Guardian

Machine learning framework to detect network malicious traffic in cloud environments

Collaborators

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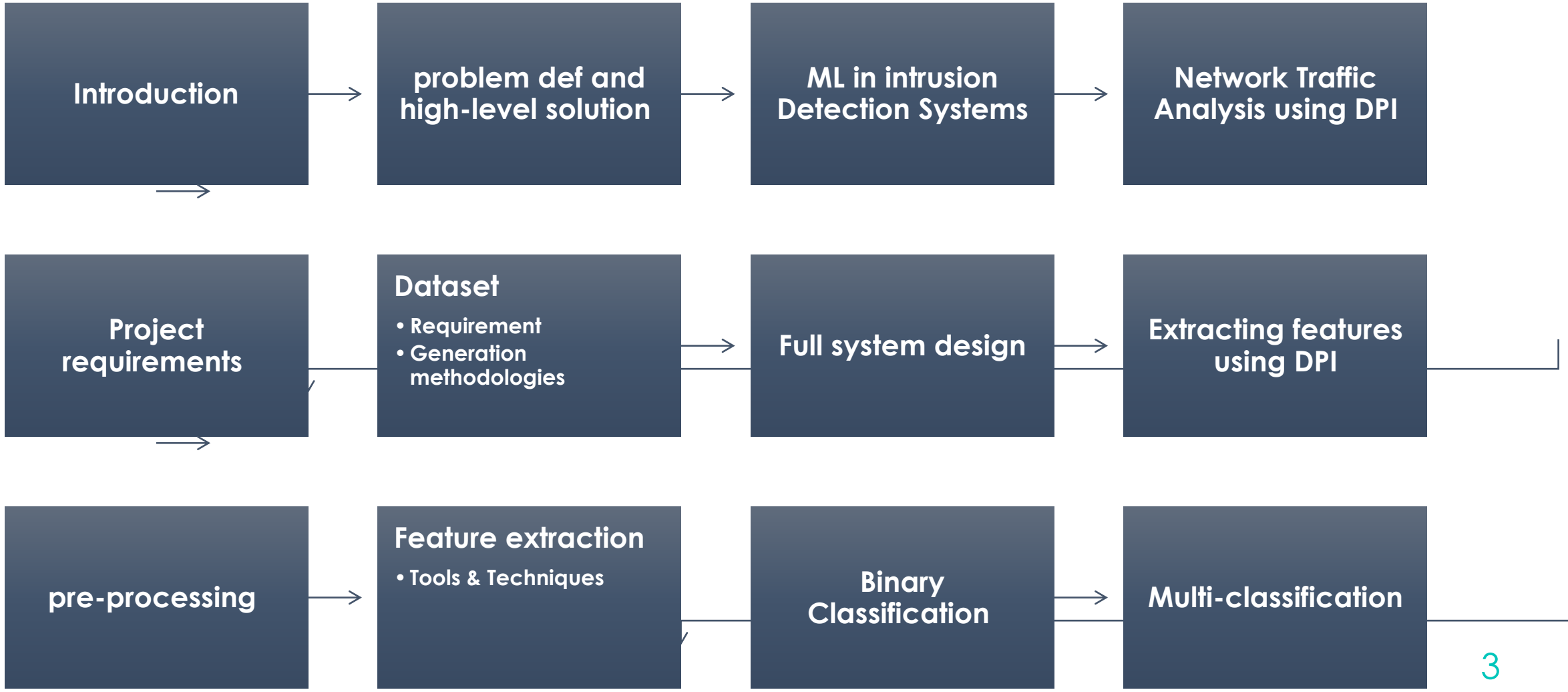
Full Thesis Outline



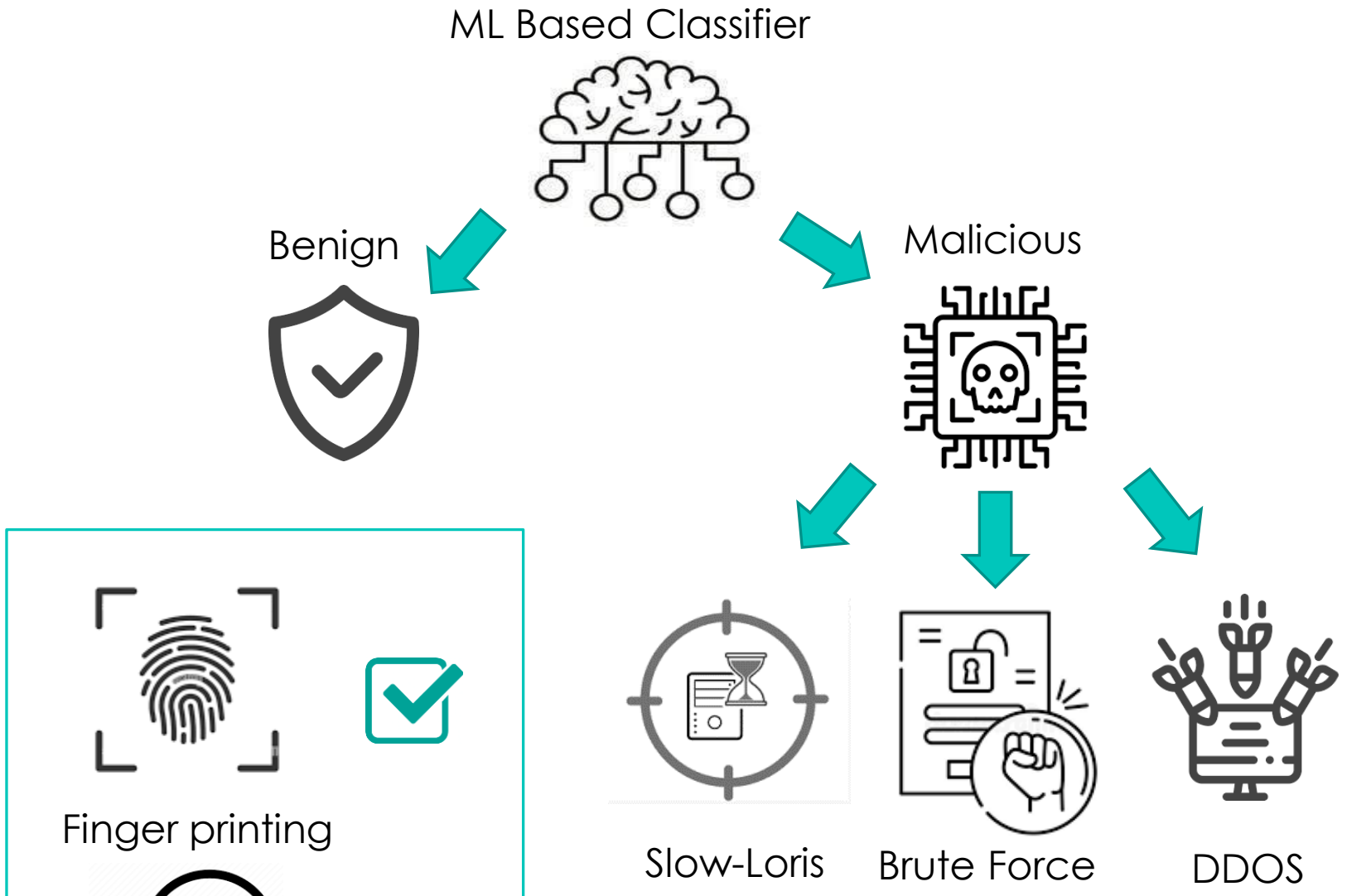
Introduction

- Clouds Data Stores
- Must provide protection and security for it
- Many approaches for network traffic monitoring and threats discovery
- Encryption is a major challenge
- Machine learning is the new approach

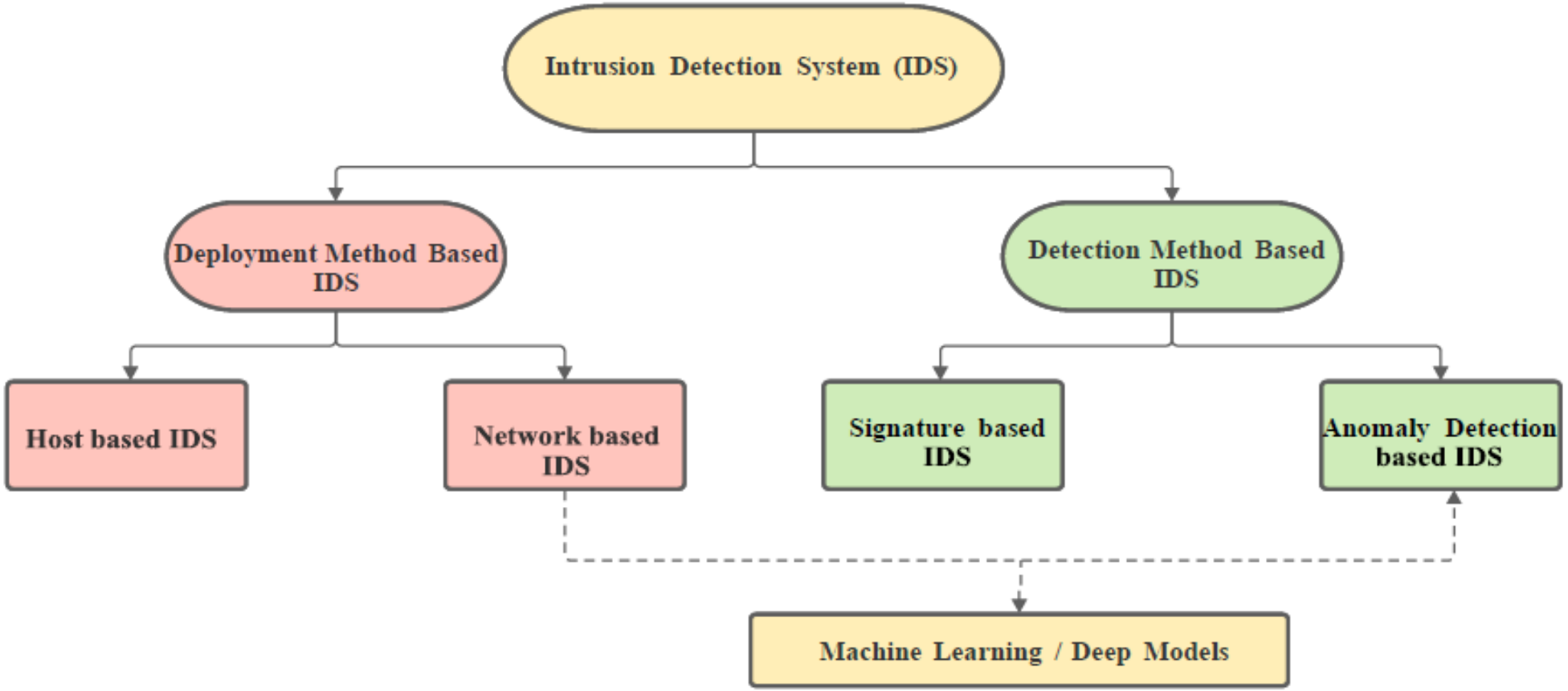
Problem Definition

- Expired Patches for outdated systems
- User Interaction and time efficiency
- Payload encrypted Data in Dataset
- Most available similar solutions are focusing on Packet Headers

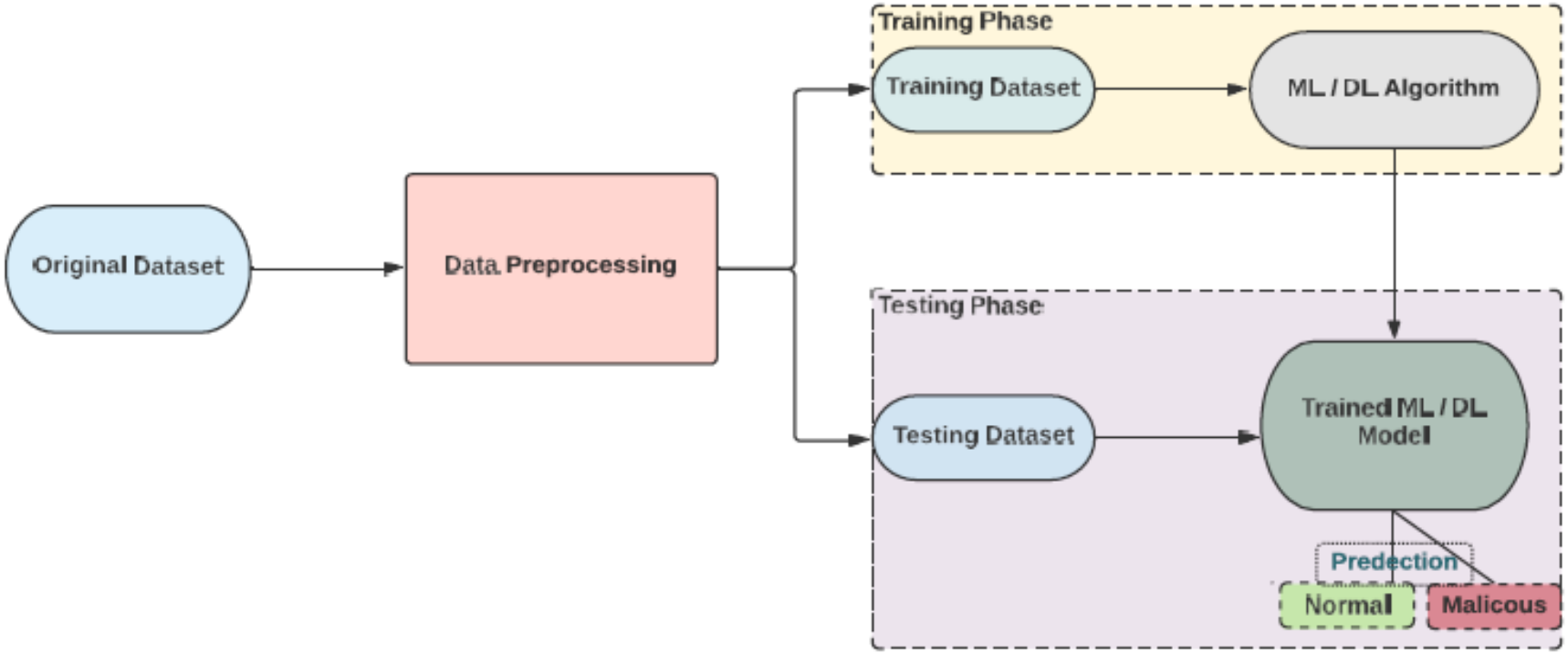
Proposed Solution



Machine Learning Based on Intrusion Detection System

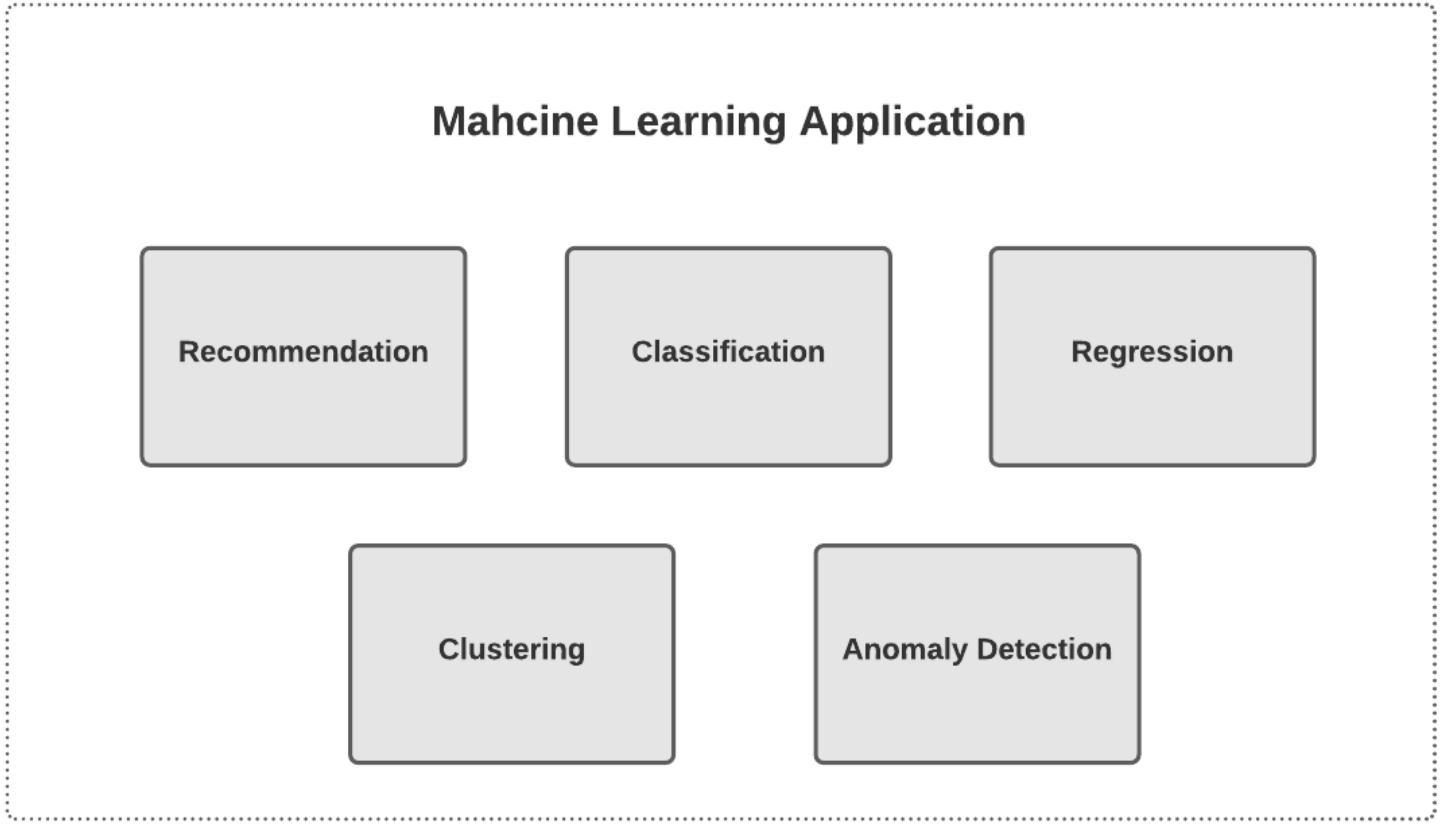

Intrusion Detection System (IDS)
Deployment Method Based IDS
Detection Method Based IDS
Host based IDS
Network based IDS
Signature based IDS
Anomaly Detection based IDS
Machine Learning / Deep Models

ML based IDS



ML Classification Schema

Machine Learning Application



Tools & Requirements

ID2T

Python

Weka

Pandas

Numpy

sklearn

TensorFlow

Hadoop

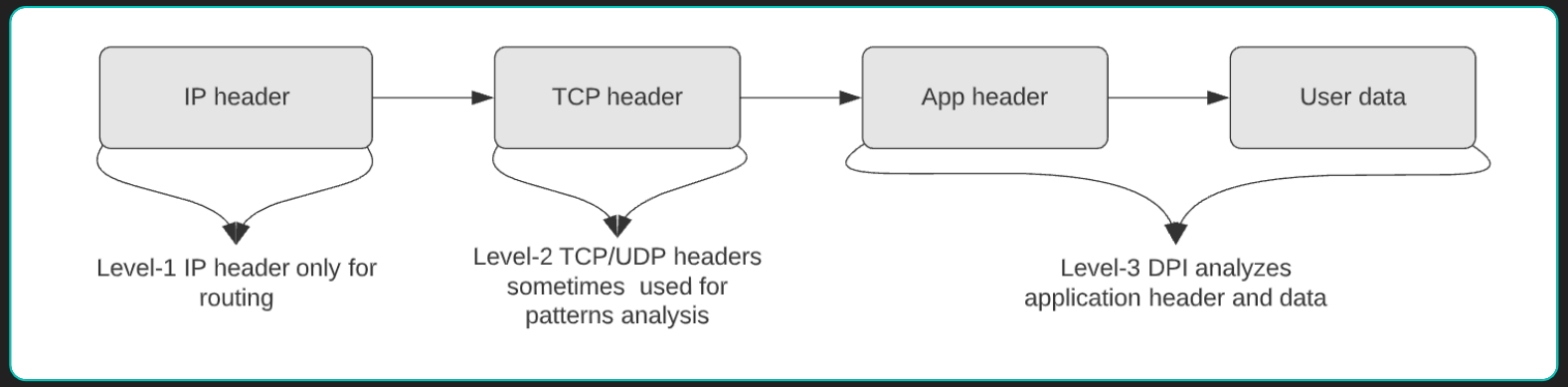
Spark

AWS

Datasets

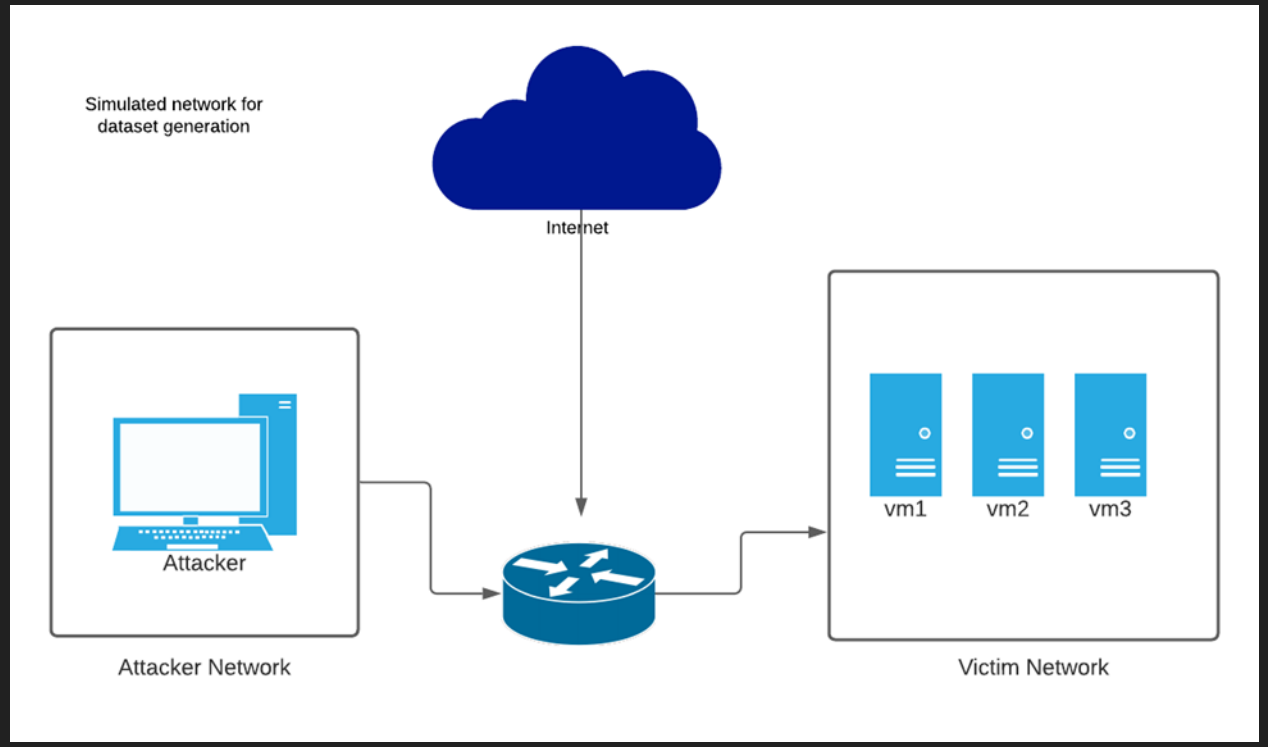
Network Packet structure and DPI

- Layers and levels
- Payload information and the importance
- Encryption



Network Configuration for Dataset Creation

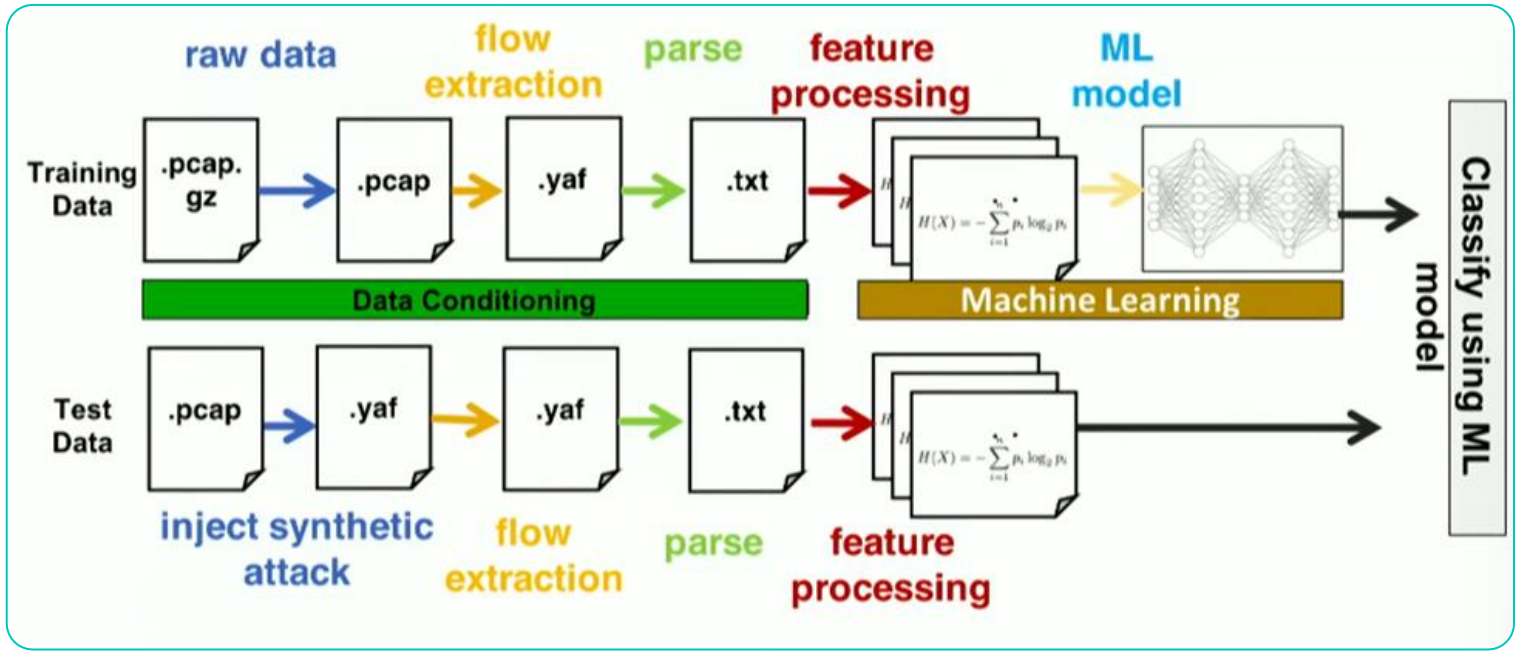
- Classical Network traffic generation methodology
- Varity of network flow



Valid IDS Dataset

- HIKARA 2021
- CICIDS 2017
- KDD99
- NSL-KDD

Network malicious traffic injection structure



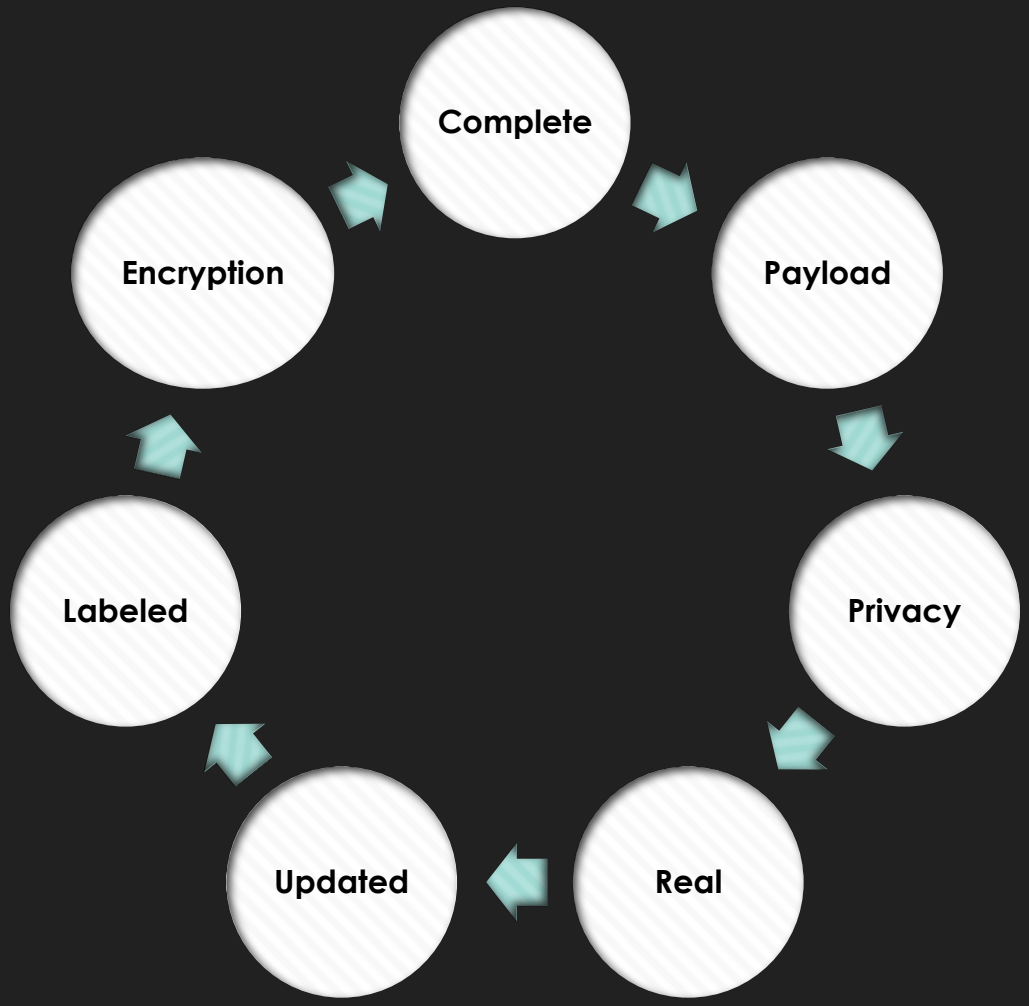
- **Injection tools**
- **Flexible methodology**

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1		Unnamed: 0	uid	originh	originp	responh	responp	flow_duration	fwd_pkts_tot	bwd_pkts_tot	fwd_data_pkts_tot	bwd_data_pkts_tot	fwd_pkts_per_sec	bwd_pkts_per_sec	flow_pkts_per_sec	down_up_
2	0	0	Cg61Jch3v	103.255.15	13316	128.199.24	443	2.207588	15	14	6	6	6.794746	6.341763	13.136509	0.933333
3	1	1	CdRIlqLWc	103.255.15	13318	128.199.24	443	15.624266	15	14	6	6	0.960045	0.896042	1.856087	0.933333
4	2	2	CLzp9KhdC	103.255.15	13320	128.199.24	443	12.203357	14	13	6	5	1.147225	1.065281	2.212506	0.928571
5	3	3	Cnf1YA4iL	103.255.15	13322	128.199.24	443	9.992448	14	13	6	5	1.401058	1.300983	2.702041	0.928571
6	4	4	C4ZKvv3fp	103.255.15	13324	128.199.24	443	7.780611	14	14	6	5	1.799345	1.799345	3.598689	1
7	5	5	CyC8D5X7	103.255.15	13326	128.199.24	443	4.571433	14	13	6	5	3.062497	2.843747	5.906244	0.928571
8	6	6	CEXyM013	103.255.15	13328	128.199.24	443	2.19264	14	13	6	5	6.384997	5.928926	12.313923	0.928571
9	7	7	CVFc4q26\	103.255.15	13330	128.199.24	443	16.082514	14	14	6	5	0.870511	0.870511	1.741021	1
10	8	8	CCvZhO2f	103.255.15	13332	128.199.24	443	13.87324	15	14	6	6	1.081218	1.009137	2.090355	0.933333
11	9	9	CIPZU1mfl	103.255.15	13334	128.199.24	443	11.331464	14	13	6	5	1.235498	1.147248	2.382746	0.928571
12	10	10	CBTv463lV	103.255.15	13336	128.199.24	443	9.117416	14	13	6	5	1.535523	1.425843	2.961365	0.928571
13	11	11	C87B4VRM	103.255.15	13338	128.199.24	443	6.907568	14	13	6	5	2.026763	1.881994	3.908756	0.928571
14	12	12	CDqmaw1	103.255.15	13340	128.199.24	443	4.69254	15	14	6	6	3.196563	2.983459	6.180022	0.933333
15	13	13	CKPhym3C	103.255.15	13342	128.199.24	443	2.198671	14	14	6	5	6.367483	6.367483	12.734967	1
16	14	14	CeAyf115\	103.255.15	13344	128.199.24	443	16.387078	14	13	6	5	0.854332	0.793308	1.64764	0.928571
17	15	15	CMgixZ2D	103.255.15	13346	128.199.24	443	14.004266	14	13	6	5	0.999695	0.928289	1.927984	0.928571
18	16	16	CHZDyc0y	103.255.15	13348	128.199.24	443	11.786487	14	13	6	5	1.187801	1.102958	2.290759	0.928571
19	17	17	CcBMW31	103.255.15	13350	128.199.24	443	9.579908	15	14	6	6	1.565777	1.461392	3.027169	0.933333
20	18	18	CMfQhm1	103.255.15	13352	128.199.24	443	7.331628	14	14	6	5	1.909535	1.909535	3.81907	1
21	19	19	C4dc1Il6w	103.255.15	13354	128.199.24	443	4.889648	14	13	6	5	2.863192	2.658678	5.52187	0.928571
22	20	20	CwTQNM2	103.255.15	13356	128.199.24	443	2.446596	15	14	6	6	6.130968	5.722236	11.853204	0.933333
23	21	21	Cl8Nw218	103.255.15	13358	128.199.24	443	18.886364	14	13	6	5	0.741276	0.688327	1.429603	0.928571
24	22	22	CFuetc4pC	103.255.15	13360	128.199.24	443	16.676013	14	14	6	5	0.839529	0.839529	1.679058	1
25	23	23	CadzA834(	103.255.15	13362	128.199.24	443	14.471357	14	12	6	5	0.967428	0.829224	1.796653	0.857143
26	24	24	Cegg5P3LY	103.255.15	13364	128.199.24	443	12.259943	14	13	6	5	1.14193	1.060364	2.202294	0.928571
27	25	25	Cw6qpM1(	103.255.15	13366	128.199.24	443	10.052126	15	13	6	5	1.492222	1.293259	2.78548	0.866667
28	26	26	Co6QPk1II	103.255.15	13368	128.199.24	443	6.841417	15	14	6	6	2.192528	2.04636	4.238888	0.933333

Dataset formats

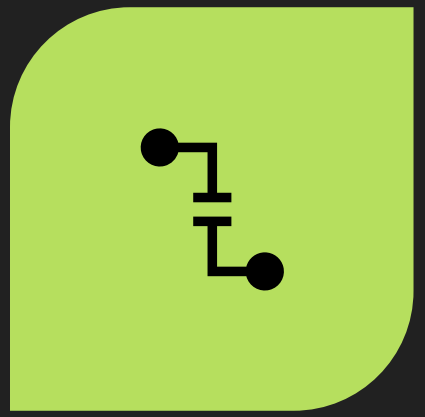
- Tabular format – human readable
- Valid extensions : .csv .yaf .json

Functional Requirements



Non-functional Requirements

PUBLIC AVAILABILITY



INTEROPERABILITY. STANDER FORMAT

QUALITY

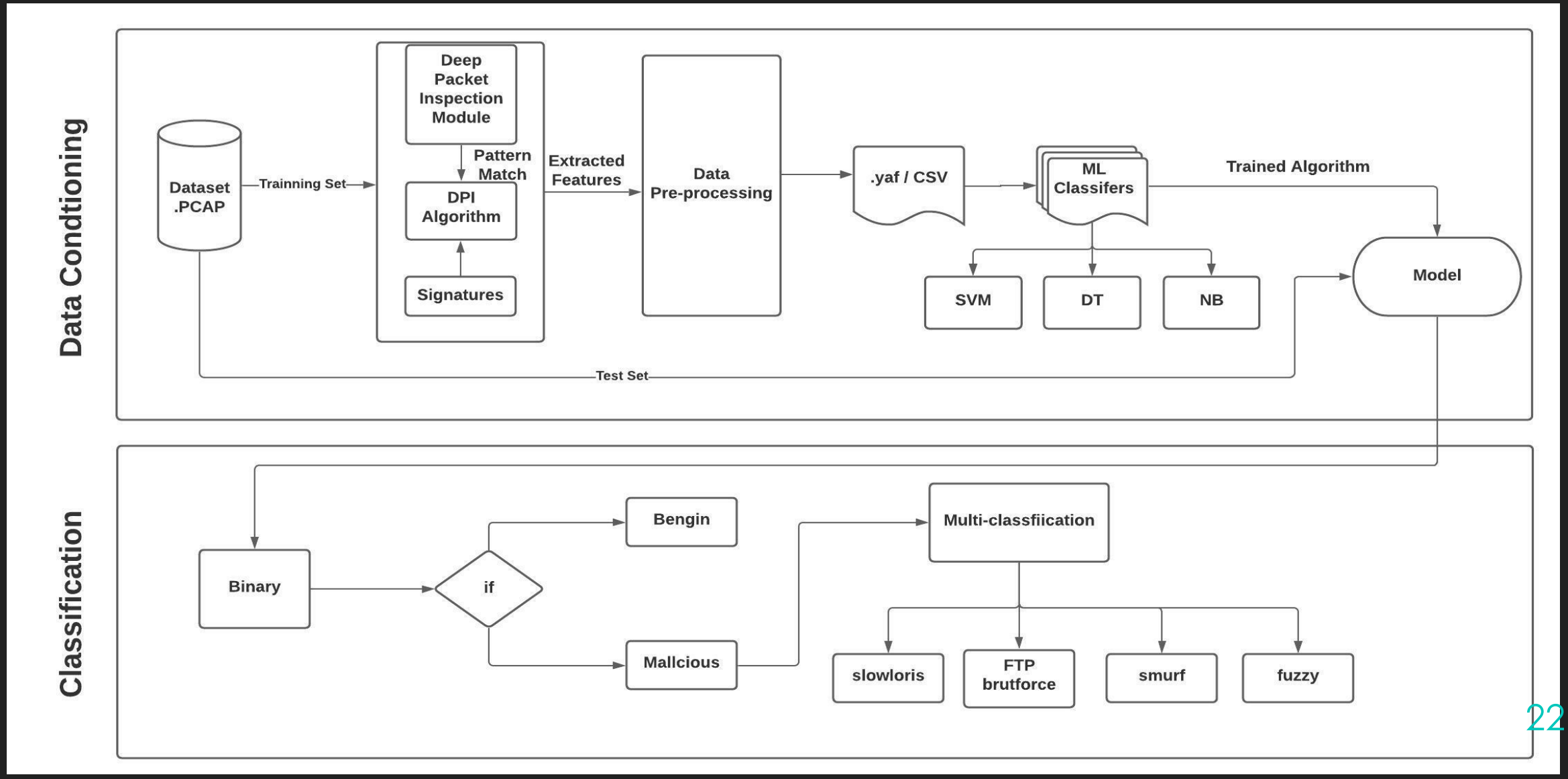
Dataset Labels

- Labels in binary could be 0 or 1
- Labels in multi-class can be assigned as classes starting by 0 , 1 , 2 ...
- Labels encoding for string names.

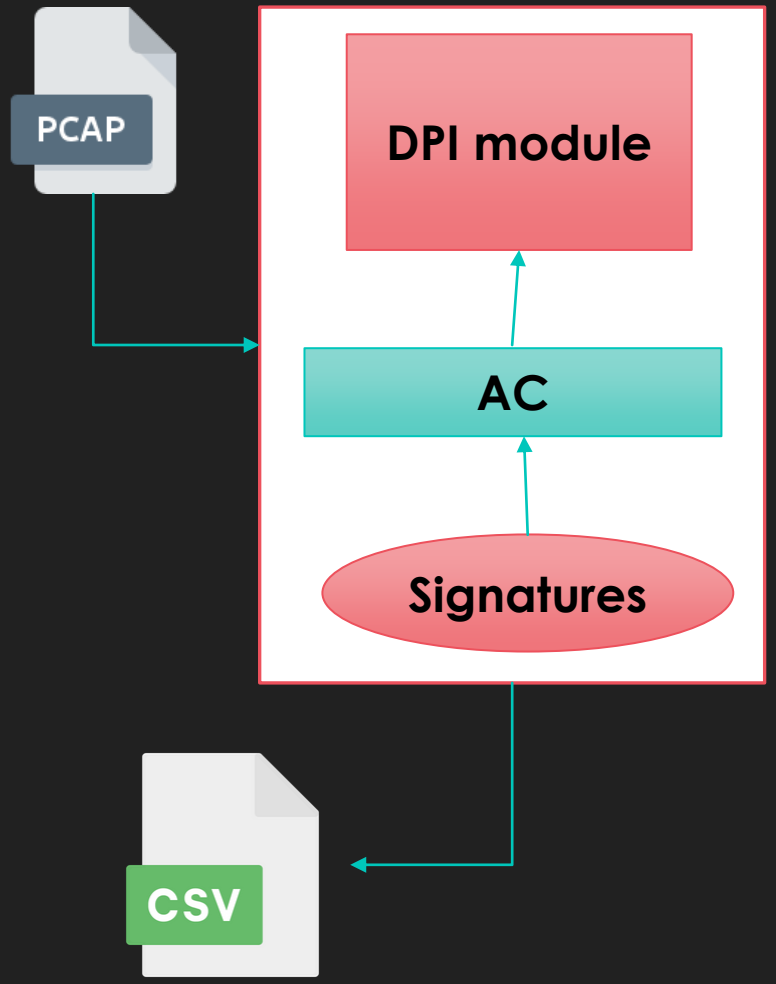
Class number	Class name
Class 0	Benign
Class 1	Bot
Class 2	DDos
Class 3	Dos Hulk
Class 4	PortScan
Class 5	Dos slowloris
Class 6	Web Attack-Brute Force

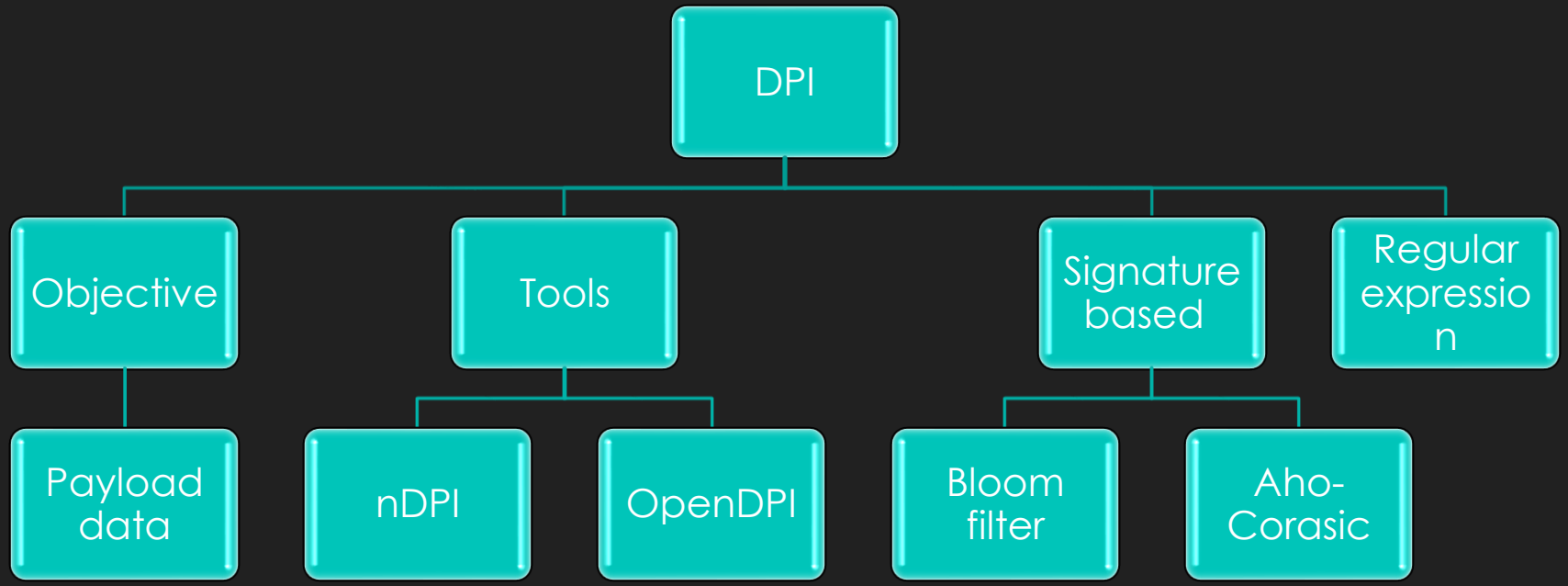
Proposed System Architecture

Full System Design

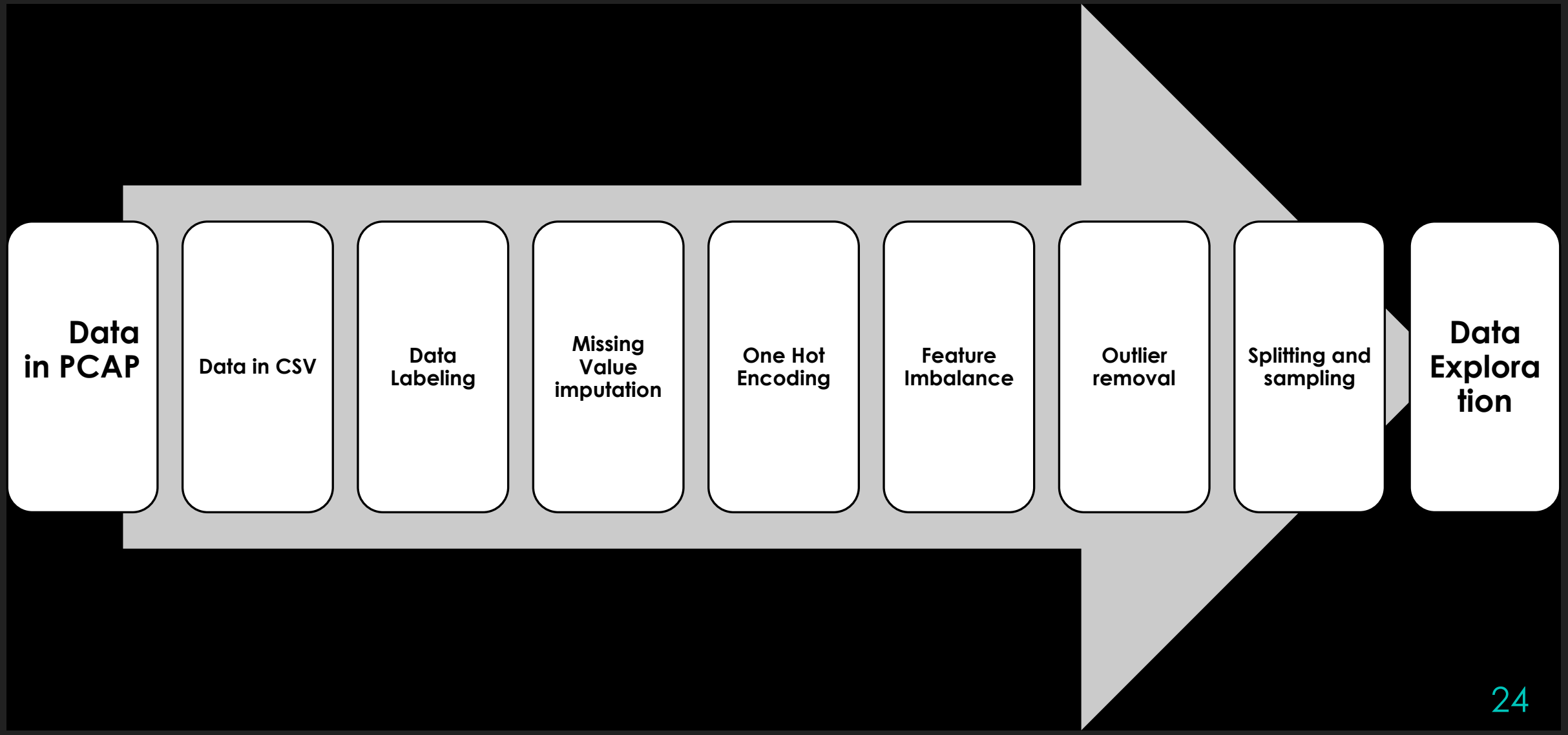


Deep Packet Inspection

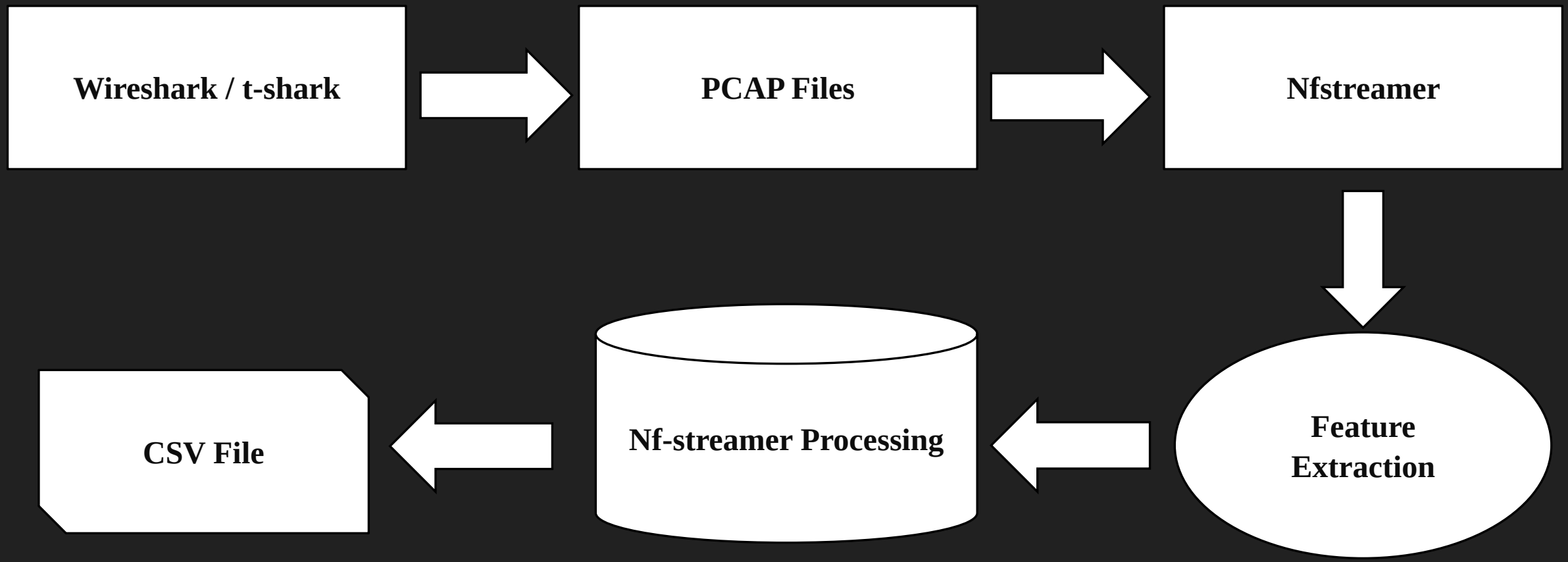




Pre-processing Phase / data cleaning



Feature Extrication



	protocol	sourceIPAdress	destinationIPAdress	timeStamp	len	data	target
0	HTTP	167.50.30.156	2.30.147.253	08-02-2019 10:10:28	70	d0ecc25418e1aca2	3
1	TCP/IP	178.76.229.13	113.144.16.192	01-06-2019 20:33:48	79	69b5faa8cd472e60	3
2	HTTP	237.224.185.211	2.108.37.18	17-06-2019 05:58:46	69	501457d8bff174bf	3
3	SMTP	251.227.74.148	220.3.101.137	05-01-2020 02:40:00	78	0000da9dd1551a42	0
4	UDP	202.178.50.102	214.157.79.86	30-01-2020 21:22:00	83	6c5fa73810164f11	1
...	...	...	...	...	...	...	...
10863	UDP	75.9.29.33	8.142.189.33	10-09-2019 05:29:49	95	4bfc3dc2f657f1b5	3
10864	TCP/IP	83.219.154.118	175.228.202.120	28-04-2019 17:47:15	86	74d619eee002c033	2
10865	FTP	195.235.123.98	240.86.210.116	10-03-2020 02:17:29	71	3800002006dfab19	0
10866	UDP	176.142.74.84	161.7.87.34	05-05-2019 14:04:11	76	bc7423805a250548	2
10867	FTP	21.164.14.96	25.12.5.126	14-04-2019 22:35:22	58	7e900002964a6098	0

Figure : Extracted Payload Data using BMHP algorithm

Feature Extrication Representatives

Nfstreamer

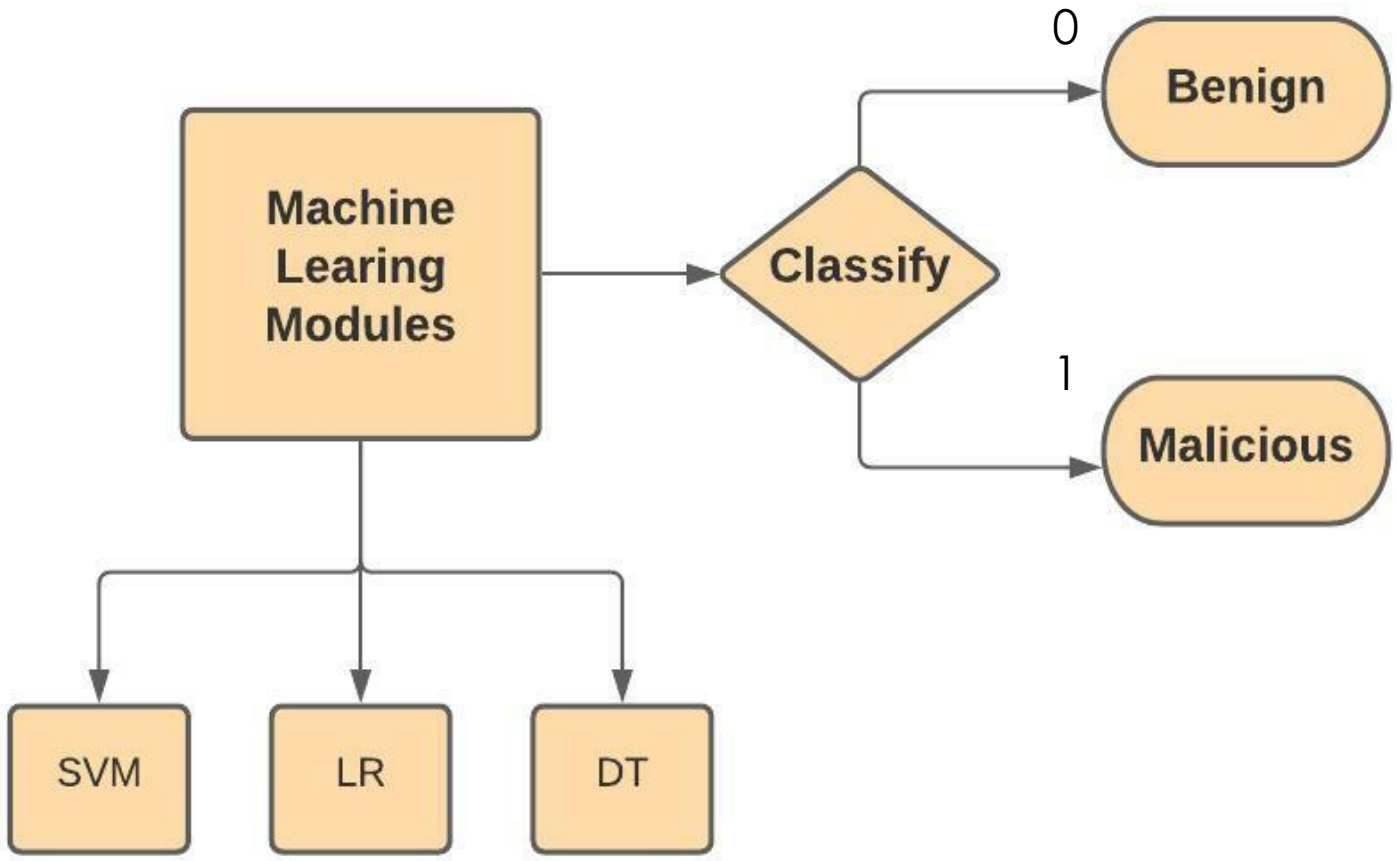
CICFlowmeter

Zeek

custom Script

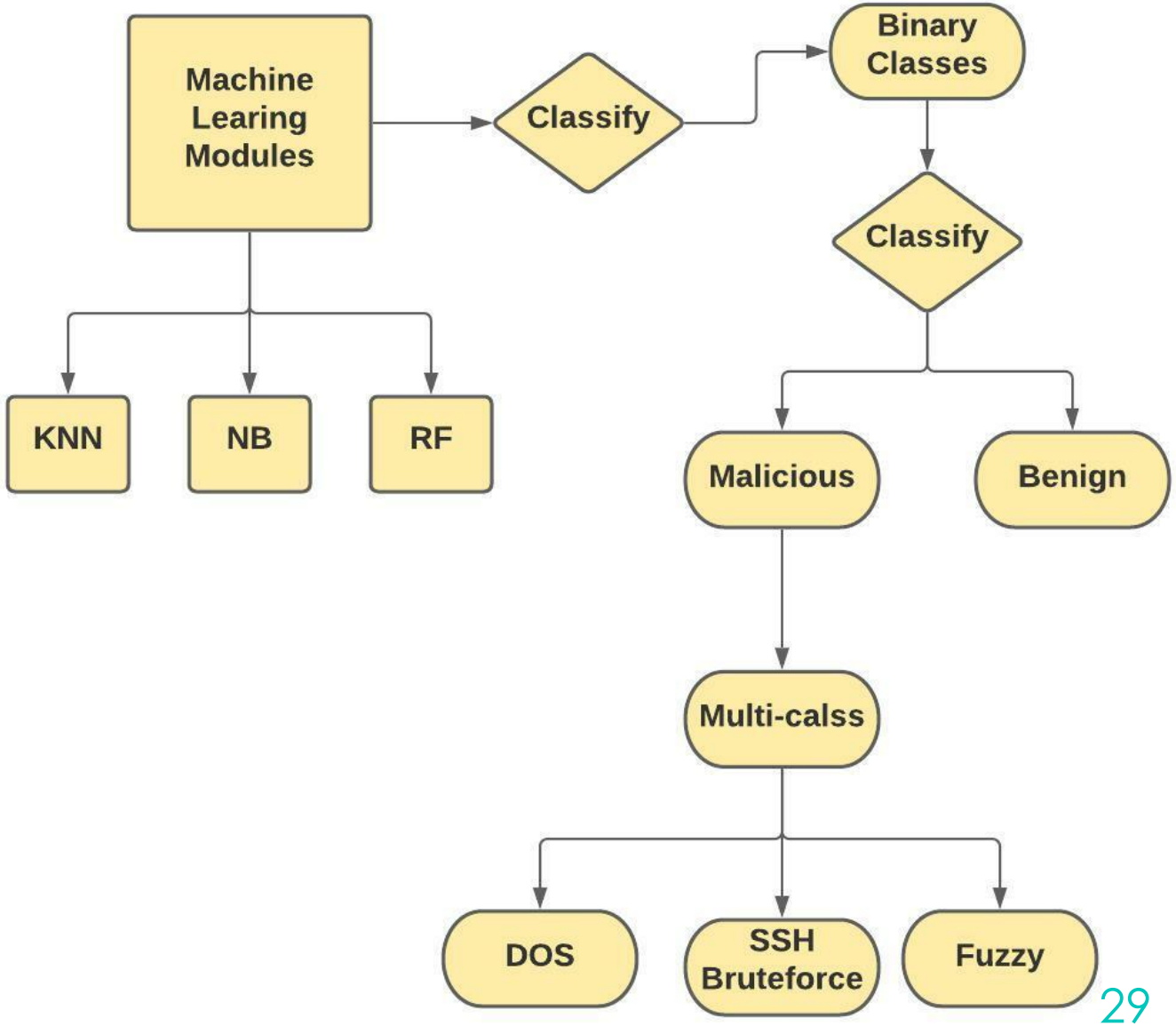
ML Binary Classification

- Using DPI
- Guided Classifiers
- ML modules



Multi-classification

- Accuracy Increasing
- Time Efficiency
- Deep Learning



Final Key Points

Patch and secure outdated systems

Eliminate user client interaction and involvement have time and effort

Hybrid approach