| **Application Domain** | **Complex Problem Identified** | **Justification** |
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| **Healthcare** | **Predictive Analytics for Patient Outcomes** | Predicting patient outcomes involves integrating vast amounts of data (medical history, genetic information, lifestyle factors) and applying complex algorithms. This complexity arises from the need to accurately model and predict individual health outcomes based on heterogeneous data. Advanced machine learning models and multi-dimensional data analysis are required to handle the intricate patterns and relationships in the data. |
| **Finance** | **High-Frequency Trading Algorithms** | High-frequency trading (HFT) involves executing a large number of orders at extremely high speeds. The complexity arises from the need to process massive amounts of data in real-time, make split-second decisions, and manage the risk associated with rapid trades. HFT algorithms must balance accuracy, speed, and computational efficiency, making them inherently complex due to the interplay of multiple factors and the need for robust risk management. |
| **Manufacturing** | **Smart Manufacturing Systems and Industry 4.0** | Smart manufacturing systems leverage IoT, AI, and robotics to create highly automated and adaptive production environments. The complexity here involves integrating various technologies, managing real-time data streams from sensors, optimizing production processes, and ensuring interoperability between diverse systems. The challenge is in handling the vast amounts of data generated, adapting to changing conditions, and ensuring system reliability and efficiency. |