Taint Checker: Tracking the taint propagation on Binary Programs

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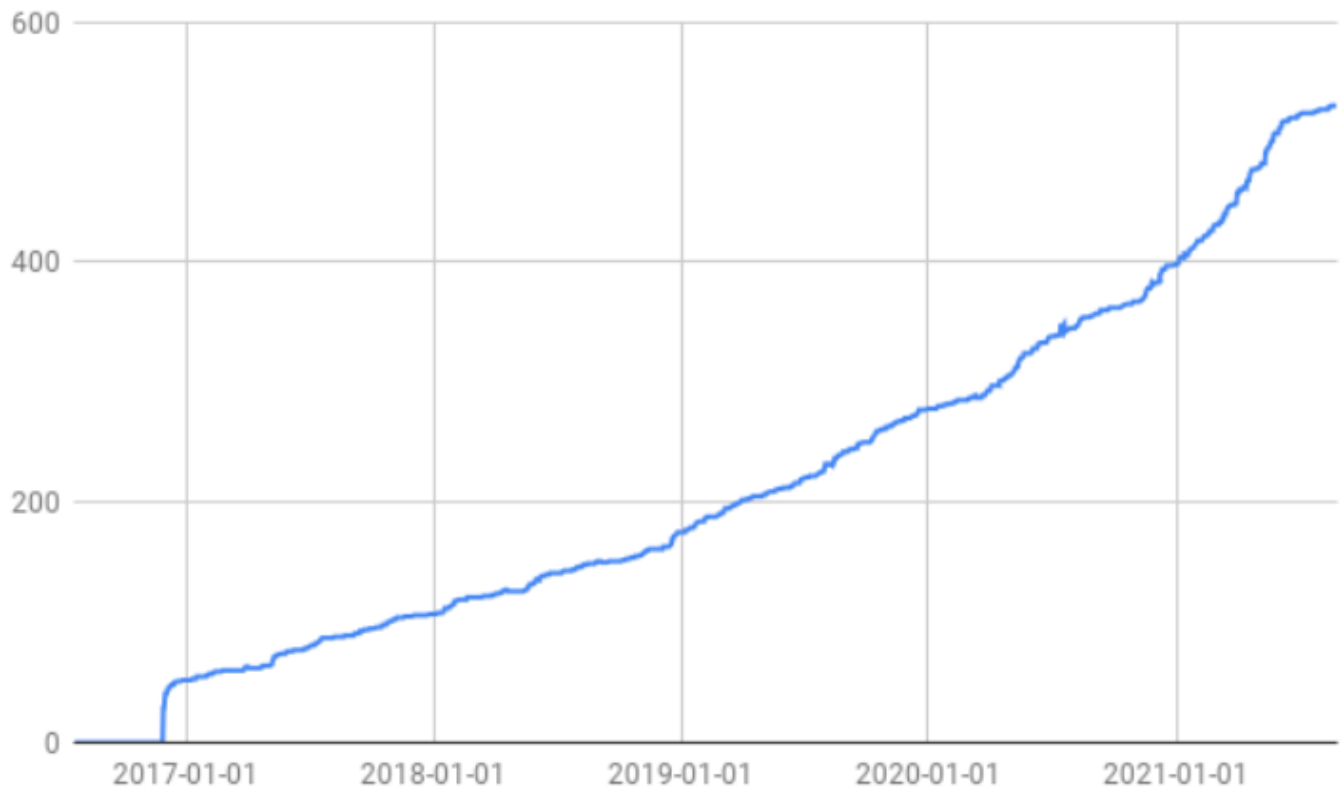
KAIST

Finding Software bugs is Important

- software bugs increase every years



Bugs type

- memory corruption

ex) Bof / UAF / Double free bugs

- non-memory corruption

ex) Logical bugs, Command injection

How to detect the bugs non-memory corruption?

Existing Methods

- Symbolic Execution

  QSym, arbirter

- Taint analysis

  SaTC, Taint pipe, code sonar, Condysta

- Concolic Execution

  Symsan

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- Symbolic Execution

  QSym, arbirter

- Taint analysis

  SaTC, Taint pipe, code sonar, Condysta

- Concolic Execution

  Symsan

Taint analysis

- Track information flow from input

Taint analysis

- Source : origin of data
- Sink : dangerous function / exploitable targets

```
void ping(char *target)
{
    char command[256];
    sprintf(command, "ping %s",target);
    system(command);
}
```

Taint analysis

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- Sink : dangerous function / exploitable targets

```
void ping(char *target)
{
    char command[256];
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}
```

source

sink

Taint analysis

- Taint Propagation
  - Mark source as taint
  - Pass the taint if value is copied to another variable/buffer
  - check if argument to sink holds the taint

Taint analysis

```c
test.c > ping(char *)
void ping(char *target)
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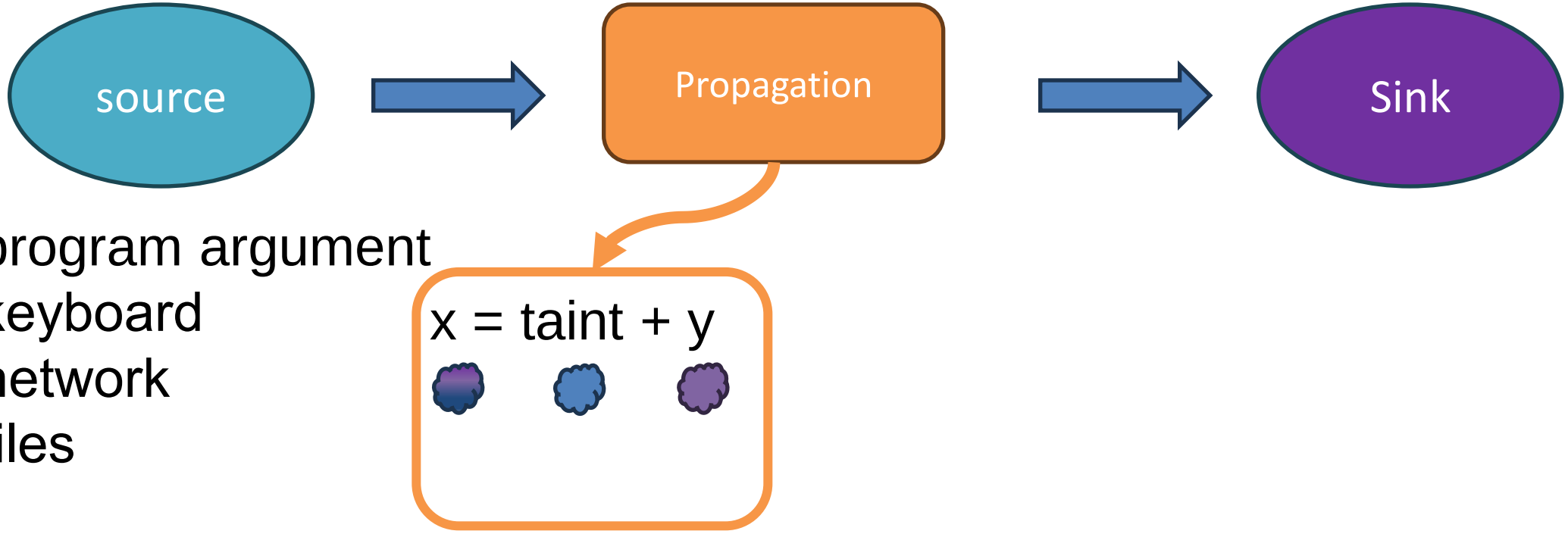
Taint analysis

- program argument
- keyboard
- network
- files

Taint analysis



- program argument
- keyboard
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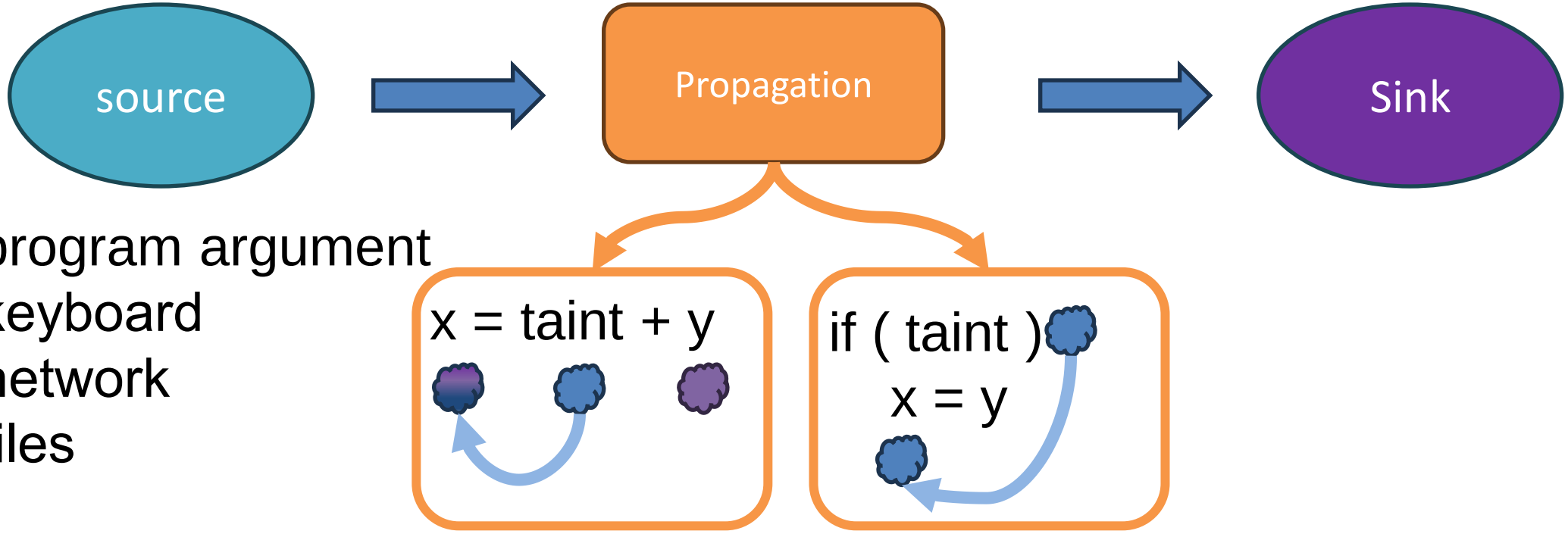
explicit
data flows

Taint analysis



- program argument
- keyboard
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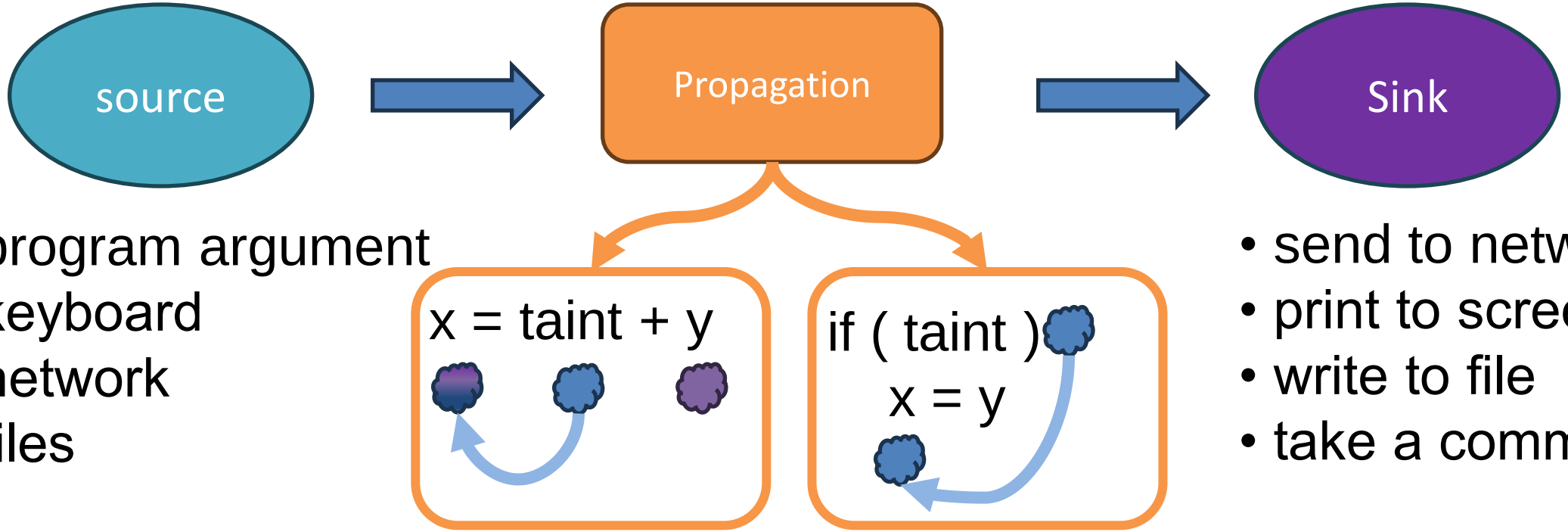
explicit
data flows

implicit
data flows

Taint analysis



- program argument
- keyboard
- network
- files

explicit
data flows

implicit
data flows

- send to network
- print to screen
- write to file
- take a command

How to implement taint propagation?

Propagation Implementation

- Need to make a rule for each function or all data transmitted.
  ex) explicit data flow / implicit data flow

Propagation Implementation

- Need to make a rule for each function or all data transmitted.
  ex) explicit data flow / implicit data flow

- Use angr for binary analysis.
  - Can simulate the program.
  - Support ARM / MIPS.
  - Symbolic execution support.
  - Actively maintained.
  - Run program to track taints.

Propagation Implementation

- angr simulate program
- When we reach a copying function like sprint
  - ➔ Pass the taint from the source string to the destination string
- When we reach the sink function
  - ➔ Check if the sink argument is tainted

```c
void ping(char *target)
{
    char command[256];
    sprintf(command, "ping %s",target);
    system(command);
}
```

```
target: BitVec(1024*8)
command : BitVec(256*8)

target <- taint
command <- taint

when we reach the sink function, check is command tainted.
```

Challenge 1

- Need to make a rule for each function or all data transmitted.

Best case

```
char *source;
char *propagate_1;

propagate_1 = source;

sprintf(propagate_1,"%s",source);

strcpy(propagate_1,source);

system(propagate_1)
```

Challenge 1

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system(propagate_1)
```

Worst case scenario

```
char *source;
char *propagate_1;

user_defined_function(propagate_1,source);

system(propagate_1)
```

Challenge 1

- Need to make a rule for each function or all data transmitted.

Best case scenario

```
char *source;
char *propagate_1;

propagate_1 = source;

sprintf(propagate_1,"%s",source);
```

Worst case scenario

```
char *source;
char *propagate_1;

user_defined_function(propagate_1,source);
```

If you set the propagation rule incorrectly for unser_defined_function, you will not be able to find the bug.

Challenge 2

- Need to make a rule for each function or all data transmitted.

Best case scenario

```
char *source;
char *propagate_1;

propagate_1 = source;

sprintf(propagate_1,"%s",source);

strcpy(propagate_1,source);

system(propagate_1)
```

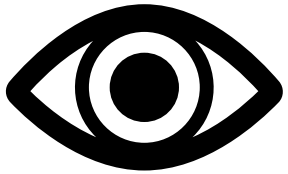
Worst case scenario2

```
char *x ="/bin/sh";
char *y ="/bin/ls";
int source;
        [illegible]
if( source )
   x = y
system(x);
```

How to find the limitation of propagation rule?

Observation

- we can evaluate the propagation rules through visualizing.
- Can find limitation of current propagation rules.



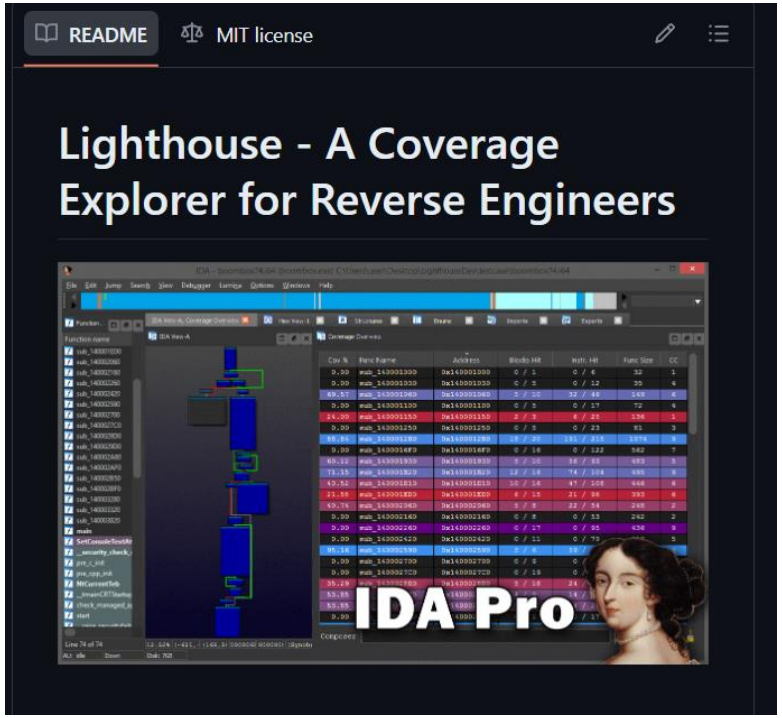
Observation

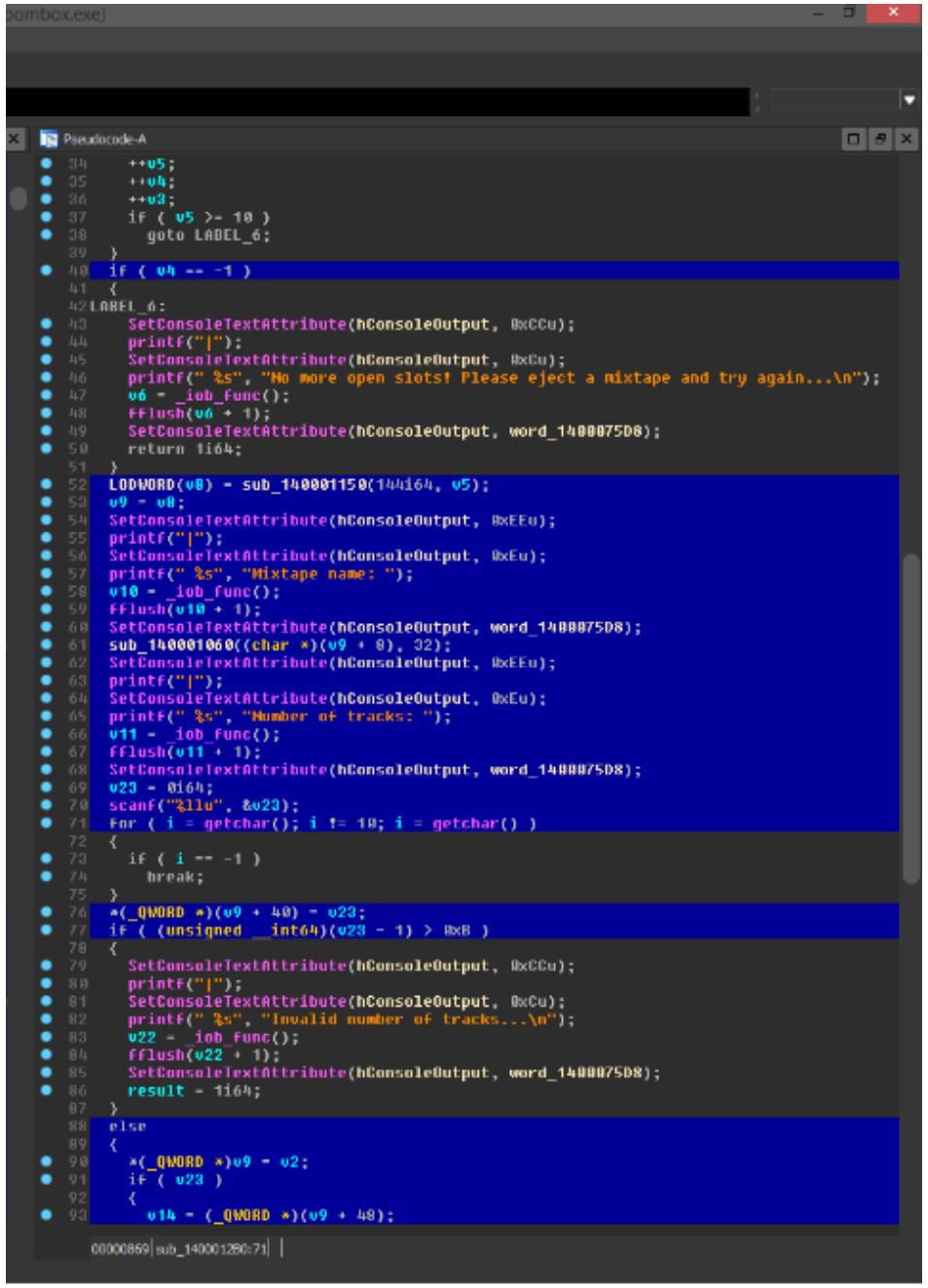
• key idea

- Matches the process in which taint propagation occurs and the decompiler source code.

Observation

- Coverage Viewer
- IDA Light House





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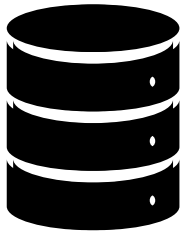

Hex-Rays

Observation

- Remark where is source and sink
- Remark propagation

```
int __cdecl main(int argc, const char **argv, const char **envp)
{
  const char *source; // [rsp+0h] [rbp-120h]
  char propagation[264]; // [rsp+10h] [rbp-110h] BYREF
  unsigned __int64 v6; // [rsp+118h] [rbp-8h]

  v6 = __readfsqword(0x28u);
  source = (const char *)input(argc, argv, envp);
  if ( source )
    printf("AAAAAAAAA");
  else
    printf("BBBBBBBBB");
  sprintf(propagation, "%s", source);
  if ( !malloc(0x100uLL) )
    exit(1);
  system(propagation);
  return 0;
}
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Expectation

- Find the limitation of taint propagation implement
- Find ways to improve to create better taint analysis tools.

Thank You

Questions?

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Propagation Implementation

- Accuracy related to distance between source and sink

Best case scenario

```
char *source;
source = input();
system(source)
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Propagation Implementation

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Best case scenario

```
char *source;
source = input();
system(source)
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Worst case scenario

```
char *source;
source = input();
...
...
...
...
system(can_taint)
```

Too many code to simulate

Propagation Implementation

- Accuracy related to distance between source and sink

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char *source;
source = input();
system(source)
```

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...
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Accuracy is low because the data flow is not tainted perfectly.

Propagation Implementation

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We cannot detect vulnerability