Getting Started with AutoGen

By Lucas Soares

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Thought + Action

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- How do we do stuff?

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- How do we do stuff? We **think** and we **act**

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- **Thought**: "Live-trainings by instructor Lucas are awesome"
- **Action**: "Schedule live-training about agents with instructor Lucas Soares"

Thinking:

What to do + planning (order, priority..)

Acting:

used **tools: search, browser, etc...**

What is an Agent?

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LLM

What is an Agent?

LLM + Tools

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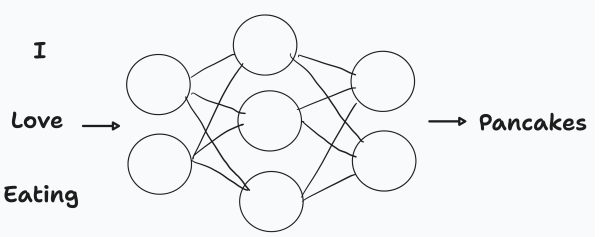
LLM= predicts next word/sentence



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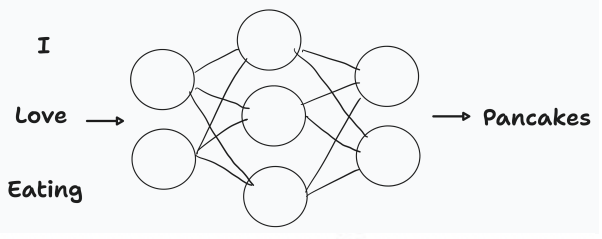


Tool= perform actions in the real-world

Agents Are Getting Popular

Agents Are Getting Popular

- [A Survey on Large Language Model based Autonomous Agents]

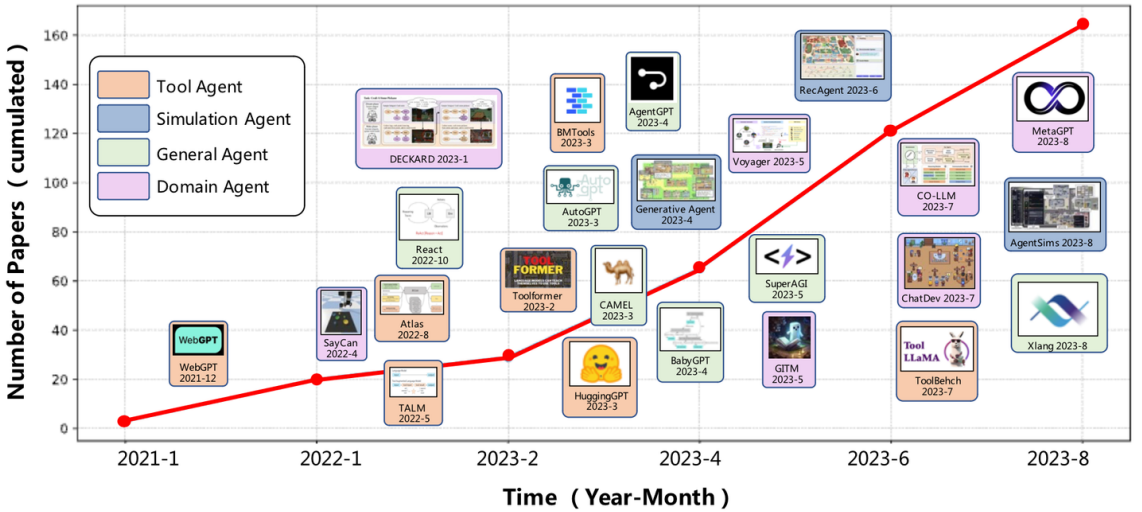


Figure 1: Illustration of the growth trend on the field of LLM-based autonomous agents.

'Toolformer'

'Toolformer'

- LLMs can teach themselves how to properly call external tools.

The New England Journal of Medicine is a registered trademark of [QA("Who is the publisher of The New England Journal of Medicine?") → Massachusetts Medical Society] the MMS.

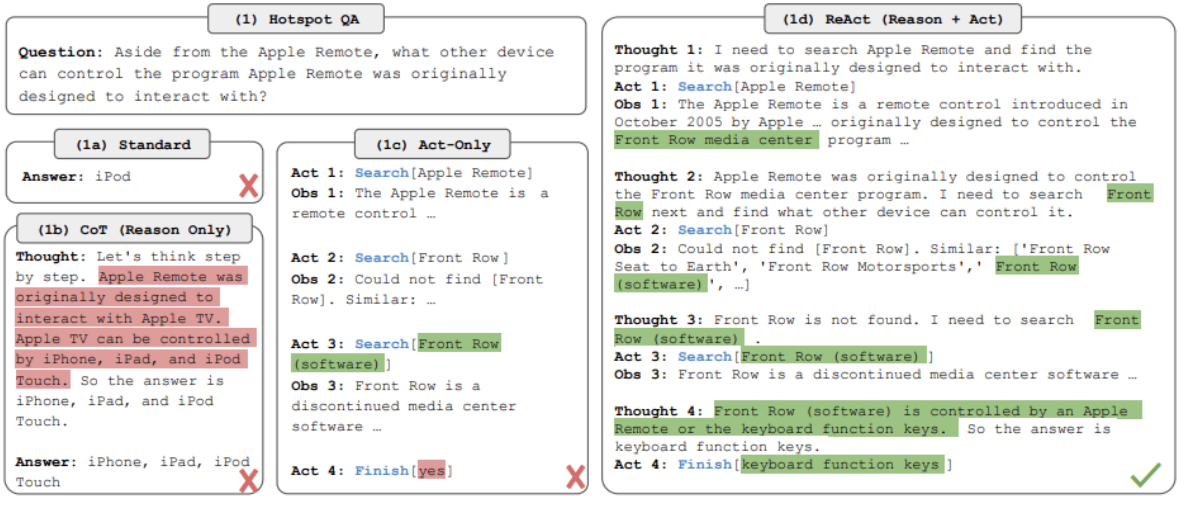
Out of 1400 participants, 400 (or [Calculator(400 / 1400) → 0.29] 29%) passed the test.

The name derives from "la tortuga", the Spanish word for [MT("tortuga") → turtle] turtle.

The Brown Act is California's law [WikiSearch("Brown Act") → The Ralph M. Brown Act is an act of the California State Legislature that guarantees the public's right to attend and participate in meetings of local legislative bodies.] that requires legislative bodies, like city councils, to hold their meetings open to the public.

ReACT

- LLMs for **RE**asoning & **ACT**ion.



Popular Agent Implementations

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- AutoGPT: created for long-running, open-ended goals
- GPT-Researcher: produce detailed, factual and unbiased research reports
- OpenGPTs: Open Source Customizable Agents

Agents in 3 Levels of Complexity

Level 1: LLM + functions inside the prompt

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- Inspired by 'Toolformer'

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Level 1: LLM + functions inside the prompt

```
from openai import OpenAI
client = OpenAI()

def get_response(prompt_question, model="gpt-3.5-turbo-16k"):
    response = client.chat.completions.create(
        model=model,
        messages=[{"role": "system", "content": "You are a helpful research and pr
                {"role": "user", "content": prompt_question}]
    )

    return response.choices[0].message.content

def create_directory(directory_name):
    subprocess.run(["mkdir", directory_name])

def create_file(file_name):
    subprocess.run(["touch", file_name])

def list_files():
    subprocess.run(["ls"])
```

Level 1: LLM + functions inside the prompt

```
task_description = "Create a folder called 'lucas-the-agent-master'. Inside that
output = get_response(f"""Given this task: {task_description}, \n
                        Consider you have access to the following functions:

def create_directory(directory_name):
    '''Function that creates a directory given a directory name.'''
    subprocess.run(["mkdir", directory_name])

def create_file(file_name):
    '''Function that creates a file given a file name.'''
    subprocess.run(["touch", file_name])

def list_files():
  '''Function that lists all files in the current directory.'''
    subprocess.run(["ls"])

Your output should be the first function to be executed to complete the task con
The OUTPUT SHOULD ONLY BE THE PYTHON FUNCTION CALL and NOTHING ELSE.
""")

Markdown(output)

# Output:
# create_directory('lucas-the-agent-master')
```

Level 1: LLM + functions inside the prompt

- Now, all we need is to find a way to execute this function.

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- We can use Python's built in `exec` method for that:

```
exec("model." + output)
!ls -d */ | grep lucas
# Output:
# lucas-the-agent-master/
```

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- Need for **structured ways to prepare the inputs** of the function calls
- Putting entire functions inside text prompts is clunky and **non-scalable**
- Solution? **OpenAI Functions**!

OpenAI's Function Calling API

OpenAI Function Calling

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1. Call the model with the user query and a set of functions defined in the functions parameter.
2. The model can choose to call one or more functions; if so, the content will be a stringified JSON object adhering to your custom schema.
3. Parse the string into JSON in your code, and call your function with the provided arguments if they exist.

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Steps

1. Call the model with the user query and a set of functions defined in the functions parameter.
2. The model can choose to call one or more functions; if so, the content will be a stringified JSON object adhering to your custom schema.
3. Parse the string into JSON in your code, and call your function with the provided arguments if they exist.
4. Call the model again by appending the function response as a new message, and let the model summarize the results back to the user.

Step 1 & 2

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```
import json

def create_directory(directory_name):
    # Function to create a directory
    subprocess.run(["mkdir", directory_name])
    return json.dumps({"directory_name": directory_name})

tool_create_directory = {
    "type": "function",
    "function": {
        "name": "create_directory",
        "description": "Create a directory given a directory name.",
        "parameters": {
            "type": "object",
            "properties": {
                "directory_name": {
                    "type": "string",
                    "description": "The name of the directory to create.",
                }
            },
            "required": ["directory_name"],
        },
    },
}
tools = [tool_create_directory]
```

Step 1 & 2

```
def run_terminal_task():
    messages = [{"role": "user", "content":
    "Create a folder called 'lucas-the-agent-master'."}]
    tools = [tool_create_directory]
    response = client.chat.completions.create(
        model="gpt-3.5-turbo-16k",
        messages=messages,
        tools=tools,
        tool_choice="auto",
    )
    response_message = response.choices[0].message
    tool_calls = response_message.tool_calls
    # Check if the model called a function
    if tool_calls:
        # Proceed to step 3
```

Step 3: Parse and execute the function

```
  available_functions = {
    "create_directory": create_directory,
}
messages.append(response_message)
for tool_call in tool_calls:
    function_name = tool_call.function.name
    function_to_call = available_functions[function_name]
    function_args = json.loads(tool_call.function.arguments)
    function_response = function_to_call(
        directory_name=function_args.get("directory_name"),
    )
    messages.append(
        {
            "tool_call_id": tool_call.id,
            "role": "tool",
            "name": function_name,
            "content": function_response,
        }
    )
```

Step 4: Summarize Results Back to User

```
    second_response = client.chat.completions.create(
      model="gpt-3.5-turbo-16k",
      messages=messages,
  )
  return second_response

  output = run_terminal_task()
```

Q&A

Break 5 Minutes

Agents and AutoGen

How Can We Effectively Perform Tasks with Agents?

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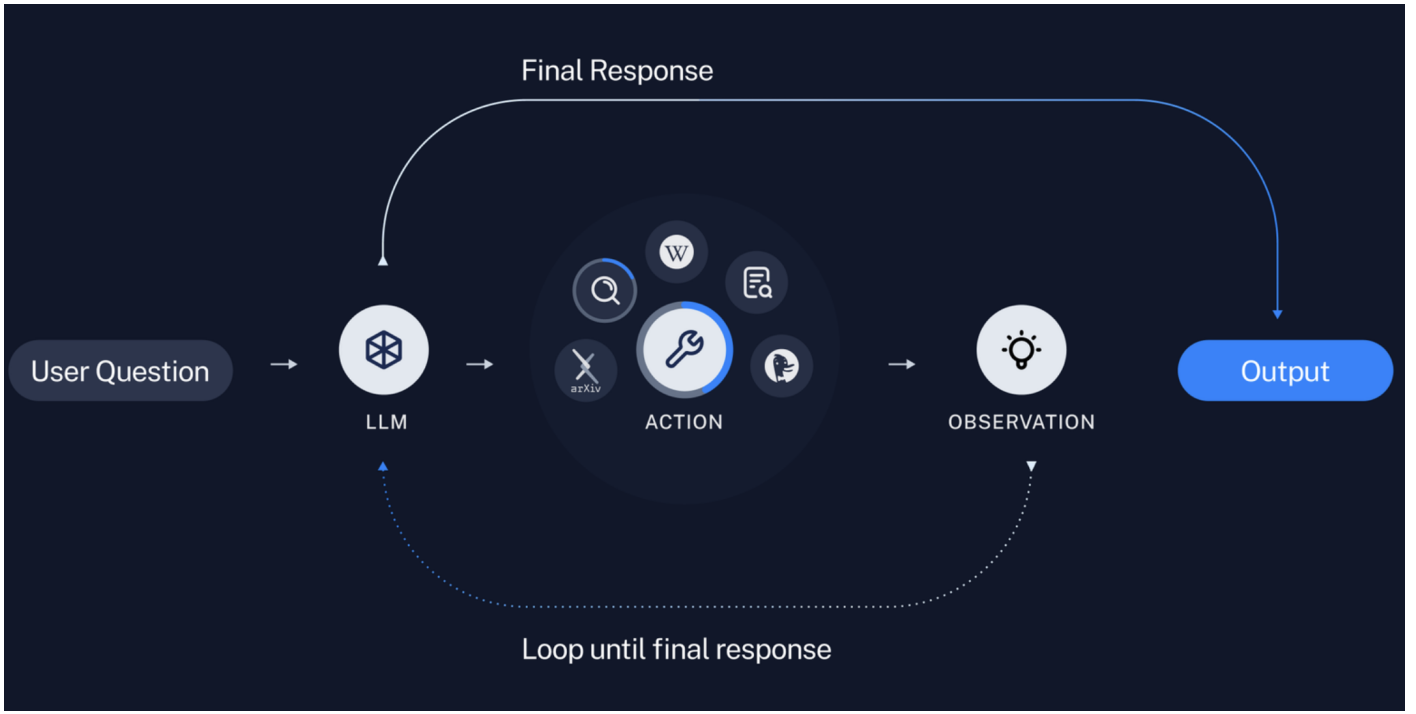
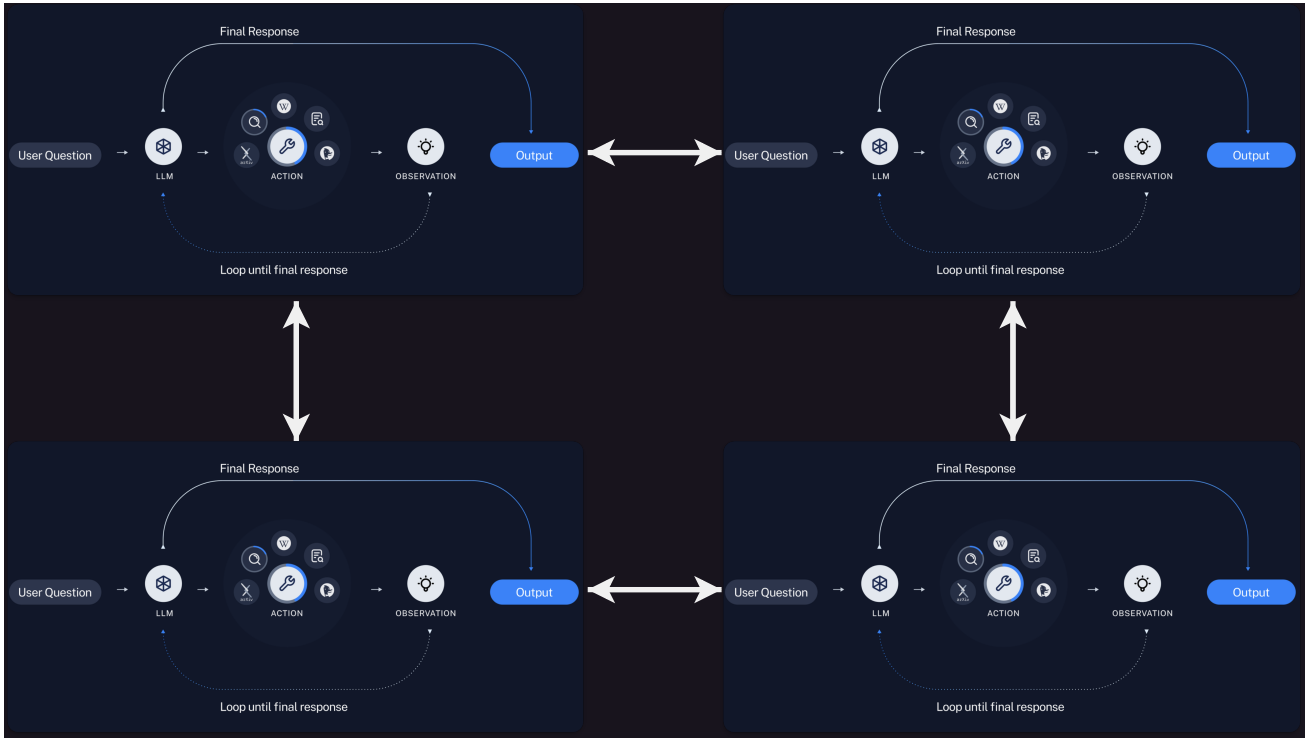


- The Agent Loop

OpenAI's Bet on a Cognitive Architecture

Good Agents Colaborate



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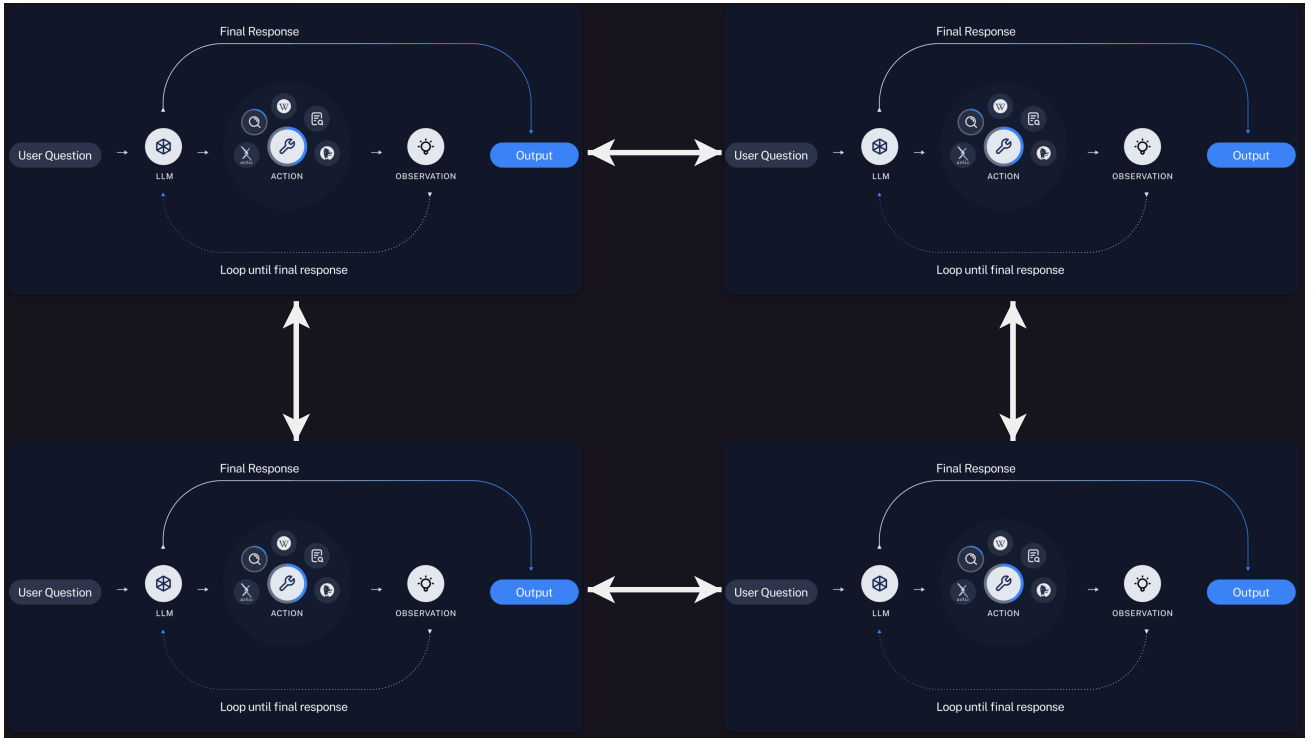

- With the increasing complexity of tasks, agents need to **collaborate** to achieve their goals

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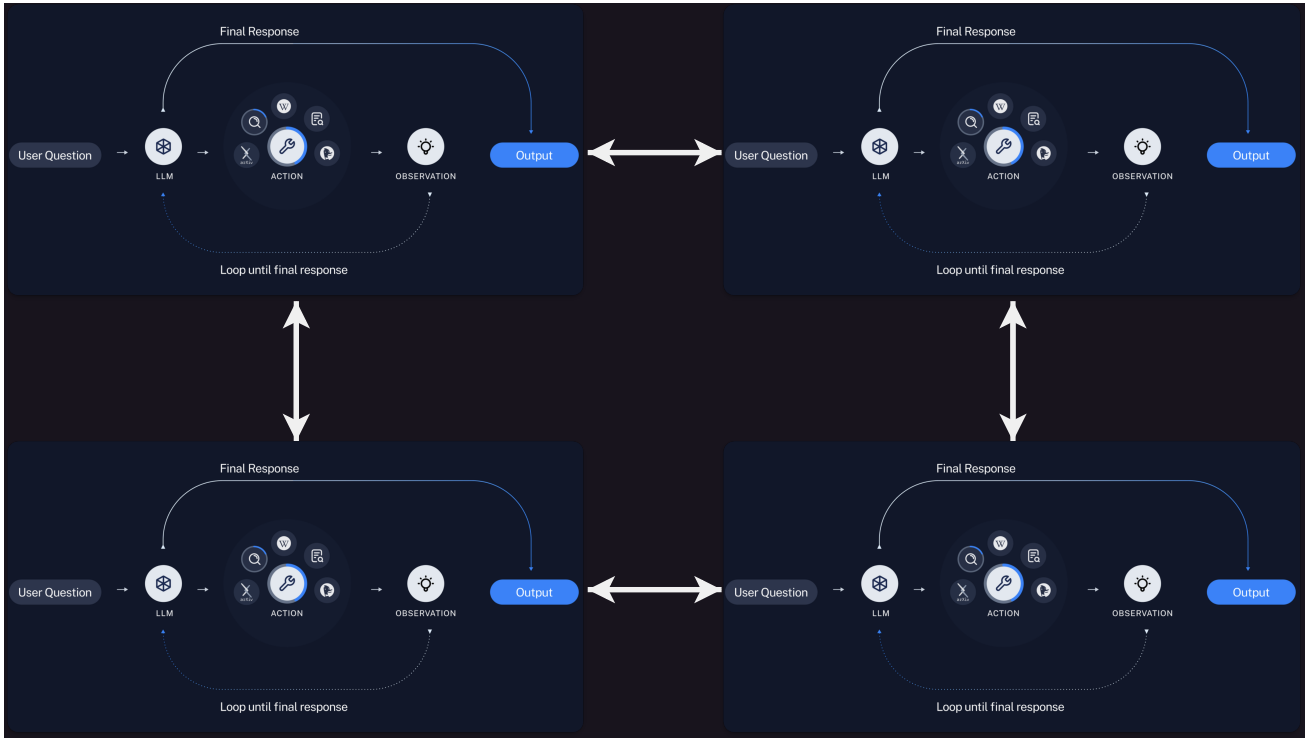

- With the increasing complexity of tasks, agents need to **collaborate** to achieve their goals
- AutoGen is a framework that facilitates the creation of agents that can easily collaborate through a 'conversation-centric' paradigm

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- Its main features
  - **Conversable agents**: a generic design of agents that can leverage LLMs, human input, tools or a combination of these to facilitate creating agents with different roles
  - **Conversation Programming**: Programming paradigm centered around inter-agent conversations

Conversable Agents

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- **Customizable**: Based on application-specific needs, each agent can be configured to have a mix of basic back-end types to display complex behavior in multi-agent conversations.

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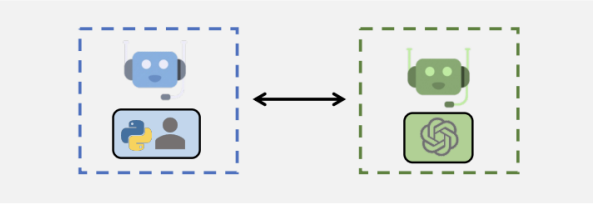
- **Example**:

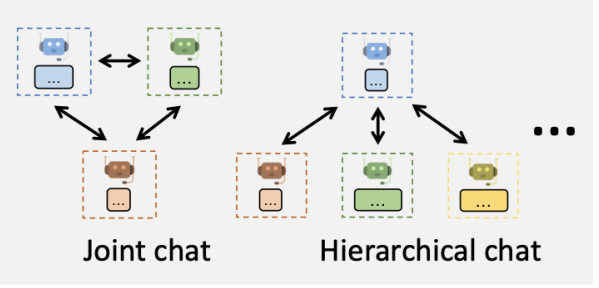
```
assistant = autogen.AssistantAgent(
            name="assistant",
            llm_config=llm_config,
            )
```

Conversation Programming

Conversation Programming



Multi-Agent Conversations



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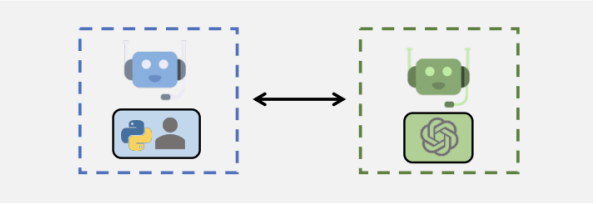

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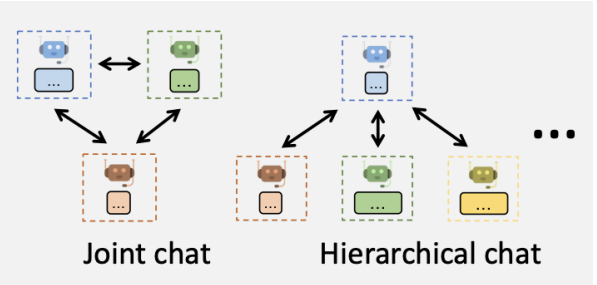
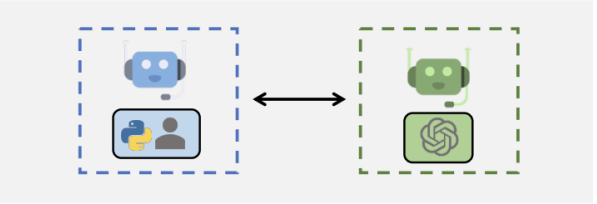


- Paradigm that blends computation and control flow within multi-agent conversations.

Conversation Programming



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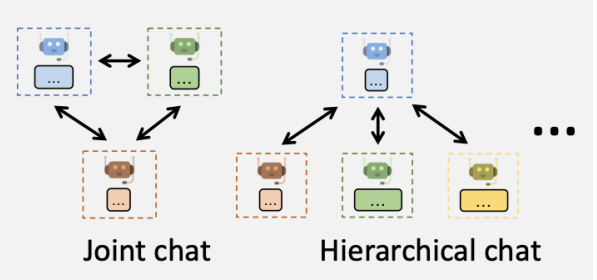

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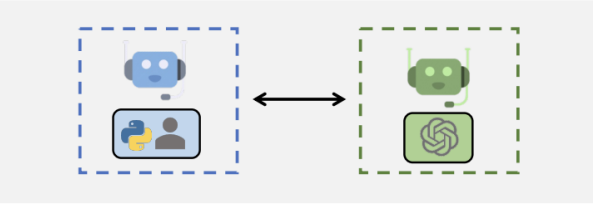

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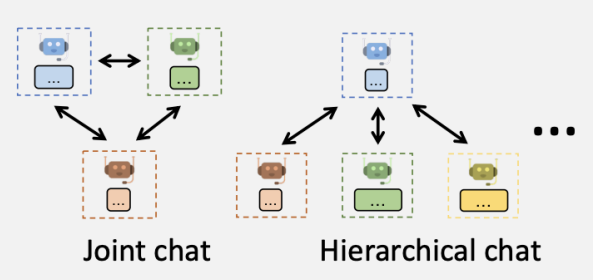

- Paradigm that blends computation and control flow within multi-agent conversations.
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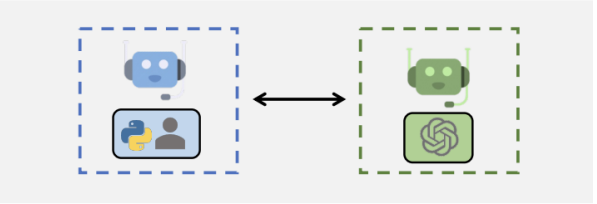
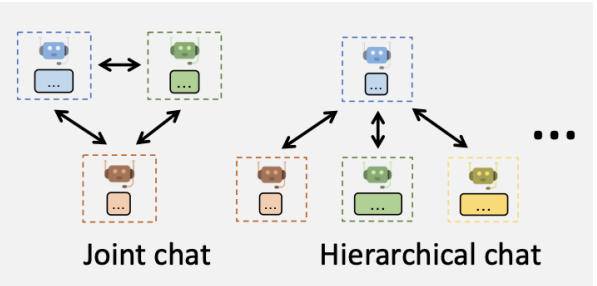
- **Computation**: Role-specific, conversation-centric actions.

Conversation Programming





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- **Control Flow**: Defined by conversation dynamics among agents.

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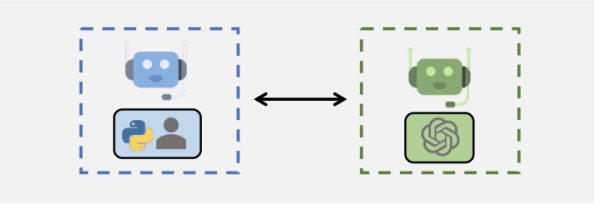

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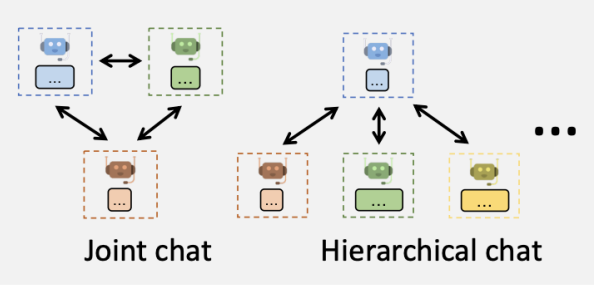

- Paradigm that blends computation and control flow within multi-agent conversations.
- Merges programming and natural language control.
- **Computation**: Role-specific, conversation-centric actions.
- **Control Flow**: Defined by conversation dynamics among agents.
- **Efficiency**: Streamlines AI development for various skill levels.

Design Patterns

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Dynamic Conversations

- Supports static and dynamic flows.
- Customizable reply functions for adaptive conversations.

Autogen Demo - Building Our First Agent

Diverse Conversation Patterns

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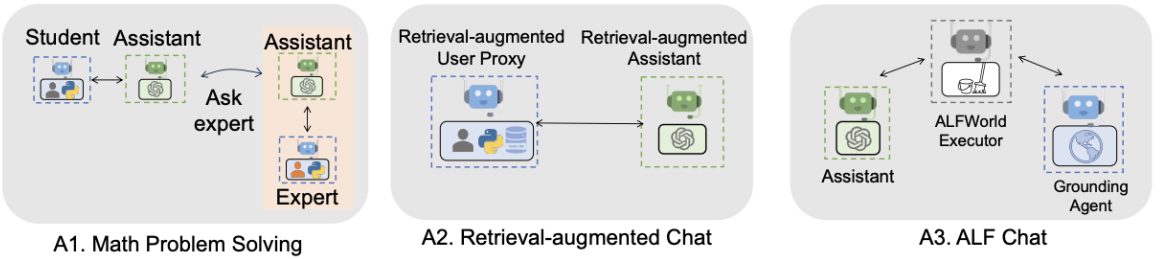

Figure 3: Six examples of diverse applications built using `AutoGen`. Their conversation patterns show `AutoGen`'s flexibility and power.

- Adaptable to different agent autonomies and topologies.

Examples of Conversation Patterns

Autogen Demo (Student - Assistant - Expert)

1. Student - Assistant - Expert

1. Student - Assistant - Expert

```
assistant = autogen.AssistantAgent(
      name="assistant",
      system_message="You are a helpful assistant.",
      llm_config={
          "timeout": 600,
          "seed": 42,
          "config_list": config_list,
      },
  )

mathproxyagent = MathUserProxyAgent(
      name="mathproxyagent",
      human_input_mode="NEVER",
      code_execution_config={"use_docker": False},
  )

math_problem = (
    "Find all $x$ that satisfy the inequality $(2x+10)(x+3)<(3x+9)(x+8)$. Express
)
mathproxyagent.initiate_chat(assistant, problem=math_problem)
```

Autogen Demo (Retrieval Augmented Chat)

2. Retrieval Augmented Chat

2. Retrieval Augmented Chat

```
assistant = RetrieveAssistantAgent(
    name="assistant",
    system_message="You are a helpful assistant.",
    llm_config={
        "timeout": 600,
        "cache_seed": 42,
        "config_list": config_list,
    },
)
ragproxyagent = RetrieveUserProxyAgent(
    name="ragproxyagent",
    human_input_mode="NEVER",
    max_consecutive_auto_reply=3,
    retrieve_config={
        "task": "code",
        "docs_path": [
            "https://raw.githubusercontent.com/microsoft/FLAML/main/website/docs
            "https://raw.githubusercontent.com/microsoft/FLAML/main/website/docs
            os.path.join(os.path.abspath(""), "..", "website", "docs"),
        ],
        ...
        ...
    code_execution_config=False,  # set to False if you don't want to execute th
)
assistant.reset()
code_problem = "How can I use FLAML to perform a classification task and use spa
ragproxyagent.initiate_chat(assistant, problem=code_problem, search_string="spar
```

Autogen Demo (Writer - Commander - Safeguard)

3. Writer - Commander - Safeguard (multi-agent coding)

3. Writer - Commander - Safeguard (multi-agent coding)

```
assistant = autogen.AssistantAgent(
    name="assistant",
    llm_config={
        "cache_seed": 42,  # seed for caching and reproducibility
        "config_list": config_list,  # a list of OpenAI API configurations
        "temperature": 0,  # temperature for sampling
    },  # configuration for autogen's enhanced inference API which is compatible
)
# create a UserProxyAgent instance named "user_proxy"
user_proxy = autogen.UserProxyAgent(
    name="user_proxy",
    human_input_mode="NEVER",
    max_consecutive_auto_reply=10,
    is_termination_msg=lambda x: x.get("content", "").rstrip().endswith("TERMINA
    code_execution_config={
        "work_dir": "coding",
        "use_docker": False,  # set to True or image name like "python:3" to use
    },
)
# the assistant receives a message from the user_proxy, which contains the task
user_proxy.initiate_chat(
    assistant,
    message="""What date is today? Compare the year-to-date gain for META and TE
)
```

Autogen Demo (Dynamic Group Chat)

4. Dynamic Group Chat

4. Dynamic Group Chat

```
llm_config = {"config_list": config_list_gpt4, "cache_seed": 42}
user_proxy = autogen.UserProxyAgent(
    name="User_proxy",
    system_message="A human admin.",
    code_execution_config={"last_n_messages": 2, "work_dir": "groupchat"},
    human_input_mode="TERMINATE",
)
coder = autogen.AssistantAgent(
    name="Coder",
    llm_config=llm_config,
)
pm = autogen.AssistantAgent(
    name="Product_manager",
    system_message="Creative in software product ideas.",
    llm_config=llm_config,
)
groupchat = autogen.GroupChat(agents=[user_proxy, coder, pm], messages=[], max_rou
manager = autogen.GroupChatManager(groupchat=groupchat, llm_config=llm_config)
user_proxy.initiate_chat(
manager, message="Find a latest paper about gpt-4 on arxiv and find its potential
)
```

Break 10 minutes

Recipe for Building AutoGen Agent Workflows

Step 1: Prepare Agent Configurations

- Config path with model name & API key
- Default configuration for each agent

```
config_file_or_env = './OAI_CONFIG_LIST'  # modify path
default_llm_config = {
  'temperature': 0
}
```

Step 2: Creating AgentBuilder Instance

- Create `AgentBuilder` instance
  - Use configuration path & default config
  - Specify builder & agent models

```
from autogen.agentchat.contrib.agent_builder import AgentBuilder
builder = AgentBuilder(config_file_or_env=config_file_or_env, builder_model='gpt-4
```

Step 3: Specifying the Building Task

- Define building task with description & examples
  - Helps build manager decide on agents
  - Example Task: "Create a multi-agent system for task X"

```
building_task = "Find a paper on arxiv about artificial intelligence,
and analyze its application in some domain. For example, find a latest
paper about gpt-4 on arxiv and find its potential applications in
software."
```

Step 4: Building Group Chat Agents

- Use `build()` method to generate agents
- Include a user proxy for tasks involving coding
    - `agent_list, agent_configs = builder.build(building_task, default_llm_config, coding=True)`

```
agent_list, agent_configs = builder.build(building_task, default_llm_config,
coding=True)
```

Step 5: Executing the Task

- Agents collaborate in a group chat to complete task
- Combine LLMs, human inputs, and tools
- Example: `start_task(execution_task, agent_list, llm_config)`

```
import autogen
def start_task(execution_task: str, agent_list: list, llm_config: dict):
    config_list = autogen.config_list_from_json(config_file_or_env, filter_dict={"

    group_chat = autogen.GroupChat(agents=agent_list, messages=[], max_round=12)
    manager = autogen.GroupChatManager(
        groupchat=group_chat, llm_config={"config_list": config_list, **llm_config
    )
    agent_list[0].initiate_chat(manager, message=execution_task)

start_task(
    execution_task="Find a recent paper about gpt-4 on arxiv and find its potentia
    agent_list=agent_list,
    llm_config=default_llm_config
)
```

source: AutoGen Blog

Step 6: Clearing Agents & Saving Configurations

- Clear agents post-task if next task differs
- Save information of built group chat agents

```
builder.clear_all_agents(recycle_endpoint=True)
saved_path = builder.save()
```

- Configurations will be saved in JSON format like such:

```
// FILENAME: save_config_TASK_MD5.json
{
"building_task": "Find a paper on arxiv about artificial intelligence,
and analyze its application in some domain. For example, find a latest
paper about gpt-4 on arxiv and find its potential applications in
software." ,
"agent_configs": [
{
    "name": "...",
    .....
},
...
],
"manager_system_message": "...",
"code_execution_config": {...},
"default_llm_config": {...}
}
```

Autogen Demo - Agent Builder Recipe

Break 5 minutes

Building a Research Agent with AutoGen

Autogen Demo Research Assistant

Building a Personal Assistant Agent with AutoGen

Autogen Demo - Personal Assistant

Conclusion and Q&A

References

- AutoGen
- AutoGen Paper
- OpenAI
- OpenAI Function Calling
- Gen Agents,
- AutoGPT
- GPT-Engineer
- BabyAGI
- Karpathy on Agents
- ReACT Paper
- HuggingGPT