach number can range from 0.2 to 3. Standard dry air is assumed. Some inputs are in inches and pounds and these are converted to the International System of Units (SI) and the calculations are performed in SI units, kg, m & s.

Assumptions: The following parameters are assumed since actual data was not available. - Drag force vs Mach: The drag force vs Mach curve is a re-creation of the a plot similar to the one found here.

- Rocket motor propellant weight: Rocket motor weight was found by search the internet and the propellant weight was assumed to be 75% of the motor weight.

- Propellant burn rate: As propellant mass is converted to reaction mass, the weight of the rocket motor decreases. This change in mass is modeled as linearly decreasing to zero over 10 seconds.
- Altitude and Mach range: The altitude and Mach number for a missile launch was modeled over a range of altitudes from 1500 to 15,000 meters and Mach numbers from 0.2 to 2.
- Thrust: Rocket motor thrust is a critical parameter. The thrust is assumed to be constant over as least the first 3 seconds of flight. The thrust can be set to different values in order to calculate the acceleration.

Analysis method: The calculations proceed as follows: - find the density of air as a function of altitude - calculate the drag force - calculate the acceleration and convert to gravity units for a given motor thrust - plot the results over a range of altitudes and Mach numbers - calculate the acceleration over the first 3 seconds of flight at worst case altitude and Mach number

Density of air

The density of air (Greek: rho) (air density) is the mass per unit volume of Earth's atmosphere. Air density, like air pressure, decreases with increasing altitude. It also changes with variation in temperature and humidity. At sea level and at 15C air has a density of approximately 1.225 kg/m^3.

p_0 = sea level standard atmospheric pressure, 101.325 kPa
T_0 = sea level standard temperature, 288.15 K
R = ideal (universal) gas constant, 8.31447 J/(molK)
M = molar mass of dry air, 0.0289644 kg/mol

Density can then be calculated according to a molar form of the ideal gas law:
$density = \frac{p*M}{R*T}$
where:
M = molar mass
R = ideal gas constant
T = absolute temperature
p = absolute pressure

Earth's atmosphere

The Earth's atmosphere is an extremely thin sheet of air extending from the surface of the Earth to the edge of space.

Standard Atmosphere:
$p_0 = 101.325kPa$
$T_0 = 288.15K$
$\rho_0 = 1.225kg/m^3$

The model has three zones with separate curve fits for the troposphere, the lower stratosphere, and the upper stratosphere.

Troposphere

The troposphere runs from the surface of the Earth to 11,000 meters. In the troposphere, the temperature decreases linearly and the pressure decreases exponentially. The rate of temperature decrease is called the lapse rate. For the temperature T and the pressure p, the metric units curve fits for the troposphere are:
$T = 15.04 - .00649 * h$
$p = 101.29 * [\frac{T+273.1}{288.08}]^{5.256}$
where the temperature is given in Celsius degrees, the pressure in kilo-Pascals and h is the altitude in meters.

Lower Stratosphere

The lower stratosphere runs from 11,000 meters to 25,000 meters. In the lower stratosphere the temperature is constant and the pressure decreases exponentially. The metric units curve fits for the lower stratosphere are:
$T = -56.46$
$p = 22.65 * e^{1.73-.000157*h}$

Upper Stratosphere

The upper stratosphere model is used for altitudes above 25,000 meters. In the upper stratosphere the temperature increases slightly and the pressure decreases exponentially. The metric units curve fits for the upper stratosphere are:
$T = -131.21 + .00299 * h$
$p = 2.488 * [\frac{T+273.1}{216.6}]^{-11.388}$

```
import numpy as np
import pandas as pd
from scipy.optimize import fsolve
from mpl_toolkits.mplot3d import axes3d
```

```
import matplotlib.pyplot as plt
from matplotlib.ticker import LinearLocator, FormatStrFormatter

alt = np.linspace(0, 50000, num=30, endpoint=True)
T = np.zeros(len(alt))  # temperature, units of degrees C
rho = np.zeros(len(alt))   # pressure as a function of temperature, units of kPa

# calculate the pressure and temperature as a function of altitude
for i in range(len(alt)):
    if alt[i] <= 11000:  # The troposphere runs from the surface of the Earth to 11,000 meters.
        T[i] =  15.04 - .00649 * alt[i]
        rho[i] = 101.29 * ((T[i] + 273.1)/288.08)**5.256
    if (alt[i] > 11000) and (alt[i] <= 25000): #The lower stratosphere runs from 11,000 meters to 2
        T[i] = -56.46  # a constant
        rho[i] = 22.65 * np.exp(1.73 - .000157 * alt[i])
    if alt[i] > 25000:  # The upper stratosphere model is used for altitudes above 25,000 meters.
        T[i] = -131.21 + 0.00299 * alt[i]
        rho[i] = 2.488 * ((T[i] + 273.1)/ 216.6)**-11.388
# convert rho from kPa to Pa
rho *= 1000

# plot the temperature and pressure vs altitude
fig, ax1 = plt.subplots()
ax2 = ax1.twinx()
ax1.plot(alt, T,'g-o')
ax2.plot(alt, rho,'b-o')
ax1.set_xlabel('Altitude, meters')
ax1.set_ylabel('Temperature, C', color='g')
ax2.set_ylabel('Pressure, Pascals', color='b')
ax1.grid()  # put grid marks on temperature axis
plt.show()
```

Molar mass of dry air

In chemistry, the molar mass M is a physical property defined as the mass of a given substance (chemical element or chemical compound) divided by the amount of substance. The base SI unit for molar mass is kg/mol. However, for historical reasons, molar masses are almost always expressed in g/mol. The molecular weight (or molar mass) of a substance is the mass of one mole of the substance, and can be calculated by summarizing the molar masses of all the atoms in the molecule.

Components in Dry Air: Air is a mixture of several gases, where the two most dominant components in dry air are oxygen and nitrogen. Oxygen has a molar mass of 16 g/mol and nitrogen has a molar mass of 14 g/mol. Since both of these elements are diatomic in air - O2 and N2, the molar mass of oxygen is 32 g/mol and the molar mass of nitrogen is 28 g/mol. The average molar mass is equal to the sum of the mole fractions of each gas multiplied by the molar mass of that particular gas:
$M_{mixture} = (x_1 * M_1 + ... + x_n * M_n)$
where
x_i = mole fractions of each gas
M_i = the molar mass of each gas

Components in Dry Air	Volume Ratio compared to Dry Air	Molar Mass M (g/mol)
Oxygen	0.2095	32.00
Nitrogen	0.7809	8.02
Carbon dioxide	0.0003	44.01
Hydrogen	0.0000005	2.02
Argon	0.00933	39.94
Neon	0.000018	20.18
Helium	0.000005	4.00
Krypton	0.000001	83.8
Xenon	0.09x10-6	131.29

The average molar mass of dry air is 28.97 g/mol.

```python
# make a dataframe for the constituents of dry air
df = pd.DataFrame(columns=['element','Volume Ratio','Molar Mass'])
df.loc[0] = ['Oxygen',0.2095,32.00]
df.loc[1] = ['Nitrogen',0.7809,28.02]
df.loc[2] = ['Carbon dioxide',0.0003,44.01]
df.loc[3] = ['Hydrogen',0.0000005,2.02]
df.loc[4] = ['Argon',0.00933,39.94]
df.loc[5] = ['Neon',0.000018,20.18]
df.loc[6] = ['Helium',0.000005,4.00]
df.loc[7] = ['Krypton',0.000001,83.8]
```

```
df.loc[8] = ['Xenon',0.09e-6,131.29]

molar_mass_air = 0
for i in range(len(df)):
    molar_mass_air += df.loc[i,'Volume Ratio']*df.loc[i,'Molar Mass']

molar_mass_air /= 1000 # convert to kg/mol
print('molar mass of dry air: {:f} kg/mol'.format(molar_mass_air))
```

```
molar mass of dry air: 0.028971 kg/mol
```

The ideal gas law

The ideal gas law, also called the general gas equation, is the equation of state of a hypothetical ideal gas. It is a good approximation of the behavior of many gases under many conditions, although it has several limitations. It was first stated by mile Clapeyron in 1834 as a combination of the empirical Boyle's law, Charles's law and Avogadro's Law. The ideal gas law is often written as
$PV = nRT$
where:
P is the pressure of the gas
V is the volume of the gas
n is the amount of substance of gas (in moles)
R is the ideal, or universal, gas constant, equal to the product of the Boltzmann constant and the Avogadro constant
T is the absolute temperature of the gas
This form of the ideal gas law is very useful because it links pressure, density, and temperature in a formula independent of the quantity of the considered gas.
$density = \frac{\text{molar mass}*P}{R*T}$
At sea level and at 15 C air has a density of approximately $1.225\frac{kg}{m^3}$

```
# density of air at a given pressure and temperature
p = 101.325 # absolute pressure at sea level, kilo-Pascals
p *= 1000  # convert to Pa
t = 15 # temperature, units of C, need to convert to K when using in equations
# ideal gas constant
k = 1.38064852e-23 # Boltzmann constant, J/T, relates the average kinetic energy in a gas with the
```

```
Na = 6.022140857e23 # Avogadro constant, 1/mol
R = k*Na  # 8.3144598 # ideal gas constant, J/(molT)
print('ideal gas constant: {:.5f} J/(molT)'.format(R))
d = p*molar_mass_air/(R*(t+273.1))
print('air density at {:,.0f} pa and {:.0f}C is {:.3f} kg/m^3'.format(p,t,d))
```

```
ideal gas constant: 8.31446 J/(molT)
air density at 101,325 pa and 15C is 1.225 kg/m^3
```

Appendix B

Fire Pulse Analysis

Appendix C

Theory of Operation