Henry Clausen, David Aspinall

Examining traffic micro-structures for model probing

WTMC 2021

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EPSRC
Pioneering research and skills

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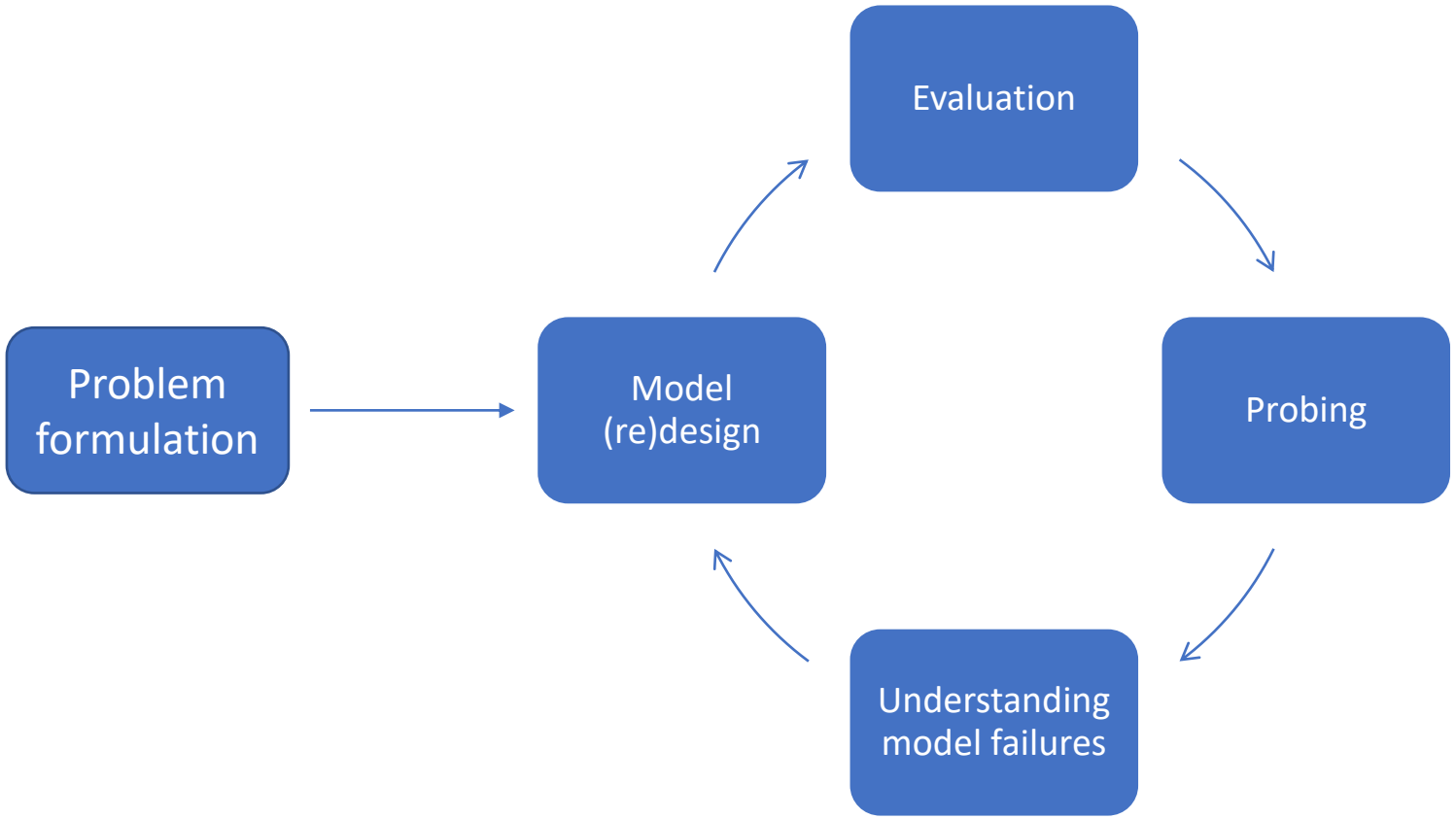
Machine learning progress



Prominent failures

- Ambiguous words in Translations

  → Attention layer

- Object sizes in video enhancement

  → Multi-scale encoders

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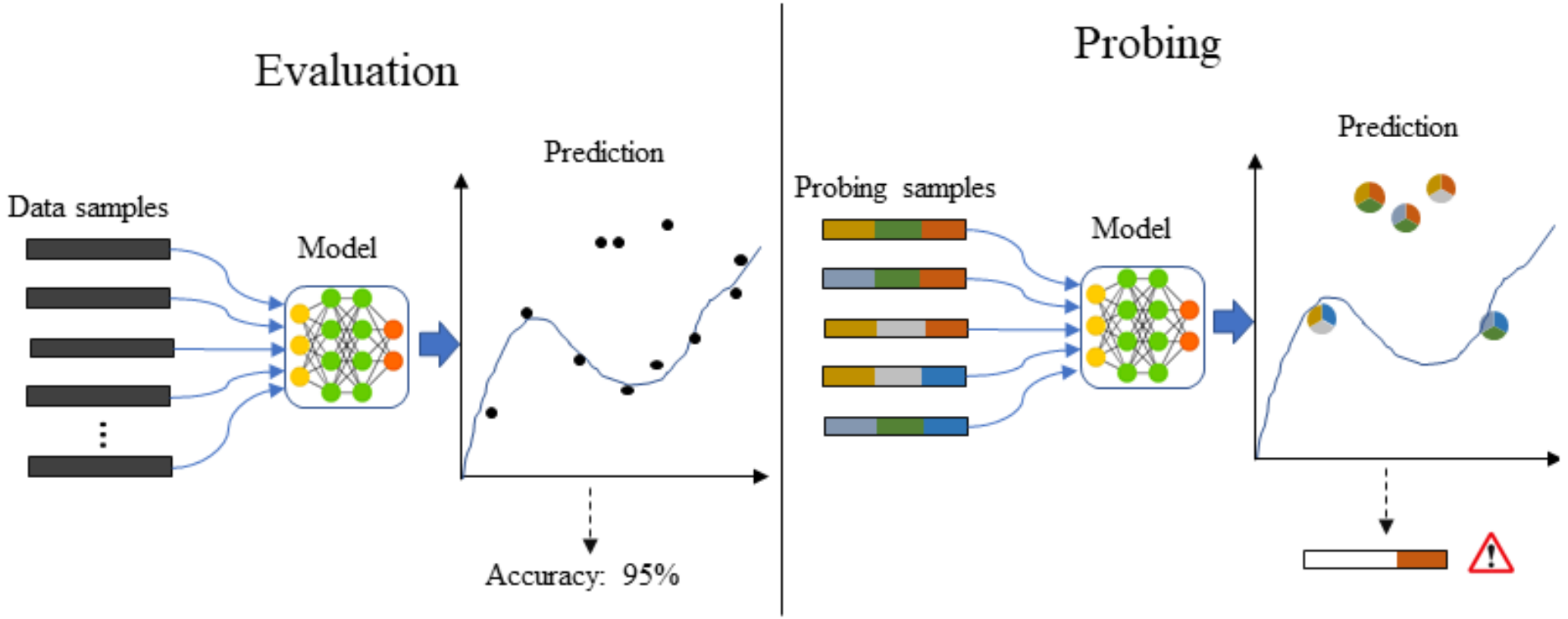
Model evaluation vs probing



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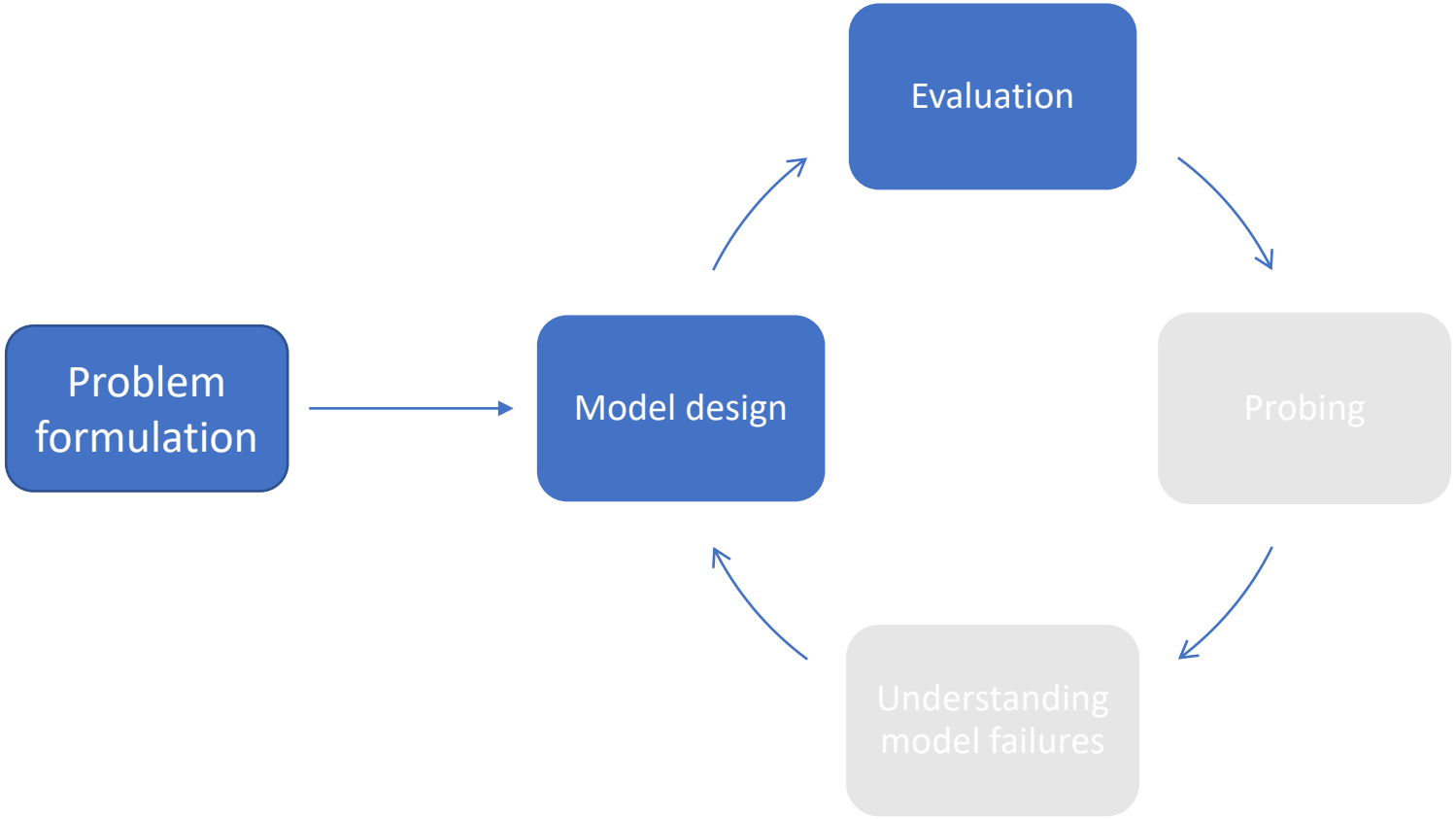
Machine learning progress in NID



NID-datasets

- Sparse labelling
- Difficult to read
- Hard to alter specific structures

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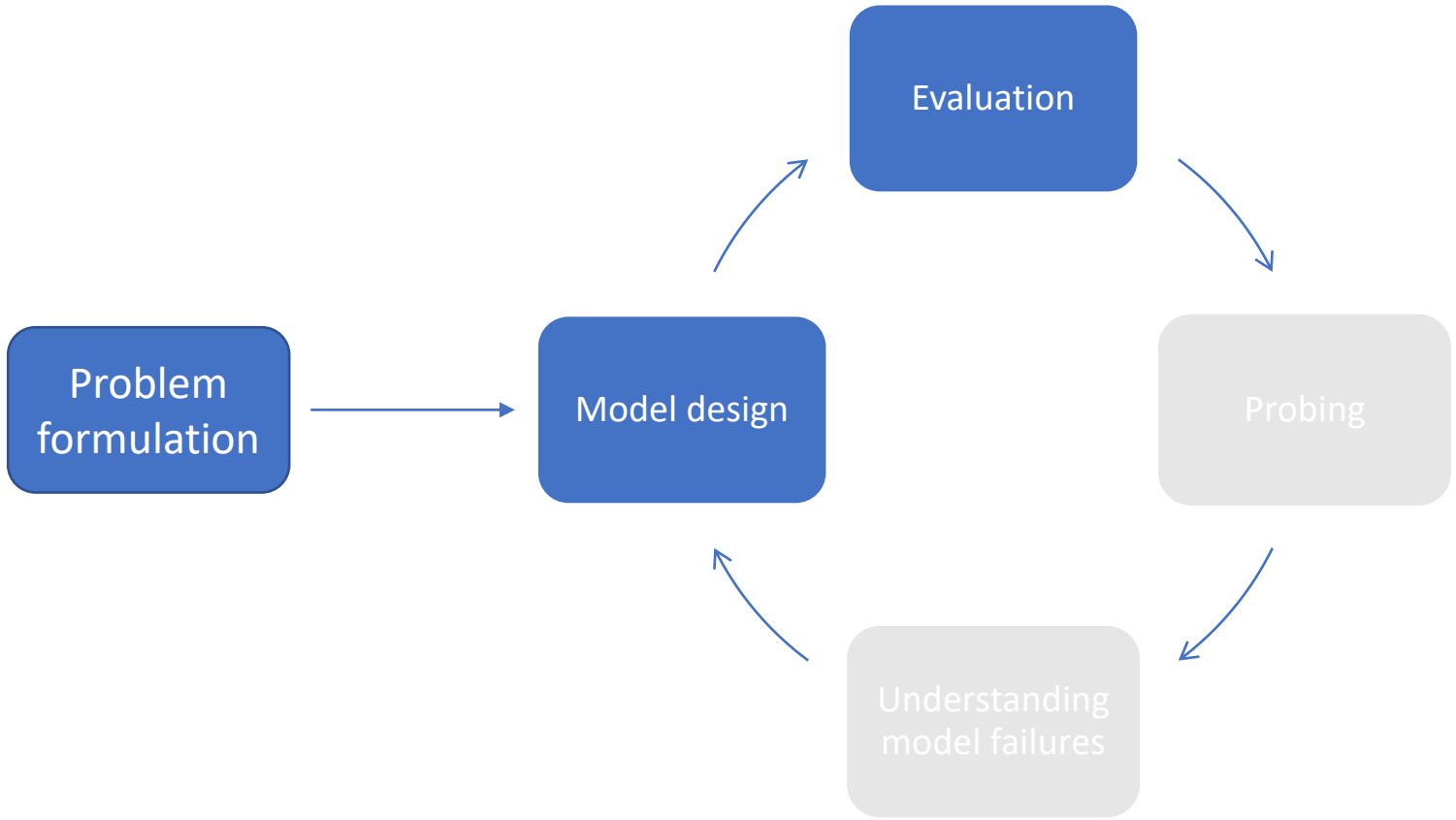
Machine learning progress in NID



Our case-study

- Probe two NID-methods
- Identify microstructures related to failures
- Measure improvements

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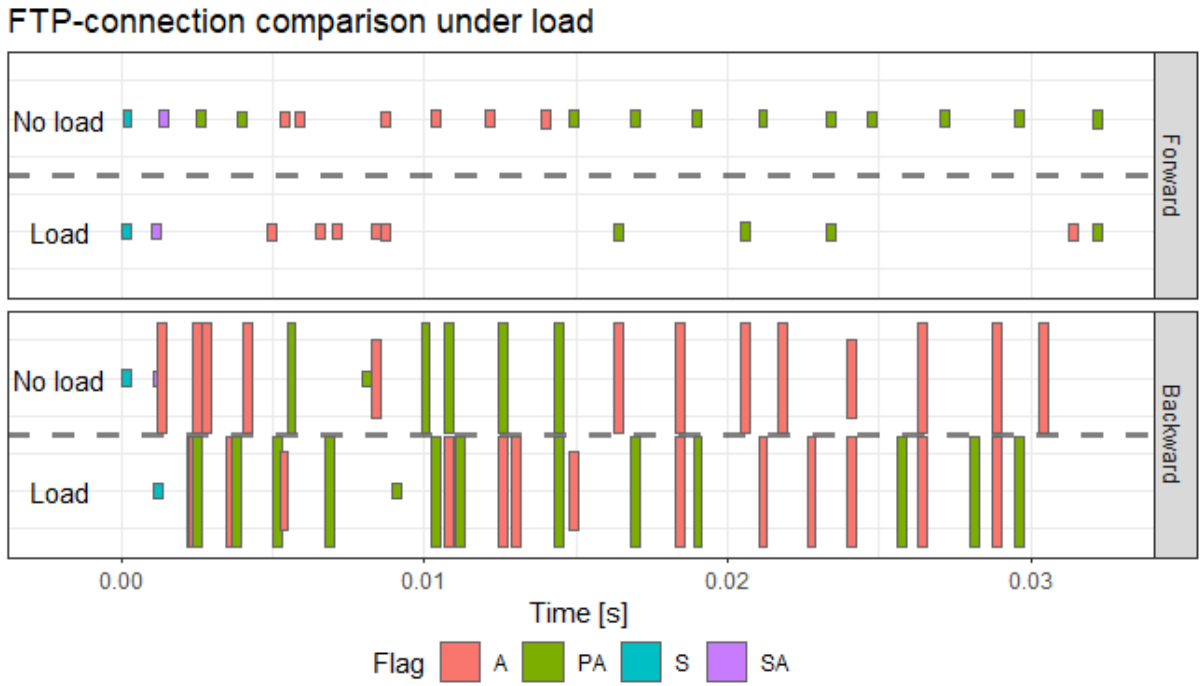
Traffic microstructures

- Short-term structures at packet or connection level
- manifest in IATs, frame sizes, flags etc.
- Altered by factors such as protocols, congestion, implementation ….
- Control with DetGen-tool
  Clausen et al., SecureComm 2021



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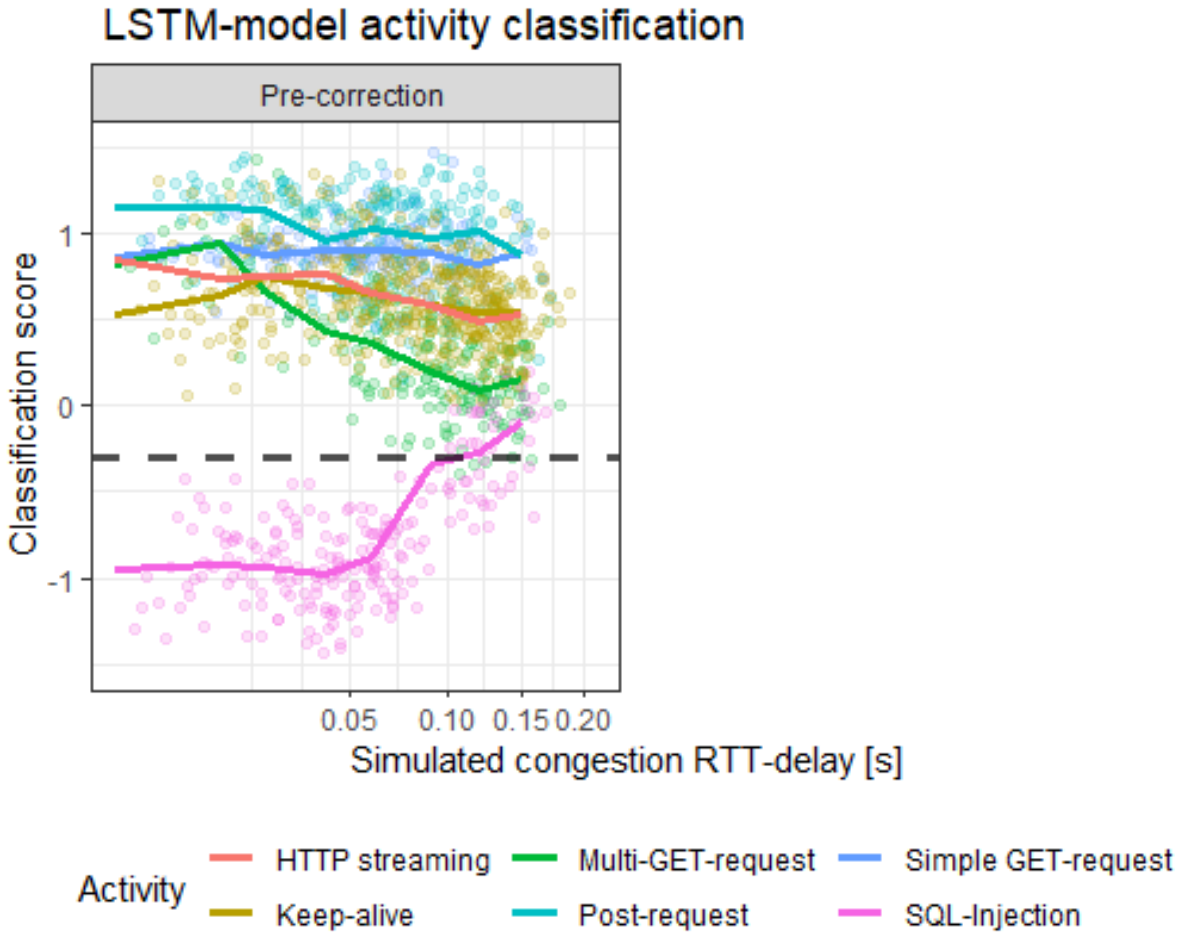
Examining a traffic classifier

- Packet-stream LSTM-classifier by Hwang et al. 2019
  - Detect SQL-injections
- Train on CICIDS-17 data (85%) + DetGen traffic (15%)
  - 96% DR, 2.7% FPR
- Probe with randomized traffic + structure labels

  → Correlation between misclassifications and latency



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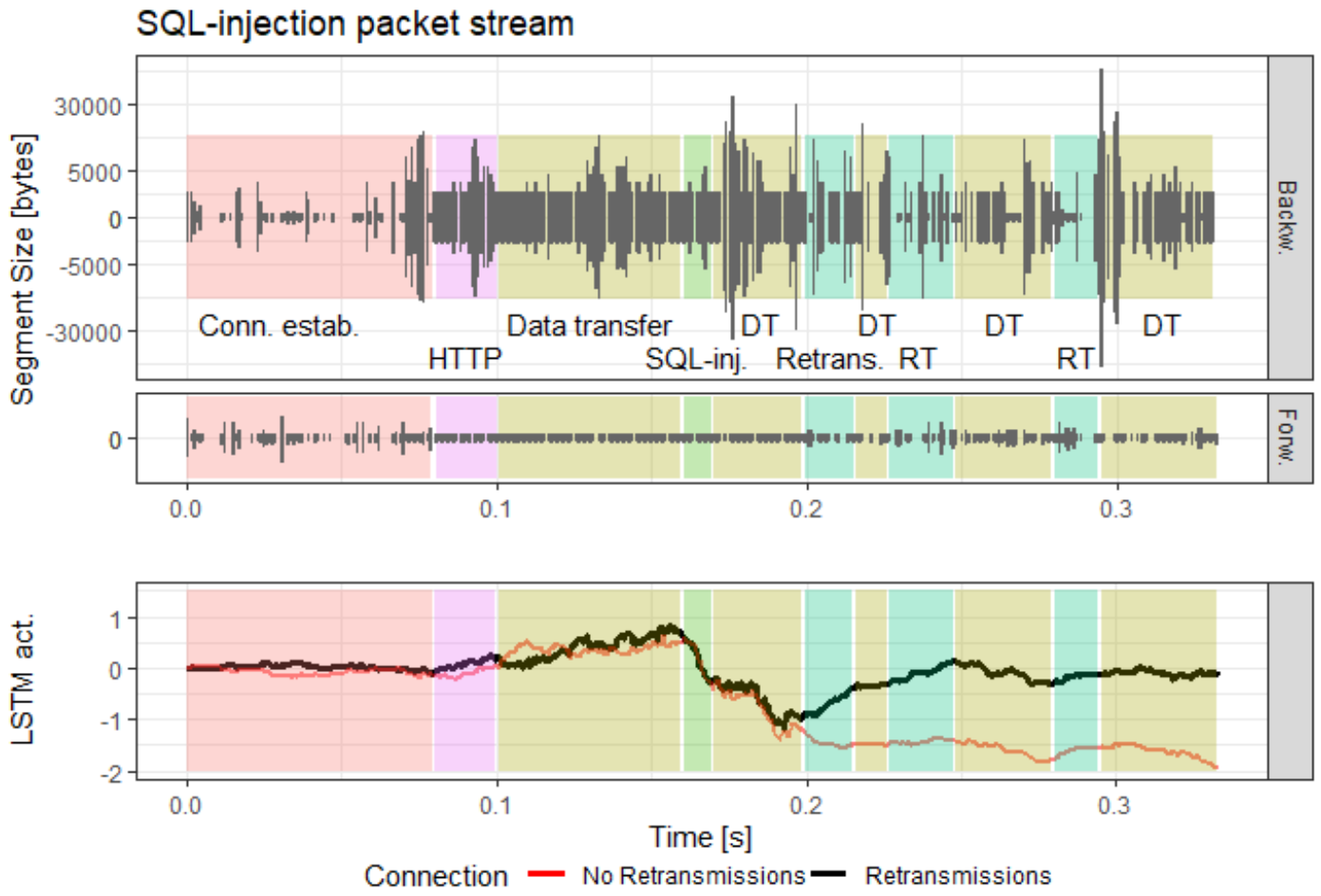
Examining a traffic classifier

- Generate two SQL-injection connections
  - Constant microstructures
  - One with high latency
- Retransmission sequences deplete activation
- Filter RT-sequences
  → 98% DR and 0.4% FPR



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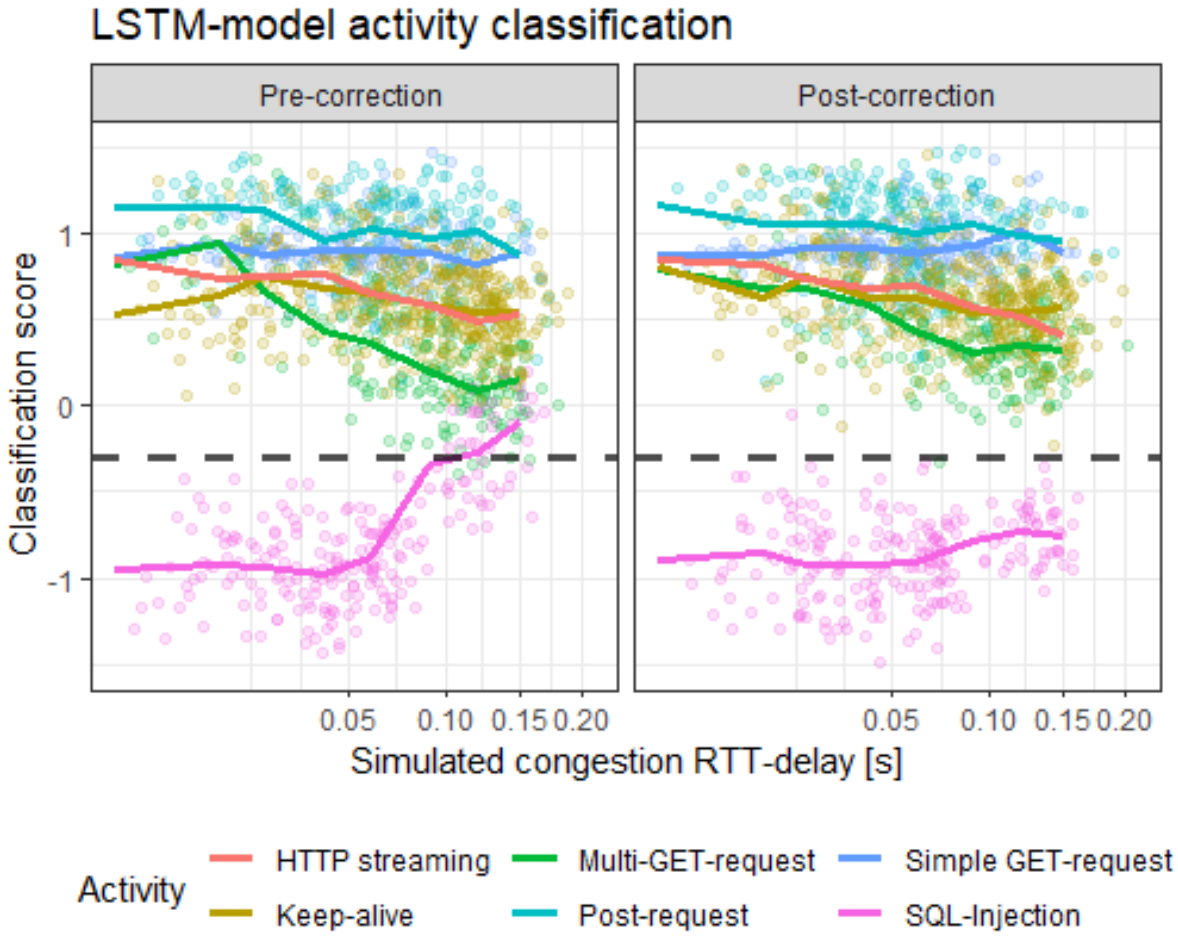

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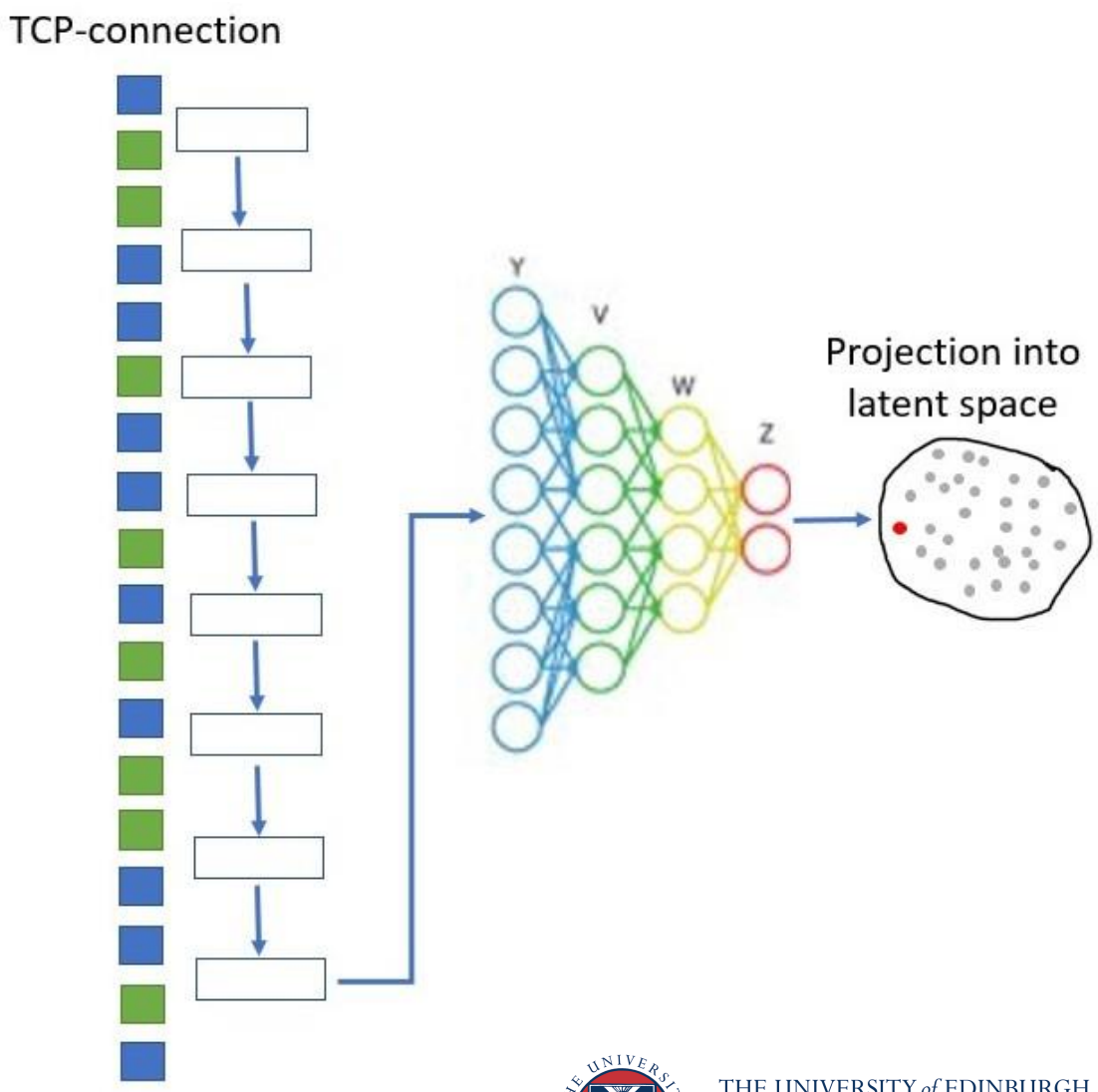
Projection sensitivity

- Kitsune 2018
  - Seq-encoding for anomaly detection
  - Botnet, man-in-middle, Brute-force,…
- Traffic groups with constant settings
- Projections should be consistent
- Sensitive to
  - connection IATs
  - half-open connections



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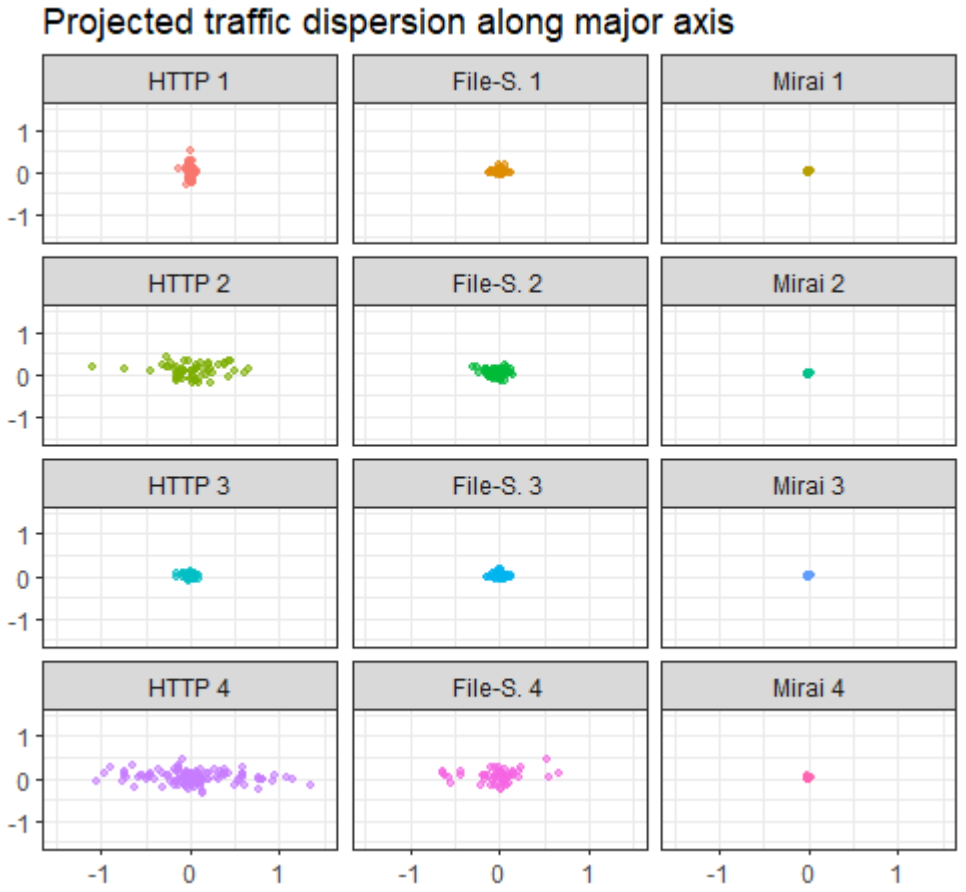

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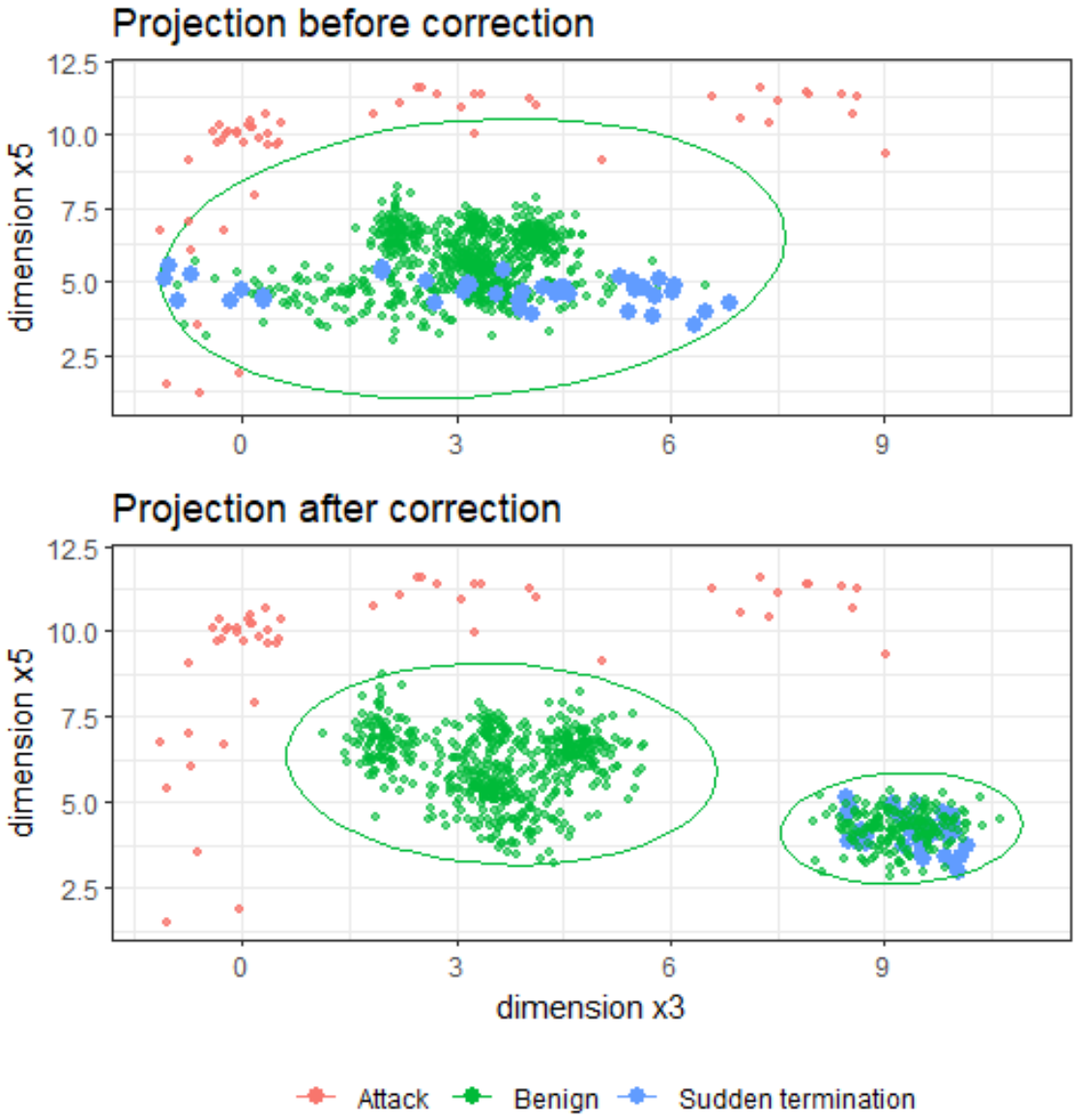

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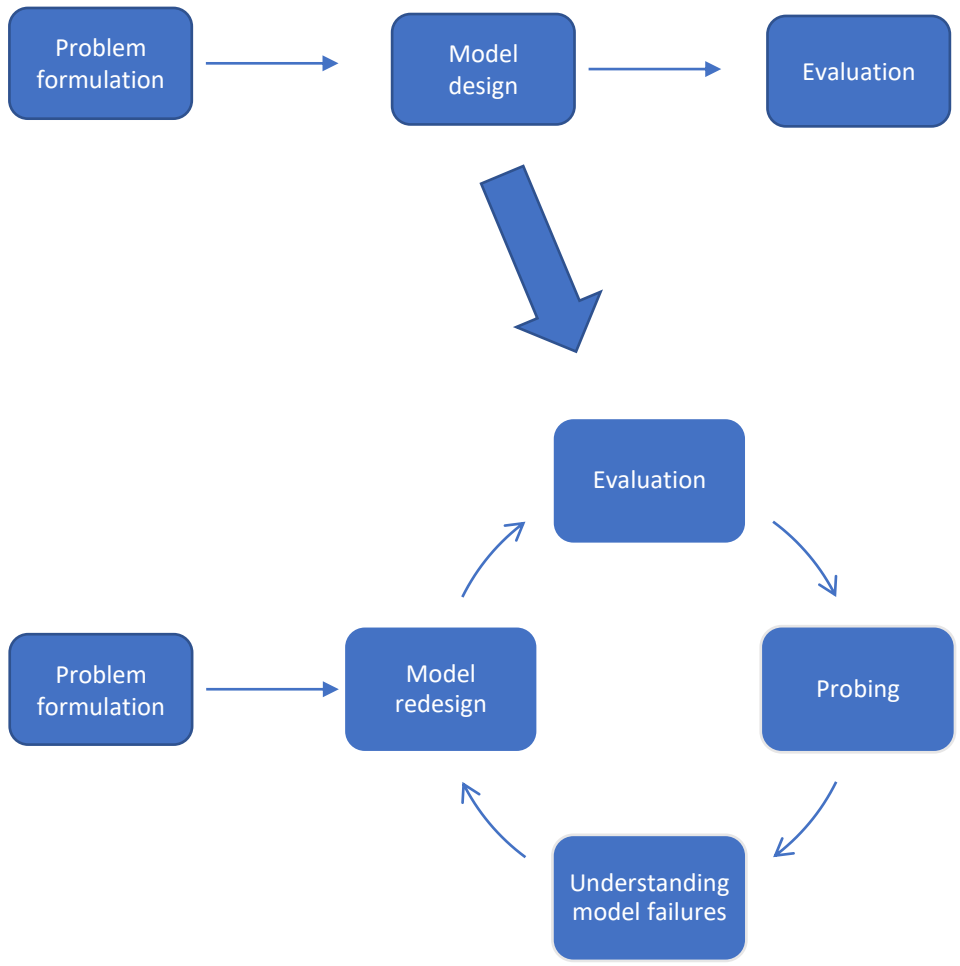
Conclusion

- Targeted probing can identify model failures
- Labelling for misclassification correlation
- Control traffic microstructures
  - Randomise for broad probing
  - Reduce variations for close examination
- github.com/detlearsom/DetGen



Controlling traffic microstructures

DetGen Clausen et al., SecureComm 2021

- Traffic generation tool

- Controlling and labelling microstructures:
  - Performed task/application
  - Implementations
  - Congestion
  - Failures
  - …

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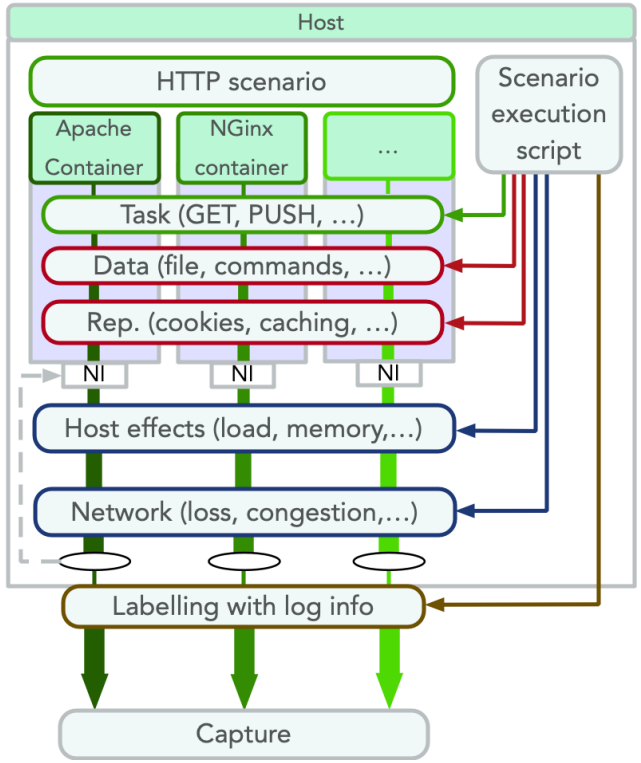

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