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Extended results of Tornado
A Run-Fail-Grow approach for Dynamic Application Tailoring

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Version: 1.1

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July 15, 2014
Abstract

Producing a small deployment version of an application is a challenge because static abstractions such as packages cannot anticipate the use of their parts. As such, an application often occupies more memory than actually needed. To solve this problem we propose Tornado, a technique to dynamically tailor applications to only embed code (classes and methods) they use. Tornado uses a run-fail-grow approach to prepare an application for deployment. It launches minimal version of an application and installs a minimal set of statements that will start the user’s application. This application is run and these statements are executed. When the application fails because there are classes or methods missing, the necessary code is installed. The application is executed until it reaches a stable point, allowing possibly human interaction for applications with UIs. Thus, Tornado creates minimal memory footprint versions of applications by tailoring the whole application’s code, including run-time and third party libraries.

In this report, we present the results we obtained from using Tornado to tailor two different applications. We succeeded to tailor a hello world application to occupy 1% of its original size. We also experimented with a Seaside web application tailoring in one case only the application’s and framework’s code and the whole application’s code in the other case. In this latter example, we reached memory savings of about 97%. In this report we present an overview on Tornado, and we give details of the results we obtained.
## Contents

1  Used Methodology  
2  Hello World Application  
3  Seaside Web Application  

A  Appendix: Method List of a Nurtured Hello World Application  
B  Appendix: Entry Points to Tailor the Seaside Web Application  
C  Appendix: Method List of Seaside Counter Application with Full Pharo Seed  
D  Appendix: Method List of Seaside Counter Application with Empty Seed
1 Used Methodology

We tested our Tornado implementation by tailoring two different Pharo applications: a hello world application and a simple but yet interactive web application based on the Seaside framework [1]. Our methodology consisted in: setting up a seed for the application, preparing the application entry points and executing the application. In the case of the interactive web application, we interacted with it through a web browser. Once we finished the process, we extracted the resulting application by making a snapshot of it in a Pharo image file. We tested the generated snapshots to verify they work properly (under the assumption that only the previously used features of the application should work).

Finally, to present our results we measured the size of the generated snapshots files and compared them with the snapshots of the full applications under Pharo’s production option. The results prove the soundness of our solution.

2 Hello World Application

We used Tornado to tailor a hello world application writing 10 times the ‘hello world’ string to the standard output (stdout). In this case study we used an empty seed to grow both base libraries and the application’s code. Figure 1 shows the installed entry point to tailor this application. Table 1 shows our results for this case. We succeed to reduce the application’s size to 1% of its original counterpart.

1 FileStream startUp: true.

Figure 1: Entry point of the Hello World application with an empty seed.

<table>
<thead>
<tr>
<th>Size(KB)</th>
<th>Occupied(%)</th>
<th>Saved(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>12872</td>
<td>100%</td>
</tr>
<tr>
<td>Tailored</td>
<td>131</td>
<td>1%</td>
</tr>
</tbody>
</table>

Table 1: Results of the tailored Hello World application.

3 Seaside Web Application

We also used Tornado to tailor a simple web application consisting in a webpage with a counter containing two buttons. These two buttons perform requests to the web server to increase and decrease the counter. The Seaside application framework was configured with its default values, without making any customizations.

Pharo allows to prepare a snapshot for production. This option cleans some caches and removes some well known objects from the system, thus, freeing space.
In this case, we used two different seeds for tailoring: a seed containing all Pharo base libraries and an empty seed. Appendix B presents the entry points for these both seeds. The tailoring was done by starting the application and exercising it by generating requests through a web browser, clicking on its decrease and increase buttons.

<table>
<thead>
<tr>
<th>Size (KB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ref. Pharo Base Libraries (P)</td>
</tr>
<tr>
<td>Ref. Seaside Framework (S)</td>
</tr>
<tr>
<td>Ref. Counter Application (R)</td>
</tr>
<tr>
<td>Total Ref. Application (P+S+C)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size (KB)</th>
<th>Occupied (%)</th>
<th>Saved (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P' + S' + C' / P + S + C</td>
<td>573</td>
<td>3%</td>
</tr>
<tr>
<td>P'' + S'' + C'' / P'' + S'' + C''</td>
<td>13090</td>
<td>76%</td>
</tr>
<tr>
<td>S'' + C'' / S + C</td>
<td>218</td>
<td>5%</td>
</tr>
</tbody>
</table>

Table 2: Results of second case study. Results of tailoring a web application with two different seeds. On the left, the total sizes of the original application deployment components (base libraries, application framework and counter application). On the right, our results when applying after tailoring. The first two results rows are compared against the total of the reference application. The third row presents the comparison without including base libraries, already inside the seed.

Table 2 shows the results obtained when tailoring this application with each of these two seeds. Figure 2 presents a tailoring map illustrating how Tornado selects the code units from a reference application given a seeds. This figure also presents the notation we use in Table 2: P is the Pharo base libraries, S is the Seaside Framework and C is the Counter application code units present in the reference application. P’, S’ and C’ are their counterparts selected by Tornado when using an empty seed. P”, S” and C” are their counterparts, as selected by Tornado when using a seed with all base libraries. In the latter, we can note that P=P”.

Figure 2: Tailoring Map. Tailoring map describing the Seaside application generated with the empty seed (left) and the full Pharo seed (right).

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References

### Appendix: Method List of a Nurtured Hello World Application

List of methods extracted from the nurtured Hello World application. This list includes all methods installed from the Pharo base libraries and the simple Hello World application.

<table>
<thead>
<tr>
<th>Class</th>
<th>Method</th>
<th>Class</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Array class » new</td>
<td>FileStream » openOnHandle: name: forWrite: Standard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ArrayedCollection » size</td>
<td>FileStream » primWrite: from: startingAt: count: Standard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Association class » key: value:</td>
<td>GreekEnvironment class » supportedLanguages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Association » value</td>
<td>HashTableSizes class » atLeast:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Association » value</td>
<td>HashTableSizes class » sizes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BlockClosure » on: do</td>
<td>HashedCollection class » newProto</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BlockClosure » repeat</td>
<td>HashedCollection » atNewIndex: put:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BlockClosure » valueNoContextSwitch</td>
<td>HashedCollection » findElementOrNull:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ByteString class » compare: with: collated:</td>
<td>HashedCollection » fullCheck</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ByteString class » findFirstInString: inSet: startingAt:</td>
<td>HashedCollection » grow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ByteString » at: put:</td>
<td>Integer » asCharacter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ByteString » at:</td>
<td>JapaneseEnvironment class » supportedLanguages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ByteString » isByteString</td>
<td>KoreanEnvironment class » supportedLanguages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ByteString » replaceFrom: to: with: startingAt:</td>
<td>LanguageEnvironment class » currentPlatform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ByteStringConverter class » unicodeToByteTable</td>
<td>LanguageEnvironment class » defaultSystemConverter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ByteStringConverter » nextPut: toStream:</td>
<td>LanguageEnvironment class » initKnownEnvironments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ByteStringConverter » unicodeToByte:</td>
<td>LanguageEnvironment class » knownEnvironments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Character class » cr</td>
<td>LanguageEnvironment class » localeID:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Character class » If</td>
<td>LanguageEnvironment » localeID:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Character » value</td>
<td>Latin1Environment class » supportedLanguages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Character » asInteger</td>
<td>Latin2Environment class » supportedLanguages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Character » asciiValue</td>
<td>Latin9Environment class » systemConverterClass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Character » charCode</td>
<td>Locale class » currentPlatform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collection » detect: ifNone:</td>
<td>Locale class » determineCurrentLocale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dictionary » at: ifAbsent:</td>
<td>Locale » determineLocaleID</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dictionary » at: ifPresent:</td>
<td>Locale » determineLocale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dictionary » at: put:</td>
<td>Locale » fetchISO2Language</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dictionary » noCheckAdd:</td>
<td>Locale » languageEnvironment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dictionary » scanFor:</td>
<td>Locale » localeID:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FileStream class » newForStdio</td>
<td>Locale » localeID</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FileStream class » new</td>
<td>Locale » primCountry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FileStream class » standardIOStreamNamed: forWrite: Locale » primLanguage</td>
<td>LocaleID class » isoLanguage: isoCountry:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FileStream class » startUp:</td>
<td>LocaleID class » isoLanguage:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FileStream class » stdioHandles</td>
<td>LocaleID class » isoLanguage:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FileStream class » stdoutCharacter » isCharacter</td>
<td>LocaleID class » isoString:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FileStream class » voidStdioFiles</td>
<td>LocaleID » hash</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FileStream » collectionSpeciesStandard</td>
<td>LocaleID » hash</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FileStream » enableReadBufferingSmalltalkImage » vmLocaleID » isoCountry</td>
<td>LocaleID » isoLanguage: isoCountry:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FileStream » isBinaryStandard</td>
<td>LocaleID » isoLanguage: isoCountry:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FileStream » next: putAll: startingAt: Standard</td>
<td>LocaleID » isoLanguage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FileStream » next: put: Standard</td>
<td>LookupKey class » key:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LookupKey = key
LookupKey = key
Magnitude = max
MultiByteFileStream = basicNext:putAll:startingAt:
MultiByteFileStream = basicNextPut:
MultiByteFileStream = converter
MultiByteFileStream = installLineEndConventionInConverter
MultiByteFileStream = nextPut:
MultiByteFileStream = nextPutAll:
Number = negative
OSPlatform class = isWin32
OSPlatform class = platformName
Object = =
Object = at:put:
Object = at:
Object = class
Object = hash
Object = isInteger
Object = isCharacter
Object = species
Object = ~
OrderedCollection class = arrayType
OrderedCollection class = new:
OrderedCollection class = new
OrderedCollection = add:
OrderedCollection = addLast:
OrderedCollection = at:
OrderedCollection = ensureBoundsFrom:
OrderedCollection = resetTo:
OrderedCollection = reset
OrderedCollection = setCollection:
OrderedCollection = size
PositionableStream class = on:
PositionableStream = isBinary
PositionableStream = on:
ProtoObject = basicIdentityHash
ProtoObject = flag:
ProtoObject = identityHash
ProtoObject = initialize
RussianEnvironment class = supportedLanguages
Appendix: Entry Points to Tailor the Seaside Web Application

Entry points as used to tailor the Seaside web application with a full Pharo seed and an empty seed. The first one (Figure 3) only consists in starting the web server as the base libraries are initialized and available in the seed. The latter one (Figure 4) includes the initialization of the minimal runtime needed to do networking.

```smalltalk
ZnZincServerAdaptor startOn: 8888.
```

**Figure 3:** Entry point of the Seaside application with a full Pharo seed.

```smalltalk
"We initialize some classes of the system"
SmalltalkImage initializeForTornado.
Symbol initializeForTornado.
Object initialize.
ExternalSemaphoreTable initialize.
Socket initialize.
Delay initialize.
Delay startUp: true.
Delay shutDown: true.
OSPlatform initialize.
DiskStore initialize.
FileStream initialize.
NetNameResolver initialize.
DateAndTime initialize.
ProcessorScheduler initialize.
WeakFinalizationList initialize.
UUIDGenerator initialize.
WeakArray initialize.
GRPharoRandomProvider initialize.
WASlime initialize.
UIManager basicDefault: DummyUIManager new.
ZnServer initialize.
WAServerManager initialize.
Smalltalk instVarNamed: 'session' put: Smalltalk newSessionObject.
Smalltalk startupImage: true snapshotWorked: true.

"Finally we start the web server"
ZnZincServerAdaptor startOn: 8888.
```

**Figure 4:** Entry point of the Seaside application with an empty seed.
C Appendix: Method List of Seaside Counter Application with Full Pharo Seed

List of methods extracted from the nurtured Web application when using a seed containing all base libraries from Pharo. This list includes all methods installed from Seaside framework and the counter application. The list of methods part of the base library are excluded as it is the same list of the methods found in Pharo base library.

WAAccessIntervalReapingStrategy»defaultConfiguration
WAAccessIntervalReapingStrategy»initialize
WAAccessIntervalReapingStrategy»interval
WAAccessIntervalReapingStrategy»reap
WAAccessIntervalReapingStrategy»stored:key:
WAActionCallback»block:
WAActionCallback»evaluateWithArgument:
WAActionCallback»isEnabledFor:
WAActionCallback»signalRenderNotification
WAActionPhaseContinuation»continue
WAActionPhaseContinuation»handleRequest
WAActionPhaseContinuation»renderContext:
WAActionPhaseContinuation»runCallbacks
WAActionPhaseContinuation»shouldRedirect
WAAdmin class»defaultServerManager
WAAdmin class»serverAdaptors
WAAdmin class»defaultServerManager
WAAnchorTag»callback:
WAAnchorTag»tag
WAAnchorTag»url
WAAnchorTag»with:
WAApplication»contentType
WAApplication»doesHandlerSupportCookies:
WAApplication»handleDefault:
WAApplication»handleFiltered:
WAApplication»isApplication
WAApplication»isImplemented:
WAApplication»keyField
WAApplication»libraries
WAApplication»mainClass
WAApplication»mimeType
WAApplication»newSession
WAApplication»resourceBaseUrl
WAApplication»sessionClass
WAApplicationConfiguration»parents
WAAttributeSearchContext class»key:target:
WAAttributeSearchContext»isAttributeInheritedOn:
WAAttributeSearchContext»isAttributeLocalOn:
WAAttributeSearchContext»key
WABrush»initialize
WABrush»parent
WABrush»with:
WABufferedResponse class»on:
WABufferedResponse»contents
WABufferedResponse»destroy
WABufferedResponse»initializeOn:
WABufferedResponse»stream
WACache»at:ifAbsent:
WACache»at:ifPresent:
WACache»at:ifRetrieved:
WACache»at:ifStored:
WACache»attribute
WACache»cachedValues
WACache»findAttributeAndSelectAncestorsOf:
WACache»initializeWithKey:
WACache»isAttributeInheritedOn:
WACache»isAttributeLocalOn:
WACache»key
WACache»keySize
WACache»missStrategy
WACache»notifyRemoved:
WACache»notifyRetrieved:
WACache»notifyStored:
WACache»pluginsDo:
WACache»reap
WACache»reapOn:
WACache»reapPolicy
WACache»reapStrategy
WACache»setExpiryPolicy:
WACache»setMissStrategy:
WACache»setRemovalAction:
WACache»setReapStrategy:
WACache»store:
WACacheCapacityConfiguration»describeOn:
WACacheMissStrategy»missed:
WACachePlugin»configuration
WACachePlugin»defaultConfiguration
WACachePlugin»initialize
WACachePlugin»removed:
WACachePlugin»retrieved:
WACachePlugin»reverted:
WACachePlugin»store:
WACachePlugin»version:
WACachePlugin»system:
WACachePlugin»family:
WACachePlugin»classes:
WACachePlugin»group:
WACachePlugin»configuration:
WACachePlugin»default:
WACachePlugin»initialize:
WACachePlugin»removed:
WACachePlugin»retrieved:
WACachePlugin»reverted:
WACachePlugin»store:
WACachePlugin»version:
WACachePlugin»system:
WACachePlugin»family:
WACachePlugin»classes:
WACachePlugin»group:
WACachePlugin»configuration:
WACachePlugin»default:
WACachePlugin»initialize:
WACachePlugin»removed:
WACachePlugin»retrieved:
WACachePlugin»reverted:
WACachePlugin»store:
WACachePlugin»version:
WACachePlugin»system:
WACachePlugin»family:
WACachePlugin»classes:
WACachePlugin»group:
WACachePlugin»configuration:
WACachePlugin»default:
WACachePlugin»initialize:
WACachePlugin»removed:
WACachePlugin»retrieved:
WACachePlugin»reverted:
WACachePlugin»store:
WACachePlugin»version:
WACachePlugin»system:
WACachePlugin»family:
WACachePlugin»classes:
WACachePlugin»group:
WACachePlugin»configuration:
WACachePlugin»default:
WACachePlugin»initialize:
WACachePlugin»removed:
WACachePlugin»retrieved:
WACachePlugin»reverted:
WACachePlugin»store:
WACachePlugin»version:
WACachePlugin»system:
WACachePlugin»family:
WACachePlugin»classes:
WACachePlugin»group:
WACachePlugin»configuration:
WACachePlugin»default:
WACachePlugin»initialize:
WACachePlugin»removed:
WACachePlugin»retrieved:
WACachePlugin»reverted:
WACachePlugin»store:
WACachePlugin»version:
WACachePlugin»system:
WACachePlugin»family:
WACachePlugin»classes:
WACachePlugin»group:
WACachePlugin»configuration:
WACachePlugin»default:
WACachePlugin»initialize:
WACachePlugin»removed:
WACachePlugin»retrieved:
WACachePlugin»reverted:
WACachePlugin»store:
WACachePlugin»version:
WACachePlugin»system:
WACachePlugin»family:
WACachePlugin»classes:
WACachePlugin»group:
WACachePlugin»configuration:
WACachePlugin»default:
WACachePlugin»initialize:
WACachePlugin»removed:
WACachePlugin»retrieved:
WACachePlugin»reverted:
WACachePlugin»store:
WACachePlugin»version:
WACachePlugin»system:
WACachePlugin»family:
WACachePlugin»classes:
WACachePlugin»group:
WACachePlugin»configuration:
WACachePlugin»default:
WACachePlugin»initialize:
WACachePlugin»removed:
WACachePlugin»retrieved:
WACachePlugin»reverted:
WACachePlugin»store:
WACachePlugin»version:
WACachePlugin»system:
WACachePlugin»family:
WACachePlugin»classes:
WACachePlugin»group:
WACachePlugin»configuration:
WACachePlugin»default:
WACachePlugin»initialize:
WACachePlugin»removed:
WACachePlugin»retrieved:
WACachePlugin»reverted:
WACachePlugin»store:
WACachePlugin»version:
WACachePlugin»system:
WACachePlugin»family:
WACachePlugin»classes:
Appendix: Method List of Seaside Counter Application with Empty Seed

List of methods extracted from the nurtured Web application when using an empty seed. This list includes all methods installed from Seaside framework, the Counter application and the base library of Pharo.

Array class»new:
Array»isSelfEvaluating
Array»printOn:
Array»replaceFrom:to:with:startingAt:
ArrayedCollection class»new:withAll:
ArrayedCollection class»new
ArrayedCollection class»with:with:with:
ArrayedCollection class»with:
ArrayedCollection class»with:with:with:
ArrayedCollection class»with:with:
ArrayedCollection class»mergeSortFrom:to:by:
ArrayedCollection»size
ArrayedCollection»sort:
Association class»key:value:
Association class»key:value:
Association»expireWeakKey
Association»expiredWeakKey
Association»key:WeakKey
Association»key:value:WeakKey
Association»keyWeakKey
Association»value:WeakKey
Association»value:
Association»valueWeakKey
Association»value:
BlockClosure»argumentCount
BlockClosure»asContextWithSender:
BlockClosure»asContext
BlockClosure»assert
BlockClosure»cull:
BlockClosure»ensure:
BlockClosure»fixCallbackTemps
BlockClosure»forkAt:named:
BlockClosure»forkAt:
BlockClosure»ifCurtailed:
BlockClosure»ifError:
BlockClosure»isNewClosure
BlockClosure»newProcess
BlockClosure»numArgs
BlockClosure»numCopiedValues
BlockClosure»outerContext
BlockClosure»renderOn:
BlockClosure»repeat
BlockClosure»repeatWithGCIf:
BlockClosure»startpc
BlockClosure»asContext
BlockClosure»assert
BlockClosure»cull:
BlockClosure»ensure:
BlockClosure»fixCallbackTemps
BlockClosure»forkAt:named:
BlockClosure»forkAt:
BlockClosure»ifCurtailed:
BlockClosure»ifError:
Character class→space
Character class→value:
Character= CompiledMethod+objectAt:
Character→asCharacter CompiledMethod+primitive
Character→asInteger ContextPart+contextEnsure:
Character→asSymbol ContextPart+contextOn:do:
Character→asciIValue ContextPart+newForMethod:
Character→asciIValue ContextPart+theReturnMethod
Character→charAt ContextPart+activateMethod:withArgs.receiver.class:
Character→characterSet ContextPart+activateReturn:value:
Character→codePoint ContextPart+at:put:
Character→digitValue ContextPart+at:
Character→greaseInteger ContextPart+bottomContext
Character→isAlphaNumeric ContextPart+cut:
Character→isCharacter ContextPart+doPop
Character→isDigit ContextPart+exceptionClass
Character→isLetter ContextPart+exceptionHandlerBlock
Character→isOctetCharacter ContextPart+exceptionHandlerIsActive:
Character→isSeparator ContextPart+exceptionHandlerIsActive
Character→isVowel ContextPart+findContextSuchThat:
Character→leadingChar ContextPart+findNextHandlerContextStarting
Character→to: ContextPart+findNextUnwindContextUpTo:
Collection class→withAll: ContextPart+handleSignal:
Collection→addAll: ContextPart+insertSender:
Collection→allSatisfy: ContextPart+isDead
Collection→anySatisfy: ContextPart+jump
Collection→asArray ContextPart+methodReturnTop
Collection→detect:ifNone: ContextPart+nextHandlerContext
Collection→emptyCheck ContextPart+pop
Collection→inject:into: ContextPart+privSender:
Collection→isCollection ContextPart+push:
Collection→isEmptyOrNil ContextPart+pushTemporaryVariable:
Collection→isEmpty ContextPart+releaseTo:
Collection→noneSatisfy: ContextPart+resume:through:
Collection→notEmpty ContextPart+resume:
Collection→printElementsOn: ContextPart+runUntilErrorOrReturnFrom:
Collection→printNameOn: ContextPart+return:from:
Collection→printOn: ContextPart+return:
Collection→removeAll: ContextPart+runUntilErrorOrReturnFrom:
Collection→removeAllFoundIn: ContextPart+sender
Collection→sorted: ContextPart+singleRelease
Collection→sorted ContextPart+stack:
CommandLineUIManager class→replacing: ContextPart+stepToCallee
CommandLineUIManager→initialize ContextPart+step
CommandLineUIManager→replacing: ContextPart+terminateTo:
CompiledMethod→frameSize Date class+fromSeconds:
CompiledMethod→header Date class+fromString:
CompiledMethod→initialPC Date class+readFrom:
CompiledMethod→isPrimitive Date class+starting:
CompiledMethod→numLiterals Date class+year:month:day:
Dictionary»includesKey: Exception class»
Dictionary»initialize:GRSmall Exception class+handles:
Dictionary»initializeSmall Exception class+signal:
Dictionary»isEmptyGRSmall Exception class+signal:
Dictionary»keyAtValue:ifAbsent: Exception+description
Dictionary»keysAndValuesDo:SmallDictionary Exception+isResumable
class+new
Dictionary»keysAndValuesDo: Exception+messageText:
Dictionary»keysAndValuesDo: Exception+printOn:
Dictionary»keysDo:GRSmall Exception+privateHandlerContext:
Dictionary»noCheckAdd: Exception+receiver
Dictionary»postCopyGRSmall Exception+resume:
Dictionary»privateAt:put:GRSmall Exception+resumeUnchecked:
Dictionary»privateAt:put:Small Exception+signal:
Dictionary»rehash Exception+signalerContext
Dictionary»removeKey:ifAbsent: Exception+signal
Dictionary»scanFor: ExceptionSet+,
Dictionary»seasideRequestFieldsGRSmall ExceptionSet+add:
Dictionary»sizeGRSmall ExceptionSet+handles:
Dictionary»valuesDo: ExceptionSet+initialize
DiskStore class+checkVMVersion
ExtendedNumberParser+allowPlusSign
DiskStore class+initialize
ExtendedNumberParser+nextNumber
DiskStore class+reset
ExternalSemaphoreTable class+clearExternalObjects
DiskStore class+shutDown:
ExternalSemaphoreTable class+collectionBasedOn:withRoomFor:
DiskStore class+startUp:
ExternalSemaphoreTable class+freedSlotsIn:ratherThanIncreaseSizeTo:
DiskStore class+useFilePlugin
ExternalSemaphoreTable class+initialize
Duration class+days:hours:minutes:seconds:nanoSeconds:
ExternalSemaphoreTable class+registerExternalObject:
Float
Fraction numerator:denominator:
Fraction>=
Fraction=reduced
Fraction=truncated
GRCodecStream on:
GRCodecStream atEnd
GRCodecStream initializeOn:
GRNullCodec codecName
GRNullCodec supportsEncoding:
GRNullCodec encoderFor:
GRNullCodec url
GRNullCodecStream nextPutAll:
GRObject initialize
GROrderedMultiMap allAt:
GROrderedMultiMap at:add:
GRPharoConverterCodecStream on:converter
GRPharoConverterCodecStream contents
GRPharoConverterCodecStream initializeOn:converter
GRPharoConverterCodecStream size
GRPharoGenericCodec supportsEncoding:
GRPharoGenericCodec supportedEncodingNames
GRPharoLatin1Codec supportedEncodingNames
GRPharoPlatform addToShutDownList:
GRPharoPlatform addToStartUpList:
GRPharoPlatform includesUnsafeUrlCharacter:
GRPharoPlatform includesUnsafeXmlCharacter:
GRPharoRandomProvider initialize:
GRPharoRandomProvider nextInt:
GRPharoRandomProvider randomClass
GRPharoUtf8Codec decode:
GRPharoUtf8Codec decoderFor:
GRPharoUtf8Codec encoderFor:
GRPharoUtf8Codec url
GRPharoUtf8CodecStream encodeFast:
GRPharoUtf8CodecStream next:
GRPharoUtf8CodecStream nextPut:
GRPharoUtf8CodecStream nextPutAll:
GRPlatform current
GRPlatform reduceConflictDictionary
GRSmallDictionary new:
GRSmallDictionary new
Integer»floor
Integer»isFraction
Integer»isInteger
Integer»noMask:
Integer»normalize
Integer»numerator
Integer»printOn:
Integer»printStringBase:length:padded:
Integer»printStringLength:padded:
Integer»quo:
Integer»rounded
Integer»timesRepeat:
Interval class»from:to:by:
Interval class»new
Interval»collect:
Interval»setFrom:to:by:
Interval»size
Interval»species
KOI8RT extConverter class»encodingNames
LanguageEnvironment class»defaultFileNameConverter
LargeNegativeInteger»negative
LargeNegativeInteger»normalize
LargePositiveInteger»*
LargePositiveInteger»+
LargePositiveInteger»-
LargePositiveInteger»//
LargePositiveInteger»asFloat
LargePositiveInteger»digitAt:
LargePositiveInteger»digitLength
LargePositiveInteger»highBitOfMagnitude
LargePositiveInteger»negated
LargePositiveInteger»negative
LargePositiveInteger»normalize
LargePositiveInteger»quo:
LimitedWriteStream»nextPut:
LimitedWriteStream»nextPutAll:
LimitedWriteStream»setLimit:limitBlock:
LookupKey class»key:
LookupKey»key:
MethodContext class»blockReturnTop
MethodContext»closure
MethodContext»contextTag
MethodContext»methodReturnContext
MethodContext»method
MethodContext»method
MethodContext»method
MethodContext»receiver
MethodContext»setSender:receiver:method:arguments:
MethodContext»setSender:receiver:method:closure:startpc:
MethodContext»tempAt:put:
MethodContext»tempAt:
MethodDictionary»at:ifAbsent:
MethodDictionary»includesKey:
MethodDictionary»scanFor:
MethodDictionary»aboutToReturn:through:
MethodDictionary»blockReturnTop
MethodDictionary»closure
MethodDictionary»includesKey:
MethodDictionary»scanFor:
Month class»daysInMonth:forYear:
Month class»indexOfMonth:
Month class»nameOfMonth:
Mutex»critical:
Mutex»initialize
NetNameResolver class»initialize
NetNameResolver class»initializeNetwork
Number class»one
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OSPlatform class»determineActivePlatformStartingAt:
OSPlatform class»initialize
OSPlatform class»isMacOS
OSPlatform class»platformName
OSPlatform class»shutdown:
OSPlatform class»startUp:ISO88597
OSPlatform class»version
OSPlatform class»shutdown:
OSPlatform class»startUp:
Object class»flushDependents
Object class»flushEvents
Object class»initializeDependentsFields
Object class»initialize
Object class»newFrom:
Object»:
Object»actAsExecutor
Object»as:
Object»asSetElement
Object»asString
Object»assert:
Object»at:put:
Object»at:
Object»basicAt:put:
Object»basicAt:
Object»basicSize
Object»breakDependents
Object»class
Object»copyFrom:
Object»copySameFrom:
Object»copy
Object»enclosedSetElement
Object»encodeOn:
Object»executor
Object»greaseString
Object»hash
Object»instVarAt:put:
Object»instVarAt:
Object»instVarNamed:put:
Object»isArray
Object»isCharacter
Object»isInteger
Object»isKindOf:
Object»isLiteral
Object»isMemberOf:
Object»isSelfEvaluating
Object»isString
Object»isSymbol
Object»myDependents:
Object»notNil
Object»perform:with:
OrderedCollection class»arrayType
OrderedCollection class»new:
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OrderedCollection class»new
OrderedCollection class»add:
OrderedCollection class»addAll:
OrderedCollection class»addAllLast:
OrderedCollection class»addFirst:
OrderedCollection class»addLast:
OrderedCollection class»asArray
OrderedCollection class»at:
OrderedCollection class»collect:
OrderedCollection class»copyEmpty
OrderedCollection class»do:
OrderedCollection class»ensureBoundsFrom:to:
OrderedCollection class»growAtLast
OrderedCollection class»makeRoomAtFirst
OrderedCollection class»makeRoomAtLast
OrderedCollection class»postCopy
OrderedCollection class»remove:ifAbsent:
OrderedCollection class»removeFirst
OrderedCollection class»removeIndex:
OrderedCollection class»resetTo:
OrderedCollection class»reset
OrderedCollection class»reverseDo:
OrderedCollection class»select:
OrderedCollection class»setCollection:
OrderedCollection class»size
PositionableStream class»on:
PositionableStream class»atEnd
PositionableStream class»isBinary
PositionableStream»isEmpty
PositionableStream»on:
PositionableStream»originalContents
PositionableStream»peekFor:
PositionableStream»peek
PositionableStream»position:
PositionableStream»position
PositionableStream»reset
PositionableStream»skip:
PositionableStream»skipSeparators
PositionableStream»skipTo:
Process class»forContext:priority:
Process»activateReturn:value:
Process»calleeOf:
Process»complete:
Process»isActiveOf:
Process»name:
Process»popTo:
Process»primitiveResume:
Process»priority:
Process»priority
Process»psValueAt:put:
Process»psValueAt:
Process»resume:
Process»return:value:
Process»suspendedContext:
Process»suspendedList:
Process»suspend:
Process»terminate:
ProcessLocalVariable class»value:
ProcessLocalVariable»value:
ProcessSpecificVariable class»soleInstance
ProcessSpecificVariable»value
ProcessSpecificVariable»default
ProcessorScheduler class»idleProcess
ProcessorScheduler class»initialize
ProcessorScheduler class»relinquishProcessorForMicroseconds:
ProcessorScheduler class»startUp
ProcessorScheduler class»startUp
ProcessorScheduler»activePriority
ProcessorScheduler»activeProcess
ProcessorScheduler»highOPriority
ProcessorScheduler»highestPriority
ProcessorScheduler»lowOPriority
ProcessorScheduler»lowestPriority
ProcessorScheduler»terminateActive
ProcessorScheduler»timingPriority
ProcessorScheduler»userInterruptPriority
ProtoObject»basicIdentityHash
ProtoObject»flag:
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WARequestHandler»initialize
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WAResponse class»messageForStatus:
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WAResponse»contentT ype
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WAResponse»found
WAResponse»headerAt:ifAbsent:
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WAResponse»headers
WAResponse»initializeOn:
WAResponse»initialize
WAResponse»location:
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WAResponse»status:message:
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WAServerAdaptor»defaultPort
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WAServerManager class»shutDown
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WASession»actionField
WASession»actionUrlForContinuation:
WASession»actionUrlForKey:
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ZnUrl\textbackslash{}enforceKnownScheme
ZnUrl\textbackslash{}hasFragment
ZnUrl\textbackslash{}hasHost
ZnUrl\textbackslash{}hasPath
ZnUrl\textbackslash{}hasPort
ZnUrl\textbackslash{}hasQuery
ZnUrl\textbackslash{}hasScheme
ZnUrl\textbackslash{}hasUsername
ZnUrl\textbackslash{}isSchemeUsingPath
ZnUrl\textbackslash{}parseFrom\textbackslash{}defaultScheme:
ZnUrl\textbackslash{}parseFrom:
ZnUrl\textbackslash{}parsePath:
ZnUrl\textbackslash{}printAuthorityOn:
ZnUrl\textbackslash{}printOn:
ZnUrl\textbackslash{}printPathOn:
ZnUrl\textbackslash{}printPathQueryFragmentOn:
ZnUrl\textbackslash{}printQueryOn:
ZnUrl\textbackslash{}query:
ZnUrl\textbackslash{}query
ZnUtils class\textbackslash{}httpDate:
ZnUtils class\textbackslash{}nextPutAll\textbackslash{}on:
ZnUtils class\textbackslash{}signalProgress\textbackslash{}total:
ZnUtils class\textbackslash{}streamingBufferSize
ZnZincServerAdaptor\textbackslash{}basicStart
ZnZincServerAdaptor\textbackslash{}configureDelegate
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ZnZincServerAdaptor\textbackslash{}requestBodyFor:
ZnZincServerAdaptor\textbackslash{}requestCookiesFor:
ZnZincServerAdaptor\textbackslash{}requestFieldsFor:
ZnZincServerAdaptor\textbackslash{}requestHeadersFor:
ZnZincServerAdaptor\textbackslash{}requestMethodFor:
ZnZincServerAdaptor\textbackslash{}requestVersionFor:
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ZnZincServerAdaptor\textbackslash{}server
ZnZincServerAdaptor\textbackslash{}shutDown
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