🎓 Prometheus & Grafana Quick Guide

☑ Step-by-Step Instructions

📊 PROMETHEUS Tutorial (http://localhost:9090)

What is Prometheus?

Prometheus shows RAW metrics data. It's where the data is stored.

Step 1: Open Prometheus

1. Open: http://localhost:9090
2. You should see a query box at the top

Step 2: Make Some Predictions First!

IMPORTANT: You need to generate data first!

1. Go to Streamlit: http://localhost:8501
2. Click "DDoS Attack" → Click "Analyze Traffic"
3. Click "Web Attack" → Click "Analyze Traffic"
4. Click "Normal Traffic" → Click "Analyze Traffic"
5. Make at least 5-10 predictions

Step 3: Query Metrics in Prometheus

Now go back to Prometheus (http://localhost:9090)

Query 1: Total Predictions

1. In the query box, type: `predictions_total`
2. Click the blue "Execute" button
3. You should see:

```
predictions_total{prediction="Attack"} 7
predictions_total{prediction="Normal"} 3
```

4. Click the "Graph" tab to see it as a chart!

Query 2: API Requests

1. Clear the query box
2. Type: `api_requests_total`
3. Click "Execute"
4. Shows how many API calls to each endpoint

Query 3: Expert Weights (Who's doing the work?)

1. Type: `expert_gating_weight`
2. Click "Execute"
3. Shows:
    - Tabular Expert (FT-Transformer): ~98%
    - Temporal Expert (CNN): ~2%

Query 4: Model Status

1. Type: `model_loaded`
2. Click "Execute"
3. Should show: `1` (model is loaded)

Query 5: Request Rate (attacks per second)

1. Type: `rate(predictions_total{prediction="Attack"}[1m])`
2. Click "Execute"
3. Click "Graph" tab
4. Shows attack detection rate over time!

GRAFANA Tutorial (http://localhost:3000)

What is Grafana?

Grafana makes BEAUTIFUL dashboards from Prometheus data.

Step 1: Login to Grafana

1. Open: http://localhost:3000
2. Login:
    - Username: `admin`
    - Password: `admin`
3. Click "Skip" when asked to change password

Step 2: Add Prometheus as Data Source

1. Click the ⚙ **(gear icon)** on the left sidebar
2. Click **"Data sources"**
3. Click **"Add data source"** (blue button)
4. Click **"Prometheus"** (first option)
5. In the URL field, enter: `http://prometheus:9090`
6. Scroll down and click **"Save & Test"**
7. You should see green message: "Successfully queried the Prometheus API"

Step 3: Create Your First Dashboard

Create Dashboard:

1. Click ➕ **(plus icon)** on left sidebar
2. Click **"Create Dashboard"**
3. Click **"Add visualization"**

Panel 1 - Total Predictions (Big Number):

1. In "Query" field, type: `sum(predictions_total)`
2. On the right side, change:
    - Panel title: "Total Predictions"
    - Visualization type: "Stat" (top right dropdown)
3. Click **"Apply"** (top right)

Add Another Panel:

1. Click **"Add"** → **"Visualization"** (top right)
2. In "Query" field, type: `predictions_total`
3. On the right side, change:
    - Panel title: "Attack vs Normal"
    - Visualization type: "Pie chart"
4. Scroll down on right, find "Legend" section
5. Set Legend values: `{{prediction}}`
6. Click **"Apply"**

Add Third Panel - Request Rate:

1. Click **"Add"** → **"Visualization"**
2. Query: `rate(api_requests_total[1m])`
3. Panel title: "API Request Rate"
4. Visualization: "Time series" (line graph)
5. Legend: `{{endpoint}} - {{method}}`
6. Click **"Apply"**

Add Fourth Panel - Expert Weights:

1. Click **"Add"** → **"Visualization"**
2. Query: `expert_gating_weight`
3. Panel title: "Expert Contribution"
4. Visualization: "Pie chart"
5. Legend: `{{expert}}`
6. Click **"Apply"**

Save Dashboard:

1. Click 💾 **(save icon)** at top
2. Name: "MoE Cybersecurity Monitor"
3. Click **"Save"**

Enable Auto-Refresh:

1. Top right corner, click the refresh dropdown

2. Select **"5s"** or **"10s"**
3. Now it updates automatically!

🎬 Live Demo - See It All Work!

Do This:

1. **Open 3 Browser Tabs:**
   - Tab 1: Streamlit (http://localhost:8501)
   - Tab 2: Prometheus (http://localhost:9090)
   - Tab 3: Grafana (http://localhost:3000)
2. **In Streamlit (Tab 1):**
   - Select "DDoS Attack"
   - Click "Analyze Traffic"
   - Wait 5 seconds
3. **In Prometheus (Tab 2):**
   - Type query: `predictions_total`
   - Click "Execute"
   - You should see the Attack counter went up by 1!
4. **In Grafana (Tab 3):**
   - Watch your dashboards
   - The numbers should update automatically
   - Pie chart changes color
5. **Repeat:**
   - Make more predictions in Streamlit
   - Watch Prometheus and Grafana update!

🐛 Troubleshooting

"No data in Prometheus"

Solution:

1. Make predictions in Streamlit first!
2. Wait 10-15 seconds (Prometheus scrapes every 10s)
3. Query: `predictions_total` and click Execute

"Grafana shows 'No data'"

Solution:

1. Check data source is added (Settings → Data Sources)
2. URL must be: `http://prometheus:9090` (NOT localhost!)
3. Make predictions to generate data
4. Change time range: Top right, click time range, select "Last 15 minutes"

"Prometheus says no data queried yet"

Solution:

1. Type a query first! (e.g., `predictions_total`)
2. Click the blue "Execute" button
3. Make sure you made predictions in Streamlit

📊 What Each Metric Means

predictions_total

- **What**: Counts how many predictions of each type
- **Use**: See attack vs normal ratio
- **Example**: `predictions_total{prediction="Attack"} 15`

api_requests_total

- **What**: Counts API calls to each endpoint
- **Use**: Monitor API usage
- **Example**: `api_requests_total{endpoint="/predict",method="POST"} 20`

expert_gating_weight

- **What**: Shows which expert (FT-Transformer vs CNN) is being used
- **Use**: Understand model behavior
- **Example**:
  - `expert_gating_weight{expert="Tabular Expert"} 0.98` (98%)
  - `expert_gating_weight{expert="Temporal Expert"} 0.02` (2%)

model_loaded

- **What**: 1 if model loaded, 0 if failed
- **Use**: Health check
- **Example**: `model_loaded 1`

🎯 Your Action Plan

Right Now:

1. ☑ Make 10 predictions in Streamlit
2. ☑ Go to Prometheus → Query `predictions_total` → Click Execute
3. ☑ Go to Grafana → Add Prometheus data source → Create dashboard

4. ☑ Watch it update in real-time!

You'll know it's working when:

- Prometheus shows numbers when you query
- Grafana charts update automatically
- Making a prediction in Streamlit updates the metrics

Need help? Common queries to copy-paste:

```
predictions_total
api_requests_total
expert_gating_weight
model_loaded
rate(predictions_total[1m])
```

Good luck! 🚀