**РУСЕНСКИ УНИВЕРСИТЕТ „АНГЕЛ КЪНЧЕВ“**

**КУРСОВА ЗАДАЧА**

ПО

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# Задание

Да се разработи програмна система, симулираща работата на модула за **управление на процесора (стратегия Highest Response-Ratio Next)** при следните изходни данни:

* ***Основни необходими структури:***
  + Ready таблица на готовите процеси
* ***Основни обработки:***
  + Load стартиране на нов процес;
  + Dispatch извикване на диспечер по стратегия HRRN;
  + Finish завършване на изпълняващия се процес
  + Show показване на състоянието на основните структури

Разработеният проект да има подходящ потребителски интерфейс за обръщение към основните обработки. Обяснителната записка да съдържа заданието, описание на използваните структури данни и алгоритми и програмен листинг.

# Описание на използваните структури и алгоритми

Дисциплината „най-високият коефициент на отговор (реакция) – следващ (Highest Response Ratio Next, HRRN)“ е дисциплина за планиране без превключване, съгласно която приоритетът на всеки процес зависи не само от времето за обслужване на този процес, но и от времето, изразходвано за изчакване. След като процесът получи процесора, изпълнението продължава до завършването му.

Основни променливи, използвани в реализацията на програмата:

private List<Process> startedProcesses; - списък на готовите процеси;

private Queue<int> processSeq; - последователността на изпълняване на процесите

private Process currentProcess; - текущият процес, който се изпълнява в процесора

Класът Process има следната структура:

private int number; - номер (идентификатор) на процеса

private int arrivalTime; - време на пристигане

private int serviceTime; - време за обслужване

Основни методи:

private void button1\_Click(object sender, EventArgs e) – изпълнява се натискане на бутона „Стартирай“ - за добавяне на нов процес в таблицата с готовите процеси;

private void button2\_Click(object sender, EventArgs e) – извиква се диспечер по HRRN и се определя последователността за изпълняване на процесите;

private void button3\_Click(object sender, EventArgs e) – стартира се процесът

# Код на програмата (листинг)



## Program.cs

using System;

using System.Collections.Generic;

using System.Linq;

using System.Threading.Tasks;

using System.Windows.Forms;

namespace OS\_HRRN

{

static class Program

{

[STAThread]

static void Main()

{

Application.EnableVisualStyles();

Application.SetCompatibleTextRenderingDefault(false);

Application.Run(new frmMain());

}

}

}

## frmMain.cs

using System;

using System.Collections.Generic;

using System.Data;

using System.Linq;

using System.Windows.Forms;

namespace OS\_HRRN

{

public partial class frmMain : Form

{

private List<Process> startedProcesses;

private Queue<int> processSeq;

private Process currentProcess;

private int processCounter = 0;

public frmMain()

{

InitializeComponent();

startedProcesses = new List<Process>();

}

private void button1\_Click(object sender, EventArgs e)

{

processCounter++;

startedProcesses.Add(new Process(processCounter, (int)numericUpDown2.Value, (int)numericUpDown1.Value));

startedProcesses = startedProcesses.OrderBy(item => item.ArrivalTime).ToList();

Repaint();

button4.Enabled = true;

}

private void Repaint()

{

BindingSource bs = new BindingSource();

bs.DataSource = startedProcesses;

dataGridView1.DataSource = bs;

}

private void button2\_Click(object sender, EventArgs e)

{

button2.Enabled = false;

button3.Enabled = true;

if (processSeq == null)

{

HRRN();

}

int index = processSeq.Dequeue();

currentProcess = startedProcesses[index];

label4.Text = "No: " + currentProcess.Number.ToString();

dataGridView1.Rows[index].Selected = true;

}

private void button3\_Click(object sender, EventArgs e)

{

button2.Enabled = true;

if (processSeq.Count == 0)

{

button2.Enabled = false;

MessageBox.Show("Няма други процеси!");

}

button3.Enabled = false;

currentProcess = null;

label4.Text = "~";

}

private void HRRN()

{

if (startedProcesses.Count > 0)

{

processSeq = new Queue<int>();

bool[] finishedProcesses = new bool[startedProcesses.Count];

int curPos = startedProcesses[0].ServiceTime;

finishedProcesses[0] = true;

processSeq.Enqueue(0);

while(true)

{

double highestResponceRatio = double.MinValue;

int highestResponceRatioIndex = int.MinValue;

bool done = true;

int k;

for (k = 0; k < finishedProcesses.Length; k++)

{

if (finishedProcesses[k] == false)

{

done = false;

break;

}

}

if (done)

{

break;

}

for (int i = k; i < startedProcesses.Count; i++)

{

if (finishedProcesses[i] == false && startedProcesses[i].ArrivalTime <= curPos)

{

double responceRatio = ((curPos - startedProcesses[i].ArrivalTime) + startedProcesses[i].ServiceTime) / (double)startedProcesses[i].ServiceTime;

if (highestResponceRatio < responceRatio)

{

highestResponceRatio = responceRatio;

highestResponceRatioIndex = i;

}

}

}

processSeq.Enqueue(highestResponceRatioIndex);

finishedProcesses[highestResponceRatioIndex] = true;

curPos += startedProcesses[highestResponceRatioIndex].ServiceTime;

}

}

}

private void button4\_Click(object sender, EventArgs e)

{

tableLayoutPanel2.Visible = false;

button2.Enabled = true;

dataGridView1.Rows[0].Selected = false;

}

}

}

## frmMain.Designer.cs

namespace OS\_HRRN

{

partial class frmMain

{

/// <summary>

/// Required designer variable.

/// </summary>

private System.ComponentModel.IContainer components = null;

/// <summary>

/// Clean up any resources being used.

/// </summary>

/// <param name="disposing">true if managed resources should be disposed; otherwise, false.</param>

protected override void Dispose(bool disposing)

{

if (disposing && (components != null))

{

components.Dispose();

}

base.Dispose(disposing);

}

#region Windows Form Designer generated code

/// <summary>

/// Required method for Designer support - do not modify

/// the contents of this method with the code editor.

/// </summary>

private void InitializeComponent()

{

System.Windows.Forms.DataGridViewCellStyle dataGridViewCellStyle1 = new System.Windows.Forms.DataGridViewCellStyle();

this.splitContainer1 = new System.Windows.Forms.SplitContainer();

this.dataGridView1 = new System.Windows.Forms.DataGridView();

this.tableLayoutPanel1 = new System.Windows.Forms.TableLayoutPanel();

this.tableLayoutPanel4 = new System.Windows.Forms.TableLayoutPanel();

this.label4 = new System.Windows.Forms.Label();

this.label3 = new System.Windows.Forms.Label();

this.tableLayoutPanel2 = new System.Windows.Forms.TableLayoutPanel();

this.button4 = new System.Windows.Forms.Button();

this.label1 = new System.Windows.Forms.Label();

this.label2 = new System.Windows.Forms.Label();

this.numericUpDown1 = new System.Windows.Forms.NumericUpDown();

this.button1 = new System.Windows.Forms.Button();

this.numericUpDown2 = new System.Windows.Forms.NumericUpDown();

this.tableLayoutPanel3 = new System.Windows.Forms.TableLayoutPanel();

this.button3 = new System.Windows.Forms.Button();

this.button2 = new System.Windows.Forms.Button();

((System.ComponentModel.ISupportInitialize)(this.splitContainer1)).BeginInit();

this.splitContainer1.Panel1.SuspendLayout();

this.splitContainer1.Panel2.SuspendLayout();

this.splitContainer1.SuspendLayout();

((System.ComponentModel.ISupportInitialize)(this.dataGridView1)).BeginInit();

this.tableLayoutPanel1.SuspendLayout();

this.tableLayoutPanel4.SuspendLayout();

this.tableLayoutPanel2.SuspendLayout();

((System.ComponentModel.ISupportInitialize)(this.numericUpDown1)).BeginInit();

((System.ComponentModel.ISupportInitialize)(this.numericUpDown2)).BeginInit();

this.tableLayoutPanel3.SuspendLayout();

this.SuspendLayout();

//

// splitContainer1

//

this.splitContainer1.Dock = System.Windows.Forms.DockStyle.Fill;

this.splitContainer1.Location = new System.Drawing.Point(0, 0);

this.splitContainer1.Name = "splitContainer1";

//

// splitContainer1.Panel1

//

this.splitContainer1.Panel1.Controls.Add(this.dataGridView1);

//

// splitContainer1.Panel2

//

this.splitContainer1.Panel2.Controls.Add(this.tableLayoutPanel1);

this.splitContainer1.Size = new System.Drawing.Size(766, 479);

this.splitContainer1.SplitterDistance = 445;

this.splitContainer1.TabIndex = 0;

//

// dataGridView1

//

this.dataGridView1.AllowUserToAddRows = false;

this.dataGridView1.AllowUserToDeleteRows = false;

this.dataGridView1.AutoSizeColumnsMode = System.Windows.Forms.DataGridViewAutoSizeColumnsMode.Fill;

this.dataGridView1.ColumnHeadersHeightSizeMode = System.Windows.Forms.DataGridViewColumnHeadersHeightSizeMode.AutoSize;

this.dataGridView1.Dock = System.Windows.Forms.DockStyle.Fill;

this.dataGridView1.Location = new System.Drawing.Point(0, 0);

this.dataGridView1.Name = "dataGridView1";

this.dataGridView1.ReadOnly = true;

this.dataGridView1.RowHeadersWidthSizeMode = System.Windows.Forms.DataGridViewRowHeadersWidthSizeMode.AutoSizeToAllHeaders;

dataGridViewCellStyle1.SelectionBackColor = System.Drawing.SystemColors.ActiveCaption;

dataGridViewCellStyle1.SelectionForeColor = System.Drawing.Color.White;

this.dataGridView1.RowsDefaultCellStyle = dataGridViewCellStyle1;

this.dataGridView1.SelectionMode = System.Windows.Forms.DataGridViewSelectionMode.FullRowSelect;

this.dataGridView1.Size = new System.Drawing.Size(445, 479);

this.dataGridView1.TabIndex = 0;

//

// tableLayoutPanel1

//

this.tableLayoutPanel1.CellBorderStyle = System.Windows.Forms.TableLayoutPanelCellBorderStyle.InsetDouble;

this.tableLayoutPanel1.ColumnCount = 1;

this.tableLayoutPanel1.ColumnStyles.Add(new System.Windows.Forms.ColumnStyle(System.Windows.Forms.SizeType.Percent, 100F));

this.tableLayoutPanel1.ColumnStyles.Add(new System.Windows.Forms.ColumnStyle(System.Windows.Forms.SizeType.Absolute, 20F));

this.tableLayoutPanel1.Controls.Add(this.tableLayoutPanel4, 0, 2);

this.tableLayoutPanel1.Controls.Add(this.tableLayoutPanel2, 0, 0);

this.tableLayoutPanel1.Controls.Add(this.tableLayoutPanel3, 0, 1);

this.tableLayoutPanel1.Dock = System.Windows.Forms.DockStyle.Fill;

this.tableLayoutPanel1.Location = new System.Drawing.Point(0, 0);

this.tableLayoutPanel1.Name = "tableLayoutPanel1";

this.tableLayoutPanel1.RowCount = 3;

this.tableLayoutPanel1.RowStyles.Add(new System.Windows.Forms.RowStyle(System.Windows.Forms.SizeType.Percent, 19.62422F));

this.tableLayoutPanel1.RowStyles.Add(new System.Windows.Forms.RowStyle(System.Windows.Forms.SizeType.Percent, 28.39248F));

this.tableLayoutPanel1.RowStyles.Add(new System.Windows.Forms.RowStyle(System.Windows.Forms.SizeType.Percent, 52.19207F));

this.tableLayoutPanel1.Size = new System.Drawing.Size(317, 479);

this.tableLayoutPanel1.TabIndex = 0;

//

// tableLayoutPanel4

//

this.tableLayoutPanel4.ColumnCount = 1;

this.tableLayoutPanel4.ColumnStyles.Add(new System.Windows.Forms.ColumnStyle(System.Windows.Forms.SizeType.Percent, 100F));

this.tableLayoutPanel4.ColumnStyles.Add(new System.Windows.Forms.ColumnStyle(System.Windows.Forms.SizeType.Absolute, 20F));

this.tableLayoutPanel4.Controls.Add(this.label4, 0, 1);

this.tableLayoutPanel4.Controls.Add(this.label3, 0, 0);

this.tableLayoutPanel4.Dock = System.Windows.Forms.DockStyle.Fill;

this.tableLayoutPanel4.Location = new System.Drawing.Point(6, 235);

this.tableLayoutPanel4.Name = "tableLayoutPanel4";

this.tableLayoutPanel4.RowCount = 2;

this.tableLayoutPanel4.RowStyles.Add(new System.Windows.Forms.RowStyle(System.Windows.Forms.SizeType.Percent, 50F));

this.tableLayoutPanel4.RowStyles.Add(new System.Windows.Forms.RowStyle(System.Windows.Forms.SizeType.Percent, 50F));

this.tableLayoutPanel4.Size = new System.Drawing.Size(305, 238);

this.tableLayoutPanel4.TabIndex = 2;

//

// label4

//

this.label4.Anchor = ((System.Windows.Forms.AnchorStyles)(((System.Windows.Forms.AnchorStyles.Top | System.Windows.Forms.AnchorStyles.Left)

| System.Windows.Forms.AnchorStyles.Right)));

this.label4.AutoSize = true;

this.label4.Font = new System.Drawing.Font("Microsoft Sans Serif", 10F, System.Drawing.FontStyle.Bold, System.Drawing.GraphicsUnit.Point, ((byte)(204)));

this.label4.Location = new System.Drawing.Point(3, 119);

this.label4.Name = "label4";

this.label4.Size = new System.Drawing.Size(299, 17);

this.label4.TabIndex = 1;

this.label4.Text = "~";

this.label4.TextAlign = System.Drawing.ContentAlignment.MiddleCenter;

//

// label3

//

this.label3.Anchor = ((System.Windows.Forms.AnchorStyles)(((System.Windows.Forms.AnchorStyles.Bottom | System.Windows.Forms.AnchorStyles.Left)

| System.Windows.Forms.AnchorStyles.Right)));

this.label3.AutoSize = true;

this.label3.Location = new System.Drawing.Point(3, 106);

this.label3.Name = "label3";

this.label3.Size = new System.Drawing.Size(299, 13);

this.label3.TabIndex = 0;

this.label3.Text = "Изпълнява се процес";

this.label3.TextAlign = System.Drawing.ContentAlignment.MiddleCenter;

//

// tableLayoutPanel2

//

this.tableLayoutPanel2.ColumnCount = 2;

this.tableLayoutPanel2.ColumnStyles.Add(new System.Windows.Forms.ColumnStyle(System.Windows.Forms.SizeType.Percent, 50F));

this.tableLayoutPanel2.ColumnStyles.Add(new System.Windows.Forms.ColumnStyle(System.Windows.Forms.SizeType.Percent, 50F));

this.tableLayoutPanel2.Controls.Add(this.button4, 0, 2);

this.tableLayoutPanel2.Controls.Add(this.label1, 0, 0);

this.tableLayoutPanel2.Controls.Add(this.label2, 0, 1);

this.tableLayoutPanel2.Controls.Add(this.numericUpDown1, 1, 1);

this.tableLayoutPanel2.Controls.Add(this.button1, 1, 2);

this.tableLayoutPanel2.Controls.Add(this.numericUpDown2, 1, 0);

this.tableLayoutPanel2.Dock = System.Windows.Forms.DockStyle.Fill;

this.tableLayoutPanel2.Location = new System.Drawing.Point(6, 6);

this.tableLayoutPanel2.Name = "tableLayoutPanel2";

this.tableLayoutPanel2.RowCount = 3;

this.tableLayoutPanel2.RowStyles.Add(new System.Windows.Forms.RowStyle(System.Windows.Forms.SizeType.Percent, 33.33333F));

this.tableLayoutPanel2.RowStyles.Add(new System.Windows.Forms.RowStyle(System.Windows.Forms.SizeType.Percent, 33.33333F));

this.tableLayoutPanel2.RowStyles.Add(new System.Windows.Forms.RowStyle(System.Windows.Forms.SizeType.Percent, 33.33333F));

this.tableLayoutPanel2.Size = new System.Drawing.Size(305, 85);

this.tableLayoutPanel2.TabIndex = 0;

//

// button4

//

this.button4.Anchor = ((System.Windows.Forms.AnchorStyles)((System.Windows.Forms.AnchorStyles.Top | System.Windows.Forms.AnchorStyles.Bottom)));

this.button4.Enabled = false;

this.button4.Location = new System.Drawing.Point(38, 59);

this.button4.Name = "button4";

this.button4.Size = new System.Drawing.Size(75, 23);

this.button4.TabIndex = 6;

this.button4.Text = "Готово";

this.button4.UseVisualStyleBackColor = true;

this.button4.Click += new System.EventHandler(this.button4\_Click);

//

// label1

//

this.label1.Anchor = System.Windows.Forms.AnchorStyles.Right;

this.label1.AutoSize = true;

this.label1.Location = new System.Drawing.Point(30, 7);

this.label1.Name = "label1";

this.label1.Size = new System.Drawing.Size(119, 13);

this.label1.TabIndex = 0;

this.label1.Text = "Време на пристигане:";

//

// label2

//

this.label2.Anchor = System.Windows.Forms.AnchorStyles.Right;

this.label2.AutoSize = true;

this.label2.Location = new System.Drawing.Point(27, 35);

this.label2.Name = "label2";

this.label2.Size = new System.Drawing.Size(122, 13);

this.label2.TabIndex = 1;

this.label2.Text = "Време за обслужване:";

//

// numericUpDown1

//

this.numericUpDown1.Anchor = ((System.Windows.Forms.AnchorStyles)((System.Windows.Forms.AnchorStyles.Left | System.Windows.Forms.AnchorStyles.Right)));

this.numericUpDown1.Location = new System.Drawing.Point(155, 32);

this.numericUpDown1.Minimum = new decimal(new int[] {

1,

0,

0,

0});

this.numericUpDown1.Name = "numericUpDown1";

this.numericUpDown1.Size = new System.Drawing.Size(147, 20);

this.numericUpDown1.TabIndex = 3;

this.numericUpDown1.Value = new decimal(new int[] {

1,

0,

0,

0});

//

// button1

//

this.button1.Anchor = ((System.Windows.Forms.AnchorStyles)((System.Windows.Forms.AnchorStyles.Top | System.Windows.Forms.AnchorStyles.Bottom)));

this.button1.Location = new System.Drawing.Point(191, 59);

this.button1.Name = "button1";

this.button1.Size = new System.Drawing.Size(75, 23);

this.button1.TabIndex = 4;

this.button1.Text = "Стартиране";

this.button1.UseVisualStyleBackColor = true;

this.button1.Click += new System.EventHandler(this.button1\_Click);

//

// numericUpDown2

//

this.numericUpDown2.Anchor = ((System.Windows.Forms.AnchorStyles)((System.Windows.Forms.AnchorStyles.Left | System.Windows.Forms.AnchorStyles.Right)));

this.numericUpDown2.Location = new System.Drawing.Point(155, 4);

this.numericUpDown2.Name = "numericUpDown2";

this.numericUpDown2.Size = new System.Drawing.Size(147, 20);

this.numericUpDown2.TabIndex = 5;

//

// tableLayoutPanel3

//

this.tableLayoutPanel3.ColumnCount = 1;

this.tableLayoutPanel3.ColumnStyles.Add(new System.Windows.Forms.ColumnStyle(System.Windows.Forms.SizeType.Percent, 100F));

this.tableLayoutPanel3.ColumnStyles.Add(new System.Windows.Forms.ColumnStyle(System.Windows.Forms.SizeType.Absolute, 20F));

this.tableLayoutPanel3.Controls.Add(this.button3, 0, 1);

this.tableLayoutPanel3.Controls.Add(this.button2, 0, 0);

this.tableLayoutPanel3.Dock = System.Windows.Forms.DockStyle.Fill;

this.tableLayoutPanel3.Location = new System.Drawing.Point(6, 100);

this.tableLayoutPanel3.Name = "tableLayoutPanel3";

this.tableLayoutPanel3.RowCount = 2;

this.tableLayoutPanel3.RowStyles.Add(new System.Windows.Forms.RowStyle(System.Windows.Forms.SizeType.Percent, 50F));

this.tableLayoutPanel3.RowStyles.Add(new System.Windows.Forms.RowStyle(System.Windows.Forms.SizeType.Percent, 50F));

this.tableLayoutPanel3.Size = new System.Drawing.Size(305, 126);

this.tableLayoutPanel3.TabIndex = 1;

//

// button3

//

this.button3.Anchor = ((System.Windows.Forms.AnchorStyles)((System.Windows.Forms.AnchorStyles.Left | System.Windows.Forms.AnchorStyles.Right)));

this.button3.Enabled = false;

this.button3.Location = new System.Drawing.Point(3, 77);

this.button3.Name = "button3";

this.button3.Size = new System.Drawing.Size(299, 35);

this.button3.TabIndex = 1;

this.button3.Text = "Спиране на процеса";

this.button3.UseVisualStyleBackColor = true;

this.button3.Click += new System.EventHandler(this.button3\_Click);

//

// button2

//

this.button2.Anchor = ((System.Windows.Forms.AnchorStyles)((System.Windows.Forms.AnchorStyles.Left | System.Windows.Forms.AnchorStyles.Right)));

this.button2.Enabled = false;

this.button2.Location = new System.Drawing.Point(3, 14);

this.button2.Name = "button2";

this.button2.Size = new System.Drawing.Size(299, 35);

this.button2.TabIndex = 0;

this.button2.Text = "Извикване на диспечера";

this.button2.UseVisualStyleBackColor = true;

this.button2.Click += new System.EventHandler(this.button2\_Click);

//

// frmMain

//

this.AutoScaleDimensions = new System.Drawing.SizeF(6F, 13F);

this.AutoScaleMode = System.Windows.Forms.AutoScaleMode.Font;

this.ClientSize = new System.Drawing.Size(766, 479);

this.Controls.Add(this.splitContainer1);

this.Name = "frmMain";

this.Text = "Управление на процесора - стратегия Priority";

this.splitContainer1.Panel1.ResumeLayout(false);

this.splitContainer1.Panel2.ResumeLayout(false);

((System.ComponentModel.ISupportInitialize)(this.splitContainer1)).EndInit();

this.splitContainer1.ResumeLayout(false);

((System.ComponentModel.ISupportInitialize)(this.dataGridView1)).EndInit();

this.tableLayoutPanel1.ResumeLayout(false);

this.tableLayoutPanel4.ResumeLayout(false);

this.tableLayoutPanel4.PerformLayout();

this.tableLayoutPanel2.ResumeLayout(false);

this.tableLayoutPanel2.PerformLayout();

((System.ComponentModel.ISupportInitialize)(this.numericUpDown1)).EndInit();

((System.ComponentModel.ISupportInitialize)(this.numericUpDown2)).EndInit();

this.tableLayoutPanel3.ResumeLayout(false);

this.ResumeLayout(false);

}

#endregion

private System.Windows.Forms.SplitContainer splitContainer1;

private System.Windows.Forms.DataGridView dataGridView1;

private System.Windows.Forms.TableLayoutPanel tableLayoutPanel1;

private System.Windows.Forms.TableLayoutPanel tableLayoutPanel2;

private System.Windows.Forms.TableLayoutPanel tableLayoutPanel3;

private System.Windows.Forms.TableLayoutPanel tableLayoutPanel4;

private System.Windows.Forms.Label label4;

private System.Windows.Forms.Label label3;

private System.Windows.Forms.Label label1;

private System.Windows.Forms.Label label2;

private System.Windows.Forms.NumericUpDown numericUpDown1;

private System.Windows.Forms.Button button1;

private System.Windows.Forms.Button button3;

private System.Windows.Forms.Button button2;

private System.Windows.Forms.NumericUpDown numericUpDown2;

private System.Windows.Forms.Button button4;

}

}

## Process.cs

namespace OS\_HRRN

{

public class Process

{

private int number;

private int arrivalTime;

private int serviceTime;

public int Number

{

get

{

return number;

}

set

{

number = value;

}

}

public int ArrivalTime

{

get

{

return arrivalTime;

}

set

{

arrivalTime = value;

}

}

public int ServiceTime

{

get

{

return serviceTime;

}

set

{

serviceTime = value;

}

}

public Process(int number, int arrivalTime, int serviceTime)

{

this.Number = number;

this.ArrivalTime = arrivalTime;

this.ServiceTime = serviceTime;

}

}

}

# Демо













