Entity Framework - sprawozdanie

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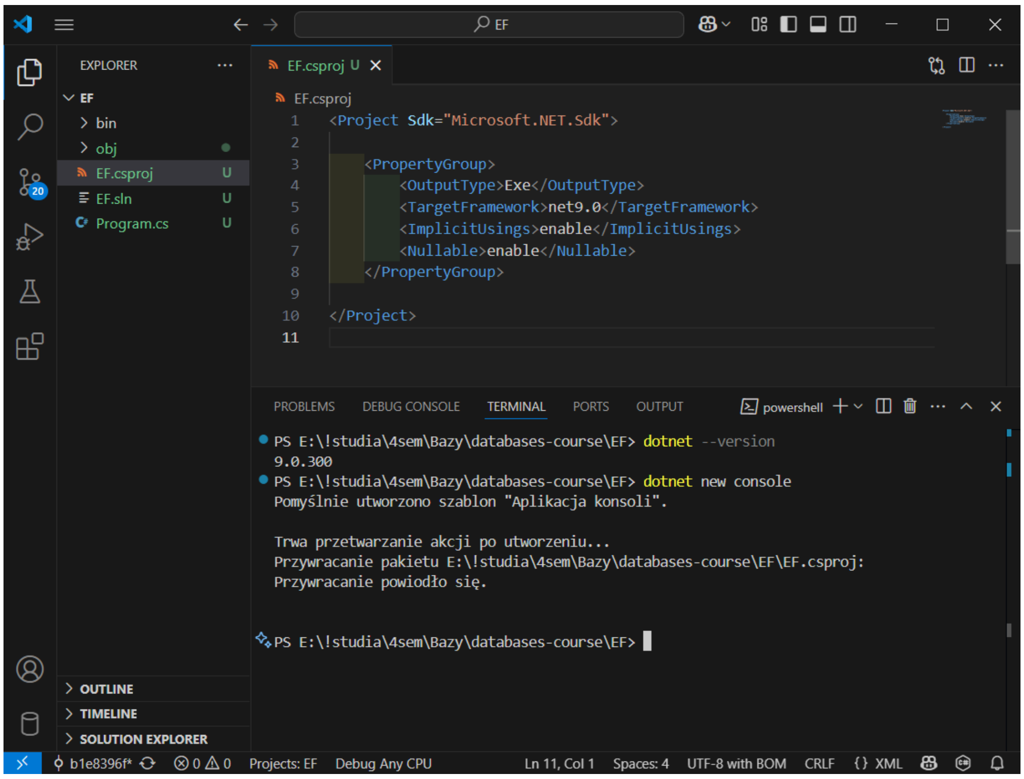
1. Wprowadzenie

1.1. Setup projektu

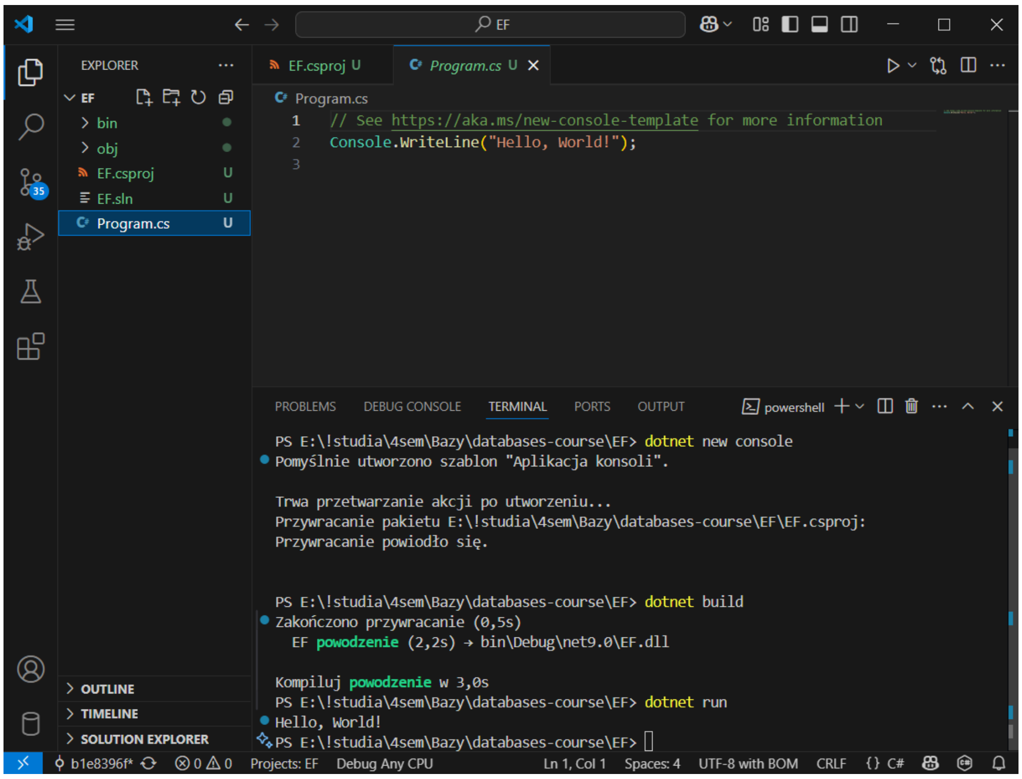
Stworzenie nowej aplikacji konsolowej:



```xml
<Project Sdk="Microsoft.NET.Sdk">

  <PropertyGroup>
    <OutputType>Exe</OutputType>
    <TargetFramework>net9.0</TargetFramework>
    <ImplicitUsings>enable</ImplicitUsings>
    <Nullable>enable</Nullable>
  </PropertyGroup>

</Project>
```

```
PS E:\!studia\4sem\Bazy\databases-course\EF> dotnet --version
9.0.300
PS E:\!studia\4sem\Bazy\databases-course\EF> dotnet new console
Pomyślnie utworzono szablon "Aplikacja konsoli".

Trwa przetwarzanie akcji po utworzeniu...
Przywracanie pakietu E:\!studia\4sem\Bazy\databases-course\EF\EF.csproj:
Przywracanie powiodło się.


PS E:\!studia\4sem\Bazy\databases-course\EF>
```

Zbudowanie i uruchomienie przykładowego programu:



```csharp
// See https://aka.ms/new-console-template for more information
Console.WriteLine("Hello, World!");
```

```
PS E:\!studia\4sem\Bazy\databases-course\EF> dotnet new console
Pomyślnie utworzono szablon "Aplikacja konsoli".

Trwa przetwarzanie akcji po utworzeniu...
Przywracanie pakietu E:\!studia\4sem\Bazy\databases-course\EF\EF.csproj:
Przywracanie powiodło się.


PS E:\!studia\4sem\Bazy\databases-course\EF> dotnet build
Zakończono przywracanie (0,5s)
  EF powodzenie (2,2s) → bin\Debug\net9.0\EF.dll

Kompiluj powodzenie w 3,0s
PS E:\!studia\4sem\Bazy\databases-course\EF> dotnet run
Hello, World!
PS E:\!studia\4sem\Bazy\databases-course\EF>
```

1.2. Dodanie klas i budowanie projektu

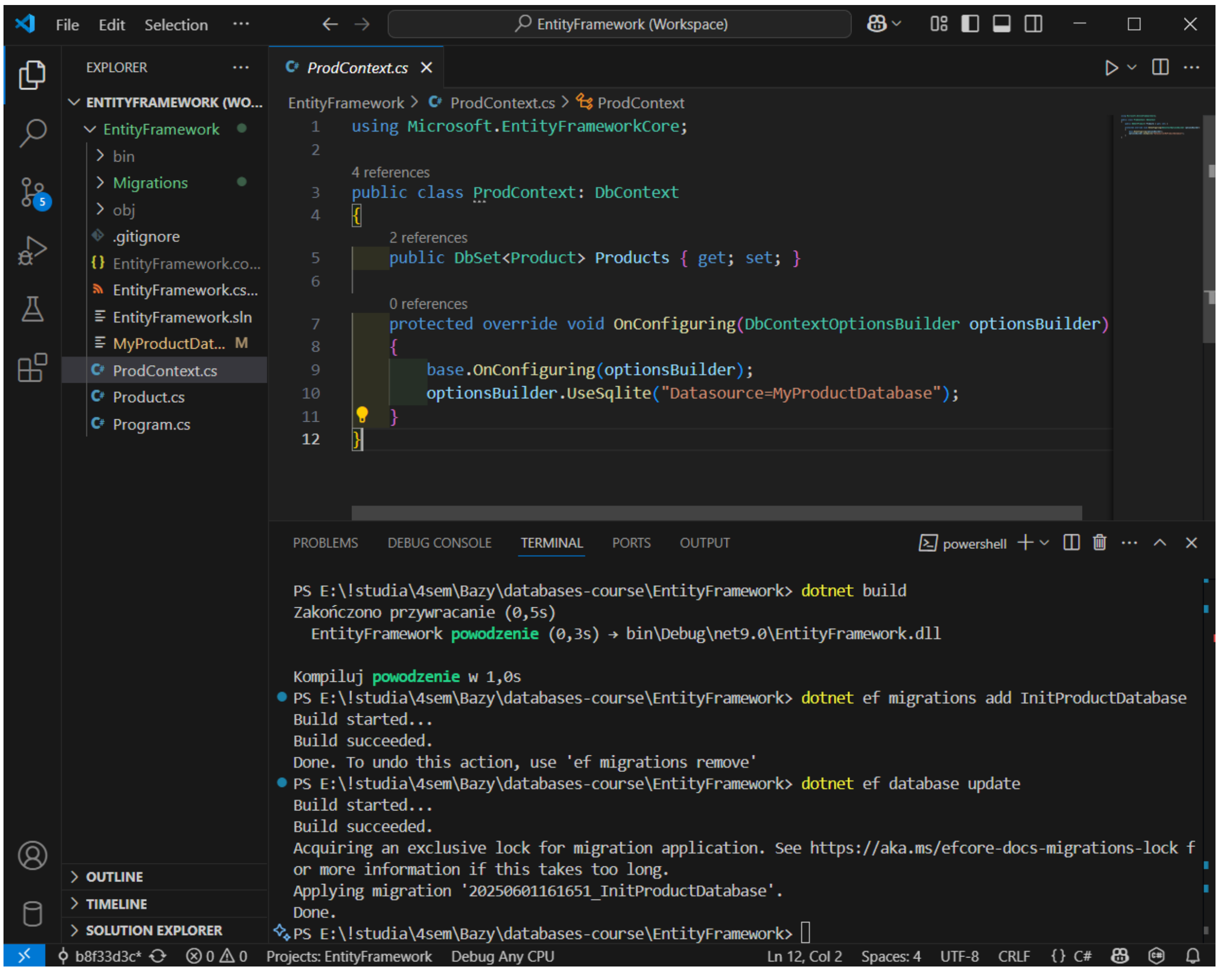
Product.cs:

```
public class Product
{
    public int ProductID { get; set; }
    public String? ProductName { get; set; }
    public int UnitsInStock { get; set; }
}
```

ProdContext.cs:

```
using Microsoft.EntityFrameworkCore;

public class ProdContext: DbContext
{
    public DbSet<Product> Products { get; set; }

    protected override void OnConfiguring(DbContextOptionsBuilder optionsBuilder)
    {
        base.OnConfiguring(optionsBuilder);
        optionsBuilder.UseSqlite("Datasource=MyProductDatabase");
    }
}
```

Konfigurację środowiska (instalację wymaganych paczek) wykonaliśmy przed rozpoczęciem pisania sprawozdania, więc poniżej prezentujemy proces budowania projektu, utworzenia kodu migracji i utworzenia bazy danych z właściwą konfiguracją:



```
using Microsoft.EntityFrameworkCore;

4 references
public class ProdContext: DbContext
{
    2 references
    public DbSet<Product> Products { get; set; }

    0 references
    protected override void OnConfiguring(DbContextOptionsBuilder optionsBuilder)
    {
        base.OnConfiguring(optionsBuilder);
        optionsBuilder.UseSqlite("Datasource=MyProductDatabase");
    }
}
```

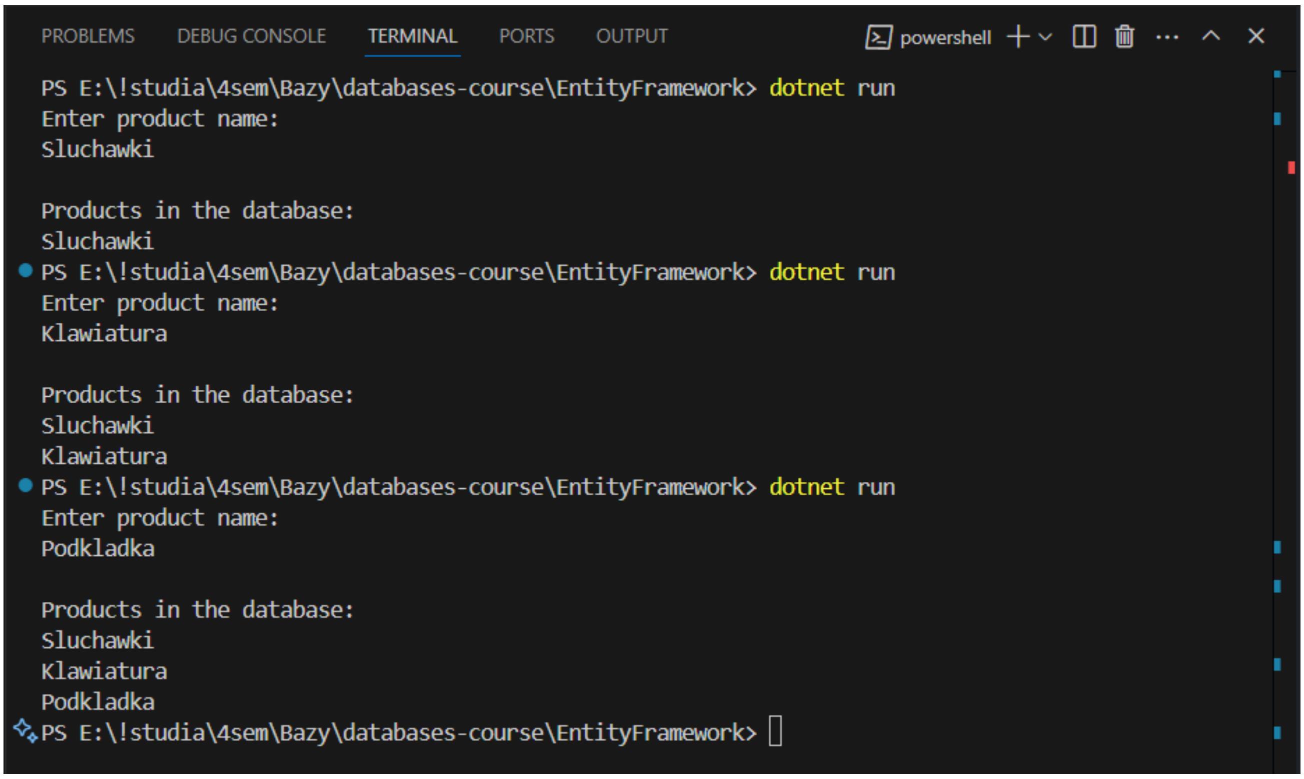
```
PS E:\!studia\4sem\Bazy\databases-course\EntityFramework> dotnet build
Zakończono przywracanie (0,5s)
  EntityFramework powodzenie (0,3s) → bin\Debug\net9.0\EntityFramework.dll

Kompiluj powodzenie w 1,0s
PS E:\!studia\4sem\Bazy\databases-course\EntityFramework> dotnet ef migrations add InitProductDatabase
Build started...
Build succeeded.
Done. To undo this action, use 'ef migrations remove'
PS E:\!studia\4sem\Bazy\databases-course\EntityFramework> dotnet ef database update
Build started...
Build succeeded.
Acquiring an exclusive lock for migration application. See https://aka.ms/efcore-docs-migrations-lock f
or more information if this takes too long.
Applying migration '20250601161651_InitProductDatabase'.
Done.
PS E:\!studia\4sem\Bazy\databases-course\EntityFramework> 
```

1.3. Dodawanie produktu do bazy oraz wyświetlanie danych

Program.cs:

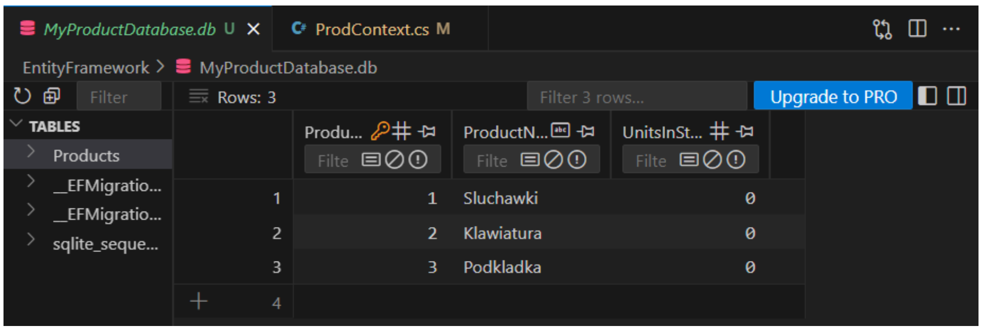
```
using System;
using System.Linq;
ProdContext prodContext = new ProdContext();
Console.WriteLine("Enter product name:");
String? prodName = Console.ReadLine();
Product product = new Product {ProductName = prodName};
prodContext.Products.Add(product);
prodContext.SaveChanges();

var query = from prod in prodContext.Products
            select prod.ProductName;

Console.WriteLine("\nProducts in the database:");

foreach (var pName in query)
{
    Console.WriteLine(pName);
}
```

Wykonanie:



```
PS E:\!studia\4sem\Bazy\databases-course\EntityFramework> dotnet run
Enter product name:
Sluchawki

Products in the database:
Sluchawki
PS E:\!studia\4sem\Bazy\databases-course\EntityFramework> dotnet run
Enter product name:
Klawiatura

Products in the database:
Sluchawki
Klawiatura
PS E:\!studia\4sem\Bazy\databases-course\EntityFramework> dotnet run
Enter product name:
Podkladka

Products in the database:
Sluchawki
Klawiatura
Podkladka
PS E:\!studia\4sem\Bazy\databases-course\EntityFramework>
```

Zawartość bazy danych:



	Produ...	ProductN...	UnitsInSt...
1	1	Sluchawki	0
2	2	Klawiatura	0
3	3	Podkladka	0
4			

2. Zadania

2.1. Wprowadzenie pojęcia dostawcy

Supplier.cs:

```
public class Supplier{
    public int SupplierID { get; set; }
    public string? CompanyName { get; set; }
    public string? Street { get; set; }
    public string? City { get; set; }
    public override string? ToString(){
        return CompanyName;
    }
}
```

Product.cs:

```
public class Product
{
    public int ProductID { get; set; }
    public string? ProductName { get; set; }
    public int UnitsInStock { get; set; }
    public Supplier? Supplier { get; set; } = null;
    public override string ToString(){
        if (ProductName == null)
        {
            return "No product name";
        }
        if (Supplier != null && Supplier.CompanyName != null)
        {
            return $"{ProductName} - {UnitsInStock}pcs, Supplier: {Supplier.CompanyName}";
        }
        return $"{ProductName} - {UnitsInStock}pcs";
    }
}
```

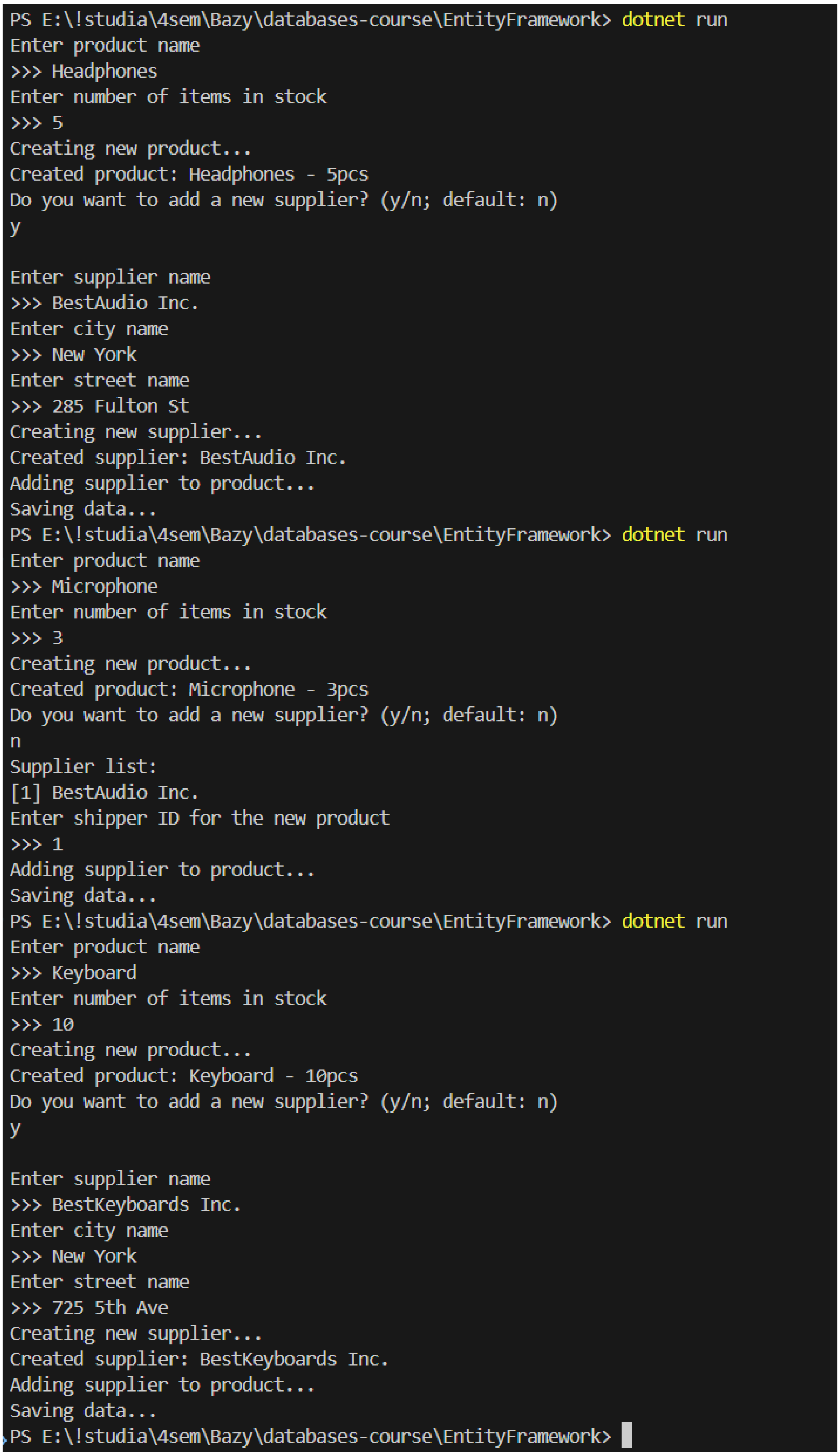
ProdContext.cs:

```
using Microsoft.EntityFrameworkCore;

public class ProdContext: DbContext
{
    public DbSet<Product> Products { get; set; }
    public DbSet<Supplier> Suppliers { get; set; }
    protected override void OnConfiguring(DbContextOptionsBuilder optionsBuilder)
    {
        base.OnConfiguring(optionsBuilder);
        optionsBuilder.UseSqlite("Datasource=MyProductDatabase.db");
    }
}
```

Program.cs:

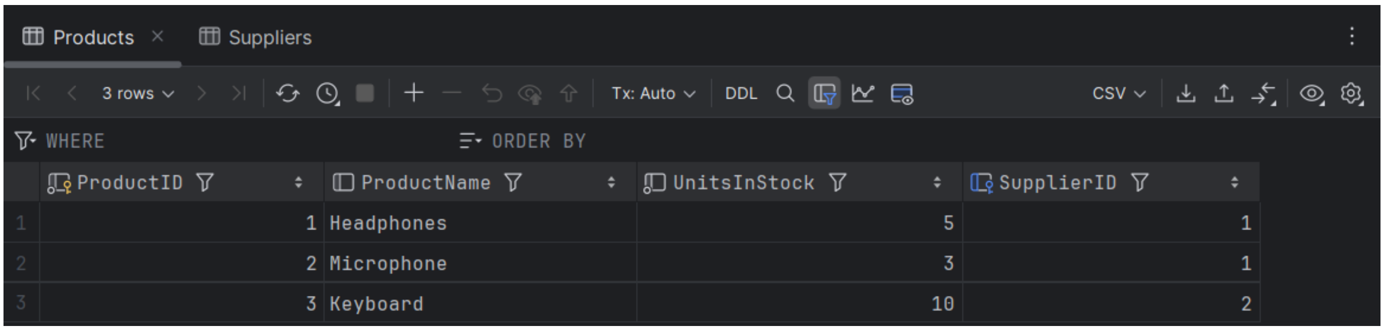
```
class Program
{
    static void Main()
    {
        var dbContext = new ProdContext();
        var newProduct = GetProductDetails();

        bool addedNewSupplier = SupplierSelection(dbContext, out Supplier? selectedSupplier);

        Console.WriteLine("Adding supplier to product...");
        newProduct.Supplier = selectedSupplier;

        Console.WriteLine("Saving data...");
        SaveToDatabase(dbContext, newProduct, selectedSupplier, addedNewSupplier);
    }

    private static bool SupplierSelection(ProdContext db, out Supplier? selectedSupplier)
    {
        bool createdNew = false;

        while (true)
        {
            Console.WriteLine("Do you want to add a new supplier? (y/n; default: n)");
            var response = Console.ReadLine()?.ToLower() ?? "";

            if (response == "y")
            {
                selectedSupplier = GetSupplierDetails();
                createdNew = true;
                break;
            }
            else if (response == "n" || response == "")
            {
                ShowSuppliers(db);
                selectedSupplier = SelectExistingSupplier(db);
                break;
            }
        }

        return createdNew;
    }

    private static void SaveToDatabase(
        ProdContext db,
        Product product,
        Supplier? supplier,
        bool isNewSupplier)
    {
        if (isNewSupplier && supplier != null)
        {
            db.Suppliers.Add(supplier);
        }
        db.Products.Add(product);
        db.SaveChanges();
    }

    private static Product GetProductDetails()
    {
        Console.Write("Enter product name\n>>> ");
        string name = Console.ReadLine() ?? "";

        int stock;
        string input;
        do
        {
            Console.Write("Enter number of items in stock\n>>> ");
            input = Console.ReadLine() ?? "";
        } while (string.IsNullOrEmpty(input) || !int.TryParse(input, out stock));

        Console.WriteLine("Creating new product...");
        var newProduct = new Product
        {
            ProductName = name,
            UnitsInStock = stock
        };

        Console.WriteLine($"Created product: {newProduct}");
        return newProduct;
    }

    private static Supplier GetSupplierDetails()
    {
        Console.Write("\nEnter supplier name\n>>> ");
        string name = Console.ReadLine() ?? "";

        Console.Write("Enter city name\n>>> ");
        string city = Console.ReadLine() ?? "";

        Console.Write("Enter street name\n>>> ");
        string street = Console.ReadLine() ?? "";

        Console.WriteLine("Creating new supplier...");
        var newSupplier = new Supplier
        {
            CompanyName = name,
            City = city,
            Street = street
        };

        Console.WriteLine($"Created supplier: {newSupplier}");
        return newSupplier;
    }

    private static Supplier? SelectExistingSupplier(ProdContext db)
    {
        int supplierId = 0;
        string input;

        do
        {
            Console.Write("Enter shipper ID for the new product\n>>> ");
            input = Console.ReadLine() ?? "";
        } while (string.IsNullOrEmpty(input) || !int.TryParse(input, out supplierId));

        return db.Suppliers
            .Where(s => s.SupplierID == supplierId)
            .FirstOrDefault();
    }

    private static void ShowSuppliers(ProdContext db)
    {
        Console.WriteLine("Supplier list:");
        foreach (var supplier in db.Suppliers)
        {
            Console.WriteLine($"[{supplier.SupplierID}] {supplier}");
        }
    }
}
```

Przykład działania:

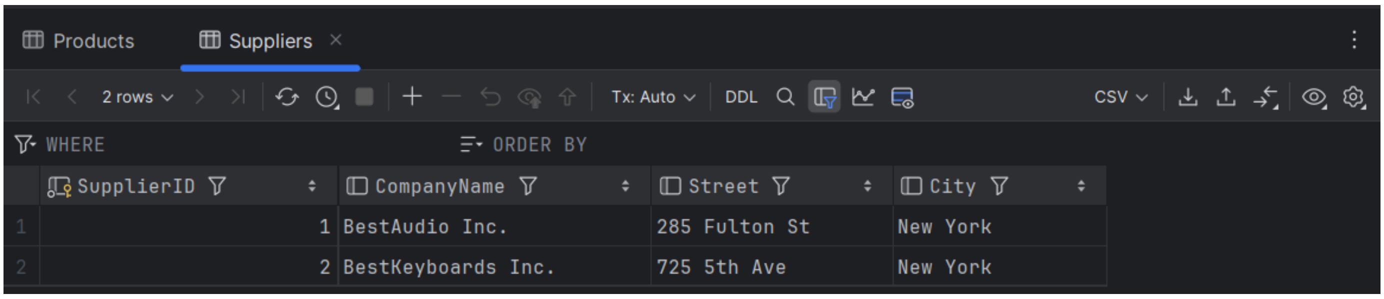


```
PS E:\!studia\4sem\Bazy\databases-course\EntityFramework> dotnet run
Enter product name
>>> Headphones
Enter number of items in stock
>>> 5
Creating new product...
Created product: Headphones - 5pcs
Do you want to add a new supplier? (y/n; default: n)
y

Enter supplier name
>>> BestAudio Inc.
Enter city name
>>> New York
Enter street name
>>> 285 Fulton St
Creating new supplier...
Created supplier: BestAudio Inc.
Adding supplier to product...
Saving data...
PS E:\!studia\4sem\Bazy\databases-course\EntityFramework> dotnet run
Enter product name
>>> Microphone
Enter number of items in stock
>>> 3
Creating new product...
Created product: Microphone - 3pcs
Do you want to add a new supplier? (y/n; default: n)
n
Supplier list:
[1] BestAudio Inc.
Enter shipper ID for the new product
>>> 1
Adding supplier to product...
Saving data...
PS E:\!studia\4sem\Bazy\databases-course\EntityFramework> dotnet run
Enter product name
>>> Keyboard
Enter number of items in stock
>>> 10
Creating new product...
Created product: Keyboard - 10pcs
Do you want to add a new supplier? (y/n; default: n)
y

Enter supplier name
>>> BestKeyboards Inc.
Enter city name
>>> New York
Enter street name
>>> 725 5th Ave
Creating new supplier...
Created supplier: BestKeyboards Inc.
Adding supplier to product...
Saving data...
PS E:\!studia\4sem\Bazy\databases-course\EntityFramework>
```

Zawartość tabel:

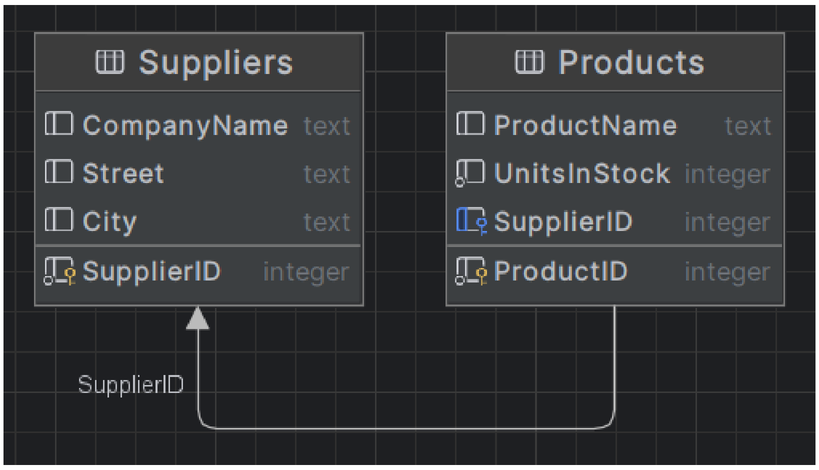


	ProductID	ProductName	UnitsInStock	SupplierID
1	1	Headphones	5	1
2	2	Microphone	3	1
3	3	Keyboard	10	2



	SupplierID	CompanyName	Street	City
1	1	BestAudio Inc.	285 Fulton St	New York
2	2	BestKeyboards Inc.	725 5th Ave	New York

Schemat bazy danych:



2.2. Odwrócenie relacji dostawca-produkt

Supplier.cs:

```
public class Supplier
{
    public int SupplierID { get; set; }
    public string? CompanyName { get; set; }
    public string? Street { get; set; }
    public string? City { get; set; }
    public List<Product> Products { get; set; } = [];
    public override string? ToString(){
        return CompanyName;
    }
}
```

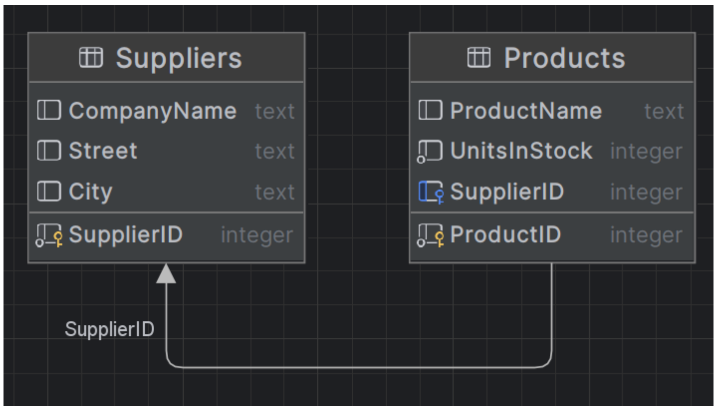
Product.cs:

```
public class Product
{
    public int ProductID { get; set; }
    public string? ProductName { get; set; }
    public int UnitsInStock { get; set; }
    public override string ToString(){
        if (ProductName == null)
        {
            return "No product name";
        }
        return $"{ProductName} - {UnitsInStock}pcs";
    }
}
```

Program.cs:

```
(...)
        Console.WriteLine("Adding product to supplier...");
        selectedSupplier?.Products.Add(newProduct);
        // ^tylko te dwie linijki zostały zmienione względem poprzedniego podpunktu
(...)
```

Schemat bazy danych:



Pomimo odwrócenia relacji w kodzie, w bazie danych jest ona reprezentowana w ten sam sposób, jak w poprzednim podpunkcie. Dzieje się tak dzięki optymalizacji wykonywanej przez Entity Framework przy tworzeniu kodu migracji - w oby przypadkach EF analizuje oba końce relacji i ustala, że to relacja jeden-do-wielu, gdzie Products zawiera klucz obcy do Suppliers.

2.3. Dwustronna relacja dostawca-produkt

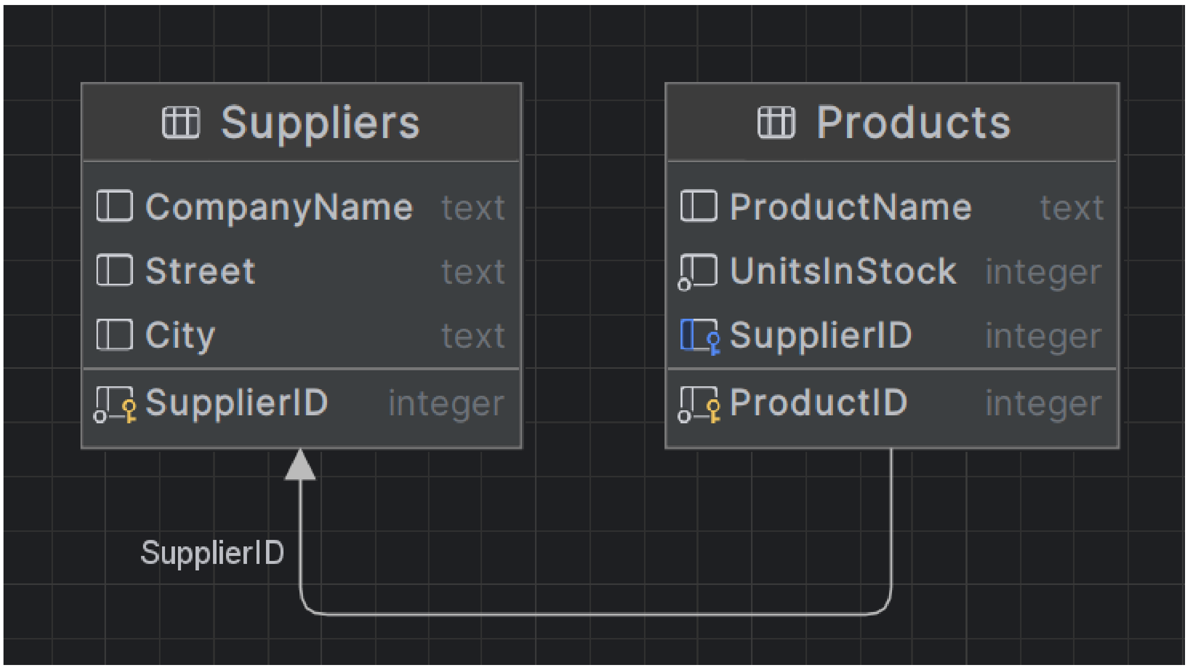
Product.cs:

```
public class Product
{
    public int ProductID { get; set; }
    public string? ProductName { get; set; }
    public int UnitsInStock { get; set; }
    public Supplier? Supplier { get; set; } = null;
    public override string ToString(){
        if (ProductName == null)
        {
            return "No product name";
        }
        if (Supplier != null && Supplier.CompanyName != null)
        {
            return $"{ProductName} - {UnitsInStock}pcs, Supplier: {Supplier.CompanyName}";
        }
        return $"{ProductName} - {UnitsInStock}pcs";
    }
}
```

Program.cs:

```
(...)
        Console.WriteLine("Adding product to supplier...");
        if (selectedSupplier != null)
        {
            selectedSupplier.Products.Add(newProduct);
            newProduct.Supplier = selectedSupplier;
        }
        // ^podobnie, jak w poprzednim przypadku, zmianie uległ tylko ten fragment
(...)
```

Schemat bazy danych:



Również w tym przypadku zmiana w kodzie nie wpływa na faktyczną strukturę tworzonej bazy danych. Można z tego wywnioskować, że Entity Framework daje dużą swobodę w zarządzaniu obiektami w kodzie, przekształcając i optymalizując relacje na poziomie migracji.

2.4. Faktury - relacja wiele-wiele

Invoice.cs:

```
namespace EntityFramework;

public class Invoice
{
    public int InvoiceID { get; set; }
    public string? InvoiceNumber { get; set; }
    public List<InvoiceProduct> Products { get; set; } = [];

    public override string? ToString()
    {
        return $"Invoice {InvoiceNumber}";
    }
}
```

InvoiceProduct.cs:

```
namespace EntityFramework;

public class InvoiceProduct
{
    public int InvoiceID { get; set; }
    public int ProductID { get; set; }
    public Invoice? Invoice { get; set; }

    public Product? Product { get; set; }

    public int Quantity { get; set; }

    public override string? ToString()
    {
        return $"{Product?.ProductName} - {Quantity} pcs";
    }
}
```

Product.cs:

```
namespace EntityFramework;
public class Product
{
    public int ProductID { get; set; }
    public string? ProductName { get; set; }
    public int UnitsInStock { get; set; }
    public Supplier? Supplier { get; set; } = null;
    public List<InvoiceProduct> Invoices { get; set; } = [];
    public override string ToString(){
        if (ProductName == null)
        {
            return "No product name";
        }
        if (Supplier != null && Supplier.CompanyName != null)
        {
            return $"{ProductName} - {UnitsInStock}pcs, Supplier: {Supplier.CompanyName}";
        }
        return $"{ProductName} - {UnitsInStock}pcs";
    }
}
```

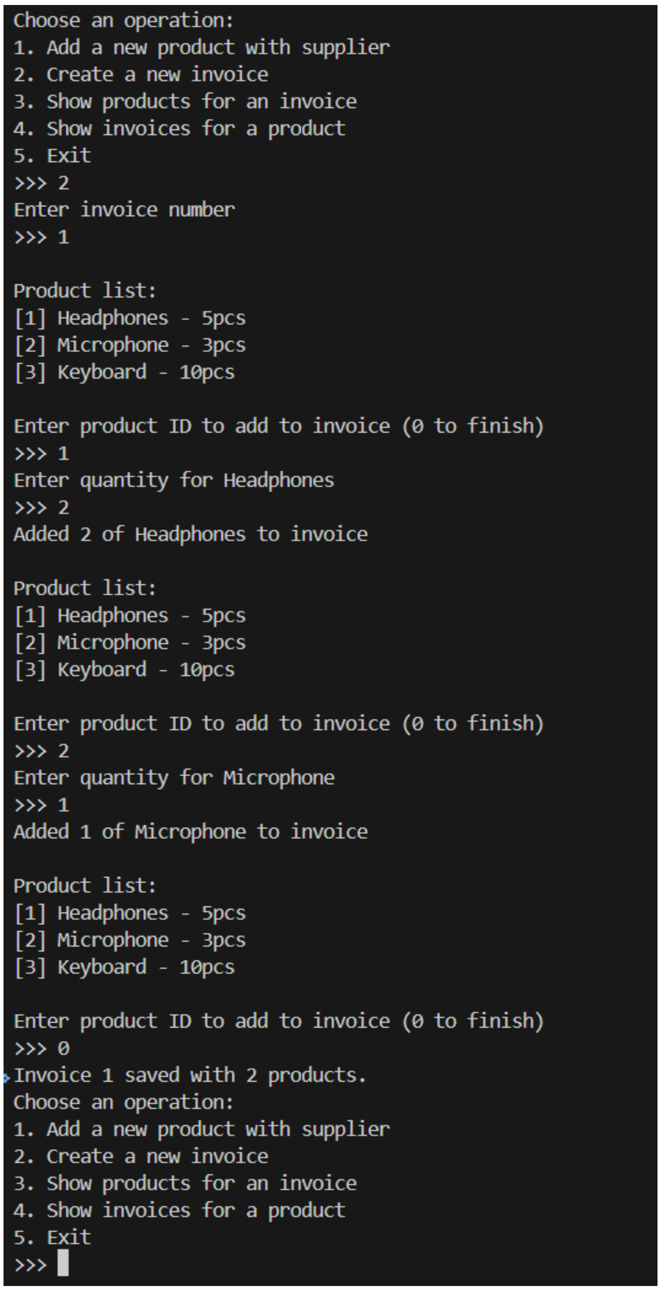
ProdContext.cs:

```
using Microsoft.EntityFrameworkCore;
using EntityFramework;

public class ProdContext: DbContext
{
    public DbSet<Product> Products { get; set; }
    public DbSet<Supplier> Suppliers { get; set; }
    public DbSet<Invoice> Invoices { get; set; }
    public DbSet<InvoiceProduct> InvoiceProducts { get; set; }

    protected override void OnConfiguring(DbContextOptionsBuilder optionsBuilder)
    {
        base.OnConfiguring(optionsBuilder);
        optionsBuilder.UseSqlite("Datasource=MyProductDatabase.db");
    }
    protected override void OnModelCreating(ModelBuilder modelBuilder)
    {
        modelBuilder.Entity<InvoiceProduct>()
            .HasKey(ip => new { ip.InvoiceID, ip.ProductID });
    }
}
```

Program.cs:

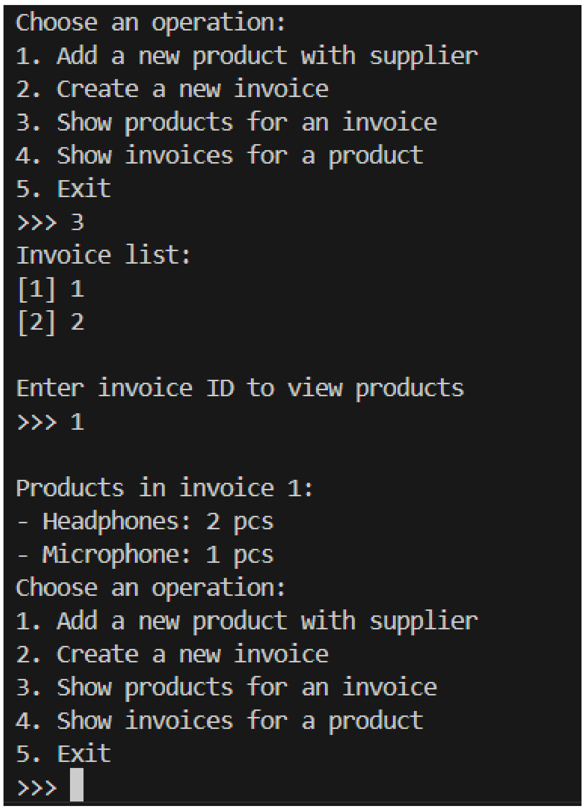
```
using Microsoft.EntityFrameworkCore;
using EntityFramework;

class Program
{
    static void Main()
    {
        var dbContext = new ProdContext();
        bool exit = false;

        while (!exit)
        {
            Console.WriteLine("Choose an operation:");
            Console.WriteLine("1. Add a new product with supplier");
            Console.WriteLine("2. Create a new invoice");
            Console.WriteLine("3. Show products for an invoice");
            Console.WriteLine("4. Show invoices for a product");
            Console.WriteLine("5. Exit");
            Console.Write(">>> ");

            string? choice = Console.ReadLine();

            switch(choice)
            {
                case "1":
                    AddProductWithSupplier(dbContext);
                    break;
                case "2":
                    CreateInvoice(dbContext);
                    break;
                case "3":
                    ShowProductsForInvoice(dbContext);
                    break;
                case "4":
                    ShowInvoicesForProduct(dbContext);
                    break;
                case "5":
                    exit = true;
                    break;
                default:
                    Console.WriteLine("Unknown option");
                    break;
            }
        }
    }

    static void AddProductWithSupplier(ProdContext dbContext)
    {
        var newProduct = GetProductDetails();

        bool addedNewSupplier = SupplierSelection(dbContext, out Supplier? selectedSupplier);

        Console.WriteLine("Adding product to supplier...");
        if (selectedSupplier != null)
        {
            selectedSupplier.Products.Add(newProduct);
            newProduct.Supplier = selectedSupplier;
        }

        Console.WriteLine("Saving data...");
        SaveToDatabase(dbContext, newProduct, selectedSupplier, addedNewSupplier);
    }

    (...)

    private static void CreateInvoice(ProdContext db)
    {
        Console.Write("Enter invoice number\n>>> ");
        string invoiceNumber = Console.ReadLine() ?? "";

        var invoice = new Invoice { InvoiceNumber = invoiceNumber };
        db.Invoices.Add(invoice);
        db.SaveChanges();

        bool addMoreProducts = true;
        while (addMoreProducts)
        {
            Console.WriteLine("\nProduct list:");
            foreach (var product in db.Products)
            {
                Console.WriteLine($"[{product.ProductID}] {product}");
            }

            Console.Write("\nEnter product ID to add to invoice (0 to finish)\n>>> ");
            if (int.TryParse(Console.ReadLine(), out int productId) && productId > 0)
            {
                var product = db.Products.Find(productId);
                if (product != null)
                {
                    Console.Write($"Enter quantity for {product.ProductName}\n>>> ");
                    if (int.TryParse(Console.ReadLine(), out int quantity) && quantity > 0)
                    {
                        var invoiceProduct = new InvoiceProduct
                        {
                            Invoice = invoice,
                            Product = product,
                            Quantity = quantity
                        };

                        invoice.Products.Add(invoiceProduct);
                        product.Invoices.Add(invoiceProduct);

                        db.InvoiceProducts.Add(invoiceProduct);
                        Console.WriteLine($"Added {quantity} of {product.ProductName} to invoice");
                    }
                }
                else
                {
                    Console.WriteLine("Product not found!");
                }
            }
            else
            {
                addMoreProducts = false;
            }
        }

        db.SaveChanges();
        Console.WriteLine($"Invoice {invoice.InvoiceNumber} saved \
        with {invoice.Products.Count} products.");
    }

    private static void ShowProductsForInvoice(ProdContext db)
    {
        Console.WriteLine("Invoice list:");
        foreach (var invoice in db.Invoices)
        {
            Console.WriteLine($"[{invoice.InvoiceID}] {invoice.InvoiceNumber}");
        }
        Console.Write("\nEnter invoice ID to view products\n>>> ");
        if (int.TryParse(Console.ReadLine(), out int invoiceId))
        {
            var invoice = db.Invoices
                .Include(i => i.Products)
                .ThenInclude(ip => ip.Product)
                .FirstOrDefault(i => i.InvoiceID == invoiceId);

            if (invoice != null)
            {
                Console.WriteLine($"\nProducts in invoice {invoice.InvoiceNumber}:");
                foreach (var item in invoice.Products)
                {
                    Console.WriteLine($"- {item.Product?.ProductName}: {item.Quantity} pcs");
                }
            }
            else
            {
                Console.WriteLine("Invoice not found!");
            }
        }
    }

    private static void ShowInvoicesForProduct(ProdContext db)
    {
        Console.WriteLine("Product list:");
        foreach (var product in db.Products)
        {
            Console.WriteLine($"[{product.ProductID}] {product.ProductName}");
        }

        Console.Write("\nEnter product ID to view invoices\n>>> ");
        if (int.TryParse(Console.ReadLine(), out int productId))
        {
            var product = db.Products
                .Include(p => p.Invoices)
                .ThenInclude(ip => ip.Invoice)
                .FirstOrDefault(p => p.ProductID == productId);

            if (product != null)
            {
                Console.WriteLine($"\nInvoices containing {product.ProductName}:");
                foreach (var item in product.Invoices)
                {
                    Console.WriteLine($"- Invoice {item.Invoice?.InvoiceNumber}: {item.Quantity} pcs");
                }
            }
            else
            {
                Console.WriteLine("Product not found!");
            }
        }
    }
}
```

Dodanie faktury:

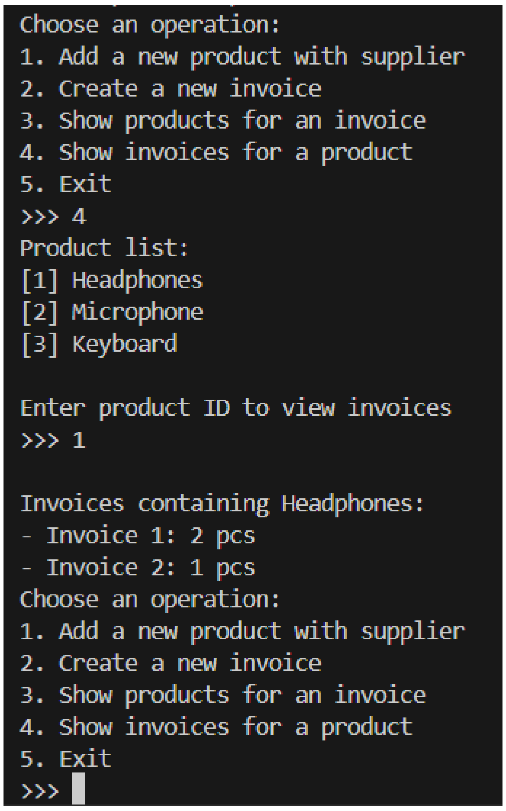


```
Choose an operation:
1. Add a new product with supplier
2. Create a new invoice
3. Show products for an invoice
4. Show invoices for a product
5. Exit
>>> 2
Enter invoice number
>>> 1

Product list:
[1] Headphones - 5pcs
[2] Microphone - 3pcs
[3] Keyboard - 10pcs

Enter product ID to add to invoice (0 to finish)
>>> 1
Enter quantity for Headphones
>>> 2
Added 2 of Headphones to invoice

Product list:
[1] Headphones - 5pcs
[2] Microphone - 3pcs
[3] Keyboard - 10pcs

Enter product ID to add to invoice (0 to finish)
>>> 2
Enter quantity for Microphone
>>> 1
Added 1 of Microphone to invoice

Product list:
[1] Headphones - 5pcs
[2] Microphone - 3pcs
[3] Keyboard - 10pcs

Enter product ID to add to invoice (0 to finish)
>>> 0
Invoice 1 saved with 2 products.
Choose an operation:
1. Add a new product with supplier
2. Create a new invoice
3. Show products for an invoice
4. Show invoices for a product
5. Exit
>>>
```

Wyświetlenie produktów oraz faktur:

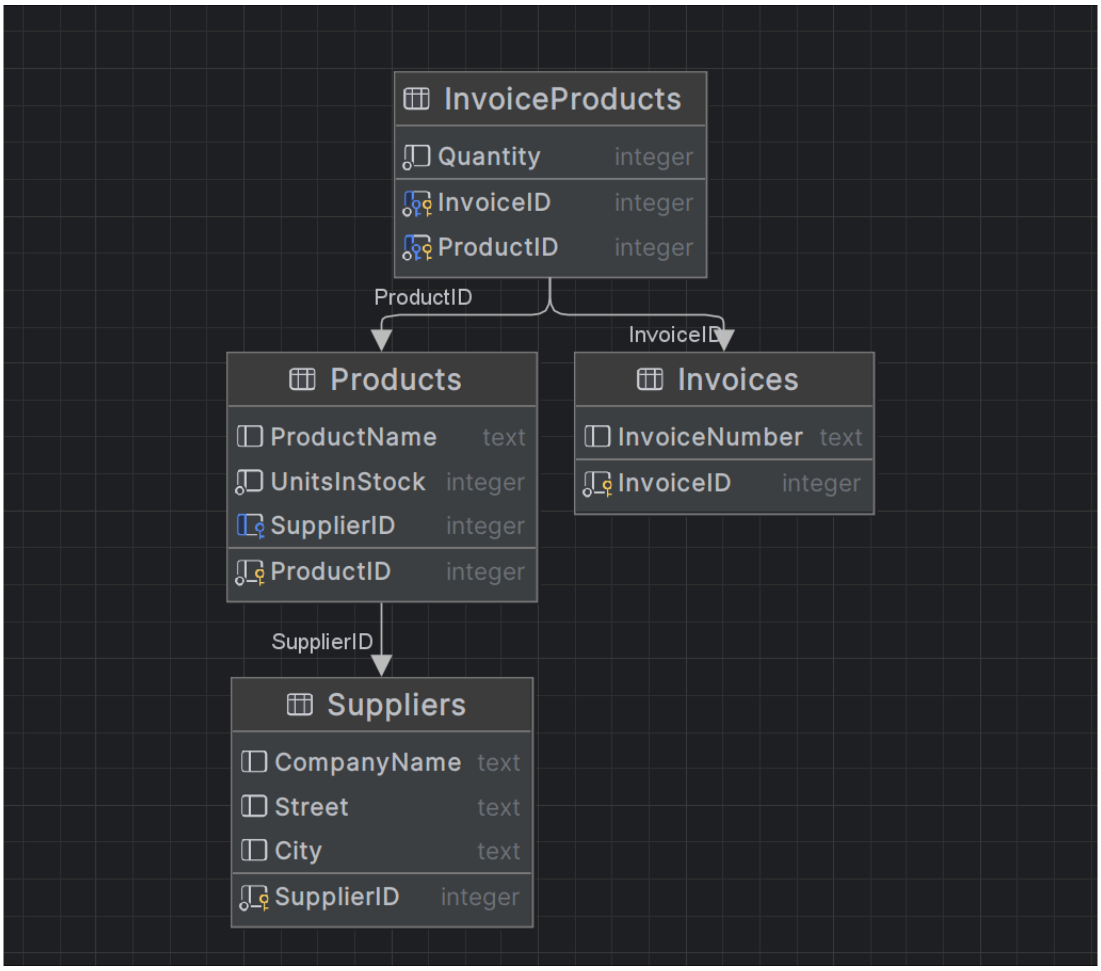


```
Choose an operation:
1. Add a new product with supplier
2. Create a new invoice
3. Show products for an invoice
4. Show invoices for a product
5. Exit
>>> 3
Invoice list:
[1] 1
[2] 2

Enter invoice ID to view products
>>> 1

Products in invoice 1:
- Headphones: 2 pcs
- Microphone: 1 pcs
Choose an operation:
1. Add a new product with supplier
2. Create a new invoice
3. Show products for an invoice
4. Show invoices for a product
5. Exit
>>>
```



```
Choose an operation:
1. Add a new product with supplier
2. Create a new invoice
3. Show products for an invoice
4. Show invoices for a product
5. Exit
>>> 4
Product list:
[1] Headphones
[2] Microphone
[3] Keyboard

Enter product ID to view invoices
>>> 1

Invoices containing Headphones:
- Invoice 1: 2 pcs
- Invoice 2: 1 pcs
Choose an operation:
1. Add a new product with supplier
2. Create a new invoice
3. Show products for an invoice
4. Show invoices for a product
5. Exit
>>>
```

Schemat bazy danych:



InvoiceProducts - tabela łącznikowa między fakturami a przedmiotami.

2.5. Hierarchia dziedziczenia - Table-Per-Hierarchy

Company.cs:

```
namespace EntityFramework;

public class Company
{
    public int CompanyID { get; set; }
    public string? CompanyName { get; set; }
    public string? Street { get; set; }
    public string? City { get; set; }
    public string? ZipCode { get; set; }

    public override string? ToString()
    {
        return CompanyName;
    }
}
```

Customer.cs:

```
namespace EntityFramework;

public class Customer : Company
{
    public decimal Discount { get; set; } = 0;
}
```

Supplier.cs:

```
namespace EntityFramework;

public class Supplier : Company
{
    public string? BankAccountNumber { get; set; }
    public List<Product> Products { get; set; } = [];
}
```

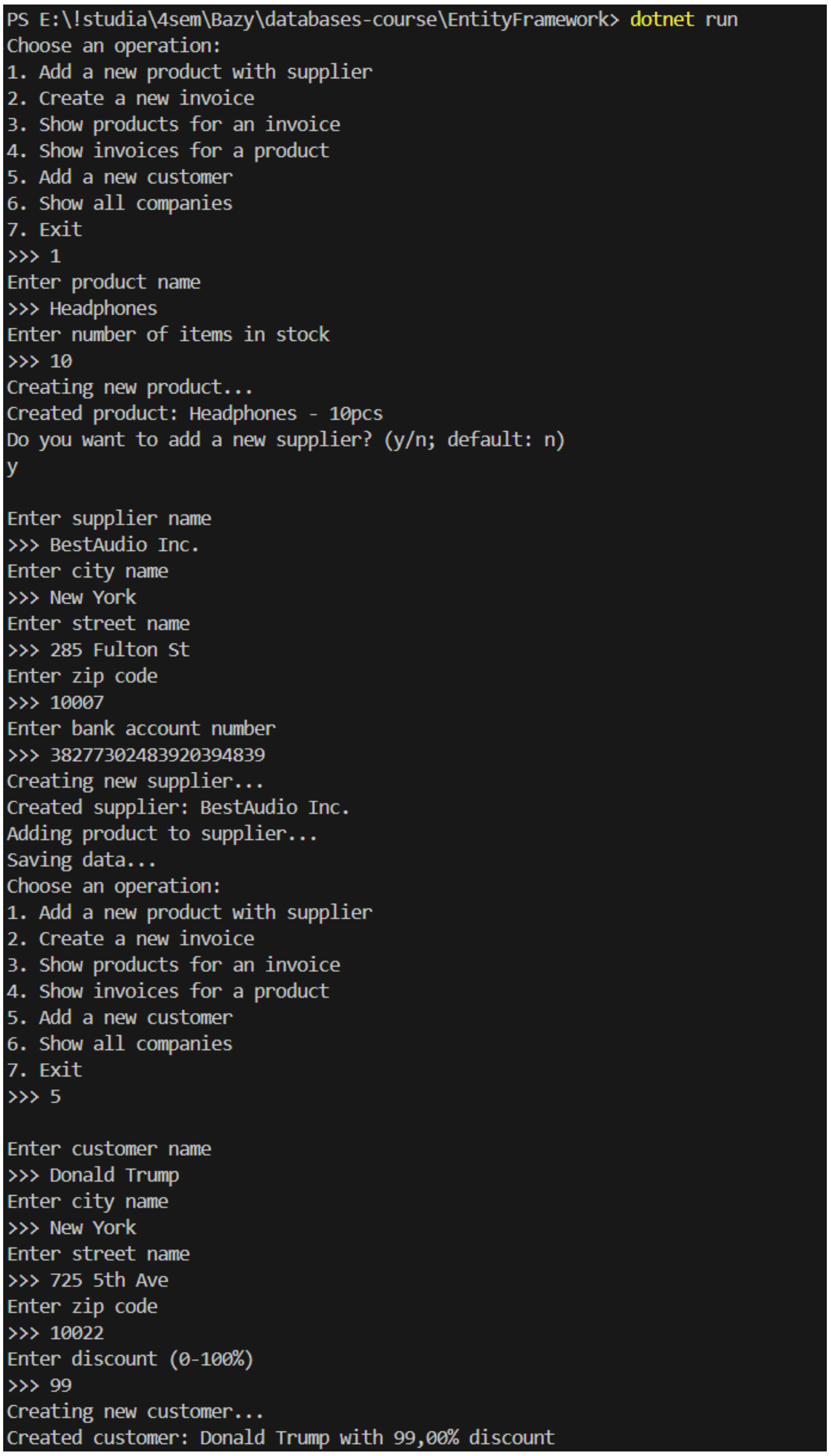
ProdContext.cs:

```
using Microsoft.EntityFrameworkCore;
using EntityFramework;

public class ProdContext: DbContext
{
    public DbSet<Product> Products { get; set; }
    public DbSet<Company> Companies { get; set; }
    public DbSet<Supplier> Suppliers { get; set; }
    public DbSet<Customer> Customers { get; set; }
    public DbSet<Invoice> Invoices { get; set; }
    public DbSet<InvoiceProduct> InvoiceProducts { get; set; }

    protected override void OnConfiguring(DbContextOptionsBuilder optionsBuilder)
    {
        base.OnConfiguring(optionsBuilder);
        optionsBuilder.UseSqlite("Datasource=MyProductDatabase.db");
    }
    protected override void OnModelCreating(ModelBuilder modelBuilder)
    {
        modelBuilder.Entity<InvoiceProduct>()
            .HasKey(ip => new { ip.InvoiceID, ip.ProductID });

        modelBuilder.Entity<Company>()
            .HasDiscriminator<string>("CompanyType")
            .HasValue<Company>("Company")
            .HasValue<Supplier>("Supplier")
            .HasValue<Customer>("Customer");
    }
}
```

Program.cs:

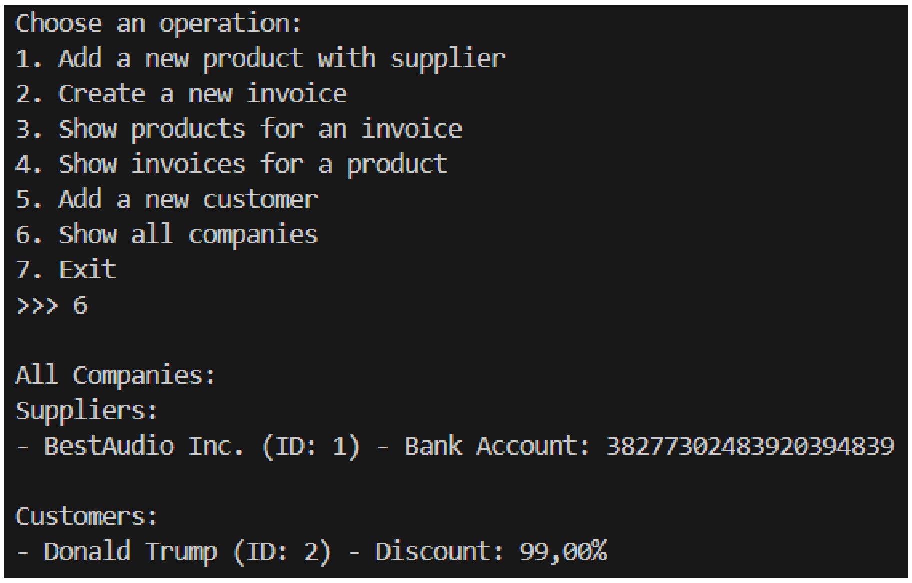
```
(...)
    private static void AddCustomer(ProdContext db)
    {
        Console.Write("\nEnter customer name\n>>> ");
        string name = Console.ReadLine() ?? "";
        Console.Write("Enter city name\n>>> ");
        string city = Console.ReadLine() ?? "";
        Console.Write("Enter street name\n>>> ");
        string street = Console.ReadLine() ?? "";
        Console.Write("Enter zip code\n>>> ");
        string zipCode = Console.ReadLine() ?? "";
        Console.Write("Enter discount (0-100%)\n>>> ");
        if (decimal.TryParse(Console.ReadLine(), out decimal discount))
        {
            Console.WriteLine("Creating new customer...");
            var newCustomer = new Customer
            {
                CompanyName = name,
                City = city,
                Street = street,
                ZipCode = zipCode,
                Discount = discount / 100
            };
            Console.WriteLine($"Created customer: {newCustomer.CompanyName} \
            with {newCustomer.Discount:P} discount");
            db.Customers.Add(newCustomer);
            db.SaveChanges();
        }
    }

    private static void ShowAllCompanies(ProdContext db)
    {
        Console.WriteLine("\nAll Companies:");
        Console.WriteLine("Suppliers:");
        foreach (var supplier in db.Suppliers)
        {
            Console.WriteLine($"- {supplier.CompanyName} (ID: {supplier.CompanyID}) - \
            Bank Account: {supplier.BankAccountNumber ?? "Not provided"}");
        }
        Console.WriteLine("\nCustomers:");
        foreach (var customer in db.Customers)
        {
            Console.WriteLine($"- {customer.CompanyName} (ID: {customer.CompanyID}) - \
            Discount: {customer.Discount:P}");
        }
    }
}
```

Dodawanie dostawcy i klienta:



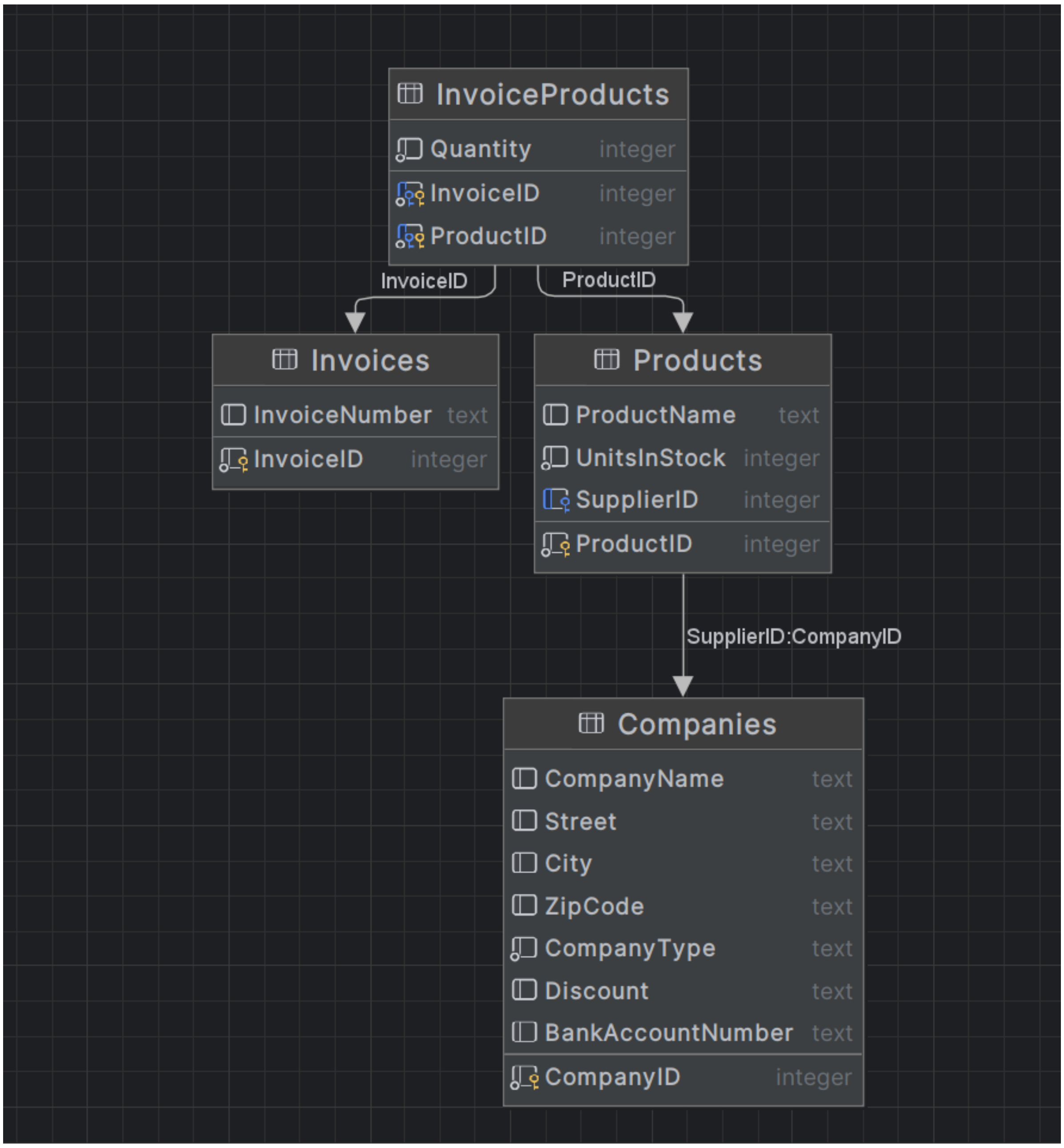
```
PS E:\!studia\4sem\Bazy\databases-course\EntityFramework> dotnet run
Choose an operation:
1. Add a new product with supplier
2. Create a new invoice
3. Show products for an invoice
4. Show invoices for a product
5. Add a new customer
6. Show all companies
7. Exit
>>> 1
Enter product name
>>> Headphones
Enter number of items in stock
>>> 10
Creating new product...
Created product: Headphones - 10pcs
Do you want to add a new supplier? (y/n; default: n)
y

Enter supplier name
>>> BestAudio Inc.
Enter city name
>>> New York
Enter street name
>>> 285 Fulton St
Enter zip code
>>> 10007
Enter bank account number
>>> 38277302483920394839
Creating new supplier...
Created supplier: BestAudio Inc.
Adding product to supplier...
Saving data...
Choose an operation:
1. Add a new product with supplier
2. Create a new invoice
3. Show products for an invoice
4. Show invoices for a product
5. Add a new customer
6. Show all companies
7. Exit
>>> 5

Enter customer name
>>> Donald Trump
Enter city name
>>> New York
Enter street name
>>> 725 5th Ave
Enter zip code
>>> 10022
Enter discount (0-100%)
>>> 99
Creating new customer...
Created customer: Donald Trump with 99,00% discount
```

Wyświetlanie firm:

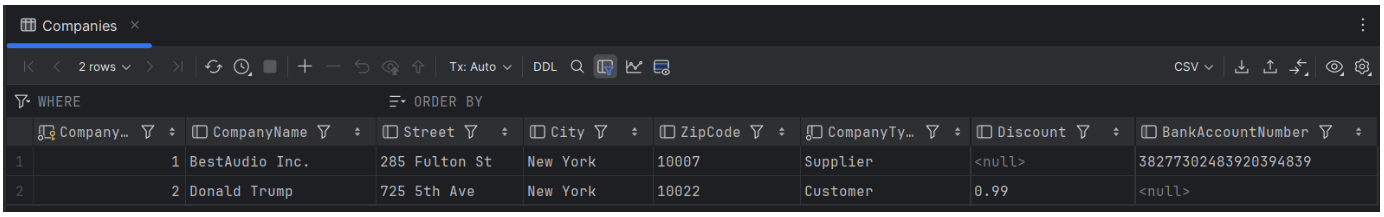


```
Choose an operation:
1. Add a new product with supplier
2. Create a new invoice
3. Show products for an invoice
4. Show invoices for a product
5. Add a new customer
6. Show all companies
7. Exit
>>> 6

All Companies:
Suppliers:
- BestAudio Inc. (ID: 1) - Bank Account: 38277302483920394839

Customers:
- Donald Trump (ID: 2) - Discount: 99,00%
```

Schemat bazy danych:



Zawartość tabeli Companies:



	Company…	CompanyName	Street	City	ZipCode	CompanyTy…	Discount	BankAccountNumber
1	1	BestAudio Inc.	285 Fulton St	New York	10007	Supplier	<null>	38277302483920394839
2	2	Donald Trump	725 5th Ave	New York	10022	Customer	0.99	<null>

Tabela Companies zawiera zarówno dostawców, jak i klientów. Informacja o tym, czy dana firma jest dostawcą czy klientem, znajduje się w kolumnie CompanyType.

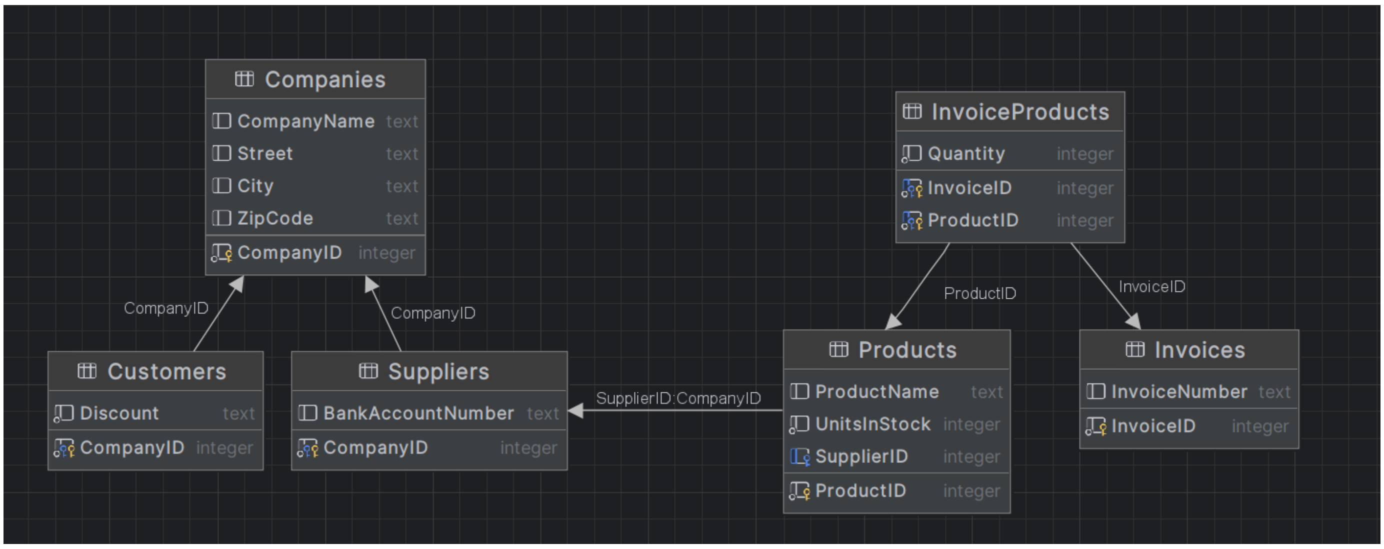
Niektóre kolumny w tabeli dotyczą tylko jednego typu firm – na przykład kolumna Discount odnosi się tylko do klientów. Dlatego dla firm, których dana kolumna nie dotyczy (np. dla dostawców w kolumnie Discount), pojawia się tam wartość `null`.

2.6. Hierarchia dziedziczenia - Table-Per-Type

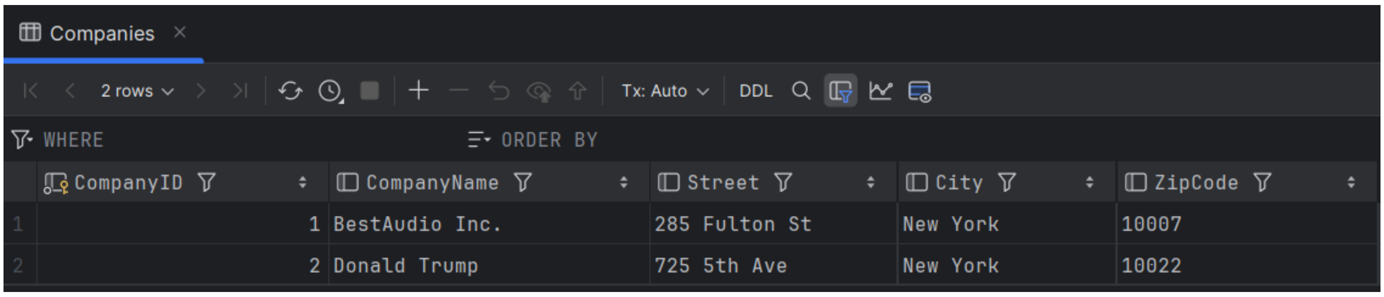
Jedyna zmiana w kodzie ma miejsce w klasie ProdContext:

```
(...)
    protected override void OnModelCreating(ModelBuilder modelBuilder)
    {
        modelBuilder.Entity<InvoiceProduct>()
            .HasKey(ip => new { ip.InvoiceID, ip.ProductID });

        modelBuilder.Entity<Company>().ToTable("Companies");
        modelBuilder.Entity<Supplier>().ToTable("Suppliers");
        modelBuilder.Entity<Customer>().ToTable("Customers");
    }
}
```

Schemat bazy danych:

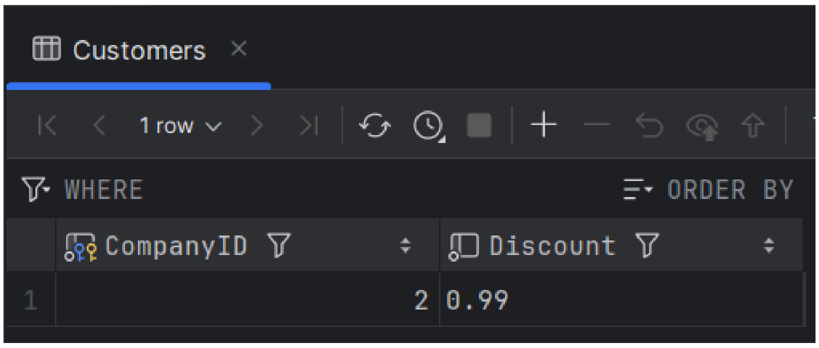


Zawartość tabel:



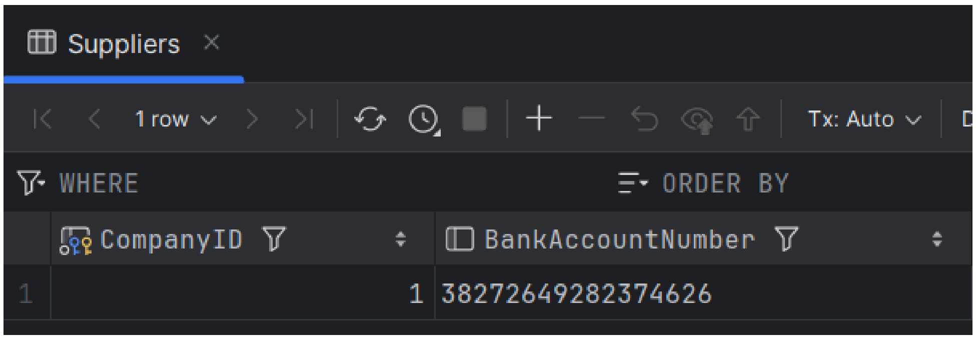
Companies

	CompanyID	CompanyName	Street	City	ZipCode
1	1	BestAudio Inc.	285 Fulton St	New York	10007
2	2	Donald Trump	725 5th Ave	New York	10022



Customers

	CompanyID	Discount
1	2	0.99



Suppliers

	CompanyID	BankAccountNumber
1	1	38272649282374626

W tym przypadku w tabeli Companies znajdują się dane wspólne dla wszystkich rodzajów firm, a w tabelach odpowiadających poszczególnym typom firm znajdują się jedynie dane dotyczące tego konkretnego typu. Eliminuje to z tabeli Companies wartości `null`.

2.7. Porównanie strategii modelowania dziedziczenia

	Table-Per-Hierarchy (TPH)	Table-Per-Type (TPT)
Zalety	- Prostsze zapytania - brak JOIN-ów między tabelami - Łatwiejsze dodawanie nowych właściwości do klasy bazowej	- Lepsze wykorzystanie miejsca - brak niepotrzebnych wartości `null` - Lepsza normalizacja danych - Możliwość nałożenia ograniczeń integralności na podklasy - Bardziej intuicyjny schemat bazy danych
Wady	- Marnotrawstwo miejsca przez wartości `null` - Ograniczenia integralności - wszystkie kolumny dotyczące podklas są nullable - Tabela może stać się bardzo szeroka przy wielu podklasach - Gorsza czytelność schematu	- Bardziej skomplikowane zapytania wymagające JOIN-ów - Trudniejsze migracje przy zmianach w hierarchii
Zastosowania	- Płytka hierarchia (mało poziomów dziedziczenia) - Podklasy mają podobne właściwości - Wydajność zapytań jest priorytetem	- Podklasy znacznie różnią się właściwościami - Integralność danych jest kluczowa - Często wykonujesz zapytania specyficzne dla konkretnych podklas - Schemat bazy danych musi być intuicyjny dla innych systemów