

# Technical Writing

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# Tech Writing/Definitions/Ethics

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- What is technical writing
- Technical Definitions
- Source:
  - Leo Finkelstein. 2007. *Pocket Book of Technical Writing for Engineers & Scientists* (3 ed.). McGraw-Hill, Inc., New York, NY, USA.
  - These slides are mildly adapted from those of Joanne DeGroat at Ohio State University.



# Technical Writing

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- What is technical writing?
  - Writing (communication) is an essential skill for all professionals
  - Technical writing is the writing of those involved in the technical fields, i.e., science and engineering.
- In science and engineering
  - Write technical reports
  - Write technical proposals
  - Various forms of technical communication



# What is technical writing

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□ For some things it is easier to say what it is not.

■ What type of writing is this?

It was a dark and stormy night. The wind was howling, the shutters were banging against the house, the rain was beating down, and a dog howled in the distance. The .....



# What is technical writing

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■ Creative writing – It describes a storm, is descriptive, but also often evokes emotion.

■ Often creative writing is seen as imaginative and “fun”.



# Technical versus creative

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- ❑ Technical writing lacks the emotional impact
- ❑ Technical writing avoids use of rich metaphors and figures of speech.
- ❑ Typically sentence structures are simple and direct.
- ❑ “Technical writing is precise, objective, direct, and clearly defined.”



# The level of abstraction

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- Technical writing describes items precisely, i.e., a low level of abstraction
  - A 33K ohm, one-watt carbon resistor
- This a low level of abstraction
- The level of abstraction can be varied
  - Resistor
  - Circuit component
  - IoT Device
- As the level of abstraction increases the level of precision of detail decreases
- Abstraction manages detail but detail can be important



# Audience

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- Always must consider your audience
- Quality of writing measure – two metrics
  - How well the reader understands, precisely, the intended meaning
  - How well the understanding fulfills the intended purpose
- In technical writing you are usually writing to communicate something to an audience so there is a **precise requirement for what is communicated**. Sometimes this is a legal requirement (e.g. in regulated domains).





# Audience and Purpose

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- ❑ Almost always known
- ❑ Typically know who the audience is
- ❑ Typically know why you are writing the document and what the required content is
  
- ❑ Technical writing is often supported by visualisations.
- ❑ Pictures/figures are an essential part of the communication process.



# Technical Definitions

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- “In technical writing, *definition* is the process by which one assigns a precise meaning to a term.”
  - Term = Classification + Differentiation
- Example:
  - A *bug* is a condition in a program which causes the program to behave in a way that deviates from its specification by producing erroneous behaviour or violating some other constraint.



# Differentiation

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- **Bug** has meaning based on the context.
  - In computing the definition was just given
  - In entomology, a **bug** is the main object of study of the science.
  - In farming, a **bug** is a particular class of insect that has an undesirable effect on the productivity of the farm.



# The audience

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- For technical definitions who the audience is matters
- Consider:
  - In water softening, *zeolite* is an exchange resin that releases sodium ions while gaining calcium and magnesium ions.
  - In water softening, *zeolite* is a special material that releases sodium into the water while absorbing calcium and magnesium from the water.



# Technical Definition challenges

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- Often need further definitions
  - To define one term introduce several others
- Circular definition structure
  - One term introduces another and so on until you are back at the original term



# Technical definition

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- Two are common mistakes
  - Define term using the same term
  - Define term using terms that also need definition
  - For example, in early definitions of IEC 61508 (*Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems*) using the software architecture of the system to structure the case for its safety (but there was no definition of Software Architecture in the standard).



# **TECHNICAL DEFINITIONS**



# Technical Definitions

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- Chapter 3 in Pocket Book of Technical Writing by Finkelstein
- “In technical writing, **definition** is the process by which one assigns a precise meaning to a term.” – Fink, p.25
- (Qualifier +) Term = Classification + Differentiation





# Technical Definitions II

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- Qualifier:
  - “used when general context for a definition needs to be established up front” – Fink p.26
- Classification:
  - “a general category in which the term fits” – Fink p.27
- Differentiation:
  - “Narrowing the meaning of the term to just one possibility within the class.” – Fink p.29



# Technical Definitions III

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- What is a **bug**?
- Needs qualifier: Bug can be used in many contexts (farming, **computing**, entomology, etc).
- (Qualifier +) Term = Classification + Differentiation
- In computing, a **bug** is a condition experienced in running a program where the behaviour of the program deviates from its requirements.



# Technical Definitions IV

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- Know Audience!
- Definition Extensions
  - Further Definitions – Define additional terms in definition
    - [In water softening, *zeolite*, is an exchange resin that releases sodium ions while gaining calcium and magnesium ions.] Zeolite is a collection of small polystyrene beads that forms a resin carrying a negative charge.
  - Compare and Contrast – Compare term (artifact) with other terms
    - [In water softening, *zeolite*, is an exchange resin that releases sodium ions while gaining calcium and magnesium ions.] Zeolite collects calcium and magnesium ions in same way a feather broom collects dust.



# Technical Definitions IV

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- Know Audience!
- Definition Extensions
  - Classification – Further classify artifact (i.e. The item is classified as ... )\
    - [In water softening, *zeolite*, is an exchange resin that releases sodium ions while gaining calcium and magnesium ions.] Zeolite is used for ion-exchange “home” water softening, while lime and soda ash are used in precipitating municipal water softeners.
  - Cause and Effect – Demonstrate why something occurs
    - [In water softening, *zeolite*, is an exchange resin that releases sodium ions while gaining calcium and magnesium ions.] Zeolite carries a negative charge and attracts the positively charged calcium and magnesium ions in water.



# Technical Definitions IV

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- Know Audience!
- Definition Extensions
  - Process – List steps in a procedure
    - [In water softening, *zeolite*, is an exchange resin that releases sodium ions while gaining calcium and magnesium ions.] First, the zeolite is charged with sodium ions from a salt brine solution in the regeneration step. Once charged, the zeolite absorbs calcium and magnesium ions from passing hard water while releasing sodium ions into the resulting soft water.
  - Exemplification – Give analogous example where artifact is used
    - [In water softening, *zeolite*, is an exchange resin that releases sodium ions while gaining calcium and magnesium ions.] Examples of the zeolite group include analcimes, chabazite, and gismondines.
  - Etymology – show the linguistic roots of the term.



# Levels of Definitions

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## □ Expert level

- In astrophysics, a black hole is a set of events from which it was not possible to escape to a large distance. A black hole gets its name from its boundary, called an event horizon, which is formed by the paths in space-time of rays of light that just fail to get away, hovering instead forever on the edge and, consequently, moving on paths parallel to or away from one another.



# Levels of Definitions

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## □ Average Reader

- In astrophysics, a black hole is a collapsed neutron star whose gravity is so great that even light cannot escape. Although fusion reactions within this collapsed star still may emit brilliant rays of light, when it is viewed from the outside, the black hole appears to be a totally dark void in space.



# **MECHANISM DESCRIPTIONS**





# The Mechanism Description

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- What is a Mechanism Description
- Example of a Mechanism Description
- An outline for writing a Description
- Putting it all together
  
- See Finkelstein Chapter 4 for more detail.



# Background

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- “Technology involves physical devices called mechanisms.”
- Writing mechanism descriptions is a critical ability of an engineer.
- The engineer creates a mechanism description to document and specify the device so the customer can decide if it fulfills their needs.



# What is a Mechanism??

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- “*Mechanism descriptions* are precise portrayals of material devices with two or more parts that function together to do something.”
- Range in Complexity
  - A pair of pliers
  - A bicycle
  - An automobile
  - A chat device like Google Home or Amazon Alexa
  - An aircraft like the Airbus A380



# Mechanism Description focus

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- A mechanism descriptions' primary focus is on the physical characteristics or attributes of the device and its parts.
- Thus they tell the size, shape, color, finish, fit, etc. for the complete mechanism and its for each of its parts.
- Descriptions typically include figures, diagrams, or photographs.



# Mechanism description may

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- It may extend to include a more expansive discussion of the function or theory of operation.
- When it does this is becomes a
- *Functional Mechanism Description*



# Mechanism Description Example

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- Internal Combustion Engine
  - Mechanism Description – the complete engine, the cylinder head, the block, the valves, the pistons, the crankshaft, ...
  - Describe the complete engine
    - Describe the cylinder head
    - Describe the block
    - Describe the piston which also has piston rings, connecting rod, piston rod, and crankshaft bearings.



# Mechanism Description

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- Introduction
  - Define the mechanism with a technical definition and add extensions necessary for the reader to understand the discussion.
  - Describe the mechanism's overall function or purpose.
  - Describe the mechanism's overall appearance
  - List the mechanism's parts in the order in which they will be described.



# Mechanism Description (2)

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- Discussion
  - Step 1
    - Define first part with a technical definition.
    - Describe the part's overall function or purpose.
    - Describe the part's shape, material, etc.
    - Transition to the next part.
  - Steps 2 to n
    - Repeat as for step 1 for the remainder of the parts.
- Conclusion
  - Summarize and provide closure.





# A Mechanism Description

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- The Mechanism – a 33-kilohm resistor
  - The 33-kilohm, 1-watt carbon resistor is a circuit component that impedes the flow of electric current.
  - The resistor impedes the movement of electrons, thereby generating a thermal response depending on temperature, cross section, and length of the resistive element. The resulting resistance ...



# The parts

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- The resistor consists of the following parts: the carbon element, the wire leads, the casing, and the color bands.
- The Part Description
  - The carbon element is the capsule of resistive material that converts electrical energy into heat. The carbon element serves as the primary active...
  - The carbon element is cylindrically shaped and is 2.4 cm long with a diameter of .32 cm. It is composed of finely ground carbon particles mixed with a ceramic binding compound. The element is gray with ...



# The conclusion

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- The 33-kilohm 1-watt carbon resistor is a circuit component that impedes the flow of electric current through the use of a carbon element. The resistor is made up of four parts: the carbon element, ...
- Together, these parts form one of the most commonly used circuit components in electronic systems today.



# The visual aids

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- Mechanism description almost require visual aids.
- BUT – only include visual aids that add to the description
  - You are writing the description of a basic car
  - Your figure if a basic Ford sedan or a Ferrari.
- The visuals specifically relate to the text discussion and numbered in sequence as referenced.
- **USE APPROPRIATE VISUAL AIDS!!!**
- How does this relate to computational mechanisms?



# Homework

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- Write a mechanism description
  - Choose a simple mechanism and write a mechanism description
  - I'll get the Piazza sorted out so you can use it to submit homework