Week 4 ML Deployment Document

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Introduction

This project aims to predict job salary using Extreme Gradient Boosting (XGB) ML model and then deploy the model on Flask API through a web app service.

Data Information

	Age	Gender	Education Level	Job Title	Years of Experience	Salary
0	32.0	Male	Bachelor's	Software Engineer	5.0	90000.0
1	28.0	Female	Master's	Data Analyst	3.0	65000.0
2	45.0	Male	PhD	Senior Manager	15.0	150000.0
3	36.0	Female	Bachelor's	Sales Associate	7.0	60000.0
4	52.0	Male	Master's	Director	20.0	200000.0

```
Data columns (total 6 columns):
 #   Column               Non-Null Count  Dtype  
---  ------               --------------  -----  
 0   Age                  373 non-null    float64
 1   Gender               373 non-null    object 
 2   Education Level      373 non-null    object 
 3   Job Title            373 non-null    object 
 4   Years of Experience  373 non-null    float64
 5   Salary               373 non-null    float64
```

Data Preprocessing

- Split categorical variables to get job level and job title features;
- Use dummy coding to code Gender, Education level, and job titles for better model performance;

```
df.loc[df['job_level'] == 'Senior', 'Senior'] = 1
df.loc[df['job_level'] != 'Senior', 'Senior'] = 0
df.loc[df['job_level'] == 'Junior', 'Junior'] = 1
df.loc[df['job_level'] != 'Junior', 'Junior'] = 0
```

```
df = df.drop(['job_level'], axis = 1)
```

```
from sklearn import preprocessing
```

```
encode = preprocessing.LabelEncoder()
```

```
df['Education'] = encode.fit_transform(df['Education Level'])
df['jobs'] = encode.fit_transform(df['title'])
```

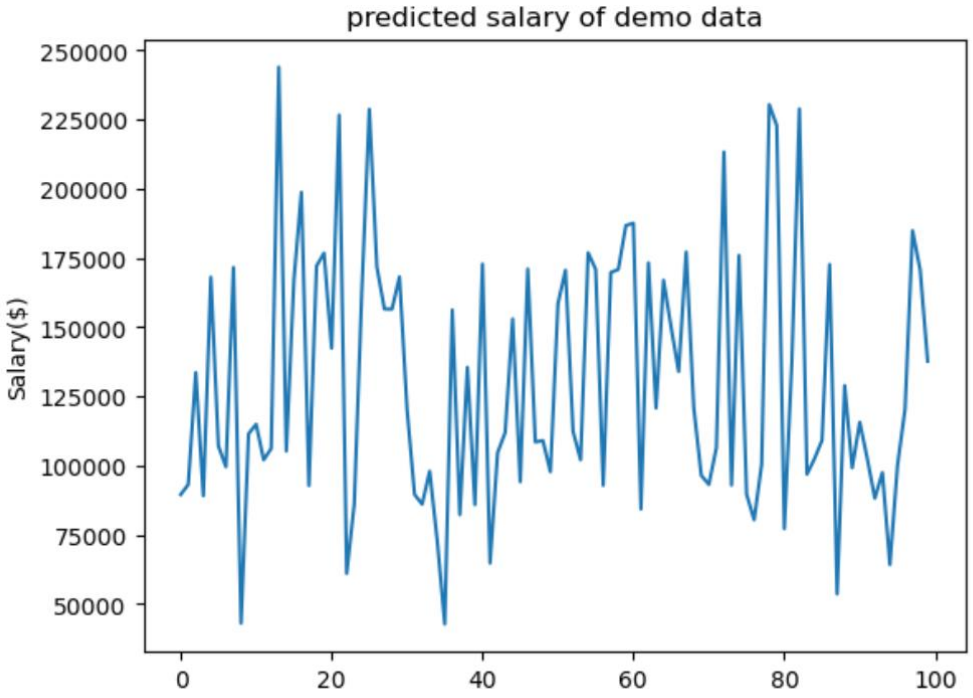
```
df['Male'] = pd.get_dummies(df['Gender'], drop_first=True)
```

```
df.head()
```

	Age	Gender	Education Level	Job Title	Years of Experience	Salary	job title	title	Senior	Junior	Education	jobs	Male
0	32.0	Male	Bachelor's	Software Engineer	5.0	90000.0	[Engineer]	Software Engineer	0.0	0.0	0	101	1
1	28.0	Female	Master's	Data Analyst	3.0	65000.0	[Analyst]	Data Analyst	0.0	0.0	1	23	0
2	45.0	Male	PhD	Senior Manager	15.0	150000.0	[Manager]	Manager	1.0	0.0	2	63	1
3	36.0	Female	Bachelor's	Sales Associate	7.0	60000.0	[Associate]	Sales Associate	0.0	0.0	0	90	0
4	52.0	Male	Master's	Director	20.0	200000.0	[]	Director	0.0	0.0	1	31	1

Model Build

After data processing, we implement XGB Regressor to fit the dataset, predict job salary, and then save the model for later deployment.



Model Deployment

Use Flask to deploy web applications allow users inputs. Then take the inputs to predict model outcomes.

```
app = Flask(__name__)
model = pickle.load(open('model.pkl', 'rb'))
```

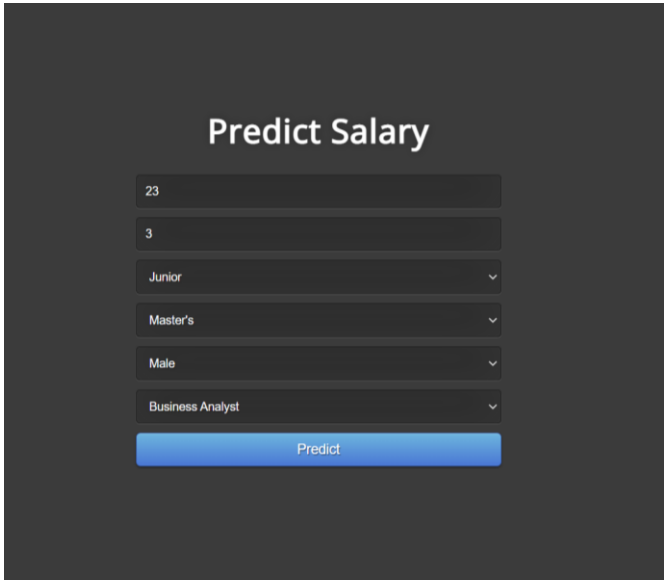
```
@app.route('/')
def home():
    return render_template('index.html')
```

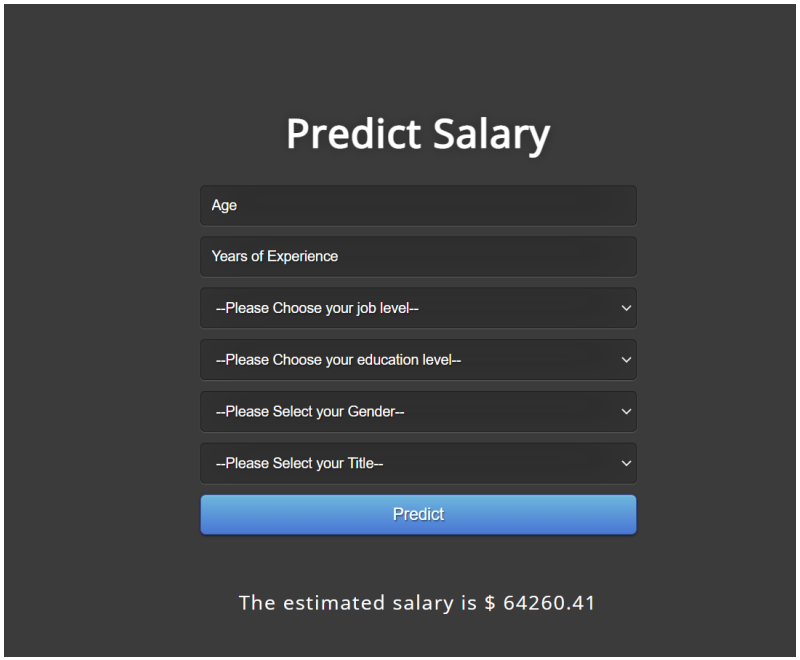
```
@app.route('/predict',methods=['POST'])
def predict():
    int_features = [int(x) for x in request.form.values()]
    if int_features[2] == 1:
        int_features.insert(0, 3)
    elif int_features[2] == 0:
        int_features.insert(1, 3)
    final_features = [np.array(int_features)]
    prediction = model.predict(final_features)

    output = round(prediction[0], 2)

    return render_template('index.html', prediction_text='The estimated salary is $ {}'.format(output))
```

```
@app.route('/results',methods=['POST'])
def results():

    data = request.get_json(force=True)
    prediction = model.predict([np.array(list(data.values()))])

    output = prediction[0]
    return jsonify(output)
```

Run on Website

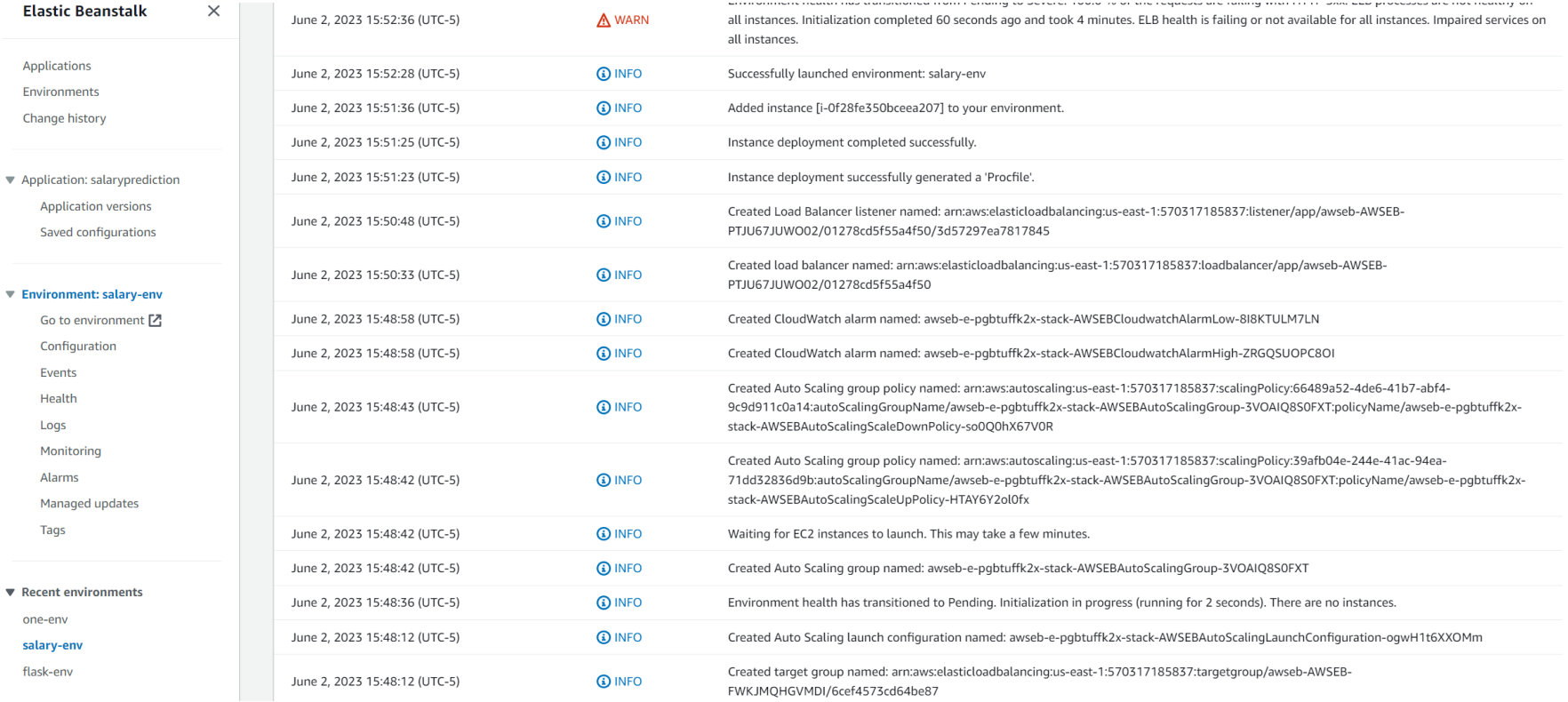
Create a simple html web that is based on the given template. Testing the API to check if it’s working.




Predict Salary
Age
Years of Experience
--Please Choose your job level--
--Please Choose your education level--
--Please Select your Gender--
--Please Select your Title--
Predict
The estimated salary is $ 64260.41

Cloud Deployment

Deploy the web app on AWS cloud service using Elastic Beanstalk.



Elastic Beanstalk

- Applications
- Environments
- Change history

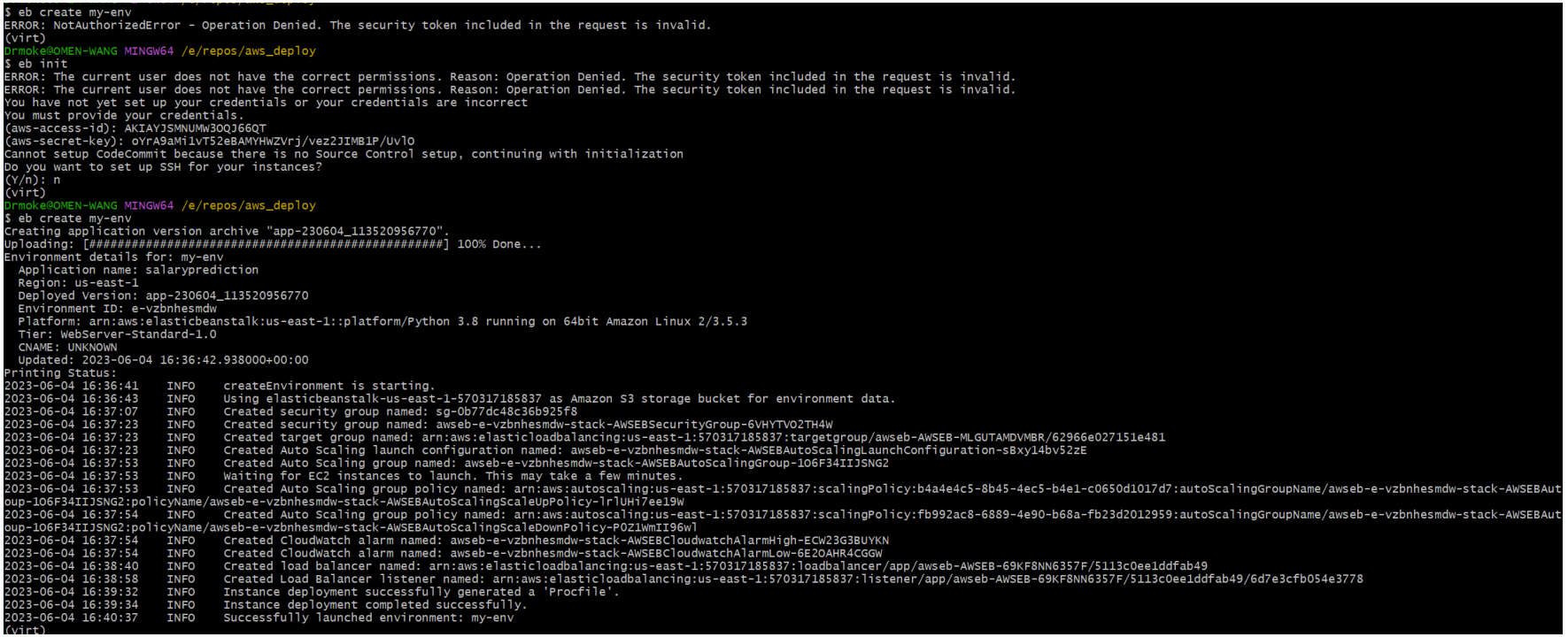
▼ Application: salaryprediction
- Application versions
- Saved configurations

▼ **Environment: salary-env**
- Go to environment
- Configuration
- Events
- Health
- Logs
- Monitoring
- Alarms
- Managed updates
- Tags

▼ **Recent environments**
- one-env
- **salary-env**
- flask-env

June 2, 2023 15:52:36 (UTC-5)	WARN	Environment health has transitioned from Pending to Severe. 100.0 % of the requests are failing with HTTP 5xx. ELB processes are not healthy on all instances. Initialization completed 60 seconds ago and took 4 minutes. ELB health is failing or not available for all instances. Impaired services on all instances.
June 2, 2023 15:52:28 (UTC-5)	INFO	Successfully launched environment: salary-env
June 2, 2023 15:51:36 (UTC-5)	INFO	Added instance [i-0f28fe350bceea207] to your environment.
June 2, 2023 15:51:25 (UTC-5)	INFO	Instance deployment completed successfully.
June 2, 2023 15:51:23 (UTC-5)	INFO	Instance deployment successfully generated a 'Procfile'.
June 2, 2023 15:50:48 (UTC-5)	INFO	Created Load Balancer listener named: arn:aws:elasticloadbalancing:us-east-1:570317185837:listener/app/awseb-AWSEB-PTJU67JUWO02/01278cd5f55a4f50/3d57297ea7817845
June 2, 2023 15:50:33 (UTC-5)	INFO	Created load balancer named: arn:aws:elasticloadbalancing:us-east-1:570317185837:loadbalancer/app/awseb-AWSEB-PTJU67JUWO02/01278cd5f55a4f50
June 2, 2023 15:48:58 (UTC-5)	INFO	Created CloudWatch alarm named: awseb-e-pgbtuffk2x-stack-AWSEBCloudwatchAlarmLow-8I8KTULM7LN
June 2, 2023 15:48:58 (UTC-5)	INFO	Created CloudWatch alarm named: awseb-e-pgbtuffk2x-stack-AWSEBCloudwatchAlarmHigh-ZRGQSUOPC8OI
June 2, 2023 15:48:43 (UTC-5)	INFO	Created Auto Scaling group policy named: arn:aws:autoscaling:us-east-1:570317185837:scalingPolicy:66489a52-4de6-41b7-abf4-9c9d911c0a14:autoScalingGroupName/awseb-e-pgbtuffk2x-stack-AWSEBAutoScalingGroup-3VOAIQ8S0FXT:policyName/awseb-e-pgbtuffk2x-stack-AWSEBAutoScalingScaleDownPolicy-so0Q0hX67V0R
June 2, 2023 15:48:42 (UTC-5)	INFO	Created Auto Scaling group policy named: arn:aws:autoscaling:us-east-1:570317185837:scalingPolicy:39afb04e-244e-41ac-94ea-71dd32836d9b:autoScalingGroupName/awseb-e-pgbtuffk2x-stack-AWSEBAutoScalingGroup-3VOAIQ8S0FXT:policyName/awseb-e-pgbtuffk2x-stack-AWSEBAutoScalingScaleUpPolicy-HTAY6Y2ol0fx
June 2, 2023 15:48:42 (UTC-5)	INFO	Waiting for EC2 instances to launch. This may take a few minutes.
June 2, 2023 15:48:42 (UTC-5)	INFO	Created Auto Scaling group named: awseb-e-pgbtuffk2x-stack-AWSEBAutoScalingGroup-3VOAIQ8S0FXT
June 2, 2023 15:48:36 (UTC-5)	INFO	Environment health has transitioned to Pending. Initialization in progress (running for 2 seconds). There are no instances.
June 2, 2023 15:48:12 (UTC-5)	INFO	Created Auto Scaling launch configuration named: awseb-e-pgbtuffk2x-stack-AWSEBAutoScalingLaunchConfiguration-ogwH1t6XXOMm
June 2, 2023 15:48:12 (UTC-5)	INFO	Created target group named: arn:aws:elasticloadbalancing:us-east-1:570317185837:targetgroup/awseb-AWSEB-FWKJMQHGVMDI/6cef4573cd64be87

Use git bash to deploy virtual environment.



App website: http://my-env.eba-iytbnfzn.us-east-1.elasticbeanstalk.com/