Survey on Multi-language Design Smells

Thank you for agreeing to participate, it will take around 30 minutes to complete.

Study Policy:

- Participation in this study is completely voluntary. If you decide not to participate there will not be any negative consequences. If you decide to participate, you may stop participating at any time and withdraw entirely your participation or you may decide not to answer any specific question.
- Your identity and the data collected thanks to your participation will remain anonymous and will never be released to the public. Only anonymous data (aggregated or not) will be published in scientific articles, ensuring that the data cannot be linked back to a particular participant. The data will be kept by the principal investigator for five years before being destroyed.
- By submitting this survey, you are indicating that you have read the description of the study, are over the age of 18, and that you agree to the terms and consent as described in https://drive.google.com/file/d/1aZfHRCr0bEX0i33l_oQHlS9ui9h6rlC5/view?usp=sharing

If you have any questions, please contact us at mouna.abidi@polymtl.ca

Study Design: The purpose of this study is to investigate the prevalence of design smells related to multi-language systems. These systems are developed using more than one programming language. We aim to investigate the perceived prevalence and impact of the design smells detailed below. Our main goal is to improve the quality of those systems.

Definition of terminologies:

Not Handling Exceptions	The exceptions are not handled, developers generally rely on the exceptions provided by the other language
Assuming Safe Return Value	A value is returned to the other language without being checked. Thus, the interaction between both languages may not be correctly performed
Excessive Inter-language Communication	A wrong partitioning in both languages leads to many calls in a way or the other. It adds complexity takes more time to run and may indicate a bad separation of concerns
Too Much Clustering	The multi-language code is concentrated in a few classes, regardless of their concerns and responsibilities.
Too Much Scattering	Many classes are scarcely used in multi-language communication
Hard Coding Libraries	When different libraries are needed depending on the operating system, they are not loaded with conditions on the operating system, but for instance, with a try-catch mechanism, making it hard to know which library has really been loaded
Local References Abuse	The developer does not manage the memory in the native space properly and does not release local and global references
Memory Management Mismatch	Reference types passed from one language to another are not released in a language that does not handle the management of memory causing memory leaks
Not Caching Objects	A method is called to retrieve a field every time this field is needed, although the field's ID or value could have been cached.
Not Securing Libraries	The code loads a foreign library without any security check or restriction privilege
Not Using Relative Path	A library is loaded using only the name not the path. It cannot be accessed in the same way from everywhere
Excessive Objects	A whole object is passed as an argument, although only some of the fields were needed, and it would have been better for the system performance to pass only these fields
Unused Method Declaration	A method is declared in the host language but not implemented in the foreign language
Unused Method Implementation	A method is declared in the host language and implemented in the foreign language, but never called from the host language
Unused Parameters	Some arguments of a function are used neither in its body nor in the other language.

(Khomh, F., & Gueheneuce, Y. G. (2008, April). Do design patterns impact software quality positively?. In Software Maintenance and Reengineering, 2008. CSMR 2008. 12th European Conference on (pp. 274-278).

IEEE.)

− Expandability: The degree to which the design of a system can be extended.

− Simplicity: The degree to which the design of a system can be understood easily.

− Reusability: The degree to which a piece of design can be reused in another design.

− Learnability: The degree to which the code source of a system is easy to learn.

− Understandability: The degree to which the code source can be understood easily.

− Performance: The degree to which the code meets its requirements for timeliness.

− Modularity: The degree to which the implementation of the functions of a system is independent of one another.

Thank you.

Best regards,

*** 1. What is your role within your organization?**

(Yamashita, A., & Moonen, L. (2013, October). Do developers care about code smells? an exploratory survey. In Reverse Engineering (WCRE), 2013 20th Working Conference on (pp. 242-251).
IEEE.)

- Software Engineer
- Team Lead
- Architect
- Project Manager
- Other, please specify
- Developer
- Tester
- QA Manager
- Self-employed

*** 2. How many years of experience do you have in software engineering?**

- Less than 1 year
- 1 year - 5 Years
- 5-10 Years
- More than 10 years

*** 3. What is the domain of activity of your organization?**

- Research and development
- Healthcare
- Banking and insurance
- Games
- Other, please specify
- Networks
- Analytics (Business,IT services, BigData...)
- Robotics and Embeeded systems
- Other, please specify

*** 4. What is your level of skill in the following languages? Please specify which other languages if relevant:**

(https://spectrum.ieee.org/at-work/innovation/the-2018-top-programming-languages)

	1 Novice	2 Little Knowledge	3 Practical	4 Comfortable	5 Expert
Python	○	○	○	○	○
C++	○	○	○	○	○
Java	○	○	○	○	○
C	○	○	○	○	○
C#	○	○	○	○	○
PHP	○	○	○	○	○
R	○	○	○	○	○
JavaScript	○	○	○	○	○
Go	○	○	○	○	○
Assembly	○	○	○	○	○
Other, please specify	○	○	○	○	○

*** 5. How often do you encounter the following design smells in your project(s)?**

Please check the definitions provided above before answering this questions

	1 Very Often	2 Often	3 Rarely	N/A
Not Handling Exceptions	○	○	○	○
Assuming Safe Return Value	○	○	○	○
Excessive Inter-language Communication	○	○	○	○
Too Much Clustering	○	○	○	○
Too Much Scattering	○	○	○	○
Hard Coding Libraries	○	○	○	○
Local References Abuse	○	○	○	○
Memory Management Mismatch	○	○	○	○
Not Caching Objects	○	○	○	○
Not Securing Libraries	○	○	○	○
Not Using Relative Path	○	○	○	○
Excessive Objects	○	○	○	○
Unused Method Declaration	○	○	○	○
Unused Method Implementation	○	○	○	○

Unused Parameters	○	○	○	○

*** 6. How do you evaluate the impact of the following design smells in those software quality attributes?**

Please carefully read the definition of the smells provided bellow and the reference provided.

(VN: Very Negative, N: Negative, NS: Not significant/Neutral, P: Positive, and VP: Very Positive)

	Expandability	Simplicity	Reusability	Learnability	Understandability	Performance	Modularity	N/A
Not Handling Exceptions								○
Assuming Safe Return Value								○
Excessive Inter-language Communication								○
Too Much Clustering								○
Too Much Scattering								○
Hard Coding Libraries								○
Local References Abuse								○
Memory Management Mismatch								○
Not Caching Objects								○
Not Securing Libraries								○
Not Using Relative Path								○
Excessive Objects								○
Unused Method Declaration								○
Unused Method Implementation								○
Unused Parameters								○

*** 7. Please rank the following design smells from the most harmful to the less harmful**

(Most harmful to the less harmful: 15 -> 1)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

Not Handling Exceptions

Assuming Safe Return Value

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

Excessive Inter-language Communication

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

Too Much Clustering

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

Too Much Scattering

Hard Coding Libraries

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

Local References Abuse

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

Memory Management Mismatch

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

Not Caching Objects

Not Securing Libraries

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

Not Using Relative Path

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

Excessive Objects

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

Unused Method Declaration

Unused Method Implementation

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

Unused Parameters

*** 8. Task:**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
void JNICALL Java_i2jrt_TAOObject__1release(JNIEnv *jni, jobject jThis)
{
jclass clazz = findClass(jni, "i2jrt/TAOObject");
jfieldID fid = jni->GetFieldID(clazz, "_jni_ptr", "J");
jlong _jni_ptr = jni->GetLongField(jThis, fid);
CORBA::Object_ptr o = reinterpret_cast(_jni_ptr);
CORBA::release(o);
jni->SetLongField(jThis, fid, reinterpret_cast(CORBA::Object::_nil()));
}
```

○ Yes ○ No

9. b) If YES, please provide an explanation or specify the design smell(s) involved?

10. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 11. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 12. e) If YES, would you apply this refactored solution?**

```
void JNICALL Java_i2jrt_TAOObject__1release(JNIEnv *jni, jobject jThis)
{
jclass clazz = findClass(jni, "i2jrt/TAOObject");
if (clazz == NULL) {
jclass newExc = env->FindClass("java/lang/NullPointerException");
env->ThrowNew(newExc, "The native object does not exist.");
return 0;}
jfieldID fid = jni->GetFieldID(clazz, "_jni_ptr", "J");
jlong _jni_ptr = jni->GetLongField(jThis, fid);
CORBA::Object_ptr o = reinterpret_cast(_jni_ptr);
CORBA::release(o);
jni->SetLongField(jThis, fid, reinterpret_cast(CORBA::Object::_nil()));
}
```

○ Yes (Refactor with this solution)
○ Yes (Refactor with an alternative solution)
○ No (No refactoring)

*** 13. <u>Task:</u>**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
public static char convertToChar(StreamItem item) throws MessageFormatException {
if (item == null) throw new NullPointerException();
final ItemKind itemKind = item.discriminator();
if (compare(itemKind, ItemKind.CHAR_KIND)) {
return item.charValue();
} else {
throw new MessageFormatException("Cannot convert stream item to char");
}
}
```

○ Yes
○ No

14. b) If YES, please provide an explanation or specify the design smell(s) involved?

15. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 16. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 17. e) If YES, would you apply this refactored solution?**

```
public static char convertToChar(StreamItem item) throws MessageFormatException {

if (item == null) throw new NullPointerException();
final ItemKind itemKind = item.discriminator();
if (ItemKind  !== null)){
if (compare(itemKind, ItemKind.CHAR_KIND)) {
return item.charValue();
}} else {
throw new MessageFormatException("Cannot convert stream item to char");
}
}
```

○ Yes (Refactor with this solution)
○ Yes (Refactor with an alternative solution)
○ No (No refactoring)

*** 18. <u>Task:</u>**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
Status WriteBatchInternal::Merge(WriteBatch* b, uint32_t column_family_id, const SliceParts& key, const SliceParts& value) {
LocalSavePoint save(b);
Status s = CheckSlicePartsLength(key, value);
if (!s.ok()) {
return s;
}
```

○ Yes
○ No

19. b) If YES, please provide an explanation or specify the design smell(s) involved?

20. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 21. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A

○	○	○	○	○	○

*** 22. e) If YES, would you apply this refactored solution?**

```
Status WriteBatchInternal::Merge(WriteBatch* b, const SliceParts& key, const SliceParts& value) {
LocalSavePoint save(b);
Status s = CheckSlicePartsLength(key, value);
if (!s.ok()) {
return s;
}
```

- ○ Yes (Refactor with this solution)
- ○ Yes (Refactor with an alternative solution)
- ○ No (No refactoring)

*** 23. <u>Task:</u>**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
static {
try {
System.loadLibrary("JMPlayer");
} catch (Throwable err) {
err.printStackTrace();
}
}
```

- ○ Yes
- ○ No

24. b) If YES, please provide an explanation or specify the design smell(s) involved?

25. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 26. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 27. e) If YES, would you apply this refactored solution?**

```
public static void loadLibrary
```

```
static {
AccessController.doPrivileged( new PrivilegedAction() {
public Void run() {
try {
System.loadLibrary("JMPlayer");
} catch (Throwable err) {
err.printStackTrace();
}} } );
}
```

- ○ Yes (Refactor with this solution)
- ○ Yes (Refactor with an alternative solution)
- ○ No (No refactoring)

*** 28. Task:**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
JNIEXPORT jint JNICALL OS_NATIVE(RemoveEventHandler) (JNIEnv *env, jobject this)
{
OSErr anErr = noErr;
anErr = AERemoveEventHandler(kInternetEventClass, kAEGetURL, NewAEEventHandlerUPP((AEEventHandlerProcPtr)NativeCallback), false);
(*env)->DeleteGlobalRef(env, ref);
jvm = 0;
ref = 0;
mid = 0;
return (jint)anErr;
}
```

- ○ Yes
- ○ No

29. b) If YES, please provide an explanation or specify the design smell(s) involved?

30. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 31. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 32. e) If YES, would you apply this refactored solution?**

```
JNIEXPORT jint JNICALL OS_NATIVE(RemoveEventHandler) (JNIEnv *env, jobject this)
{
```

```
OSErr anErr = noErr;
anErr = AERemoveEventHandler(kInternetEventClass, kAEGetURL, NewAEEventHandlerUPP((AEEventHandlerProcPtr)NativeCallback), false);
(*env)->DeleteGlobalRef(env, ref);
jvm = 0;
ref = 0;
mid = 0;
if ( anErr not null){
return (jint)anErr; }}
```

- ○ Yes (Refactor with this solution)
- ○ Yes (Refactor with an alternative solution)
- ○ No (No refactoring)

*** 33. Task:**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
std::vector certBufferRefs(numCerts);
std::vector certBuffers(numCerts);
for (size_t i = 0; i < numCerts; ++i) {
ScopedLocalRef certArray(env, reinterpret_cast(env->GetObjectArrayElement(encodedCertificatesJava, i)));
certBufferRefs[i] = ByteArrayToCryptoBuffer(env, certArray.get(), nullptr);
if (!certBufferRefs[i]) {
return;
}
certBuffers[i] = certBufferRefs[i].get();
}
}
```

- ○ Yes
- ○ No

34. b) If YES, please provide an explanation or specify the design smell(s) involved?

35. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 36. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 37. e) If YES, would you apply this refactored solution?**

```
std::vector<bssl::uniqueptr> certBufferRefs(numCerts);
std::vector<crypto_buffer*> certBuffers(numCerts);
```

```
for (size_t i = 0; i < numCerts; ++i) {
ScopedLocalRef certArray(
env, reinterpret_cast(
env->GetObjectArrayElement(encodedCertificatesJava, i)));
certBufferRefs[i] = ByteArrayToCryptoBuffer(env, certArray.get(), nullptr);
if (!certBufferRefs[i]) {
return;
}
certBuffers[i] = certBufferRefs[i].get();
(*env)->DeleteLocalRef(env, certBufferRefs);
}
```

- ○ Yes (Refactor with this solution)
- ○ Yes (Refactor with an alternative solution)
- ○ No (No refactoring)

*** 38. Task:**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
public NativeLoader(File parent) throws IOException {
logger.debug("Using native directory: %s", parent.GetFullPathName());
this.parent = Files.verifyDirectory(parent);
}
```

- ○ Yes
- ○ No

39. b) If YES, please provide an explanation or specify the design smell(s) involved?

40. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 41. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 42. e) If YES, would you apply this refactored solution?**

```
public NativeLoader(File parent) throws IOException {
logger.debug("Using native directory: %s", parent.getAbsolutePath());
this.parent = Files.verifyDirectory(parent);
}
```

- ○ Yes (Refactor with this solution)
- ○ Yes (Refactor with an alternative solution)

- No (No refactoring)

*** 43. Task:**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
bool setApplicationProtocols(JNIEnv* e, jbyteArray applicationProtocolsJava) {
clearApplicationProtocols();
if (applicationProtocolsJava != nullptr) {
jbyte* applicationProtocols =
e->GetByteArrayElements(applicationProtocolsJava, nullptr);
if (applicationProtocols == nullptr) {
clearCallbackState();
JNI_TRACE("appData=%p setApplicationCallbackState => applicationProtocols == null", this);
return false;
}
applicationProtocolsLength = static_cast(e->GetArrayLength(applicationProtocolsJava));
applicationProtocolsData = new char[applicationProtocolsLength];
memcpy(applicationProtocolsData, applicationProtocols, applicationProtocolsLength);
}
return true;
}
```

- Yes
- No

44. b) If YES, please provide an explanation or specify the design smell(s) involved?

45. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 46. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 47. e) If YES, would you apply this refactored solution?**

```
bool setApplicationProtocols(JNIEnv* e, jbyteArray applicationProtocolsJava) {
clearApplicationProtocols();
if (applicationProtocolsJava != nullptr) {
jbyte* applicationProtocols =
e->GetByteArrayElements(applicationProtocolsJava, nullptr);
if (applicationProtocols == nullptr) {
clearCallbackState();
```

```
JNI_TRACE("appData=%p setApplicationCallbackState => applicationProtocols == null", this);
return false;
}
applicationProtocolsLength =
static_cast(e->GetArrayLength(applicationProtocolsJava));
applicationProtocolsData = new char[applicationProtocolsLength];
memcpy(applicationProtocolsData, applicationProtocols, applicationProtocolsLength);
e->ReleaseByteArrayElements(applicationProtocolsJava, applicationProtocols, JNI_ABORT);
}
return true;
}
```

- ○ Yes (Refactor with this solution)
- ○ Yes (Refactor with an alternative solution)
- ○ No (No refactoring)

*** 48. Task:**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
public synchronized void loadLibrary(final String tmpDir) throws IOException {
try {
System.loadLibrary(sharedLibraryName);
System.loadLibrary(jniLibraryName);
} catch(final UnsatisfiedLinkError ule) {
loadLibraryFromJar(tmpDir);}}}
```

- ○ Yes
- ○ No

49. b) If YES, please provide an explanation or specify the design smell(s) involved?

50. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 51. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 52. e) If YES, would you apply this refactored solution?**

```
public synchronized void loadLibrary(final String tmpDir) throws IOException {
try {
System.loadLibrary(sharedLibraryName);
} catch(final UnsatisfiedLinkError ule1) {
```

```
try {
System.loadLibrary(jniLibraryName);
} catch(final UnsatisfiedLinkError ule2) {
loadLibraryFromJar(tmpDir);}}}
```

- ○ Yes (Refactor with this solution)
- ○ Yes (Refactor with an alternative solution)
- ○ No (No refactoring)

*** 53. Task:**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
bool composite_mapping::gen_struct(UTL_ScopedName *name, const vector &fields, const char *repoid)
{
for (vector::iterator it(components_.begin());
it != components_.end(); ++it) {
if (!(*it)->gen_struct(name, fields, repoid))
return false;
}
 return true;
}
```

- ○ Yes
- ○ No

54. b) If YES, please provide an explanation or specify the design smell(s) involved?

55. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 56. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 57. e) If YES, would you apply this refactored solution?**

```
bool composite_mapping::gen_struct(UTL_ScopedName *name, const vector &fields, const char *repoid)
{
for (vector::iterator it(components_.begin());
it != components_.end(); ++it) {
if (!(*it)->gen_struct(name, fields, repoid))
return false;
}
```

return true;
}

- Yes (Refactor with this solution)
- Yes (Refactor with an alternative solution)
- No (No refactoring)

*** 58. Task:**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

int sumNative(JNIEnv* env,jobject obj,jobject allVal)
{ jint anative= (*env)->GetIntField(env,allVal,a);
jint bnative= (*env)->GetIntField(env,allVal,b);
jint cnative= (*env)->GetIntField(env,allVal,c);
return anative + bnative + cnative;}

- Yes
- No

59. b) If YES, please provide an explanation or specify the design smell(s) involved?

60. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 61. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 62. e) If YES, would you apply this refactored solution?**

int sumNative (JNIEnv* env, jobject obj, jint a, jint b,jint c){ return a + b + c};

- Yes (Refactor with this solution)
- Yes (Refactor with an alternative solution)
- No (No refactoring)

*** 63. Task:**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

int sumNative (JNIEnv* env,jobject obj,jobject allVal){
jclass cls=(*env)->GetObjectClass(env,allVal);
jfieldID a=(*env)->GetFieldID(env,cls,"a","I");
jfieldID b=(*env)->GetFieldID(env,cls,"b","I");

```
jfieldID c=(*env)->GetFieldID(env,cls,"c","I");
jint anative=(*env)->GetIntField(env,allVal,a);
jint bnative=(*env)->GetIntField(env,allVal,b);
jint cnative=(*env)->GetIntField(env,allVal,c);
return anative + bnative + cnative;}
```

- ○ Yes
- ○ No

64. b) If YES, please provide an explanation or specify the design smell(s) involved?

65. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 66. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 67. e) If YES, would you apply this refactored solution?**

```
int sumNative (JNIEnv* env,jobject obj,jobject allVal){
jint anative=(*env)->GetIntField(env,allVal,a);
jint bnative=(*env)->GetIntField(env,allVal,b);
jint cnative=(*env)->GetIntField(env,allVal,c);
return anative + bnative + cnative;}
```

- ○ Yes (Refactor with this solution)
- ○ Yes (Refactor with an alternative solution)
- ○ No (No refactoring)

*** 68. <u>Task:</u>**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
public class GodotLib {
public static GodotIO io;
static { System.loadLibrary("godot_android");}
public static native void initialize(Godot p_instance, Object p_asset_manager, boolean use_apk_expansion);
public static native void setup(String[] p_cmdline);
public static native void resize(int width, int height);
public static native void newcontext(boolean p_32_bits);
public static native void back();
public static native void step();
public static native void touch(int what, int pointer, int howmany, int[] arr);
public static native void accelerometer(float x, float y, float z);
```

```
public static native void gravity(float x, float y, float z);
public static native void magnetometer(float x, float y, float z);
public static native void gyroscope(float x, float y, float z);
public static native void key(int p_scancode, int p_unicode_char, boolean p_pressed);
public static native void compress(int p_device, int p_but, boolean p_pressed);
public static native void decompress(int p_device, int p_axis, float p_value);
public static native void securehat(int p_device, int p_hat_x, int p_hat_y);
public static native void joyconnectionchanged(int p_device, boolean p_connected, String p_name);
public static native void image();
public static native void video();
public static native void audio();
public static native void setmedia(String p_name, Object p_object);
public static native void secure(String p_sname, String p_name, String p_ret, String[] p_params);
public static native String getGlobal(String p_key);
public static native void callobject(int p_ID, String p_method, Object[] p_params);
public static native void calldeferred(int p_ID, String p_method, Object[] p_params);
public static native void requestPermissionConenctionString p_permission, boolean p_result);
public static native void setVirtualKeyboardHeight(int p_height);
}
```

○ Yes ○ No

69. b) If YES, please provide an explanation or specify the design smell(s) involved?

70. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 71. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 72. e) If YES, would you apply this refactored solution?**

```
public class GodotLib {
public static GodotIO io;
static { System.loadLibrary("godot_android");}
public static native void initialize(Godot p_instance, Object p_asset_manager, boolean use_apk_expansion);
public static native void setup(String[] p_cmdline);
public static native void newcontext(boolean p_32_bits);
public static native void resize(int width, int height);
public static native void back();
public static native void step();
public static native void touch(int what, int pointer, int howmany, int[] arr);
public static native void accelerometer(float x, float y, float z);
public static native void gravity(float x, float y, float z);
```

```
public static native void magnetometer(float x, float y, float z);
public static native void gyroscope(float x, float y, float z);
public static native String getGlobal(String p_key);}
public class media{
public static native void image();
public static native void video();
public static native void audio();
public static native void setmedia(String p_name, Object p_object);}
public class compression{
public static native void compress(int p_device, int p_but, boolean p_pressed);
public static native void decompress(int p_device, int p_axis, float p_value);}
public class connection{
public static native void key(int p_scancode, int p_unicode_char, boolean p_pressed);
public static native void securehat(int p_device, int p_hat_x, int p_hat_y);
public static native void joyconnectionchanged(int p_device, boolean p_connected, String p_name);
public static native void secure(String p_sname, String p_name, String p_ret, String[] p_params);
public static native void callobject(int p_ID, String p_method, Object[] p_params);
public static native void calldeferred(int p_ID, String p_method, Object[] p_params);
public static native void requestPermissionConenctionString p_permission, boolean p_result);
public static native void setVirtualKeyboardHeight(int p_height);}
```

- ○ Yes (Refactor with this solution)
- ○ Yes (Refactor with an alternative solution)
- ○ No (No refactoring)

*** 73. Task:**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
package DDS;
public final class DATAREADER_QOS_DEFAULT {
private DATAREADER_QOS_DEFAULT() {}
public static native DataReaderQos get();
}

package DDS;
public final class DATAREADER_QOS_USE_TOPIC_QOS {
private DATAREADER_QOS_USE_TOPIC_QOS() {}
public static native DataReaderQos get();
}

package DDS;
public final class DATAWRITER_QOS_DEFAULT {
private DATAWRITER_QOS_DEFAULT() {}
public static native DataWriterQos get();
}

package DDS;
public final class DATAWRITER_QOS_USE_TOPIC_QOS {
private DATAWRITER_QOS_USE_TOPIC_QOS() {}
public static native DataWriterQos get();
}
```

- ○ Yes
- ○ No

74. b) If YES, please provide an explanation or specify the design smell(s) involved?

75. **c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?**

* 76. **d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

* 77. **e) If YES, would you apply this refactored solution?**

```
package DDS;
public final class DATAREADER_QOS{
private DATAREADER_QOS() {}
public static native DataReaderQos get();
public static native DataWriterQos get();
}
```

- ○ Yes (Refactor with this solution)
- ○ Yes (Refactor with an alternative solution)
- ○ No (No refactoring)

* 78. **<u>Task:</u>**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
public static String[] WinRegGetSubKeys(int hKey, String subKey, int maxKeyLength) {
byte[] lpSubKey = stringToByteArray(subKey);
int[] openResult = RegOpenKey(hKey, lpSubKey, KEY_READ);
if (openResult == null) {
return null;
}
if (openResult[ERROR_CODE] != ERROR_SUCCESS) {
return null;
} else {
int[] queryResult = RegQueryInfoKey(openResult[OPENED_KEY_HANDLE]);
int subKeysNum = queryResult[SUBKEYS_NUMBER];
if (subKeysNum == 0) {
RegCloseKey(openResult[OPENED_KEY_HANDLE]);
return null;
} else {
String[] keyStrings = new String[subKeysNum];
byte[] keyBytes;
for (int subKeyIndex = 0; subKeyIndex < subKeysNum; subKeyIndex++) {
keyBytes = RegEnumKeyEx(openResult[OPENED_KEY_HANDLE],
subKeyIndex, maxKeyLength);
keyStrings[subKeyIndex] = byteArrayToString(keyBytes);
```

```
}
RegCloseKey(openResult[OPENED_KEY_HANDLE]);
return keyStrings;
}
}
}

private static native byte[] RegEnumKeyEx(int hKey, int subKeyIndex,
int maxKeyLength);
```

- ○ Yes
- ○ No

79. b) If YES, please provide an explanation or specify the design smell(s) involved?

80. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 81. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 82. e) If YES, would you apply this refactored solution?**

```
public static String[] WinRegGetSubKeys(int hKey, String subKey, int maxKeyLength) {
byte[] lpSubKey = stringToByteArray(subKey);
int[] openResult = RegOpenKey(hKey, lpSubKey, KEY_READ);
if (openResult == null) {
return null;
}
if (openResult[ERROR_CODE] != ERROR_SUCCESS) {
return null;
} else {
int[] queryResult = RegQueryInfoKey(openResult[OPENED_KEY_HANDLE]);
int subKeysNum = queryResult[SUBKEYS_NUMBER];
if (subKeysNum == 0) {
RegCloseKey(openResult[OPENED_KEY_HANDLE]);
return null;
} else {
String[] keyStrings = new String[subKeysNum];
byte[] keyBytes;
keyBytes = RegEnumKeyEx(openResult[OPENED_KEY_HANDLE],subKeysNum, maxKeyLength);
RegCloseKey(openResult[OPENED_KEY_HANDLE]);
return keyStrings;
}}}
```

- ○ Yes (Refactor with this solution)
- ○ Yes (Refactor with an alternative solution)
- ○ No (No refactoring)

*** 83. Task:**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
final class LibDispatchNative {
static {
java.security.AccessController.doPrivileged(
(PrivilegedAction) () -> {
System.loadLibrary("dispatch");
return null;
});
}
private LibDispatchNative() {
}
static native boolean nativeIsDispatchSupported();
static native void nativeExecuteAsync(long nativeQueue, Runnable task)
}
public final class Dispatch {
public static Dispatch getInstance() {
checkSecurity();
if (!LibDispatchNative.nativeIsDispatchSupported()) return null;
return instance;
}
JNIEXPORT jboolean JNICALL Java_com_apple_concurrent_LibDispatchNative_nativeIsDispatchSupported(JNIEnv *env, jclass clazz)
{
return JNI_TRUE;
}
```

- ○ Yes
- ○ No

84. b) If YES, please provide an explanation or specify the design smell(s) involved?

85. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 86. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 87. e) If YES, would you apply this refactored solution?**

```
final class LibDispatchNative {
static {
java.security.AccessController.doPrivileged(
(PrivilegedAction) () -> {
System.loadLibrary("dispatch");
return null;
});
}
private LibDispatchNative() {
}
static native boolean nativeIsDispatchSupported();
}
public final class Dispatch {
public static Dispatch getInstance() {
checkSecurity();
if (!LibDispatchNative.nativeIsDispatchSupported()) return null;
return instance;
}
JNIEXPORT jboolean JNICALL Java_com_apple_concurrent_LibDispatchNative_nativeIsDispatchSupported(JNIEnv *env, jclass clazz)
{
return JNI_TRUE;
}
```

- ○ Yes (Refactor with this solution)
- ○ Yes (Refactor with an alternative solution)
- ○ No (No refactoring)

*** 88. <u>Task:</u>**
a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
static {
java.security.AccessController.doPrivileged(
(PrivilegedAction) () -> {
System.loadLibrary("dispatch");
return null;
});
}
private LibDispatchNative() {
}
static native boolean nativeIsDispatchSupported();
static native long nativeCreateConcurrentQueue(int priority);
}
public final class Dispatch {
public static Dispatch getInstance() {
checkSecurity();
if (!LibDispatchNative.nativeIsDispatchSupported()) return null;
return instance;
}
JNIEXPORT jboolean JNICALL Java_com_apple_concurrent_LibDispatchNative_nativeIsDispatchSupported (JNIEnv *env, jclass clazz)
{
return JNI_TRUE;
}
JNIEXPORT jlong JNICALL Java_com_apple_concurrent_LibDispatchNative_nativeCreateConcurrentQueue (JNIEnv *env, jclass clazz, jint priority)
{
dispatch_queue_t queue = dispatch_get_global_queue((long)priority, 0);
return pt
```

- ○ Yes
- ○ No

89. **b) If YES, please provide an explanation or specify the design smell(s) involved?**

90. **c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?**

* 91. **d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

* 92. **e) If YES, would you apply this refactored solution?**

```
static {
java.security.AccessController.doPrivileged(
(PrivilegedAction) () -> {
System.loadLibrary("dispatch");
return null;
});
}
private LibDispatchNative() {
}
static native boolean nativeIsDispatchSupported();
}
public final class Dispatch {
public static Dispatch getInstance() {
checkSecurity();
if (!LibDispatchNative.nativeIsDispatchSupported()) return null;
return instance;
}
JNIEXPORT jboolean JNICALL Java_com_apple_concurrent_LibDispatchNative_nativeIsDispatchSupported (JNIEnv *env, jclass clazz)
{
return JNI_TRUE;
}
```

- ○ Yes (Refactor with this solution)
- ○ Yes (Refactor with an alternative solution)
- ○ No (No refactoring)

* 93. **<u>Task:</u>**

a) In your opinion, does the following code(s) contain any occurrence of design smell(implementation and-or design problem)?

```
public static void setSearchField(JTextField txt, boolean isSearchField) {
if (isSearchField == isSearchField(txt)) {
```

```
txt.putClientProperty(MAC_TEXT_FIELD_VARIANT_PROPERTY, "_triggerevent_");
} else if (isSearchField) {
uiChangeHandler.install(txt);
} else {
uiChangeHandler.uninstall(txt);
}

if (isSearchField) {
txt.putClientProperty(MAC_TEXT_FIELD_VARIANT_PROPERTY, MAC_SEARCH_VARIANT);
txt.putClientProperty("Quaqua.TextField.style", MAC_SEARCH_VARIANT);
} else {
txt.putClientProperty(MAC_TEXT_FIELD_VARIANT_PROPERTY, "default");
txt.putClientProperty("Quaqua.TextField.style", "default");

}}
```

- ○ Yes
- ○ No

94. b) If YES, please provide an explanation or specify the design smell(s) involved?

95. c) If YES, (In your opinion,) What is the motivation behind using this specific way of implementation?

*** 96. d) Please rate the severity of the implementation problem (if any), from 1 (Very Low) to 5 (Very High)**

1 Very Low	2 Low	3 Medium	4 High	5 Very High	N/A
○	○	○	○	○	○

*** 97. e) If YES, would you apply this refactored solution?**

```
public static void setSearchField(JTextField txt, boolean isSearchField) {
if (isSearchField == isSearchField(txt)) {
txt.putClientProperty(MAC_TEXT_FIELD_VARIANT_PROPERTY, "_triggerevent_");
} else if (isSearchField) {
uiChangeHandler.install(txt);
} else {
uiChangeHandler.uninstall(txt);
}
txt.putClientProperty(MAC_TEXT_FIELD_VARIANT_PROPERTY, "default");
txt.putClientProperty("Quaqua.TextField.style", "default");

}}
```

- ○ Yes (Refactor with this solution)
- ○ Yes (Refactor with an alternative solution)
- ○ No (No refactoring)

Your responses have been registered!

Thank you for taking the time to complete the survey, your input is valuable to us.