1.1 ./Platform.RegularExpressions.Transformer.CSharpToCpp/CSharpToCppTransformer.cs

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text.RegularExpressions;

#pragma warning disable CS1591 // Missing XML comment for publicly visible type or member

namespace Platform.RegularExpressions.Transformer.CSharpToCpp
{
    public class CSharpToCppTransformer : Transformer
    {
        public static readonly IList<ISubstitutionRule> FirstStage = new List<SubstitutionRule>
        {
            // // ...
            //
            (new Regex(@"(\r?\n)?[ \t]+//+.+"), "", null, 0),
            // #pragma warning disable CS1591 // Missing XML comment for publicly visible type or member
            //
            (new Regex(@"^\s*?\#pragma[\sa-zA-Z0-9]+$"), "", null, 0),
            // {\n\n\n
            // {
            (new Regex(@"{\s+[\r\n]+"), "{" + Environment.NewLine, null, 0),
            // Platform.Collections.Methods.Lists
            // Platform::Collections::Methods::Lists
            (new Regex(@"(namespace[^\r\n]+?)\.([^\r\n]+?)"), "$1::$2", null, 20),
            // out TProduct
            // TProduct
            (new Regex(@"(?<before>(<|, ))(in|out) (?<typeParameter>[a-zA-Z0-9]+)(?<after>(>|,))"), "${before}${typeParameter}${after}", null, 10),
            // public static bool CollectExceptions { get; set; }
            // public static bool CollectExceptions;
            (new Regex(@"(?<before>(private|protected|public)( static?) [^\r\n]+)(?<name>[a-zA-Z0-9]+) {[^;}]*(?<=\W)get;[^;}]*(?<=\W)set;[^;}]*}"), "${before}${name};", null, 0),
            // public abstract class
            // class
            (new Regex(@"(public abstract|static) class"), "class", null, 0),
            // class GenericCollectionMethodsBase {
            // class GenericCollectionMethodsBase { public:
            (new Regex(@"class ([a-zA-Z0-9]+)(\s+){"), "class $1$2{" + Environment.NewLine + "    public:", null, 0),
            // class GenericCollectionMethodsBase<TElement> {
            // template <typename TElement> class GenericCollectionMethodsBase { public:
            (new Regex(@"class ([a-zA-Z0-9]+)<([a-zA-Z0-9]+)>([^{]+){"), "template <typename $2> class $1$3{" + Environment.NewLine + "    public:", null, 0),
            // static void TestMultipleCreationsAndDeletions<TElement>(SizedBinaryTreeMethodsBase<TElement> tree, TElement* root)
            // template<typename T> static void TestMultipleCreationsAndDeletions<TElement>(SizedBinaryTreeMethodsBase<TElement> tree, TElement* root)
            (new Regex(@"static ([a-zA-Z0-9]+) ([a-zA-Z0-9]+)<([a-zA-Z0-9]+)>\(([^\)\r\n]+)\)"), "template <typename $3> static $1 $2($4)", null, 0),
            // interface IFactory<out TProduct> {
            // template <typename TProduct> class IFactory { public:
            (new Regex(@"interface (?<interface>[a-zA-Z0-9]+)<(?<typeParameters>[a-zA-Z0-9,]+)>(?<whitespace>[^{]+){"), "template <typename...> class ${interface};
            template <typename ${typeParameters}> class ${interface}<${typeParameters}>${whitespace}{" + Environment.NewLine + "    public:", null, 0),
            // template <typename TObject, TProperty, TValue>
            // template <typename TObject, typename TProperty, TValue>
            (new Regex(@"(?<before>template <(, )?typename [a-zA-Z0-9]+)+, )(?<typeParameter>[a-zA-Z0-9]+)(?<after>(,|>))"), "${before}typename ${typeParameter}${after}", null, 10),
            // Insert markers
            // private static void BuildExceptionString(this StringBuilder sb, Exception exception, int level)
            // /*~extensionMethod~BuildExceptionString~*/private static void BuildExceptionString(this StringBuilder sb, Exception exception, int level)
            (new Regex(@"private static [^\r\n]+ (?<name>[a-zA-Z0-9]+)\(this [^\)\r\n]+\)"), "/*~extensionMethod~${name}~*/$0", null, 0),
```

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54              // Move all markers to the beginning of the file.
55              (new Regex(@"\A(?<before>[^\r\n]+\r?\n(.|\n)+)(?<marker>/\*~extensionMethod~(?<name>
                ↪  [a-zA-Z0-9]+)~\*/)"), "${marker}${before}", null,
                ↪  10),
56              // /*~extensionMethod~BuildExceptionString~*/...sb.BuildExceptionString(exception.In
                ↪  nerException, level +
                ↪  1);
57              // /*~extensionMethod~BuildExceptionString~*/...BuildExceptionString(sb,
                ↪  exception.InnerException, level + 1);
58              (new Regex(@"(?<before>/\*~extensionMethod~(?<name>[a-zA-Z0-9]+)~\*/(.|\n)+\W)(?<var
                ↪  iable>[_a-zA-Z0-9]+)\.\k<name>\("), "${before}${name}(${variable}, ", null,
                ↪  50),
59              // Remove markers
60              // /*~extensionMethod~BuildExceptionString~*/
61              //
62              (new Regex(@"/\*~extensionMethod~[a-zA-Z0-9]+~\*/"), "", null, 0),
63              // (this
64              // (
65              (new Regex(@"\(this "), "(", null, 0),
66              // public static readonly EnsureAlwaysExtensionRoot Always = new
                ↪  EnsureAlwaysExtensionRoot();
67              // inline static EnsureAlwaysExtensionRoot Always;
68              (new Regex(@"public static readonly (?<type>[a-zA-Z0-9]+) (?<name>[a-zA-Z0-9_]+) =
                ↪  new \k<type>\(\);"), "inline static ${type} ${name};", null, 0),
69              // public static readonly string ExceptionContentsSeparator = "---";
70              // inline static const char* ExceptionContentsSeparator = "---";
71              (new Regex(@"public static readonly string (?<name>[a-zA-Z0-9_]+) =
                ↪  ""(?<string>(\""|[^""\r\n])+)"";"), "inline static const char* ${name} =
                ↪  \"${string}\";", null, 0),
72              // private const int MaxPath = 92;
73              // static const int MaxPath = 92;
74              (new Regex(@"private (const|static readonly) ([a-zA-Z0-9]+) ([_a-zA-Z0-9]+) =
                ↪  ([^;\r\n]+);"), "static const $2 $3 = $4;", null, 0),
75              //  ArgumentNotNull(EnsureAlwaysExtensionRoot root, TArgument argument) where
                ↪  TArgument : class
76              //  ArgumentNotNull(EnsureAlwaysExtensionRoot root, TArgument* argument)
77              (new Regex(@"(?<before> [a-zA-Z]+\(([a-zA-Z *,]+, |))(?<type>[a-zA-Z]+)(?<after>(|
                ↪  [a-zA-Z *,]+)\))[ \r\n]+where \k<type> : class"), "${before}${type}*${after}",
                ↪  null, 0),
78              // protected virtual
79              // virtual
80              (new Regex(@"protected virtual"), "virtual", null, 0),
81              // protected abstract TElement GetFirst();
82              // virtual TElement GetFirst() = 0;
83              (new Regex(@"protected abstract ([^;\r\n]+);"), "virtual $1 = 0;", null, 0),
84              // TElement GetFirst();
85              // virtual TElement GetFirst() = 0;
86              (new Regex(@"([\r\n]+[ ]+)((?!return)[a-zA-Z0-9]+ [a-zA-Z0-9]+\([^\)\r\n]*\))(;[
                ↪  ]*[\r\n]+)"), "$1virtual $2 = 0$3", null, 1),
87              // public virtual
88              // virtual
89              (new Regex(@"public virtual"), "virtual", null, 0),
90              // protected readonly
91              //
92              (new Regex(@"protected readonly "), "", null, 0),
93              // protected readonly TreeElement[] _elements;
94              // TreeElement _elements[N];
95              (new Regex(@"(protected|private) readonly ([a-zA-Z<>0-9]+)([\[\]]+)
                ↪  ([_a-zA-Z0-9]+);"), "$2 $4[N];", null, 0),
96              // protected readonly TElement Zero;
97              // TElement Zero;
98              (new Regex(@"(protected|private) readonly ([a-zA-Z<>0-9]+) ([_a-zA-Z0-9]+);"), "$2
                ↪  $3;", null, 0),
99              // private
100             //
101             (new Regex(@"(\W)(private|protected|public|internal) "), "$1", null, 0),
102             // static void NotImplementedException(ThrowExtensionRoot root) => throw new
                ↪  NotImplementedException();
103             // static void NotImplementedException(ThrowExtensionRoot root) { return throw new
                ↪  NotImplementedException(); }
104             (new Regex(@"(^\s+)(template \<[^>\r\n]+\> )?(static )?(override )?([a-zA-Z0-9]+
                ↪  )([a-zA-Z0-9]+)\(([^\(\r\n]*)\)\s+=>\s+throw([^;\r\n]+);"), "$1$2$3$4$5$6($7) {
                ↪  throw$8; }", null, 0),
105             // SizeBalancedTree(int capacity) => a = b;
106             // SizeBalancedTree(int capacity) { a = b; }
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            (new Regex(@"(^\s+)(template \<[^>\r\n]+\> )?(static )?(override )?(void )?([a-zA-Z0-9]+)\(([^\(\r\n]*)\)\s+=>\s+([^;\r\n]+);"), "$1$2$3$4$5$6($7) { $8; }", null, 0),
            // int SizeBalancedTree(int capacity) => a;
            // int SizeBalancedTree(int capacity) { return a; }
            (new Regex(@"(^\s+)(template \<[^>\r\n]+\> )?(static )?(override )?([a-zA-Z0-9]+)([a-zA-Z0-9]+)\(([^\(\r\n]*)\)\s+=>\s+([^;\r\n]+);"), "$1$2$3$4$5$6($7) { return $8; }", null, 0),
            // () => Integer<TElement>.Zero,
            // () { return Integer<TElement>.Zero; },
            (new Regex(@"\(\)\s+=>\s+([^,;\r\n]+?),"), "() { return $1; },", null, 0),
            // => Integer<TElement>.Zero;
            // { return Integer<TElement>.Zero; }
            (new Regex(@"\)\s+=>\s+([^;\r\n]+?);"), ") { return $1; }", null, 0),
            // () { return avlTree.Count; }
            // [&]()-> auto { return avlTree.Count; }
            (new Regex(@", \(\) { return ([^;\r\n]+); }"), ", [&]()-> auto { return $1; }", null, 0),
            // Count => GetSizeOrZero(Root);
            // GetCount() { return GetSizeOrZero(Root); }
            (new Regex(@"(\W)([A-Z][a-zA-Z]+)\s+=>\s+([^;\r\n]+);"), "$1Get$2() { return $3; }", null, 0),
            // Func<TElement> treeCount
            // std::function<TElement()> treeCount
            (new Regex(@"Func<([a-zA-Z0-9]+)> ([a-zA-Z0-9]+)"), "std::function<$1()> $2", null, 0),
            // Action<TElement> free
            // std::function<void(TElement)> free
            (new Regex(@"Action<([a-zA-Z0-9]+)> ([a-zA-Z0-9]+)"), "std::function<void($1)> $2", null, 0),
            // Predicate<TArgument> predicate
            // std::function<bool(TArgument)> predicate
            (new Regex(@"Predicate<([a-zA-Z0-9]+)> ([a-zA-Z0-9]+)"), "std::function<bool($1)> $2", null, 0),
            // var
            // auto
            (new Regex(@"(\W)var(\W)"), "$1auto$2", null, 0),
            // unchecked
            //
            (new Regex(@"[\r\n]{2}\s*?unchecked\s*?$"), "", null, 0),
            // throw new InvalidOperationException
            // throw std::runtime_error
            (new Regex(@"throw new (InvalidOperationException|Exception)"), "throw std::runtime_error", null, 0),
            // void RaiseExceptionIgnoredEvent(Exception exception)
            // void RaiseExceptionIgnoredEvent(const std::exception& exception)
            (new Regex(@"(\(|, )(System\.Exception|Exception)( |\))"), "$1const std::exception&$3", null, 0),
            // EventHandler<Exception>
            // EventHandler<std::exception>
            (new Regex(@"(\W)(System\.Exception|Exception)(\W)"), "$1std::exception$3", null, 0),
            // override void PrintNode(TElement node, StringBuilder sb, int level)
            // void PrintNode(TElement node, StringBuilder sb, int level) override
            (new Regex(@"override ([a-zA-Z0-9 \*\+]+)(\([^\)\r\n]+?\))"), "$1$2 override", null, 0),
            // string
            // const char*
            (new Regex(@"(\W)string(\W)"), "$1const char*$2", null, 0),
            // sbyte
            // std::int8_t
            (new Regex(@"(\W)sbyte(\W)"), "$1std::int8_t$2", null, 0),
            // uint
            // std::uint32_t
            (new Regex(@"(\W)uint(\W)"), "$1std::uint32_t$2", null, 0),
            // char*[] args
            // char* args[]
            (new Regex(@"([_a-zA-Z0-9:\*]?)\[\] ([a-zA-Z0-9]+)"), "$1 $2[]", null, 0),
            // @object
            // object
            (new Regex(@"@([_a-zA-Z0-9]+)"), "$1", null, 0),
            // using Platform.Numbers;
            //
            (new Regex(@"([\r\n]{2}|^)\s*?using [\.a-zA-Z0-9]+;\s*?$"), "", null, 0),
            // struct TreeElement { }
            // struct TreeElement { };
            (new Regex(@"(struct|class) ([a-zA-Z0-9]+)(\s+){([\sa-zA-Z0-9;:_]+?)}([^;])"), "$1$2$3{$4};$5", null, 0),
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171             // class Program { }
172             // class Program { };
173             (new Regex(@"(struct|class) ([a-zA-Z0-9]+[^\r\n]*)([\r\n]+(?<indentLevel>[\t
                ↪  ]*)?)\{([\S\s]+?[\r\n]+\k<indentLevel>)\}([^;]|$)"), "$1 $2$3{$4};$5", null, 0),
174             // class SizedBinaryTreeMethodsBase : GenericCollectionMethodsBase
175             // class SizedBinaryTreeMethodsBase : public GenericCollectionMethodsBase
176             (new Regex(@"class ([a-zA-Z0-9]+) : ([a-zA-Z0-9]+)"), "class $1 : public $2", null,
                ↪  0),
177             // class IProperty : ISetter<TValue, TObject>, IProvider<TValue, TObject>
178             // class IProperty : public ISetter<TValue, TObject>, IProvider<TValue, TObject>
179             (new Regex(@"(?<before>class [a-zA-Z0-9]+ : ((public [a-zA-Z0-9]+(<[a-zA-Z0-9
                ↪  ,]+>)?, )+)?)(?<inheritedType>(?!public)[a-zA-Z0-9]+(<[a-zA-Z0-9
                ↪  ,]+>)?)(?<after>(, [a-zA-Z0-9]+(?!>)|[ \r\n]+))"), "${before}public
                ↪  ${inheritedType}${after}", null, 10),
180             // Insert scope borders.
181             // ref TElement root
182             // ~!root!~ref TElement root
183             (new Regex(@"(?<definition>(?<= |\()(ref [a-zA-Z0-9]+|[a-zA-Z0-9]+(?<!ref))
                ↪  (?<variable>[a-zA-Z0-9]+)(?=\)|, | =))"), "~!${variable}!~${definition}", null,
                ↪  0),
184             // Inside the scope of ~!root!~ replace:
185             // root
186             // *root
187             (new Regex(@"(?<definition>~!(?<pointer>[a-zA-Z0-9]+)!~ref [a-zA-Z0-9]+
                ↪  \k<pointer>(?=\)|, | =))(?<before>((?<!~!\k<pointer>!~)(.|\n))*?)(?<prefix>(\W
                ↪  |\())\k<pointer>(?<suffix>( |\)|;|,))"),
                ↪  "${definition}${before}${prefix}*${pointer}${suffix}", null, 70),
188             // Remove scope borders.
189             // ~!root!~
190             //
191             (new Regex(@"~!(?<pointer>[a-zA-Z0-9]+)!~"), "", null, 5),
192             // ref auto root = ref
193             // ref auto root =
194             (new Regex(@"ref ([a-zA-Z0-9]+) ([a-zA-Z0-9]+) = ref(\W)"), "$1* $2 =$3", null, 0),
195             // *root = ref left;
196             // root = left;
197             (new Regex(@"\*([a-zA-Z0-9]+) = ref ([a-zA-Z0-9]+)(\W)"), "$1 = $2$3", null, 0),
198             // (ref left)
199             // (left)
200             (new Regex(@"\(ref ([a-zA-Z0-9]+)(\)|\(|,)"), "($1$2", null, 0),
201             //  ref TElement
202             //  TElement*
203             (new Regex(@"( |\()ref ([a-zA-Z0-9]+) "), "$1$2* ", null, 0),
204             // ref sizeBalancedTree.Root
205             // &sizeBalancedTree->Root
206             (new Regex(@"ref ([a-zA-Z0-9]+)\.([a-zA-Z0-9\*]+)"), "&$1->$2", null, 0),
207             // ref GetElement(node).Right
208             // &GetElement(node)->Right
209             (new Regex(@"ref ([a-zA-Z0-9]+)\(([a-zA-Z0-9\*]+)\)\.([a-zA-Z0-9]+)"),
                ↪  "&$1($2)->$3", null, 0),
210             // GetElement(node).Right
211             // GetElement(node)->Right
212             (new Regex(@"([a-zA-Z0-9]+)\(([a-zA-Z0-9\*]+)\)\.([a-zA-Z0-9]+)"), "$1($2)->$3",
                ↪  null, 0),
213             // [Fact]\npublic static void SizeBalancedTreeMultipleAttachAndDetachTest()
214             // TEST_METHOD(SizeBalancedTreeMultipleAttachAndDetachTest)
215             (new Regex(@"\[Fact\][\s\n]+(static )?void ([a-zA-Z0-9]+)\(\)"), "TEST_METHOD($2)",
                ↪  null, 0),
216             // class TreesTests
217             // TEST_CLASS(TreesTests)
218             (new Regex(@"class ([a-zA-Z0-9]+)Tests"), "TEST_CLASS($1)", null, 0),
219             // Assert.Equal
220             // Assert::AreEqual
221             (new Regex(@"Assert\.Equal"), "Assert::AreEqual", null, 0),
222             // $"Argument {argumentName} is null."
223             // ((std::string)"Argument ").append(argumentName).append(" is null.").data()
224             (new Regex(@"\$""(?<left>(\\""|[^""\r\n])*){(?<expression>[_a-zA-Z0-9]+)}(?<right>(\
                ↪  \""|[^""\r\n])*)"""),
                ↪  "((std::string)$\"${left}\").append(${expression}).append(\"${right}\").data()",
                ↪  null, 10),
225             // $"
226             // "
227             (new Regex(@"\$"""), "\"", null, 0),
228             // Console.WriteLine("...")
229             // printf("...\n")
230             (new Regex(@"Console\.WriteLine\(""([^""\r\n]+)""\)"), "printf(\"$1\\n\")", null, 0),
231             // TElement Root;
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232             // TElement Root = 0;
233             (new Regex(@"(\r?\n[\t ]+)([a-zA-Z0-9:_]+(?<!return)) ([_a-zA-Z0-9]+);"), "$1$2 $3 =
                ↪  0;", null, 0),
234             // TreeElement _elements[N];
235             // TreeElement _elements[N] = { {0} };
236             (new Regex(@"(\r?\n[\t ]+)([a-zA-Z0-9]+) ([_a-zA-Z0-9]+)\[([_a-zA-Z0-9]+)\];"),
                ↪  "$1$2 $3[$4] = { {0} };", null, 0),
237             // auto path = new TElement[MaxPath];
238             // TElement path[MaxPath] = { {0} };
239             (new Regex(@"(\r?\n[\t ]+)[a-zA-Z0-9]+ ([a-zA-Z0-9]+) = new
                ↪  ([a-zA-Z0-9]+)\[([_a-zA-Z0-9]+)\];"), "$1$3 $2[$4] = { {0} };", null, 0),
240             // Insert scope borders.
241             // auto added = new StringBuilder();
242             // /*~sb~*/std::string added;
243             (new Regex(@"(auto|(System\.Text\.)?StringBuilder) (?<variable>[a-zA-Z0-9]+) = new
                ↪  (System\.Text\.)?StringBuilder\(\);"), "/*~${variable}~*/std::string
                ↪  ${variable};", null, 0),
244             // static void Indent(StringBuilder sb, int level)
245             // static void Indent(/*~sb~*/StringBuilder sb, int level)
246             (new Regex(@"(?<start>, |\()(System\.Text\.)?StringBuilder
                ↪  (?<variable>[a-zA-Z0-9]+)(?<end>,|\))"), "${start}/*~${variable}~*/std::string&
                ↪  ${variable}${end}", null, 0),
247             // Inside the scope of ~!added!~ replace:
248             // sb.ToString()
249             // sb.data()
250             (new Regex(@"(?<scope>/\*~(?<variable>[a-zA-Z0-9]+)~\*/)(?<separator>.|\n)(?<before>
                ↪  ((?<!/\*~\k<variable>~\*/)(.|\n))*?)\k<variable>\.ToString\(\)"),
                ↪  "${scope}${separator}${before}${variable}.data()", null, 10),
251             // sb.AppendLine(argument)
252             // sb.append(argument).append('\n')
253             (new Regex(@"(?<scope>/\*~(?<variable>[a-zA-Z0-9]+)~\*/)(?<separator>.|\n)(?<before>
                ↪  ((?<!/\*~\k<variable>~\*/)(.|\n))*?)\k<variable>\.AppendLine\((?<argument>[^\),\
                ↪  r\n]+)\)"),
                ↪  "${scope}${separator}${before}${variable}.append(${argument}).append('\\n')",
                ↪  null, 10),
254             // sb.Append('\t', level);
255             // sb.append(level, '\t');
256             (new Regex(@"(?<scope>/\*~(?<variable>[a-zA-Z0-9]+)~\*/)(?<separator>.|\n)(?<before>
                ↪  ((?<!/\*~\k<variable>~\*/)(.|\n))*?)\k<variable>\.Append\('(?<character>[^'\r\n]
                ↪  +)', (?<count>[^\),\r\n]+)\)"),
                ↪  "${scope}${separator}${before}${variable}.append(${count}, '${character}')",
                ↪  null, 10),
257             // sb.Append(argument)
258             // sb.append(argument)
259             (new Regex(@"(?<scope>/\*~(?<variable>[a-zA-Z0-9]+)~\*/)(?<separator>.|\n)(?<before>
                ↪  ((?<!/\*~\k<variable>~\*/)(.|\n))*?)\k<variable>\.Append\((?<argument>[^\),\r\n]
                ↪  +)\)"), "${scope}${separator}${before}${variable}.append(${argument})", null,
                ↪  10),
260             // Remove scope borders.
261             // /*~sb~*/
262             //
263             (new Regex(@"/\*~(?<pointer>[a-zA-Z0-9]+)~\*/"), "", null, 0),
264             // Insert scope borders.
265             // auto added = new HashSet<TElement>();
266             // ~!added!~std::unordered_set<TElement> added;
267             (new Regex(@"auto (?<variable>[a-zA-Z0-9]+) = new
                ↪  HashSet<(?<element>[a-zA-Z0-9]+)>\(\);"),
                ↪  "~!${variable}!~std::unordered_set<${element}> ${variable};", null, 0),
268             // Inside the scope of ~!added!~ replace:
269             // added.Add(node)
270             // added.insert(node)
271             (new Regex(@"(?<scope>~!(?<variable>[a-zA-Z0-9]+)!~)(?<separator>.|\n)(?<before>((?<
                ↪  !~!\k<variable>!~)(.|\n))*?)\k<variable>\.Add\((?<argument>[a-zA-Z0-9]+)\)"),
                ↪  "${scope}${separator}${before}${variable}.insert(${argument})", null, 10),
272             // Inside the scope of ~!added!~ replace:
273             // added.Remove(node)
274             // added.erase(node)
275             (new Regex(@"(?<scope>~!(?<variable>[a-zA-Z0-9]+)!~)(?<separator>.|\n)(?<before>((?<
                ↪  !~!\k<variable>!~)(.|\n))*?)\k<variable>\.Remove\((?<argument>[a-zA-Z0-9]+)\)"),
                ↪  "${scope}${separator}${before}${variable}.erase(${argument})", null, 10),
276             // if (added.insert(node)) {
277             // if (!added.contains(node)) { added.insert(node);
278             (new Regex(@"if \((?<variable>[a-zA-Z0-9]+)\.insert\((?<argument>[a-zA-Z0-9]+)\)\)(?
                ↪  <separator>[\t ]*[\r\n]+)(?<indent>[\t ]*){"), "if
                ↪  (!${variable}.contains(${argument}))${separator}${indent}{" +
                ↪  Environment.NewLine + "${indent}    ${variable}.insert(${argument});", null, 0),
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            // Remove scope borders.
            // ~!added!~
            //
            (new Regex(@"~!(?<pointer>[a-zA-Z0-9]+)!~"), "", null, 5),
            // Insert scope borders.
            // auto random = new System.Random(0);
            // std::srand(0);
            (new Regex(@"[a-zA-Z0-9\.]+ ([a-zA-Z0-9]+) = new
            ↪  (System\.)?Random\(([a-zA-Z0-9]+)\);"), "~!$1!~std::srand($3);", null, 0),
            // Inside the scope of ~!random!~ replace:
            // random.Next(1, N)
            // (std::rand() % N) + 1
            (new Regex(@"(?<scope>~!(?<variable>[a-zA-Z0-9]+)!~)(?<separator>.|\n)(?<before>((?<
            ↪  !~!\k<variable>!~)(.|\n))*?)\k<variable>\.Next\((?<from>[a-zA-Z0-9]+),
            ↪  (?<to>[a-zA-Z0-9]+)\)"), "${scope}${separator}${before}(std::rand() % ${to}) +
            ↪  ${from}", null, 10),
            // Remove scope borders.
            // ~!random!~
            //
            (new Regex(@"~!(?<pointer>[a-zA-Z0-9]+)!~"), "", null, 5),
            // Insert method body scope starts.
            // void PrintNodes(TElement node, StringBuilder sb, int level) {
            // void PrintNodes(TElement node, StringBuilder sb, int level) {/*method-start*/
            (new Regex(@"(?<start>\r?\n[\t ]+)(?<prefix>((virtual )?[a-zA-Z0-9:_]+
               )?)(?<method>[a-zA-Z][a-zA-Z0-9]*)\((?<arguments>[^\)]*)\)(?<override>(
            ↪  override)?)(?<separator>[ \t\r\n]*)\{(?<end>[^~])"), "${start}${prefix}${method}
            ↪  (${arguments})${override}${separator}{/*method-start*/${end}", null,
            ↪  0),
            // Insert method body scope ends.
            // {/*method-start*/...}
            // {/*method-start*/.../*method-end*/}
            (new Regex(@"\{/\*method-start\*/(?<body>((?<bracket>\{)|(?<-bracket>\})|[^\{\}]*)+)
            ↪  \}"), "{/*method-start*/${body}/*method-end*/}", null,
            ↪  0),
            // Inside method bodies replace:
            // GetFirst(
            // this->GetFirst(
            //(new Regex(@"(?<separator>(\(|, |([\W]) |return ))(?<!(->|\*
            ↪  ))(?<method>(?!sizeof)[a-zA-Z0-9]+)\((?!\) \{)"),
            ↪  "${separator}this->${method}(", null, 1),
            (new Regex(@"(?<scope>/\*method-start\*/)(?<before>((?<!/\*method-end\*/)(.|\n))*?)(
            ↪  ?<separator>[\W](?<!(::|\.|->)))(?<method>(?!sizeof)[a-zA-Z0-9]+)\((?!\)
            ↪  \{)(?<after>(.|\n)*?)(?<scopeEnd>/\*method-end\*/)"),
            ↪  "${scope}${before}${separator}this->${method}(${after}${scopeEnd}", null, 100),
            // Remove scope borders.
            // /*method-start*/
            //
            (new Regex(@"/\*method-(start|end)\*/"), "", null, 0),
            // throw new ArgumentNullException(argumentName, message);
            // throw std::invalid_argument(((std::string)"Argument
            ↪  ").append(argumentName).append(" is null: ").append(message).append("."));
            (new Regex(@"throw new
               ArgumentNullException\((?<argument>[a-zA-Z]*[Aa]rgument[a-zA-Z]*),
            ↪  (?<message>[a-zA-Z]*[Mm]essage[a-zA-Z]*)\);"), "throw
            ↪  std::invalid_argument(((std::string)\"Argument \").append(${argument}).append(\"
            ↪  is null: \").append(${message}).append(\".\"));", null, 0),
            // throw new ArgumentException(message, argumentName);
            // throw std::invalid_argument(((std::string)"Invalid
            ↪  ").append(argumentName).append(" argument: ").append(message).append("."));
            (new Regex(@"throw new ArgumentException\((?<message>[a-zA-Z]*[Mm]essage[a-zA-Z]*),
               (?<argument>[a-zA-Z]*[Aa]rgument[a-zA-Z]*)\);"), "throw
            ↪  std::invalid_argument(((std::string)\"Invalid \").append(${argument}).append(\"
            ↪  argument: \").append(${message}).append(\".\"));", null, 0),
            // throw new NotSupportedException();
            // throw std::logic_error("Not supported exception.");
            (new Regex(@"throw new NotSupportedException\(\);"), "throw std::logic_error(\"Not
            ↪  supported exception.\");", null, 0),
            // throw new NotImplementedException();
            // throw std::logic_error("Not implemented exception.");
            (new Regex(@"throw new NotImplementedException\(\);"), "throw std::logic_error(\"Not
            ↪  implemented exception.\");", null, 0),
        }.Cast<ISubstitutionRule>().ToList();

        public static readonly IList<ISubstitutionRule> LastStage = new List<SubstitutionRule>
        {
            // ICounter<int, int> c1;
```

```
            // ICounter<int, int>* c1;
            (new Regex(@"(?<abstractType>I[A-Z][a-zA-Z0-9]+(<[^>\r\n]+>)?)
            ↪  (?<variable>[_a-zA-Z0-9]+);"), "${abstractType}* ${variable};", null, 0),
            // (expression)
            // expression
            (new Regex(@"(\(| )\(([a-zA-Z0-9_\*:]+)\)(,| |;|\))"), "$1$2$3", null, 0),
            // (method(expression))
            // method(expression)
            (new Regex(@"(?<firstSeparator>(\(|
            ↪  ))\((?<method>[a-zA-Z0-9_\->\*:]+)\((?<expression>((?<parenthesis>\()|(?<-parent
            ↪  hesis>\))|[a-zA-Z0-9_\->\*:]*)+)(?(parenthesis)(?!))\)\)(?<lastSeparator>(,|
            ↪  |;|\)))"), "${firstSeparator}${method}(${expression})${lastSeparator}", null, 0),
            // return ref _elements[node];
            // return &_elements[node];
            (new Regex(@"return ref ([_a-zA-Z0-9]+)\[([_a-zA-Z0-9\*]+)\];"), "return &$1[$2];",
            ↪  null, 0),
            // null
            // NULL
            (new Regex(@"(?<before>\r?\n[^""\r\n]*(""(\\""|[^""\r\n])*""[^""\r\n]*)*)(?<=\W)null
            ↪  (?<after>\W)"), "${before}NULL${after}", null,
            ↪  10),
            // default
            // 0
            (new Regex(@"(?<before>\r?\n[^""\r\n]*(""(\\""|[^""\r\n])*""[^""\r\n]*)*)(?<=\W)defa
            ↪  ult(?<after>\W)"), "${before}0${after}", null,
            ↪  10),
            // #region Always
            //
            (new Regex(@"(^|\r?\n)[ \t]*\#(region|endregion)[^\r\n]*(\r?\n|$)"), "", null, 0),
            // //#define ENABLE_TREE_AUTO_DEBUG_AND_VALIDATION
            //
            (new Regex(@"\/\/[ \t]*\#define[ \t]+[_a-zA-Z0-9]+[ \t]*"), "", null, 0),
            // #if USEARRAYPOOL\r\n#endif
            //
            (new Regex(@"#if [a-zA-Z0-9]+\s+#endif"), "", null, 0),
            // [Fact]
            //
            (new Regex(@"(?<firstNewLine>\r?\n|\A)(?<indent>[\t
            ↪  ]+)\[[a-zA-Z0-9]+(\((?<expression>((?<parenthesis>\()|(?<-parenthesis>\))|[^()\r
            ↪  \n]*)+)(?(parenthesis)(?!))\))?\][ \t]*(\r?\n\k<indent>)?"),
            ↪  "${firstNewLine}${indent}", null, 5),
            // \n ... namespace
            // namespace
            (new Regex(@"(\S[\r\n]{1,2})?[\r\n]+namespace"), "$1namespace", null, 0),
            // \n ... class
            // class
            (new Regex(@"(\S[\r\n]{1,2})?[\r\n]+class"), "$1class", null, 0),
        }.Cast<ISubstitutionRule>().ToList();

        public CSharpToCppTransformer(IList<ISubstitutionRule> extraRules) :
        ↪  base(FirstStage.Concat(extraRules).Concat(LastStage).ToList()) { }

        public CSharpToCppTransformer() : base(FirstStage.Concat(LastStage).ToList()) { }
    }
}
```

1.2 ./Platform.RegularExpressions.Transformer.CSharpToCpp.Tests/CSharpToCppTransformerTests.cs

```
using Xunit;

namespace Platform.RegularExpressions.Transformer.CSharpToCpp.Tests
{
    public class CSharpToCppTransformerTests
    {
        [Fact]
        public void HelloWorldTest()
        {
            const string helloWorldCode = @"using System;
class Program
{
    public static void Main(string[] args)
    {
        Console.WriteLine(""Hello, world!"");
    }
}";
            const string expectedResult = @"class Program
{
    public:
    static void Main(const char* args[])
```

```
22      {
23          printf(""Hello, world!\n"");
24      }
25  };";
26              var transformer = new CSharpToCppTransformer();
27              var actualResult = transformer.Transform(helloWorldCode, new Context(null));
28              Assert.Equal(expectedResult, actualResult);
29          }
30      }
31  }
```

Index