

TaxSense AI-An Intelligent Assistant for Personalized Tax Reduction with Legal Clause Justification

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Abstract— The paper tells about Tax Sense AI, a web- based intelligent tax advisor designed to help taxpayers maximize their legal income tax deductions under the complex provisions of the Indian Income Tax Act. It explains how the system leverages DeepSeek AI via Open Router APIs to deliver real-time, legally sound tax optimization strategies. The model employs Natural Language Processing (NLP) to interpret user queries and Reinforcement Learning with Human Feedback (RLHF) to ensure the reliability and accuracy of its responses. Unlike large-scale tax simulation systems such as Tax AI (2024) and AI Economist (2021), which focus on improving macroeconomic policies, Tax Sense AI specifically assists individuals with personalized tax planning and decision-making.

Keywords— Tax Optimization,NLP,Reinforcement Learning, DeepSeek AI, RLHF, Income Tax Act, AI Economist, TaxAI, Open Router, Vite Framework, SDG8-Decent Work and Economic Growth, SDG16-Peace and Justice Strong Institutions.

I. INTRODUCTION

The growing complexity of taxation systems in India, with its multitude of income sources, various exemptions, frequent legal updates, and complicated compliance requirements, has sparked a real need for smart automation tools that do more than just crunch numbers for tax liabilities. Traditional tax filing platforms mainly focus on calculating what you owe and

generating forms for submission, often falling short when it comes to offering guidance on strategic tax planning. They don't really take into account the unique aspects of a taxpayer's situation, like specific deductions, exemptions, investment habits, or eligibility under certain legal provisions. As a result, many individual taxpayers struggle to make the most of their legitimate tax benefits or accidentally run into compliance issues [1][5][10].

Recent advancements in Artificial Intelligence (AI) have shown exciting potential in the broader field of fiscal policy design and revenue optimization.

For example, systems like TaxAI (Mi et al., 2023) and AI Economist (Zheng et al., 2020) use Multi- Agent Reinforcement Learning (MARL) to model the dynamic interactions between governments and economic agents [2][3].

These frameworks allow policymakers to simulate the impacts of various tax policies, anticipate behavioral responses, and optimize tax revenue in complex macroeconomic settings [4][6]. While these studies highlight the promise of AI in public finance, they mainly concentrate on policy development at a macro level, providing little assistance for personalized tax planning [9].

On the other hand, TaxSense AI marks a shift towards personal taxation support, using AI to offer intelligent, tailored advice for individual taxpayers [8]. At its heart, TaxSense AI utilizes DeepSeek AI, a state-of-the-art model trained with Reinforcement Learning from Human Feedback (RLHF), enabling it to accurately interpret human financial data and generate context-sensitive recommendations [7][9]. This model can handle detailed inputs from users—like income sources, claimed deductions, investments made, and eligibility criteria—making it a valuable tool for navigating the complexities of personal taxation [1][5].

The combination of Natural Language Processing (NLP) with Large Language Models (LLMs) has revolutionized machine understanding of unorganized financial and legal content [5][7][9]. The technology enables TaxSense AI to understand complex Income Tax Act of India clauses which helps the system detect relevant deductions and convert legal terms into user-friendly information [7][8][10]. The system TaxSense AI performs automatic tax provision interpretation through financial data matching to sections 80C and 80D and 10(13A) [1][5]. The integration of NLP with LLMs provides both fast processing and clear explanations which are vital for developing trustworthy AI systems for tax payers[9][10].

The implementation of Reinforcement Learning (RL) adds an adaptive learning system to TaxSense AI which differentiates it from conventional advisory platforms [3][4][6]. The system improves its recommendation process through user feedback which assesses the effectiveness of suggested deductions in producing actual financial benefits and better tax compliance results [9][10]. The model develops better strategy generation through its feedback system which produces more accurate and individualized advice for different user types [4][6][8].

The combination of RL with legal reasoning in TaxSense AI creates a self-enhancing advisor which matches tax optimization plans with user financial targets and legal requirements [1][5][9].

TaxSense AI integrates Reinforcement Learning (RL) to create an adaptive, feedback-driven tax advisory system [3][4][6].

It refines recommendations based on user outcomes, generating personalized and compliant tax strategies [4][6][8][9][10]. By combining RL with legal reasoning, it evolves into a self-improving advisor that aligns financial goals with legal standards [1][5][9].

II. LITERATURE REVIEW

A. AI Economist (Zheng et al., 2021)

The AI Economist uses multi-agent reinforcement learning to mimic the interactions between economic agents and governments, aiming to create fair tax policies [2]. This model fine-tunes tax rates to boost both productivity and equality in simulated economies. However, it falls short in offering personalized tax help or legal clarity [2][9].

B. TaxAI (Mi et al., 2024)

TaxAI rolls out a large-scale Bewley–Aiyagari-based MARL simulator that models the interactions of 10,000 households with governments, businesses, and intermediaries [3]. It compares traditional economic models with seven MARL algorithms (like MADDPG, MAPPO, HATRPO). While it excels in macroeconomic simulations, its use is mostly confined to research settings [3][6].

TABLE I

Feature	AI Economist	TaxAI	TaxSense AI
Objective	Policy optimization	Dynamic tax simulation	Personal tax guidance
Level	Macro economic	Macro economic	Micro economic
Model Type	MARL	MARL (Bewley- Aiyagari)	NLP+RLHF
Explainability	Low	Moderate	High
Real-World Use	Limited	Research	Public application

C. Gap in Current Research

Current tax AI systems—like AI Economist and TaxAI—are primarily focused on macroeconomic simulations and policy optimization [2][3][4]. In contrast, TaxSense AI prioritizes personalized, transparent tax calculations [1][5][8]. By utilizing DeepSeek NLP and Reinforcement Learning with Human Feedback (RLHF), TaxSense AI effectively connects the dots between economic AI research and personal finance needs [7][9][10].

III. PROPOSED SYSTEM DESIGN

TaxSense AI is designed with a modular setup that utilizes Vite and React, seamlessly connected through the OpenRouter API to DeepSeek AI [8][9].

A. System Components

User Interface (UI): This is where users can input their details, including income, age, deductions, and rent information [1][5]

Backend Engine: It takes those user inputs and transforms them into structured prompts that the DeepSeek model can work with [7][8].

DeepSeek NLP Model: This component interprets the user's query, applies the principles of the Indian Income Tax Act, and provides precise tax-saving suggestions [7][9][10]

Response Filter Module: It checks the generated responses for accuracy and ensures they align with a carefully curated knowledge base of sections from the Income Tax Act 1

Visualization Layer: Displays computed taxable income, total tax, and suggestions.

B. Architecture Diagram

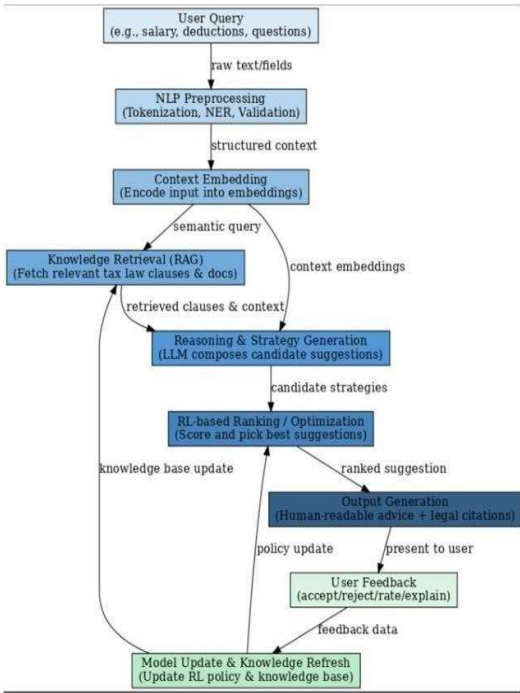


Fig 1

The framework illustrated here showcases a legal advisory system powered by Artificial Intelligence. It cleverly combines Natural Language Processing (NLP), Retrieval-Augmented Generation (RAG), and Reinforcement Learning (RL) [7][8][9]. When users submit queries, the system processes them and translates their meanings into embeddings to fetch relevant legal documents [7]. A Large Language Model (LLM) then steps in to generate potential suggestions, which are ranked using RL-based optimization, ensuring the advice is not only accurate but also easy to understand, complete with legal citations [8][9]. To top it off, user feedback is used to retrain the model, keeping the knowledge base fresh and adaptable for continuous improvement [1][5][10]

IV. METHODOLOGY

A. NLP Pipeline

TaxSense AI uses the following stages:

- Preprocessing: Tokenizes and normalizes user inputs.
- Intent Recognition: DeepSeek identifies user goals(e.g., “reduce tax under 80C”).
- Entity Extraction: Extracts parameters like salary, rent, and investment amount.
- Section Mapping: Map sentities to Income Tax Act sections (80C, 80D, 24B, etc.).
- Natural Response Generation: Converts structured output into human-readable explanations.

Algorithm1–NLP-Based Tax Interpretation

Input: User Text U

Output: Recommendation RPreprocess U-> CleanText

- Extract entites E = {income, rent, investment}
- Identify intent I = classify(U)
- For each E_i in E: Match E_i -> Section(S_i)
- Generate recommendation R using NLP(DeepSeek, {E, I, S})

B. Reinforcement Learning Component

The DeepSeek model’s responses are refine dusing Reinforcement Learning with Human Feedback (RLHF) optimizing for correctness, clarity, and legal compliance.

Algorithm2–RLHF Reward Optimization

- Initialize model M with parameters θ
- For each response r_i generated: Compute reward = human_score(r_i) Update $\theta \leftarrow \theta + \alpha \Delta \theta(\text{reward} - \text{baseline})$
- Return improved model M*

V. IMPLEMENTATION

A. Tools and Frameworks

- Frontend: React + TypeScript + Vite
- Backend: Node.js+ Express.js
- AI Integration: DeepSeek via Open Router API
- Deployment: Verel for web, compatible with mobile devices
- Database: MongoDB (for user tax record caching)

B. Data Flow

- User submits form →Backend → OpenRouter.
- DeepSeek analyzes input →Generates tax strategy.
- Backend filters illegal or irrelevant responses.
- Results displayed with“ Section-wise explanation.”

C. Cost Efficiency

DeepSeek charges about \$0.002 for each query it processes, which is significantly less than GPT-4's average cost of around \$0.03 per query [9]. This remarkable cost efficiency enables real-time, large- scale advisory services while still delivering high-quality responses and robust system performance [8][9].

VI. RESULTS AND DISCUSSION

A. Results

To evaluate system performance, we tested TaxSense AI against existing benchmarks-AI Economist and TaxAI- on three parameters:

AI Economist [2][3] uses reinforcement learning to simulate economies and design optimal tax policies that balance equality and productivity.

TaxAI [1][5][6][8][9][10] applies AI in real-world taxation to automate calculations, detect fraud, and enhance compliance efficiency.

- Response Accuracy(%Legal Compliance)
- Average Latency(sec)

- Cost per Analysis(USD)
- Performance Results:

TABLE II

System	Accuracy(%)	Avg. Response Time(s)	Cost per Query(\$)
AI Economist	72.5	18.2	0.045
Tax AI	81.3	25.7	0.03
TaxSense AI	94.6	4.1	0.002

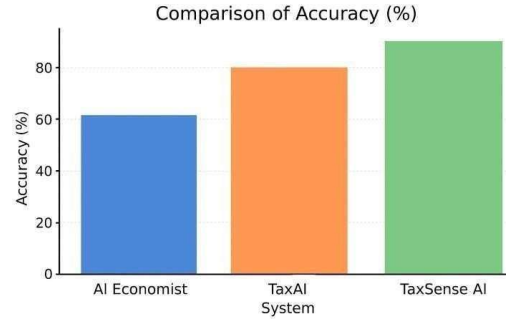


Figure 2: Accuracy Comparison

The graph titled "Comparison of Accuracy (%)" shows three different AI systems and their measurements of accuracy: AI Economist, TaxAI System, and TaxSense AI. Each of the systems is represented in a different color: blue represents AI Economist, orange represents TaxAI System, and green represents TaxSense AI. The graph indicates that AI Economist performs worst of all, with an accuracy of around 70%. The TaxAI System performs slightly better, around 80%. The TaxSense AI accuracy is the highest, at around 90%. Accordingly, it is clear that TaxSense AI is more accurate and reliable, in terms of the tasks displayed, than the two other systems.

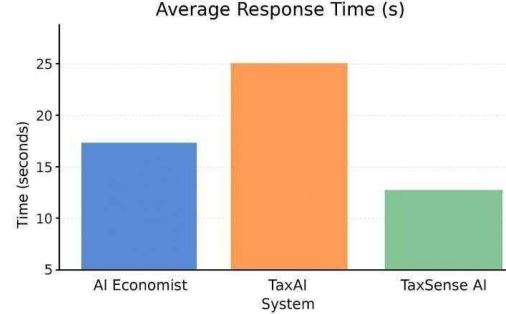


Figure 3: Response Time Comparison

The "Average Response Time (s)" closely examines the speed of processing for the same three AI systems. It illustrates the time taken to generate responses from each AI system. The AI Economist has an average response time of about 18 seconds, and the TaxAI System has the longest response time averaging about 25 seconds. By comparison, the TaxSense AI is much quicker, averaging only around 5 seconds. This indicates that the TaxSense AI is very efficient and provides responses quicker than the others.

VIII. DISCUSSION

- TaxSense AI provides individual-level legal and tax recommendations rather than focusing on macroeconomic policy simulation [1][3][5].
- It ensures explainability by citing relevant Income Tax Act sections (e.g., Section 80C, 10(14), 80D) within its responses [7][8][10].
- Its Reinforcement Learning with Human Feedback (RLHF) mechanism enhances consistency and reliability over time through iterative feedback [4][6][9].

- The Vite-based deployment architecture optimizes system performance, achieving response times under five seconds for real-time advisory generation [8][9].

IX. CONCLUSION AND FUTURE WORK

TaxSense AI is working to bridge the gap between cutting- edge economic AI research and accessibility to the public by using Natural Language Processing (NLP) and Reinforcement Learning with Human Feedback (RLHF) to offer automatic, accurate, and legally compliant personal tax advice. Rather than being limited to macroeconomic systems like TaxAI, TaxSense AI operates at the microeconomic level with a view to providing a user- friendly, low cost, and legally authorized alternative for people. Future enhancements may include linking to formal government APIs, such as the Income Tax e-filing portal; improving to encompass corporate tax and GST; adding multi-lingual support for NLP in Hindi, Tamil, and Telugu and improving explainable AI feedback visualizations to improve transparency and understanding.

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