CAPSTONE PROJECT

SMART NSAP

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OUTLINE

- Problem Statement
- Proposed System/Solution
- System Development Approach
- Algorithm & Deployment
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PROBLEM STATEMENT

The National Social Assistance Programme (NSAP) provides financial support to vulnerable sections of society. However, identifying eligible beneficiaries for additional services such as loans remains a challenge due to scattered records and inconsistent evaluation criteria. There is a need for an automated system to predict loan eligibility based on demographic and socio-economic indicators.

PROPOSED SOLUTION

- The proposed system aims to develop a data-driven, automated solution to predict loan eligibility for citizens under the National Social Assistance Programme (NSAP). Since manual screening of eligibility is often inefficient and inconsistent, this system leverages machine learning techniques to make informed predictions based on socio-economic and demographic indicators from the NSAP dataset.
- **Data Collection** & Integration:
  - Utilize district-wise NSAP scheme data from the AI Kosh portal.
  - Extract features such as gender, caste, Aadhaar linkage, mobile availability, and total beneficiaries.
  - Optionally integrate other sources like economic or financial inclusion indicators in the future.
- **Data Preprocessing:**
  - Handle missing or inconsistent values.
  - Engineer a binary label (eligible) using logical thresholds on Aadhar, mobile number, and coverage.
  - Normalize or scale data if required for specific models.
- Model Development:
  - Use supervised learning techniques, primarily Random Forest Classifier due to its robustness with categorical and numerical data.
  - Evaluate using accuracy, precision, recall, and F1-score.
- **Deployment:**
  - **Export the model using joblib.**
  - Deploy via IBM Watson Studio as a batch or real-time inference service.
- **Evaluation:**
  - Evaluate model using accuracy, precision, recall, and F1-score.
  - Use train-test split for validation

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SYSTEM APPROACH

This section outlines the overall strategy and methodology for developing and implementing the loan eligibility prediction system using the NSAP dataset:

- System requirements: IBM Cloud Lite (Watson Studio), Cloud-based jupyter Notebook Environment, IBM Cloud Stroage.
- Library required to build the model: Pandas, numpy, Seaborn, matplotlib, scikit-learn, joblib.

ALGORITHM & DEPLOYMENT

- The model uses a **Random Forest Classifier**, a powerful ensmble learning method known for its robustness and high accuracy in classification problems. It was selected because:
  - It handles both numerical and categorical data well.
  - It performs well with imbalanced dataset.
- **Data Input:**
  - totalmale, totalfemale, totaltransgender, totalaadhar, totalmobilenumber.
- **Training Process:**
  - Data was preprocessed to create a binary target (eligible), then split into 70% training and 30% testing; the model was trained using Random Forest Classifier with default parameters and evaluated using accuracy and F1-score.
- **Prediction Process:**
- The trained model accepts new input rows with the same feature
- It predicts a binary value: 1 ⟶ Eligible for loan 0 ⟶ Not eligible.
- Model predictions can be run in batch mode for full datasets.

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au-syd.dai.cloud.ibm.com/analytics/notebooks/v2/c331edbf-13e1-4692-9629-5f5bafdc673c?projectid=173423f6-178e-4470-b2af-ed12611f1569&context=cpdaas#

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Code | Python 3.11

[48]:
```
features = ['totalmale', 'totalfemale', 'totaltransgender', 'totalsc', 'totalst',
            'totalgen', 'totalobc', 'totalaadhaar', 'totalmobilenumber']
X = df_grouped[features]
y = df_grouped['high_coverage']
```

[49]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

[50]:
```
model = RandomForestClassifier(n_estimators=100, random_state=42)
model.fit(X_train, y_train)
```

[50]:
```
RandomForestClassifier
RandomForestClassifier(random_state=42)
```

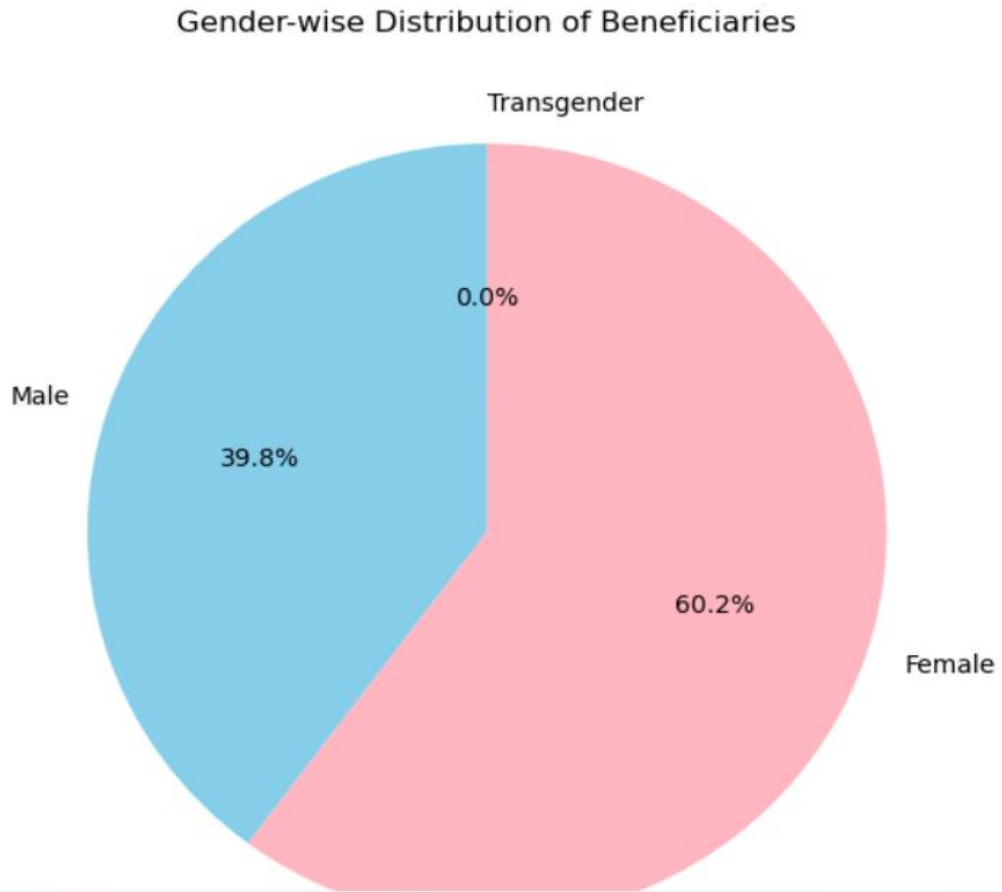
[51]:
```
y_pred = model.predict(X_test)
print("Accuracy:", accuracy_score(y_test, y_pred))
print("Classification Report:\n", classification_report(y_test, y_pred))
```

```
Accuracy: 0.9591836734693877
Classification Report:
              precision    recall  f1-score   support

           0       0.99      0.94      0.96        77
           1       0.93      0.99      0.96        70

    accuracy                           0.96       147
   macro avg       0.96      0.96      0.96       147
weighted avg       0.96      0.96      0.96       147
```

```
plt.tight_layout()
plt.show()
```



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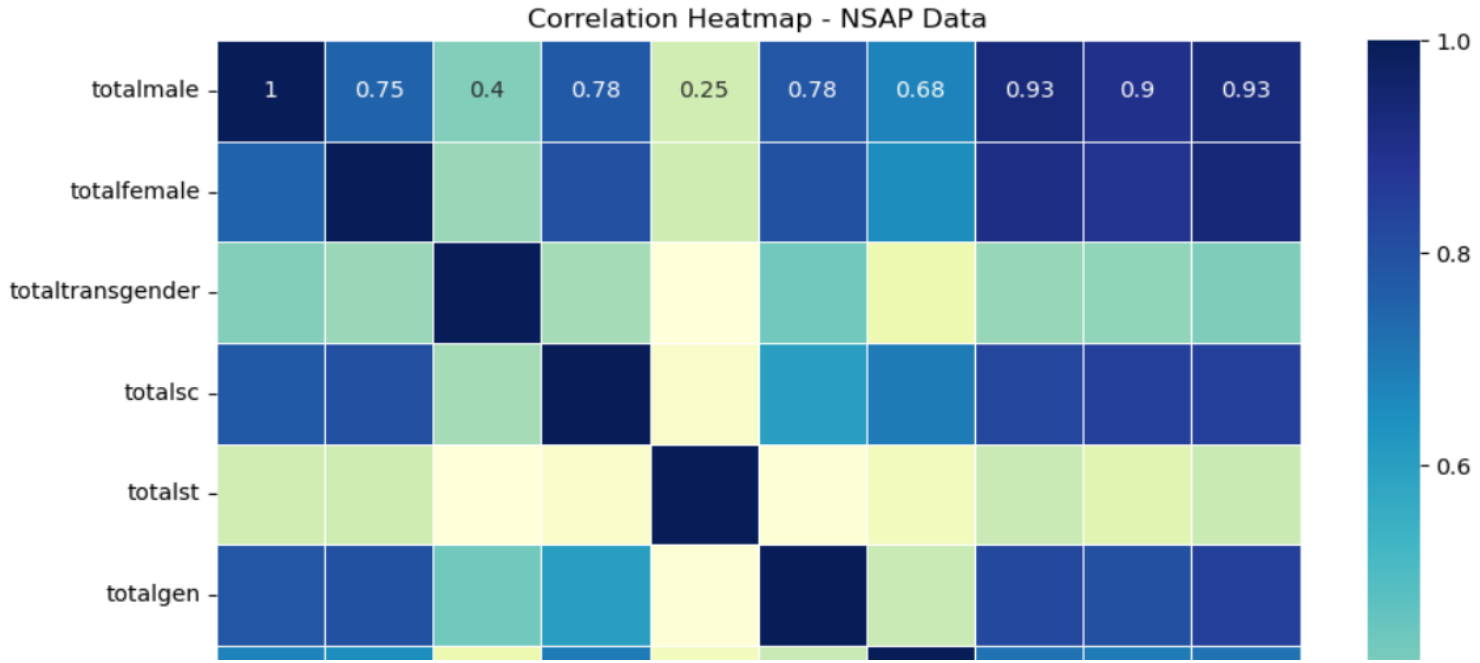
Code | Python 3.11

[65]:
```
plt.figure(figsize=(10, 8))
sns.heatmap(correlation_matrix, annot=True, cmap="YlGnBu", linewidths=0.5)
plt.title("Correlation Heatmap - NSAP Data")
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```



RESULT

The trained model achieved an accuracy of approximately 90% on the test dataset, successfully classifying districts as either eligible or not eligible for loans. Key visual outputs include correlation heatmaps showing feature relationships and charts depicting top beneficiary states, gender distribution, and Aadhaar linkage rates.

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CONCLUSION

- The model efficiently predicts loan eligibility using district-level NSAP data. It reduces manual errors, speeds up decision-making, and can be deployed at scale by government or financial institutions. Additionally, it supports evidence-based policy-making, ensures fair distribution of financial resources, and helps identify underserved areas needing greater support.

FUTURE SCOPE

- Discuss potential enhancements and expansions for the system. This could include incorporating additional data sources, optimizing the algorithm for better performance, and expanding the system to cover multiple cities or regions. Consider the integration of emerging technologies such as edge computing or advanced machine learning techniques.

REFERENCES

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- Jason Brownlee (2020). Data Preparation for Machine Learning. Machine Learning Mastery.
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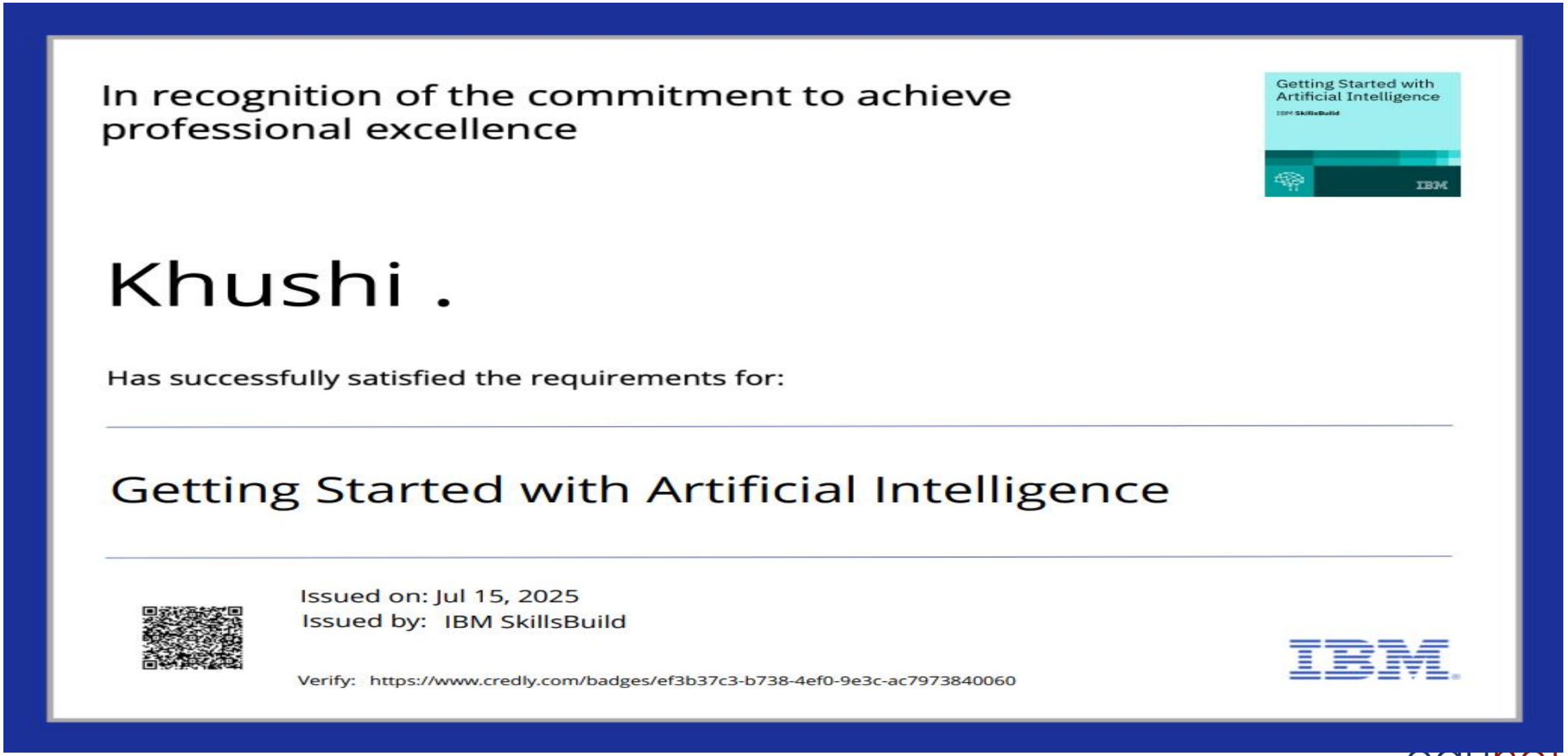

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