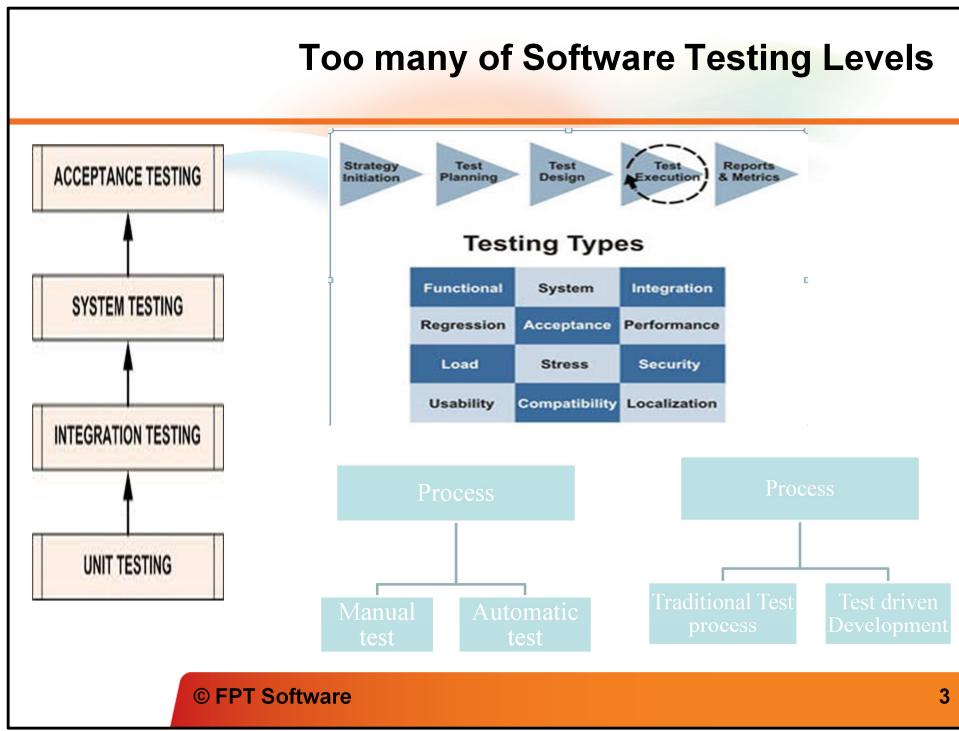


Unit Testing Execution

Instructor << >>

Agenda

- Software testing levels
- Manual unit testing
- Unit Testing based on UT cases
- Automated Unit Testing
- Automated Unit Testing with NUnit
- Automated Tests vs. Manual Tests
- Best Practices



Software testing view theo nhiều hướng:

- Theo chiều dọc
- Theo chiều ngang
- Theo quy trình tiến hành

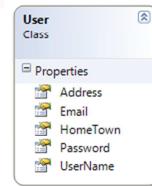
How we test this function?

Requirement :

- Write a module to add an User to DataBase

Business rule :

- Email can not be duplicated
- Email must be in valid form
- UserName 's length must be > 8
- UserName can not be duplicated
- Password length must be > 8



Giảng viên write a simple method to test như trên

Manual Unit Testing

- Write code
- Uploading the code to some place
- Build it
- Running the code manually (in many cases filling up forms etc step by step)
- Check Log files, Database, External Services, Values of variable names, Output on the screen etc
- If it does not work, repeat the above process

Giang vien demo traditional tesst

Manual Unit Testing - Limitation

- Developer nhớ được trường hợp nào thì test trường hợp đó
- Đến cuối dự án số lượng test case càng lúc càng nhiều, khả năng cover của lập trình viên giảm xuống!
- Nhiều test case bị trùng lắp
- Nhiều test case bị lack
- Team lead không thể review hết được
- → Kết quả dự án chỉ trông chờ vào tester!!!!
- → Rất nhiều lỗi phát sinh sau khi system test, đa phần các lỗi xuất phát do Dev test không kỹ từ lúc Unit Test!

Giảng viên write a simple method to test như trên

Unit Testing based on UT cases

- Để giải quyết vấn đề trên Mỗi khi developer test xong phải viết tài liệu mô tả test case trên word hoặc excel !
- Điều này giúp team rất dễ dàng review.. Tuy nhiên, cách làm này sẽ phát sinh ra rất nhiều hạn chế!

| Function Code | Function A <Developer Name> | Function B | Function C |
|------------------|--------------------------------|--------------------|------------------|
| Created By | | Executed By | |
| Lines of code | 100 | Lack of test cases | -5 |
| Test requirement | | | |
| Passed | 0 | Failed | 15 |
| | | Untested | N/A/B |
| | | 5 | 1 1 |
| | | | Total Test Cases |
| | | | 15 |

| Precondition | | 100D20 | 100D21 | 100D22 | 100D23 | 100D24 | 100D25 | 100D26 | 100D27 | 100D28 | 100D29 | 100D30 | 100D31 | 100D32 | 100D33 | 100D34 | 100D35 | 100D36 | 100D37 | 100D38 | 100D39 | 100D40 | 100D41 | 100D42 | 100D43 | 100D44 | 100D45 | 100D46 | 100D47 | 100D48 | 100D49 | 100D50 | 100D51 | 100D52 | 100D53 | 100D54 | 100D55 | 100D56 | 100D57 | 100D58 | 100D59 | 100D60 | 100D61 | 100D62 | 100D63 | 100D64 | 100D65 | 100D66 | 100D67 | 100D68 | 100D69 | 100D70 | 100D71 | 100D72 | 100D73 | 100D74 | 100D75 | 100D76 | 100D77 | 100D78 | 100D79 | 100D80 | 100D81 | 100D82 | 100D83 | 100D84 | 100D85 | 100D86 | 100D87 | 100D88 | 100D89 | 100D90 | 100D91 | 100D92 | 100D93 | 100D94 | 100D95 | 100D96 | 100D97 | 100D98 | 100D99 | 100D100 | 100D101 | 100D102 | 100D103 | 100D104 | 100D105 | 100D106 | 100D107 | 100D108 | 100D109 | 100D110 | 100D111 | 100D112 | 100D113 | 100D114 | 100D115 | 100D116 | 100D117 | 100D118 | 100D119 | 100D120 | 100D121 | 100D122 | 100D123 | 100D124 | 100D125 | 100D126 | 100D127 | 100D128 | 100D129 | 100D130 | 100D131 | 100D132 | 100D133 | 100D134 | 100D135 | 100D136 | 100D137 | 100D138 | 100D139 | 100D140 | 100D141 | 100D142 | 100D143 | 100D144 | 100D145 | 100D146 | 100D147 | 100D148 | 100D149 | 100D150 | 100D151 | 100D152 | 100D153 | 100D154 | 100D155 | 100D156 | 100D157 | 100D158 | 100D159 | 100D160 | 100D161 | 100D162 | 100D163 | 100D164 | 100D165 | 100D166 | 100D167 | 100D168 | 100D169 | 100D170 | 100D171 | 100D172 | 100D173 | 100D174 | 100D175 | 100D176 | 100D177 | 100D178 | 100D179 | 100D180 | 100D181 | 100D182 | 100D183 | 100D184 | 100D185 | 100D186 | 100D187 | 100D188 | 100D189 | 100D190 | 100D191 | 100D192 | 100D193 | 100D194 | 100D195 | 100D196 | 100D197 | 100D198 | 100D199 | 100D200 | 100D201 | 100D202 | 100D203 | 100D204 | 100D205 | 100D206 | 100D207 | 100D208 | 100D209 | 100D210 | 100D211 | 100D212 | 100D213 | 100D214 | 100D215 | 100D216 | 100D217 | 100D218 | 100D219 | 100D220 | 100D221 | 100D222 | 100D223 | 100D224 | 100D225 | 100D226 | 100D227 | 100D228 | 100D229 | 100D230 | 100D231 | 100D232 | 100D233 | 100D234 | 100D235 | 100D236 | 100D237 | 100D238 | 100D239 | 100D240 | 100D241 | 100D242 | 100D243 | 100D244 | 100D245 | 100D246 | 100D247 | 100D248 | 100D249 | 100D250 | 100D251 | 100D252 | 100D253 | 100D254 | 100D255 | 100D256 | 100D257 | 100D258 | 100D259 | 100D260 | 100D261 | 100D262 | 100D263 | 100D264 | 100D265 | 100D266 | 100D267 | 100D268 | 100D269 | 100D270 | 100D271 | 100D272 | 100D273 | 100D274 | 100D275 | 100D276 | 100D277 | 100D278 | 100D279 | 100D280 | 100D281 | 100D282 | 100D283 | 100D284 | 100D285 | 100D286 | 100D287 | 100D288 | 100D289 | 100D290 | 100D291 | 100D292 | 100D293 | 100D294 | 100D295 | 100D296 | 100D297 | 100D298 | 100D299 | 100D300 | 100D301 | 100D302 | 100D303 | 100D304 | 100D305 | 100D306 | 100D307 | 100D308 | 100D309 | 100D310 | 100D311 | 100D312 | 100D313 | 100D314 | 100D315 | 100D316 | 100D317 | 100D318 | 100D319 | 100D320 | 100D321 | 100D322 | 100D323 | 100D324 | 100D325 | 100D326 | 100D327 | 100D328 | 100D329 | 100D330 | 100D331 | 100D332 | 100D333 | 100D334 | 100D335 | 100D336 | 100D337 | 100D338 | 100D339 | 100D340 | 100D341 | 100D342 | 100D343 | 100D344 | 100D345 | 100D346 | 100D347 | 100D348 | 100D349 | 100D350 | 100D351 | 100D352 | 100D353 | 100D354 | 100D355 | 100D356 | 100D357 | 100D358 | 100D359 | 100D360 | 100D361 | 100D362 | 100D363 | 100D364 | 100D365 | 100D366 | 100D367 | 100D368 | 100D369 | 100D370 | 100D371 | 100D372 | 100D373 | 100D374 | 100D375 | 100D376 | 100D377 | 100D378 | 100D379 | 100D380 | 100D381 | 100D382 | 100D383 | 100D384 | 100D385 | 100D386 | 100D387 | 100D388 | 100D389 | 100D390 | 100D391 | 100D392 | 100D393 | 100D394 | 100D395 | 100D396 | 100D397 | 100D398 | 100D399 | 100D400 | 100D401 | 100D402 | 100D403 | 100D404 | 100D405 | 100D406 | 100D407 | 100D408 | 100D409 | 100D410 | 100D411 | 100D412 | 100D413 | 100D414 | 100D415 | 100D416 | 100D417 | 100D418 | 100D419 | 100D420 | 100D421 | 100D422 | 100D423 | 100D424 | 100D425 | 100D426 | 100D427 | 100D428 | 100D429 | 100D430 | 100D431 | 100D432 | 100D433 | 100D434 | 100D435 | 100D436 | 100D437 | 100D438 | 100D439 | 100D440 | 100D441 | 100D442 | 100D443 | 100D444 | 100D445 | 100D446 | 100D447 | 100D448 | 100D449 | 100D450 | 100D451 | 100D452 | 100D453 | 100D454 | 100D455 | 100D456 | 100D457 | 100D458 | 100D459 | 100D460 | 100D461 | 100D462 | 100D463 | 100D464 | 100D465 | 100D466 | 100D467 | 100D468 | 100D469 | 100D470 | 100D471 | 100D472 | 100D473 | 100D474 | 100D475 | 100D476 | 100D477 | 100D478 | 100D479 | 100D480 | 100D481 | 100D482 | 100D483 | 100D484 | 100D485 | 100D486 | 100D487 | 100D488 | 100D489 | 100D490 | 100D491 | 100D492 | 100D493 | 100D494 | 100D495 | 100D496 | 100D497 | 100D498 | 100D499 | 100D500 | 100D501 | 100D502 | 100D503 | 100D504 | 100D505 | 100D506 | 100D507 | 100D508 | 100D509 | 100D510 | 100D511 | 100D512 | 100D513 | 100D514 | 100D515 | 100D516 | 100D517 | 100D518 | 100D519 | 100D520 | 100D521 | 100D522 | 100D523 | 100D524 | 100D525 | 100D526 | 100D527 | 100D528 | 100D529 | 100D530 | 100D531 | 100D532 | 100D533 | 100D534 | 100D535 | 100D536 | 100D537 | 100D538 | 100D539 | 100D540 | 100D541 | 100D542 | 100D543 | 100D544 | 100D545 | 100D546 | 100D547 | 100D548 | 100D549 | 100D550 | 100D551 | 100D552 | 100D553 | 100D554 | 100D555 | 100D556 | 100D557 | 100D558 | 100D559 | 100D560 | 100D561 | 100D562 | 100D563 | 100D564 | 100D565 | 100D566 | 100D567 | 100D568 | 100D569 | 100D570 | 100D571 | 100D572 | 100D573 | 100D574 | 100D575 | 100D576 | 100D577 | 100D578 | 100D579 | 100D580 | 100D581 | 100D582 | 100D583 | 100D584 | 100D585 | 100D586 | 100D587 | 100D588 | 100D589 | 100D590 | 100D591 | 100D592 | 100D593 | 100D594 | 100D595 | 100D596 | 100D597 | 100D598 | 100D599 | 100D600 | 100D601 | 100D602 | 100D603 | 100D604 | 100D605 | 100D606 | 100D607 | 100D608 | 100D609 | 100D610 | 100D611 | 100D612 | 100D613 | 100D614 | 100D615 | 100D616 | 100D617 | 100D618 | 100D619 | 100D620 | 100D621 | 100D622 | 100D623 | 100D624 | 100D625 | 100D626 | 100D627 | 100D628 | 100D629 | 100D630 | 100D631 | 100D632 | 100D633 | 100D634 | 100D635 | 100D636 | 100D637 | 100D638 | 100D639 | 100D640 | 100D641 | 100D642 | 100D643 | 100D644 | 100D645 | 100D646 | 100D647 | 100D648 | 100D649 | 100D650 | 100D651 | 100D652 | 100D653 | 100D654 | 100D655 | 100D656 | 100D657 | 100D658 | 100D659 | 100D660 | 100D661 | 100D662 | 100D663 | 100D664 | 100D665 | 100D666 | 100D667 | 100D668 | 100D669 | 100D670 | 100D671 | 100D672 | 100D673 | 100D674 | 100D675 | 100D676 | 100D677 | 100D678 | 100D679 | 100D680 | 100D681 | 100D682 | 100D683 | 100D684 | 100D685 | 100D686 | 100D687 | 100D688 | 100D689 | 100D690 | 100D691 | 100D692 | 100D693 | 100D694 | 100D695 | 100D696 | 100D697 | 100D698 | 100D699 | 100D700 | 100D701 | 100D702 | 100D703 | 100D704 | 100D705 | 100D706 | 100D707 | 100D708 | 100D709 | 100D710 | 100D711 | 100D712 | 100D713 | 100D714 | 100D715 | 100D716 | 100D717 | 100D718 | 100D719 | 100D720 | 100D721 | 100D722 | 100D723 | 100D724 | 100D725 | 100D726 | 100D727 | 100D728 | 100D729 | 100D730 | 100D731 | 100D732 | 100D733 | 100D734 | 100D735 | 100D736 | 100D737 | 100D738 | 100D739 | 100D740 | 100D741 | 100D742 | 100D743 | 100D744 | 100D745 | 100D746 | 100D747 | 100D748 | 100D749 | 100D750 | 100D751 | 100D752 | 100D753 | 100D754 | 100D755 | 100D756 | 100D757 | 100D758 | 100D759 | 100D760 | 100D761 | 100D762 | 100D763 | 100D764 | 100D765 | 100D766 | 100D767 | 100D768 | 100D769 | 100D770 | 100D771 | 100D772 | 100D773 | 100D774 | 100D775 | 100D776 | 100D777 | 100D778 | 100D779 | 100D780 | 100D781 | 100D782 | 100D783 | 100D784 | 100D785 | 100D786 | 100D787 | 100D788 | 100D789 | 100D790 | 100D791 | 100D792 | 100D793 | 100D794 | 100D795 | 100D796 | 100D797 | 100D798 | 100D799 | 100D800 | 100D801 | 100D802 | 100D803 | 100D804 | 100D805 | 100D806 | 100D807 | 100D808 | 100D809 | 100D810 | 100D811 | 100D812 | 100D813 | 100D814 | 100D815 | 100D816 | 100D817 | 100D818 | 100D819 | 100D820 | 100D821 | 100D822 | 100D823 | 100D824 | 100D825 | 100D826 | 100D827 | 100D828 | 100D829 | 100D830 | 100D831 | 100D832 | 100D833 | 100D834 | 100D835 | 100D836 | 100D837 | 100D838 | 100D839 | 100D840 | 100D841 | 100D842 | 100D843 | 100D844 | 100D845 | 100D846 | 100D847 | 100D848 | 100D849 | 100D850 | 100D851 | 100D852 | 100D853 | 100D854 | 100D855 | 100D856 | 100D857 | 100D858 | 100D859 | 100D860 | 100D861 | 100D862 | 100D863 | 100D864 | 100D865 | 100D866 | 100D867 | 100D868 | 100D869 | 100D870 | 100D871 | 100D872 | 100D873 | 100D874 | 100D875 | 100D876 | 100D877 | 100D878 | 100D879 | 100D880 | 100D881 | 100D882 | 100D883 | 100D884 | 100D885 | 100D886 | 100D887 | 100D888 | 100D889 | 100D890 | 100D891 | 100D892 | 100D893 | 100D894 | 100D895 | 100D896 | 100D897 | 100D898 | 100D899 | 100D900 | 100D901 | 100D902 | 100D903 | 100D904 | 100D905 | 100D906 | 100D907 | 100D908 | 100D909 | 100D910 | 100D911 | 100D912 | 100D913 | 100D914 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 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Unit Testing based on UT cases

- Các dự án lớn thì số lượng tài liệu test case thường cũng rất lớn!
- Các dự án lớn thì requirement thường hay thay đổi
- Mỗi khi requirement thay đổi → Phải sửa code → phải cập nhật lại tài liệu testcase → và lại manual retest , rất tốn effort → Càng đến cuối dự án, lượng việc sinh ra càng nhiều , viết test case document trở thành “địa ngục” thực sự ! → dev không còn đủ effort update test case document, tài liệu nhanh chóng bị lạc hậu, hoặc việc update chỉ là đối phó!
- Một số trường hợp không thể dùng Excel Unit TestCase



So, what is the solution?

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8

Giảng viên trình bày nhược điểm

Automated Unit Testing First Step

- Coding Process with Automated Unit Tests
 - Write code
 - Write one or more test cases script
 - Auto-compile and run
 - If tests fail -> make appropriate modifications
 - If tests pass -> repeat for next method

Automated Unit Testing Common Tools

- UT Tools for references:
 - Java: JUnit, J2MEUnit
 - C/C++: CPPUNIT
 - Python: pyUnit
 - Perl: PerlUnit
 - Visual Basic: vbUnit
 - C# .NET: Nunit,csUnit

- Refferences:
 - ★ <http://www.testingfaqs.org/t-unit.html>
 - ★ www.junit.org
 - ★ <http://www.codeproject.com/gen/design/autp5.asp>

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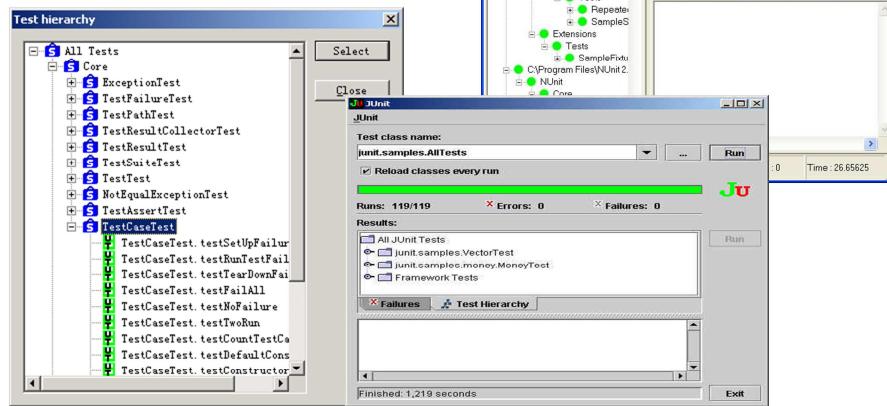
10

Automated Unit Testing Common Tools

<http://sourceforge.net/projects/cppunit/>

<http://www.nunit.org>

<http://www.junit.org/>



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11



Automated Unit Testing Demo

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12

Giảng viên demo cách viết sử dụng manual code, sử dụng code có sẵn trong thư mục “UnitTest.Demo”

Automated Unit Testing with NUnit

What is NUnit?

Milk ? Beer or
Coffee?

- NUnit – an open source test tool for .NET
- Useful for development and regression
- Leads to a design-for-test approach
- Tests can be written in VB.NET or C#



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13

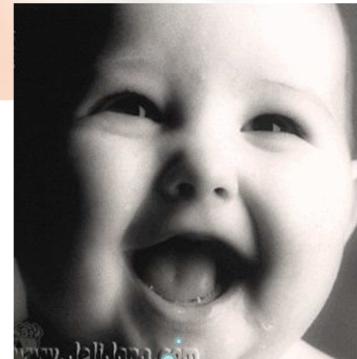
Automated Unit Testing with NUnit

Where to get NUnit?

- Let's go to website:
<http://www.nunit.org/index.php?p=download>

| NUnit 2.4.3 (Recommended) | |
|---------------------------|-----------------------------------------|
| win .net 1.1 | NUnit-2.4.3-net-1.1.msi |
| win .net 2.0 | NUnit-2.4.3-net-2.0.msi |
| bin .net 1.1 | NUnit-2.4.3-net-1.1.zip |
| bin .net 2.0 | NUnit-2.4.3-net-2.0.zip |
| src | NUnit-2.4.3-src.zip |
| doc | NUnit-2.4.3-doc.zip |

| NUnit 2.4.2 | |
|--------------|-----------------------------------------|
| win .net 1.1 | NUnit-2.4.2-net-1.1.msi |
| win .net 2.0 | NUnit-2.4.2-net-2.0.msi |
| bin .net 1.1 | NUnit-2.4.2-net-1.1.zip |
| bin .net 2.0 | NUnit-2.4.2-net-2.0.zip |
| src | NUnit-2.4.2-src.zip |
| doc | NUnit-2.4.2-doc.zip |

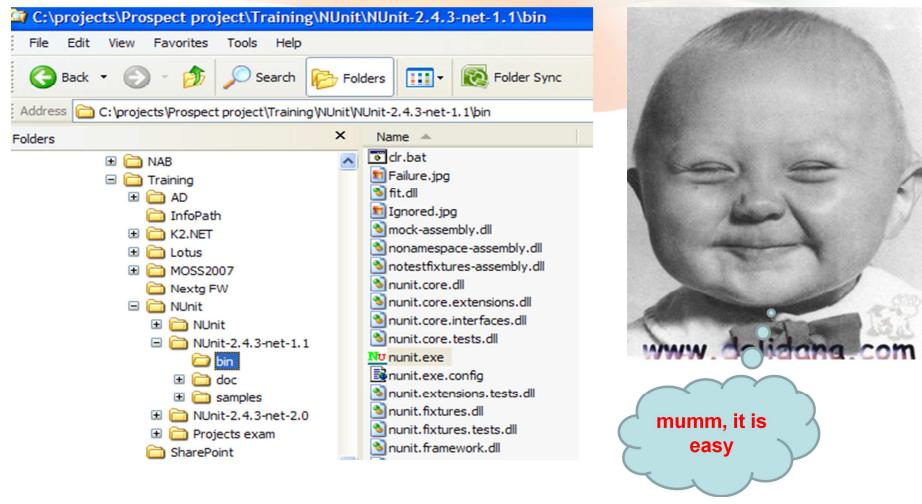


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14

Automated Unit Testing with NUnit

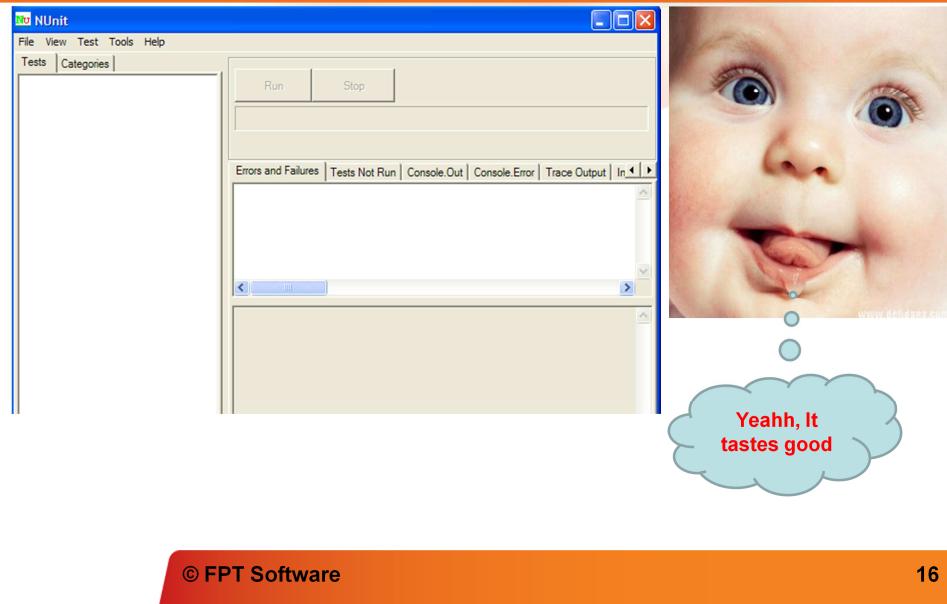
Where to get NUnit? - Extract to any folder



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15

Automated Unit Testing with Nunit Screens of tool



Automated Unit Testing with Nunit

How to use NUnit?

- Create a test case base on NUnit framework
- Deploy and Run

Who knows...



Automated Unit Testing with Nunit

Create a test case

- Step 1: Create a Class
- Step 2: Add a reference nunit.Framework.dll to this class
- Step 3: Add a reference to *.dll contains function which you want to do Unit test
- Step 4: Restructure class following Nunit frame work
- Step 5: Write a test case



www.delidana.com

Let's me go...

Automated Unit Testing with Nunit Create a test case

- Step 1: Create a Class
- Step 2: Add a reference nunit.Framework.dll to this class
- Step 3: Add a reference to *.dll contains function which you want to do Unit test
- Step 4: Restructure class following Nunit frame work

```
namespace NUnitEx
{
    using System;
    using NUnit.Framework;
    /// <summary>
    /// Description about this class
    /// </summary>
    [TestFixture]
    public class TestNUnit1
    {
        private int intA;

        [SetUp]
        protected void SetUp()
        {
            intA = 0;
        }
        /// <summary>
        /// Write test case here
        [Test]
        public void testMultifly1()
        {
            Assert.AreEqual(0, intA);
        }
    }
}
```

Automated Unit Testing with Nunit

Create a test case

- Step 5: Write a test case
 - * Each test case will be a function/method of class
 - * Must have attribute [Test] above a function/method
 - * Ex:

```
[Test]
public void testCase1()
{
    Assert.AreEqual(0, intA);
}

[Test]
public void testCase2()
{
    Assert.AreEqual(0, divides(intA, intB));
}
```



Automated Unit Testing with Nunit

Core Features

- Core Features to code a test case
 - * **Assertions**
 - Equality Asserts:
 - Ex: `Assert.AreEqual(int expected, int actual);`
 - Condition Tests:
 - Ex: `Assert.IsTrue(bool condition);`
 - Comparison Asserts:
 - Ex: `Assert.Greater(int arg1, int arg2);`
 - Type Asserts:
 - Ex: `Assert.IsInstanceOfType(Type expected, object actual);`
 - Utility methods:
 - Ex: `Assert.Fail();`
 - String Assert:
 - Ex: `StringAssert.Contains(string expected, string actual);`
 - Collection Asserts:
 - Ex: `CollectionAssert.AreEqual(Collection expected, Collection actual);`
 - * **Attributes**

- CORE FEATURES
- ASSERTIONS
- CLASSIC MODEL
 - EQUALITY ASSERTS
 - IDENTITY ASSERTS
 - CONDITION TESTS
 - COMPARISON ASSERTS
 - TYPE ASSERTS
 - UTILITY METHODS
 - STRING ASSERT
 - COLLECTION ASSERT
 - FILE ASSERT
- CONSTRAINT MODEL
- ATTRIBUTES
- CONFIGURATION FILES
- MULTIPLE ASSEMBLIES
- VISUAL STUDIO SUPPORT
- EXTENSIBILITY

Automated Unit Testing with Nunit Core Features

* Attributes

```
[TestFixture]
[Category("TestUnitExample")]
public class TestNUnit
{
    private int intA;
    private int intB;
    private CaculatesSomeThings objCal;

    [SetUp]
    protected void SetUp()
    {
        intA = 0;
        intB = 0;
        objCal = new CaculatesSomeThings();
    }

    [Test]
    Public void TestCase1()
    {
        Assert.AreEqual(0, objCal.Multifly(intA, intB));
    }
}
```

- CORE FEATURES
 - ASSERTIONS
 - ATTRIBUTES
 - CATEGORY
 - CULTURE
 - DESCRIPTION
 - EXPECTED EXCEPTION
 - EXPLICIT
 - IGNORE
 - PLATFORM
 - PROPERTY
 - SETCULTURE
 - SETUP
 - SETUP FIXTURE
 - SUITE
 - TEARDOWN
 - TEST
 - TEST FIXTURE
 - TEST FIXTURE SETUP
 - TEST FIXTURE TEARDOWN
- CONFIGURATION FILES
- MULTIPLE ASSEMBLIES
- VISUAL STUDIO SUPPORT
- EXTENSIBILITY

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22

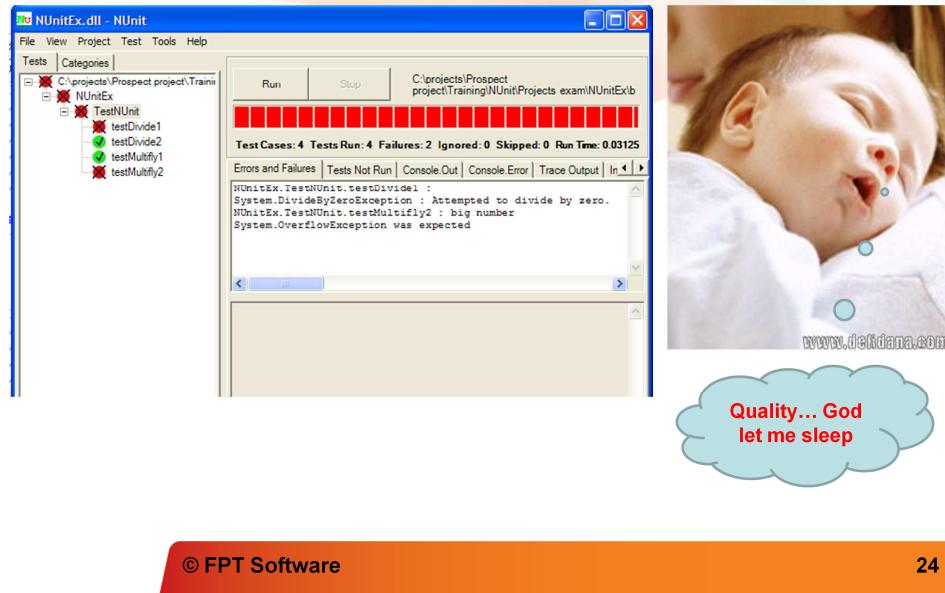
Automated Unit Testing with Nunit Deploy and Run

- Step 1: Compile a test case class to dll
- Step 2: Run NUnit tool
- Step 3: Open *.dll contains test case class
- Step 4: Choose the test case you want to run
- Step 5: Click run button to see the report

I don't believe...



Automated Unit Testing with Nunit Deploy and Run



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24



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25