Microsoft
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MICROSOFT TECHNOLOGY ASSOCIATE

Student Study Guide

EXAM 98-372

Microsoft .NET Fundamentals

Microsoft

Preparing for MTA Certification

MICROSOFT TECHNOLOGY ASSOCIATE (MTA)
STUDENT STUDY GUIDE FOR DEVELOPERS

98-372 Microsoft .NET Fundamentals Course 10754

Authors

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Introduction

MTA validates building-block technology concepts and helps students explore, discover and pursue successful careers in Information Technology (IT) in an exciting and rewarding way! As the first step in the Microsoft Technology Certification Series, this new, entry-level certification provides students with confidence, credibility, and differentiation.

Explore IT career options without committing a lot of time and resources MTA exams validate the core technology knowledge that is in demand today by businesses around the world. Whether you want to explore becoming a network administrator, software engineer, web developer, or database analyst, MTA gets you started on the right path.

Prepare to compete A little investment in IT can go a long way in today's job market. Becoming MTA certified helps you build a solid foundation to prepare for intermediate technology studies and for Microsoft Certified Technology Specialist (MCTS) certifications. It can also help you compete on college admissions and jumpstart your IT career planning!

Empower yourself As the first step toward becoming an MCTS, MTA shows your commitment to technology while connecting you with a community of more than five million Microsoft Certified Professionals. Learn from them and show them what you know by becoming MTA certified!

This MTA Student Study Guide serves as a study tool to help students prepare for their MTA certification exam. Students are challenged with real-life situations for each of the major topics covered in the exam. Although successful completion of the study guide exercises does not guarantee that you will pass your MTA exam, it is an excellent way to gauge your readiness to take the exam and build confidence that you know your stuff on exam day.

I wish you all the best as you prepare for a successful career in technology!

Victoria Pohto

Victoria Pohto
MTA Product Marketing Manager

Career Planning

Most IT solutions or infrastructure built on Microsoft technologies require proficiency with one or all of the following products, often referred to as “The Microsoft Stack.”

- Microsoft Windows® Server® as the data center or development platform
- Microsoft SQL Server® as the data and business intelligence (BI) platform
- Microsoft Visual Studio® as the suite of application life-cycle management tools

MTA is the starting point of Microsoft technology certifications, providing aspiring technologists with the fundamental knowledge essential to succeed with continued studies and a successful career with technology.

Preparing for and becoming MTA certified helps you explore a variety of career paths in technology without investing a lot of time and money in a specialized career path. When you find a path that is right for you, Microsoft learning products and certification can help you prepare and guide your longer-term career planning.

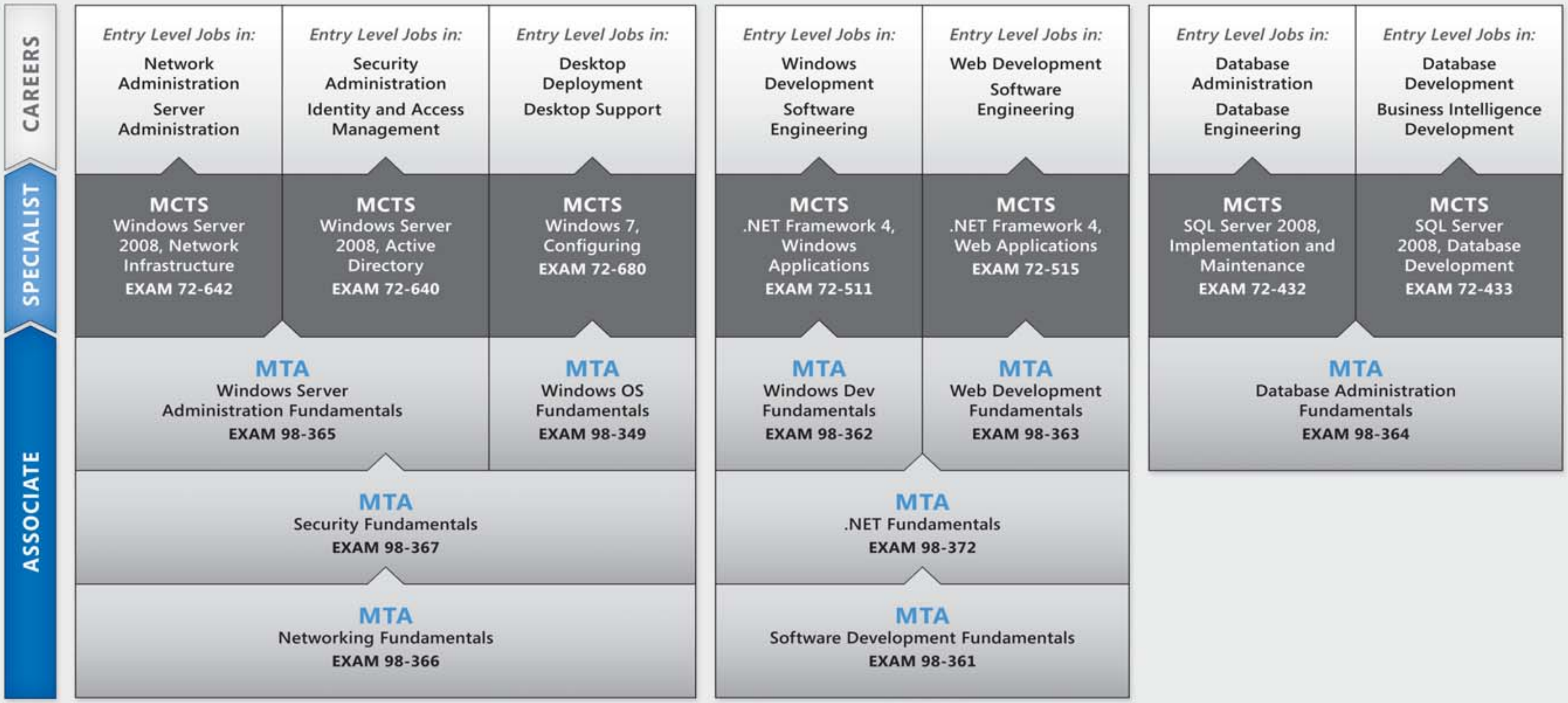
If you already know that you want to start building a career in technology, MTA preparation and certification is the recommended entry point. Becoming MTA certified shows that you have a firm working knowledge of the fundamental IT concepts critical for success with intermediate learning and certifications such as Microsoft Certified Technology Specialist (MCTS). Moreover, Microsoft certifications demonstrate an individual’s commitment of self-investment and confidence to take his or her knowledge and skills to the next level with an industry-recognized credential.

MTA is not a “career certification,” meaning that employers recognize you as “job ready,” but it is the first step toward that career goal and can help differentiate you for an internship or to college admissions committees. As you prepare for your first job focusing on technology, be sure that you are equipped with an MCTS credential—the intermediate level certification that validates Microsoft product and technology skills.

The MTA Certification path on the next page shows you the MTA exams that are recommended prior to taking on some of Microsoft’s intermediate technology certification, MCTS.

Microsoft Technology Associate Certification Paths

MTA is the first step in the Microsoft® Technology Certification Series. MTA is a recommended but not required pre-requisite to MCTS exams. One certification is earned for each exam passed. Free Student Study Guides are available for download at **www.certiport.com/mta.**



CAREERS

SPECIALIST

ASSOCIATE

IT PRO

Entry Level Jobs in:
Network Administration
Server Administration

Entry Level Jobs in:
Security Administration
Identity and Access Management

Entry Level Jobs in:
Desktop Deployment
Desktop Support

MCTS
Windows Server 2008, Network Infrastructure
EXAM 72-642

MCTS
Windows Server 2008, Active Directory
EXAM 72-640

MCTS
Windows 7, Configuring
EXAM 72-680

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Windows Server Administration Fundamentals
EXAM 98-365

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Windows OS Fundamentals
EXAM 98-349

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Security Fundamentals
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Networking Fundamentals
EXAM 98-366

DEVELOPER

Entry Level Jobs in:
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Software Engineering

Entry Level Jobs in:
Web Development
Software Engineering

MCTS
.NET Framework 4, Windows Applications
EXAM 72-511

MCTS
.NET Framework 4, Web Applications
EXAM 72-515

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DATABASE

Entry Level Jobs in:
Database Administration
Database Engineering

Entry Level Jobs in:
Database Development
Business Intelligence Development

MCTS
SQL Server 2008, Implementation and Maintenance
EXAM 72-432

MCTS
SQL Server 2008, Database Development
EXAM 72-433

MTA
Database Administration Fundamentals
EXAM 98-364

For full Microsoft Certification roadmaps, visit **http://www.microsoft.com/learning/certification**

Exploring Job Roles

Choosing a career path is a big decision and it's not always easy, but you're not alone! Microsoft created a career site to help students understand the options and possibilities of pursuing a career in IT. The site also connects you with learning resources, student techie communities, and much more to help you prepare for a career in technology.

To chart your career with Microsoft technology, visit *www.microsoft.com/learning/career/en/us/career-org-charts.aspx*.

Database Administrator

As a database administrator, you are in charge of important databases that span multiple platforms and environments. You are a strong team player who thrives in a fast-paced environment. You build complex, highly scalable databases that meet business needs and security requirements. You are an expert in optimizing, maintaining, and troubleshooting databases, but also in designing archival, data distribution, and high-availability solutions.

Server Administrator

As a server administrator, you are in charge of implementing and managing some of the most important technology in your organization—the servers. You use extensive monitoring and profiling tools to manage the network and tune systems so they perform at optimal levels. You are an expert in Active Directory®, and you have an in-depth understanding of network protocols, and file and directory security.

Computer Support Technician

Consider starting your IT career by becoming a consumer support technician. You don't need any formal work experience, but a company might require that you know how to install, administer, and troubleshoot operating systems in a home network environment that has desktop computers, laptops, and printers. As a consumer support technician, you'll also handle network, virus, malicious software, and hardware support issues. You'll typically find this position in small to medium-sized organizations.

Exploring Job Roles

Web Developer

As a web developer, you are an expert in using the dynamic programming tools and languages that fuel the web. You might work independently or be part of a team that builds and integrates interactive web sites, applications, and services for both internal and public sites. Your role is to make it work, which means developing web applications and testing them on various browsers, enhancing and modifying them as necessary to ensure the best experience for the user. As a web developer, you might also architect websites, design data-driven applications, and find efficient client-server solutions. You must have an in-depth understanding of the software development life cycle and be able to communicate project status, issues, and resolutions.

Windows Developer

As a Windows client developer, knowing how to optimize Windows code and track bugs is a given. But you also know how to use Microsoft Visual Studio® and the Microsoft .NET framework to design, develop, test, and deploy Windows-based applications that run on both corporate servers and desktop computers. Your key talents include understanding multiple Windows application models and n-tier applications, and knowing how to work with object-oriented programming, algorithms, data structures, and multithreading. Windows developers have an in-depth understanding of software engineering principles, software life cycles, and security principles.

Additional Online Resources for New Developers:

http://msdn.microsoft.com/beginner

http://msdn.microsoft.com/rampup

Imagine Cup

The Imagine Cup is the world's premier student technology competition where students from around the world can learn new skills, make new friends, and change the world. Competitions include Software Design, Embedded Development, Game Design, Digital Media and Windows Phone 7. The brightest young minds harness the power of technology to take on the world's toughest problems.

www.imaginecup.com

Value of Certification

Technology plays a role in virtually everything we do. In the 20-plus years since Microsoft has been certifying people on its products and technologies, millions of people have gained the knowledge, expertise, and credentials to enhance their careers, optimize business solutions, and create innovation within just about every business and social sector imaginable. Today's Information Technology (IT) hiring managers are more often using professional credentials, such as Microsoft certification, to identify properly skilled IT candidates. Certification becomes a way to easily differentiate qualified candidates in a sea of resumes.

The job outlook for IT professionals, as reported in a study prepared by the U.S. Department of Labor's Bureau of Labor Statistics (BLS), is positive! The BLS indicates an increase that will be "faster than the average for all occupations through 2014" for Computer Support Specialists, Systems Engineers, Database Administrators, and Computer Software Engineers. One significant message resulting from this study is that information and communications technology (ICT) skills are the entry ticket to the job market, regardless of the country, industry, or job function. Information Technology is clearly an area worth investing time, resources, and education in – and technology certification is a key part of the education process, validating product and technology expertise as a result of their learning experiences.

Microsoft IT Certifications provide objective validation of the ability to perform critical IT functions successfully for worldwide IT professionals, developers, and information workers. Microsoft certifications represent a rich and varied spectrum of knowledge, job roles, and responsibilities. Further, earning a specific certification provides objective validation of the candidate's ability to perform critical IT functions successfully. Embraced by industry professionals worldwide, Microsoft certification remains one of the most effective ways to help reach long-term career goals.

MTA 98-372

MICROSOFT .NET FUNDAMENTALS

1

Understanding .NET Framework Concepts

IN THIS CHAPTER

- 1.1 Understand basic application settings
- 1.2 Understand events and event handling in the .NET Framework
- 1.3 Understand structured exception handling in the .NET Framework

Understand basic application settings

SCENARIO: Tomas Kutej has created a WPF database application that helps users keep track of their CD collection. He knows that some computers may have multiple users—two roommates might share a computer, with both individuals using the same application on the same computer to manage their CD collections. His database is setup to handle multiple users without mixing up the collections.

Tomas has implemented a very stylish "skinning" system that allows users to change the colors, fonts, and icon graphics in his application, giving it a customized look and feel.

1. **How should the database connection string be stored in Tomas' application?**
   - **a.** As a String literal in the source code
   - **b.** As a setting with Application scope
   - **c.** As a setting with User scope
2. **How should Tomas's application store the users' color choices**
   - **a.** As a String literal in the source code
   - **b.** As a setting with Application scope
   - **c.** As a setting with User scope
3. **What is the file name of the configuration file created by Visual Studio for Tomas' application?**
   - **a.** app.config
   - **b.** settings.config
   - **c.** web.config

hint

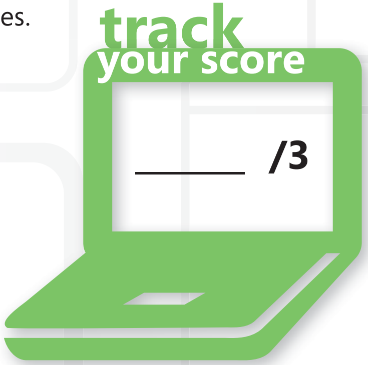
Application Settings enable .NET developers to store data they don't want to put in the application source code.

Answers

1. How should Tomas store the database connection string?
   - **b. As a setting with Application scope.** Since all users on a machine with use the same database, it does not need to be different for different users.
2. How should the application store color choices for each user?
   - **c. As a setting with User scope.** Specifying the scope as “User” enables the application to store different settings for each user of the program.
3. What is the file name of the project’s configuration file?
   - **a. app.config.** Since Tomas’ project is a Windows application (WPF, in this case), Visual Studio will name the file app.config by default; a Web application would use web.config.

Essential details

- Application Settings are a great place to store important data you don’t want to put in the source code. Making a change to data in an Application Setting doesn’t require recompiling code.
- Settings are stored in a configuration file as XML data.
  - In ASP.NET applications, this file is named web.config.
  - In client applications (Windows Forms and WPF, for example), the file is named app.config.
- Each setting includes a name, data type, and scope, in addition to the value it stores.
  - Use Application scope for settings that are universal for all users of an application, such as a database connection string.
  - Use User scope for settings that are unique to each user of the application; these settings are often used to store user preferences within an application.



FAST TRACK HELP

- **http://msdn.microsoft.com/en-us/library/k4s6c3a0.aspx**
- **http://msdn.microsoft.com/en-us/library/wabtadw6.aspx**
- **http://msdn.microsoft.com/en-us/library/25zf0ze8.aspx**

Understand events and event handling in the .NET Framework

SCENARIO: Gustavo Achong coaches a youth football team in his spare time and frequently uses timed drills during practices. He is working on a “stopwatch” application for his mobile phone so he doesn’t have to remember to take his stopwatch when he leaves work to go to practice.

The application has a button for starting and stopping the timer, as well as a button for clearing or resetting the timer. He uses labels to display the elapsed time (the actual timer) as well as the current time, so he doesn’t accidentally keep the children at practice too long.

1. **Which of the following best describes what happens when a user clicks the Reset button on the stopwatch?**
   - **a.** A Click event is raised, and the method that clears the elapsed time is called.
   - **b.** A Reset event is raised, and the method that clears the elapsed time is called.
   - **c.** The Button delegate is raised, and the method that clears the elapsed time is called.
2. **When using the Windows Forms Designer, where are event handlers generally created?**
   - **a.** The Properties panel
   - **b.** Solution Explorer
   - **c.** The Toolbox
3. **Gustavo has a method that is called when the start button is clicked, and it initiates the elapsed time counter. What is this method?**
   - **a.** A delegate
   - **b.** An event
   - **c.** An event handler

hint

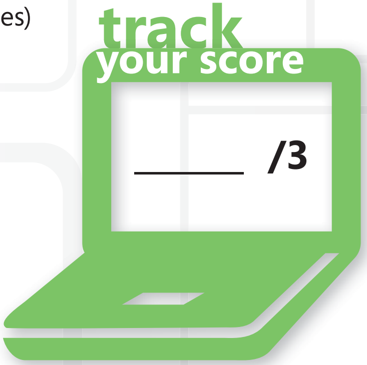
An event is like a signal—it indicates that some action has taken place.

Answers

1. Which of the following best describes what happens when a user clicks the Reset button on the stopwatch?
   a. **A Click event is raised, and the method that clears the elapsed time is called.** Although the event uses a delegate, it is not the delegate that is "raised"—events are raised.
2. When using the Windows Forms Designer, where are event handlers generally created?
   a. **The Properties panel**
3. Gustavo has a method that is called when the start button is clicked, and it initiates the elapsed time counter. What is this method?
   c. **An event handler**

Essential details

- Many .NET applications use the **event-driven programming** model.
- In event-driven programming, the flow of program execution is determined by events that occur at run time—in other words, the application responds to events rather than following a predetermined sequence.
- An **event** is like a signal that indicates a particular action has taken place. Often, these actions are related to the user's interaction with the user interface, such as a button click.
- All events are ignored by the application unless the developer has created **event handlers** to respond to them. These are code blocks (methods or procedures) that are called when the corresponding event is raised.
- **Delegates** are objects that refer to methods. They are used by .NET applications to link events to event handlers.



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- **http://msdn.microsoft.com/en-us/library/awbftdfh.aspx**
- **http://msdn.microsoft.com/en-us/library/ms172879.aspx**

Understand structured exception handling in the .NET Framework

SCENARIO: Manoj Syamala plays a massively multiplayer online role playing game (MMORG) with several of his friends. He is a talented programmer and has several ideas on how to improve his group's success in the game. He created an application that looks at all the loot items the group has found and distributes them to group members in a fair, semi-random fashion.

The program reads data from a simple, comma-separated text file. After the loot has been divided among the group, it overwrites the text file with a roster listing the items that each member received.

1. **Which portions of Manoj's application are most likely to need structured exception handling?**
   - **a.** Declaring and initializing variables for tracking the items received by each member
   - **b.** Opening the text file for reading and writing
   - **c.** Iterating through a loop to award items until all items have been distributed
2. **What structure should Manoj use to handle the exception?**
   - **a.** `Try-catch`
   - **b.** `Catch-exception`
   - **c.** `Throw-catch`
3. **Manoj is unable to compile his application due to errors. What type of errors is he experiencing?**
   - **a.** Exceptions
   - **b.** Logic errors
   - **c.** Syntax errors

hint

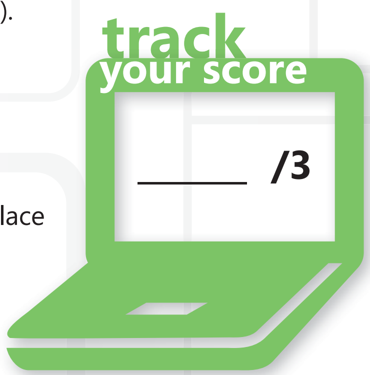
Exceptions are events that are raised when the application cannot handle the current situation.

Answers

1. Which portions of Manoj's application are most likely to need structured exception handling?
   - b. **Opening the text file for reading and writing.** Attempting to open files can throw several possible exceptions, such as a *FileNotFoundException*.
2. What structure should Manoj use to handle the exception?
   - a. `Try-catch`
3. Manoj is unable to compile his application due to errors. What type of errors is he experiencing?
   - c. **Syntax errors.** Logic errors and exceptions cannot be detected by the compiler; therefore, they can't be what is preventing his application from compiling.

Essential details

- A **syntax error** is an error that occurs when code does not meet the rules (or "syntax") of the programming language in use. The compiler cannot compile code that contains syntax errors.
- A **logic error** is an error that occurs when code executes but does not behave in the intended manner. These are often described as bugs—the program runs, but doesn't work correctly.
- An **exception** is an event that is raised when a method encounters a condition that prevents it from executing. Exceptions are said to be "thrown."
- Exceptions are handled using `try-catch` blocks (or `try-catch-finally` blocks).
- Putting code in a **`try` block** is like saying, "Hey! This might not work, but I'm going to give it a shot!"
- A **catch block** contains code that responds to an exception if something does go wrong.
- A **`finally` block** executes whether an exception occurred or not, so it's a great place to close files and handle other "cleanup" chores.



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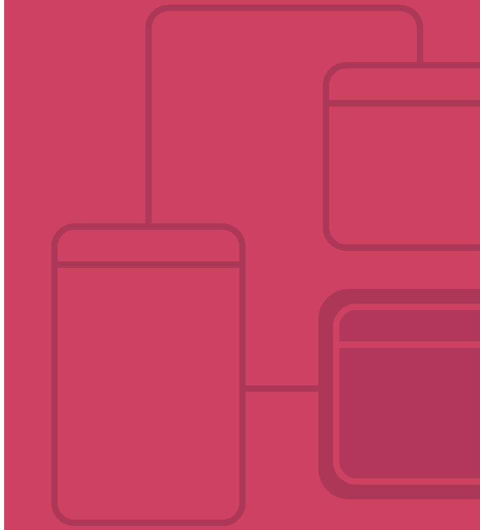
- **http://msdn.microsoft.com/en-us/beginner/bb308817.aspx**
- **http://msdn.microsoft.com/en-us/library/8a9f2ew0.aspx**

2

Understanding Namespaces and Classes in the .NET Framework



IN THIS CHAPTER

- 2.1 Understand .NET class hierarchies
- 2.2 Understand Object Oriented Concepts in the .NET Framework
- 2.3 Understand .NET namespaces
- 2.4 Understand and create class libraries
- 2.5 Understand and use different data types in the .NET Framework
- 2.6 Understand generics

Understand .NET class hierarchies

SCENARIO: Mark Steele is a first-year computer science student who is just learning how to program with Microsoft Visual Studio. A requirement of a recent assignment is to create a program that will display the results of some calculations on the monitor using a method—but Mark is having some problems. His method, called *OutputResults()*, includes the following lines of code in Microsoft C# (with line numbers added):

```
public void OutputResults()
{
    MyData reportData = new MyData();
    System.Console.WriteLine(reportData.GetResults());
}
```

1. **The *Console* class is found in which namespace?**
   - **a.** *reportData*
   - **b.** *System*
   - **c.** *WriteLine*
2. **Visual Studio isn’t recognizing the *MyData* class, which belongs to the namespace *DataPoints*. What is the correct fully qualified name for *MyData*?**
   - **a.** *DataPoints.MyData*
   - **b.** *System.MyData*
   - **c.** *MyData.DataPoints*
3. **In addition to using a fully qualified name, what is the best way for Mark to instruct Visual Studio to find *MyData*?**
   - **a.** Add *MyData* to the *System* namespace.
   - **b.** Add a `using` statement.
   - **c.** Use the full path for the MyData.cs file.

hint

A “fully qualified name” includes the namespaces (and classes) to which a class belongs.

Answers

1. The *Console* class is found in which namespace?

   b. System

2. Visual Studio isn't recognizing the *MyData* class, which belongs to the namespace *DataPoints*. What is the correct fully qualified name for *MyData*?

   a. *DataPoints.MyData.* Fully qualified names include the namespace(s) followed by the class name.

3. In addition to using a fully qualified name, what is the best way for Mark to instruct Visual Studio to find *MyData*?

   b. Add a `using` statement.

Essential details

- All classes in the .NET Framework are ultimately derived from a class called ***Object.***
- An **assembly** is a collection of types and resources that are built to work together and form a logical unit of functionality.
- A **namespace** is an organizational structure for categorizing classes and for preventing name collisions (that is, two classes with the same name).
- The *System* namespace includes many classes commonly used in .NET applications (such as *Console*).
- A fully qualified name includes all of the logical hierarchy.
  In our example, *Console* is a member of the *System* namespace.
  Its fully qualified name is *System.Console*.

FAST TRACK HELP

- **http://msdn.microsoft.com/en-us/library/ms973231.aspx**
- **http://msdn.microsoft.com/en-us/library/system.aspx**

Understand Object Oriented Concepts in the .NET Framework

SCENARIO: Boris Scholl is creating a 2D video game using XNA Game Studio, a library for Microsoft Visual C# that enables Boris to develop games for the Xbox 360 console. In his game, the player will control a spaceship that flies around and fires lasers. The object of the game is to destroy the enemy aliens without damaging any planets or civilian spaceships.

He has designed several classes: *SpaceShip*, for the player-controlled ship; *Planet* and *Civilian* for the objects the player should avoid; and an *Alien* class, which will not appear in the game but will be the basis of the three enemy aliens: *FastAlien, DodgyAlien*, and *TeleportingAlien*.

1. **Which feature would ensure that every class that implements *Alien* must implement the same methods?**
   - **a.** Encapsulation
   - **b.** Interface
   - **c.** Polymorphism
2. **There will be multiple *Planet* objects in the game at once. What is the term used to describe each *Planet*?**
   - **a.** Inherited objects
   - **b.** Instances
   - **c.** Subclasses
3. **What feature allows Boris to treat *FastAlien, DodgyAlien*, and *TeleportingAlien* as objects of type *Alien*?**
   - **a.** Encapsulation
   - **b.** Inheritance
   - **c.** Polymorphism

hint

Classes are like blueprints or recipes for objects.

Answers

1. Which feature would ensure that every class that implements *Alien* must implement the same methods?

   b. Interface

2. There will be multiple *Planet* objects in the game at once. What is the term used to describe each *Planet*?

   b. Instances

3. What feature allows Boris to treat *FastAlien*, *DodgyAlien*, and *TeleportingAlien* as objects of type *Alien*?

   c. Polymorphism

Essential details

- **Inheritance** allows you to create new classes that reuse, extend, and modify the behavior that is defined in other classes.
- Use the "**is a**" test to see if inheritance is appropriate. In Boris' game, a *FastAlien* is an *Alien*, for example, so *FastAlien* could extend *Alien*. A *Planet* is not a *SpaceShip*, so it should not extend *SpaceShip*.
- **Interfaces** are like contracts that define a set of properties, methods, and events but do not provide any implementation.
- **Polymorphism** allows a derived class to be used interchangeably with its base class. This is especially useful in collections, such as a list.

FAST TRACK HELP

- **http://msdn.microsoft.com/en-us/beginner/bb308752.aspx**
- **http://msdn.microsoft.com/en-us/beginner/bb308750.aspx**
- **http://msdn.microsoft.com/en-us/library/dd460654.aspx**

Understand .NET namespaces

SCENARIO: Markus Rankenburg has just started an internship with Contoso, Ltd. as a developer. He is updating the company's inventory system to make use of barcode and GPS technologies to improve package tracking. Markus's supervisor wants him to use classes from the company's existing inventory system as much as possible, both to save time and because the older code has been tested thoroughly. The classes are part of a Microsoft Visual Studio project called *Inventory Project;* Markus's Visual Studio project is called *Tracking Project*.

Markus is having problems because several of his classes (`Package`, `Barcode`, and `Destination`) have names that already exist in *Inventory Project*. Both projects use the default namespaces defined by Visual Studio when the projects were created.

1. **What is most likely the fully qualified name of Markus's new Package class?**
   - **a.** `InventoryProject.Package`
   - **b.** `System.Default.Package`
   - **c.** `Windows.Form.Package`
2. **What is the best way for Markus to use classes from *InventoryProject?***
   - **a.** Include a file path as part of the fully qualified name.
   - **b.** Add a reference to the other project's classes.
   - **c.** Copy and paste the code into his project.
3. **Which line of code will allow Markus to avoid having to use fully qualified names for the ShippingSource class in *InventoryProject?***
   - **a.** `using ShippingSource.InventoryProject;`
   - **b.** `using InventoryProject.*;`
   - **c.** `using InventoryProject.ShippingSource;`

hint

The fully qualified name, System. Windows. Forms.Button, refers to the common Button control.

Answers

1. What is most likely the fully qualified name of Markus's new `Package` class?
   - a. **`InventoryProject.Package.`** By default, Visual Studio creates a namespace with the same name as the project name.
2. What is the best way for Markus to use classes from *InventoryProject?*
   - **b. Add a reference to the other project's classes**.
3. Which line of code will allow Markus to avoid having to use fully qualified names for the `ShippingSource` class in *InventoryProject?*
   - **c. `using InventoryProject.ShippingSource;`**

Essential details

- A **name space** is an organizational structure for categorizing classes and for preventing name collisions.
- **Name collisions** occurs when the same name is used for different things in two separate areas that share the same namespace.
- To avoid using **fully qualified names,** add `using` (C#) or `Imports` (Visual Basic) statements to your code.
- In C#, use the `namespace` keyword:

```
namespace MyNamespace
{
  // …
}
```

- In Visual Basic, use `Namespace:`

```
Namespace MyNamespace
' …
End Namespace
```

FAST TRACK HELP

- **http://msdn.microsoft.com/en-us/library/zt9tafza.aspx**
- **http://msdn.microsoft.com/en-us/library/0d941h9d.aspx**
- **http://msdn.microsoft.com/en-us/library/ms973231.aspx**

Understand and create class libraries

SCENARIO: Markus Rankenburg has studied the documentation for the old inventory system at Contoso, Ltd., where his internship supervisor has asked him to enhance the company's ability to track packages. Markus spoke to the developers of the original inventory system, and they suggested that he gather the classes he needs from the old system into a few class library files. They created the first one (called `InventoryLibrary`) for him to help him get started. Markus located the completed class library on the server and is ready to begin.

Once he fully understands how the first class library works and has a chance to explore the original developers' project files, he will be able to create the additional classes needed for this new inventory assignment.

1. **When Markus looks for the InventoryLibraryfile on the server, he sees several files with that name. Which is likely to be the class library file he needs?**
   - **a.** InventoryLibrary.cl
   - **b.** InventoryLibrary.cs
   - **c.** InventoryLibrary.dll
2. **How can Markus make use of `InventoryLibrary` in his own project?**
   - **a.** Add a reference to the file in its original location.
   - **b.** Make a copy of the file in his application folder.
   - **c.** Add a `using` (C#) or `Imports` (Visual Basic) directive to his code.
3. **What is a primary advantage of using class libraries?**
   - **a.** They build and deploy quicker than full applications.
   - **b.** The secure source code with a basic encryption system.
   - **c.** They are easy to maintain and distribute.

hint

Class libraries package multiple classes into one file.

Answers

1. When Markus looks for the InventoryLibrary file on the server, he sees several files with that name. Which is likely to be the class library file he needs?

   c. **InventoryLibrary.dll**

2. How can Markus make use of `InventoryLibrary` in his own project?

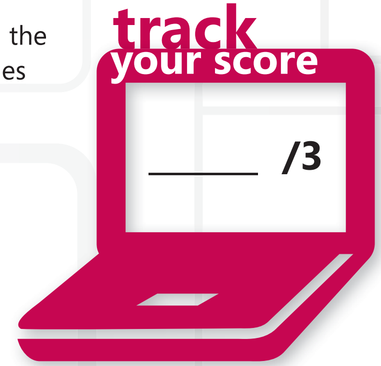
   a. **Add a reference to the file in its original location**. By using the original location, Markus's project will always use the most recent version.

3. What is a primary advantage of using class libraries?

   c. **They are easy to maintain and distribute.**

Essential details

- A **class library** is a collection of classes that can be packaged as a DLL for distribution, reuse, or both.
- A **dynamic-linklibrary** (DLL) is a package of classes and associated code that is linked to your application at run time. They typically have the file extension .dll.
- To create a class library, use one of the Class Library templates in Visual Studio. When you build the project, Visual Studio creates a DLL file.
- By using class libraries, you ensure that your code is easy to reuse—and easy to maintain or revise—because you need to work with only one copy of the code.
- To use a DLL file, add a reference to the file to your project. You can do this from the Build menu in Visual Studio. Then, refer to the classes by their fully qualified names or just add a `using` or `Imports` directive.



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- **http://msdn.microsoft.com/en-us/library/3707x96z(VS.80).aspx**
- **http://msdn.microsoft.com/en-us/library/ms228390(v=VS.90).aspx**

Understand and use different data types in the .NET Framework

SCENARIO: Cristina Potra has a friend with an extensive collection of vintage comic books. His collection is so large—and his organization so poor—that he has a difficult time keeping track of the comic books he already owns and the comic books he plans to buy. At a recent auction, he paid a large amount of money for a comic book he already owned!

Cristina wants to help, so she offered to develop an application for tracking her friend's collection. The application will need to track each book's title, issue number, date, and condition, as well as the price paid for the book.

1. **Which of the following is likely to be a reference type in Cristina's program?**
   - **a.** The issue number
   - **b.** The purchase price
   - **c.** The title of the book
2. **Cristina made an array named `comicBooks` to store all the data. How can she reference the first book in the list?**
   - **a.** `comicBooks.Get(0)`
   - **b.** `comicBooks[0]`
   - **c.** `comicBooks<0>`
3. **Which of the following is a good choice for storing the price of a book?**
   - **a.** `double`
   - **b.** `int`
   - **c.** `String`

hint

Reference data types store a pointer to a value, not the value itself.

Answers

1. Which is likely to be a reference type in Cristina's program?

   c. **The title of the book**. String is a reference type, while numeric types are value types.

2. Cristina made an array named `comicBooks` to store all the data. How can she reference the first book in the list?

   b. **`comicBooks [0]`**

3. Which of the following is a good choice for storing the price of a book?

   a. **`double`.** Unlike `int, double` can storing floating-point data. `String` could store the data, but it would need to be converted for use in any calculations.

Essential details

- A **data type** is a classification that determines how data is stored and what operations can be performed on the data. Types can be value types or reference types.
- **Value** refers to a data type that stores an actual value.
- **Reference** refers toa data type that stores a pointer or reference to a memory location where a value is stored.
- An **array** is a data structure that contains numerous variables of the same type.
- Square brackets generally refer to individual members of the array. The first item in the array has the index 0.
- A **collection** is a specialized class for storing and retrieving groups of related or similar data.
- Most collections implement a common set of interfaces. If you learn to use one collection type, it's easy to learn others.

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- **http://msdn.microsoft.com/en-us/library/ms173104.aspx**
- **http://msdn.microsoft.com/en-us/library/esc8tb11.aspx**
- **http://msdn.microsoft.com/en-us/library/ybcx56wz.aspx**
- **http://msdn.microsoft.com/en-us/library/ms973231.aspx**

Understand generics

SCENARIO: Diliana Alexieva-Bosseva is part of a development team working to update an application for Fabrikam, Inc. The application manages the production schedule of the company's sports equipment factory. For example, for one week the employees make tennis rackets, and the next week they change and produce small soccer goals for young children. The application plans the schedule for the next six months, but increased demand means Diliana's team must update the application to schedule up to one year in advance.

The old application uses an `Array` to manage the collection of `ProductionItem` objects, and it throws an exception when the schedule gets beyond the original six-month limit. Another member of the team changed this to an `ArrayList`, which stores everything as the `Object` type.

1. **How can Diliana tell the compiler to castan instance in the `ArrayList` (named obj) to the `ProductionItem` type?**

   a. `(ProductionItem) obj`

   b. `Convert.ToProductionItem(obj)`

   c. `Obj.ToProductionItem`

2. **Dilliana finds that this casting occasionally results in exceptions. Which of these collection types use generics to specify a type placeholder?**

   a. `Array`

   b. `ArrayList`

   c. `List<T>`

3. **What is the correct syntax for declaring a Stack called `itemStack` using generics?**

   a. `Stack itemStack<ProductionItem>;`

   b. `<Stack>itemStack(ProductionItem);`

   c. `Stack<ProductionItem>itemStack;`

hint

Array List does not use generics, so objects in the list must be cast.

Answers

1. How can Diliana tell the compiler to cast an instance in the `ArrayList` (named `obj`) to the `ProductionItem` type?

   a. `(ProductionItem) obj`

2. Dilliana finds that this casting occasionally results in exceptions. Which of these collection types use generics to specify a type placeholder?

   c. `List<T>`

3. What is the correct syntax for declaring a `Stack` called `itemStack` using generics?

   c. `Stack<ProductionItem>itemStack;`

Essential details

- Generics let you tailor a method, class, structure, or interface to the precise data type it acts upon.
- Developers often use generics when working with collections of objects in their applications.
- Generics use a template or placeholder—called a *generic type parameter*—to indicate the data type to be used when the code is executed.
- Specify these generic type parameters with angle brackets:
  `<String>`
  `<int>`
  `<ProductionItem>`
- Collection types that take advantage of the power of generics are easy to use. You don't have to worry about converting (or *casting*) objects to the necessary data type—they already *are* that data type.

FAST TRACK HELP

- **http://msdn.microsoft.com/en-us/library/ms172193.aspx**
- **http://msdn.microsoft.com/en-us/library/ms172192.aspx**
- **http://msdn.microsoft.com/en-us/library/6sh2ey19.aspx**

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3

Understanding .NET Code Compilation

IN THIS CHAPTER

- 3.1 Understand the fundamentals of Microsoft Intermediate Language and Common Language Infrastructure
- 3.2 Understand the use of strong naming
- 3.3/3.4 Understand version control; Understand assemblies and metadata

Understand the fundamentals of Microsoft Intermediate Language and Common Language Infrastructure

SCENARIO: Bart Wessels is responsible for developing applications to manage an automotive racing team. His projects include programs that keep records of the cars' maintenance, performance statistics, and team employee contract and payroll information.

On a recent morning, he arrived at work to find that a damaged hard drive had destroyed some files related to a data-driven application that analyzesa car's performance on different tracks under various weather conditions, tire brands, and fuel mixtures. Luckily, the data is safe, but the executables don't seem to work—and the team's biggest sponsor is meeting with the team to review the performance data in just a few days.

1. **Bart knows that he can execute the program by using the JIT compiler on a backup that he kept of a portable executable (PE). What type of code is in a PE file?**
   - **a.** Binary code
   - **b.** MSIL code
   - **c.** Native code
2. **How does the default JIT compiler process the code from an application?**
   - **a.** It compiles the entire application and saves the output to disk.
   - **b.** It compiles the application in parts, as needed.
   - **c.** It compiles only those parts that are not compiled into MSIL.
3. **Which tool would help Bart extract the MSIL code for his application?**
   - **a.** MSIL Assembler
   - **b.** MSIL Disassembler
   - **c.** Visual Studio Code Viewer

hint

MSIL stands for Microsoft Intermediate Language. JIT stands for Just-In-Time.

Answers

1. Bart knows that he can execute the program by using the JIT compiler on a backup that he kept of a portable executable (PE). What type of code is in a PE file?

   b. MSIL code. It also contains metadata about the application.

2. How does the default JIT compiler process the code from an application?

   b. It compiles the application in parts, as needed.

3. Which tool would help Bart extract the MSIL code for his application?

   b. MSIL Disassembler. This tool stores the MSIL instructions in a text file.

Essential details

- No matter which .NET language is used to develop an application, the source code is translated into **Microsoft Intermediate Language (MSIL).**
- The MSIL instructions are stored in **portable executable (PE)** format, which also stores metadata related to the application.
- MSIL is platform-independent, so it must be compiled into native code that is specific to that platform.
- Rather than compiling to native code ahead of time, .NET uses a **Just-In-Time (JIT)** compiler that translates the MSIL as the application executes.
- The JIT compiles individual methods as needed—methods that never execute are never compiled. If the user closes the application, then runs it again later, the JIT compiler repeats the process.

FAST TRACK HELP

- **http://msdn.microsoft.com/en-us/library/ht8ecch6.aspx**
- **http://msdn.microsoft.com/en-us/library/c5tkafs1.aspx**
- **http://msdn.microsoft.com/en-us/library/k5532s8a.aspx**

Understand the use of strong naming

SCENARIO: Markus Rankenburg is continuing his work to update the inventory system for Contoso, Ltd. His application uses several class libraries created by the developers of the company's original inventory system.

Michael Affronti, the project manager, has uncovered a security breach in the network that the development teams use for their work. Although no damage was discovered, Michael has assessed the teams' security practices and has decided to implement new policies that will protect the project files better and offer a greater level of security and confidence for all the team members. Markus will have to adjust to these changes as he finishes up his project.

1. **From now on, all assemblies will use strong names. Which of the following is *not* part of a strong name?**
   - **a.** The version number
   - **b.** A public key
   - **c.** A private key
2. **How can the original developers share their libraries securely so that Markus's application (and others) can use them?**
   - **a.** Use the Global Assembly Cache (GAC) and a strong name.
   - **b.** Give Markus a private key to access them on the server.
   - **c.** Distribute a simple name and keep the strong name private.
3. **What will Markus need to do if the original team members update the assemblies and delete the old assemblies?**
   - **a.** Nothing—his application will use the most recent version.
   - **b.** Rebuild his application against the new version.
   - **c.** Ask for a new public key.

hint

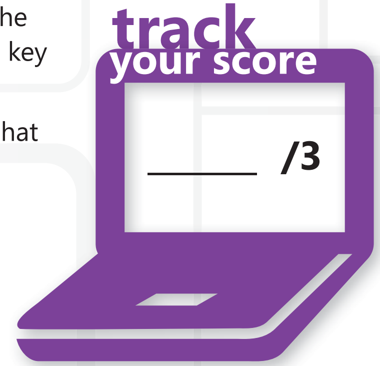
Strong naming uses a public key encryption model.

Answers

1. From now on, all assemblies will use strong names. Which of the following is not part of a strong name?
   c. **A private key.** The private key is kept secure—the public key is released to developers wishing to use the assembly.
2. How can the original developers share their libraries securely so that Markus's application can use them?
   a. Use the Global Assembly Cache (GAC) and a strong name.
3. What will Markus need to do if the original team members update the assemblies and delete the old assemblies?
   b. Rebuild his application against the new version. The public key will change only if the developers change their private key.

Essential details

- **Strong names** provide security and unique names for assemblies.
- Strong names rely on a **public key** encryption system: a public key is distributed so that users can verify the authenticity of the assembly, which can be built only with the **private key** kept by the developer.
- A strong name includes the assembly's name, version, and a public key. It also may include information about culture and target machine architecture.
- Developers can opt to use delay signing, where the private key is not used until the assembly is ready to be distributed. This allows the developer to keep the private key more secure.
- The **Global Assembly Cache (GAC)** is a system folder used to store assemblies that are shared by multiple applications on a computer.



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- **http://msdn.microsoft.com/en-us/magazine/cc163583.aspx**
- **http://msdn.microsoft.com/en-us/library/yf1d93sz.aspx**

Understand version control; Understand assemblies and metadata

SCENARIO: Anna Misiec has published a small application that helps the students at her university schedule their classes each semester. The program allows the students to enter a list of courses required for graduation, download the current list of course times, and drag those courses to a blank schedule. It even provides warnings if classes overlap or a required course is left off the list.

Because the university has changed the format of their course listings, Anna has to upgrade her program; she also has decided to make some additional improvements. The new version will flag classes that are nearly full and will handle degree requirements that could be met by choosing from a list of classes rather than one specific class.

This new version is a significant update, and students will be required to upgrade if they want to use her utility—the old version (which consumers call version 1.0) will no longer work with the new system.

1. **Which of the following would be the best version number for Anna's new release?**
   - **a.** 1.0.1
   - **b.** 1.5
   - **c.** 2.0
2. **When Anna compiles her application, where is the version number stored?**
   - **a.** The assembly manifest
   - **b.** In README.TXT
   - **c.** As part of the executable's file name
3. **The information stored by the compiler which describes the assembly and its contents can be referred to as what?**
   - **a.** An MSIL file
   - **b.** Metadata
   - **c.** The common language runtime

hint

An assembly is generally either an executable (.exe file) or a library (.dll file).

Answers

1. Which of the following would be the best version number for Anna's new release?

   c. **2.0.** Because the new version introduces major changes (and is not compatible with v1.0), she should change the major version number.

2. When Anna compiles her application, where is the version number stored?

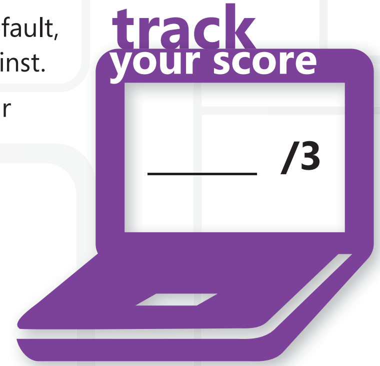
   a. The assembly manifest

3. The information stored by the compiler which describes the assembly and its contents can be referred to as what?

   b. Metadata

Essential details

- The basic building block of a .NET application is an **assembly**.
- You can think of an assembly as a collection of types and resources that form a logical unit of functionality and are built to work together.
- When an assembly is compiled, .NET also produces an **assembly manifest**—a collection of data that describe how the elements in the assembly relate to each other.
- This type of "data about data" is called "metadata."
- Each assembly has its own version that is independent of other assemblies. By default, an application can use only the exact version of an assembly that it was built against.
- These versions are identified by number, and a .NET version number includes four parts: major version, minor version, build number, and revision.



FAST TRACK HELP

- **http://msdn.microsoft.com/en-us/library/51ket42z.aspx**
- **http://msdn.microsoft.com/en-us/library/30azhh5b.aspx**
- **http://msdn.microsoft.com/en-us/library/1w45z383.aspx**

4

Understanding I/O Classes in the .NET Framework

IN THIS CHAPTER

- 4.1 Understand .NET file classes
- 4.2 Understand console I/O
- 4.3 Understand XML classes in the .NET Framework

Understand .NET file classes

SCENARIO: Sanjay Patel is a music enthusiast. Over time, he has accumulated a large number of .mp3 and .wma files from purchases through a variety of online music stores. He has organized his music into folders based on album names; each folder contains all the songs from a particular album.

When Sanjay transfers his music to his portable music player, the songs are all in one long list, and he has a difficult time finding the music he wants to listen to. However, he's learned that his music player supports .m3u playlist files, which are playlists in text file format. He is writing an application that will go through his music folders and create a playlist for each album in his collection.

1. **Some of Sanjay's folders have playlist files already. What code can Sanjay use to check if a playlist exists?**
   - **a.** `File.Exist`
   - **b.** `StreamReader.Exist`
   - **c.** `StreamWriter.Exist`
2. **Sanjay's code is almost working, but all his data is written to one line in the file. How can he add a line terminator?**
   - **a.** `StreamWriter.Append`
   - **b.** `StreamWriter.Close`
   - **c.** `StreamWriter.WriteLine`
3. **What will happen if a playlist file does exist and Sanjay creates a `StreamWriter` object with the append parameter set to `false`?**
   - **a.** The existing file will be renamed.
   - **b.** The new data will be added to the end of the existing file.
   - **c.** The existing file will be overwritten.

hint

To "append" means to join components or add on to something.

Answers

1. Some of Sanjay's folders have playlist files already. What code can Sanjay use to check if a playlist exists?

   a. **`File.Exist`**. The `File` class exposes many methods useful for general file handling.

2. Sanjay's code is almost working, but all his data is written to one line in the file. How can he add a line terminator?

   c. **`StreamWriter.WriteLine.`** `Append` is not a member of the `StreamWriter` class; `Close` will close the file.

3. What will happen if a playlist file does exist and Sanjay creates a `StreamWriter` object with the `append` parameter set to `false`?

   c. **The existing file will be overwritten**.

Essential details

- The **`File`** class provides an assortment of methods for basic file handling, such as determining if a file exists and deleting, copying, or moving a file.
- The **`StreamReader`** and **`StreamWriter`** classes expose methods for working with streams of text data. They are often used when reading and writing text files.
- `StreamReader` and `StreamWriter` move through data sequentially and keep track of the current location within the file.
- **`StreamReader.Read`** and **`StreamReader.ReadLine`** return the next character and next line, respectively, in a text stream.
- **`StreamWriter.Write`** and **`StreamWriter.WriteLine`** write data to the stream, with `WriteLine` adding a line terminator.

FAST TRACK HELP

- **http://msdn.microsoft.com/en-us/library/db5x7c0d.aspx**
- **http://msdn.microsoft.com/en-us/library/6ka1wd3w.aspx**
- **http://support.microsoft.com/kb/304430**

Understand console I/O

SCENARIO: Karina Leal is a computer gaming enthusiast who loves vintage computer games. In particular, she enjoys playing text-based role-playing games (RPGs). As a novice programmer, she wants to try putting together a simple text-based RPG of her own.

Her game will describe the current scene to the player, and then wait for the player to enter a command, such as "`open door`." The program will then evaluate the user's input and, if it is a valid command, proceed to the next scene. She has created a console application project in Microsoft Visual Studio as a starting point for creating her game.

1. **Which method can Karina use to display information to the player?**
   - **a.** `System.Console.Output`
   - **b.** `System.Console.Print`
   - **c.** `System.Console.Write`
2. **Which method will return a full line of text entered by the player?**
   - **a.** `System.Console.Read`
   - **b.** `System.Console.ReadKey`
   - **c.** `System.Console.ReadLine`
3. **Which method will allow Karina to process function keys, as well as modifiers (such as SHIFT, ALT, and CTRL) typed by the player?**
   - **a.** `System.Console.Read`
   - **b.** `System.Console.ReadKey`
   - **c.** `System.Console.ReadLine`

hint

***System.Console* provides static methods for both input and output through the console.**

Answers

1. Which method can Karina use to display information to the player?

   c. `System.Console.Write`

2. Which method will return a full line of text entered by the player?

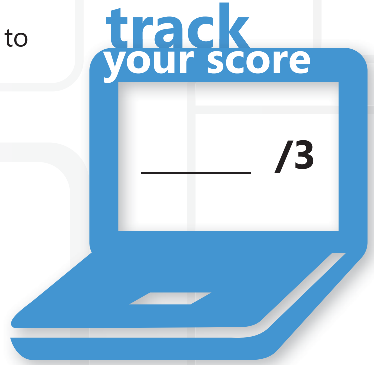
   c. `System.Console.ReadLine`

3. Which method will allow Karina to process function keys, as well as modifiers (such as SHIFT, ALT, and CTRL) typed by the player?

   b. `System.Console.ReadKey`

Essential details

- **Console applications** rely on text input and output at the command line as a user interface. Keep in mind that other .NET applications can use console I/O as well.
- The console relies on text-based data streams for inputting and outputting information.
- **`Console.Write`** and **`Console.WriteLine`** write data to the console window; **`WriteLine`** adds a line terminator, which essentially moves the cursor to the start of the next line.
- **`System.Console.Read`**, **`System.Console.ReadKey`**, and **`System.Console.ReadLine`** return data entered by the user.
- **Read** returns a character as soon as it's typed, while **ReadLine** waits for the user to press ENTER and then returns a string.
- **ReadKey** returns a data type that will handle function key presses, as well as modifier keys (such as SHIFT, ALT, and CTRL)



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- **http://msdn.microsoft.com/en-us/library/system.console.aspx**
- **http://msdn.microsoft.com/en-us/library/0wc2kk78.aspx**
- **http://msdn.microsoft.com/en-us/library/system.console.read.aspx**

Understand XML classes in the .NET Framework

SCENARIO: Sanjay Patel has completed writing a program that scans through his music collection and creates playlist files for his portable media player. It is working great, and he is able to navigate through his collection much more easily now. In fact, many other students at his school are interested in using his software, and this has given Sanjay a new idea.

He wants to make a new version of his application that also catalogs the songs in the collection. He plans to then create a website application that will provide basic social networking for the users of his application. They will be able to see who has similar music in their collections and then interact with those users by using simple messages. They might want to suggest other music titles in the same genre or discuss recent concerts with their online acquaintances. He has decided to use Extensible Markup Language (XML) files to store the data generated as the program scans through the music files.

1. **Which of the following is an advantage of XML in this application?**
   - **a.** XML provides relational database functionality.
   - **b.** XML provides a standardized format for transferring data.
   - **c.** XML is the language used to create websites.
2. **Which class provides the methods that Sanjay will use to write the XML data to disk?**
   - **a.** `XmlDataWriter`
   - **b.** `XmlFileWriter`
   - **c.** `XmlTextWriter`
3. **Sanjay wants to formalize the structure (schema) of his XML documents. What type of file should he use?**
   - **a.** A Hypertext Markup Language (HTML) file.
   - **b.** An XML Schema Definition (XSD) file.
   - **c.** A Microsoft Visual C# or Microsoft Visual Basic class.

hint

XML files are text files that use a tag-based syntax similar to HTML.

Answers

1. Which of the following is an advantage of XML in this application?

   b. **XML provides a standardized format for transferring data.** XML does not have relational functionality, and though it is syntactically similar to HTML, it serves a different purpose.

2. Which class provides the methods that Sanjay will use to write the XML data to disk?

   c. `XmlTextWriter`

3. Sanjay wants to formalize the structure (schema) of his XML documents. What type of file should he use?

   b. **An XML Schema Definition (XSD) file.**

Essential details

- **Extensible Markup Language (XML)** is a markup language for formatting data in a document which is useful for storing data or transferring data between different computer platforms or applications.
- Although syntactically similar to Hypertext Markup Language (HTML), XML is used to define the structure of data, not its layout or appearance.
- **`XmlTextReader`** implements the abstract class **`XmlReader`**, which provides an efficient way to read XML data into memory. It exposes a method named Read to process one node of XML data at a time.
- **`XmlTextWriter`** implements **`XmlWriter`**, which provides pairs of methods that correspond to the paired tags in the XML output file.

FAST TRACK HELP

- **http://msdn.microsoft.com/en-us/beginner/bb308816.aspx**
- **http://msdn.microsoft.com/en-us/beginner/bb308812.aspx**
- **http://msdn.microsoft.com/en-us/library/wkee9k2s.aspx**

5

Understanding Security

IN THIS CHAPTER

- 5.1/5.2 Understand the System.Security namespace; Understand authentication and authorization

Understand the System.Security namespace; Understand authentication and authorization

SCENARIO: Enrique Gil is a computer science student and an intern at Consolidated Messenger. In class, he has been learning about implementing security systems in applications, and he has noticed that it is very similar in some ways to the physical security at the corporate offices of Consolidated Messenger.

The building uses an electronic key system along with a retina scanner for high-security areas. In addition, each employee is required to wear a name badge that is color-coded to match his or her job. Secretaries wear yellow name badges, supervisors wear green, IT personnel wear red, and managers wear blue. Visitors and interns, such as Enrique, wear a plain white name badge. That badge system corresponds with an electronic key to provide employees with access only to the areas where they are allowed entrance.

1. **Which model best describes the security system used by Consolidated Messenger?**
   - **a.** Code access security
   - **b.** Cryptographic security
   - **c.** Role-based security
2. **The employee name badge includes a photograph to help verify the employee's identity—which function does this serve?**
   - **a.** Authentication
   - **b.** Authorization
   - **c.** Cryptography
3. **When an employee scans the electronic key to a door, the computer checks the job assignment and then unlocks the door if that job requires access to the area behind it. Which function is this?**
   - **a.** Authentication
   - **b.** Authorization
   - **c.** Cryptography

hint

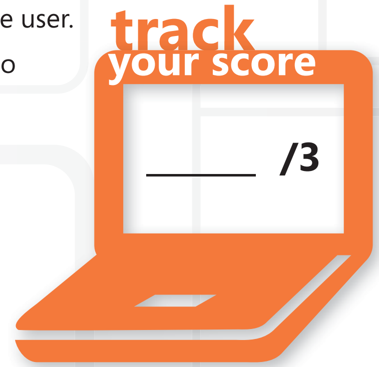
In software, the authentication process often involves prompting the user for a password.

Answers

1. Which model best describes the security system used by Consolidated Messenger?
   c. **Role-based security.** Each individual's access is determined by the role he or she plays.
2. The employee name badge includes a photograph to help verify the employee's identity—which function does this serve?
   a. **Authentication.** Authentication refers to validating that an individual is who she or he claims to be.
3. When an employee scans the electronic key to a door, the computer checks the job assignment and then unlocks the door if that job requires access to the area behind it. Which function is this?
   b. **Authorization.** Authorization is a check to see if the person has the right to gain access to the requested task or area.

Essential details

- The Microsoft .NET Framework uses two basic security models: **role-based security** and **code access security.**
- In role-based security, each user has a particular identity or is a member of a specified role, and that role determines the user's permissions.
- Code access security prevents potentially malicious code from executing restricted actions.
- In role-based security, authentication is the process of verifying the identity of the user.
- Authorization is the process of determining whether a person or user is allowed to perform a task.
- Security-related classes are located in the `System.Security` namespace.



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- **http://msdn.microsoft.com/en-us/library/z164t8hs.aspx**
- **http://msdn.microsoft.com/en-us/library/system.security.aspx**
- **http://msdn.microsoft.com/en-us/library/5ba4k1c5.aspx**

6

Understanding .NET Languages

IN THIS CHAPTER

- 6.1 Understand language interoperability
- 6.2 Understand type safety

Understand language interoperability

SCENARIO: IdanPlonsky and James Alvord are longtime friends who attended high school together before moving to separate cities to go to college. Both are studying computer science, and they want to use their new programming skills to collaborate on an application. Their idea is to create a program that their high school math teacher can use to graph simple algebraic equations to display with a digital projector.

The curricula at Idan's school is different than at James' school—Idan programs using Microsoft Visual Basic, while James programs using Microsoft Visual C#.

1. **The development teams for Visual Basic and C# have worked to ensure that each language has the same feature set as the other. What is this characteristic called?**
   - **a.** Language interoperability
   - **b.** Language compliance
   - **c.** Language parity
2. **What is the name of the environment that will execute code written in any .NET language?**
   - **a.** Common Language Specification (CLS)
   - **b.** Common Language Runtime (CLR)
   - **c.** Microsoft Intermediate Language (MSIL)
3. **How can Idan use one of James's C# assemblies in a Visual Basic project?**
   - **a.** By adding a reference to James's assembly
   - **b.** By having Microsoft Visual Studio convert James's assembly into Visual Basic
   - **c.** By converting both sets of source code to C++

hint

.NET's language interoperability features allow James and Idan to use each other's assemblies.

Answers

1. The development teams for Visual Basic and C# have worked to ensure that each language has the same feature set as the other. What is this characteristic called?

   c. Language parity.

2. What is the name of the environment that will execute code written in any .NET language?

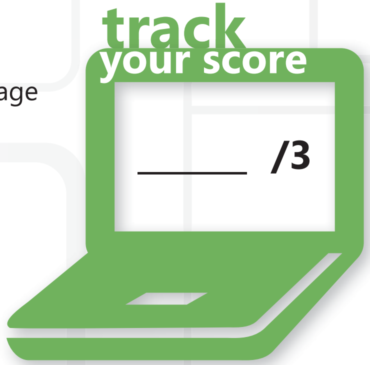
   b. Common Language Runtime (CLR). All source code is compiled to MSIL; the CLR compiles MSIL to native code at run time.

3. How can Idan use one of James's C# assemblies in a Visual Basic project?

   a. By adding a reference to James's assembly. If he has access to the project, he can simply add a reference to it; if not, James can send him a dynamic-link library (DLL) and Idan can add a reference to that.

Essential details

- **Language interoperability** refers to the ability of code to interact with code that is written using a different programming language.
- **Language parity** means that languages share the same features; that is, anything that you can do in one language, you can do in the other.
- Language interoperability is made possible by the **Common Language Runtime (CLR)**—the run-time environment that executes managed .NET code.
- Because two languages may not have perfect parity, writing code in a .NET language does not guarantee that other .NET languages can use that code.
- **Common Language Specification (CLS)** is a fundamental set of language features and rules for how those features are used.



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- **http://msdn.microsoft.com/en-us/library/12a7a7h3.aspx**
- **http://msdn.microsoft.com/en-us/library/730f1wy3.aspx**

Understand type safety

SCENARIO: Jordao Moreno has taken a part-time job with Woodgrove Bank using his expert programming skills to help pay for his education. The bank tellers use an application to input transactions and provide balance information to customers. Jordao's task is to port the Microsoft Visual Basic application to Microsoft Visual C#. The original application was written in Visual Basic 6 and makes frequent use of weakly typed programming, such as the following:

```
Dim balance = 5
deposit = “10”
newBalance = balance + deposit
```

Jordao will have to decide how to handle this type of code as he ports it into Visual C#.

1. **In Jordao's C# version, every variable must have an explicit data type. What is the name of this language feature?**
   - **a.** Strong typing
   - **b.** Type casting
   - **c.** Type safety
2. **At what point in the development process will Jordao's C# code be verified for type safety?**
   - **a.** Before the code is compiled to MSIL code.
   - **b.** When the Microsoft Intermediate Language (MSIL) code is Just-In-Time (JIT)–compiled.
   - **c.** It will not be checked for type safety during development.
3. **Which system defines how data types are declared and used in the Common Language Runtime (CLR)?**
   - **a.** Common Type System (CTS)
   - **b.** Common Language Specification (CLS)
   - **c.** Security policies

hint

Visual C# is a strongly typed language; it does not allow "typeless" programming.

Answers

1. In Jordao's C# version, every variable must have an explicit data type. What is the name of this language feature?

   a. **Strong typing.**

2. At what point in the development process will Jordao's C# code be verified for type safety?

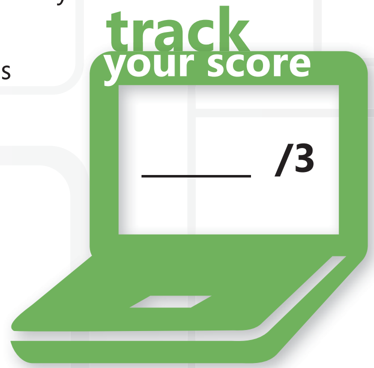
   b. **When Microsoft Intermediate Language (MSIL) code is Just-In-Time (JIT)–compiled.** The compiler will examine the assembly's metadata and MSIL code to verify type safety.

3. Which system defines how types are declared and used in the Common Language Runtime (CLR)?

   a. **Common Type System (CTS).**

Essential details

- **Type-safe** code is code that accesses only the memory locations that it is authorized to access. For example, type-safe code cannot read or write values in another object's private fields.
- Type safety is not mandatory, but it helps make code more secure.
- At runtime, the **Just-In-Time (JIT)** compiler performs a check to verify that the code being compiled is type-safe.
- In Visual C#, you can execute unsafe code—code that is not verifiable as type-safe—by using the `unsafe` keyword, although this is not typically used in practice.
- C# is a **strongly typed language:** every variable and constant has a type, as does every expression that evaluates to a value.
- Visual Basic allows data that is not strongly typed; most of the time, however, a Visual Basic programmer should declare types explicitly.



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- **http://msdn.microsoft.com/en-us/library/t2yzs44b.aspx**
- **http://msdn.microsoft.com/en-us/library/xe53dz5w.aspx**

7

Understanding Memory Management

IN THIS CHAPTER

- 7.1 Understand resource allocation
- 7.2 Understand the difference between managed and unmanaged applications

Understand resource allocation

Scenario: Christa Geller learned to program in Pascal and C, and is now learning how to use Microsoft Visual Studio to create applications in Microsoft Visual Basic and Microsoft Visual C#. Based on her previous experience, she is accustomed to allocating the memory that her applications require manually, then freeing (or "disposing of") memory when it is no longer needed. When she is not careful about allocating and releasing memory, she gets "stack overflow" errors.

Christa is surprised (and excited) to learn that she no longer needs to manage memory now that she is using Visual Basic and Visual C#—the Microsoft .NET Framework handles all that for her! Being curious, though, she wants to understand how the system works.

1. **What is the name of the system that manages memory in .NET applications?**
   - **a.** Garbage collector
   - **b.** Memory manager
   - **c.** Resource allocator
2. **When Christa creates an object, where does the .NET Framework allocate memory for the instance?**
   - **a.** On the hard disk
   - **b.** On the heap
   - **c.** On the stack
3. **Which method can Christa use to initiate a cleanup of the heap?**
   - **a.** `Collect`
   - **b.** `Release`
   - **c.** `Free`

hint

The stack stores value data; the heap (or "managed heap") stores reference data.

Answers

1. What is the name of the system that manages memory in .NET applications?

   a. Garbage collector.

2. When Christa creates an object, where does the .NET Framework allocate memory for the instance?

   b. On the heap. Reference types are stored on the heap; value types are placed on the stack.

3. Which method can Christa use to initiate a cleanup of the heap?

   a. Collect. This method is part of the GC (garbage collector) class.

Essential details

- .NET Framework uses a mechanism called the **garbage collector** to manage the allocation and release of memory for an application.
- This garbage collector is represented by the GC **class.** Although it is rarely necessary to initiate the garbage collection process manually, you can do so by calling `GC.Collect.`
- The memory available to an application is divided into two regions: the **heap** and the **stack**.
- The **heap** is used for reference data, such as object instances. In the .NET Framework, the heap is the region managed by the garbage collector; therefore, it is referred to as the "managed heap."
- The **stack** is used for method overhead and value data. Space in the stack is allocated and released automatically based on execution scope.

FAST TRACK HELP

- **http://msdn.microsoft.com/en-us/library/ee787088.aspx**
- **http://msdn.microsoft.com/en-us/library/system.gc.aspx**
- **http://msdn.microsoft.com/en-us/library/0xy59wtx.aspx**

Understand the difference between managed and unmanaged applications

SCENARIO: Christa Geller continues to learn more about developing applications in the Microsoft .NET Framework. When she looks in the folder for a project she's working on, she sees a number of files that Microsoft Visual Studio created automatically when she built the solution to her last project.

Christa expected to see an executable file—and she does. But apparently it's not the kind of executable that she anticipated. In fact, when she put the executable on a USB drive and tried to run it on her mother's computer, it wouldn't work. She didn't know that it required installation of the .NET Framework on the computer.

1. **Christa's previous programming experience is with native code—what is native code?**
   - **a.** Code that does not use classes and objects
   - **b.** Code that is executed by the CPU
   - **c.** Code that can run on any system based on Microsoft Windows
2. **What is installed as part of the .NET Framework that would run the executable that Christa has created?**
   - **a.** Common Language Runtime (CLR)
   - **b.** Visual Studio
   - **c.** A Windows application programming interface (API)
3. **Which of the following is NOT a characteristic of managed code?**
   - **a.** Automatic memory management
   - **b.** Executable in any operating system
   - **c.** Uses a Just-In-Time (JIT) compiler

hint

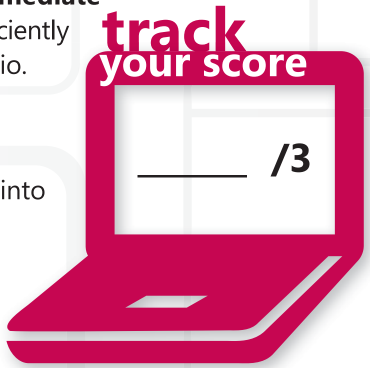
Managed code is compiled when you build it, and again when it executes.

Answers

1. Christa's previous programming experience is with native code—what is native code?
   - **b. Code that is executed by the CPU.**
2. What is installed as part of the .NET Framework that would run the executable that Christa has created?
   - **a. Common Language Runtime (CLR).** Both Visual Studio and the Windows API are application development tools.
3. Which of the following is NOT a characteristic of managed code?
   - **b. Executable in any operating system.** The target operating system must have a CLR.

Essential details

- **Native code** is code that is intended to be run directly by a CPU without any additional translation or conversion. Native code is specific to a CPU/architecture.
- Native code is compiled one time—from source code to the low-level machine language.
- The **Common Language Runtime (CLR)** provides numerous services, including memory management, type safety, and a security system.
- **Managed code** is code that is executed ("managed") by the CLR environment.
- Before it is processed by the CLR, managed code is converted to **Microsoft Intermediate Language (MSIL)**, a CPU-independent set of instructions that can be converted efficiently to native code. MSIL is created when you build a project or solution in Visual Studio.
- When the application is executed, the CLR analyzes this MSIL file(s) and compiles native code that the target machine understands.
- This last step is handled by the **Just-In-Time (JIT)** compiler, which converts MSIL into native code as the application is executing.



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- **http://msdn.microsoft.com/en-us/library/db5x7c0d.aspx**
- **http://blogs.msdn.com/b/brada/archive/2004/01/09/48925.aspx**
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