Logical Theory Describing Double Entry Bookkeeping

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A logical description and explanation of the mechanical, mathematical, structural, and other logical aspects of double entry bookkeeping

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Contributors

Introduction

Double entry bookkeeping[1] is a well understood mathematical model[2] and global open industry standard which has been used for thousands of years and was formally documented by Luca Pacioli in 1494 within his scientific textbook, *Summa de arithmetica, geometria, proportioni et proportionalità*[3].

The *Summa* was the most comprehensive mathematical text published at the time and represents the first formally published description of many accounting techniques, including double-entry bookkeeping.

Double entry bookkeeping has been described in the form of a theory written in natural language[4], an entry on Wikipedia[5], articles written as helpful resources[6], as courses[7], in helpful videos[8], and a plethora of other helpful ways.

But none of these explanations of double entry booking is really a formal specification for double entry bookkeeping and none are represented in machine readable form.

The purpose of this document is to take the description of double entry bookkeeping and represent that logic in the form of axioms such that a machine interpretable representation of double entry bookkeeping can be created and in the form of a machine interpretable theory. This document will explain the things, associations between things, and the rules of double entry bookkeeping at a high level.

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[1] Wikipedia, *Double-entry Bookkeeping*, https://en.wikipedia.org/wiki/Double-entry_bookkeeping

[2] David Ellerman, *The Mathematics of Double Entry Bookkeeping*, https://www.ellerman.org/wp-content/uploads/2012/12/DEB-Math-Mag.CV_.pdf

[3] Wikipedia, Summa de Arithmetica, https://en.wikipedia.org/wiki/Summa_de_arithmetica

[4] Responsive Software, *Accounting Theory*, https://www.responsive.co.nz/theory.html

[5] Wikipedia, Double Entry Bookkeeping, https://en.wikipedia.org/wiki/Double-entry_bookkeeping

[6] Corporate Finance Institute, Double Entry, https://corporatefinanceinstitute.com/resources/accounting/double-entry/

[7] Accounting Exam Mastery (Canada), *Principles of the Double-Entry System in Accounting*, https://accountingexamsmastery.ca/accounting-fundamentals/03-double-entry-bookkeeping/3-1-principles-of-the-double-entry-system/

[8] Investopedia, *Double Entry: What It Means in Accounting and How It's Used*, https://www.investopedia.com/terms/d/double-entry.asp

To begin, we will provide a narrative to help the reader understand the double entry bookkeeping model from the 50,000 foot perspective.

1. Logical Description Narrative

Double-entry bookkeeping is a professional tool which was purpose-built to minimize accounting entry errors and to enable the differentiation between an unintended mistake (e.g. error) and an intentional manipulation of accounting entries (e. g. fraud).

This objective is achieved by using two separate but synchronized ledgers which enables a separation of duties such that no none person had 100% control or the accounting entries.

Business events of an *economic entity* spawn *accounting/bookkeeping entries* which then result in *accounting transactions* (a.k.a. financial transaction) which are recorded within a double-entry bookkeeping system.

Typically, these days double-entry bookkeeping or accounting systems are implemented as computer software applications.

Every accounting transaction is recorded in at least two different *ledger accounts* using a *journal*. Entries are made into a journal which serves as a summary of all accounting transactions. Then journal entries are posted to ledger accounts (a.k.a. T-accounts).

The sum of all journal entries within the ledger accounts must always add up to zero.

There are five broad types of accounts: assets, liabilities, equity (a.k.a. capital, share capital, net assets), revenues (a.k.a. income), and expenses.

The five broad types of accounts can be grouped into two categories: *real* (a.k.a. permanent) and *nominal* (a.k.a. temporary).

Double entry accounting has two specially defined terms, *debit* and *credit*, that are used to describe accounting transactions. The accounting terms debit and credit come from Latin. Debit derives from *debere* which means "to owe", and credit comes from *credere* which means "to believe or entrust". Debit is commonly abbreviated "DR" and credit is commonly abbreviated "CR". Luca Pacioli insisted that debit entries belong on the

left side of the ledger and credits belonged on the right side of the ledger[9].

Posting accounting transactions to a ledger or "T-account"; again, a debit would always go on the left side of the "T" and a credit would always go on the right side of the "T" and the sum of all debits and the sum of all credits must always agree.

The following table summarizes this key information about how double entry bookkeeping works:

Assets	Real	Debit
Liabilities	Real	Credit
Equity	Real	Credit
Revenues	Nominal	Credit
Expenses	Nominal	Debit

A foundation of the double entry bookkeeping system and financial accounting is the *accounting equation*[10] (a.k.a. fundamental accounting equation, balance sheet equation) which is:

Assets = Liabilities + Equity

Balanced journal entries which carry forward to ledgers and even financial statements are the corner stone of double entry bookkeeping and financial accounting. In bookkeeping, "debits = credits", is equivalent to the financial accounting notion of "Assets = Liabilities + Equity". This is two different ways of saying exactly the same thing.

The accounting transactions within a double entry bookkeeping system are used to generate financial statements. The four core or primary financial statements are the: balance sheet (a.k.a. statement of financial position), income statement (a.k.a. statement of financial performance, statement of income), cash flow statement (a.k.a. statement of cash flows), and changes in equity (a.k.a. statement of changes in equity).

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[9] YouTube.com, *Colin Dodds - Debit Credit Theory (Accounting Rap Song)*, https://youtu.be/j71Kmxv7smk

[10] Wikipedia, *Accounting Equation*, https://en.wikipedia.org/wiki/Accounting_equation

Financial statements are intentionally interrelated and interconnected. This deliberate mathematical interconnectedness of the four primary financial statements is referred to as articulation[11].

Articulation is kind of parity check or internal coherence that allows each statement to reinforce, validate, and help explain the other statements.

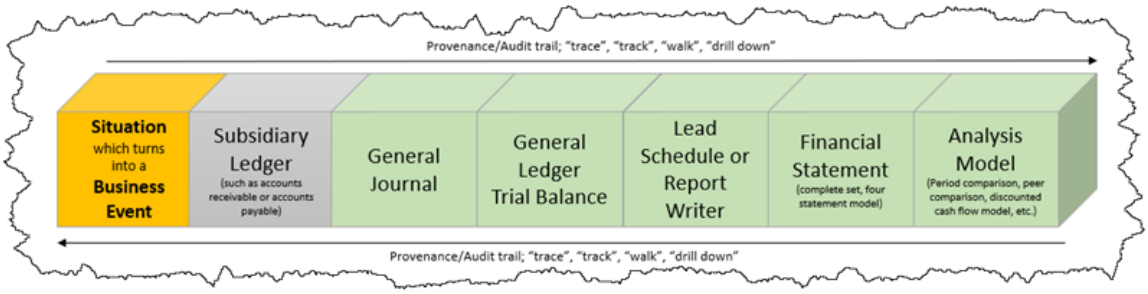
To round out this high-level overview we need to mention the notion of "general" ledgers and journals, and "subsidiary" (a.k.a. subledger, special ledger) ledgers and journals.

General journals and ledgers are the master record of accounting transactions; think of them as high-level information. General journals and ledgers contain all the information necessary to create the set of primary financial statements but detailed information is not provided in these journals and ledgers. For example, a general journal entry for all sales transactions for a month from a sales subsidiary system might be one summary entry for the entire month.

Subsidiary journals and ledgers can be used to track information at a lower level of detail. For example, the accounts receivable subsidiary ledger tracks things like customer information that would never be provided in the general journals and ledgers typically. And so, the subsidiary system has the details that might have been posted to a general journal in summary form.

In summary, a double entry bookkeeping system is purpose built to track financial information in a specific manner. While different financial reporting schemes might use, say, the accounting in a different form such as perhaps "Net assets = Assets - Liabilities"; there is an accounting equation in some form, there is some set of core accounting elements, there are different ways those core elements can be totaled and subtotaled (a.k.a. intermediate components, reporting styles), and a double entry bookkeeping system can facilitate the creation of financial statements for that financial reporting scheme.

[11] Digital Financial Reporting, *Understanding Articulation*, https://digitalfinancialreporting.blogspot.com/2023/08/understanding-articulation.html



1.1. Bookkeeping versus Accounting

Many people tend to use the terms bookkeeping and accounting interchangeably. But there is a difference.

- Bookkeeping is a mechanical process of recording transactions. Bookkeeping is an action; it is a record keeping process.
- Accounting is about determining what constitutes the transactions that are then recorded per the bookkeeping process. Accounting is the language used by bookkeeping. Accounting is a communications tool. Accounting is a classification system.

2. Axioms

Axioms describe self-evident logical principles that no one would argue with. Axioms deal with primitives and fundamentals.

This section summarizes self-evident principles relating to double entry bookkeeping in the form of true statements about double entry bookkeeping. Note that these are not necessarily the actual axioms that describe the theory but rather are used to derive those actual axioms.

2.1. Closed System

The double entry bookkeeping system (a.k.a. double entry accounting system) is a closed system.

2.2. Book

A book is a record of transactions for an economic entity[12]. Both a journal and a ledger are books.

[12] Arxiv.org, *Triple-entry Accounting, Blockchain and Next of Kin: Towards a Standardisation of Ledger Terminology*, https://arxiv.org/abs/2101.02632

2.3. Economic Entity

A double entry system is used to capture information for an economic entity.

Examples of an economic entity include a corporation, a partnership, an individual, a not-for-profit organization, a global multinational corporation, or a neighborhood lemonade stand.

2.4. Counterparty

A counterparty[13] is the other party to an economic entity in an accounting transaction. An economic entity can be both the party and the counterparty of an accounting transaction; for example, a transfer from one part of an economic entity to another part.

2.5. Business Event

Situations for an economic entity spawn business event (a.k.a. financial business event, economic event) of that economic entity.

2.5.1. Core Event

A core event is effectively a set of facets into which a business events can be categorized which help describe the business event.

For example, a business event could be monetary in nature and involve a customer of the economic entity.

2.6. Accounting Transaction

Business events are posted to a double entry bookkeeping system by describing the business event in the form of an accounting transaction (a.k.a. financial transaction).

2.7. Debits=Credits

Within a double entry bookkeeping system the sum of all debits must always equal sum of all credits for every accounting transaction posted to a journal such as the general journal.

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[13] Investopedia, *Counterparty*, https://www.investopedia.com/terms/c/counterparty.asp

2.8. Accounting Equation

The accounting equation[14] is the foundation of double entry bookkeeping system and the cornerstone of accounting science. The accounting equation states:

Assets = Liabilities + Equity

The accounting equation can be expressed using different forms but fundamentally, all versions of the accounting equation resolve to the fundamental equation above. For example, a few other versions of the accounting equation are "Net Assets = Assets – Liabilities" and "Equity = Assets – Liabilities". All versions of the accounting equation resolve to the same meaning[15].

2.8.1. Assets

Assets are things a business owns.

2.8.2. Liabilities

Liabilities are things a business owes to third parties.

2.8.3. Equity

Equity is things a business owes to its owners.

2.9. Account

An account is effectively an identifier which represents a container into which accounting transactions can be grouped. There are two types of accounts: real and nominal.

2.9.1. Real

A real account (a.k.a. permanent) continues on from fiscal period to fiscal period, it is never closed.

2.9.2. Nominal

A nominal account (a.k.a. temporary) is closed at the end of a fiscal period and the balance is reset to zero to begin the next fiscal period.

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[14] Wikipedia, *Accounting Equation*, https://en.wikipedia.org/wiki/Accounting_equation

[15] YouTube.com, *The Accounting Equation for Beginners*, https://youtu.be/56xscQ4viWE

2.10. Chart of Accounts

A chart of accounts is effectively a list of all accounts that are allowed to have a accounting transaction posted to.

2.10.1. Account Types

Accounts can be categorized into types. Account types are used to help group accounts in terms of where the account appears within the financial statements (a.k.a. financial statement line items).

2.11. Journal

A journal is where accounting transactions are accumulated before they are posted to a ledger. A journal is a book of first entry.

2.12. Journal Entry

A journal entry is effectively an entry into a journal. A journal entry, at a minimum, would include the following information:

- Reporting economic entity to which an accounting transaction relates.
- Date of the accounting transaction.
- Account to which the accounting transaction relates.
- Business event grouping code to which an accounting transaction relates
- Amount of the accounting transaction.
- Currency of the accounting transaction.
- An indication as to whether the journal entry is a DEBIT or a CREDIT in some way, shape, or form.

Note that there can be additional information such as a journal entry identifier, a sequence, a description, user defined information of all sorts; but here we specify the absolutely essential information necessary in order to generate a proper set of financial statements.

2.13. Ledger

A ledger is effectively a list. A ledger is the book of second/final entry to which the transactions recorded in a journal are processed and imported ("posted") in an analytical order.

2.14. Trial Balance

A trial balance is a summary of information from a ledger. For example, the general ledger trial balance is a summary of all the accounting transactions that had been accumulated into the general ledger. The general ledger trial balance is a summary of information which could be provided by period, by account, by business event, or other such useful grouping.

2.15. Lead Schedule

A lead schedule (a.k.a. lead sheet) is somewhat like the backbone of a financial report in that it reconciles accounts from a reporting economic entity's accounts to where those accounts appear in the line items of the financial statement.

2.16. Report Writer

A report writer is used to generate a financial statement from a trial balance.

2.17. Financial Reporting Scheme

A financial reporting scheme specifies the details of how a financial statement is to be created per that specific financial reporting scheme.

Examples of financial reporting schemes include United States Generally Accepted Accounting Principles (US GAAP), International Financial Reporting Standards (IFRS), and other such reporting schemes.

2.18. Reporting Style

A reporting style is the approach used by a reporting economic entity to prepare its financial statement per some financial reporting scheme. Effectively, a reporting style is which subtotals and totals are used (a.k.a. intermediate components) and which specific line items are used by a reporting economic entity.

For example, a financial institution such as a bank, a software company, a retailer, and an airline might have different reporting styles even though they use exactly the same financial reporting scheme.

2.19. Financial Statement

A financial statement (a.k.a. financial report) is a means that a reporting economic entity provides information about its financial condition (a.k.a. status, state, stock) as of a point in time and financial performance (a.k.a. flow) between points in time (a.k.a. fiscal period).

2.20. General Ledger

A general ledger is a ledger to which accounting transactions that reflect business events of an economic entity are summarized.

2.21. Subsidiary Ledger

A subsidiary ledger is affectively a sub system used within a double entry bookkeeping system in order to achieve specific information accumulation and reporting objectives. Common subsidiary legers or subsystems are sales and accounts receivable, purchases and accounts payable, inventories tracking, fixed assets tracking, job costing, etc.

2.22. Post

To post is to take information from a journal and put that information into a ledger.

For example, information from a general journal is posted to the general ledger and then ends up being shown within the general ledger trial balance.

2.23. Closing the Books

Closing the books is the process of taking all information posted to nominal or temporary accounts and moving that information into temporary accounts through what is sometimes referred to as the income summary and retained earnings.

3. Resources

The following are resources that are helpful in terms of understanding digitizing double entry bookkeeping tasks and processes using the global open industry standard XBRL:

- XBRL Global Ledger Taxonomy Framework 2017[16]
- Internal Reporting Using XBRL Global Ledger[17]
- XBRL GL[18]
- Introducing the XBRL GL Taxonomy Framework: Tuple and Dimension Models for Granular Accounting Data[19]
- Accounting Semantics Arcroles 1.0[20]
- GAAP Meta Model Relationships Taxonomy[21]
- ISO/IEC 15944 - Accounting and Economic Ontology Implementation[22]
- Accounting, the Language of Business[23]
- Data Centric Accounting[24]

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[16] XBRL International, *XBRL Global Ledger Taxonomy Framework 2017*, https://www.xbrl.org/int/gl/2016-12-01/gl-framework-2017-PWD-2016-12-01.html

[17] Strategic Finance, *Internal Reporting Using XBRL Global Ledger*, https://www.sfmagazine.com/articles/2015/october/internal-reporting-with-xbrl-global-ledger/

[18] Scholarly Community Encyclopedia, *XBRL GL*, https://encyclopedia.pub/entry/31551

[19] Nobuyuki SAMBUICHI, *Introducing the XBRL GL Taxonomy Framework: Tuple and Dimension Models for Granular Accounting Data*, https://www.sambuichi.jp/?p=15487&lang=en

[20] XBRL International, *Accounting Semantics Arcroles 1.0*, https://www.xbrl.org/REQ/accounting-semantics-req/REQ-2023-01-04/accounting-semantics-req-2023-01-04.html

[21] FASB, *GAAP Meta Model Relationships Taxonomy*, https://www.fasb.org/page/detail?pageId=/projects/FASB-Taxonomies/gaap-meta-model-relationships-taxonomy.html

[22] Digital Financial Reporting, *ISO/IEC 15944 - Accounting and Economic Ontology Implementation*, https://digitalfinancialreporting.blogspot.com/2025/09/isoiec-16944-accounting-and-economic.html

[23] Digital Financial Reporting, *Accounting, the Language of Business*, https://digitalfinancialreporting.blogspot.com/2025/09/accounting-language-of-business.html

[24] Semantic Arts, *Data Centric*, https://www.semanticarts.com/data-centric/