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QA automation community

Static and dynamic Page Objects

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About ☺

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COREHARD
C++ COMMUNITY

Agenda, part 1 (to refresh)

1. Page Object – just to “refresh”
2. State-less or state-full solution - just to “refresh”
3. How to select a proper PO implementation?

Agenda, part 2 (to compare)

4. Hypothetical project context
5. Compare complexity
6. Compare “tech” limitations
7. Compare “business” limitations
8. Rationale “business” limitations
9. How to find and “update” a balance for your own project?

Agenda, part 3 (theory)

10. Encapsulation – the most important OOP principle
11. Refactoring, Design Patterns
12. Refactoring and Design Patterns (to \ from)
13. Refactoring Catalog / Language
14. Replace Conditional with Polymorphism and vice versa (to \ from … DP to \ from R)
15. Replace Conditional with … more sophisticated options
16. Replace Conditional with Polymorphism – detailed description
17. How to select a proper PO implementation?

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Agenda, part 4 (practice)

18. Base class, inheritance, virtual functions and overloading
19. Page Base
20. Page examples
21. Dialog Base
22. Dialog examples
23. Test Base
24. Test examples
25. Infrastructure

Agenda, part 5 (take away points)

26. A real-life example
27. “Homework”
28. “Rules” and principles
29. A set of useful links
30. What’s next?
31. Questions

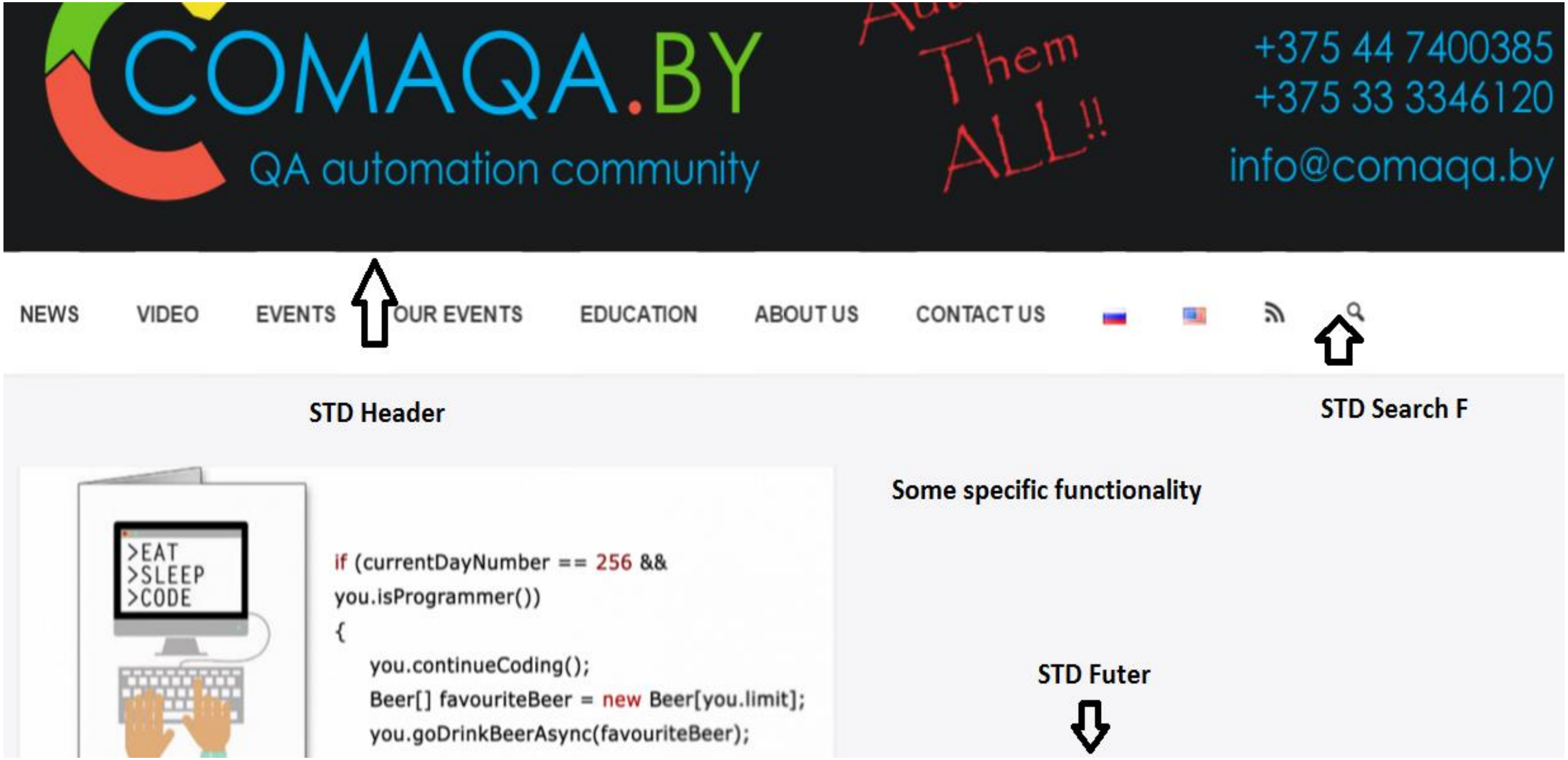
Page Object – just to “refresh”

1. Page Objects – encapsulates the way of identification and logical grouping of widgets.

2. Page Object == Logical Page

3. Page Object != Physical Page

Page Object – “example” ☺



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STD Header

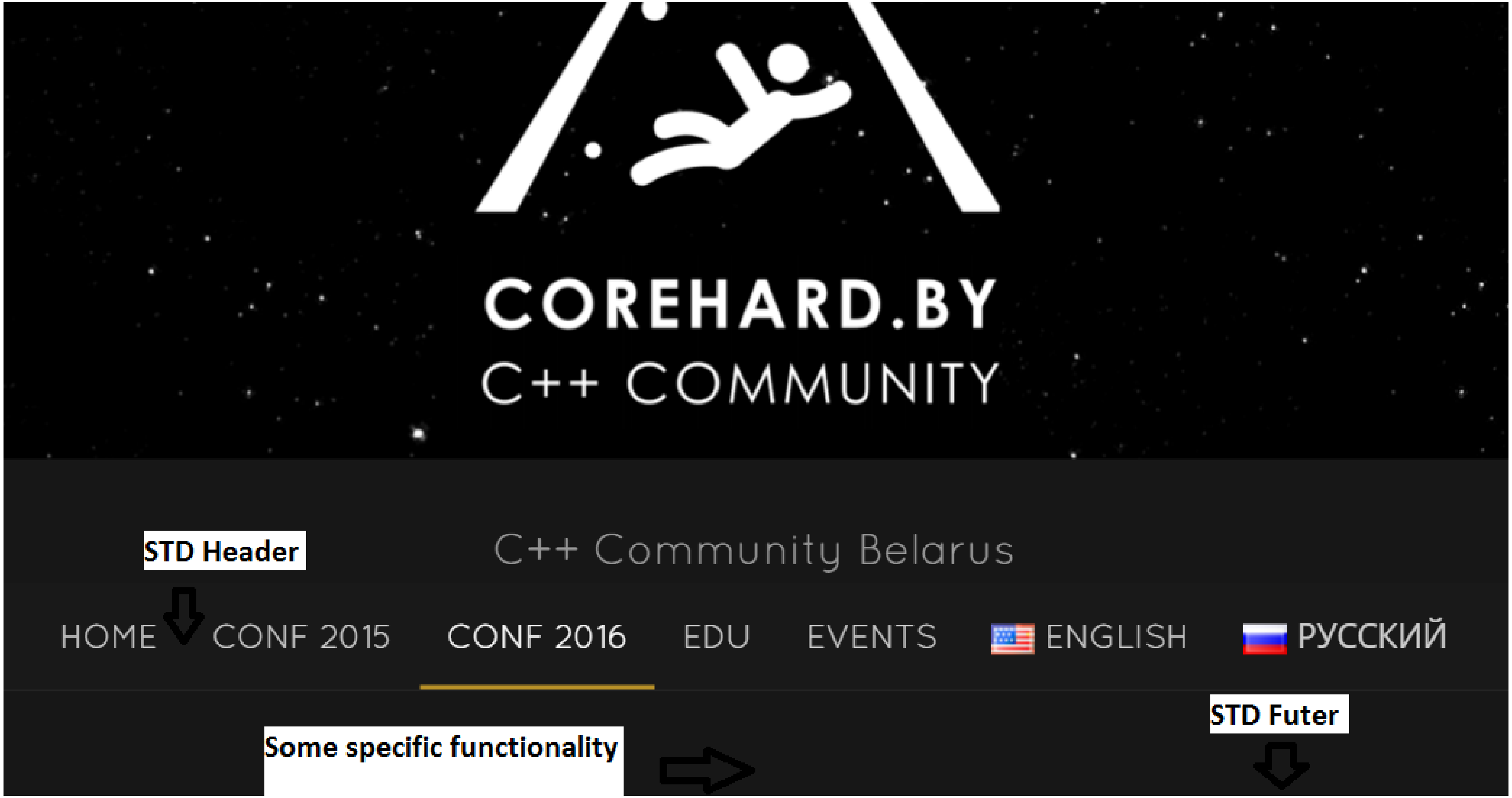
STD Search F

Some specific functionality

```
if (currentDayNumber == 256 &&
you.isProgrammer())
{
    you.continueCoding();
    Beer[] favouriteBeer = new Beer[you.limit];
    you.goDrinkBeerAsync(favouriteBeer);
```

STD Futer

Page Object – “example” ☺



State-less or state-full solution?

1. Let’s compare:

- Photo
  - ✓ Share – looks like parallelism (easy parallelism).
- Video
  - ✓ Share – looks like parallelism (not trivial parallelism).

State-less or state-full solution?

1. How easy transform solution from “single” to “multi” threading (to decrease “QA Automation Windows”)
   - State-less – like share a photo
     - Just 5 minutes of work.
   - State-full – like share a video
     - Not trivial task, could be a night mare.

2. Summary
   - prefer state-less solutions to state-full solutions in mooooost cases;
   - before start implementation a state-full solution, please, take a break for a minute, and re-thing everything again, possibly you can find a proper state-less solution.

Object or static class \ State-full or state-less solution?

1. Static class
   – could be implemented as a state-less solution easily

2. Object
   – State-full solution in 99,99% cases

3. Summary
   – prefer static class based solutions (state-less) to object based (state-full) in mooooost cases;
   –before start implementation based on objects, please, take a break for a minute, and re-thing everything again, possibly you can find a proper solution based on static classes.

Page Objects – state-full, general case

1. Too complicated business logic due to Domain
2. Too complicated business logic due to System size (thousands test-cases)
3. Too many “contexts”
   - Browser versions
   - Environments
   - Customers with a tiny nuances of functionality
   - Platforms (cross-browser Web plus cross-platform Mobile)
   - Combination ☺
4. Combination ☺

Page Objects – state-full, special cases

1. Web UI that behaves like a Wizard
2. Web UI in combination with Mobile in one use case
3. Internet of Things (in most cases)
4. More then 1 page during 1 test (for example several portals or several instances of one portal to implement one “business use case”):

- Really seldom;
- Looks like integration tests (in most cases):
  - Std solution- some type of “Unit” Tests or “White Box” Testing (terminology question).

5. Many others “special cases”

How to select a proper PO implementation?

Hypothetical project context – to compare

1. 30 Physical Pages
2. Standard Header, footer and search functionality for all physical pages
3. Each Physical Page consists of
   - Header – H
   - Footer – F
   - Search – S
   - Some functionality, specific for the Page – U (unique)

Compare complexity – Static Page Object based

1. 33 Static Page Objects = Logical Pages
2. 0 explicit and 30 implicit Physical Pages
3. Just share 33 Static Page Objects between 30 implicit Physical Pages
   - For example, Header Static Page Object (static class) is used in test cases for all 30 Physical Page Objects
4. **Complexity - just 33 static state-less entities** (plus limitations due to state-less solutions)

Compare complexity – Dynamic Page Object based (option 1)

1. 33 Dynamic Page Objects = Logical Pages
2. It depends on implementation (one of the ways):
   - 0 explicit and 30 implicit Physical Pages
   - implicit Physical Page implements on Action layer (limitations example)
   - Action for Physical Page aggregates all necessary Dynamic Logical Pages
     - ✓ Physical Pages are implemented in a next way: create all necessary instances of logical pages, aggregate in some way, use Action layer as a point of aggregation in most cases, free resources

Compare complexity – Dynamic Page Object based (option 1)

1. 120 objects (min), each with some state, dynamically created and frees to implement necessary behavior - to implement 30 implicit Physical Pages
2. **Complexity - 120 dynamic, state-full entities min** (plus some limitations due to state-full solution implementation nuances)

Compare complexity – Dynamic Page Object based (option 2)

1. 33 Dynamic Page Objects = Logical Pages
2. It depends on implementation (another way):
   - 30 explicit Physical Pages
   - Multiple Interface inheritance
   - Combine Page Objects and Actions layer (at least low level actions, in most cases)
   - Action-Physical Page (low level actions, sometimes “business” actions or both plus limitations example)
     - Implements all Logical Pages interfaces using aggregation and “delegation”
     - Aggregate all Dynamic Logical Page Objects
     - Create and frees resources (Dynamic Logical Page Objects)

Compare complexity - Dynamic Page Object based (option 2)

1. 150 objects, each with some state, dynamically created and frees to implement necessary behavior - to implement 30 explicit Physical Pages
2. **Complexity - 150 dynamic, state-full not trivial entities with a multiple interface inheritance** (plus some limitations due to state-full solution implementation nuances)

Compare “tech” limitations - Static Page Object based

1. Can be used together with next Design Patterns \ Approaches
   - Action (both static – preferable and dynamic)
   - Key-word driven
   - DSL – external only
   - BDD – partially, it depends on exact BDD engine implementation limitations

2. Can’t be used together with next Design Patterns
   - Factory
   - Flow (Fluent Interface)
   - Navigator (for Web)

Compare “tech” limitations - Dynamic Page Object based

1. No limitations, but …
    - For example, in most cases it’s hard to isolate Action and Page Objects layers

Compare “business” limitations - Static

1. (-) Too complicated business logic due to Domain
2. (-) Too complicated business logic due to System size (thousands test-cases)
3. (-) Too many “contexts”
   - Browser versions
   - Environments
   - Customers with a tiny nuances of functionality
   - Platforms (cross-browser Web plus cross-platform Mobile)
   - Combination ☺
4. (-) Combination ☺

Rationale “business” limitations – Static (Transformation)

1. State-less approach - you have a conditional that chooses different behavior depending on …
2. Solution to simplify the project – refactoring “**Replace Conditional with Polymorphism**”
3. Polymorphism = object = State-full approach

Rationale “business” limitations – Static (Balance)

1. “From Refactoring to Patterns”
   - There is a set of specific Design Patterns

2. The trickiest part – find a balance for your project now and update point of balance in time

Compare “business” limitations - Dynamic

1. (-) Relatively simple business logic due to Domain
2. (-) Relatively simple business logic due to System size (hundreds test-cases)
3. (-) Not so many “contexts”
   - Browser versions
   - Environments
   - Customers with a tiny nuances of functionality
   - Platforms (cross-browser Web plus cross-platform Mobile)

Rationale “business” limitations – Dynamic (Transformation)

1. State-full approach - you have a set of objects \ classes, which developed, possibly, using several Design Patterns to implement necessary functionality – to choose different behavior depending on …
2. Solution to simplify the project – refactoring “**Replace Polymorphism with Conditional**”
3. Polymorphism ~= object ~= State-full approach
4. No Polymorphism ~= no objects ~= State-less approach

Rationale “business” limitations – Dynamic (Balance)

1. “From Patterns to refactoring”
   - There is no need to use a set of specific Design Patterns

2. The trickiest part – find a balance for your project now and update point of balance in time

Find and “update” a balance for your own project

Encapsulation – the most important OOP principle

1. Ask yourself "how can I hide some details from the rest of the software?“
2. What is encapsulation?
   - hide variability
   - hide complexity
   - Details
     - “conflict of interests”
     - “tech” discussions
3. Example of public member or private member + setter/getter
   - What is really hidden?
   - Where is simplicity?

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Refactoring by Martin Fowler

1. “Refactoring is a controlled technique for **improving the design of an existing code base.**”
2. “Its essence is applying a series of **small behavior-preserving transformations**, each of which "too small to be worth doing".”
3. “The cumulative effect of each of these transformations is quite significant.”
4. “By doing Refactoring in small steps you reduce the risk of introducing errors. You also avoid having the system broken while you are carrying out the restructuring - which allows you to gradually refactor a system over an extended period of time.”

Refactoring and Design Patterns by Martin Fowler

1. “There is a **close relationship between refactoring and patterns.**”
2. “Often the best way to use patterns is to **gradually refactor your code to use the pattern once you realize it’s needed.**”
3. “Joshua Kerievsky’s Refactoring to Patterns explores this topic, making this a great topic to learn about once you’ve got the basic refactoring's under your belt.”
4. “From Refactoring To Design Pattern” path – from pure design to adequate design
5. “From ~Design Patterns To Refactoring” path – from over design to adequate design

Refactoring and Design Patterns by Joshua Kerievsky

1. “Refactoring to Patterns is the marriage of refactoring - the process of improving the design of existing code - with patterns, the classic solutions to recurring design problems.”
2. “Refactoring to Patterns suggests that using patterns to improve an existing design is better than using patterns early in a new design. This is true whether code is years old or minutes old.”
3. “We improve designs with patterns by applying sequences of low-level design transformations, known as refactoring's.”
4. And vice versa

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Refactoring Catalog / Language

1. There are more then **90 types of refactoring**
2. Refactoring types that relate to a particular field is called a **”Refactoring Language”**
3. **”Refactoring Language”** gives a common terminology for discussing the situations specialists are faced with:
   – “The elements of this language are entities called Refactoring types”;
   – “Each type of Refactoring describes a problem that occurs over and over again in our environment”;
   – “Each type of Refactoring describes the core of the solution to that “~low level” problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice!”

Replace Conditional with Polymorphism and vice versa

1. You have a conditional that chooses different behavior depending on the type of an object.
2. Move each leg of the conditional to an overriding method in a subclass. Make the original method abstract.
3. And vice versa
4. Example

Replace Conditional with … more sophisticated options

1. Replace Conditional Dispatcher with Command Design Pattern
   - Create a Command for each action. Store the Commands in a collection and replace the conditional logic with code to fetch and execute Commands.
2. Replace Conditional Logic with Strategy Design Pattern
   - Create a Strategy for each variant and make the method delegate the “calculation” to a Strategy instance.
3. Replace Conditional Logic with State Design Pattern
   - Create a State for each variant as a part of “State Machine” and make the method delegate tricky “calculation” to the “State Machine”.

Replace Conditional with Polymorphism – detailed description

1. **Problem:**
   - You have a conditional that performs various actions depending on object type or properties.

2. **Solution:**
   - Create subclasses matching the branches of the conditional.
   - In them, create a shared method and move code from the corresponding branch of the conditional to it.
   - Replace the conditional with the relevant method call.
   - The result is that the proper implementation will be attained via polymorphism depending on the object class.

Why refactor

1. This refactoring technique can help if your code contains operators performing various tasks that vary based on:
   - Class of the object or interface that it implements
   - Value of an object's field
   - Result of calling one of an object's methods

2. If a new object property or type appears, you will need to search for and add code in all similar conditionals. Thus the benefit of this technique is multiplied if there are multiple conditionals scattered throughout all of an object's methods.

Benefits

1. This technique adheres to the *Tell-Don't-Ask* principle: instead of asking an object about its state and then performing actions based on this, it is much easier to simply tell the object what it needs to do and let it decide for itself how to do that.

2. Removes duplicate code. You get rid of many almost identical conditionals.

3. If you need to add a new execution variant, all you need to do is add a new subclass without touching the existing code (*Open/Closed Principle*).

Preparing to Refactor

1. For this refactoring technique, you should have a ready hierarchy of classes that will contain alternative behaviors. If you do not have a hierarchy like this, create one. Other techniques will help to make this happen:
2. Replace Type Code with Subclasses. Subclasses will be created for all values of a particular object property. This approach is simple but less flexible since you cannot create subclasses for the other properties of the object.
3. Replace Type Code with State/Strategy. A class will be dedicated for a particular object property and subclasses will be created from it for each value of the property. The current class will contain references to the objects of this type and delegate execution to them.
4. The following steps assume that you have already created the hierarchy.

Refactoring Steps

1. If the conditional is in a method that performs other actions as well, perform Extract Method.
2. For each hierarchy subclass, redefine the method that contains the conditional and copy the code of the corresponding conditional branch to that location.
3. Delete this branch from the conditional.
4. Repeat replacement until the conditional is empty. Then delete the conditional and declare the method abstract.

How to select a proper PO implementation?

1. Follow **Refactoring to Patterns** or Patterns to Refactoring flows

Find and “update” a balance for your own project

Base class, inheritance, virtual functions and overloading

PageBase example

```
public class PageBase {
    protected static void titleShouldAppear(String title) {
        Waiter.getWaiter().until(ExpectedConditions.titleIs(title));
    }
}
```

Some page example, general

```
public class HomePage extends PageBase {
    private static final String TITLE = "Sign Documents Online - Build, Deliver Track Sales Collateral";
    public static void titleShouldAppear() {
        titleShouldAppear(TITLE);
    }
}
```

Some page example, specific

```
private static final By LOGIN_BUTTON = get("HomePage.LoginButton");
  private static void clickLoginButton() {
    $(LOGIN_BUTTON).click(); }
  public static void login() {
    login(USERNAME, PASSWORD); }
  public static void login(String username, String password) {
    clickLoginButton(); LoginPage.titleShouldAppear();
     LoginPage.login(username, password);}
```

checkExpectedElements example (base)

```
protected static void checkExpectedElements(By... locators) {
        for (By locator : locators) {
              $(locator).shouldBe(Condition.visible);
        }
  }
```

checkExpectedElements example (derived)

```
public static void checkExpectedElements() {
        checkExpectedElements(USERNAME_INPUT, PASSWORD_INPUT,
LOGIN_BUTTON);
    }
```

Header example

```
public class Header {
    public static final By INFORMATION_SPAN = get("Header.InformationSpan");
    private static final By AVATAR_LINK = get("Header.AvatarLink");
    private static final By USER_INFORMATION_CONTAINER = get("Header.UserInformationContainer");
    private static final By LOGOUT_LINK = get("Header.LogoutLink");
    private static final By MENU_ICON = get("Header.MenuIcon");
    public static void openMenu() {$(MENU_ICON).click(); LeftMenu.shouldAppear();}
```

DialogBase example

```
public class DialogBase {
     protected static void windowShouldAppear(By window) {
        $(window).waitUntil(Condition.appears, TIMEOUT);
    }
     protected static void windowShouldDisappear(By window) {
        $(window).waitUntil(Condition.disappears, TIMEOUT);
    }
}
```

Some dialog example, general

```
public class ModalDialog extends DialogBase {
    private static final By WINDOW = get("ModalDialog.Window");
    public static void windowShouldAppear() {
        windowShouldAppear(WINDOW);
    }
    public static void windowShouldDisappear() {
        windowShouldDisappear(WINDOW);
    }}
```

Some dialog example, specific

```
public class ModalDialog extends DialogBase {
    private static final By X_BUTTON = get("ModalDialog.XButton");
    public static void close() {
        $(X_BUTTON).click();
    }
}
```

Hierarchy of Tables counter-example

1. Base Table - ???
2. Simple Table
3. Sorted Table
4. Filtered Table
5. Combination, for example, Filtered Sorted Table

TestBase: BeforeTest

```
@BeforeTest(alwaysRun = true)
    protected void beforeTestRunSetup() {
        Configuration.baseUrl = URL;
        Configuration.timeout = 10000;
    }
```

TestBase: BeforeMethod

```
@BeforeMethod(alwaysRun = true)
    protected void setup() {
        open(Configuration.baseUrl);
        HomePage.titleShouldAppear();
        HomePage.login();
        DashboardPage.titleShouldAppear();
    }
```

TestBase: AfterMethod

```
@AfterMethod(alwaysRun = true)
  protected void tearDown() {
      close();
  }
```

SignIn Test example

```
public void simpleSignInTest() {
        HomePage.clickLoginButton();
        LoginPage.titleShouldAppear();
        LoginPage.login(USERNAME, PASSWORD);
        DashboardPage.titleShouldAppear();
    }
```

SignOut Test example

```
public void signOutTest() {
          HomePage.login();
          DashboardPage.titleShouldAppear();
          Header.clickOnAvatar();
          Header.logout();
          LoginPage.titleShouldAppear();
     }
```

“Meta” info test example 1 (SignIn)

```
@Test(groups = {"smoke"})
    @Features("Sign in")
    @Stories("Verify ability to make a simple login to PandaDoc application")
    @TestCaseId("1.1")
    public void simpleSignInTest()
```

“Meta” info test example 2 (SignOut)

```
@Test(groups = {"smoke"})
    @Features("Sign in")
    @Stories("Verify ability to logout from PandaDoc application")
    @TestCaseId("1.5")
    public void signOutTest()
```

Infrastructure

1. public class CommonDataProvider; // ~30 lines of code
2. public class Locators; // ~ 70 lines of code
3. public class Waiter; // ~ 10 lines of code
4. That’s all ☺

A real-life example

1. Business context
2. Tech context
   - Challenge
   - Solution
   - Technology Stack

3. QA Automation process context
4. Source code example
5. Summary

example

A real-life example

1. Example and “home work”
   - How to setting up environment
     - “Java - set up and configuration.docx”
     - “Selenium WebDriver essentials.docx”
     - Where to download (https://github.com/comaqaby/PDoc-QA-Automation-Prototype)
   - How to build
   - How to configure
   - How to run

example

“Homework”, part 1 ☺

1. Download example’s source code
2. “Investigate”
3. Develop a TODO list with a set of improvements
4. Setting up environment
5. Compile and Run
6. “Play”
7. Improve \ Update TODO list with a set of improvements

“Homework”, part 2 ☺

1. Read recommended books and articles
2. Improve \ Update TODO list with a set of improvements
3. Provide me via email with an intermediate and final list of improvements
4. Develop at least 1 more auto-test

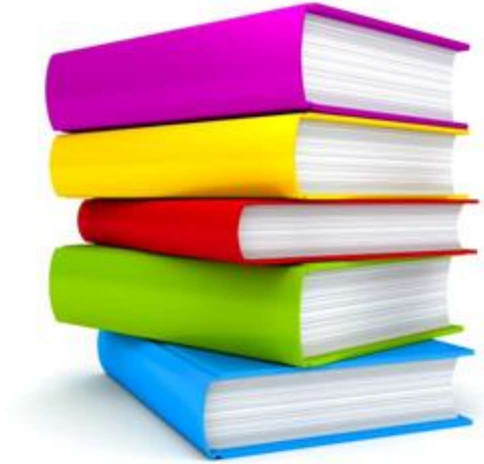
“Rules” and principles

1. Could you please “refresh” your knowledge, slides **30-41**, thanks

Useful links

1. Martin Fowler “Refactoring”

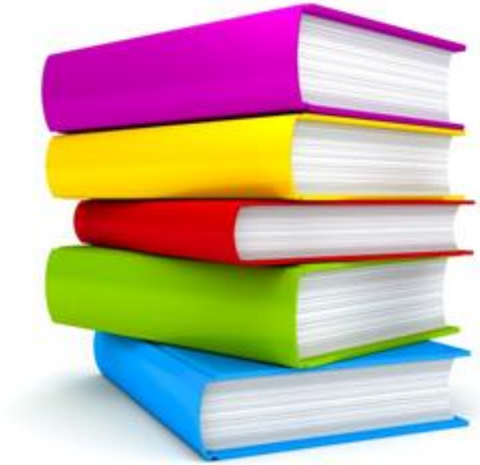
   - http://martinfowler.com/books/refactoring.html
   - http://refactoring.com/
   - http://refactoring.com/catalog/
   - http://refactoring.com/catalog/replaceConditionalWithPolymorphism.html



Useful links

1. Refactoring to Patterns and vice versa

   - https://industriallogic.com/xp/refactoring/
   - https://industriallogic.com/xp/refactoring/catalog.html
   - https://industriallogic.com/xp/refactoring/conditionDispatcherWithCommand.html
   - https://industriallogic.com/xp/refactoring/conditionalWithStrategy.html
   - http://martinfowler.com/books/r2p.html



Useful links

1. https://sourcemaking.com/

- https://sourcemaking.com/refactoring
- https://sourcemaking.com/refactoring/replace-conditional-with-polymorphism
- https://sourcemaking.com/design_patterns
- https://sourcemaking.com/antipatterns
  - https://sourcemaking.com/antipatterns/software-development-antipatterns
  - https://sourcemaking.com/antipatterns/software-architecture-antipatterns
- https://sourcemaking.com/uml

Tech “basement”

- Grady **Butch** «**Object oriented analysis and design with examples of apps on C++**

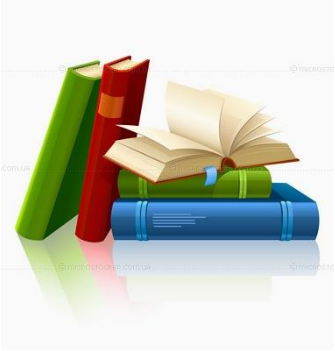
Notes: IMHO No need to be afraid of C++, 95% of the material is conceptual, there is no strict connection to chosen language. From my point of view is one of the best books for true getting to know with OOP.

- Martin **Fowler** «**Refactoring**»

Notes: IMHO strongly recommend to read from cover to cover, twice, in order to have contents of the book – you active professional luggage.

- **Gang of four** “**Design patterns**”

Notes: IMHO strongly recommend to read from cover to cover, twice, in order to have contents of the book – you active professional luggage.



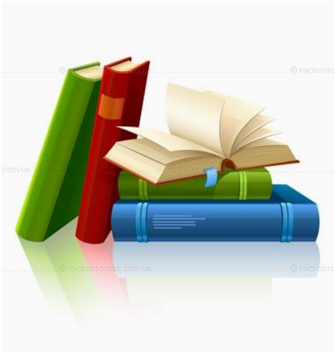
Tech “basement”

- D. **Thomas**, Andrew **Hunt** “**Pragmatic Programmer**, The: From Journeyman to Master”

Notes: IMHO Amazing book that consists of a ton of advices. IMHO strongly recommend to read from cover to cover, twice, in order to have contents of the book – you active professional luggage. And then look through different chapters before talking to a customer.

- Steve **McConnel** “**Code complete**”

Notes: IMHO No need to be afraid of the size of the book ... it should be read or before “going to bed”, or from any place, of separate chapters, just to fresh things in the memory in the chosen field of problem.



What’s next?!

- “Out of box Page Object Design Pattern, Java”
  - Dynamic solutions
  - Let’s compare with a static one
- “Out of box Page Object Design Pattern, .Net C#”
  - Dynamic solutions
  - Let’s compare with a static one
- “Variants of implementation Page Object Design Pattern from the scratches, without being bind to any programming language”
  - Static solutions
  - Dynamic solutions
  - Let’s compare static and dynamic
  - Answer to all our questions

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