

# **Title: Method and System for AI Agents in Accounting**

## **1.0 Technical Field of Invention**

The invention relates generally to artificial intelligence agents, and more particularly, to autonomous multi-agentic systems specialized for bookkeeping and accounting jobs.

## **2.0 Background**

### 2.1 Historical Evolution of Accounting

Accounting has been practiced since ancient times, with the earliest known records dating back to the Sumerian civilization around 4,000 BCE, in tandem with developments in writing, counting, and money. As the domain of accounting advanced and evolved, the technologies to aid in accounting practice have advanced and evolved as well. A retrospective on this evolution is useful for understanding the paradigm shift presented by this invention.

#### **Pre-Digital Accounting Tables**

While the roots of accounting can be traced back to the ancient Sumerian civilization as early as 4,000 BCE, the first systematically structured tables are recorded only from about 1850 BCE onwards. These early tabular formats already allowed cells to be quantitatively linked in a formal mathematical way, enabling “numerical data and relationships to be seen and explored in ways hitherto unimaginable,” and laying the foundation the system of future accounting practices. For the centuries that followed, businesses relied on similarly structured handwritten ledgers to track their financial transactions, a practice that remained largely unchanged until the advent of computers in the mid-20th century.

#### **Spreadsheets & Automated Calculations**

The invention of computers marked a significant milestone in the evolution of accounting. In 1961, Richard Mattessich outlined the concept of a computerized spreadsheet, which he called the "Budget Simulation and Report Generator" or BSRG. This early prototype paved the way for the development of electronic spreadsheets, which revolutionized financial record-keeping and data analysis by allowing users to easily perform calculations and organize data. The release of VisiCalc in 1979, followed by Lotus 1-2-3 in 1983 and Microsoft Excel in 1985, further solidified the role of spreadsheets in accounting by automating many of the tasks that accountants used to do manually and dramatically reducing the need for manual calculations and data entry.

#### **Desktop Accounting Software**

As technology advanced, specialized accounting software emerged to cater to the unique needs of various industries and businesses. These programs offered a comprehensive suite of accounting tools and features, including invoicing, payroll processing, and financial reporting, built on top of the basic spreadsheet capabilities. Desktop accounting software provided user-friendly interfaces and templates, making it easier for businesses to manage their finances and streamline their accounting processes.

## **Cloud Accounting**

The rise of cloud computing in the early 21st century brought about another significant shift in the accounting industry. Cloud-based accounting solutions enabled businesses to access their financial data from anywhere with an internet connection, facilitating real-time updates, collaboration, and integration with external platforms and data flows. This technology also allowed for cross-platform accessibility, with users being able to manage their accounts on mobile devices, web browsers, and desktop applications.

## **Artificial Intelligence Agentic Accounting (Proposed Invention)**

Finally, the proposed invention represents the fifth evolutionary step in accounting technology: Artificial Intelligence (AI) agentic accounting. In this paradigm, users no longer need to interact directly with specific accounting software or spreadsheets to execute bookkeeping and accounting jobs. Instead, they delegate the work to an AI Worker, in natural language communication, to achieve intended outcomes. This evolution allows users to focus on oversight and management, while the AI Worker takes on the responsibility of jobs and tasks completion.

## 2.2 Status Quo Technology for Accounting & Bookkeeping

Even with the use of current software, which allow for some automation of work, many routine bookkeeping and accounting jobs remain time-consuming and labor-intensive. The present adoption of AI-enabled functionalities in commercial accounting software may further assist with such routine tasks, but many of these functionalities are currently designed to assist humans with tasks rather than enable delegation of tasks (i.e. serve as “co-pilots”, rather than autonomous workers), and thus still require significant manual effort from humans-in-the-loop.

These “co-pilot” AI functionalities may be broadly categorized as follows:

### **Automation**

AI-powered tools are being used to automate discrete accounting tasks, such as data extraction, classification, categorization, reconciliation, invoice creation/issuance, and simple communication (e.g., follow-ups).

### **Improved Accuracy & Error Prevention**

AI algorithms are being used to enhance the accuracy of financial data by identifying and flagging errors, detecting fraud, and ensuring compliance with regulations. These tools can quickly analyze large amounts of data to flag anomalies that might be missed by human accountants, and can also ensure real-time compliance to keep up with changing regulations.

### **Information Retrieval, Reporting, & Analysis**

AI-powered systems are being used to generate financial reports, provide data-driven insights and forecasts, and respond to natural language queries. These tools can retrieve relevant data on demand, offer real-time reporting, and summarize complex financial information into easily digestible formats.

### **Text Editing, Generation & Recommendation**

AI is also being applied to assist with text-based tasks in accounting, such as drafting related client communications, proposing meeting agendas, and interpreting text to create summaries and priority lists. These applications help accountants save time and ensure consistency in their written communications.

While at first these AI functions were accessible only as fragmented functionalities, today there are a number of general-purpose “AI assistants” for accounting that combine a number of the above functionalities. However, these AI assistants still require significant time from human users as they are not designed to enable the complete delegation of tasks. These assistants fall into two opposing categories:

### **Interactive but Non-Autonomous Assistants**

These AI assistants, often called “co-pilots”, are designed to be highly interactive but not fully autonomous. They often come with a chatbot-style text or voice prompt interface, through which they can receive and respond to a variety of natural language queries with relevant outputs. However, they can often only execute tasks in linear or programmatic sequences. To execute a more complex task sequence or job, a human is required in the loop to break down the job into smaller, manageable steps; provide these as sequential inputs to the assistant while receiving interim output. As a human user has to stay involved throughout the assistant workflow, the time and effort saved is limited.

### **Autonomous but Non-Interactive Assistants**

These are often standalone applications or plug-ins integrated with existing accounting software, focused on automating highly specific tasks such as transaction classification or reconciliation, so that these specific processes become “hands off” and asynchronous for humans. While these assistants can work independently in the background, they do not accept varied queries and requests in natural language communication. A human user only needs to be involved in the initial assistant setup and to periodically verify the output; however, since this type of assistant offers only a narrow and inflexible scope of automation, the time and effort saved is again limited as a human user must still take care of all other routine tasks outside the assistant’s scope, including any ad-hoc manual modifications to the assistant’s work outside of its typical scope.

### **Autonomous and Interactive Assistants**

While there exist a few AI agents that demonstrate both autonomy and interactivity for applications such as customer support, there is currently a lack of such agents specifically designed / trained for the bookkeeping and accounting domain. This presents a space for the proposed invention to fill: an AI agentic system that communicates with human users in natural language, and also autonomously plan, sequence, and execute domain-specific tasks without need for human supervision. By simply being capable of both natural communication and reliable, autonomous execution, this invention enables users to completely delegate tasks, in complete contrast to currently available AI assistants. The proposed AI Worker thus has the potential to revolutionize the way users approach their bookkeeping and accounting work.

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### 3.0 Summary of Invention

The invention solves the technical problem of automating bookkeeping and accounting tasks that traditionally require significant manual effort and human intervention. Existing software solutions require users to manually input data, navigate user interfaces, and provide explicit step-by-step instructions, which is time-consuming and prone to errors, especially for complex multi-step tasks.

The present invention relates to an autonomous AI system and method for performing bookkeeping and accounting tasks based on natural language instructions received via email communication. The system comprises several key components:

1. **Inbound Email Service:** This service receives emails from users containing job requests and contextual information for bookkeeping or accounting tasks. It extracts the email content and metadata, and triggers the AI Worker by sending this information to the Communication Agent.
2. **AI Worker:** The core assembly system that orchestrates and enables the end-to-end job completion. It consists of:
  - a. **Communication Agents:** Responsible for natural language interaction with the user. It ingests user emails, builds context based on the current email content and prior interactions, determines the appropriate Task Agents to invoke, formulates inputs for the Task Agents where needed, invokes the Task Agents, collects the Task Agents' response, and sends it back to the user via the Outbound Email Service.
  - b. **Task Agents:** Specialized based on the type of accounting job (e.g., invoicing, reporting, reconciliation). Task Agents can break down a job request into an executable sequence of steps; determine the Tools needed for each step; collect and pre-process requisite data and artifacts; validate data sufficiency; execute the steps by invoking Tools; analyze and summarize the results; and determine if the job objective is met or if reflective adaptation is needed.
3. **Tools:** A set of functions that interface with APIs, data repositories, and backend services that provide specific accounting capabilities. The Task Agents utilize these Tools to accomplish the steps in their workflows. Example operations include but are not limited to create, update, delete, read (CRUD) of:
  - a. Data Extraction and Processing (e.g. OCR, e-invoicing)
  - b. Transactions Management (e.g. invoices, bills, journal entries)
  - c. Integrations Management (e.g. payment gateways, banks)
  - d. Transactions Matching and Bank Reconciliations
  - e. Business, Financial, Accounting, Tax Reports
4. **Outbound Email Service:** This service receives the natural language response composed by the Communication Agent, and transmits it to the user by direct email reply with appropriate task summary, status, and artifacts in proper formatting.

Illustratively, the invention operates as follows:

1. A user sends an email containing a job request and contextual information (e.g., documents, attachments) for a bookkeeping or accounting task.
2. The Inbound Email Service receives the email, extracts the email content and metadata, and passes this to the Communication Agent (thus triggering the AI Worker).
3. The Communication Agent uses LLM to interpret the job intent, extract relevant entities and context, and leverages its long-term memory for additional context to enhance accuracy and efficiency. It then formulates a prompt for the appropriate Task Agent.
4. The invoked Task Agent maps the interpreted job to a predefined skill or workflow, breaks it down into executable steps, and determines the tools and data needed for each step.
5. The Task Agent orchestrates the execution of the steps by interacting with the Tools, performing the necessary actions autonomously without human intervention. It adapts the execution based on intermediate results.
6. Upon completion, the Communication Agent prepares the output and/or notifications to be sent the user via email, such as generated reports, invoices, or confirmations of job completion, and pushes this to the Outbound Email Service.
7. The Outbound Email Service receives the response content from the Communication Agent, matches it to the relevant user email from the Inbound Email Service, and delivers the response as a reply to the matched user's email address with appropriate formatting and attachments.
8. The user receives an email reply that states completion of the given task with relevant attachments as requested, if any.

As illustrated in the aforementioned example, the AI Worker exhibits the following key characteristics, comparable to that of a human employee, that allow for complete delegation of bookkeeping and accounting jobs:

**Communication:** It interacts with users in natural language, requiring no translation from thought to action by the human.

**Context:** It extracts and interprets user intent, instructions, and input from emails, while enhancing the accuracy and efficiency of job context with historical context of prior user interactions, requests, and learned preferences.

**Self-governance:** It can break down, plan, and sequence the granular tasks for a complex job, execute them without human intervention, and reflectively adapt the workflow based on intermediate results.

In summary, the invention enables users to delegate bookkeeping and accounting jobs to an AI Worker using natural language instructions via email, without the need for manual software interactions or step-by-step programmatic instructions. The AI Worker can handle complex jobs, learn from previous interactions, and follow-up with natural language email responses, significantly streamlining the overall bookkeeping and accounting process.

## 4.0. Detailed Description

### 4.1 User Interaction and Natural Language Processing

The invention provides a natural language interface, such as email, for users to delegate high-level bookkeeping and accounting "jobs". A user composes a job request using plain natural language instructions within the email body, for example: "Please close the books for March and prepare quarterly financial statements by next Tuesday."

Alternatively, the user could forward an email thread containing relevant information and explicitly ask the AI Worker to "Create a link with an approval flow for this invoice payment based on the details below. Send to Fifi for approval." The AI Worker receives the user's email through an inbound email service that parses the email and extracts its email body, attachments, and metadata, which is then passed to the AI Worker for processing.

The Communication Agent in the AI Worker orchestration, which specializes in communication with the user (translating natural language user requests into agentic workflows, and formulating the results of the workflows into a natural language response for the user), is triggered by the receipt of an email. It processes the job request using an LLM, which interprets the semantic meaning and contextual nuances of the extracted email content. It identifies key elements like:

- The primary intent behind the request (e.g. close books, pay invoice)
- The instructions that support the intent (e.g. close the books before preparing financial statements, generate payment link before sending for approval)
- References to specific objects, entities, or attachments (e.g. March books, Q1 statements, this invoice payment, Fifi)
- Date or timeline constraints (e.g. by next Tuesday)
- Relevant accounting domain terminology (e.g. reconcile, accrue expenses, run payroll)

The Communication Agent is pre-configured with prompt-chaining that enable it to understand job-specific accounting vocabulary, task definitions, templates and examples so that it interprets instructions accurately and effectively within the specific domain of bookkeeping and accounting. To further enrich this contextual understanding, the Communication Agent incorporates a variety of additional information, such as:

- From Email: Extracting and parsing relevant data from email attachments like documents, spreadsheets, PDFs, etc.; analyzing quoted text from previous messages in the email thread conversation
- RAG: Accessing external knowledge bases, shared cloud storage volumes, or other supporting databases; incorporating historical context of prior user interactions, requests, and learned preferences from a long-term memory component

If the intent, instructions, and input and/or additional information are insufficient to determine what job is requested, its parameters, or required access, the AI Worker will proactively seek clarification through a natural language response email.

## 4.2 Task Planning and Delegation

With the user's intent and relevant context interpreted, the AI Worker maps this high-level job request to a comprehensive, multi-step plan with granular tasks. Each task is analyzed to determine required Tools and input parameters.

For example, a "here's June's payroll file. Prepare bank transfer for payment on 28<sup>th</sup>" job request may map to a sequence of tasks like:

1. Extract and parse data from the attached payroll file
2. Derive pay items from parsed data (e.g. gross pay, claims, contributions)
3. Classify the chart of account for each pay item
4. Pre-process all inputs and validations to create an active bill
5. Record a bank payment for the bill
6. Generate a bank transfer file for the recorded payment
7. Set payment status as pending transfer
8. Queue sending of bank transfer file on 28 June

The planning component sequences these tasks based on their dependencies, ensuring prerequisites are met before execution. It also maps out integrations wherever needed (e.g. an external excel file data parsing service is required to read the payroll file).

This entire executable workflow plan is persisted in a job-specific context workflow that maintains overarching computational memory, state, and conditionality for parameters, calculations, intermediate outputs, and task dependencies. If any clarification or inputs are needed, the AI Worker asks the user for the additional needed prerequisites or inputs through a natural language email reply. While the workflow is temporarily terminated at this stage, the activity is persisted in the AI Worker's long-term memory component, which allows it to resume the workflow with no context lost, on the follow-up reply from the user.

## 4.3 Autonomous Task Execution

With the workflow planned and sequenced, the AI Worker autonomously invokes Tools to execute each task without user involvement. As tasks complete, output artifacts and responses are collected and stored in the AI Worker's computational memory to contribute towards the final outcome, as well as to persist or update relevant agentic workflow states. In addition to invoking Tools, the AI Worker can also process data locally through parsers, calculators, and conditional edge rules.

To execute these tasks and actions, the AI Worker utilizes pre-defined Tools that interface with a wide range of APIs, data repositories, and backend services through integrated connectors and adapters. These include, but are not limited to: External APIs, webhooks, queues, listeners, serverless instances, cloud repositories etc. for:

- Domain-specific accounting and bookkeeping functionalities (e.g. CRUD invoices, reconcile bank transactions, and generate various financial reports)
- General system functionalities (e.g. essentials such as user authentication, access management, digital document signing, file creation, and URL shortening)

- Financial data retrieval (e.g. banks, digital wallets)
- Payment processing (e.g. payment gateways for payments acceptance, clearance, settlement)
- Access to public data (e.g. up-to-date foreign exchange rates, GST rate tables)

For example, a "close monthly books" workflow may invoke Tools in the following autonomously defined sequence:

1. Bank transactions retrieval: Fetches all bank and financial statement data in real-time at end of month
2. Matching and reconciliations: Completes matching between statement lines and transactions, and records the reconciliations
3. Single report generation: Prepares a bank reconciliation report in Excel and PDF format
4. Transaction creation: Creates draft invoices and bills for unreconciled records, and submit for approval
5. Journal creation: Records accounting adjustments in journal entries for non-standard transactions (e.g. prepaid expense amortizations, deferred revenue recognition)
6. Consolidated report generation: Generates and prepares key accounting and financial reports in formats pre-defined or preferred by the user for their final reviews and subsequent management reviews
7. Variance check: Analyzes financial reports for discrepancies and anomalies that may require user review and/or reflective adaption of the agentic workflow
8. Scheduled reminders: Sets and sends email reminders ahead of submission deadline date

The AI Worker maintains a detailed audit trail with logs of all agentic outputs at nodes, tasks carried out, external responses generated, etc. as part of the self-monitoring and self-observability of each job's workflow. These logs can be reviewed by the AI Worker as part of its job completion review process, and also summarized and included as part of the final response sent back to the user if requested.

#### 4.4 Job Completion and User Communication

Once all tasks in the workflow are completed, the AI Worker generates a natural language email to the user reporting the final task summary, status, and artifacts.

Using the payroll file conversion example, the summary may read: "I have created an active bill (for review [here](#)). The total gross employee earnings of S\$62,245 were categorized as Wages Payable, the statutory contributions of S\$6,800 were categorized as CPF Payable, the claim amounts were each mapped to various accounts such as Travel Expenses and Entertainment Expenses according to their respective claim types. A payment has been recorded for payment due employees and statutory boards. The bank files for each of them will be sent to you on 28<sup>th</sup> June. I have also set a reminder for 12 noon, just like you had asked the last time. Let me know if you'd like to change that."

For long-running or open-ended jobs, the AI Worker sends progress update emails at configured milestones or when human input is required. This allows users to stay informed, provide feedback, or approve interim steps through natural language replies. The conversational interaction enables back-and-forth clarifications in a form that users are comfortable and familiar with, without the common frustrations of programmatic automations. If a request is unclear like "Please do not process payment for the recent Fruit Planet payables for this period," the AI Worker can seek specifics: "I understand

you want to hold off payments for some bills until a later time, but could you clarify which of these bills here in the last month should be excluded from this month's payments process?"

This ability to interact in natural language and leverage contextual awareness (from user communication and RAG of historical context) differentiates the AI Worker experience from rigid software scripting or robotic automations that require precise upfront inputs and task sequence setups. As such, the AI Worker ensures that workflows adapt as needed to yield reliable outcomes in response to variations in language or semantic expression of the user's primary intent, or adapt to accept freeform variations of similar or adjacent task requests. In this way, users can express intent, instructions, and inputs in plain conversational language and have tasks autonomously executed asynchronously without needing to be involved or frustrated through the process.

### **4.3. Figures**

None.

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## CLAIMS:

1. A method for autonomously processing a book-keeping and accounting request using an artificial intelligence (AI) worker that is communicatively coupled to an email service, the method comprising:
  - receiving, using the email service, the book-keeping and accounting request whereby the request is in an email format;
  - extracting, using the email service, contents of the request and metadata from the received request and providing the extracted contents of the request and the metadata to the AI worker;
  - identifying, using a large language model (LLM) and a prompt-chaining model provided within the AI worker, intents and key elements associated with each of the intents based on the contents of the request and the metadata, whereby the prompt-chaining model is configured to assist the LLM understand job-specific accounting vocabulary, task definitions and examples, wherein the key elements comprise instructions corresponding to the primary intent, references to items associated with the primary intent, temporal data associated with the primary intent or accounting domain terminology associated with the primary intent;
  - identifying, using the AI worker, a task agent to be used to process each of the identified intents and the key elements based on features of each of the identified intents, wherein each task agent is associated with an executable sequence of steps that are processed by a corresponding tool;
  - processing, using the AI worker, each of the identified intents and the key elements using the task agent identified for the intent by executing the executable sequence of steps associated with the identified task agent using tools associated with the task agent; and
  - collecting, using the AI worker, outcomes from all the task agents and generating a natural language processed email to be used as a response to the book-keeping and accounting request, using the LLM, based on the collected outcomes.
2. The method according to claim 1, wherein the tools corresponding to the executable sequence of steps comprises domain-specific accounting and bookkeeping functionalities, general system functionalities, financial data retrieval functionalities, payment processing functionalities and accessing of public data functionalities.
3. The method according to claim 1 wherein the step of identifying intents and key elements associated with each of the intents based on the contents of the request and the metadata, further comprises the step of providing, using a long-term memory component provided within the AI worker, historical context of prior user interactions, requests, and learned preferences to the LLM to assist the LLM understand the job-specific accounting vocabulary, task definitions and examples.

4. A system for autonomously processing a book-keeping and accounting request comprising:
  - an email service configured to:
    - receive the book-keeping and accounting request whereby the request is in an email format;
    - extract contents of the request and metadata from the received request; and
    - provide the extracted contents of the request and the metadata to an AI worker communicatively coupled to the email service;
  - the AI worker being configured to:
    - identify using a large language model (LLM) and a prompt-chaining model intents and key elements associated with each of the intents based on the contents of the request and the metadata, whereby the prompt-chaining model is configured to assist the LLM understand job-specific accounting vocabulary, task definitions and examples, wherein the key elements comprise instructions corresponding to the primary intent, references to items associated with the primary intent, temporal data associated with the primary intent or accounting domain terminology associated with the primary intent;
    - identify a task agent to be used to process each of the identified intents and the key elements based on features of each of the identified intents, wherein each task agent is associated with an executable sequence of steps that are processed by a corresponding tool;
    - process each of the identified intents and the key elements using the task agent identified for the intent by executing the executable sequence of steps associated with the identified task agent using tools associated with the task agent; and
    - collect outcomes from all the task agents and generate a natural language processed email, using the LLM, based on the collected outcomes.
5. The system according to claim 4, wherein the tools corresponding to the executable sequence of steps comprises domain-specific accounting and bookkeeping functionalities, general system functionalities, financial data retrieval functionalities, payment processing functionalities and accessing of public data functionalities.
6. The system according to claim 4 wherein the identification of intents and key elements associated with each of the intents based on the contents of the request and the metadata by the AI worker further comprises the AI worker being configured to:
  - provide using a long-term memory component provided within the AI worker, historical context of prior user interactions, requests, and learned preferences to the LLM to assist the LLM understand the job-specific accounting vocabulary, task definitions and examples.