

Tool Result (handoff):

Arguments: {'to_agent': 'LiquidityAgent', 'reason': "Need to analyze the liquidity ratios for Apple (AAPL) to complete the fundamental analysis and provide a comprehensive view of the company's financial health."}

Output: Agent LiquidityAgent is now handling the request due to the following reason: Need to analyze the liquidity ratios for Apple (AAPL) to complete the fundamental analysis and provide a comprehensive view of the company's financial health..

Please continue with the current request.

```
=====
Agent: LiquidityAgent
=====
```

Output: I'll now analyze Apple's liquidity ratios to provide insights on the company's financial health from a liquidity perspective. Let me collect the liquidity ratios for Apple (AAPL).

Planning to use tools: ['get_liquidity_ratios']

Calling Tool: get_liquidity_ratios

With arguments: {}

Tool Result (get_liquidity_ratios):

Arguments: {}

Output: Liquidity ratios extracted and Comments performed: To analyze the financial health of Apple Inc. (AAPL) based on the provided profitability ratios, we will evaluate each ratio against the given thresholds, assign a score from 1 to 10, and provide a justification for each score. Finally, we will summarize the overall financial health of the firm.

1. Current Ratio

- **Value:** 0.8673
- **Healthy Range:** 1.5 - 3.0
- **Evaluation:**
 - **Score:** 3
 - **Justification:** The current ratio of 0.8673 is below the healthy range, indicating that Apple may not have enough current assets to cover its current liabilities. This suggests potential liquidity issues, as the company might struggle to meet short-term obligations without relying on additional financing or asset liquidation.

2. Quick Ratio

- **Value:** 0.5589
- **Healthy Range:** > 1.0
- **Evaluation:**
 - **Score:** 2
 - **Justification:** The quick ratio is significantly below the healthy threshold of 1.0, indicating that Apple has limited liquid assets (excluding inventory) to cover its current liabilities. This further emphasizes potential liquidity concerns, as the company may face challenges in meeting immediate

financial obligations without converting inventory to cash.

3. Debt-to-Equity Ratio

- **Value:** 2.0906
- **Healthy Range:** 0.3 - 1.5
- **Evaluation:**
 - **Score:** 4
 - **Justification:** The debt-to-equity ratio exceeds the healthy range and falls into the warning zone (> 2.0). This suggests that Apple is highly leveraged, relying more on debt financing than equity. While this can amplify returns, it also increases financial risk, especially if the company faces downturns or interest rate hikes.

4. Interest Coverage Ratio

- **Value:** Infinity (inf)
- **Healthy Range:** > 3.0
- **Evaluation:**
 - **Score:** 10
 - **Justification:** An infinite interest coverage ratio indicates that Apple has no difficulty covering its interest expenses, likely due to substantial earnings before interest and taxes (EBIT) relative to interest obligations. This is a strong indicator of financial health in terms of solvency, as it shows the company can comfortably meet its interest payments.

Overall Insight on Apple's Financial Health

Strengths:

- **Interest Coverage:** Apple demonstrates exceptional ability to cover interest expenses, indicating strong operational profitability and low risk of default on interest payments.

Weaknesses:

- **Liquidity Ratios (Current and Quick Ratios):** Both ratios are below the healthy range, suggesting potential liquidity issues. Apple may need to improve its short-term asset management or consider restructuring its liabilities to enhance liquidity.
- **Leverage (Debt-to-Equity Ratio):** The high debt-to-equity ratio indicates significant reliance on debt, which could pose risks if market conditions change or if the company faces unexpected financial challenges.

Conclusion:

While Apple shows strong solvency with an excellent interest coverage ratio, its liquidity ratios and high leverage raise concerns about its ability to manage short-term obligations and financial flexibility. The company may benefit from strategies to improve liquidity and manage debt levels to ensure long-term financial stability.

Output: Apple's liquidity analysis reveals a mixed financial picture:

The company shows concerning liquidity metrics with a Current Ratio of 0.87 (below the healthy range of 1.5-3.0) and a Quick Ratio of 0.56 (below the healthy threshold of 1.0), indicating potential challenges in meeting short-term obligations. Apple's Debt-to-Equity Ratio of 2.09 exceeds the healthy range (0.3-1.5), suggesting high leverage and increased financial risk. However, the company demonstrates exceptional strength with an infinite Interest Coverage Ratio, showing it can easily meet interest obligations. While Apple has strong operational profitability, its below-optimal liquidity ratios and high leverage suggest areas for improvement in short-term asset management and debt structure to ensure long-term financial stability.

Planning to use tools: ['handoff']

Calling Tool: handoff

With arguments: {'to_agent': 'SupervisorAgent', 'reason': "Now that both profitability and liquidity analyses are complete for Apple (AAPL), the SupervisorAgent should provide an overall comment on the company's financial health based on the combined insights."}

Tool Result (handoff):

Arguments: {'to_agent': 'SupervisorAgent', 'reason': "Now that both profitability and liquidity analyses are complete for Apple (AAPL), the SupervisorAgent should provide an overall comment on the company's financial health based on the combined insights."}

Output: Agent SupervisorAgent is now handling the request due to the following reason: Now that both profitability and liquidity analyses are complete for Apple (AAPL), the SupervisorAgent should provide an overall comment on the company's financial health based on the combined insights..
Please continue with the current request.

=====

Agent: SupervisorAgent

=====

Output: Now that I have both the profitability and liquidity analyses for Apple (AAPL), I'll provide a comprehensive assessment of the company's financial health.

Planning to use tools: ['get_overall_comments']

Calling Tool: get_overall_comments

With arguments: {'overall_comments': "Based on the comprehensive analysis of Apple Inc. (AAPL), we observe a company with exceptional profitability metrics but some concerns regarding liquidity and leverage.\n\nFrom a profitability perspective, Apple demonstrates outstanding performance:\n- Return on Assets (ROA): 26.13% (far exceeding the healthy threshold of 5%)\n- Return on Equity (ROE): 157.41% (substantially above the healthy threshold of 15%)\n- Net Profit Margin: 23.97% (well above the healthy threshold of 10%)\n- Gross Margin: 46.21% (exceeding the healthy threshold of 40%)\n\nThese metrics indicate that Apple is highly efficient in utilizing its assets and equity to generate substantial profits, with strong pricing power and effective cost management.\n\nHowever, the liquidity analysis reveals potential areas of concern:\n- Current Ratio: 0.87 (below the healthy range of 1.5-3.0)\n- Quick Ratio: 0.56 (below the

healthy threshold of 1.0)\n- Debt-to-Equity Ratio: 2.09 (exceeding the healthy range of 0.3-1.5)\n- Interest Coverage Ratio: Infinity (exceptionally strong, well above the healthy threshold of 3.0)\n\nThe below-optimal liquidity ratios suggest that Apple may face challenges in meeting short-term obligations without additional financing or asset liquidation. The high debt-to-equity ratio indicates significant leverage, which could increase financial risk during economic downturns or interest rate increases.\n\nOverall Assessment:\nApple presents a financial profile of a highly profitable company with some liquidity constraints and elevated leverage. The company's exceptional profitability and ability to cover interest expenses provide a strong foundation, but the liquidity metrics suggest a potential area for improvement in financial management.\n\nThis financial structure likely reflects a strategic decision by Apple's management to optimize capital allocation, possibly prioritizing shareholder returns through dividends and share repurchases, as well as investments in growth initiatives, over maintaining high liquidity levels. The company's strong market position, brand value, and consistent cash flow generation may allow it to operate comfortably with lower liquidity ratios than typically recommended.\n\nFor investors, this means Apple represents a highly profitable investment with some financial risk factors that should be monitored, particularly in challenging economic environments. The company's ability to generate substantial profits provides a significant buffer against these risks, but prudent financial management would suggest addressing the liquidity constraints and high leverage over time to ensure long-term financial stability."}

Tool Result (get_overall_comments):

Arguments: {'overall_comments': "Based on the comprehensive analysis of Apple Inc. (AAPL), we observe a company with exceptional profitability metrics but some concerns regarding liquidity and leverage.\n\nFrom a profitability perspective, Apple demonstrates outstanding performance:\n- Return on Assets (ROA): 26.13% (far exceeding the healthy threshold of 5%)\n- Return on Equity (ROE): 157.41% (substantially above the healthy threshold of 15%)\n- Net Profit Margin: 23.97% (well above the healthy threshold of 10%)\n- Gross Margin: 46.21% (exceeding the healthy threshold of 40%)\n\nThese metrics indicate that Apple is highly efficient in utilizing its assets and equity to generate substantial profits, with strong pricing power and effective cost management.\n\nHowever, the liquidity analysis reveals potential areas of concern:\n- Current Ratio: 0.87 (below the healthy range of 1.5-3.0)\n- Quick Ratio: 0.56 (below the healthy threshold of 1.0)\n- Debt-to-Equity Ratio: 2.09 (exceeding the healthy range of 0.3-1.5)\n- Interest Coverage Ratio: Infinity (exceptionally strong, well above the healthy threshold of 3.0)\n\nThe below-optimal liquidity ratios suggest that Apple may face challenges in meeting short-term obligations without additional financing or asset liquidation. The high debt-to-equity ratio indicates significant leverage, which could increase financial risk during economic downturns or interest rate increases.\n\nOverall Assessment:\nApple presents a financial profile of a highly profitable company with some liquidity constraints and elevated leverage. The company's exceptional profitability and ability to cover interest expenses provide a strong foundation, but the liquidity metrics suggest a potential area for improvement in financial

management.\n\nThis financial structure likely reflects a strategic decision by Apple's management to optimize capital allocation, possibly prioritizing shareholder returns through dividends and share repurchases, as well as investments in growth initiatives, over maintaining high liquidity levels. The company's strong market position, brand value, and consistent cash flow generation may allow it to operate comfortably with lower liquidity ratios than typically recommended.\n\nFor investors, this means Apple represents a highly profitable investment with some financial risk factors that should be monitored, particularly in challenging economic environments. The company's ability to generate substantial profits provides a significant buffer against these risks, but prudent financial management would suggest addressing the liquidity constraints and high leverage over time to ensure long-term financial stability."}

Output: bad operand type for unary ~: 'CompletionResponse'

Output: # Comprehensive Financial Analysis of Apple Inc. (AAPL)

Based on the detailed analysis of Apple's financial ratios, I can provide the following assessment of the company's overall financial health:

Profitability Analysis: Exceptional Strength

Apple demonstrates outstanding profitability metrics across all key indicators:

- **Return on Assets (ROA)**: 26.13% (significantly exceeding the 5% healthy threshold)
- **Return on Equity (ROE)**: 157.41% (extraordinarily above the 15% healthy threshold)
- **Net Profit Margin**: 23.97% (well above the 10% healthy threshold)
- **Gross Margin**: 46.21% (exceeding the 40% healthy threshold)

These metrics indicate Apple is exceptionally efficient at utilizing its assets to generate profits, has strong pricing power, and maintains effective cost control. The company's ability to generate such high returns on both assets and equity demonstrates superior operational efficiency and management effectiveness.

Liquidity Analysis: Areas of Concern

Despite strong profitability, Apple shows some concerning liquidity metrics:

- **Current Ratio**: 0.87 (below the healthy range of 1.5-3.0)
- **Quick Ratio**: 0.56 (below the healthy threshold of 1.0)
- **Debt-to-Equity Ratio**: 2.09 (above the healthy range of 0.3-1.5)
- **Interest Coverage Ratio**: Infinity (exceptionally strong, indicating no difficulty covering interest expenses)

The below-optimal liquidity ratios suggest Apple may face challenges meeting short-term obligations without additional financing or asset liquidation. The high debt-to-equity ratio indicates significant leverage, which could increase financial risk during economic downturns.

Overall Financial Health Assessment

Apple presents a somewhat paradoxical financial profile - a highly profitable company with some liquidity constraints and elevated leverage. This structure likely reflects strategic decisions by Apple's management to optimize capital allocation, possibly prioritizing:

1. Shareholder returns through dividends and share repurchases
2. Investments in growth initiatives and R&D
3. Tax-efficient capital structure using debt financing

The company's exceptional profitability and infinite interest coverage ratio provide significant financial strength, allowing it to operate with lower liquidity ratios than typically recommended. Apple's strong market position, brand value, and consistent cash flow generation create a substantial buffer against potential liquidity risks.

Investment Implications

For investors, Apple represents a highly profitable investment with some financial risk factors that should be monitored. The company's ability to generate substantial profits provides significant protection against these risks, but the liquidity constraints and high leverage should be watched, particularly in challenging economic environments.

Apple would benefit from addressing these liquidity constraints and high leverage over time to ensure long-term financial stability, though its current profitability levels suggest it has considerable flexibility in managing these aspects of its financial structure.

In conclusion, Apple demonstrates exceptional operational and profitability strength with manageable liquidity concerns, resulting in an overall strong financial position despite some areas that could be improved.

Comprehensive Financial Analysis of Apple Inc. (AAPL) Based on the detailed analysis of Apple's financial ratios, I can provide the following assessment of the company's overall financial health:

5.11 Profitability Analysis: Exceptional Strength

Apple demonstrates outstanding profitability metrics across all key indicators:

- **Return on Assets (ROA):** 26.13% (significantly exceeding the 5% healthy threshold)
- **Return on Equity (ROE):** 157.41% (extraordinarily above the 15% healthy threshold)
- **Net Profit Margin:** 23.97% (well above the 10% healthy threshold)
- **Gross Margin:** 46.21% (exceeding the 40% healthy threshold)

These metrics indicate Apple is exceptionally efficient at utilizing its assets to generate profits,

has strong pricing power, and maintains effective cost control. The company's ability to generate such high returns on both assets and equity demonstrates superior operational efficiency and management effectiveness.

5.12 Liquidity Analysis: Areas of Concern

Despite strong profitability, Apple shows some concerning liquidity metrics:

- **Current Ratio:** 0.87 (below the healthy range of 1.5-3.0)
- **Quick Ratio:** 0.56 (below the healthy threshold of 1.0)
- **Debt-to-Equity Ratio:** 2.09 (above the healthy range of 0.3-1.5)
- **Interest Coverage Ratio:** Infinity (exceptionally strong, indicating no difficulty covering interest expenses)

The below-optimal liquidity ratios suggest Apple may face challenges meeting short-term obligations without additional financing or asset liquidation. The high debt-to-equity ratio indicates significant leverage, which could increase financial risk during economic downturns.

5.13 Overall Financial Health Assessment

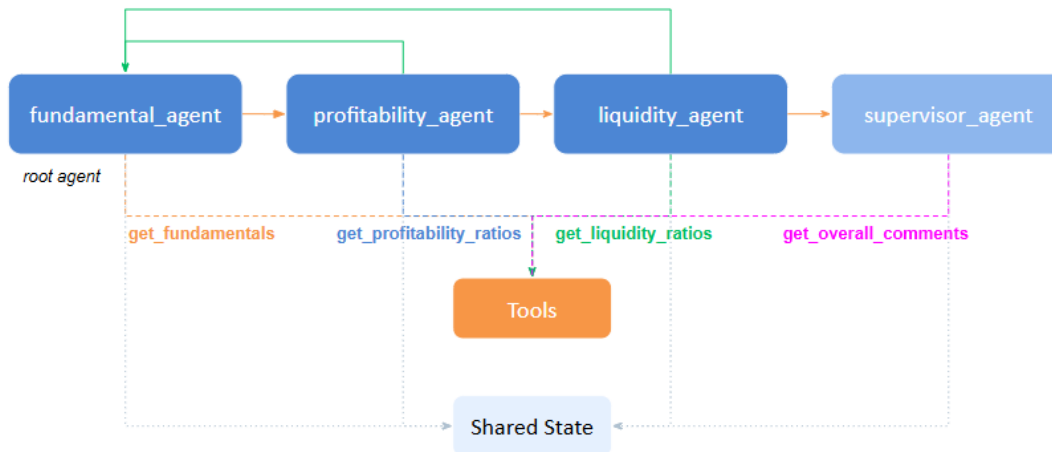
Apple presents a somewhat paradoxical financial profile - a highly profitable company with some liquidity constraints and elevated leverage. This structure likely reflects strategic decisions by Apple's management to optimize capital allocation, possibly prioritizing:

1. Shareholder returns through dividends and share repurchases
2. Investments in growth initiatives and R&D
3. Tax-efficient capital structure using debt financing

The company's exceptional profitability and infinite interest coverage ratio provide significant financial strength, allowing it to operate with lower liquidity ratios than typically recommended. Apple's strong market position, brand value, and consistent cash flow generation create a substantial buffer against potential liquidity risks.

5.14 Other Workflows

```
[5]: from IPython.display import Image, display
display(Image(filename=path+'/fundamental_multi_agent_system_2nd_workflow.png'))
```



5.14.1 Agents and Workflow

```
[ ]: from llama_index.core.agent.workflow import FunctionAgent

fundamental_agent = FunctionAgent(
    name="FundamentalAgent",
    description="Get various fundamental ratios for a given ticker.",
    system_prompt=(
        "You are the fundament analyst that can extract different fundamental_
        ↪ratios for a given ticker. "
        "Once you have extracted the fundamental financial ratios, you should_
        ↪hand off control to the ProfitabilityAgent to extract the profitability_
        ↪ratios or/and the LiquidityAgent to extract the liquidity ratios."
    ),
    llm=LLM_4o,
    tools=[get_fundamentals],
    can_handoff_to=["ProfitabilityAgent"],
)

profitability_agent = FunctionAgent(
    name="ProfitabilityAgent",
    description="Collect profitability ratios for a given ticker: ROA, ROE, Net_
    ↪Profit Margin and Gross Margin and Comment on the results given a set of_
    ↪threshold values.",
    system_prompt=(
        """"You are the ProfitabilityAgent that collects profitability ratios_
        ↪(profitability_ratios) on a given ticker.
        You collect these ratios from the FundamentalAgent.
    """
    )
)
```



```

        If it doesn't work, try calling the FundamentalAgent again to retrieve
        ↪the ratios.

        Once these ratios are collected in profitability_ratios, you should
        ↪comment on these ratios based on the thresholds values provided in
        ↪get_profitability_ratios.

        These comments must be included in threshold_profitability_comments. At
        ↪the end provide ONLY these comments included in
        ↪threshold_profitability_comments. DO NOT ADD anything else.

        Once the comments are done, you should hand off control to the
        ↪LiquidityAgent.
        """
    ),
    llm=LLM_4o,
    tools=[get_profitability_ratios],
    can_handoff_to=["LiquidityAgent", "FundamentalAgent"],
)

liquidity_agent = FunctionAgent(
    name="LiquidityAgent",
    description="Collect liquidity ratios for a given ticker: Current Ratio,
    ↪Quick Ratio, Debt-to-Equity Ratio, Interest Coverage Ratio and comments on
    ↪these ratios given a set of threshold values.",
    system_prompt=(
        """You are the LiquidityAgent that can collect liquidity ratios
        ↪(liquidity_ratios) on a given ticker.

        You collect these ratios from the FundamentalAgent.

        If it doesn't work, try calling the FundamentalAgent again to retrieve
        ↪the ratios.

        Once these ratios are collected in liquidity_ratios, you should comment
        ↪on these ratios based on the thresholds values provided in
        ↪get_liquidity_ratios.

        These comments must be included in threshold_liquidity_comments. At the
        ↪end provide ONLY these comments included in threshold_liquidity_comments. DO
        ↪NOT ADD anything else.

        Once the comments are done, you should hand off control to the
        ↪SupervisorAgent.
        """
    ),
    llm=LLM_4o,
    tools=[get_liquidity_ratios],
    can_handoff_to=["SupervisorAgent", "FundamentalAgent"],
)

supervisor_agent = FunctionAgent(
    name="SupervisorAgent",

```

```

        description="Provide an overall comment based on the comments coming from the ProfitabilityAgent and LiquidityAgent and stored on overall_comments.",
        system_prompt=(
            "You are an fundament analyst expert and supervisor. You collect comments coming from various agents such as ProfitabilityAgent and LiquidityAgent. "
            "If you collect only one or no comments, go back to ProfitabilityAgent and LiquidityAgent until you get the desired feedbacks on the ratios."
            "If you don't collect threshold_liquidity_comments, you should hand off control to the LiquidityAgent to gather these comments."
            "If you don't collect threshold_profitability_comments, you should hand off control to the ProfitabilityAgent to gather these comments."
            "Based on the results in the comments coming from the ProfitabilityAgent and LiquidityAgent, provide an overall comment on the health of the firm."
            "Justify your comment with details and data. "
        ),
        llm=LLM_4o,
        tools=[get_overall_comments],
        can_handoff_to=["FundamentalAgent", "ProfitabilityAgent", "LiquidityAgent"],
    )

```

```

[ ]: # from llama_index.core.agent.workflow import AgentWorkflow

agent_workflow = AgentWorkflow(
    agents=[fundamental_agent, profitability_agent, liquidity_agent, supervisor_agent],
    root_agent=fundamental_agent.name,
    initial_state={
        "ratios": pd.DataFrame(),
        "profitability_ratios": {},
        "liquidity_ratios": {},
        "threshold_profitability_comments": None,
        "threshold_liquidity_comments": None,
        "overall_comments": None,
        "ticker": "",
    },
)

```

5.14.2 Launch Workflow

```

[ ]: # from llama_index.core.agent.workflow import (
#     AgentInput,
#     AgentOutput,
#     ToolCall,

```

```

#     ToolCallResult,
#     AgentStream,
# )

handler = agent_workflow.run(
    user_msg=(
        "Provide the fundamental analysis of Apple and comments on the
        ↪financial health of the company."
    )
)

current_agent = None
current_tool_calls = ""
async for event in handler.stream_events():
    if (
        hasattr(event, "current_agent_name")
        and event.current_agent_name != current_agent
    ):
        current_agent = event.current_agent_name
        print(f"\n{'='*50}")
        print(f" Agent: {current_agent}")
        print(f"{'='*50}\n")

    elif isinstance(event, AgentOutput):
        if event.response.content:
            print(" Output:", event.response.content)
        if event.tool_calls:
            print(
                " Planning to use tools:",
                [call.tool_name for call in event.tool_calls],
            )

    elif isinstance(event, ToolCallResult):
        print(f" Tool Result ({event.tool_name}):")
        print(f" Arguments: {event.tool_kwargs}")
        print(f" Output: {event.tool_output}")

    elif isinstance(event, ToolCall):
        print(f" Calling Tool: {event.tool_name}")
        print(f" With arguments: {event.tool_kwargs}")

```

```

=====
Agent: FundamentalAgent
=====

```

```

Planning to use tools: ['get_fundamentals']

```

```

Obtaining financial statements: 100%|      | 3/3 [00:00<00:00, 4.06it/s]
Obtaining historical data: 100%|      | 2/2 [00:00<00:00, 9.55it/s]

```

```

ratios 2022      NaN
2023      0.275
2024      0.2613
Freq: Y-DEC, Name: Return on Assets, dtype: float64
Calling Tool: get_fundamentals
With arguments: {'ticker': 'AAPL'}
Tool Result (get_fundamentals):
Arguments: {'ticker': 'AAPL'}
Output: Ratios extracted for AAPL.
Planning to use tools: ['handoff']
Calling Tool: handoff
With arguments: {'to_agent': 'ProfitabilityAgent', 'reason': 'Collect
profitability ratios for AAPL and comment on the results given a set of
threshold values.'}
Tool Result (handoff):
Arguments: {'to_agent': 'ProfitabilityAgent', 'reason': 'Collect profitability
ratios for AAPL and comment on the results given a set of threshold values.'}
Output: Agent ProfitabilityAgent is now handling the request due to the
following reason: Collect profitability ratios for AAPL and comment on the
results given a set of threshold values..
Please continue with the current request.

```

```

=====
Agent: ProfitabilityAgent
=====

```

```

Planning to use tools: ['get_profitability_ratios']
Calling Tool: get_profitability_ratios
With arguments: {}
Tool Result (get_profitability_ratios):
Arguments: {}
Output: Profitability ratios extracted and Comments performed: To analyze the
financial health of Apple Inc. (AAPL) based on its profitability ratios, we will
evaluate each ratio against the provided thresholds and assign a score from 1 to
10. This score will reflect the health of each ratio, with 1 being very
unhealthy and 10 being very healthy. Let's proceed with the analysis:

```

```

### 1 Return on Assets (ROA)

```

```

- **Value**: 26.13%
- **Thresholds**:
  - Healthy: > 5%
  - Moderate: 2% - 5%
  - Weak: < 2%

```

```

**Score**: 10/10

```

```

**Justification**: Apple's ROA of 26.13% is significantly above the healthy

```

threshold of 5%. This indicates that the company is highly efficient in using its assets to generate earnings. A high ROA suggests strong operational efficiency and effective asset management, which is a positive indicator of financial health.

2 Return on Equity (ROE)

- **Value**: 157.41%
- **Thresholds**:
 - Healthy: > 15%
 - Moderate: 8% - 15%
 - Weak: < 8%

Score: 10/10

Justification: With an ROE of 157.41%, Apple far exceeds the healthy threshold of 15%. This exceptionally high ROE indicates that the company is generating substantial profits from its shareholders' equity, reflecting strong financial performance and effective use of equity capital. Such a high ROE is often indicative of a competitive advantage and strong profitability.

3 Net Profit Margin

- **Value**: 23.97%
- **Thresholds**:
 - Healthy: > 10%
 - Moderate: 5% - 10%
 - Weak: < 5%

Score: 10/10

Justification: Apple's net profit margin of 23.97% is well above the healthy threshold of 10%. This high margin indicates that the company retains a significant portion of its revenue as profit after all expenses, showcasing strong cost management and pricing power. A high net profit margin is a sign of a financially robust company.

4 Gross Margin

- **Value**: 46.21%
- **Thresholds**:
 - Healthy: > 40%
 - Moderate: 20% - 40%
 - Weak: < 20%

Score: 10/10

Justification: The gross margin of 46.21% is above the healthy threshold of

40%, indicating that Apple is effectively managing its production costs relative to its sales. A high gross margin suggests that the company has a strong competitive position and can maintain profitability even with fluctuations in sales or costs.

Overall Insight

Based on the analysis of Apple's profitability ratios, the company demonstrates exceptional financial health. Each ratio significantly exceeds the healthy thresholds, indicating strong operational efficiency, effective asset and equity utilization, and robust profit margins. Apple's financial strengths include its ability to generate high returns on assets and equity, maintain substantial profit margins, and manage costs effectively. There are no apparent weaknesses in the profitability ratios, suggesting that Apple is in a very strong financial position. This analysis reflects a company that is well-positioned for continued success and growth.

Planning to use tools: ['handoff']

Calling Tool: handoff

With arguments: {'to_agent': 'LiquidityAgent', 'reason': "Profitability ratios for AAPL have been collected and commented on. Now, it's time to collect and comment on liquidity ratios."}

Tool Result (handoff):

Arguments: {'to_agent': 'LiquidityAgent', 'reason': "Profitability ratios for AAPL have been collected and commented on. Now, it's time to collect and comment on liquidity ratios."}

Output: Agent LiquidityAgent is now handling the request due to the following reason: Profitability ratios for AAPL have been collected and commented on. Now, it's time to collect and comment on liquidity ratios..

Please continue with the current request.

```
=====
Agent: LiquidityAgent
=====
```

Planning to use tools: ['get_liquidity_ratios']

Calling Tool: get_liquidity_ratios

With arguments: {}

Tool Result (get_liquidity_ratios):

Arguments: {}

Output: Liquidity ratios extracted and Comments performed: To analyze the financial health of Apple Inc. (AAPL) based on the provided profitability ratios, we will evaluate each ratio against the given thresholds, assign a score from 1 to 10, and provide a justification for each score. Finally, we will summarize the overall financial health of the firm.

1. Current Ratio

- **Value**: 0.8673

- **Healthy Range**: 1.5 - 3.0

- ****Evaluation****: The current ratio of 0.8673 is below the healthy range, indicating that Apple may not have enough current assets to cover its current liabilities. This suggests potential liquidity issues.
- ****Score****: 3/10
- ****Justification****: The score reflects the fact that the current ratio is significantly below the healthy range, indicating a potential liquidity risk. However, it is not in the extremely risky zone (>3.0), which would suggest excess cash.

2. Quick Ratio

- ****Value****: 0.5589
- ****Healthy Range****: > 1.0
- ****Evaluation****: The quick ratio is also below the healthy threshold, indicating that Apple may struggle to meet its short-term obligations without relying on inventory sales.
- ****Score****: 2/10
- ****Justification****: The quick ratio is well below the healthy range, suggesting a more pronounced liquidity concern than the current ratio. This score reflects the potential difficulty in covering immediate liabilities with liquid assets.

3. Debt-to-Equity Ratio

- ****Value****: 2.0906
- ****Healthy Range****: 0.3 - 1.5
- ****Evaluation****: The debt-to-equity ratio is above the healthy range and in the warning zone, indicating that Apple is using a higher level of debt relative to equity, which could increase financial risk.
- ****Score****: 4/10
- ****Justification****: While the ratio is above the healthy range, it is not in the extremely risky zone (<0.3), which would suggest under-leverage. The score reflects a moderate level of concern regarding financial leverage.

4. Interest Coverage Ratio

- ****Value****: Infinity (inf)
- ****Healthy Range****: > 3.0
- ****Evaluation****: An infinite interest coverage ratio suggests that Apple has no interest expenses or that its earnings are significantly higher than its interest obligations, indicating excellent financial health in terms of covering interest expenses.
- ****Score****: 10/10
- ****Justification****: The infinite interest coverage ratio indicates that Apple is in an extremely strong position to cover its interest expenses, reflecting excellent financial health in this aspect.

Overall Insight

- ****Strengths****: Apple's infinite interest coverage ratio is a significant strength, indicating robust earnings relative to interest expenses. This suggests strong operational performance and the ability to manage debt costs effectively.

- **Weaknesses**: The current and quick ratios are below the healthy range, indicating potential liquidity concerns. Additionally, the debt-to-equity ratio is in the warning zone, suggesting a higher reliance on debt financing, which could pose a risk if not managed carefully.

- **Overall Financial Health**: While Apple demonstrates strong earnings capability, as evidenced by its interest coverage ratio, the liquidity ratios suggest potential short-term financial challenges. The firm should focus on improving its liquidity position and managing its debt levels to enhance overall financial stability.

Planning to use tools: ['handoff']

Calling Tool: handoff

With arguments: {'to_agent': 'SupervisorAgent', 'reason': "Liquidity ratios for AAPL have been collected and commented on. Now, it's time to provide an overall comment based on the profitability and liquidity analysis."}

Tool Result (handoff):

Arguments: {'to_agent': 'SupervisorAgent', 'reason': "Liquidity ratios for AAPL have been collected and commented on. Now, it's time to provide an overall comment based on the profitability and liquidity analysis."}

Output: Agent SupervisorAgent is now handling the request due to the following reason: Liquidity ratios for AAPL have been collected and commented on. Now, it's time to provide an overall comment based on the profitability and liquidity analysis..

Please continue with the current request.

=====
Agent: SupervisorAgent
=====

Output: Based on the comprehensive analysis of Apple's financial health, we can draw the following conclusions:

Profitability Analysis

Apple Inc. demonstrates exceptional financial health in terms of profitability. The company has a Return on Assets (ROA) of 26.13%, a Return on Equity (ROE) of 157.41%, a Net Profit Margin of 23.97%, and a Gross Margin of 46.21%. Each of these ratios significantly exceeds the healthy thresholds, indicating strong operational efficiency, effective asset and equity utilization, and robust profit margins. Apple's profitability ratios reflect a company that is well-positioned for continued success and growth, showcasing strong financial performance and competitive advantage.

Liquidity Analysis

In contrast to its profitability, Apple's liquidity ratios suggest potential short-term financial challenges. The current ratio of 0.8673 and the quick ratio of 0.5589 are both below the healthy range, indicating potential liquidity concerns. The debt-to-equity ratio of 2.0906 is above the healthy range, suggesting a higher reliance on debt financing, which could pose a risk if not managed carefully. However, the infinite interest coverage ratio indicates that

Apple is in an extremely strong position to cover its interest expenses, reflecting excellent financial health in this aspect.

Overall Financial Health

While Apple demonstrates strong earnings capability and profitability, the liquidity ratios suggest potential short-term financial challenges. The firm should focus on improving its liquidity position and managing its debt levels to enhance overall financial stability. Despite these liquidity concerns, Apple's strong profitability and interest coverage indicate that the company is fundamentally sound and well-positioned for future growth. The overall financial health of Apple Inc. is robust, but attention to liquidity management will be crucial to maintaining this strength.

5.14.3 Output:

Based on the analysis of Apple's profitability and liquidity ratios, the company exhibits a mixed financial health profile.

5.14.4 Profitability Analysis:

Apple's profitability ratios are exceptionally strong, with all key metrics such as ROA, ROE, Net Profit Margin, and Gross Margin significantly exceeding healthy thresholds. This indicates robust operational efficiency, effective asset and equity utilization, strong profit generation, and excellent cost management. These strengths position Apple as a highly profitable and efficient company, providing a solid foundation for future growth and stability.

5.14.5 Liquidity Analysis:

However, the liquidity ratios present a different picture. The current and quick ratios are below the healthy thresholds, suggesting potential liquidity issues. This indicates that Apple may face challenges in covering its short-term obligations without relying on inventory sales. Additionally, the high debt-to-equity ratio suggests that Apple is highly leveraged, which could pose risks if not managed properly. Despite these concerns, the infinite interest coverage ratio is a significant strength, indicating that Apple can comfortably cover its interest expenses, reflecting strong financial stability in terms of interest coverage.

5.14.6 Overall Conclusion:

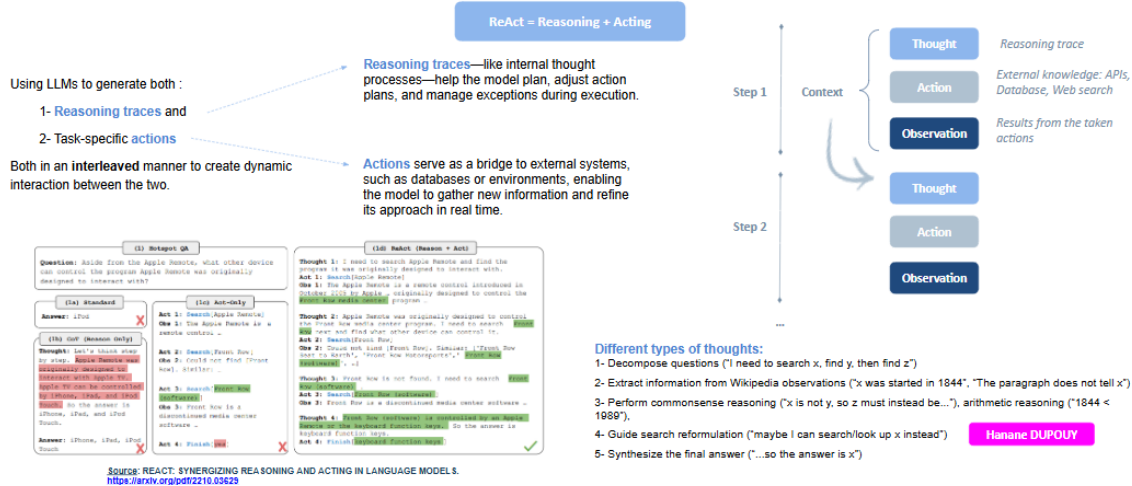
In conclusion, while Apple's profitability is outstanding, the liquidity ratios highlight areas of concern. The company should focus on improving its liquidity position and managing its debt levels to enhance overall financial stability. Addressing these issues will ensure that Apple maintains its strong market position and continues to deliver value to its shareholders.

6 2- Agentic RAG

- Before starting building this agentic RAG system with a ReAct agent, let's have a look on what does mean ReAct Paradigm:

```
[9]: from IPython.display import Image, display
display(Image(filename=path+'/reasoning_pattern_ReAct.png'))
```

Agents Reasoning Paradigms- ReAct



- Let's start building our RAG ReAct agent

```
[ ]: from llama_index.llms.openai import OpenAI
from llama_index.embeddings.openai import OpenAIEmbedding
from llama_index.core import Settings

Settings.llm = OpenAI(model="gpt-4o-mini")
Settings.embed_model = OpenAIEmbedding(model="text-embedding-3-small", api_key_
=> OPENAI_API_KEY)
```

Apple 10K 2024: (https://s2.q4cdn.com/470004039/files/doc_earnings/2024/q4/filing/10-Q4-2024-As-Filed.pdf)

Nvidia 10K 2024: (https://s201.q4cdn.com/141608511/files/doc_financials/2024/q4/1cbe8fe7-e08a-46e3-8dcc-b429fc06c1a4.pdf)

```
[ ]: !wget 'https://s2.q4cdn.com/470004039/files/doc_earnings/2024/q4/filing/
10-Q4-2024-As-Filed.pdf' -O 'apple_10k.pdf'
!wget 'https://s201.q4cdn.com/141608511/files/doc_financials/2024/q4/
1cbe8fe7-e08a-46e3-8dcc-b429fc06c1a4.pdf' -O 'nvidia_10k.pdf'
```

--2025-06-09 13:31:18--

https://s2.q4cdn.com/470004039/files/doc_earnings/2024/q4/filing/10-Q4-2024-As-Filed.pdf

Resolving s2.q4cdn.com (s2.q4cdn.com)... 68.70.205.4, 68.70.205.2, 68.70.205.3,

...

```
Connecting to s2.q4cdn.com (s2.q4cdn.com)|68.70.205.4|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 963934 (941K) [application/pdf]
Saving to: 'apple_10k.pdf'
```

```
apple_10k.pdf          0%[                               ]      0  --.-KB/s
apple_10k.pdf          100%[=====>] 941.34K  --.-KB/s    in 0.04s
```

```
2025-06-09 13:31:18 (21.5 MB/s) - 'apple_10k.pdf' saved [963934/963934]
```

```
--2025-06-09 13:31:18-- https://s201.q4cdn.com/141608511/files/doc_financials/2024/q4/1cbe8fe7-e08a-46e3-8dcc-b429fc06c1a4.pdf
Resolving s201.q4cdn.com (s201.q4cdn.com)... 68.70.205.3, 68.70.205.1, 68.70.205.2, ...
Connecting to s201.q4cdn.com (s201.q4cdn.com)|68.70.205.3|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 1074533 (1.0M) [application/pdf]
Saving to: 'nvidia_10k.pdf'
```

```
nvidia_10k.pdf         100%[=====>] 1.02M  --.-KB/s    in 0.01s
```

```
2025-06-09 13:31:18 (75.6 MB/s) - 'nvidia_10k.pdf' saved [1074533/1074533]
```

```
[8]: ## If you cannot run the code above, you can do it this way:
# import requests

# url = 'https://s2.q4cdn.com/470004039/files/doc_earnings/2024/q4/filing/10-Q4-2024-As-Filed.pdf'
# response = requests.get(url)

# with open('apple_10k.pdf', 'wb') as f:
#     f.write(response.content)
```

```
[ ]: from llama_index.core import StorageContext, load_index_from_storage

try:
    storage_context = StorageContext.from_defaults(
        persist_dir="./data_storage/apple"
    )
    apple_index = load_index_from_storage(storage_context)

    storage_context = StorageContext.from_defaults(
        persist_dir="./data_storage/nvidia"
    )
    nvidia_index = load_index_from_storage(storage_context)
```

```

        index_loaded = True
    except:
        index_loaded = False

```

```

Loading llama_index.core.storage.kvstore.simple_kvstore from
./data_storage/apple/docstore.json.
Loading llama_index.core.storage.kvstore.simple_kvstore from
./data_storage/apple/index_store.json.
Loading llama_index.core.storage.kvstore.simple_kvstore from
./data_storage/nvidia/docstore.json.
Loading llama_index.core.storage.kvstore.simple_kvstore from
./data_storage/nvidia/index_store.json.

```

```

[ ]: from llama_index.core import SimpleDirectoryReader, VectorStoreIndex

if not index_loaded:
    # load data
    apple_docs = SimpleDirectoryReader(
        input_files=["./apple_10k.pdf"]
    ).load_data()
    nvidia_docs = SimpleDirectoryReader(
        input_files=["./nvidia_10k.pdf"]
    ).load_data()

    # build index
    apple_index = VectorStoreIndex.from_documents(apple_docs)
    nvidia_index = VectorStoreIndex.from_documents(nvidia_docs)

    # persist index
    apple_index.storage_context.persist(persist_dir="./data_storage/apple")
    nvidia_index.storage_context.persist(persist_dir="./data_storage/nvidia")

```

```

[ ]: apple_engine = apple_index.as_query_engine(similarity_top_k=3)
    nvidia_engine = nvidia_index.as_query_engine(similarity_top_k=3)

```

```

[ ]: from llama_index.core.tools import QueryEngineTool

query_engine_tools = [
    QueryEngineTool.from_defaults(
        query_engine=apple_engine,
        name="apple_10k",
        description=(
            "Delivers insights and information about Apple's 2024 financial_
↪data. "
            "You'll provided with a detailed, plain text question to obtain_
↪the most relevant and precise responses"
        ),
    ),

```

```

    ),
    QueryEngineTool.from_defaults(
        query_engine=nvidia_engine,
        name="nvidia_10k",
        description=(
            "Delivers insights and information about Nvidia's 2024 financial
data. "
            "You'll provided with a detailed, plain text question to obtain
the most relevant and precise responses"
        ),
    ),
]

```

```

[ ]: from llama_index.core.agent.workflow import ReActAgent
from llama_index.core.workflow import Context

agent = ReActAgent(
    tools=query_engine_tools,
    llm=OpenAI(model="gpt-4o-mini"),
)

ctx = Context(agent)

```

```

[ ]: from llama_index.core.agent.workflow import ToolCallResult, AgentStream

handler = agent.run("What was the revenue of Nvidia in 2024? Comapre this the
value to 2023 revnue?", ctx=ctx)

async for ev in handler.stream_events():
    if isinstance(ev, AgentStream):
        print(f"{ev.delta}", end="", flush=True)

response = await handler

```

Thought: The current language of the user is: English. I need to use a tool to help me answer the question.

Action: nvidia_10k

Action Input: {"input": "What was Nvidia's revenue in 2024 and how does it compare to the revenue in 2023?"}Thought: I can answer without using any more tools. I'll use the user's language to answer.

Answer: Nvidia's revenue in 2024 was \$60.9 billion, which represents an increase of 126% compared to the revenue of \$27.0 billion in 2023.

```

[ ]: from llama_index.core.agent.workflow import ToolCallResult, AgentStream

handler = agent.run("What was the revenue of Apple in 2024? Comapre it to
Nvidia's revenue?", ctx=ctx)

```

```

async for ev in handler.stream_events():
    if isinstance(ev, AgentStream):
        print(f"{ev.delta}", end="", flush=True)

response = await handler

```

Thought: The current language of the user is: English. I need to use a tool to help me answer the question.

Action: apple_10k

Action Input: {'input': 'What was Apple's revenue in 2024?'}Thought: I can answer without using any more tools. I'll use the user's language to answer.

Answer: Apple's revenue in 2024 was \$391.035 billion, while Nvidia's revenue for the same year was \$60.9 billion. This means Apple's revenue was significantly higher than Nvidia's, approximately 6.4 times greater.

7 Readings

1- **Agentic AI Systems Applied to tasks in Financial Services: Modeling and model risk management crews** <https://arxiv.org/abs/2502.05439>

2- AI Agents vs. Agentic AI: A Conceptual Taxonomy, Applications and Challenges <https://arxiv.org/pdf/2505.10468>

3- AI Agents: Evolution, Architecture, and Real-World Applications <https://arxiv.org/html/2503.12687v1>

4- LlamaIndex: Multi-Agent Research Workflow with AgentWorkflow https://docs.llamaindex.ai/en/stable/examples/agent/agent_workflow_multi/

My Github repo: LLMs-in-Finance: <https://github.com/hananedupouy/LLMs-in-Finance>

- <https://github.com/hananedupouy/LLMs-in-Finance/tree/main/Agents>