Module 2 Day 6

Data Access Objects

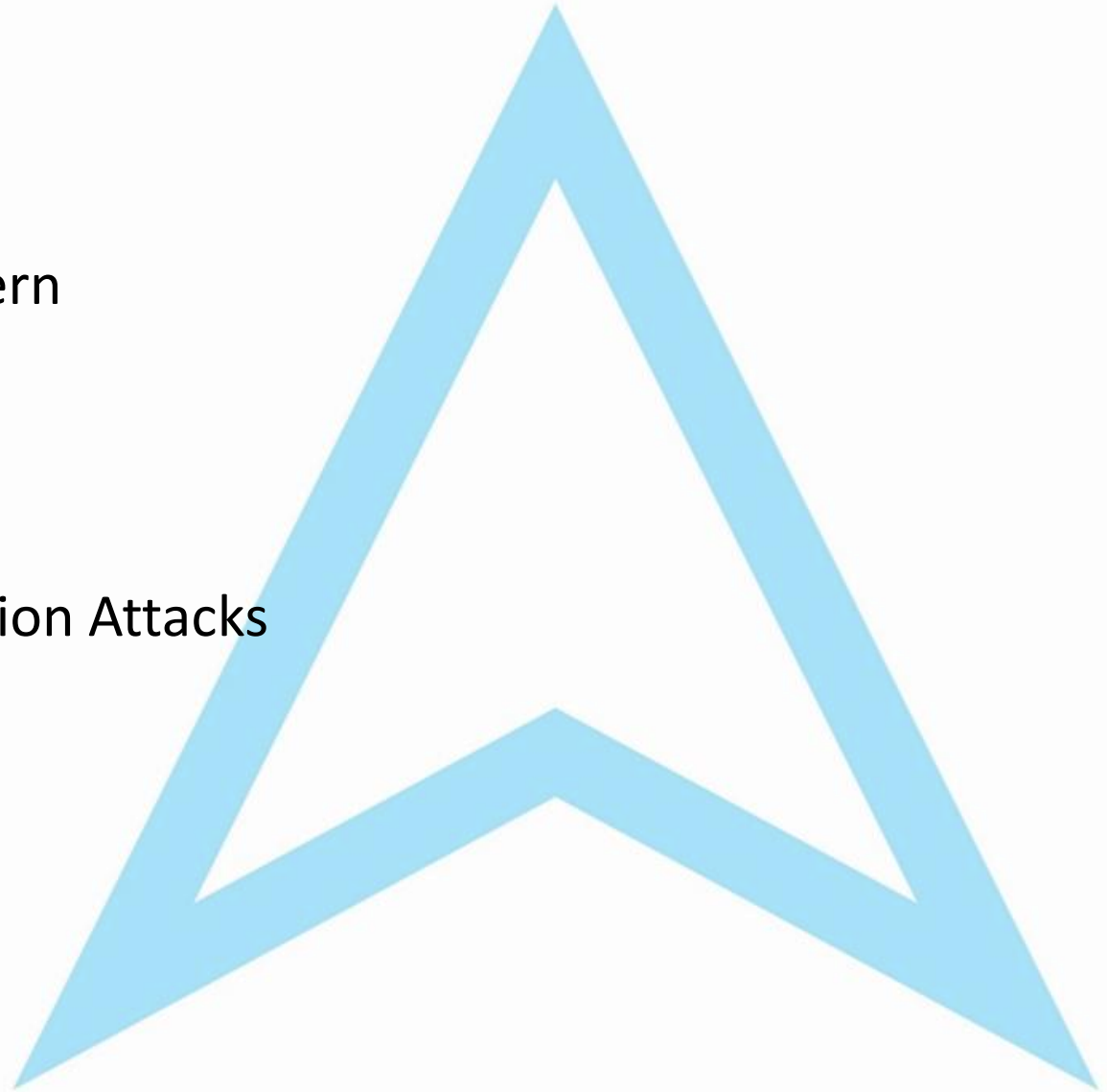
What makes an application?

- Program Data
  - ✓ Variables & .NET Data Types
  - ✓ Arrays
  - ✓ More Collections (list, dictionary, stack, queue)
  - ✓ Classes and objects (OOP)
- Program Logic
  - ✓ Statements and expressions
  - ✓ Conditional logic (if)
  - ✓ Repeating logic (for, foreach, do, while)
  - ✓ Methods (functions / procedures)
  - ✓ Classes and objects (OOP)
  - ❑ Frameworks (MVC)

- Input / Output
  - User
    - ✓ Console read / write
    - ❑ HTML / CSS
    - ❑ Front-end frameworks (HTML / CSS / JavaScript)
  - Storage
    - ✓ File I/O
    - ❖ Relational database
    - ❑ APIs

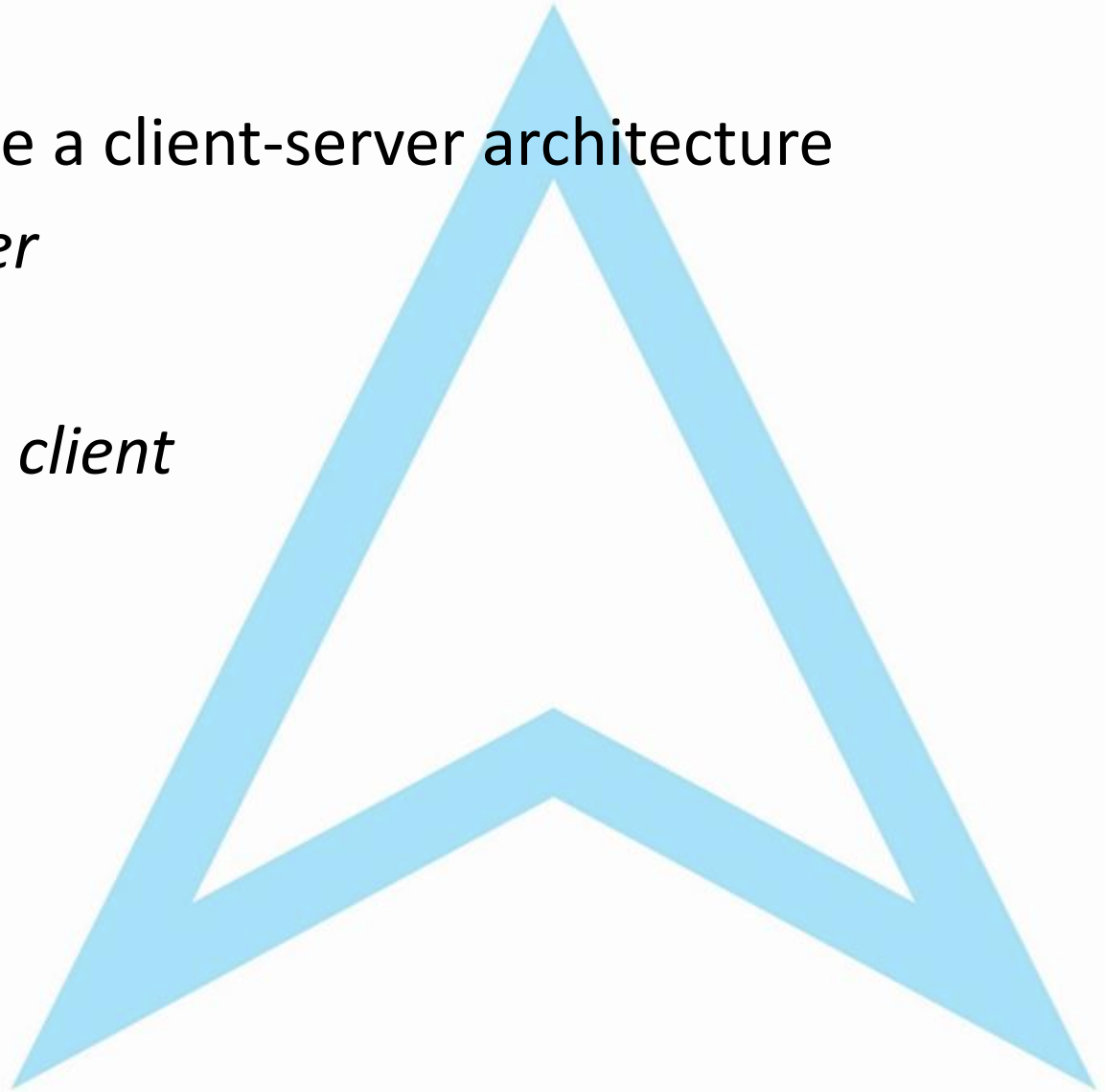
This Week

- Monday
  - Database Connectivity from C#
  - Data Access Objects – The DAO pattern
- Tuesday
  - Integration Testing – Testing DAOs
- Wednesday
  - Data Security - Preventing SQL Injection Attacks
- Thursday & Friday
  - Module 2 Capstone
- All Pairs Exercises this week



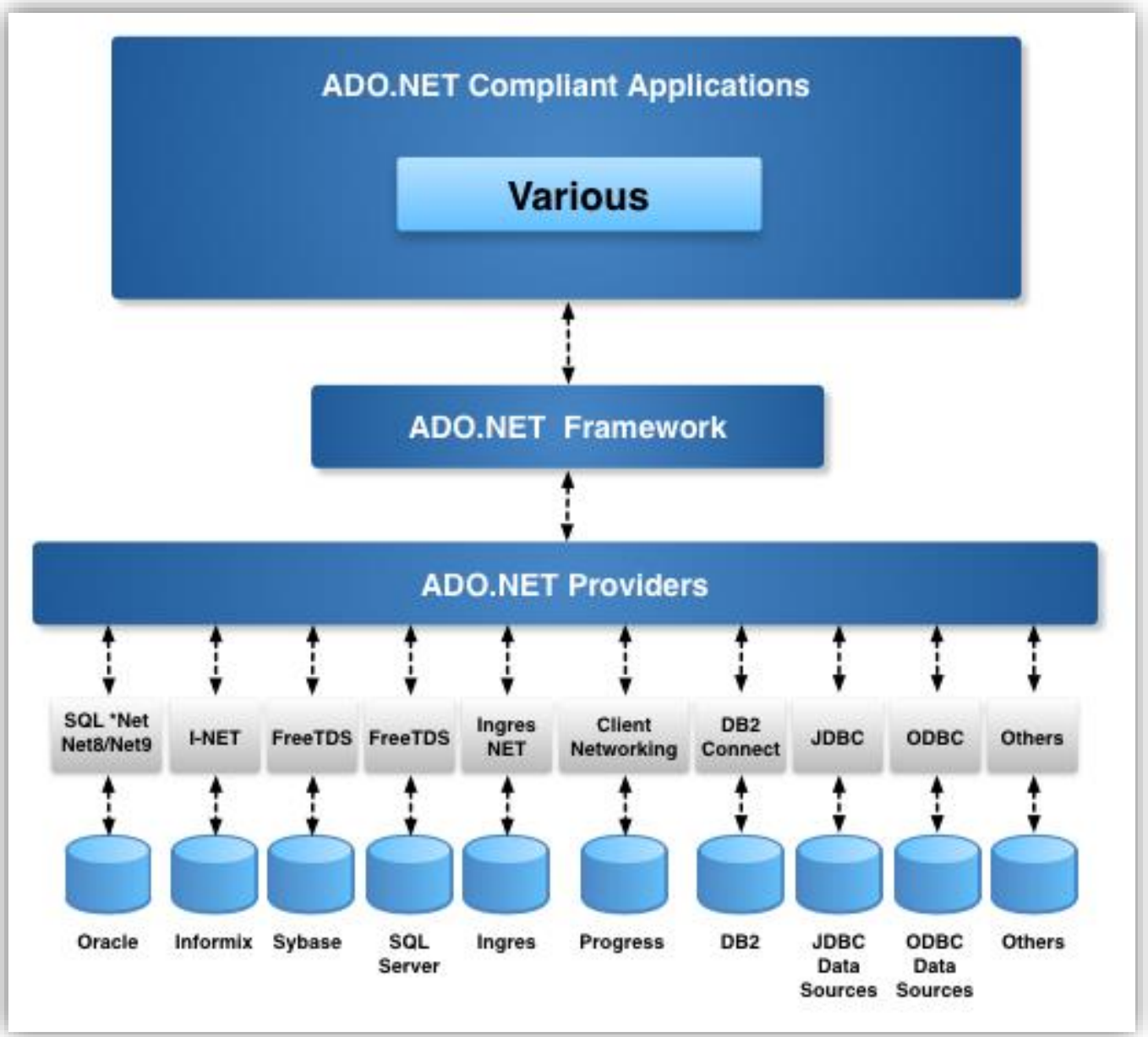
Database Connectivity

- SQL Server and other databases use a client-server architecture
- The DBMS (SQL Server) is the *server*
- Last week, SSMS was the *client*
- This week, C# programs will be the *client*



ADO.Net

- *Consumers* – applications that need access to data
- *Providers* – components that provide data
- *ADO.Net Framework* – defines how consumers talk to providers to get data
- Allows access to lots of databases using a common model



ADO.Net - Interfaces

- IDbConnection
  - Represents an open connection to a data source, and is implemented by .NET Framework data providers that access relational databases.
- IDbCommand
  - Represents an SQL statement that is executed while connected to a data source, and is implemented by .NET Framework data providers that access relational databases.
- IDataReader
  - Provides a means of reading one or more forward-only streams of result sets obtained by executing a command at a data source, and is implemented by .NET Framework data providers that access relational databases.
- SQL Server provider implements these in SqlConnection, SqlCommand, SqlDataReader classes

Data Access

- using
- Connection string
- SqlCommand constructor
- ExecuteReader()
- Read()
- Accessing column data (dictionary-like access)

Let's Code

```
// Things can go awry, so put it in a try
try
{
    using (SqlConnection conn = new SqlConnection("conn str..."))
    {
        conn.Open();              // Open the connection to the DB
        // A command is a query statement
        SqlCommand cmd = new SqlCommand("SELECT * FROM city", conn);
        // Execute the statement and get the results
        SqlDataReader reader = cmd.ExecuteReader();
        // Read row by row
        while (reader.Read())
        {
            // Do something with the row
            string name = Convert.ToString(reader["name"]);
            int population = Convert.ToInt32(reader["population"]);
            Console.WriteLine($"City: {name}, population {population}");
        }
    }  // End of the "using". Closes the connection in Dispose()
}
catch (SqlException ex)
{
    // There was an exception...do something with it here
}
```

Parameterized Queries

- Placeholders for each parameter in the query
- Parameters collection (on Command)

```
string countryCode = "USA";
SqlCommand cmd = new SqlCommand(
        "SELECT * FROM city WHERE countryCode = @countryCode;",
        conn);
cmd.Parameters.AddWithValue("@countryCode", countryCode);
```

Other methods to Execute SQL

- *ExecuteNonQuery*: When no results will be returned
  - Example: UPDATE or DELETE
- *ExecuteScalar*: When exactly one column and one row will be returned
  - That is, a single value
  - Example: INSERT with Select @@Identity

The DAO Pattern

- Data Access Objects
- Only role is to store and retrieve data
- Decouples the application from the persistence layer
  - Could be DB, file system, test objects, etc.
  - Isolates changes needed if the schema changes
- Performs object-to-relational mapping (ORM)
- Use of Interfaces provides additional flexibility