

Aptos AI-LawGuard – AI-Powered Smart Contract Compliance & Dispute Resolution

(GitHubRepository: <https://github.com/vermaom2905/aptos-ai-lawguard>)

Problem Statement-

Blockchain adoption is hindered by the lack of legal compliance and fairness in smart contracts. Projects and businesses often face disputes and financial losses due to unfair terms, ambiguous clauses, and legal loopholes. No existing AI-driven solution analyzes, validates, and improves smart contracts specifically for the Aptos blockchain—until now.

Objective-

Develop an AI-powered platform to:

- Analyze smart contracts for legal risks using NLP.
- Assign risk scores and categories to flag potential issues.
- Deploy contracts on the Aptos blockchain for verification.
- Provide dispute resolution mechanisms and compliance tracking.

Project Development Journey-

- **Initial Setup:**
 - Created a directory structure: frontend/, scripts/, sources/, etc.
 - Installed dependencies: Node.js (for React), Python (for FastAPI/AI), Aptos CLI (for blockchain).
 - Configured Move.toml for Aptos testnet deployment.
- **Frontend Development:**
 - Built frontend/src/App.js with React for user interaction: manual input, file uploads, wallet connection, analysis, and submission.
 - Styled with App.css for a responsive, dark/light-mode UI.
- **Backend Development:**
 - Implemented scripts/backend_api.py with FastAPI for /upload and /analyze endpoints.
 - Developed ai_nlp.py using NLTK for risk analysis and risk_scoring.py for categorization.

- Added `compliance_tracker.py` as a placeholder for future compliance monitoring.
- **Blockchain Integration:**
 - Wrote `sources/smart_contract.move` to store contracts, `dao_dispute.move` for disputes, and `zkp_audit.move` for audits.
 - Faced deployment issues with `0x9964305c1de24c13ac65106e6b6c5dabd0543fce2cb01bb712c34f3740f9753` a due to backward incompatibility (ContractStorage struct mismatch).
 - Switched to a new address `0x82d32ba2dd39a66c8e860773959ccd93a4eb4dc013ba64c0079128fe886efee2` and deployed successfully (transaction: `0x2939279...`).
- **Petra Wallet Integration:**
 - Integrated Petra Wallet in `App.js` via `window.aptos` for signing and submitting transactions to Aptos.
- **Testing:**
 - Ran backend (`uvicorn backend_api:app`), frontend (`npm start`), and tested end-to-end: uploaded contracts, analyzed risks, submitted to testnet.

Technology Stack-

- **Blockchain:** Aptos (Move language, testnet deployment).
- **Frontend:** React.js (`App.js`, `App.css`).
- **Backend:** Python (`FastAPI`, `NLTK`, `backend_api.py`, `ai_nlp.py`, `risk_scoring.py`).
- **Wallet:** Petra Wallet for Aptos interaction.
- **Dependencies:**
 - **Node.js:** `npm install` for React dependencies (`react`, etc.).
 - **Python:** `pip install fastapi uvicorn pydantic pdfminer.six python-docx nltk`.
 - **Aptos CLI:** Version 6.1.1, installed manually.
 - **Petra Wallet:** Chrome extension for wallet connection.

Key Features & Implementation-

- **AI-Powered Legal Review:**
 - `ai_nlp.py`: Tokenizes contract text, scans for risky keywords (e.g., "penalty"), calculates risk score.
- **Automated Risk Scoring:**
 - `risk_scoring.py`: Maps scores (0-10) to categories (e.g., "Low Risk", "Critical Risk").
- **On-Chain Audit & Verification:**

- smart_contract.move: Stores contracts in ContractStorage at 0x82d32ba2....
- **Dispute Resolution:**
 - dao_dispute.move: Initiates disputes, groundwork for AI resolutions.
- **Compliance Tracking:**
 - compliance_tracker.py: Fetches mock compliance data (future expansion planned).

Deployment Details-

- **Address:**
0x82d32ba2dd39a66c8e860773959ccd93a4eb4dc013ba64c0079128fe886efee2.
- **Transaction:**
0x2939279fca7da754407d070410050ac9ac486e763c9209c5ab8818c6392a54fa.
- **Explorer:**
<https://explorer.aptoslabs.com/account/0x82d32ba2...?network=testnet>.
- **Gas Used:** 3057 units, 0.003057 APT.

Target Audience-

- **Blockchain Developers:** Validate contracts pre-deployment.
- **DAOs & Web3 Startups:** Ensure fair, secure agreements.
- **LegalTech Companies:** Integrate AI-driven compliance tools.

Monetization Strategy-

- **Validation Fees:** Charge for contract analysis.
- **Risk Reports:** Paid detailed safety reports.
- **Arbitration Services:** Fees for dispute resolution.
- **Partnerships:** Integrate with compliance platforms.

Competitive Edge-

- First AI-powered compliance tool for Aptos.
- Reduces disputes and fraud risks.
- Enhances trust in blockchain transactions.
- Bridges Web3 legal gaps.

Future Work-

- **Fetch Button:** Add a UI feature to retrieve contracts from Aptos, enhancing visibility.
- **GPT-4 Integration:** Upgrade AI with advanced LLMs for clause suggestions and deeper analysis.
- **Dispute Dashboard:** UI for stakeholders to vote on AI-suggested resolutions.
- **Compliance Alerts:** Real-time notifications for legal updates via `compliance_tracker.py`.
- **IPFS Storage:** Store contract files on IPFS, linking hashes on-chain.
- **Multi-Chain Support:** Extend to Ethereum, Sui, etc., for broader adoption.

Conclusion-

Aptos AI-LawGuard combines AI and blockchain to revolutionize smart contract compliance. From frontend to backend and Aptos integration, it's a pioneering solution ready for Web3 adoption, with exciting future potential.