

The background of the slide is a photograph of trees and foliage. In the upper left, there are dark, out-of-focus branches. In the lower left, there are bright yellow-green leaves. On the right side, there are green leaves and a distant, dark spire of a building. The overall lighting is bright and natural.

# *pForest: In-Network Inference with Random Forests*

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# Introduction

An aerial photograph of a dense, lush green forest covering a hillside. The trees are thick and vibrant green, with some lighter green patches visible in the center. The word "Introduction" is written in white, sans-serif font on the left side of the image.





# Problem Context

- Malicious traffic can be detected using machine learning models
- Detection is faster and more effective if the classifier can be integrated directly on the data plane
- How do we fit the model in a switch with limited capabilities?



# pForest

- Multiple Random Forest models trained on packet flow statistics
- Framework for efficiently integrating the models in ***P4***

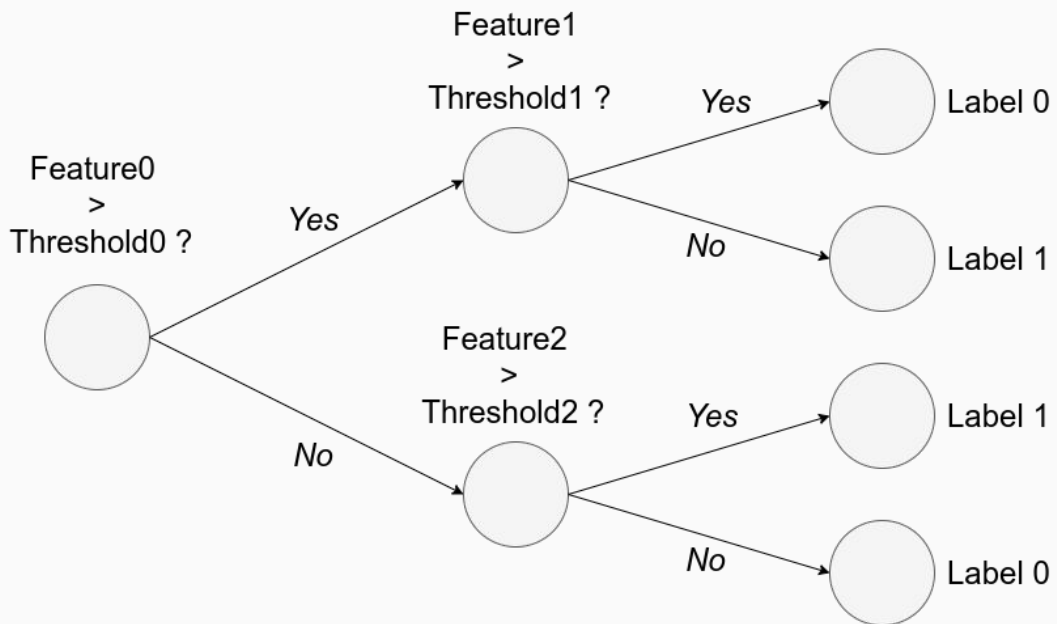


An aerial photograph of a dense, lush green forest. The canopy is thick and textured, with various shades of green indicating different tree species and light penetration. The text "Random Forest Classifier" is overlaid in the center in a white, sans-serif font.

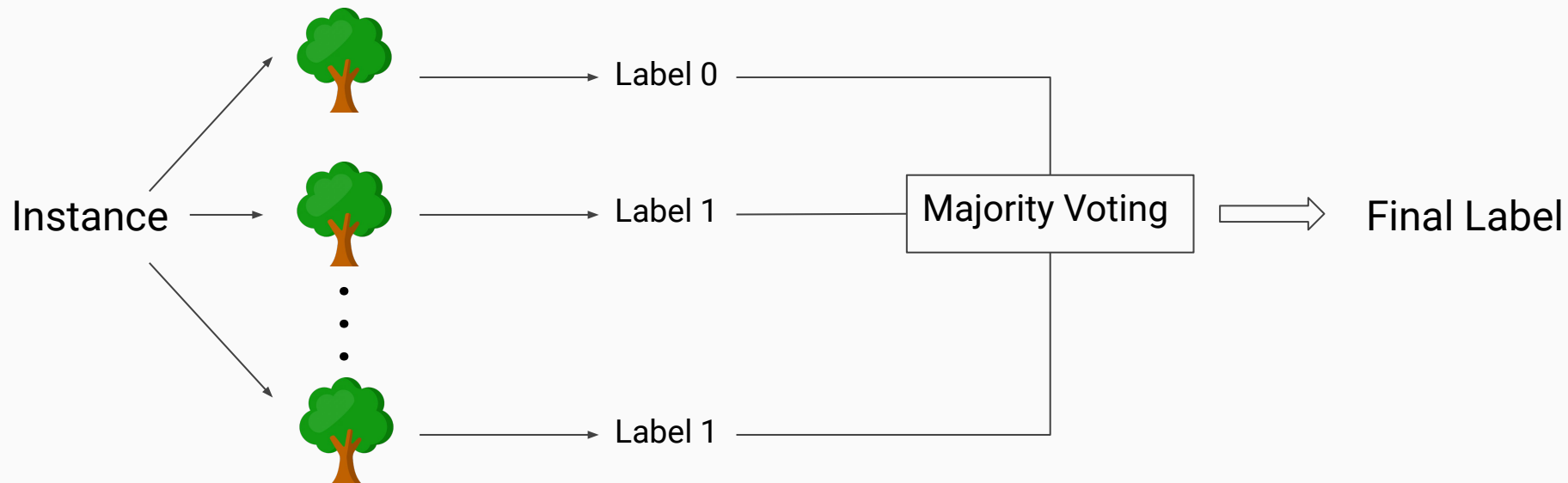
# Random Forest Classifier



# Decision Tree



# Random Forest Classifier





An aerial photograph of a dense, lush green forest covering a hillside. The trees are thick and vibrant green, with some lighter green patches indicating different tree species or sunlight filtering through. The text "P4 Implementation" is overlaid in white, sans-serif font on the left side of the image.

# P4 Implementation





# Flow Features

- Packets are classified according to various statistics of their flow :
  - Packet Inter-arrival time
  - Packet length
  - Flow duration
  - TCP flag counts
  - Number of packets





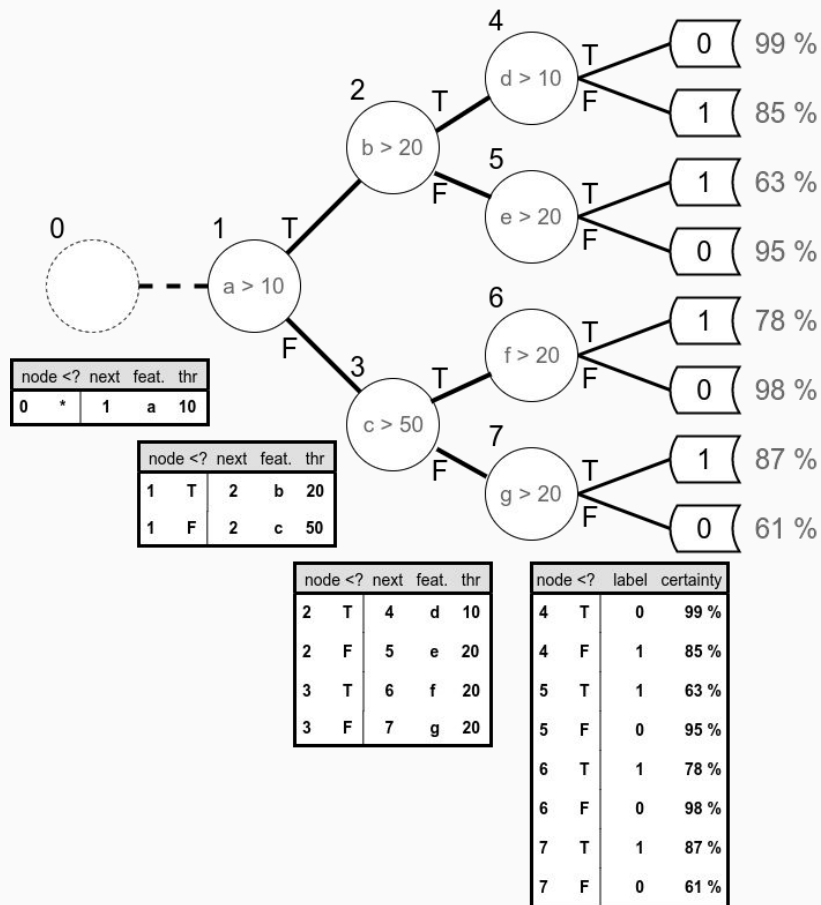
# Handling Features

- Switch maintains multiple registers to store flow features
- Storage is organized using hash tables
- Features are updated at each subsequent packet of the same flow



# Random Forest to Table Entries

- One match-action table per decision tree per level







# Classification

- Apply all the tables of each trees until the leaves are reached
- Perform majority voting and compute total certainty
- Classify the packet if certainty of the prediction is above the wanted threshold





# P4 Code Generation

- Various elements (such as table entries, tables, actions, etc.) depend on the model chosen and P4 has no loops
  - ➡ It becomes necessary to have a script that generates the code
- Python script that trains a model, then generates all the match-action table entries and the P4 code



An aerial photograph of a dense, lush green forest covering a hillside. The trees are thick and vibrant green, with some lighter green patches indicating different tree species or sunlight filtering through. The text "Our Work" is overlaid in white on the left side of the image.

Our Work





# Our Work

- CICIDS Dataset Analysis
- Random Forest model training & testing
- ***P4*** code and table entries generation



**DEMO**





An aerial photograph of a dense, lush green forest covering a hillside. The trees are thick and vibrant, with varying shades of green. The word "Questions" is overlaid in white text on the left side of the image.

Questions



A serene winter scene featuring a snow-covered path that leads into a dense forest of evergreen trees. The trees are heavily laden with snow, and the ground is a smooth, white expanse. In the background, the sun is setting, creating a warm, golden glow that filters through the branches and illuminates the sky with soft, horizontal clouds. The overall atmosphere is peaceful and festive.

Thank You

And

Merry  
Christmas!