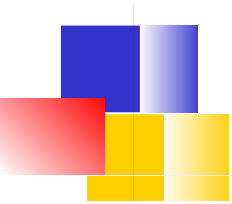


Logging

James Brucker

KBank data stolen

Pipit Aneaknithi, Kasikornbank president, revealed that on July 25, KBank found that 3,000 names of corporate customers using KBank's website for the letter of guarantee service might have been leaked.

As soon as KBank detected the irregularity, it said it immediately closed the loophole... The data that may have been leaked was the names and telephone numbers of KBank's corporate customers using the letter of guarantee service via the website only.

The Nation August 01, 2018 18:47

http://www.nationmultimedia.com/detail/business/30351237

KTB customer data stolen

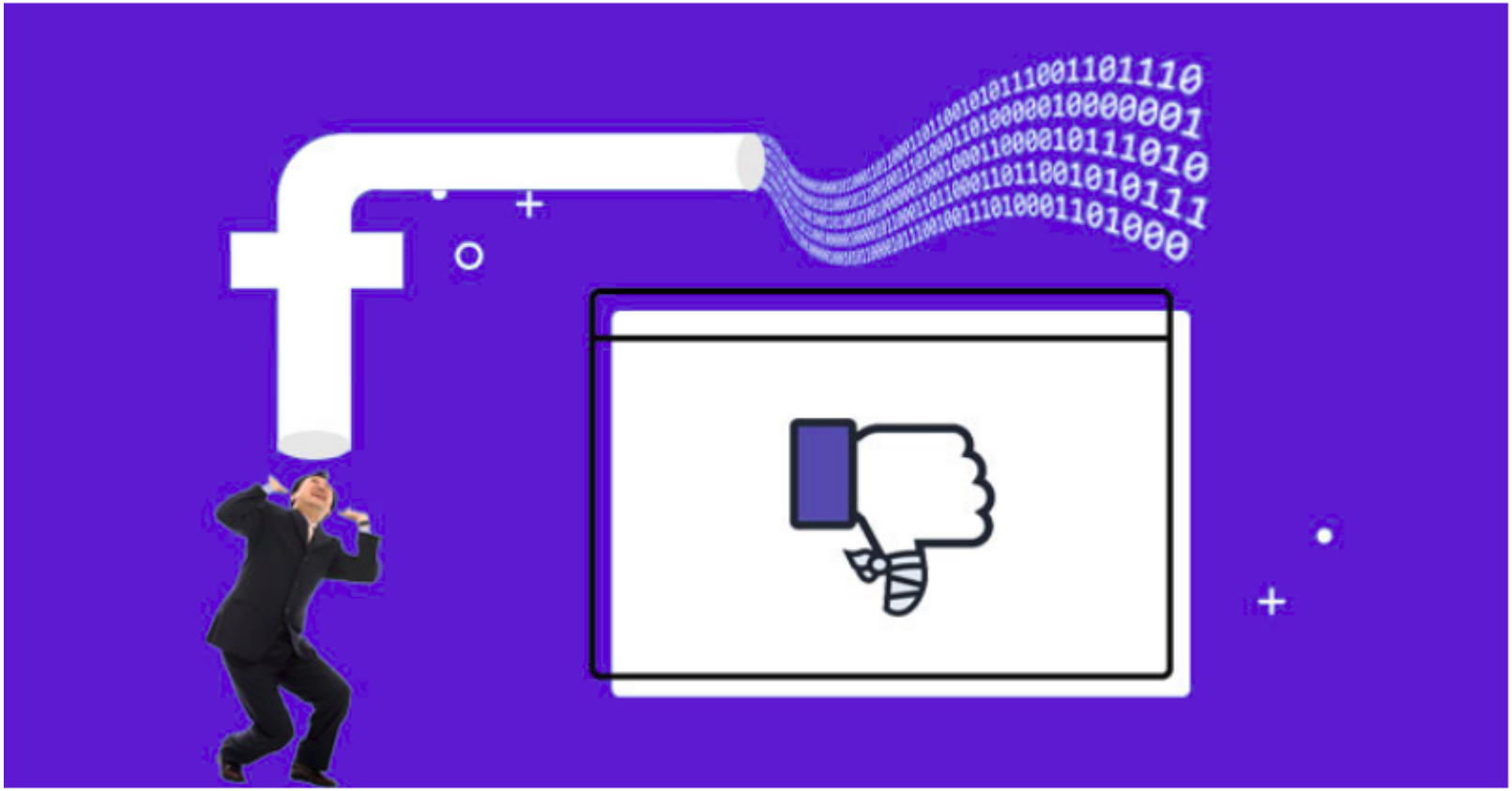
KTB president Payong Srivanich said that the bank had detected general information from 120,000 retail customers who applied for mortgages and personal loans online ... **was hacked** in the days leading up the July holidays.

Bangkok Post - August 01, 2018 04:00

https://www.bangkokpost.com/news/security/1513410/kbank-ktb-targeted-in-cyber-attacks

30 Million Facebook Accounts Were Hacked: Cl Them

October 12, 2018 Swati Khandelwal



Late last month Facebook announced its worst-ever security breach that allowed an unknown group of hackers to steal secret access tokens for millions of accounts by taking advantage of a flaw in the 'View As' feature.

How Facebook was Hacked

A flaw in "View As" feature that enables someone to preview a page as another user. Flaw has been present since 2017, but first detected on 14 Sep 2018 due to rise in suspicious activity.

Facebook knows exactly which accounts were hacked and you can check your account.

https://www.wired.com/story/how-facebook-hackers-compromised-30-million-accounts/

https://thehackernews.com/2018/10/hack-facebook-account.html

How Did They *Know*?

How did **KBank** know 3,000 customer's data stolen ... and what data was stolen?

How did **KTB** know 120,000 customers "who applied for a mortgage or loan" had data stolen?

How did **Facebook** know whose data was stolen?

LOGGING

They keep "logs" of events and activity.

Linux Logs Almost Everything

Unix/Linux keep logs for many services is **`/var/log`**.

Typical logs are:

`auth.log` - authentication related (login, sudo)

`boot.log` - system start-up (boot) activity

`dpkg.log` - package install and configuration messages

`kern.log` - messages from the kernel

`lastlog` - most recent login by each user

`ufw.log` - firewall messages

Log files are automatically rotated every 1 - 7 days, so they do not become too large.

Python Logging

`logging` - Python logging package

```
# get a named logger.  Use a module or app name
logger = logging.getLogger( "test" )

# log messages at different log levels
logger.debug( "I found a bug" )
logger.info( "some interesting info" )
logger.warning( "something unusual happened" )
logger.error( "An error occurred & I squashed it." )
logger.critical( "A critical error or failure" )
```

"Convenience" Methods

I really dislike this and don't use it.
It obscures what is really happening.

The `logging` module provides functions that invoke the default logger:

```
logging.debug( "looks like a bug" )
logging.info( "something happened" )
logging.warning( "something unusual happened" )
logging.error( "An error occurred." )
logging.critical( "A critical error or failure" )
```

5 Log Levels

Level Names:

CRITICAL = 50

ERROR = 40

WARNING = 30

INFO = 20

DEBUG = 10

FATAL = 50

Any log level

Example:

```
logger.critical("Can't connect to db")
logger.error("Error rendering template")
logger.warning("Failed login by ...")
logger.info("Successful login by ...")
logger.debug(request)
```

an *alias* for CRITICAL

logger.log(*level*, *message*)

```
logger.log(5, "Enter vote function")
```

What to Log?

```
# log some events
logger.critical( "Connection to database failed" )
logger.error( "Poll question has no choices: "+question )
logger.warning( "Failed login by " + form.username )
logger.info( "Successful login by " + user.username )
logger.debug( f"foo(x) called with x = {x}" )
```

Logging Exceptions

```
try:
    q = Question.objects.get(id=1)
except Exception as ex:
    logger.exception("Expected question not found", ex)
```

`logger.exception( )` is same as `error()` but it also prints a stack trace of the exception.

Loggers have a Named Hierarchy

Root logger: root = logging.getLogger( )

'polls' logger: log1 = logging.getLogger('polls')

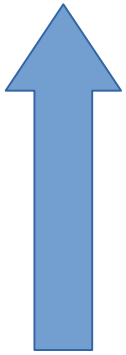
'polls.models' log: log2 = logging.getLogger('polls.models')

Inherit Config from Parent Loggers

root logger

'`polls`' logger

'`polls.models`' logger



Log messages propagate to parent loggers (optional).

logger.getLogger("name") is Singleton

This creates only **one** instance for each **named** logger.

```
log1 = logging.getLogger("auth")
log2 = logging.getLogger("auth")
# are they the same object?
log1 is log2
True
# is the logger name case sensitive?
log3 = logging.getLogger("AUTH")
log1 is log3
False
```

Good! *We can get the logger whenever we need it.*
Don't need to save logger as an attribute.

Use module name for logger name

You can use *any name* you want for logger.

Convention: use module name or package name

A good name helps you track source of messages.

1. A logger for this module

```
log = logging.getLogger(__name__)
```

2. One logger for "polls" app

```
log = logging.getLogger("polls")
```

When to Use Logging?

Python "*Logging HOWTO*" has clear advice.

https://docs.python.org/3/howto/logging.html#when-to-use-logging

Where to Log?

You specify where log messages are printed.

- Console, *aka* Standard Output (the default)
- a File
- Database
- Network connection to a log server

You can use more than one destination, or route log messages based on log level or source.

You Can Control Logging

1. Set the threshold level

   "Only print messages of level WARNING or higher"

```
logging.setLevel(logging.WARNING)
```

2. Write log messages to a file or other service

```
logging.basicConfig(filename="myapp.log")
```

3. Change the format of log messages

```
logging.basicConfig(
  format="%(asctime)s %(name)s %
  (levelname)s: %(message)s")
```

How to Configure Logging?

1. In Code: `logging.basicConfig()`

2. In Code: detailed configuration: logging.setLevel(n)

3. Configuration file

`https://docs.python-guide.org/writing/logging/`

Django `settings.py`

```
LOGGING = { 'formatters': ...,
            'handlers': ...,
            'loggers':  ...
          }
```

Example log configuration in code

```
# Default:   only print WARNING or higher
logger = logging.getLogger( )
logger.info("This message is not printed")
logger.warn("This is a warning")
This is a warning
```

```
# Set message threshold level to INFO (or higher)
logger.setLevel( logging.INFO )
logger.info("This message IS printed")
This message IS printed
logger.debug("this is not printed")
```

Logging Practice

Instructions: Logging practice on course github.io site

demo_log.py code you can use (also on github.io site)

Log Message Propagation

If **`logger.propagate = True`** (the default) then events logged to this logger will be passed to handlers of higher level loggers, in addition to handlers of this logger. Threshold & filters of ancestor loggers are ignored.

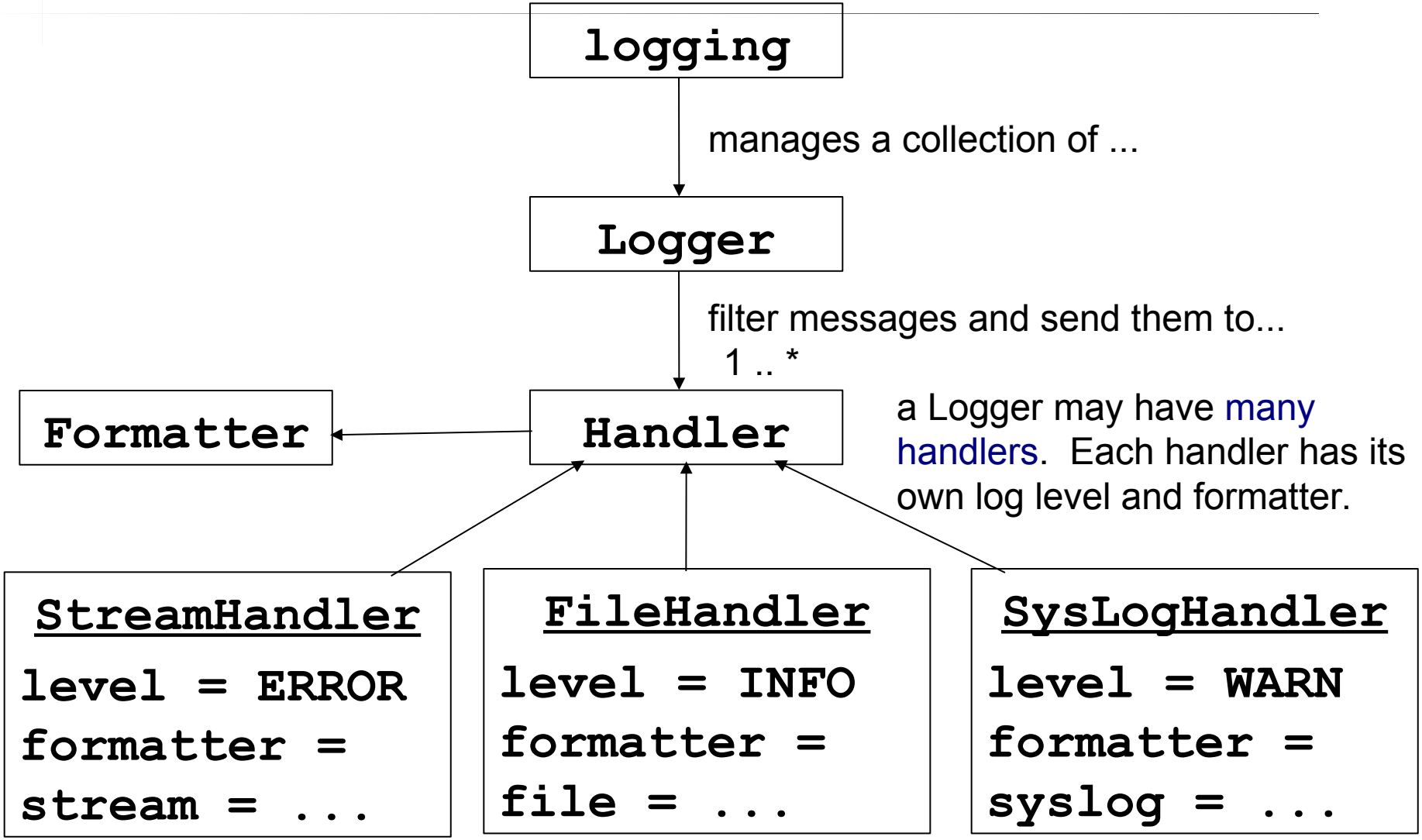
[see "class logging.Logger" in Python Docs]

```
root = logging.getLogger( )         - the root logger
loga = logging.getLogger( 'a' )     - descendent of root
logb = logging.getLogger('a.b') - descendent of 'a' & root

logb.warn("Warning!")   - sent to logb, then loga, then root
```

You must try this yourself in order to understand what it does.

Logging Architecture



Separation of Responsibilities

Draw a UML class diagram showing relationship between:

`Logger`

`Handler`

`FileHandler`

`ConsoleHandler`

`Formatter`

One we didn't cover: `Filter`

Configuration Example

```
# A handler that writes to a file
filehandler = logging.FileHandler( "/tmp/demo.log" )
# This handler should log everything
# Note that logger's own log-level may override this.
filehandler.setLevel( logging.DEBUG )
# Message format is:  2019-10-28 10:45:23 a.b INFO: hi there
formatter = logging.Formatter(
    "%(asctime)s %(name)s %(levelname)s: %(message)s"
  )
# Tell file handler to use this formatter
filehandler.setFormatter( formatter )
# Add it to root logger
root = logging.getLogger( )
root.addHandler( filehandler )
```

Why Separate Responsibilities?

1. What is the benefit of separating Logger, Handler, and Formatter?
   Imagine if we had:
   SteamLogger
   FileLogger
   RotatingFileLogger
   SyslogLogger
   . . .
2. Is there a *Design Principles* that recommends this design?

FYI: Log4J & SLF4J use the same design.

Why Separate Responsibilities?

Design Principles

Single Responsibility Principle

Don't Repeat Yourself - use delegation & Strategy Pattern

- avoid duplicate code, duplicate logic, duplicate bugs

Open-Closed Principle - we can *extend* functionality of Logging by writing our own Handler or Formatter.

How to Use the 5 Log Levels

What *should* you log to each of these levels?

CRITICAL

ERROR

WARNING

INFO

DEBUG

See: *Python Logging Tutorial*

https://docs.python.org/3/howto/logging.html

What do the method names tell you?

```
# Tell file handler to use this formatter
filehandler.setFormatter( formatter )
# Add handler to root logger
logger = logging.getLogger( )
logger.addHandler( filehandler )
```

Why is one named "setSomething" and the other "addSomething"?

Log Handlers and Formatters

Python has many Log Handlers you can choose:

https://docs.python.org/3/library/logging.handlers.html

Important Handlers:

logging.StreamHandler(stream=sys.stdout)

logging.FileHandler(*filename*)

logging.RotatingFileHandler(*filename, maxBytes=...*)

logging.TimeRotatingFileHandler

logging.SysLogHandler(*address*=("localhost",port),...)

Web App Logging

Web Apps have some special concerns:

1. want to know IP address for events and activity

2. Web app may be deployed on many hosts, and may not be persistent. How can you make separate logs from web app?

3. How to aggregate logs from different parts of app?

Web App Logging

What events or activity should a web app log?

1. Login - username, IP address, date-time
2. Logout
3. Errors and exceptions
4. Deployment
5. User activity - at least all activity that changes something
6. Invalid requests

Logging Done Wrong

Facebook stored 200 - 600 Million users' passwords in **plain text** in log files for years.

https://krebsonsecurity.com/2019/03/facebook-stored-hundreds-of-millions-of-user-passwords-in-plain-text-for-years/

What Info Should You Log When...

1. A login attempt (success or failure)

> username

> IP address

> date/time

2. A user submits a "vote" to the polls application.

> question and choice he voted

> which session or IP address he voted from

> date/time

> not username (to protect privacy)

Learn Python Logging

Logging HOWTO in the Python Library docs

- Use guide in the Advanced Tutorial.
- Don't use the Basic Tutorial (static log methods)
- https://docs.python.org/3/howto/logging.html

Logging - Logging Facility for Python

- in the Python library docs
- configuration, using formats, and handlers

How to Configure Logging

- `https://docs.python-guide.org/writing/logging/`
- 3 ways: .INI file, a dict or JSON file, function calls

Learn Python Logging

Logging Cookbook

https://docs.python.org/3/howto/logging-cookbook.html

Django Logging

Django uses Python Logging, adds some "conveniences".

See: Django User Guide, section on Logging (only 10 pages with many examples)

Configuration: Django uses JSON-format text to configure loggers in `settings.py`.

Configure Django Logging

```
LOGGING = {
    'disable_existing_loggers': False,
    'handlers': {
        'file': {
            'level': 'DEBUG',
            'class': 'logging.FileHandler',
            'filename': '/path/to/myapp.log',
        },
        'console': {
            'class': 'logging.StreamHandler'
        }
     }
     'loggers': {
        'myapp': {
            'handlers': ['console'],
            'level': 'INFO',
            'propagate': False,
            ...
```

Logging Advice

1. Configure the root logger, but don't use it directly.
2. For deployed web apps, log to console (12FactorApp)
3. Configure logger via config variables, not settings.py.
   - OK to partially configure in settings.py but get details from configuration file

Java Has More Log Levels

java.util.logging	Log4J & SLF4J Levels
SEVERE	FATAL
WARNING	ERROR
INFO	WARN
(CONFIG)	INFO
FINE - stupid name	DEBUG
FINER - stupider	TRACE
FINEST	
OFF	OFF
ALL	ALL

Experience at KU

Chinese are Attacking My Server!

In **`/var/log/auth.log`** on se.cpe.ku.ac.th:

Nov 18 06:29:48 se sshd[6720]: Failed password for root from 116.31.116.16 port 61430 ssh2

Nov 18 06:29:52 se sshd[6720]: message repeated 2 times: [Failed password for root from 116.31.116.16 port 61430 ssh2]

Someone is trying to login as root.

Where is 116.31.116.16?

Search Google...

116.31.116.16

116.31.116.16 | ChinaNet Guangdong Province Network | AbuseIPDB

https://www.abuseipdb.com/check/116.31.116.16

116.31.116.16 has been reported 409 times. ... 116.31.116.16 was first reported on December 3rd 2017 , and the most recent report was 4 hours ago .

IP List of Brute force attackers

https://report.cs.rutgers.edu/DROP/attackers

... 115.186.147.235 115.249.205.29 116.196.76.135 116.31.116.11 116.31.116.12 116.31.116.14 116.31.116.16 116.31.116.21 116.31.116.23 116.31.116.24 ...

The Anti Hacker Alliance™ fights against 116.31.116.20

https://anti-hacker-alliance.com/index.php?ip=116.31.116.20

116.31.116.x

The "Fix"

1. ssh was already configured to deny root login. (hacker could not login as root even if he guessed password.)

1. Add firewall rule to deny all traffic from IPs in China.