Лабораторна робота №2
Перевантаження операцій.

Мета: Одержати практичні навички створення абстрактних типів даних і перевантаження операцій у мові C++.

Основний зміст роботи.

Визначити і реалізувати клас — абстрактний тип даних. Визначити і реалізувати операції над даними цього класу. Написати і виконати програму повного тестування цього класу.

Завдання 1

В клас Money додати перевантаження:

- операції ++ (--): одночасно збільшує (зменшує) значення полів first і second;
- операції !: повертає значення true, якщо поле second не нульове, інакше false;
- операції бінарний +: додає до значення поля second значення скаляра;
- перетворення типу Money в string (і навпаки).

Код програми

Money.h

```
#ifndef MONEY_H
#define MONEY_H

#include <string>

class Money
{

private:
	unsigned int _denominations;
	unsigned long _counts;

public:

	//--------- Constructors and Destructor -----------
#pragma region
	Money() {}
	Money(unsigned int denominations = 0, unsigned long counts = 0);
	Money(const Money& other);
	Money(Money&& other) noexcept;
	~Money();

#pragma endregion
	//---------------------------- Gets / Sets --------------------------------
#pragma region
	int getDenominations() const;
	long getCounts() const;
	bool setDenominations(int denominations);
	bool setCounts(long counts);
#pragma endregion
```

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```
        //------------------------ Overloaded Operators --------------------------
#pragma region

        Money operator+(const Money& other) const;
        Money operator-(const Money& other) const;
        Money& operator=(const Money& other);
        Money& operator=(Money&& other) noexcept;
        bool operator==(const Money& other) const;
        bool operator!=(const Money& other) const;
        bool operator<(const Money& other) const;
        bool operator<=(const Money& other) const;
        bool operator>(const Money& other) const;
        bool operator>=(const Money& other) const;
        operator std::string() const;
        Money& operator++();          // Prefix increment
        Money operator++(int);        // Postfix increment
        Money& operator--();          // Prefix decrement
        Money operator--(int);        // Postfix decrement
        friend std::ostream& operator<<(std::ostream& os, const Money& money);
        friend std::istream& operator>>(std::istream& is, Money& money);

#pragma endregion
};

#endif // MONEY_H
```

Money.cpp

```
#include "Money.h"
#include <iostream>

//---------------------- Constructors and Destructor ----------------------
#pragma region

Money::Money(unsigned int denominations, unsigned long counts)
        : _denominations(denominations), _counts(counts)
{
        std::cout << "Money::Money(int denominations, long counts) called" << std::endl;
}

Money::Money(const Money& other)
        : _denominations(other._denominations), _counts(other._counts)
{
        std::cout << "Money::Money(const Money& other) called" << std::endl;
}

Money::Money(Money&& other) noexcept
{
        _denominations = other._denominations;
        _counts = other._counts;
        other._denominations = 0;
        other._counts = 0;
        std::cout << "Money::Money(Money&& other) called" << std::endl;
}

Money::~Money()
{
        _denominations = 0;
        _counts = 0;
        std::cout << "Money::~Money called" << std::endl;
}
#pragma endregion
//---------------------------- Gets / Sets --------------------------------
#pragma region
```

```
int Money::getDenominations() const
{
	return _denominations;
}

long Money::getCounts() const
{
	return _counts;
}

bool Money::setDenominations(int denominations)
{
	if (denominations >= 0)
	{
		_denominations = denominations;
		return true;
	}
	else return false;
}

bool Money::setCounts(long counts)
{
	if (counts >= 0)
	{
		_counts = counts;
		return true;
	}
	else return false;
}
#pragma endregion

//------------------------ Overloaded Operators --------------------------
#pragma region
Money Money::operator+(const Money& other) const
{
	std::cout << "operator+ called" << std::endl;
	if (_denominations < 0)
		return Money(0, _counts + other._counts);

	if (_counts < 0)
		return Money(_denominations, 0);

	return Money(_denominations + other._denominations, _counts + other._counts);
}

Money Money::operator-(const Money& other) const
{
	std::cout << "operator- called" << std::endl;
	{
		if (_denominations < 0)
			return Money(0, _counts - other._counts);

		if (_counts < 0)
			return Money(_denominations - other._denominations, 0);

		return Money(_denominations - other._denominations, _counts - other._counts);
	}
}

Money& Money::operator=(const Money& other)
{
	std::cout << "operator= called" << std::endl;
	if (this != &other) {
```

```
                _denominations = other._denominations;
                _counts = other._counts;
        }
        return *this;
}

Money& Money::operator=(Money&& other) noexcept
{
        std::cout << "operator=(move) called" << std::endl;
        if (this != &other) {
                _denominations = std::move(other._denominations);
                _counts = std::move(other._counts);
                other._denominations = 0;
                other._counts = 0;
        }
        return *this;
}

bool Money::operator==(const Money& other) const
{
        std::cout << "operator== called" << std::endl;
        if (_denominations == other._denominations && _counts == other._counts)
                return true;
        else
                return false;
}

bool Money::operator!=(const Money& other) const
{
        std::cout << "operator!= called" << std::endl;
        if (_denominations == other._denominations || _counts == other._counts)
                return false;
        else
                return true;
}

bool Money::operator<(const Money& other) const
{
        std::cout << "operator< called" << std::endl;
        if (_denominations < other._denominations && _counts < other._counts)
                return true;

        else if (_denominations == other._denominations && _counts < other._counts)
                return true;

        else if (_denominations < other._denominations && _counts == other._counts)
                return true;

        else return false;
}

bool Money::operator<=(const Money& other) const
{
        std::cout << "operator<= called" << std::endl;
        if (_denominations <= other._denominations && _counts <= other._counts)
                return true;

        else return false;
}

bool Money::operator>(const Money& other) const
{
        std::cout << "operator> called" << std::endl;
```

```
	if (_denominations > other._denominations && _counts > other._counts)
		return true;

	else if (_denominations == other._denominations && _counts > other._counts)
		return true;

	else if (_denominations > other._denominations && _counts == other._counts)
		return true;

	else return false;
}

bool Money::operator>=(const Money& other) const
{
	std::cout << "operator>= called" << std::endl;
	if (_denominations >= other._denominations && _counts >= other._counts)
		return true;

	else return false;
}

Money::operator std::string() const
{
	std::cout << "operator std::string() called" << std::endl;
	std::string a = "_denominations " + std::to_string(_denominations);
	a += "  _counts " + std::to_string(_counts);
	return a;
}

Money& Money::operator++() // Prefix increment
{
	std::cout << "operator++ called" << std::endl;
	++_counts;
	return *this;
}

Money Money::operator++(int) // Postfix increment
{
	std::cout << "operator++(int) called" << std::endl;
	Money temp = *this;
	++_counts;
	return temp;
}

Money& Money::operator--() // Prefix decrement
{
	std::cout << "operator-- called" << std::endl;
	if (_counts > 0)
		--_counts;
	return *this;
}

Money Money::operator--(int) // Postfix decrement
{
	std::cout << "operator--(int) called" << std::endl;
	Money temp = *this;
	if (_counts > 0)
		--_counts;
	return temp;
}

std::ostream& operator<<(std::ostream& os, const Money& money) {
	std::cout << "operator<<(ostream) called" << std::endl;
```

```
	return os << "Denomination: " << money._denominations << std::endl << "Counts: " << money._counts << std::endl;
}
std::istream& operator>>(std::istream& is, Money& money) {
	std::cout << "operator>>(istream) called" << std::endl;
	return is >> money._denominations >> money._counts;
}

#pragma endregion
```

Main.cpp

```
#include <iostream>
#include "Money.h"


int main()
{
   std::cout << "----------------------- Constructors -------------------------" << std::endl;
   Money walletOne(10, 5);
   Money walletTwo(50, 200);
   Money walletThree = walletTwo;
   Money walletFour = std::move(walletThree);

   std::cout << std::endl;

   std::cout << "----------------------- Overloaded operators -------------------------" << std::endl;

   Money walletFive(100, 20);
   Money walletSix(100, 50);

   Money sum = walletSix + walletFive;
   std::cout << "walletSix + walletFive:" << std::endl;
   std::cout << sum << std::endl;

   Money diff = walletSix - walletFive;
   std::cout << "walletSix - walletFive:" << std::endl;
   std::cout << diff << std::endl;

   walletThree = walletTwo;
   std::cout << "walletThree after assigmetn walletTwo:" << std::endl;
   std::cout << walletThree << std::endl;

   std::cout << std::boolalpha;
   std::cout << "walletFive == walletSix ? " << (walletFive == walletSix) << std::endl;
   std::cout << "walletFive != walletSix ? " << (walletFive != walletSix) << std::endl;

   ++walletFive;
   std::cout << "walletFive after ++ : " << walletFive << std::endl;
   walletFive--;
   std::cout << "walletFive after -- : " << walletFive << std::endl;

   std::string str = static_cast<std::string>(walletSix);
   std::cout << "walletSix as a string: " << str << std::endl;
}
```

Результат

```
---------------------- Constructors ----------------------
Money::Money(int denominations, long counts) called
Money::Money(int denominations, long counts) called
Money::Money(const Money& other) called
Money::Money(Money&& other) called

---------------------- Overloaded operators ----------------------
Money::Money(int denominations, long counts) called
Money::Money(int denominations, long counts) called
operator+ called
Money::Money(int denominations, long counts) called
walletSix + walletFive:
operator<<(ostream) called
Denomination: 200
Counts: 70

operator- called
Money::Money(int denominations, long counts) called
walletSix - walletFive:
operator<<(ostream) called
Denomination: 0
Counts: 30

operator= called
walletThree after assigmetn walletTwo:
operator<<(ostream) called
Denomination: 50
Counts: 200

operator== called
walletFive == walletSix ? false
operator!= called
walletFive != walletSix ? false
operator++ called
walletFive after ++ : operator<<(ostream) called
Denomination: 100
Counts: 21

operator--(int) called
Money::Money(const Money& other) called
Money::~Money called
walletFive after -- : operator<<(ostream) called
Denomination: 100
Counts: 20

operator std::string() called
walletSix as a string: _denominations 100  _counts 50
Money::~Money called
Money::~Money called
Money::~Money called
Money::~Money called
Money::~Money called
Money::~Money called
Money::~Money called
```

Завдання 2

Windows Form

PhoneClass.cs

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;

namespace Lab_WinForm_Daryev
{
    internal class PhoneClass
    {
        public string phoneName { get; set; }
        public string phoneModel { get; set; }
        public DateTime phoneYear { get; set; }
        public double phonePrice { get; set; }

        public PhoneClass()
        {
            phoneName = "default";
            phoneModel = "default";
            phoneYear = new DateTime(1960, 01, 01);
            phonePrice = 0;
        }
        public PhoneClass(string name, string number, DateTime year, double price)
        {
            phoneName = name;
            phoneModel = number;

            if (year <= new DateTime(1960, 01, 01))
            {
                phoneYear = new DateTime(1960, 01, 01);
            }
            else if (year >= DateTime.Now)
            {
                phoneYear = DateTime.Now;
            }
            else phoneYear = year;

            phonePrice = price;
        }

        // ---------------------------- Operator Overloading ----------------------------
        static public bool operator >(PhoneClass phone1, PhoneClass phone2)
        {
            return phone1.phonePrice > phone2.phonePrice;
        }
        static public bool operator <(PhoneClass phone1, PhoneClass phone2)
        {
            return phone1.phonePrice < phone2.phonePrice;
        }
        static public bool operator ==(PhoneClass phone1, PhoneClass phone2)
        {
            return phone1.Equals(phone2);
        }
        static public bool operator !=(PhoneClass phone1, PhoneClass phone2)
        {
            return !phone1.Equals(phone2);
        }
        static public bool operator >=(PhoneClass phone1, PhoneClass phone2)
        {
            return phone1.phonePrice >= phone2.phonePrice;
        }
        static public bool operator <=(PhoneClass phone1, PhoneClass phone2)
        {
            return phone1.phonePrice <= phone2.phonePrice;
        }
        public override bool Equals(object obj)
        {
```

```
            if (obj == null)
                return false;

            if (obj is PhoneClass phone)
            {
                return this.phoneName.Equals(phone.phoneName, StringComparison.OrdinalIgnoreCase)
                    && this.phoneModel.Equals(phone.phoneModel, StringComparison.OrdinalIgnoreCase)
                    && this.phoneYear == phone.phoneYear
                    && this.phonePrice == phone.phonePrice;
            }
            return false;
        }
        public override string ToString()
        {
            return string.Format("{0,-15} {1,-15} {2,10} {3,10}",
                this.phoneName, this.phoneModel, this.phoneYear, this.phonePrice);
        }
        public override int GetHashCode()
        {
            return HashCode.Combine(phoneName.GetHashCode(), phoneModel.GetHashCode(),
phoneYear.GetHashCode(), phonePrice.GetHashCode());
        }
        static public PhoneClass operator ++(PhoneClass phone)
        {
            phone.phonePrice++;
            return phone;
        }
        static public PhoneClass operator --(PhoneClass phone)
        {
            if (phone.phonePrice > 0)
                phone.phonePrice--;

            return phone;
        }
        static public PhoneClass operator +(PhoneClass phone, double value)
        {
            phone.phonePrice += value;
            return phone;
        }
        static public PhoneClass operator -(PhoneClass phone, double value)
        {
            if (phone.phonePrice - value >= 0)
                phone.phonePrice -= value;
            else
                phone.phonePrice = 0;
            return phone;
        }

        //------------------------------------------------------------------------------


    }
}
```

MainForm.cs

```
using System.Data;
using System.IO;
using System.Numerics;

namespace Lab_WinForm_Daryev
{
   public partial class MainForm : Form
   {
      private List<PhoneClass> phoneList;
      private DataTable DT;
```

```
private DataTable filteredDT; // Filter results
private DataTable searchDT; // Search results
private int classCounter;
// ------------------------- Constructor --------------------------
public MainForm()
{
    InitializeComponent();
    phoneList = new List<PhoneClass>();
    DT = new DataTable();

    DT.Columns.Add("Company", typeof(string));
    DT.Columns.Add("Phone model", typeof(string));
    DT.Columns.Add("Phone year", typeof(DateTime));
    DT.Columns.Add("Price", typeof(int));

    filteredDT = DT.Clone();
    searchDT = DT.Clone();

    dataGridView1.DataSource = DT;
}

// ----------------------- Input controls -------------------------
private void ControlInput(object sender, KeyPressEventArgs e)
{
    switch (sender)
    {
        case TextBox tb:
            switch (tb.Name)
            {
                case "modelFilterTB":
                case "nameFilterTB":
                case "phNameTB":
                case "phModelTB":
                    if (e.KeyChar != '-' && !char.IsDigit(e.KeyChar) &&
                        !char.IsLetter(e.KeyChar) && !char.IsControl(e.KeyChar))
                        e.Handled = true;
                    break;

                case "phYearMTB":
                case "yearFilterTB":
                    if (!char.IsDigit(e.KeyChar) && !char.IsControl(e.KeyChar))
                        e.Handled = true;
                    break;

                case "phPriceTB":
                case "priceFilterTB":
```

```
                if (!char.IsDigit(e.KeyChar) && !char.IsControl(e.KeyChar) && e.KeyChar !=
        '.')
                    e.Handled = true;

                if (e.KeyChar == '.')
                {

                    if (tb.Text.Contains('.') || tb.SelectionStart == 0)
                        e.Handled = true;
                }
                break;
            }
            break;

        case MaskedTextBox mtb:
            if (!char.IsDigit(e.KeyChar) && !char.IsControl(e.KeyChar))
                e.Handled = true;
            break;
    }
}
private void searchTBControlInput(object sender, KeyPressEventArgs e)
{
    if (searchByYearRB.Checked)
    {
        if (!char.IsDigit(e.KeyChar) && !char.IsControl(e.KeyChar))
            e.Handled = true;
    }
    else
    {
        if (e.KeyChar != '-' && !char.IsDigit(e.KeyChar) &&
            !char.IsLetter(e.KeyChar) && !char.IsControl(e.KeyChar))
            e.Handled = true;
    }
}
// ---------------------- Update class counter -----------------------
private void UpdateCounter()
{
    classCountL.Text = phoneList.Count.ToString();
}
// ---------------------------- Events -----------------------------
// Create object
private void createButton_Click(object sender, EventArgs e)
{
    if (withParChB.CheckState == CheckState.Checked)
    {
        var phOne = new PhoneClass();
        phoneList.Add(phOne);
```

```
            DT.Rows.Add(phOne.phoneName, phOne.phoneModel, phOne.phoneYear,
            phOne.phonePrice);
            UpdateCounter();
            return;
        }
        if (!ValidateInputs(out string company, out string model, out DateTime year, out double
            price))
            return;

        var phone = new PhoneClass(company, model, year, price);
        phoneList.Add(phone);
        DT.Rows.Add(phone.phoneName, phone.phoneModel, phone.phoneYear,
            phone.phonePrice);
        phNameTB.Clear();
        phModelTB.Clear();
        phYearMTB.Clear();
        phPriceTB.Clear();
        UpdateCounter();
    }
    // Save file
    private void saveFileTSMI_Click(object sender, EventArgs e)
    {
        var saveFile = new SaveFileDialog();
        string filePath;
        saveFile.Filter = "Binary File(.bin)|*.bin";

        if (saveFile.ShowDialog() == DialogResult.OK)
        {
            filePath = saveFile.FileName;
            using (var binWritter = new BinaryWriter(new FileStream(filePath,
            FileMode.Create)))
            {
                foreach (var value in phoneList)
                {
                    binWritter.Write(value.phoneName);
                    binWritter.Write(value.phoneModel);
                    binWritter.Write(value.phoneYear.Date.ToBinary());
                    binWritter.Write(value.phonePrice);
                }
            }
        }
    }
    // Open file
    private void openFileTSMI_Click(object sender, EventArgs e)
    {
        var openFile = new OpenFileDialog();
        string filePath;
```

```
    openFile.Filter = "Binary File(.bin)|*.bin";

    if (openFile.ShowDialog() == DialogResult.OK)
    {
        filePath = openFile.FileName;

        phoneList.Clear();
        try
        {
            using (var binReader = new BinaryReader(new FileStream(filePath,
          FileMode.Open)))
            {
                while (binReader.BaseStream.Position < binReader.BaseStream.Length)
                {
                    var value = new PhoneClass
                    {
                        phoneName = binReader.ReadString(),
                        phoneModel = binReader.ReadString(),
                        phoneYear = DateTime.FromBinary(binReader.ReadInt64()),
                        phonePrice = binReader.ReadDouble()
                    };
                    phoneList.Add(value);
                }
            }
        }
        catch (Exception ex)
        {
            MessageBox.Show(ex.Message, "Error", MessageBoxButtons.OK,
          MessageBoxIcon.Error);
        }
        foreach (var phone in phoneList)
        {
            DT.Rows.Add(phone.phoneName, phone.phoneModel, phone.phoneYear,
          phone.phonePrice);
        }
    }
}

private void filterButton_Click(object sender, EventArgs e)
{
    var filteredList = new List<PhoneClass>();

    foreach (var phone in phoneList)
    {
        bool matches = true;

        if (nameFilterCB.Checked && !string.IsNullOrWhiteSpace(nameFilterTB.Text))
```

```
            {
                if (!phone.phoneName.Equals(nameFilterTB.Text,
            StringComparison.OrdinalIgnoreCase))
                    matches = false;
            }

            if (modelFilterCB.Checked && !string.IsNullOrWhiteSpace(modelFilterTB.Text))
            {
                if (!phone.phoneModel.Equals(modelFilterTB.Text,
            StringComparison.OrdinalIgnoreCase))
                    matches = false;
            }

            if (yearFilterCB.Checked && DateTime.TryParse(yearFilterTB.Text, out DateTime
            year))
            {
                if (phone.phoneYear != year)
                    matches = false;
            }

            if (priceFilterCB.Checked && double.TryParse(priceFilterTB.Text, out double price))
            {
                if (phone.phonePrice != price)
                    matches = false;
            }

            if (matches)
                filteredList.Add(phone);
        }

        filteredDT.Clear();
        foreach (var phone in filteredList)
        {
            filteredDT.Rows.Add(phone.phoneName, phone.phoneModel, phone.phoneYear,
            phone.phonePrice);
        }

        dataGridView1.DataSource = filteredDT;
    }
    private void resetButtonTSMI_Click(object sender, EventArgs e)
    {
        dataGridView1.DataSource = DT;
    }
    private void searchButton_Click(object sender, EventArgs e)
    {
        var searchList = new List<PhoneClass>();
```

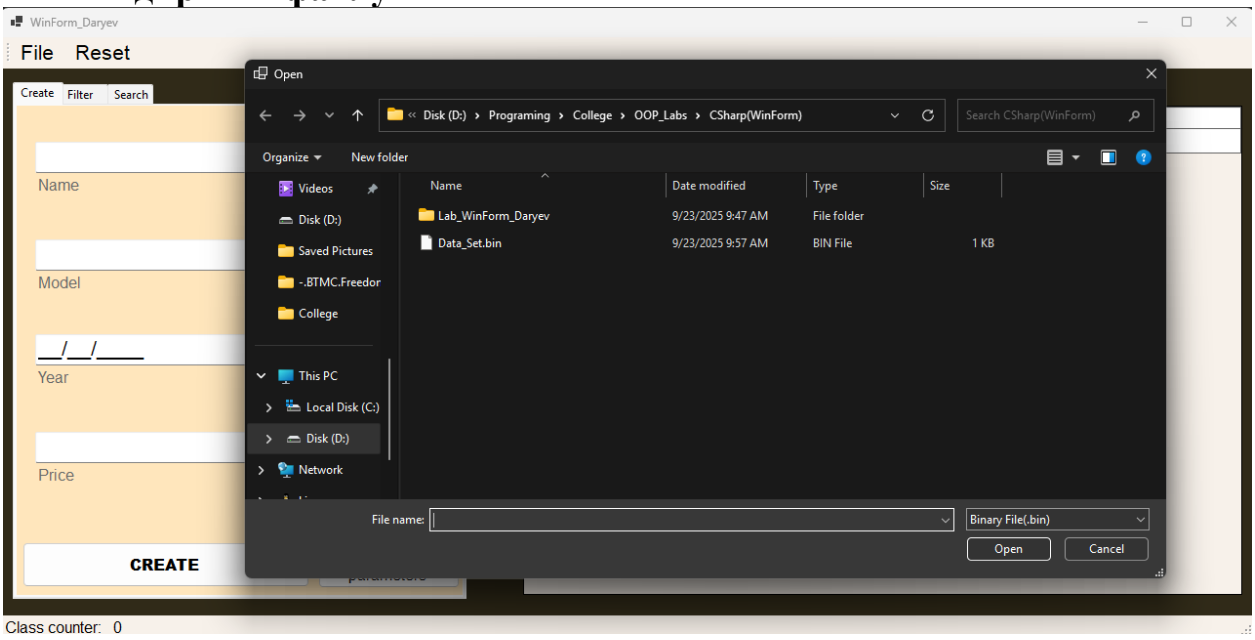
```
DateTime year;
double price;

foreach (var phone in phoneList)
{
   bool matches = true;


   if (searchNameRB.Checked)
   {
      if (!phone.phoneName.Equals(allSearchValueTB.Text,
  StringComparison.OrdinalIgnoreCase))
         matches = false;
   }


   if (searchByModelRB.Checked)
   {
      if (!phone.phoneModel.Equals(allSearchValueTB.Text,
  StringComparison.OrdinalIgnoreCase))
         matches = false;
   }


   if (searchByYearRB.Checked)
   {
      if (DateTime.TryParse(yearSearchValTB.Text, out year))
      {
         if (phone.phoneYear != year)
            matches = false;
      }
   }

   if (searchByPriceRB.Checked)
   {
      if (double.TryParse(allSearchValueTB.Text, out price))
      {
         if (phone.phonePrice != price)
            matches = false;
      }
   }

   if (matches)
      searchList.Add(phone);
}

searchDT.Clear();
```

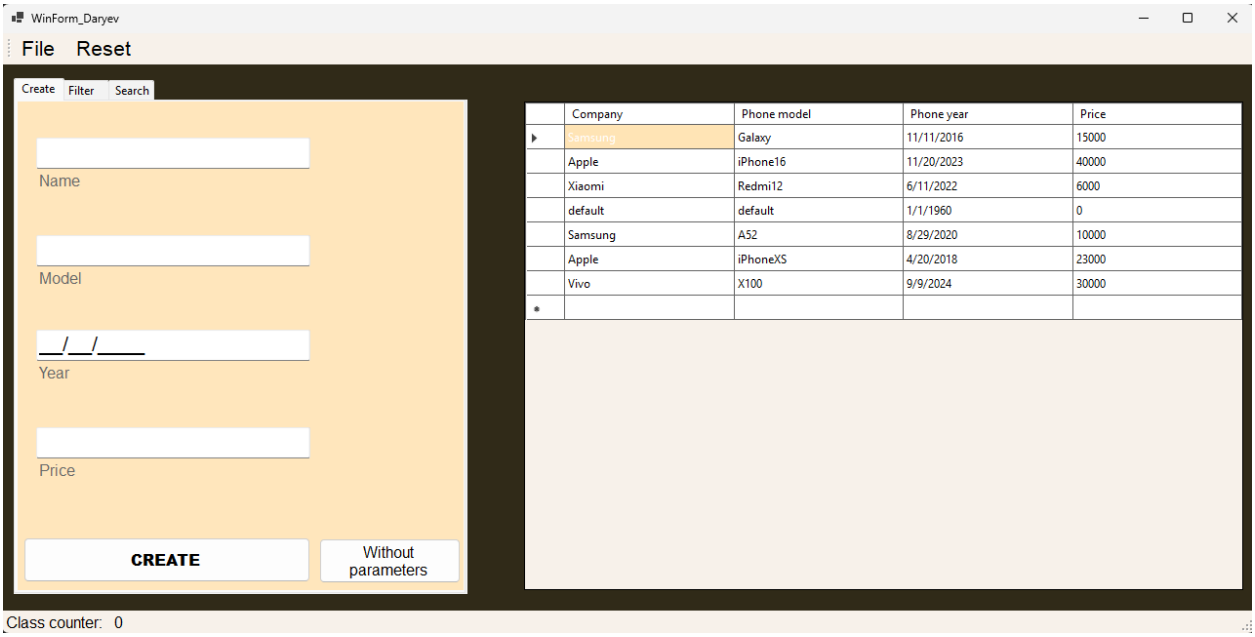
```
    foreach (var phone in searchList)
    {
        searchDT.Rows.Add(phone.phoneName, phone.phoneModel, phone.phoneYear,
       phone.phonePrice);
    }

    dataGridView1.DataSource = searchDT;
}
private void searchByYearRB_CheckedChanged(object sender, EventArgs e)
{
    if (searchByYearRB.Checked)
    {
        yearSearchValTB.Visible = true;
        allSearchValueTB.Visible = false;
    }
    else
    {
        yearSearchValTB.Visible = false;
        allSearchValueTB.Visible = true;
    }
}



// --------------------------- Methodes ----------------------------
// Validate parametrs
private bool ValidateInputs(out string company, out string model, out DateTime year, out
      double price)
{
    company = phNameTB.Text.Trim();
    model = phModelTB.Text.Trim();
    year = DateTime.MinValue;
    price = 0;

    if (string.IsNullOrWhiteSpace(company) ||
        string.IsNullOrWhiteSpace(model) ||
        string.IsNullOrWhiteSpace(phYearMTB.Text) ||
        string.IsNullOrWhiteSpace(phPriceTB.Text))
    {
        MessageBox.Show("Please, fill all fields", "Error", MessageBoxButtons.OK,
       MessageBoxIcon.Error);
        return false;
    }

    if (!DateTime.TryParse(phYearMTB.Text, out year))
    {
```

```
            MessageBox.Show("Year is invalid", "Error", MessageBoxButtons.OK,
            MessageBoxIcon.Error);
            return false;
        }
        if (year <= new DateTime(1960, 01, 01))
        {
            year = new DateTime(1960, 01, 01);
        }
        else if (year >= DateTime.Now)
        {
            year = DateTime.Now.Date;
        }

        if (!double.TryParse(phPriceTB.Text, out price) || price <= 0)
        {
            MessageBox.Show("Price must be a positive number", "Error",
            MessageBoxButtons.OK, MessageBoxIcon.Error);
            return false;
        }

        return true;
    }



}
}
```

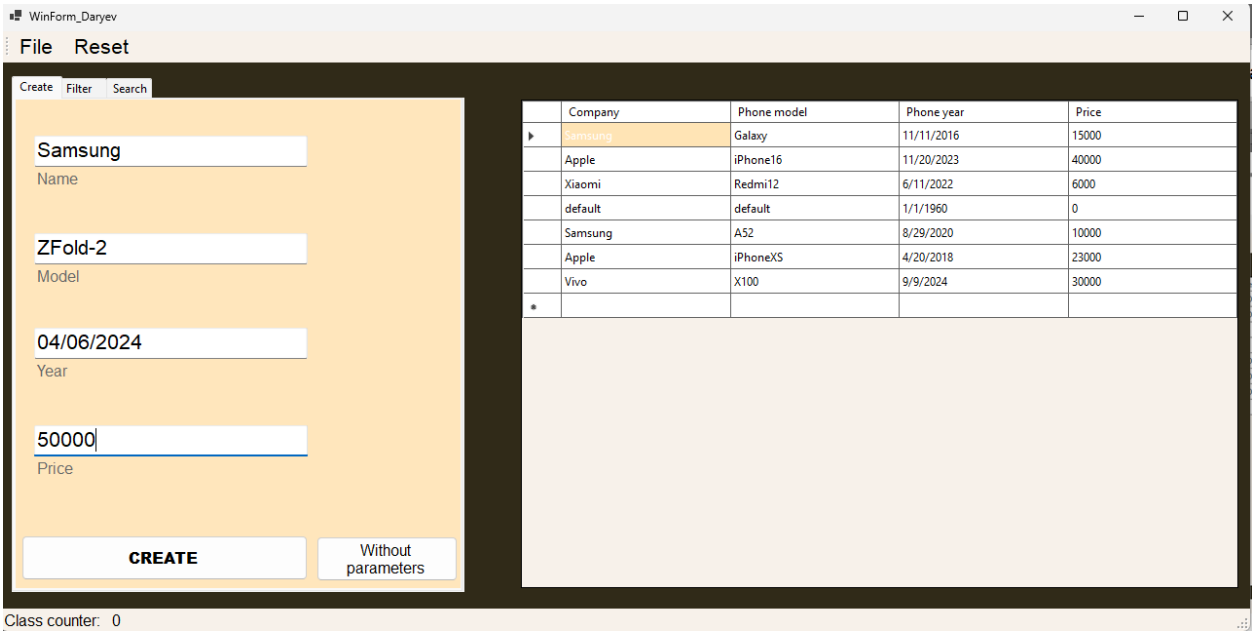
Результат

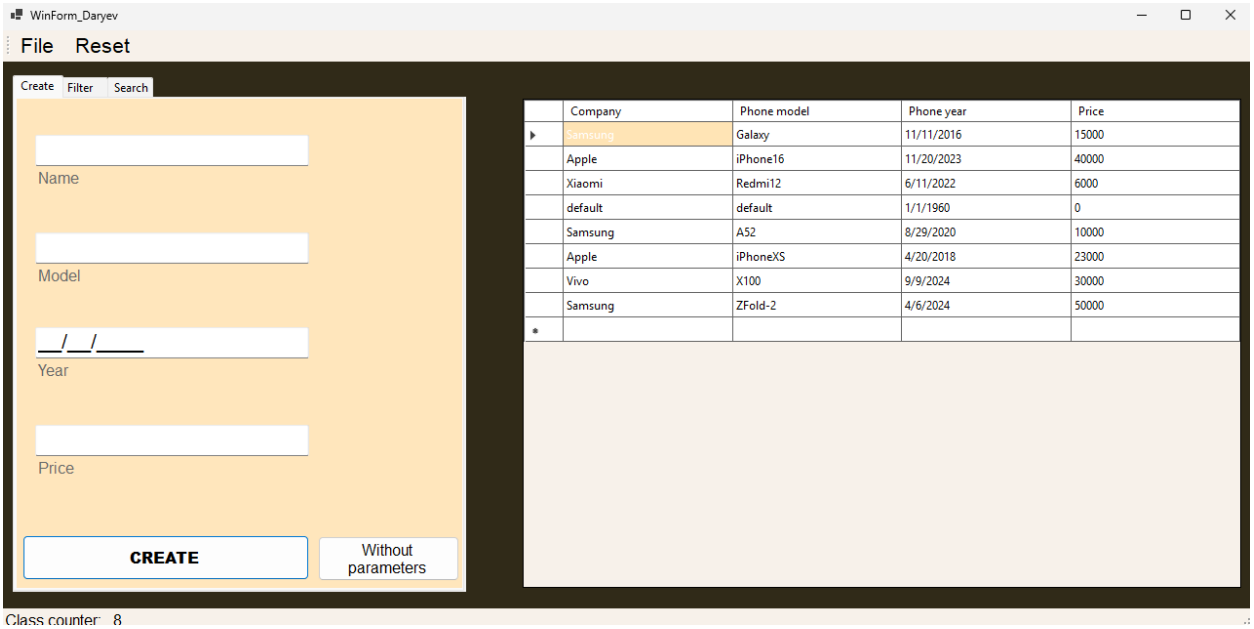
- **Відкриття файлу**



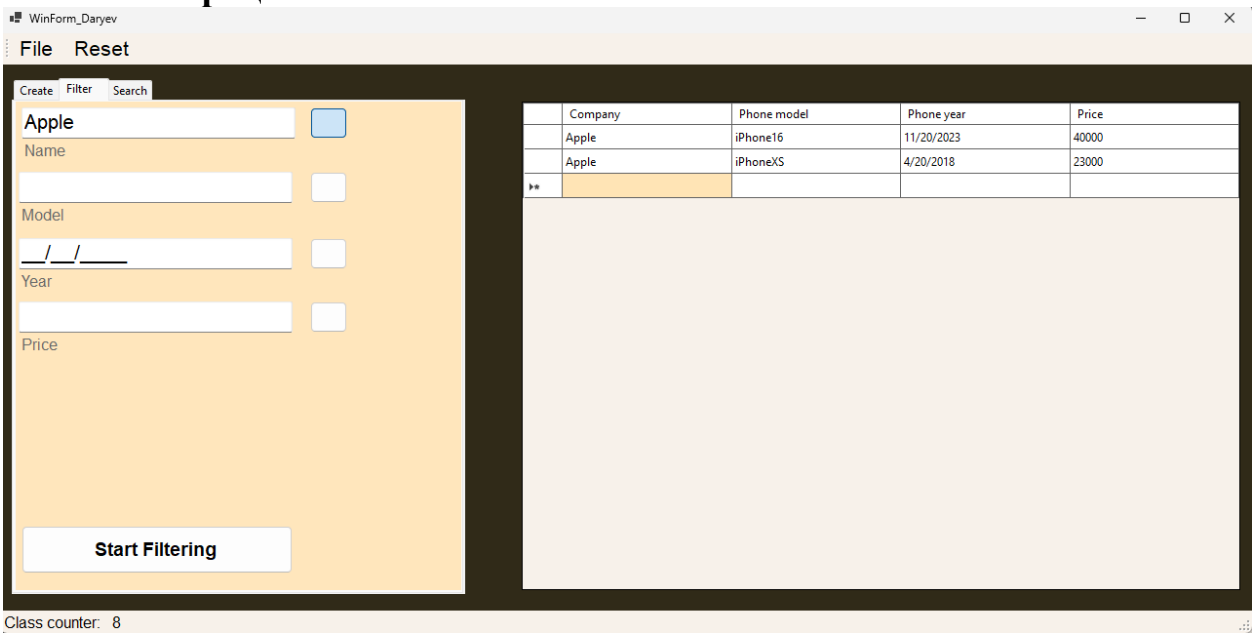


- **Додавання нового об’єкта класу**

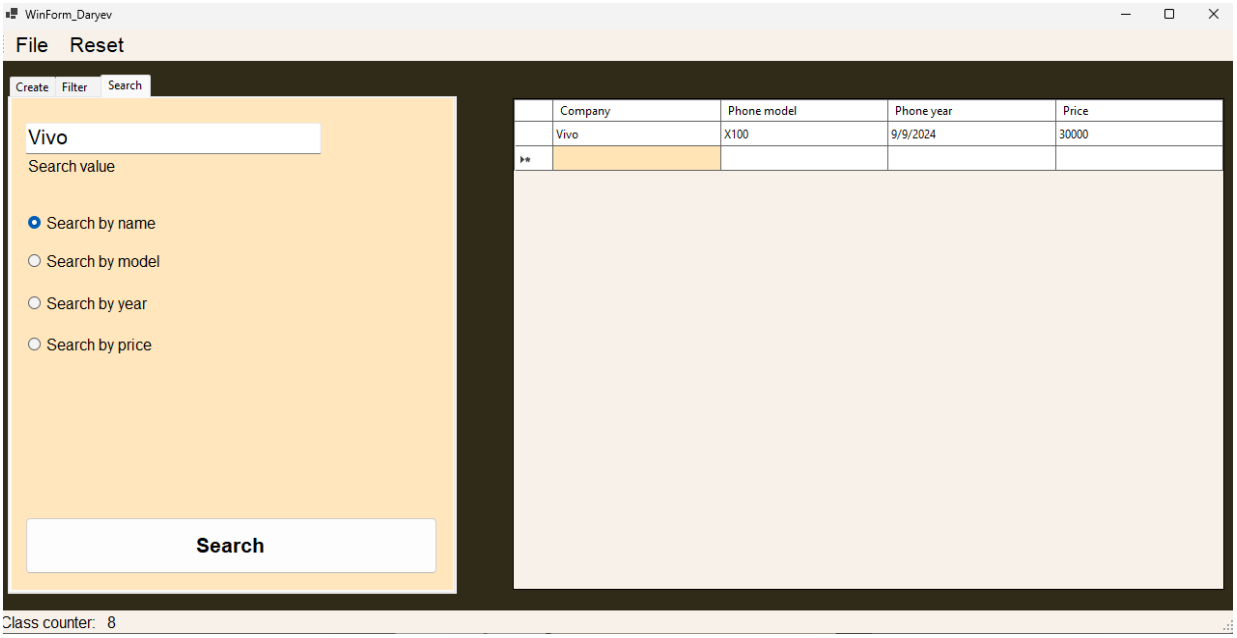




- **Фільтрація**



- **Пошук**



Висновок: на лабораторній роботі було одержано практичні навички створення абстрактних типів даних і перевантаження операцій у мові C++ та C#.