

| | | |
|-----|---|-----|
| 6.1 | A visualization of the design process as the selection of an element from the design space \mathcal{D} that is in a region of the output space \mathcal{O} that meets the requirements. | 208 |
| 6.2 | A single design set D , the solution f of its set E of governing equations, and the inverse solution f^{-1} . The local optimal design $d^* = f^{-1}(y^*)$. | 212 |
| 6.3 | Sketch of the extruder design. | 214 |
| 6.4 | The constrained loss function $L(d)$ versus a single adjustable, the thermal resistance R_T . | 218 |

D.2 List of Tables



| | | |
|-----|--|-----|
| 1.1 | Boolean and comparison operators on Boolean and integer inputs x and y | 17 |
| 1.2 | Format specifier terms. | 19 |
| 1.3 | Format specifier types. | 19 |
| 1.4 | Some particularly useful string methods. | 20 |
| 1.5 | Mutability of commonly used built-in types. | 22 |
| 1.6 | Commonly used list methods for a list l . | 23 |
| 1.7 | Dictionary instance methods for dictionary instance d and class method for class <code>dict</code> . | 26 |
| 2.1 | Python standard library modules of particular interest to the engineer. | 42 |
| 3.1 | JSON to Python reading conversion. | 77 |
| 3.2 | Python to JSON writing conversion. | 78 |
| 4.1 | Elementary mathematical functions in SymPy. | 105 |

Bibliography

- Abelson, Hal, and Gerald Jay Sussman. 2016. *Structure and Interpretation of Computer Programs*. 2nd ed. MIT Press (orig. 1996). <https://engcom.org/5n>.
- Carvill, James. 1994. *Mechanical Engineer's Data Handbook*. Butterworth-Heinemann.
- Cross, Nigel. 2021. *Engineering Design Methods: Strategies for Product Design*, 5th Edition. 5th ed. Wiley. <http://gen.lib.rus.ec/book/index.php?md5=988D6046DBEE3E1452E2F099079B445E>.
- Filik, Ruth, Alexandra Turcan, Christina Ralph-Nearman, and Alain Pitiot. 2019. "What is the difference between irony and sarcasm? An fMRI study." [in eng]. *Cortex* 115 (June): 112–122. <https://doi.org/10.1016/j.cortex.2019.01.025>. <https://engcom.org/e8>.
- Gilens, Martin, and Benjamin I. Page. 2014. "Testing Theories of American Politics: Elites, Interest Groups, and Average Citizens." *Perspectives on Politics* 12 (3): 564–581. <https://doi.org/10.1017/S1537592714001595>.
- Gonzalez, Ryan, Philip House, Ivan Levkivskyi, et al. 2024. *PEP 526 – Syntax for Variable Annotations*, February (orig. 2016). <https://engcom.org/9x>.
- Google. 2024. *Google Python Style Guide*, February. <https://engcom.org/ne>.
- Harris, Charles R., K. Jarrod Millman, Stéfan J. van der Walt, et al. 2020. "Array Programming with NumPy." *Nature* 585, no. 7825 (September): 357–362. <https://doi.org/10.1038/s41586-020-2649-2>. <https://doi.org/10.1038/s41586-020-2649-2>.
- Hunt, A., and D. Thomas. 1999. *The Pragmatic Programmer: From Journeyman to Master*. Pearson Education.
- Hunter, J. D. 2007. "Matplotlib: A 2D graphics environment." *Computing in Science & Engineering* 9 (3): 90–95. <https://doi.org/10.1109/MCSE.2007.55>.
- Johnston, Nathaniel, and Dave Greene. 2022. *Conway's Game of Life: Mathematics and Construction*. Self-published. <https://doi.org/10.5281/zenodo.6097284>.
- Kreyszig, E. 2010. *Advanced Engineering Mathematics*. 10th ed. John Wiley & Sons.
- Langa, Łukasz, and contributors to Black. 2024. *Black: The Uncompromising Python Code Formatter*, February. <https://engcom.org/8n>.
- NASA. 2002. *NACA High Speed Flight Station "Computer Room"*, June (orig. 1949). <https://engcom.org/mz>.
- NumPy Developers. 2024a. *NumPy Reference*, February (orig. 2022). <https://engcom.org/u5>.

- NumPy Developers. 2024b. *NumPy User Guide*, February (orig. 2022). <https://engcom.org/5y>.
- NumPy Developers. 2024c. *NumPy: The Absolute Basics for Beginners*, February (orig. 2022). <https://engcom.org/3l>.
- Python Community. 2024a. *Python 3.X Documentation*, January. <https://engcom.org/n3>.
- Python Community. 2024b. *Python Package Index*, January. <https://engcom.org/e0>.
- Python Community. 2024c. *Python Packaging User Guide*, January. <https://engcom.org/w9>.
- Rossum, Guido van, Jukka Lehtosalo, and Łukasz Langa. 2024. *PEP 484 – Type Hints*, February (orig. 2014). <https://engcom.org/z9>.
- Rossum, Guido van, Barry Warsaw, and Alyssa Coghlan. 2024. *PEP 8 – Style Guide for Python Code*, February (orig. 2001). <https://engcom.org/3z>.
- SymPy Development Team. 2023a. *Advanced Expression Manipulation*, May. <https://engcom.org/95>.
- SymPy Development Team. 2023b. *Core [SymPy Documentation]*, May. <https://engcom.org/92>.
- SymPy Development Team. 2023c. *Simplification*, May. <https://engcom.org/14>.
- SymPy Development Team. 2023d. *Writing Custom Functions*, May. <https://engcom.org/3c>.
- Tufte, Edward R. 2001. *The Visual Display of Quantitative Information*. 2nd ed. Graphics Press.
- Yasskin, Jeffrey. 2024. *PEP 3141 – A Type Hierarchy for Numbers*, February (orig. 2007). <https://engcom.org/41>.

Contributors

Associate Professor Rico A. R. Picone
Department of Mechanical Engineering
Saint Martin's University
Lacey, Washington, USA