VICTORIA SOLUTIONS
CONSULTING GROUP

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Project Title (Example – Week1, Week2, Week3)	Week1: AI Text Classifier case study

Project Guidelines and Rules

1. **Formatting and Submission**
   - **Format:** Use a readable font (e.g., Arial/Times New Roman), size 12, 1.5 line spacing.
   - **Title:** Include Week and Title (Example - Week 1: TravelEase Case Study.)
   - **File Format:** Submit as PDF or Word file to contact@victoriasolutions.co.uk
   - **Page Limit:** 4–5 pages, including the title and references.

2. **Answer Requirements**
   - **Word Count:** Each answer should be 100–150 words; total 800–1,200 words.
   - **Clarity:** Write concise, structured answers with key points.
   - **Tone:** Use formal, professional language.

3. **Content Rules**
   - Answer all questions thoroughly, referencing case study concepts.
   - Use examples where possible (e.g., risk assessment techniques).
   - Break complex answers into bullet points or lists.

4. **Plagiarism Policy**
   - Submit original work; no copy-pasting.
   - Cite external material in a consistent format (e.g., APA, MLA).

5. **Evaluation Criteria**

- **Understanding:** Clear grasp of business analysis principles.
- **Application:** Effective use of concepts like cost-benefit analysis and Agile/Waterfall.
- **Clarity:** Logical, well-structured responses.
- **Creativity:** Innovative problem-solving and examples.
- **Completeness:** Answer all questions within the word limit.

6. **Deadlines and Late Submissions**
   - **Deadline:** Submit on time; trainees who submit fail to submit the project will miss the "Certificate of Excellence"

7. **Additional Resources**
   - Refer to lecture notes and recommended readings.
   - Contact the instructor or peers for clarifications before the deadline.

START YOUR PROJECT FROM HERE:

Part1: questions answering

Q1 — Explaining AI to a non-technical stakeholder

AI builds systems that learn from data to automate decisions and tasks. Example: a bank uses AI for real-time fraud detection, catching anomalies faster than manual review. Business benefits: faster decision-making, lower operational losses, and scalable personalization. uses AI as an assistive tool that augments, not replaces, human judgment [1][2].

Q2 — Supervised vs. Unsupervised learning

Supervised learning uses labeled examples to predict outcomes (e.g., loan approvals). Unsupervised learning finds structure in unlabeled data (e.g., customer segments for targeted marketing). Choose supervised when KPIs are clear; choose unsupervised for exploratory insights. Combine both for discovery → prediction pipelines to support strategic decisions [1][2].

Q3 — Handling overfitting in neural networks

Overfitting means a model memorizes training noise and fails on new data. Mitigate with:

- dropout, regularization, early stopping, and cross-validation.
  Business impact: prevents erroneous inventory or financial forecasts. Cost→benefit: extra tuning cost vs. avoided operational losses and improved trust in predictions [2].

Q4 — How transformers changed NLP

Transformers use self-attention to weigh context across entire sequences, enabling better handling of long text and polysemy (e.g., “bank” meaning). Business outcomes: faster model training, superior translation, and robust summarization—useful for contract analysis, customer feedback mining, and automating document workflows [1][2].

Q5 — Deploying a TensorFlow model in production

Deploy via TensorFlow Serving for APIs or TensorFlow Lite for mobile. Use Docker for consistency and Prometheus/Grafana for monitoring. Agile rollout (pilot → scale) reduces operational risk. Cost: infra + monitoring; Benefit: real-time predictions, reduced manual work, and measurable ROI through faster decisions [2].

Q6 — Building a chatbot using LLMs

Define scope, fine-tune with domain logs, and craft prompts for tone. Integrate with CRM and add fallback rules and content filters. Agile testing with staged users identifies failure cases quickly. Business gains: lower support costs and faster response times; risks require monitoring for hallucinations [2].

Q7 — Designing an e-commerce recommendation system

Use a hybrid approach: collaborative filtering (behavior) + content-based (product attributes). Handle cold start with metadata and popularity signals. Measure CTR, conversion, and diversity to avoid echo chambers. Iterate in short sprints to tune relevance and maximize incremental revenue [1].

Q8 — Debugging a model that fails in production

Systematic steps:

- check data drift,
- verify preprocessing parity,
- examine feature distribution changes,

- test with representative holdout.
  Example: retrain credit models after economic shifts. Business priority: restore accuracy quickly to preserve trust and compliance [1].

Q9 — Addressing bias in AI models

Mitigate bias by auditing datasets, re-sampling or re-weighting, and using fairness metrics. Add post-deployment monitoring and a redress process. Example: correct an applicant-screening model by augmenting underrepresented groups—this reduces legal risk and improves talent diversity [1][2].

Q10 — Learning from failure in an AI project

Common cause: insufficient data quality. Remedy: invest early in data collection, labeling standards, and exploratory analysis. Use rapid prototypes to reveal gaps (Agile). Cost up-front yields reduced rework, better model performance, and stronger stakeholder confidence [2].

Q11 — Explaining the attention mechanism simply

Attention lets a model focus on the most relevant inputs when making a decision, like highlighting key sentences in a report. In practice, it improves accuracy in translation, summarization, and targeted responses—delivering clearer automated outputs for business users [2].

Q12 — Most exciting AI trend and why

Multimodal AI (text + vision + audio) is exciting: it enables richer, human-like interactions. Example: a diagnostic tool that reads scans, notes, and voice logs together. Business trade-off: higher development cost vs. significantly better decision support and competitive differentiation .

Q13 — How reinforcement learning works (example)

RL trains agents by rewards/penalties. Example: logistics use RL to optimize routing policies that minimize fuel and delay. Cost: simulation or interaction data; benefit: sustained operational savings and adaptive policies aligned with evolving constraints **[2].**

Q14 — PyTorch vs. TensorFlow: pros and cons

PyTorch: flexible, researcher-friendly, great for prototyping (supports Agile experimentation). TensorFlow: strong production tooling and deployment options (appeals to

enterprise Waterfall pipelines). Choose based on team skills, speed-to-prototype, and production reliability needs [2].

Q15 — Generative AI business applications

Generative models create content—copy, images, and synthetic data. Uses: automated marketing content, quick design prototypes, and synthetic datasets for privacy-safe training. Consider governance: review costs vs. time savings and brand consistency benefits .

Q16 — Validating a medical computer vision model

Validation steps: clinical expert review, diverse demographic testing, sensitivity analysis (minimize false negatives), and real-world pilots. Risk assessment and regulatory readiness are essential. Benefits: improved patient outcomes and justified adoption after rigorous trials.

Q17 — Why the SQL query generation case study worked

Success factors: contextual schema prompts, iterative refinement, and seamless UI integration for non-technical users. Business result: faster data access by analysts, increased productivity, and reduced analyst backlog—demonstrating clear operational ROI .

Q18 — How I stay updated in AI

I balance reading key chapters from core texts, practicing small projects, and reviewing recent techniques through applied notebooks. This mix keeps skills practical and aligned with business needs, enabling quick adoption of relevant methods .

Q19 — Harder: data cleaning or model tuning?

Data cleaning is harder: it requires domain judgment, handling missing values, and bias checks. Quality data reduces tuning effort; tuning is more systematic and often automatable. Prioritize data investment for reliable, interpretable models [2].

Q20 — Where AI should not be used

Avoid AI where ethics and empathy dominate decisions (e.g., sensitive mental health judgments), where biases cause harm, or when ROI is negative for simple tasks. Prefer human judgment or rule-based systems in such contexts

Part2: AI Text Classifier: Sort Positive vs. Negative Movie Reviews

Methodology and Best Practices

To ensure the integrity and reliability of the model, the following best practices were implemented during the data preparation phase:

- **Stratified Data Splitting**: The dataset was split into training and testing sets using stratified sampling. This approach ensures that the proportion of 'positive' and 'negative' reviews is consistent across both sets, which is **particularly crucial for a small dataset to prevent biased sampling** and ensure a reliable model evaluation.
- **Preventing Data Leakage:** The CountVectorizer was fitted exclusively on the training data. **This step prevents data leakage by ensuring the model's vocabulary is learned only from the training set**. The same fitted vectorizer was then used to transform the testing data, ensuring the model's performance is evaluated on truly unseen data.

Results:

```
print(f"Model Accuracy: {accuracy}")
print(f"Prediction for new review: {new_prediction[0]}")
```

```
Model Accuracy: 0.5
Prediction for new review: positive
```

Some enhancement and modifications:

- **Expanded Dataset:** Used a larger, more diverse dataset with 28 reviews to improve model training and evaluation.
- **Hyperparameter Tuning**: Implemented GridSearchCV to automatically find the best alpha parameter for the Naive Bayes model.
- **Advanced Metrics:** Included a classification report and a confusion matrix to provide a detailed breakdown of the model's performance beyond simple accuracy.
- **Model Analysis:** Added code to calculate the ROC-AUC score and generate data for a learning curve to help diagnose model bias or variance**.**

Results after modifications:

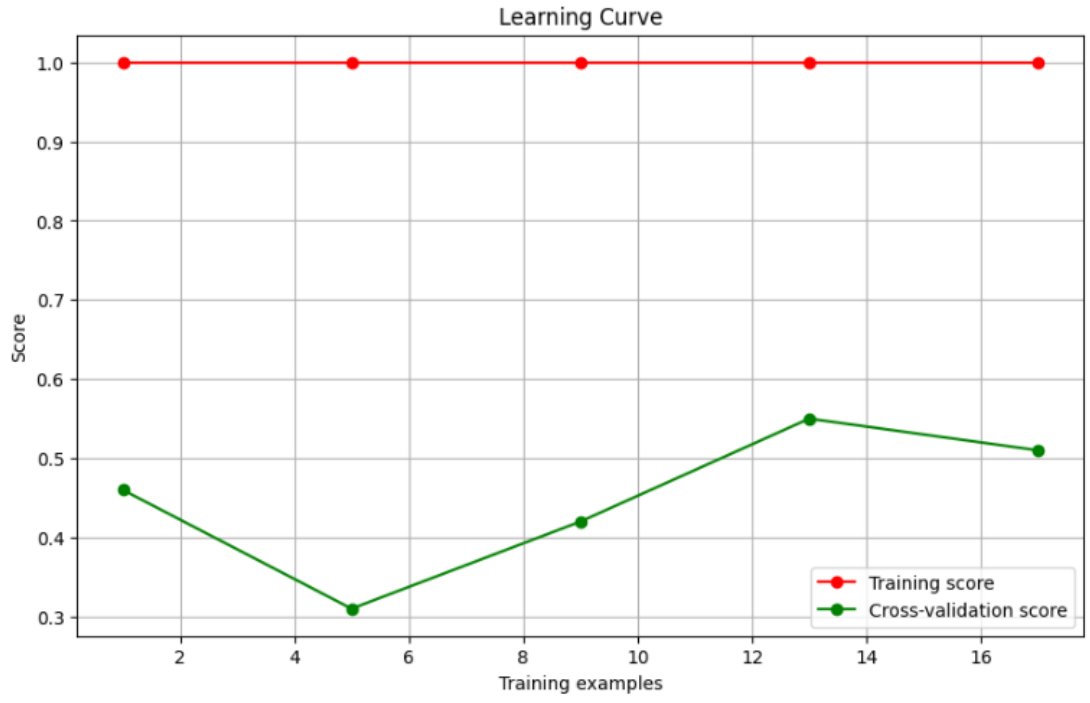
Classfication_Report:

```
--- Running Grid Search for best alpha ---
Fitting 5 folds for each of 6 candidates, totalling 30 fits
Best parameters found by Grid Search: {'alpha': 0.5}
Best cross-validation accuracy: 0.56

--- Model Evaluation (using best model from Grid Search) ---
Test Set Accuracy: 0.83

--- Classification Report ---
              precision    recall  f1-score   support

    negative       0.75      1.00      0.86         3
    positive       1.00      0.67      0.80         3

    accuracy                           0.83         6
   macro avg       0.88      0.83      0.83         6
weighted avg       0.88      0.83      0.83         6
```

Confusion Matrix:

```
--- Confusion Matrix ---
True Positive (Predicted Positive, Actual Positive): 2
False Negative (Predicted Negative, Actual Positive): 1
False Positive (Predicted Positive, Actual Negative): 0
True Negative (Predicted Negative, Actual Negative): 3

Raw Confusion Matrix:
[[2 1]
 [0 3]]
```

Learning curve:

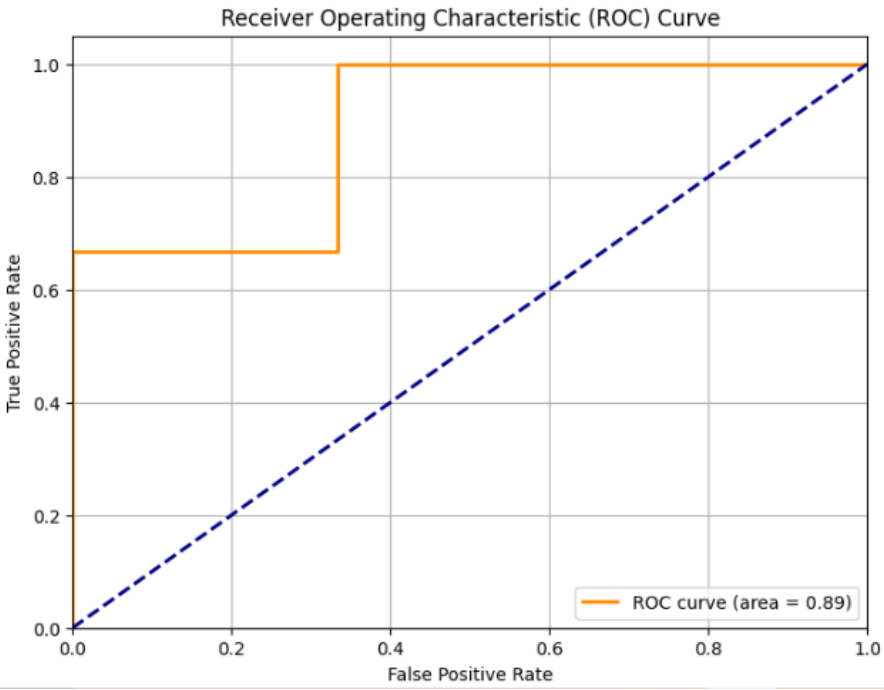


Analysis of learning curve:

High Variance (Overfitting): The large gap between the training score (1.0) and cross-validation score indicates that the model is likely overfitting. It's performing perfectly on the data it's seen but struggling with new, unseen data.

Action: To address this, the size and diversity of the training data must be increased. Also, regularization techniques will be added or simplifying the model if it's too complex for the current dataset.

Roc-Auc_Curve:



Analysis of roc_auc curve:

- **Strong Performance**: An AUC of 0.89 shows the model is very good at distinguishing between positive and negative reviews.
- **Action:** This is an excellent result! but I must Consider testing with more diverse data to ensure consistency.

Final_result:

```
Review: "I would not recommend this movie, it was so boring"
Predicted Sentiment: negative
```

Future recommendations:

- **Dataset Expansion**: The dataset should be significantly expanded to improve generalization and reduce overfitting.
- **Advanced Feature Exploration:** More advanced text representations, such as TF-IDF or word embeddings, could be explored for richer semantic understanding.
- **Alternative Model Evaluation:** Other classification models, like Support Vector Machines (SVMs) or Logistic Regression, should be experimented with for potential performance gains.
- **Misclassification Review:** Misclassifications should be systematically reviewed to identify areas for model improvement.

Code link:

The link of the code is here

References

[1] Koul, D. (2022). *Designing Machine Learning Systems: An iterative process for production-ready applications*. O'Reilly Media.

[2] Géron, A. (2022). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* (3rd ed.). O'Reilly Media.