

JVM. Java Compilation.

Zadanie 2 • Odovzdanie
Checkpoint 29.marec 2026 23:59

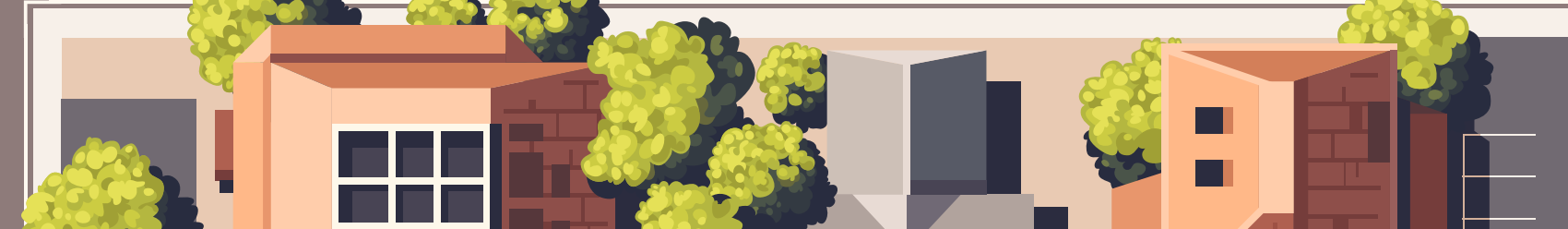
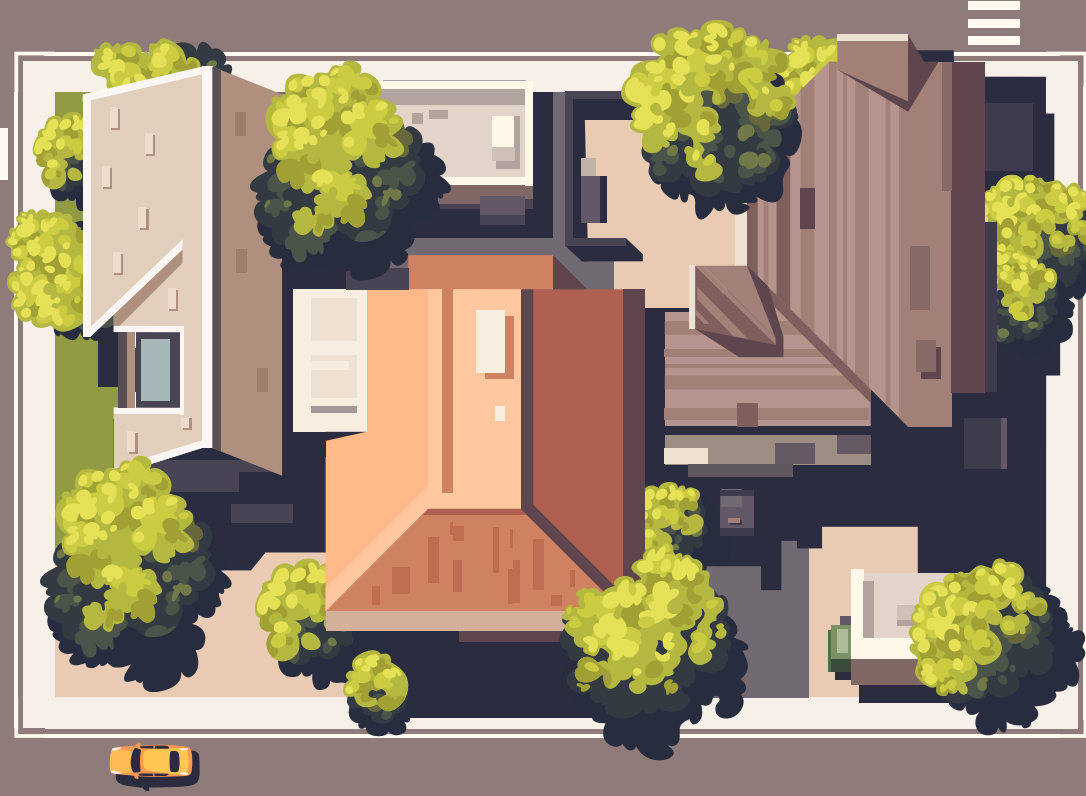
Semestrálny • Dátum: **9. marec**
Test

- Čas: **9:00 - 12:00**
- Miestnosť: **CPU**
- Test bude **v AIS**
- Trvanie: **1h**
- **Dva behy** - rozdelenie príde do mailu
- Rôzne typy otázok
- Obsah: 7. prednáška, 8. cvičenie

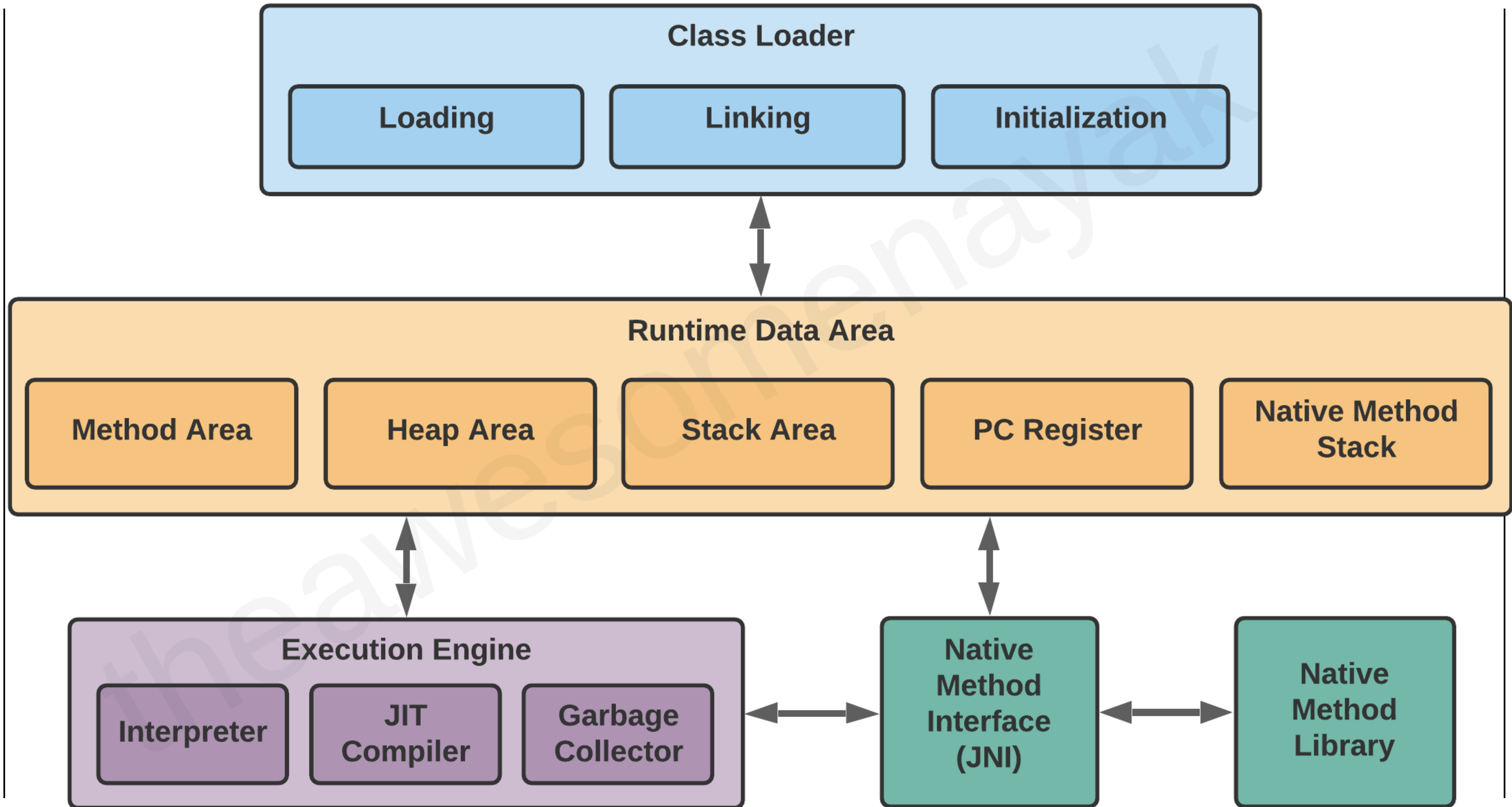
- 10 bodov (min. 4)

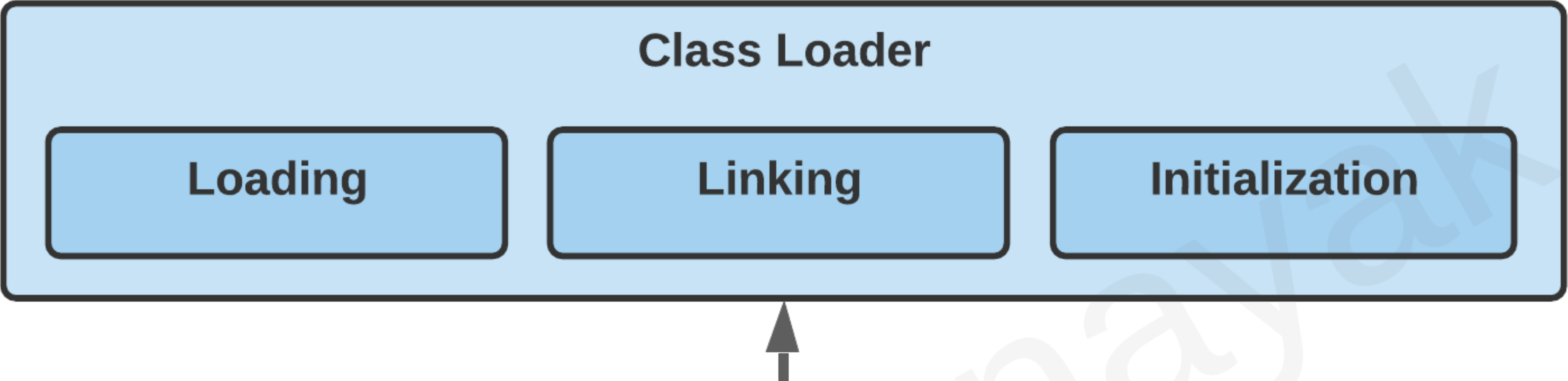
JVM - Java Virtual Machine



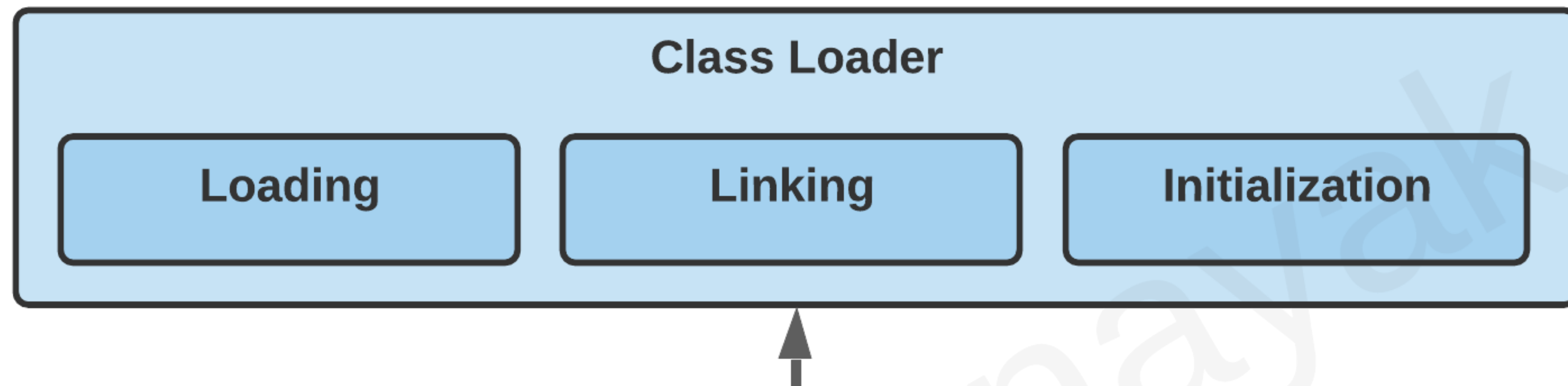




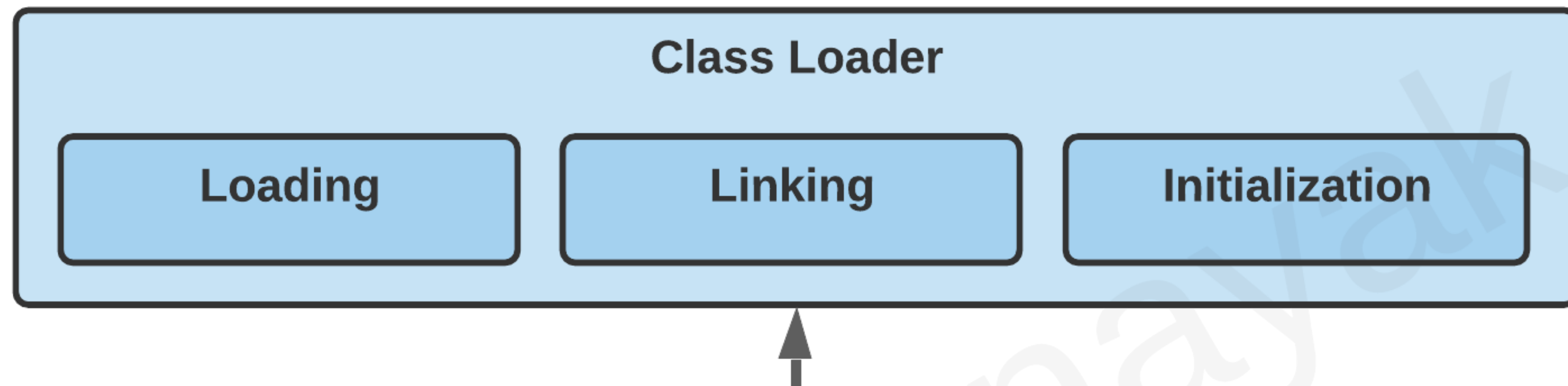




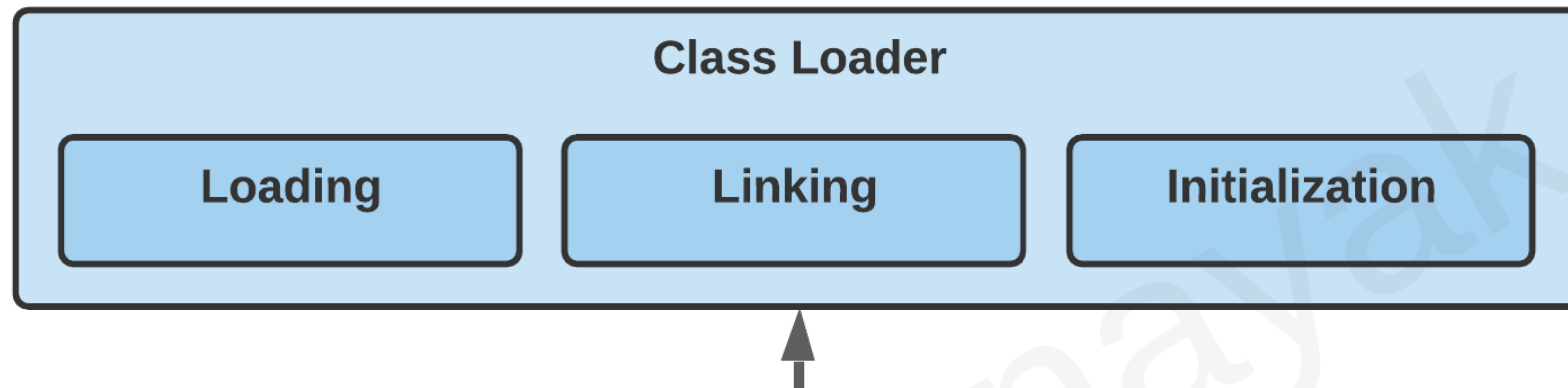
- Loading



- Loading
- Linking

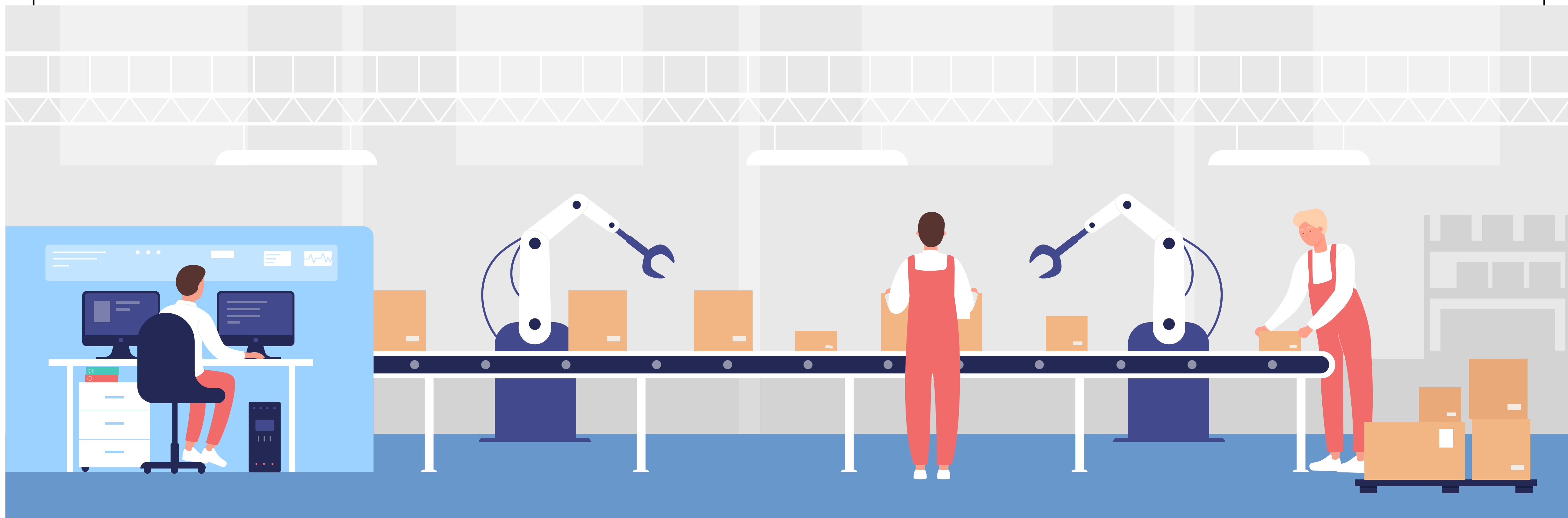


- Loading
- Linking
- Initialization



Loading

- Nemôžete stavať interier ak ešte nemáte auto.
Najskôr sa načítajú rodičovské triedy.



Class Loader

Loading

Bootstrap Class Loader

Extension Class Loader

Application Class Loader

Linking

Verify

Prepare

Resolve

Initialization

Initialize

Class Loader

Loading

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Class Loader

Loading

`java.lang.java.net.java.util.java.io`

Bootstrap Class Loader

Extension Class Loader

Application Class Loader

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Class Loader

Loading

java.lang, java.net, java.util, java.io

Bootstrap Class Loader

.../jre/lib/ext => Externé knižnice

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Application Class Loader

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java.lang, java.net, java.util, java.io

Bootstrap Class Loader

.../jre/lib/ext => Externé knižnice

Extension Class Loader

“Triedy v mojom Projekte”

Application Class Loader

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Class Loader

Loading

`ClassLoader.loadClass()`

Linking

Initialization

`java.lang,java.net,java.util,java.io`

Bootstrap Class Loader

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`.../jre/lib/ext => Externé knižnice`

Extension Class Loader

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`"Triedy v mojom Projekte"`

Application Class Loader

Resolve

Initialize

Class Loader

Loading

`ClassLoader.loadClass()`

Linking

Initialization

`java.lang, java.net, java.util, java.io`

Bootstrap Class Loader

Si tu?

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`java.lang, java.net, java.util, java.io`

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Si tu?

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Extension Class Loader

Si tu?

Prepare

`"Triedy v mojom Projekte"`

Application Class Loader

Si tu?

Resolve

Initialize

Class Loader

Loading

`ClassLoader.loadClass()`

Linking

Initialization

`java.lang,java.net,java.util,java.io`

Bootstrap Class Loader

Si tu?

Verify

`.../jre/lib/ext => Externé knižnice`

Extension Class Loader

Si tu?

Prepare

`"Triedy v mojom Projekte"`

Application Class Loader

Si tu?

Resolve

Initialize

`NoClassDefFoundError;`
`ClassNotFoundException`

Class Loader

Loading

Bootstrap Class Loader

Extension Class Loader

Application Class Loader

Linking

Verify

Prepare

Resolve

Initialization

Initialize

Class Loader

Loading

Bootstrap Class Loader

Extension Class Loader

Application Class Loader

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Initialization

Initialize

Class Loader

Loading

Bootstrap Class Loader

Extension Class Loader

Application Class Loader

Linking

Verify

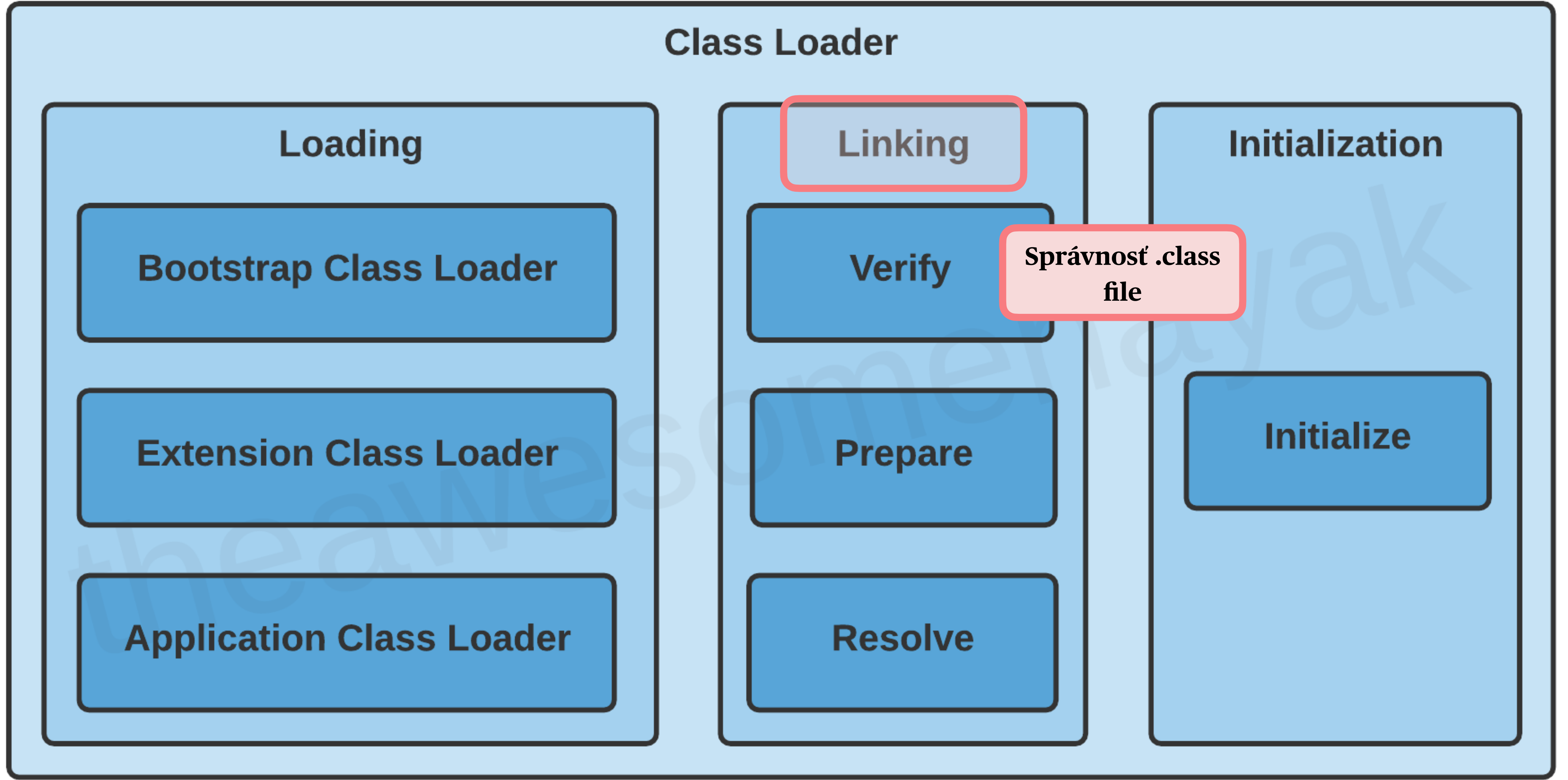
Prepare

Resolve

Správnosť .class
file

Initialization

Initialize



Class Loader

Loading

Bootstrap Class Loader

Extension Class Loader

Application Class Loader

Linking

Verify

Správnosť .class file

Prepare

Alokácia pamäte

Resolve

Initialization

Initialize

Class Loader

Loading

Bootstrap Class Loader

Extension Class Loader

Application Class Loader

Linking

Verify

Správnosť .class file

Prepare

Alokácia pamäte

Resolve

Initialization

Stické časti triedy a interface. Inicializuje defaultnými hodnotami. 0 alebo null alebo false

Class Loader

Loading

Bootstrap Class Loader

Extension Class Loader

Application Class Loader

Linking

Verify

Správnosť .class file

Prepare

Alokácia pamäte

Statické časti triedy a interface. Inicializuje defaultnými hodnotami. 0 alebo null alebo false

Resolve

Symbolické referencie nahradené reálnymi

Initialization

- Aká bude hodnota premennej *enabled* počas Preparation fázy?

```
private static final boolean enabled = true;
```

- Aká bude hodnota premennej *enabled* počas Preparation fázy?

```
private static final boolean enabled = false
```

Class Loader

Loading

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Extension Class Loader

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Linking

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Resolve

Initialization

Initialize

Class Loader

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Bootstrap Class Loader

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Prepare

Resolve

Initialization

Initialize

Class Loader

Loading

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Verify

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Initialization

Inicializácia metód,
tried alebo interface

Initialize

Class Loader

Loading

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Extension Class Loader

Application Class Loader

Linking

Verify

Prepare

Resolve

Initialization

Inicializácia metód,
tried alebo interface

Initialize

Zavolá sa <clinit>

Class Loader

Loading

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Application Class Loader

Linking

Verify

Prepare

Resolve

Initialization

Inicializácia metód,
tried alebo interface

Initialize

Zavolá sa <clinit>

Volanie konštruktora,
statického bloku,
pridelenie hodnoty
statickým premenným

- Premenná *enabled* sa v kroku Initialization nastaví na svoju reálnu hodnotu *true*.

```
private static final boolean enabled = true;
```

Runtime Data Area

Method Area

Heap Area

Stack Area

Thread #1

Thread #2

Thread #N

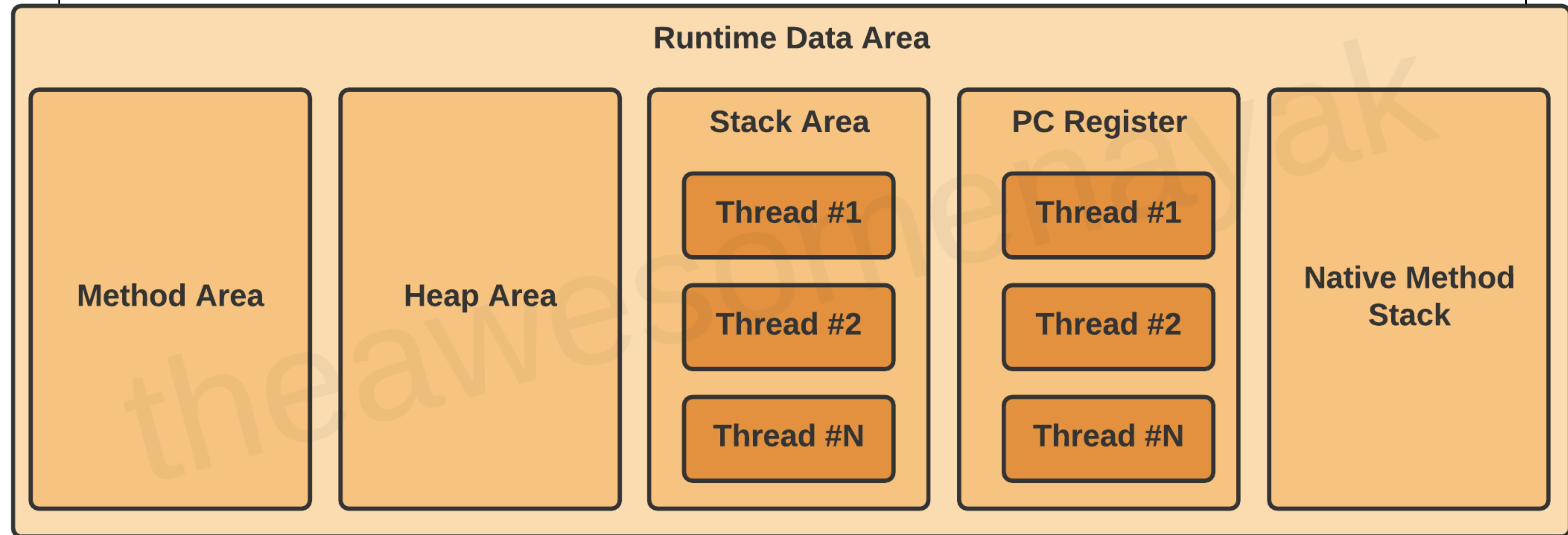
PC Register

Thread #1

Thread #2

Thread #N

Native Method Stack



Runtime Data Area

Atribúty, metódy,
konštruktory - tu sa
nachádza ich kód

Method Area

Heap Area

Stack Area

Thread #1

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PC Register

Thread #1

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Thread #N

Native Method
Stack

Runtime Data Area

Atribúty, metódy,
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Method Area

Objekty a ich
inštanície

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PC Register

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Native Method
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inštalácie

Heap Area

Stack Area

Thread #1

Thread #2

Thread #N

PC Register

Thread #1

Thread #2

Thread #N

Native Method
Stack

Zdielaná pamäť. Not
thread safe!

Runtime Data Area

Method Area

Heap Area

Stack Area

Thread #1

Thread #2

Thread #N

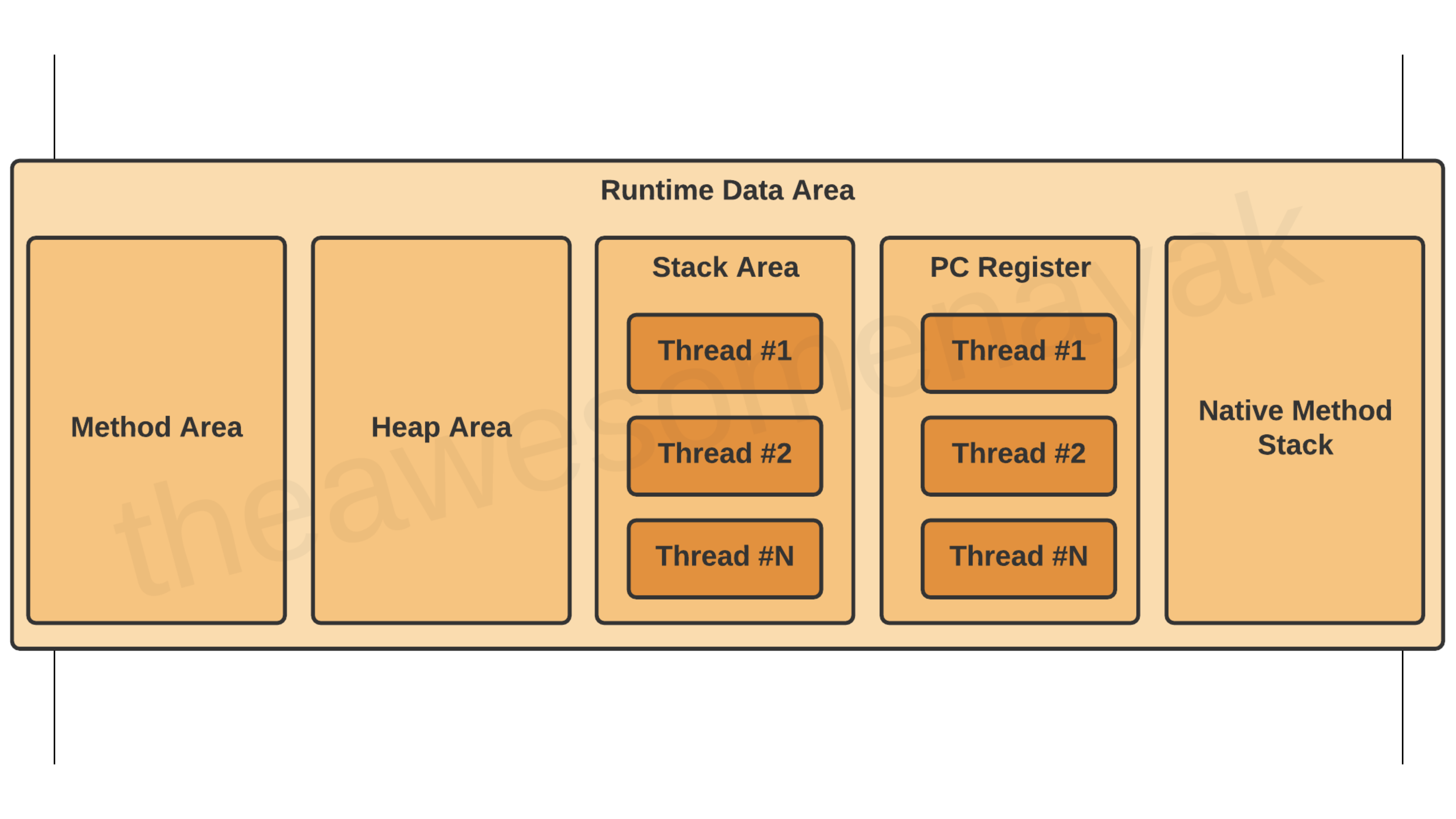
PC Register

Thread #1

Thread #2

Thread #N

Native Method Stack



Runtime Data Area

Method Area

Heap Area

Stack Area

Thread #1

Thread #2

Thread #N

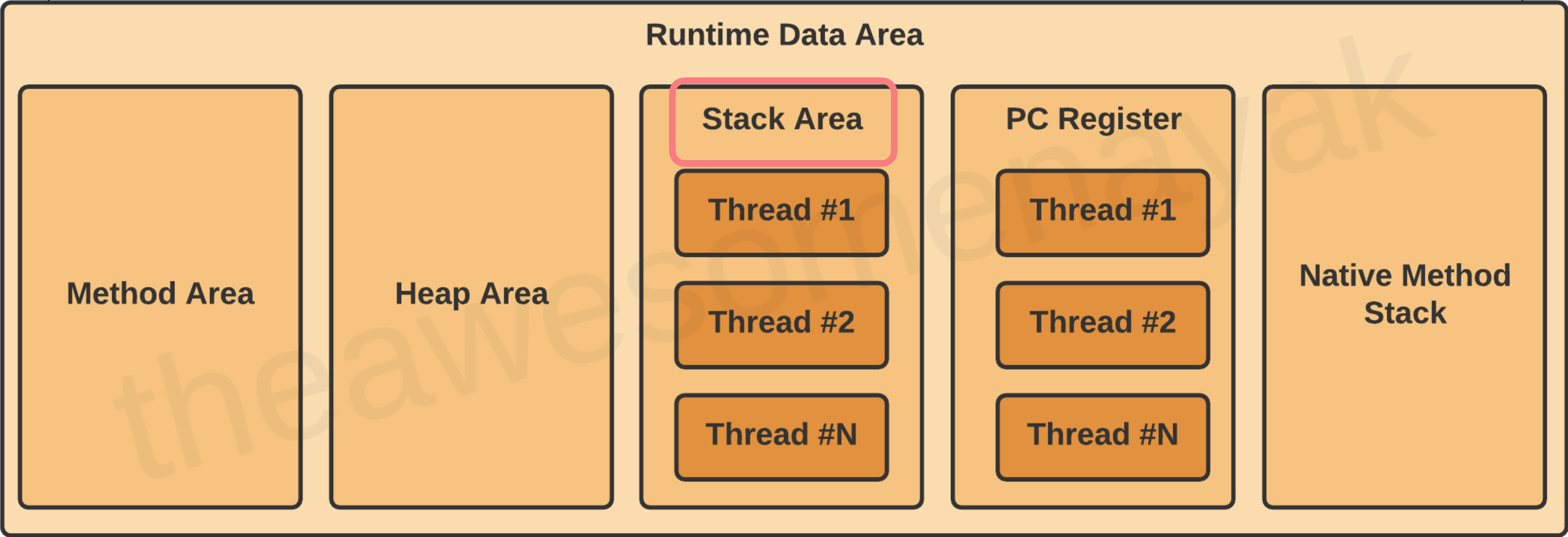
PC Register

Thread #1

Thread #2

Thread #N

Native Method Stack



Runtime Data Area

Method Area

Heap Area

Stack Area

PC Register

Native Method Stack

Thread #1

Thread #2

Thread #N

Pre každé volanie metódy sa
vytvorí StackFrame

Thread #2

Thread #N

Runtime Data Area

Method Area

Heap Area

Stack Area

PC Register

Lokálne premenné

Thread #1

Pre každé volanie metódy sa vytvorí StackFrame

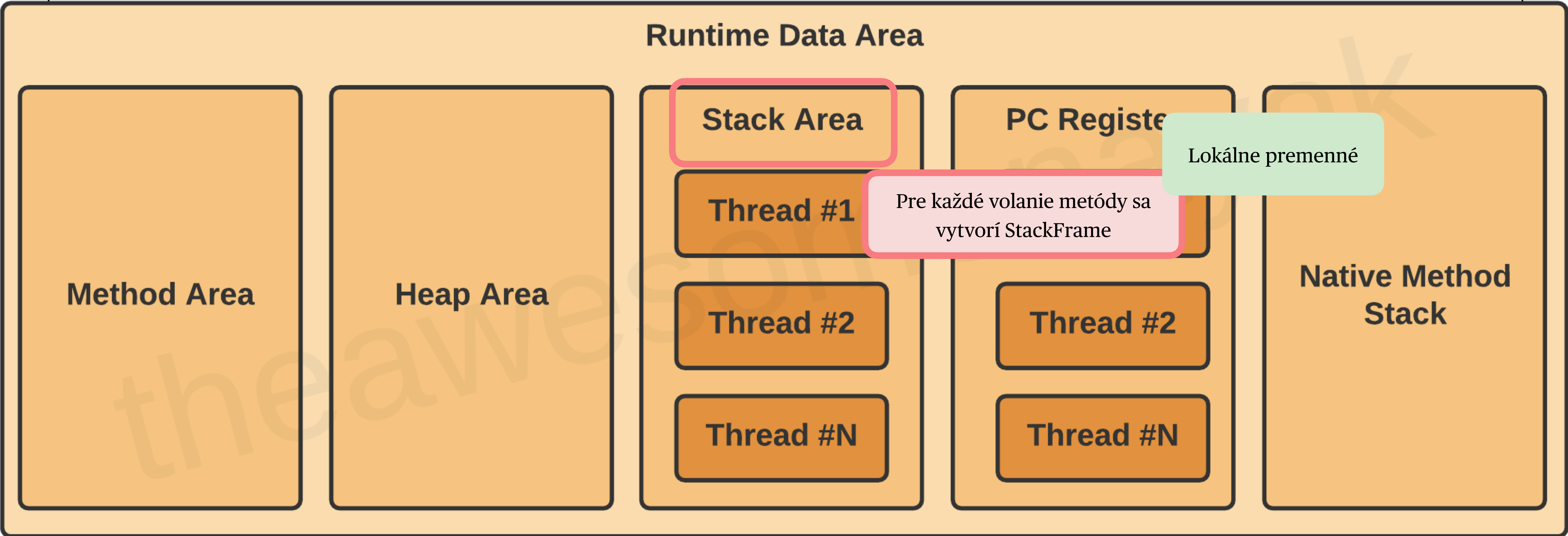
Thread #2

Thread #2

Thread #N

Thread #N

Native Method Stack



Runtime Data Area

Method Area

Heap Area

Stack Area

PC Register

Thread #1

Thread #2

Thread #N

Pre každé volanie metódy sa
vytvorí StackFrame

Lokálne premenné

Operand Stack

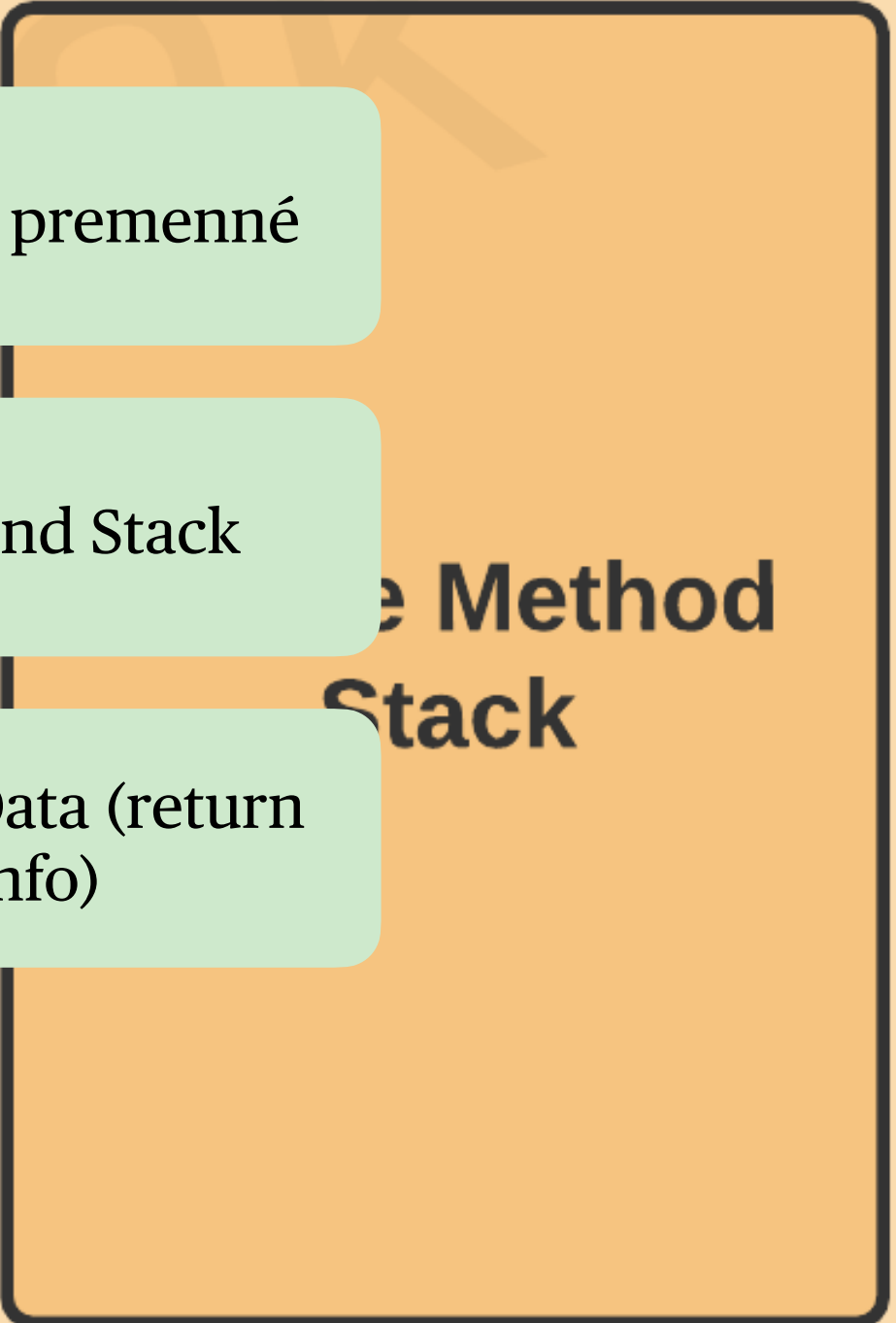
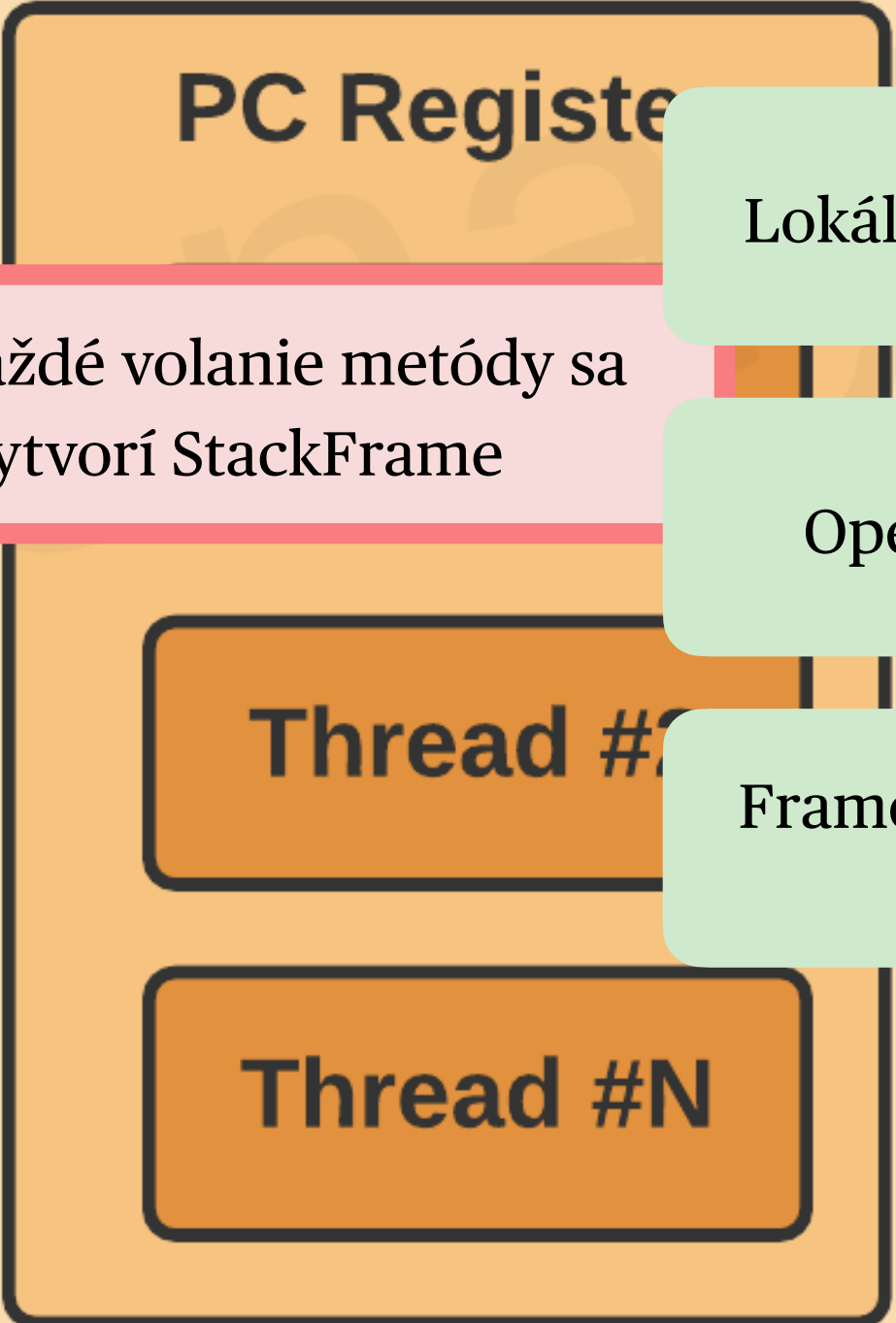
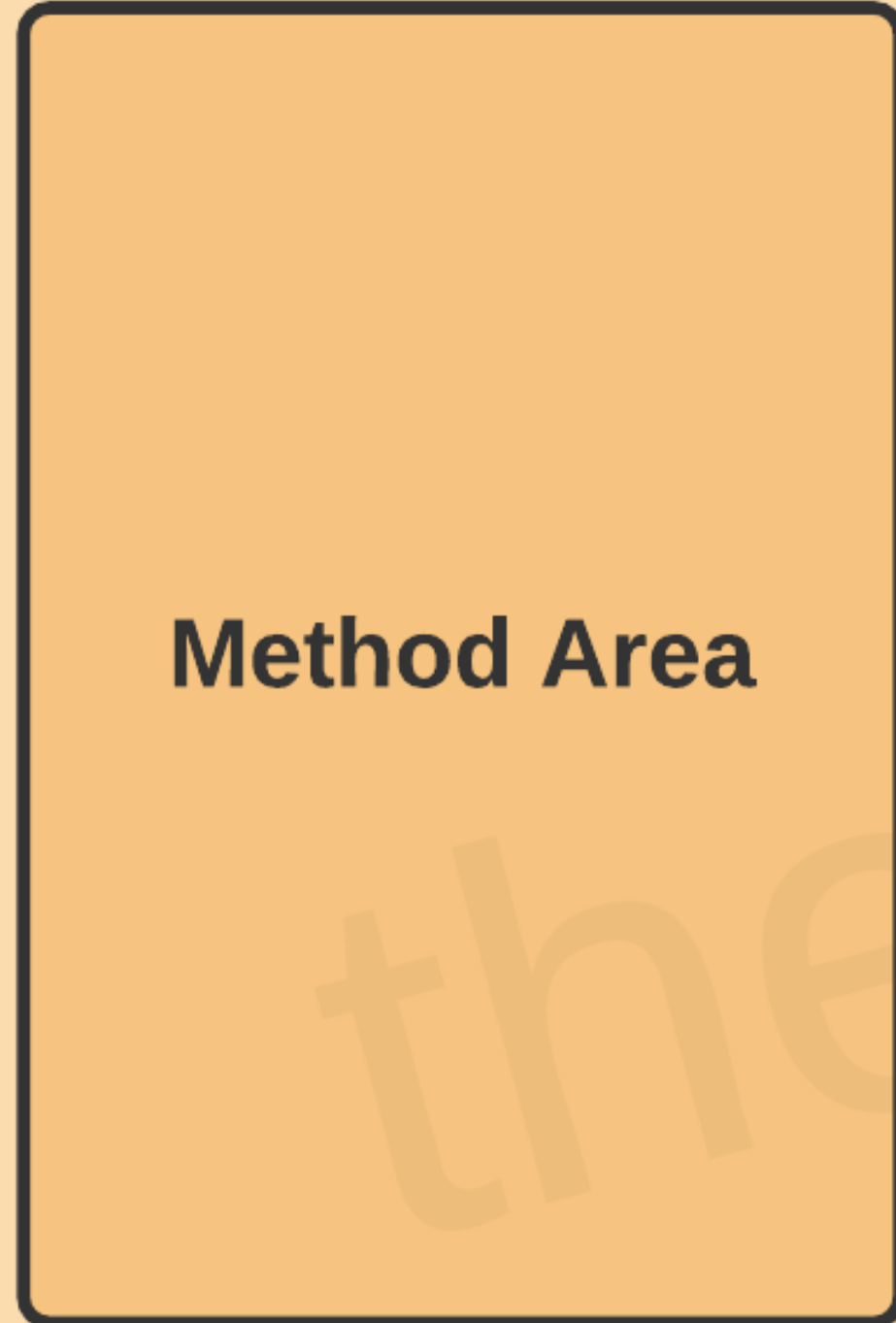
Thread #2

Thread #N

Method Stack

theaware

Runtime Data Area



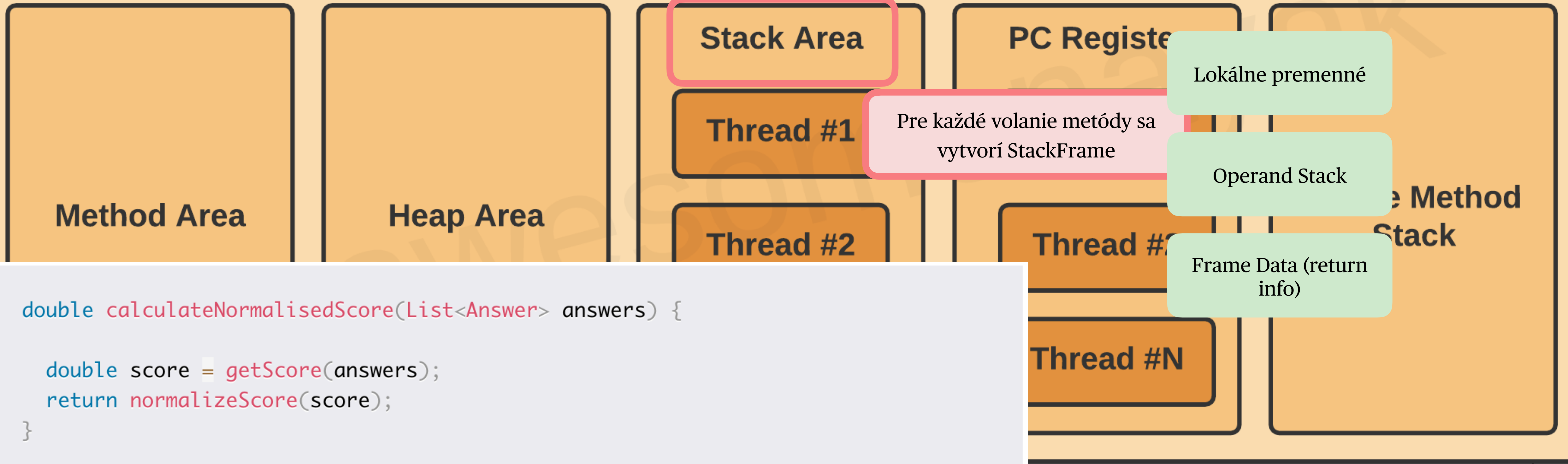
Pre každé volanie metódy sa vytvorí StackFrame

Lokálne premenné

Operand Stack

Frame Data (return info)

Runtime Data Area



```
double calculateNormalisedScore(List<Answer> answers) {  
    double score = getScore(answers);  
    return normalizeScore(score);  
}
```

```
double normalizeScore(double score) {  
    return (score - minScore) / (maxScore - minScore);  
}
```

Runtime Data Area

Method Area

Heap Area

Stack Area

PC Register

Thread #1

Thread #2

Thread #?

Thread #N

Lokálne premenné

Pre každé volanie metódy sa vytvorí StackFrame

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Runtime Data Area

Method Area

Heap Area

Stack Area

PC Register

Thread #1

Thread #2

Thread #3

Thread #N

Lokálne premenné

Pre každé volanie metódy sa vytvorí StackFrame

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double normalizeScore(double score) {  
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}
```

calculateNormalisedScore();

Runtime Data Area

Method Area

Heap Area

Stack Area

PC Register

Thread #1

Thread #2

Thread #3

Thread #N

Lokálne premenné

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Thread #3

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Lokálne premenné

Pre každé volanie metódy sa vytvorí StackFrame

Operand Stack

Frame Data (return info)

Method Stack

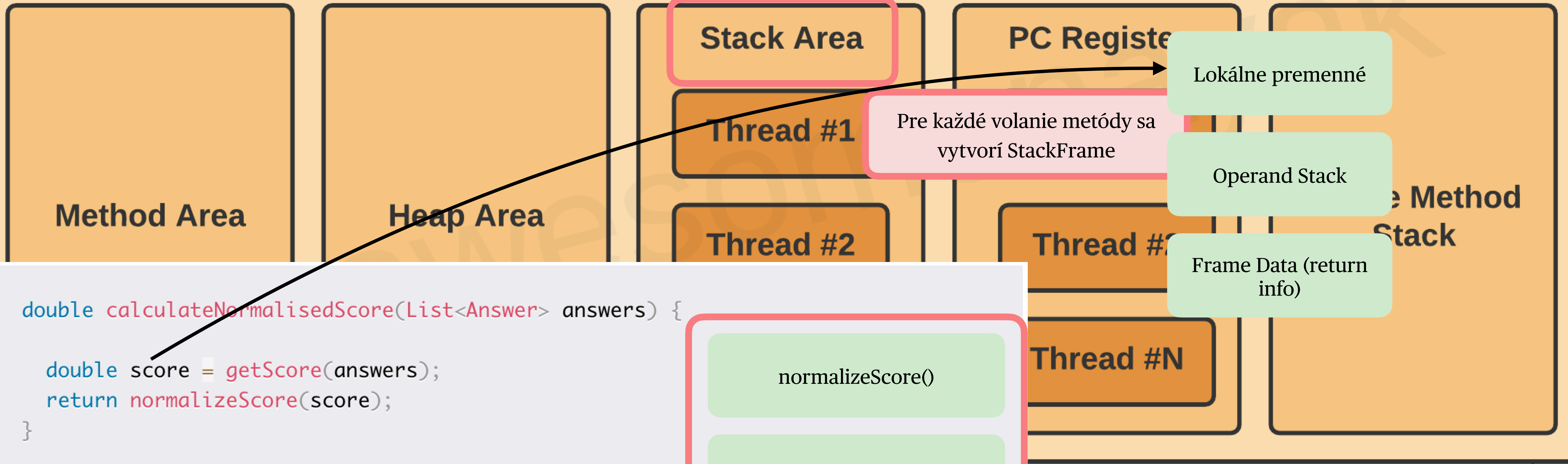
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normalizeScore()

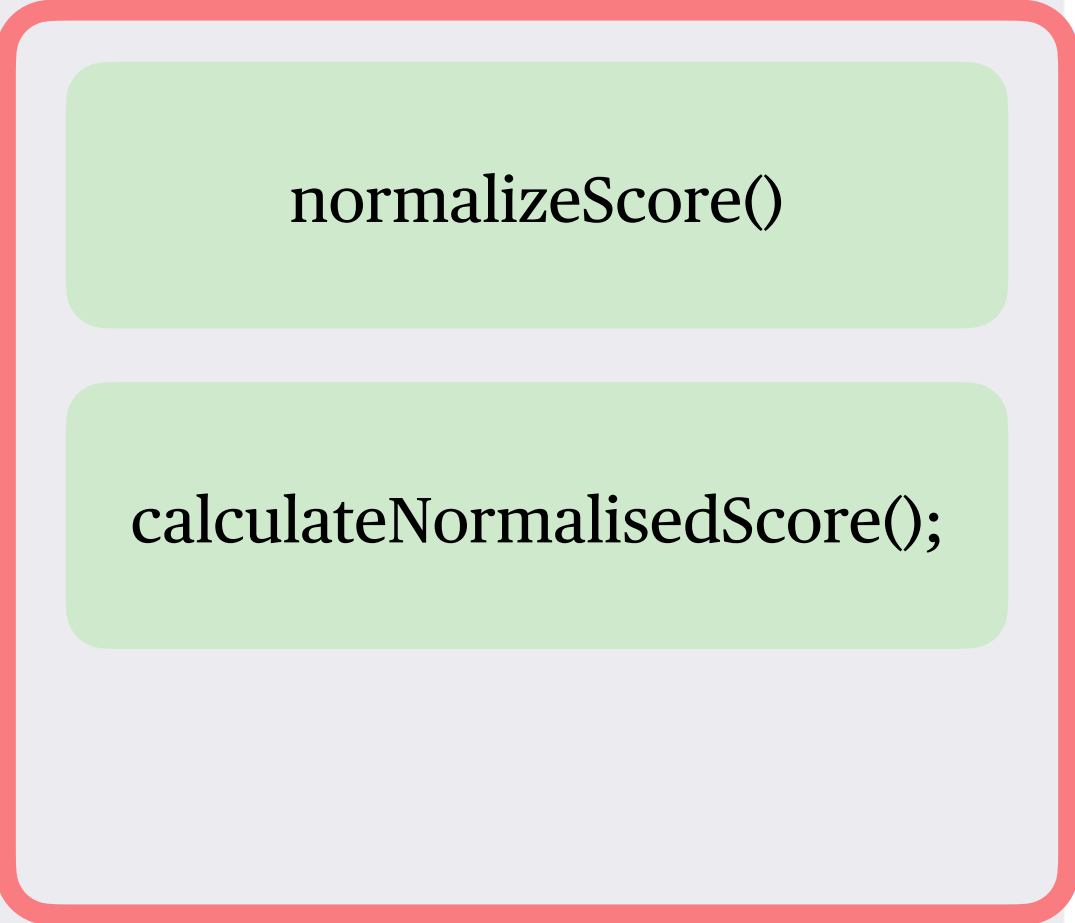
calculateNormalisedScore();

Runtime Data Area

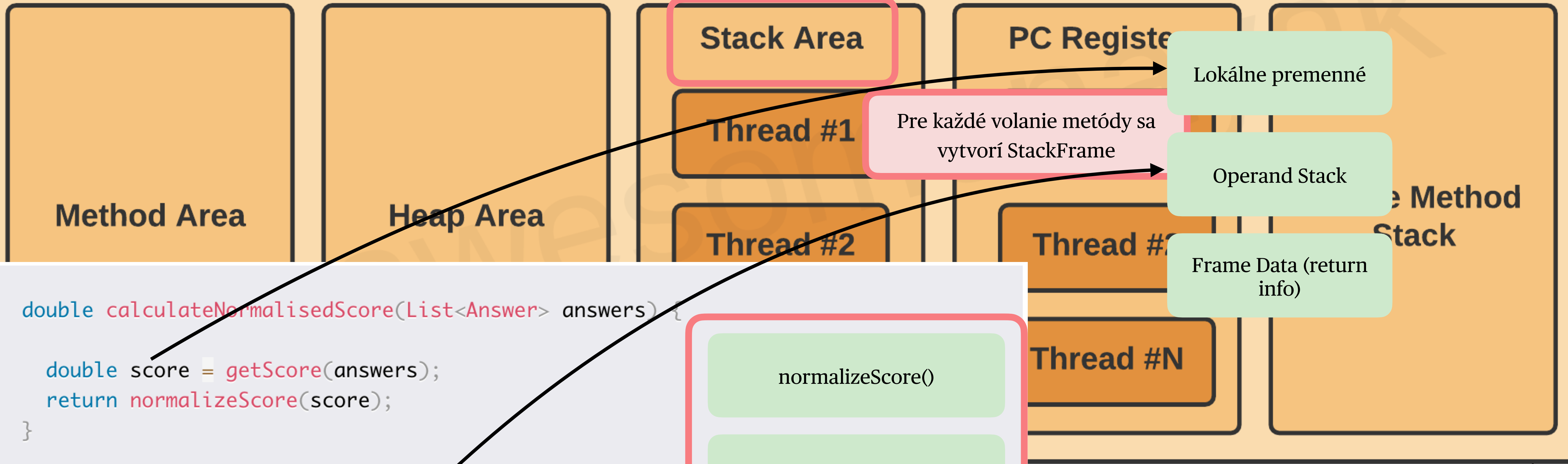


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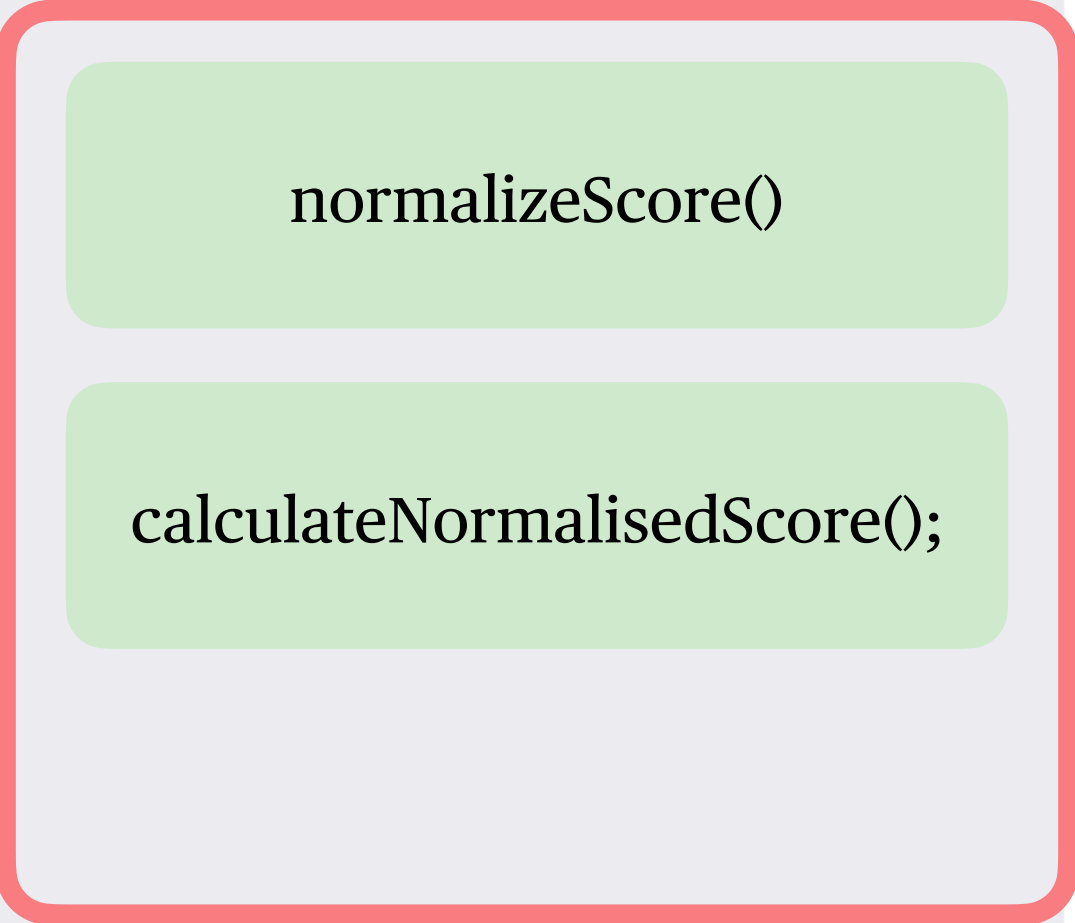
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Runtime Data Area



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Runtime Data Area

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Heap Area

Stack Area

Thread #1

Thread #2

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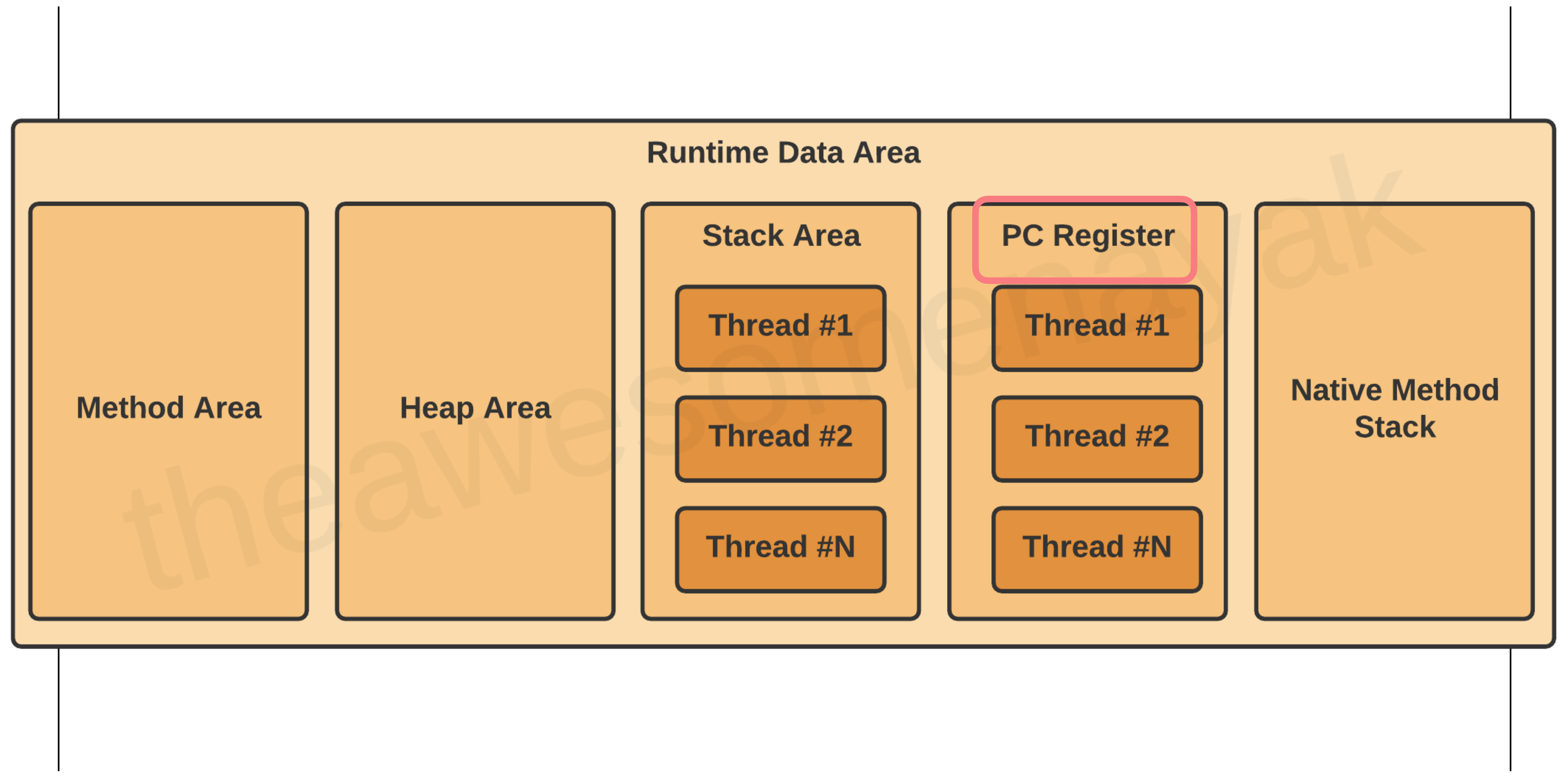
PC Register

Thread #1

Thread #2

Thread #N

Native Method Stack



Execution Engine

Interpreter

**JIT
Compiler**

**Garbage
Collector**

Bytecode

Execution Engine

Interpreter

**JIT
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Bytecode

Execution Engine

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**JIT
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Execution Engine

**Machine language
instructions**

Interpreter

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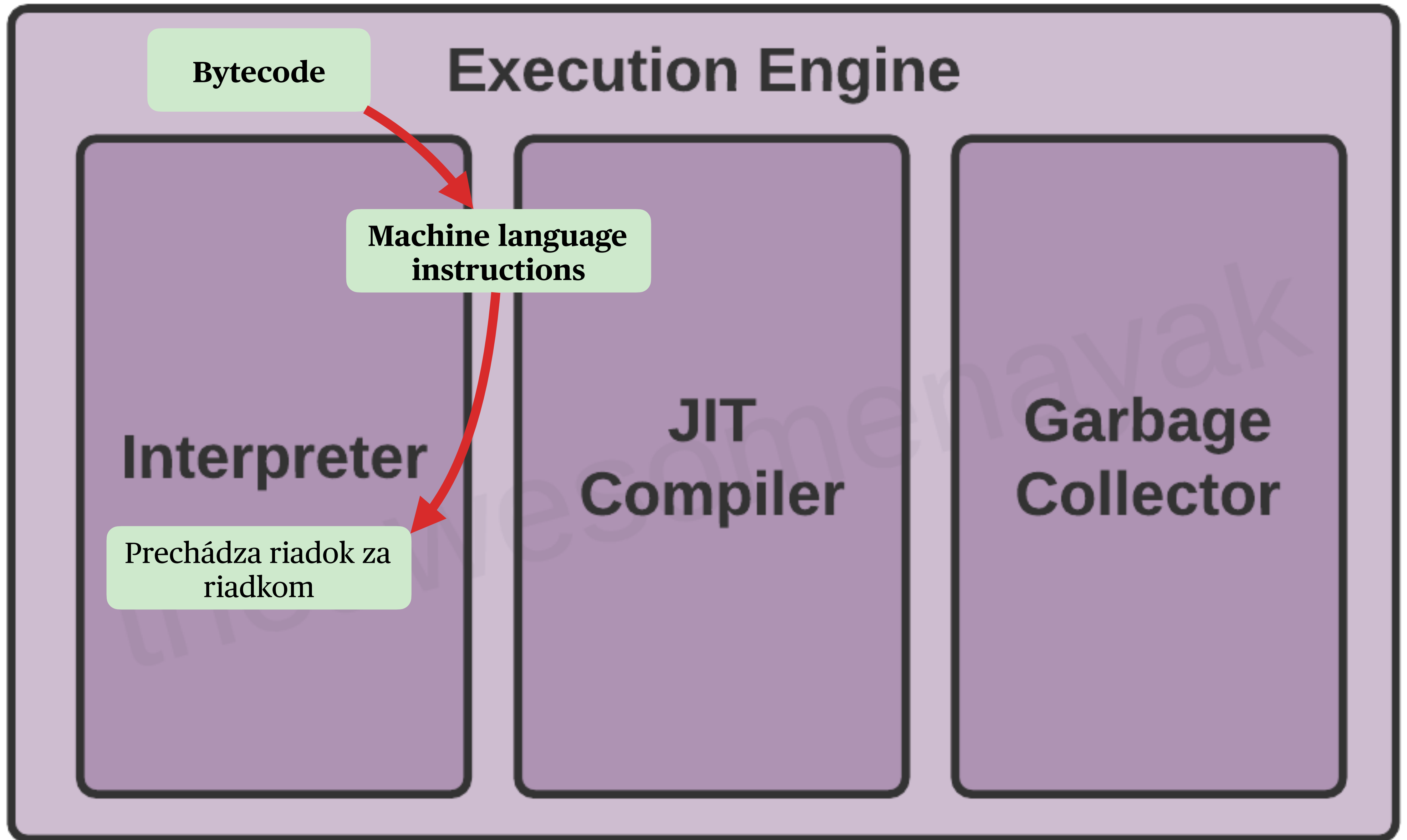
Machine language
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Prechádza riadok za
riadkom



Execution Engine

Bytecode

Machine language instructions

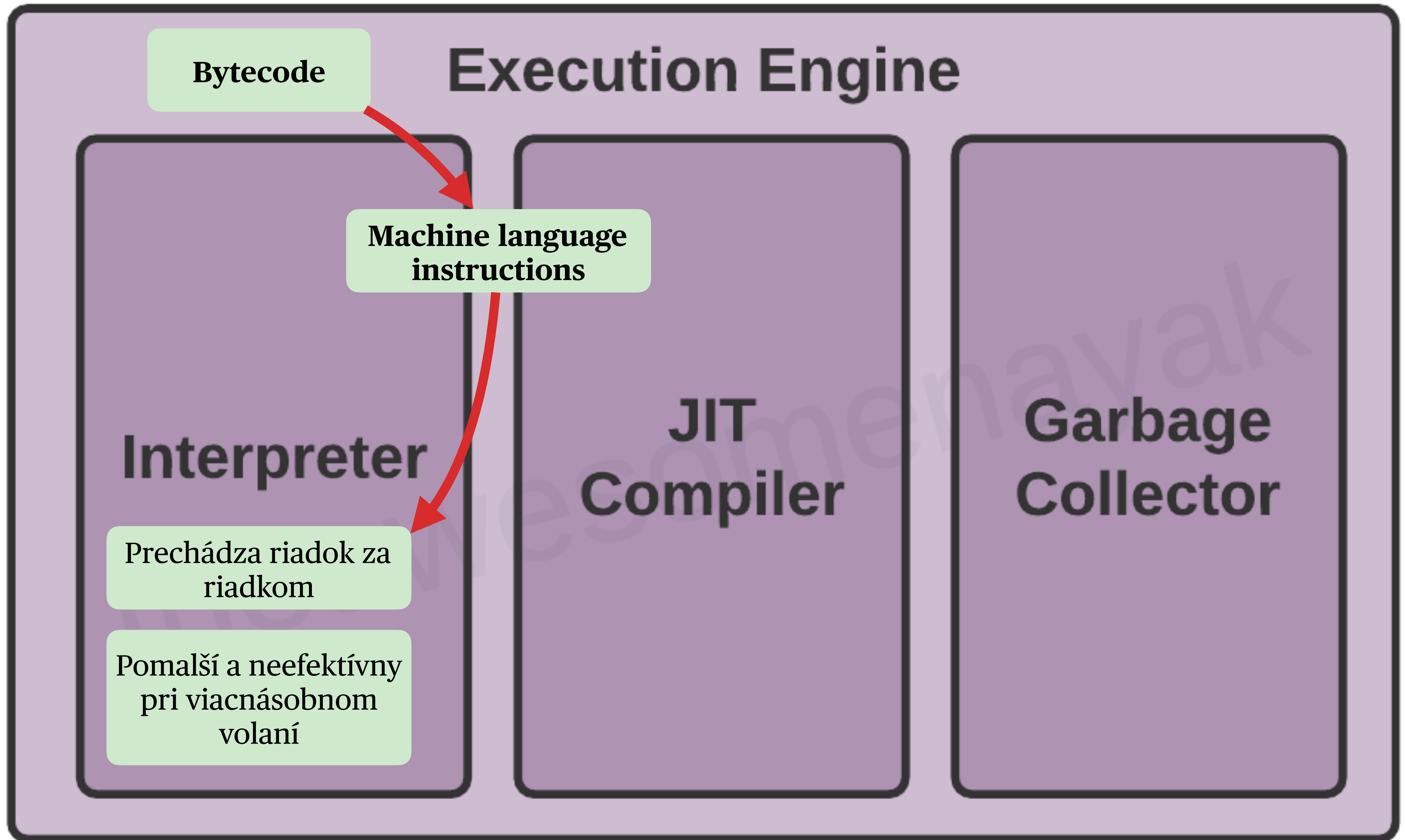
Interpreter

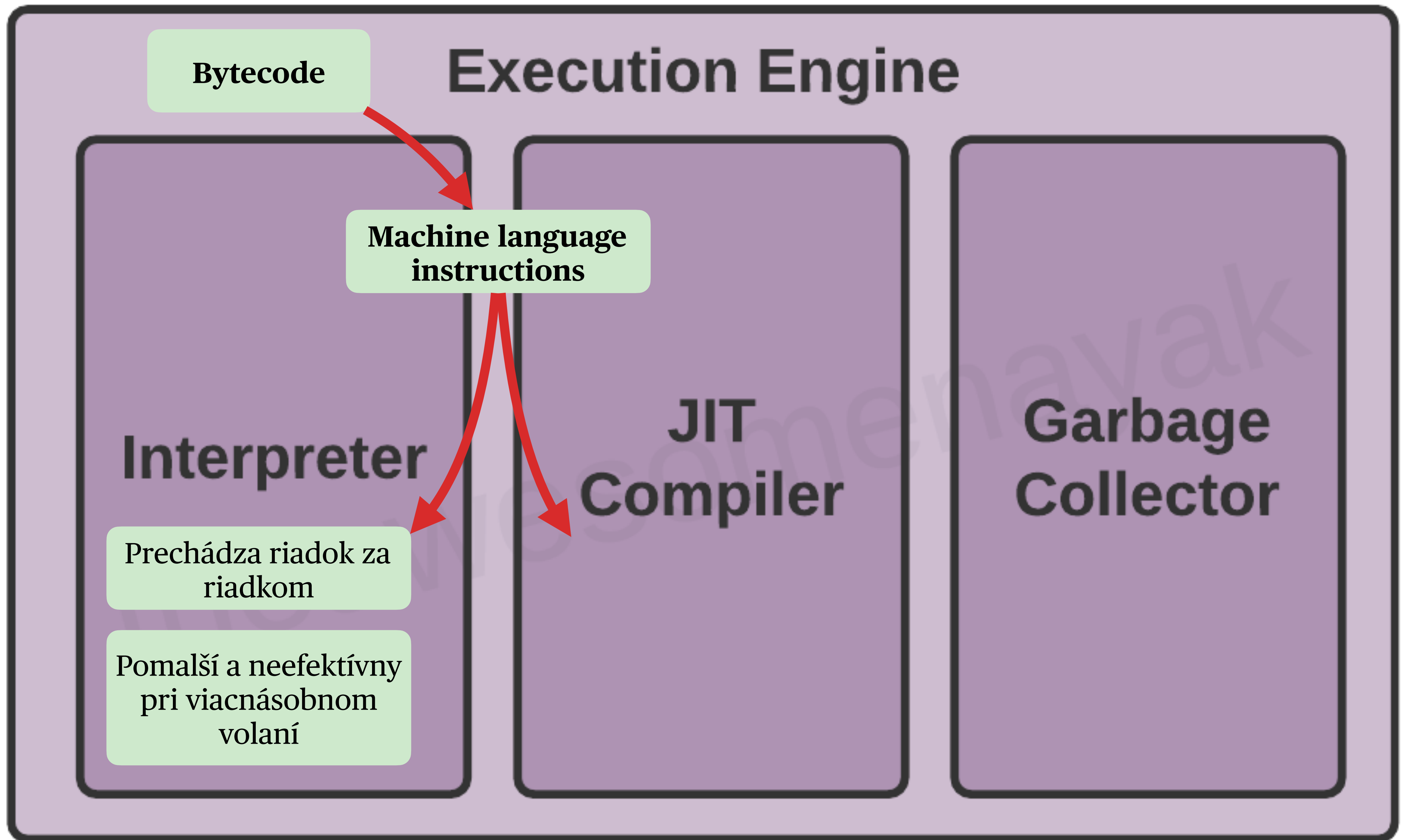
Prechádza riadok za riadkom

Pomalší a neefektívny pri viacnásobnom volaní

JIT Compiler

Garbage Collector





Execution Engine

Bytecode

Machine language instructions

Interpreter

Prechádza riadok za riadkom

Pomalší a neefektívny pri viacnásobnom volaní

JIT Compiler

Optimalizácia prekladu

Garbage Collector

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Prechádza riadok za riadkom

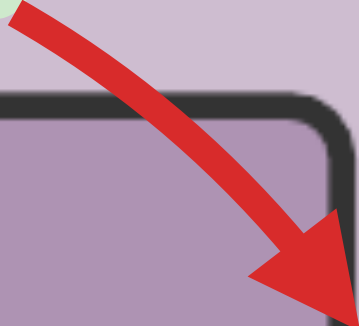
Pomalší a neefektívny pri viacnásobnom volaní

JIT Compiler

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Garbage Collector

Mark



Execution Engine

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Prechádza riadok za riadkom

Pomalší a neefektívny pri viacnásobnom volaní

JIT Compiler

Optimalizácia prekladu

Garbage Collector

Mark

Sweep

Quiz
time!

OOP Kvíz #5

