

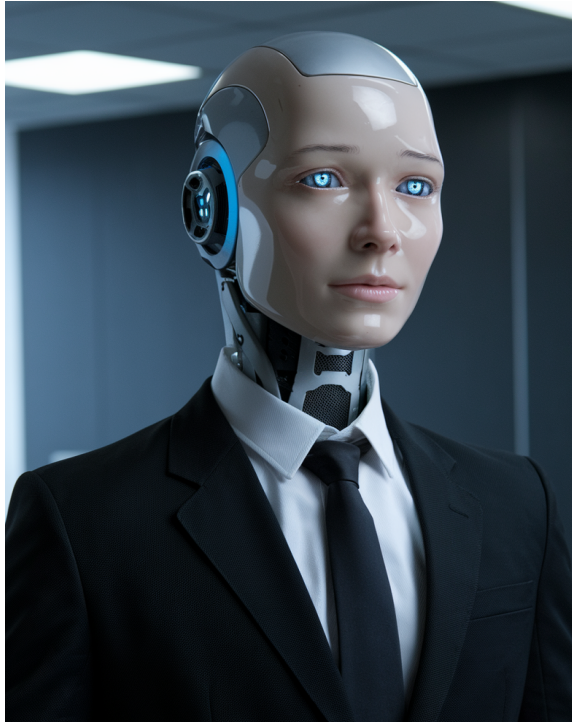
Chapter 6 - AI Agents: Transforming Economics and Beyond

Murat Yıldızoğlu
Bordeaux School of Economics
University of Bordeaux
UMR CNRS-INRAE 6060
<https://yildizoglu.fr>

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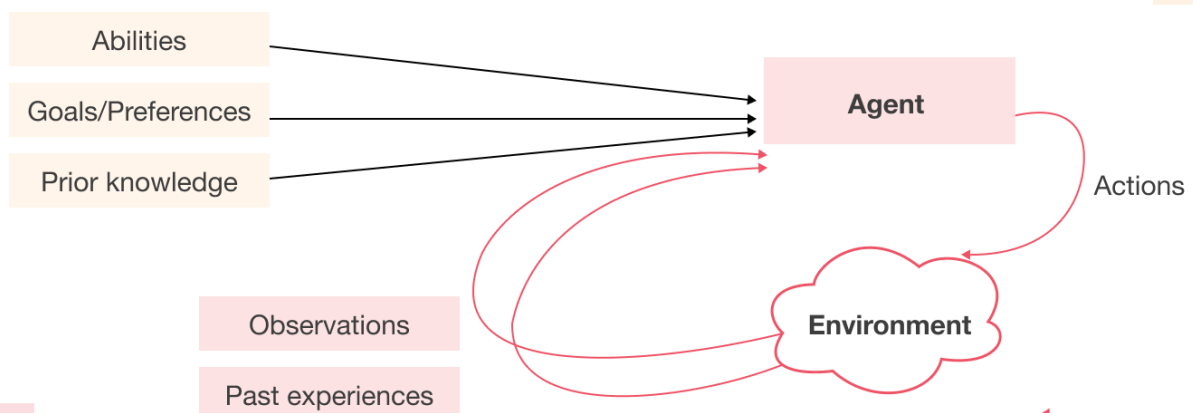
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- AI agents are rapidly transforming industries, including economics.
- Represent a shift towards autonomous, intelligent systems.

Agents in their environment

What is an AI agent?



Source: [SIMFORM Website](#)

What are AI Agents?

- Autonomous entities that:
 - **Perceive:** Sense their environment through sensors (data, APIs, etc.).
 - **Act:** Take actions to achieve specific goals.
- **Key Concept:** *Rationality* - Agents strive to maximize expected utility.
- **Examples:**
 - **AutoGPT:** Autonomous task completion using GPT-4 (e.g., "Research and write a blog post on the impact of AI on the gig economy").
 - **BabyAGI:** Continuously learns and executes tasks.
 - **AgentGPT:** Creates, configures, and deploys autonomous agents in your browser.
- **Note:** These agents leverage LLMs, but their autonomy and goal-directedness are the keys.

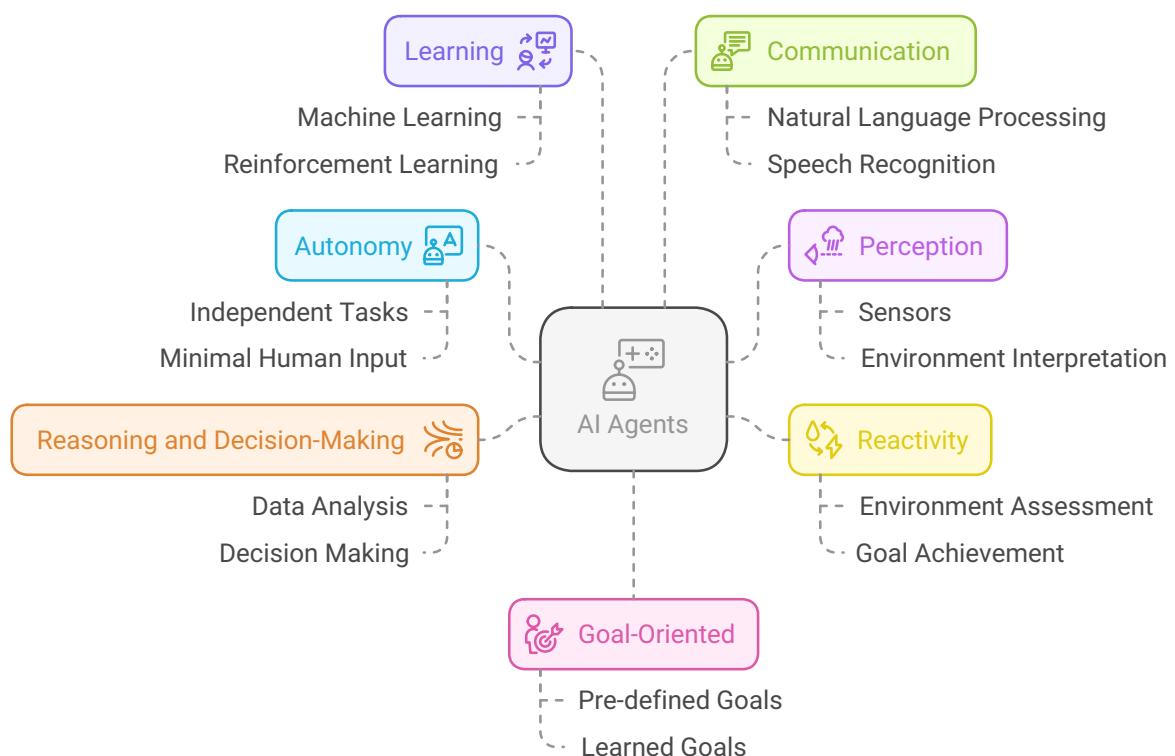
Many AI tools exist, but not all are agents

- **Key Characteristics of AI Agents:**
 - **Autonomy:** Operates without constant human intervention. (*Example: Can autonomously adjust bidding strategy in an online ad campaign*)
 - **Perception:** Senses the environment and interprets information. (*Example: Monitoring market prices, reading news articles for sentiment analysis*)
 - **Reactivity:** Responds to changes in the environment. (*Example: Automatically adjusting inventory levels based on demand fluctuations*)
 - **Reasoning and Decision-Making:** Analyzes data and makes choices. (*Example: Deciding whether to approve a loan application*)
 - **Learning:** Improves performance through experience. (*Example: Optimizing trading strategies based on past performance*)
 - **Communication:** Interacts with other agents or humans. (*Example: Negotiating prices with suppliers*)
- **Analogy:** Think of an agent as having a "mind" of its own, not just executing pre-programmed instructions.

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Components of AI Agents

Characteristics and Capabilities of AI Agents



The Structure of an AI Agent

- **Environment:** The context in which the agent operates (e.g., stock market, e-commerce website).
- **Sensors:** Gather information about the environment (e.g., market data feeds, user browsing history).
- **Actuators:** Take actions that affect the environment (e.g., placing trades, displaying personalized recommendations).
- **Decision-Making Mechanism:** The "brain" that processes information and chooses actions (e.g., machine learning model, rule-based system, SoftMax).
- **Learning System:** Allows the agent to improve its performance over time (e.g., reinforcement learning algorithm).
- **Note:** This is a simplified model; real-world agents can be much more complex.

The AI Agent Workflow

- **Cyclical Process:** Agents continuously repeat these steps:
 - **1. Perceiving the Environment:** Gathering data from sensors.
 - **2. Processing Input Data:** Cleaning, organizing, and transforming data.
 - **3. Decision-Making:** Using algorithms and models to select the best action.
 - **4. Planning and Executing Action:** Implementing the chosen action.
 - **5. Learning and Improvement:** Evaluating the outcome and updating the decision-making process.
- **Example:** A supply chain management agent:
 - **Perceives:** Inventory levels, demand forecasts, transportation costs.
 - **Processes:** Cleans data, identifies trends.
 - **Decision-Making:** Optimizes ordering quantities and delivery schedules.
 - **Action:** Places orders with suppliers, schedules deliveries.
 - **Learning:** Adjusts its forecasting models based on actual demand.

Example: AutoGPT in Action

- **Autonomous Task Completion:** AutoGPT aims to complete tasks without constant human guidance.
- **Simplified Workflow:**
 - **1. Name and Role:** Define the agent's purpose (e.g., "Economic Analyst," "Marketing Assistant").
 - **2. Data Training (Initialization):** Initial knowledge base (e.g., access to economic data APIs, marketing reports).
 - **3. Prompt Generation:** Creates its own prompts to achieve its goals.
 - **4. Independent Data Collection:** Searches the web, accesses databases.
 - **5. Evaluation and Filtering:** Verifies and refines information.
 - **6. Continuous Improvement:** Learns from results and adjusts strategies.
 - **7. Output Generation:** Delivers the final result (e.g., a report, a marketing plan).
- **Key takeaway:** Self-prompting allows complex task execution.

Example: BabyAGI

- **Mimicking Cognitive Development:** Focuses on learning and knowledge acquisition.
- **Core Components:**
 - **Task Management:** Maintains a list of tasks to be completed.
 - **Execution Agent (OpenAI API):** Executes tasks using LLMs.
 - **Memory (Pinecone):** Stores task results and context.
- **Simplified Workflow:**
 - **1. High-Level Objective:** Defined by the user (e.g., "Increase website traffic").
 - **2. Task Retrieval:** Selects the next task from the list.
 - **3. Task Execution:** Uses OpenAI API to complete the task.
 - **4. Result Storage:** Stores the results in Pinecone.
 - **5. Task Generation/Prioritization:** Creates new tasks based on the objective and results of previous tasks.
- **Relevance to Economics:** Potential for automating research, data analysis, and report generation.

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AI Agents in Economics: Applications

- AI agents are being applied across various economic domains.
- Offer the potential to improve efficiency, accuracy, and decision-making.
- Two main categories: Microeconomic and Macroeconomic applications.

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Automated Trading:

- High-frequency trading (HFT) algorithms react to market signals.
- *Example:* Agents executing arbitrage opportunities across different exchanges.
- **Agent Advantage:**
 - **Autonomy:** Continuously monitors markets and executes trades without human intervention, 24/7.
 - **Perception:** Processes real-time market data (prices, volumes, news) to identify opportunities.
 - **Learning:** Adapts trading strategies based on past performance and market conditions.
- **Economic Impact:** Increased market efficiency, liquidity, but also potential for flash crashes.

- **Alpaca Trading API:** Provides an API for building and deploying algorithmic trading strategies, which can be used to create AI-powered trading agents. Supports both commission-free stock and crypto trading.
- **QuantConnect:** A cloud-based platform for algorithmic trading with backtesting capabilities. Supports multiple programming languages (Python, C#) and data sources. Enables the development and deployment of autonomous trading agents.
- **Example of approach:** Using reinforcement learning agents to optimize trading strategies in volatile markets.

Personalized Pricing:

- Dynamic pricing based on consumer data.
- *Example:* E-commerce sites adjusting prices based on browsing history and purchase patterns.
- **Agent Advantage:**
 - **Autonomy:** Dynamically adjusts prices in response to changing demand and competitor prices.
 - **Perception:** Collects and analyzes consumer data to determine willingness to pay.
 - **Reasoning:** Uses pricing algorithms to maximize revenue based on individual consumer profiles.
- **Economic Impact:** Potential for price discrimination, impacting consumer surplus. Ethical concerns.

- **PROS:** Offers AI-powered pricing and revenue management solutions for various industries.
- **Pricefx:** Cloud-native pricing software that uses AI to optimize pricing strategies.
- **Example:** An e-commerce website (ex. airlines) using an AI agent to personalize prices based on a customer's browsing history, purchase patterns, and loyalty status.

Recommendation Systems:

- Suggesting products or services based on preferences.
- *Example:* Amazon's product recommendations, Netflix's movie suggestions.
- **Agent Advantage:**
 - **Perception:** Learns user preferences from browsing history, purchase patterns, and ratings.
 - **Reasoning:** Matches user profiles to relevant products or services.
 - **Learning:** Improves recommendations over time based on user feedback and engagement.
- **Economic Impact:** Influence on consumer choice, market concentration, increased sales.

- Amazon Personalize: A fully managed service for building and deploying personalized recommendation systems.
- Google Recommendations AI: A similar service offered by Google Cloud.

Smart Contracts:

- Automated agreements that execute based on predefined conditions.
- *Example:* Supply chain contracts that automatically trigger payments upon delivery.
- **Agent Advantage:**
 - **Autonomy:** Automatically executes contract terms when conditions are met, without human intervention.
 - **Transparency:** Provides a transparent and auditable record of contract execution.
 - **Reliability:** Reduces risk of fraud and errors.
- **Economic Impact:** Reduced transaction costs, increased transparency, improved trust.

- **Chainlink:** A decentralized Oracle network that provides smart contracts with access to real-world data. This enables the creation of AI-powered smart contracts that can react to external events.
- **IBM Blockchain Platform:** Offers tools and services for building and deploying blockchain-based supply chain solutions.
- **Example:** A supply chain using smart contracts to automatically trigger payments upon delivery of goods, with AI agents monitoring shipment status and verifying data from IoT devices.

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Economic Forecasting:

- Analyzing vast amounts of data to predict economic trends.
- *Example:* Predicting GDP growth, inflation, unemployment rates.
- **Agent Advantage:**
 - **Perception:** Ingests and processes massive datasets from various sources (government statistics, news articles, social media).
 - **Learning:** Continuously updates forecasting models based on new data and economic events.
 - **Automation:** Generates forecasts automatically, saving time and resources compared to traditional methods.
- **Economic Impact:** Improved policy-making, but potential for biases in data.

Policy Simulation:

- Agent-based models (ABMs) simulate the behavior of interacting agents.
- *Example:* Modeling the impact of a tax policy on consumer spending.
- **Agent Advantage:**
 - **Granularity:** Models individual agent behavior (consumers, firms, government agencies) to capture complex interactions.
 - **Flexibility:** Allows for "what-if" scenarios and policy experimentation.
 - **Adaptability:** Agents can adapt their behavior in response to policy changes.
- **Economic Impact:** Testing policies in a virtual environment before implementation.

- Automating tasks previously performed by human workers.
- *Example:* AI-powered customer service chatbots.
- **Agent Advantage:**
 - **Cost Savings:** Automated systems help reduce staffing costs.
 - **Consistency:** Delivers a consistent level of service.
 - **Scalability:** Allows the business to scale capacity on demand.
- **Economic Impact:** Changes in skills demand, potential for unemployment, increased productivity.

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Advantages of AI Agents

- **Increased Efficiency:**
 - Automate repetitive tasks, freeing up human workers for more creative and strategic work.
 - *Example:* Automating data entry, processing invoices, and generating reports.
- **Better Decision-Making:**
 - Analyze large datasets to identify patterns and trends that humans may miss.
 - *Example:* Identifying fraudulent transactions, predicting market movements, optimizing pricing strategies.
- **Improved Customer Experience:**
 - Provide personalized and timely interactions with customers.
 - *Example:* Offering instant support, answering queries, and providing recommendations.
- **Cost Savings:**
 - Reduce the need for human resources and manual labor.
 - *Example:* Automating customer service, managing inventory, and optimizing logistics.

Challenges and Risks

- **Data Bias:**
 - AI agents can perpetuate and amplify existing biases in data.
 - *Example:* Amazon's recruiting tool, Amazon Scout, trained with skewed historical data, biased against women.
- **Lack of Accountability:**
 - Difficulty assigning responsibility for AI agent actions.
 - *Example:* Uber's autonomous vehicle accident kill (March 18, 2018, Tempe, Arizona).
- **Lack of Transparency:**
 - Opaque decision-making processes.
 - *The 'black box' problem*

- **Ethical Considerations:**
 - Potential for AI agents to make unethical decisions.
 - *Example:* Microsoft's Tay chatbot making racist and sexist comments.
- **Security Risks:**
 - Vulnerability to cyber attacks.
- **Lack of Adaptability:**
 - Struggling to adapt to new situations or contexts that differ significantly from their training data (like Trading Algorithms During Market Shocks).

Ethical and Regulatory Considerations

- **Bias Mitigation:**
 - Careful data selection and preprocessing.
 - Algorithmic fairness techniques.
- **Explainable AI (XAI):**
 - Developing methods to understand and interpret AI agent decisions.
 - *Example:* Using *SHAP values* to understand feature importance.
- **Data Privacy:**
 - Implementing strong data protection measures.
 - Complying with regulations like GDPR.
- **Algorithmic Accountability:**
 - Establishing mechanisms for monitoring and auditing AI agent behavior.
- **Regulation:**
 - Need for new regulations to address the unique challenges posed by AI agents.
 - *EU AI Act* for example.

- The AI Act classifies AI according to its risk
- Mainly regulating high-risk AI systems
- Specifies obligation for developers of high-risk AI systems
- Users (deployers) of high-risk AI systems have also some obligations
- For General purpose AI (GPAI) systems:
 - All GPAI model providers must provide technical documentation and comply with the Copyright Directive
 - Free and open licence GPAI model providers only need to comply with copyright and publish the training data summary, unless they present a systemic risk.
 - All providers of GPAI models that present a systemic risk – open or closed – must also conduct model evaluations, adversarial testing, track and report serious incidents and ensure cybersecurity protections.
- Many non-ethical AI systems are prohibited

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- **Customization:**
 - Tailoring AI agents highly customized to specific business needs and trained on specific data generated by companies.
- **Enhanced Decision-Making:**
 - Using more sophisticated algorithms and models to make better decisions in complex and uncertain environments thanks to advancements in areas such as deep learning, reinforcement learning, and Bayesian optimization.
- **Ethical Considerations:**
 - Addressing privacy, bias, and accountability. This trend would help to ensure that AI agents are used in a responsible and ethical manner, promoting trust and acceptance.

Future trends: Collaboration and agent networks

- **Agent-to-Agent Collaboration:** The future is not individual agents, but network of agents working together. Some platforms already start to implement this possibility.
 - Common communication and collaboration protocols and their efficiency will be a crucial dimension.
 - The risk of unexpected emergent behavior and behavior patterns.
- **Human-AI Collaboration:**
 - Developing agents that are capable of working together with human workers, understanding human intentions, communicating effectively, and coordinating their actions with humans.
 - *This could augment human decision making*

- **Low-Code/No-Code Platforms:** Democratizing AI agent development.
 - **AgentGPT:** Creates, configures, and deploys autonomous agents in your browser.
 - **MindStudio**
 - **Mindpal** (no free plans)
 - **Microsoft Power Virtual Agents** (with MS Copilot)
 - **Dialogflow (Google)** (In development but accessible already)
 - **Rasa:** (Open-source framework, free developer access)
- **Note:** These platforms often provide pre-built components and templates, making it easier to create and deploy AI agents.

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- AI agents are transforming economics and other industries.
- Offer the potential to improve efficiency, accuracy, and decision-making.
- However, it is important to address the ethical and regulatory challenges associated with AI agents.
- It seems that we will have to live and work with AI agents;
- So we need to ensure that we make agents with whom we will like to live and work..
- Example: [Creating agents in Mindstudio](#)