

马哥教育



Tomcat

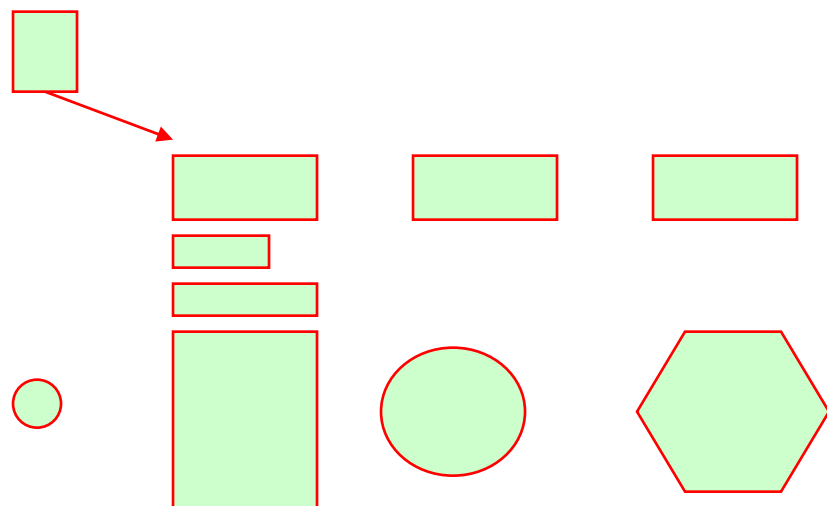
主讲：马永亮(马哥)

QQ:113228115

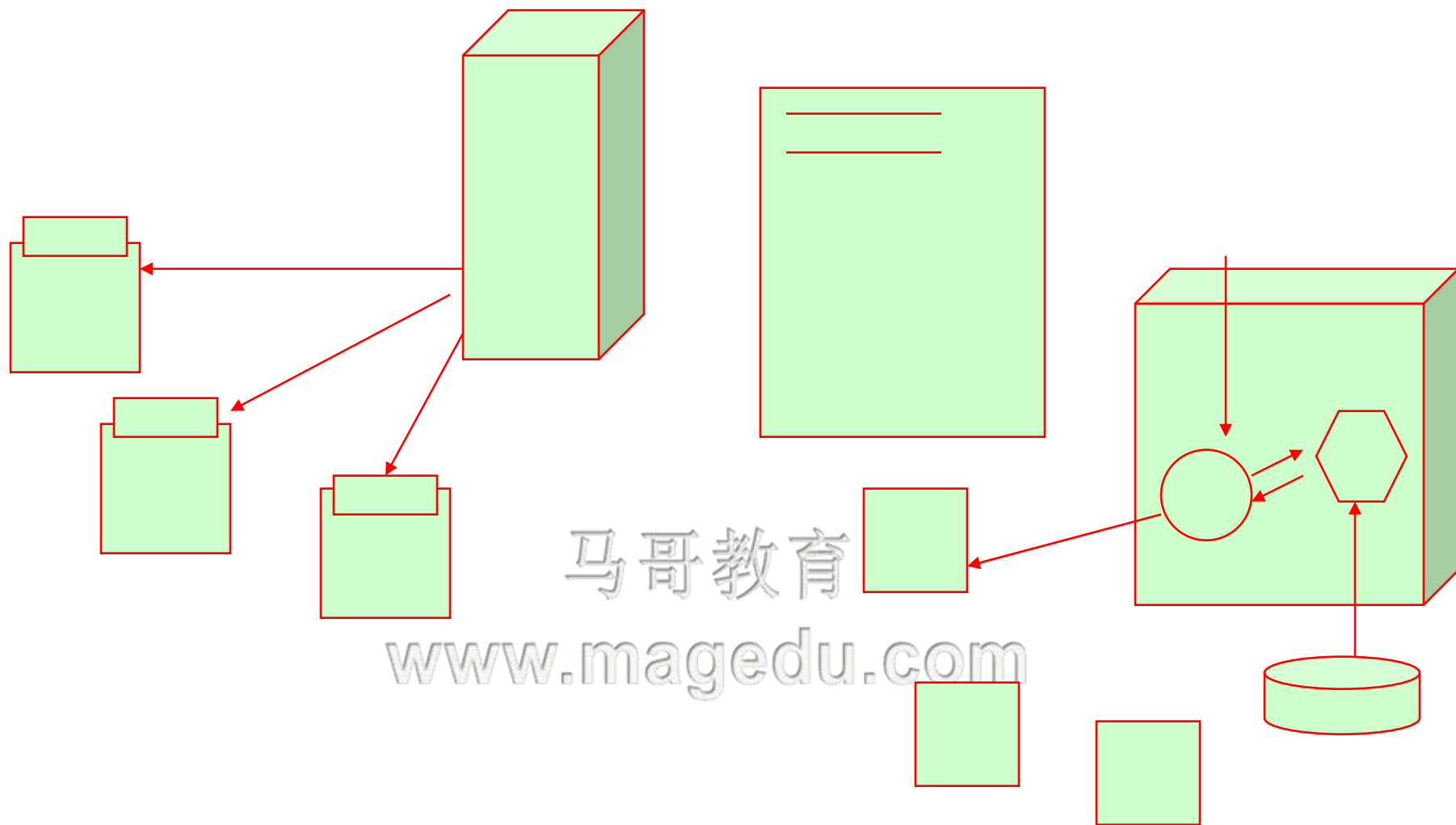
客服QQ: 2813150558, 1661815153

<http://www.magedu.com>

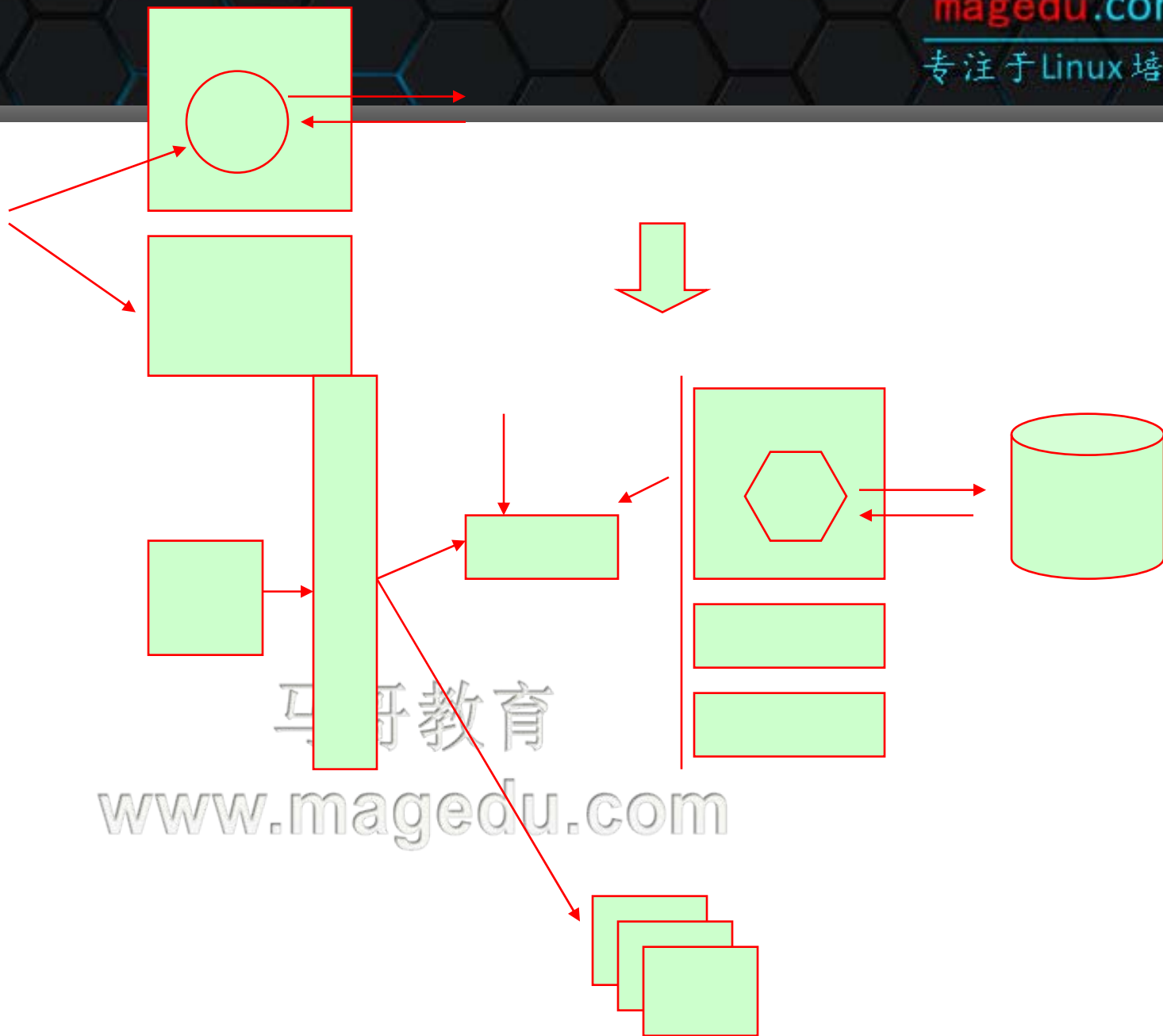
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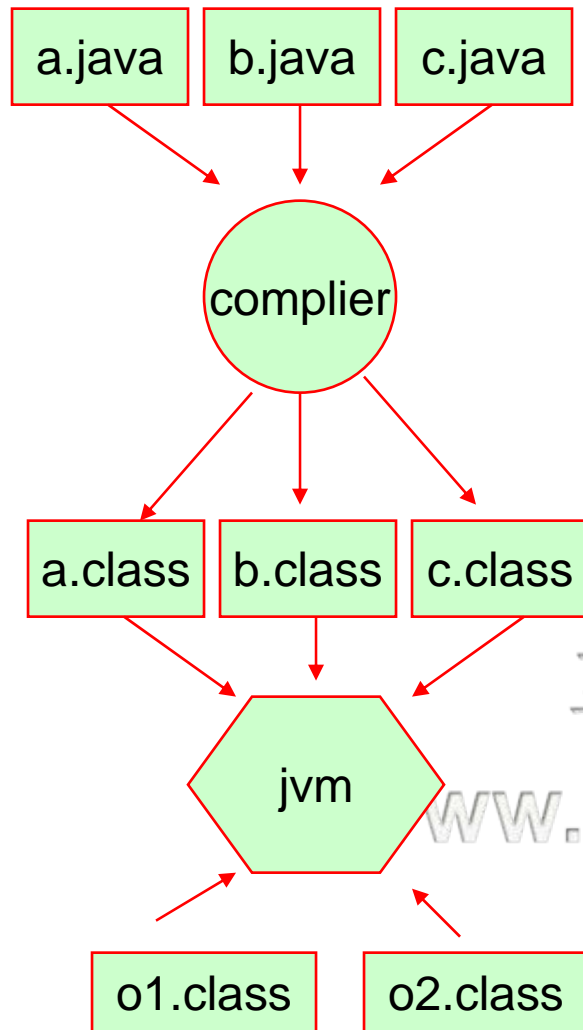


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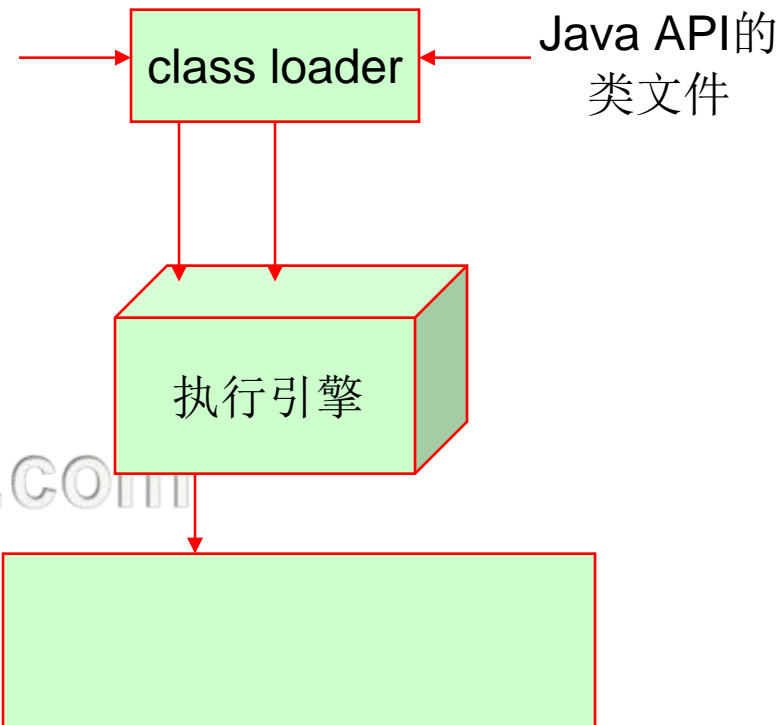


❖ 20000



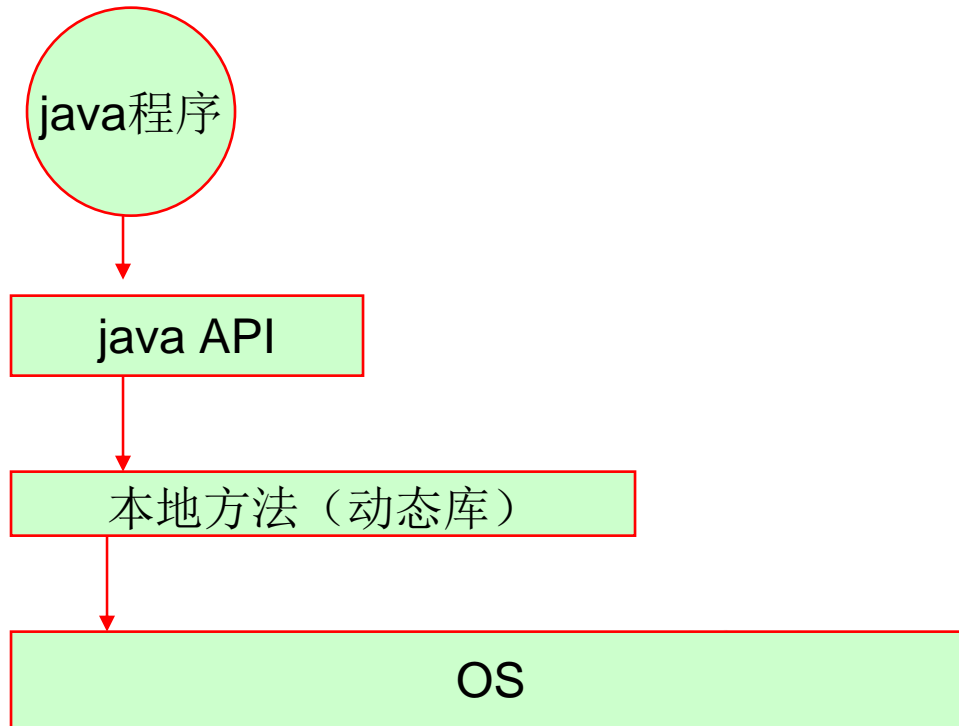


程序的
类文件

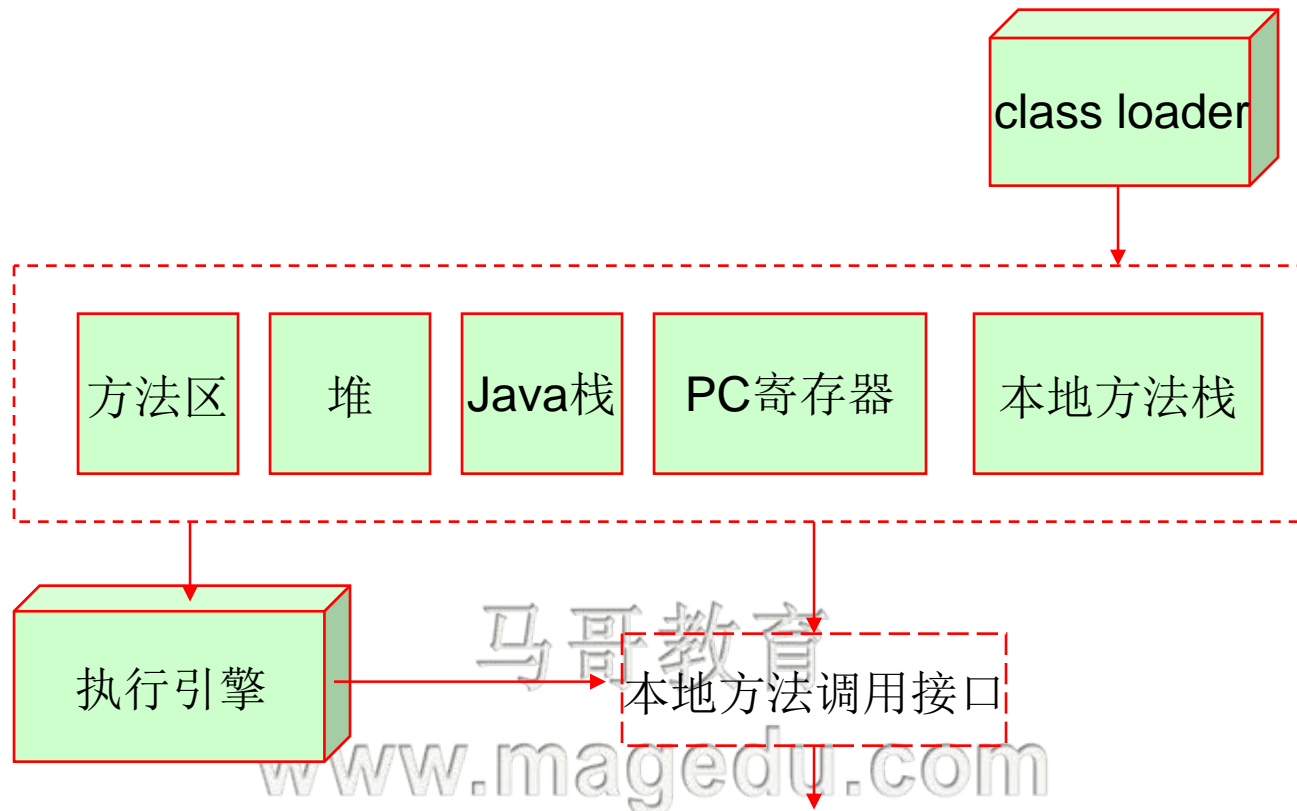


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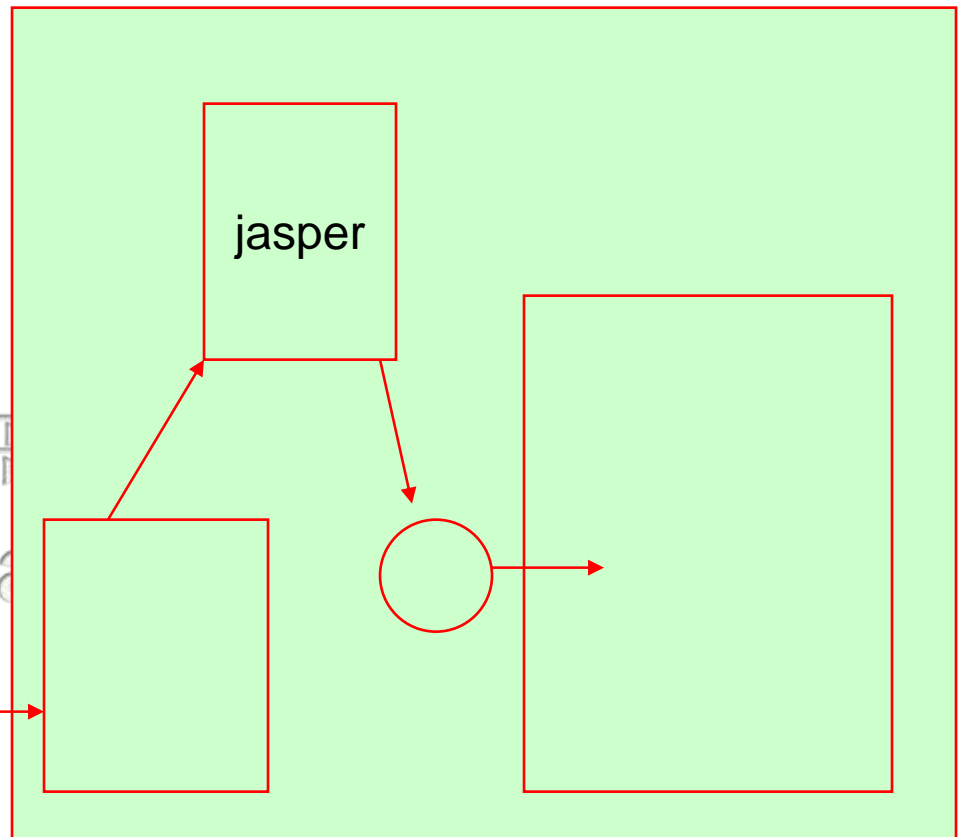
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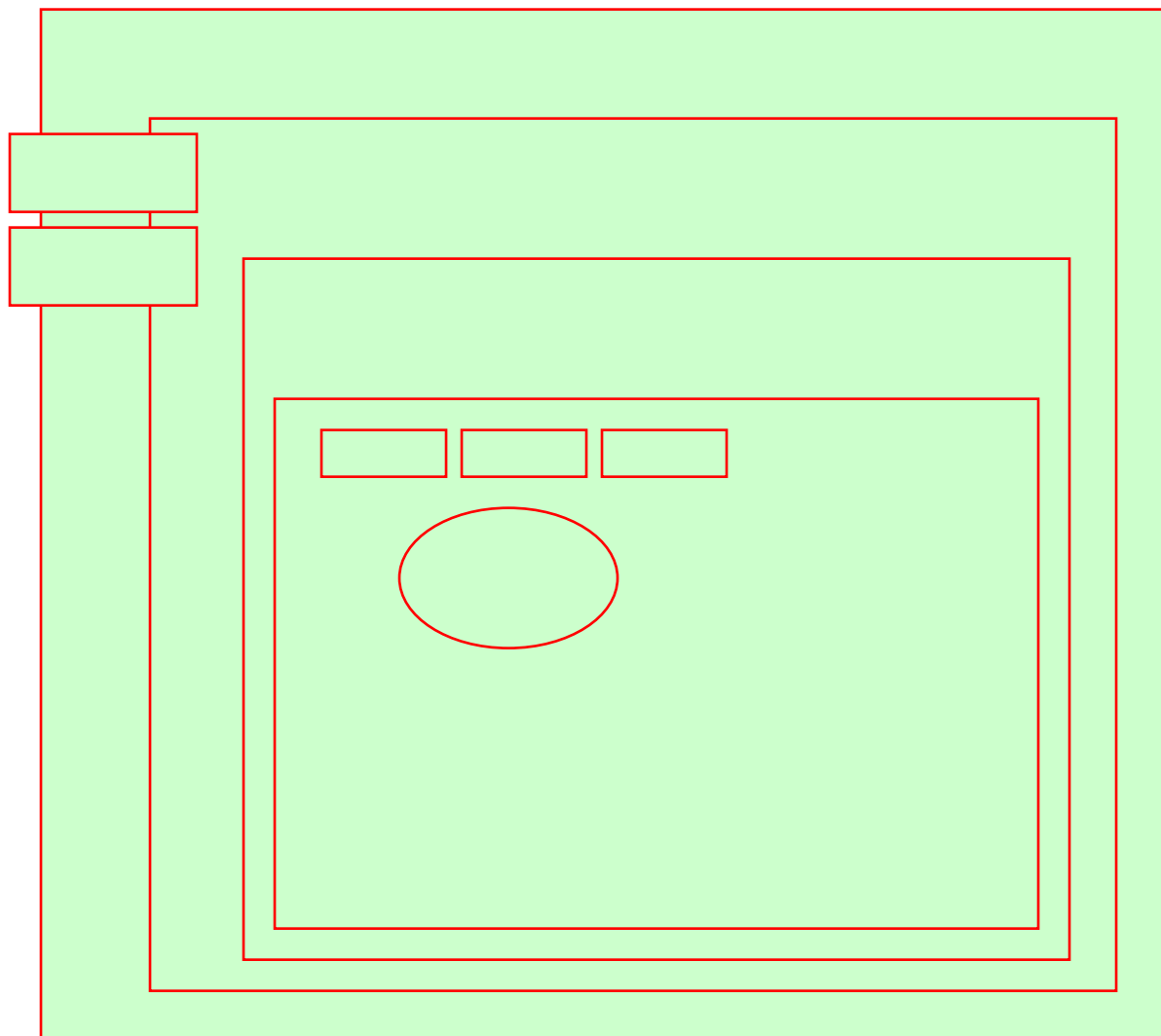


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```
<?php  
    phpinfo();  
?>  
  
<html>  
  
<%  
    java程序  
%>  
  
</html>
```





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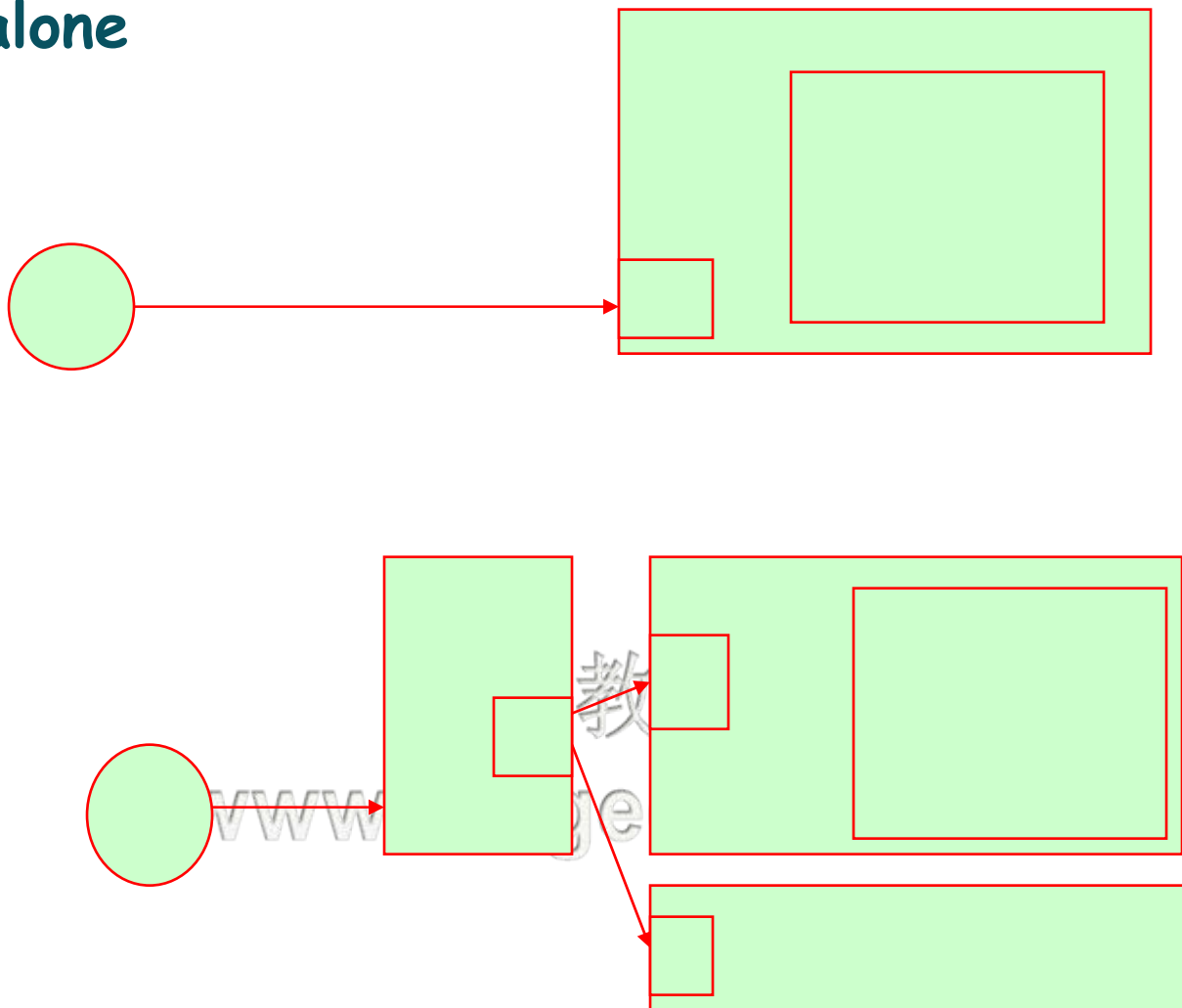
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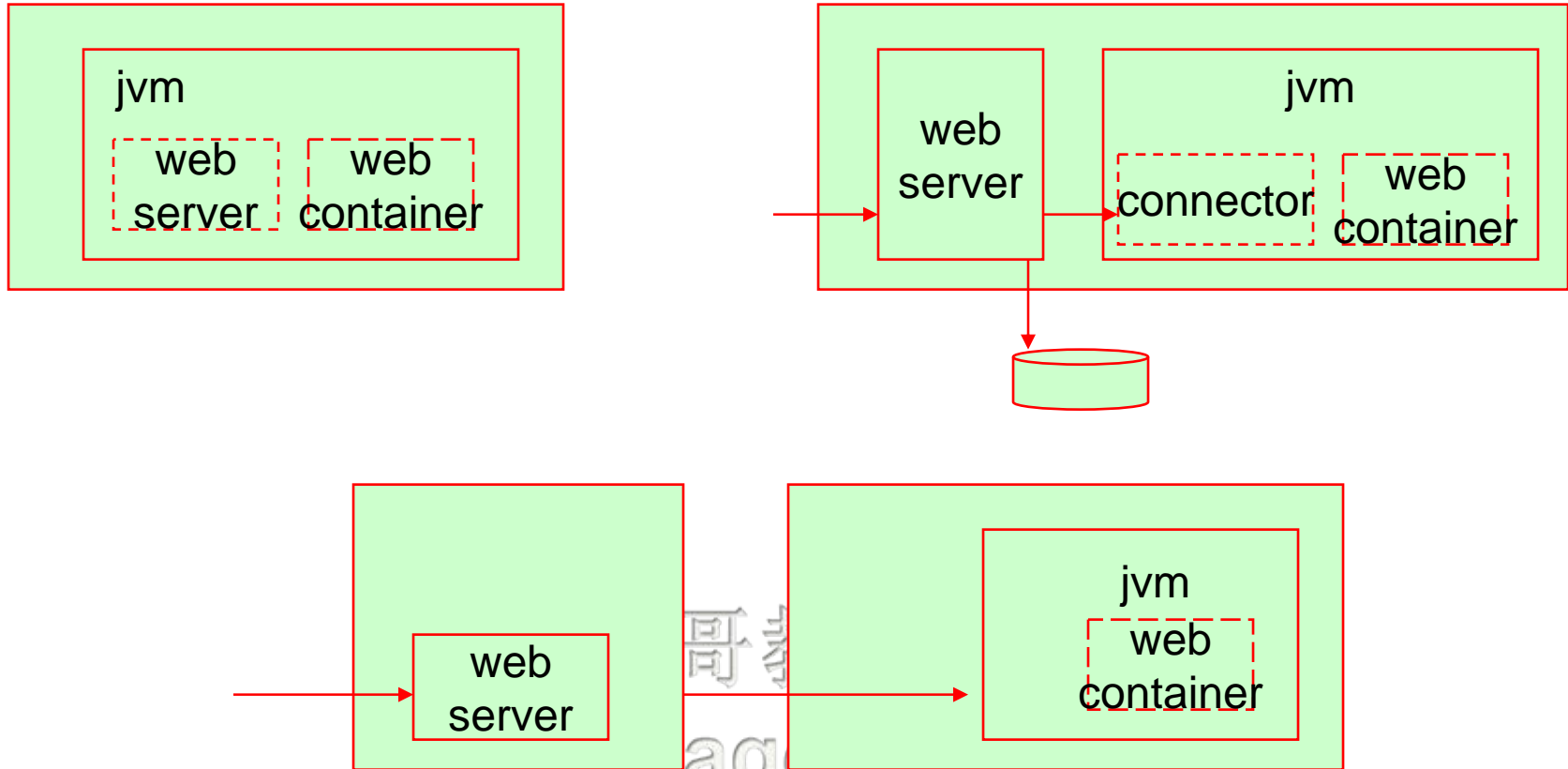
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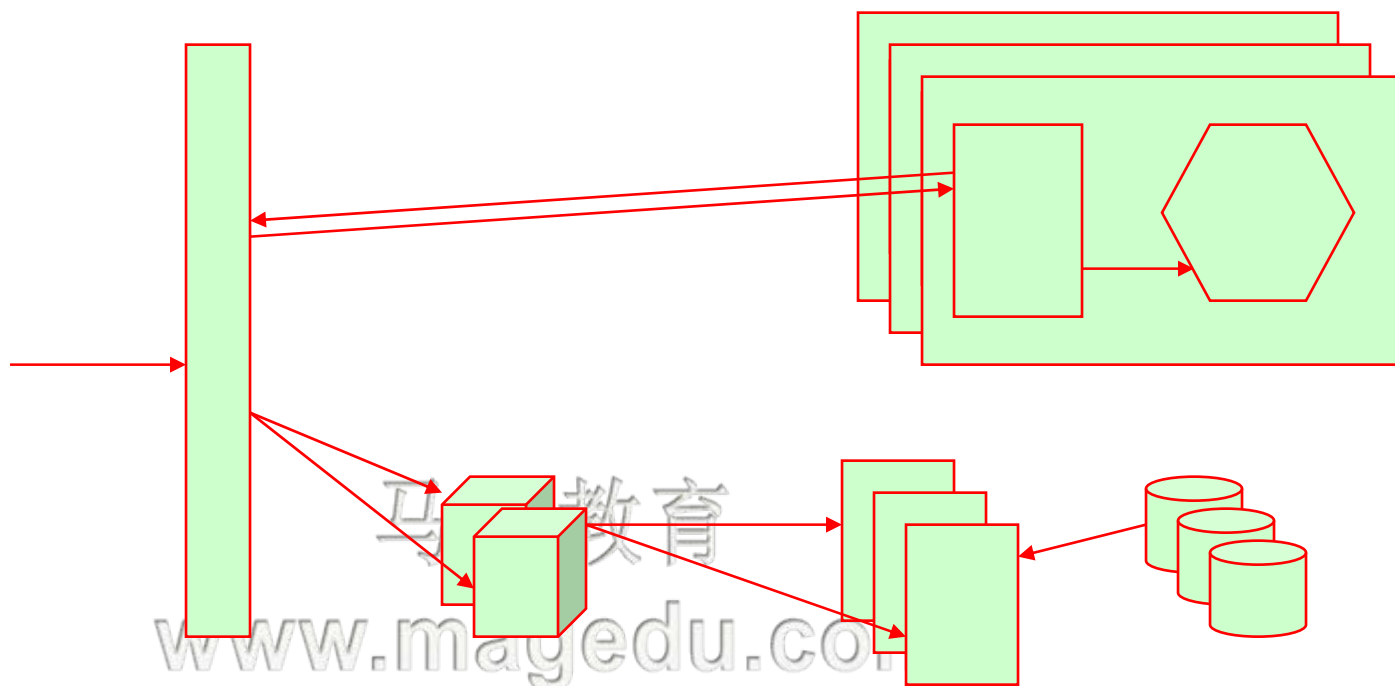
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ajp: apache jserv protocol

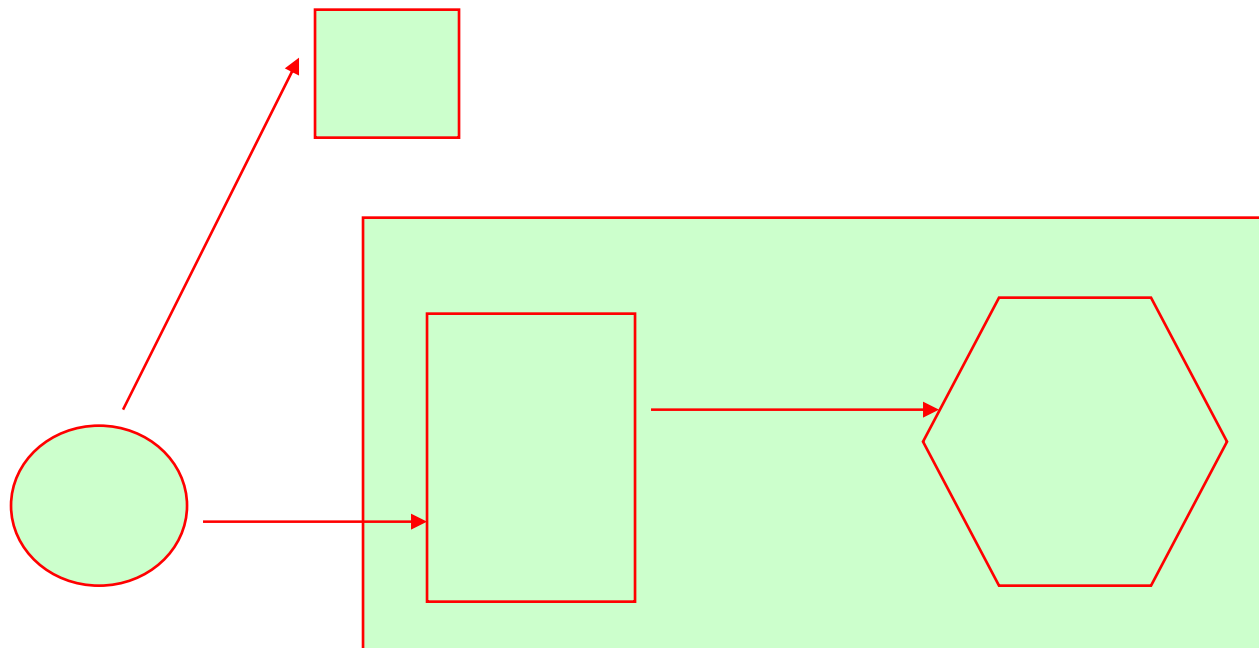
❖ standalone



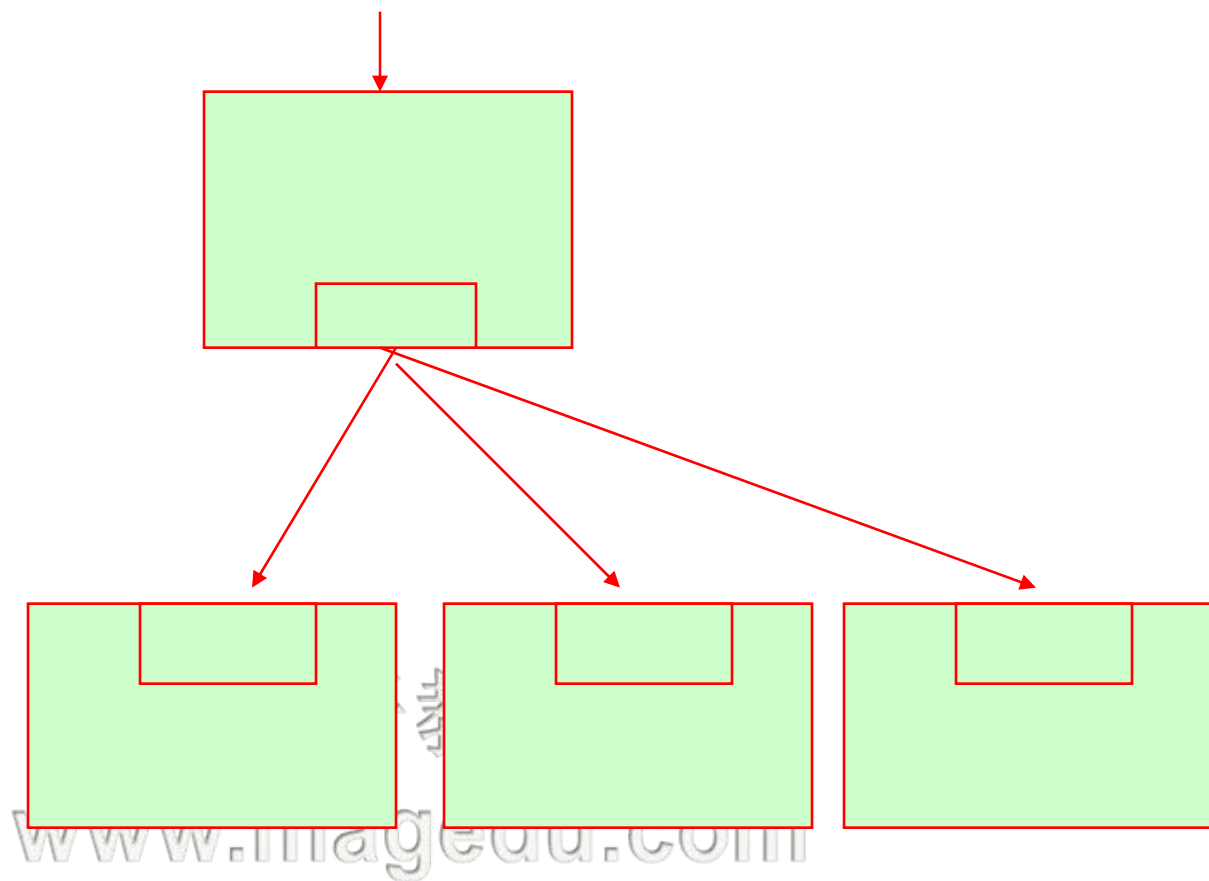




❖ Host: www.magedu.com

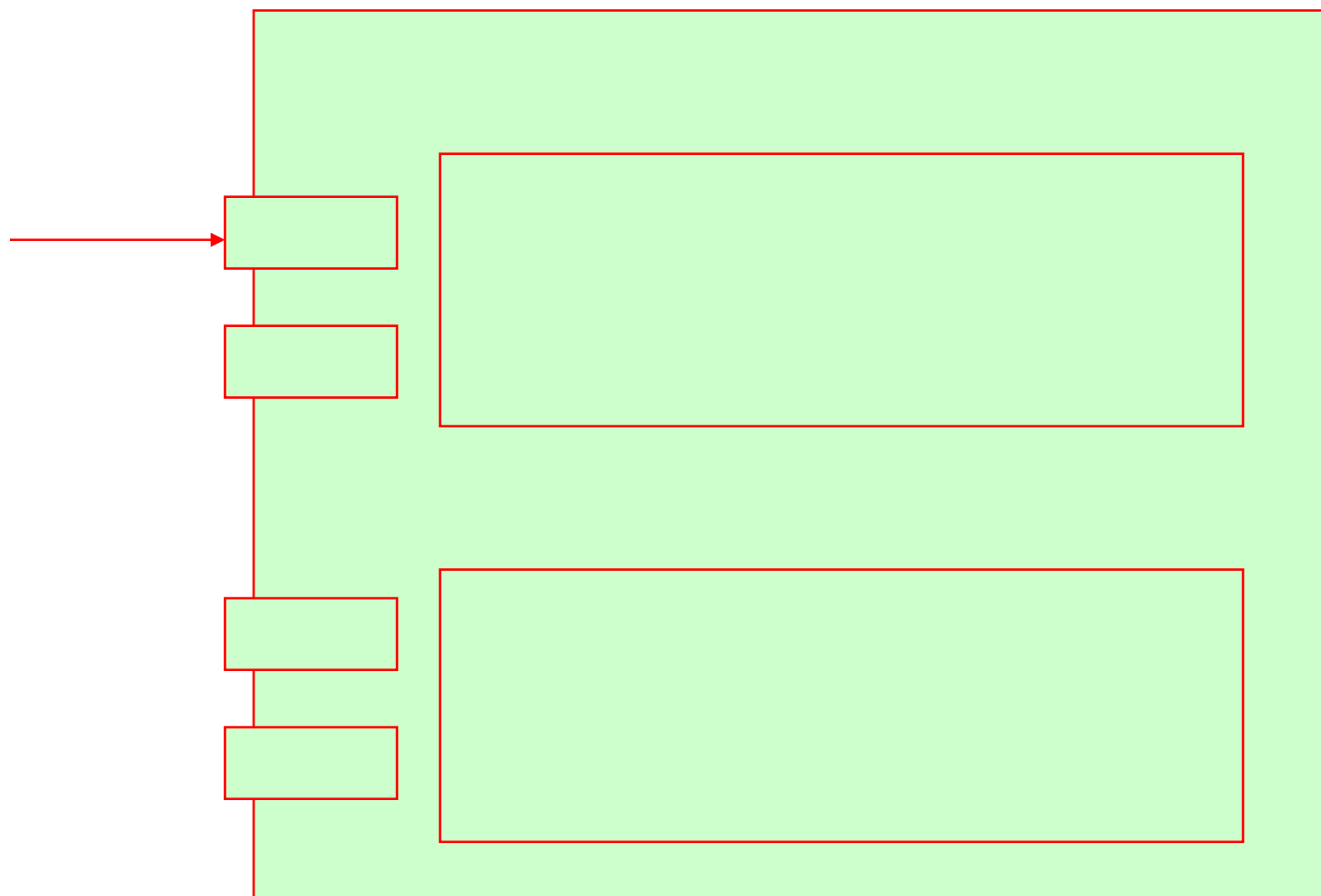


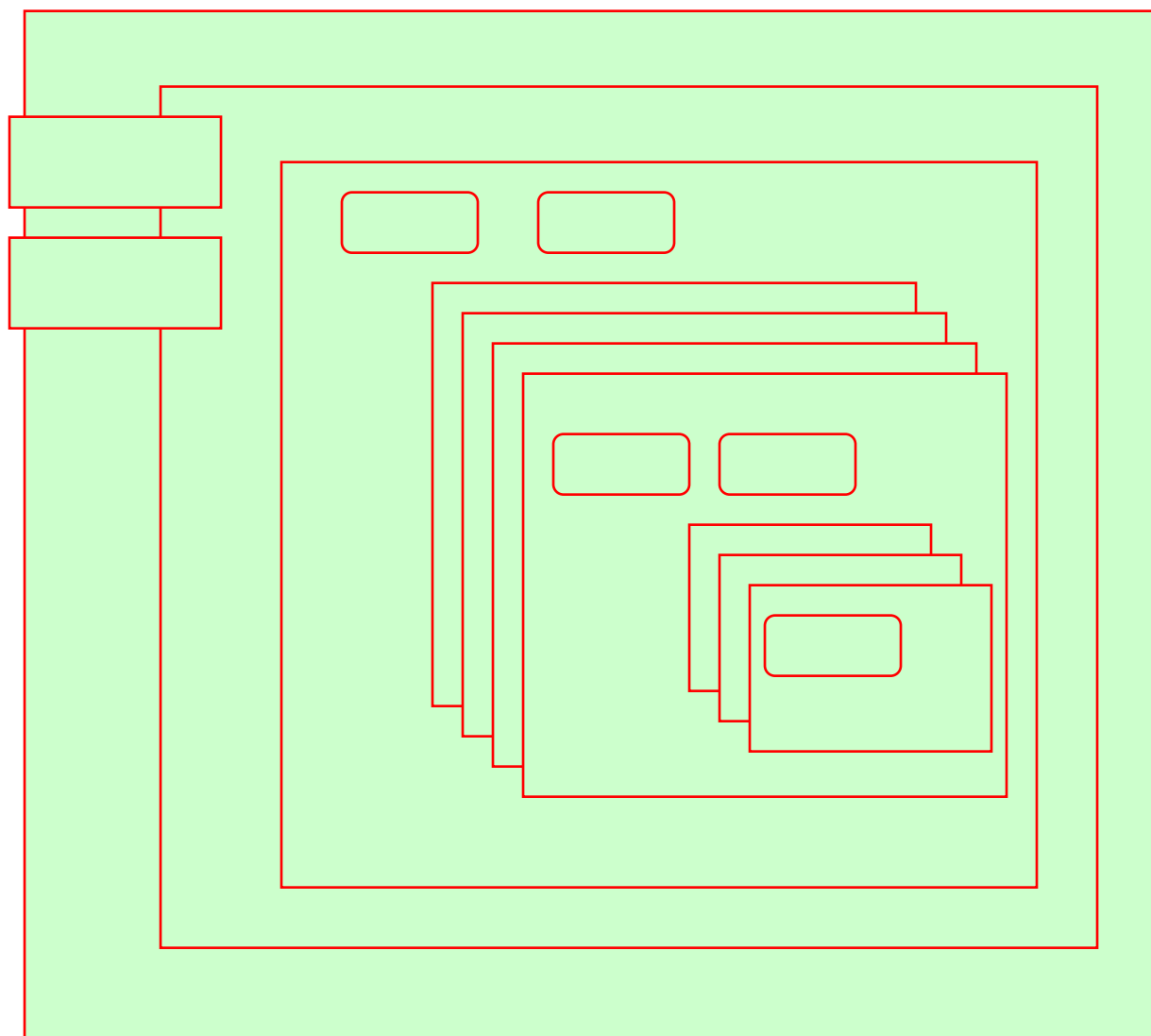
www.magedu.com

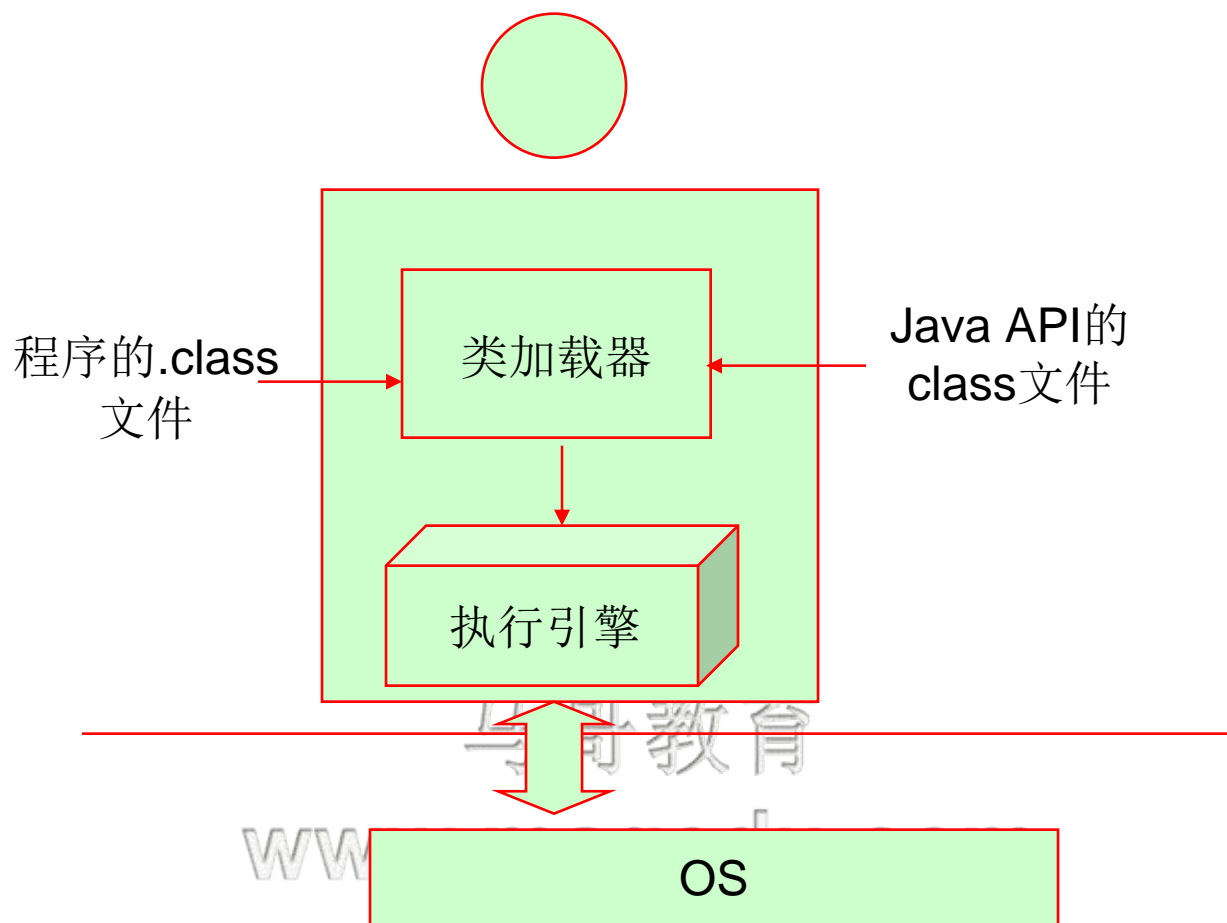


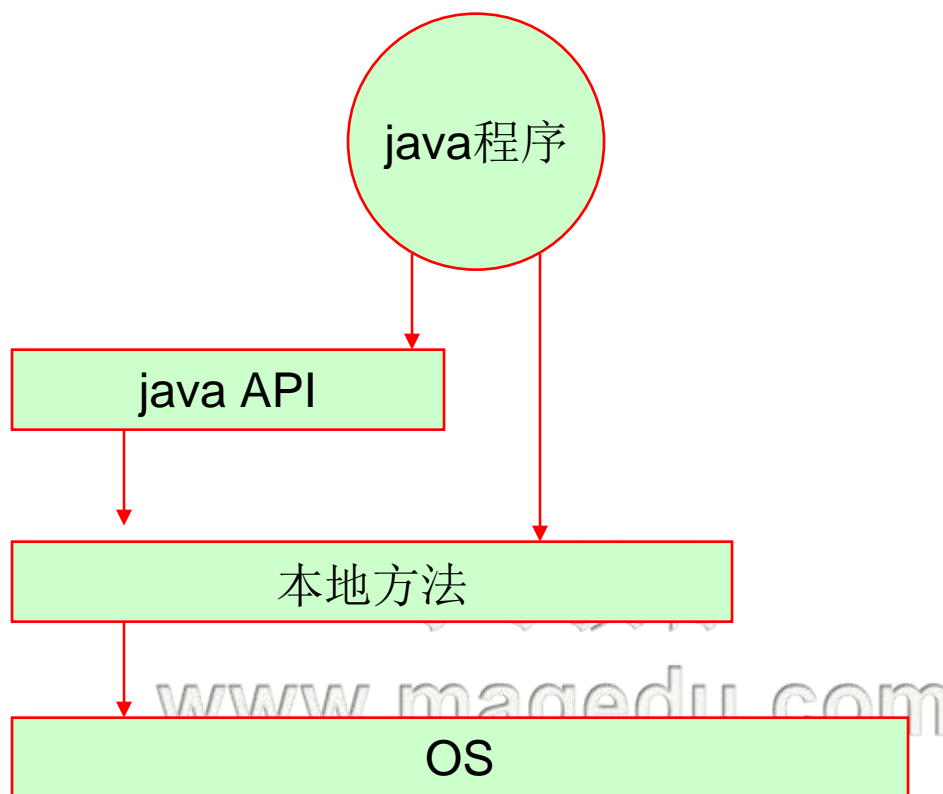
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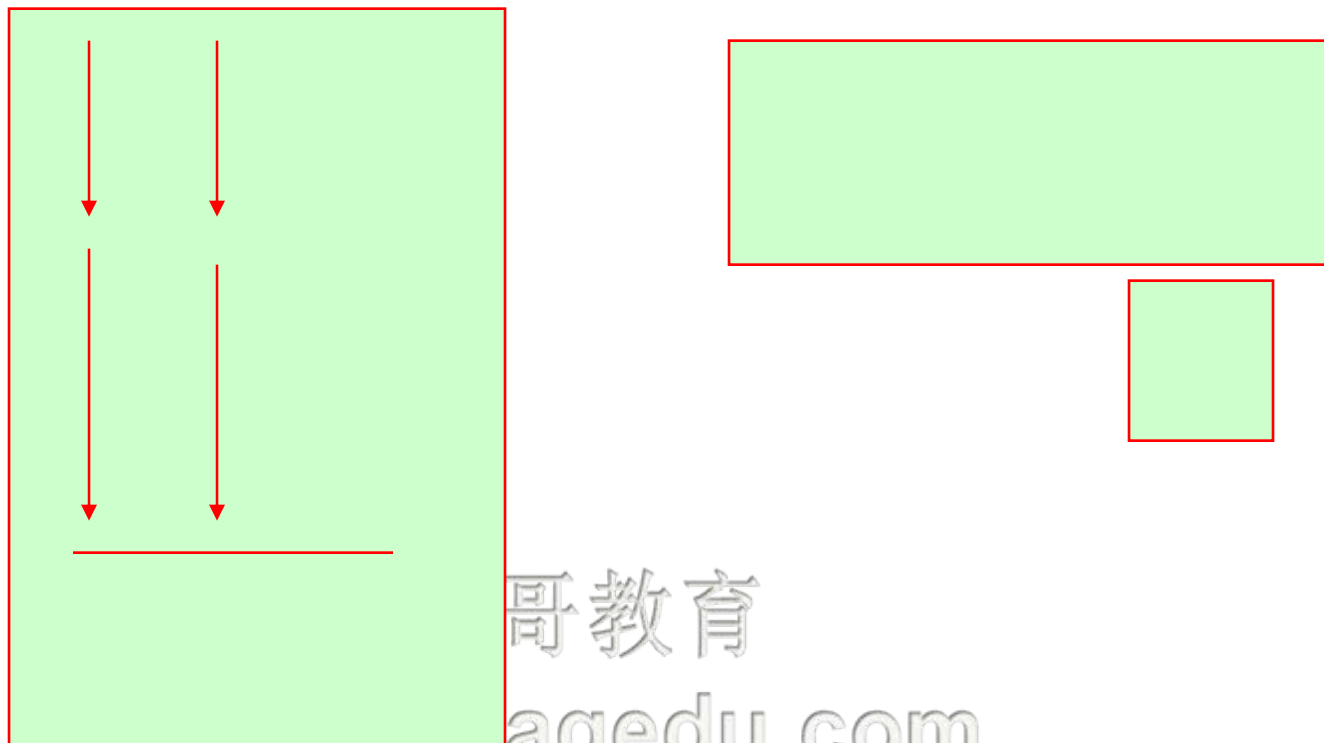




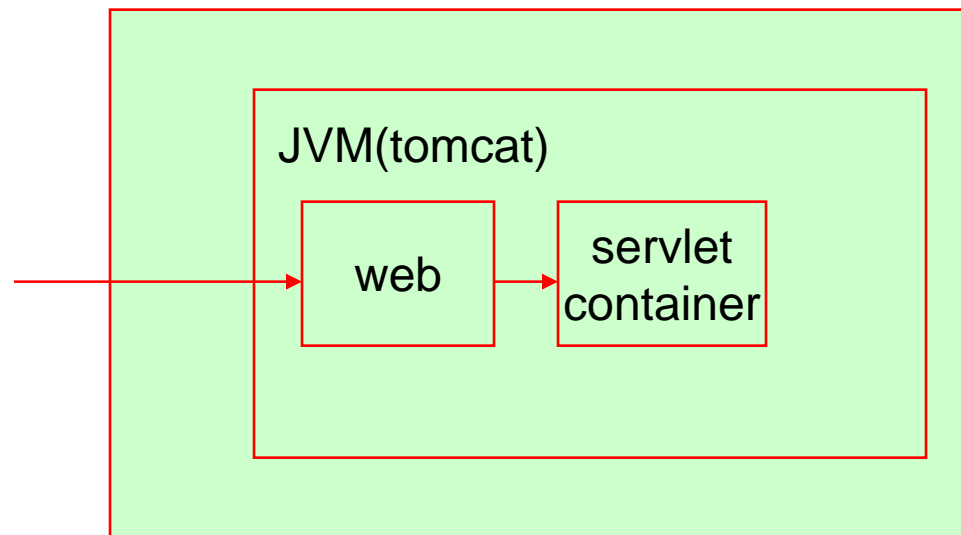




❖ 执行流，只有一个

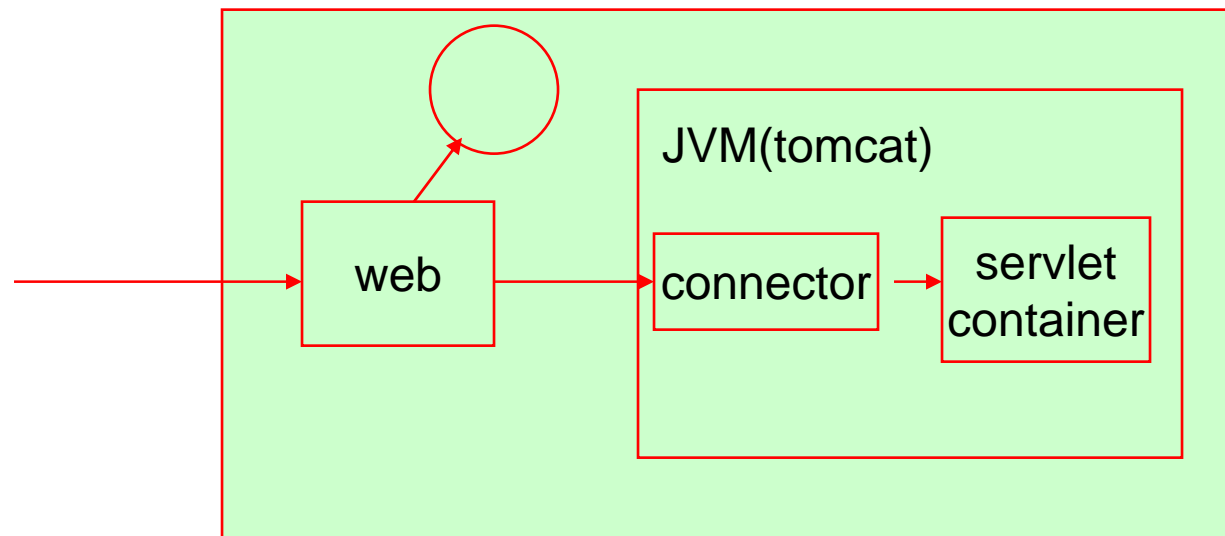


❖ 单独



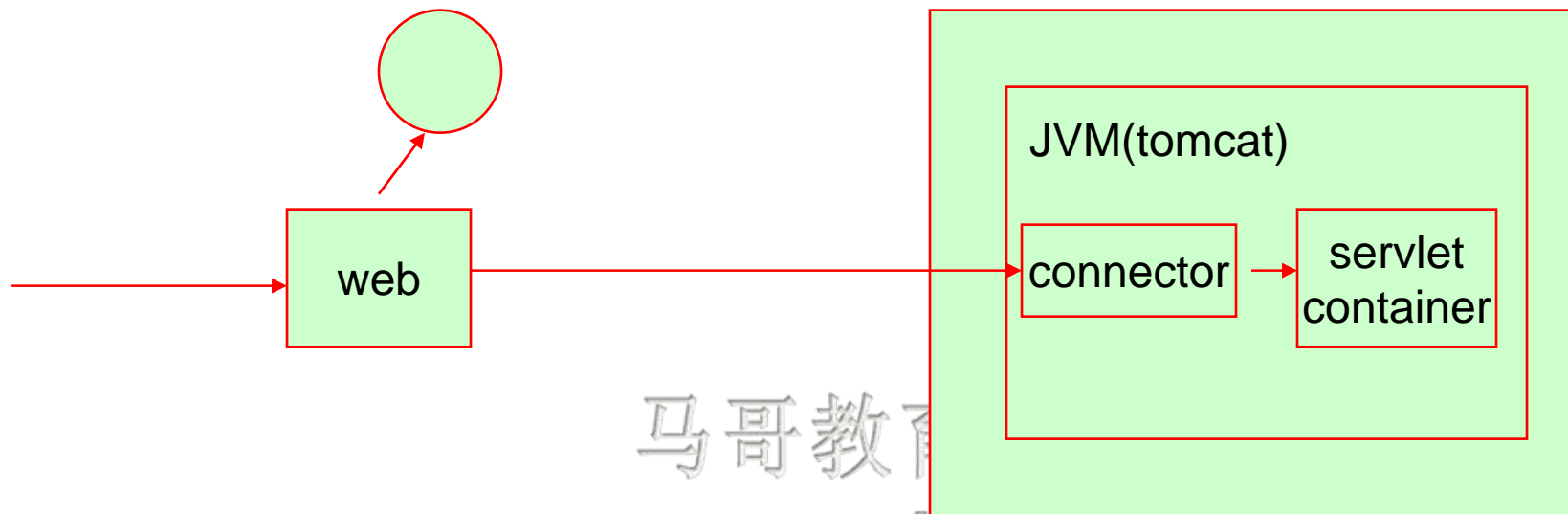
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❖ 进程间配置

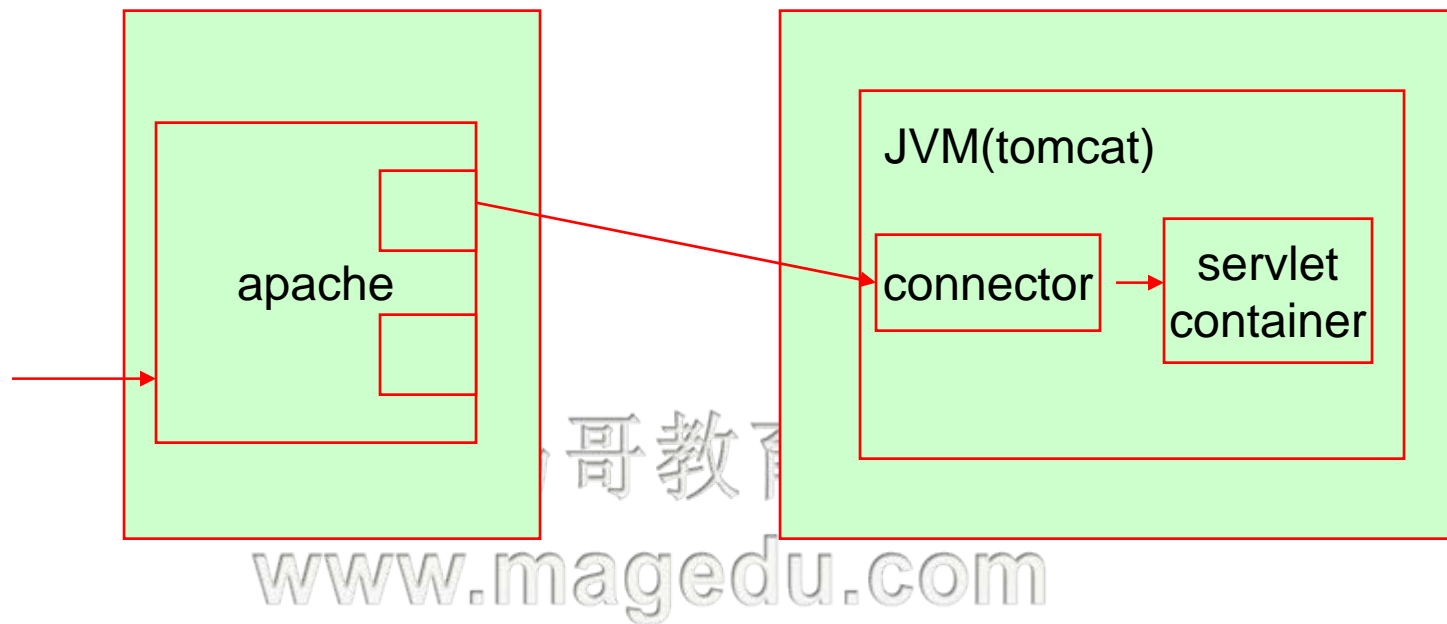


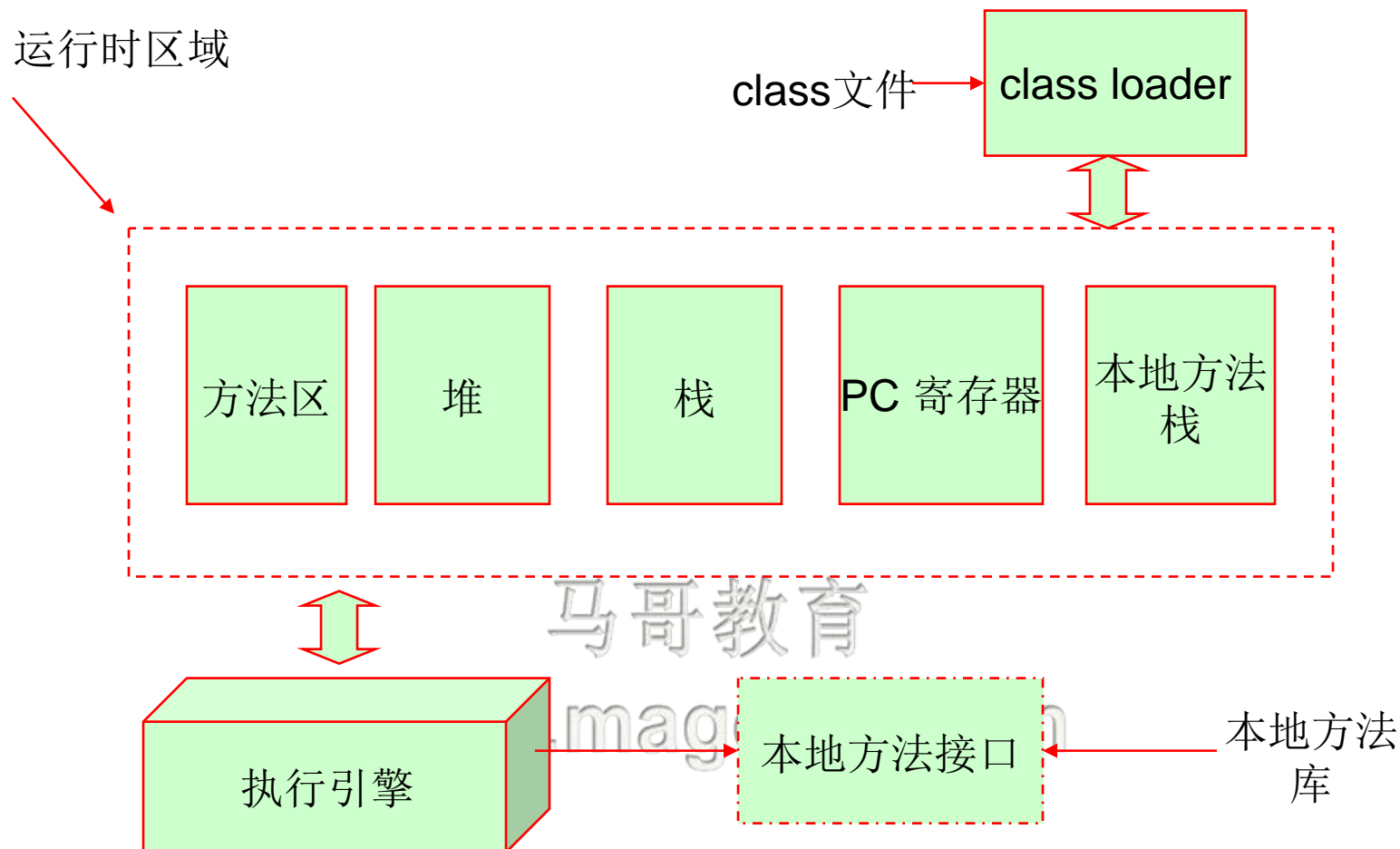
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❖ 独立/网络配置



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❖ servlet

➡ html必须硬编码在java代码中:

❖ jsp: 类

➡ <html>

➡ <%

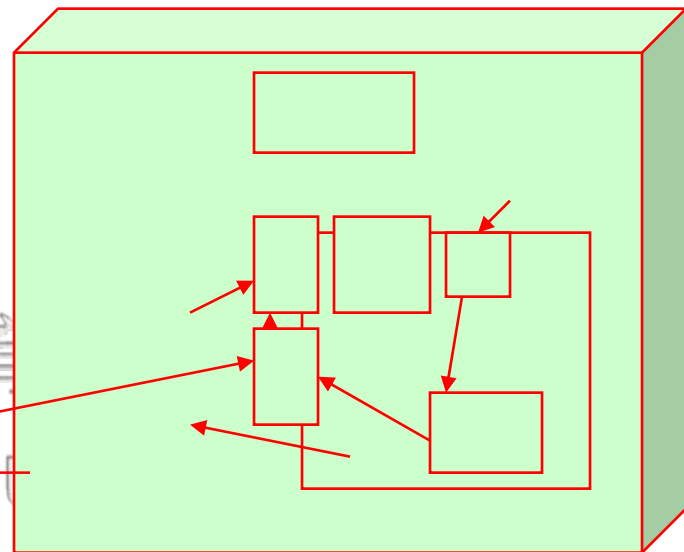
➡ %>

➡ </html>

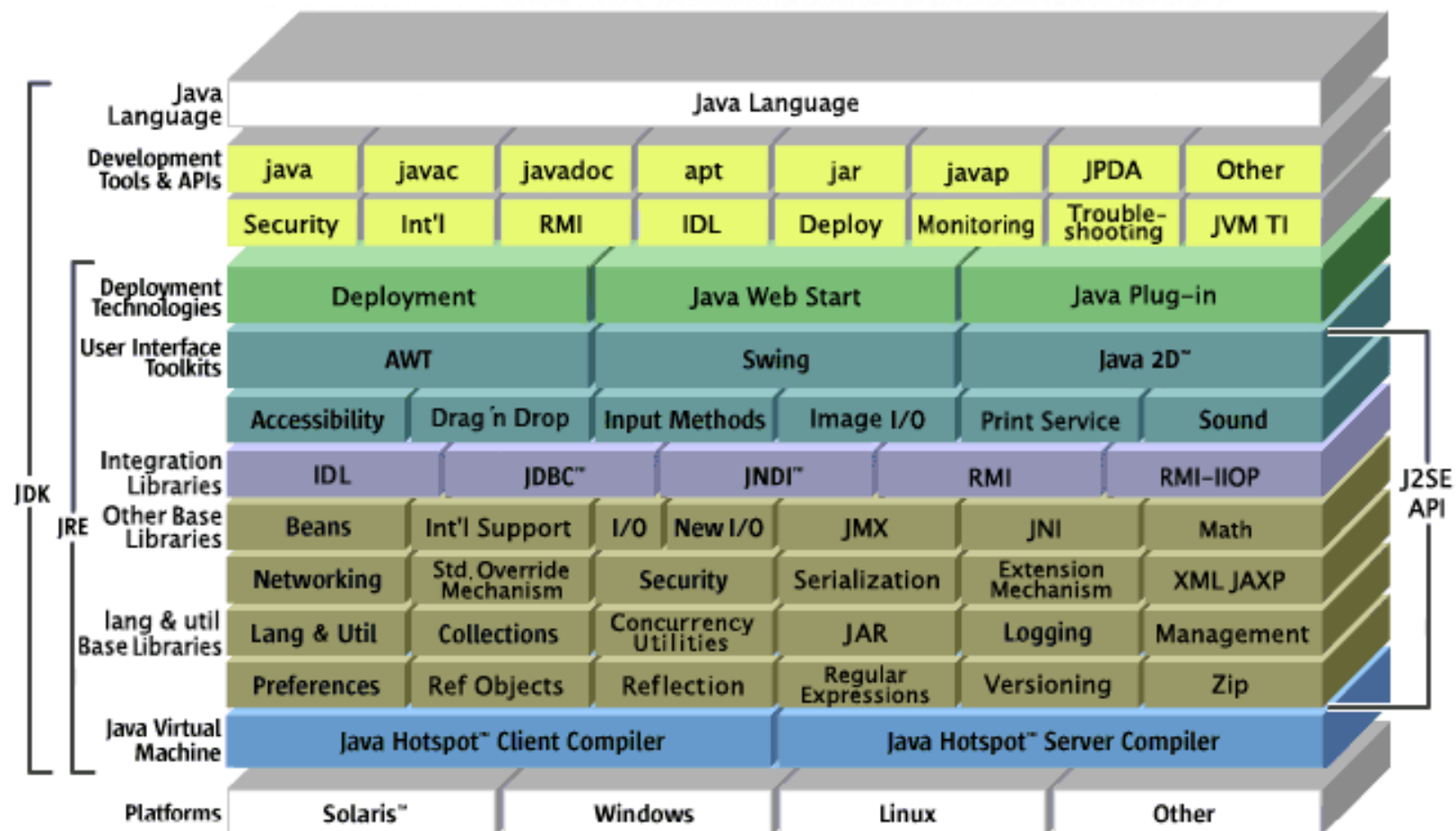
➡ jasper

➡ 将存在着嵌入在html文档的程序整

➡ 个儿的转换为servlet代码



Java™ 2 Platform Standard Edition 5.0



版本	名称	发行日期
JDK 1.1.4	Sparkler (宝石)	1997-09-12
JDK 1.1.5	Pumpkin (南瓜)	1997-12-13
JDK 1.1.6	Abigail (阿比盖尔-女子名)	1998-04-24
JDK 1.1.7	Brutus (布鲁图-古罗马政治家和将军)	1998-09-28
JDK 1.1.8	Chelsea (切尔西-城市名)	1999-04-08
J2SE 1.2	Playground (运动场)	1998-12-04
J2SE 1.2.1	none (无)	1999-03-30
J2SE 1.2.2	Cricket (蟋蟀)	1999-07-08
J2SE 1.3	Kestrel (美洲红隼)	2000-05-08
J2SE 1.3.1	Ladybird (瓢虫)	2001-05-17
J2SE 1.4.0	Merlin (灰背隼)	2002-02-13
J2SE 1.4.1	grasshopper (蚱蜢)	2002-09-16
J2SE 1.4.2	Mantis (螳螂)	2003-06-26
Java SE 5.0 (1.5.0)	Tiger (老虎)	2004-09-30
Java SE 6.0 (1.6.0)	Mustang (野马)	2006-04
Java SE 7.0 (1.7.0)	Dolphin (海豚)	2011-07-28
Java SE 8.0 (1.8.0)	未知	2014-03-18

- ❖ **javac** - 编译器，将源程序转成字节码
- ❖ **jar** - 打包工具，将相关的类文件打包成一个文件
- ❖ **javadoc** - 文档生成器，从源码注释中提取文档
- ❖ **jdb - debugger**，查错工具
- ❖ **java** - 运行编译后的**java**程序（**.class**后缀的）
- ❖ **appletviewer**: 小程序浏览器，一种执行**HTML**文件上的**Java**小程序的**Java**浏览器
- ❖ **Javah**: 产生可以调用**Java**过程的**C**过程，或建立能被**Java**程序调用的**C**过程的头文件
- ❖ **Javap**: **Java**反汇编器，显示编译类文件中的可访问功能和数据，同时显示字节代码含义
- ❖ **Jconsole**: **Java**进行系统调试和监控的工具

常用的包

- ❖ **java.lang**: 这个是系统的基础类，比如**String**等都是这里面的，这个包是唯一一个可以不用引入(**import**)就可以使用的包
- ❖ **java.io**: 这里面是所有输入输出有关的类，比如文件操作等。
- ❖ **java.nio**: 为了完善**io**包中的功能，提高**io**包中性能而写的一个新包，例如**NIO**非堵塞应用
- ❖ **java.net**: 这里面是与网络有关的类，比如**URL**，**URLConnection**等
- ❖ **java.util**: 这个是系统辅助类，特别是集合类**Collection**，**List**，**Map**等
- ❖ **java.sql**: 这个是数据库操作的类，**Connection**，**Statement**，**ResultSet**等
- ❖ **javax.servlet**: 这个是**JSP**，**Servlet**等使用到的类

❖ server

❖ service

❖ connector

❖ engine

❖ host

❖ context

❖ realm

❖ valve

❖ logger

❖ connector:

➡ http

➡ ajp

➡ https

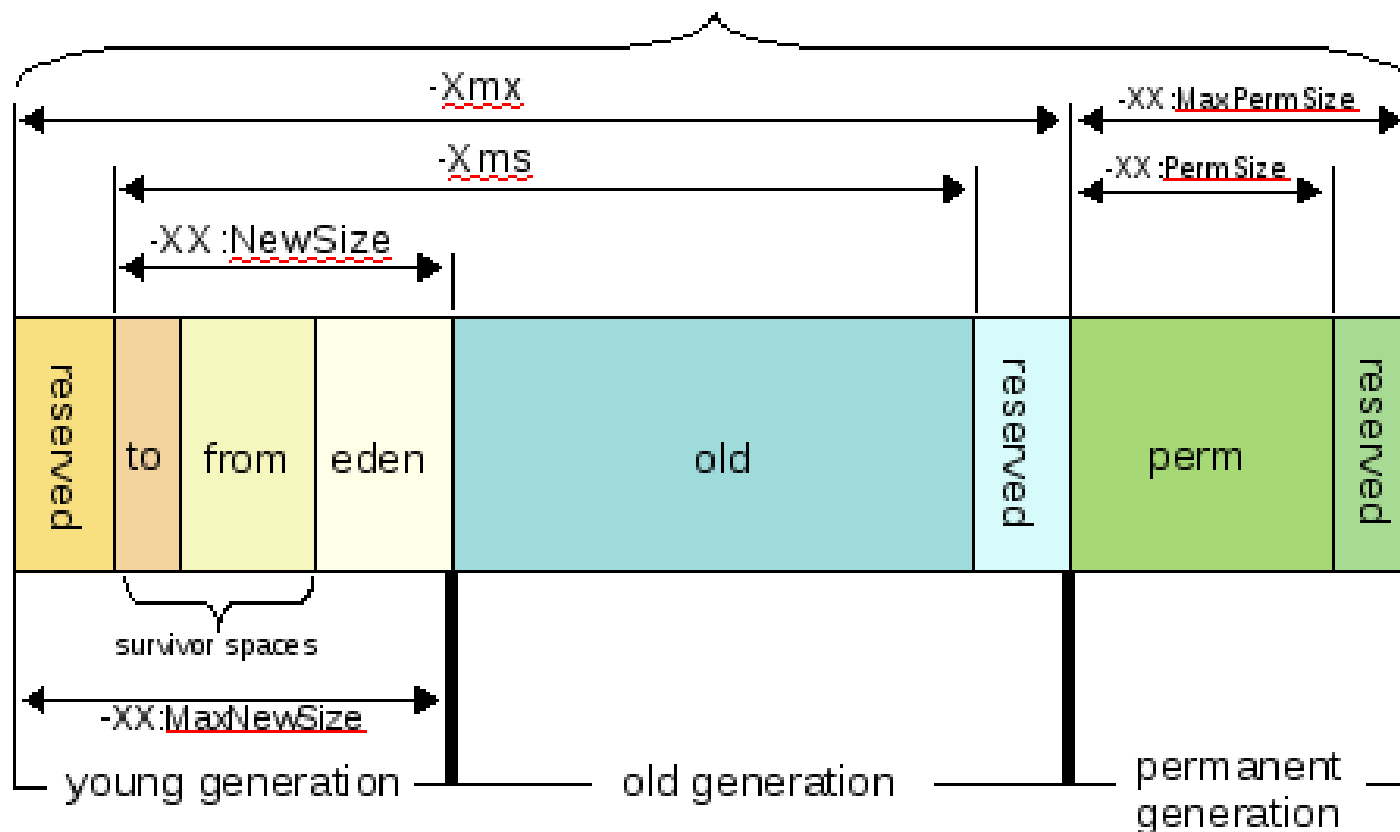
➡ apr:

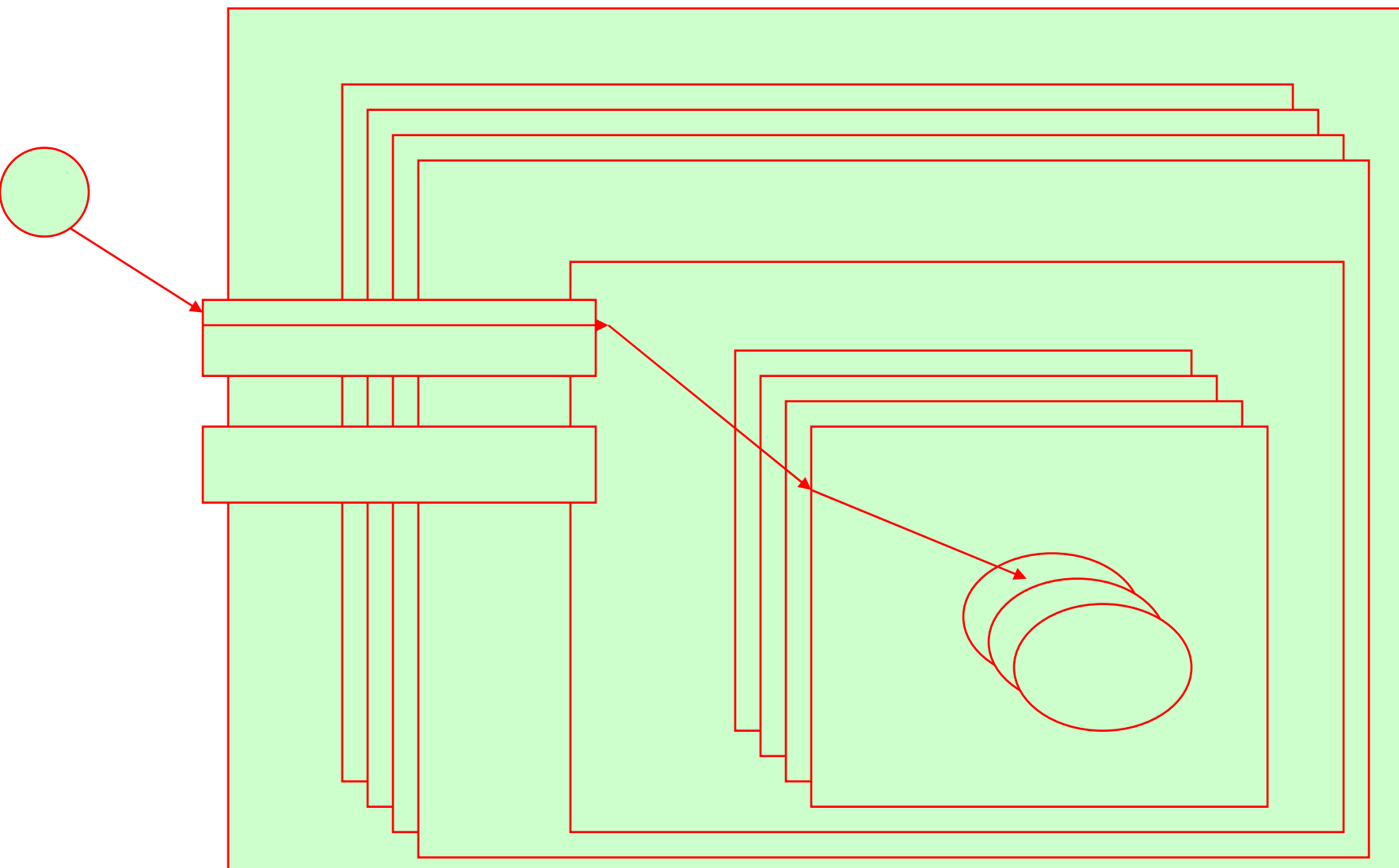
➡ apache portable runtime

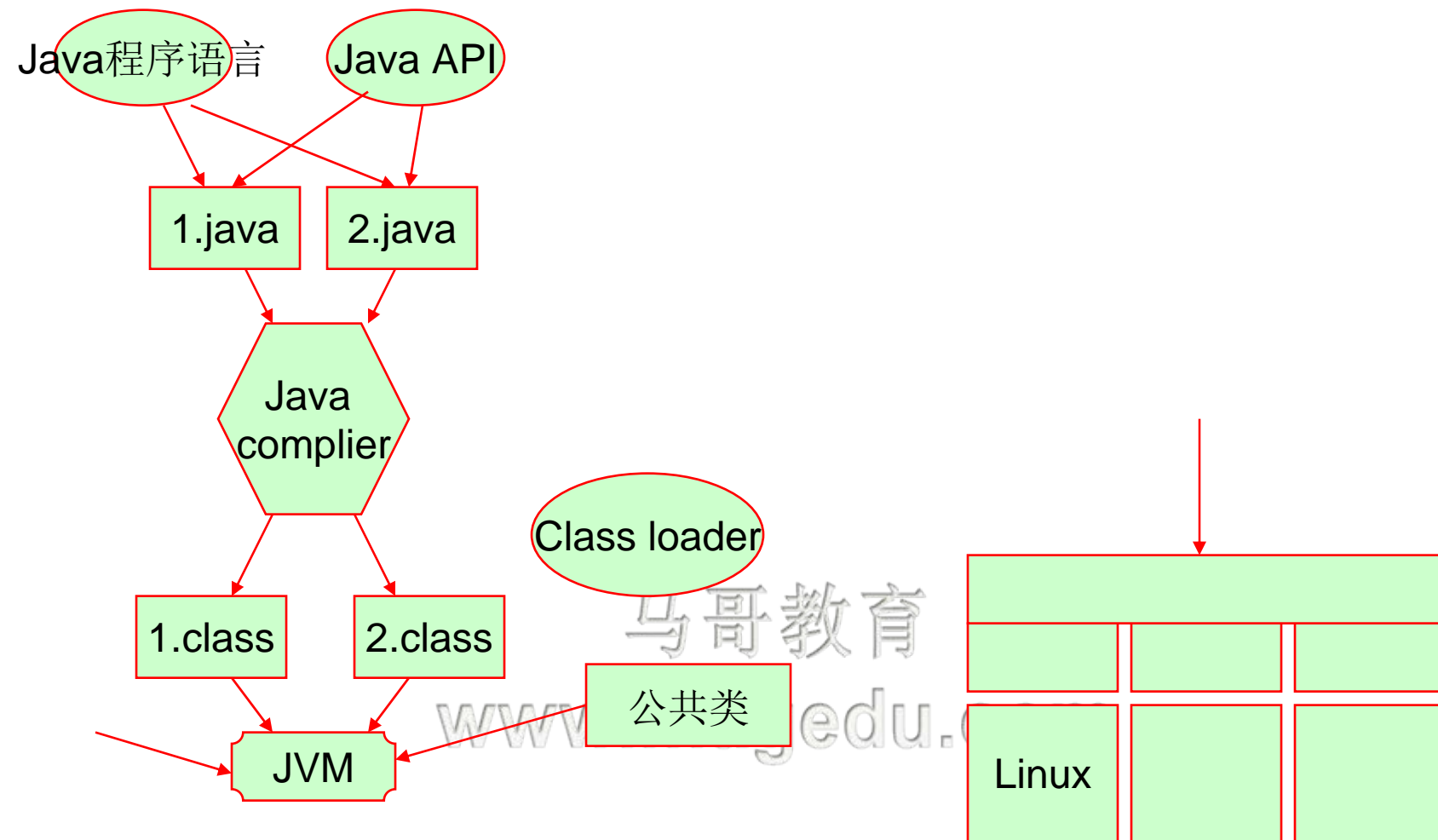
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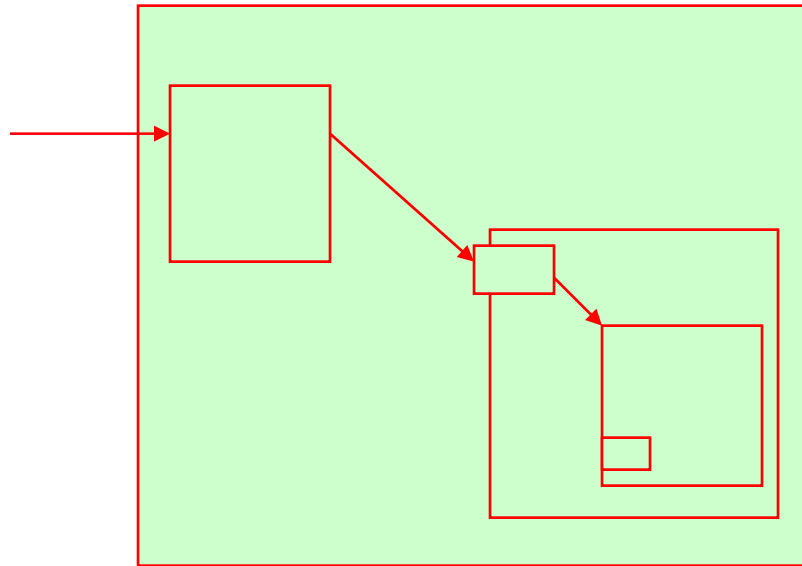
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The memory structure of a JVM process



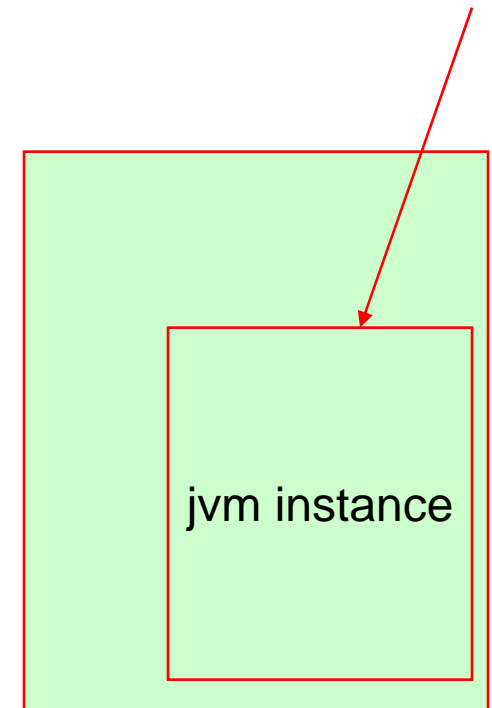
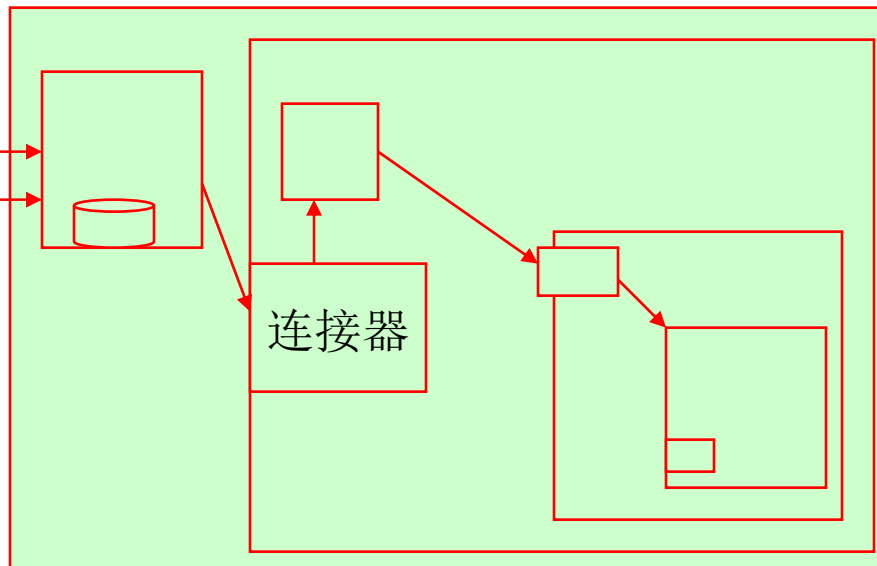






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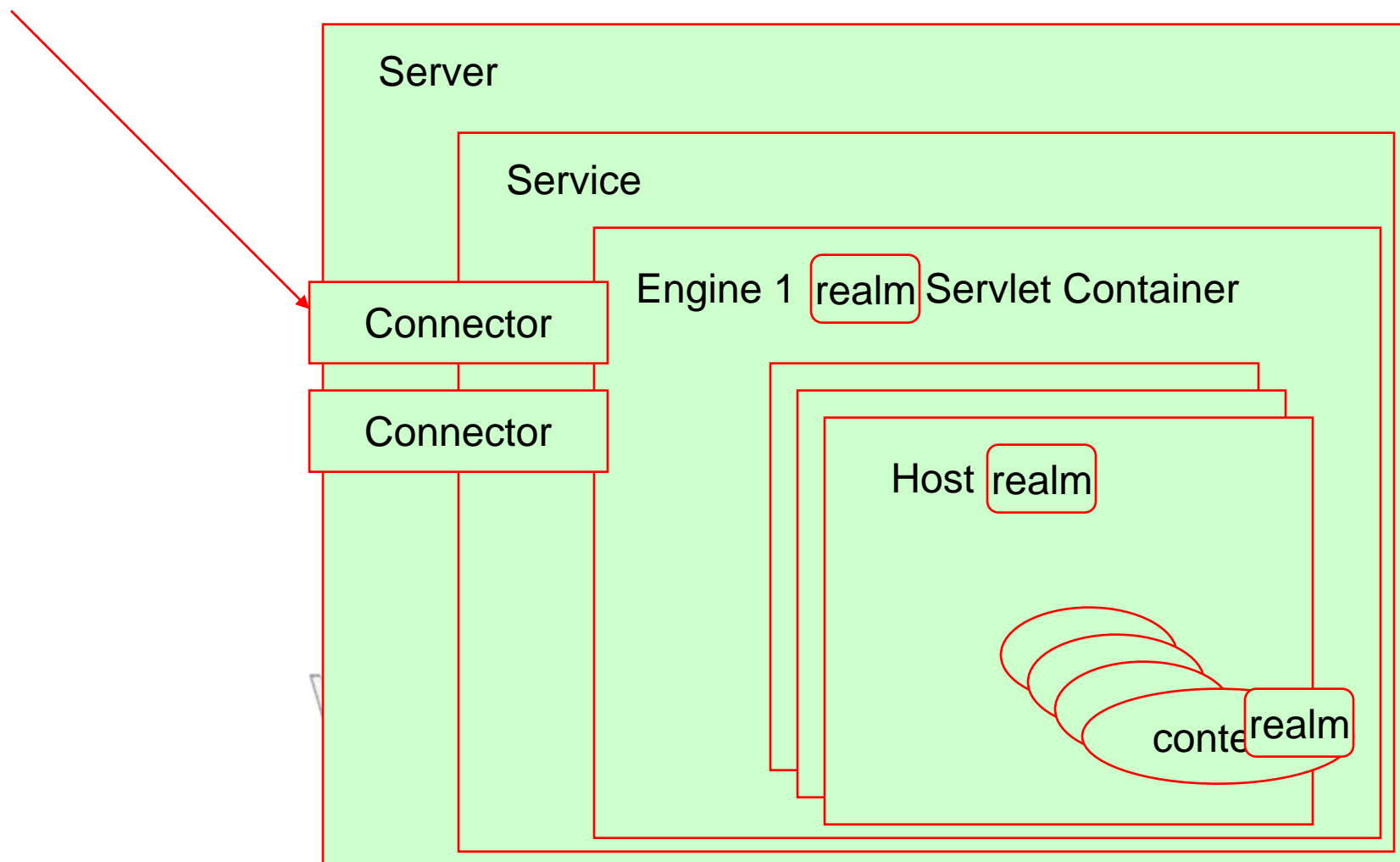


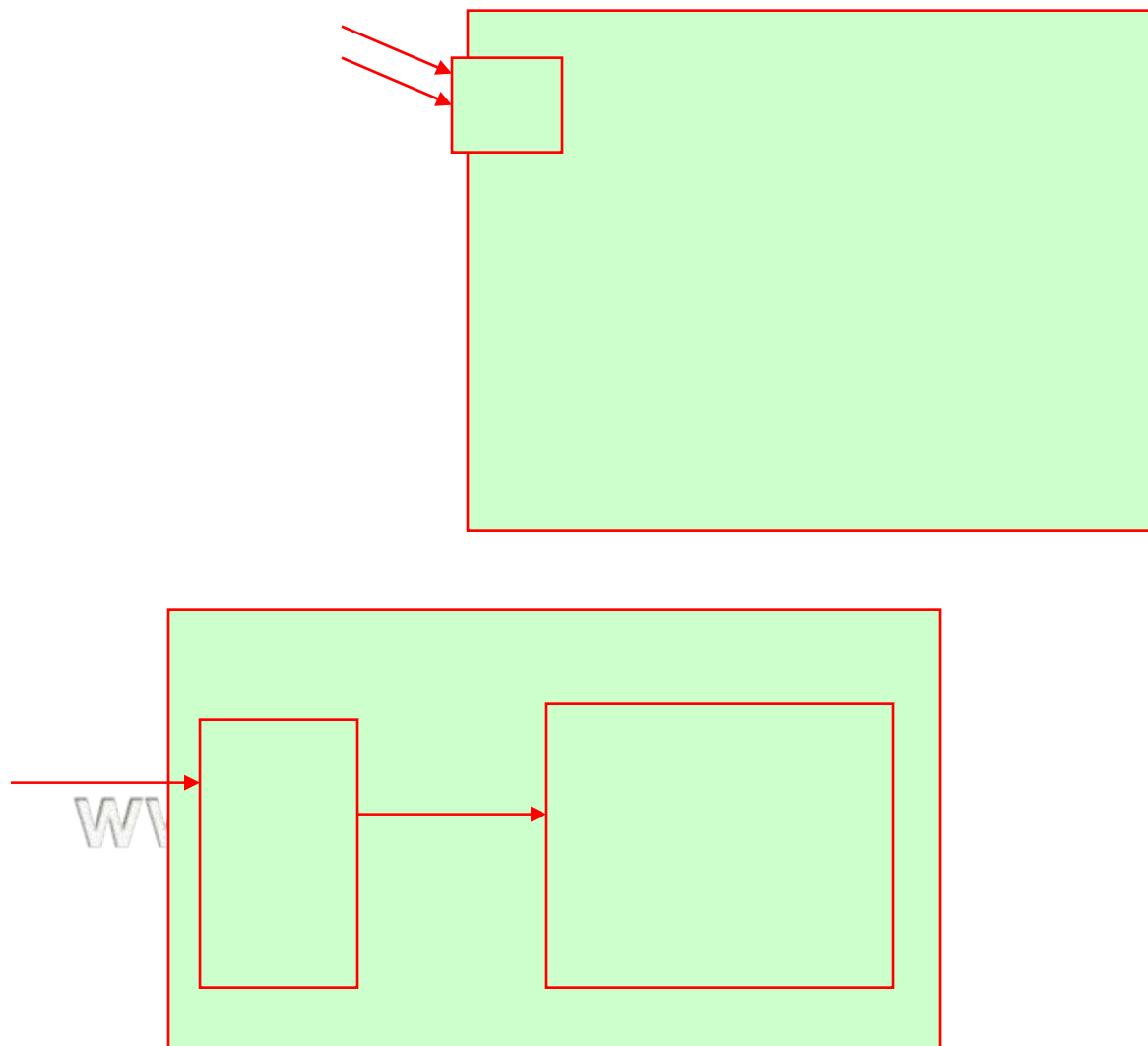
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- ❖ Loading
- ❖ Verification
- ❖ Preparation
- ❖ Resolution
- ❖ Initialization
- ❖ Using
- ❖ Unloading

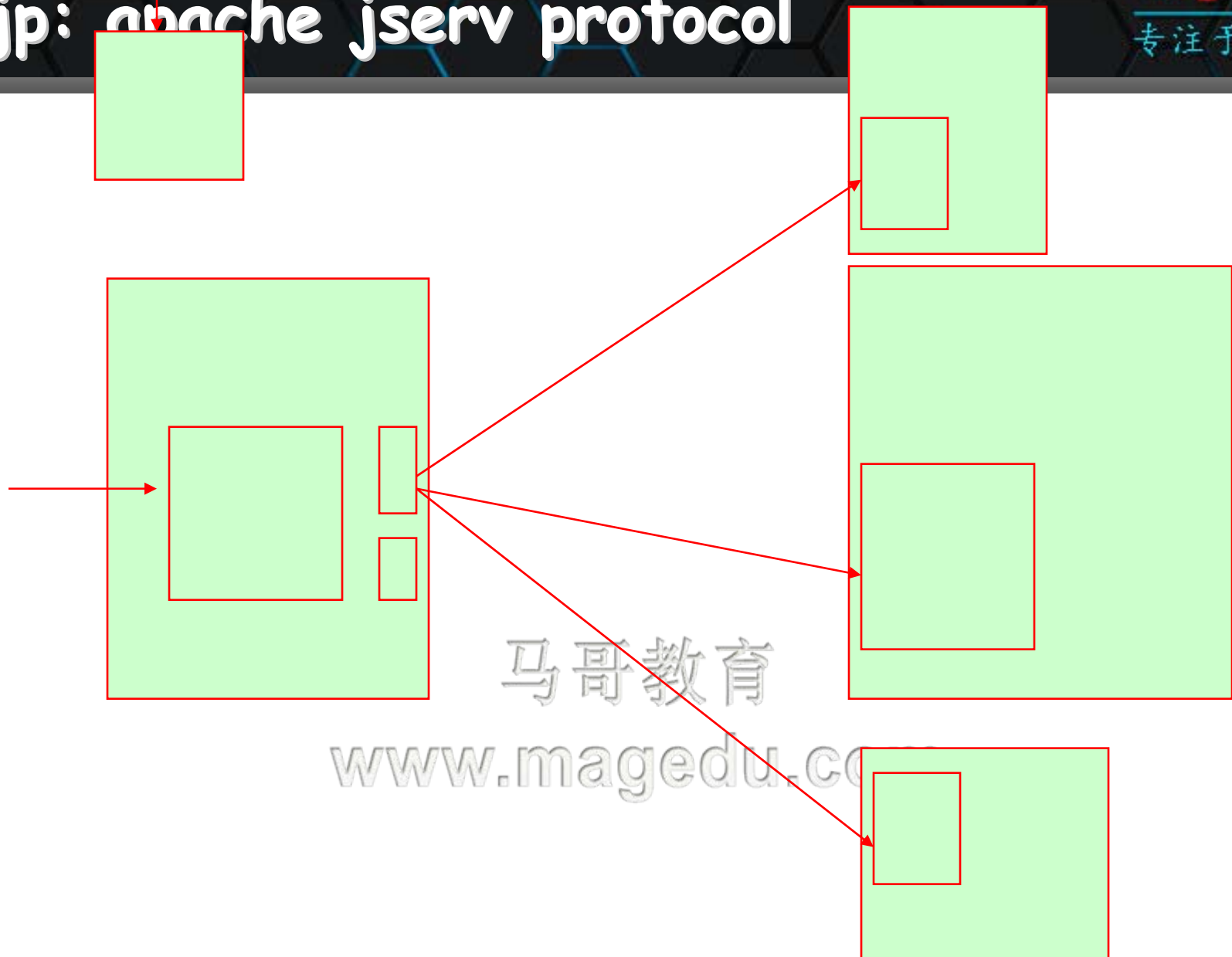
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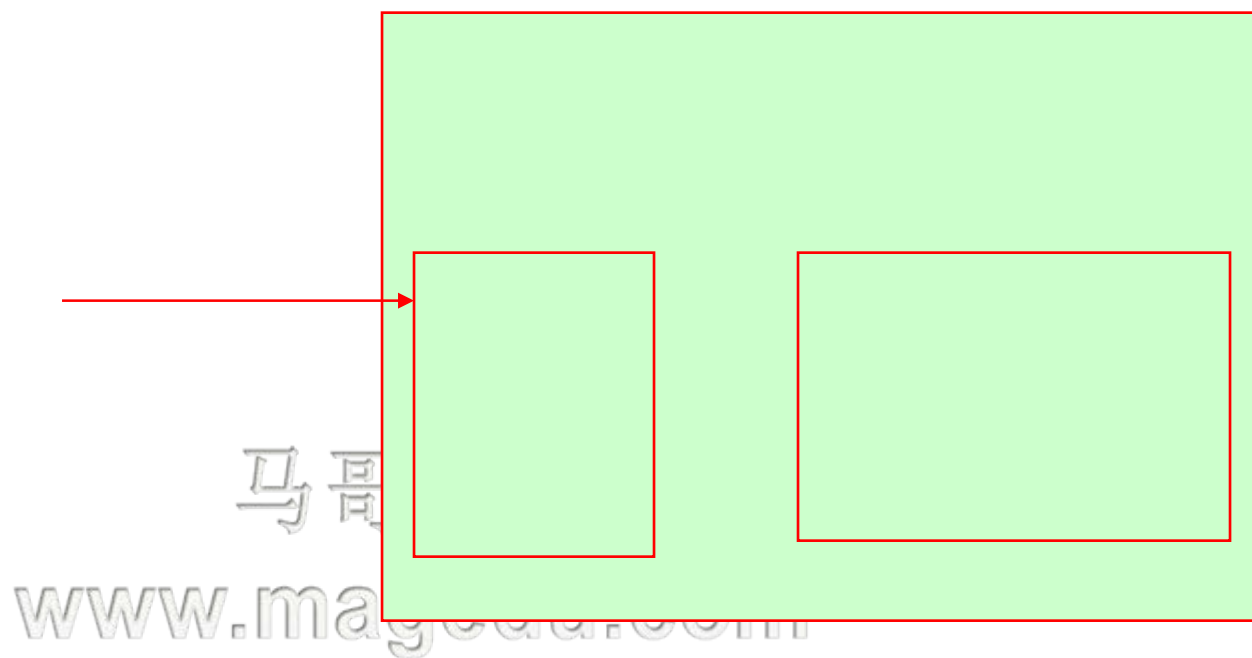


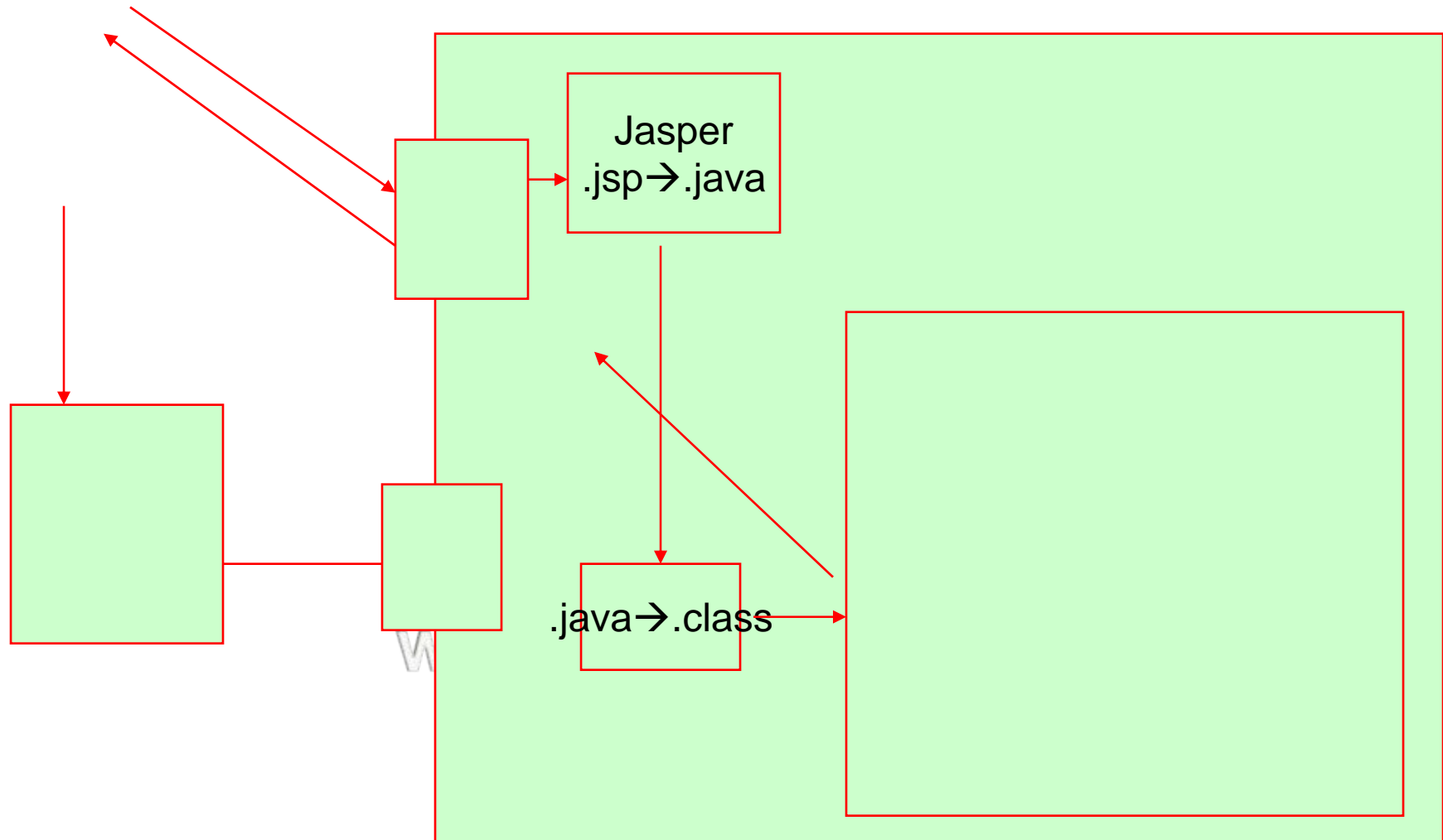


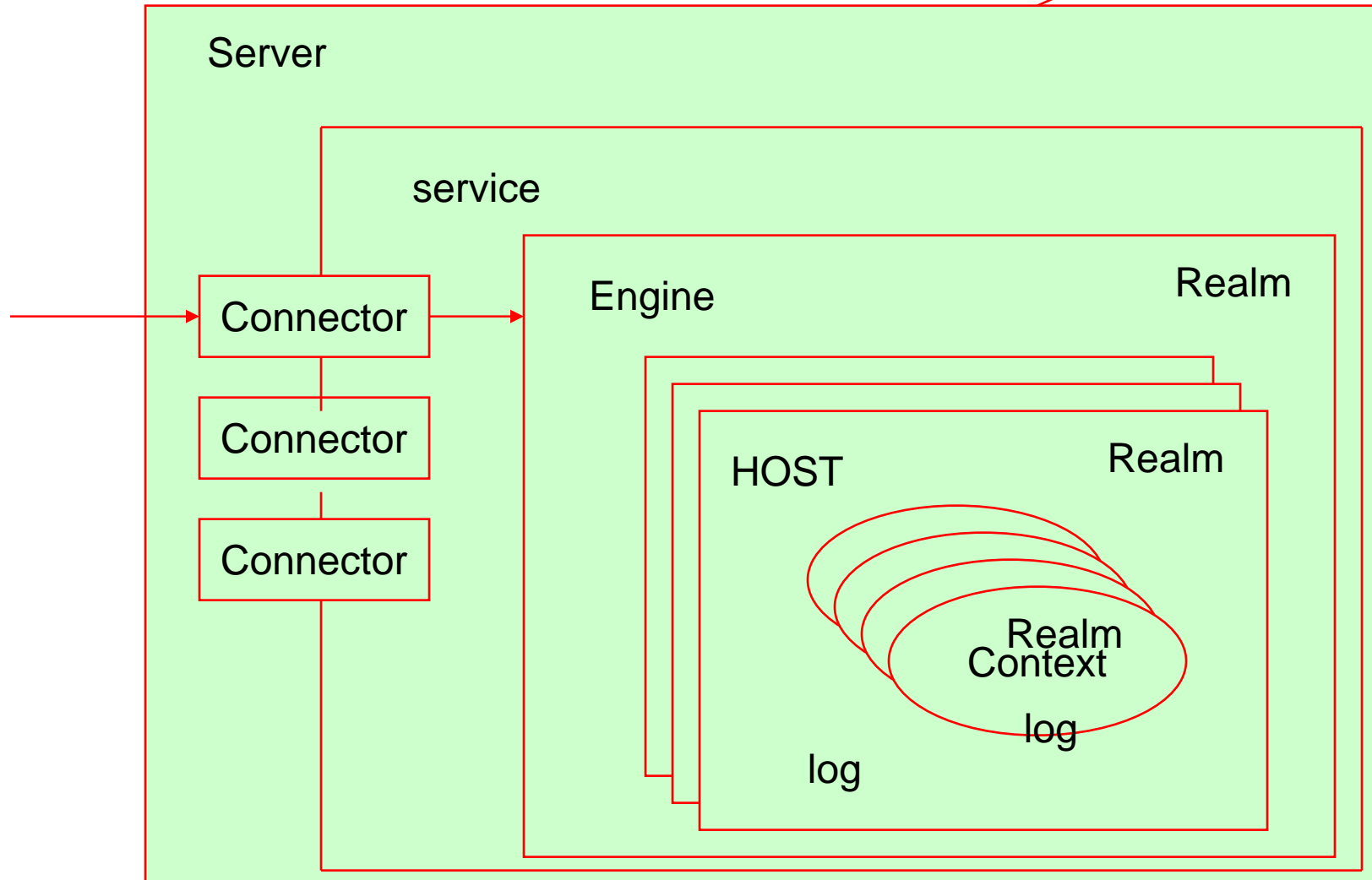
ajp: apache jserv protocol



❖ nginx+tomcat







❖ Java

➡ Applet

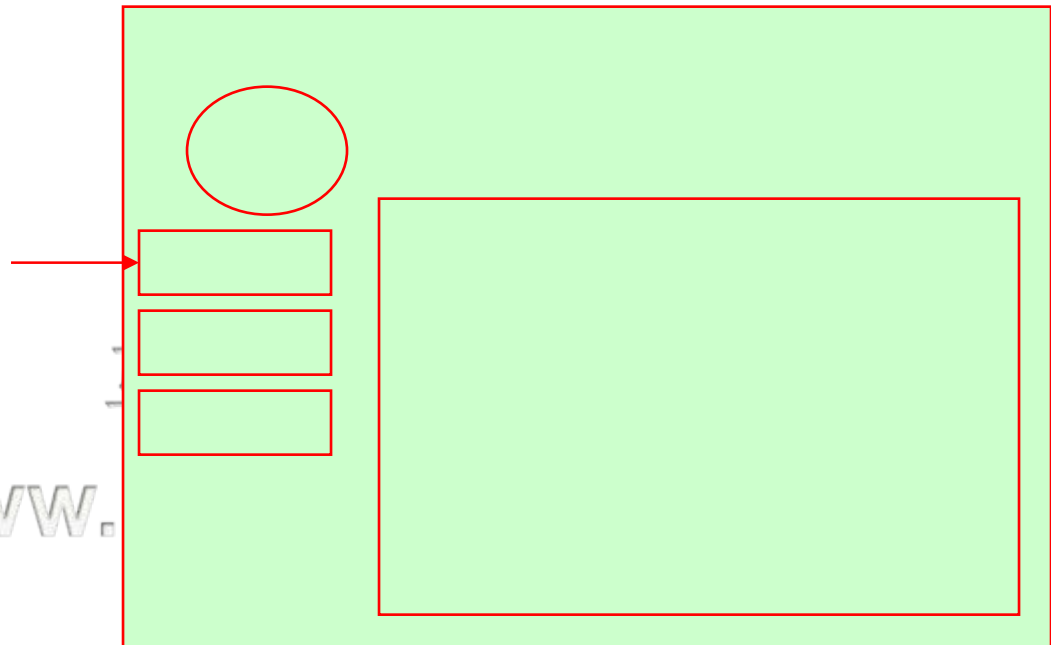
➡ Servlet: 请求-响应

➡ JSP

➡ Jasper

HTTP
HTTPS
AJP

WWW.



❖ .java → .class

❖ JDK:

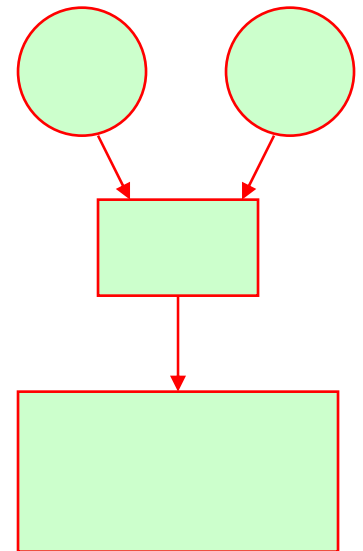
❖ Java SE,

❖ Java EE

➡ jsp, servlet

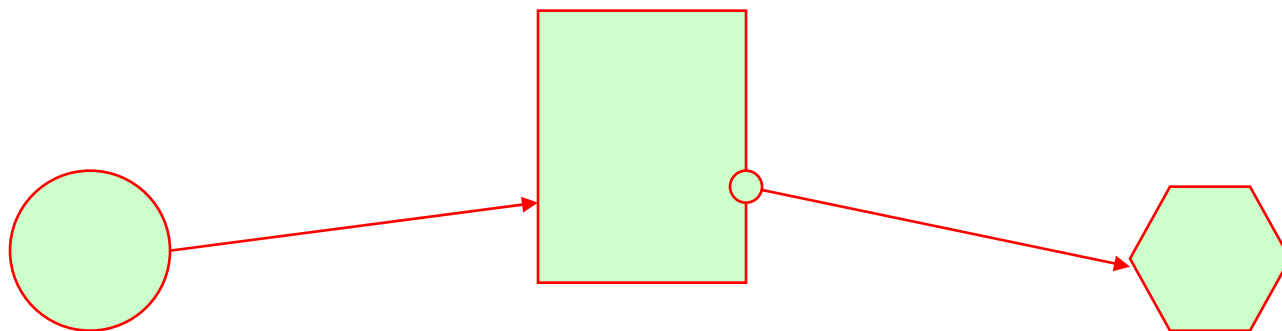
➡ jmx, jms, ejb

❖ .jsp → Jasper → .java → javac → .class



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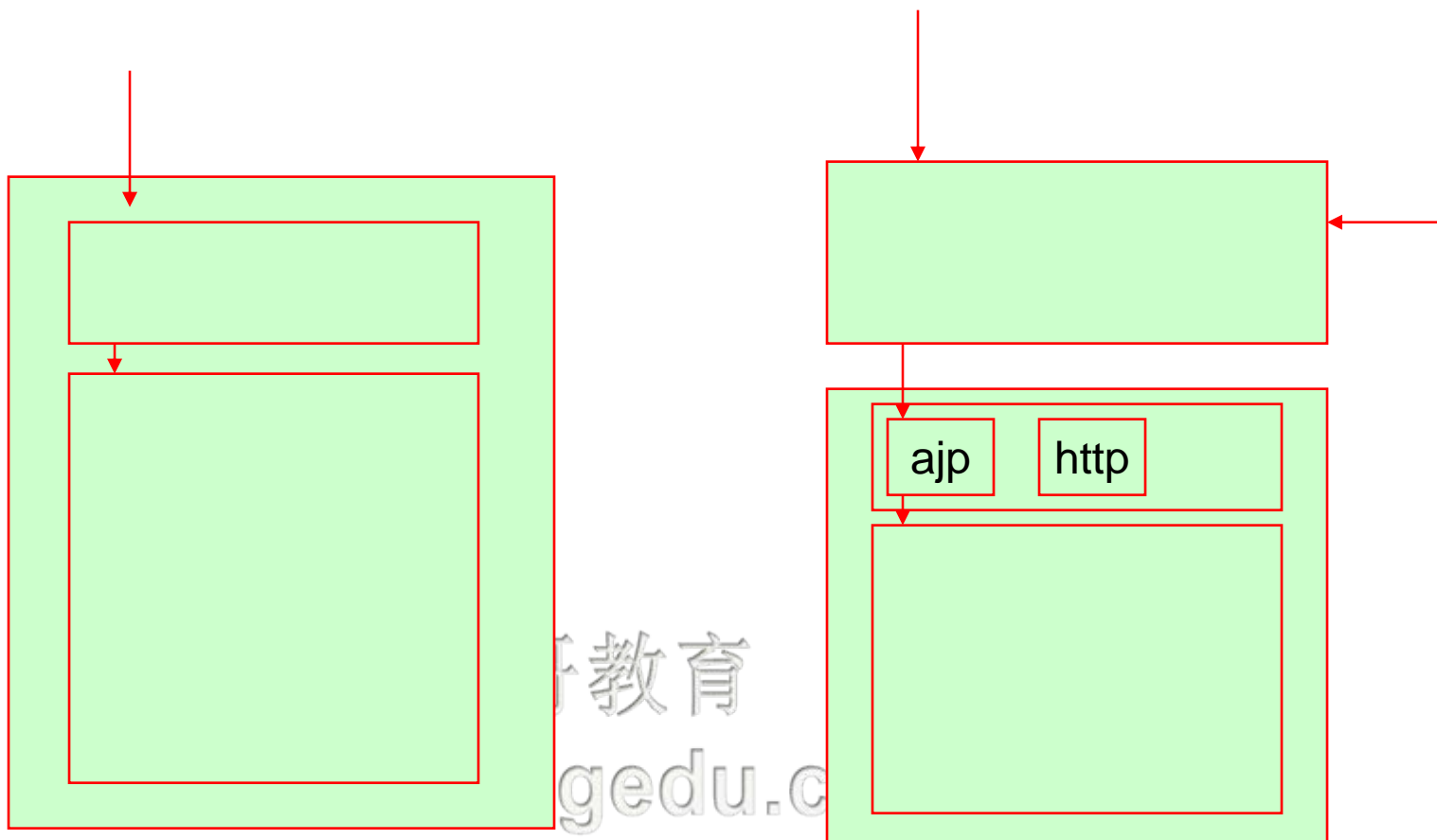
- ❖ X-Forward-For
- ❖ X-Client-IP



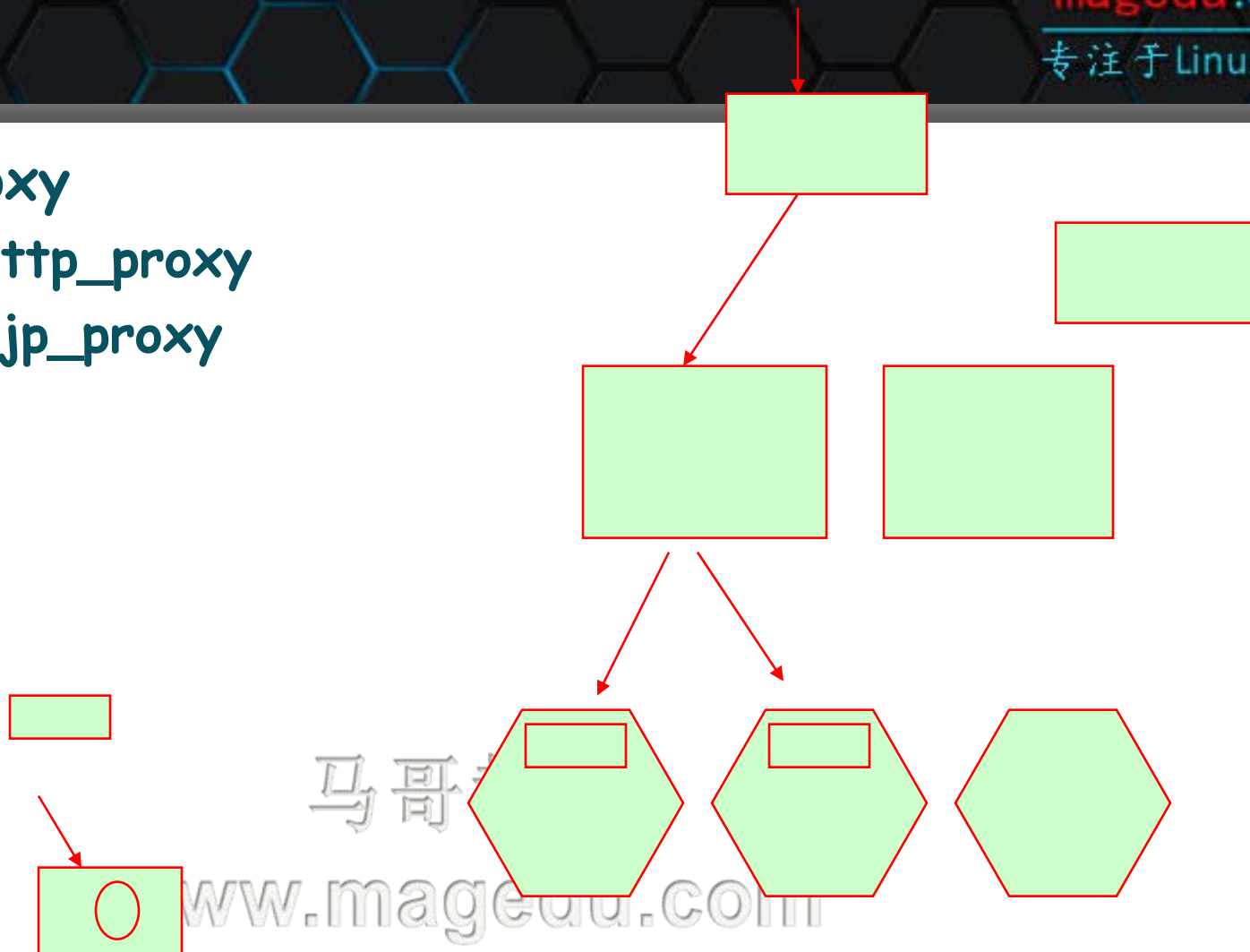
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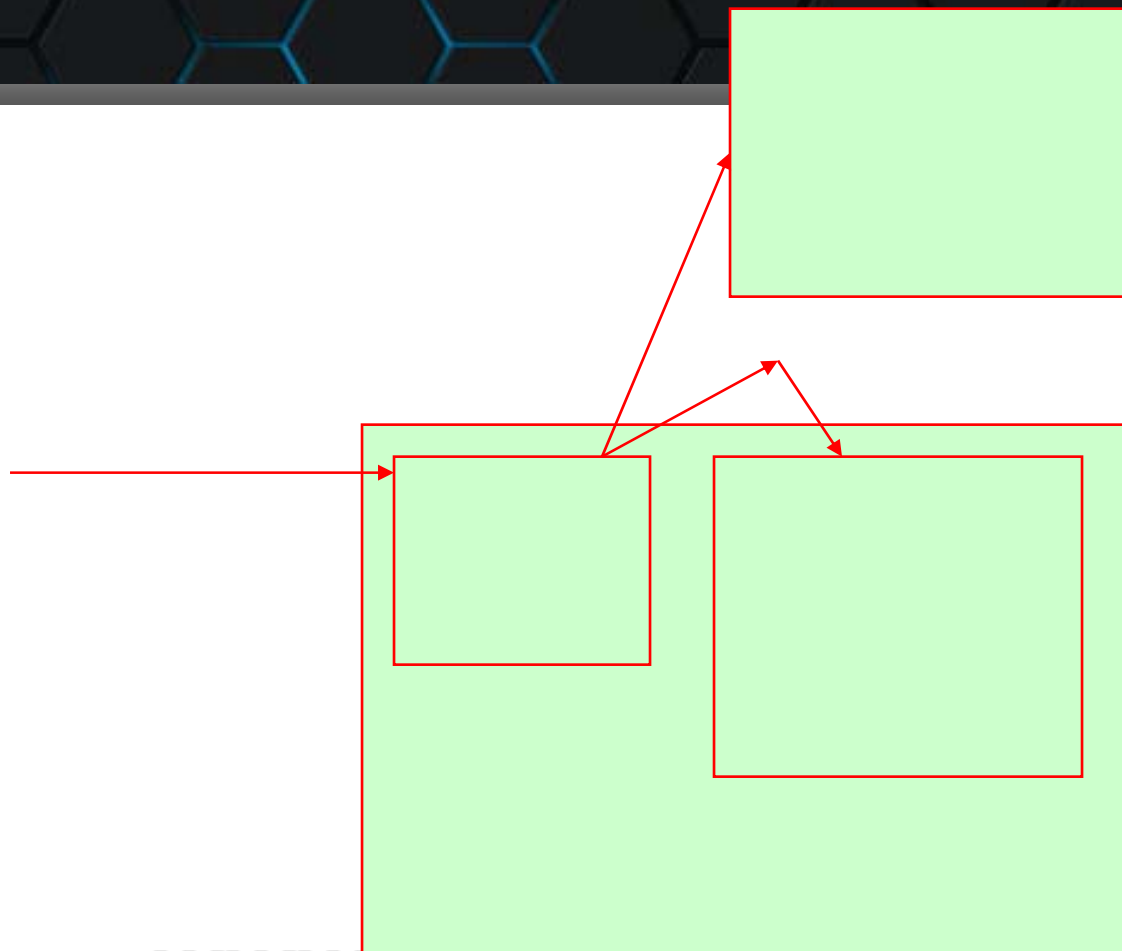
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❖ 线程



- ❖ mod_proxy
 - ➡ mod_http_proxy
 - ➡ mod_ajp_proxy
- ❖ mod_jk

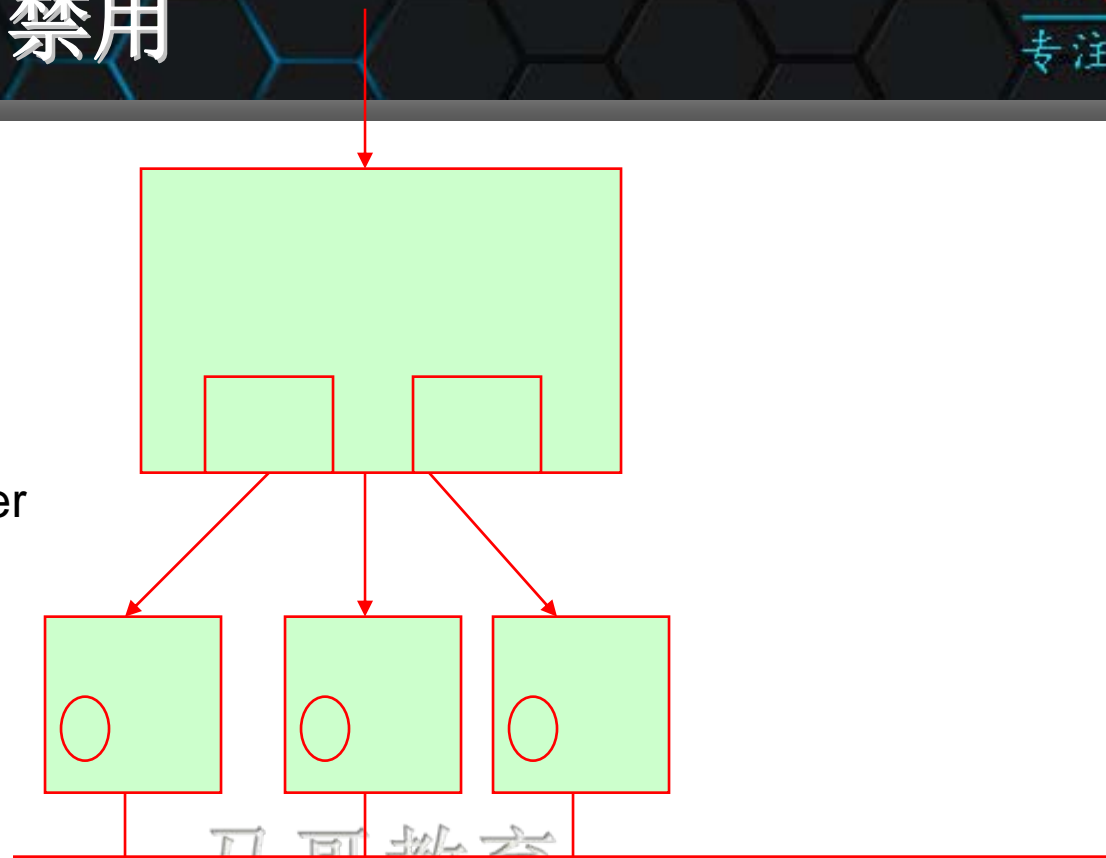




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http连接器，禁用

mod_proxy
mod_proxy_http
mod_proxy_ajp
mod_proxy_balancer
mod_jk
mod_jk2

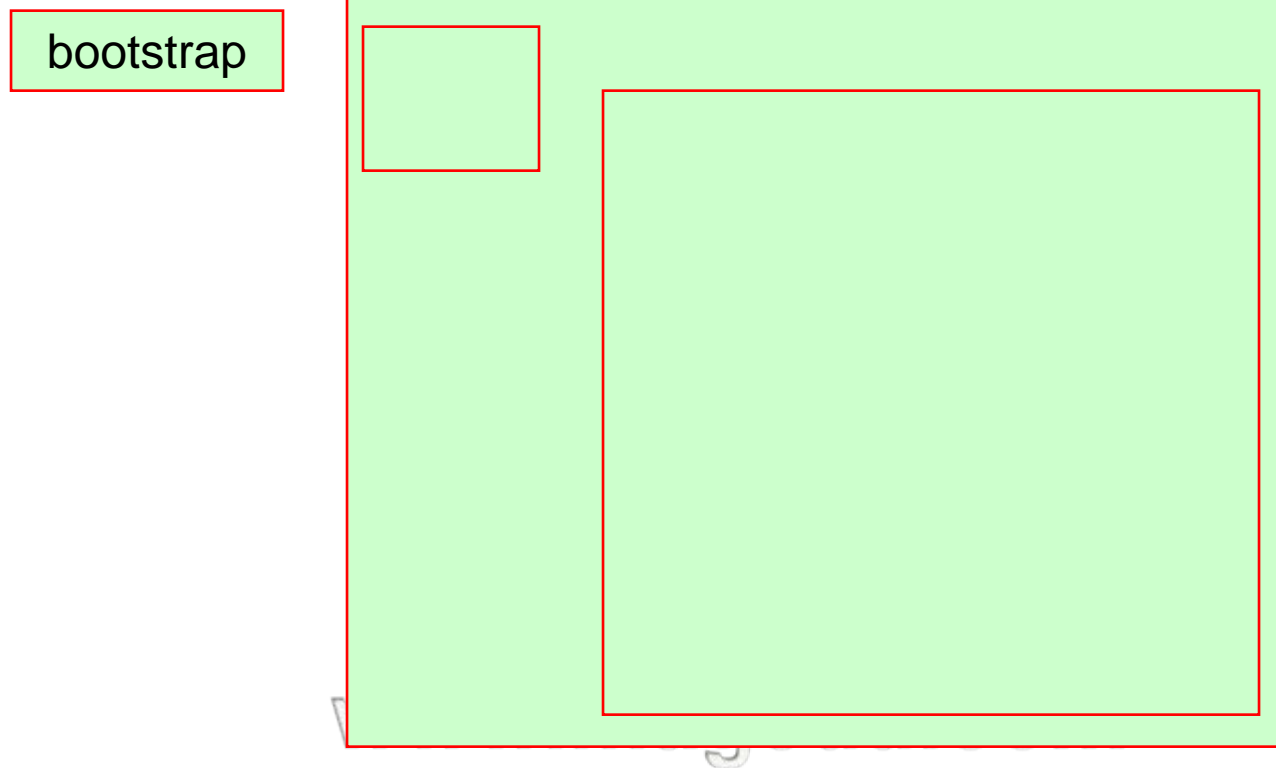


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ajp: 效率高

❖ Jvm: Java VM



- ❖ <Directory "">
- ❖ </Directory>
- ❖ <LocationMatch "\.(jsp|do)">
 - ➔ ProxyPass http:
- ❖ </LocationMatch>
- ❖ <Location "/bbs">
- ❖ </Location>

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❖ Nginx

➡ Web

➡ Web reverse proxy

➤ Varnish

➤ Squid, Apache

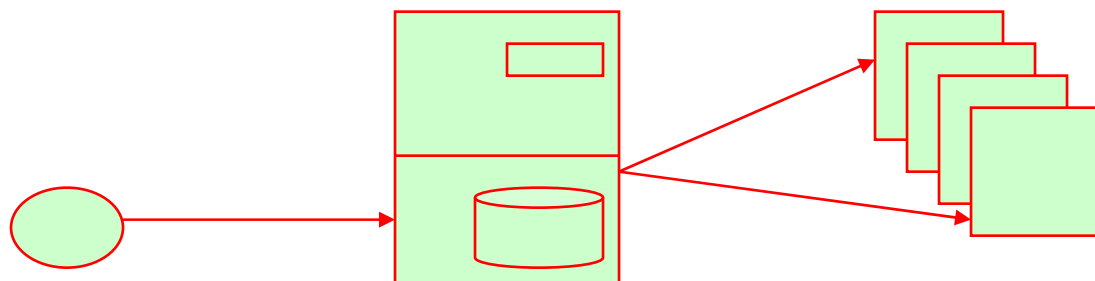
➡ Mail reverse proxy

❖ event-based

❖ AIO

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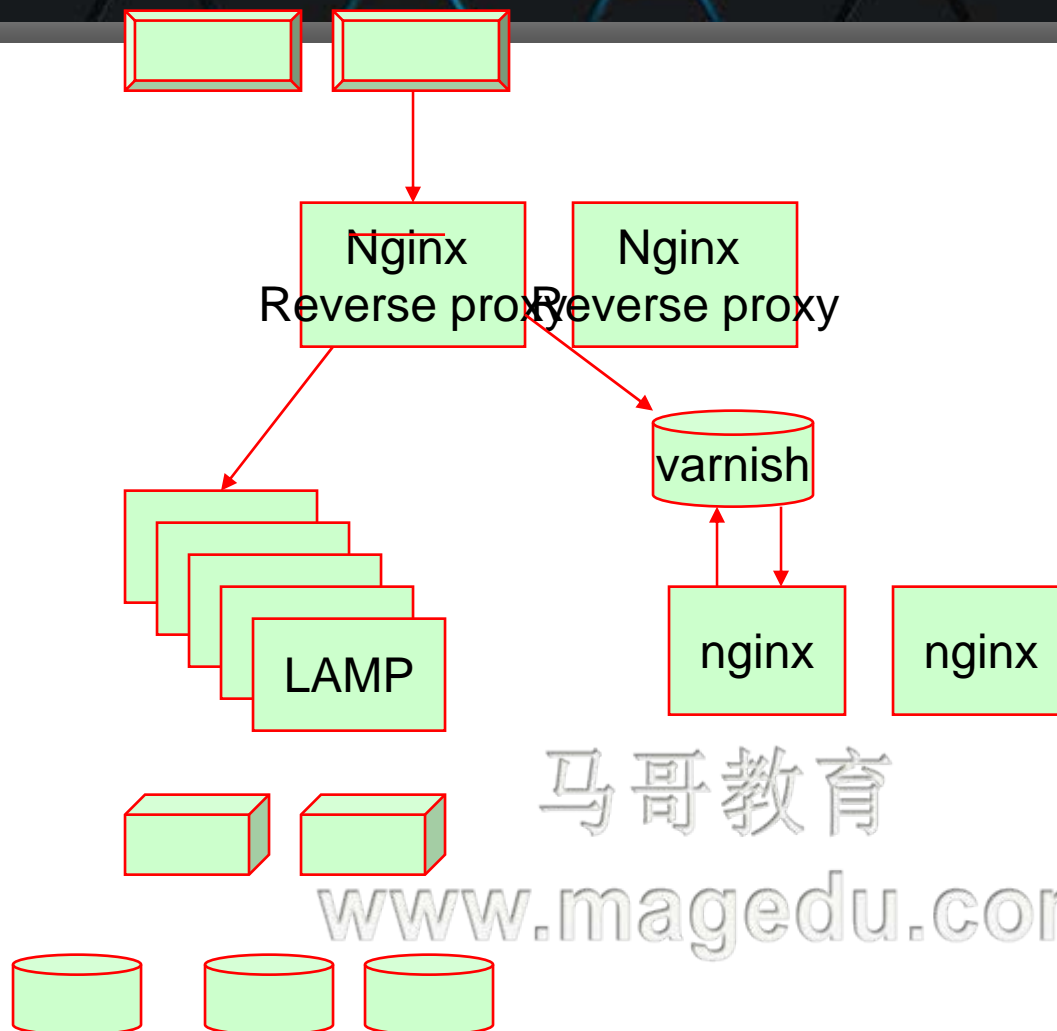
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URL hash: /path/to/cache_object

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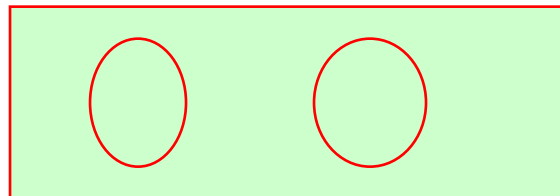
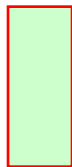
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❖ a.so

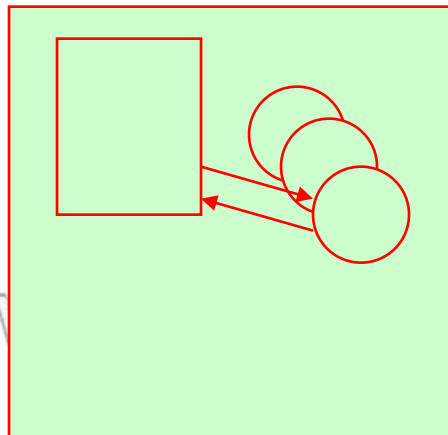
❖ x

❖ y



500

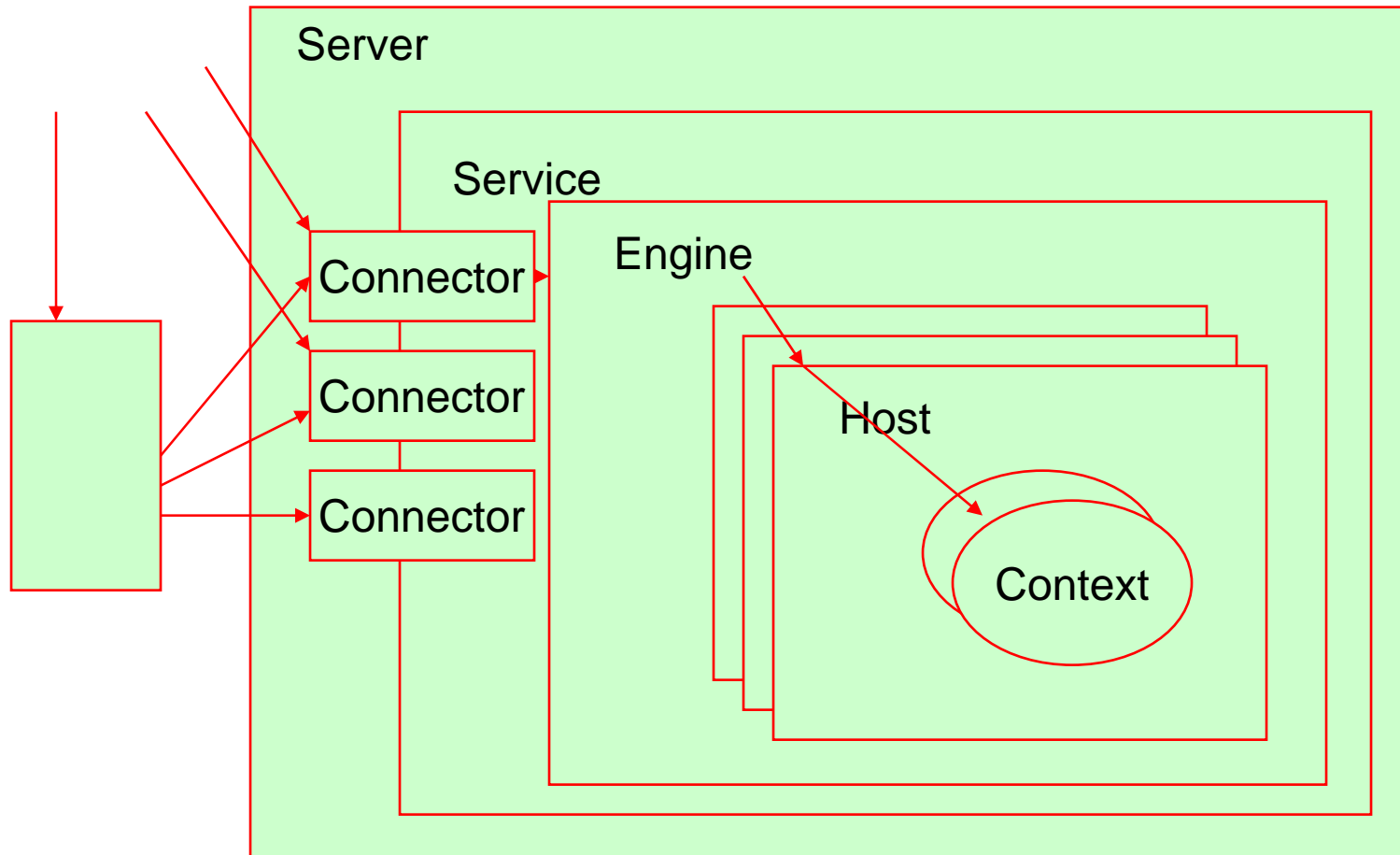
400



html格式页面

php(opcode): xcache

perl,



AJP: Apache Jserv Protocol

❖ http connection:

➡ http, cotyo

➡ NIO

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Tomcat Cluster

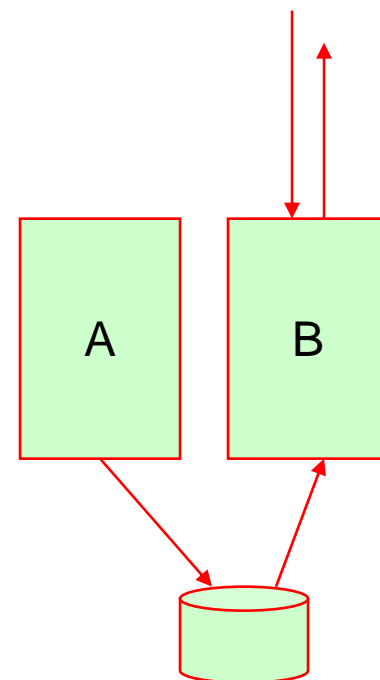
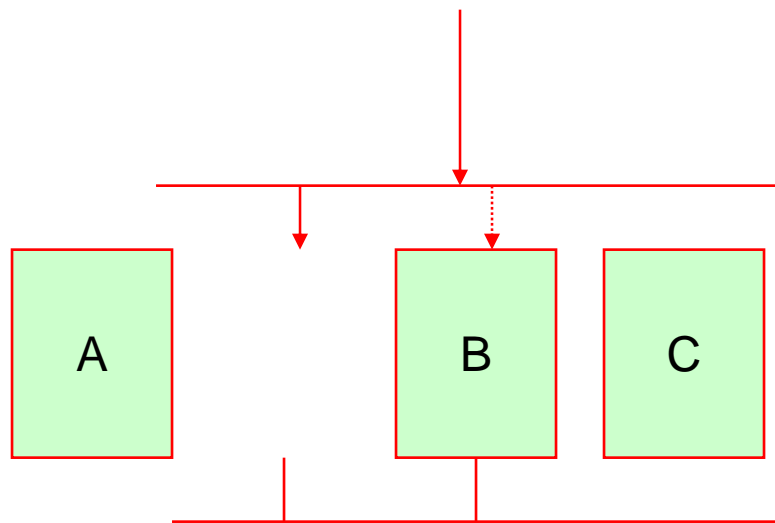
主讲：马永亮(马哥)

QQ:113228115

客服QQ: 2813150558, 1661815153

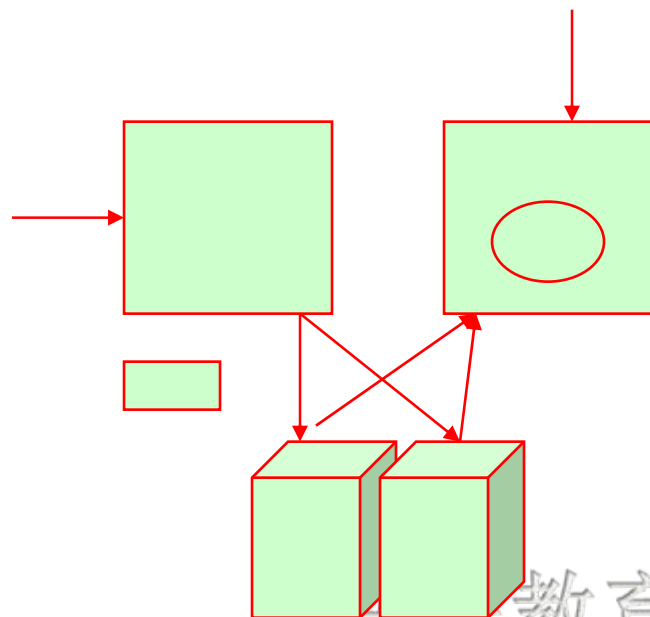
<http://www.magedu.com>

<http://mageedu.blog.51cto.com>



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❖ Cluster

➡ LB

➤ 4层lb

- lvs, haproxy(tcp)

➤ 7层lb

- apache(mod_jk, mod_proxy): ajp
- apache(mod_proxy), haproxy, nginx: http

➡ HA

➤ corosync: LSB (start, stop, restart, status)

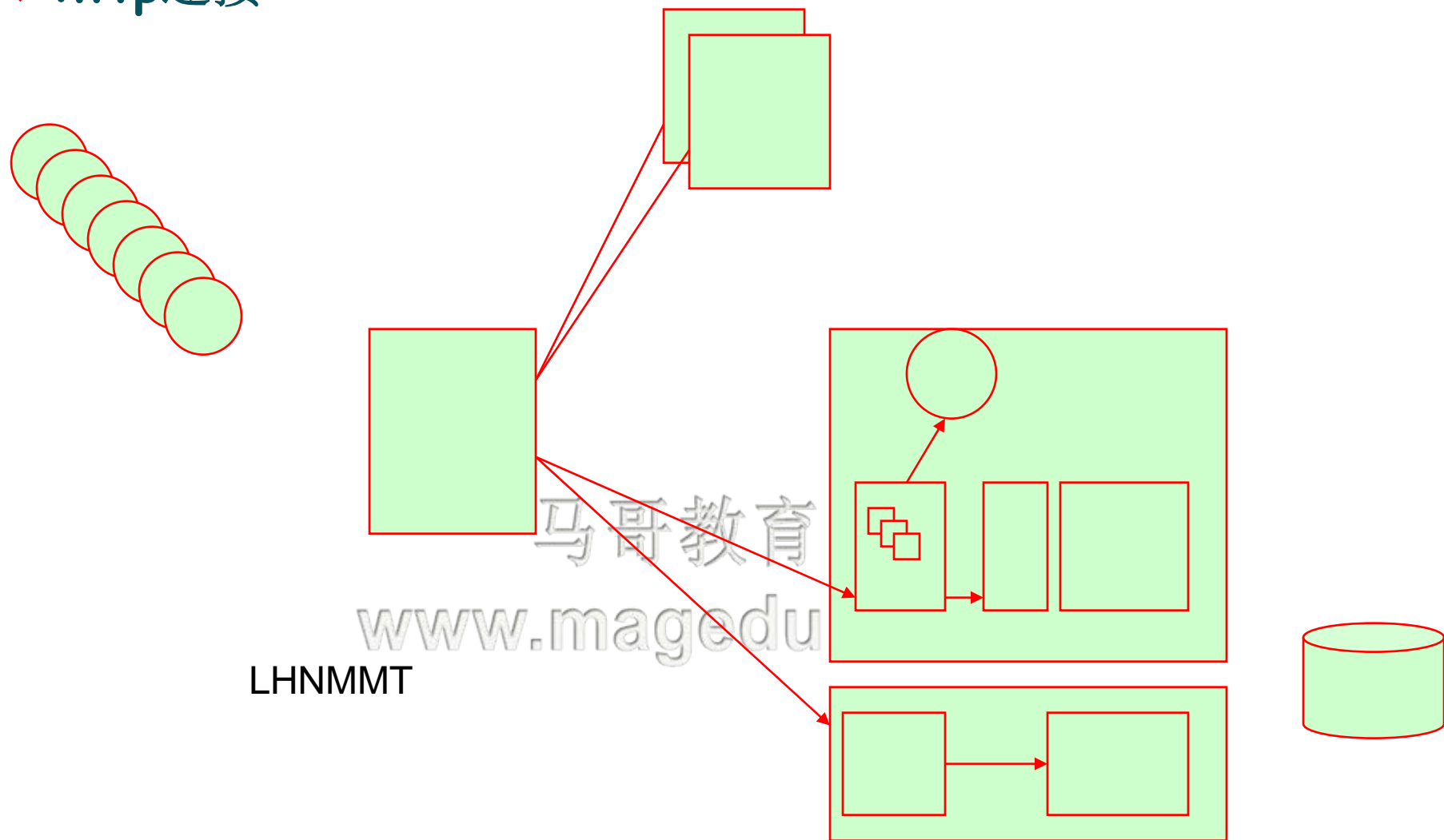
➤ keepalived

➡ HP

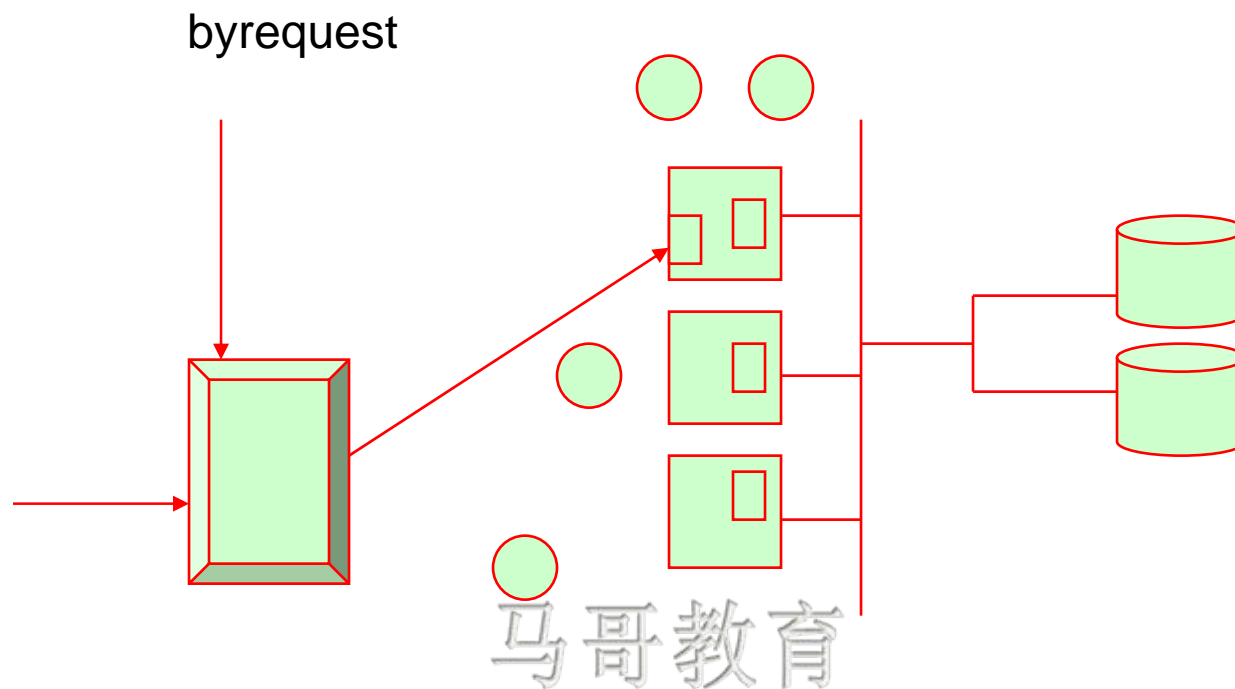
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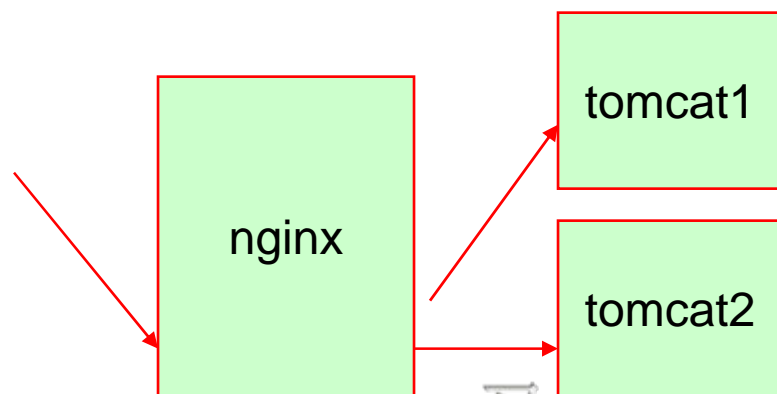
❖ http连接



❖ 双写

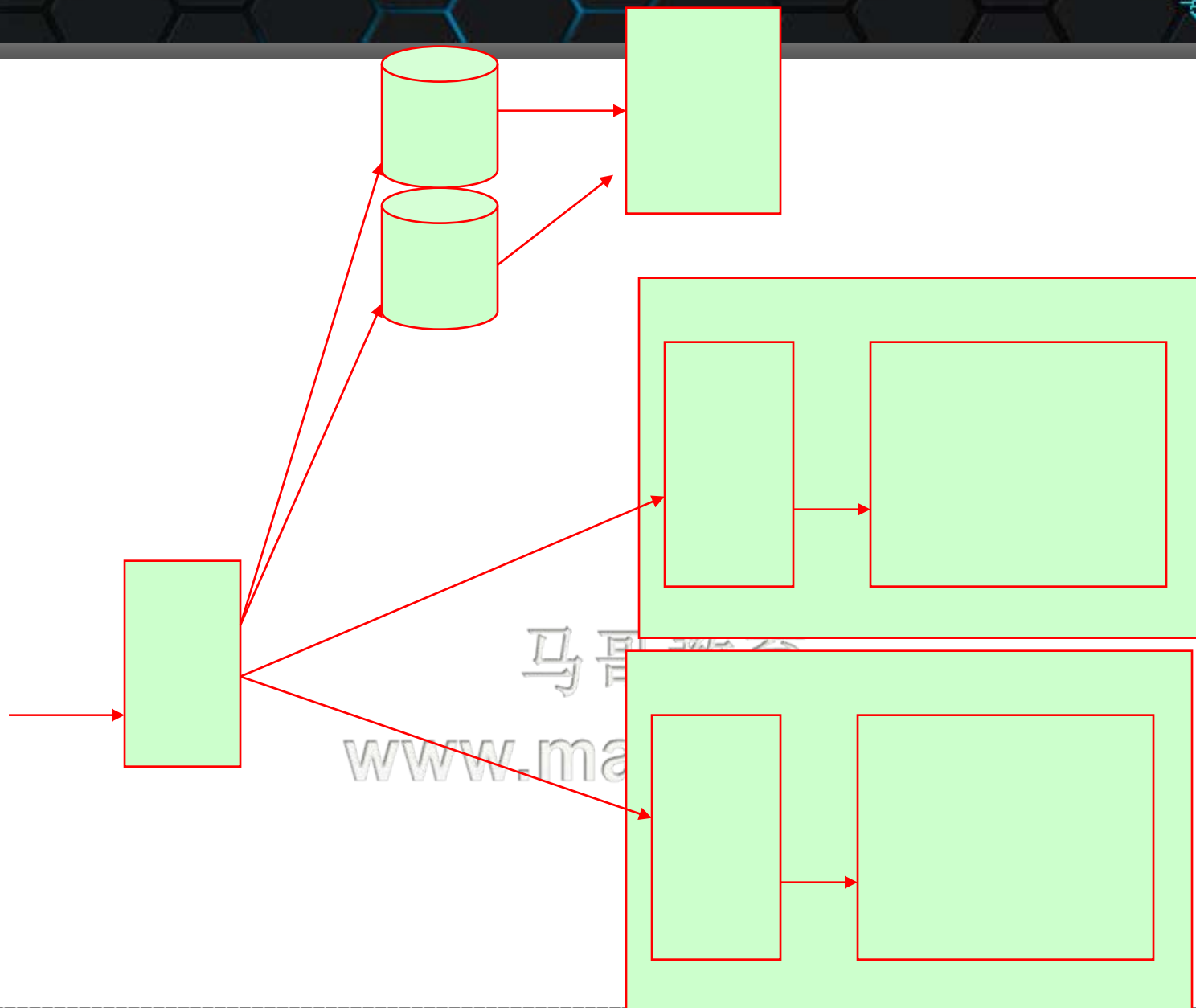


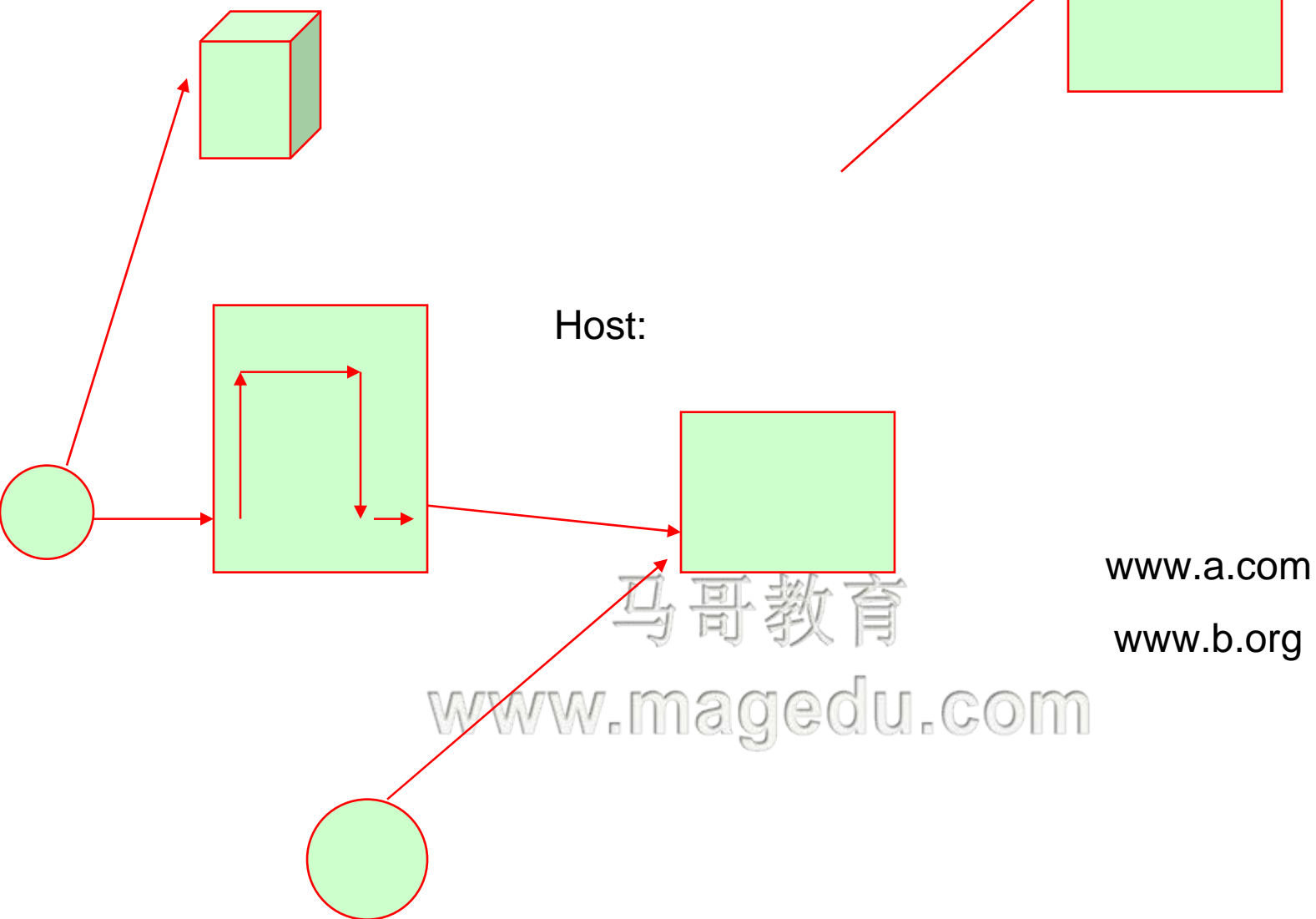
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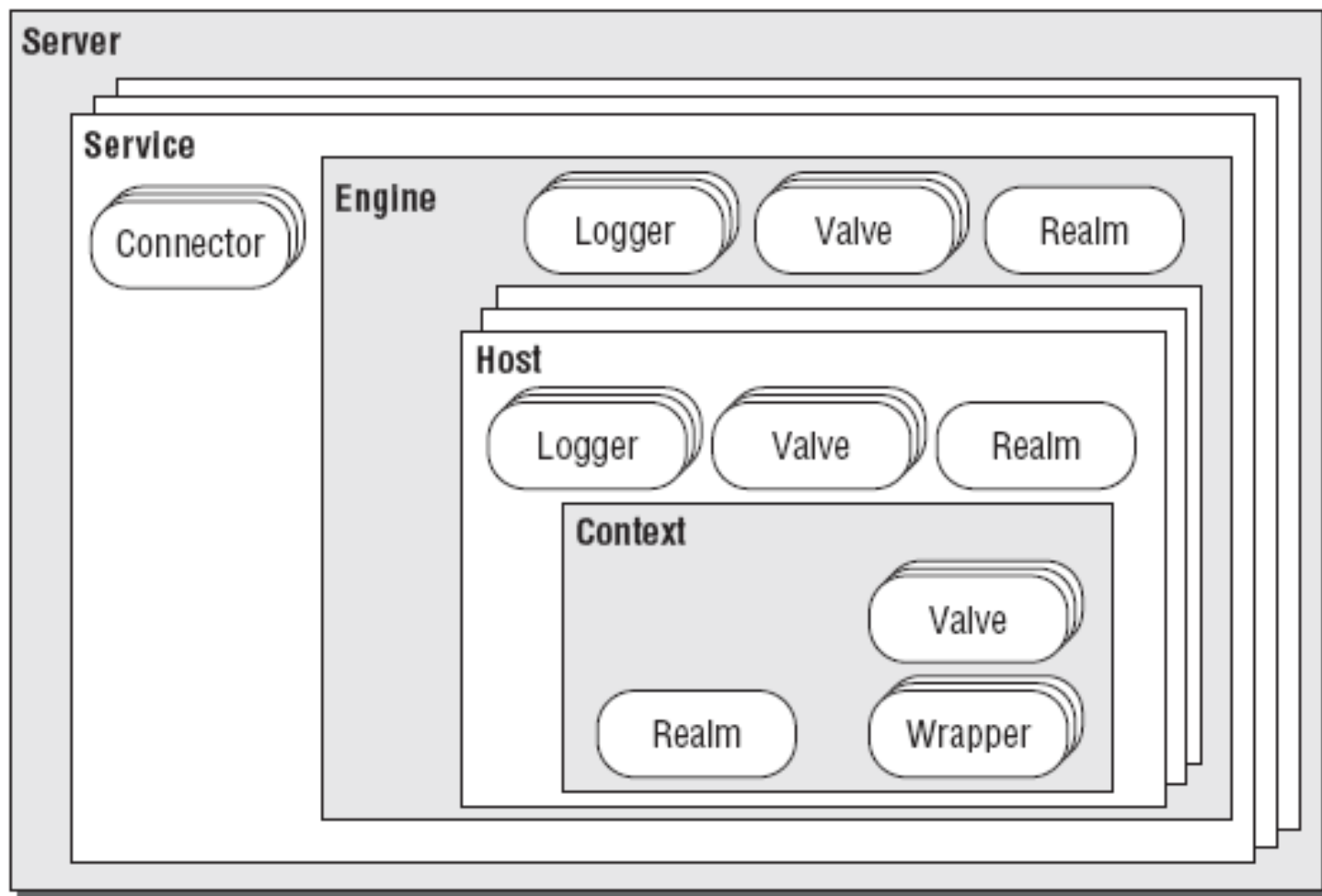
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JNDI: Resource, 用户认证



❖ /www/htdocs/webapps

➡ bbs/

- index.jsp
- logo.jpg
- WEB-INF/
 - web.xml
 - classes
 - lib

➡ WAR

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❖ URL, `http://server/manager/`

❖ Web GUI

➡ manager

➤ 程序部署操作

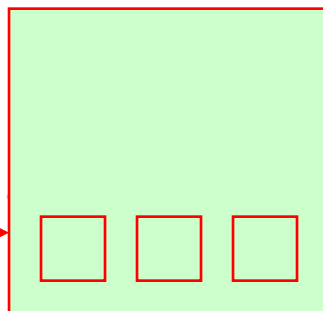
➤ 会话管理

➤ status

➡ host manager

➤ 虚拟主机

➡ Realm → 用户



❖ Session Manager

➡ StandardManager

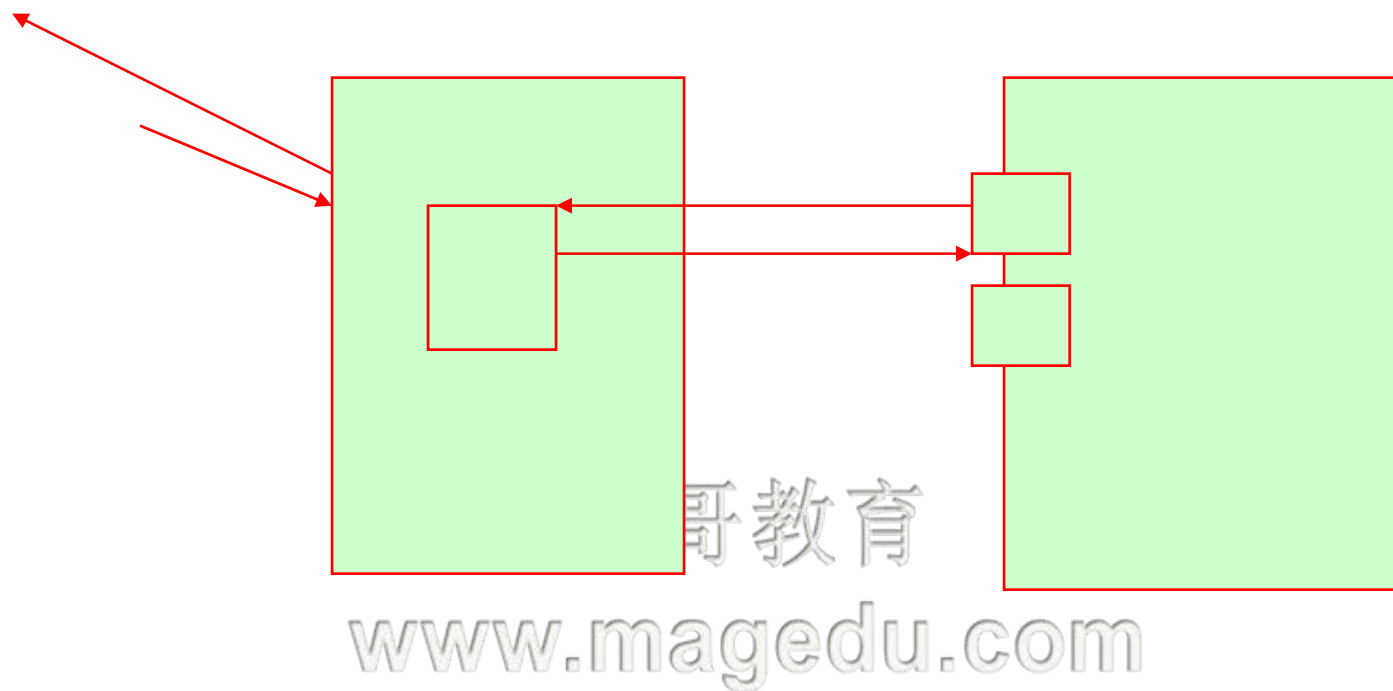
- Tomcat服务要正常关闭
- kill -9
- 保存至文件SESSIONS.ser

➡ PersistentManager

- session id.session
- FileStore
 - abd78fd9afhdagy89ewqtrjg.session
- JDBCStore
 - RDMBS

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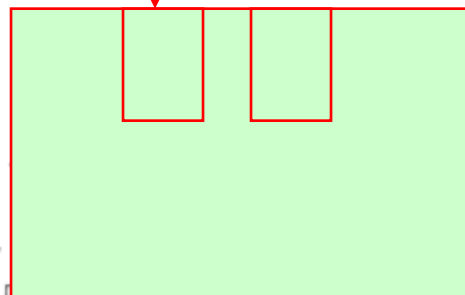
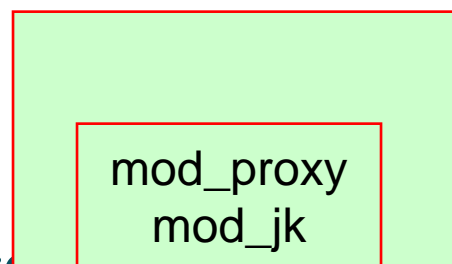
❖ `mod_jk` → `AJP` → `tomcat`

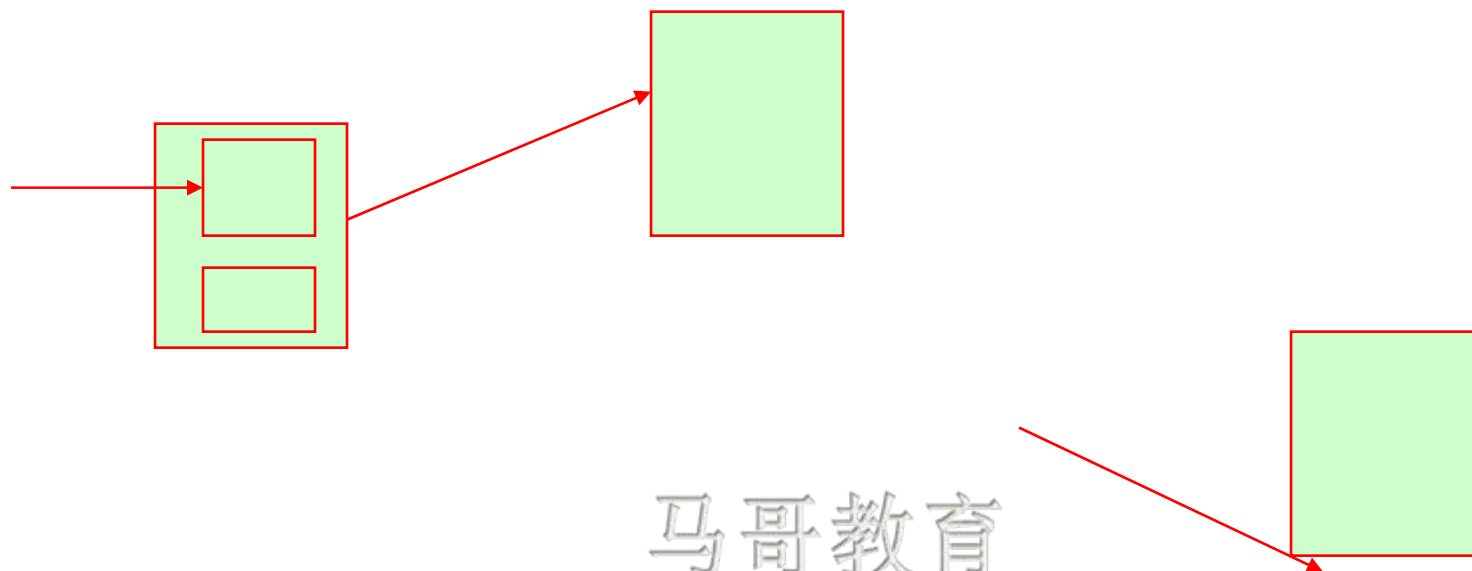
❖ `mod_proxy`:

➡ `mod_proxy_http`

➡ `mod_proxy_ajp`

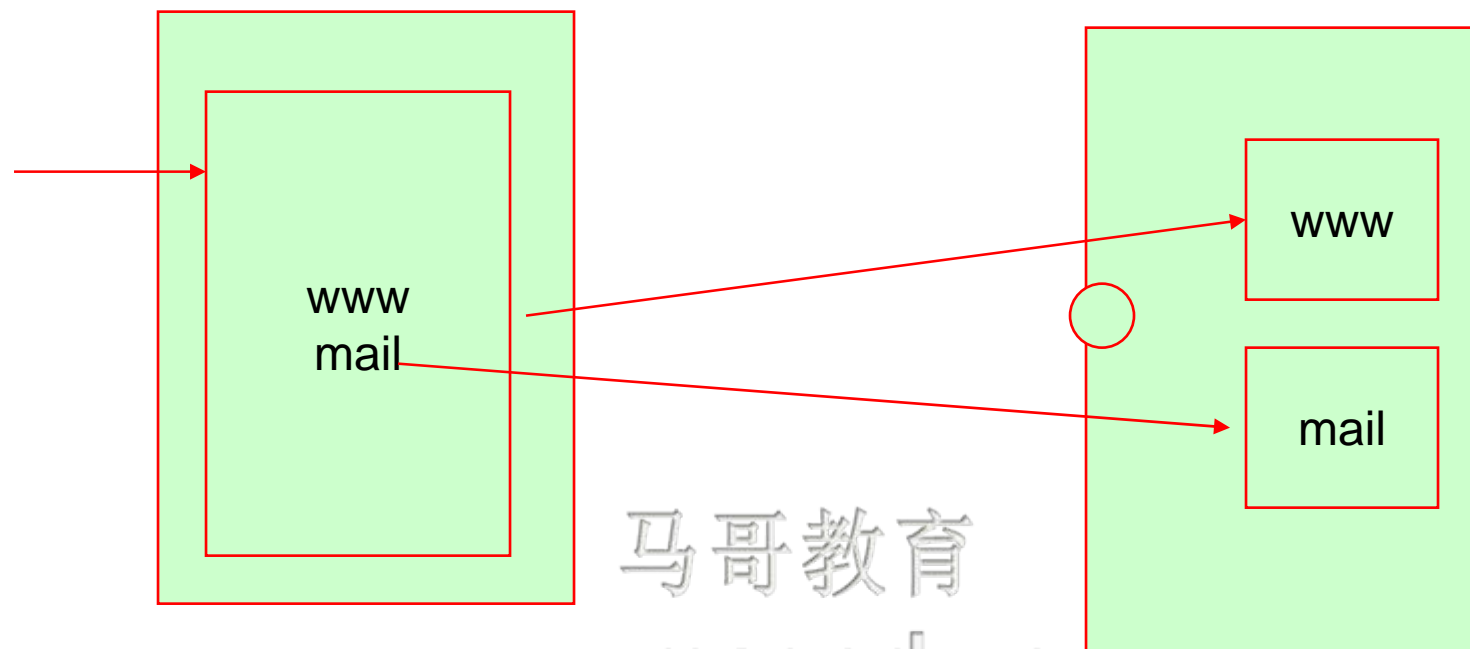
➡ `mod_proxy_balancer`





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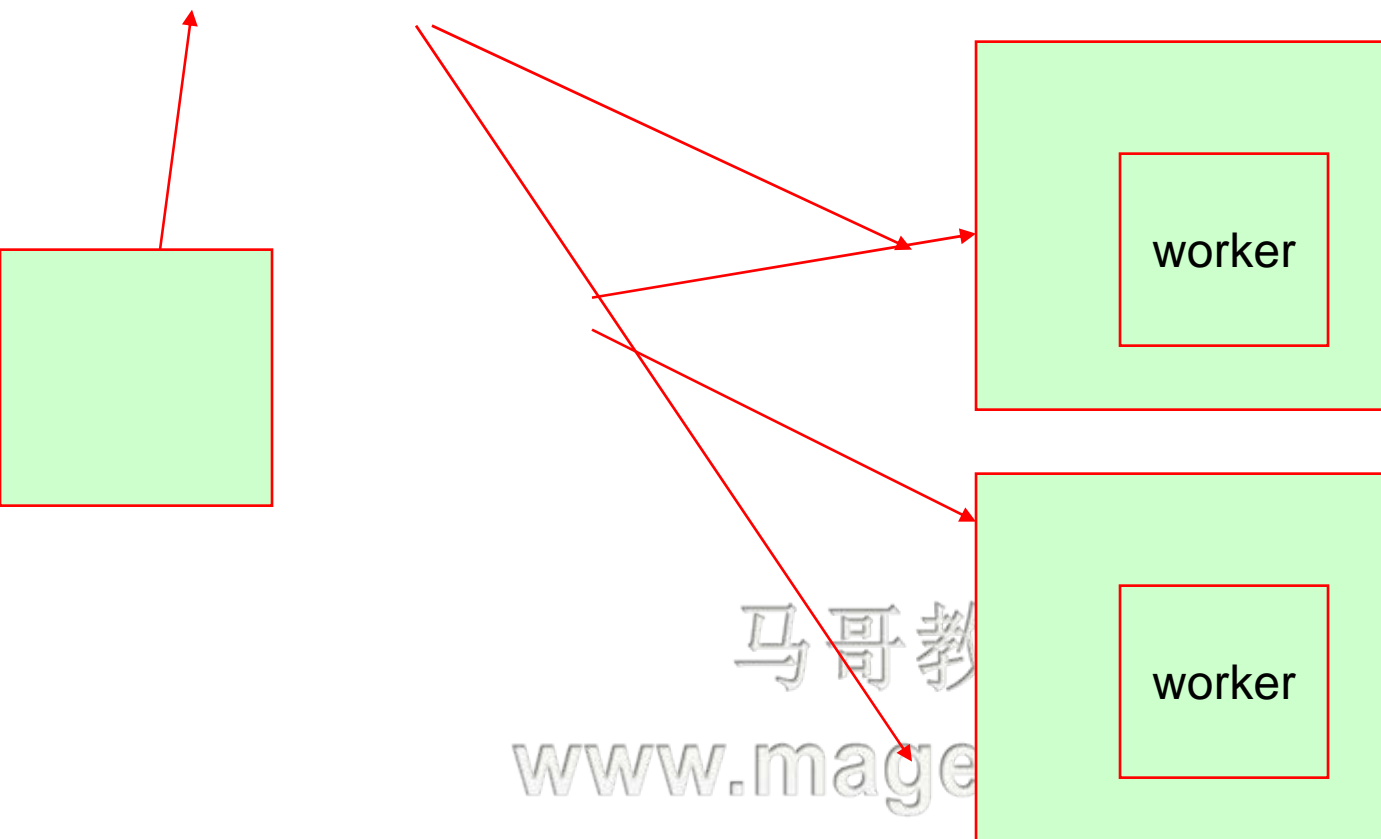
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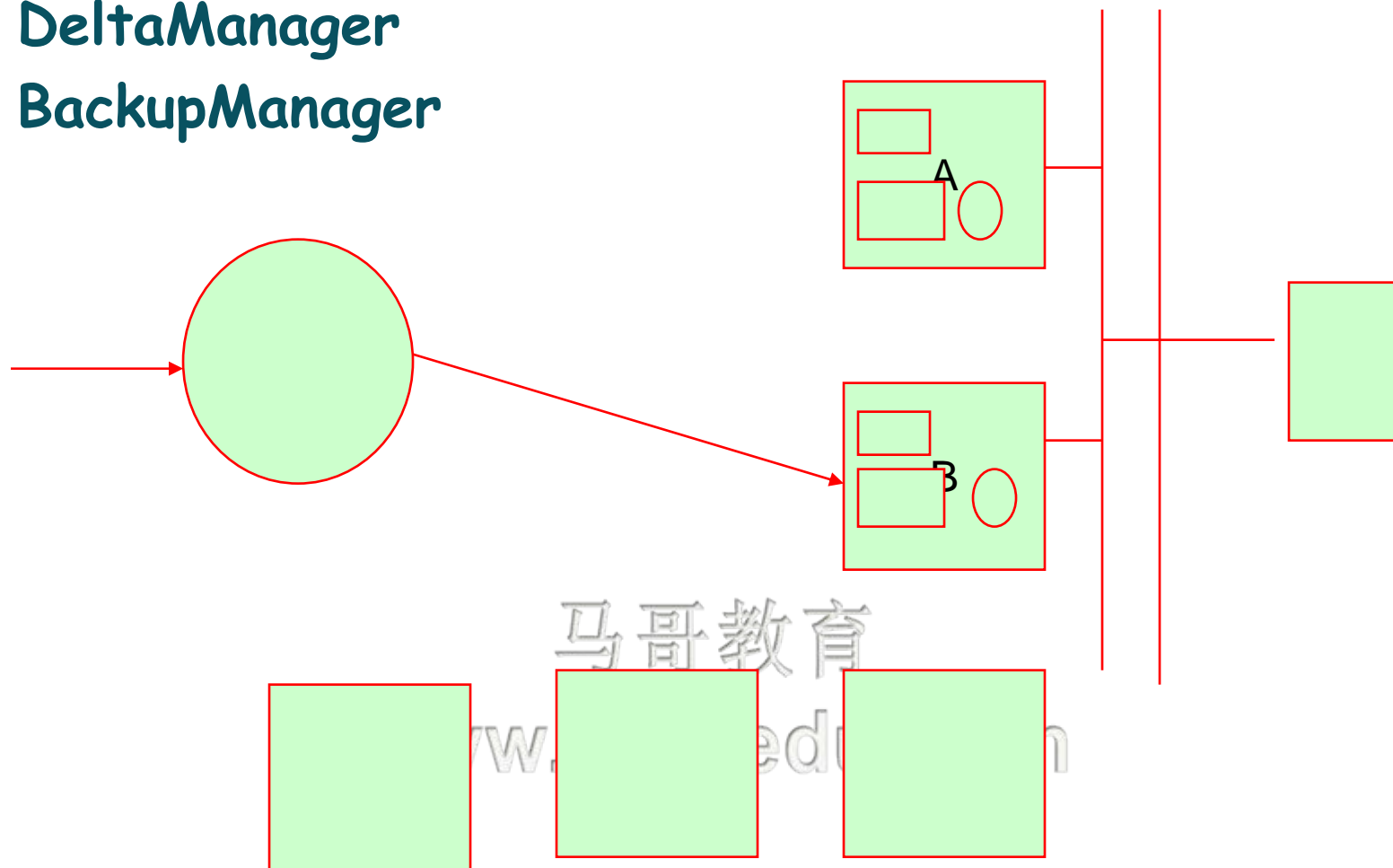
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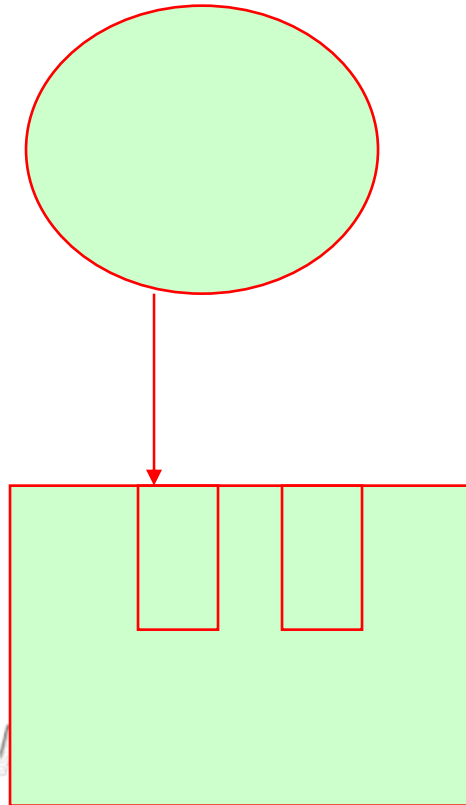
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❖ worker

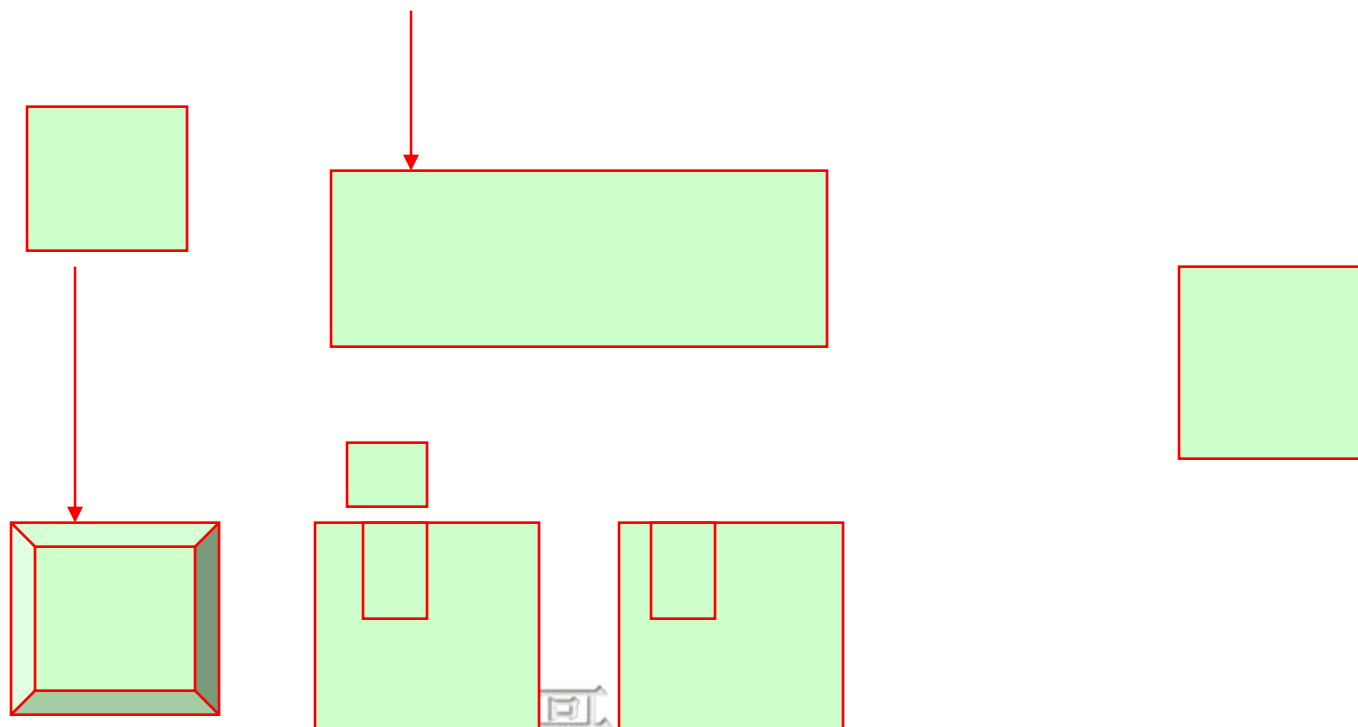


- ❖ DeltaManager
- ❖ BackupManager





❖ LVS



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Relative Path	Description
/	Web application root: All files that are publicly accessible are placed in this directory. Examples include HTML, JSP, and GIF files.
/WEB-INF	All files in this directory and its subdirectories are not publicly accessible. A single file, <code>web.xml</code> , called the <i>deployment descriptor</i> , contains configuration options for the Web application. The various options for the deployment descriptor are defined by the Servlet API.
/WEB-INF/classes	All of the Web application's class files are placed here.
/WEB-INF/lib	Class files can be archived into JAR files and placed in this directory.

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Script	Purpose
catalina	The main Tomcat script. This runs the <code>java</code> command to invoke the Tomcat startup and shutdown classes.
cpappend	This is used internally, and then only on Windows systems, to append items to Tomcat classpath environment variables.
digest	This makes a <code>crypto</code> digest of Tomcat passwords. Use it to generate encrypted passwords.
service	This script installs and uninstalls Tomcat as a Windows service.
setclasspath	This is also only used internally and sets the Tomcat classpath and several other environment variables.
shutdown	This runs <i>catalina stop</i> and shuts down Tomcat.
startup	This runs <i>catalina start</i> and starts up Tomcat.
tool-wrapper	This is a generic Tomcat command-line tool wrapper script that can be used to set environment variables and then call the main method of any fully qualified class that is in the classpath that is set. This is used internally by the <code>digest</code> script.
version	This runs the <i>catalina version</i> , which outputs Tomcat's version information.

Option	Purpose
-config [<i>server.xml</i> file]	This specifies an alternate <i>server.xml</i> configuration file to use. The default is to use the <i>server.xml</i> file that resides in the <code>\$CATALINA_BASE/conf</code> directory. See the “ <i>server.xml</i> ” section in Chapter 7 for more information about <i>server.xml</i> ’s contents.
-help	This prints out a summary of the command-line options.
-nonaming	This disables the use of JNDI within Tomcat.
-security	This enables the use of the <i>catalina.policy</i> file.
debug	This starts Tomcat in debugging mode.
embedded	This allows Tomcat to be tested in an embedded mode, and is usually used by application server developers.
jpda start	This starts Tomcat as a Java Platform Debugger Architecture-compliant debugger. See Sun’s JPDA documentation at http://java.sun.com/products/jpda .
run	This starts up Tomcat without redirecting the standard output and errors.
start	This starts up Tomcat, with standard output and errors going to the Tomcat logfiles.
stop	This stops Tomcat.
version	This outputs Tomcat’s version information.

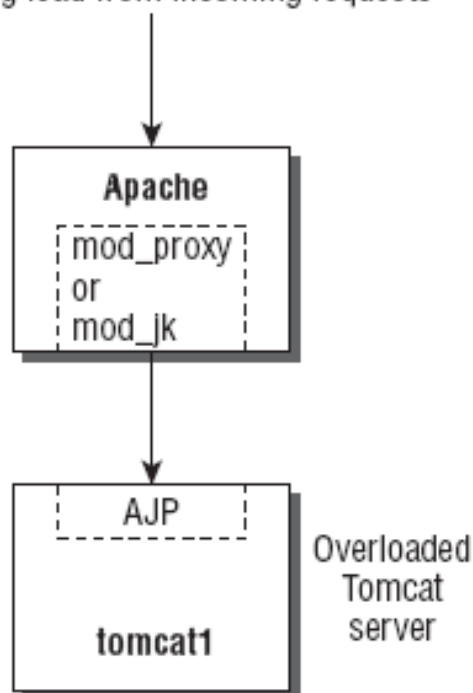
Tomcat Environment Variables

Option	Purpose	Default
CATALINA_BASE	This sets the base directory for writable or customized portions of a Tomcat installation tree, such as logging files, work directories, Tomcat's <i>conf</i> directory, and the <i>webapps</i> directory. It is an alias for CATALINA_HOME.	Tomcat installation directory
CATALINA_HOME	This sets the base directory for static (read-only) portions of Tomcat, such as Tomcat's <i>lib</i> directories and command-line scripts.	Tomcat installation directory
CATALINA_OPTS	This passes through Tomcat-specific command-line options to the <i>java</i> command.	None
CATALINA_TMPDIR	This sets the directory for Tomcat temporary files.	CATALINA_HOME/temp
JAVA_HOME	This sets the location of the Java runtime or JDK that Tomcat will use.	None
JRE_HOME	This is an alias to <i>JAVA_HOME</i> .	None
JAVA_OPTS	This is where you may set any Java command-line options.	None
JPDA_TRANSPORT	This variable may set the transport protocol used for JPDA debugging.	dt_socket
JPDA_ADDRESS	This sets the address for the JPDA used with the <i>catalina jpda start</i> command.	8000
JSSE_HOME	This sets the location of the Java Secure Sockets Extension used with HTTPS.	None
CATALINA_PID	This variable may optionally hold the path to the process ID file that Tomcat should use when starting up and shutting down.	None

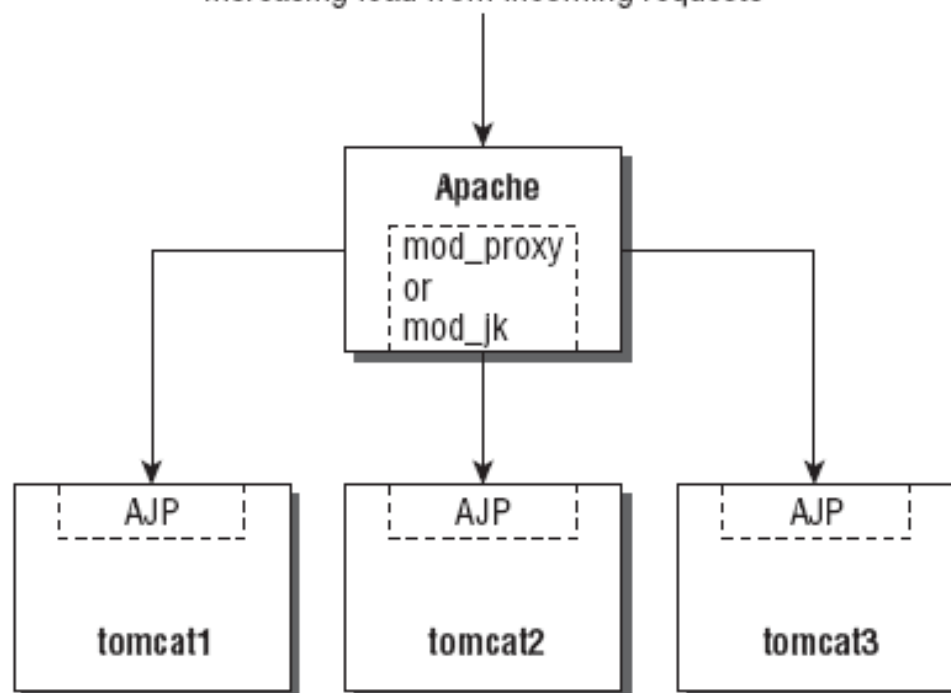
Java VM configuration options

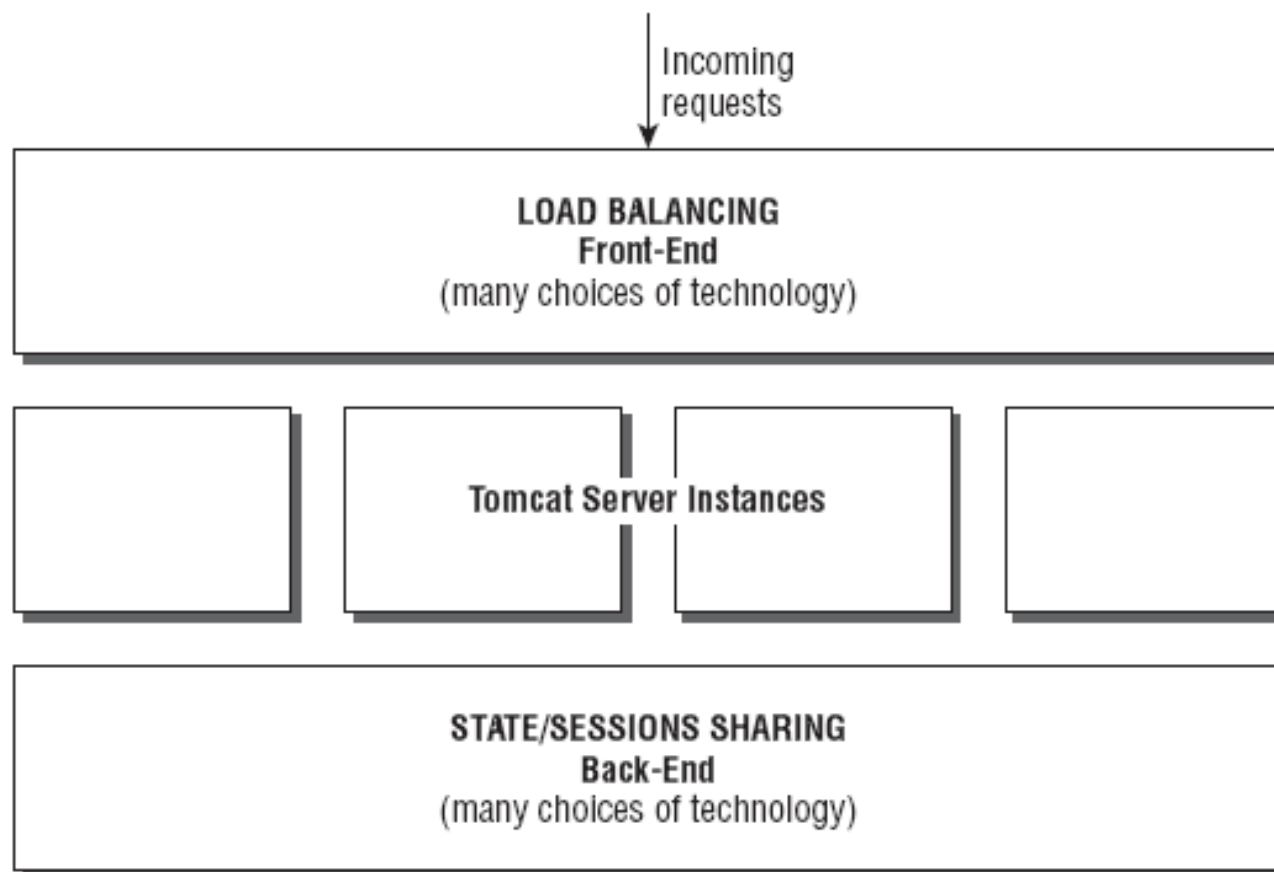
Use	JVM option	Meaning
Memory setting	-Xms384M	Sets the heap memory size at JVM startup time.
Memory setting	-Xmx384M	Sets the maximum heap memory size the JVM can expand to.
Debugging security	-Djava.security.debug=all	Turns on all debug output for security. ^a
Debugging	-enableassertions	Enables assertion checking. ^b
Debugging	-verbose:class	Enables verbose class loading debug output.
Debugging	-verbose:gc	Enables verbose garbage collection debug output.
Graphical	-Djava.awt.headless=true	Allows the JVM to run without any graphical display software installed.
Localization	-Duser.language=en	Sets the language bundle that Tomcat uses.
Localization	-Dfile.encoding=UTF-8	Sets the default file encoding that Tomcat uses.
Networking	-Djava.net.preferIPv4Stack=true	Configures the JVM to use IPv4 instead of IPv6; thus, any misconfiguration of IPv6 does not prevent Tomcat from working properly over IPv4. On some operating systems such as FreeBSD, this switch appears to be required for Tomcat to work.

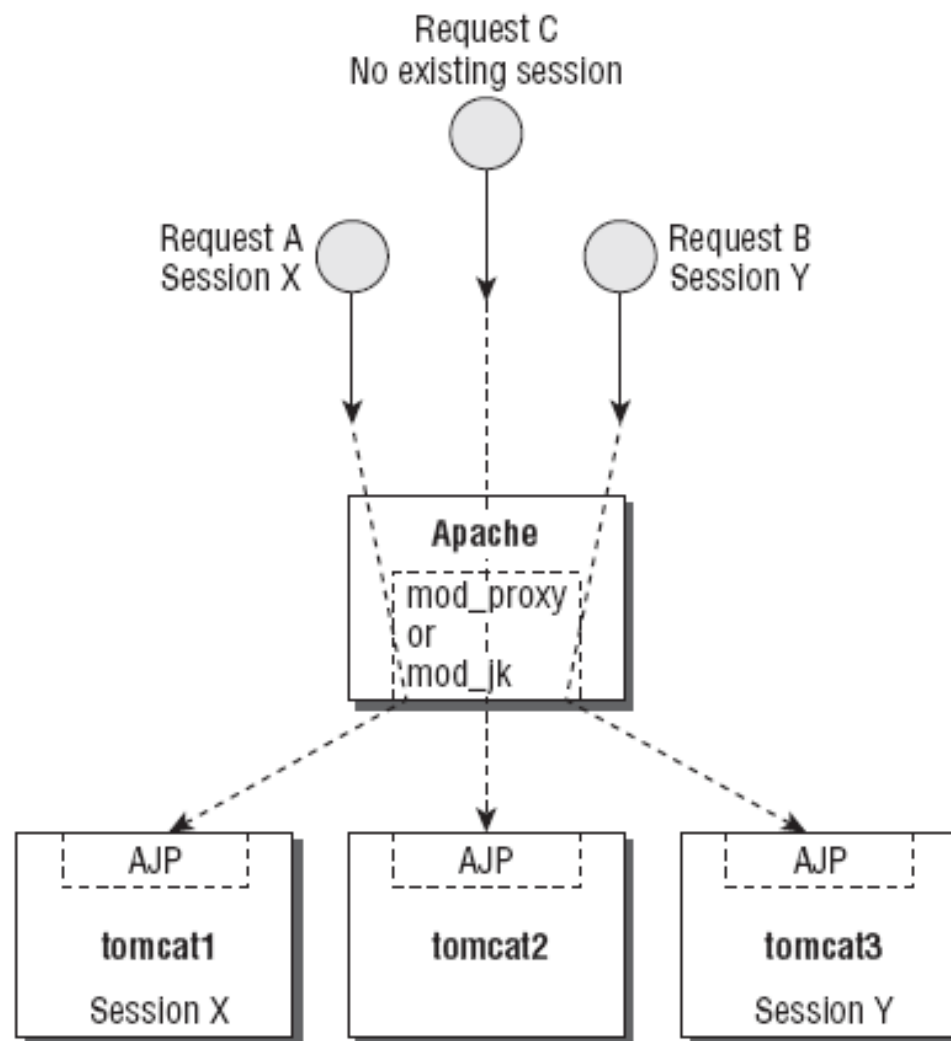
Without load balancing
Increasing load from incoming requests

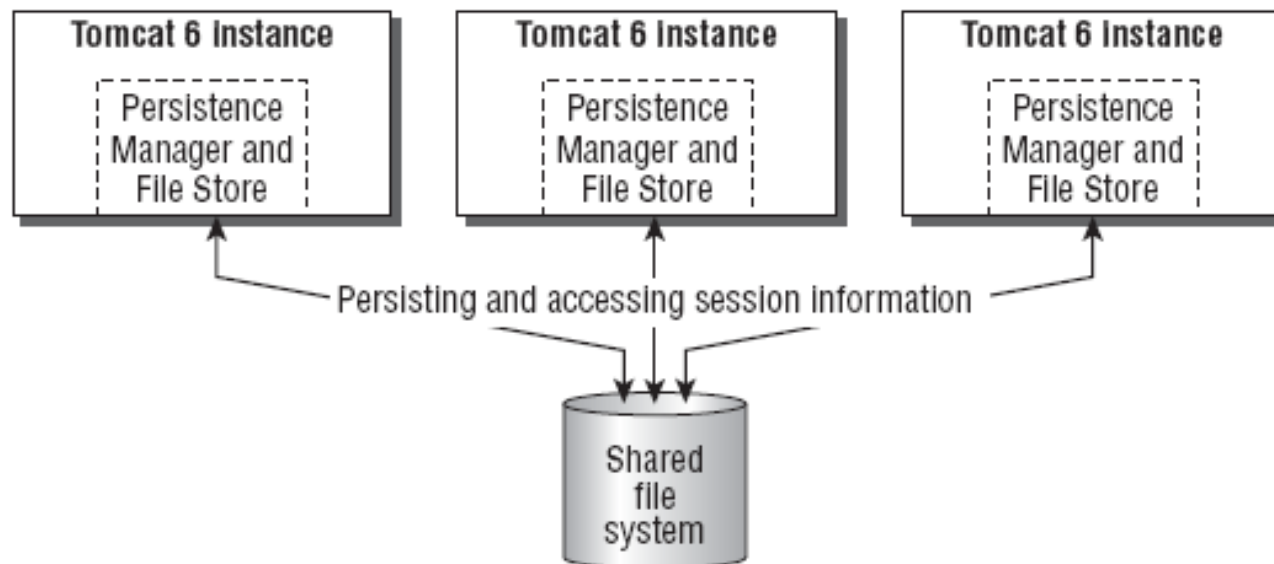


With load balancing
Increasing load from incoming requests

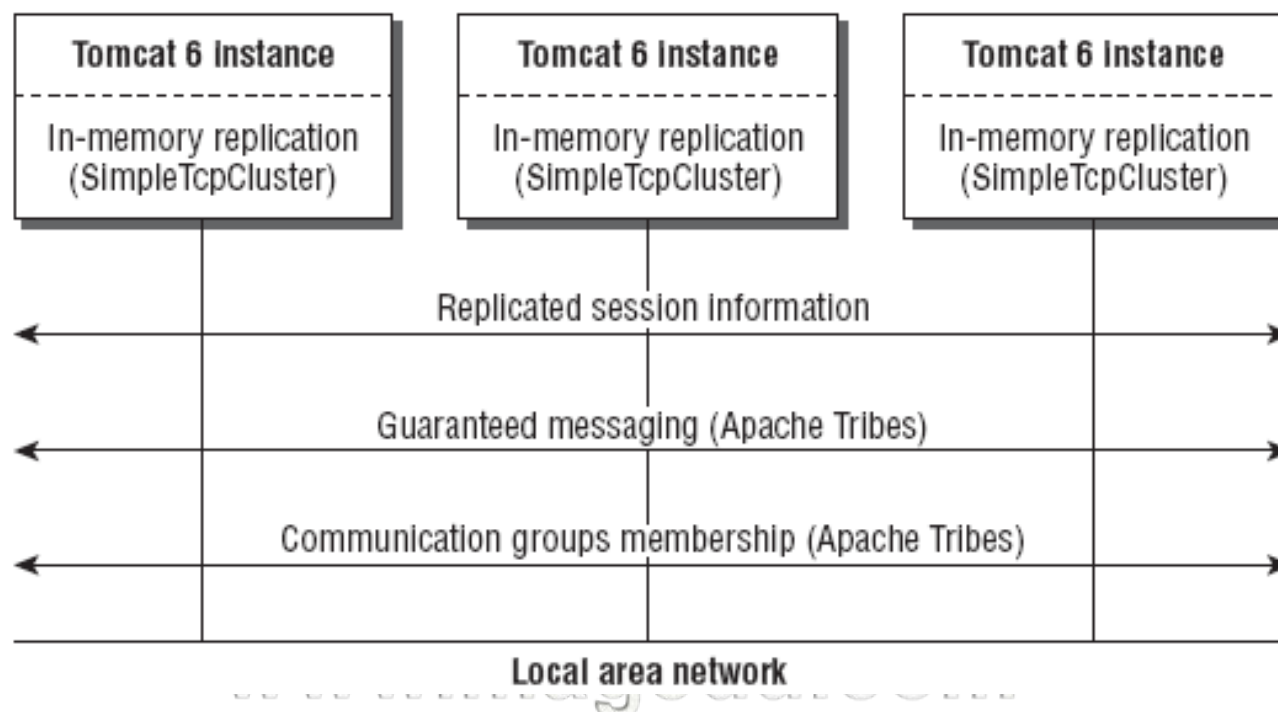








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❖ 分布式系统

➡ CAP, BASE

➡ consistent hash

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JVM

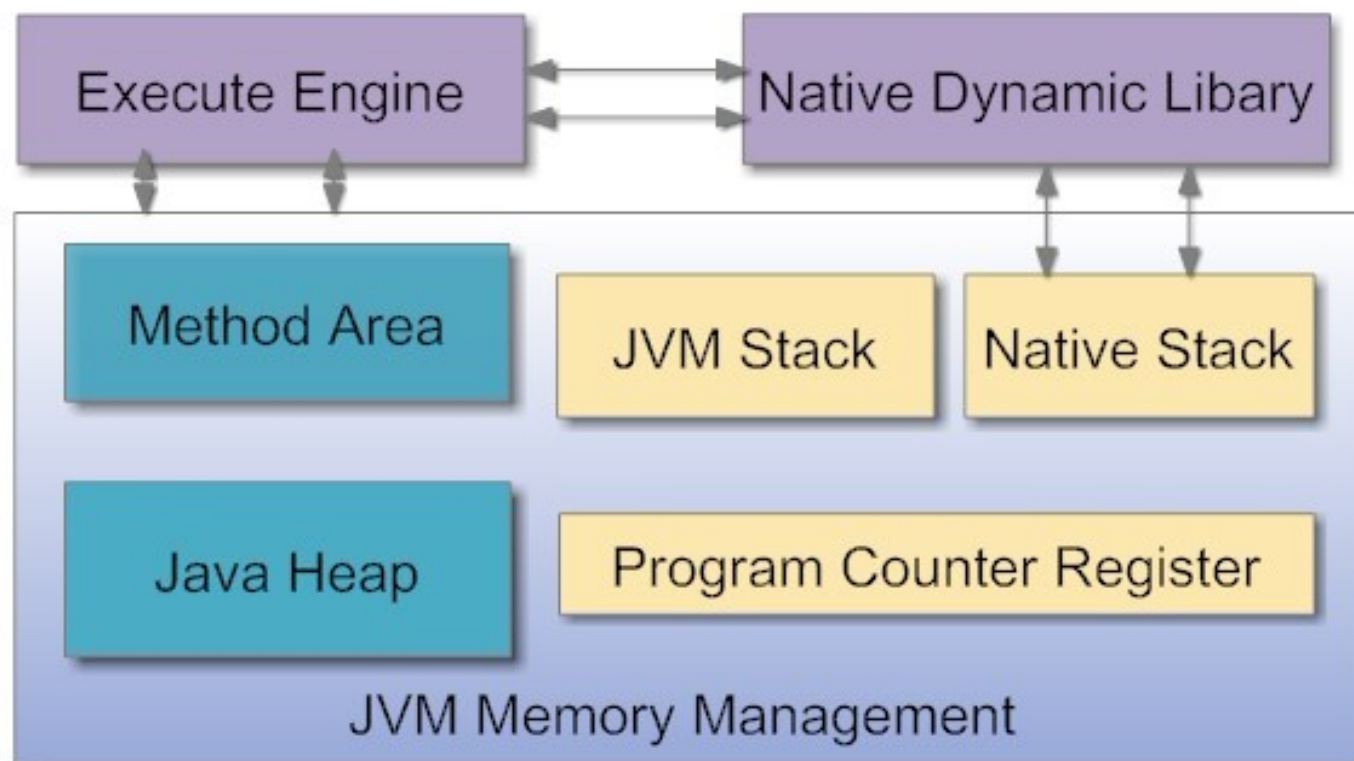
主讲：马永亮(马哥)

QQ:113228115

客服QQ: 2813150558, 1661815153

<http://www.magedu.com>

<http://mageedu.blog.51cto.com>



❖ JVM管理的内存段可分为两大类：线程共享内存和线程私有内存

➡ 线程共享内存

- 方法区：存储jvm加载的class、常量、静态变量、即时编译器编译后的代码等
- java堆：存储java的所有对象实例、数组等

➡ 线程私有内存

- 程序计数寄存器：每个线程有自己的计数寄存器，存储当前线程执行字节码的地址
- jvm栈：jvm会为每个运行线程分配一个栈区，线程调用方法时和方法返回时会进行入栈和出栈操作
- 本地方法栈区：与jvm stack类似，只不过此区域是为调用本地方法服务

Categories of Java HotSpot VM Options

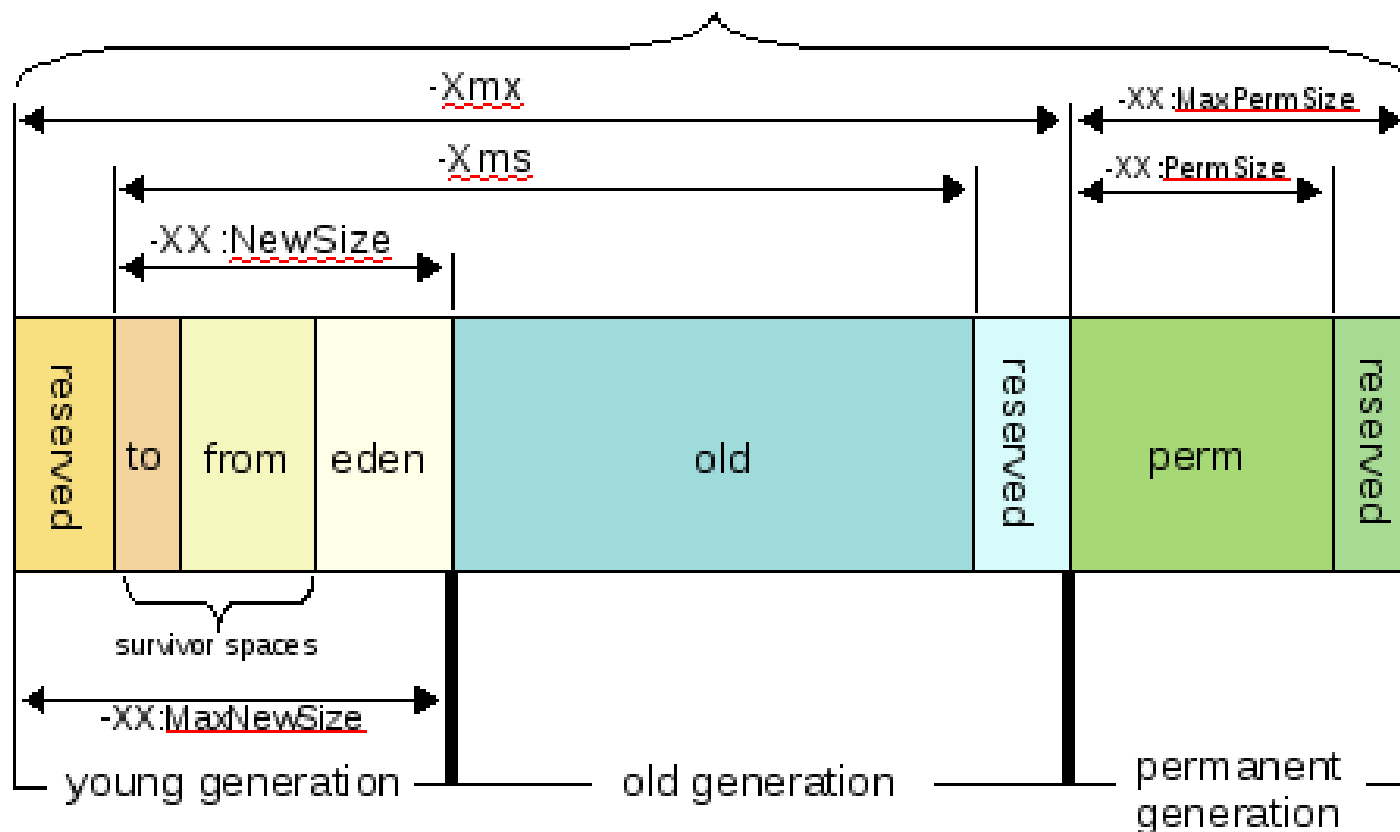
- ❖ Standard options recognized by the Java HotSpot VM are described on the Java Application Launcher reference pages for Windows, Solaris and Linux
- ❖ -X options are non-standard
 - ➡ Not guaranteed to be supported on all VM implementations
 - ➡ Subject to change without notice in subsequent releases of the JDK
- ❖ -XX options are not stable and are subject to change without notice
- ❖ # jinfo -flags

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Java Heap Size Options

Task	Option	Comments
Setting the New generation heap size	<code>-XX:NewSize</code>	<p>As a general rule, set <code>-XX:NewSize</code> to be one-fourth the size of the heap size. Increase the value of this option for larger numbers of short-lived objects.</p> <p>Be sure to increase the New generation as you increase the number of processors. Memory allocation can be parallel, but garbage collection is not parallel.</p>
Setting the maximum New generation heap size	<code>-XX:MaxNewSize</code>	Set the maximum size of the New Generation heap size.
Setting New heap size ratios	<code>-XX:SurvivorRatio</code>	<p>The New generation area is divided into three sub-areas: Eden, and two survivor spaces that are equal in size.</p> <p>Configure the ratio of the Eden/survivor space size. Try setting this value to 8, and then monitor your garbage collection.</p>
Setting initial heap size	<code>-Xms</code>	As a general rule, set initial heap size (<code>-Xms</code>) equal to the maximum heap size (<code>-Xmx</code>) to minimize garbage collections.
Setting maximum heap size	<code>-Xmx</code>	Set the maximum size of the heap.

The memory structure of a JVM process



❖ JVM Memory Handling

- » When the JVM starts, the host OS assigns a dedicated memory space to that VM
- » The VM allocates memory to the application within that dedicated memory space
- » The VM frees memory automatically via garbage collectors
- » Garbage Collection is an expensive algorithm

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❖ JVM Memory Handling

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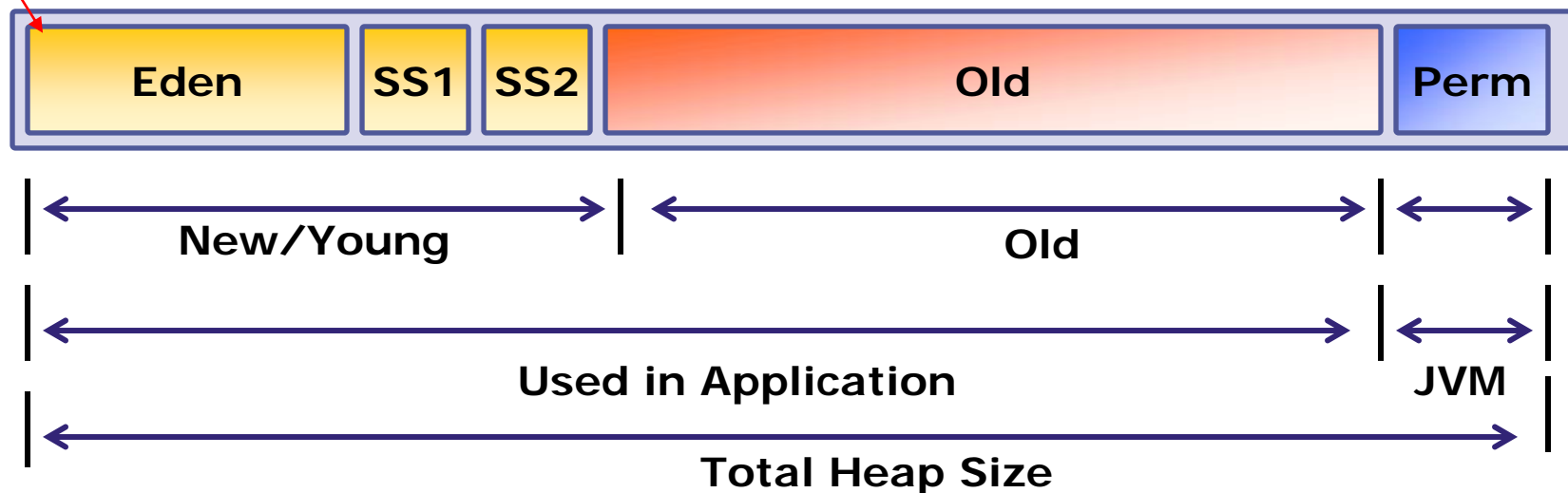
❖ Generational Memory Space

- ➔ The memory space is divided into three separated memory spaces
 - Eden Space: Where objects are born
 - Survivor Spaces: Where objects mature
 - Tenure Space: Where objects grow old and die

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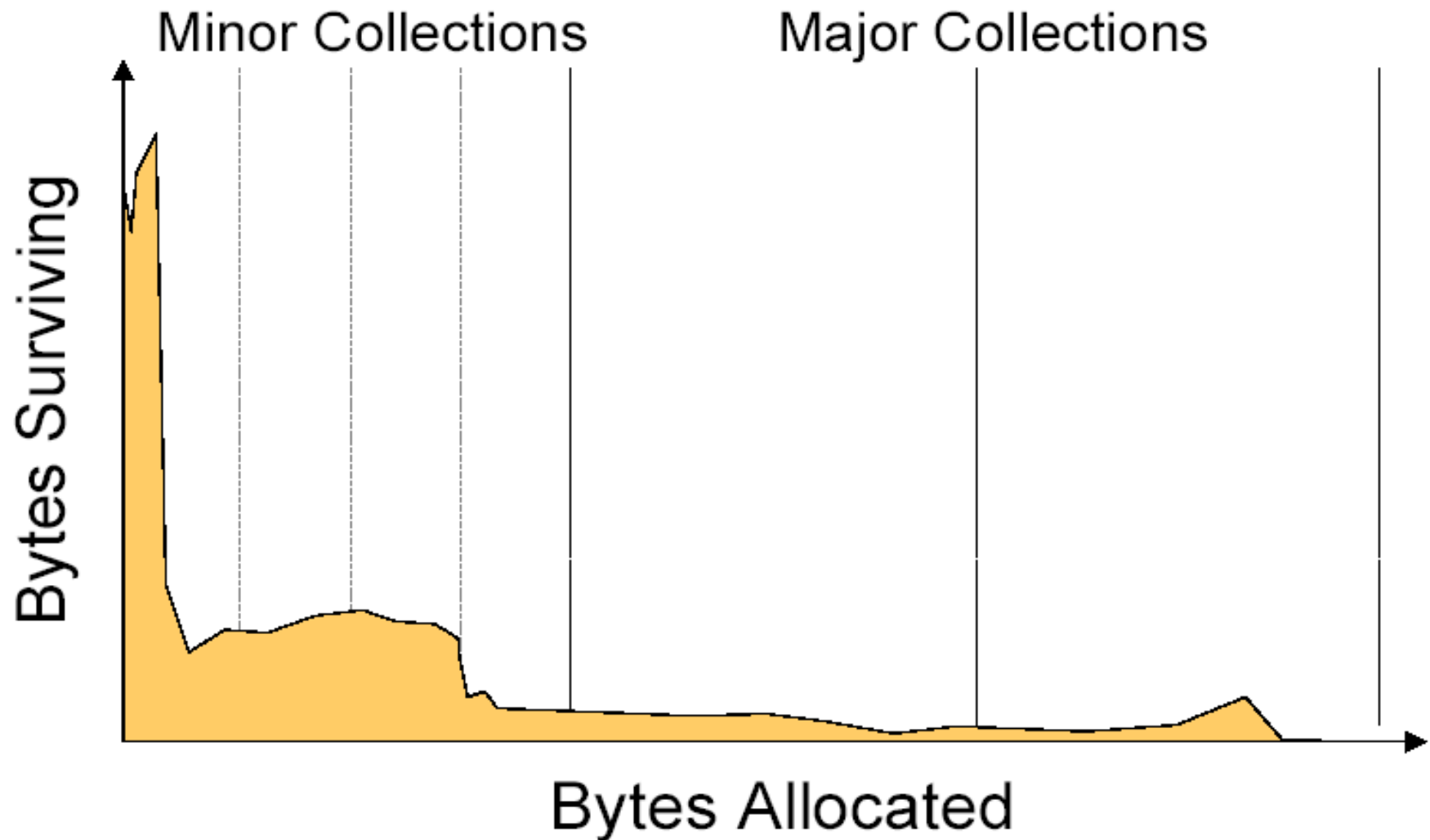
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JVM Memory Layout



- ❖ New/Young – Recently created object
- ❖ Old – Long lived object
- ❖ Perm – JVM classes and methods

Generational Garbage Collection



❖ Garbage Collection

- ➡ Collecting unused java object
- ➡ Cleaning memory
- ➡ Minor GC
 - Collection memory in New/Young generation
- ➡ Major GC (Full GC)
 - Collection memory in Old generation

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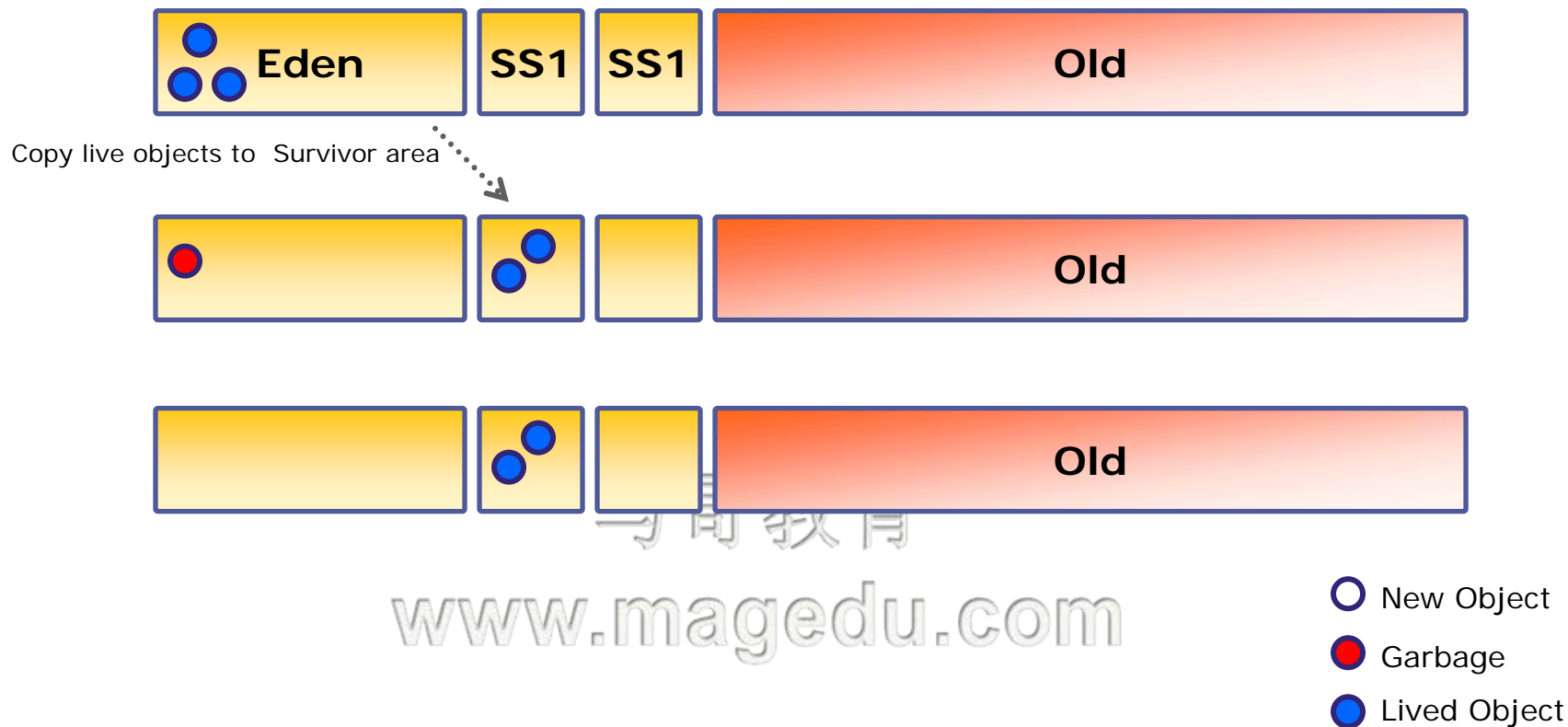
❖ Minor Collection

- ➡ New/Young Generation
- ➡ Copy and Scavenge
- ➡ Very Fast

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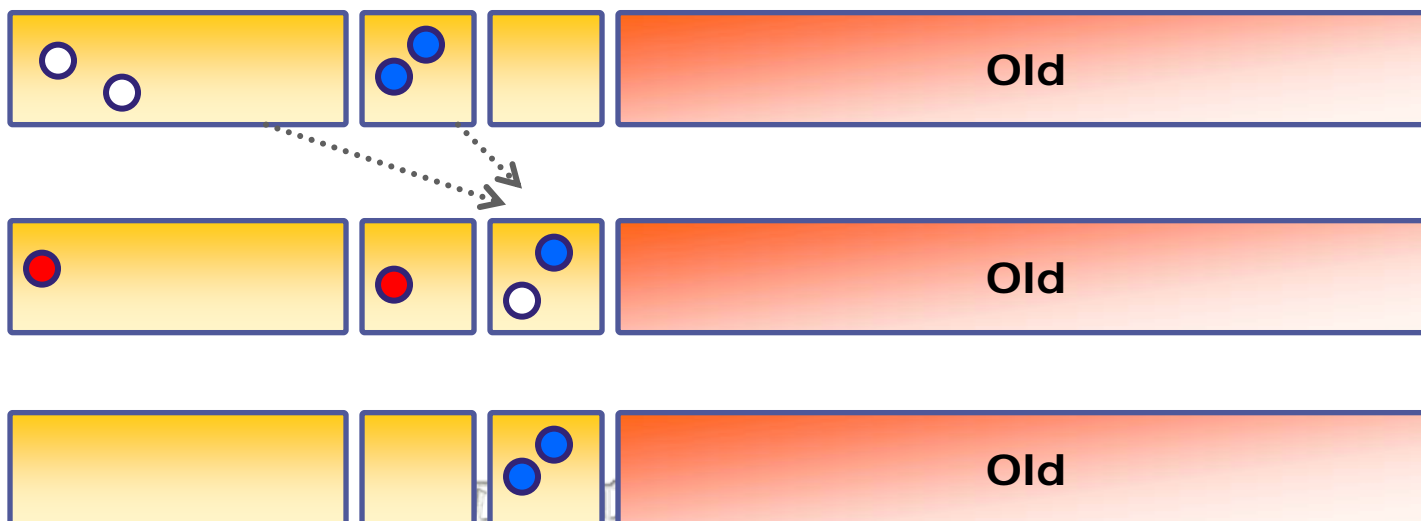
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1st Minor GC



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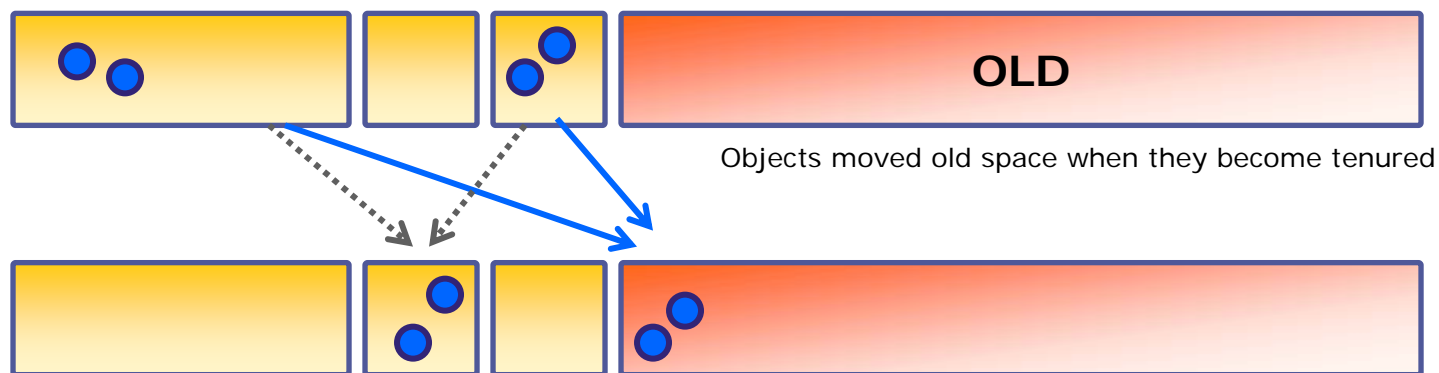
2nd Minor GC



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- New Object
- Garbage
- Lived Object

3rd Minor GC



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- New Object
- Garbage
- Lived Object

❖ Major Collection

➡ Old Generation

➡ Mark and compact

➡ Slow

➡ 1st – goes through the entire heap, marking unreachable objects

➡ 2nd – unreachable objects are compacted

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Mark the objects to be removed



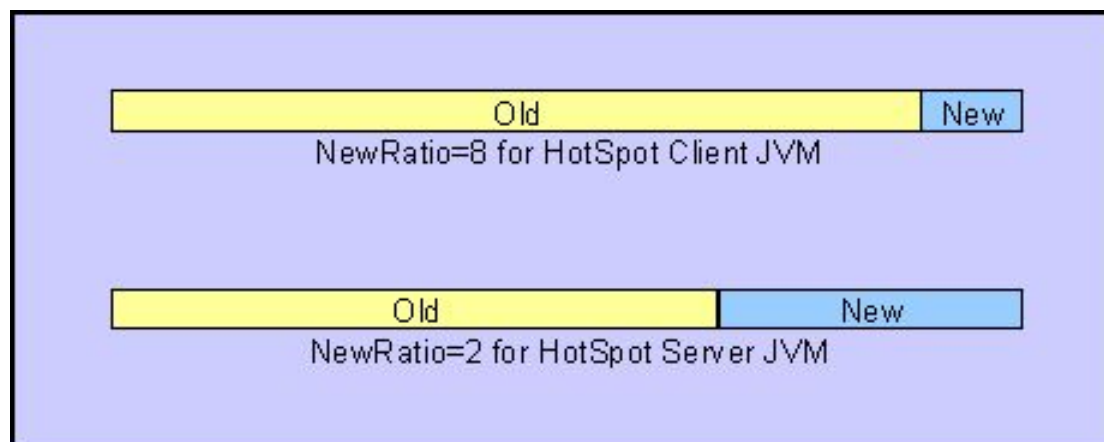
Compact the objects to be removed



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Server option versus Client option

- ❖ `-X:NewRatio=2 (1.3)` , `-Xmn128m(1.4)`, `-XX:NewSize=<size>` -
`XX:MaxNewSize=<size>`



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❖ Memory Tuning Parameter

- ➡ Perm Size : `-XX:MaxPermSize=64m`
- ➡ Total Heap Size : `-Xms512m -Xmx 512m`
- ➡ New Size
 - `-XX:NewRatio=2` → Old/New Size
 - `-XX:NewSize=128m`
 - `-Xmn128m` (JDK 1.4)
- ➡ Survivor Size : `-XX:SurvivorRatio=64` (eden/survivor)
- ➡ Heap Ratio
 - `-XX:MaxHeapFreeRatio=70`
 - `-XX:MinHeapFreeRatio=40`
- ➡ Survivor Ratio
 - `-XX:TargetSurvivorRatio=50`

Support for `-XX` Option

- ❖ Options that begin with `-X` are nonstandard (not guaranteed to be supported on all VM implementations), and are subject to change without notice in subsequent releases of the Java 2 SDK.
- ❖ Because the `-XX` options have specific system requirements for correct operation and may require privileged access to system configuration parameters, they are not recommended for casual use. These options are also subject to change without notice.

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❖ New type of GC

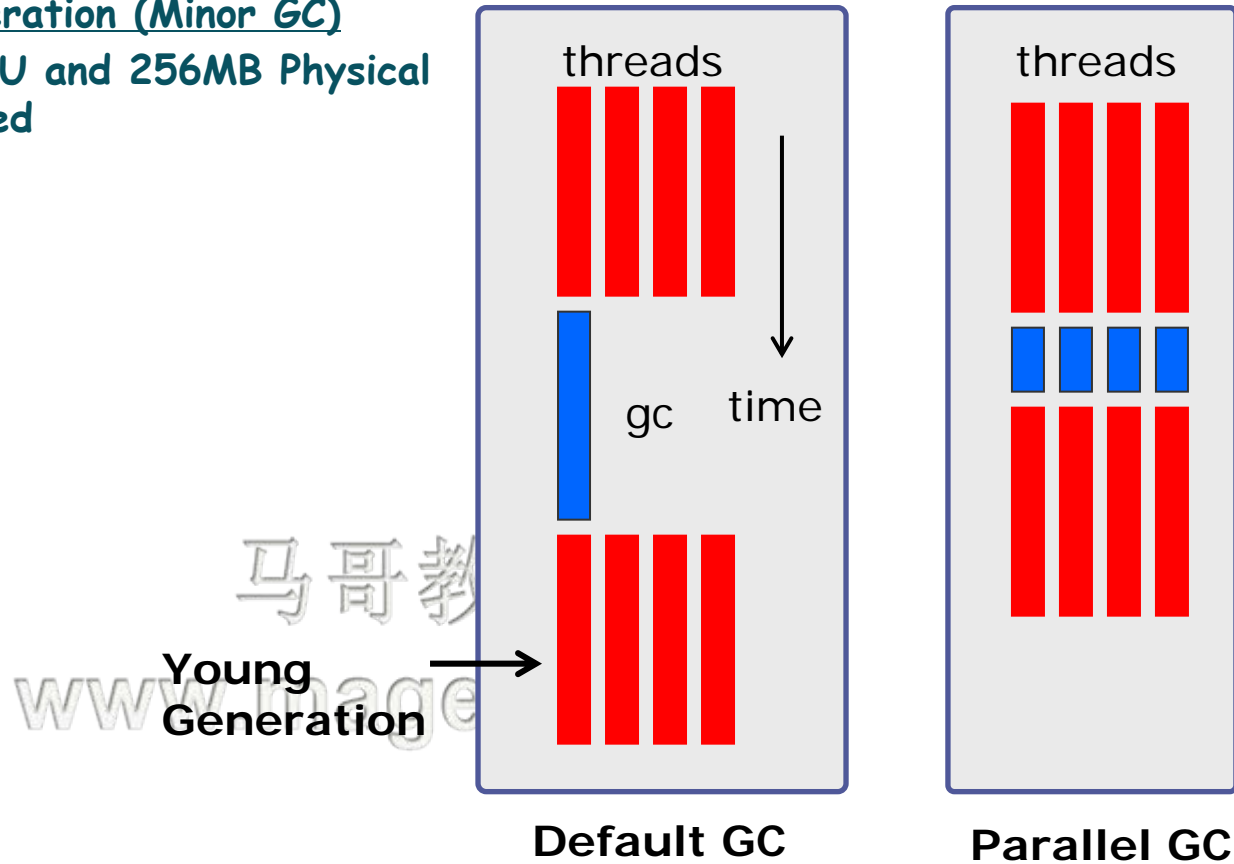
- ➡ Default Collector
- ➡ Parallel GC for young generation - **JDK 1.4**
- ➡ Concurrent GC for old generation - **JDK 1.4**
- ➡ Incremental Low Pause Collector (Train GC)

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❖ Parallel GC

- ➔ Improve performance of GC
- ➔ For young generation (Minor GC)
- ➔ More than 4CPU and 256MB Physical memory required



❖ Two Parallel Collectors

➡ Low-pause : -XX:+UseParNewGC

- Near real-time or pause dependent application
- Works with
 - Mark and compact collector
 - Concurrent old area collector

➡ Throughput : -XX:+UseParallelGC

- Enterprise or throughput oriented application
- Works only with the mark and compact collector

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❖ Throughput Collector

- ➡ `-XX:+UseParallelGC`
- ➡ `-XX:ParallelGCThreads=<desired number>`
- ➡ `-XX:+UseAdaptiveSizePolicy`
 - ➡ Adaptive resizing of the young generation

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❖ Throughput Collector

➡ AggressiveHeap

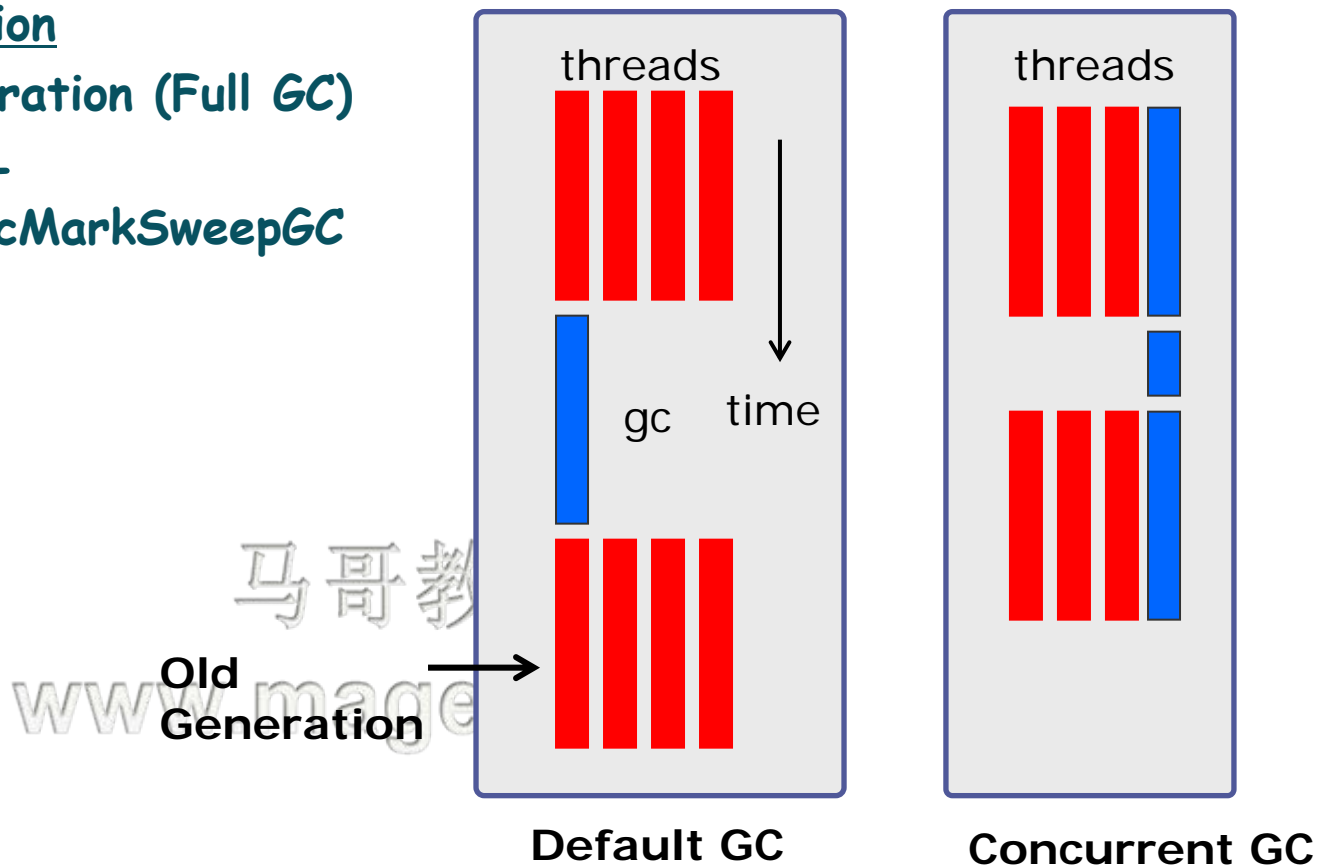
- Enabled By-XX:+AggressiveHeap
- Inspect machine resources and attempts to set various parameters to be optimal for long-running, memory-intensive jobs
 - Useful in more than 4 CPU machine, more than 256M
 - Useful in Server Application
 - Do not use with -ms and -mx
- Example) HP Itanium 1.4.2 `java -XX:+ServerApp -XX:+AggressiveHeap -Xmn3400m -spec.jbb.JBBmain -propfile Test1`

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❖ Concurrent GC

- ➔ Reduce pause time to collect Old Generation
- ➔ For old generation (Full GC)
- ➔ Enabled by -
XX:+UseConcMarkSweepGC



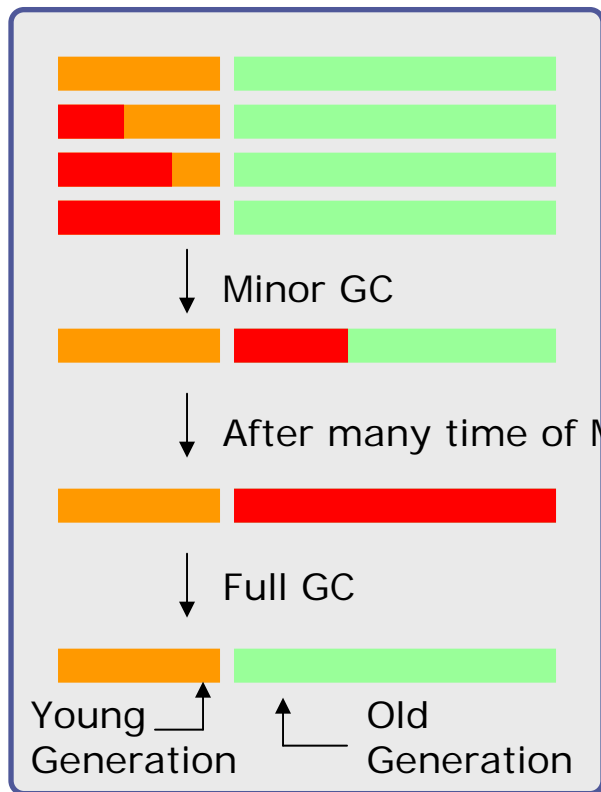
❖ Incremental GC

- ➡ Enabled by `-XIncgc` (from JDK 1.3)
- ➡ Collect Old generation whenever collect young generation
- ➡ Reduce pause time for collect old generation
- ➡ Disadvantage
 - More frequently young generation GC has occurred.
 - More resource is needed
 - Do not use with `-XX:+UseParallelGC` and `-XX:+UseParNewGC`

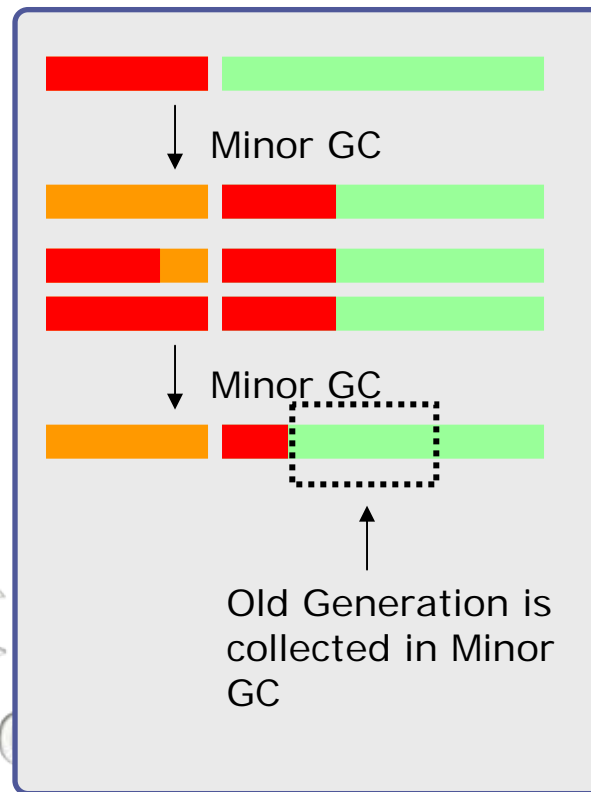
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❖ Incremental GC



Default GC



Incremental GC

❖ Incremental GC

-client -XX:+PrintGCDetails -Xincgc -ms32m -mx32m

```
[GC [DefNew: 540K->35K(576K), 0.0053557 secs][Train: 3495K->3493K(32128K), 0.0043531 secs] 4036K->3529K(32704K), 0.0099856 secs]
[GC [DefNew: 547K->64K(576K), 0.0048216 secs][Train: 3529K->3540K(32128K), 0.0058683 secs] 4041K->3604K(32704K), 0.0109779 secs]
[GC [DefNew: 575K->64K(576K), 0.0164904 secs] 4116K->3670K(32704K), 0.0169019 secs]
[GC [DefNew: 576K->64K(576K), 0.0057541 secs][Train: 3671K->3651K(32128K), 0.0051286 secs] 4182K->3715K(32704K), 0.0113042 secs]
[GC [DefNew: 575K->56K(576K), 0.0114559 secs] 4227K->3745K(32704K), 0.0191390 secs]
[Full GC [Train MSC: 3689K->3280K(32128K), 0.0909523 secs] 4038K->3378K(32704K), 0.0910213 secs]
[GC [DefNew: 502K->64K(576K), 0.0173220 secs][Train: 3329K->3329K(32128K), 0.0066279 secs] 3782K->3393K(32704K), 0.0325125 secs]
```

Minor GC

Young Generation GC

Old Generation GC in Minor GC Time

Full GC

Sun JVM 1.4.1 in Windows OS

Mark-compact	Better throughput
Incremental GC(Train)	Better Pause
Parallel GC	Best Throughput
Concurrent GC	Best Pause

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Garbage Collection Measurement

- ❖ -verbosegc (All Platform)
- ❖ -XX:+PrintGCDetails (JDK 1.4)
- ❖ -Xverbosegc (HP)

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Garbage Collection Measurement

❖ -verbosegc

```
[GC 40549K->20909K(64768K), 0.0484179 secs]
[GC 41197K->21405K(64768K), 0.0411095 secs]
[GC 41693K->22995K(64768K), 0.0846190 secs]
[GC 43283K->23672K(64768K), 0.0492838 secs]
[Full GC 43960K->1749K(64768K), 0.1452965 secs]
[GC 22037K->2810K(64768K), 0.0310949 secs]
[GC 23098K->3657K(64768K), 0.0469624 secs]
[GC 23945K->4847K(64768K), 0.0580108 secs]
```

← Full GC

GC Time

Total Heap Size

Heap size after GC

Heap size before GC

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- ❖ Serial GC
 - ❖ Parallel GC
 - ❖ Parallel Old GC (Parallel Compacting GC)
 - ❖ Concurrent Mark & Sweep GC (or "CMS")
 - ❖ Garbage First (G1) GC
-
- ❖ Among these, the serial GC must not be used on an operating server
 - ➔ This GC type was created when there was only one CPU core on desktop computers
 - ➔ Using this serial GC will drop the application performance significantly

❖ CLI

➞ jstat

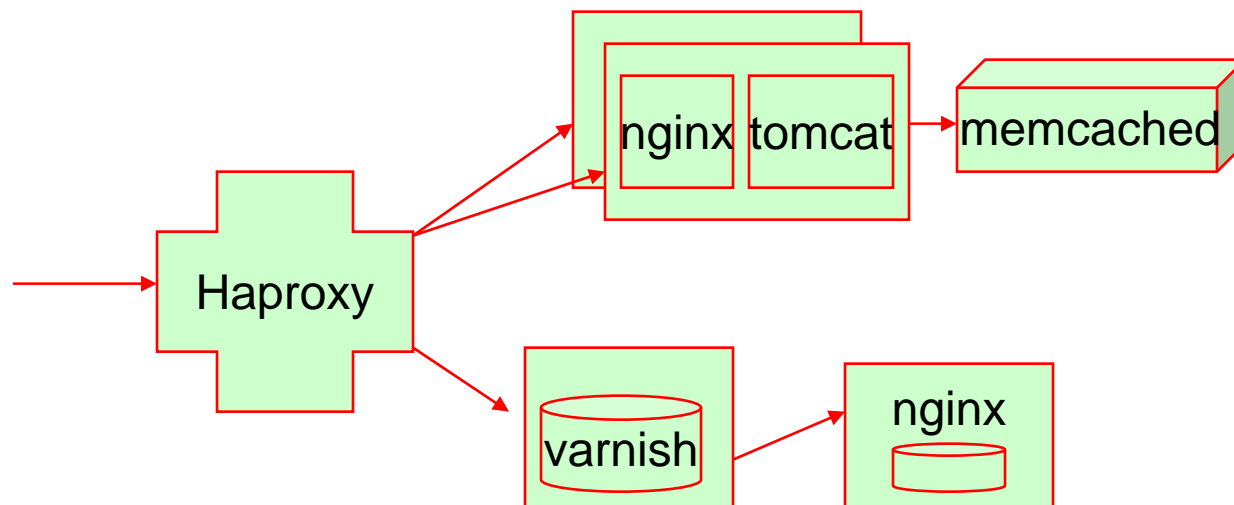
➞ jstat -gc JVM_ID delay

❖ GUI

➞ jconsole

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- ❖ QQ群: 203585050, 279599283



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Thank You!