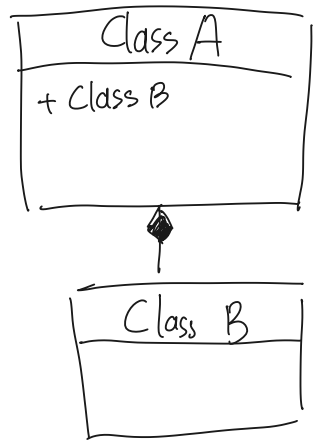
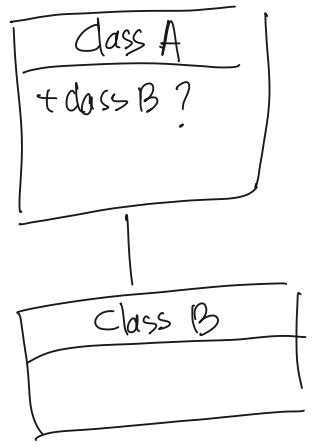
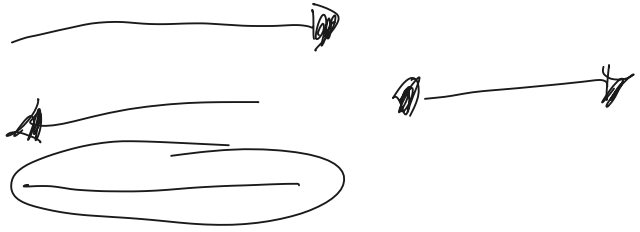
Composition



Aggregation



Assoadtion ⇒ enum



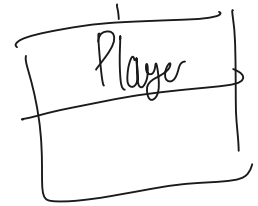
Composition

```
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)

}

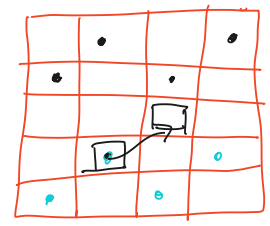
+ Action<Piece, Position, Position>

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(_ , _ , _)

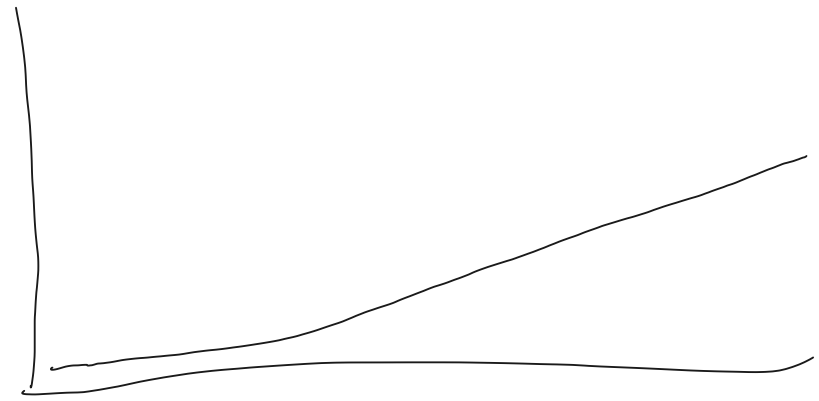
p = Piece.id;

}

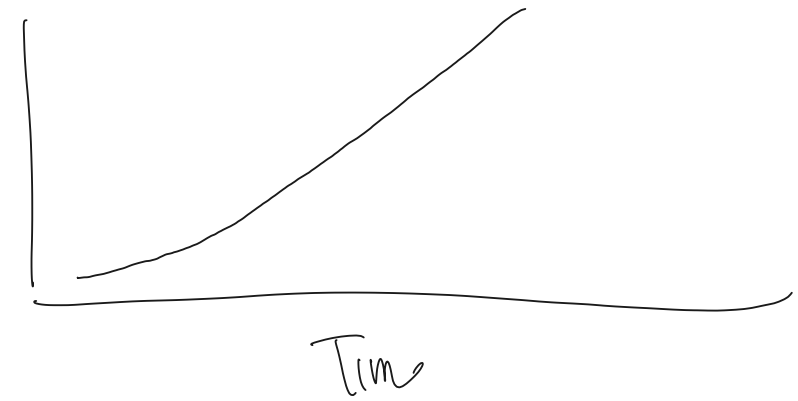
p 3

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 #

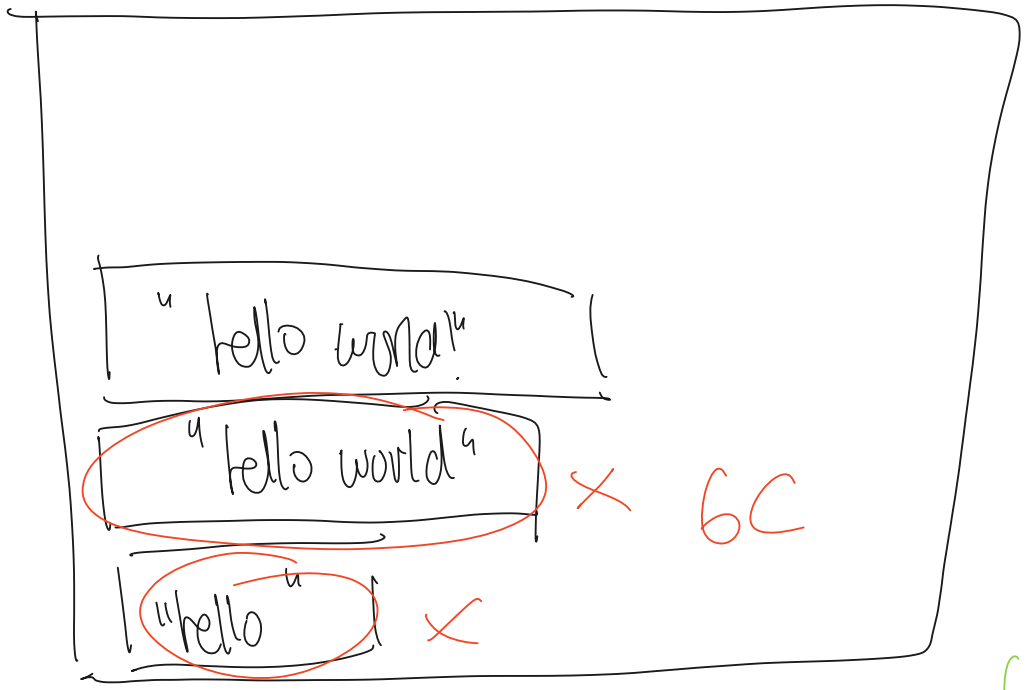


Garbage Collection

Garbage Collector

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

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



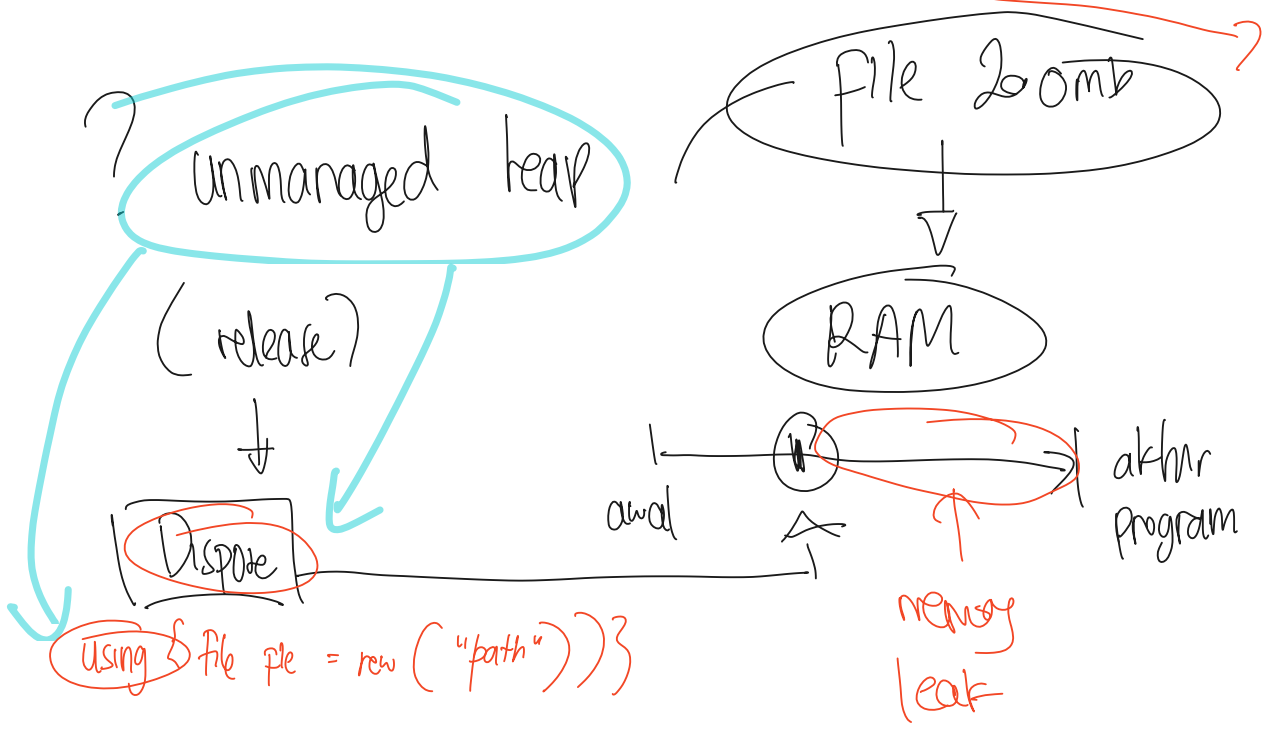
memory
- stack ✗
- heap
  - managed heap (array, class, string, dcb)
    - (internal Program)
  - unmanaged heap (external) ✗
    - (file, api, http request, database, smtp)

GC → Managed heap

60

61+60

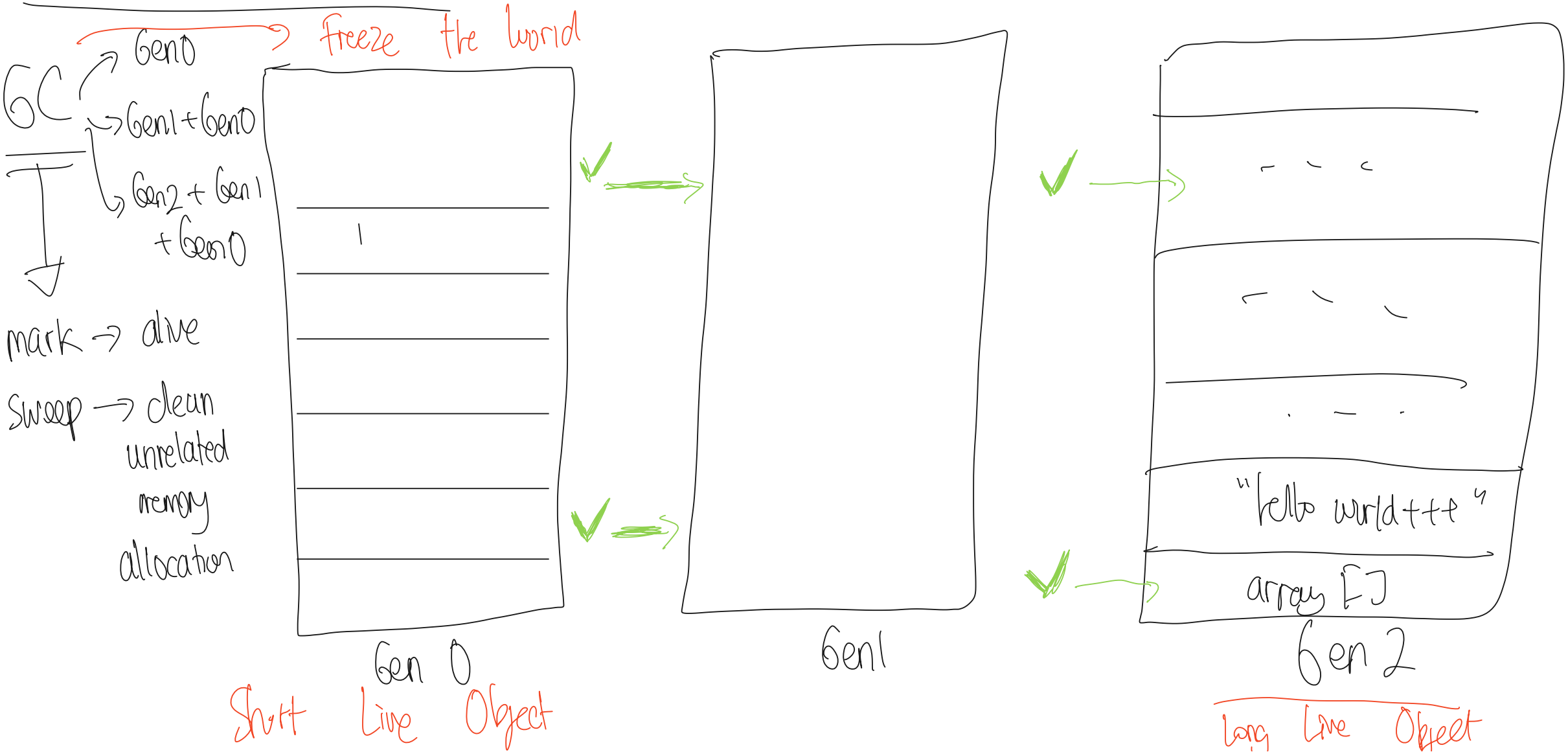
62+61+60



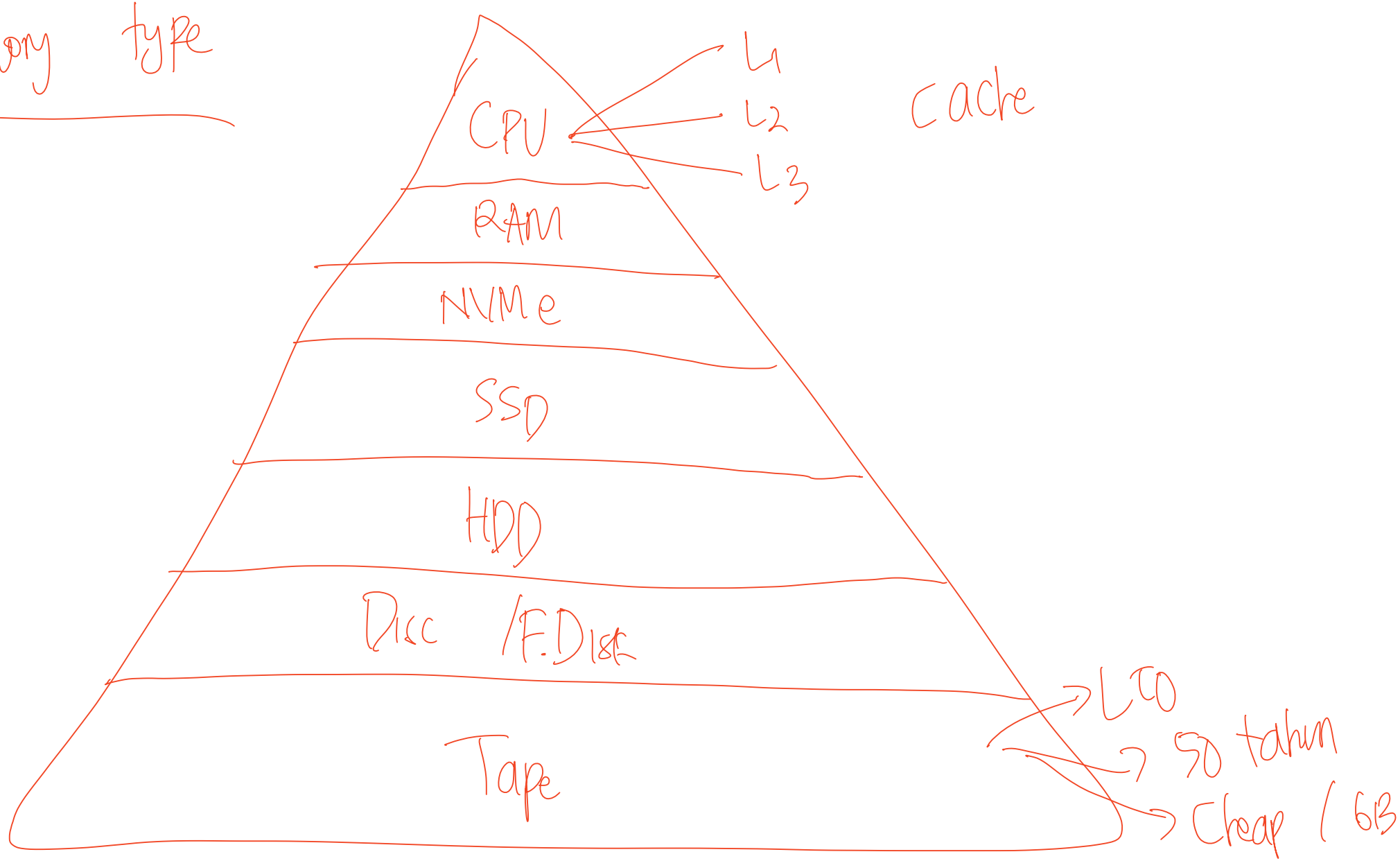
Clean?

- mark = alive
- sweep = Gen

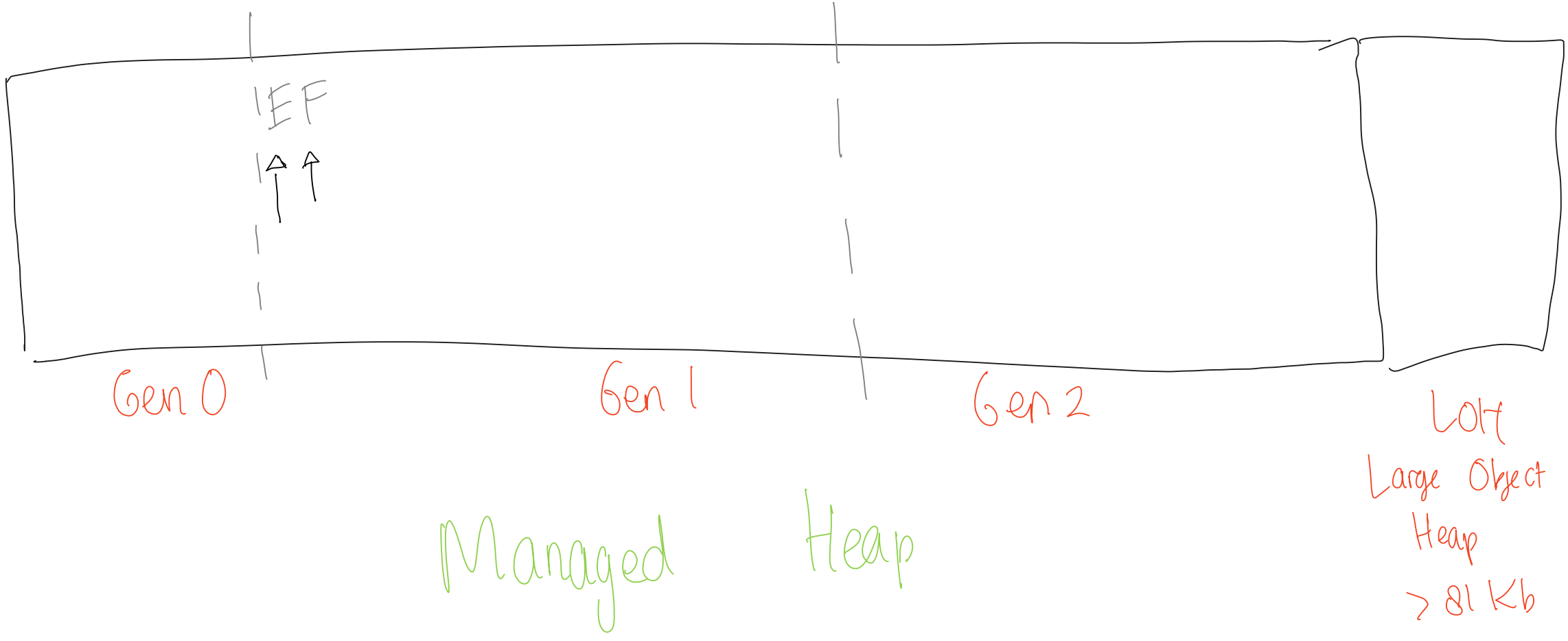
Managed heap

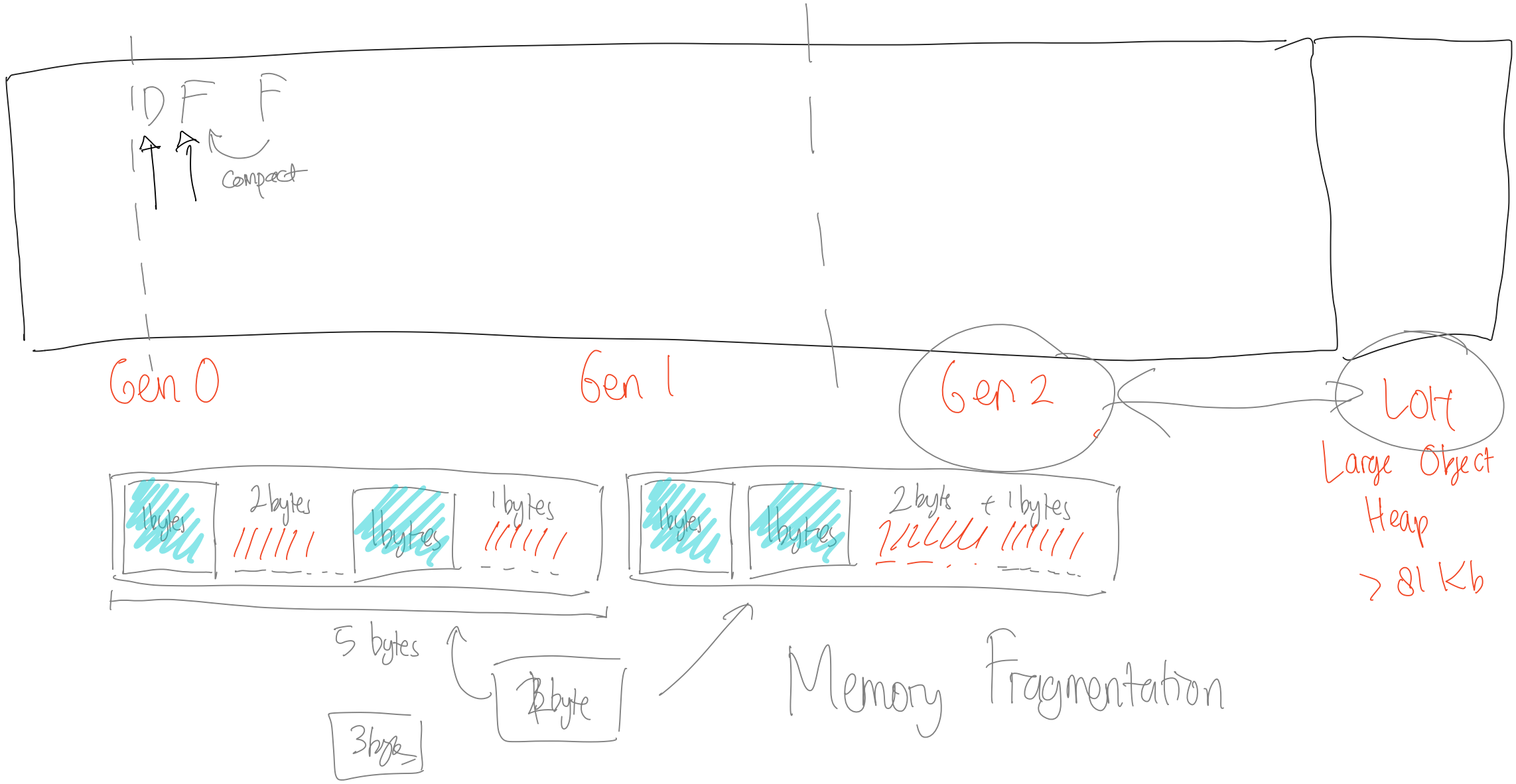


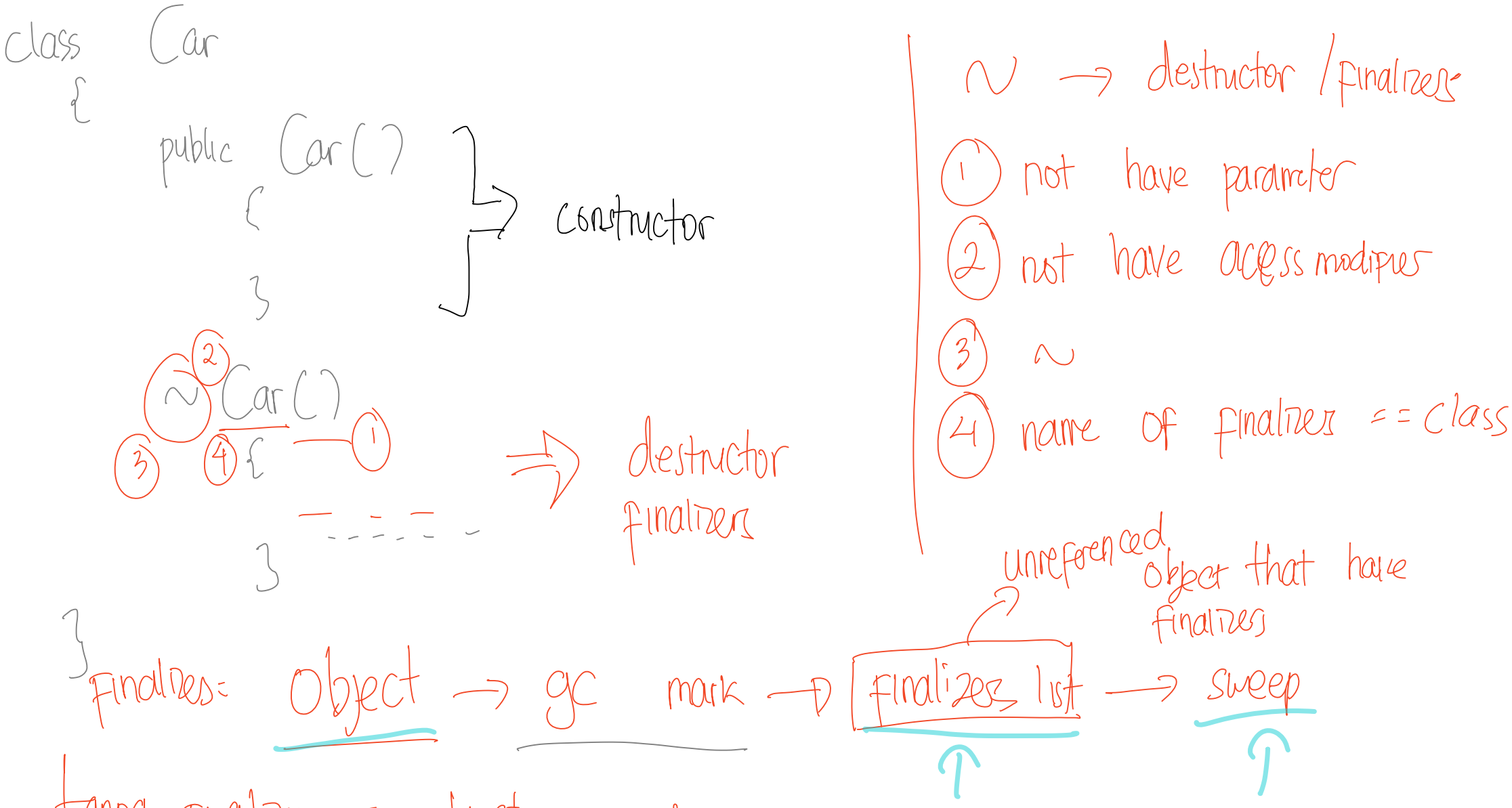
Memory type

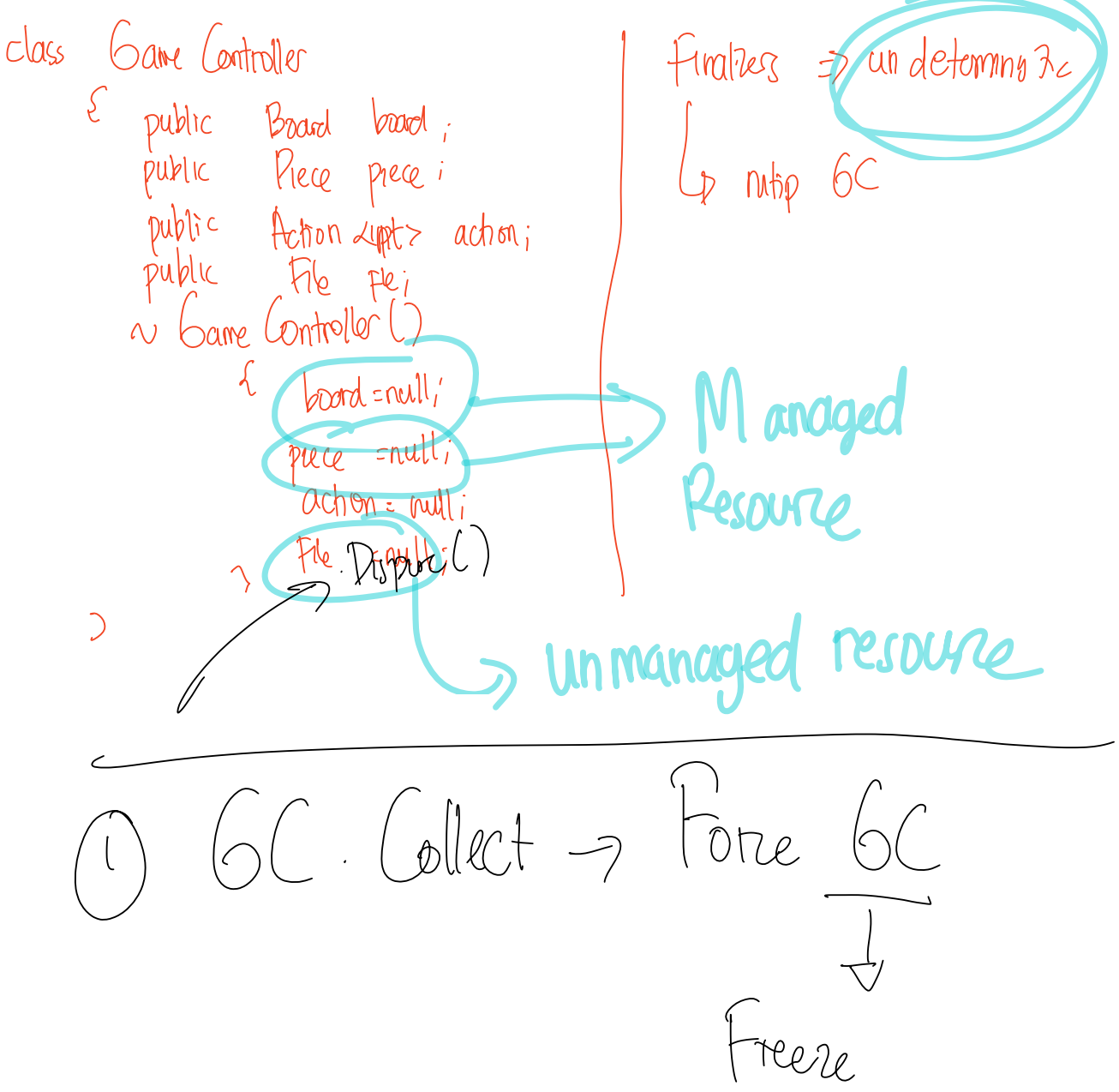

CPU
L1
L2
L3
cache
RAM
NVMe
SSD
HDD
Disc / F.Disk
Tape
LTO
SD tahun
Cheap / GB

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

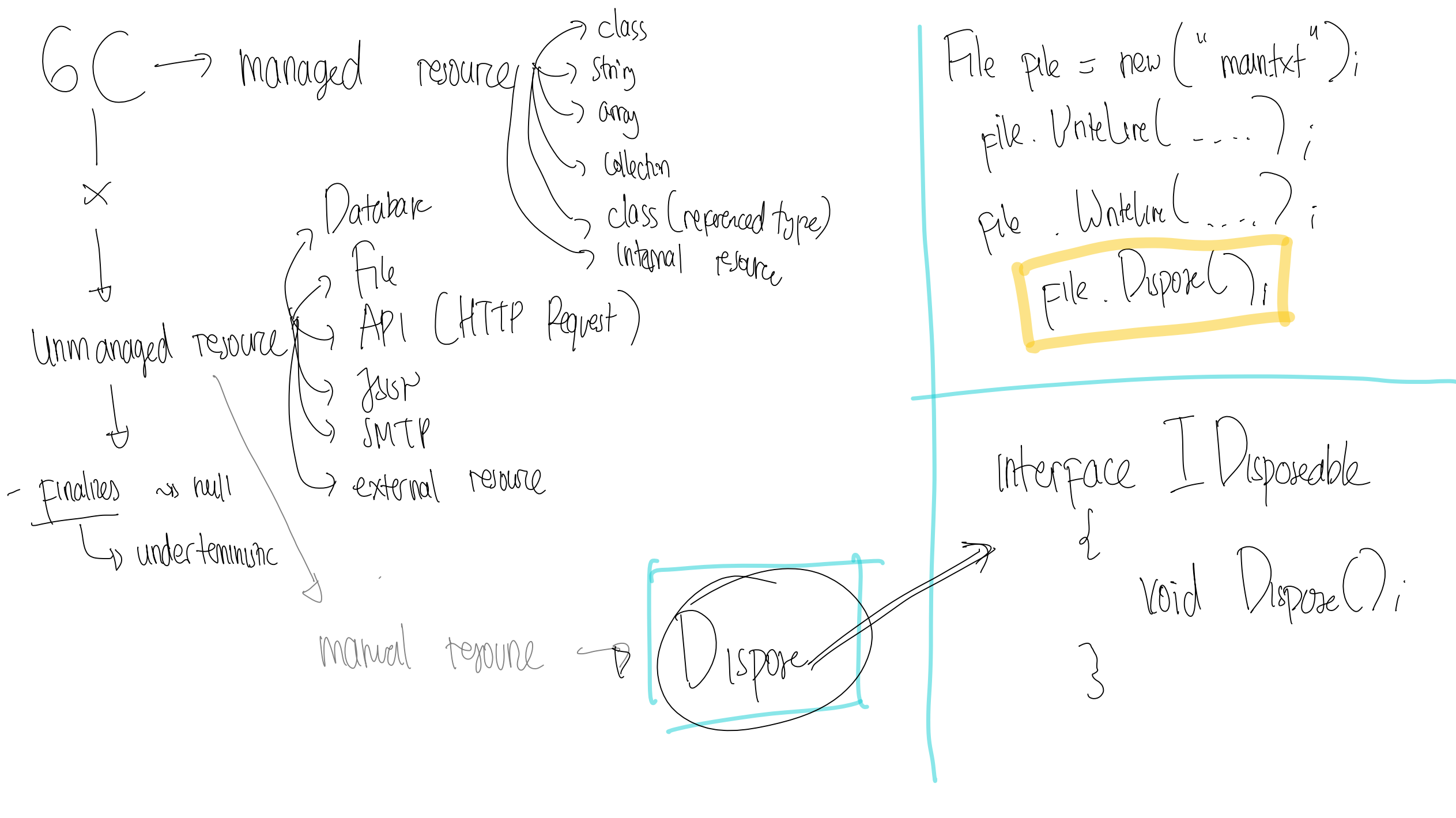
④ Avoid using finalizes

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

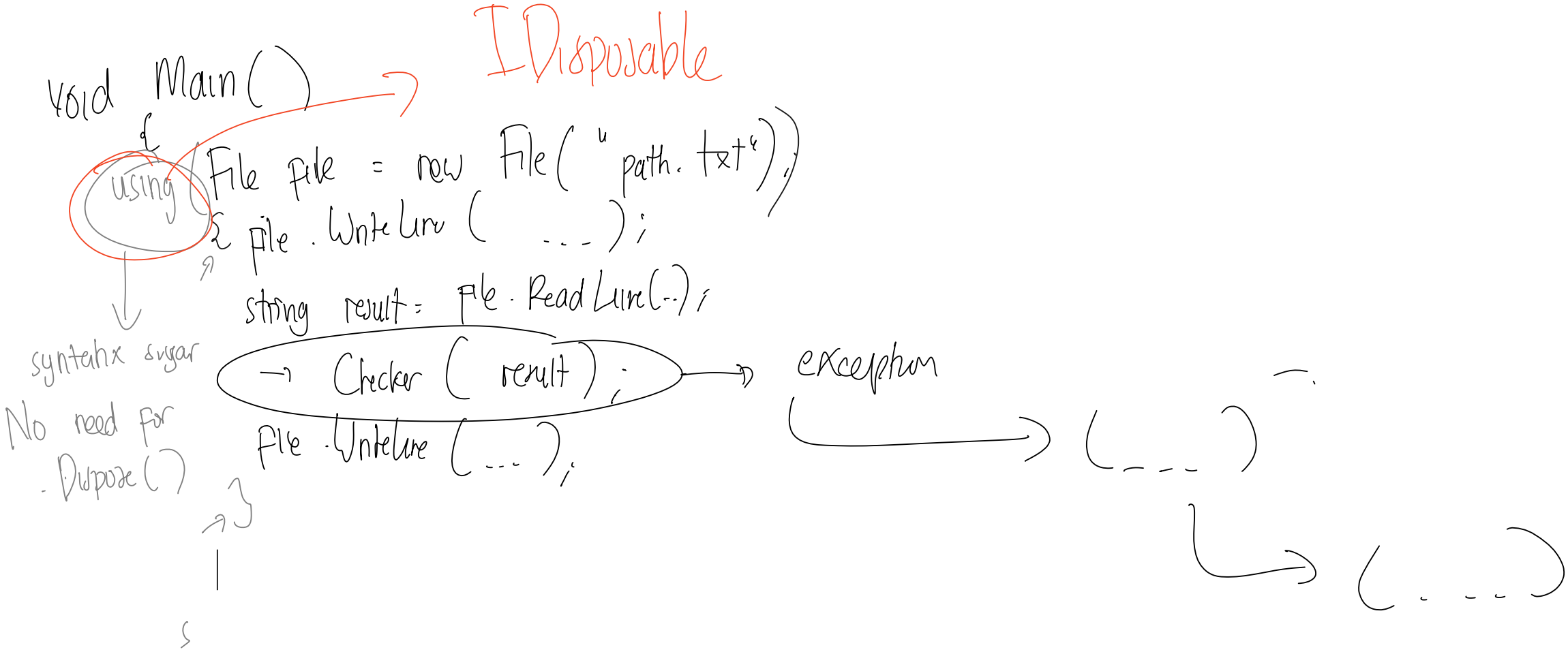
↳ IDisposeable ⟶ void Dispose();

```
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

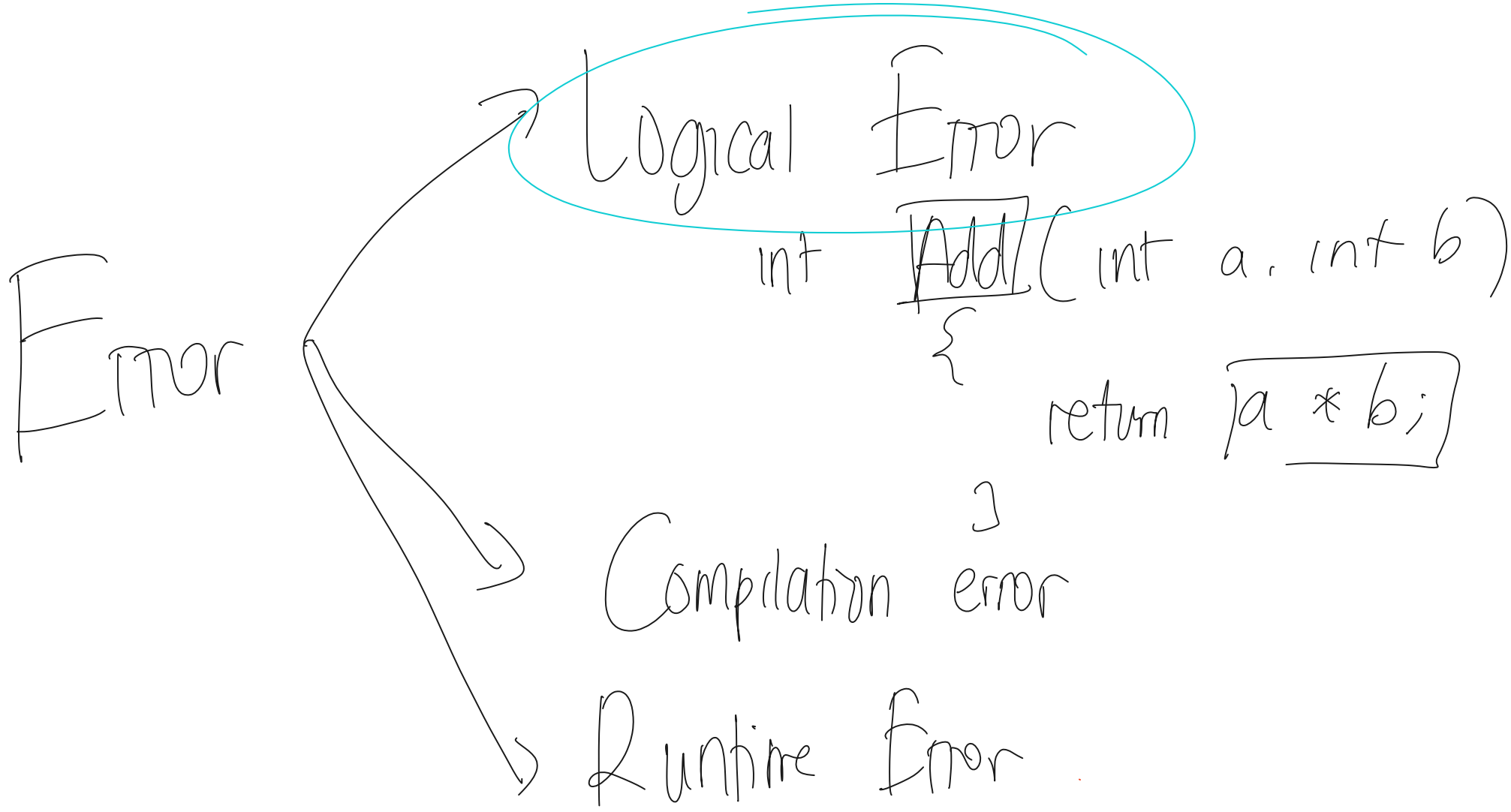
① #define Release ✓

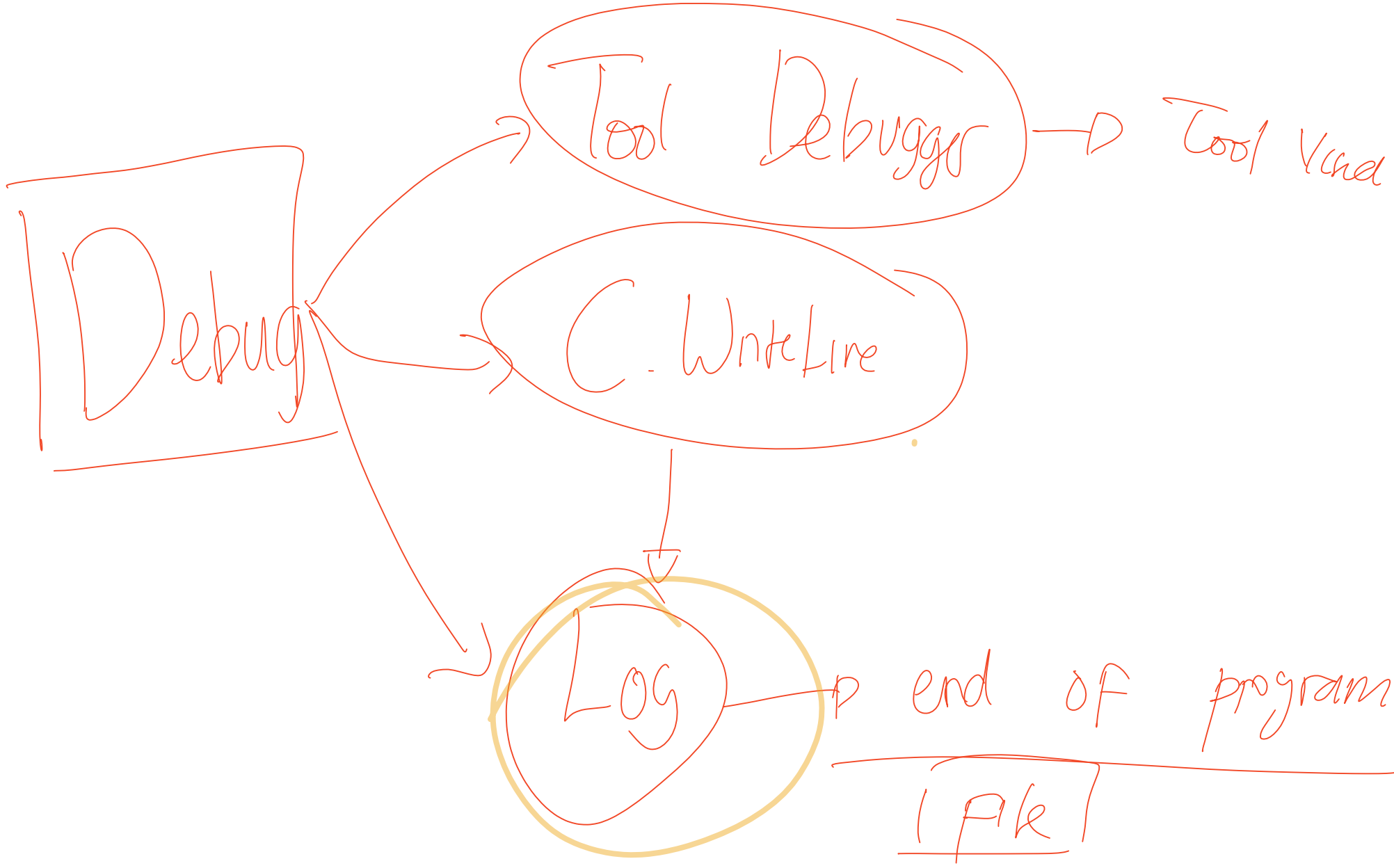
② .csproj ✓

③ dotnet build -c Release

→ compile

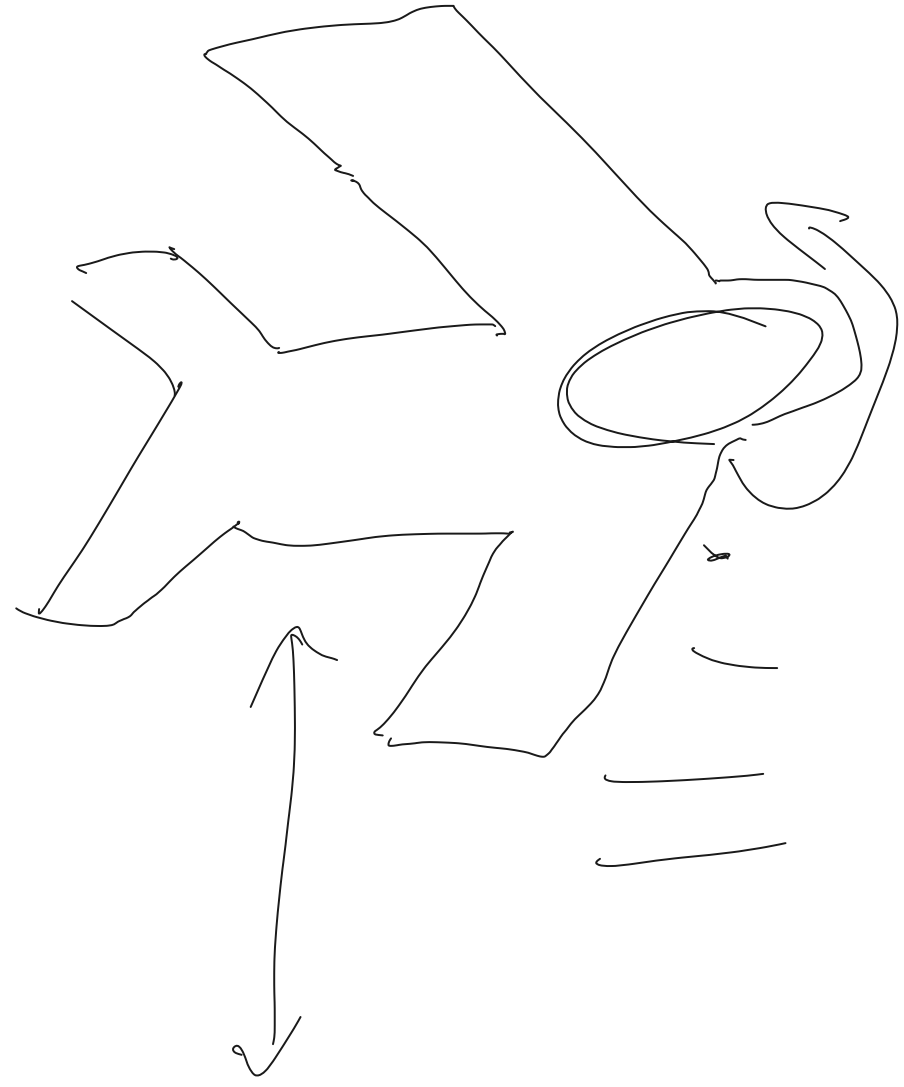
```
void Main
{
#if WINDOWS
string path = "C:/Users/defaultuser/....";

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

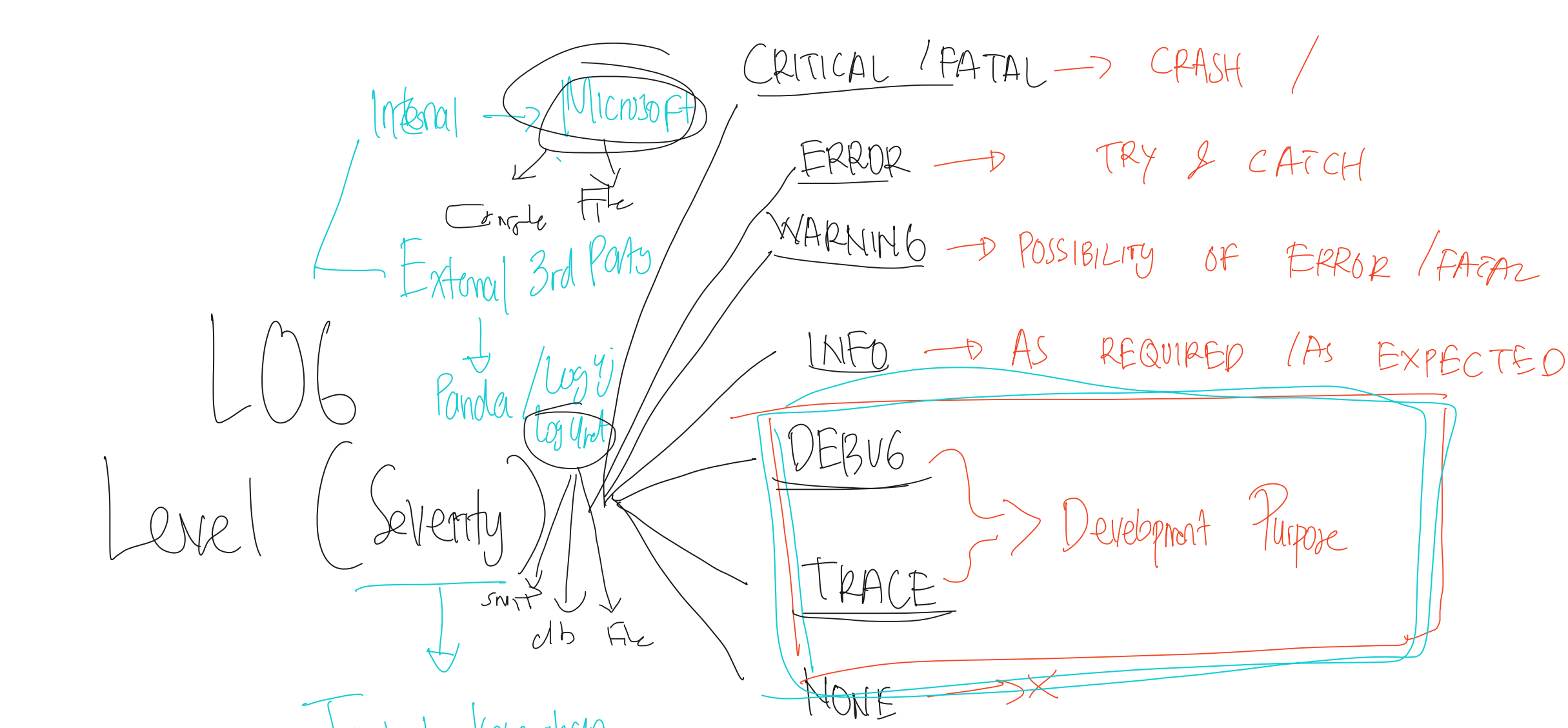

Error
Logical Error
int Add(int a, int b)
{
return a * b;
}
Compilation error
Runtime Error

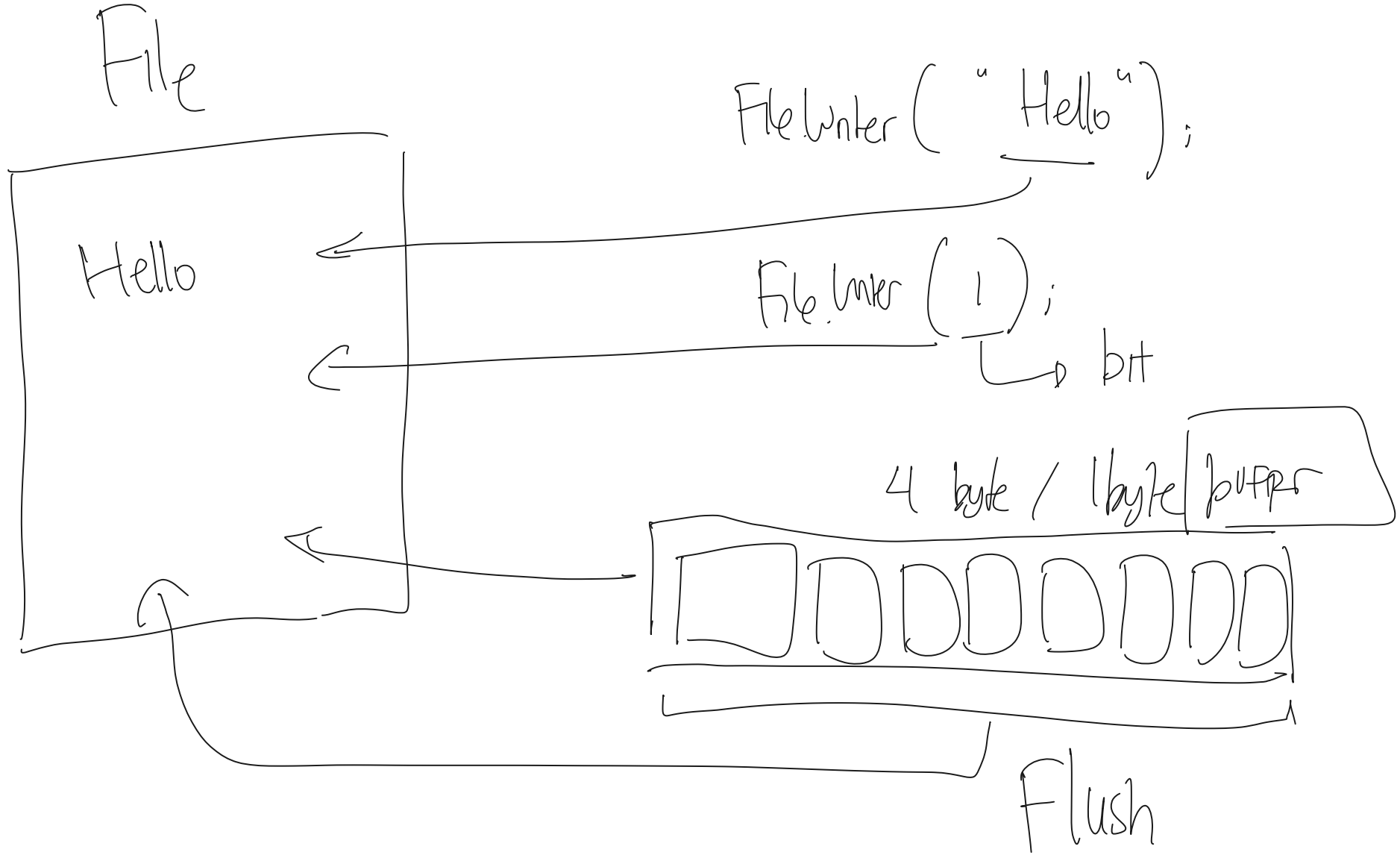

Debug
Tool Debugger
Tool Visual
C. WriteLine
Log
end of program
file

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

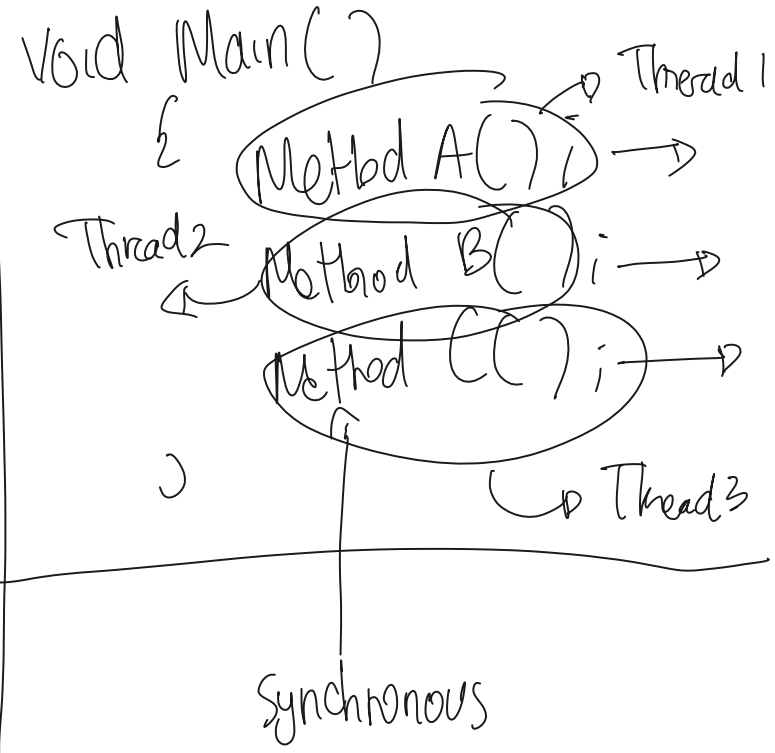
Process

Different App
Different Process
Isolate

Thread

Multiple Unit of process

thread → another thread resource



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

synchronous

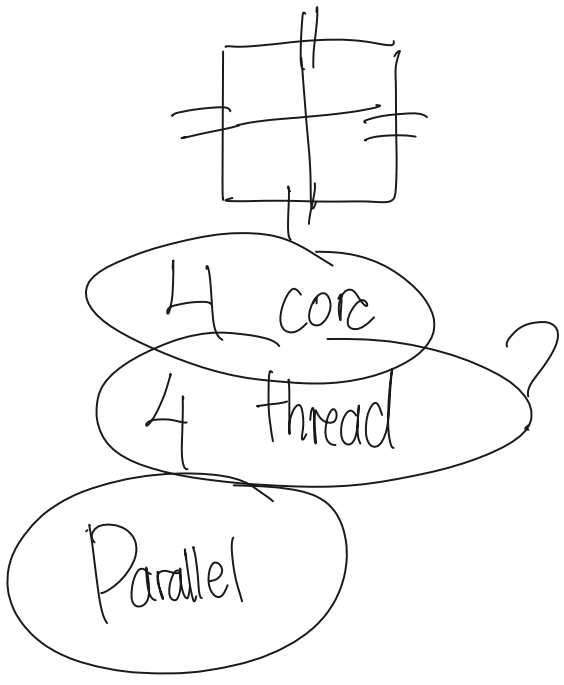
Thread

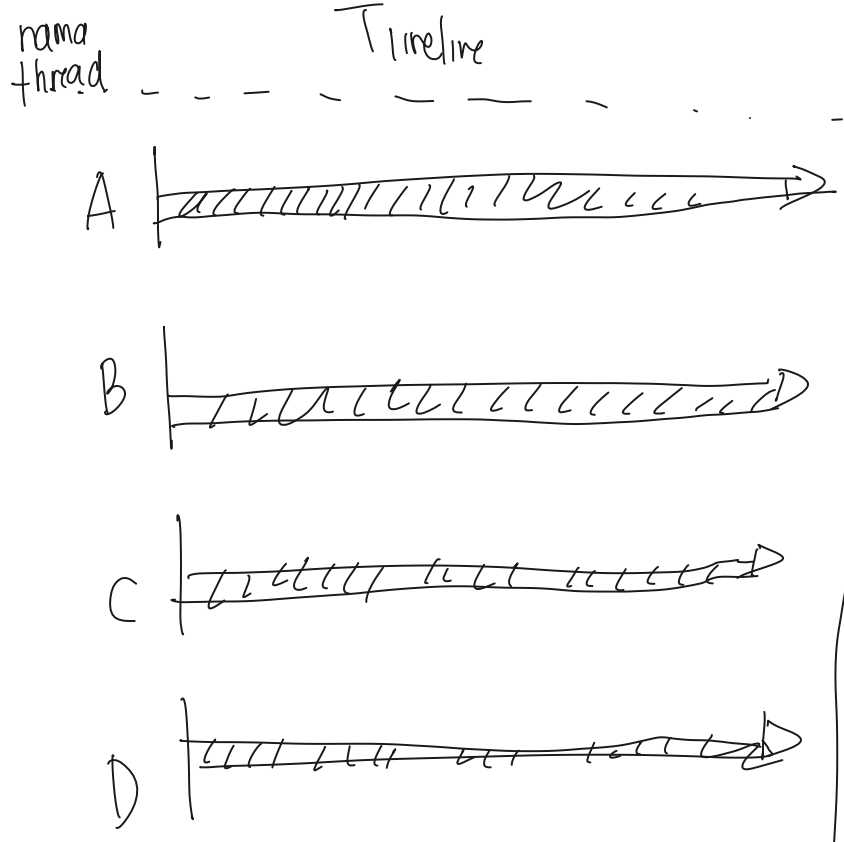
Main Thread

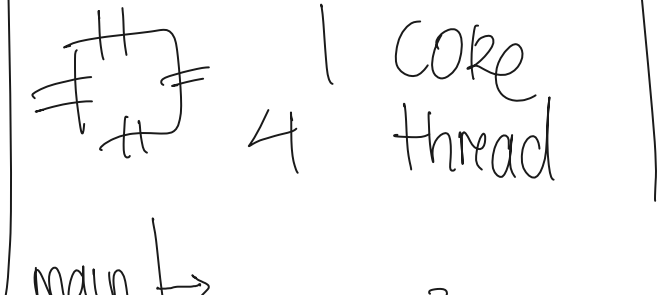
```
void Main()
{ Thread threada = new Thread(MethodA);
  Thread threadb = new Thread(MethodB);
  Thread threadc = new Thread(MethodC);
   threada.Start();
   threadb.Start();
} threadc.Start();
```

concurrency

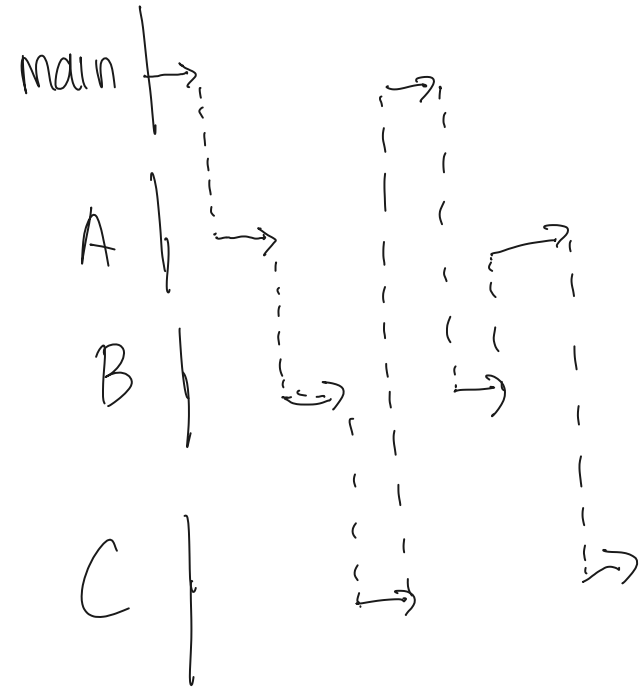
Thread







time slicing CPU



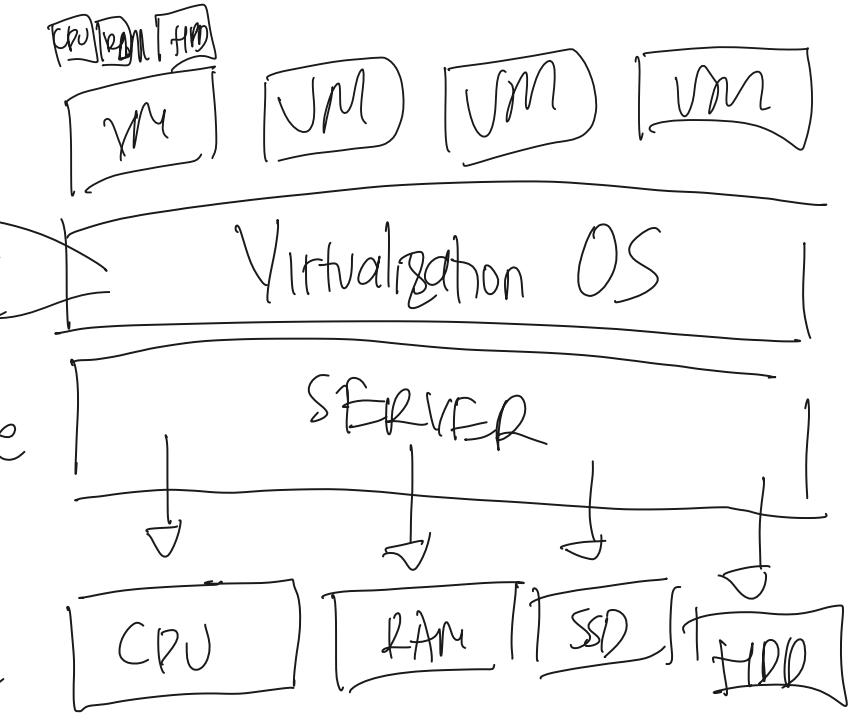
high priority

lower priority

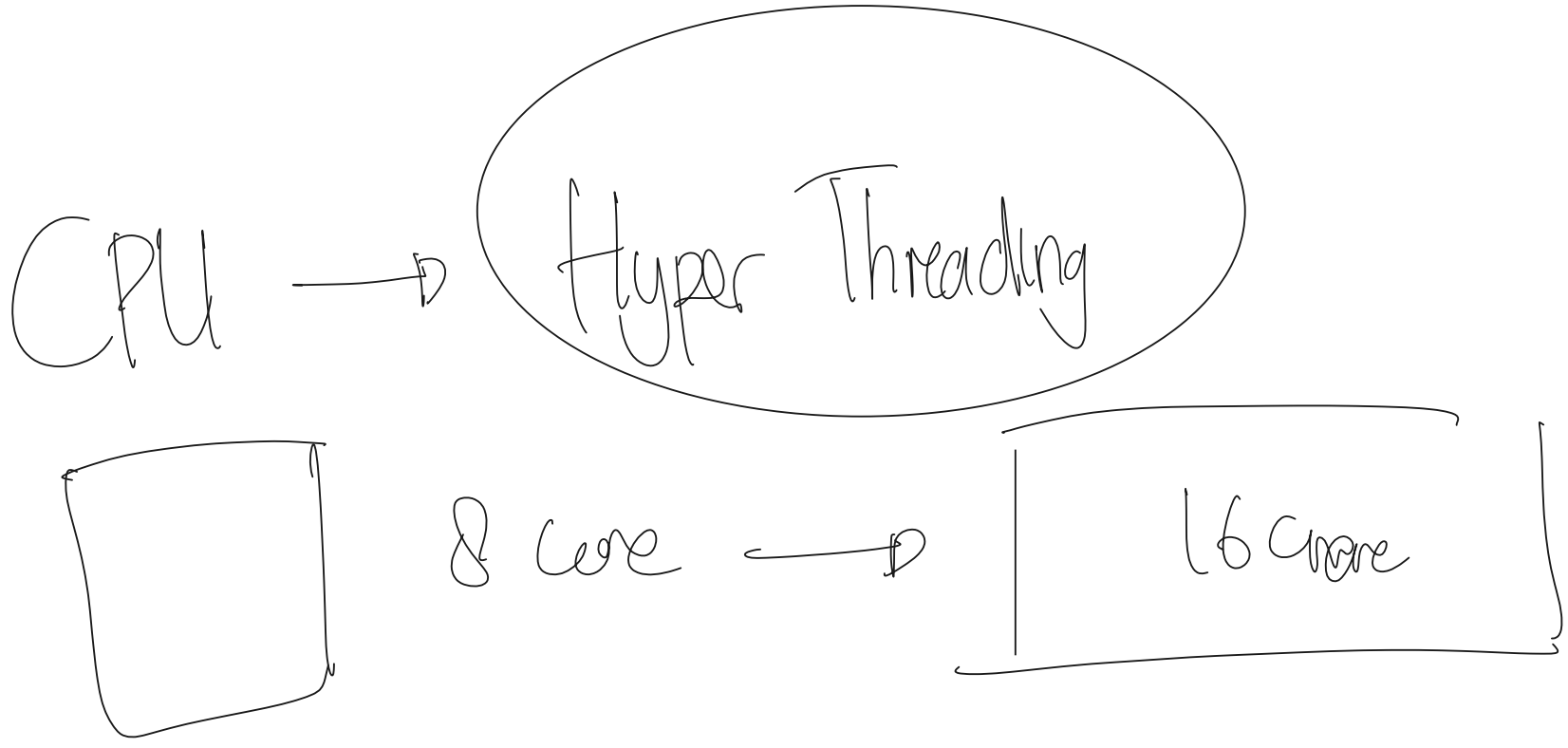
SERVER

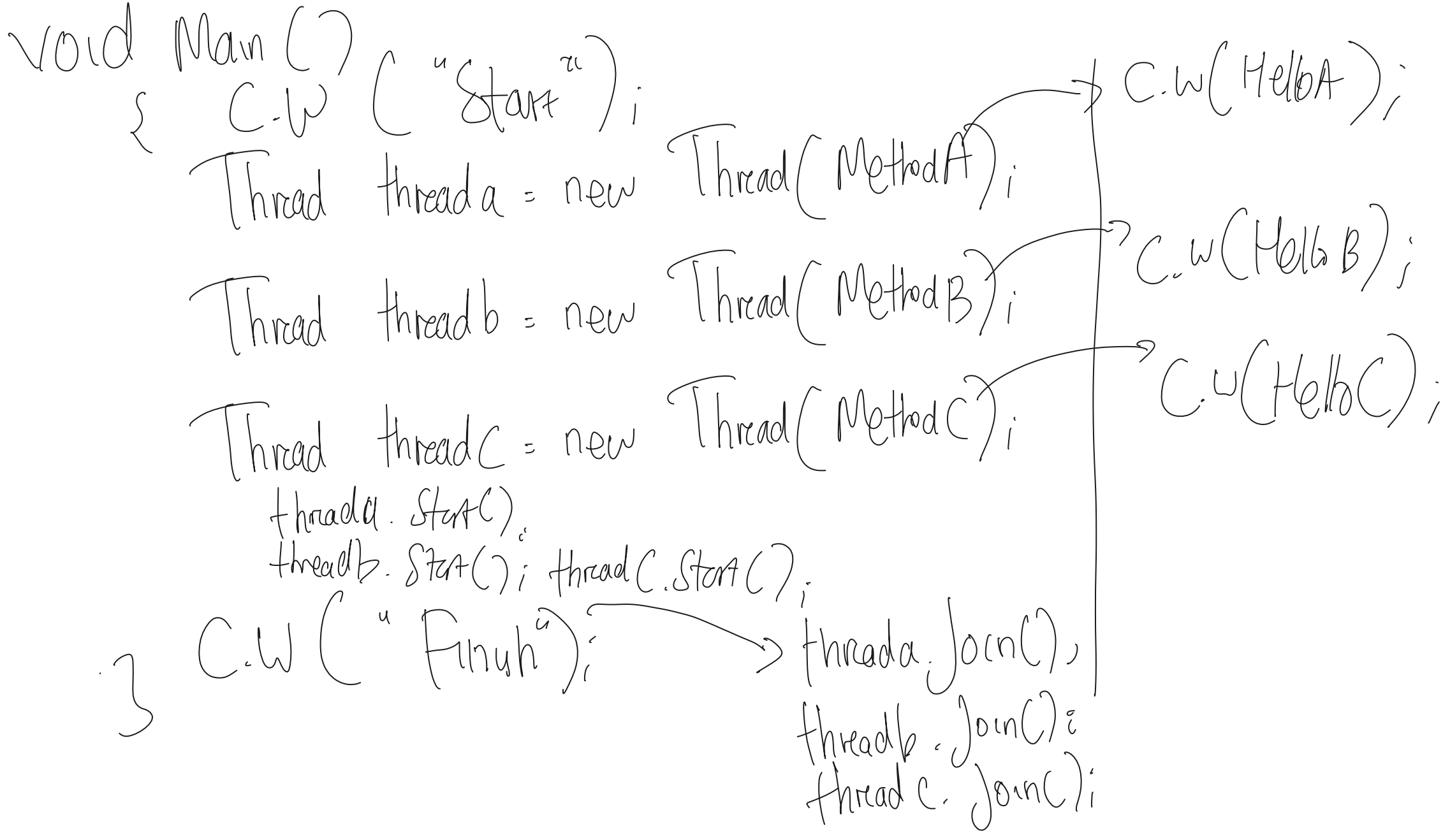
AMD → EPYC → 8 – 128 core
→ Ryzen

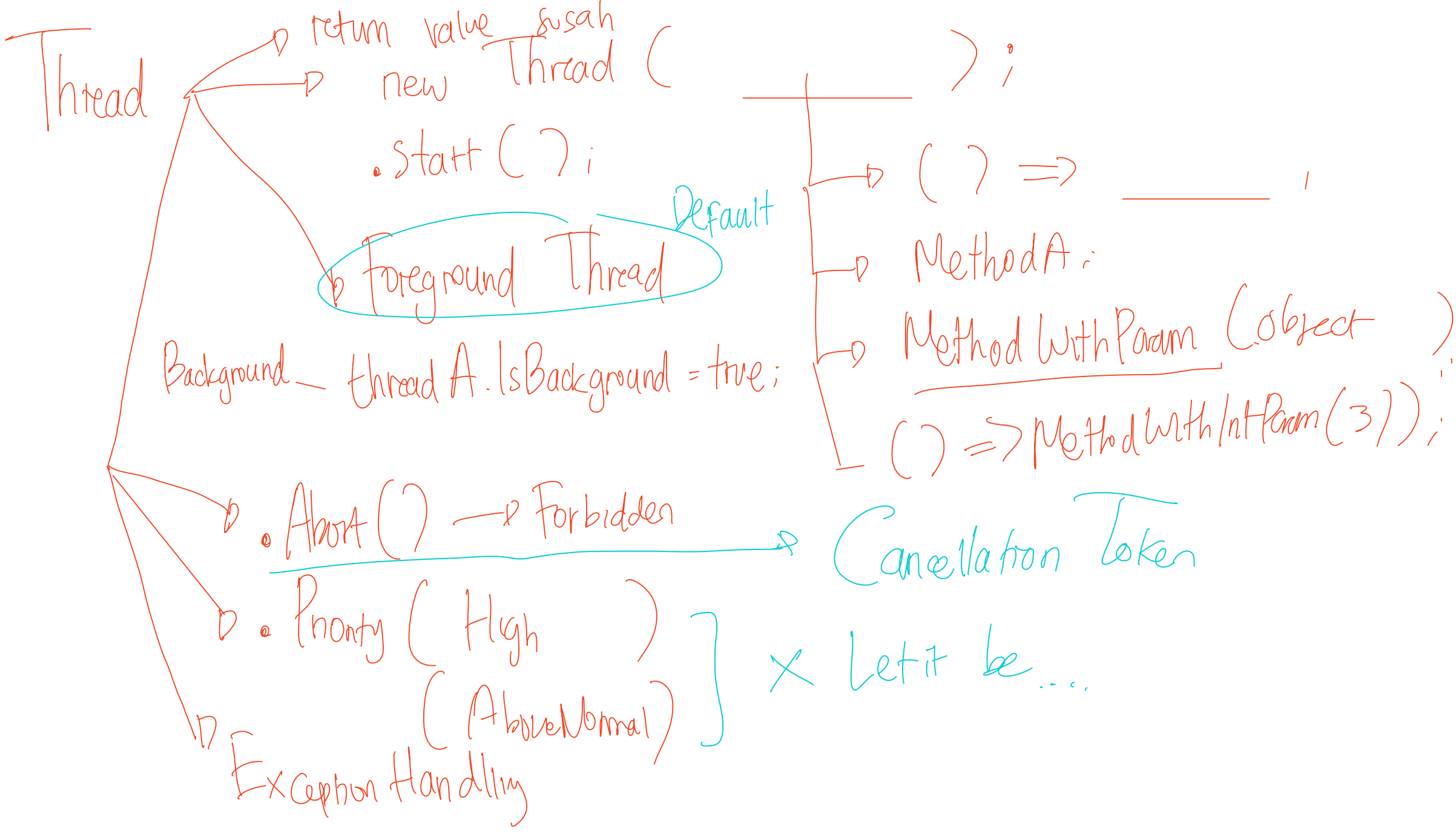
Intel → XEON → 8 – 96 core
→ i3, i5, i7, i9

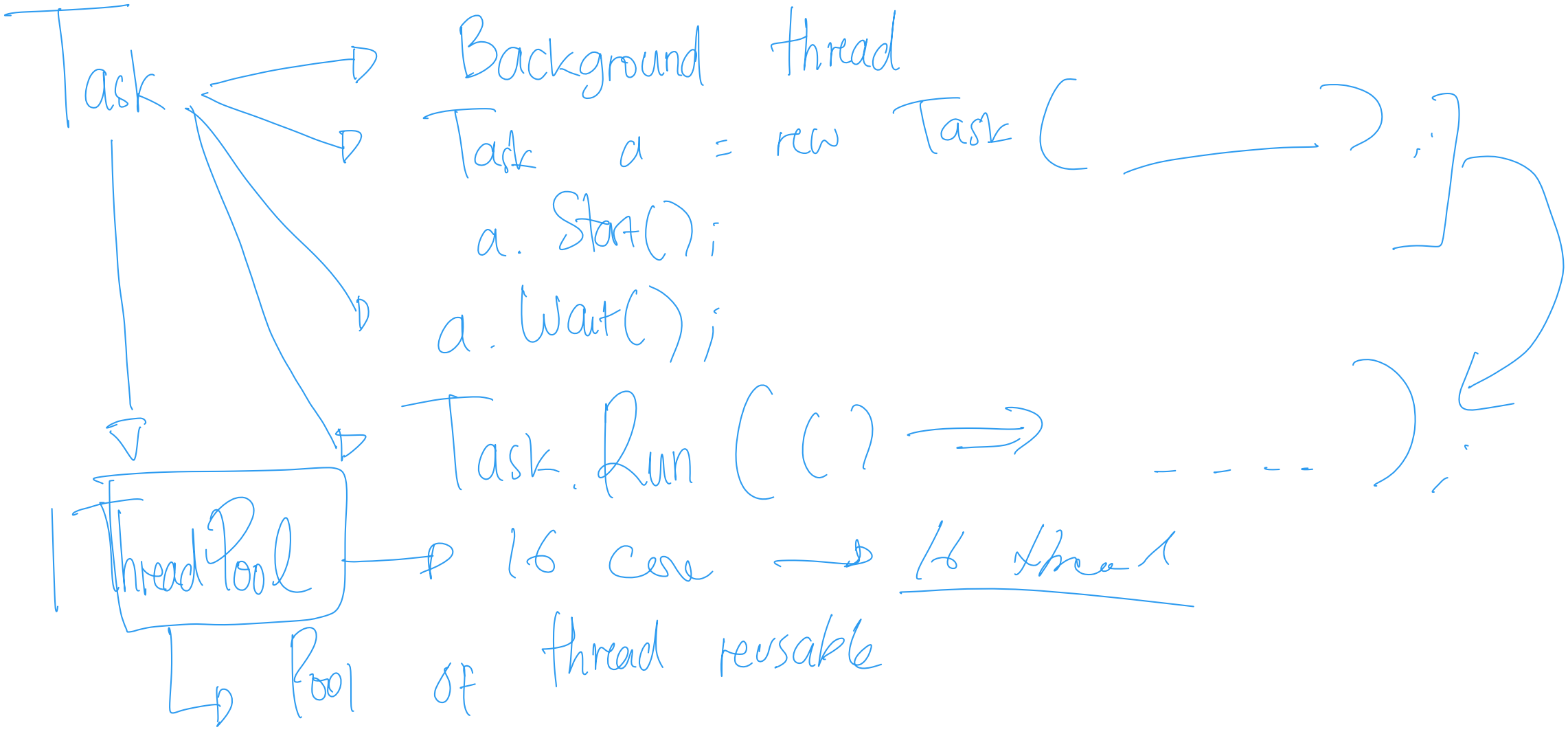


8 core
16 logical processor → 8 core / 16 thread




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

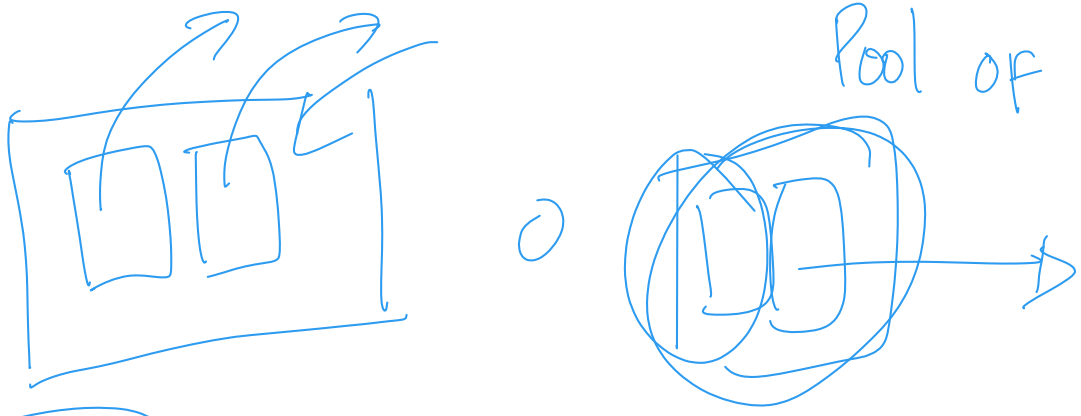

Task
Background thread
Task a = new Task(———);
a.Start();
a.Wait();
Task.Run(() ⟹ .....);
ThreadPool
16 core ⟶ 16 thread
Pool of thread reusable

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

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

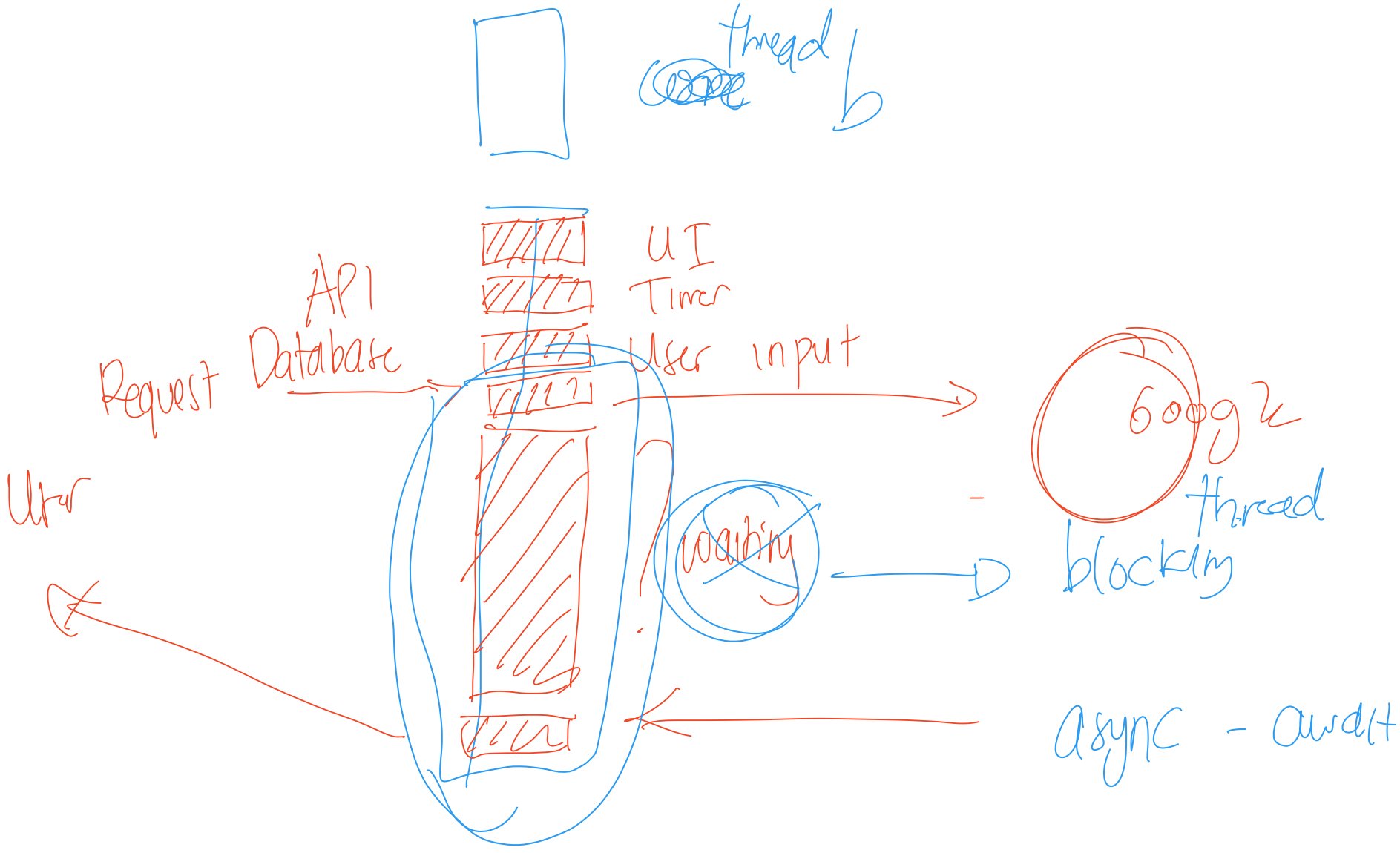
Pool of Thread

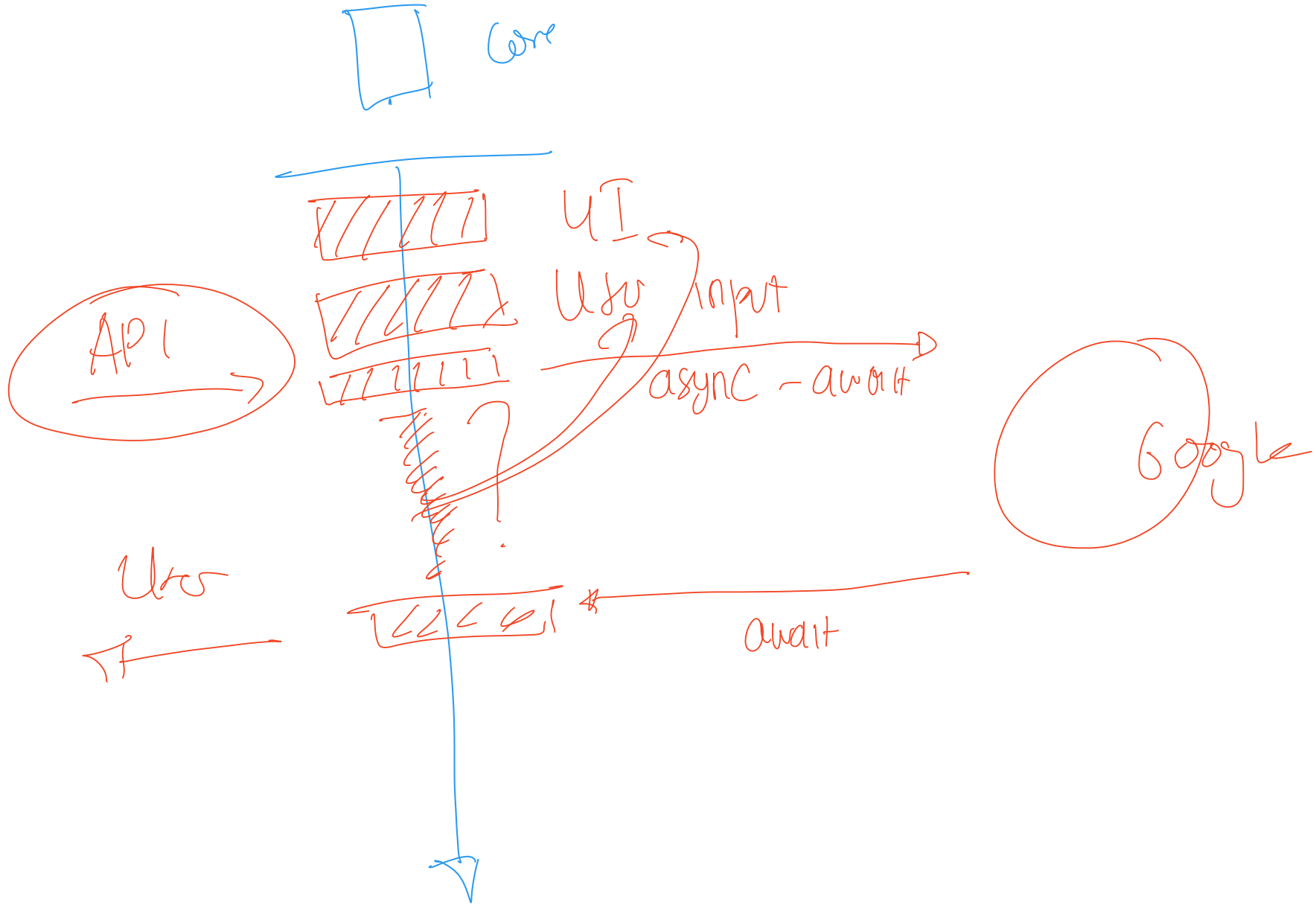
Reusable

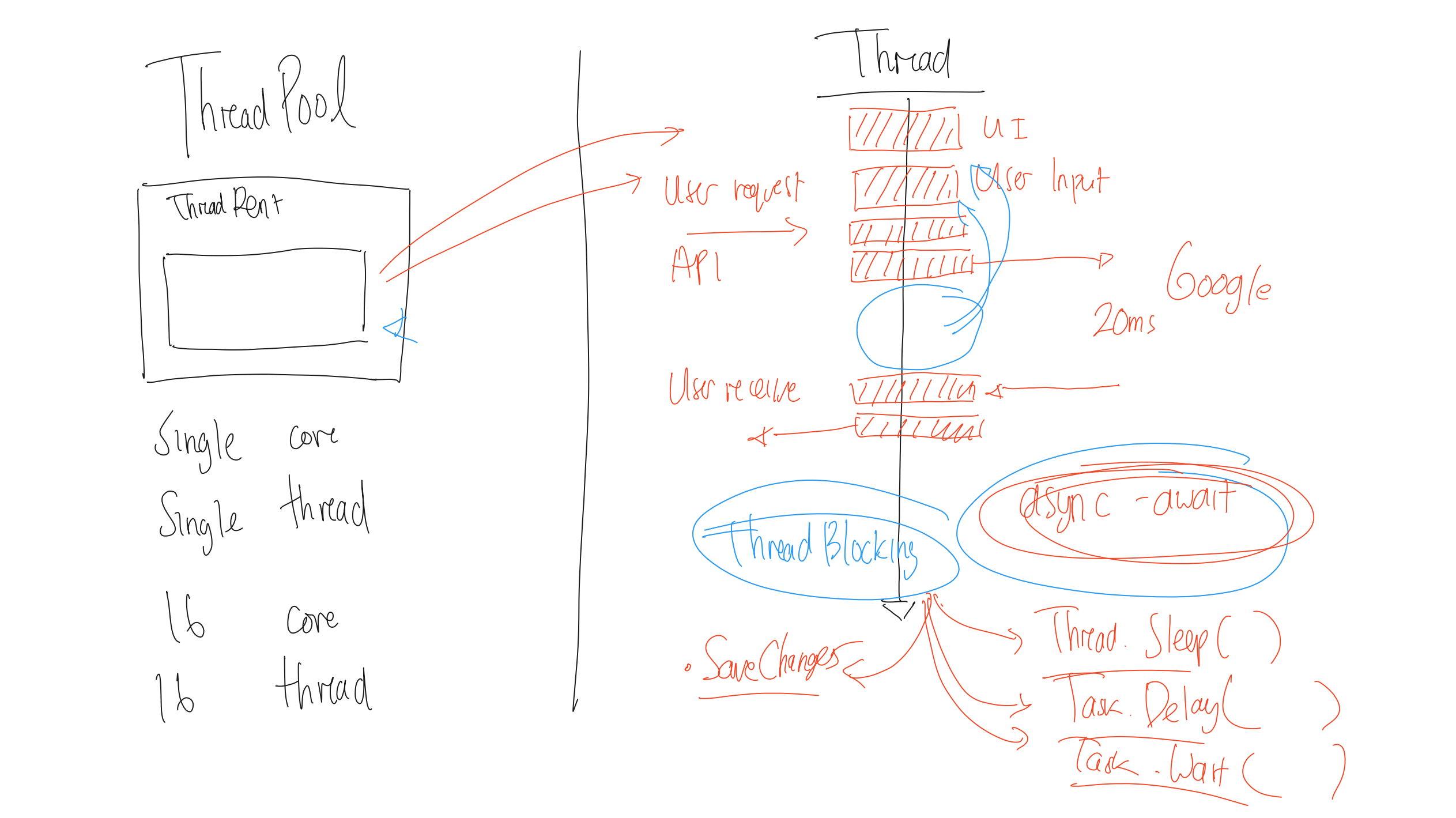


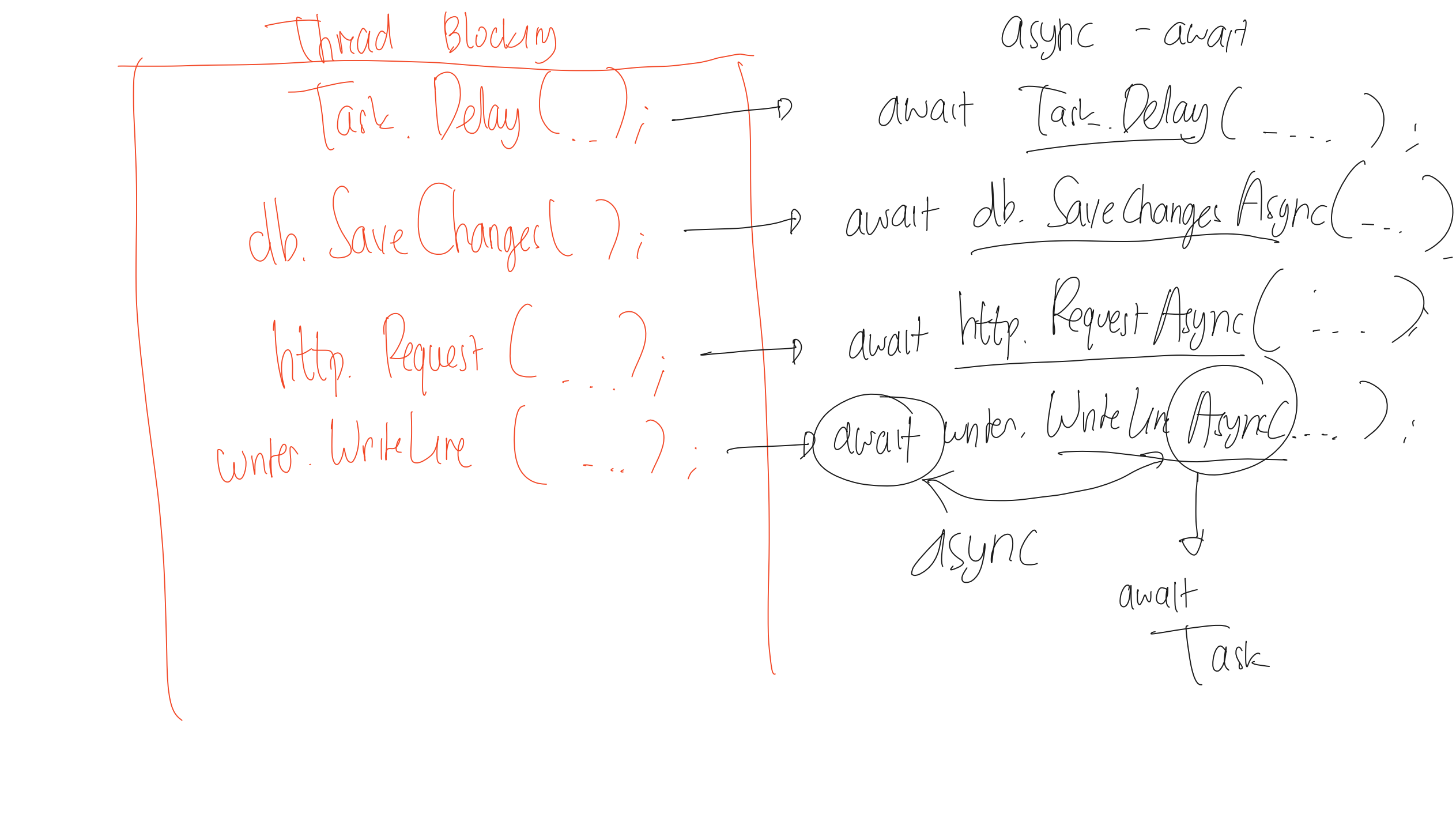
Thread → allocate new thread with its memory

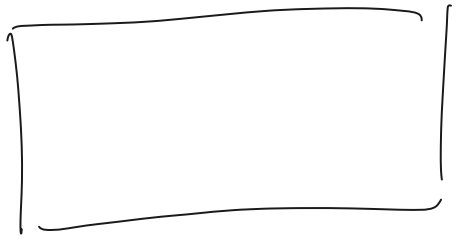
Long Running Task → new Thread


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

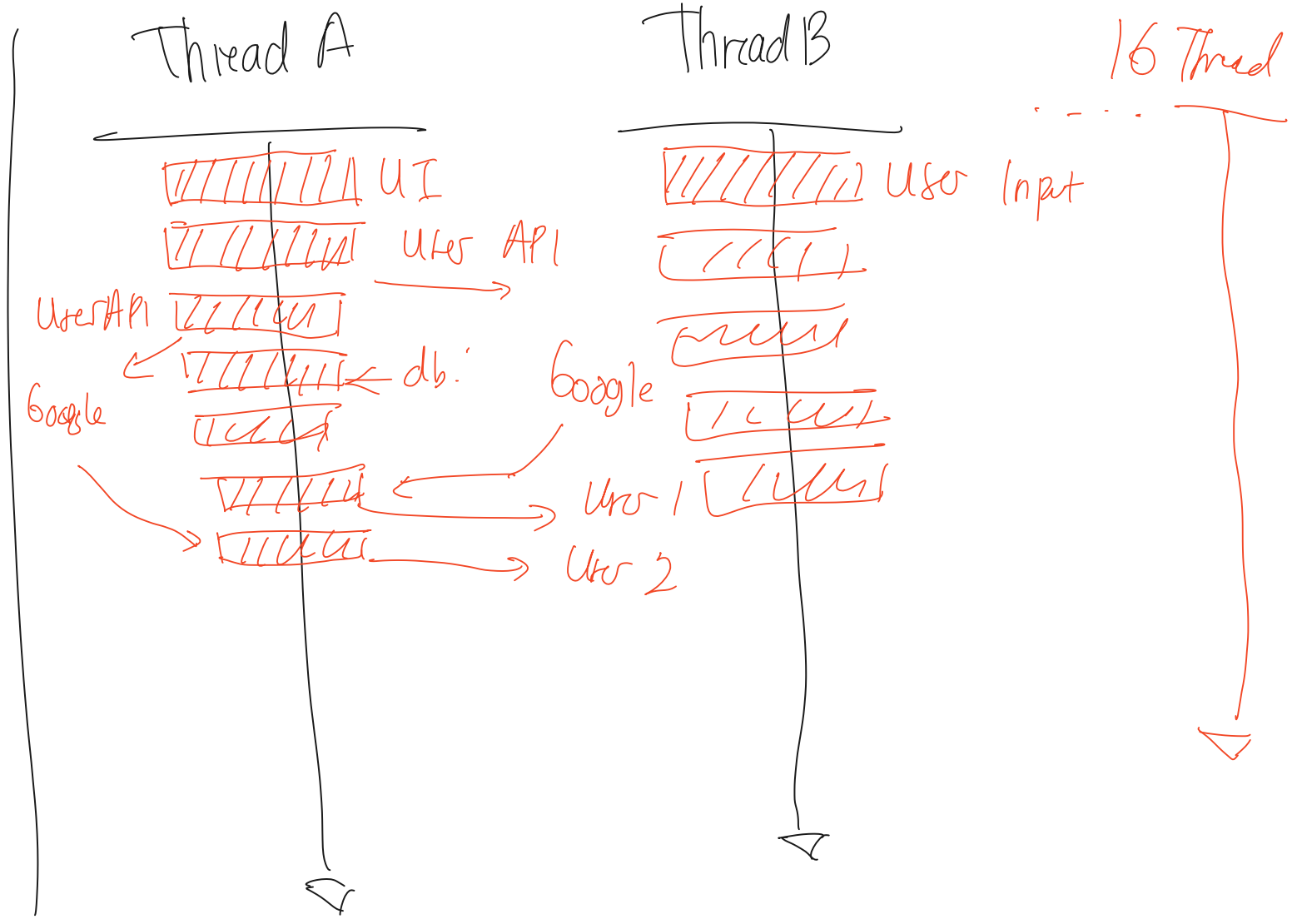

Thread Pool
Thread Pool
Single core
Single thread
16 core
16 thread
Thread
UI
User request
User Input
API
Google
20ms
User receive
Thread Blocking
async - await
Save Changes
Thread. Sleep( )
Task. Delay( )
Task. Wait( )

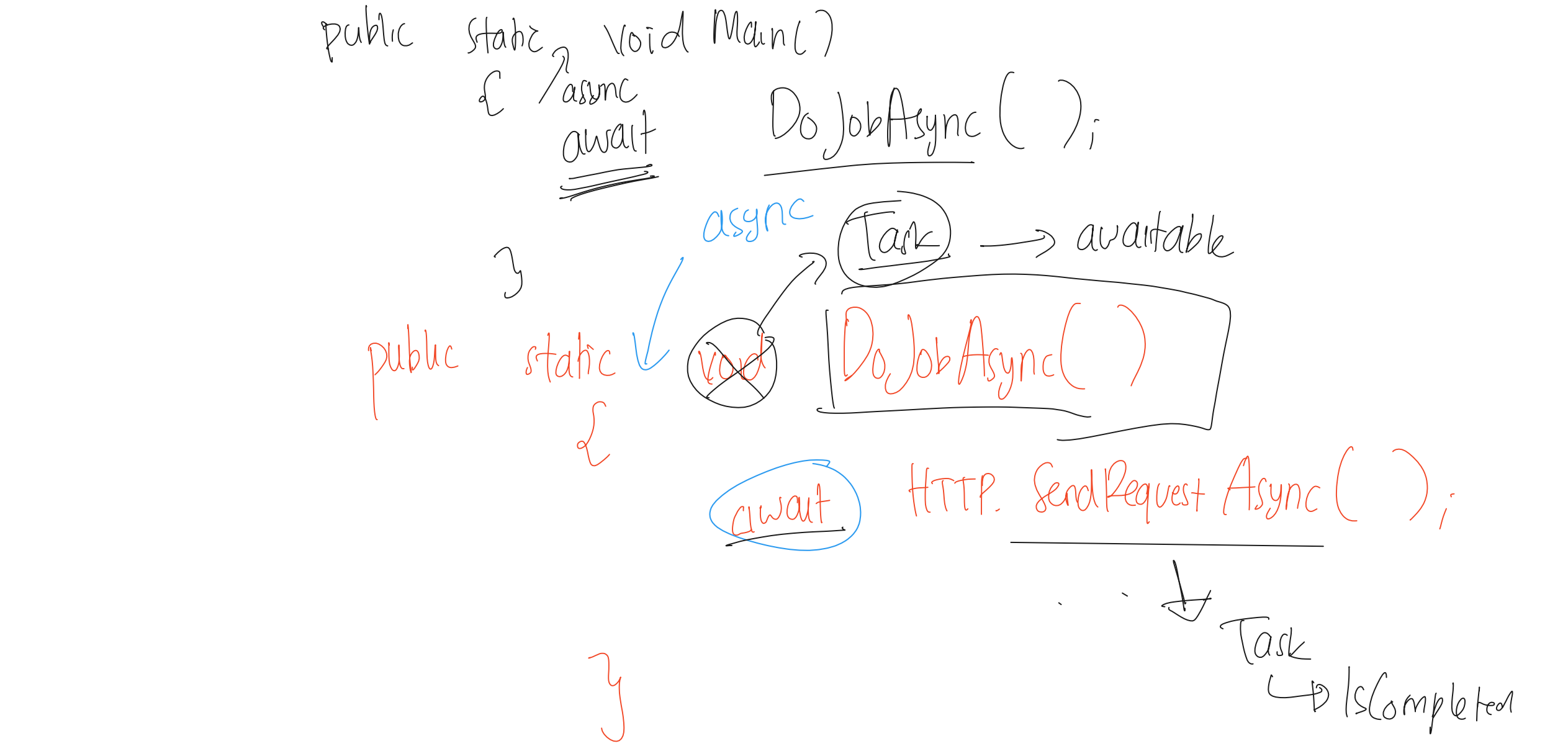

Thread Blocking
Task.Delay(...);
db.SaveChanges();
http.Request(...);
writer.WriteLine(...);
async - await
await Task.Delay(....);
await db.SaveChangesAsync(...);
await http.RequestAsync(...);
await writer.WriteLineAsync(...);
await
async
await
Task

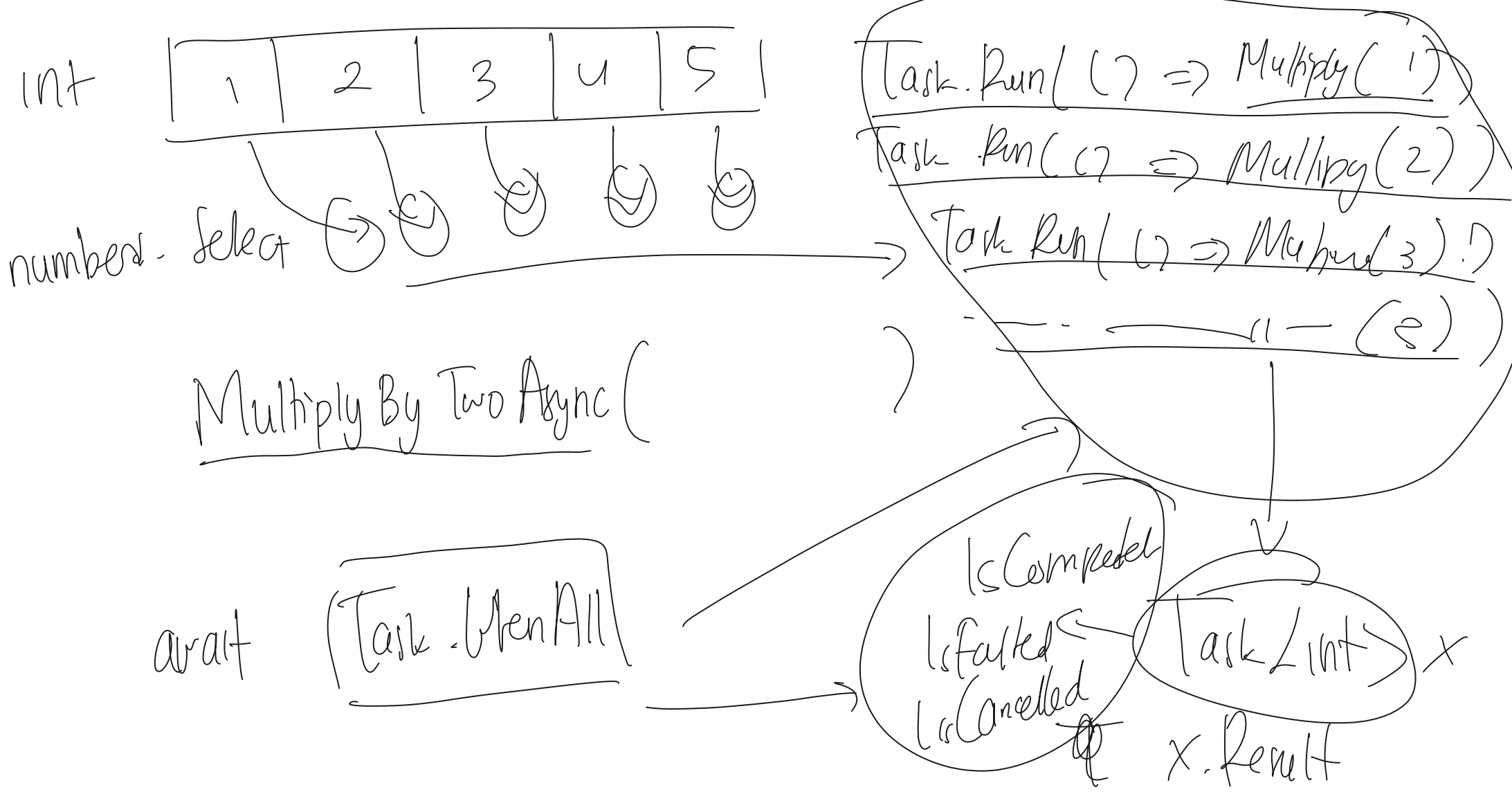


2 Core

2 threadPool



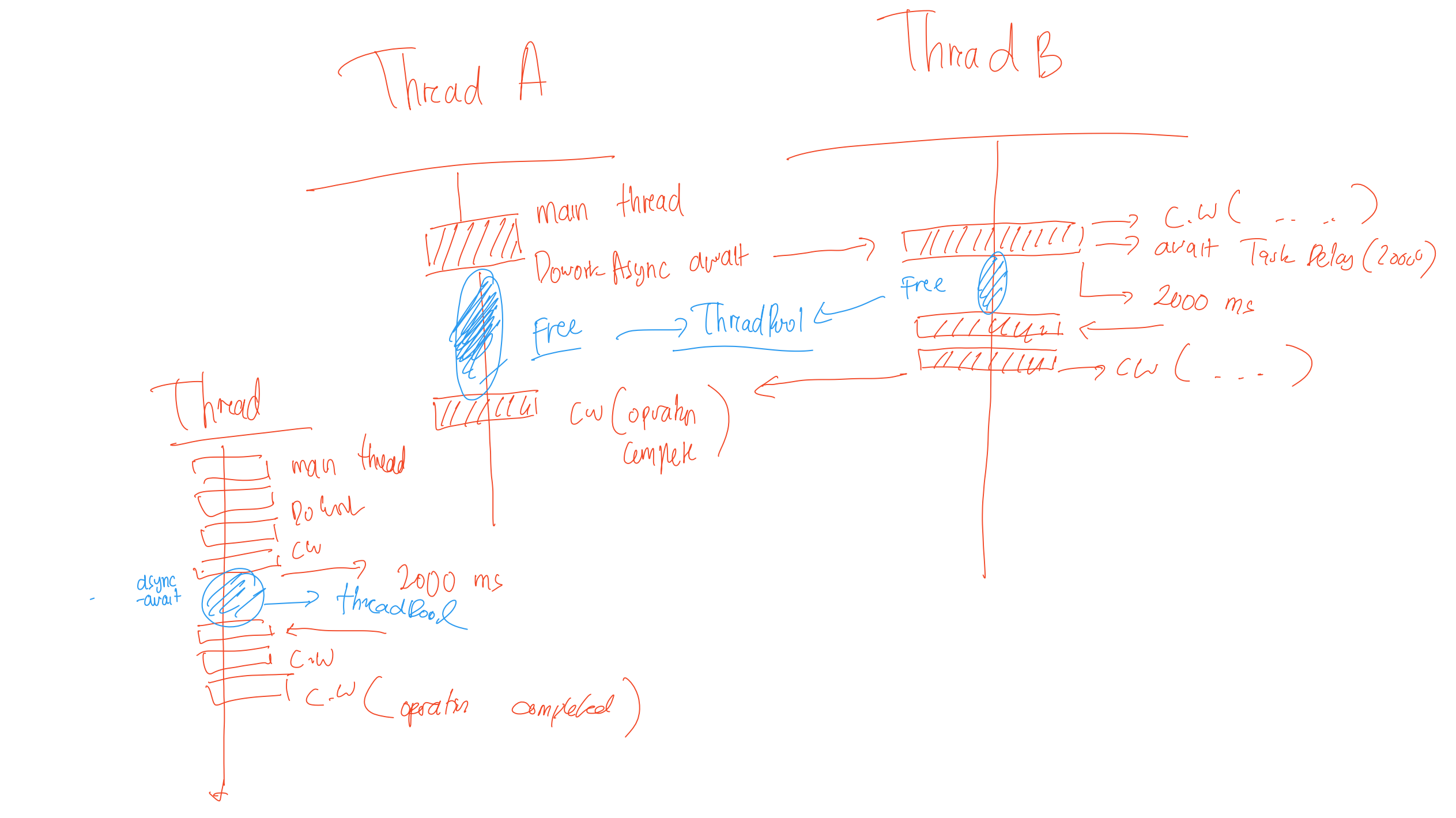

public static void Main()
{
async
await
DoJobAsync();
}
async
Task
awaitable
public static
void
DoJobAsync()
{
await
HTTP.SendRequestAsync();
Task
IsCompleted
}


int
1
2
3
4
5
numbers.Select
Task.Run(() => Multiply(1))
Task.Run(() => Multiply(2))
Task.Run(() => Multiply(3))
...
MultiplyByTwoAsync()
await
Task.WhenAll
IsCompleted
IsFaulted
IsCanceled
Task<int>
x
x.Result

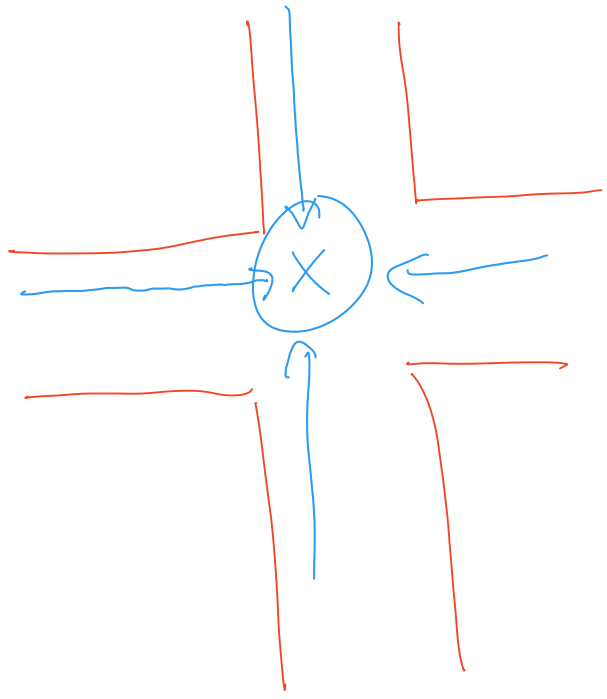
```
Task<int>[] tasks = new Task<int>[5];
for(int i=0; i<4; i++)
{
    tasks[i] = MultiplyByTwoAsync(i);
}
int[] result = await Task.WhenAll(tasks);
```

`MultiplyByTwoAsync(i)` → `Task<int>`

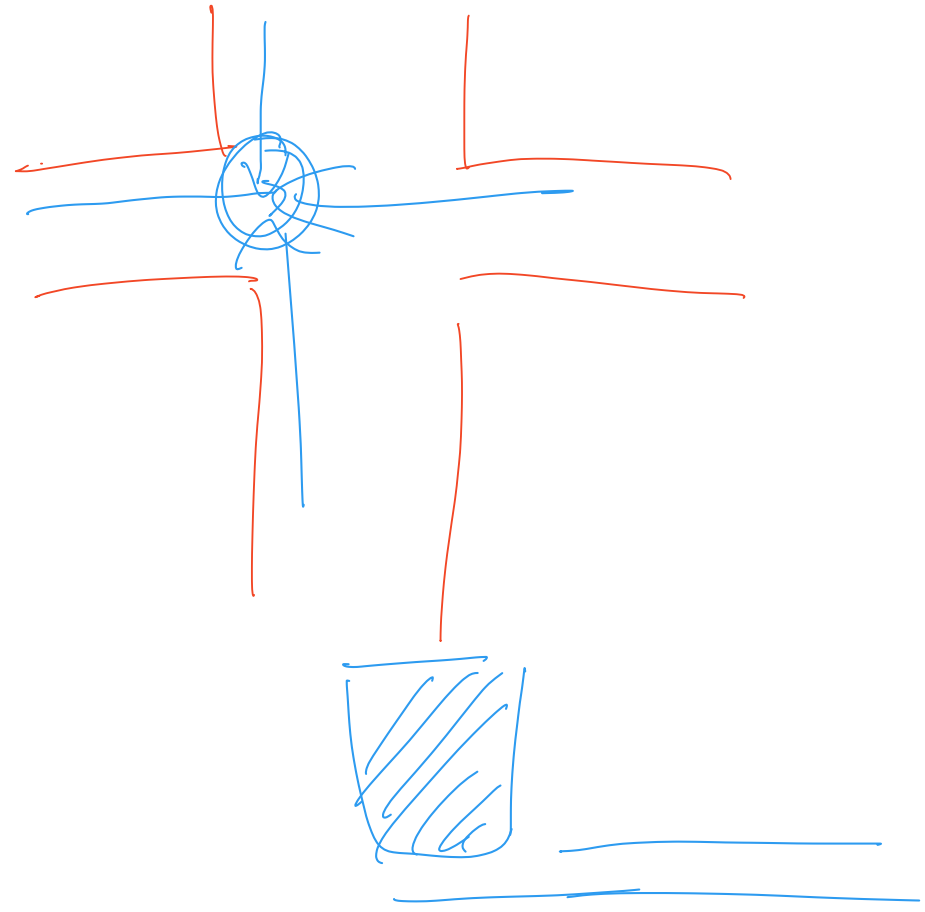
`int[]` ← `tasks.GetResult()`


Thread A
Thread B
main thread
DoWorkAsync await
Free
ThreadPool
cw(operation
complete
C.W(.. ..)
await Task.Delay(2000)
2000 ms
cw(...)
Thread
main thread
DoWork
cw
async
await
2000 ms
threadPool
c.w
c.w(operation completed)

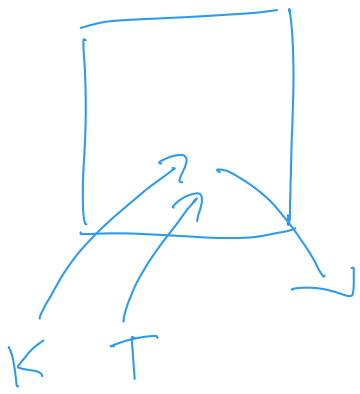
Deadlock



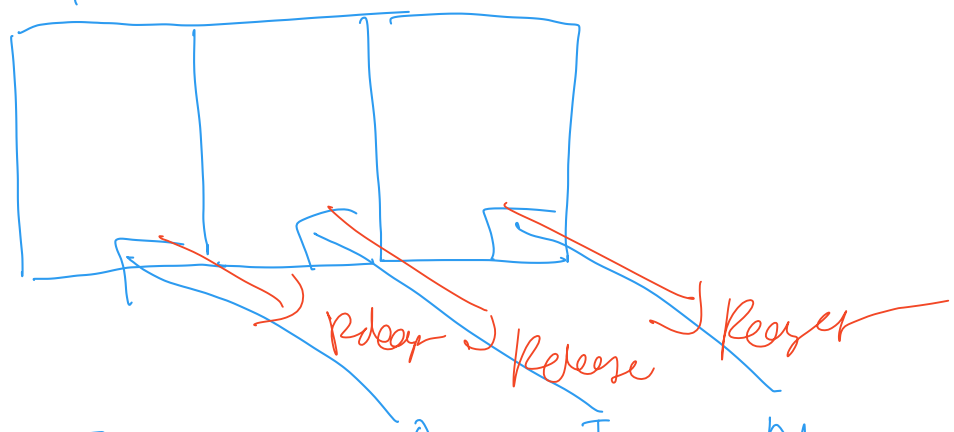
Race Condition



lock



Semaphore



K T O A I AL O2

WaitOne()

Program handle database