

Bazy danych – Northwind

System do składania zamówień

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Wstęp

Przebieg prac:

Do synchronizowania efektów pracy używamy oprogramowania GIT i serwisu GitHub

Adres do repozytorium:

<https://github.com/pixellos/agh.6.bd>

Użyte technologie:

- PostgreSQL,
- Hibernate,
- Java,
- Spring boot
- Swagger
- SwaggerUI

Uzasadnienie:

(tutaj parę słów żeby wyjaśnić czemu to wybraliście)

Uruchomienie dla developera:

W celu uruchomienia aplikacji należy:

- Sklonować repozytorium,
- Zainstalować na lokalnym komputerze bazę danych PostgreSQL
- Wykonać na bazie danych skrypty które znajdują się w repozytorium w lokalizacji /resources/db-schema
- Uruchomić aplikację backendową przez klasę NorthwindApplication.java

Uruchomienie:

W celu uruchomienia aplikacji należy zainstalować:

- Docker for Windows
- WSL2

Wykonujemy `initialize.ps1` i aplikacja działa na

<http://localhost:5000>

jest też hostowana

<https://northwind-java-pixellos.cloud.okteto.net/swagger-ui/>

Odnosińiki w aplikacji

- pobranie produktow po kategorii

<http://localhost:8080/products/category/Beverages>

- pobranie produktow po kraju zapewniajacego

<http://localhost:8080/products/supplier/country/USA>

<http://localhost:8080/products/supplier/country/Japan>

- pobranie produktow po zapewniajacym

<http://localhost:8080/products/supplierId/1>

- pobranie produktow po id klienta

<http://localhost:8080/orders/customer/SUPRD>

- poranie zamowien po id klienta

<http://localhost:8080/orders/customer/VINET>

- pobranie zamowien po id klienta

<http://localhost:8080/orders/employee/2>

- pobranie pracownikow po id

<http://localhost:8080/employees/2>

- pobranie detale zamowien po id zamowienia

<http://localhost:8080/orderDetails/order/10248>

- pobranie detali zamowien po id produktu

<http://localhost:8080/orderDetails/product/11>

- pobranie detali zamowien w kategorii produktow

<http://localhost:8080/orderDetails/product/category/Beverages>

- pobranie detali zamowien po id zapewniajacego produkt

<http://localhost:8080/orderDetails/product/supplier/1>

- pobranie zamowien po id spedytora

<http://localhost:8080/orders/shipper/1>

Dokumentacja funkcjonalna

Interfejs użytkownika

Podstawowym interfejsem użytkownika jest Swagger UI, który pozwala na łatwy dostęp do endpointów aplikacji z poziomu przeglądarki

Rysunek X. Swagger UI W aplikacji

Konfiguracja

Aby go skonfigurować trzeba:

Dodać paczki

Rysunek X. Zrzut ekranu z paczkami

Skonfigurować middleware

```
package com.agh;

import org.springframework.boot.SpringApplication;
import org.springframework.boot.autoconfigure.SpringBootApplication;
import org.springframework.context.annotation.Bean;
import org.springframework.context.annotation.Configuration;
import org.springframework.context.annotation.Import;
import org.springframework.web.servlet.view.InternalResourceViewResolver;
import springfox.documentation.spring.data.rest.configuration.SpringDataRestConfiguration;
import springfox.documentation.swagger2.annotations.EnableSwagger2;

@SpringBootApplication
@EnableSwagger2
@Configuration
@Import(SpringDataRestConfiguration.class)
public class NorthwindApplication {

    @Bean
    public InternalResourceViewResolver defaultViewResolver() {
        return new InternalResourceViewResolver();
    }

    public static void main(String[] args) {
        SpringApplication._run_(NorthwindApplication.class, args);
    }
}
```

Rysunek X. Konfiguracja middleware

Trzeba zwrócić uwagę na linię

```

@Bean
public InternalResourceViewResolver defaultViewResolver() {
    return new InternalResourceViewResolver();
}

```

Rysunek 4. Konfiguracja ViewResolvera

W obecnej wersji w swaggerUI występuje błąd, przez który ViewResolver działa niepoprawnie z najnowszym springiem. Rozwiązaniem jest ustawienie defaultViewResolvera na właściwy typ.

Część backendowa - bottom up

Odtąd przedstawiona będzie konstrukcja backendu, zaczynając od warstwy dostępu do danych, kończąc na warstwie interfejsu ze światem oraz na przykładowych wywołaniach wraz z generowanym SQL-em.

Mapowanie obiektowo - relacyjne

W tym celu użyliśmy Hibernate'a. Konfiguracja w pliku `DatabaseConfig` :

```

@Configuration
@ComponentScan(basePackages = "com.agh")
public class DatabaseConfig {

    @Bean
    public LocalSessionFactoryBean hibernateSessionFactory() {
        LocalSessionFactoryBean sessionFactory = new LocalSessionFactoryBean();
        sessionFactory.setDataSource(dataSource());
        sessionFactory.setPackagesToScan("com.agh");
        sessionFactory.setHibernateProperties(hibernateProperties());
        return sessionFactory;
    }

    @Bean
    public DataSource dataSource() {
        DriverManagerDataSource dataSource = new DriverManagerDataSource();
        dataSource.setDriverClassName("org.postgresql.Driver");
        dataSource.setUrl("jdbc:postgresql://northwind:5432/northwind");
        dataSource.setUsername("postgres");
        dataSource.setPassword("postgres");
        return dataSource;
    }

    private Properties hibernateProperties() {
        Properties properties = new Properties();
        properties.put("hibernate.dialect", "org.hibernate.dialect.PostgreSQLDialect");
        properties.put("hibernate.show_sql", "true");
        properties.put("hibernate.format_sql", "true");
        return properties;
    }
}

```

Encje zostały zamodelowane jako klasy Java odpowiadające tabelom bazy Northwind, wraz ze związkami między nimi. Przykładowo Products:

```
@Entity
@Table(name = "products")
public class Products {

    @Id
    @Column(name = "product_id")
    @SequenceGenerator(name = "productSEQ", sequenceName = "product_id_seq", allocationSize = 1)
    @GeneratedValue(strategy = GenerationType.SEQUENCE, generator = "productSEQ")
    private short productId;
    @Column(name = "product_name")
    private String productName;
    @Column(name = "quantity_per_unit")
    private String quantityPerUnit;
    @Column(name = "unit_price")
    private BigDecimal unitPrice;
    @Column(name = "units_in_stock")
    private Short unitsInStock;
    @Column(name = "units_on_order")
    private Short unitsOnOrder;
    @Column(name = "reorder_level")
    private Short reorderLevel;
    @Column(name = "discontinued")
    private int discontinued;

    @ManyToOne
    @JoinColumn(name = "supplier_id", referencedColumnName = "supplier_id")
    private Suppliers suppliers;

    @ManyToOne
    @JoinColumn(name = "category_id", referencedColumnName = "category_id")
    private Categories categories;

    public Products() {
    }

    public short getProductId() {
        return productId;
    }

    public void setProductId(short productId) {
        this.productId = productId;
    }

    public String getProductName() {
        return productName;
    }

    public void setProductName(String productName) {
        this.productName = productName;
    }

    public String getQuantityPerUnit() {
        return quantityPerUnit;
    }
}
```

```
public void setQuantityPerUnit(String quantityPerUnit) {
    this.quantityPerUnit = quantityPerUnit;
}

public BigDecimal getUnitPrice() {
    return unitPrice;
}

public void setUnitPrice(BigDecimal unitPrice) {
    this.unitPrice = unitPrice;
}

public Short getUnitsInStock() {
    return unitsInStock;
}

public void setUnitsInStock(Short unitsInStock) {
    this.unitsInStock = unitsInStock;
}

public Short getUnitsOnOrder() {
    return unitsOnOrder;
}

public void setUnitsOnOrder(Short unitsOnOrder) {
    this.unitsOnOrder = unitsOnOrder;
}

public Short getReorderLevel() {
    return reorderLevel;
}

public void setReorderLevel(Short reorderLevel) {
    this.reorderLevel = reorderLevel;
}

public int getDiscontinued() {
    return discontinued;
}

public void setDiscontinued(int discontinued) {
    this.discontinued = discontinued;
}

public Suppliers getSuppliers() {
    return suppliers;
}

public void setSuppliers(Suppliers suppliers) {
    this.suppliers = suppliers;
}

public Categories getCategories() {
    return categories;
}

public void setCategories(Categories categories) {
    this.categories = categories;
}
```

```
}  
}
```

Do zapisywania / odczytywania danych użyliśmy wzorca Repository, żeby zenkapsulować szczegóły implementacji. `AbstractRepository` prezentuje się następująco:

```
import org.hibernate.Session;  
import org.hibernate.SessionFactory;  
import org.springframework.beans.factory.annotation.Autowired;  
  
public abstract class AbstractRepository {  
  
    @Autowired  
    private SessionFactory sessionFactory;  
  
    protected Session getSession() {  
        return sessionFactory.getCurrentSession();  
    }  
  
    protected Session getOpenSession() {  
        return sessionFactory.openSession();  
    }  
  
}
```

A przykładowe repozytorium dla produktów:

```
@Repository  
public class ProductsRepository extends AbstractRepository {  
  
    public List<Products> getAll() {  
        Session session = getOpenSession();  
        Transaction transaction = session.beginTransaction();  
        List<Products> products = session  
            .createQuery("SELECT p FROM Products p" +  
                " INNER JOIN FETCH p.suppliers s" +  
                " INNER JOIN FETCH p.categories c", Products.class)  
            .list();  
        transaction.commit();  
        session.close();  
        return products;  
    }  
  
    public Optional<Products> getById(Short productId) {  
        Session session = getOpenSession();  
        Transaction transaction = session.beginTransaction();  
        Optional<Products> product = session  
            .createQuery("SELECT p FROM Products p WHERE p.productId=:productId", Products.class)  
            .setParameter("productId", productId)  
            .uniqueResultOptional();  
        transaction.commit();  
        session.close();  
        return product;  
    }  
  
    public List<Products> getAllByCategory(String categoryName) {
```



```

Session session = getOpenSession();
Transaction transaction = session.beginTransaction();

List<Products> products = session.createQuery(
    "SELECT p FROM Products p" +
        " INNER JOIN FETCH p.suppliers s" +
        " INNER JOIN FETCH p.categories c" +
        " WHERE c.categoryName=:categoryName", Products.class)
    .setParameter("categoryName", categoryName)
    .list();

transaction.commit();
session.close();
return products;
}

public List<Products> getAllBySupplierId(Short supplierId) {
    Session session = getOpenSession();
    Transaction transaction = session.beginTransaction();

    List<Products> products = session.createQuery(
        "SELECT p FROM Products p" +
            " INNER JOIN FETCH p.suppliers s" +
            " INNER JOIN FETCH p.categories c" +
            " WHERE s.supplierId=:supplierId", Products.class)
        .setParameter("supplierId", supplierId)
        .list();

    transaction.commit();
    session.close();
    return products;
}

public List<Products> getAllBySuppliersCountry(String suppliersCountry) {
    Session session = getOpenSession();
    Transaction transaction = session.beginTransaction();

    List<Products> products = session.createQuery(
        "SELECT p FROM Products p" +
            " INNER JOIN FETCH p.suppliers s " +
            " INNER JOIN FETCH p.categories c" +
            " WHERE s.country=:suppliersCountry", Products.class)
        .setParameter("suppliersCountry", suppliersCountry)
        .list();

    transaction.commit();
    session.close();
    return products;
}

public void persist(Products product) {
    Session session = getOpenSession();
    Transaction transaction = session.beginTransaction();
    session.persist(product);
    transaction.commit();
    session.close();
}
}

```

Można zauważyć tu kilka rzeczy:

- Metody `get...` korzystają z napisanych ręcznie kwerend, żeby uniknąć problemu n+1 zapytań
- Zgodnie z sugestią prowadzącego, zamieniono `left joiny` na `inner join`-y, które są szybsze
- Korzystamy z `join fetch` dla eager loading
- Odczyt / zapis odbywa się w transakcjach
- Zapisywanie pozostawiamy Hibernate'owemu `persist`.

Część biznesowo - aplikacyjna

Z repozytoriów korzystają następnie klasy `service`, zawierające odrobinę więcej logiki biznesowej - na przykład konstrukcja odpowiedniego obiektu do zapisania na podstawie requestu, jak również walidacja tego obiektu.

Przykładowo - `ProductsService`:

```
package com.agh.service;

import com.agh.model.Categories;
import com.agh.model.Products;
import com.agh.model.Suppliers;
import com.agh.repository.ProductsRepository;
import com.agh.request.CreateProductRequest;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.stereotype.Service;

import java.util.List;

@Service
public class ProductsService {

    private final ProductsRepository productsRepository;
    private final SuppliersService suppliersService;
    private final CategoriesService categoriesService;
    private final ValidationService validationService;

    @Autowired
    public ProductsService(ProductsRepository productsRepository, SuppliersService suppliersService,
                           ValidationService validationService) {
        this.productsRepository = productsRepository;
        this.suppliersService = suppliersService;
        this.categoriesService = categoriesService;
        this.validationService = validationService;
    }

    public List<Products> getAll() {
        return productsRepository.getAll();
    }

    public Products getById(Short productId) {
        return productsRepository.getById(productId).orElseThrow(IllegalArgumentException::new)
    }

    public List<Products> getAllByCategory(String categoryName) {
```

```

        return productsRepository.getAllByCategory(categoryName);
    }

    public List<Products> getAllBySupplierId(Short supplierId) {
        return productsRepository.getAllBySupplierId(supplierId);
    }

    public List<Products> getAllBySuppliersCountry(String countryName) {
        return productsRepository.getAllBySuppliersCountry(countryName);
    }

    public void create(CreateProductRequest request) {
        Products product = new Products();
        Suppliers supplier = suppliersService.getById(request.getSupplierId());
        Categories category = categoriesService.getById(request.getCategoryId());
        product.setSuppliers(supplier);
        product.setCategories(category);

        product.setProductName(request.getProductName());
        product.setQuantityPerUnit(request.getQuantityPerUnit());
        product.setUnitPrice(request.getUnitPrice());
        product.setUnitsInStock(request.getUnitsInStock());
        product.setUnitsOnOrder(request.getUnitsOnOrder());
        product.setReorderLevel(request.getReorderLevel());
        product.setDiscontinued(request.getDiscontinued());

        validationService.validate(product);
        productsRepository.persist(product);
    }
}

```

`ValidationService` sprawdza, czy obiekt który chcemy zapisać spełnia nasze założenia:

```

@Service
public class ValidationService {

    public void validate(Products product) {
        if (product.getProductName() == null || product.getProductName().trim().isEmpty()) {
            throw new IllegalArgumentException("Product name cannot be empty");
        }

        if (product.getQuantityPerUnit() == null || product.getQuantityPerUnit().trim().isEmpty()) {
            throw new IllegalArgumentException("Quantity per unit cannot be empty");
        }

        if (product.getUnitPrice().compareTo(BigDecimal.ZERO) <= 0) {
            throw new IllegalArgumentException("Unit price has to be greater than 0");
        }

        if (product.getUnitsInStock() <= 0 || product.getUnitsOnOrder() <= 0) {
            throw new IllegalArgumentException("Units in stock and Units on order has to be greater than 0");
        }
    }

    public void validate(Orders order) {
        if (order.getOrderDate().isAfter(order.getRequiredDate())) {
            throw new IllegalArgumentException("Order date has to be before required date");
        }
    }
}

```

```

    }

    if (order.getShippedDate().isAfter(order.getRequiredDate())) {
        throw new IllegalArgumentException("Shipped date has to be before required date");
    }

    if (order.getFreight() <= 0) {
        throw new IllegalArgumentException("Freight has to be greater than 0");
    }

    if (order.getShipName() == null || order.getShipName().trim().isEmpty()) {
        throw new IllegalArgumentException("Ship name cannot be empty");
    }

    if (order.getShipAddress() == null || order.getShipAddress().trim().isEmpty()) {
        throw new IllegalArgumentException("Ship address cannot be empty");
    }

    if (order.getShipCity() == null || order.getShipCity().trim().isEmpty()) {
        throw new IllegalArgumentException("Ship city cannot be empty");
    }

    if (order.getShipRegion() == null || order.getShipRegion().trim().isEmpty()) {
        throw new IllegalArgumentException("Ship region cannot be empty");
    }

    if (order.getShipPostalCode() == null || order.getShipPostalCode().trim().isEmpty()) {
        throw new IllegalArgumentException("Ship postal code cannot be empty");
    }

    if (order.getShipCountry() == null || order.getShipCountry().trim().isEmpty()) {
        throw new IllegalArgumentException("Ship country cannot be empty");
    }
}

public void validate(OrderDetails orderDetails) {
    if (orderDetails.getQuantity() <= 0) {
        throw new IllegalArgumentException("Quantity has to be greater than 0");
    }

    if (orderDetails.getUnitPrice() <= 0) {
        throw new IllegalArgumentException("Unit price has to be greater than 0");
    }

    if (orderDetails.getOrderDetailsId().getOrders() == null) {
        throw new IllegalArgumentException("OrderDetails has to be in relationship with Order");
    }

    if (orderDetails.getOrderDetailsId().getProducts() == null) {
        throw new IllegalArgumentException("OrderDetails has to be in relationship with Product");
    }
}
}

```

Serwisy następnie używane są przez kontrolery frameworka Spring, który obsługuje zapytania po HTTP. Przykładowo produkt:

```

@RestController
public class ProductsController {

    private final ProductsService productsService;

    @Autowired
    public ProductsController(ProductsService productsService) {
        this.productsService = productsService;
    }

    @GetMapping("products")
    public ResponseEntity<List<Products>> getAll() {
        return new ResponseEntity<>(productsService.getAll(), HttpStatus.OK);
    }

    @GetMapping("products/category/{categoryName}")
    public ResponseEntity<List<Products>> getAllByCategory(@PathVariable String categoryName) {
        return new ResponseEntity<>(productsService.getAllByCategory(categoryName), HttpStatus.OK);
    }

    @GetMapping("products/supplierId/{supplierId}")
    public ResponseEntity<List<Products>> getAllBySupplierId(@PathVariable Short supplierId) {
        return new ResponseEntity<>(productsService.getAllBySupplierId(supplierId), HttpStatus.OK);
    }

    @GetMapping("products/supplier/country/{countryName}")
    public ResponseEntity<List<Products>> getAllBySuppliersCountry(@PathVariable String countryName) {
        return new ResponseEntity<>(productsService.getAllBySuppliersCountry(countryName), HttpStatus.OK);
    }

    @PostMapping("products")
    public ResponseEntity<Void> create(@RequestBody CreateProductRequest request) {
        productsService.create(request);
        return new ResponseEntity<>(HttpStatus.OK);
    }
}

```

Tutaj też pojawiają się klasy będące ciałem requestów - jak `CreateProductRequest` :

```

public class CreateProductRequest {
    private Short supplierId;
    private Short categoryId;
    // ***
    private String productName;
    private String quantityPerUnit;
    private BigDecimal unitPrice;
    private Short unitsInStock;
    private Short unitsOnOrder;
    private Short reorderLevel;
    private Integer discontinued;
    // [...getters, setters...]
}

```

Przykładowe wywołania na produkcie:

1. GetAll

GET http://localhost:8080/products

Odpowiedź:

```
[
  {
    "productId": 1,
    "productName": "Chai",
    "quantityPerUnit": "10 boxes x 30 bags",
    "unitPrice": 18,
    "unitsInStock": 39,
    "unitsOnOrder": 0,
    "reorderLevel": 10,
    "discontinued": 1,
    "suppliers": {
      "supplierId": 8,
      "companyName": "Specialty Biscuits, Ltd.",
      "contactName": "Peter Wilson",
      "contactTitle": "Sales Representative",
      "address": "29 King's Way",
      "city": "Manchester",
      "region": null,
      "postalCode": "M14 6SD",
      "country": "UK",
      "phone": "(161) 555-4448",
      "fax": null,
      "homepage": null
    },
    "categories": {
      "categoryId": 1,
      "categoryName": "Beverages",
      "description": "Soft drinks, coffees, teas, beers, and ales",
      "picture": ""
    }
  }
]...
```

Generowany SQL:

Hibernate:

```
select
  products0_.product_id as product_1_15_0_,
  suppliers1_.supplier_id as supplier1_20_1_,
  categories2_.category_id as category1_0_2_,
  products0_.category_id as category9_15_0_,
  products0_.discontinued as disconti2_15_0_,
  products0_.product_name as product_3_15_0_,
  products0_.quantity_per_unit as quantity4_15_0_,
  products0_.reorder_level as reorder_5_15_0_,
  products0_.supplier_id as supplie10_15_0_,
  products0_.unit_price as unit_pri6_15_0_,
  products0_.units_in_stock as units_in7_15_0_,
  products0_.units_on_order as units_on8_15_0_,
  suppliers1_.address as address2_20_1_,
```

```

suppliers1_.city as city3_20_1_,
suppliers1_.company_name as company_4_20_1_,
suppliers1_.contact_name as contact_5_20_1_,
suppliers1_.contact_title as contact_6_20_1_,
suppliers1_.country as country7_20_1_,
suppliers1_.fax as fax8_20_1_,
suppliers1_.homepage as homepage9_20_1_,
suppliers1_.phone as phone10_20_1_,
suppliers1_.postal_code as postal_11_20_1_,
suppliers1_.region as region12_20_1_,
categories2_.category_name as category2_0_2_,
categories2_.description as descript3_0_2_,
categories2_.picture as picture4_0_2_
from
  products products0_
inner join
  suppliers suppliers1_
    on products0_.supplier_id=suppliers1_.supplier_id
inner join
  categories categories2_
    on products0_.category_id=categories2_.category_id

```

2. GetAllByCategory

GET http://localhost:8080/products/category/Beverages

Odpowiedź:

```

[
  {
    "productId": 1,
    "productName": "Chai",
    "quantityPerUnit": "10 boxes x 30 bags",
    "unitPrice": 18,
    "unitsInStock": 39,
    "unitsOnOrder": 0,
    "reorderLevel": 10,
    "discontinued": 1,
    "suppliers": {
      "supplierId": 8,
      "companyName": "Specialty Biscuits, Ltd.",
      "contactName": "Peter Wilson",
      "contactTitle": "Sales Representative",
      "address": "29 King's Way",
      "city": "Manchester",
      "region": null,
      "postalCode": "M14 GSD",
      "country": "UK",
      "phone": "(161) 555-4448",
      "fax": null,
      "homepage": null
    },
    "categories": {
      "categoryId": 1,
      "categoryName": "Beverages",
      "description": "Soft drinks, coffees, teas, beers, and ales",

```

```
    "picture": ""
  }
}...
```

Generowany SQL:

Hibernate:

```
select
    products0_.product_id as product_1_15_0_,
    suppliers1_.supplier_id as supplier1_20_1_,
    categories2_.category_id as category1_0_2_,
    products0_.category_id as category9_15_0_,
    products0_.discontinued as disconti2_15_0_,
    products0_.product_name as product_3_15_0_,
    products0_.quantity_per_unit as quantity4_15_0_,
    products0_.reorder_level as reorder_5_15_0_,
    products0_.supplier_id as supplie10_15_0_,
    products0_.unit_price as unit_pri6_15_0_,
    products0_.units_in_stock as units_in7_15_0_,
    products0_.units_on_order as units_on8_15_0_,
    suppliers1_.address as address2_20_1_,
    suppliers1_.city as city3_20_1_,
    suppliers1_.company_name as company_4_20_1_,
    suppliers1_.contact_name as contact_5_20_1_,
    suppliers1_.contact_title as contact_6_20_1_,
    suppliers1_.country as country7_20_1_,
    suppliers1_.fax as fax8_20_1_,
    suppliers1_.homepage as homepage9_20_1_,
    suppliers1_.phone as phone10_20_1_,
    suppliers1_.postal_code as postal_11_20_1_,
    suppliers1_.region as region12_20_1_,
    categories2_.category_name as category2_0_2_,
    categories2_.description as descript3_0_2_,
    categories2_.picture as picture4_0_2_
from
    products products0_
inner join
    suppliers suppliers1_
        on products0_.supplier_id=suppliers1_.supplier_id
inner join
    categories categories2_
        on products0_.category_id=categories2_.category_id
where
    categories2_.category_name=?
```

3. Create

POST http://localhost:8080/products/

```
{
  "categoryId": 1,
  "discontinued": 0,
  "productName": "test",
  "quantityPerUnit": "5",
  "reorderLevel": 1,
  "supplierId": 1,
```



```
"unitPrice": 1,  
"unitsInStock": 1,  
"unitsOnOrder": 1  
}
```

Odpowiedź:

```
200 OK
```

Generowany SQL:

```
Hibernate:  
insert  
into  
    products  
    (category_id, discontinued, product_name, quantity_per_unit, reorder_level, supplier_id)  
values  
    (?, ?, ?, ?, ?, ?, ?, ?, ?, ?)
```

Encje z rozbudowanym CRUD-em

- Products
 - getAll
 - getByld
 - getAllByCategory
 - getAllBySupplierId
 - getAllBySuppliersCountry
 - persist
- Orders
 - getAll
 - getByld
 - getAllByCustomerId
 - getAllByEmployeeId
 - getAllByShipperId
 - persist
- OrderDetails
 - getAll
 - getByOrderId
 - getByProductId
 - getByProductsCategory
 - getBySupplierId
 - persist

Powyższe zrealizowane są analogicznie w stosunku do tego co przedstawiono wyżej dla Produktu.

Pozostałe mają podstawowe `getAll` oraz `getById` .