Explanations Are Answers To Questions

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Explanations and Help Facilities

Automated help facilities are terrible:

- Somewhere in the maze of menus is the feature you want, but you can't ask for help about it unless you know its name.
- For anything but the simplest cases, you can't use an automated telephone system without shouting "AGENT."
- A 3-year-old child can produce better explanations than the latest versions of Siri, Alexa, or any of their sisters.

Basic problems:

- People talk and think in some version of natural language.
- Precise definitions of system terms can't help if people don't know what to ask for.
- Machine-learning systems are even worse: they learn a maze of numbers that have no words of any kind.

We need systems that can explain how, what, and why.

Aristotle's Categories

Ten ways of describing anything that exists or can exist.

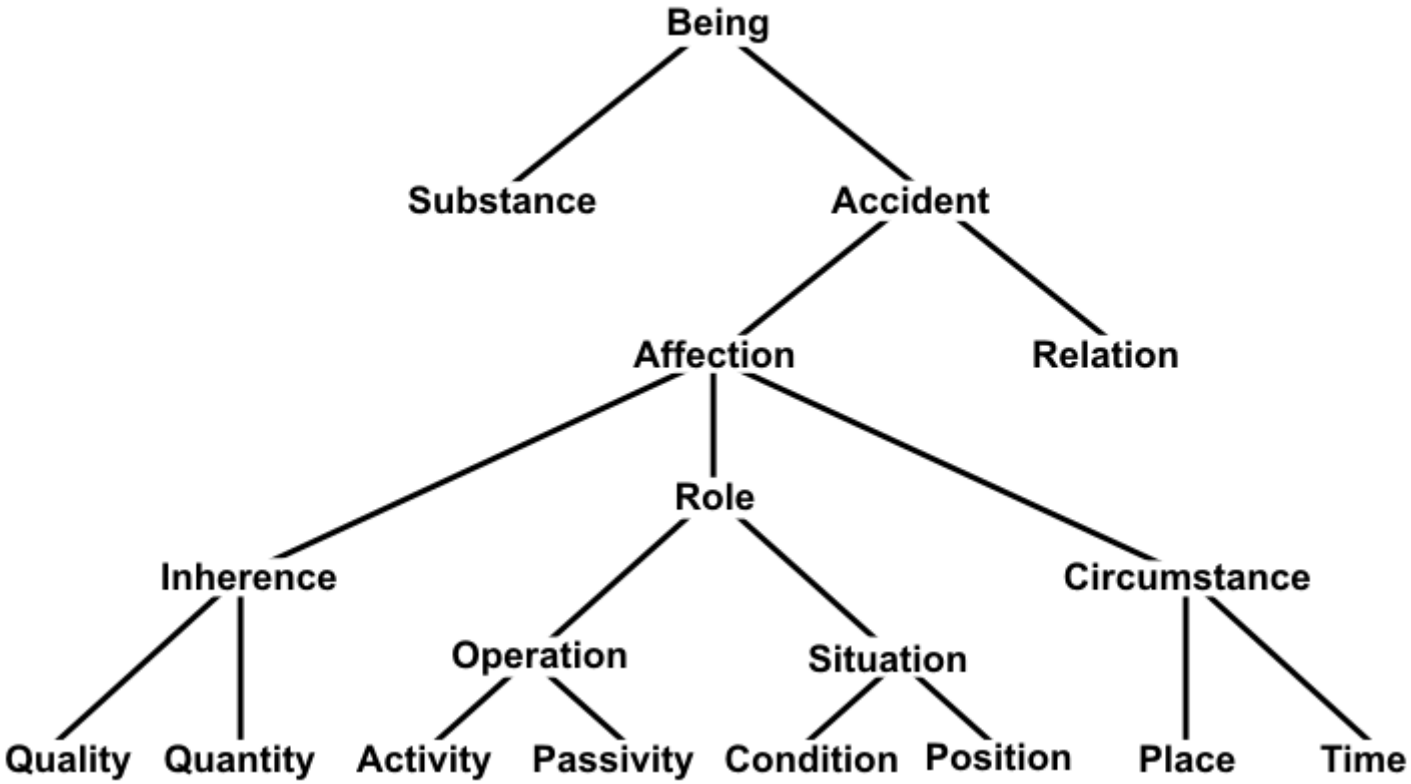
Each category has a corresponding question:

- **Substance – What is it?**
- **Relation – Toward what?**
- **Quantity – How much?**
- **Quality – What kind?**
- **Activity – Doing what?**
- **Passivity – Undergoing what?**
- **Condition – Having what?**
- **Position – How situated?**
- **Place – Where?**
- **Time – When?**

Substance is the unchanging form that determines what something is.

The other nine categories describe accidents that can change.

Tree of Aristotle's Categories



Aristotle's categories, as arranged by Franz Brentano (1862).

The ten categories are the endpoints (leaves) of the tree.

The items in each category are answers to the question posed by that category.

Describing George Washington

Category	Question	Answer
Substance	What is it?	A man
Relation	Toward what?	A general of the US army
Quality	What kind?	Handsome
Quantity	How much?	Tall
Activity	Doing what?	Talking
Passivity	Undergoing what?	Listening
Condition	Having what?	Victory in battle
Position	How situated?	Mounted on a horse
Place	Where?	Yorktown, Virginia
Time	When?	19 October 1781, 2 pm

Body and Soul

All the Greeks used the word *psychê*, which is translated as *anima* in Latin and *soul* in English.

Plato assumed a separable psyche, which uses the body as the instrument of perception and action.

To answer the question "How does it live and behave?" Aristotle assumed that every living thing has an embodied psyche:

- **Nutritive psyche for plants.**
- **Sensitive psyche for sessile animals like sponges and clams.**
- **Locomotive psyche for worms.**
- **Psyche with imagery for animals with eyes.**
- **Rational psyche for humans (animals with *logos*).**

The psyche controls all growth and motion from birth to death.

The psyches of the more advanced animals inherit all the functions of the more primitive psyches.

Explaining Change

Aristotle defined four modes or principles for explaining change.

His Greek word *aitia* was translated to Latin as *causa*, but the English word *cause* has shifted in meaning.

Aristotle's four aitiai pose questions:

- **Efficient: What initiates a change or carries it through?**
- **Material: What is the matter or resources used in the change?**
- **Formal: What is the form, plan, or pattern of the change?**
- **Final: What is the goal, purpose, or function (in Greek, *telos*)?**

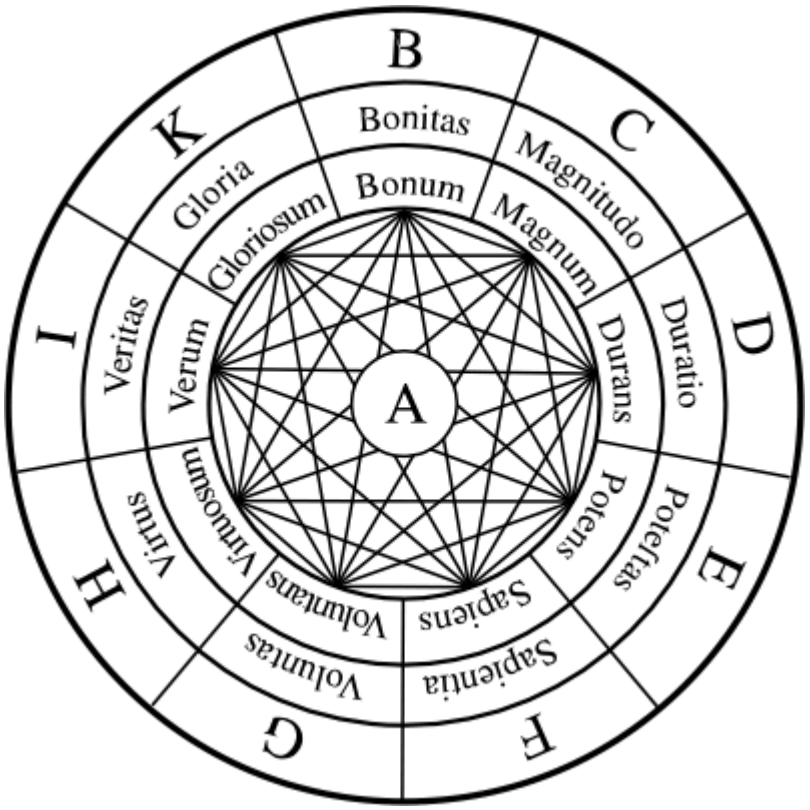
The English word *cause* is usually limited to the efficient aitia.

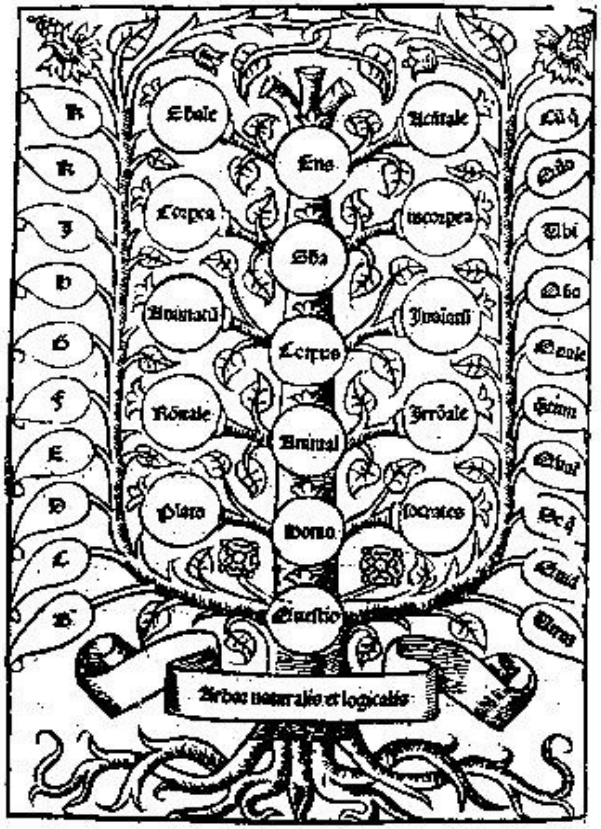
In biological explanations, Aristotle emphasized the function (final aitia or telos) of any organ or feature of a living thing.

For artifacts in engineering and everyday life, the goal, purpose, function, or intention is the starting point for the design.

In explanations, it answers the question "Why?"

Circles and Diagrams by Ramon Llull



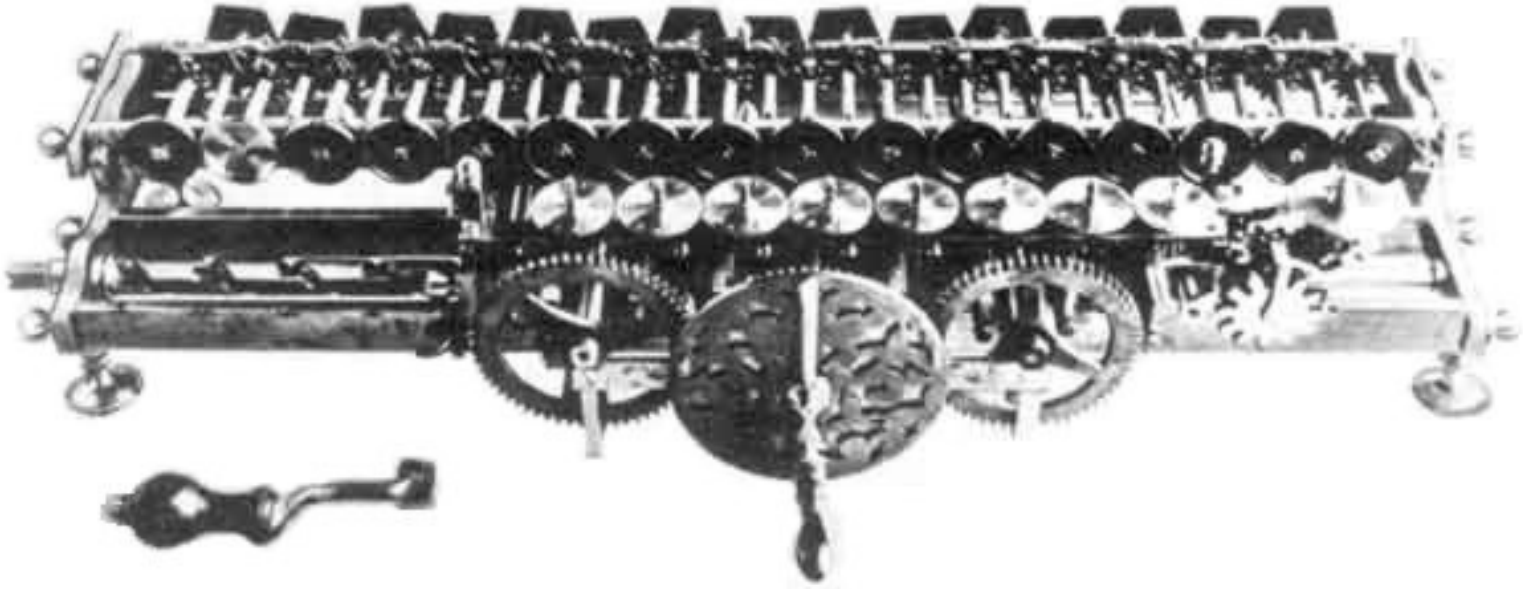


Llull was a Catalan poet, philosopher, and missionary.

He designed a system of rotating circles for combining attributes and relating them to Aristotle's categories.

Every step of reasoning was a response to a question.

Leibniz: “Let Us Calculate”



Leibniz was inspired by Llull’s circles and diagrams.

He invented the first calculating machine that could do multiplication and division.

He used it for mechanical reasoning about patterns of relations in the numeric encoding of his categories.

His method of using prime numbers inspired Kurt Gödel, who used prime numbers to encode patterns of logic.

Zachman ISA Framework

The Information System Architecture (ISA):

- **Originally intended as a guide to system design and development.**
- **But John Zachman also calls it an ontology. ***

Whatever it's called, it illustrates some important points:

- **Different people have different views of the same system: Owner, planner, designer, subcontractor, and user.**
- **The same person may use different notations for different aspects of the same system or even the same task.**
- **Despite the multiple perspectives for different purposes by different people, all subtasks must interoperate smoothly.**

Implications for ontology:

- **Different goals and perspectives of different people for different tasks must be accommodated.**
- **The issues for a single system become even more critical when multiple systems interoperate.**

*** The framework for enterprise architecture, by John A. Zachman.**

From 3 Columns to 6 Columns

The original ISA framework (1987) had only three columns:

- **The headings were Data, Function, and Network.**
- **But Zachman felt that more columns should be added.**

Zachman and Sowa (1992) extended it to six columns:

- **The first three headings are answers to What? How? and Where?**
- **Three more headings are answers to Who? When? and Why?**
- **Six columns and five rows provide 30 perspectives on systems.**

The next slide shows an example:

- **The ISO technical report on Conceptual Schemas (1987) developed an example about the Oz Car Registration Authority.**
- **The 30 boxes show examples of 30 perspecitves on OCRA.**
- **Thirty is much better than 1, but there is no limit to the number of perspectives for viewing anything of any kind.**

*** Extending and formalizing the ISA framework, by Sowa & Zachman.**

Oz Car Registration Authority

	What?	How?	Where?	Who?	When?	Why?
Scope Planner	Oz, OCRA, cars, fees, licenses, car histories.	Register, transfer, collect, enforce.	Emerald City, Munchkin Land, Kansas, Hollywood.	Director, managers, clerks, car owners.	Time of sale, transfer, registration destruction.	Regulate sales, raise money, trace cars.
Enterprise Director	Each car is of a particular model.	Ownership is transferred by reistration of the transfer.	Registrations are recorded at offices of OCRA.	An OCRA clerk must record each registration.	When a car is constructed, transferred, or destroyed.	Keep accurate records and collect fees.
System Designer	Functional dependency from car to model.	Car history updated by transfer module.	Each office must have a connection to OCRA HQ.	A clerk must enter information at a terminal.	DB updates occur at irregular intervals.	Old batch system does not respond fast enough.
Technology Builder	Car relation has a column for model identifier.	Transfer done by COBOL program XFTR397A.	Branch office records are backed up at OCRA HQ.	Clerk completes form REG972 to initiate registration.	Each module is invoked by a menu selection.	Efficient reliable service within budget.
Components Sub-contractor	Model ID PIC X(15).	SELECT SNO FROM HIST WHERE...	Install TCP/IP link to OZNET.	Install cordons to guide queue for clerks.	Use pop-up windows selected by mouse.	Meet specifications for each module.
Working system.	Data about people, places, things, events.	Functions performed.	Places on the network.	Organization.	History, plans, and schedule.	Motivation and strategy.