Wrocław, 2019

Wybrane zagadnienia projektowania obiektowego

(projekt)

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Prowadzący:
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1. Wstęp i założenia

Projekt ma na celu wykonanie systemu przedstawiającego wykorzystanie w praktyce paradygmatów programowania obiektowego oraz wzorców projektowych. System zostanie napisany z wykorzystaniem języka C++ oraz kod źródłowy zostanie udostępniony do wglądu na repozytorium internetowym wykorzystującym system kontroli wersji Git.

Program ma za zadanie symulować dzień w szpitalu. Niedeterministyczny system generować będzie lekarza oraz jego dzienne zajęcia wraz z pacjentami.

2. Program

Program został napisany w języku C++. Aby pobrać pliki źródłowe należy za pomocą komendy git sklonować projekt na swój komputer:

```
$ mkdir project && cd project
$ git clone https://github.com/comm0/wzpo2019.git
$ cd wzpo2019/
```

Następnie jego uruchomienie ogranicza się do wygenerowania prostego pliku make przy użyciu pliku MakeFile oraz kompilacji całości:

```
$ cmake CMakeLists.txt
$ make
$ ./wzpo
```

Po wykonaniu poprawnie powyższych komend, program powinien się uruchomić, a strumień wyjściowy przedstawić wynik programu, którym będzie słowny opis dnia lekarza.

2.1 Fabryka

Wzorzec **Fabryka** jest głównym wzorcem wykorzystanym w programie. Dostarcza on interfejs do tworzenia różnych obiektów jednego typu. W stworzonym programie wyróżniamy dwa typy fabryk:

PeopleFactory - fabryka osób. Framework dostarcza nam możliwość generowania lekarzy oraz pacjentów

Stworzenie przykładowo lekarza ogranicza się więc do wydobycia fabryki osób i wywołania go z argumentem “Doctor” :

```
auto doctor = PeopleFactory::getFactory("Doctor")->createPerson();
```

Generowanie pacjentów:

```
std::vector<Patient*> patients(12);
   std::generate(std::begin(patients), std::end(patients),
   []() { return (Patient*)PeopleFactory::getFactory("Patient")->
                createPerson(); });
```

RoomFactory - Fabryka generująca pomieszczenie, w którym wykonywana jest praca przez lekarza. Możliwe pokoje to:

- prywatny gabinet
- przychodnia
- sala chirurgiczna

Generacja sal przy wykorzystaniu standardowej funkcji std::generate :

```
   std::vector<Room*> rooms(6);
   std::generate(std::begin(rooms), std::begin(rooms) + 3,
   []() { return RoomFactory::getFactory("Surgery")->
                createRoom(); });
   std::generate(std::begin(rooms) + 2, std::begin(rooms) + 5,
```

```
   []() { return RoomFactory::getFactory("HospitalRoom")->
                createRoom(); });
   std::generate(std::begin(rooms) + 4, std::end(rooms),
   []() { return RoomFactory::getFactory("PrivateOffice")->
                createRoom(); });
```

WorkFactory - fabryka generująca typ pracy lekarza:

- Operacja
- Konsultacje
- Nauka

2.2 Dziedziczenie

Umożliwia kreowanie klas, które opierają się na klasach już istniejących. Zastosowane zostało ono przede wszystkim w klasach fabryk, osób oraz pokoi.

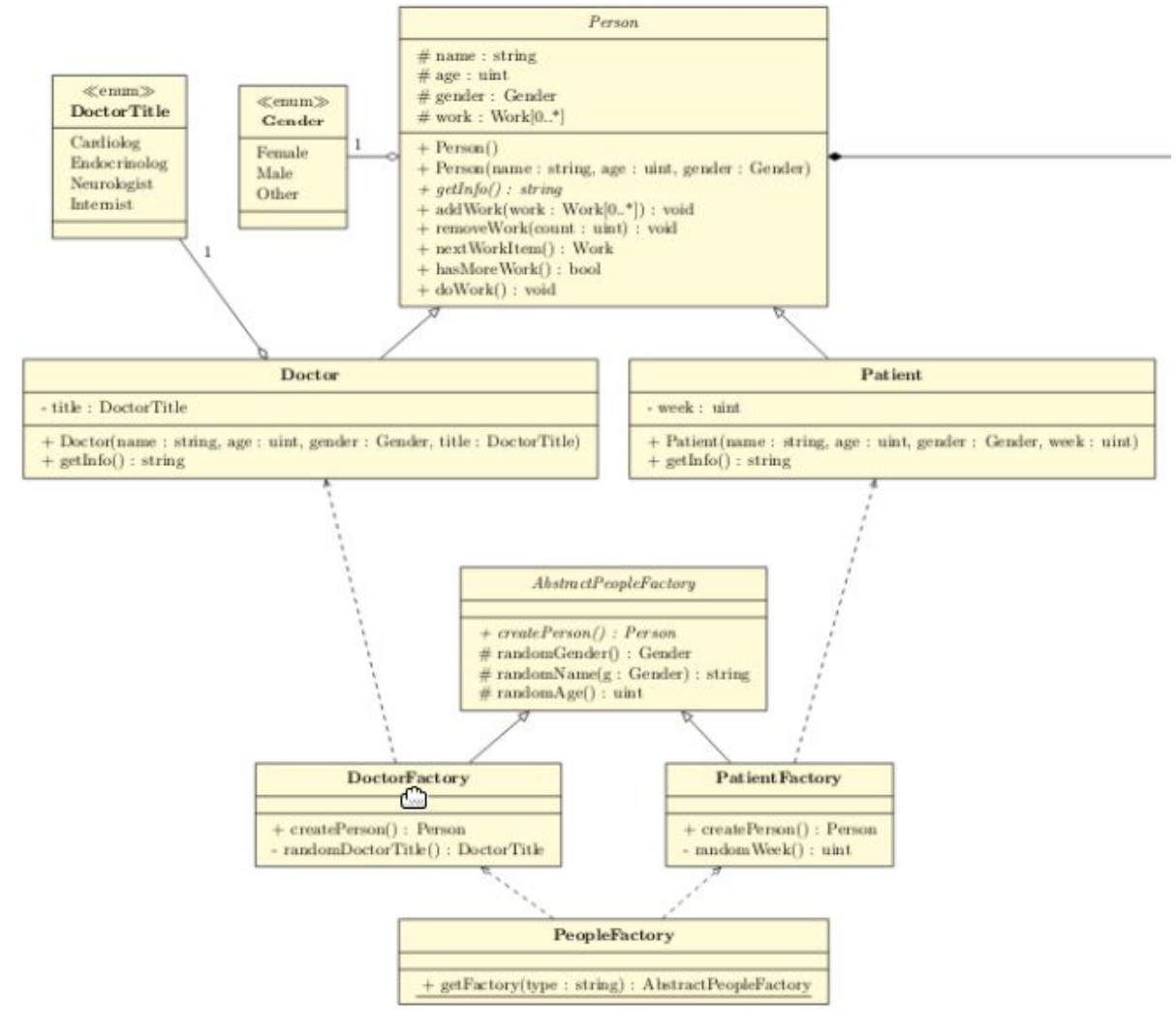
Podstawowo klasa *Doctor* oraz *Patient* dziedziczą z klasy *Person*.
Surgery, *PrivateOffice* oraz *HospitalRoom* dziedziczą publicznie z klasy *Room.*
Operation, *ConsultationWork*, *Study* z *Work*.

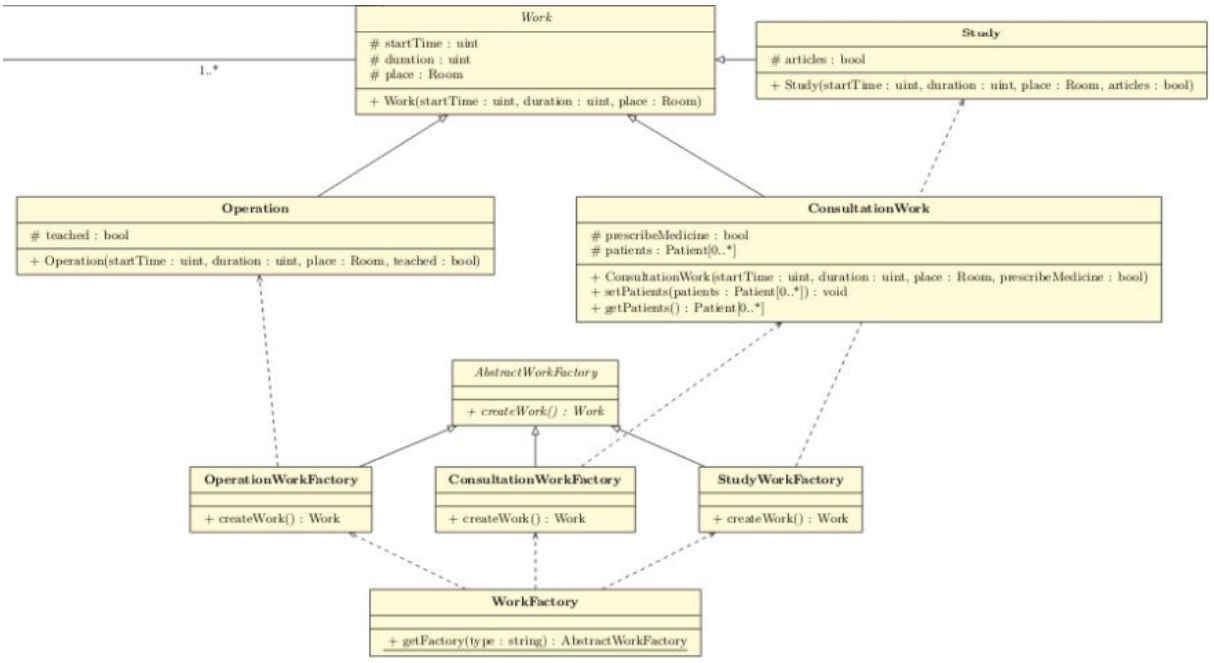
Klasy *OperationWorkFactory*, *ConsultationWorkFactory* oraz *StudyWorkFactory* dziedziczą z klasy abstrakcyjnej AbstractWorkFactory. Następnie klasa *WorkFactory* udostępnia ogólnodostępny wskaźnik na metodę generująca pożądaną fabrykę.

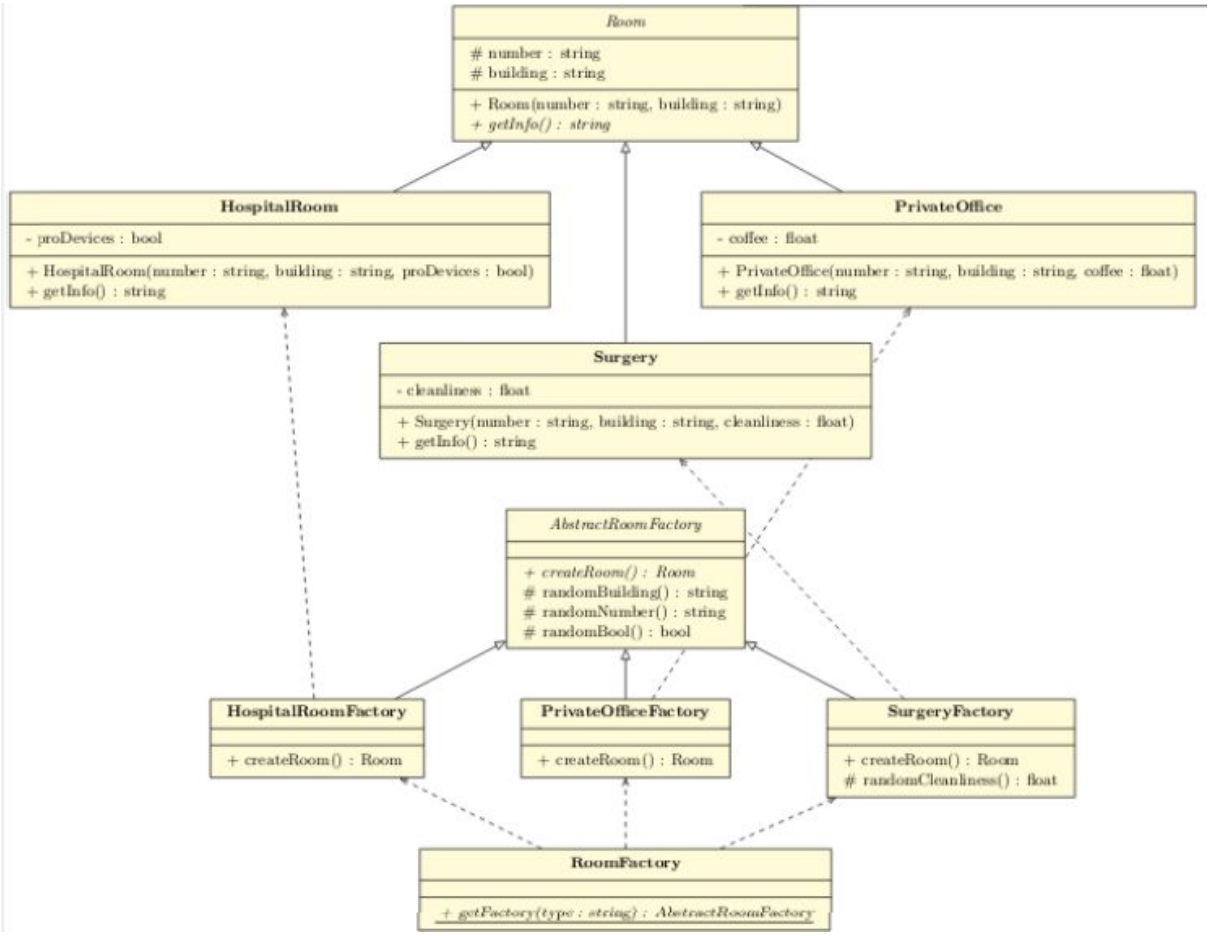
```
class AbstractWorkFactory
{
   public:
       virtual Work* createWork(Room* place) = 0;

   protected:
```

```
        bool randomBool();
        uint32_t randomStartTime();
        uint32_t randomDuration();
};

class OperationWorkFactory : public AbstractWorkFactory
{
   public:
        Work* createWork(Room* place);
};

class ConsultationWorkFactory : public AbstractWorkFactory
{
   public:
        Work* createWork(Room* place);
};

class StudyWorkFactory : public AbstractWorkFactory
{
   public:
        Work* createWork(Room* place);
};

class WorkFactory
{
   public:
        static
        std::unique_ptr<AbstractWorkFactory>
getFactory(std::string);
};
```

Analogicznie sytuacja przebiega z klasami *PeopleFactory* oraz *RoomFactory*.


Person
name : string
age : uint
gender : Gender
work : Work[0..*]
+ Person()
+ Person(name : string, age : uint, gender : Gender)
+ getInfo() : string
+ addWork(work : Work[0..*]) : void
+ removeWork(count : uint) : void
+ nextWorkItem() : Work
+ hasMoreWork() : bool
+ doWork() : void
≪enum≫
DoctorTitle
Cardiolog
Endocrinolog
Neurologist
Internist
≪enum≫
Gender
Female
Male
Other
1
1
Doctor
- title : DoctorTitle
+ Doctor(name : string, age : uint, gender : Gender, title : DoctorTitle)
+ getInfo() : string
Patient
- week : uint
+ Patient(name : string, age : uint, gender : Gender, week : uint)
+ getInfo() : string
AbstractPeopleFactory
+ createPerson() : Person
# randomGender() : Gender
# randomName(g : Gender) : string
# randomAge() : uint
DoctorFactory
+ createPerson() : Person
- randomDoctorTitle() : DoctorTitle
PatientFactory
+ createPerson() : Person
- randomWeek() : uint
PeopleFactory
+ getFactory(type : string) : AbstractPeopleFactory


1..*
Work
startTime : uint
duration : uint
place : Room
+ Work(startTime : uint, duration : uint, place : Room)
Study
articles : bool
+ Study(startTime : uint, duration : uint, place : Room, articles : bool)
Operation
teached : bool
+ Operation(startTime : uint, duration : uint, place : Room, teached : bool)
ConsultationWork
prescribeMedicine : bool
patients : Patient[0..*]
+ ConsultationWork(startTime : uint, duration : uint, place : Room, prescribeMedicine : bool)
+ setPatients(patients : Patient[0..*]) : void
+ getPatients() : Patient[0..*]
AbstractWorkFactory
+ createWork() : Work
OperationWorkFactory
+ createWork() : Work
ConsultationWorkFactory
+ createWork() : Work
StudyWorkFactory
+ createWork() : Work
WorkFactory
+ getFactory(type : string) : AbstractWorkFactory



2.3 Całość programu

Program po uruchomieniu generuje lekarza, pacjentów oraz 5 dni przez które wygenerowany lekarz zajmuję się pacjentami bądź poświęca czas na naukę. Przykładowym wynikiem działania programu jest strumień wyjściowy:

```
Helga (Doctor, 80 y.o.) identifies as female and holds the title of Neurologist.
 and does following work:
*** Day 1
trying to perform work: consultation work at 9 for 1 hours with 7 patients in HospitalRoom (without
professional devices) located in M11, room number 307.
with following patients:
  Wiolonczela (Patient, 58 y.o.) identifies as female and currently is curing on week number 7.
  Jan (Patient, 44 y.o.) identifies as male and currently is curing on week number 1.
  Tom (Patient, 60 y.o.) identifies as other and currently is curing on week number 7.
  Helga (Patient, 83 y.o.) identifies as female and currently is curing on week number 1.
  Tom (Patient, 46 y.o.) identifies as male and currently is curing on week number 6.
  Krysztof (Patient, 56 y.o.) identifies as male and currently is curing on week number 1.
  Jan (Patient, 29 y.o.) identifies as male and currently is curing on week number 7.
```

work done.
trying to perform work: consultation work at 10 for 2 hours with 2 patients in HospitalRoom (without professional devices) located in M11, room number 307.
with following patients:
  Wiolonczela (Patient, 58 y.o.) identifies as female and currently is curing on week number 7.
  Jan (Patient, 44 y.o.) identifies as male and currently is curing on week number 1.
work done.
trying to perform work: operation at 14 for 3 hours in Surgery (cleanliness level: 0.266158) located in M11, room number 211.

exception caught: At least two work items are scheduled to occur at the same time.
removing this work item and moving on

trying to perform work: operation and teaching new doctors at 14 for 3 hours in Surgery (cleanliness level: 0.266158) located in M11, room number 211.
work done.

*** Day 2
trying to perform work: operation and teaching new doctors at 9 for 3 hours in Surgery (cleanliness level: 0.266158) located in M11, room number 211.

exception caught: At least two work items are scheduled to occur at the same time.
removing this work item and moving on

trying to perform work: consultation work at 9 for 1 hours with 11 patients in HospitalRoom (without professional devices) located in C2, room number 208.
with following patients:
  Tom (Patient, 46 y.o.) identifies as male and currently is curing on week number 6.
  Krysztof (Patient, 99 y.o.) identifies as other and currently is curing on week number 3.
  Krysztof (Patient, 56 y.o.) identifies as male and currently is curing on week number 1.
  Wiolonczela (Patient, 21 y.o.) identifies as other and currently is curing on week number 2.
  Tom (Patient, 60 y.o.) identifies as other and currently is curing on week number 7.
  Helga (Patient, 83 y.o.) identifies as female and currently is curing on week number 1.
  Helga (Patient, 51 y.o.) identifies as female and currently is curing on week number 6.
  Joanna (Patient, 45 y.o.) identifies as other and currently is curing on week number 3.
  Jan (Patient, 44 y.o.) identifies as male and currently is curing on week number 1.
  Krysztof (Patient, 43 y.o.) identifies as other and currently is curing on week number 1.
  Wiolonczela (Patient, 58 y.o.) identifies as female and currently is curing on week number 7.
work done.
trying to perform work: operation and teaching new doctors at 13 for 2 hours in Surgery (cleanliness level: 0.164412) located in M11, room number 316.
work done.
trying to perform work: consultation work and prescribe a medicinal at 16 for 3 hours with 1 patients in HospitalRoom (without professional devices) located in M11, room number 307.
with following patients:
  Krysztof (Patient, 99 y.o.) identifies as other and currently is curing on week number 3.
work done.

*** Day 3
trying to perform work: consultation work and prescribe a medicinal at 8 for 2 hours with 6 patients in PrivateOffice with free coffee located in C2, room number 206.
with following patients:
  Tom (Patient, 46 y.o.) identifies as male and currently is curing on week number 6.
  Helga (Patient, 51 y.o.) identifies as female and currently is curing on week number 6.
  Joanna (Patient, 45 y.o.) identifies as other and currently is curing on week number 3.
  Helga (Patient, 83 y.o.) identifies as female and currently is curing on week number 1.
  Tom (Patient, 60 y.o.) identifies as other and currently is curing on week number 7.

Jan (Patient, 44 y.o.) identifies as male and currently is curing on week number 1.
work done.
trying to perform work: consultation work and prescribe a medicinal at 10 for 3 hours with 6 patients in PrivateOffice with free coffee located in C2, room number 206.
with following patients:
Tom (Patient, 46 y.o.) identifies as male and currently is curing on week number 6.
Tom (Patient, 60 y.o.) identifies as other and currently is curing on week number 7.
Helga (Patient, 83 y.o.) identifies as female and currently is curing on week number 1.
Krysztof (Patient, 99 y.o.) identifies as other and currently is curing on week number 3.
Wiolonczela (Patient, 58 y.o.) identifies as female and currently is curing on week number 7.
Helga (Patient, 51 y.o.) identifies as female and currently is curing on week number 6.

exception caught: At least two work items are scheduled to occur at the same time.
removing this work item and moving on

trying to perform work: operation at 11 for 3 hours in Surgery (cleanliness level: 0.266158) located in M11, room number 211.

exception caught: At least two work items are scheduled to occur at the same time.
removing this work item and moving on

trying to perform work: operation at 13 for 1 hours in Surgery (cleanliness level: 0.164412) located in M11, room number 316.
work done.

*** Day 4
trying to perform work: consultation work and prescribe a medicinal at 8 for 1 hours with 2 patients in PrivateOffice with free coffee located in C2, room number 206.
with following patients:
Wiolonczela (Patient, 21 y.o.) identifies as other and currently is curing on week number 2.
Helga (Patient, 83 y.o.) identifies as female and currently is curing on week number 1.
work done.
trying to perform work: operation at 11 for 1 hours in Surgery (cleanliness level: 0.266158) located in M11, room number 211.

exception caught: At least two work items are scheduled to occur at the same time.
removing this work item and moving on

trying to perform work: consultation work at 11 for 3 hours with 1 patients in HospitalRoom (without professional devices) located in C2, room number 208.
with following patients:
Joanna (Patient, 45 y.o.) identifies as other and currently is curing on week number 3.
work done.
trying to perform work: operation at 15 for 3 hours in Surgery (cleanliness level: 0.266158) located in M11, room number 211.
work done.

*** Day 5
trying to perform work: operation at 9 for 2 hours in Surgery (cleanliness level: 0.164412) located in M11, room number 316.
work done.
trying to perform work: consultation work at 11 for 1 hours with 8 patients in PrivateOffice with free coffee located in C2, room number 206.
with following patients:
Krysztof (Patient, 43 y.o.) identifies as other and currently is curing on week number 1.
Wiolonczela (Patient, 21 y.o.) identifies as other and currently is curing on week number 2.
Tom (Patient, 46 y.o.) identifies as male and currently is curing on week number 6.

```
  Jan (Patient, 29 y.o.) identifies as male and currently is curing on week number 7.
  Joanna (Patient, 45 y.o.) identifies as other and currently is curing on week number 3.
  Krysztof (Patient, 99 y.o.) identifies as other and currently is curing on week number 3.
  Krysztof (Patient, 56 y.o.) identifies as male and currently is curing on week number 1.
  Helga (Patient, 51 y.o.) identifies as female and currently is curing on week number 6.
work done.
trying to perform work: consultation work and prescribe a medicinal  at 12 for 2 hours with 8 patients in
HospitalRoom (without professional devices) located in C2, room number 208.
with following patients:
  Jan (Patient, 29 y.o.) identifies as male and currently is curing on week number 7.
  Krysztof (Patient, 56 y.o.) identifies as male and currently is curing on week number 1.
  Jan (Patient, 44 y.o.) identifies as male and currently is curing on week number 1.
  Wiolonczela (Patient, 58 y.o.) identifies as female and currently is curing on week number 7.
  Helga (Patient, 83 y.o.) identifies as female and currently is curing on week number 1.
  Joanna (Patient, 45 y.o.) identifies as other and currently is curing on week number 3.
  Tom (Patient, 60 y.o.) identifies as other and currently is curing on week number 7.
  Wiolonczela (Patient, 21 y.o.) identifies as other and currently is curing on week number 2.

exception caught: At least two work items are scheduled to occur at the same time.
removing this work item and moving on

trying to perform work: operation and teaching new doctors at 13 for 3 hours in Surgery (cleanliness level:
0.164412) located in M11, room number 316.
work done.
```

3. Testy

Weryfikacja poprawności działania pojedynczych elementów programu została dodana wraz z plikiem *tests.cpp*.

```
TEST_CASE("Basic object creation")
{
   SECTION("Person creation")
   {
       Doctor p("Alfred", 44, Gender::Male,
DoctorTitle::Cardiolog);
       auto info = p.getInfo();
       REQUIRE(info == "Alfred (Doctor, 44 y.o.) identifies as
male and holds the title of Cardiolog.\n");
   }
```

```
    SECTION("Room creation")
    {
        PrivateOffice r("001", "M-11", true);
        auto info = r.getInfo();
        REQUIRE(info == "PrivateOffice with free coffee located in
M-11, room number 001.\n");
    }

    SECTION("Work creation")
    {
        Surgery r("001", "M-11", 0.5);
        Operation w(12, 2, &r, true);
        auto info = w.getInfo();
        REQUIRE(info == "operation and teaching new doctors at 12
for 2 hours in Surgery (cleanliness level: 0.5) located in M-11,
room number 001.\n");
    }
}
```

```
TEST_CASE("EnumToString")
{
    SECTION("GenderToString")
    {
        REQUIRE(EnumToString::GenderToString(Gender::Other) ==
"other");
    }

    SECTION("DoctorTitleToString")
    {

REQUIRE(EnumToString::DoctorTitleToString(DoctorTitle::Neurologis
t) == "Neurologist");
    }
}
```

Po skompilowaniu i uruchomieniu testów za pomocą komendy *./wzpo_tests*, otrzymujemy werdykt:

```
./wzpo_tests
===============================================================
All tests passed (5 assertions in 2 test cases)
```

4. Wnioski

Wykonany program przedstawił w praktyce wykorzystanie paradygmatów programowania obiektowego oraz wykorzystania wzorców projektowych. Głównymi elementami, na których się skupiono było dziedziczenie oraz wzorzec fabryka. Program posiada również testy weryfikujące poprawność jego działania. Całość systemu jest możliwa do wglądu i odtworzenia poprzez umieszczenie jej na publicznym repozytorium.