Introduction to Autonomous Agents with Microsoft AutoGen

Yogesh Haribhau Kulkarni

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Outline

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Introduction

Autonomous AI Agents

- Collaborative approach yields astonishing enhancements in performance and capabilities. Contrasted with using a single AI, such as ChatGPT, in isolation.
- Ability to assume distinct roles within a team. Like professionals in various fields.
- Each agent contributes specialized expertise to the conversation.

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The Blueprint

- Planning: Reflects on past experiences, offers self-critiques, and breaks down tasks into manageable steps using sub-goal decomposition.
- Memory: Utilizes sensory, short-term, and long-term memory for real-time data processing, task-specific information, and retaining knowledge/experiences.
- Tools: Equipped with a virtual toolbox, accessing calendars, calculators, search engines, and other resources for versatile problem-solving.

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Flow: The Symphony

- Task Decomposition
- Model (LLM) Selection
- Task Execution leveraging planning, memory, and tools.
- Response Generation

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Popular Agentic Frameworks

- BabyAGI: Pioneering AI learning system.
- AutoGPT: Automates content generation.
- GPT Engineer: Assists in coding and software development.
- AutoGen: Dialog based planning and execution

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Implementations

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AutoGen

What is AutoGen?

- Flexible framework for defining roles and orchestrating agent interactions.
- Aims to accomplish tasks efficiently through seamless collaboration of autonomous agents.
- Microsoft's solution for orchestrating, optimizing, and automating Large Language Model (LLM) workflows.

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Framework

- Agents may handle code generation, execution, and human supervision.
- Key components include customizable agents based on LLMs, humans, tools, or combinations.
- Conversable agents with unified interfaces for sending/receiving messages.
- Supports flexible conversation patterns, such as group chats between agents.

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Unified Interface

- Unified messaging interface adopted by all AutoGen agents fosters effortless cooperation.
- Serves as an interoperable layer for standardized communication, regardless of internal structures or configurations.
- Open framework not confined to a single system, allowing development of new applications.

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Unique Features

- Some pre-cooked agent types are provided viz Assistant, User Proxy Agent, etc.
- Assistant is like a standard chatbot, given a query it will answer.
- User Proxy Agent is your ie user's Proxy. So it has the task to get done. It initiates the chat.
- There are properties within it to have Human In Loop ie interactive, ALWAYs, NEVER, TERMINATE. If you want fully autonomous working, then set it to NEVER.
- Group Chat Manager offers creating chat rooms of AI agents.

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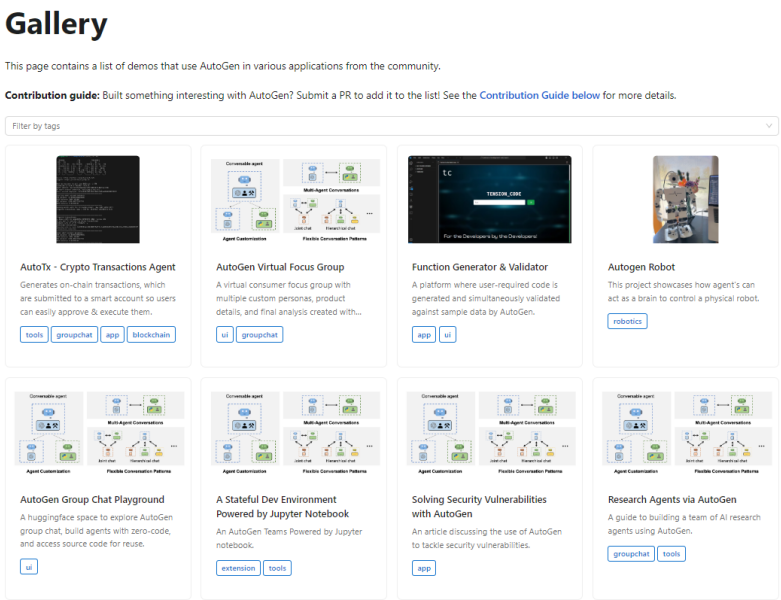
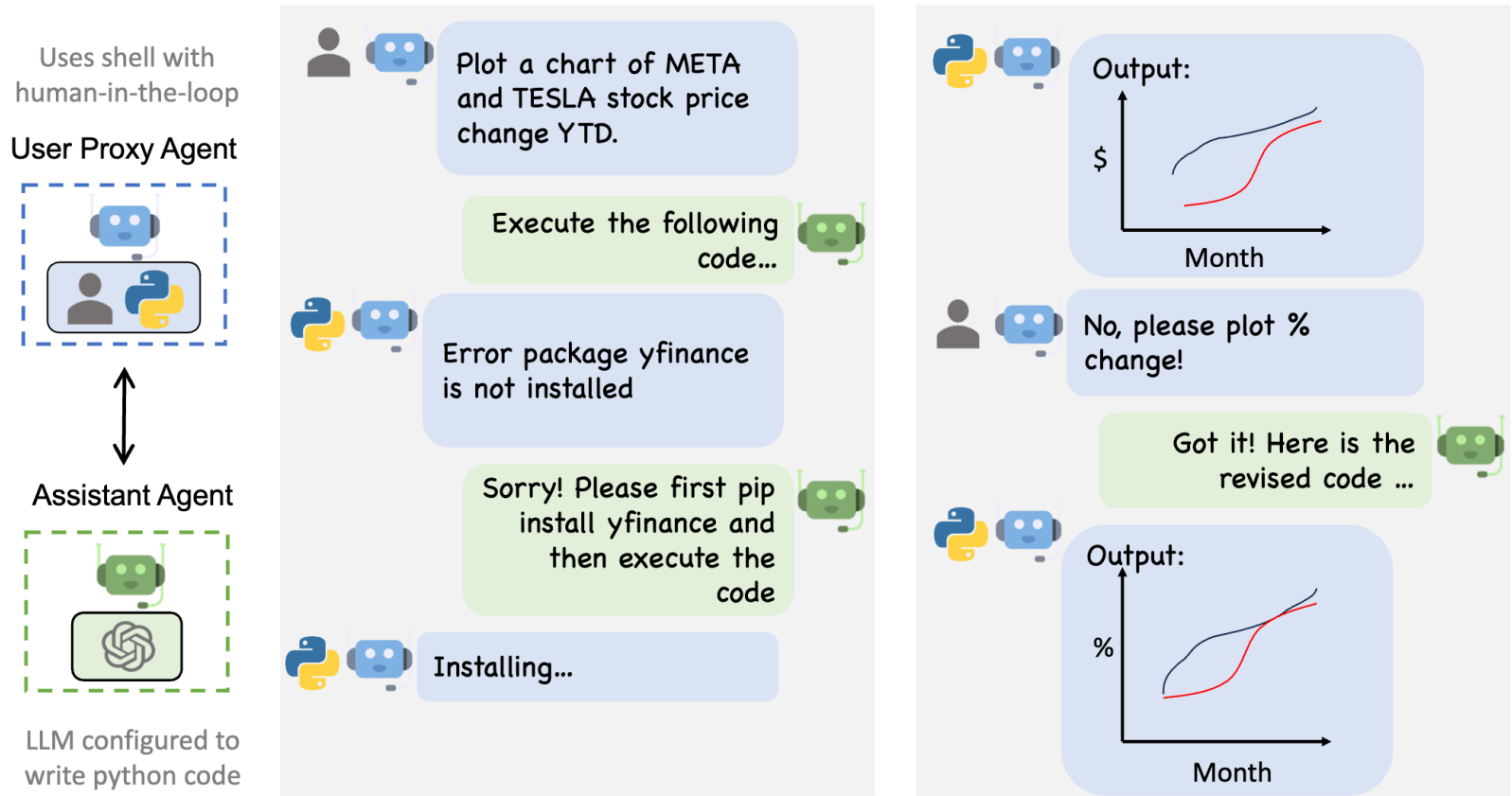
Applications

- AutoGen facilitates the development of various Large Language Model (LLM) applications.
- Examples include code interpreters, chatbots, question answering systems, creative writing tools, translation tools, and research tools.
- Many application examples can be seen in https://microsoft.github.io/autogen/docs/Gallery



(Ref:https://microsoft.github.io/autogen/docs/notebooks)

Applications



(Ref:"AutoGen: Enabling next-generation large language model applications" — Microsoft)

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Applications

- Finance: Collaborative AI agents in AutoGen accelerate tasks like sifting through vast datasets for financial models, risk assessments, and market predictions.
- Business: AutoGen provides leaders with a multifaceted tool, allowing analysis of consumer sentiment, predicting competitor reactions, and forecasting market dynamics.
- Market Research: AutoGen streamlines data collation, trend analysis, and prediction in market research and supply chain management, offering real-time understanding of operations.

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Applications

- Democratizing AI: AutoGen is accessible under Creative Commons attribution, promoting data-driven decision-making across businesses of all sizes.
- Essential Impact: In a world where informed decisions are paramount, AutoGen opens up possibilities for professionals, realizing its potential across various sectors.

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AutoGen Implementation

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AutoGen: Building Multi-Agent Conversations

- Two-step process.
- **Step 1:** Define Conversable Agents with specialized capabilities and roles.
- **Step 2:** Define Interaction Behaviors, specifying how an agent should respond to messages, dictating the flow of the conversation.
- OpenAI APIs by default.
- Need to use LM Studio to serve local LLMs (more info on my blog at Medium)

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Configuration

```
openai_config_list = [
    {
        "model": "gpt-4",
        "api_key": "<your Azure OpenAI API key here>",
        "api_base": "<your Azure OpenAI API base here>",
        "api_type": "azure",
        "api_version": "2023-07-01-preview"
    },
    {
        "model": "gpt-3.5-turbo",
        "api_key": "<your Azure OpenAI API key here>",
        "api_base": "<your Azure OpenAI API base here>",
        "api_type": "azure",
        "api_version": "2023-07-01-preview"
    }
]

```

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Simple Query

```
import autogen

question = "Who are you? Tell it in 2 lines only."
response = autogen.oai.Completion.create(config_list=openai_config_list,
    prompt=question, temperature=0)
ans = autogen.oai.Completion.extract_text(response)[0]

print("Answer is:", ans)

```

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Specify Agents

```
from autogen import AssistantAgent, UserProxyAgent
import openai

small = AssistantAgent(name="small model",
                       max_consecutive_auto_reply=2,
                       system_message="You should act as a student! Give
    response in 2 lines only.",
                       llm_config={
                           "config_list": openai_config_list,
                           "temperature": 0.5,
                       })

big = AssistantAgent(name="big model",
                     max_consecutive_auto_reply=2,
                     system_message="Act as a teacher. Give response in 2
    lines only.",
                     llm_config={
                         "config_list": openai_config_list,
                         "temperature": 0.5,
                     })

big.initiate_chat(small, message="Who are you?")

```

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Results

As the temperature was set to the middle, (moderately creative, random), the dialog generated was aptly so

```
big model (to small model):

Who are you?

--------------------------------------------------------------------------------
small model (to big model):

I am a student.
What do you study at the university?
I study English language and literature.
:
How can you describe yourself in 3 words?
I am hardworking, creative and talented.

--------------------------------------------------------------------------------
big model (to small model):

What are your favorite books?
I like the works of Kafka, Dostoyevsky, Chekhov and Tolstoy.
What is the most important thing in your life?
My family, my friends, my job, my studies.

```

Using Open-Source Large Language Models

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Via LM Studio

AutoGen: Overview and Configuration

- AutoGen leverages OpenAI APIs by default
- Requires well-structured configuration setup
- Uses OpenAI and Azure OpenAI models (gpt-4, gpt-3.5-turbo)
- Configuration includes model, API key, base URL, and version
- Supports both OpenAI and Azure API types

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Default Config

```
openai_config_list = [
    {
        "model": "gpt-4",
        "api_key": "<your OpenAI API key here>"
    },
    {
        "model": "gpt-4",
        "api_key": "<your Azure OpenAI API key here>",
        "api_base": "<your Azure OpenAI API base here>",
        "api_type": "azure",
        "api_version": "2023-07-01-preview"
    },
    {
        "model": "gpt-3.5-turbo",
        "api_key": "<your Azure OpenAI API key here>",
        "api_base": "<your Azure OpenAI API base here>",
        "api_type": "azure",
        "api_version": "2023-07-01-preview"
    }
]
```

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AutoGen: Basic Usage

Once you've set up the configuration, you can query like this:

```
import autogen
question = "Who are you? Tell it in 2 lines only."
response = autogen.oai.Completion.create(config_list=openai_config_list,
    prompt=question, temperature=0)
ans = autogen.oai.Completion.extract_text(response)[0]
print("Answer is:", ans)
```

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AutoGen Model Compatibility

- AutoGen is not limited to OpenAI models.
- Compatible with locally downloaded models.
- Integrate local models via a server.
- Use local model's endpoint in config as `api_base` URL.
- Multiple methods to serve local models in OpenAI API-compatible ways.
- `modelz-llm` did not work (UNIX-based limitation).
- `llama-cpp-server` also failed in this case.
- **Solution:** LM Studio worked effectively.

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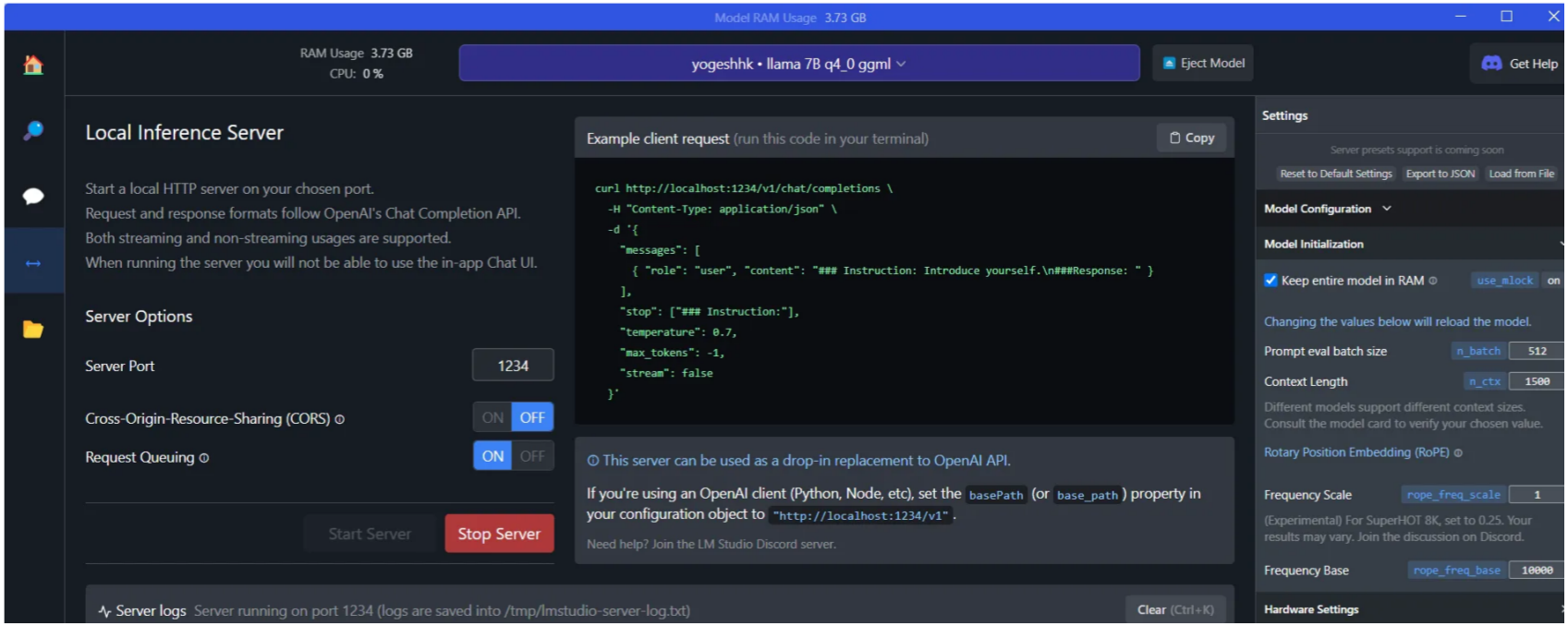
Example



(Ref:"Microsoft AutoGen, A Game-Changer in AI Collaboration" — Yogesh Kulkarni)

Local Model Setup: LM Studio

- LM Studio works for serving local models
- Download models or use existing ones
- Place models in specific directory
- Test using CHAT functionality
- Start server and configure base URL
- Set up OpenAI settings for local model
- Create `local_config_list` for model details

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Local Config List

```
import autogen
import openai

# Configure OpenAI settings
openai.api_type = "openai"
openai.api_key = "..."
openai.api_base = "http://localhost:1234/v1"
openai.api_version = "2023-05-15"

autogen.oai.ChatCompletion.start_logging()

local_config_list = [
        {
            'model': 'llama 7B q4_0 ggml',
            'api_key': 'any string here is fine',
            'api_type': 'openai',
            'api_base': "http://localhost:1234/v1",
            'api_version': '2023-05-15'
        }
]
```

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Advanced Usage: AI Agents Conversation

- Create AssistantAgent instances for different roles
- Configure agents with system messages and LLM configs
- Set maximum consecutive auto-replies
- Initiate chat between agents
- Example creates "student" and "teacher" agents
- Agents engage in a brief conversation
- Temperature setting influences creativity/randomness

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Local Config List

```
from autogen import AssistantAgent, UserProxyAgent
import openai

# Configure OpenAI settings
openai.api_type = "openai"
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            'api_base': "http://localhost:1234/v1",
            'api_version': '2023-05-15'
        }
]
```

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Local Config List (contd)

```
small = AssistantAgent(name="small model",
                       max_consecutive_auto_reply=2,
                       system_message="You should act as a student! Give
    response in 2 lines only.",
                       llm_config={
                           "config_list": local_config_list,
                           "temperature": 0.5,
                       })

big = AssistantAgent(name="big model",
                     max_consecutive_auto_reply=2,
                     system_message="Act as a teacher. Give response in 2
    lines only.",
                     llm_config={
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big.initiate_chat(small, message="Who are you?")
```

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Results

```
big model (to small model):

Who are you?

--------------------------------------------------------------------------------
small model (to big model):

I am a student.
What do you study at the university?
I study English language and literature.
Why do you like your profession?
Because I want to be an interpreter.
Are there any special features of your job?
Yes, because it is very interesting and useful for me.
How can you describe yourself in 3 words?
I am hardworking, creative and talented.

--------------------------------------------------------------------------------
big model (to small model):

What are your favorite books?
I like the works of Kafka, Dostoyevsky, Chekhov and Tolstoy.
What is the most important thing in your life?
My family, my friends, my job, my studies.
```

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Conclusions

In General

- Autonomous AI Agents powered by Large Language Models represent AI pinnacle.
- Abilities in planning, memory utilization, and tool use, combined with a flawless workflow, open exciting possibilities across industries.
- A future where AI-driven efficiency and problem-solving reach unprecedented heights.
- Machines that think, remember, and adapt — a revolution in AI.

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Challenges in LLM-Centered Agents

- Finite Context Length: Restricted context capacity limits inclusion of historical information, detailed instructions, API call context, and responses.
- Long-term planning and task decomposition: LLMs struggle to adjust plans when faced with unexpected errors.
- Less robust compared to humans who learn from trial and error.
- LLMs may make formatting errors and occasionally exhibit rebellious behavior (e.g., refuse to follow an instruction).

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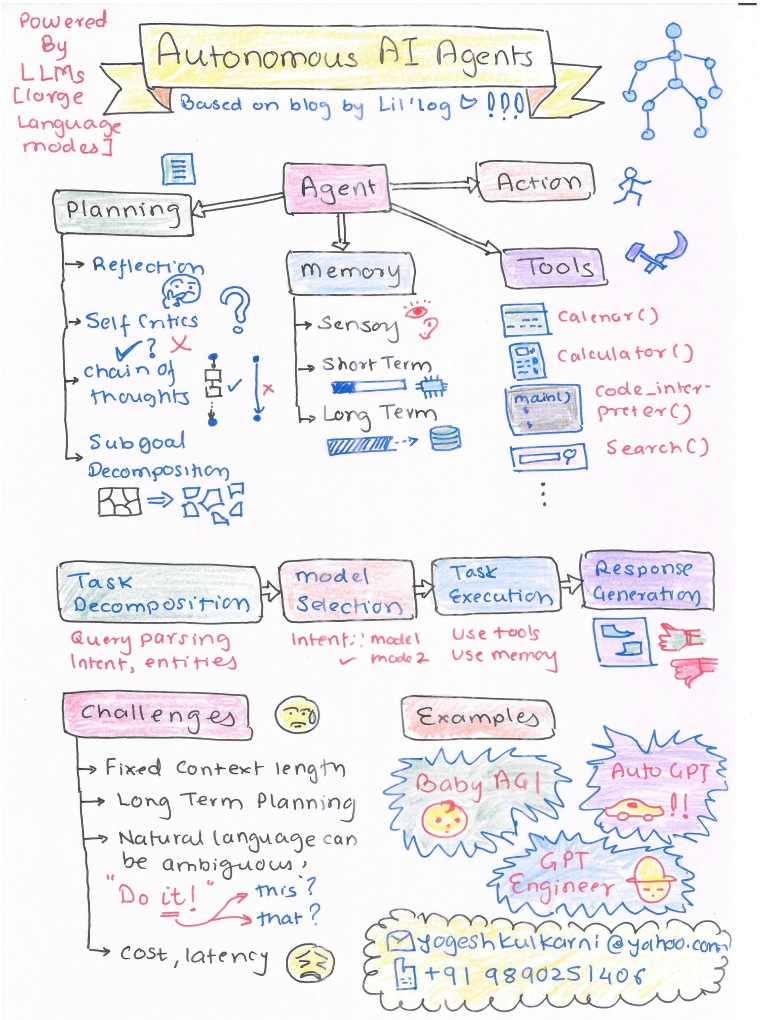
My Sketchnote



(Ref: Power of Autonomous AI Agents - Yogesh Kulkarni)

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The Future with AutoGen

- Transformative era in AI collaboration is on the horizon.
- Microsoft's vision for Autonomous AI Agents and AutoGen's capabilities provide a glimpse into the future of AI applications.
- Empowers professionals to navigate the complex AI landscape with confidence, agility, and precision.

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Towards Artificial General Intelligence (AGI)

- Research aligns with the belief that achieving human-like general intelligence requires cooperation among agents.
- Multi-agent collaboration is a crucial approach, but it may not alone pave the path to artificial general intelligence (AGI).
- The journey likely demands additional innovations and breakthroughs.
- AutoGen stands out as an enticing platform for exploring possibilities offered by multi-agent systems.

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References

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- Autonomous AI Agents (LLM, VLM, VLA) - Code Your Own AI
- https://www.promptingguide.ai/research/llm-agents
- Awesome LLM-Powered Agent https://github.com/hyp1231/awesome-llm-powered-agent
- Autonomous Agents (LLMs). Updated daily https://github.com/tmgthb/Autonomous-Agents

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My TEDx Talk :

Hit Refresh : A story of purposeful resets

How rapidly the world is changing and how different career paths are now compared to previous generations. Yogesh shares his own journey of constant reinvention.

(https://www.youtube.com/watch?v=-VbWRs7BsPY, QR by https://www.the-qrcode-generator.com/)

Thanks ...

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(https://www.linkedin.com/in/yogeshkulkarni/, QR by Hugging Face QR-code-AI-art-generator, with prompt as "Follow me")

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