

NEO Community TechNote

How to run NPCdApp 1.0

NEO Testnet: 0x7074acf3f06dd3f456e11053ebf61c5b04b07ebc

Submission to the CoZ dApp Competition #2
Closing date: February 24, 2018

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<https://github.com/mwherman2000/neo-persistibleclasses>

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What is NPCdApp 1.0?

- ▶ NPC
 - ▶ NEO Persistable Classes
 - ▶ Long name: NEO Persistable Class (NPC) Framework 1.0
 - ▶ Byline: An Efficient Object-Oriented Framework for C#.NEO Smart Contract Development
- ▶ NPCdApp 1.0 is a C#.NEO smart contract dApp built for the CoZ dApp Competition #2 (closing date: February 24, 2018) to demonstrate NPC's
 - ▶ Unique object-oriented programming style for C#.NEO smart contract development
 - ▶ Layered entity persistence model



Unique Object-Oriented Programming Style

```
Point p4 = Point.New();  
Point.Set(p4, 10, 20);  
Point.Log("p4", p4);
```

```
for (int index = 30; index < 40; index++)  
{  
    NeoTrace.Trace("index", index);  
    Point.Set(p4, index, -index);  
    Point.PutElement(p4, vau, index);  
}
```

```
for (int index = 30; index < 40; index++)  
{  
    Point.Set(p4, index, -index);  
    Point x = Point.GetElement(vau, index);  
    Point.Log("loop.x", x);  
    if (Point.GetX(p4) != index || Point.GetY(p4) != -index)  
    {  
        msg = ">>>>(x,y) are different";  
        NeoTrace.Trace(msg);  
        break;  
    }  
}
```



Layered Entity Persistence Model

```
Point p4 = Point.New();  
Point.Set(p4, 10, 20);  
Point.Log("p4", p4);
```

```
for (int index = 30; index < 40; index++)  
{  
    NeoTrace.Trace("index", index);  
    Point.Set(p4, index, -index);  
    Point.PutElement(p4, vau, index);  
}
```

```
for (int index = 30; index < 40; index++)  
{  
    Point.Set(p4, index, -index);  
    Point x = Point.GetElement(vau, index);  
    Point.Log("loop.x", x);  
    if (Point.GetX(p4) != index || Point.GetY(p4) != -index)  
    {  
        msg = ">>>>(x,y) are different";  
        NeoTrace.Trace(msg);  
        break;  
    }  
}
```

See Appendix A of this PPT for more C#.NEO object-oriented programming examples



Running NPCdApp 1.0 with neo-debugger

- ▶ Source to build NPCdApp.avm for loading into neod.exe:
 - ▶ <https://github.com/mwherman2000/neo-persistibleclasses/blob/master/NPCdApp/NPCdApp.cs>
- ▶ Use latest version of neo-debugger with new Storage viewer (F6) smart formatting support
 - ▶ Should be in <https://github.com/CityOfZion/neo-debugger-tools/pull/48>
 - ▶ Backup plan: <https://github.com/mwherman2000/neo-debugger-tools>
- ▶ This version includes specific smart formatting support for NEO Storage Keys that implement the new NEO-KONG NEO Storage Key format
 - ▶ NEO-KONG = NEO Key-Object Notation for Geeks
- ▶ **Calling Conventions**
 - ▶ Prototype: `Main(string operation, param objects[])`
 - ▶ Operations: `“test1” | “test2” | “test3” | “test4” | “test5” | “test6”`
 - ▶ ArrayOfObjects: `[5]` - only used by “test6” to control the maximum number of iterations
- ▶ **Results**
 - ▶ Main will return “success”
 - ▶ The real results are available by pressing F6 to display the neo-debugger Storage viewer
 - ▶ The real results also include the messages in the Event Log panel (lower-left corner of neo-debugger)



Running NPCdApp 1.0 with neo-debugger

NEO debugger

File Search View Debug Tools

NPCdAPP.avm

GAS used: 0

```
301
302     string app = "FooBar";
303     byte[] user = WIF2Account
304     NeoVersionedAppUser vau =
305     NeoVersionedAppUser.Log("
306
307     int index = 24;
308     NeoTrace.Trace("index", i
309     Point.PutElement(p4, vau,
310     index = 25;
311     NeoTrace.Trace("index", i
312     Point.PutElement(p4, vau,
313
314     index = 24;
315     Point p4get = Point.GetEl
316     Point.LogExt("p4get", p4g
317
318     Point p4bury1 = Point.Bur
319     Point.LogExt("p4bury1", p
320     Point p4bury2 = Point.Get
321     Point.LogExt("p4bury2", p
322
```

Storage

Key	Content
{a:7=FooBar;M:2=1;m:2=0;b:2=2034;u:5=23-BA-27-03-C5-32-63-E8-D6-E5-22-DC-32-20-33-39-DC-D8-EE-E9;c:7=Point;i:2=24;c:7=_STA:}	6
{a:7=FooBar;M:2=1;m:2=0;b:2=2034;u:5=23-BA-27-03-C5-32-63-E8-D6-E5-22-DC-32-20-33-39-DC-D8-EE-E9;c:7=Point;i:2=24;c:7=_EXT:}	
{a:7=FooBar;M:2=1;m:2=0;b:2=2034;u:5=23-BA-27-03-C5-32-63-E8-D6-E5-22-DC-32-20-33-39-DC-D8-EE-E9;c:7=Point;i:2=24;c:7=X:}	
{a:7=FooBar;M:2=1;m:2=0;b:2=2034;u:5=23-BA-27-03-C5-32-63-E8-D6-E5-22-DC-32-20-33-39-DC-D8-EE-E9;c:7=Point;i:2=24;c:7=Y:}	
{a:7=FooBar;M:2=1;m:2=0;b:2=2034;u:5=23-BA-27-03-C5-32-63-E8-D6-E5-22-DC-32-20-33-39-DC-D8-EE-E9;c:7=Point;i:2=25;c:7=_STA:}	3
{a:7=FooBar;M:2=1;m:2=0;b:2=2034;u:5=23-BA-27-03-C5-32-63-E8-D6-E5-22-DC-32-20-33-39-DC-D8-EE-E9;c:7=Point;i:2=25;c:7=_EXT:}	
{a:7=FooBar;M:2=1;m:2=0;b:2=2034;u:5=23-BA-27-03-C5-32-63-E8-D6-E5-22-DC-32-20-33-39-DC-D8-EE-E9;c:7=Point;i:2=25;c:7=X:}	
{a:7=FooBar;M:2=1;m:2=0;b:2=2034;u:5=23-BA-27-03-C5-32-63-E8-D6-E5-22-DC-32-20-33-39-DC-D8-EE-E9;c:7=Point;i:2=25;c:7=Y:}	20

Log

```
"StorageKey(nsk).bkey$BSK" / {a:7= FooBar;M:2= 1;m:2=0;b:2=2
63-E8-D6-E5-22-DC-32-20-33-39-DC-D8-EE-E9;c:7=Point;i:2=2
"StorageKey(nsk,i,fb).nsk" / "FooBar" / 1 / False / F2-07 / "Point
AKFw8byCZnsdJBg5KfU3q5dvnJiB4UMtd2 / 1
"StorageKey(nsk).bkey$BSK" / {a:7= FooBar;M:2= 1;m:2=0;b:2=2034;u:5= 23-BA-27-03-C5-32-
63-E8-D6-E5-22-DC-32-20-33-39-DC-D8-EE-E9;c:7=Point;i:2=24;c:7=X;}
"StorageKey(nsk,i,fb).nsk" / "FooBar" / 1 / False / F2-07 / "Point" / False / False /
AKFw8byCZnsdJBg5KfU3q5dvnJiB4UMtd2 / 1
"StorageKey(nsk).bkey$BSK" / {a:7= FooBar;M:2= 1;m:2=0;b:2=2034;u:5=23-BA-27-03-C5-32-
63-E8-D6-E5-22-DC-32-20-33-39-DC-D8-EE-E9;c:7=Point;i:2=24;c:7=Y;}
```



Running NPCdApp 1.0 with neo-gui-developer

- ▶ Network: **NEO Testnet**
- ▶ NPCdApp SC Address: **0x7074acf3f06dd3f456e11053ebf61c5b04b07ebc**
- ▶ Use latest version of neo-gui-developer with new Event Log smart formatting support
 - ▶ Should be here: <https://github.com/CityOfZion/neo-gui-developer/pull/46>
 - ▶ Backup plan: <https://github.com/mwherman2000/neo-gui-developer>
 - ▶ This version includes specific smart formatting support for a range of NEO data types and key types
 - ▶ No direct support for NEO-KONG (yet) = NEO Key-Object Notation for Geeks
- ▶ **Calling Conventions**
 - ▶ Prototype: `Main(string operation, param objects[])`
 - ▶ Parameter Types: `0710`
 - ▶ Operations: `test1 | test2 | test3 | test4 | test5 | test6`
 - ▶ ArrayOfObjects: `[5]` - only used by test6 to control the maximum number of iterations
- ▶ **Results**
 - ▶ Main will return “success”
 - ▶ The real results are the messages in the Event Log tab



Running NPCdApp 1.0 with neo-gui-developer

Invoke Contract

Invoke **Custom**

ScriptHash:

Name:

Version:

Author:

Parameters:

Description:

Contract Parameters

- Parameter List
 - ByteArray=test4
 - Params Array
 - Integer=5
 - [add param]
 - Params Array
 - [add param]

Fee: not evaluated



Running NPCdApp 1.0 with neo-gui-developer

neo-gui - ChainDockerPrivateNet2

Wallet Transaction Advanced Help

Account Asset Transaction History Event Log

Time	Block	Script Hash	Name	Type	Message
2018-02-2...	1010	0x7074acf3f06dd3...	a	Notify	nullkeyp missing? / (BOOL5) False
2018-02-2...	1010	0x7074acf3f06dd3...	a	Notify	nullkeyp extended? / (BOOL5) False
2018-02-2...	1010	0x7074acf3f06dd3...	a	Notify	Missing key test...
2018-02-2...	1010	0x7074acf3f06dd3...	a	Notify	Get(ks).bs / (BINT1) 0 / (BIN0) [binary]
2018-02-2...	1010	0x7074acf3f06dd3...	a	Notify	Missing0.p / (BIN0) [binary] / (BIN0) [binary] / (BINT1) 5 / (BIN0) [binary]
2018-02-2...	1010	0x7074acf3f06dd3...	a	Notify	Get(ks).p / (BIN0) [binary] / (BIN0) [binary] / (BINT1) 5 / (BIN0) [binary]
2018-02-2...	1010	0x7074acf3f06dd3...	a	Notify	missingp / (BIN0) [binary] / (BIN0) [binary]
2018-02-2...	1010	0x7074acf3f06dd3...	a	Notify	missingp null? / (BOOL5) False
2018-02-2...	1010	0x7074acf3f06dd3...	a	Notify	missingp missing? / (BOOL4) True
2018-02-2...	1010	0x7074acf3f06dd3...	a	Notify	missingp extended? / (BOOL5) False
2018-02-2...	1010	0x7074acf3f06dd3...	a	Notify	-----
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	=====
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	NPCdApp - NEO Persistable Class (NPC) Framework
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	NPCdApp - Version 0.1 Reference Implementation
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	-----
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	operation / (STR5) 7465737434 'test4' /
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	=====
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	Empty key test...
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	_Initialize(p).p / (BIN0) [binary] / (BIN0) [binary] / (BIN0) [binary] / (BIN0) [binary]
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	Null0.p / (BIN0) [binary] / (BIN0) [binary] / (BIN0) [binary] / (BIN0) [binary]
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	nullkey / (BIN0) [binary] / (BIN0) [binary]
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	nullkeyp null? / (BOOL4) True
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	nullkeyp missing? / (BOOL5) False
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	nullkeyp extended? / (BOOL5) False
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	Missing key test...
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	Get(ks).bs / (BINT1) 0 / (BIN0) [binary]
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	Missing0.p / (BIN0) [binary] / (BIN0) [binary] / (BINT1) 5 / (BIN0) [binary]
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	Get(ks).p / (BIN0) [binary] / (BIN0) [binary] / (BINT1) 5 / (BIN0) [binary]
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	missingp / (BIN0) [binary] / (BIN0) [binary]
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	missingp null? / (BOOL5) False
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	missingp missing? / (BOOL4) True
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	missingp extended? / (BOOL5) False
2018-02-2...	1011	0x7074acf3f06dd3...	a	Notify	-----

Height: 1013/1013/1013 Connected: 2

Waiting for next block:



Appendix A - Test Case Code



Test1() - Code

```
public static string test1(object[] args)
{
    string msg = "success";

    NeoTrace.Trace("NullHash", NeoEntityModel.NullScriptHash);

    NeoTrace.Trace("NeoEntityModel.EntityState...");
    NeoEntityModel.EntityState state1 = NeoEntityModel.EntityState.MISSING;
    NeoTrace.Trace("state", state1);
    int ystate = (int)state1;
    NeoTrace.Trace("state1", state1);

    BigInteger bis = state1.AsBigInteger();
    NeoTrace.Trace("bis", bis);

    byte[] bsta = { 0x4 };
    NeoTrace.Trace("bsta", bsta);
    NeoEntityModel.EntityState state2 = NeoEntityModel.BytesToEntityState(bsta);
    NeoTrace.Trace("state2", state2);

    return msg;
}
```



Test2() - Code

```
public static string test2(object[] args)
{
    string msg = "success";

    NeoTrace.Trace("Make P0...");
    Point p0 = Point.New();
    Point.Log("p0", p0);
    Point.SetX(p0, 7);
    Point.SetY(p0, 8);
    Point.Log("p0", p0);
    Point.Set(p0, 9, 10);
    Point.Log("p0", p0);

    NeoTrace.Trace("Make P1...");
    Point p1 = Point.New();
    Point.Set(p1, 2, 4);
    Point.Log("p1", p1);

    NeoTrace.Trace("Make P2...");
    Point p2 = Point.New();
    Point.Set(p2, 15, 16);
    Point.Log("p2", p2);

    NeoTrace.Trace("Make line1...");
    Point[] line1 = new[]
    {
        p1, p2
    };
    NeoTrace.Trace("line1", line1, p1, p2); // TODO: neo-gui doesn't understand this: line1

    NeoTrace.Trace("Add 2 points...");
    Point p3 = Add(line1[0], line1[1]);
    Point.Log("p3", p3);

    return msg;
}
```



Test3() - Code

```
public static string test3(object[] args)
{
    string msg = "success";

    NeoTrace.Trace("Make P1...");
    Point p1 = Point.New();
    Point.Set(p1, 2, 4);
    Point.Log("p1", p1);

    NeoTrace.Trace("Make P2...");
    Point p2 = Point.New();
    Point.Set(p2, 12, 14);
    Point.Log("p2", p2);

    NeoTrace.Trace("Make P3...");
    Point p3 = Point.New();
    Point.Set(p3, 22, 24);
    Point.Log("p3", p3);

    NeoTrace.Trace("Put P1...");
    Point.Put(p1, "p1");
    NeoTrace.Trace("Put P2...");
    Point.Put(p2, "p2");
    NeoTrace.Trace("Put P3...");
    Point.Put(p3, "p3");

    NeoTrace.Trace("Get P1...");
    Point p1get = Point.Get("p1");
    Point.Log("p1get", p1get);
    NeoTrace.Trace("Get P2...");
    Point p2get = Point.Get("p2");
    Point.Log("p2get", p2get);
    NeoTrace.Trace("Get P3...");
    Point p3get = Point.Get("p3");
    Point.Log("p3get", p3get);

    return msg;
}
```



Test4() - Code

```
public static string test4(object[] args)
{
    string msg = "success";

    NeoTrace.Trace("Empty key test...");
    Point nullkeyp = Point.Get("");
    Point.Log("nullkeyp", nullkeyp);
    NeoTrace.Trace("nullkeyp null?", Point.IsNull(nullkeyp));
    NeoTrace.Trace("nullkeyp missing?", Point.IsMissing(nullkeyp));
    NeoTrace.Trace("nullkeyp extended?", Point.IsExtended(nullkeyp));

    NeoTrace.Trace("Missing key test...");
    Point missingp = Point.Get("missingp");
    Point.Log("missingp", missingp);
    NeoTrace.Trace("missingp null?", Point.IsNull(missingp));
    NeoTrace.Trace("missingp missing?", Point.IsMissing(missingp));
    NeoTrace.Trace("missingp extended?", Point.IsExtended(missingp));

    return msg;
}
```



Test5() - Code

```
public static string test5(object[] args)
{
    string msg = "success";

    NeoTrace.Trace("Test NeoStorageKeys...");
    Point p4 = Point.New();
    Point.Set(p4, 10, 20);
    Point.Log("p4", p4);

    string app = "FooBar";
    byte[] user = WIF2AccountAddressScriptHash;
    NeoVersionedAppUser vau = NeoVersionedAppUser.New(app, 1, 0, 2034, user);
    NeoVersionedAppUser.Log("test5.vau", vau);

    int index = 24;
    NeoTrace.Trace("index", index);
    Point.PutElement(p4, vau, index);
    index = 25;
    NeoTrace.Trace("index", index);
    Point.PutElement(p4, vau, index);

    index = 24;
    Point p4get = Point.GetElement(vau, index);
    Point.LogExt("p4get", p4get);

    Point p4bury1 = Point.BuryElement(vau, index);
    Point.LogExt("p4bury1", p4bury1);
    Point p4bury2 = Point.GetElement(vau, index);
    Point.LogExt("p4bury2", p4bury2);

    return msg;
}
```



Test6() - Code

```
public static string test6(object[] args)
{
    string msg = "success";
    int maxIterations = 10;
    if (args.Length > 0)
    {
        maxIterations = (int)((byte[])args[0]).AsBigInteger();
        NeoTrace.Trace("maxIterations", maxIterations);
    }
    if (maxIterations <= 0) maxIterations = 10;
    if (maxIterations > 20) maxIterations = 10;
    NeoTrace.Trace("maxIterations", maxIterations);

    byte[] callingUserScriptHash = ExecutionEngine.CallingScriptHash;
    NeoTrace.Trace("callingUserScriptHash", callingUserScriptHash);
    byte[] entryUserScriptHash = ExecutionEngine.EntryScriptHash;
    NeoTrace.Trace("entryUserScriptHash", entryUserScriptHash);
    byte[] executingUserScriptHash = ExecutionEngine.ExecutingScriptHash;
    NeoTrace.Trace("executingUserScriptHash", executingUserScriptHash);
    byte[] invokingUserScriptHash = GetInvokingUserScriptHash();
    NeoTrace.Trace("invokingUserScriptHash", invokingUserScriptHash.Length, invokingUserScriptHash);
    if (invokingUserScriptHash.Length == 0) invokingUserScriptHash = WIF2AccountAddressScriptHash;
    NeoTrace.Trace("invokingUserScriptHash", invokingUserScriptHash);

    Point p4 = Point.New();
    Point.Set(p4, 10, 20);
    Point.Log("p4", p4);
}
```



Test6() - Code (con't)

```
string app = "FooBar";
NeoVersionedAppUser vau = NeoVersionedAppUser.New(app, 1, 0, 2034, invokingUserScriptHash);
NeoVersionedAppUser.Log("test6.vau", vau);

int iteration = 0;
for (int index = 30; index < 40; index++)
{
    NeoTrace.Trace("index", index);
    Point.Set(p4, index, -index);
    Point.PutElement(p4, vau, index);
    iteration++;
    if (iteration > maxIterations) break;
}

iteration = 0;
for (int index = 30; index < 40; index++)
{
    Point.Set(p4, index, -index);
    Point x = Point.GetElement(vau, index);
    Point.Log("loop.x", x);
    if (Point.GetX(p4) != index || Point.GetY(p4) != -index)
    {
        msg = ">>>>(x,y) are different";
        NeoTrace.Trace(msg);
        break;
    }
    iteration++;
    if (iteration > maxIterations) break;
}

return msg;
}
```



Questions?

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