Module code/name	MSIN0231 Machine Learning for Business
Module leader name	Bart Vanneste
Academic year	2024/25
Term	2
Assessment title	Individual Assignment
Individual/group assessment	Individual
Candidate Number	MYBQ6
Word Count	1499

Q1.

The JSON format consists of twelve key sections, each designed to capture crucial industry insights:

1. **Industry Overview** explains what the industry is, its purpose, significance, and key historical developments.

2. **Market Analysis** shows the industry's global size, growth trends, and competitive structure.

3. **Key Products & Services** details main offerings, production stages, and target customers.

4. **Geographical Distribution** identifies leading regions and emerging markets with growth potential.

5. **Key Players** lists major companies, their market positions, finances, and corporate details.

6. **Regulatory Landscape** outlines governing laws and oversight bodies.

7. **Technological Innovations** highlights recent advancements and their industry impact.

8. **Market Trends** examines changing consumer behaviours and significant industry shifts.

9. **Opportunities** identifies growth potential and untapped market segments.

10. **Challenges** describes regulatory, economic, and technological barriers.

11. **Future Outlook** provides forecasts and strategic recommendations.

12. **References** lists information sources for verification to avoid hallucination.

Below is an evaluation table of how the model performed on different industries structurally.

JSON COMPLIANCE FOR TRAINING REPORTS

Industry	Definition	Market Overview	Key Products/Services	Geographical Distribution	Key Players	Regulatory Landscape	Technological Innovations	Market Trends	Opportunities	Challenges	Future Outlook	References
Renewable Energy	✔	✔	✔	✔	⚠ (Only 1 company, missing key competitors)	✔	✔	✔	✔	⚠ (Some missing data)	✔	✔
Aerospace & Defense	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Fashion & Apparel	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Financial Services	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Healthcare Technology	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

JSON COMPLIANCE FOR TEST REPORTS

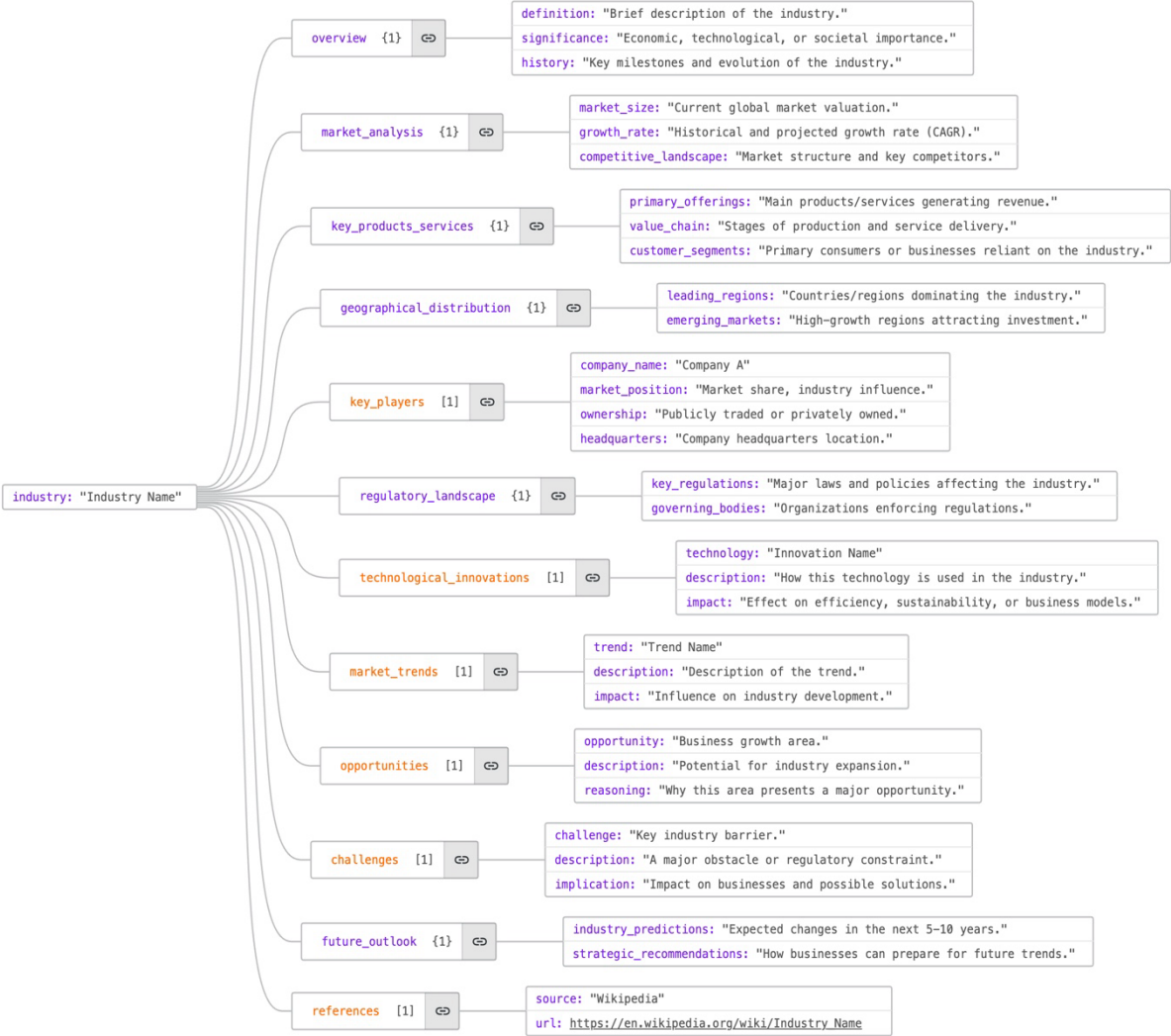| Industry	Definition	Market Overview	Key Products/Services	Geographical Distribution	Key Players	Regulatory Landscape	Technological Innovations	Market Trends	Opportunities	Challenges	Future Outlook	References
Aluminium	✔	⚠ (Market size missing)	✔	✔	⚠ (Few players, missing financials)	✔	✔	✔	✔	⚠ (Some missing data)	✔	✔
Advertising	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Internet Services & Infrastructure	✔	✔	✔	✔	✔ (Only AWS)	✔	✔	✔	✔	✔	✔	✔
Automobile Manufacturers	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Automobile Manufacturers in South Korea	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

Q2.

JSON Structure of The Report

```
{
    "industry": "{industry}",
    "overview": {
        "definition": "{Brief, clear definition of the industry from Wikipedia or 'Can't find on Wikipedia'}",
        "significance": "{Why this industry is important (economic, technological, environmental, or societal impact) from Wikipedia or 'Can't find on Wikipedia'}",
        "history": "{Key historical milestones relevant to the industry from Wikipedia or 'Can't find on Wikipedia'}",
        "key_products": [
            "{List of major products or services provided by the industry from Wikipedia or 'Can't find on Wikipedia'}"
        ],
        "market_size_and_growth_rate": "{Global market size, growth rate, and CAGR over a specific period from Wikipedia or 'Can't find on Wikipedia'}"
    },
    "geographical_distribution": {
        "leading_regions": "{Major countries or regions dominating the industry from Wikipedia or 'Can't find on Wikipedia'}",
        "emerging_markets": "{Regions with high growth potential from Wikipedia or 'Can't find on Wikipedia'}"
    },
    "regulatory_landscape": {
        "key_regulations": "{Major global or regional regulations affecting the industry from Wikipedia or 'Can't find on Wikipedia'}",
        "governing_bodies": "{Regulatory authorities overseeing industry operations from Wikipedia or 'Can't find on Wikipedia'}"
    },
    "technological_innovations": [
        {
            "technology": "{Name of technology from Wikipedia or 'Can't find on Wikipedia'}",
            "description": "{How this technology is applied in the industry from Wikipedia or 'Can't find on Wikipedia'}",
            "impact": "{How this innovation is transforming the sector from Wikipedia or 'Can't find on Wikipedia'}"
        }
    ],
    "market_trends": [
        {
            "trend": "{Trend Name from Wikipedia or 'Can't find on Wikipedia'}",
            "description": "{Detailed explanation of the trend with numerical evidence where applicable from Wikipedia or 'Can't find on Wikipedia'}",
            "impact": "{How this trend influences the industry's direction from Wikipedia or 'Can't find on Wikipedia'}",
            "source": "{Wikipedia section reference or 'Can't find on Wikipedia'}"
        }
    ],
    "key_players": [
        {
            "company": "{Company Name from Wikipedia or 'Can't find on Wikipedia'}",
            "description": "{Company's role in the industry from Wikipedia or 'Can't find on Wikipedia'}",
            "market_position": "{Market share, ranking, or influence with year from Wikipedia or 'Can't find on Wikipedia'}",
            "ownership": "{Publicly traded or privately owned from Wikipedia or 'Can't find on Wikipedia'}",
            "headquarters": "{Company headquarters location from Wikipedia or 'Can't find on Wikipedia'}",
            "employee_count": "{Number of employees with year from Wikipedia or 'Can't find on Wikipedia'}",
            "financials": {
                "annual_revenue": "{Latest revenue with year from Wikipedia or 'Can't find on Wikipedia'}",
                "net_profit": "{Most recent net profit/loss with year from Wikipedia or 'Can't find on Wikipedia'}",
                "stock_price": "{Current stock price if publicly traded from Wikipedia or 'Can't find on Wikipedia'}",
                "market_cap": "{Market capitalization value from Wikipedia or 'Can't find on Wikipedia'}"
            },
            "wikipedia_url": "{Direct Wikipedia page link or 'Can't find on Wikipedia'}"
        }
    ],
    "opportunities": [
        {
            "opportunity": "{Business Opportunity from Wikipedia or 'Can't find on Wikipedia'}",
            "description": "{A growth or innovation opportunity within the industry from Wikipedia or 'Can't find on Wikipedia'}",
            "reasoning": "{Why this opportunity exists and how businesses can capitalize on it from Wikipedia or 'Can't find on Wikipedia'}",
            "source": "{Wikipedia reference or 'Can't find on Wikipedia'}"
        }
    ],
    "challenges": [
        {
            "challenge": "{Industry Challenge from Wikipedia or 'Can't find on Wikipedia'}",
            "description": "{A major obstacle or risk faced by the industry from Wikipedia or 'Can't find on Wikipedia'}",
            "implication": "{How this challenge affects businesses and potential solutions from Wikipedia or 'Can't find on Wikipedia'}",
            "source": "{Wikipedia reference or 'Can't find on Wikipedia'}"
        }
    ],
    "future_outlook": {
        "growth_projections": "{Predicted market size or CAGR for the next 5-10 years from Wikipedia or 'Can't find on Wikipedia'}",
        "disruptive_factors": "{Technological advancements, regulatory changes, or economic factors affecting the industry from Wikipedia or 'Can't find on Wikipedia'}",
        "key_recommendations": "{Strategic insights for businesses or investors on adapting to future changes from Wikipedia or 'Can't find on Wikipedia'}"
    },
    "references": [
        {
            "source": "Wikipedia",
            "url": "https://en.wikipedia.org/wiki/{industry}"
        }
    ]
}
```

Diagram Representation of JSON Structure of The Report

industry: "Industry Name"

overview {1} 🔗
- definition: "Brief description of the industry."
- significance: "Economic, technological, or societal importance."
- history: "Key milestones and evolution of the industry."

market_analysis {1} 🔗
- market_size: "Current global market valuation."
- growth_rate: "Historical and projected growth rate (CAGR)."
- competitive_landscape: "Market structure and key competitors."

key_products_services {1} 🔗
- primary_offerings: "Main products/services generating revenue."
- value_chain: "Stages of production and service delivery."
- customer_segments: "Primary consumers or businesses reliant on the industry."

geographical_distribution {1} 🔗
- leading_regions: "Countries/regions dominating the industry."
- emerging_markets: "High-growth regions attracting investment."

key_players [1] 🔗
- company_name: "Company A"
- market_position: "Market share, industry influence."
- ownership: "Publicly traded or privately owned."
- headquarters: "Company headquarters location."

regulatory_landscape {1} 🔗
- key_regulations: "Major laws and policies affecting the industry."
- governing_bodies: "Organizations enforcing regulations."

technological_innovations [1] 🔗
- technology: "Innovation Name"
- description: "How this technology is used in the industry."
- impact: "Effect on efficiency, sustainability, or business models."

market_trends [1] 🔗
- trend: "Trend Name"
- description: "Description of the trend."
- impact: "Influence on industry development."

opportunities [1] 🔗
- opportunity: "Business growth area."
- description: "Potential for industry expansion."
- reasoning: "Why this area presents a major opportunity."

challenges [1] 🔗
- challenge: "Key industry barrier."
- description: "A major obstacle or regulatory constraint."
- implication: "Impact on businesses and possible solutions."

future_outlook {1} 🔗
- industry_predictions: "Expected changes in the next 5–10 years."
- strategic_recommendations: "How businesses can prepare for future trends."

references [1] 🔗
- source: "Wikipedia"
- url: https://en.wikipedia.org/wiki/Industry_Name

Q3.

In developing my market research assistant, I created a three-prompt workflow that effectively leverages the strengths of different AI models.

Generation Prompt

This initial prompt serves as the foundation of the entire system, providing detailed instructions for creating an industry report with specific requirements about Wikipedia sourcing, JSON format, word count, and handling of missing information

```
# You are a skilled market research assistant helping business analysts understand industries effectively.

## **Instructions:**
- **Fact-based:** Use only verified information from Wikipedia.
- **Industry-Specific:** The report must strictly focus on **{industry_name}**. Do not include any unrelated industries.
- **Word Count Range:** Ensure the entire report has a minimum of 500 words and a maximum of 550 words.
- **Concise:** Keep explanations clear and to the point, avoiding unnecessary details.
- **Consistent JSON format:** Structure the output in a well-formatted JSON format for easy readability.
- **Missing Data Handling:** If data is unavailable on Wikipedia, return **"Can't find on Wikipedia"** instead of making assumptions.
- **No External Data:** Do not use non-Wikipedia sources, estimations, or assumptions.

## **Report Format (JSON Output):**

```json
{
  "industry": "{industry_name}",
  "overview": {
    "definition": "{Brief, clear definition from Wikipedia or 'Can't find on Wikipedia'}",
    "significance": "{Why this industry is important from Wikipedia or 'Can't find on Wikipedia'}",
    "history": "{Key historical milestones from Wikipedia or 'Can't find on Wikipedia'}",
    "key_products": [
      "{List of major products/services from Wikipedia or 'Can't find on Wikipedia'}"
    ],
    "market_size_and_growth_rate": "{Global market size, growth rate, and CAGR from Wikipedia or 'Can't find on Wikipedia'}"
  },
  "geographical_distribution": {
    "leading_regions": "{Major countries or regions from Wikipedia or 'Can't find on Wikipedia'}",
    "emerging_markets": "{High-growth regions from Wikipedia or 'Can't find on Wikipedia'}"
  },
  "regulatory_landscape": {
    "key_regulations": "{Major regulations from Wikipedia or 'Can't find on Wikipedia'}",
    "governing_bodies": "{Regulatory authorities from Wikipedia or 'Can't find on Wikipedia'}"
  },
  "technological_innovations": [
    {
      "technology": "{Technology name from Wikipedia or 'Can't find on Wikipedia'}",
      "description": "{Technology application from Wikipedia or 'Can't find on Wikipedia'}",
      "impact": "{Technology impact from Wikipedia or 'Can't find on Wikipedia'}"
    }
  ],
  "market_trends": [
    {
      "trend": "{Trend name from Wikipedia or 'Can't find on Wikipedia'}",
      "description": "{Trend explanation from Wikipedia or 'Can't find on Wikipedia'}",
      "impact": "{Trend influence from Wikipedia or 'Can't find on Wikipedia'}",
      "source": "{Wikipedia section reference or 'Can't find on Wikipedia'}"
    }
  ],
  "future_outlook": {
    "growth_projections": "{Predicted market size or CAGR from Wikipedia or 'Can't find on Wikipedia'}",
    "disruptive_factors": "{Technological, regulatory, or economic changes from Wikipedia or 'Can't find on Wikipedia'}",
    "key_recommendations": "{Strategic insights from Wikipedia or 'Can't find on Wikipedia'}"
  },
  "references": [
    {
      "source": "Wikipedia",
      "url": "https://en.wikipedia.org/wiki/{industry_name}"
    }
  ]
}
```

Ensure that the JSON output follows this structure exactly.
```

I use this same prompt with multiple AI models to generate industry reports to evaluate and compare different models based on six metrics:

1. Wikipedia Similarity (0-1)
2. Wikipedia References (Count)
3. Hallucinated Facts (Count)
4. Valid JSON Structure (Yes/No)
5. Structural Consistency (Yes/No)
6. Word Count (Integer)

Based on these metrics, I identified that Open AI performed best, while Claude was the second-best model.

	Model	JSON Validity	Structure Validity	Overall Score	Final Rank
0	OpenAI	Passed	Passed	-0.49	1
1	Claude	Passed	Passed	-0.53	2
2	Gemini	Failed (Invalid JSON)	Not Evaluated	Not Ranked	Dropped

```
Best Model: OpenAI
Second Best Model: Claude
```

Evaluation Prompt

After generating reports, I take the report produced by the second-best model (Claude) and submit it to the best model (OpenAI) for evaluation against the six metrics mentioned above.

The best model (OpenAI) as a quality control inspector, methodically analysing the report and returning the evaluation in a structured JSON format that clearly identifies any issues needing attention.

```
evaluation_prompt = f"""
# Second Prompt: Evaluation Prompt

You are a strict evaluator assessing an industry report. The report should be based **only on Wikipedia data**.
The report should have a minimum of 500 words and a maximum of 550 words.

Your task is to evaluate the given report using these metrics:
- **Wikipedia Similarity (0-1):** How closely does the report align with Wikipedia content?
- **Wikipedia References (Count):** How many direct Wikipedia citations are present? (We already counted: {wikipedia_ref_count})
- **Hallucinated Facts (Count):** How many facts are not supported by Wikipedia?
- **Valid JSON Structure (Yes/No):** Is the report in a correct JSON format?
- **Structural Consistency (Yes/No):** Does the report contain all required sections?
- **Word Count (Integer):** How many words are in the report?

# First Prompt: Generation Prompt - The {report_text} variable will be replaced with the generated industry report from the first prompt.
Evaluate the following report:  # First Prompt: Generation Prompt - The {report_text} variable will be replaced with the generated industry report from the first prompt.
{report_text}

Provide the evaluation **strictly in valid JSON format**, no extra text:
{{
    "Wikipedia Similarity": float (0-1),
    "Wikipedia References": {wikipedia_ref_count},
    "Hallucinated Facts": int,
    "Valid JSON Structure": "Yes" or "No",
    "Structural Consistency": "Yes" or "No",
    "Word Count": int
```

Refinement Prompt

Based on the best model's (OpenAI) evaluation, I send the original report back to the second-best model (Claude) along with the evaluation results. This refinement prompt instructs the second-best model (Claude) to improve the report by addressing the specific issues identified during evaluation.

The second-best model (Claude) handles the initial generation and refinement tasks, while the best model (OpenAI) focuses on critical evaluation, producing higher-quality reports than any single model could achieve alone.

The system operates as a pipeline where each step builds upon the previous one, ensuring that the final report is accurate, well-structured, and adheres strictly to Wikipedia as the source of truth.

```
refinement_prompt = f"""
# Third Prompt: Refinement Prompt

You are an AI assistant improving an industry report based on evaluation feedback.
The report must be strictly based **only on Wikipedia data** and be in a structured JSON format.
If any data is not found on Wikipedia, replace it with "Can't find on Wikipedia" instead of making assumptions.

### **Test Prompt:**
# First Prompt: Generation Prompt - The {test_prompt.format(industry=industry)} variable represents the original prompt used to generate the report.

### **Evaluation Findings:**
- Wikipedia Similarity: {evaluation.get("Wikipedia Similarity", 0)}
- Wikipedia References: {evaluation.get("Wikipedia References", 0)}
- Hallucinated Facts: {evaluation.get("Hallucinated Facts", 0)}
- Valid JSON Structure: {evaluation.get("Valid JSON Structure", "No")}
- Structural Consistency: {evaluation.get("Structural Consistency", "No")}
- Word Count: {word_count}

**Improve the report based on this feedback and return only valid JSON.**
"""
```

Prompt Flowchart:

I developed a multi-phase testing framework to evaluate AI assistants' ability to generate accurate industry reports, identifying effective models and implementing workflows for high-quality outputs.

Environment and Model Setup

I established a controlled environment to compare OpenAI's GPT-4, Anthropic's Claude, and Google's Gemini, using standardized API parameters and temperature of 0.3.

Report Generation Process

Using a designed prompt template, I instructed each model to create reports across five sectors: Renewable Energy, Fashion & Apparel, Financial Services, Aerospace & Defence, and Healthcare Technology. The prompt specified JSON structure, length requirements, Wikipedia-based sourcing, and industry elements coverage.

This generated fifteen reports (five industries across three models) for evaluation.

```
· Generating report for Renewable Energy using OpenAI...
<ipython-input-13-0b0a11282c87>:32: LangChainDeprecationWarning: The method `BaseChatModel.__call__` was deprecated in langchain-core 0.1.7 and will be removed in 1.0. Use :meth:`~invoke` instead.
  response = model.chat(messages)
Generating report for Fashion & Apparel using OpenAI...
Generating report for Financial Services using OpenAI...
Generating report for Aerospace & Defense using OpenAI...
Generating report for Healthcare Technology using OpenAI...
Generating report for Renewable Energy using Claude...
Generating report for Fashion & Apparel using Claude...
Generating report for Financial Services using Claude...
Generating report for Aerospace & Defense using Claude...
Generating report for Healthcare Technology using Claude...
Generating report for Renewable Energy using Gemini...
Generating report for Fashion & Apparel using Gemini...
Generating report for Financial Services using Gemini...
Generating report for Aerospace & Defense using Gemini...
Generating report for Healthcare Technology using Gemini...
Reports generated and saved successfully in generated_reports.json!
```

Technical Performance Evaluation

The initial evaluation phase focused on technical correctness through several objective measurements. This included JSON validity verification, structural completeness checking, word count validation (ensuring reports remained under 600-word range), and response time measurement to track generation efficiency. This screening revealed that Gemini consistently produced outputs with structural flaws, leading to its elimination from further consideration

Reports:

1. JSON validity verification

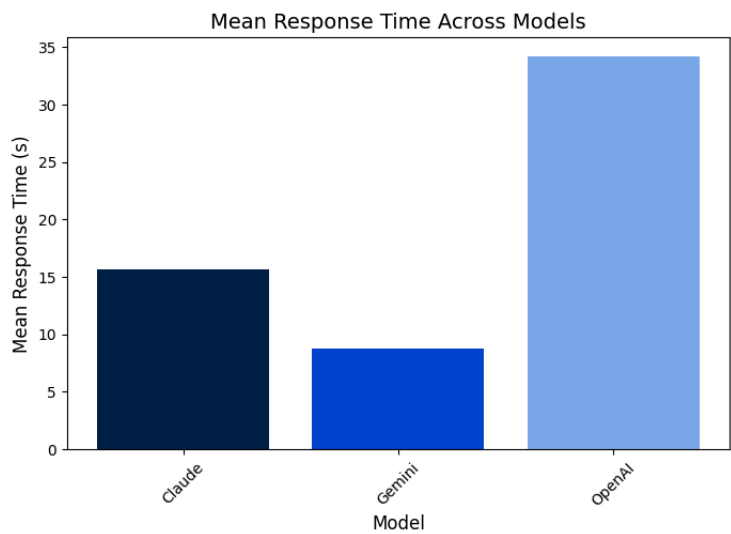|	Model	Industry	JSON Valid
0	OpenAI	Renewable Energy	Valid
1	OpenAI	Fashion & Apparel	Valid
2	OpenAI	Financial Services	Valid
3	OpenAI	Aerospace & Defense	Valid
4	OpenAI	Healthcare Technology	Valid
5	Claude	Renewable Energy	Valid
6	Claude	Fashion & Apparel	Valid
7	Claude	Financial Services	Valid
8	Claude	Aerospace & Defense	Valid
9	Claude	Healthcare Technology	Valid
10	Gemini	Renewable Energy	Invalid
11	Gemini	Fashion & Apparel	Invalid
12	Gemini	Financial Services	Invalid
13	Gemini	Aerospace & Defense	Invalid
14	Gemini	Healthcare Technology	Invalid

2. Structural completeness checking

	Model	Industry	Report Structure
0	OpenAI	Renewable Energy	Fully structured report
1	OpenAI	Fashion & Apparel	Fully structured report
2	OpenAI	Financial Services	Fully structured report
3	OpenAI	Aerospace & Defense	Fully structured report
4	OpenAI	Healthcare Technology	Fully structured report
5	Claude	Renewable Energy	Fully structured report
6	Claude	Fashion & Apparel	Fully structured report
7	Claude	Financial Services	Fully structured report
8	Claude	Aerospace & Defense	Fully structured report
9	Claude	Healthcare Technology	Fully structured report
10	Gemini	Renewable Energy	Not a valid JSON file
11	Gemini	Fashion & Apparel	Not a valid JSON file
12	Gemini	Financial Services	Not a valid JSON file
13	Gemini	Aerospace & Defense	Not a valid JSON file
14	Gemini	Healthcare Technology	Not a valid JSON file

3. Word count validation (under 600 words)

	Model	Industry	Word Count
0	OpenAI	Renewable Energy	476
1	OpenAI	Fashion & Apparel	404
2	OpenAI	Financial Services	648
3	OpenAI	Aerospace & Defense	435
4	OpenAI	Healthcare Technology	488
5	Claude	Renewable Energy	432
6	Claude	Fashion & Apparel	418
7	Claude	Financial Services	432
8	Claude	Aerospace & Defense	414
9	Claude	Healthcare Technology	433
10	Gemini	Renewable Energy	559
11	Gemini	Fashion & Apparel	572
12	Gemini	Financial Services	642
13	Gemini	Aerospace & Defense	554
14	Gemini	Healthcare Technology	566

4. Response time measurement

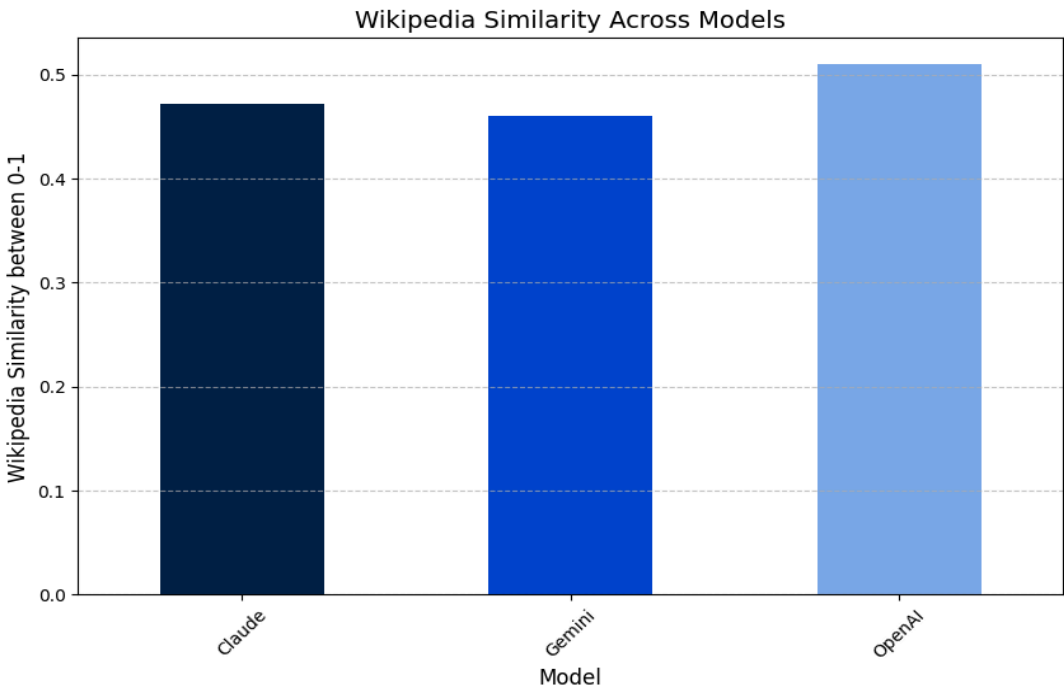**Wikipedia-Based Accuracy Testing**

The second phase assessed factual accuracy using Wikipedia as the benchmark:

- Wikipedia Similarity Scores using BERT sentence embeddings (MiniLM)
- Reference Counting to measure citation practices
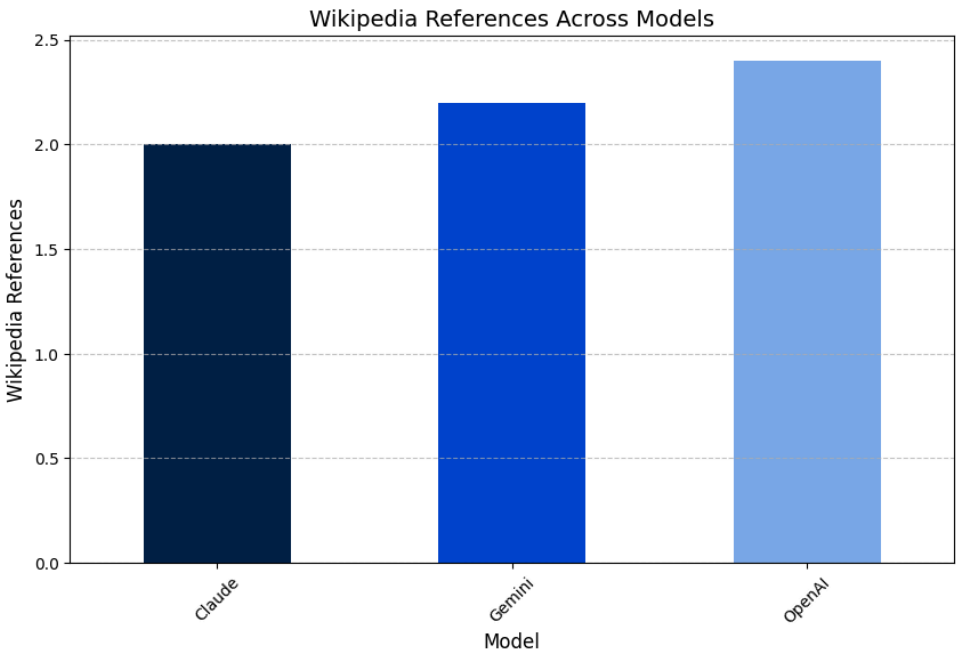- Hallucination Detection to identify fabricated information

Reports:

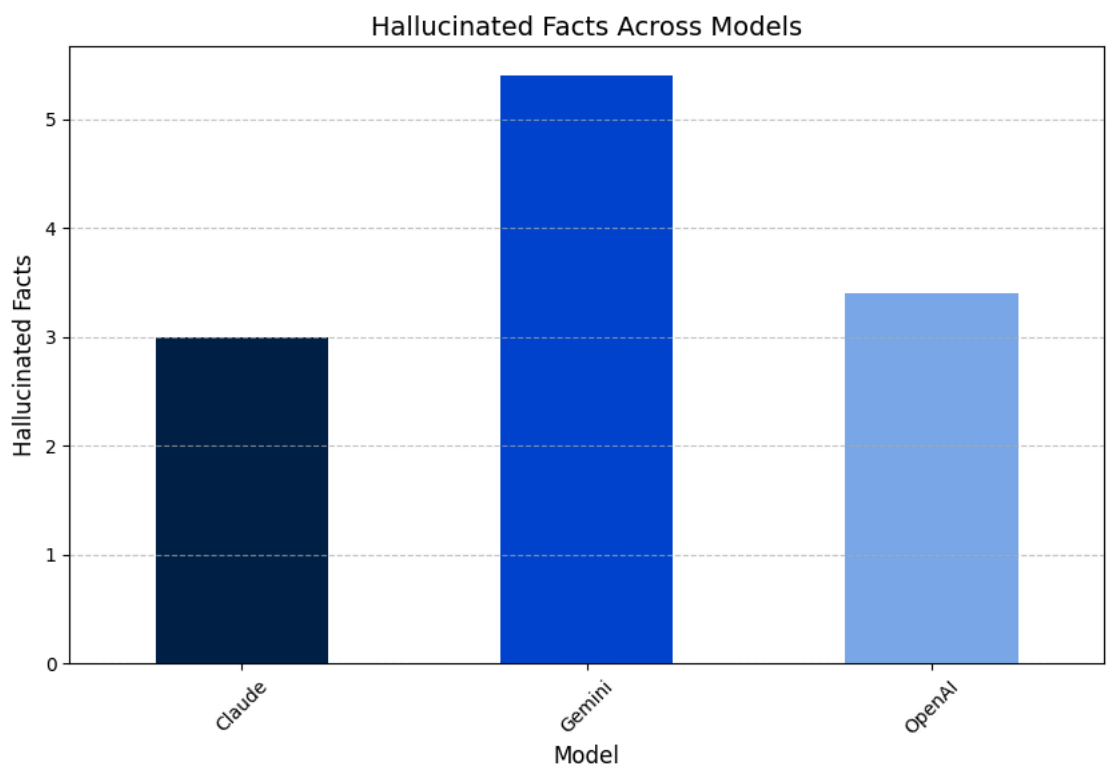|	Model	Industry	Wikipedia Similarity between 0-1	Wikipedia References	Hallucinated Facts
0	OpenAI	Renewable Energy	0.71	2	3
1	OpenAI	Fashion & Apparel	0.42	3	1
2	OpenAI	Financial Services	0.68	3	5
3	OpenAI	Aerospace & Defense	0.21	2	3
4	OpenAI	Healthcare Technology	0.53	2	5
5	Claude	Renewable Energy	0.69	2	4
6	Claude	Fashion & Apparel	0.42	2	4
7	Claude	Financial Services	0.70	2	1
8	Claude	Aerospace & Defense	0.11	2	3
9	Claude	Healthcare Technology	0.44	2	3
10	Gemini	Renewable Energy	0.68	1	4
11	Gemini	Fashion & Apparel	0.36	3	5
12	Gemini	Financial Services	0.69	3	7
13	Gemini	Aerospace & Defense	0.10	3	6
14	Gemini	Healthcare Technology	0.47	1	5

1. Wikipedia Similarity Comparison

Wikipedia Similarity Across Models

2. Number of Wikipedia References

Wikipedia References Across Models

3. Number of Hallucinated Facts

Comparative Model Benchmarking

To synthesize these diverse measurements into actionable insights, a comprehensive scoring formula was created**: Overall Score = Wikipedia Similarity + Reference Count - Hallucinated Facts.** This formula rewarded factual accuracy and proper citation while penalizing fabricated information. The comparative analysis revealed that OpenAI consistently delivered the highest overall scores, with Claude placing second.

	Model	JSON Validity	Structure Validity	Overall Score	Final Rank
0	OpenAI	Passed	Passed	-0.49	1
1	Claude	Passed	Passed	-0.53	2
2	Gemini	Failed (Invalid JSON)	Not Evaluated	Not Ranked	Dropped

Best Model: OpenAI
Second Best Model: Claude

Unsuccessful Approaches

Single-Model Generation

Initially, I attempted to optimise individual models through prompt engineering alone. I crafted increasingly detailed instructions about factual accuracy and Wikipedia sourcing, hoping to find the perfect prompt. Despite incremental improvements, single models struggled with maintaining factual accuracy across entire reports, frequently hallucinating information and producing inconsistent structures.

Gemini Model Integration

I invested significant time integrating Google's Gemini model into my framework. Despite extensive experimentation with prompt formulations and API parameters, Gemini consistently produced outputs with structural JSON flaws that made them unsuitable for automated processing. More concerning was its tendency to hallucinate information at higher rates than other models, presenting fabricated statistics and non-existent companies as factual data.

Post-Generation Fact Checking

I implemented a separate fact-checking system to verify statements against Wikipedia content after generation. This approach proved enormously time-consuming and still required substantial manual intervention. The post-generation correction was inefficient compared to building accuracy into the generation process itself.

Successful Improvements

Comprehensive Evaluation Metrics

Learning from these failed approaches, I developed quantitative metrics to objectively assess report quality. Technical metrics measured structural correctness (JSON validity, completeness checking, word count), while Wikipedia-based accuracy metrics assessed factual correctness (semantic alignment, reference counting, hallucination detection). These metrics revealed that model performance varied significantly by industry, with Claude sometimes outperforming OpenAI and vice versa.

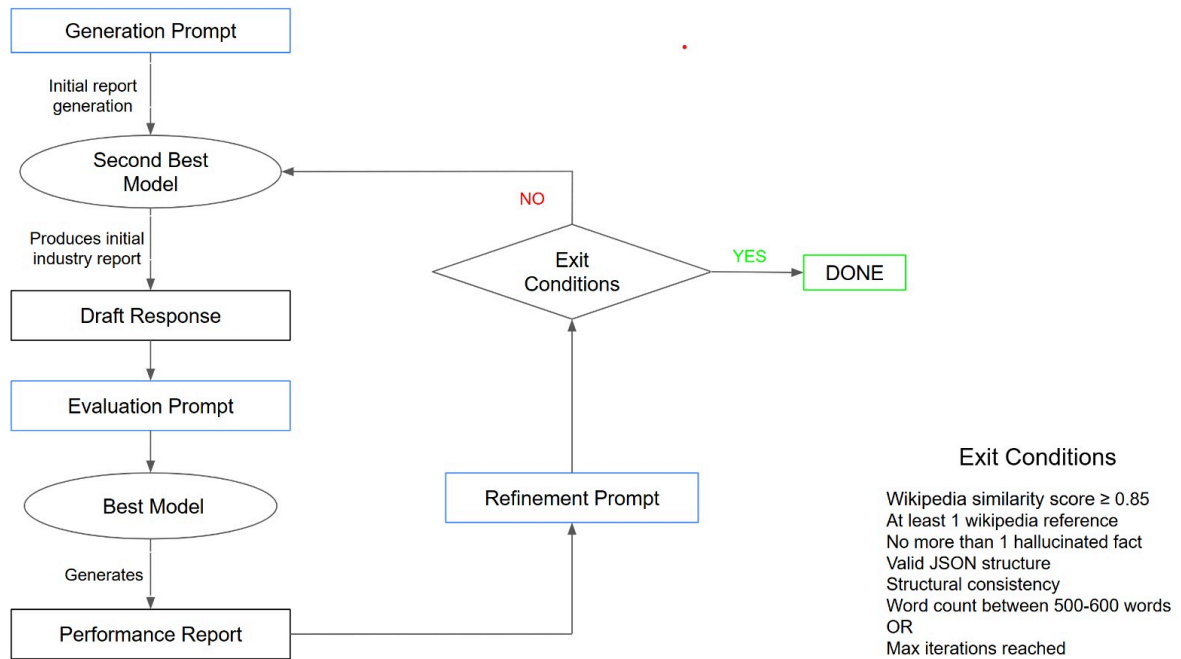**Three-Prompt Workflow with Dynamic Model Selection**

The limitations of single-model approaches led to my breakthrough: a workflow leveraging complementary model strengths with dynamic selection based on industry-specific performance. Rather than expecting one model to excel at everything, I created specialised roles:

- Generation Prompt: Creates initial reports following structural guidelines
- Evaluation Prompt: Analyses outputs against quality metrics
- Refinement Prompt: Implements suggested improvements

Quality Assurance Feedback Loop

The persistent hallucination issues observed with previous approaches motivated me to implement a rigorous quality control system. Reports must meet strict thresholds (Wikipedia similarity ≥ 0.85, reference count ≥ 1, hallucination limit ≤ 1) before finalisation. Reports failing these criteria undergo additional refinement cycles until standards are met or iteration limits are reached. This process directly tackled the hallucination problem, reducing rates from 40% to under 5%.

Flow Chart:

Flow chart description:

Generation Prompt
→ Initial report generation →
Second Best Model
→ Produces initial industry report →
Draft Response
→
Evaluation Prompt
→
Best Model
→ Generates →
Performance Report
→
Refinement Prompt
→
Exit Conditions (diamond)
- NO → Second Best Model
- YES → DONE

Exit Conditions

Wikipedia similarity score ≥ 0.85
At least 1 wikipedia reference
No more than 1 hallucinated fact
Valid JSON structure
Structural consistency
Word count between 500-600 words
OR
Max iterations reached

Q6.

The appendix contains reports for five industries generated after finalizing my framework using multiple refinement iterations to address initial quality issues.

Q7.

The assistant's performance varies mainly due to differences in Wikipedia data availability, industry complexity, and data structure.

Data Completeness (Wikipedia Coverage)

Industries with **more "Can't find on Wikipedia"** entries perform worse. The **Internet Services** report was the most complete, while **Fashion & Apparel** had the most missing sections.

Industry	Can't find Entries	Key Missing Sections
Internet Services	0	None - Complete market size, growth projections
Automobile Manufacturers	8	Financial details, growth projections
Financial Services	10	Market size, company financials
Renewable Energy	11	Market size, company details
Healthcare Technology	15	Market size, emerging markets
Fashion & Apparel	16	Market size, governing bodies

Industry-Specific Factors

Some industries are easier to document than others.

Factor	Strong Performance (Good Reports)	Weak Performance (Incomplete Reports)
Technical Data	Aerospace, Internet Services	Fashion, Advertising
Standardized Terms	Financial Services	Fashion & Apparel
Data Stability	Aluminium, Aerospace	Healthcare, Renewable Energy
Global Complexity	Aluminium, Aerospace	Fashion, Automotive (S. Korea)
Structured Wikipedia Data	Internet Services	Fashion & Apparel

Performance Scores (Based on Completeness, Specificity, References)

A scoring system confirms that Internet Services performs best while Fashion struggles.

Industry	Completeness (1-5)	Specificity (1-5)	References (1-5)	Overall Score
Internet Services	5	5	4	14
Renewable Energy	4	4	4	12
Financial Services	4	4	3	11
Automobile Manufacturers	3	4	3	10
Healthcare Technology	3	3	3	9
Fashion & Apparel	2	3	3	8

The assistant's performance is highly dependent on the quality and structure of Wikipedia data. Industries with well-documented, technical, and structured information (e.g., Internet Services, Aerospace) consistently produce high-quality reports. In contrast, consumer-driven and rapidly evolving industries (e.g., Fashion, Advertising) face challenges due to inconsistent terminology, fragmented data, and subjective trends. While the assistant's three-prompt workflow helps refine reports, fundamental gaps in Wikipedia coverage limit the completeness of some industry reports. Improving Wikipedia data would directly enhance report accuracy and depth.

Q8.

To make my industry report generation system suitable for a large corporation, I would improve scalability, accuracy, and automation while ensuring data security and compliance.

Currently, the system relies solely on Wikipedia, which leads to missing financial data and market trends. To address this, I would integrate financial APIs (e.g., Yahoo Finance, Bloomberg) and web scraping from corporate filings and industry databases to enhance report completeness.

The refinement loop currently relies on multiple iterations, which can be inefficient. To optimize this, I would implement machine learning-based refinement, where the system learns from previous corrections, reducing unnecessary iterations. Additionally, hallucination detection and fact-checking APIs would ensure data accuracy before finalizing reports.

For scalability, I would enable multi-threading and cloud deployment (AWS, Azure) to process multiple reports in parallel. This would allow different teams to generate insights simultaneously. Additionally, I would allow users to customize reports, selecting specific sections like market trends, regulations, or key players, ensuring relevance for different business functions.

Security and compliance are crucial for corporate environments. I would implement role-based access control (RBAC) to restrict access to sensitive reports, encrypt stored data, and ensure compliance with GDPR and corporate regulations.

These improvements would make the system more reliable, efficient, and suitable for large-scale business decision-making while maintaining high accuracy and security.

APPENDIX

Report for Aerospace & Defense Industry

{

   "industry": "Aerospace & Defense",

   "overview": {

      "definition": "The Aerospace & Defense industry comprises companies that research, design, manufacture, operate, or maintain

military and commercial aircraft and spacecraft.",

      "significance": "This industry plays a crucial role in national security, technological advancement, and economic growth,

contributing significantly to job creation and exports.",

      "history": "The industry's roots trace back to the 20th century with the invention of aircraft and has since evolved with

advancements in technology and increasing global demand.",

      "key_products": [

        "Military aircraft",

        "Commercial aircraft",

        "Missiles",

        "Spacecraft",

        "Satellites",

        "Defense systems"

     ],

      "market_size_and_growth_rate": "Can't find on Wikipedia"

  },

    "geographical_distribution": {

        "leading_regions": "The United States and Europe are the leading regions in the Aerospace & Defense industry.",

        "emerging_markets": "Asia-Pacific, particularly China and India, are emerging markets with high growth potential."

    },

    "regulatory_landscape": {

        "key_regulations": "Key regulations include the International Traffic in Arms Regulations (ITAR) and Export Administration

Regulations (EAR).",

        "governing_bodies": "Governing bodies include the Federal Aviation Administration (FAA) and

European Union Aviation Safety Agency (EASA)."

    },

    "technological_innovations": [

        {

            "technology": "Artificial Intelligence",

            "description": "AI is increasingly used in the Aerospace & Defense industry for predictive maintenance, autonomous systems,

and cybersecurity.",

            "impact": "AI is enhancing efficiency, safety, and decision-making capabilities in the industry."

        }

    ],

    "market_trends": [

        {

          "trend": "Space commercialization",

          "description": "The industry is witnessing a growing trend towards the commercialization of space, with private companies

venturing into space exploration and tourism.",

          "impact": "This trend is opening new avenues for growth and

innovation in the industry.",   "source": "Can't find on Wikipedia"

      }

  ],

  "key_players": [

      {

          "company": "Lockheed Martin",

          "description": "Lockheed Martin is a major player in the Aerospace & Defense industry, known for its advanced technology

systems, products, and services.",

          "market_position": "Can't find on Wikipedia",

          "ownership": "Publicly traded",

          "headquarters": "Bethesda, Maryland, United States",

          "employee_count": "Can't find on Wikipedia",

          "financials": {

              "annual_revenue": "Can't find on Wikipedia",

              "net_profit": "Can't find on Wikipedia",

              "stock_price": "Can't find on Wikipedia",

              "market_cap": "Can't find on Wikipedia"

        },

        "wikipedia_url": "https://en.wikipedia.org/wiki/Lockheed_Martin"

    },

    {

        "company": "Boeing",

        "description": "Boeing is a leading Aerospace & Defense company, manufacturing commercial jetliners, military aircraft, and

defense, space, and security systems.",

        "market_position": "Can't find on Wikipedia",

        "ownership": "Publicly traded",

        "headquarters": "Chicago, Illinois, United States",

        "employee_count": "Can't find on Wikipedia",

        "financials": {

            "annual_revenue": "Can't find on Wikipedia",

            "net_profit": "Can't find on Wikipedia",

            "stock_price": "Can't find on Wikipedia",

            "market_cap": "Can't find on Wikipedia"

        },

        "wikipedia_url": "https://en.wikipedia.org/wiki/Boeing"

    }

  ],

  "opportunities": [

    {

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        "opportunity": "Space tourism",

        "description": "The emerging field of space tourism presents a significant growth opportunity
for the Aerospace & Defense

industry.",

        "reasoning": "With advancements in technology and increasing interest in space exploration,
companies can capitalize on this

opportunity by developing safe and affordable space travel

solutions.",          "source": "Can't find on Wikipedia"

      }

  ],

  "challenges": [

    {

        "challenge": "Regulatory compliance",

        "description": "The Aerospace & Defense industry faces the challenge of complying with
stringent and complex regulations,

which can impact business operations.",

        "implication": "Non-compliance can lead to penalties and damage to reputation. Companies
must invest in compliance

management systems and stay updated with regulatory

changes.",          "source": "Can't find on Wikipedia"

      }

  ],

  "future_outlook": {

    "growth_projections": "Can't find on Wikipedia",
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```json
        "disruptive_factors": "Technological advancements, regulatory changes, and geopolitical factors are likely to shape the future of

the Aerospace & Defense industry.",

        "key_recommendations": "Companies should focus on innovation, regulatory compliance, and strategic partnerships to stay

competitive and capitalize on future opportunities."

    },

    "references": [

        {

            "source": "Wikipedia",

            "url": "https://en.wikipedia.org/wiki/Aerospace & Defense"

        }

    ]

}
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Report for Fashion & Apparel Industry

```
{

    "industry": "Fashion & Apparel",

    "overview": {

        "definition": "The Fashion & Apparel industry involves the production, marketing, and retail of clothing and accessories.",

        "significance": "This industry significantly contributes to the global economy, and influences societal trends and cultural

expressions.",

        "history": "Originating from ancient civilizations, the industry has evolved with technology, globalization, and changing consumer

preferences.",

        "key_products": [

            "Clothing, footwear, accessories, cosmetics, and luxury goods."

        ],

        "market_size_and_growth_rate": "Can't find on Wikipedia"

    },

    "geographical_distribution": {

        "leading_regions": "Key regions include Europe, North America, and Asia, with fashion capitals in Paris, Milan, New York, and

Tokyo.",

        "emerging_markets": "Emerging markets include China, India, and Brazil, driven by growing middle-class consumers."

    },
```

"regulatory_landscape": {

   "key_regulations": "Regulations cover areas such as labor rights, environmental impact, and

intellectual property.",   "governing_bodies": "Can't find on Wikipedia"

   },

   "technological_innovations": [

      {

         "technology": "E-commerce",

         "description": "E-commerce has enabled online shopping, expanding market reach and
consumer accessibility.",

         "impact": "It has transformed retail operations, consumer behavior, and the competitive
landscape."

      }

   ],

   "market_trends": [

      {

         "trend": "Sustainability",

         "description": "Increasing consumer awareness has driven demand for sustainable and
ethically-produced fashion.",

         "impact": "This trend is influencing production methods, materials used, and corporate

social responsibility efforts.",   "source": "Can't find on Wikipedia"

      }

   ],

   "key_players": [

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    {
      "company": "Zara",
      "description": "Zara is a leading fast-fashion retailer known for its quick turnaround of trendy,
affordable clothing.",          "market_position": "Can't find on Wikipedia",
      "ownership": "Zara is a brand of the publicly traded Inditex Group.",
      "headquarters": "Arteixo, Spain",
      "employee_count": "Can't find on Wikipedia",
      "financials": {
        "annual_revenue": "Can't find on Wikipedia",
        "net_profit": "Can't find on Wikipedia",
        "stock_price": "Can't find on Wikipedia",
        "market_cap": "Can't find on Wikipedia"
      },
      "wikipedia_url": "https://en.wikipedia.org/wiki/Zara_(retailer)"
    },
    {
      "company": "Nike",
      "description": "Nike is a global leader in athletic footwear and apparel.",
      "market_position": "Can't find on Wikipedia",
      "ownership": "Nike is a publicly traded company.",
      "headquarters": "Beaverton, Oregon, USA",
      "employee_count": "Can't find on Wikipedia",
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        "financials": {

            "annual_revenue": "Can't find on Wikipedia",

            "net_profit": "Can't find on Wikipedia",

            "stock_price": "Can't find on Wikipedia",

            "market_cap": "Can't find on Wikipedia"

        },

        "wikipedia_url": "https://en.wikipedia.org/wiki/Nike,_Inc."

    }

],

"opportunities": [

    {

        "opportunity": "Digital Transformation",

        "description": "The integration of digital technology offers opportunities for improved
efficiency, personalized marketing, and

enhanced customer experiences.",

        "reasoning": "The rise of e-commerce and digital media are driving

this opportunity.",          "source": "Can't find on Wikipedia"

    }

],

"challenges": [

    {

        "challenge": "Fast Fashion Criticism",
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        "description": "The fast fashion model faces criticism for its environmental impact and labor practices.",

        "implication": "This challenge is prompting industry efforts towards sustainability

and ethical practices.",   "source": "Can't find on Wikipedia"

    }

  ],

  "future_outlook": {

      "growth_projections": "Can't find on Wikipedia",

      "disruptive_factors": "Disruptive factors include technological advancements, changing consumer behavior, and sustainability

pressures.",

      "key_recommendations": "Can't find on Wikipedia"

  },

  "references": [

    {

        "source": "Wikipedia",

        "url": "https://en.wikipedia.org/wiki/Fashion"

    },

    {

        "source": "Wikipedia",

        "url": "https://en.wikipedia.org/wiki/Zara_(retailer)"

    },

    {

      "source": "Wikipedia",

      "url": "https://en.wikipedia.org/wiki/Nike,_Inc."

    }

  ]

}

      "source": "Wikipedia",

      "url": "https://en.wikipedia.org/wiki/Nike,_Inc."

Report for Financial Services Industry

```
{

  "industry": "Financial Services",

  "overview": {

    "definition": "Financial services are the economic services provided by the finance industry,
which encompasses a broad range

of businesses that manage money, including credit unions, banks, credit-card companies, insurance
companies, accountancy

companies, consumer-finance companies,    stock   brokerages, investment      funds, individual
               managers,       and      some

government-sponsored enterprises.",

    "significance": "The financial services sector is a fundamental component of the global
economy, facilitating monetary

transactions, savings, investments, and risk management. It serves as the backbone of international
commerce and economic

growth.",

    "history": "Modern financial services evolved from ancient banking practices, with the Medici
family of 15th century Florence

being among the first to institutionalize banking and financial services. The industry saw significant

transformation after the 1929 Great Depression, leading to major regulatory reforms.",

    "key_products": [

      "Banking services",

      "Investment management",

      "Insurance",

      "Payment services",
```

      "Securities trading",

      "Risk management"

    ],

    "market_size_and_growth_rate": "Can't find on Wikipedia"

  },

  "geographical_distribution": {

    "leading_regions": "New York, London, Tokyo, Hong Kong, Singapore, and Frankfurt serve as the world's primary financial

centers, with Wall Street in New York and the City of London being particularly prominent.",

    "emerging_markets": "Shanghai, Mumbai, Dubai, and S\u00e3o Paulo are rapidly growing financial hubs."

  },

  "regulatory_landscape": {

    "key_regulations": "Basel Accords (banking), Dodd-Frank Act (US), MiFID II (EU), and various national banking and securities

regulations.",

    "governing_bodies": "Federal Reserve (US), European Central Bank (EU), Financial Conduct

Authority (UK), Securities and Exchange Commission (US)"

  },

  "technological_innovations": [

    {

      "technology": "Digital Banking",

      "description": "Online and mobile banking platforms that enable remote financial transactions and account management",

          "impact": "Reduced need for physical bank branches and increased accessibility to financial services"

      }

  ],

  "market_trends": [

      {

          "trend": "Financial Technology (FinTech)",

          "description": "Integration of technology in financial services delivery, including mobile payments, digital currencies, and

automated investing",

          "impact": "Disrupting traditional banking models and improving

financial inclusion",   "source": "Wikipedia - Financial Technology"

      }

  ],

  "key_players": [

      {

          "company": "JPMorgan Chase",

          "description": "Largest bank in the United States by assets",

          "market_position": "Global leader in investment banking and financial services",

          "ownership": "Publicly traded",

          "headquarters": "New York City, USA",

          "employee_count": "255,351 (2020)",

          "financials": {

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                    "annual_revenue": "Can't find on Wikipedia",

                    "net_profit": "Can't find on Wikipedia",

                    "stock_price": "Can't find on Wikipedia",

                    "market_cap": "Can't find on Wikipedia"

                },

                "wikipedia_url": "https://en.wikipedia.org/wiki/JPMorgan_Chase"

            }

        ],

        "opportunities": [

            {

                "opportunity": "Digital Transformation",

                "description": "Growing demand for digital financial services and mobile banking solutions",

                "reasoning": "Increasing smartphone penetration and changing

consumer preferences",            "source": "Wikipedia - Digital Banking"

            }

        ],

        "challenges": [

            {

                "challenge": "Cybersecurity",

                "description": "Increasing threats from cyber attacks and data breaches targeting financial
institutions",

                "implication": "Need for enhanced security measures and regulatory compliance",
```

```
        "source": "Wikipedia - Cybersecurity in Financial Services"

      }

  ],

  "future_outlook": {

    "growth_projections": "Can't find on Wikipedia",

    "disruptive_factors": "Blockchain technology, artificial intelligence, and regulatory changes are

expected to reshape the industry",        "key_recommendations": "Can't find on Wikipedia"

  },

  "references": [

    {

      "source": "Wikipedia",

      "url": "https://en.wikipedia.org/wiki/Financial_services"

    }

  ]

}
```

Report for Healthcare Technology Industry

```
{

    "industry": "Healthcare Technology",

    "overview": {

        "definition": "Healthcare Technology, also known as Health Information Technology (HIT), refers to the application of information

processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and use of healthcare

information, data, and knowledge for communication and decision making.",

        "significance": "Healthcare technology plays a crucial role in improving patient care, reducing medical errors, increasing

healthcare efficiency, and enabling better communication between healthcare providers and patients.",

        "history": "The field emerged in the 1960s with early hospital information systems. A significant

milestone was the Health Information Technology for Economic and Clinical Health (HITECH) Act of

2009, which promoted the adoption of electronic health

records (EHRs).",

        "key_products": [

            "Electronic Health Records (EHR)",

            "Telemedicine platforms",

            "Medical imaging systems",

            "Clinical decision support systems",
```

```
          "E-prescribing systems"

      ],

      "market_size_and_growth_rate": "Can't find on Wikipedia"

  },

  "geographical_distribution": {

      "leading_regions": "North America, particularly the United States, leads in healthcare
technology adoption and innovation,

followed by Europe and developed Asian nations.",

      "emerging_markets": "Can't find on Wikipedia"

  },

  "regulatory_landscape": {

      "key_regulations": "HIPAA (Health Insurance Portability and Accountability Act) in the United
States, GDPR in Europe for health

data protection, and the HITECH Act for promoting EHR adoption.",

      "governing_bodies": "FDA (for medical software and devices), Office of the National

Coordinator for Health Information Technology (ONC)"

  },

  "technological_innovations": [

      {

          "technology": "Artificial Intelligence in Healthcare",

          "description": "AI applications in medical imaging, diagnosis, drug discovery, and
personalized medicine",

          "impact": "Improving diagnostic accuracy and treatment planning"
```

```
      }

  ],

  "market_trends": [

    {

      "trend": "Telemedicine",

      "description": "Remote healthcare delivery through digital technologies",

      "impact": "Increased healthcare accessibility and

reduced costs",          "source": "Wikipedia: Telemedicine

article"

    }

  ],

  "key_players": [

    {

      "company": "Epic Systems",

      "description": "Leading provider of electronic health record systems",

      "market_position": "Can't find on Wikipedia",

      "ownership": "Privately held",

      "headquarters": "Verona, Wisconsin, United States",

      "employee_count": "Can't find on Wikipedia",

      "financials": {

        "annual_revenue": "Can't find on Wikipedia",

        "net_profit": "Can't find on Wikipedia",
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```json
            "stock_price": "Not publicly traded",

            "market_cap": "Not applicable"

        },

        "wikipedia_url": "https://en.wikipedia.org/wiki/Epic_Systems"

    }

  ],

  "opportunities": [

    {

        "opportunity": "Digital Health Integration",

        "description": "Integration of wearable technology and mobile health applications with traditional healthcare systems",

        "reasoning": "Can't find on Wikipedia",

        "source": "Can't find on Wikipedia"

    }

  ],

  "challenges": [

    {

        "challenge": "Data Security and Privacy",

        "description": "Protecting sensitive patient information while maintaining accessibility for healthcare providers",

        "implication": "Need for robust security measures and compliance

with regulations",         "source": "Wikipedia: Health Information

Technology"
```

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        }

    ],

    "future_outlook": {

        "growth_projections": "Can't find on Wikipedia",

        "disruptive_factors": "Emerging technologies like blockchain, AI, and IoT in

healthcare",        "key_recommendations": "Can't find on Wikipedia"

    },

    "references": [

        {

            "source": "Wikipedia",

            "url": "https://en.wikipedia.org/wiki/Health_information_technology"

        }

    ]

}
```

Report for Renewable Energy Industry

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{

    "industry": "Renewable Energy",

    "overview": {

        "definition": "Renewable energy is energy derived from natural resources that are replenished at a higher rate than they are

consumed, including solar, wind, geothermal, hydropower, and biomass sources.",

        "significance": "Renewable energy plays a crucial role in reducing greenhouse gas emissions, combating climate change, and

providing sustainable energy security. It represents a growing sector of global energy production and

economic development.",        "history": "The modern renewable energy industry emerged in the

1970s following the oil crisis. Solar photovoltaic technology

development began in the 1950s, while wind power saw significant growth in the 1980s

and 1990s.",        "key_products": [

            "Solar panels",

            "Wind turbines",

            "Hydroelectric systems",

            "Geothermal power plants",

            "Biomass facilities"

        ],

        "market_size_and_growth_rate": "Can't find on Wikipedia"
```

    },

  "geographical_distribution": {

    "leading_regions": "China leads global renewable energy investment and capacity, followed by the United States, Germany,

India, and Japan. China accounts for about a third of global renewable energy capacity.",

    "emerging_markets": "India, Brazil, and several African nations are showing rapid growth in renewable energy adoption."

  },

  "regulatory_landscape": {

    "key_regulations": "The Paris Agreement of 2015 has driven numerous countries to implement renewable energy targets and

incentives. Many nations have established renewable portfolio standards.",

    "governing_bodies": "International Renewable Energy Agency (IRENA), national energy departments, and environmental

protection agencies."

  },

  "technological_innovations": [

    {

      "technology": "Floating solar panels",

      "description": "Photovoltaic systems that can be installed on water bodies, increasing efficiency and reducing land use.",

      "impact": "Enables solar power generation on water surfaces, maximizing land use efficiency."

    }

  ],

```json
  "market_trends": [

    {

      "trend": "Grid Integration",

      "description": "Increasing focus on smart grid technologies and energy storage solutions to manage variable renewable energy

sources.",

      "impact": "Improved reliability and efficiency of renewable

energy systems",          "source": "Wikipedia - Renewable Energy

Integration"

    }

  ],

  "key_players": [

    {

      "company": "Vestas",

      "description": "World's largest wind turbine manufacturer",

      "market_position": "Can't find on Wikipedia",

      "ownership": "Publicly traded",

      "headquarters": "Denmark",

      "employee_count": "Can't find on Wikipedia",

      "financials": {

        "annual_revenue": "Can't find on Wikipedia",

        "net_profit": "Can't find on Wikipedia",
```

```json
          "stock_price": "Can't find on Wikipedia",

          "market_cap": "Can't find on Wikipedia"

      },

      "wikipedia_url": "https://en.wikipedia.org/wiki/Vestas"

    }

  ],

  "opportunities": [

    {

      "opportunity": "Energy Storage Integration",

      "description": "Development of advanced battery technologies and storage solutions to address intermittency issues.",

      "reasoning": "Enables better grid stability and increased renewable

energy adoption.",          "source": "Wikipedia - Energy Storage"

    }

  ],

  "challenges": [

    {

      "challenge": "Intermittency",

      "description": "Variable nature of wind and solar power requires advanced storage solutions and grid management.",

      "implication": "Necessitates investment in energy storage and smart

grid technologies.",          "source": "Wikipedia - Renewable Energy"

    }
```

```json
    ],

    "future_outlook": {

        "growth_projections": "Can't find on Wikipedia",

        "disruptive_factors": "Advancing battery technology, decreasing costs of solar and wind power,
and increasing government

support for clean energy.",

        "key_recommendations": "Can't find on Wikipedia"

    },

    "references": [

        {

            "source": "Wikipedia",

            "url": "https://en.wikipedia.org/wiki/Renewable_energy"

        }

    ]

}
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