Classification of System Call Sequences using Anomalous Detection

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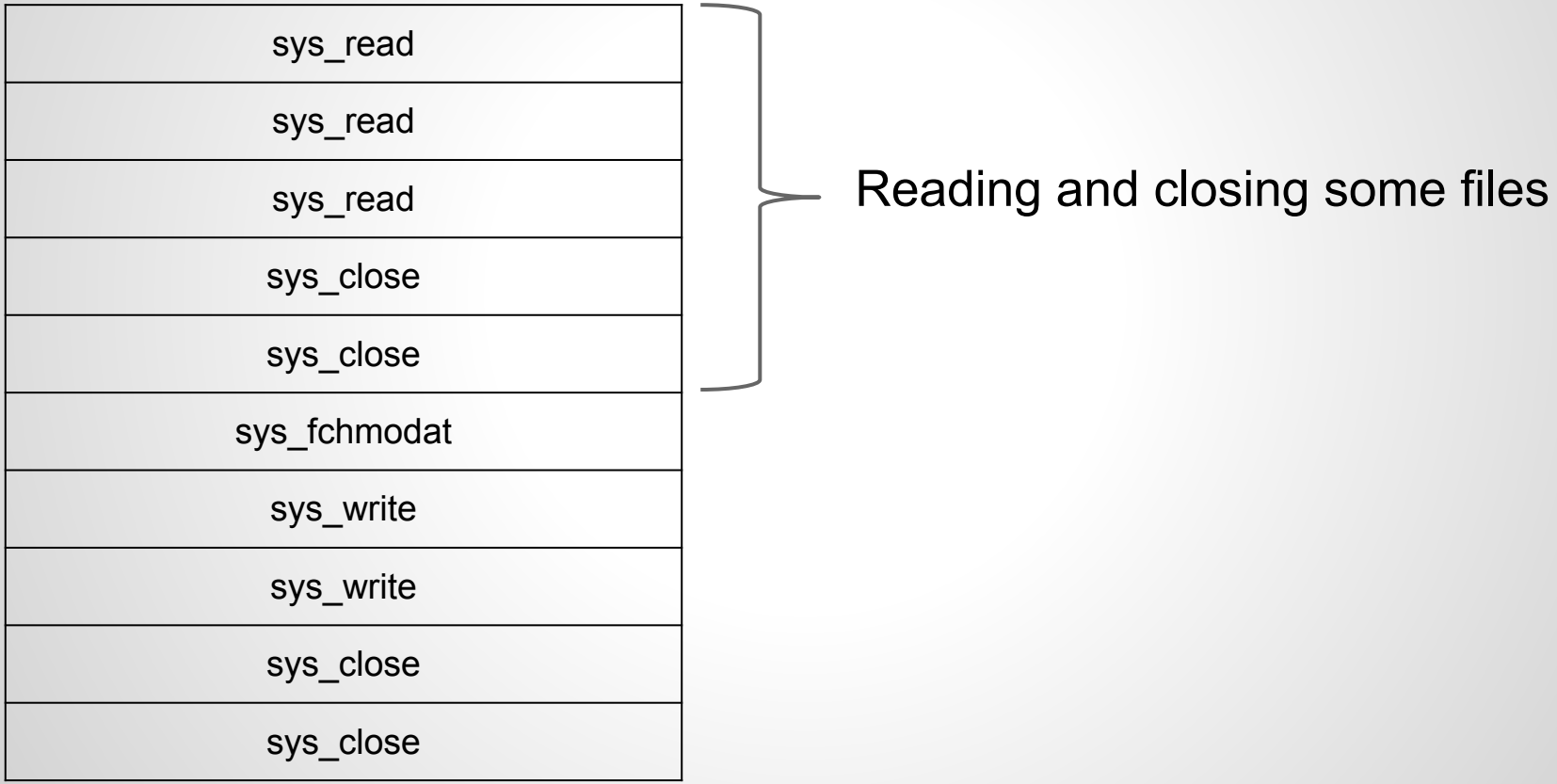
- You’re on an open network at a cafe and become the victim of a hacker
- The hacker attempts to read your file system and find your admin user information
- Once the hacker finds it they write a keylogger onto your computer for their benefit

Understanding the Sequences

sys_read
sys_read
sys_read
sys_close
sys_close
sys_fchmodat
sys_write
sys_write
sys_close
sys_close

Understanding the Sequences



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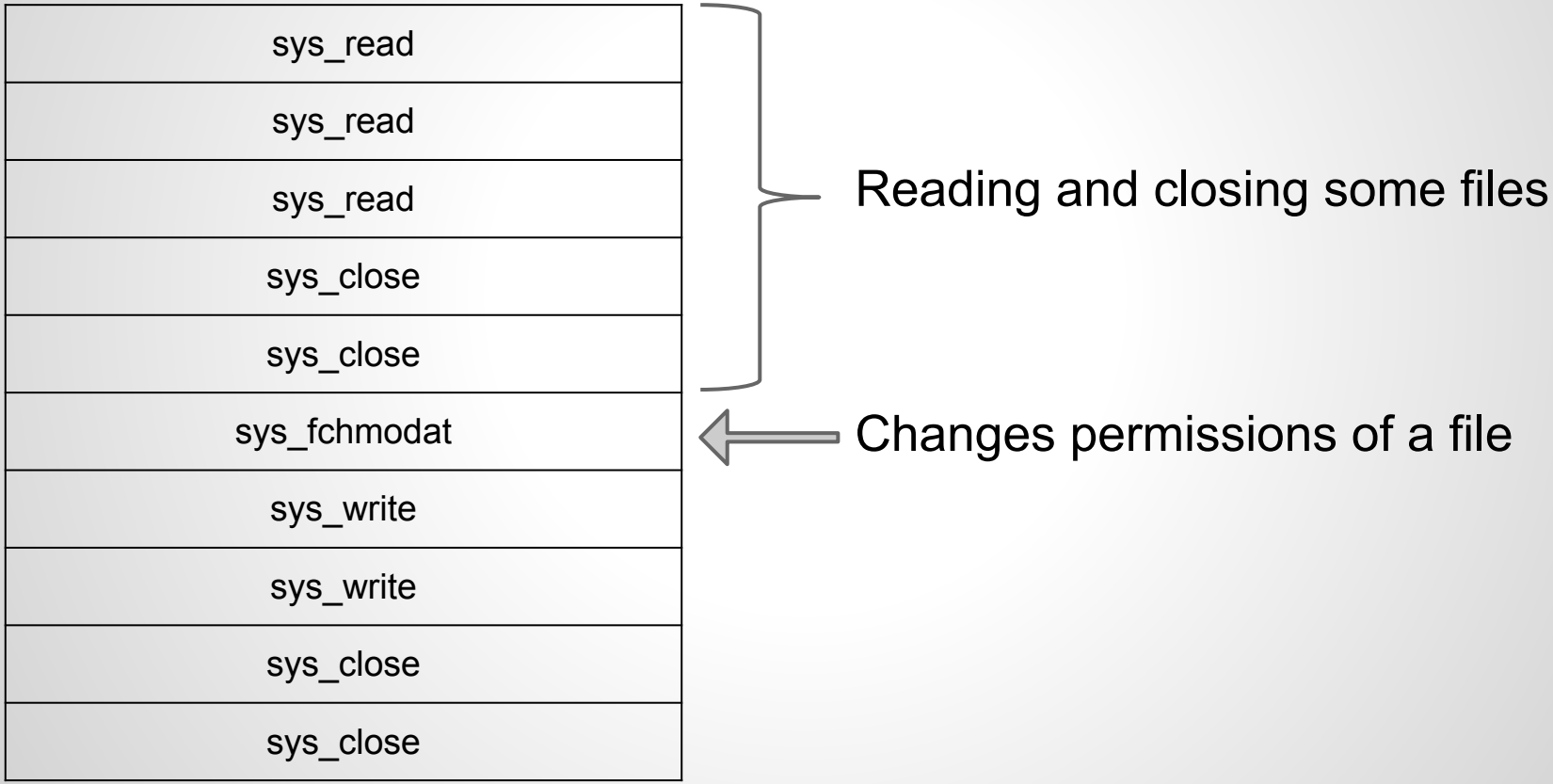

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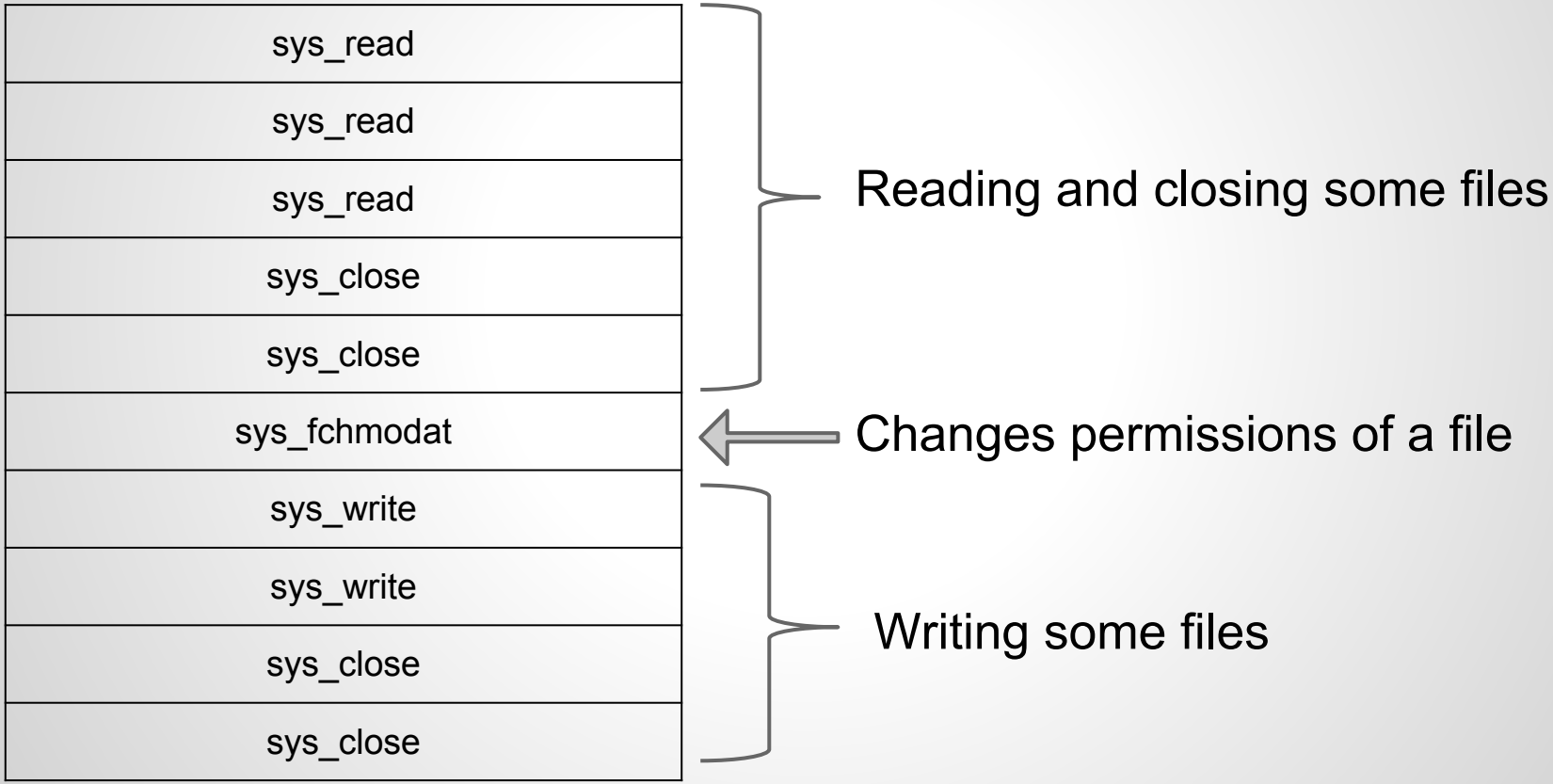

Understanding the Sequences

sys_read
sys_read
sys_read
sys_close
sys_close
sys_fchmodat
sys_write
sys_write
sys_close
sys_close

Understanding the Sequences

sys_read	3
sys_read	3
sys_read	3
sys_close	6
sys_close	6
sys_fchmodat	306
sys_write	4
sys_write	4
sys_close	6
sys_close	6

Understanding the Sequences

- Now that we have a sequence how can we represent it?

3
3
3
6
6
306
4
4
6
6

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- **Goal**: “Learn” typical sequences used by attackers

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- Want to accomplish this without “learning” the exact attack sequences

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Understanding the Sequences

- Now that we have a sequence how can we represent it?
- **Goal**: “Learn” typical sequences used by attackers
- Want to accomplish this without “learning” the exact attack sequences
- In other words, we want to instead find the ***anomalies*** among the sequences

3
3
3
6
6
306
4
4
6
6

Understanding the Sequences

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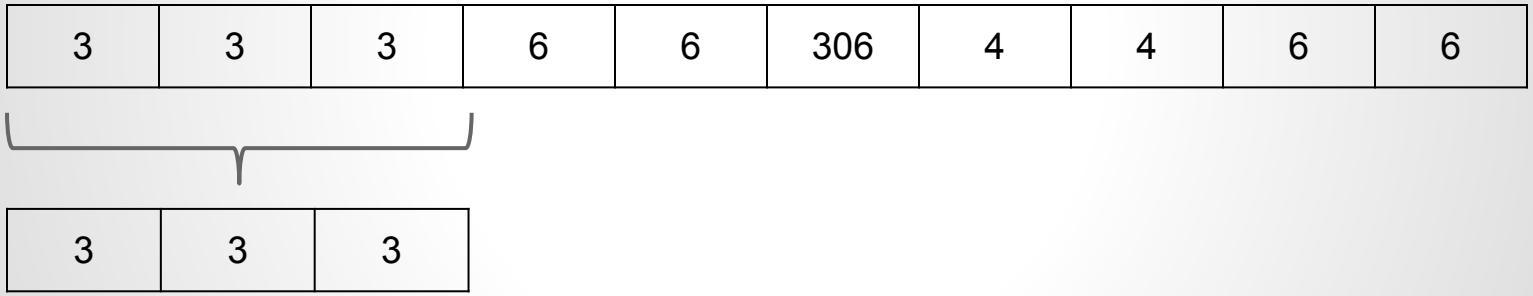

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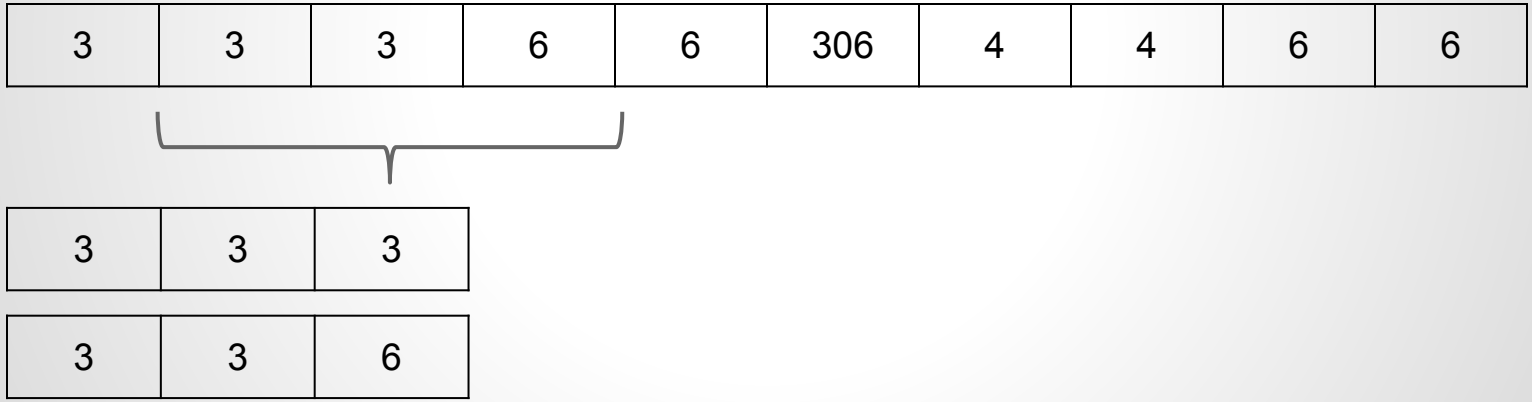

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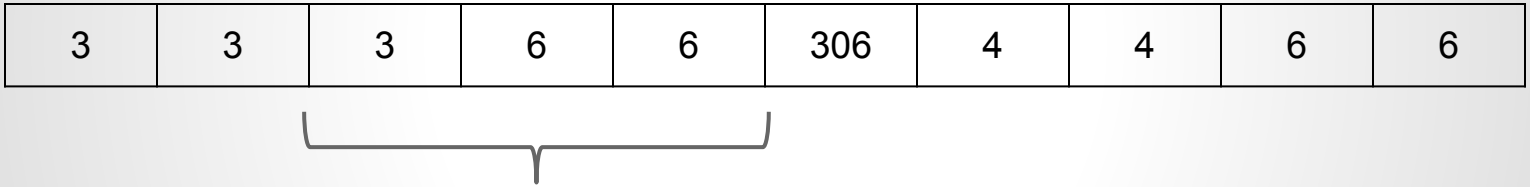

3	3	3

3	3	6

3	6	6

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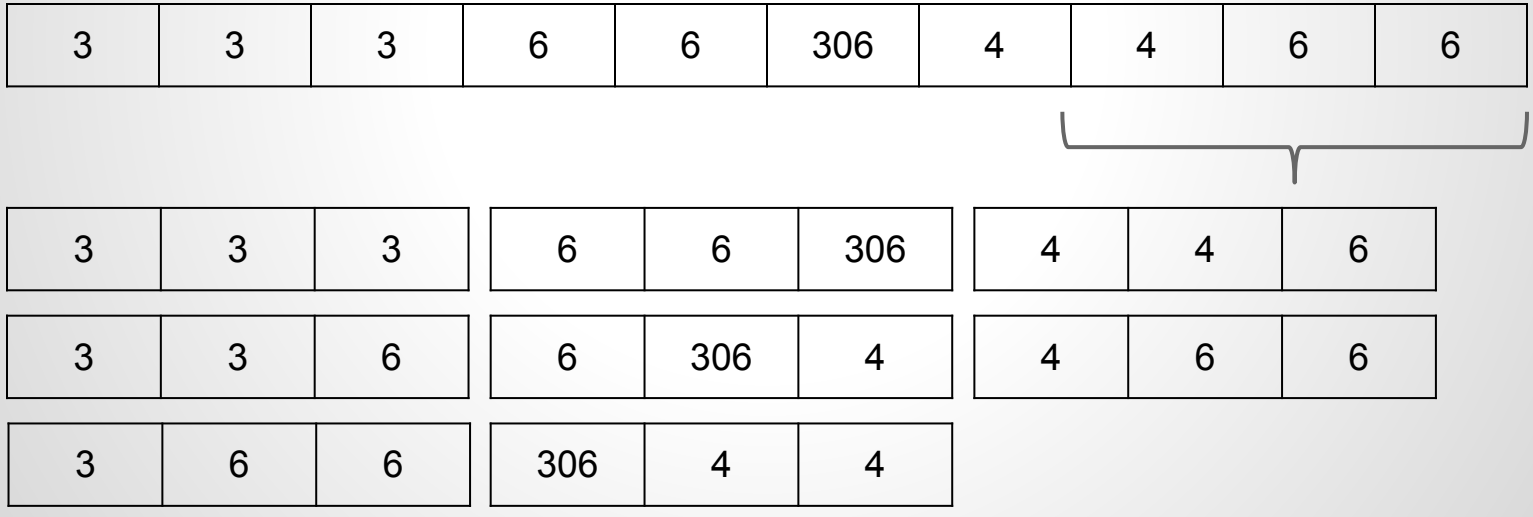

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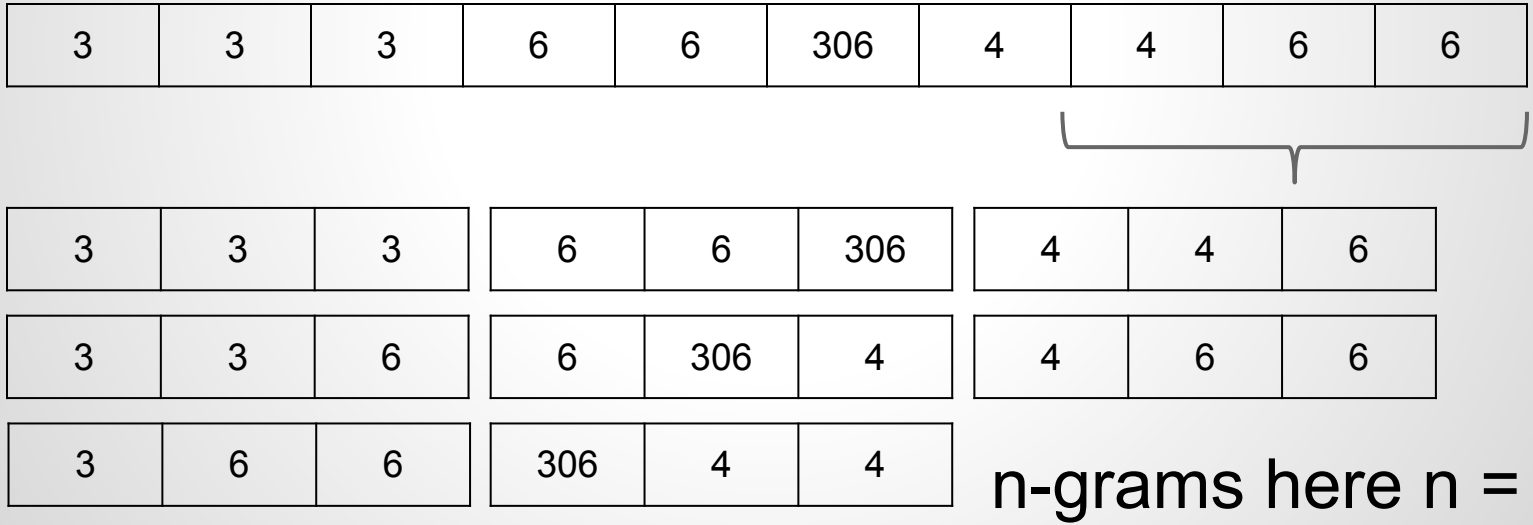
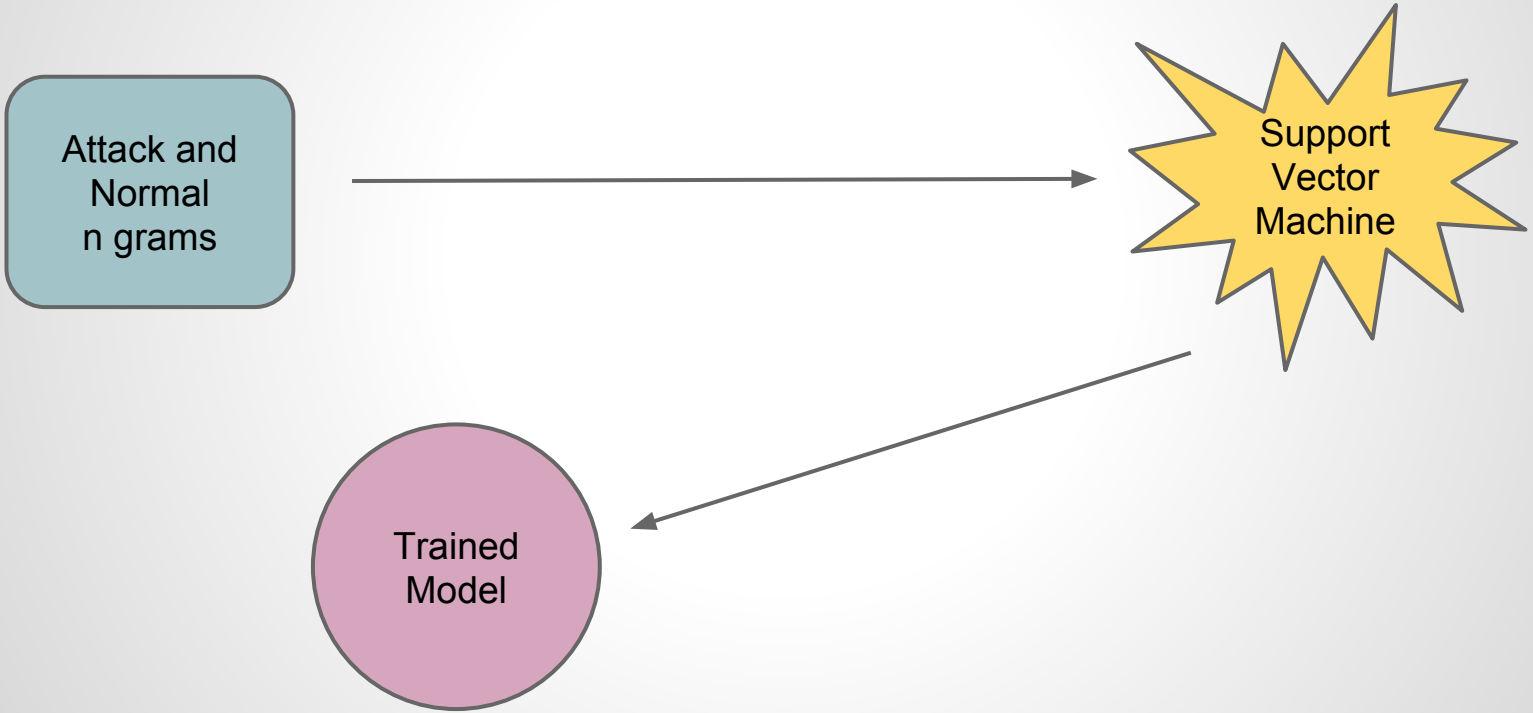
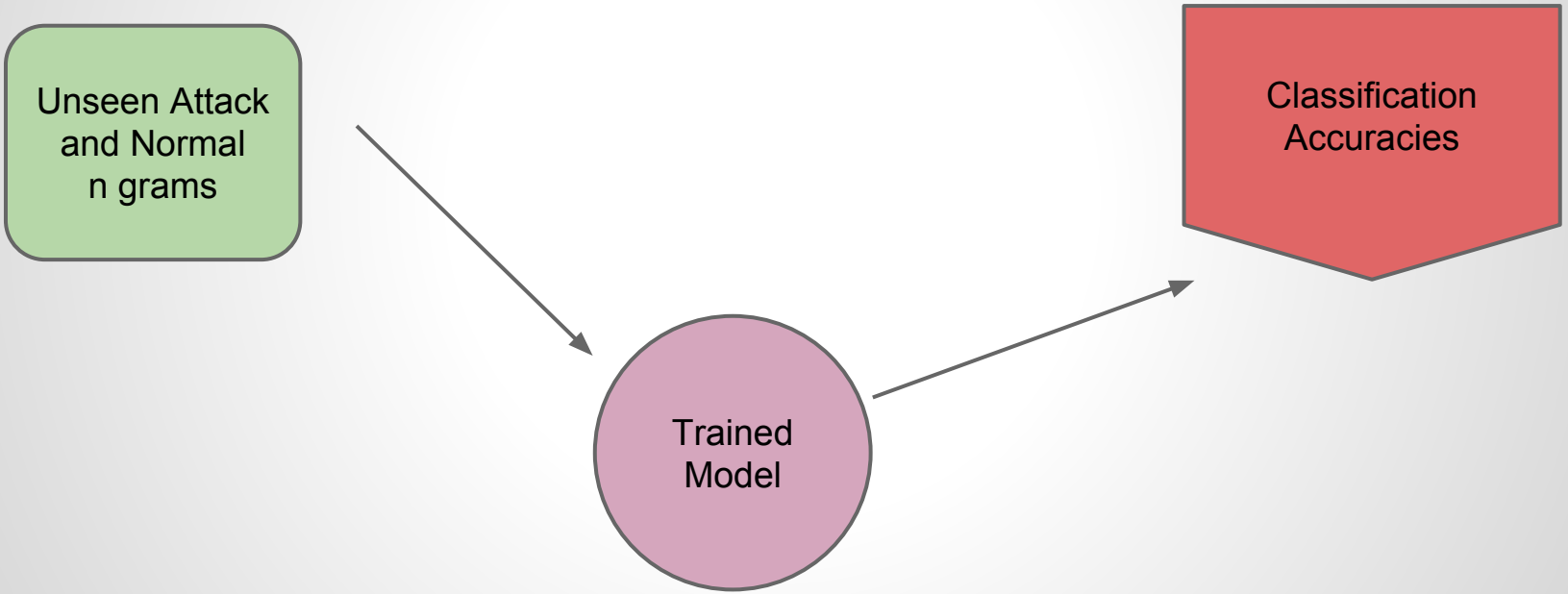


Training the Model



Testing the Model



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- We have large typical attack and normal sequences
- Instead of looking at the whole sequence we will break it down into n-grams
- These will be the pieces that we will learn from to ***classify*** the difference when looking at a new sequence
- **Theory:** Attack subsequences will have patterns separate from normal subsequences

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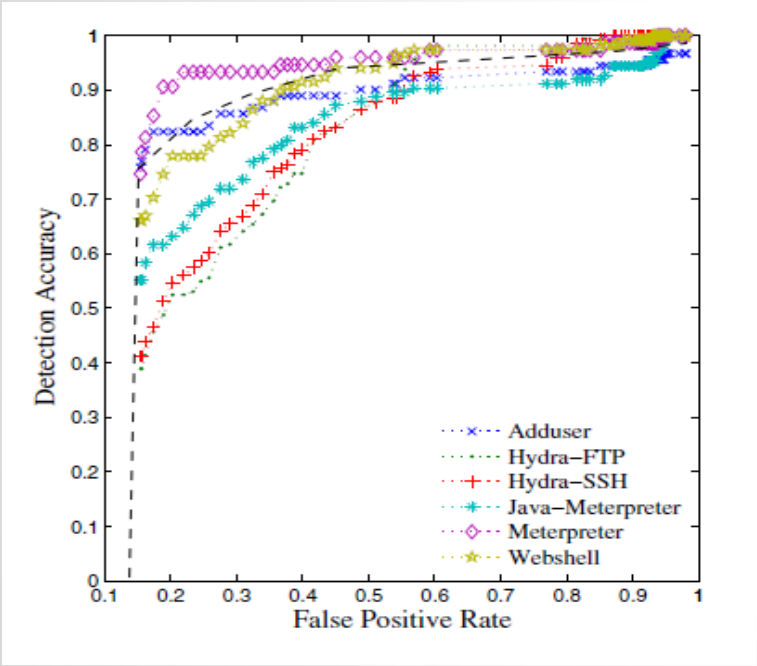
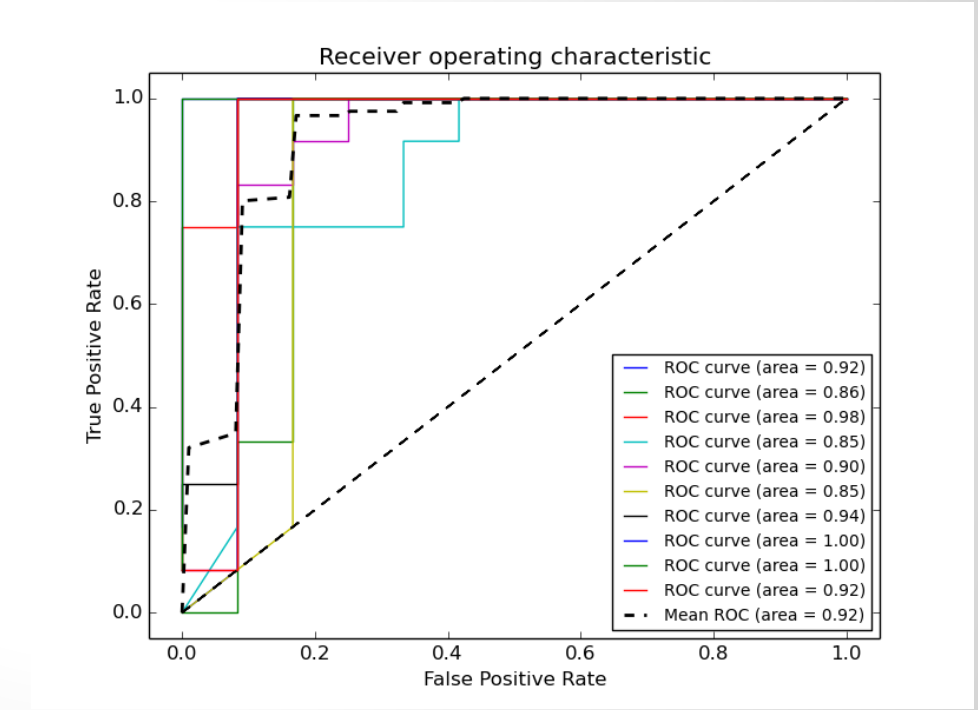
- Because there are many possible sequences, can we look to trim them down without degrading performance
- We suspect we can “combine” system calls during the preprocessing phase of the classifier
- Aid in lowering computation as well as possibly increasing correct classification

ROC Curve Analysis





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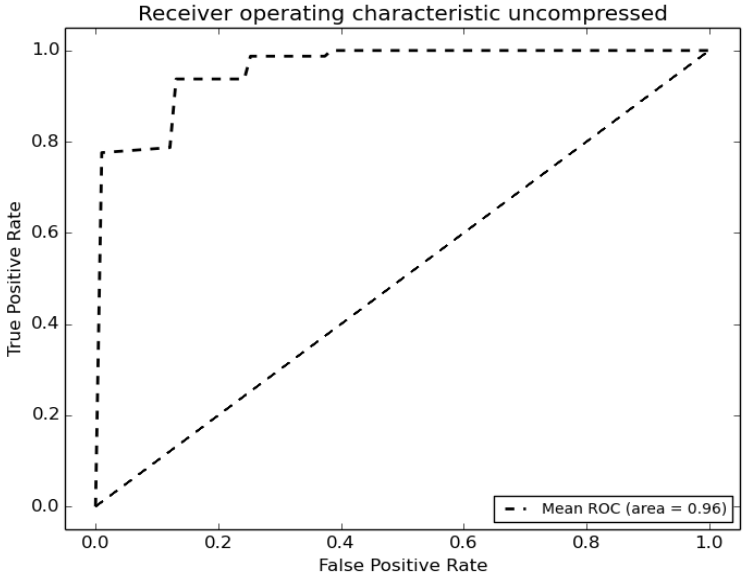
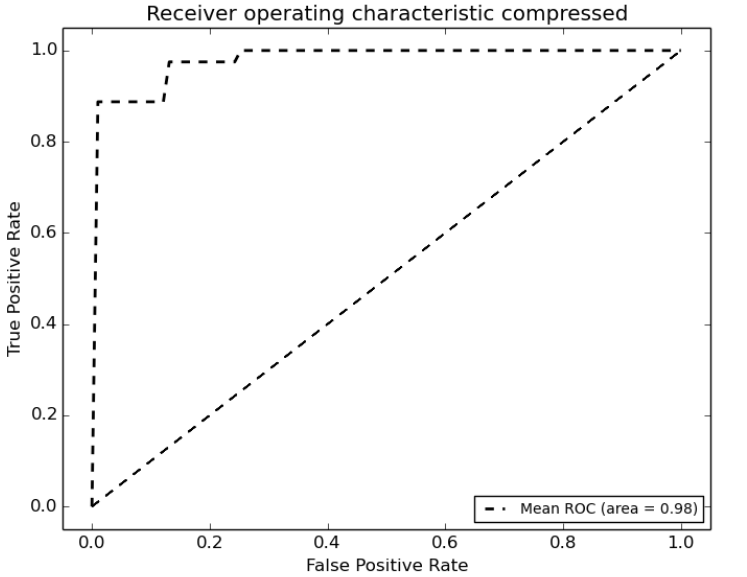
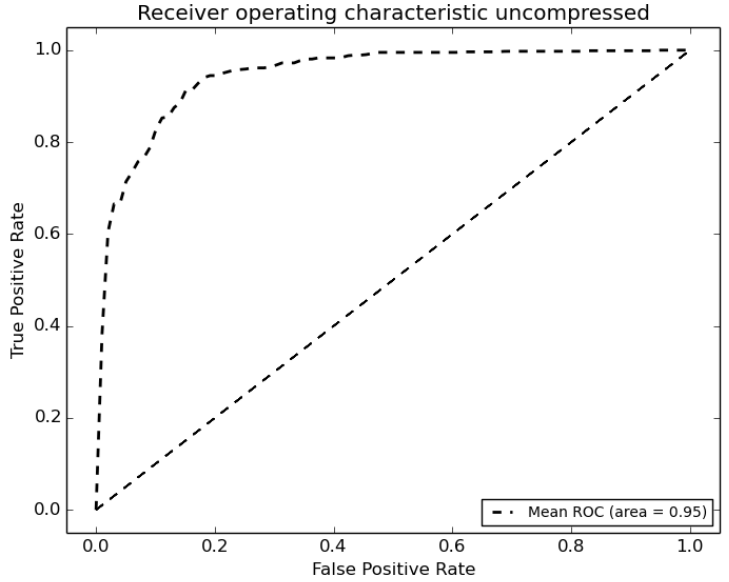
Our initial mean ROC curve

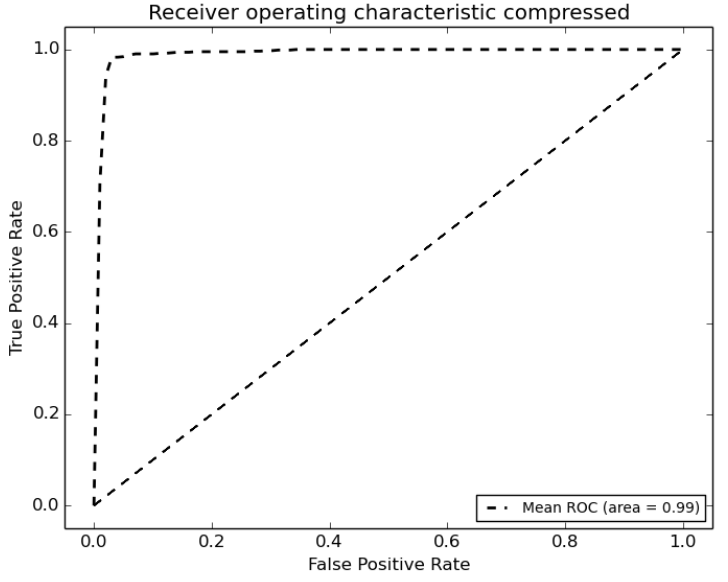
ROC Curve Analysis (subset)





ROC Curve Analysis (full dataset)





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- Compressed less frequent system calls into one dummy system call
- Found a statistical difference between compressing versus uncompressed using subsets of the data

Future Work

- Identify when the model stops being significant when training compressed models from large datasets

- Optimize the classifier further:
  - Alter the length of our n-grams generated
  - Changing the metric for compression
  - Adjusting the classification threshold in our model

Questions...