Міністерство освіти і науки України
Національний технічний університет України "Київський політехнічний інститут імені Ігоря Сікорського"
Факультет інформатики та обчислювальної техніки
Кафедра обчислювальної техніки

ЗВІТ

з лабораторної роботи №3.3 з дисципліни
«Інтелектуальні вбудовані системи»

Виконав:
ІП-83
Сергійчук Н. С.

Київ 2020

1. Завдання

Налаштувати генетичний алгоритм для знаходження цілих коренів діофантового рівняння ax1+bx2+cx3+dx4=y. Розробити відповідний мобільний додаток і вивести

2. отримані значення. Провести аналіз витрат часу на розрахунки.Лістинг програми

```
import 'dart:math';


abstract class Phenotype {
int fitness();
List<Phenotype> crossover(Random rng, Phenotype other);
Phenotype mutate(Random rng);
}
```

```
class CachedPhenotype {
Phenotype ph;
int fitness;
```

```
CachedPhenotype(this.ph, this.fitness);
}
```

```
class WeightedPhenotype {
Phenotype ph;
double weight;
```

```
WeightedPhenotype(this.ph, this.weight);
```

```
String toString() => "Wp($weight)";
```

```
}

List<WeightedPhenotype> weight(List<CachedPhenotype> ph) {
double sum =
ph.map((w) => 1.0 / w.fitness).fold(0, (prev, next) => prev + next);

var weighted =
ph.map((c) => WeightedPhenotype(c.ph, 1.0 / c.fitness / sum)).toList();

for (int i = 1; i < weighted.length; i++) {
weighted[i].weight += weighted[i - 1].weight;
}
return weighted;
}

Phenotype chooseWeighted(Random rng, List<WeightedPhenotype> ph) {
var random = rng.nextDouble();
for (var w in ph) {
if (random < w.weight) {
return w.ph;
}
}
throw Unreachable();
}

class Unreachable extends Error {}

class Simulator {
```

```
List<Phenotype> _population;
int maxIters;
int iters = 0;
Random rng = Random();
Stopwatch stopwatch = Stopwatch();
```

```
Simulator(this._population, {this.maxIters});
```

```
Duration get elapsed => stopwatch.elapsed;
```

```
Phenotype run() {
stopwatch.start();
while (true) {
var sorted = _population
.map((ph) => CachedPhenotype(ph, ph.fitness()))
.toList()
..sort((a, b) => a.fitness.compareTo(b.fitness));
assert(sorted.first.fitness >= 0);
```

```
if (sorted.first.fitness == 0 || iters == maxIters) {
stopwatch.stop();
return sorted.first.ph;
}
```

```
var weights = weight(sorted);
var nextPopulation = <Phenotype>[];
for (int i = 0; i < _population.length / 2; i++) {
var mom = chooseWeighted(rng, weights);
```

```
var dad = chooseWeighted(rng, weights);
var childs = mom.crossover(rng, dad);
nextPopulation.addAll(childs);
}
for (var ph in nextPopulation) {
ph.mutate(rng);
}
_population = nextPopulation;
iters++;
}
}
}
```

```
class DiophantineEquation {
List<int> coeffs;
int goal;
```

```
DiophantineEquation(this.coeffs, this.goal);
}
```

```
class Diophantine extends Phenotype {
List<int> solutions;
DiophantineEquation equation;
```

```
Diophantine(this.equation, this.solutions);
```

```
@override
List<Phenotype> crossover(Random rng, Phenotype other) {
```

```
var dad = other as Diophantine;
var len = solutions.length;
var mid = rng.nextInt(len);
var alice = Diophantine(equation, List<int>.filled(len, 0));
var bob = Diophantine(equation, List<int>.filled(len, 0));
for (int i = 0; i < len; i++) {
if (i < mid) {
alice.solutions[i] = solutions[i];
bob.solutions[i] = dad.solutions[i];
} else {
alice.solutions[i] = dad.solutions[i];
bob.solutions[i] = solutions[i];
}
}
return [alice, bob];
}
```

```
@override
int fitness() {
int sum = 0;
for (int i = 0; i < solutions.length; i++) {
sum += solutions[i] * equation.coeffs[i];
}
sum -= equation.goal;
return sum < 0 ? -sum : sum;
}
```

```
@override
```

```
Phenotype mutate(Random rng) {
var index = rng.nextInt(solutions.length);
var delta = rng.nextBool() ? 1 : -1;
solutions[index] += delta;
return this;
}
```

```
String toString() {
var result = "";
var plus = "";
for (int i = 0; i < solutions.length; i++) {
result += "$plus${solutions[i]} * ${equation.coeffs[i]}";
plus = " + ";
}
result += " = ${equation.goal}";
return result;
}
}
```

```
// void main() {
// var rng = Random();
// var coeffs = List<int>.generate(10, (index) => index);
// var eqaution = DiophantineEquation(coeffs, 10);
// var start = List<Diophantine>.generate(10, (index) {
// var solutions = List<int>.generate(10, (index) => rng.nextInt(5));
// return Diophantine(eqaution, solutions);
// });
// var simulation = Simulator(start, maxIters: 100);
```

```
// var result = simulation.run();
// print(result);
// }
```

/============================

```
import 'dart:math';

import 'package:flutter/material.dart';
import 'package:flutter/services.dart';
import 'package:lab3_3/genetic.dart';

void main() {
runApp(MyApp());
}

class MyApp extends StatelessWidget {
// This widget is the root of your application.
@override
Widget build(BuildContext context) {
return MaterialApp(
title: 'Flutter Demo',
theme: ThemeData(
primarySwatch: Colors.blue,
),
home: MyHomePage(title: 'Flutter Demo Home Page'),
```

```
);
}
}
```

```
class MyHomePage extends StatefulWidget {
MyHomePage({Key key, this.title}) : super(key: key);
final String title;
@override
_MyHomePageState createState() => _MyHomePageState();
}
```

```
class _MyHomePageState extends State<MyHomePage> {
List<int> result = [0, 0, 0, 0];
List<int> coeffs = [1, 1, 1, 1, 1];
String stats = "";
Random rng = Random();
final int populationSize = 10;
final int eqautionSize = 4;
final int maxIters = 100;
```

```
void _runSimulation() {
setState(() {
var cfs = coeffs.take(eqautionSize).toList();
var goal = coeffs.last;
var eqaution = DiophantineEquation(cfs, eqautionSize);
var start = List<Diophantine>.generate(populationSize, (index) {
var solutions =
List<int>.generate(eqautionSize, (index) => rng.nextInt(goal));
```

```
return Diophantine(eqaution, solutions);
});
var simulation = Simulator(start, maxIters: maxIters);
var res = simulation.run() as Diophantine;
result = res.solutions;
var time = simulation.elapsed.inMilliseconds;
var iters = simulation.iters;
stats = "Took: ${time}ms\nIterations: $iters";
});
}
```

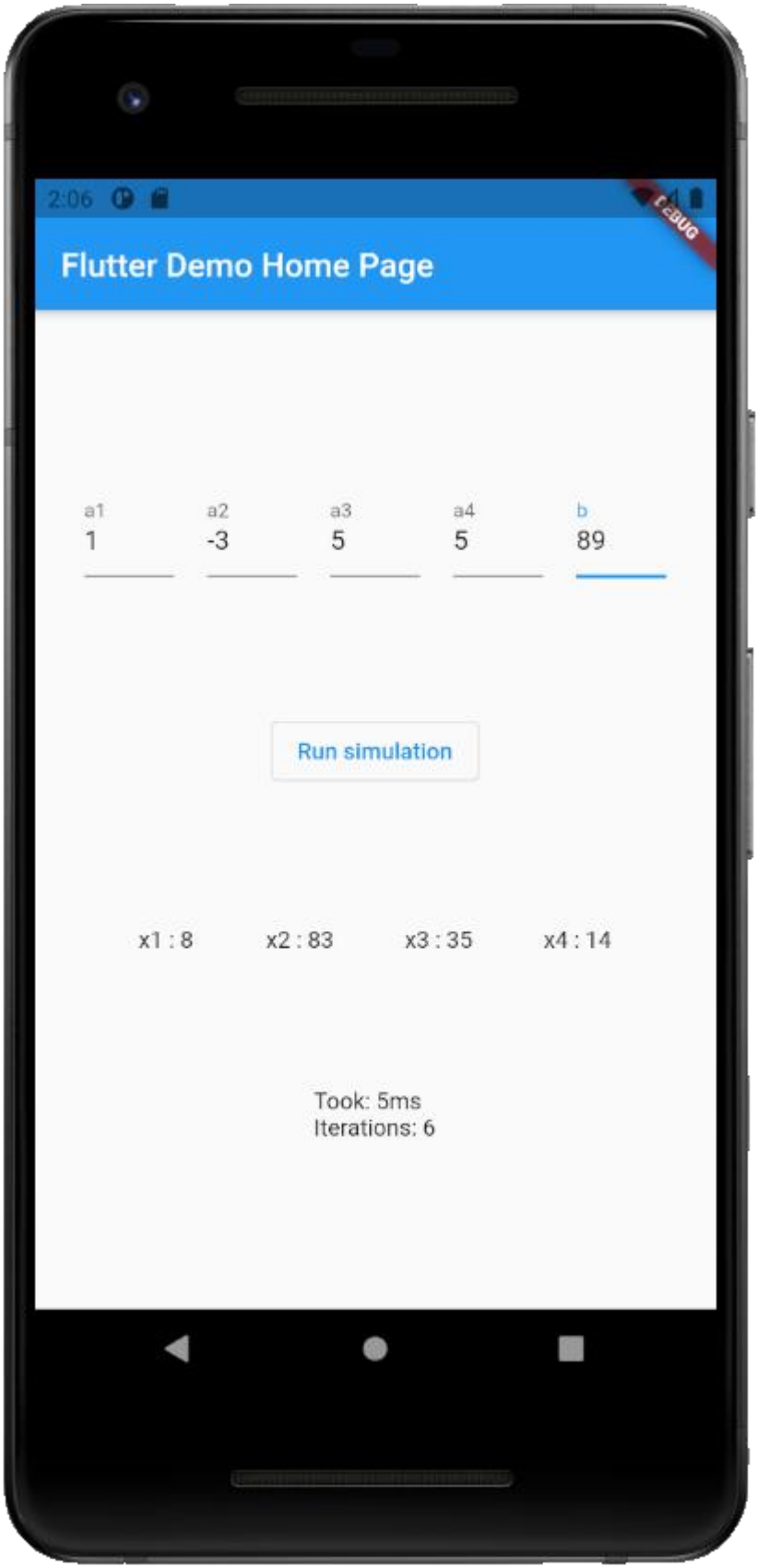
```
@override
Widget build(BuildContext context) {
// This method is rerun every time setState is called, for instance as
done
// by the _incrementCounter method above.
//
// The Flutter framework has been optimized to make rerunning build
methods
// fast, so that you can just rebuild anything that needs updating rather
// than having to individually change instances of widgets.
return Scaffold(
appBar: AppBar(
// Here we take the value from the MyHomePage object that was created by
// the App.build method, and use it to set our appbar title.
title: Text(widget.title),
),
body: Container(
padding: const EdgeInsets.all(20.0),
```

```
child: Column(
mainAxisAlignment: MainAxisAlignment.spaceEvenly,
children: <Widget>[
Row(
mainAxisAlignment: MainAxisAlignment.spaceEvenly,
children: List<Widget>.generate(
5,
(index) => _buildInputField(index),
),
),
OutlinedButton(
child: Text("Run simulation"),
onPressed: () => _runSimulation()),
Row(
mainAxisAlignment: MainAxisAlignment.spaceEvenly,
children: List<Widget>.generate(
result.length, (i) => Text("x${i + 1} : ${result[i]}"))),
Text(
stats,
textAlign: TextAlign.left,
),
],
),
),
);
}
```

```
Widget _buildInputField(int index) {
```

```
var label = index < 4 ? "a${index + 1}" : "b";
return Expanded(
child: Container(
child: TextField(
decoration: InputDecoration(labelText: label),
keyboardType:
TextInputType.numberWithOptions(signed: true, decimal: false),
onChanged: (String value) => coeffs[index] = int.tryParse(value) ?? 1,
inputFormatters: [
FilteringTextInputFormatter(RegExp("^-?[0-9]{0,4}"), allow: true)
],
),
padding: const EdgeInsets.symmetric(horizontal: 10),
),
);
}
}
```

3. Результати виконання кожної програми.


2:06
DEBUG
Flutter Demo Home Page
a1
1
a2
-3
a3
5
a4
5
b
89
Run simulation
x1 : 8
x2 : 83
x3 : 35
x4 : 14
Took: 5ms
Iterations: 6