Data Literacy: Glossary and Index

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# Glossary

### ADVANCED RESEARCH COMPUTING

Advanced research computing (ARC) provides massive computational horsepower and [storage](#storage-and-physical-data-sources) in a [cloud environment](#cloud-computing) to handle problems and data that are too complex for a single desktop computer. [1](#fn1),[2](#fn2) <#disciplines>

### ALGORITHM

A sequence of instructions telling a computer how to answer a specific question. [3](#fn3),[4](#fn4) <#processing>

### ANALYTICS

The process of using [statistical models](#machine-learning) and software to [transform data](#data-transformation) into useful [information](#information) and to draw conclusions towards effective decision making.[5](#fn5),[6](#fn6) <#disciplines>

### ARTIFICIAL INTELLIGENCE

A branch of computer science that allows machines to acquire and apply knowledge to handle new inputs and analyze patterns to solve diverse problems. [7](#fn7) <#disciplines> <#lesson-03>

### Aggregations

A cluster of things that have come or been brought together. [8](#fn8) <#operations> <#lesson-08>

### Arithmetic operations

Includes basic statistics: such as *sums*, *counts*, *means* (or *averages*), *medians*, *percentiles*, or [*standard deviations*](#standard-deviation). <#operations> <#lesson-08>

### BEHAVIOUR(AL) ANALYTICS

A type of business [analytics](#analytics) that examines behavioural data about people to understand how and why individuals act the way they do and to make more accurate predictions for future behaviour.[9](#fn9),[10](#fn10) <#data-analysis>

### BIG DATA

Refers to the massive amounts of [data](#data) generated around the world that is too large, complex or varied for traditional processing software. Its potential to be analyzed for valuable information is enabled by technology such as [advanced research computing](#advanced-research-computing). [11](#fn11),[12](#fn12) <#disciplines> <#lesson-04>

### Big data isn’t always big.

Many describe it with “[The Four V’s](http://www.ibmbigdatahub.com/infographic/four-vs-big-data)” and there exist other definitions as well, including the [5 Vs](https://bicorner.com/2015/04/17/why-only-one-of-the-5-vs-of-big-data-really-matters/)’ or [7 V’s](http://dataconomy.com/seven-vs-big-data/). <#disciplines> <#lesson-04>

* Volume: includes the amount of data.
* Velocity: is data that arrives quickly and constantly, for example, streaming data.
* Variety: includes many differently-structured (or less-structured) input data sets.
* Veracity: is some data that might be incorrect or of unknown correctness.

### Binning

An operation on a range of numbers values in which the entire range is divided into *bins* (or *intervals*) of a *bin width* (or *bin size*, *step size*). Another name for binning is *bucketing* <#operations> <#lesson-08>

### Bucketing

Another name for bucketing is [binning](#binning). <#operations> <#lesson-08>

### CAUSAL INFERENCE

Determines whether observations made in one variable are the reason for an effect observed in another variable, possibly occurring at a later time. See also [correlation mining](#correlation-mining) and [predictive analytics](#predictive-analytics). <#data-analysis>

### CLASSIFICATION

An approach in [machine learning](#machine-learning) where a program is [trained](#model-fitting) with labeled [data](#data) to determine which category a new observation belongs to. See also [clustering](#clustering). <#data-analysis>

### CLOUD COMPUTING

Access to data, [storage](#distributed-file-system), applications, and other computing resources made available to many users on-demand over the [Internet](#network) to improve [scalable computing power](#advanced-research-computing) and reliability. [13](#fn13),[14](#fn14) <#disciplines>

### CLUSTER

A [network](#network) of computers (or compute nodes) that work on tasks together in parallel. The concept is different from [clustering](#clustering).

### CLUSTERING

A [machine learning](#machine-learning) technique that groups similar data points together to uncover hidden structure. Unlike [classification](#classification), clustering does not require labelled training data and is a type of unsupervised learning. <#data-analysis>

### COMPUTING WITH DATA

Learning from data using computing tools and programming languages, such as Python or R with large ecosystems of libraries providing a convenient level of abstraction and statistical methods that can be organized into data processing pipelines.[15](#fn15) <#disciplines>

### CORRELATION MINING

As a measure of association between two variables, correlation can be used for [prediction](#predictive-analytics) and indicate the presence of [causal relationship](#causal-inference). It does, however, not sufficiently imply causation. [16](#fn16) <#data-analysis>

### CYBERSECURITY

A model in information security designed to govern and evaluate how an organization handles data when it is stored, transmitted or processed. This model emphasizes that data should not be accessed without authorization, should not be altered or compromised without authorization, and should be accessible upon legitimate request. See [Secure Computing](#secure-computing). [17](#fn17) <#disciplines>

### Correlation

Correlation or dependence is any statistical relationship between two random variables or bivariate data, whether causal or not. In the broadest sense, correlation is any statistical association, though it accurately refers to the degree to which a pair of variables are linearly related. <#lesson-05>

### Critical Thinking

The objective analysis and evaluation of an issue to form a judgement [18](#fn18). The process of analysing information in order to make a logical decision about the extent to which you believe something to be true or false [19](#fn19). <#disciplines> <#lesson-04>

### Crowdsourcing

TODO. <#lesson-03>

### DATA

Collection of examples, observations, measurements, facts, points, or other items of information that can be represented in [structured](#structured-data) or [unstructured](#unstructured-data) form. <#data-types> <#lesson-03>

### DATA AGGREGATION

TODO:

### DATA CLEANING

Careful removal of erroneous or unreliable data points. Also see [clean and dirty data](#clean). <#processing>

### DATA EXPLORATION AND PREPARATION

Exploratory data analysis (EDA) is a formative step in the [creation of models](#model-fitting). [Views of the data](#visualization) are used to learn about patterns or relationships among variables. This includes [data cleaning](#data-cleaning) and manipulation for further analysis. <#processing>

### DATA INTEGRATION

The process of combining information from different data sources in preparation for data processing. [20](#fn20) <#processing> <#lesson-06> <#lesson-10> <#lesson-11> <#lesson-12>

### DATA MINING

An analytical process where large datasets are explored or “mined” in search of meaningful patterns, relationships or insights. The process can include statistics, [machine learning](#machine-learning) or other forms of artificial intelligence.[21](#fn21),[22](#fn22) <#disciplines>

### DATA REPRESENTATION

The form in which [data](#data) are stored, processed and transmitted such that its [information content](#information) and [context](#metadata) are retained as much as possible. Choices of form are influenced by hardware, software or other constraints around processing and analysis resources. [23](#fn23) <#processing>

### DATA SCIENCE

A multidisciplinary activity combining programming skills, math and statistical analysis, and sector-specific expertise to extract [insights](#insight) from [data](#data). Often performed in stages: 1. [Data Exploration and Preparation](#data-exploration-and-preparation), 2. [Data Representation](#data-representation) and [Transformation](#data-transformation), 3. [Computing with Data](#computing-with-data), 4. [Machine Learning](#machine-learning), 5. [Data Visualization and Presentation](#visualization). [24](#fn24),[25](#fn25) <#disciplines>

### DATA TRANSFORMATION

The process of converting data from [one form into another](#data-representation) to gain better [insight](#insight). For instance, converting [unstructured data](#unstructured-data) into [structured form](#structured-data) that can be analyzed further. <#processing> <#operations> <#lesson-03> <#lesson-03> <#lesson-06> <#lesson-08> <#lesson-12>

### DATABASE

An organized collection of [data](#data) that allows easy access, management, updating and analysis of data. Commonly used databases are MySQL, PostgreSQL, as well as various [NoSQL](#no-sql-database) options.[26](#fn26) <#storage>

### DESCRIPTIVE ANALYTICS

An initial stage of data processing that involves creating a summary of historical data with the goal of answering the question, “What happened?”[27](#fn27),[28](#fn28) <#data-analysis>

### DISTRIBUTED FILE SYSTEM

A mechanism that stores files on servers and allows clients, with permission, to store and process files as if they were stored on their own computer.[29](#fn29),[30](#fn30) <#storage>

### Data (Clean, Dirty)

Data that contains erroneous or unreliable data points is called dirty data. Dirty data must be cleaned to correct and adjusted before it is usable, usually a tedious task. Causes of dirty data include being Outdated, insecure, incomplete, incomplete (missing), Inaccurate data, Misplaced data, Inconsistent, or duplicated.[31](#fn31) <#processing> <#lesson-04> <#lesson-06>

### Data Bias

Whether the (sample) data’s [balance](#balance) in the is representative [sample](#sample) or not. If the balance is representative, then there is No Bias. When the balance is not representative, then the dataset is biased. <#data-analysis> <#lesson-04>

### Data Literacy

Data literacy is the intersection of verbal, numerical and graphical literacy. It is not label reserved for data scientists or specialists. Data literacy should be thought of as “the ability of non-specialists to make use of data” and measure “a person’s ability to read, work with, analyze and argue with data”, presumably using simple statistics such as means and percentages [32](#fn32). <#disciplines> <#lesson-01>

### Data Privacy

Refers to the vast range of technologies, protocols, and concepts that give individual users or other parties more privacy protections in their online use. Online privacy takes many forms, including mandatory privacy statements on websites, data sharing controls, data transparency initiatives and more. [33](#fn33) <#disciplines> <#lesson-04>

### Data Quality

The usefulness and reliability of data are assessed by its quality. High-quality data can be defined as appropriate, consistent, complete and accurate.

TODO: Dimensions that the quality can be assessed on include relevance (does the statistical information matter?), accessibility (can users access the statistical information?), accuracy (is the statistical information representative of the targeted measurement?), timeliness (is the lag between the period of reference and the availability of the statistical information acceptable?), interpretability (is metadata available and complete?), and coherence (is the statistical information consistent over time, between regions and across sub-populations?). [34](#fn34) <#processing> <#lesson-04>

### Data types

TODO intro. <#data-types> <#lesson-03>

#### Float

Any number, whole or fraction, with unknown decimal places.

#### Integer

A whole number.

#### String

Multiple characters together are called strings. e.g ‘aeiou’ is a string of the characters ‘a’, ‘e’, ‘i’, ‘o’, ‘u’.

#### Date / Datetime

A representation of a date (may include time) e.g. YYYYMMDD or YYYYMMDDhhmmss.

### FEATURE

A key property that characterizes a data point (representing some real-world object) in the context of a [machine learning](#machine-learning) problem or other type of [analysis](#analytics).

### FEATURE ENGINEERING

A human-driven process of finding the most important [features](#feature) to develop [predictive](#predictive-analytics) models. Formerly, as “art” to the “science” of [machine learning](#machine-learning), [big data](#big-data) increasingly moves towards automated representation learning.

### FLEXIBLE SCHEMA

Unlike [SQL](#sql) databases with a [tabular](#tabular-data) [structure](#structured-data), objects or documents stored in a flexible schema can be different from one another.[35](#fn35) <#data-types>

### File Formats

TODO intro <#data-types> <#lesson-03>

### Filter

TODO: <#operations> <#lesson-07>

#### TXT

A generic file format which may hold [structured](#structured-data) data. The structure is preserved with a delimiter or separator; comma, semicolon or tab indentations are common separators.

#### CSV

A text file that uses commas as a delimiter. Often the file extension is .csv but the generic .txt is also used. The structured in the text file are *comma*-separated values.

#### TSV

A text file that uses tab indentation as a delimiter. Often the file extension is .tsv but the generic .txt is also used. The structured in the text file are *tab*-separated values.

#### JSON

*JavaScript Object Notation* is a human-readable file format that stores [structured](#structured-data) data as attribute-value pairs. JSON is a language-independent data format and is a common format for use with web applications,

#### XML

*eXtensible Markup Language* is human-readable file format that stores [structured](#structured-data) data using *tags*, *elements* and *attributes*. The XML format is commonly used across the Internet.

#### YAML

*Yet Another Markup Language* is a human-readable file format that stores data using indents, hyphens (–) and colon punctuation (:) to impose [structured](#structured-data). YAML is a compact format and is commonly used to share configurations, settings and unsophisticated data files.

### GENERATIVE MODELING

[Fitting](#model-fitting) a [model](#machine-learning) that can generate synthetic data beyond [given observations](#data). For example, a language model trained on a collection of text can be used to suggest possible words to modify or continue a given phrase. [36](#fn36)

### GOODNESS OF FIT

Summarizes how well the values observed in the data agree with those values expected by the model. <#processing>

### Groupby

TODO: Collect and [aggregations](#aggregation) and [transformations](#data-transformations) summarize…. <#operations> <#lesson-07>

### Histogram

A histogram is a graphical representation that organizes a group of data points into user-specified ranges. Similar in appearance to a bar graph, the histogram condenses a data series into an easily interpreted <#visualization> by taking many data points and grouping them into logical, ordered ranges or bins. <#data-analysis> <#lesson-05>

### INFORMATION

Meaning encoded in [data](#data) that answers questions to better understand a concept by interpreting data within the context of its problem setting or domain. See also data analysis [algorithms](#algorithm) and information [visualization](#visualization). [37](#fn37)

### INSIGHT

Actionable [information](#information) gained by interpreting [data analysis](#analytics) results, helping people to make more informed decisions. [38](#fn38)

### IOT (INTERNET OF THINGS)

A system of [connected](#network), “smart” objects, including smartphones, wearables and smart-appliances, that collect and exchange information without requiring human interaction. The IoT is a huge generator of data.[39](#fn39),[40](#fn40) <#storage>

### KNOWLEDGE DISCOVERY

Aims to extract [insight](#insight) from data in [databases](#database). It involves a [number of steps](#data-science) including the evaluation and possibly [interpretation](#visualization) of [patterns](#data-mining) to gather [insight](#insight) and knowledge.[41](#fn41) <#disciplines>

### Logical operations

Operations and manipulations according to the rules of logic and boolean algebra. Logical operations evaluate *truth values* (true or false) of a logical statement. Logical statements are constructed with statements including conjunction (*and*), the disjunction (*or*), and the negation (*not*), along with comparators *greater than*, *less than*, and *equals to*. <#operations> <#lesson-08>

### MACHINE LEARNING

A part of [artificial intelligence](#artificial-intelligence) that enables machines to learn from experience to perform certain tasks by using [algorithmic](#algorithm) models that are [trained](#model-fitting) to imitate patterns present in [data](#data) to support [prediction](#predictive-analytics), [data generation](#generative-modeling) and other forms of [data analytics](#analytics). <#disciplines> <#lesson-03>

### METADATA

Also called “data about data,” it provides a [structured description](#structured-data) and context for a data point - document, image, or file - to help organize, find and understand the data. [42](#fn42) <#data-types> <#lesson-03> <#lesson-11>

### MODEL FITTING

Optimizes [how well](#goodness-of-fit) a [machine learning model](#machine-learning) can make predictions for previously unseen test data.

### NETWORK

A system where multiple computing devices are connected to each other to exchange information and resources through a data link. For example, the Internet.[43](#fn43),[44](#fn44)

### NETWORK ANALYSIS

Mapping and measuring the relationships between people, groups, organizations, computers and other connected entities. It is used to simplify complex relationships, to make them easier to analyze. [45](#fn45)

### NO-SQL DATABASE

A type of database designed to handle [large](#advanced-research-computing) volumes of data that [may not have a structure](#flexible-schema). <#storage>

### Null values

Null or NULL is a special marker to indicate that a value does not exist. A null value indicates a lack of a value, which is not the same thing as a value of zero. [46](#fn46) <#lesson-06>

### PREDICTIVE ANALYTICS

A process for analyzing current [data](#data) to determine future events or other unknowns. Related to [descriptive](#descriptive-analytics) and [prescriptive analytics](#prescriptive-analytics), it draws on techniques from [data mining](#data-mining), modeling, [machine learning](#machine-learning) and statistics.[47](#fn47),[48](#fn48)

### PRESCRIPTIVE ANALYTICS

A type of [analytics](#analytics) with the goal of using data to determine the best course of action for a specific scenario. [49](#fn49) <#data-analysis>

### Pivot

Pivoting is an extension of the [transpose](#transpose) operation. The pivot operation converts between [wide-](#wide-table-format) and [narrow-](#narrow-table-format) table formats. <#operations> <#lesson-03> <#lesson-08>

### Population

A collection of items under consideration. [50](#fn50) <#data-analysis> <#lesson-04>

### Query (Data)

TODO: check. Queries are not restricted to SQL A query is a request for data or information from a [table](#tabular) or combination of tables. This data may be generated as results returned by Structured Query Language ([SQL](#sql)) or as pictorials, graphs or complex results, e.g., trend analyses from data-mining tools. <#lesson-07> <#lesson-10> <#lesson-11>

### REGRESSION

A type of [statistical model](#machine-learning) that [predicts](#predictive-analytics) numerical values (instead of [class labels](#classification)). <#data-analysis>

### RELATIONSHIP MINING

Relationship mining examines associations between two or more variables in a dataset, for example, by [correlation mining](#correlation-mining) and [causal mining](#causal-inference). <#data-analysis>

### SECURE COMPUTING

Efforts to ensure privacy and to protect data, devices and computing systems from harm such as hacking, damage, and malpractice, and mitigate service disruptions. [51](#fn51),[52](#fn52) <#disciplines>

### SQL

SQL (pronounced “ess-que-el” or “sequel”) stands for Structured [Query](#query) Language. SQL is a language that works with structured, [tabular data](#tabular-data) allowing to query and construct such data. It forms a standard for many [database](#database) systems. [28] <#processing> <#lesson-07> <#lesson-10> <#lesson-11> <#lesson-12>

### STRUCTURED DATA

[Data](#data) that is organized into clearly defined fields associated with variables or attributes, such as dates, words, or numbers that are recorded for each observation or item. Items are often represented as rows of [tabular spreadsheets](#tabular-data) that can be stored in a [database](#database) for easy processing and analysis.[53](#fn53),[54](#fn54) <#data-types> <#lesson-03>

### Sample (Representative, Proxy)

A subset of the units of a [population](#population). The sample serves as a proxy, or representative sample subset of the true nature of the [population](#population). [55](#fn55) <#data-analysis> <#lesson-04>

### Select

TODO: <#operations> <#lesson-07>

### Sort

TODO: Also called *rank*… [transformations](#data-transformations)…. <#operations> <#lesson-07>

### Standard Deviation

Standard deviation is the square root of [variance](#variance). It is a measure of dispersion, meaning it is a measure of how far a set of numbers is spread out from their average value. <#lesson-05>

### Statistics

Statistics is the discipline concerned with developing and studying methods for collecting, organizing, analyzing, interpreting and presenting empirical data. Common statistical metrics are mean (average), median, mode and percentiles. <#data-analysis> <#lesson-05>

### String or character operations

Manipulations with [string data types](#data-types). <#operations> <#lesson-08>

#### Parse

To analyze (a string or text) into logical syntactic components.[56](#fn56)

#### Indexing

Indexing (or selecting) string characters by their position, *zero-th* character, *first* character

#### Concatenation

Combining strings end-to-end.

### TABULAR DATA

Data items or observations that are organized as rows that contain values under columns that correspond to specific variables or properties. [57](#fn57),[58](#fn58) <#data-types> <#lesson-03>

* Synonyms: row(s), record(s), example(s), observation(s), measurement(s), fact(s), point(s) and other items of information
* Synonyms: column(s) also referred to as field(s), header(s), attribute(s), [feature(s)](#feature), property(ies), variable(s), key(s) (as in key-value), factor(s), dimension(s)
* Synonyms: pairs, key-value, attribute-value

#### Narrow table format

TODO: one column contains all the attributes and another column contains the lists of values [pivot](#pivot). <#data-types> <#lesson-03>

#### Wide table format

TODO: each holds different attributes in separate columns [pivot](#pivot). <#data-types> <#lesson-03>

### TEXT MINING

A process of analyzing [text](#unstructured-data) to capture key concepts, themes, relationships and trends.[59](#fn59) <#data-analysis>

### Tidy tables

Datasets are commonly messy. Getting data into tidy [60](#fn60) format requires upfront work, but that work pays off in the long term. There are three interrelated rules which make a dataset tidy:

1. Each variable must have its own column.
2. Each observation must have its own row.
3. Each value must have its own cell.

<#lesson-06>

### Transpose

A mathematical operation on a table where a new table is obtained by interchanging each row and the corresponding column. <#operations> <#lesson-08>

### Tree structure

A *tree* is a widely used data type that simulates a hierarchical tree structure, with a root value, branches, leaves, and subtrees of children with a parent node. [61](#fn61) <#data-types> <#data-types> <#lesson-03>

### UNSTRUCTURED DATA

Data that is not organized in a pre-defined way under a single data model. Examples include text, images, audio, or video. [62](#fn62),[63](#fn63) <#data-types>, <#lesson-03>

### Unbalanced Data

Whether majority or minorities groups exist in a dataset; imbalance is common and sometimes expected. <#lesson-04>

### VISUALIZATION

Visual representation of data including plots, charts, maps and infographics to support people with tasks such as sensemaking, effective communication of information, and improved pattern detection. For example, flight operations using a radar screen that displays sensor data in real-time. [64](#fn64),[65](#fn65) <#data-analysis> <#lesson-05>

### Visualization

The technique for creating images, diagrams, or animations to communicate a message. <#data-analysis> <#lesson-05>

### VISUALIZATION DASHBOARD

Multiple interactive graphical views of [data](#data) that would be too complex if presented in a [single visualization](#visualization), for instance, to support complex narratives and [insights](#insight) by showing key performance indicators (KPIs) for monitoring of a business or other processes. <#data-analysis>

### Variance

In probability theory and statistics, variance is the expectation of the squared deviation of a random variable from its [population](#population) mean or [sample](#sample) mean. Variance is a measure of dispersion, meaning it is a measure of how far a set of numbers is spread out from their average value. <#lesson-05>

# Categories

The categories offer an alternative grouping that helps to find related terms.

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[DATA TRANSFORMATION](#data-transformation)

[SQL](#sql)

## Lesson 13

## Lesson 14

## Lesson 15

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