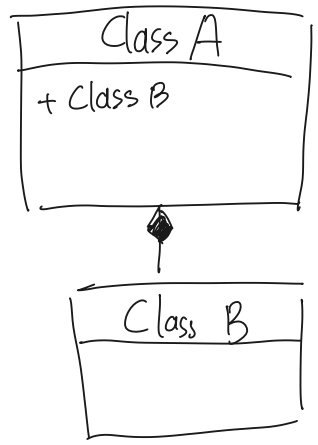
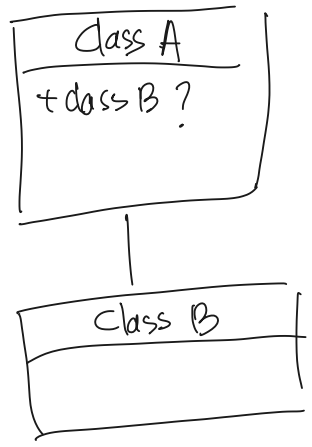
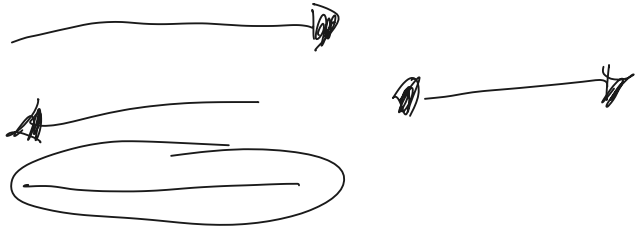
Composition



Aggregation



Assoadtion ⇒ enum



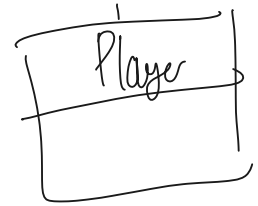
Composition

```
class GameController
{   Board board = new Board();
}
```

Dependency

```
class GameController
{   Board board;
    public GameController(Board b)
    {   board = b;
    }
}
```

Realization



Program.cs

Piece[,] piece = game.GetPieceOnBoard();

C.W( )

8×8×12 = 600-700

Class GameController

+ Action<Piece, Position> action

+ GetPieceOnBoard() : Piece[8,8]

+ MovePiece( )

{

action.Invoke(Piece, Post)

}

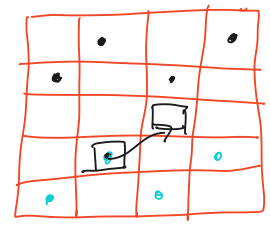
+ Action<Piece, Position, Position>

UI.cs

+ void UpdateUI(Piece, Position)

C.W( ) → Piece = 3

→ 2,2



Piece[8,8] p = GetPieceOnBoard();

p[2,2] = null

p[3,2] =

Program.cs

+ OnPieceUpdate(Piece, Position, Piece)

{

for(_ , _ , _)

for(_ , _ , _)

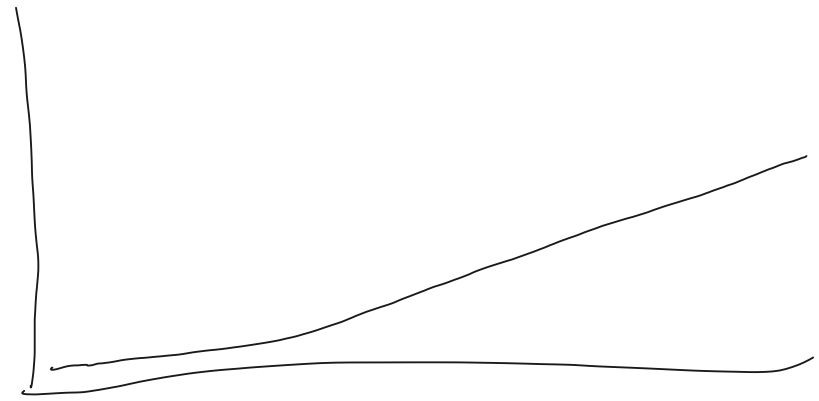
p = Piece.id;

}

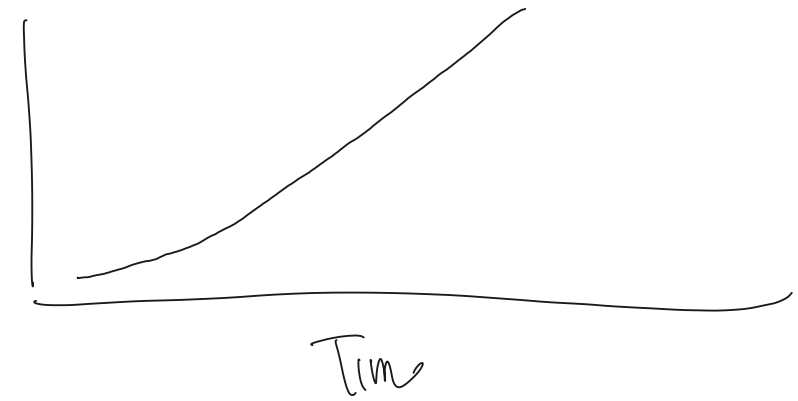
p 3

C / C++	C#
Low Level (Near assembly)	High Level (Human Language)
Functional Programming	OOP
Manual Allocation Manual Free	Garbage Collection
Performance	–
–	Learning Curve easier
Single platform	Multi platform
For small device	For faster / complex device

C / C++



C #

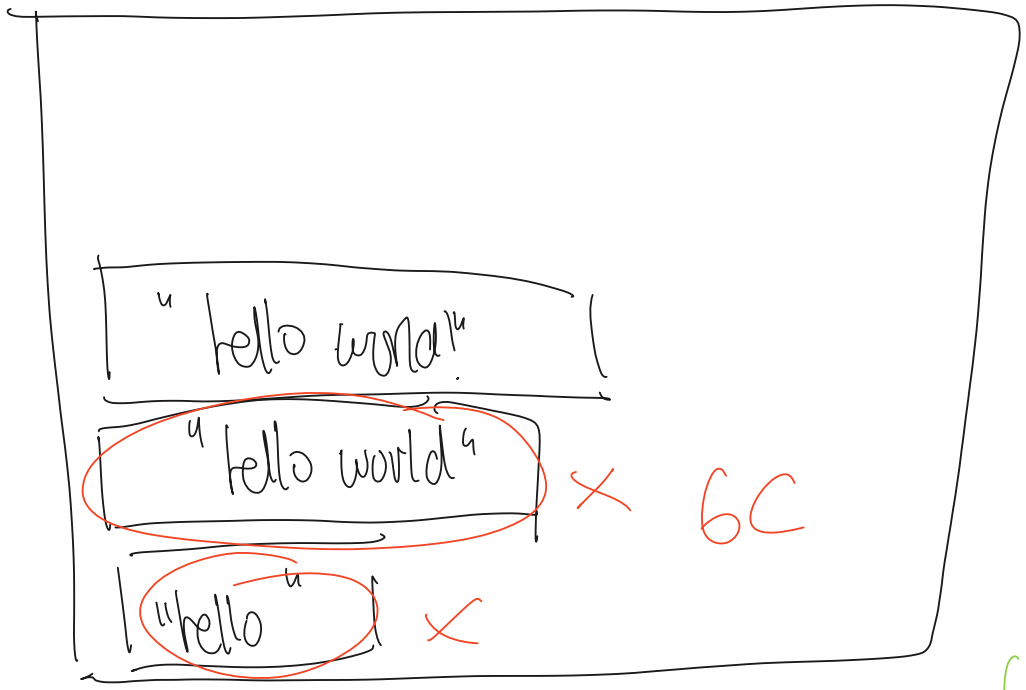


Garbage Collection

Garbage Collector

Factor
- how much garbage
- memory full (near)
- time from last Collection

managed heap / managed resource
- class
- string
- array
- collection
- dicb.



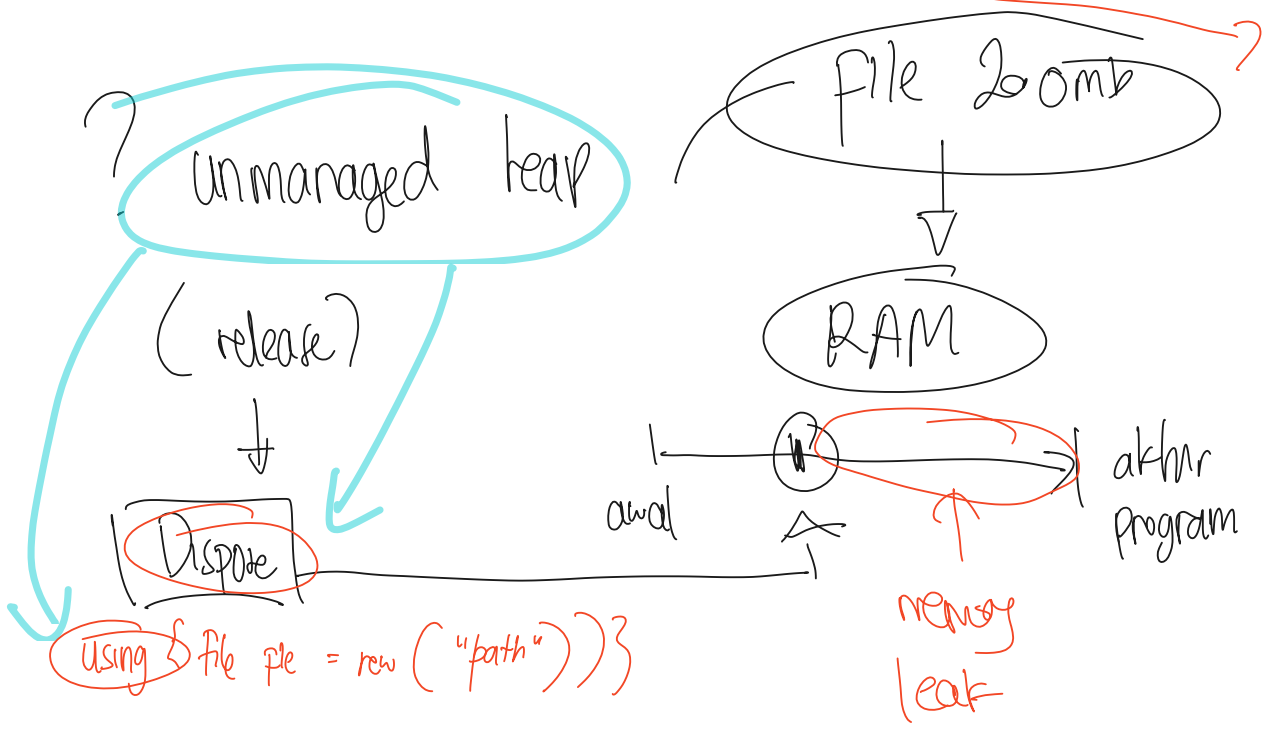
memory
- stack ✗
- heap
  - managed heap (array, class, string, dcb)
    - (internal Program)
  - unmanaged heap (external) ✗
    - (file, api, http request, database, smtp)

GC → Managed heap

60

61+60

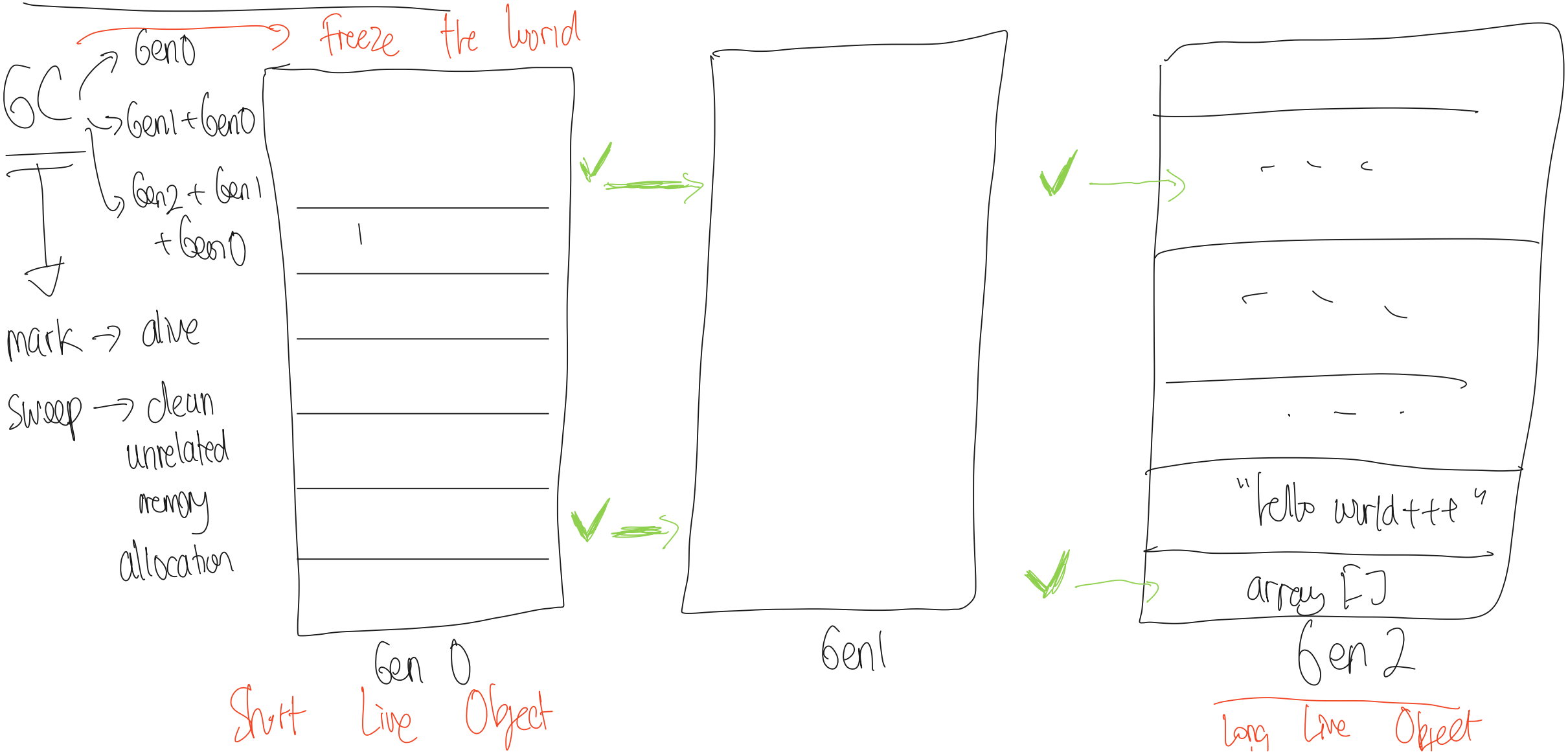
62+61+60



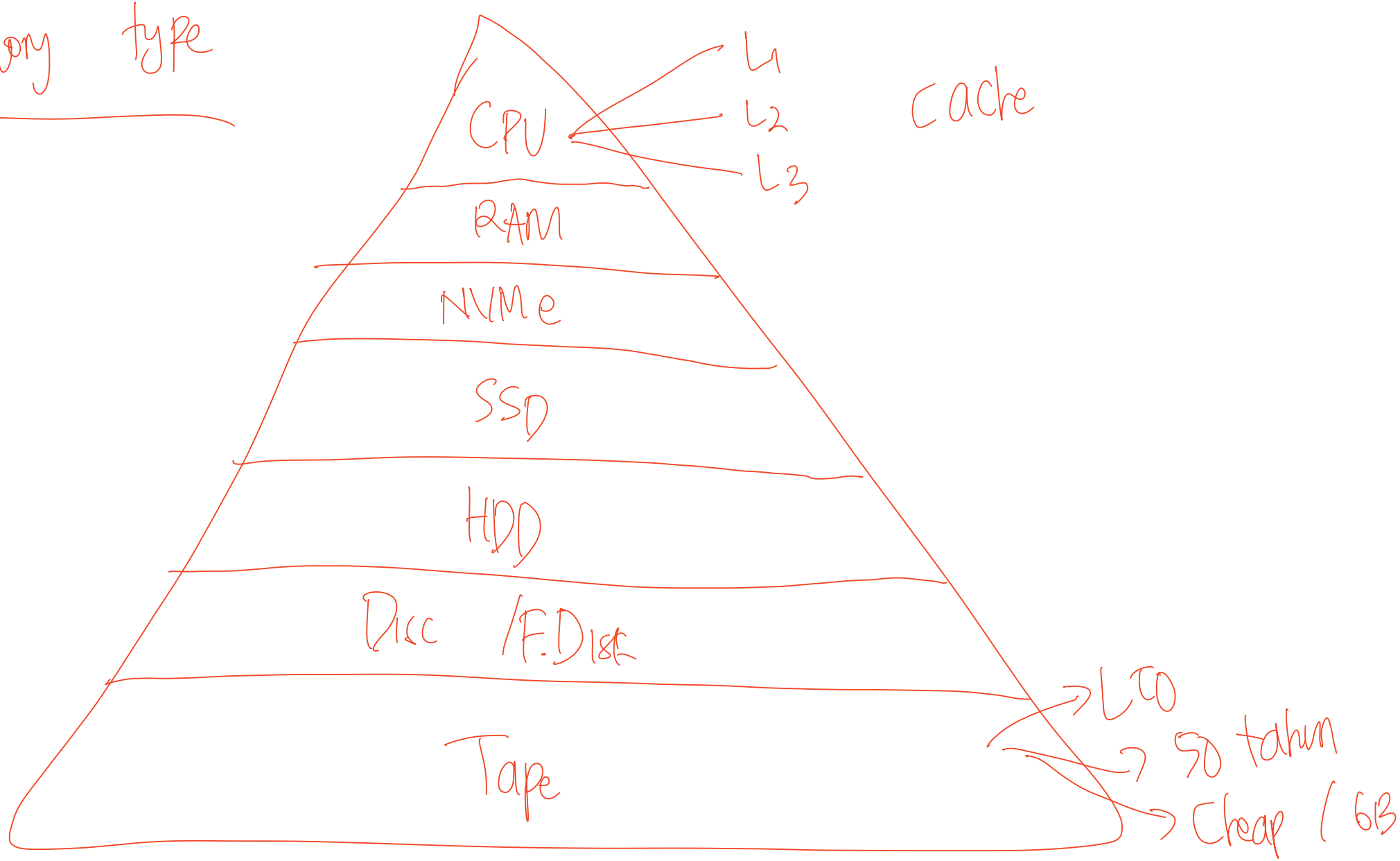
Clean?

- mark = alive
- sweep = Gen

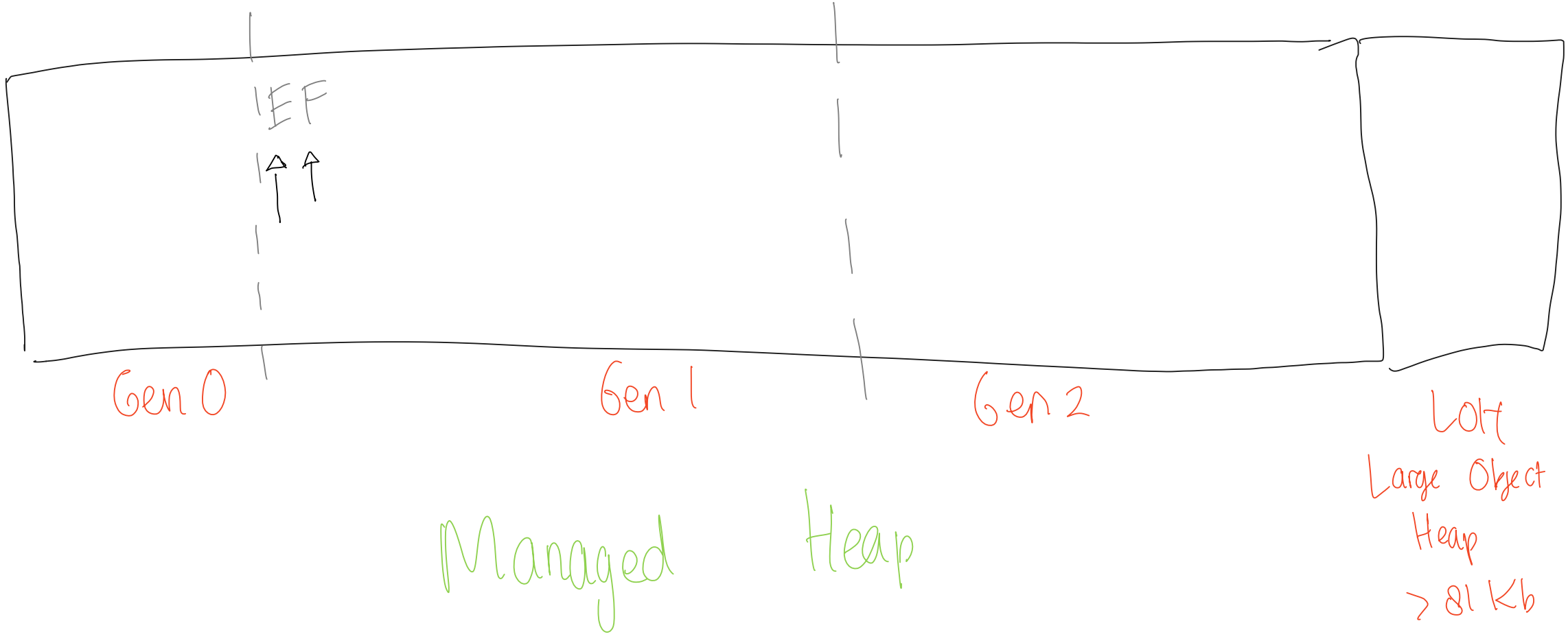
Managed heap

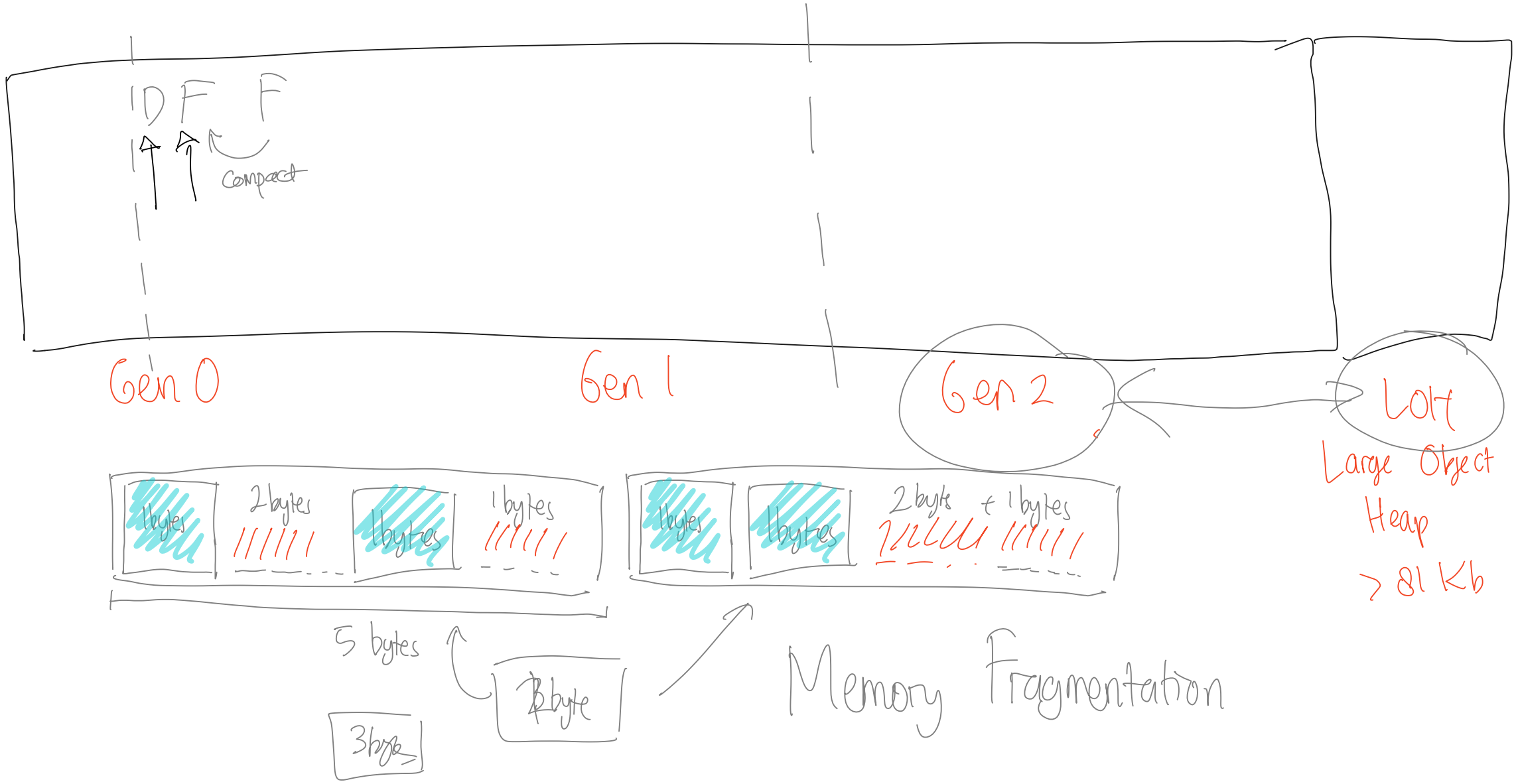


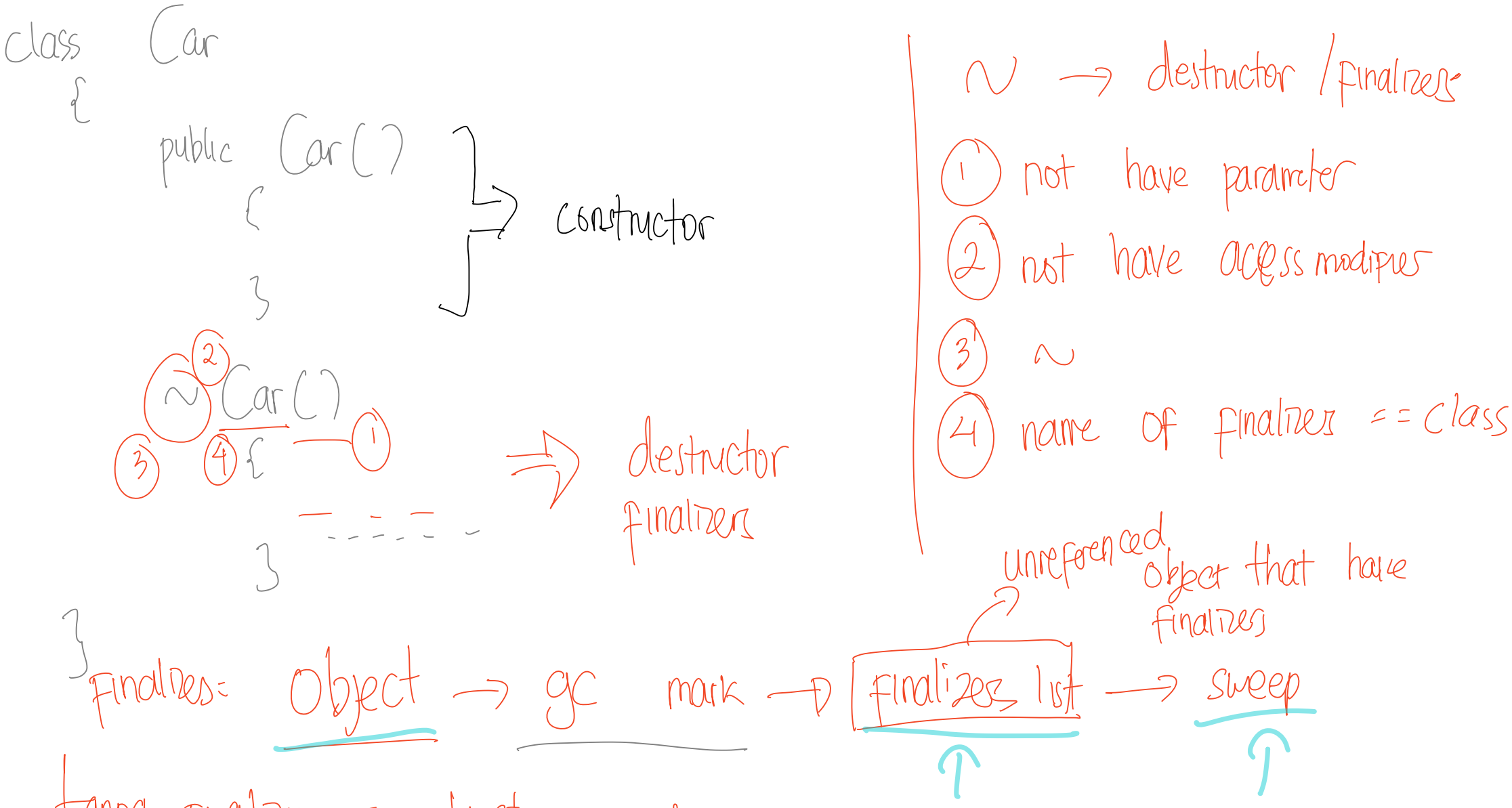
Memory type

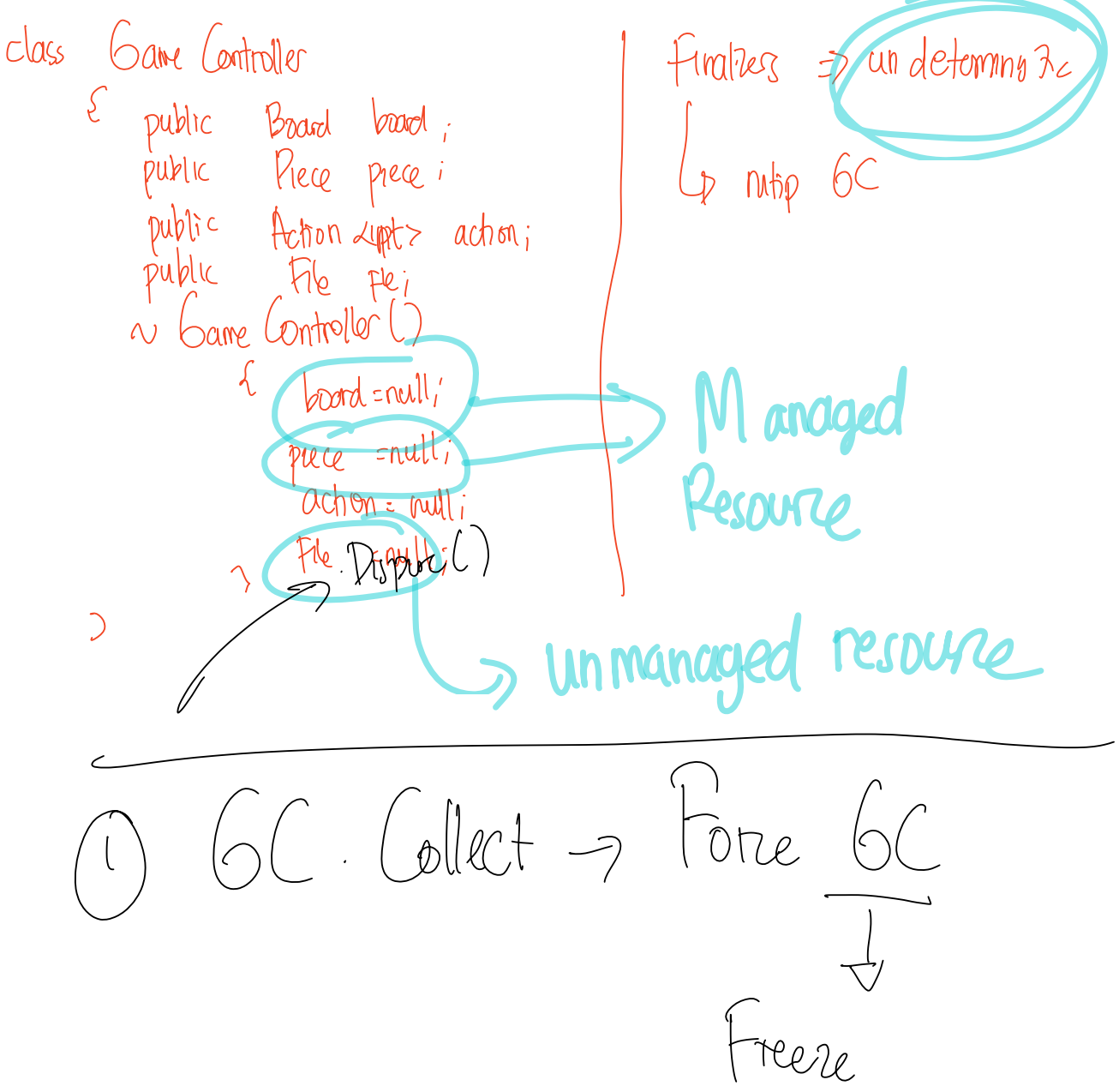

CPU
L1
L2
L3
cache
RAM
NVMe
SSD
HDD
Disc / F.Disk
Tape
LTO
SD tahun
Cheap / GB

Garbage Collector → mark → instance alive
→ sweep → dihapus object mati
→ Compact → di copy → memory fragmentation




D F F
Compact
Gen 0
Gen 1
Gen 2
LOH
Large Object Heap
> 81 Kb
1bytes
2bytes
1bytes
1bytes
1bytes
2byte + 1bytes
5 bytes
3byte
Memory Fragmentation


class Car
{
public Car()
{
}
constructor
~Car()
1
2
3
4
{
}
destructor
finalizers
~ → destructor / finalizers
1 not have parameter
2 not have access modifier
3 ~
4 name of finalizers == class
}
finalizes: object → gc mark → finalizes list → sweep
unreferenced object that have finalizes
tanpa finalizes = object → sweep



① GC.Collect → Force GC

↓

Freeze

① Slow performance | Object
↳ finalizers(s)

② Undeterministic

③ Memory consume

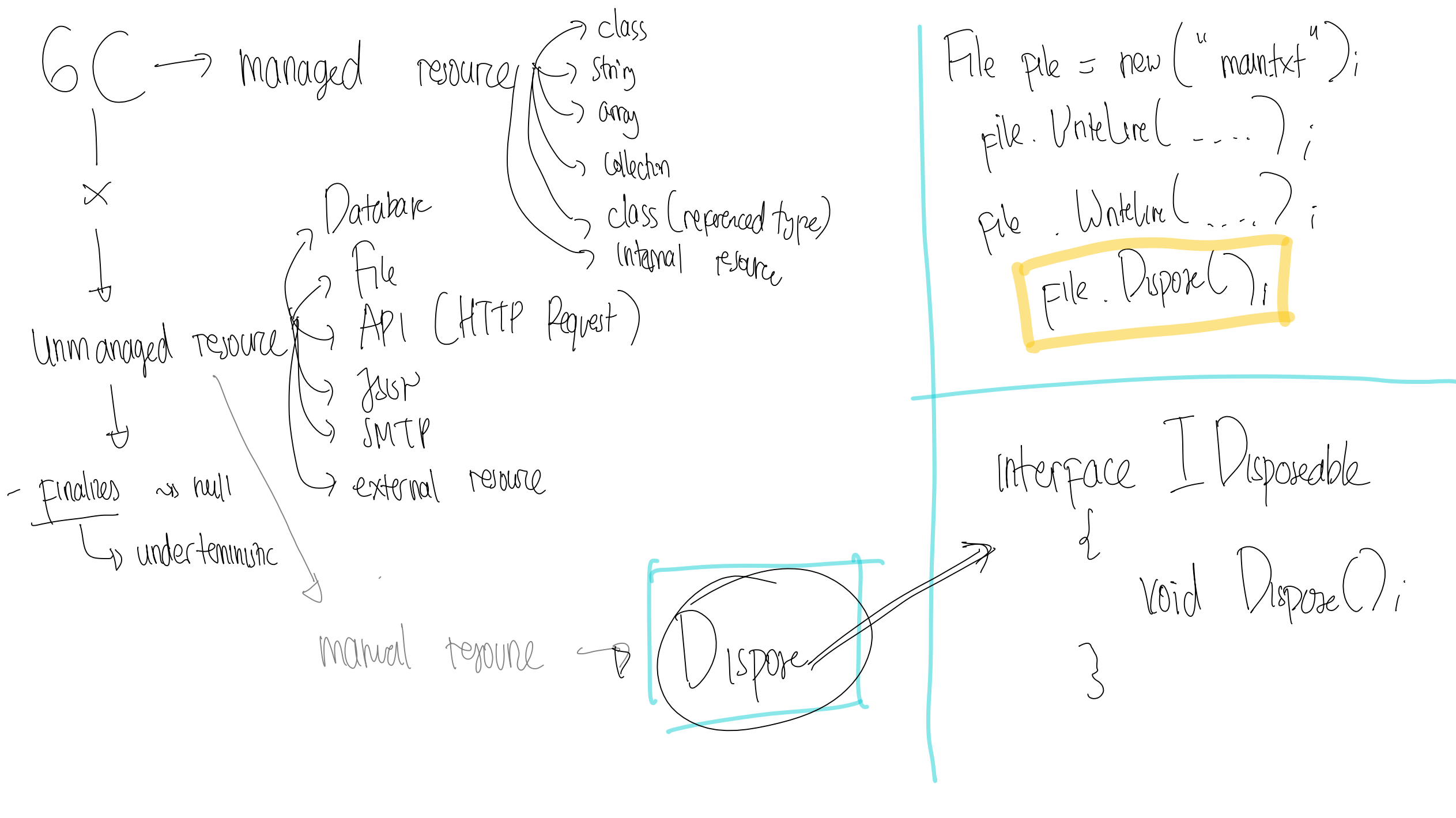
④ Avoid using finalizes

⑤ Dont have empty finalizes

⑥ Purpose → set null for object

⑦ Finalizes but contain unreference object

⑧ Object = null


GC → managed resource
class
string
array
collection
class (referenced type)
internal resource
Database
File
API (HTTP Request)
Jsur
SMTP
external resource
Unmanaged resource
- Finalizes → null
→ undeterministic
manual resource → Dispose
File file = new ("main.txt");
file.WriteLine(....);
file.WriteLine(....);
File.Dispose();
Interface IDisposeable
{
void Dispose();
}

. Dispose ⟶ external resource will be released

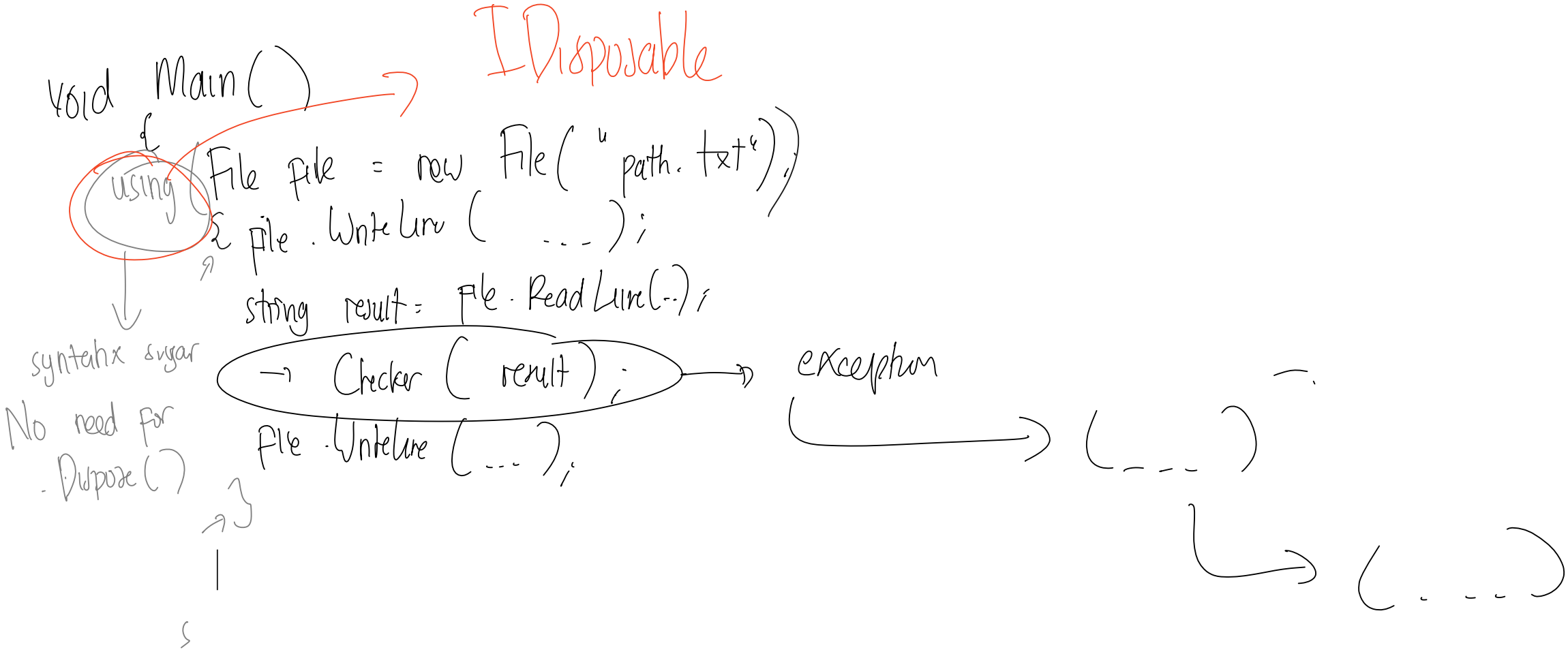
↳ IDisposeable ⟶ void Dispose();

```
void Main()
{
    File file = new File("path.txt");
    file.WriteLine(...);
    string result = file.ReadLine(..);
try {
    → Checker(result);
    file.WriteLine(...);
finally {
    File.Dispose();   X → hdak kena
}
}
```

exception

(...)

(...)


IDisposable
void Main()
{
using (File file = new File("path.txt"))
{ file.WriteLine(...);
string result = file.ReadLine(..);
Checker(result);
file.Unteline(...);
}
syntaxh sugar
No need for .Dispose()
exception
(...)
(...)

```
class Car : IDisposable
{
    1 reference
    public Engine engine; → managed resource
    2 references
    public File file; → unmanaged resource
    2 references
    private bool disposedValue; //status Dispose already called or not

    2 references
    protected virtual void Dispose(bool disposing)
    {
        if (!disposedValue) → check .Dispose() already called or not
        {
            if (disposing)
            {
                engine = null;
                // TODO: dispose managed state (managed objects)
            }
            file.Dispose();
            file = null;

            // TODO: free unmanaged resources (unmanaged objects) and override finalizer
            // TODO: set large fields to null
            disposedValue = true;
        }
    }

    // // TODO: override finalizer only if 'Dispose(bool disposing)' has code to free unmanaged resources → Safety net
    0 references
    ~Car()
    {
        // Do not change this code. Put cleanup code in 'Dispose(bool disposing)' method
        Dispose(disposing: false);
    }

    0 references
    public void Dispose()
    {
        // Do not change this code. Put cleanup code in 'Dispose(bool disposing)' method
        Dispose(disposing: true);
        GC.SuppressFinalize(this); → deactivate Finalizer
    }
    You, 3 minutes ago • Uncommitted changes
```

https://github.com/kinarajv/Day-16

Formulatrix Trainer

- Conditional Compilation
- Debugging
- Log (internal) (Microsoft)

dotnet build → Debug ← Debug, Trace

dotnet build -c Windows → Window → Trace

Debug.WriteLine( )

Trace.WriteLine( )

ConsoleTraceListner

TextWriterTraceListner

https://github.com/kinarajv/Day17

* Conditional Compilation

if / else

Compile → translate / compile

Code → assembly

#define
#elif
#if
#else
#warning
#error
#endif
#region

```
void Main()
{
    android / arm / apple / mobile
    demo
    x86
}
```

1. comment +/-
2. diff project
3. conditional compilation

#define

```
void Main()
{
    #if ANDROID
        ...
    #elif WINDOWS
        ...
    #endif
}
```

#else →

#define ~~ANDROID~~ WINDOWS ✓

① dual program

android

windows / x86

② ✗ → .csproj

<DefineConstant>

✗ ✓

③ dotnet build

Default

Debug ↓ ↓

/bin/Debug

dotnet build -c Windows

```
void Main()
{
#if Debug
// Test Code → Development
MethodA();
Method1();
#elif Release
// Program Jadi → Production
MethodA();
MethodB();
MethodC();
#endif
}
```

① #define Debug ✗

② .csproj

✗ <DefineConstants>Debug</...>

③ dotnet build -c Debug

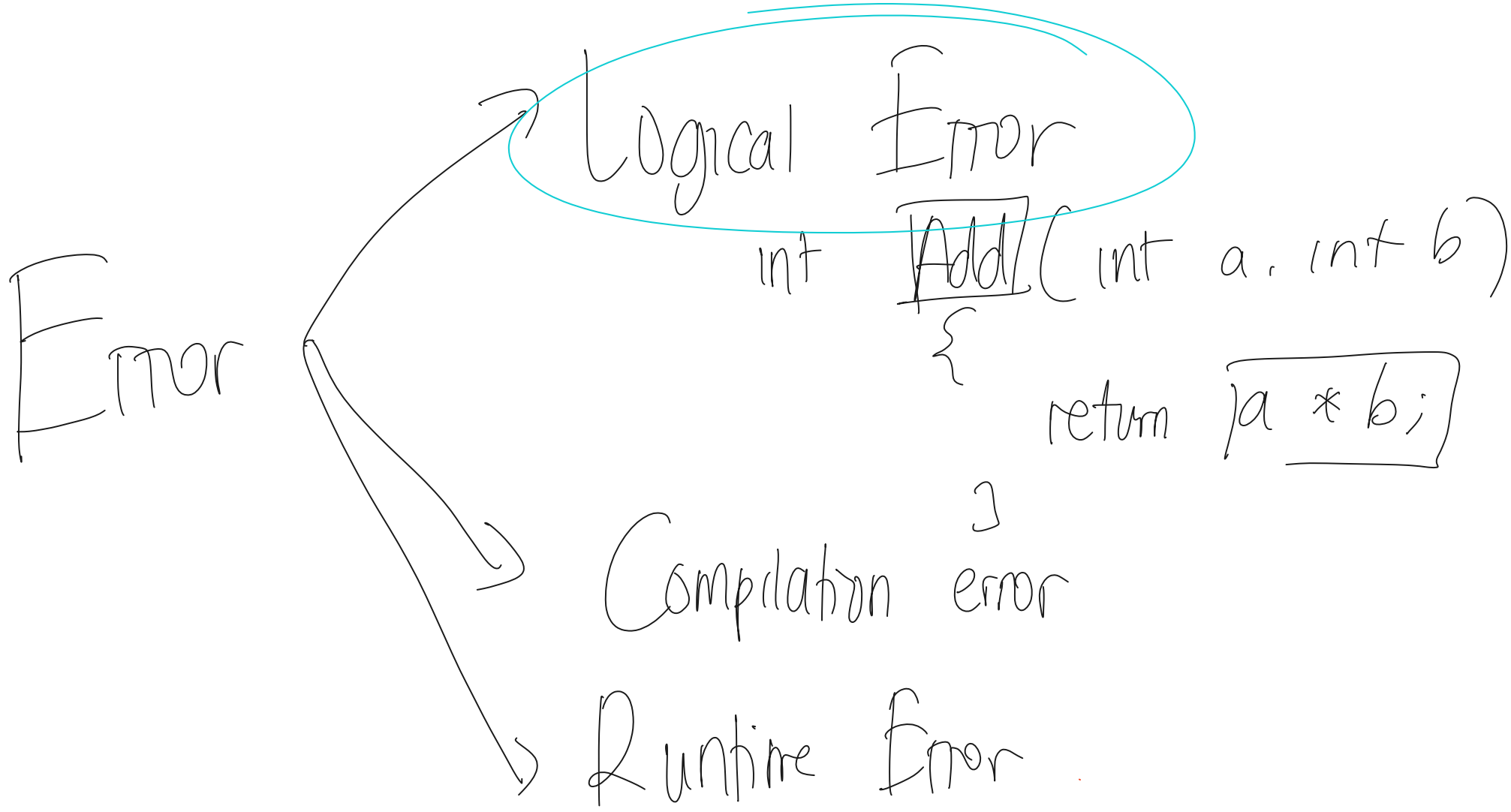
① #define Release ✓

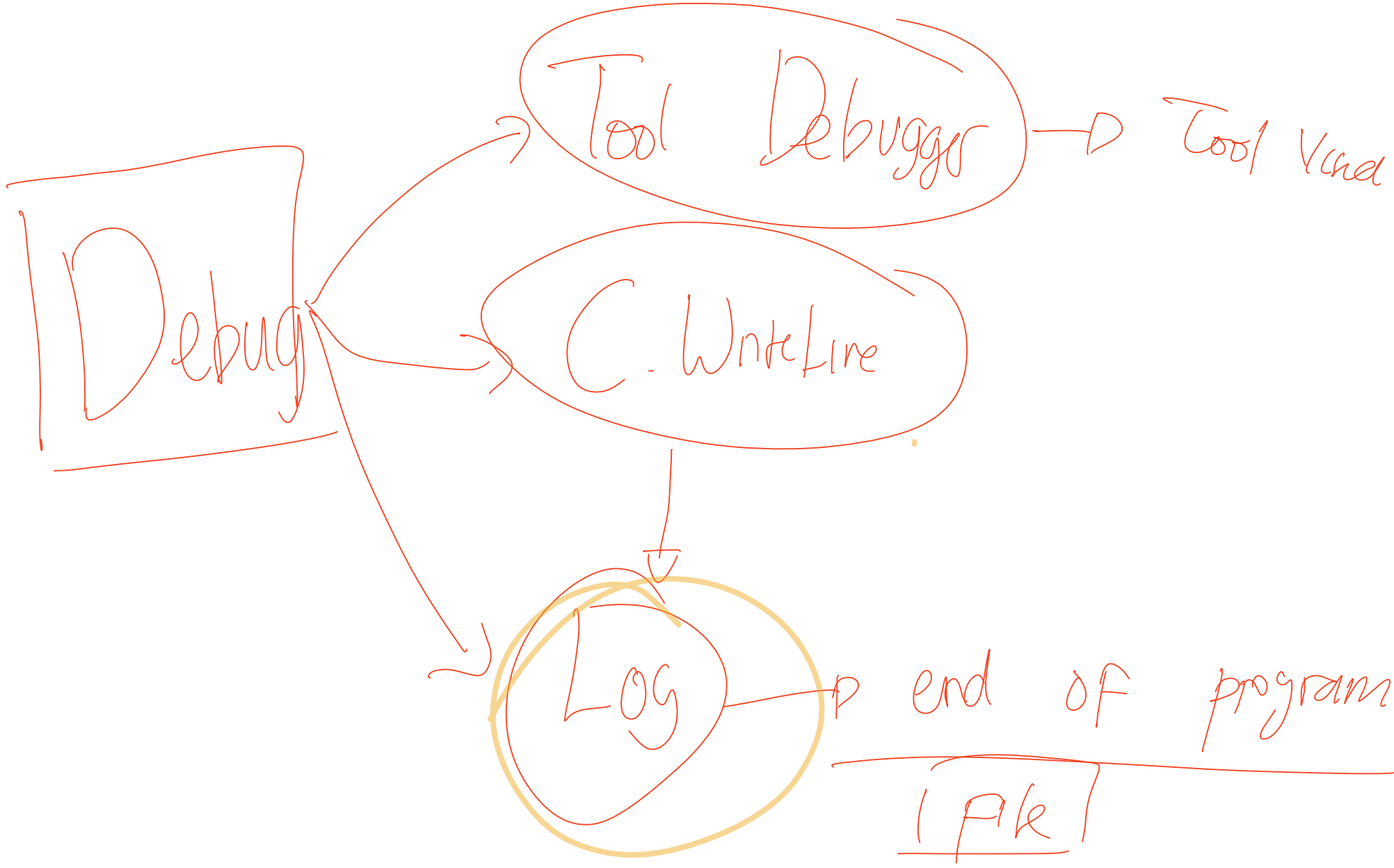
② .csproj ✓

③ dotnet build -c Release

→ compile

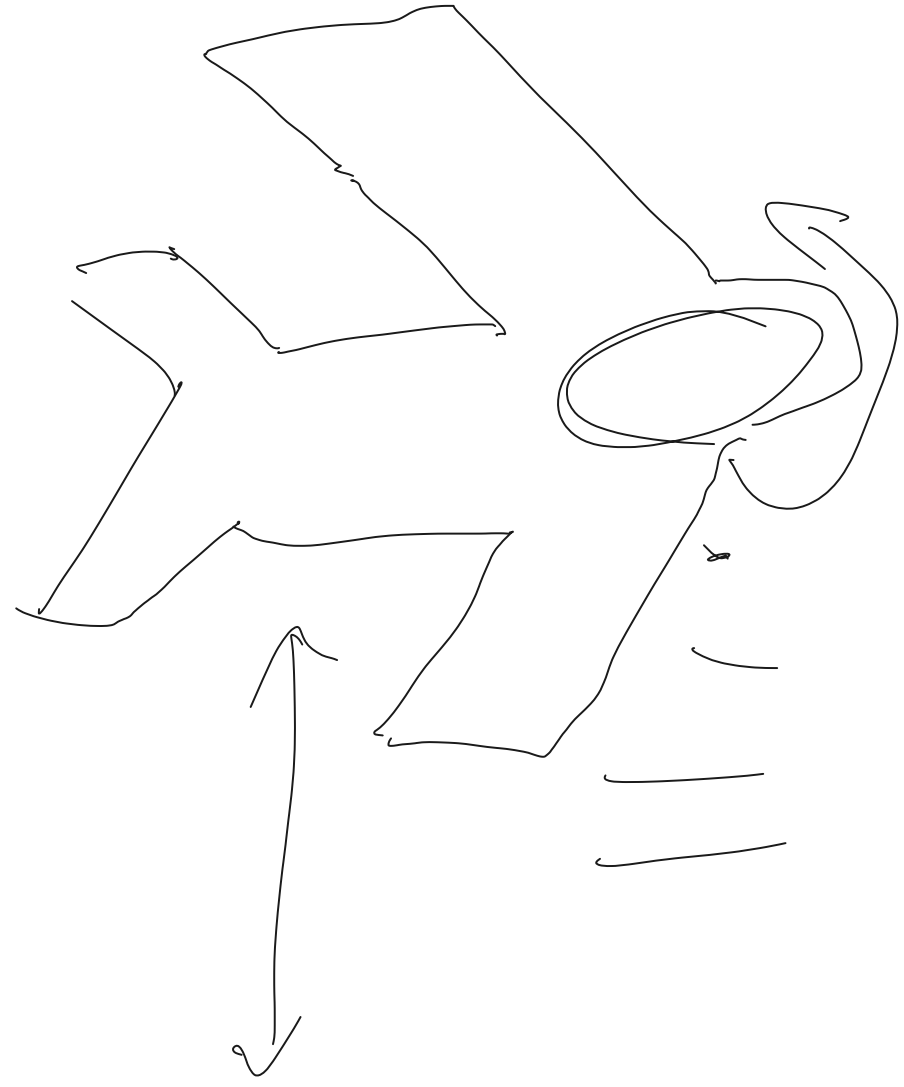
```
void Main
{
#if WINDOWS
string path = "C:/Users/defaultuser/....";

#elif Linux
string path = "~";
#elif Ubuntu
string path = "$HOME";
#endif
}
```

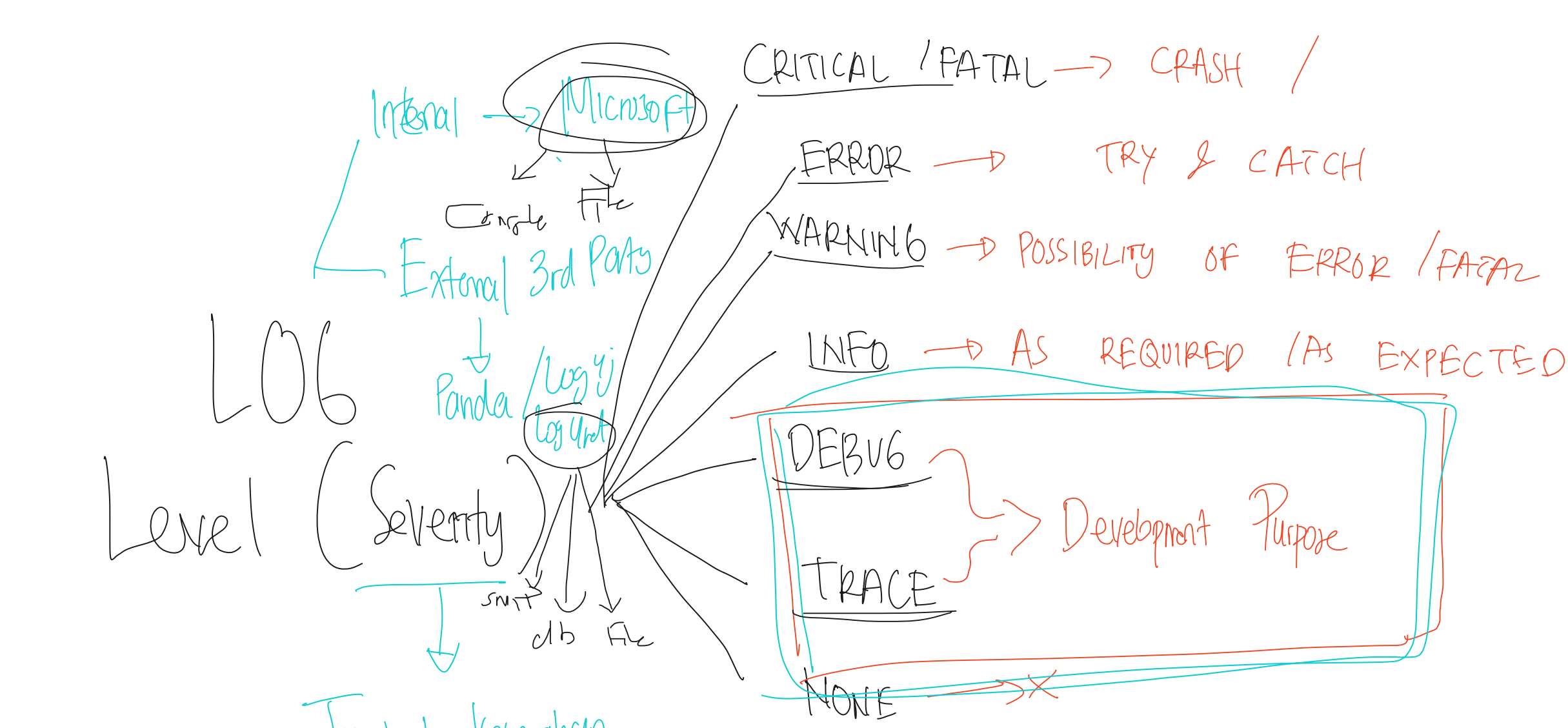

Error
Logical Error
int Add(int a, int b)
{
return a * b;
}
Compilation error
Runtime Error

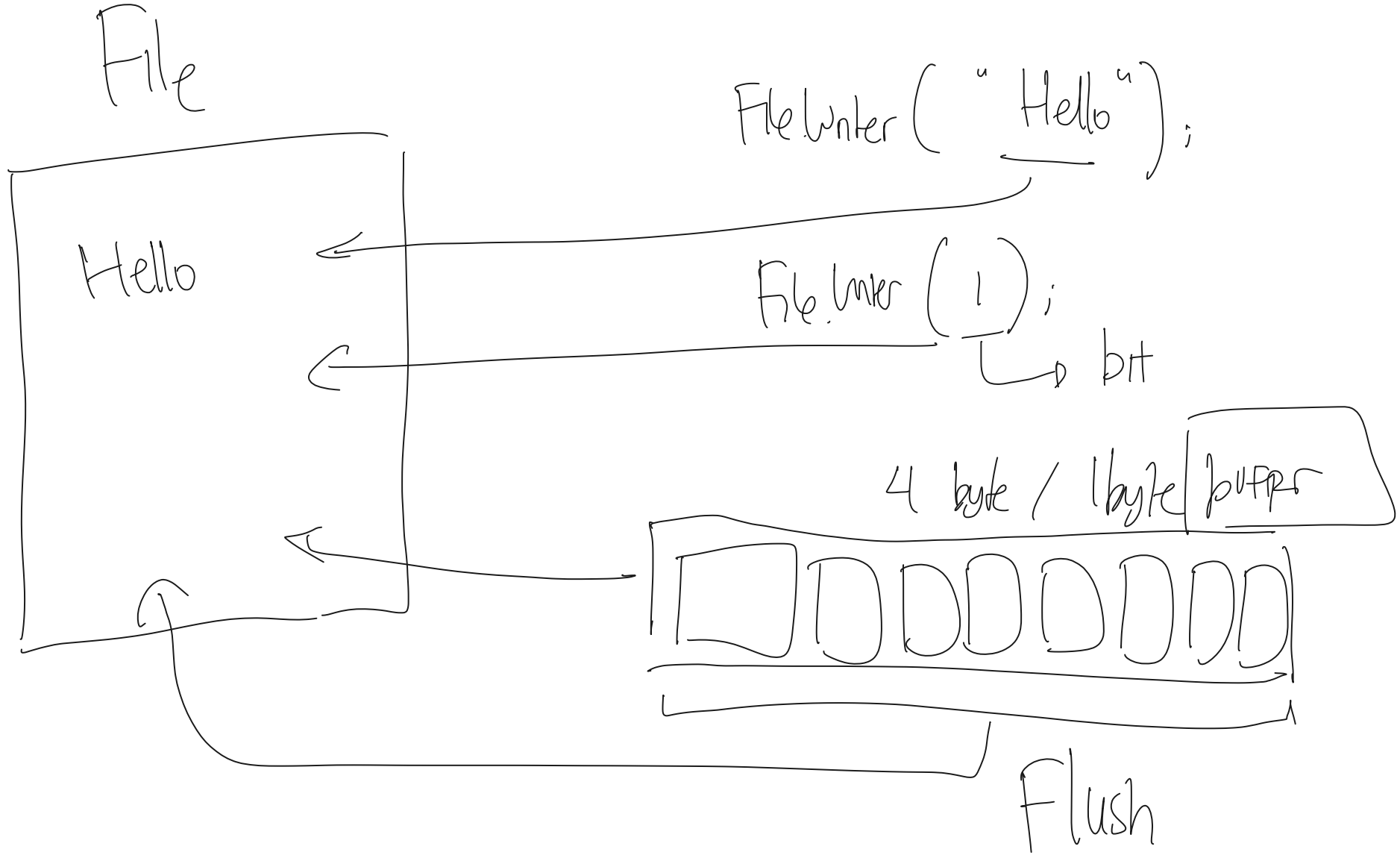

Debug
Tool Debugger
Tool Visual
C. WriteLine
Log
end of program
file

LOG →

- Pencatatan
- Display data
- Record event
- Gather data
- Audit
- Check History




LOG
Level (Severity)
Internal
Microsoft
Console
File
External 3rd Party
Panda / Log4j
Log4net
SMTP
db
File
Tingkat keparahan kerawanan
CRITICAL / FATAL → CRASH /
ERROR → TRY & CATCH
WARNING → POSSIBILITY OF ERROR / FATAL
INFO → AS REQUIRED / AS EXPECTED
DEBUG
TRACE
Development Purpose
NONE


File
Hello
FileWriter (" Hello ");
FileWriter (1);
bit
4 byte / 1byte
buffer
Flush

MULTITHREADING
- PROCESS vs Thread
- Thread
- Background vs Foreground
- Task
- (AggregateException)
- asynchronous (async-await)

- Condition : DEADLOCK & RACE CONDITION
- LOCK
- SEMAPHORE, SLIMSEMAPHORE
- MONITOR (TryEnter)

Multi Threading

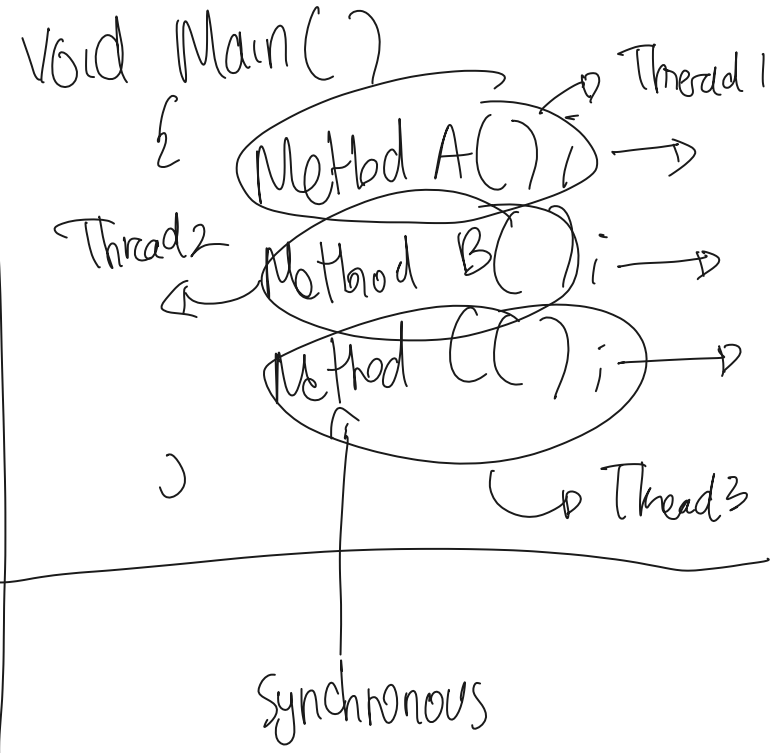
Process

Different App
Different Process
Isolate

Thread

Multiple Unit of process

thread → another thread resource



```
void Main()
{
    MethodA();
    MethodB();
}MethodC();
```

synchronous

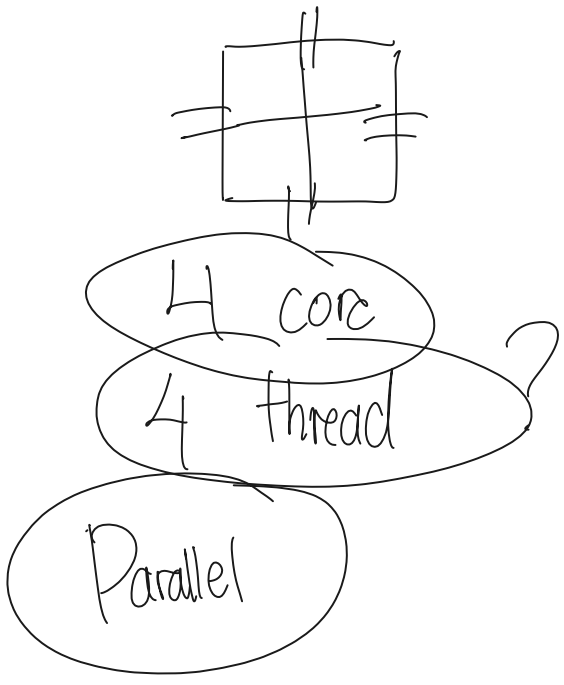
Thread

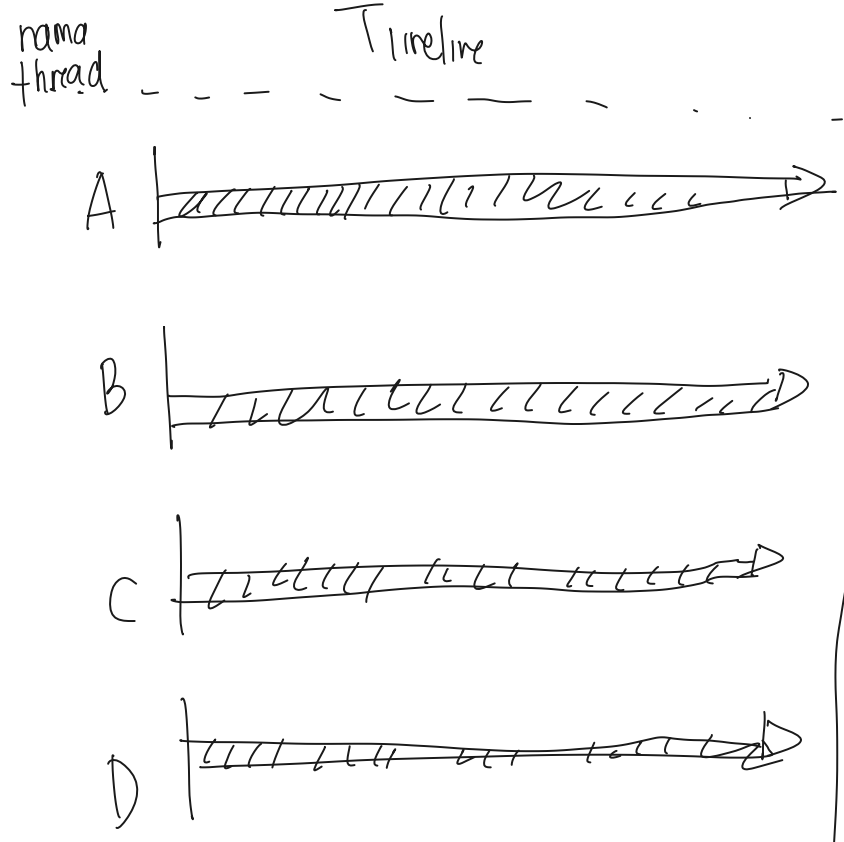
Main Thread

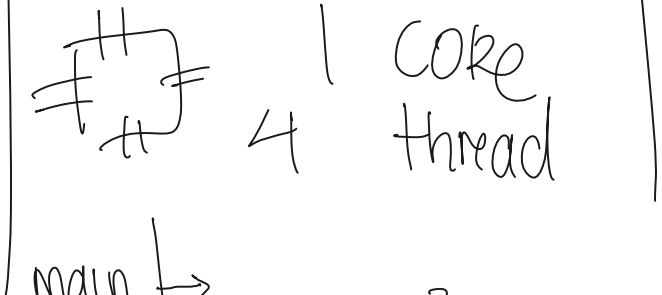
```
void Main()
{ Thread threada = new Thread(MethodA);
  Thread threadb = new Thread(MethodB);
  Thread threadc = new Thread(MethodC);
   threada.Start();
   threadb.Start();
} threadc.Start();
```

concurrency

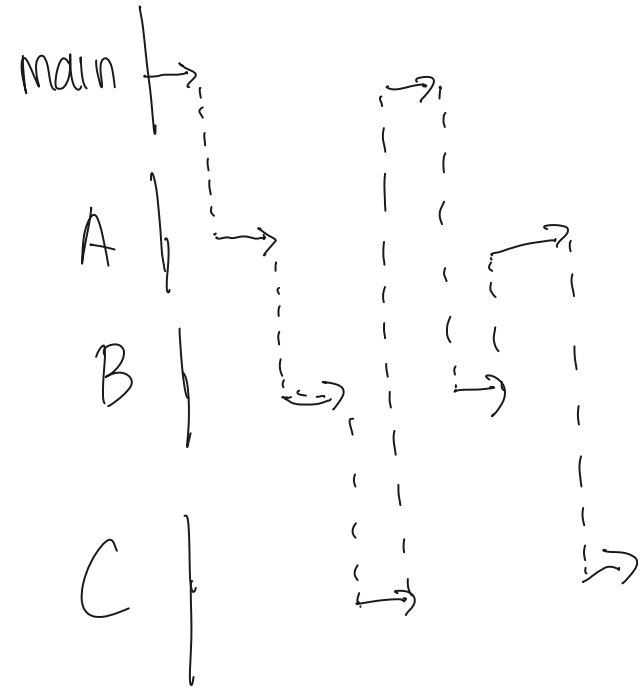
Thread







time slicing CPU



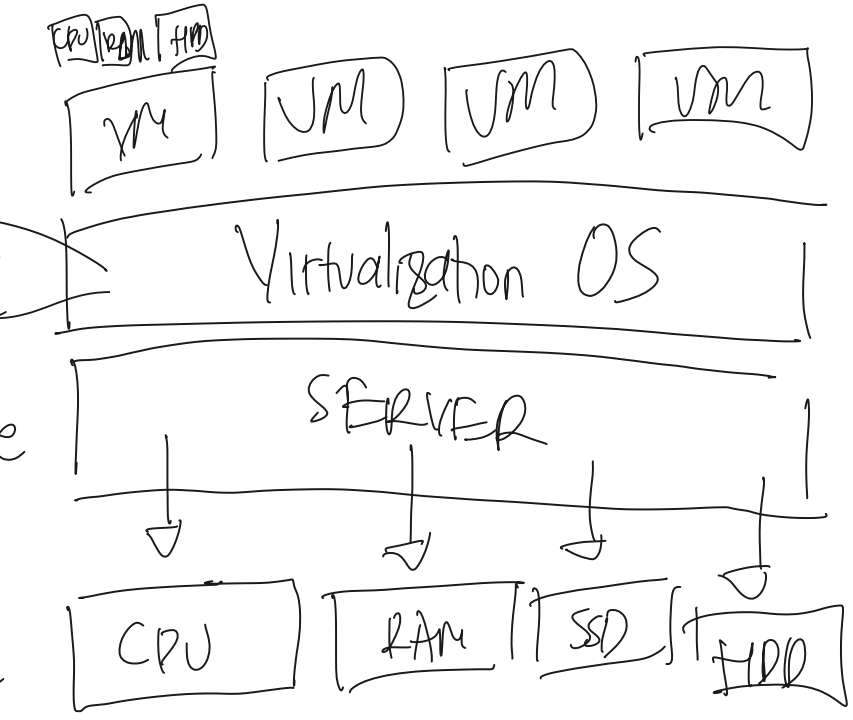
high priority

lower priority

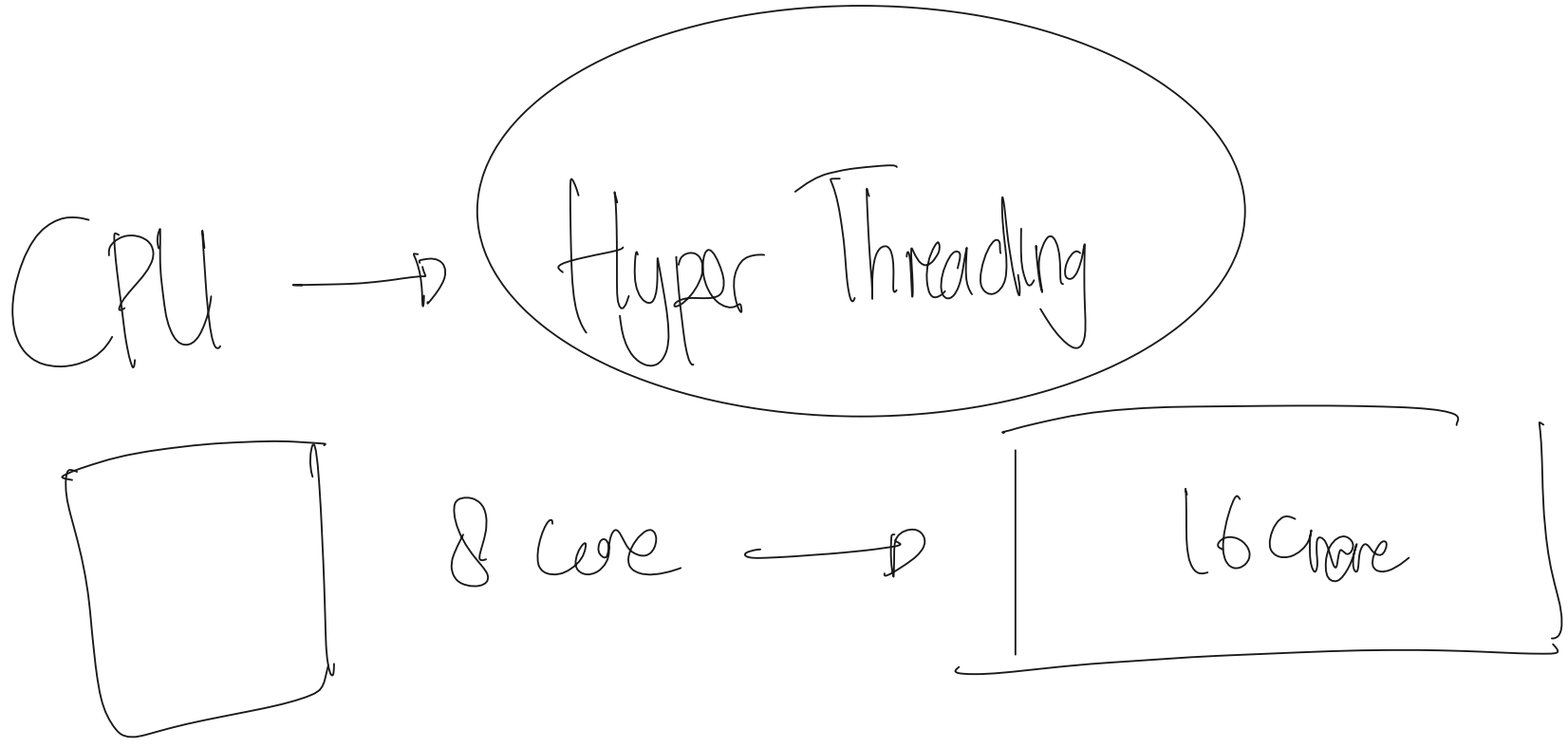
SERVER

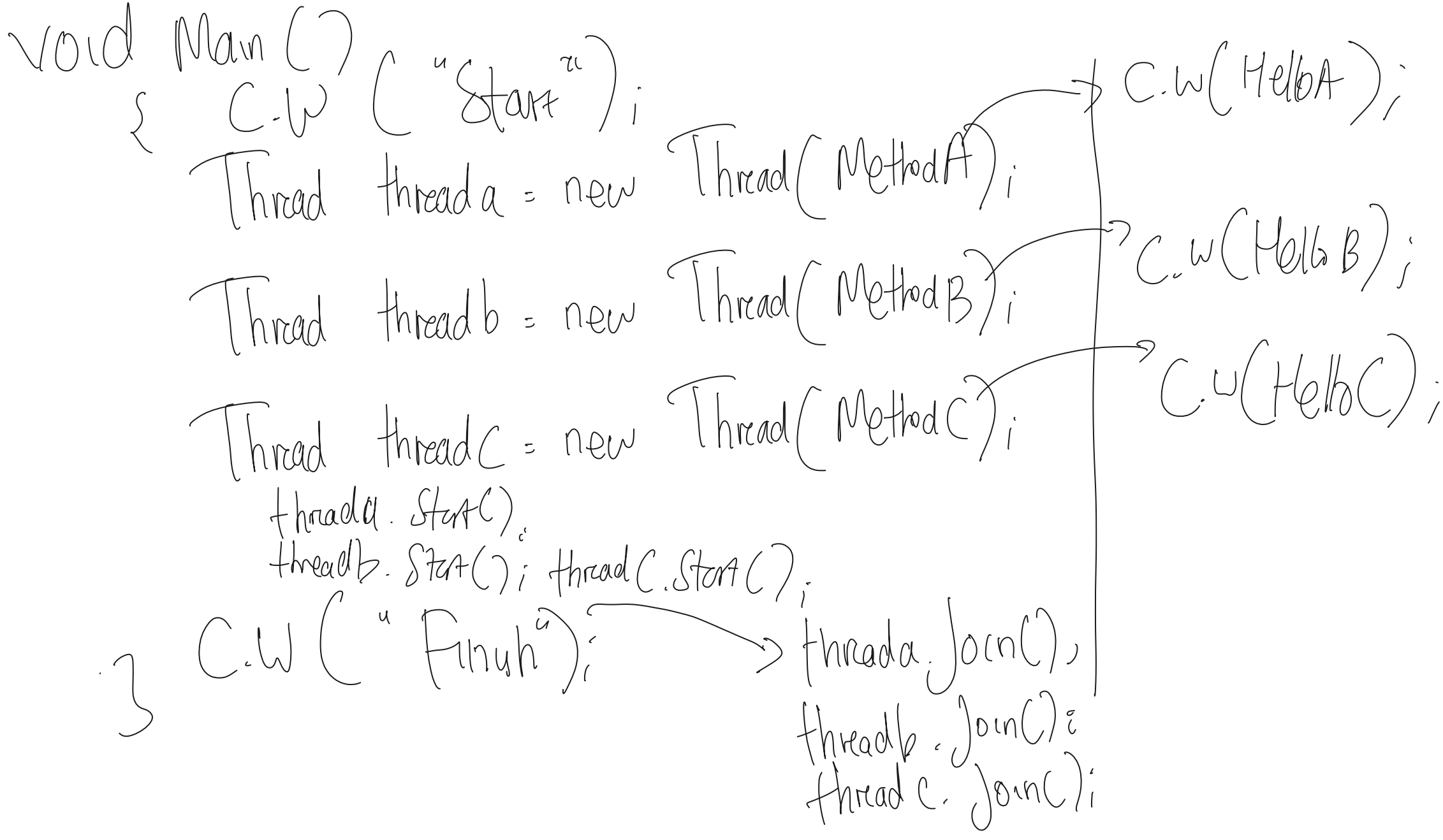
AMD → EPYC → 8 – 128 core
→ Ryzen

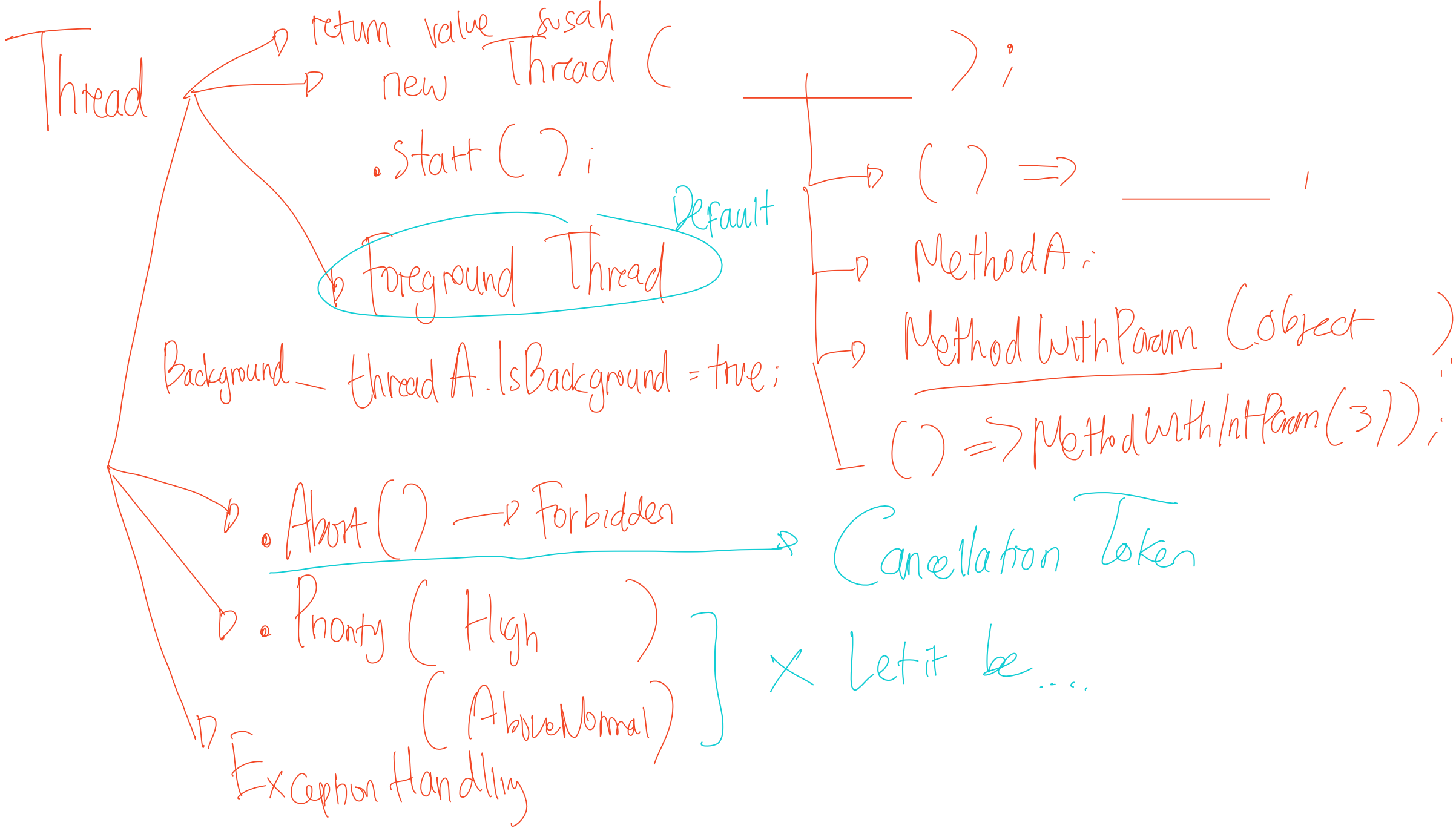
Intel → XEON → 8 – 96 core
→ i3, i5, i7, i9

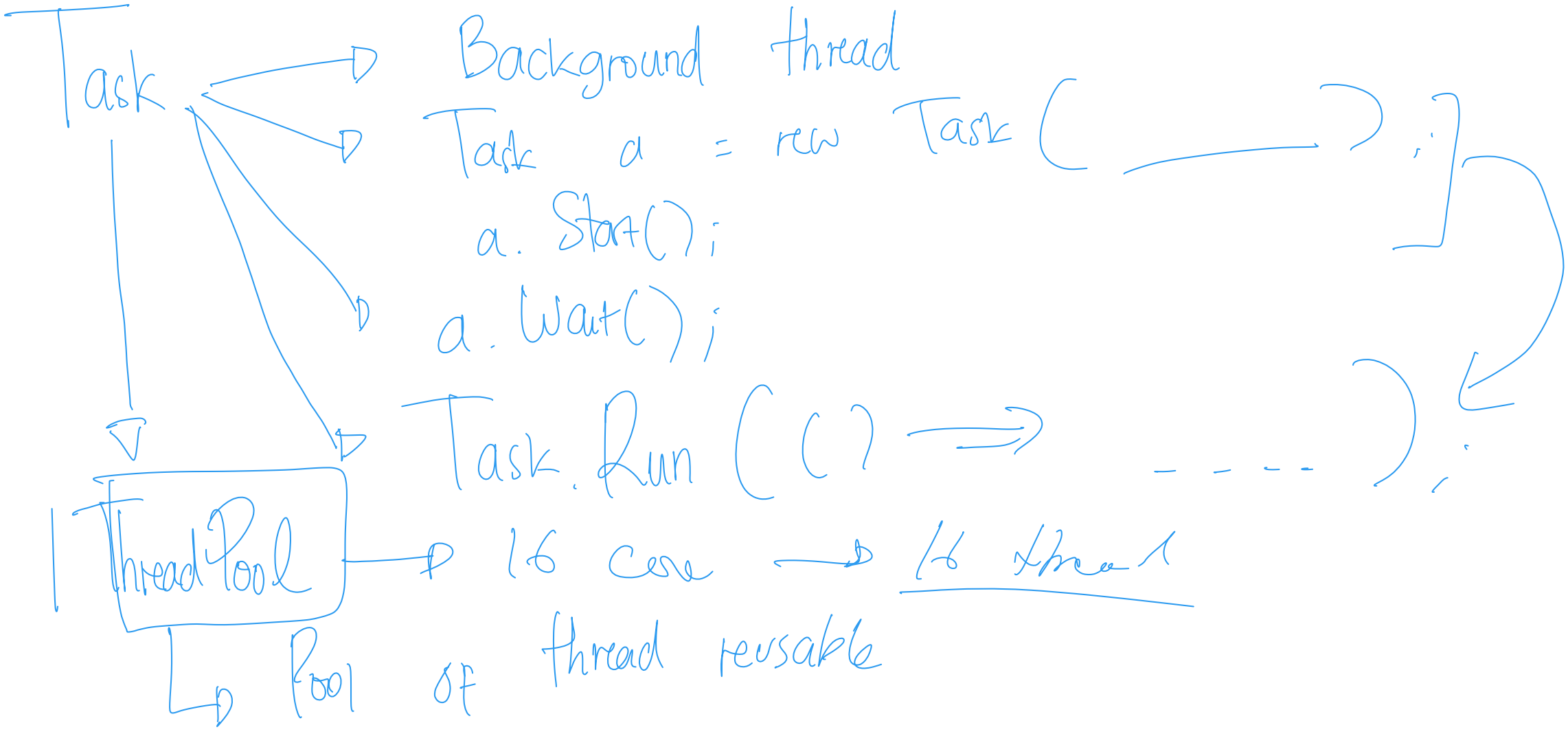


8 core
16 logical processor → 8 core / 16 thread




void Main()
{
C.W("Start");
Thread threada = new Thread(MethodA);
Thread threadb = new Thread(MethodB);
Thread threadC = new Thread(MethodC);
threada.Start();
threadb.Start(); threadC.Start();
C.W("Finish");
}
threada.Join();
threadb.Join();
threadC.Join();
C.W(HelloA);
C.W(HelloB);
C.W(HelloC);


Thread
return value &usah
new Thread (____);
.Start ();
Foreground Thread
Default
Background_ thread A.IsBackground = true;
() => ____ ;
MethodA;
Method WithParam (object);
() => MethodWithIntParam(3));
.Abort () → Forbidden
Cancellation Token
.Prority (High)
(AboveNormal)
× Let it be....
Exception Handling

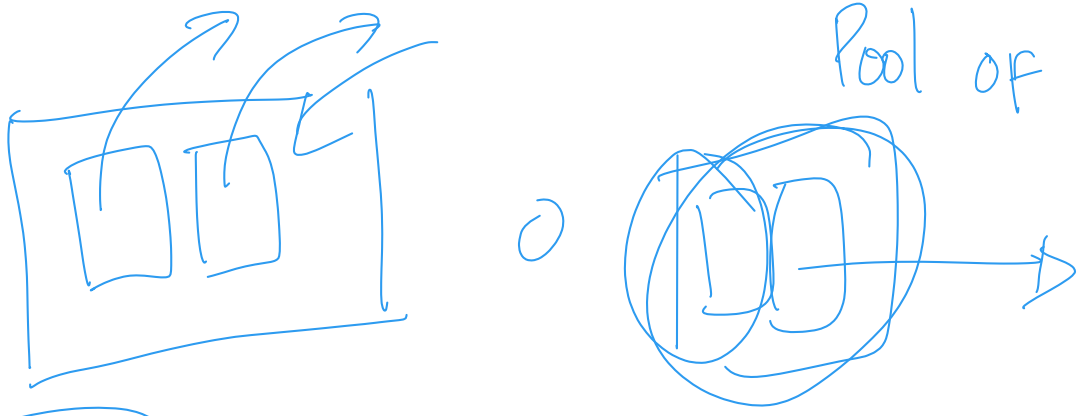

Task
Background thread
Task a = new Task(———);
a.Start();
a.Wait();
Task.Run(() ⟹ .....);
ThreadPool
16 core ⟶ 16 thread
Pool of thread reusable

```
void Main()
{
  try {
  Task.Run (() => ExceptionMaker());
  }
  catch (AggregateException e)
  {
  }
}
```

Task → Thread → Thread Pool → 2 core → 2 mobile

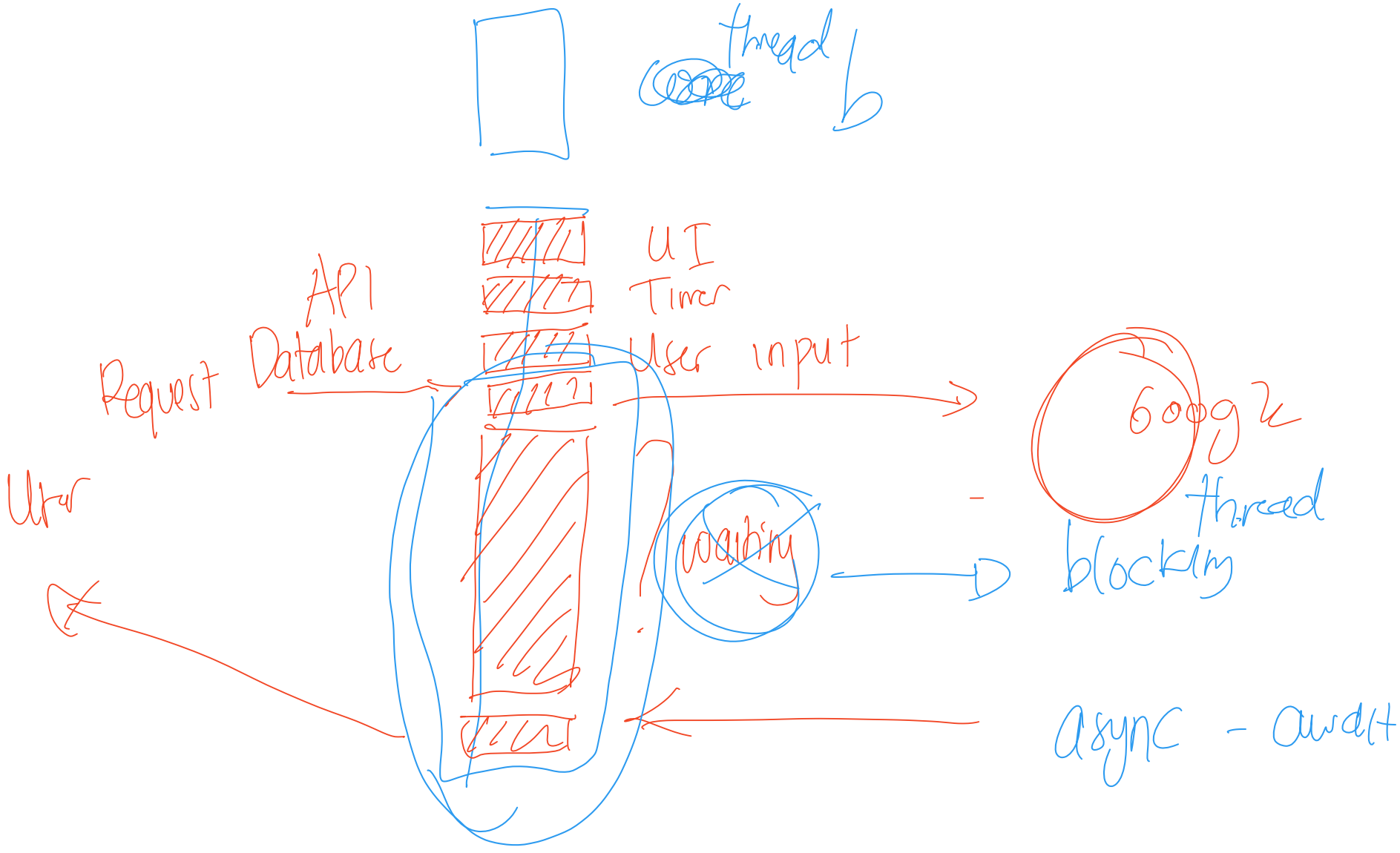
Pool of Thread

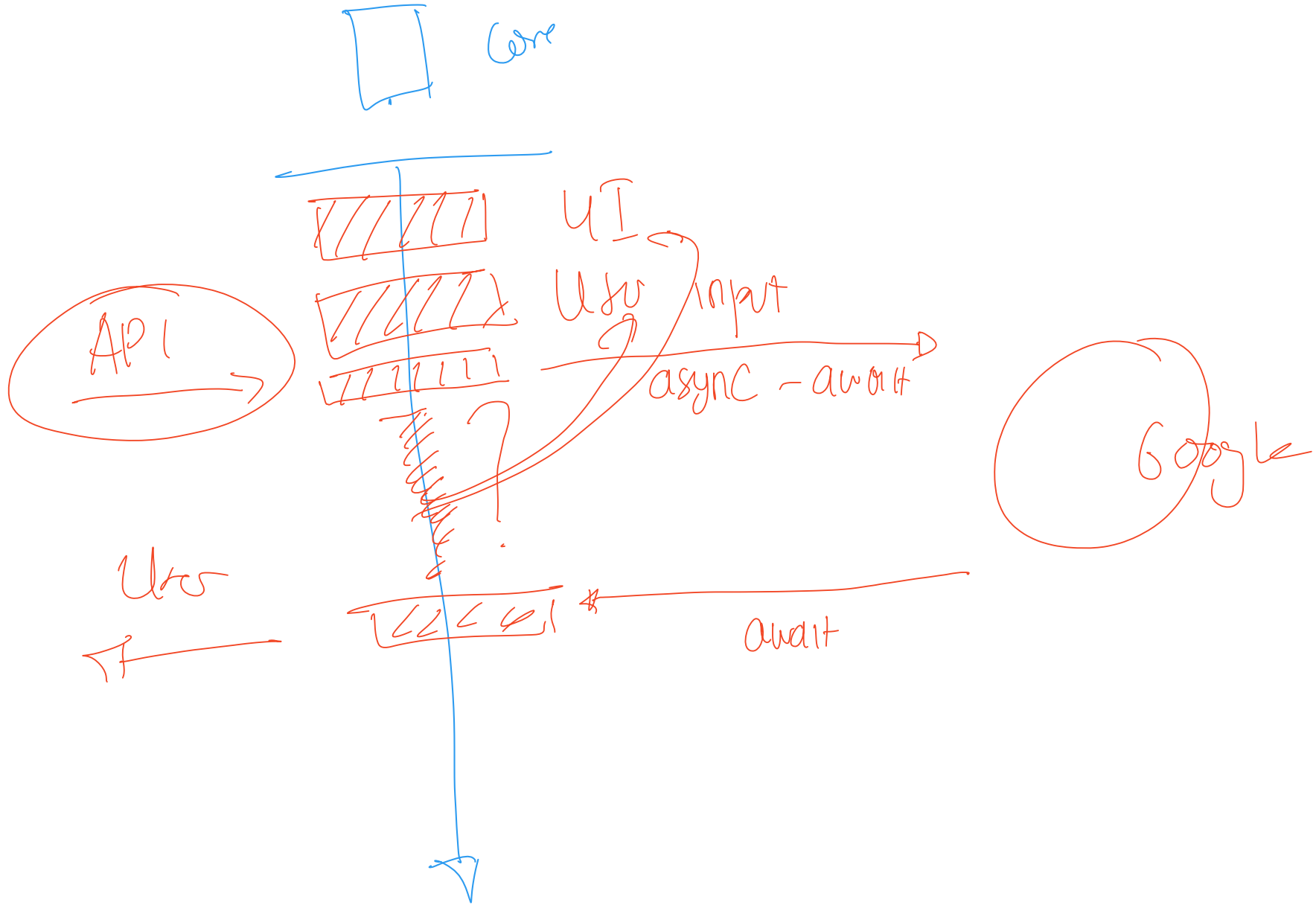
Reusable



Thread → allocate new thread with its memory

Long Running Task → new Thread


thread
UI
Timer
User input
API
Request
Database
User
waiting
Google
thread
blocking
async - await


Core
UI
Usr input
API
async - await
Google
Usr
await