The Problem

- **7.4 million acres** burned annually
- **$2.4 billion** in damages a year
- **Thousands** of lives affected
Goals

- Research different machine learning models
- Develop accurate approaches to wildfire prediction
- Visualize fire risk for individual or professional use
Existing Solutions

- Mathematical Models
- Traditional Machine Learning
- Deep Learning Approaches
Datasets

UCSB

Special thanks to
Dr. Isaac Park

Google Earth Engine
Logistic Regression
Baseline Model

Trained from 2003-2013

Predictions for 2014-2017

Average ROC/AUC Score: 0.68

S-shaped curve

Predicted Y (Probability) lies between 0 and 1 range
Variational Autoencoder
Spatial Dependencies

Preprocessed data into images
Average AUC: 0.75
10% improvement over LR

Input
Encoder
$\mu_x$
$\sigma_x$

$z \sim N(\mu_x, \sigma_x)$

Output
Decoder

Spatial Dependencies
**LSTM + CNN Hybrid**

Spatial & Temporal Dependencies

**Model Architecture**

- Input
- 3x3 conv, 64
- LSTM, 64
- FC1
- FC2
- FC3
- Fire probability
- Spatial Dependencies
- Temporal Dependencies

**Loss function**

\[ L = |y_{true} - y_{pred}| \times \min(10^5, \max(1, 10(y_{true} - y_{pred}) \times 100/k)) \]

Average AUC: 0.79

5% increase over VAE

16% increase over LR
Further Analysis

Effect of Varying Sliding Window Sizes

<table>
<thead>
<tr>
<th>Sliding Window Size</th>
<th>AUC Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 month</td>
<td>0.50</td>
</tr>
<tr>
<td>6 month</td>
<td>0.60</td>
</tr>
<tr>
<td>9 month</td>
<td>0.70</td>
</tr>
<tr>
<td>1 year</td>
<td>0.80</td>
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</tbody>
</table>

Effect of Time of the Year on Model Performance

<table>
<thead>
<tr>
<th>Evaluation Month</th>
<th>AUC Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>0.75</td>
</tr>
<tr>
<td>Mar</td>
<td>0.70</td>
</tr>
<tr>
<td>Jun</td>
<td>0.90</td>
</tr>
<tr>
<td>Aug</td>
<td>0.85</td>
</tr>
<tr>
<td>Oct</td>
<td>0.75</td>
</tr>
<tr>
<td>Nov</td>
<td>0.80</td>
</tr>
</tbody>
</table>
Conclusion

- Outperformed existing models by 2.6%
- Applicable for property/area fire risk assessments
- Interactive visualizations for California
THANK YOU

Be aware, be prepared, trust Flare