

Autore: Jevgeņija Babčenoka, jб19045

## Mazais praktiskais darbs

### 1. Uzdevuma formulējums:

Sociālajā dienestā strādā  $n$  darbinieki, kuru uzdevums ir apmeklēt vientuļos, maznodrošinātos pensionārus. Ir sastādīts apmeklējumu grafiks ar  $m$  apmeklējumiem, kur katram apmeklējumam ir zināms sākuma laiks un ilgums. Piekārtot apmeklējumiem darbiniekus tā, lai nevienam darbiniekam nebūtu vienlaicīgi jābūt vairākās vietās, kā arī kopējais katra darbinieka apmeklējumu laiks nepārsniegtu viņam noteikto slodzi  $s[i]$ .

### 2. Algoritma apraksts

Lai izveidotu sākuma risinājumu, tika izmatots First Fit algoritms, kurš katram apmeklējumam piešķir darbinieku. Lai optimizētu problēmas risinājumu, tika izmantots Simulated Annealing algoritms.

**Domēns** – katra darbinieka pensionāru apmeklējumu grafiks (laiks no, laiks līdz, darbinieka numurs).

**Izmaksu (cost) funkcija** – izmaksu funkcija tiek palielināta par 1, ja:

- sakrīt divi darbinieka apmeklējumi sociālajā dienestā;
- darbinieka slodze tika pārsniegta.

**Apkārtnes (neighborhood) funkcija** – izlases veida apmeklējums tiek nozīmēts nejauši izvēlētam darbiniekam, kuram nav noteikts dotais apmeklējums.

**Saite uz GitHub repozitoriju**

<https://github.com/jbabcenoka/combinatorialOptimization>

### 3. Testēšanas apraksts

Risinājuma pārbaudei tika izveidoti 5 (pieci) testpiemēri. Testēšanas rezultātus var redzēt 1. un 2. tabulā. Testēšanas rezultāts (patiešs vai nepatiešs) ir atkarīgs no tā, vai izmaksas ir uzlabotas, izmantojot Simulated Annealing algoritmu.

Tabula 1 – Testēšanas rezultāti

SimulatedAnnealin...	25.7 sec	
SimulatedAnneali...	25.7 sec	
OptimizatorTests	25.7 sec	
TestMethod1	702 ms	
TestMethod2	414 ms	
TestMethod3	661 ms	
TestMethod4	457 ms	
TestMethod5	23.5 sec	Assert.AreEqual failed. Expected:<1>. Actual:<0>.

Tabula 2 – Testēšanas rezultāti

Tasta numurs	Rezultāts
Test1	<div data-bbox="612 347 1251 1131"> <p>Test Detail Summary</p> <p>✓ TestMethod1</p> <p>Source: <a href="#">UnitTest1.cs</a> line 14</p> <p>Duration: 269 ms</p> <p>Standard Output:</p> <p>First fit:</p> <p>Worker 1 (max hours 5) has following visits:</p> <p>From 01/10/2023 08:00:00 to 01/10/2023 10:00:00</p> <p>From 01/10/2023 11:00:00 to 01/10/2023 13:00:00</p> <p>From 01/10/2023 17:00:00 to 01/10/2023 19:00:00</p> <p>Worker 2 (max hours 6) has following visits:</p> <p>From 01/10/2023 09:00:00 to 01/10/2023 11:00:00</p> <p>From 01/10/2023 12:00:00 to 01/10/2023 14:00:00</p> <p>From 01/10/2023 17:00:00 to 01/10/2023 18:00:00</p> <p>Cost: 1</p> <p>Simulated Annealing:</p> <p>Worker 1 (max hours 5) has following visits:</p> <p>From 01/10/2023 08:00:00 to 01/10/2023 10:00:00</p> <p>From 01/10/2023 11:00:00 to 01/10/2023 13:00:00</p> <p>From 01/10/2023 17:00:00 to 01/10/2023 18:00:00</p> <p>Worker 2 (max hours 6) has following visits:</p> <p>From 01/10/2023 09:00:00 to 01/10/2023 11:00:00</p> <p>From 01/10/2023 12:00:00 to 01/10/2023 14:00:00</p> <p>From 01/10/2023 17:00:00 to 01/10/2023 19:00:00</p> <p>Cost: 0</p> </div>
Test2	<div data-bbox="547 1160 1315 1984"> <p>Test Detail Summary</p> <p>✓ TestMethod2</p> <p>Source: <a href="#">UnitTest1.cs</a> line 48</p> <p>Duration: 201 ms</p> <p>Standard Output:</p> <p>First fit:</p> <p>Worker 1 (max hours 8) has following visits:</p> <p>From 01/10/2023 08:00:00 to 01/10/2023 13:00:00</p> <p>Worker 2 (max hours 4) has following visits:</p> <p>From 01/10/2023 08:00:00 to 01/10/2023 12:00:00</p> <p>Worker 3 (max hours 8) has following visits:</p> <p>From 01/10/2023 08:00:00 to 01/10/2023 10:00:00 - intersecting</p> <p>From 01/10/2023 09:00:00 to 01/10/2023 10:00:00 - intersecting</p> <p>From 01/10/2023 12:00:00 to 01/10/2023 14:00:00 - intersecting</p> <p>From 01/10/2023 13:00:00 to 01/10/2023 15:00:00 - intersecting</p> <p>Cost: 2</p> <p>Simulated Annealing:</p> <p>Worker 1 (max hours 8) has following visits:</p> <p>From 01/10/2023 08:00:00 to 01/10/2023 12:00:00</p> <p>From 01/10/2023 13:00:00 to 01/10/2023 15:00:00</p> <p>Worker 2 (max hours 4) has following visits:</p> <p>From 01/10/2023 09:00:00 to 01/10/2023 10:00:00</p> <p>From 01/10/2023 12:00:00 to 01/10/2023 14:00:00</p> <p>Worker 3 (max hours 8) has following visits:</p> <p>From 01/10/2023 08:00:00 to 01/10/2023 13:00:00 - intersecting</p> <p>From 01/10/2023 08:00:00 to 01/10/2023 10:00:00 - intersecting</p> <p>Cost: 1</p> </div>

Tasta numurs	Rezultāts
Test3	<div><div>Test Detail Summary</div><div><div>✔ TestMethod3</div><div><div>Source: <a href="#">UnitTest1.cs</a> line 85</div><div>Duration: 328 ms</div></div></div><div><div>Standard Output:</div><div>First fit: Worker 1 (max hours 10) has following visits: From 01/10/2023 09:00:00 to 01/10/2023 12:00:00 - intersecting From 01/10/2023 10:00:00 to 01/10/2023 11:30:00 - intersecting From 01/10/2023 15:10:00 to 01/10/2023 16:30:00 - intersecting From 01/10/2023 16:10:00 to 01/10/2023 18:00:00 - intersecting From 01/10/2023 18:10:00 to 01/10/2023 19:00:00 - intersecting From 01/10/2023 18:10:00 to 01/10/2023 19:00:00 - intersecting Worker 2 (max hours 6) has following visits: From 01/10/2023 08:00:00 to 01/10/2023 11:00:00 - intersecting From 01/10/2023 09:00:00 to 01/10/2023 10:00:00 - intersecting From 01/10/2023 12:00:00 to 01/10/2023 13:00:00 - intersecting From 01/10/2023 12:00:00 to 01/10/2023 13:00:00 - intersecting From 01/10/2023 16:10:00 to 01/10/2023 18:00:00 From 01/10/2023 18:10:00 to 01/10/2023 19:00:00 Worker 3 (max hours 4) has following visits: From 01/10/2023 09:00:00 to 01/10/2023 12:00:00 From 01/10/2023 15:00:00 to 01/10/2023 16:00:00 Cost: 6  Simulated Annealing: Worker 1 (max hours 10) has following visits: From 01/10/2023 09:00:00 to 01/10/2023 12:00:00 - intersecting From 01/10/2023 09:00:00 to 01/10/2023 12:00:00 - intersecting From 01/10/2023 16:10:00 to 01/10/2023 18:00:00 From 01/10/2023 18:10:00 to 01/10/2023 19:00:00 Worker 2 (max hours 6) has following visits: From 01/10/2023 09:00:00 to 01/10/2023 10:00:00 From 01/10/2023 12:00:00 to 01/10/2023 13:00:00 From 01/10/2023 15:10:00 to 01/10/2023 16:30:00 From 01/10/2023 18:10:00 to 01/10/2023 19:00:00 Worker 3 (max hours 4) has following visits: From 01/10/2023 08:00:00 to 01/10/2023 11:00:00 - intersecting From 01/10/2023 10:00:00 to 01/10/2023 11:30:00 - intersecting From 01/10/2023 12:00:00 to 01/10/2023 13:00:00 From 01/10/2023 15:00:00 to 01/10/2023 16:00:00 From 01/10/2023 16:10:00 to 01/10/2023 18:00:00 From 01/10/2023 18:10:00 to 01/10/2023 19:00:00 Cost: 3</div></div></div>

Tasta numurs	Rezultāts
Test4	<div data-bbox="611 271 1251 1368"> <p>Test Detail Summary</p> <p>✓ TestMethod4</p> <p>Source: <a href="#">UnitTest1.cs</a> line 130</p> <p>Duration: 251 ms</p> <p>Standard Output:</p> <p>First fit:</p> <p>Worker 1 (max hours 2) has following visits:</p> <p>From 01/10/2023 08:00:00 to 01/10/2023 09:00:00</p> <p>From 01/10/2023 12:00:00 to 01/10/2023 13:00:00</p> <p>From 01/10/2023 18:10:00 to 01/10/2023 19:00:00</p> <p>Worker 2 (max hours 10) has following visits:</p> <p>From 01/10/2023 10:00:00 to 01/10/2023 11:30:00</p> <p>From 01/10/2023 12:30:00 to 01/10/2023 13:30:00</p> <p>From 01/10/2023 15:00:00 to 01/10/2023 16:00:00</p> <p>From 01/10/2023 16:10:00 to 01/10/2023 18:00:00</p> <p>From 01/10/2023 18:10:00 to 01/10/2023 19:00:00</p> <p>Worker 3 (max hours 2) has following visits:</p> <p>From 01/10/2023 09:00:00 to 01/10/2023 10:00:00</p> <p>From 01/10/2023 15:10:00 to 01/10/2023 16:30:00</p> <p>From 01/10/2023 18:10:00 to 01/10/2023 19:00:00</p> <p>Cost: 2</p> <p>Simulated Annealing:</p> <p>Worker 1 (max hours 2) has following visits:</p> <p>From 01/10/2023 08:00:00 to 01/10/2023 09:00:00</p> <p>From 01/10/2023 18:10:00 to 01/10/2023 19:00:00</p> <p>Worker 2 (max hours 10) has following visits:</p> <p>From 01/10/2023 10:00:00 to 01/10/2023 11:30:00</p> <p>From 01/10/2023 12:30:00 to 01/10/2023 13:30:00</p> <p>From 01/10/2023 15:00:00 to 01/10/2023 16:00:00</p> <p>From 01/10/2023 16:10:00 to 01/10/2023 18:00:00</p> <p>From 01/10/2023 18:10:00 to 01/10/2023 19:00:00</p> <p>Worker 3 (max hours 2) has following visits:</p> <p>From 01/10/2023 09:00:00 to 01/10/2023 10:00:00</p> <p>From 01/10/2023 12:00:00 to 01/10/2023 13:00:00</p> <p>From 01/10/2023 15:10:00 to 01/10/2023 16:30:00</p> <p>From 01/10/2023 18:10:00 to 01/10/2023 19:00:00</p> <p>Cost: 1</p> </div>
Test5	<p>Šajā testā tiek izmantoti 50 dažādi apmeklējumi un 8 darbinieki, kuriem ir 8 darba slodži. Izpildes laiks - 1.3 sekundes, cost gan pēc First Fit, gan pēc Simulated Annealing algoritma palaišanas ir 3. Tā kā pēc Simulated Annealing algoritma izmaksu rezultāts neizmainījās, testa rezultāts ir negatīvs.</p>