

## SNAPSHOTS

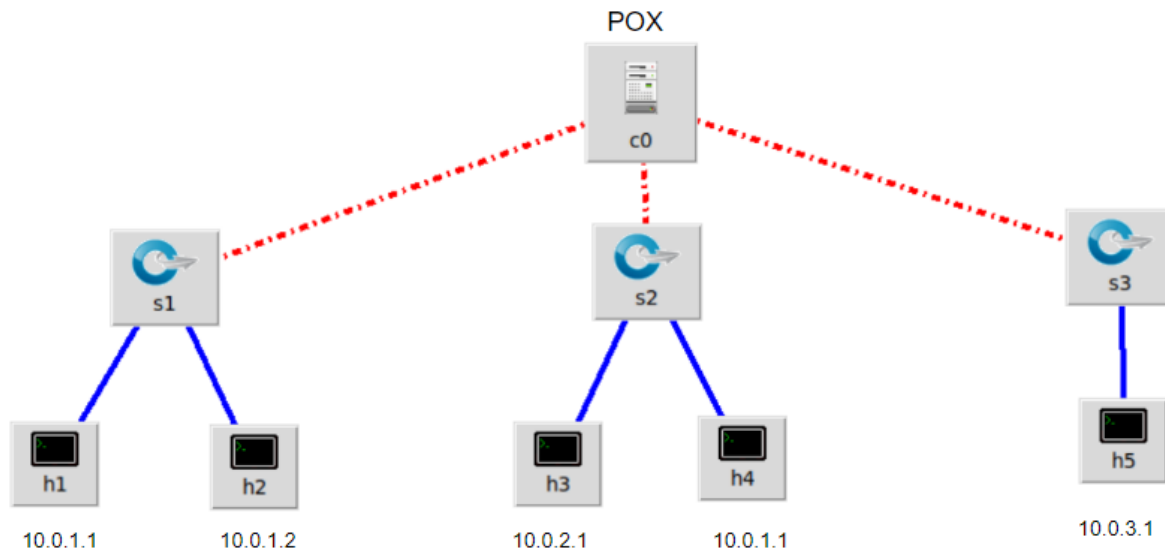


Fig. 4.1 - Mininet Topology

```
madhu@madhu-VirtualBox: ~/pox
File Edit View Search Terminal Help
madhu@madhu-VirtualBox:~$ cd pox
madhu@madhu-VirtualBox:~/pox$ ./pox.py forwarding.l2_learning
POX 0.3.0 (dart) / Copyright 2011-2014 James McCauley, et al.
INFO:core:POX 0.3.0 (dart) is up.
INFO:openflow.of_01:[00-00-00-00-00-01 1] connected
INFO:openflow.of_01:[00-00-00-00-00-03 2] connected
INFO:openflow.of_01:[00-00-00-00-00-02 3] connected

madhu@madhu-VirtualBox: ~/mininet/examples
File Edit View Search Terminal Help
madhu@madhu-VirtualBox:~$ cd mininet/examples
madhu@madhu-VirtualBox:~/mininet/examples$ ./miniedit.py
topo=None
New Prefs = None
New controller details for c0 = {'remotePort': 6633, 'controllerProtocol': 'tcp',
'hostname': 'c0', 'remoteIP': '127.0.0.1', 'controllerType': 'remote'}
New host details for h1 = {'ip': '10.0.1.1', 'nodeNum': 1, 'sched': 'host', 'hostname': 'h1'}
New host details for h2 = {'ip': '10.0.1.2', 'nodeNum': 2, 'sched': 'host', 'hostname': 'h2'}
New host details for h3 = {'ip': '10.0.2.1', 'nodeNum': 3, 'sched': 'host', 'hostname': 'h3'}
New host details for h4 = {'ip': '10.0.2.2', 'nodeNum': 4, 'sched': 'host', 'hostname': 'h4'}
New host details for h5 = {'ip': '10.0.3.1', 'nodeNum': 5, 'sched': 'host', 'hostname': 'h5'}
```

Fig. 4.2 - Pox connectivity with Mininet



```
"Host: h1" "Host: h2"
10.0.1.2 - - [17/Mar/2023 16:22:59] "GET /?W5C7EL=ol15wUnnG&FjP=YaGlyPspM&Wn0yJB root@madhu-VirtualBox:/home/madhu/mininet/examples/GoldenEye# ./goldeneye.py ht
r=22Unsu HTTP/1.1" 200 - tp://10.0.1.1 -s 10
10.0.1.2 - - [17/Mar/2023 16:22:59] "GET /?2ukusRAat=X8gxG&BSu=QpHxao02xUJsX41Xx&
OUh14s=T3vGvFMd20aEsIkLNF&OpbSC=ApWUUGx0i=Fqmh HTTP/1.1" 200 - GoldenEye v2.1 by Jan Seidl <jseidl@wroot.org>
10.0.1.2 - - [17/Mar/2023 16:22:59] "GET /?HIFLfo=VLQ95nRsk77JJn3&tGd5UL=KLDUODo
eoA2R8K1&ljr=aFp0QsJI=L42X3cf8CEFFHDG HTTP/1.1" 200 - Hitting webservice in mode 'get' with 10 workers running 10 connections each, Hit
10.0.1.2 - - [17/Mar/2023 16:22:59] "GET /?ygu=CJFu830&A5yNF1suGt=rUbEbWVPwNL4&n CTRL+C to cancel.
x0jT6p=e6JthFus339nugL&UC8F&GdftJ2SnA=8c7ixjVt65sb&4TdRLUn=qP3gdeJb0Jf HTTP/1.1" 1821 GoldenEye strikes hit. (0 Failed)
200 - 3283 GoldenEye strikes hit. (0 Failed)
10.0.1.2 - - [17/Mar/2023 16:22:59] "GET /?356oJEj=Hnhk0kEkJVnAjs75 HTTP/1.1" 2 4591 GoldenEye strikes hit. (0 Failed)
00 - 6067 GoldenEye strikes hit. (0 Failed)
10.0.1.2 - - [17/Mar/2023 16:22:59] "GET /?4h&K1wXk=DF4cFY HTTP/1.1" 200 - ^CTRL+C received. Killing all workers
10.0.1.2 - - [17/Mar/2023 16:22:59] "GET /?ubBT=eBKJtrG7SpqJRCx86&EMDX5aB4cB=4Hb Shutting down GoldenEye
QExNAE1Um4u2icp HTTP/1.1" 200 - root@madhu-VirtualBox:/home/madhu/mininet/examples/GoldenEye#
10.0.1.2 - - [17/Mar/2023 16:22:59] "GET /?hTjybLc5=R0dsJwjdMhVLC&RfqNnVnR=GLJs
E2Cqfi10xJfgFL&EpalldiVgds=wU25EABG HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 16:22:59] "GET /?waV=QMSorRBC7uaBxx HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 16:22:59] "GET /?035E1=0K0b HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 16:22:59] "GET /?677c=shGYOSDYnVIUTVA&gJlb=wIAlu&Gknf&
2R1VjvSBn=Aqtr4chGCHypnSDMu4r&7BK0xilc=U2tDR5n6sUy&M&27KngJN=Lc5hEODIJoce HTTP/1
.1" 200 -
10.0.1.2 - - [17/Mar/2023 16:22:59] "GET /?bMNNtH=HwvLknQ0M5ykV45E&076dV=RxvMH
qBjH&mtgJfXf=cCtJ HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 16:22:59] "GET /?I3pvXPfK=DNF11hNt&ESnW=iBYrxGu HTTP/
```

Fig. 4.5 - Attack Generation - GoldenEye

```
"Host: h1" "Host: h2"
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?MCCG=IDZPWJBNQ HTTP/1.1" 200 - root@madhu-VirtualBox:/home/madhu/mininet/examples# cd hulk-master
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?NLMB=aQI HTTP/1.1" 200 - root@madhu-VirtualBox:/home/madhu/mininet/examples/hulk-master# sudo python hul
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?VRRG0AT=ME0G HTTP/1.1" 200 - k.py http://10.0.1.1:80
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?UXHMTPEMO=EJFFSOY HTTP/1.1" 200 - -- HULK Attack Started --
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?FBOXTEEB=PPGHORIOZ HTTP/1.1" 200 - 269 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?YMG5ORRKEED=DHD HTTP/1.1" 200 - 370 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?QTFH=JZGXSZ HTTP/1.1" 200 - 474 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?QCKJB=USCGPICFME HTTP/1.1" 200 - 575 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?CVALDNFH=ZXKX HTTP/1.1" 200 - 681 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?CTSDHKL=DOYZ HTTP/1.1" 200 - 783 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?TURDO=WEAO HTTP/1.1" 200 - 885 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?PTGEFE=LRLMLVPASG HTTP/1.1" 200 - 986 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?WIPWJSC=XLMDFYNB HTTP/1.1" 200 - 1087 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?MCCG=IDZPWJBNQ HTTP/1.1" 200 - 1188 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?FBOXTEEB=PPGHORIOZ HTTP/1.1" 200 - 1289 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?SKMWVZSN HTTP/1.1" 200 - 1391 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?RETWF=DCHZKVER HTTP/1.1" 200 - 1497 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?UZV=JABSTFNH HTTP/1.1" 200 - 1599 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?RLLNJGRH=ENTOMEOD HTTP/1.1" 200 - 1701 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?GKNCU=NML HTTP/1.1" 200 - 1802 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?QCKJB=USCGPICFME HTTP/1.1" 200 - 1904 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?CTSDHKL=DOYZ HTTP/1.1" 200 - 2009 Requests Sent
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?TURDO=WEAO HTTP/1.1" 200 - ^X^X^X^
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?PTGEFE=LRLMLVPASG HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?VAKP=LCGMPXMI HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?SKTTJUNUU=CBHVIDNY HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?UZV=JABSTFNH HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?XTFO=EDIFVH HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?VLYE=LKQYMS HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?VNLISZZE=IWPXMX HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?TUUBCVAGFL=PDN HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?VYN=ZBQZGBR HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?FNVIQW=XWVTZEE HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?SAOGF=MKAS HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?LGDPMHBJJ=ISUBXFGJ2Q HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?OTABZAH=YPMOBB HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?ORGE=EKNU HTTP/1.1" 200 -
10.0.1.2 - - [17/Mar/2023 23:12:46] "GET /?NEQWU=OJNOLAP HTTP/1.1" 200 -
```

Fig. 4.6 - Attack Generation - Rudy

```
=====
PERCENTAGE OF ATTACK TRAFFIC : 45.1240842607
PERCENTAGE OF NORMAL TRAFFIC : 54.8759157393
=====
=====
INFO:core:POX 0.3.0 (dart) is up.
INFO:openflow.of_01:[00-00-00-00-00-03 2] connected
INFO:openflow.of_01:[00-00-00-00-00-01 1] connected
INFO:openflow.of_01:[00-00-00-00-00-02 3] connected
```

Fig. 4.7 - REP tree component

```
=====
PERCENTAGE OF ATTACK TRAFFIC : 21.7478128213
PERCENTAGE OF NORMAL TRAFFIC : 78.2521871787
=====
```

Fig. 4.8 - J48 component

```
=====
PERCENTAGE OF ATTACK TRAFFIC : 21.7663436908
PERCENTAGE OF NORMAL TRAFFIC : 78.2336563092
=====
```

Fig. 4.9 - Random Forest component

```

=====
PERCENTAGE OF ATTACK TRAFFIC : 3.89633958224
PERCENTAGE OF NORMAL TRAFFIC : 96.1036604178
=====

```

Fig. 4.10 - Random Tree component

```

Normal Traffic
Normal Traffic
Normal Traffic

=====

PERCENTAGE OF ATTACK TRAFFIC : 22.124234626
PERCENTAGE OF NORMAL TRAFFIC : 77.875765374

=====
INFO:core:POX 0.3.0 (dart) is up.
INFO:openflow.of_01:[00-00-00-00-00-04 1] connected

```

Fig. 4.11 - MLP Component

```

04/21-22:02:01.823280 10.0.1.2:56398 -> 10.0.1.1:80
TCP TTL:64 TOS:0x0 ID:41780 IpLen:20 DgmLen:52 DF
***A**R** Seq: 0x8BB4A5 Ack: 0x9A98AD30 Win: 0x480 TcpLen: 32
TCP Options (3) => NOP NOP TS: 508332023 1048039940
=====
04/21-22:02:01.823580 10.0.1.2:56404 -> 10.0.1.1:80
TCP TTL:64 TOS:0x0 ID:51880 IpLen:20 DgmLen:52 DF
***A**R** Seq: 0x643B1CEF Ack: 0xF576A890 Win: 0x480 TcpLen: 32
TCP Options (3) => NOP NOP TS: 508332023 1048039947
=====
04/21-22:02:01.823864 10.0.1.2:56414 -> 10.0.1.1:80
TCP TTL:64 TOS:0x0 ID:3131 IpLen:20 DgmLen:52 DF
***A**R** Seq: 0xBF6EA981 Ack: 0xF92A5DC1 Win: 0x480 TcpLen: 32
TCP Options (3) => NOP NOP TS: 508332023 1048039947
=====
04/21-22:02:17.478904 fe80::ccad:d3ff:fe99:b9aa -> ff02::2
IPv6-ICMP TTL:255 TOS:0x0 ID:0 IpLen:40 DgmLen:56
=====

```

Fig. 4.12- Snort Logs



```

WARNING:reptreecomp:Same port for packet from ce:ad:d3:99:b9:aa -> 7a:6c:a3:46:fb:3e on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from ce:ad:d3:99:b9:aa -> 7a:6c:a3:46:fb:3e on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from ce:ad:d3:99:b9:aa -> 7a:6c:a3:46:fb:3e on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from ce:ad:d3:99:b9:aa -> 7a:6c:a3:46:fb:3e on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from 7a:6c:a3:46:fb:3e -> ce:ad:d3:99:b9:aa on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from 7a:6c:a3:46:fb:3e -> ce:ad:d3:99:b9:aa on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from 7a:6c:a3:46:fb:3e -> ce:ad:d3:99:b9:aa on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from 7a:6c:a3:46:fb:3e -> ce:ad:d3:99:b9:aa on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from 7a:6c:a3:46:fb:3e -> ce:ad:d3:99:b9:aa on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from 7a:6c:a3:46:fb:3e -> ce:ad:d3:99:b9:aa on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from 7a:6c:a3:46:fb:3e -> ce:ad:d3:99:b9:aa on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from 7a:6c:a3:46:fb:3e -> ce:ad:d3:99:b9:aa on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from 7a:6c:a3:46:fb:3e -> ce:ad:d3:99:b9:aa on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from 7a:6c:a3:46:fb:3e -> ce:ad:d3:99:b9:aa on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from 7a:6c:a3:46:fb:3e -> ce:ad:d3:99:b9:aa on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from 7a:6c:a3:46:fb:3e -> ce:ad:d3:99:b9:aa on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from 7a:6c:a3:46:fb:3e -> ce:ad:d3:99:b9:aa on 00-00-00-00-00-01.1. Drop.
WARNING:reptreecomp:Same port for packet from 7a:6c:a3:46:fb:3e -> ce:ad:d3:99:b9:aa on 00-00-00-00-00-01.1. Drop.

```

Fig. 4.13 - Malicious packets dropped in Snort

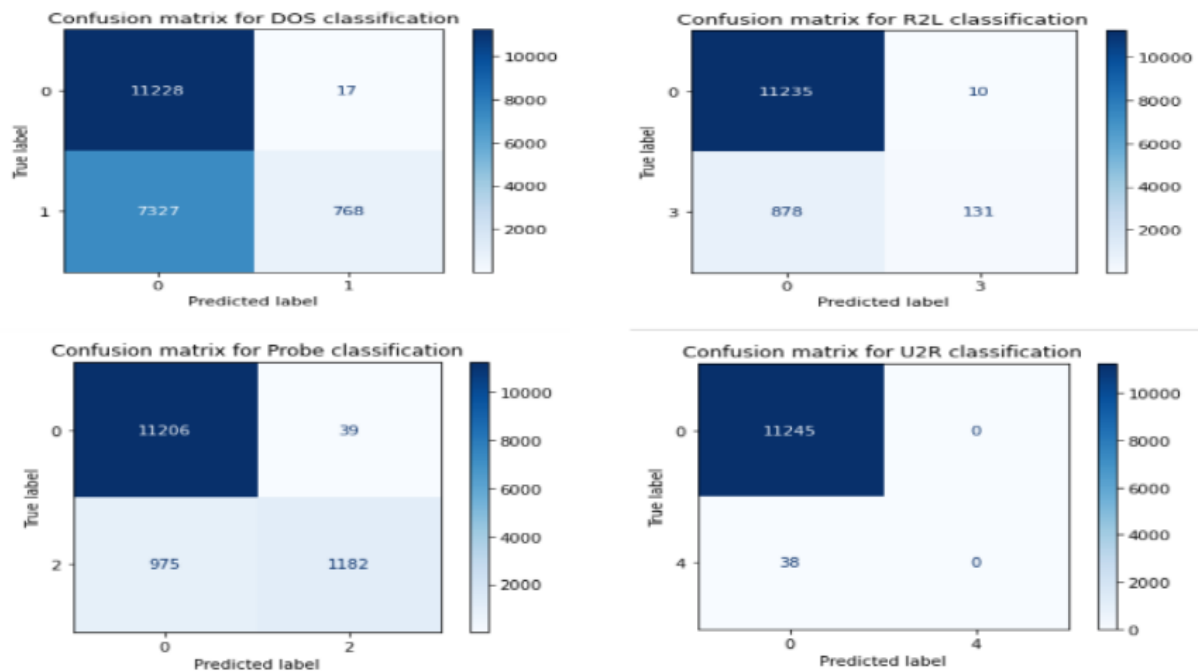


Fig 4.14 - Confusion Matrix of Random Tree Component

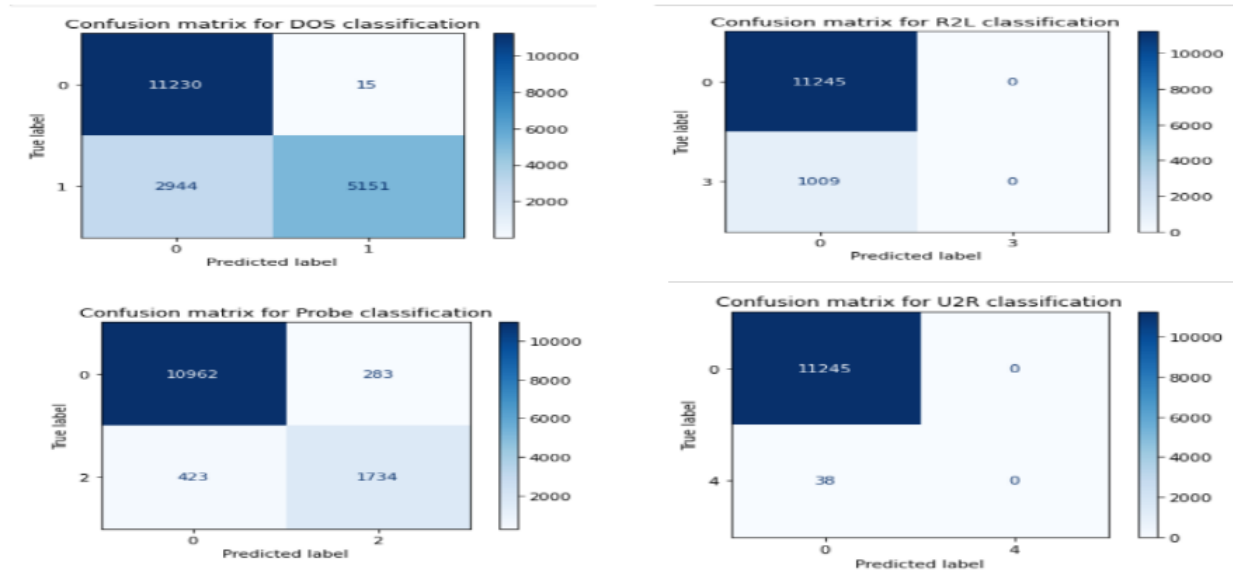


Fig. 4.15 - Confusion Matrix of Random Forest component

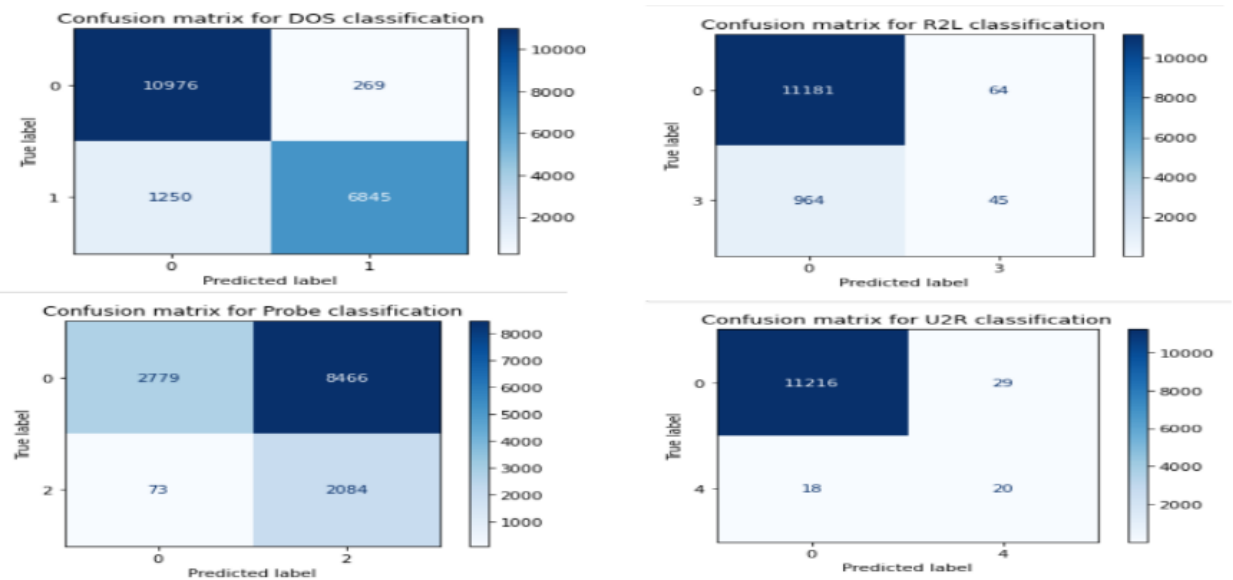


Fig. 4.16 - Confusion Matrix of REP Tree Component

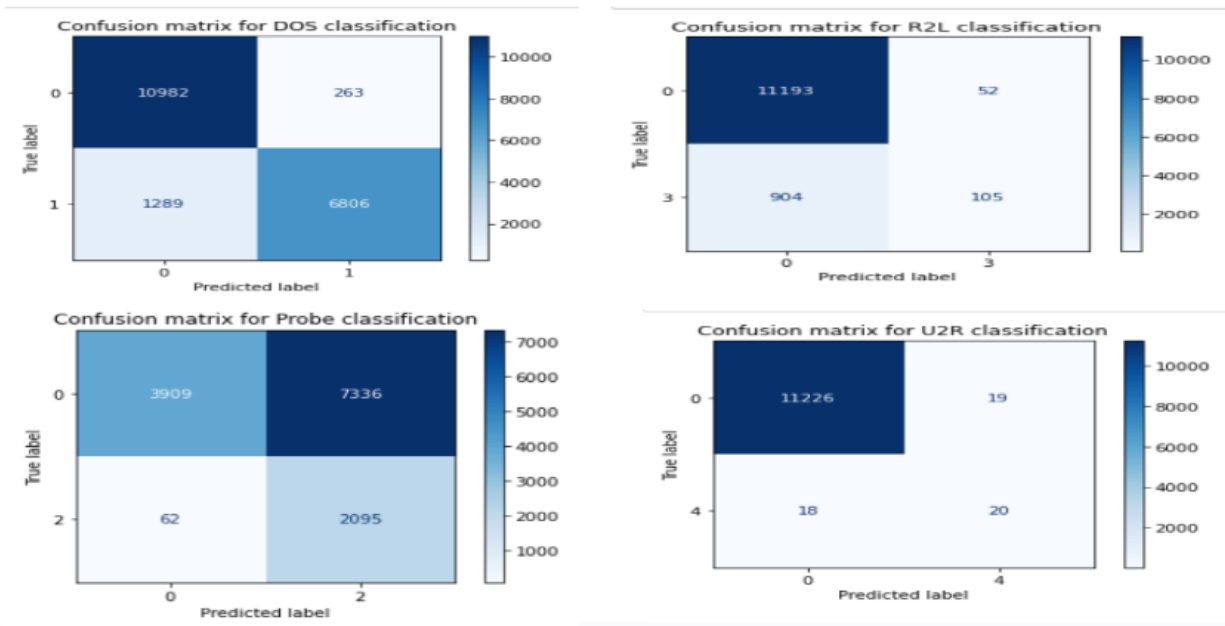


Fig. 4.17 - Confusion Matrix of J48 Tree Component

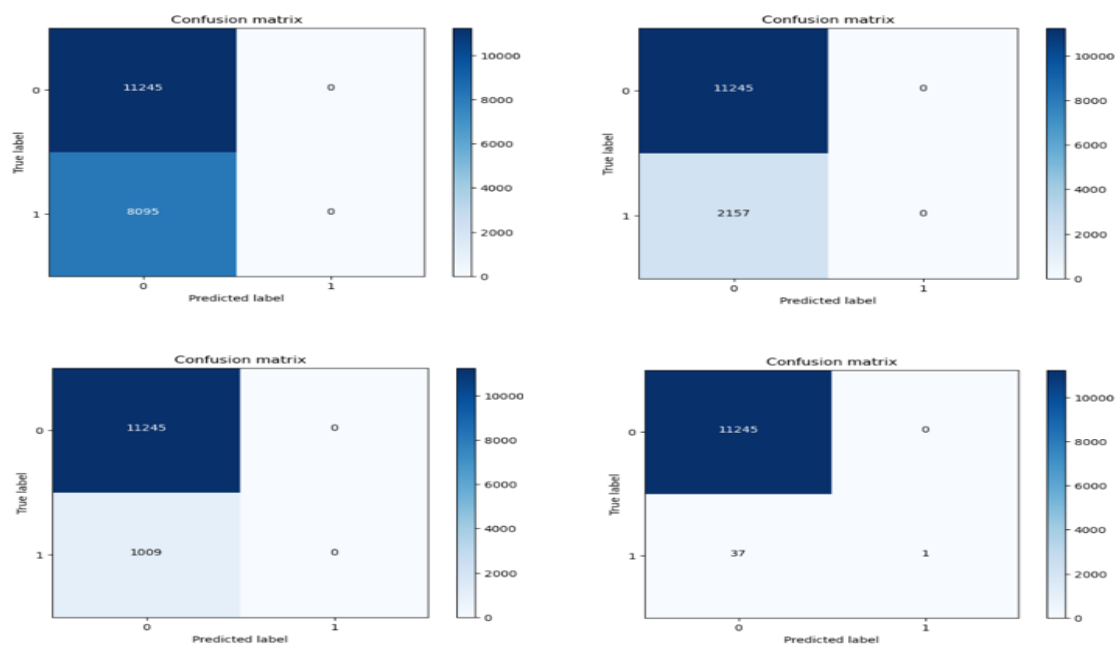


Fig. 4.18 - Confusion Matrix of MLP Component



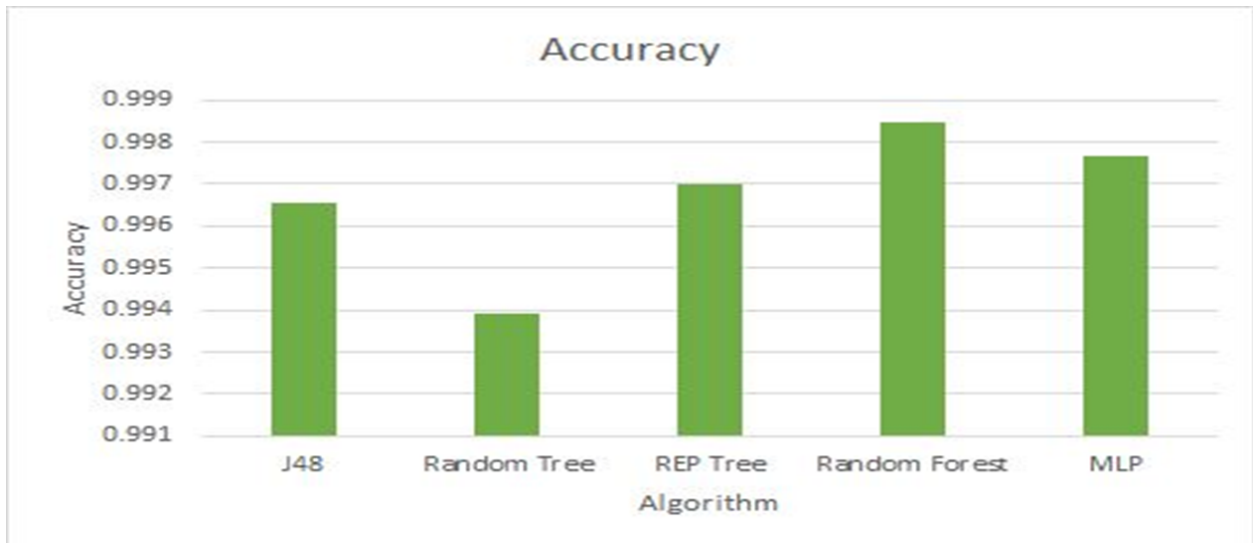


Fig. 4.19 - Graphical analysis of the Accuracy Parameter

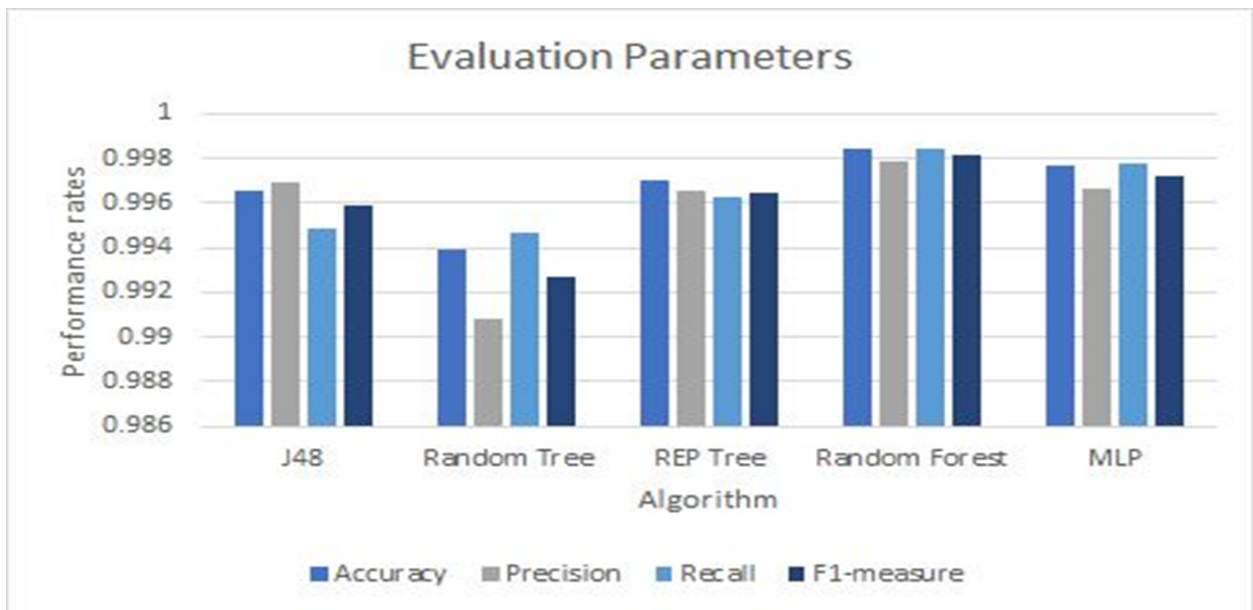


Fig. 4.20 - Graphical analysis of the Evaluation Parameters

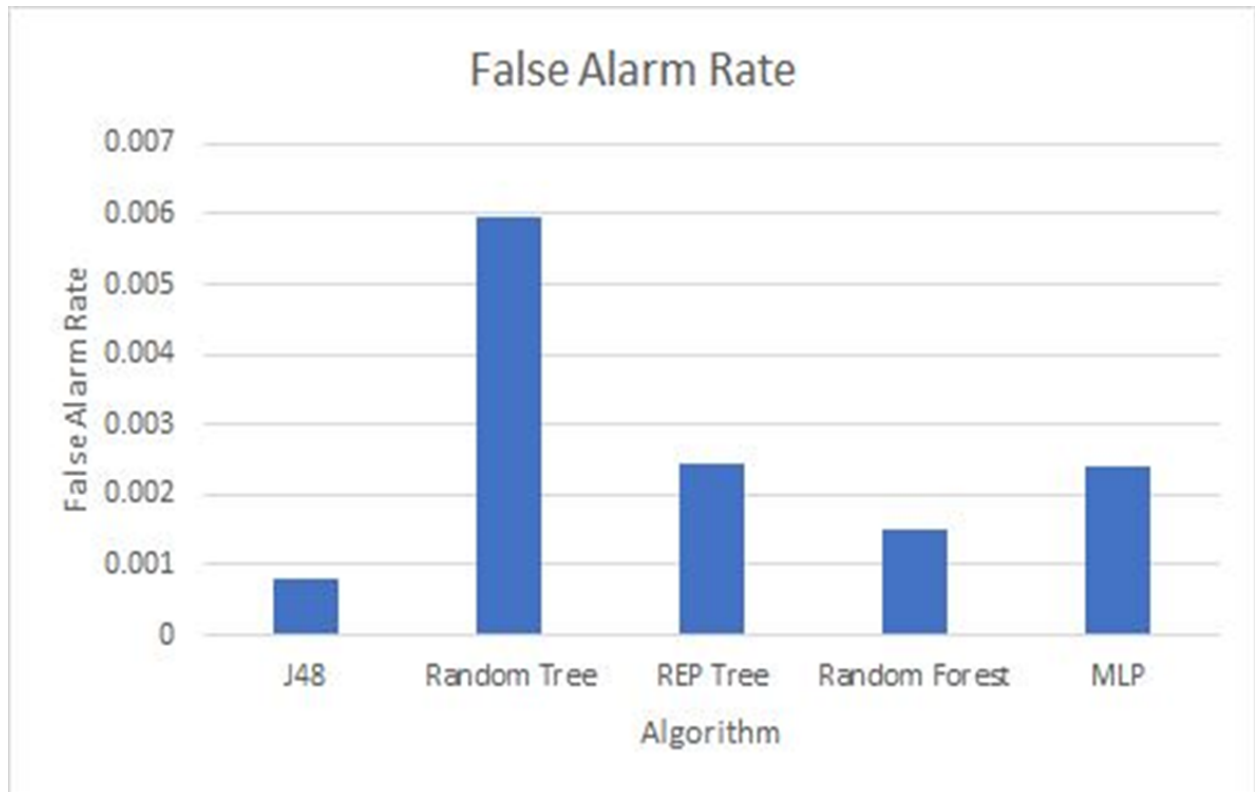


Fig. 4.21 - Graphical analysis of False Alarm Rate