DATA LITERACY

LEARN THE LANGUAGE OF DATA & AI

21 KEY TRAITS OF DATA & AI LITERACY

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Introduction

Data literacy is the ability to read, understand, create and communicate data as information.

AI literacy is the ability to recognize, grasp, use, and critically assess artificial intelligence technologies and their impacts.

These two areas of fluency go hand in hand, and they are quickly becoming fundamental requirements for professionals in every discipline and industry. Much like word processing or internet navigation in previous decades, both data literacy and AI literacy have shifted from specialized skills to commonly sought-after attributes, as organizations both small and large seek to transition to data-informed and AI-enabled cultures.

The current state of affairs, though, is that there's a major gap between the level of fluency in data and AI disciplines that companies and organizations of all types require of their people, and the actual level of fluency that the people in those groups have. This gap is particularly evident as AI technologies become more prevalent in our daily work.

If poor data and AI literacy represent such an incredibly large opportunity for the advancement of our corporate cultures and for society as a whole, then it behooves us to have a clear understanding of what it means to possess these capabilities.

The following list of 21 characteristics describes what is needed in order for individuals to participate in and contribute to a data-informed and AI-enabled cultural transition. These traits are grouped into four distinct categories:

- **Knowledge**
- **Skills**
- **Attitudes**
- **Behaviors**

No one is perfect, and it’s not reasonable to expect people to be great at everything. Nevertheless, people who are highly literate in both data and AI possess these traits to varying degrees.

The Four Categories of Data & AI Literacy

Overview of Knowledge

A person with high levels of data and AI literacy grasps the following core concepts:

1. **Basic Elements of Data** - Understanding of both traditional data types (categorical, quantitative) and unstructured data types (text, images, audio, video), including how these serve as building blocks for both statistical analysis and AI model training
2. **Data Storage Methods** - Familiarity with how data is collected, structured, and stored across various systems, from spreadsheets and databases to modern data lakes and AI-ready architectures
3. **Data Analysis Principles** - Understanding of fundamental statistical concepts and AI/ML principles, including the comparative strengths of traditional versus AI approaches and factors affecting their reliability
4. **Data Visualization Rules of Thumb** - Knowledge of how humans perceive and interpret visual information, including principles related to different kinds of charts, graphs, and maps, along with the display of uncertainty and AI model outputs
5. **AI Systems & Capabilities** - Understanding of major AI system types, their capabilities and limitations, including knowledge of when AI can reliably augment human decision-making and when traditional analytical approaches may be more appropriate

Overview of Skills

A person with high levels of data and AI literacy has acquired and honed the following capabilities:

6. **Reading & Interpreting Data** - Effective interpretation of individual data points, summary statistics, tabular data, and visual displays of data, taking into account both the presented content and the underlying context and limitations
7. **Evaluating AI Outputs** - Critical assessment of AI-generated results and recommendations, including the ability to verify outputs for accuracy, identify potential biases or limitations, and determine when human judgment should override AI suggestions
8. **Cleaning & Preparing Data** - Proficient cleaning, transformation, and combination of data using both traditional and AI-powered tools, ensuring data quality and appropriate formatting whether for conventional analysis or AI applications
9. **Exploring & Analyzing Data** - Investigation of datasets using a combination of traditional analytical methods and AI-powered discovery tools to uncover patterns, identify outliers, and generate insights about the underlying information
10. **Visualizing Data** - Design and creation of effective graphical displays of data, and the selection of appropriate visual encodings and formats to convey important findings clearly to specific audiences
11. **Communicating Data** - Development and effective presentation of data insights, from simple messages to complex narratives that illuminate important topics

Overview of Attitudes

A person with high levels of data and AI literacy tends to have the following mindsets:

12. **Inclusive** - The belief that working with data and AI involve learnable skills that anyone can develop with proper support and dedication
13. **Critical yet Open-minded** - A balanced skepticism combined with an openness to receiving insights from both traditional and AI-powered analysis
14. **Alert** - Vigilance about potential errors, biases, and limitations in both data analysis and AI applications
15. **Ethical** - A deep conviction that data and AI work must serve human welfare, uphold fairness, and operate with transparency
16. **Adaptable** - The perspective that data and AI technologies continually transform how we work, paired with the conviction that embracing change creates opportunities for growth

Overview of Behaviors

A person with high levels of data and AI literacy tend to show these behaviors:

17. **Resourceful Utilization of Data & AI** - Proactively seeking out and leveraging both traditional data sources and AI tools to gather insights and inform decisions
18. **Continuous Improvement of Data & AI Systems** - Repeatedly identifying and implementing improvements in data quality, analysis methods, and AI applications
19. **Effective Advocacy for Responsible Use** - Championing thoughtful use of both data and AI in decision-making while ensuring ethical considerations are addressed
20. **Enthusiastic Promotion of Literacy** - Actively sharing knowledge and best practices about working with data and AI, helping others build their capabilities
21. **Effective Integration of AI Tools** - Skillfully determining when and how to employ AI capabilities to complement human analysis and decision-making.

Now, let’s dive deeper into each category.

> Working with data requires a certain degree of numerical and graphical literacy, respectively called numeracy and graphicacy.
>
> Numeracy isn't just math, statistics, or logic, but a sixth sense that depends on grasping fundamental, high-level concepts of all those areas, and more.
>
> Graphicacy, on the other hand, consists of developing intuitions of what kinds of graphs, charts, or maps are more adequate to either explore our data or communicate the insights we obtained to other people.

–Alberto Cairo
Knight Chair at the University of Miami
www.albertocairo.com

Knowledge

Our knowledge is the body of facts and information with which we are aware or familiar. It's the first category of data and AI literacy traits enumerated because our development starts with the knowledge that we obtain either through academic study or through practical experience.

What does a data and AI literate person know? A data and AI literate person knows...

#1 BASIC ELEMENTS OF DATA

The data and AI literate person knows how to distinguish between different types of data, from traditional structured types such as categorical and quantitative variables, to unstructured data like text, images, audio, and video. Beyond merely identifying data types, they understand what can and can't be done with them in both traditional analysis and AI applications.

Just as the poet studies vowels and consonants, verbs and nouns, individuals who are highly literate in data and AI embrace the fundamental building blocks of both structured and unstructured data. This enables them to see data for what it is – information that can be grouped, aggregated, summarized, and processed by both human and machine intelligence to generate powerful insights and messages.

#2 DATA STORAGE METHODS

The person who is highly literate in data and AI is familiar with ways that data is collected, structured, and stored, and the attributes associated with each approach. They understand traditional storage systems like spreadsheets with their cells in rows and columns, databases with their records arranged in relational tables, as well as modern data architectures that support AI operations, including data lakes and model storage systems.

Similar to how farmers are knowledgeable about growing, harvesting, and storing grain in silos, people who are highly literate in data and AI understand various ways that data is collected, structured, and archived. They're aware of different ways data is imported, exported, and transformed between various storage types, including how data needs to be organized and versioned for AI model training and deployment.

#3 DATA ANALYSIS PRINCIPLES

Those who are highly literate in data and AI understand that storing data is not an end in itself, but rather a means of extracting valuable insight about one's environment. They grasp the fundamental principles of both traditional statistical analysis and modern AI/ML concepts, understanding when each approach is most appropriate.

Much like an investigator knows what types of deductive and inductive reasoning are useful when solving a crime, a person who is highly literate in data and AI appreciates critical thinking, statistical significance, and what types of insights can be reasonably derived from both traditional analysis and AI-powered approaches. They understand the strengths and limitations of each method, knowing when to apply classical statistics versus when to leverage AI capabilities.

#4 DATA VISUALIZATION RULES OF THUMB

Since, according to Dr. Tamara Munzner, the human visual system is a "very high bandwidth channel to the brain," the person who is highly literate in data and AI understands various ways to visualize both traditional data analysis and AI model outputs. They grasp the principles of cognition relating to how humans decode visual encodings such as position, length, area, and color, and understand how to effectively represent AI-specific concepts like model uncertainty and decision processes.

Like a doctor who knows how the body will react to prescribed medications and therapies, those who have high levels of data and AI literacy know how their audience members will interpret various visual treatments and forms. They understand how to create visualizations that make both traditional analysis and AI-driven insights clear and accessible to their intended audience.

#5 AI SYSTEMS & CAPABILITIES

The person who is highly literate in data and AI understands the landscape of AI systems, their capabilities, and their limitations. They know the major types of AI applications, from language models to computer vision systems, and understand when these tools can reliably augment human decision-making versus when traditional analytical approaches may be more appropriate.

Like a mechanic who knows which tools to use for different repairs, they understand the strengths and limitations of various AI systems. They recognize that AI tools, while powerful,

are not magical solutions but rather sophisticated information processing systems that require appropriate data, careful implementation, and human oversight to be effective.

"Probing exploratory analysis expands your personal knowledge and generates insights. It also creates visual artifacts that document what the data has to show.

As you comprehend the data, a new comprehensive understanding emerges. You note that certain perspectives may also help others see what you have learned.

The second lens catches these insights and focuses them into a coherent data story for the reader."

–RJ Andrews
Author of *Info We Trust*
https://infowetrust.com

Skills

Simply defined, skills are the abilities we possess to do something well. Data and AI literacy doesn't just involve knowledge about concepts and principles, it also involves the ability to perform tasks and activities that uncover and convey meaning from both traditional analysis and AI-powered insights. It's the second group of traits because it naturally follows that when we know the elements of these languages, we want to take action and put them to use.

What can a data and AI literate person do? A data and AI literate person is skilled at…

#6 READING & INTERPRETING DATA

Organizations of every type are making use of tables, charts, graphs, maps, and dashboards to inform stakeholders on the status of the organization and its environment. Therefore, those who are highly literate in data and AI know how to read and understand visual displays of information created by both humans and AI systems.

They're adept at viewing and interacting with such visual aids to answer questions, formulating new questions based on what they see, and identifying shortcomings or potential biases in how the information has been presented. When either traditional data analysis or AI-generated insights are shared with them, they're able to consume and comprehend the meaning being conveyed while maintaining appropriate skepticism about the results.

#7 EVALUATING AI OUTPUTS

Individuals who are highly literate in data and AI know how to critically assess AI-generated results and recommendations. They verify outputs for accuracy, identify potential biases or limitations, and determine when human judgment should override AI suggestions.

Like a skilled editor reviewing a draft, they examine AI outputs carefully, understanding that while AI can provide powerful insights, it requires human oversight and validation. They know how to test AI-generated results against other data sources, recognize when outputs may reflect biases or limitations in the underlying training data, and maintain appropriate skepticism while leveraging AI's capabilities.

#8 CLEANING & PREPARING DATA

The answers to our questions can rarely be answered by one single, clean data set. Data is most often 'dirty' – full of errors and formatting issues – and relevant information is often stored in multiple places. For this reason, people who are highly literate in data and AI know how to clean dirty data and combine multiple data sets together for analysis, whether using traditional tools or AI-powered assistance.

These data preparation activities, often called 'data wrangling' or 'data munging', are critical skills to learn and can take up the largest amount of time in a given analysis. Data and AI literacy involves knowing how to find and fix problems in data, blend disparate data sets together, and ensure data quality is appropriate for both traditional analysis and AI applications.

#9 EXPLORING & ANALYZING DATA

Like gold in a mine, insights do not reveal themselves without effort – they must be actively mined and extracted using helpful tools and effective techniques. Those who are highly literate in data and AI know how to explore data sets using both traditional analytical methods and AI-powered discovery tools to identify relevant facts, patterns, and trends.

Fundamental exploration can involve visual analytics, summary statistics, hypothesis testing, and regression analysis, enhanced by AI capabilities for pattern recognition and anomaly detection. A higher level of fluency involves knowing when to leverage AI-powered exploration versus traditional methods, understanding the strengths and limitations of each approach.

#10 VISUALIZING DATA

Building on their knowledge of principles of visual cognition, individuals who are highly literate in data and AI create clear visual displays to reveal insights to others. They design, craft, and publish effective visuals using both traditional and AI-assisted methods, ensuring their audience members notice, clearly understand, and remember the key messages.

Whether they're sharing explanatory visuals that articulate a key finding or exploratory ones that allow their audience to interact with the data, they employ a task-oriented mindset to help people get a particular job done. This involves appropriate chart type choices, good design and layout, and effective use of visualization techniques for both traditional analysis and AI-generated insights.

#11 COMMUNICATING DATA

People who are highly literate in data and AI know that the true power of information lies in shaping the minds and directing the decisions of their fellow human beings. They know how to communicate effectively using insights derived from both traditional analysis and AI systems, adapting their approach to their audience's needs and context.

They craft their message thoughtfully, adjusting their approach depending on the circumstances, channel, and method – whether presenting in person to a live audience or publishing content for others to read on their own. They augment facts and figures with helpful annotations and context, explaining both traditional analytical results and AI-generated insights in ways their audience can understand and trust.

"We every day look at numbers, indicators, percentages and electoral maps thinking they are the final answers to our questions, but they rarely are.

No data is perfect, nor objective. And if we recognize this, we can start seeing data as the beginning of the conversation, not the end.

Data is already human, in a way, and if we recognize it's less perfect than we think, then we can finally feel authorized to consider data as the starting point, not the end of the conversation. It's its interpretation according to the context that matters.

Data has a unique power to abstract the world, to help us understand it according to different - relevant - factors - every time."

–Giorgia Lupi
Partner at Pentagram
http://giorgialupi.com

Attitudes

Attitudes are ways of thinking or feeling that often affect how we behave. Our attitudes stem from our knowledge and skills, and are also shaped by our interactions with others. It's possible to know a great deal about data and AI and build many powerful skills, and yet to be held back by unhelpful and sometimes even harmful attitudes.

How does a data and AI literate person think & feel? A data and AI literate person is...

#12 INCLUSIVE

Data and AI work can be either an individual or team endeavor. For situations in which other people are involved, those who are highly literate in data and AI fundamentally believe that working with these tools represents learnable skills that anyone can develop with proper support and dedication.

While they appreciate that people have varying degrees of literacy and comfort with different aspects of data and AI work at any given moment, they're not of the opinion that certain individuals are incapable of developing competency given enough time and instruction. Furthermore, they recognize their own opportunities for improvement and they're patient with the developing capabilities of others. They actively work to make data and AI concepts accessible to all, regardless of technical background.

#13 CRITICAL YET OPEN-MINDED

The person who is highly literate in data and AI maintains a balanced approach that combines healthy skepticism with openness to new possibilities. They question results and assumptions from both traditional analysis and AI systems while remaining receptive to insights these tools can provide.

This balanced mindset allows them to critically evaluate outputs without dismissing innovative approaches. They understand that both traditional analysis and AI systems have their strengths and limitations, and they remain open to different methods while maintaining appropriate skepticism about results. Neither overly cynical nor naively accepting, they strike a thoughtful balance between criticism and receptivity.

#14 ALERT

Since errors abound in both traditional data work and AI applications, the person who is highly literate in data and AI remains vigilant about potential pitfalls. Their education and experience have led them to appreciate that there are many common mistakes we often make when working with data and AI systems, from epistemic errors to mathematical miscues to AI hallucinations.

They don't let these common pitfalls deter them from forging ahead, but they are constantly on the lookout for warning signs. Over time they build a sense of familiarity with the territory that empowers them to avoid pitfalls themselves as well as to provide helpful guidance to others. They maintain a proactive approach to identifying and addressing issues in both traditional and AI-powered analysis.

#15 ETHICAL

Data and AI can be used to help or to harm, and people who are highly literate in data and AI consider their responsible use and impact on society to be of utmost importance. They find ways to use these tools to help their organizations grow, but they only do so while respecting the rights and privacy of others and while seeking to improve the lives of those affected.

They value truth and transparency, and they actively seek to recognize and mitigate any biases within themselves, within their data, and within AI systems they employ. They are open to feedback about their work, and they invite dialogue about its effect on others, including any unintended negative consequences. Whenever possible, they use data and AI to help solve real-world problems in ways that benefit humanity.

#16 ADAPTABLE

The person who is highly literate in data and AI embraces the evolving nature of the associated technologies, maintaining a growth mindset and willingness to continuously learn new tools and approaches as the field develops. They understand that these disciplines are rapidly changing, requiring ongoing adaptation and skill development.

Like a sailor adjusting to changing winds, they remain flexible in their thinking and approaches, recognizing that methods and best practices will continue to evolve. They view challenges as opportunities for growth rather than obstacles, and they actively seek to expand their capabilities as new tools and techniques emerge.

> Anyone who has worked with data knows that it doesn't all come in pristine form.
>
> For this reason, a data literate person needs to learn how to handle data that needs some work, or that doesn't even exist in a data form and needs to be gathered.
>
> This is often missed, but it's one of the key points in becoming data literate.

–Cheryl Phillips
Hearst Professional in Residence,
Stanford Graduate Program in
Journalism
https://journalism.stanford.edu/
people/cheryl-phillips

Behaviors

Our behaviors are the ways in which we act or conduct ourselves in the world. This is the final category of data and AI literacy traits because our actions are the outcome of our knowledge, skills, and attitudes, and how we ultimately make a difference. The other three categories don't amount to anything if they don't drive behaviors that reflect our level of literacy in these domains.

How does a data and AI literate person act? A data and AI literate person...

#17 RESOURCEFUL UTILIZATION OF DATA & AI

A data and AI literate person actively seeks out and leverages both traditional data sources and AI tools as means of gathering insights. If information exists that will help them make an important decision or come to a much-needed understanding about the current situation, they can be counted on to find it and make good use of it, whether through traditional analysis or AI-assisted methods.

Not content with simply using readily available resources, they generate or compile new data when doing so will help them achieve their goals. They implement data collection processes and build repositories that relate to their most important questions and challenges, thoughtfully incorporating both traditional and AI-powered tools to enhance their analytical capabilities.

#18 CONTINUOUS IMPROVEMENT OF DATA & SYSTEMS

Knowing that analyses and their underlying data are always imperfect and incomplete to some degree, data and AI literate individuals identify areas of improvement in their data, analysis methods, and AI applications. Once identified, they proactively seek to implement improvements as time and resources permit.

They also sense, however, when the current state of their data and systems is sufficient for the task at hand, and they aren't paralyzed by an impractical need for perfection. They capture, convey and document any known issues or uncertainties and they move forward, committing to make incremental improvements to continually evolve their capabilities across both traditional and AI-powered approaches.

#19 EFFECTIVE ADVOCACY FOR RESPONSIBLE USE

Data and AI literate team members champion the thoughtful use of both data and AI in decision-making while ensuring ethical considerations and potential impacts are addressed. When these resources are not being utilized in important discussions and decisions, they proactively suggest ways to add data-driven and AI-enhanced perspectives, offering their advice or assistance to make it happen.

When data or AI is being utilized in a particular scenario, they act as helpful advisors, humbly pointing out potential issues or opportunities for improvement. They find the right way to provide feedback and go beyond critique to act as advocates and resources, always emphasizing responsible and ethical use of these powerful tools.

#20 ENTHUSIASTIC PROMOTION OF LITERACY

Like any other language, the languages of data and AI thrive and spread with effective usage and refinement. Data and AI literate individuals actively share knowledge and best practices, helping others build their capabilities through example, instruction, and encouragement.

Like articulate orators or writers, they emulate effective use of these languages for others to observe. Like teachers or speaking coaches, they provide instruction and feedback on how to work well with data and AI. Like evangelists, they encourage others to build their skills. Like change-agents, they help organizations incorporate data and AI into their processes, products, and culture in responsible ways.

#21 EFFECTIVE INTEGRATION OF AI TOOLS

The data and AI literate person skillfully determines when and how to employ AI capabilities to complement human analysis and decision-making. They maintain appropriate human oversight while maximizing the value of AI-assisted workflows and processes.

They thoughtfully integrate AI tools into their analytical workflows, understanding both their potential and limitations. Rather than viewing AI as a replacement for human judgment, they see it as a powerful complement to traditional analysis methods, carefully balancing automated and human-driven approaches to achieve optimal results.

Conclusion

These are 21 key traits that characterize individuals who are highly literate in data and AI, separated into the knowledge they possess, the skills they acquire, the attitudes they convey, and the behaviors they demonstrate.

While individuals who index highly in each and every one of these traits are rare, they can be found in every organizational department and discipline and from every walk of life and background. As our world becomes increasingly driven by both data and AI, these individuals are incredibly valuable to the companies in which they work, the communities in which they interact, and the planet on which we all dwell.

Our belief is that together we can educate and encourage people in our world to learn to work with data and AI similar to how they learn to speak any foreign language – through exposure, study, and practice. And like any skill, these literacies involve multiple levels of proficiency. Data and AI literate individuals can go on to develop their capabilities further to become more fluent with advanced tools and methods.

The ability to successfully attract, hire, and retain such individuals will become a major competitive advantage for firms in the 21st century. Even more importantly, our ability to mobilize individuals with these fluencies to solve our world's major challenges and problems will affect how well our species thrives in coming generations.

The integration of AI into our world doesn't change the fundamental importance of human judgment, ethical considerations, and critical thinking. Rather, it amplifies the need for individuals who can thoughtfully combine traditional analytical approaches with AI-powered capabilities, always keeping human welfare at the center of their work.

These 21 traits provide a framework for understanding and developing the capabilities needed to thrive in an era where both data and AI literacy are essential skills for professional success and societal progress. By cultivating these traits, individuals and organizations can better harness the power of data and AI while ensuring their responsible and effective use.

Learn the Language of Data & AI
https://dataliteracy.com