IOWA STATE UNIVERSITY

CprE 558 Final Project

Implementation of Feedback Control Scheduling with EDF and Exploration on the Relationship Between Miss Ratio and CPU Utilization

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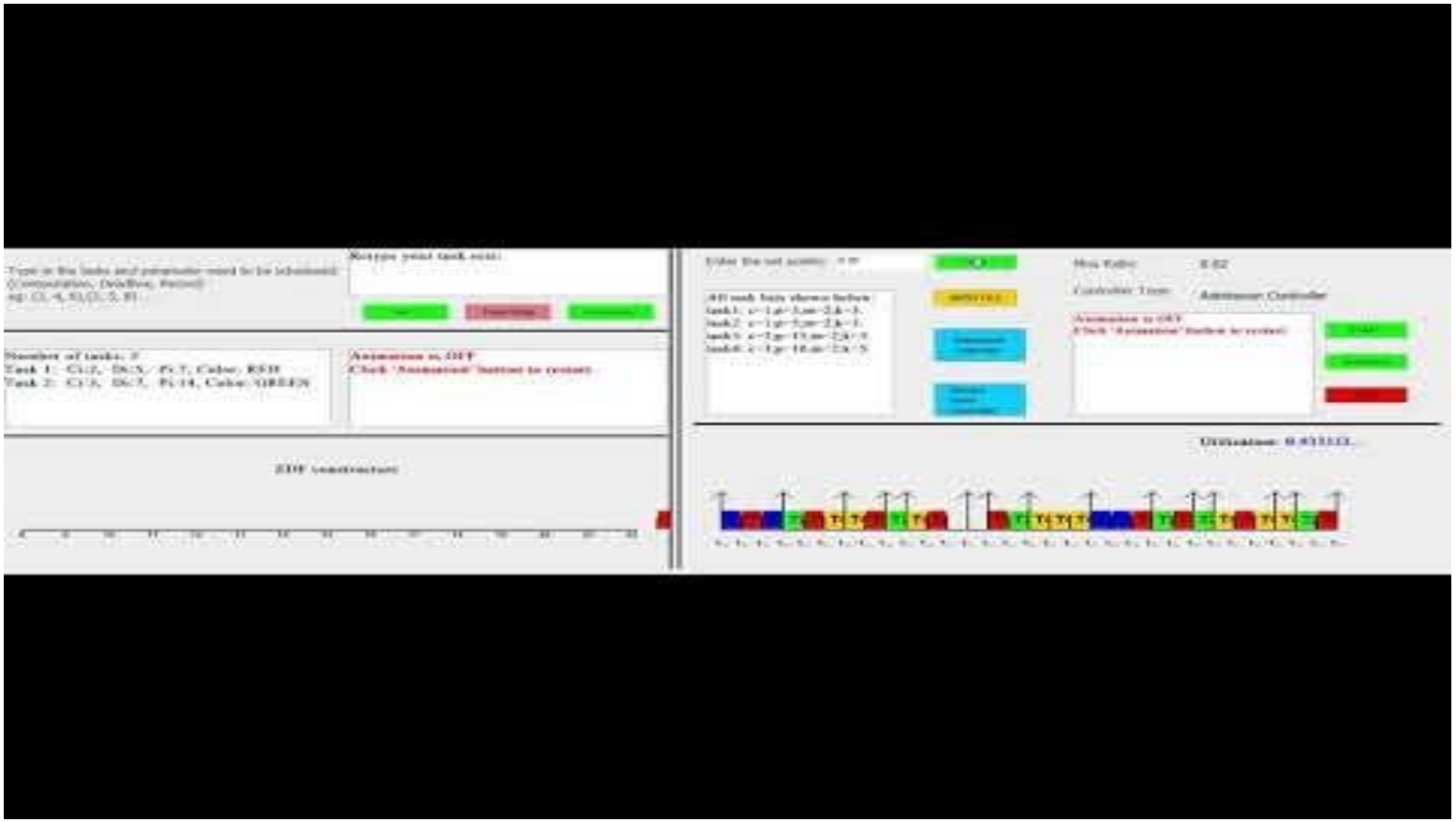
Brief Function Demo



https://www.youtube.com/watch?v=TRAbNR7CqyM

BACKGROUND

- Overload Handling: to degrade gracefully in order to prevent an overrun to introducing unbounded delays on tasks' execution

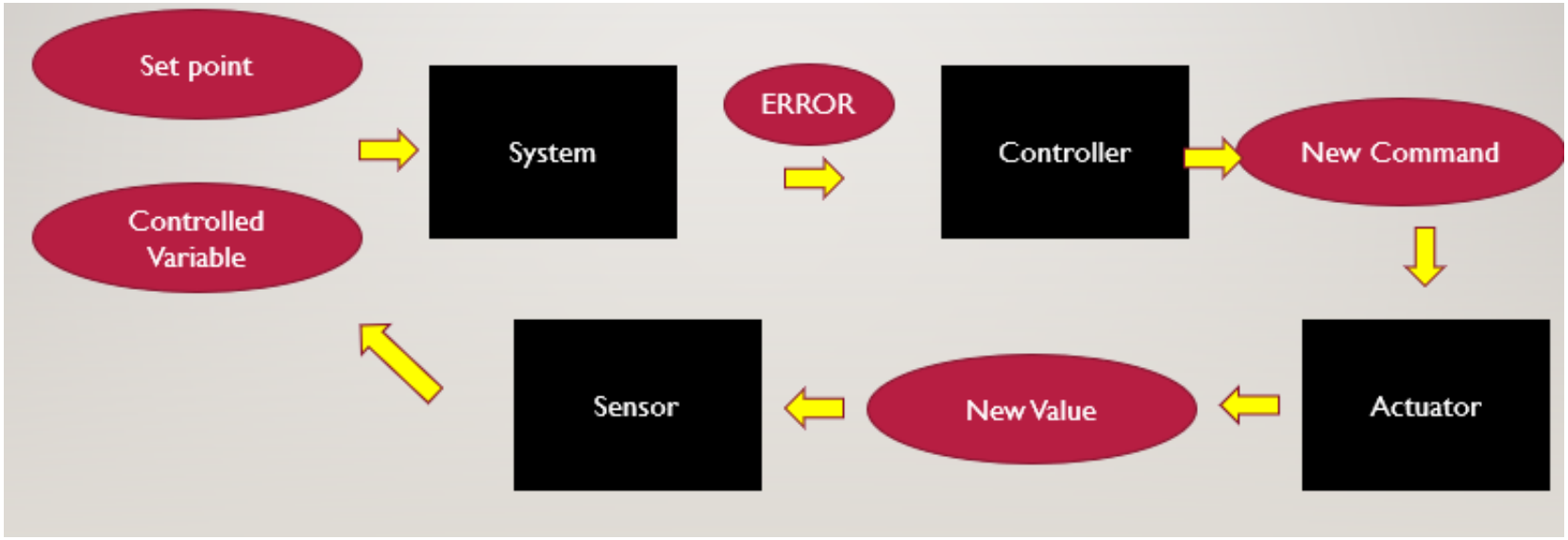
  Imprecision Computation Model

  (m,k) Firm Real-Time Model

BACKGROUND: FEEDBACK COMPONENTS

- Feedback System: using the measured quantities as feedback to correct the behavior of system
  - Controller
  - Plant to be controlled
  - Actuator
  - Sensor
  - Controlled variables
  - Set point
  - Error
  - Control variable

BACKGROUND: FEEDBACK LOOP



BACKGROUND:SYSTEM PARAMETERS

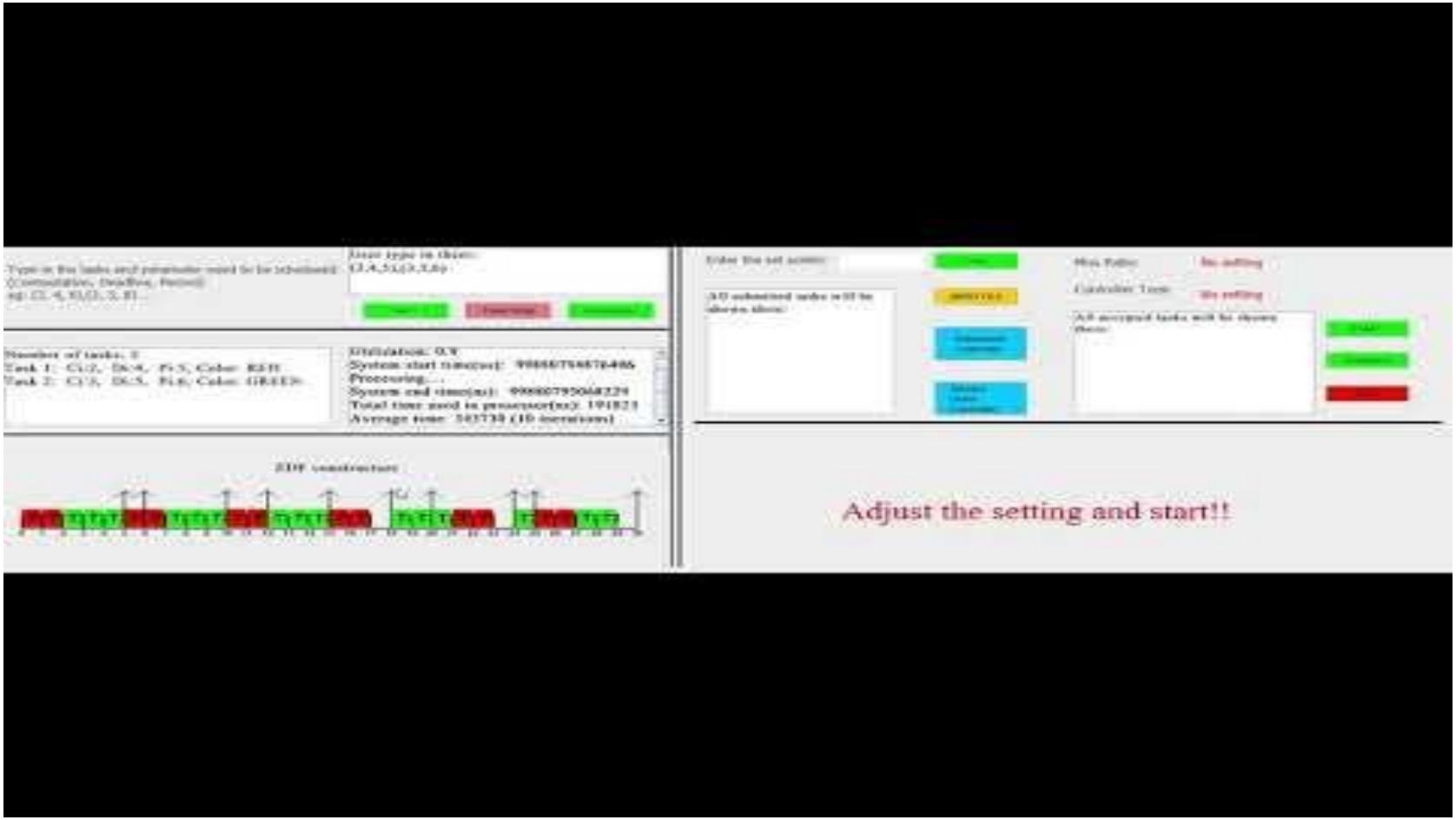
Set point = $\frac{\#\ MissedTasks}{\#\ AllTasks}$

Controlled Variable = *Measured by Sensor*

ERROR = *Difference between set point and controlled variable*

- Task Set $T_i = (c_i, p_i, m_i, k_i)$ $(i = 1, 2, 3, \ldots)$
- Utilization = $\sum_i \frac{c_i}{p_i}$

EDF System Demo

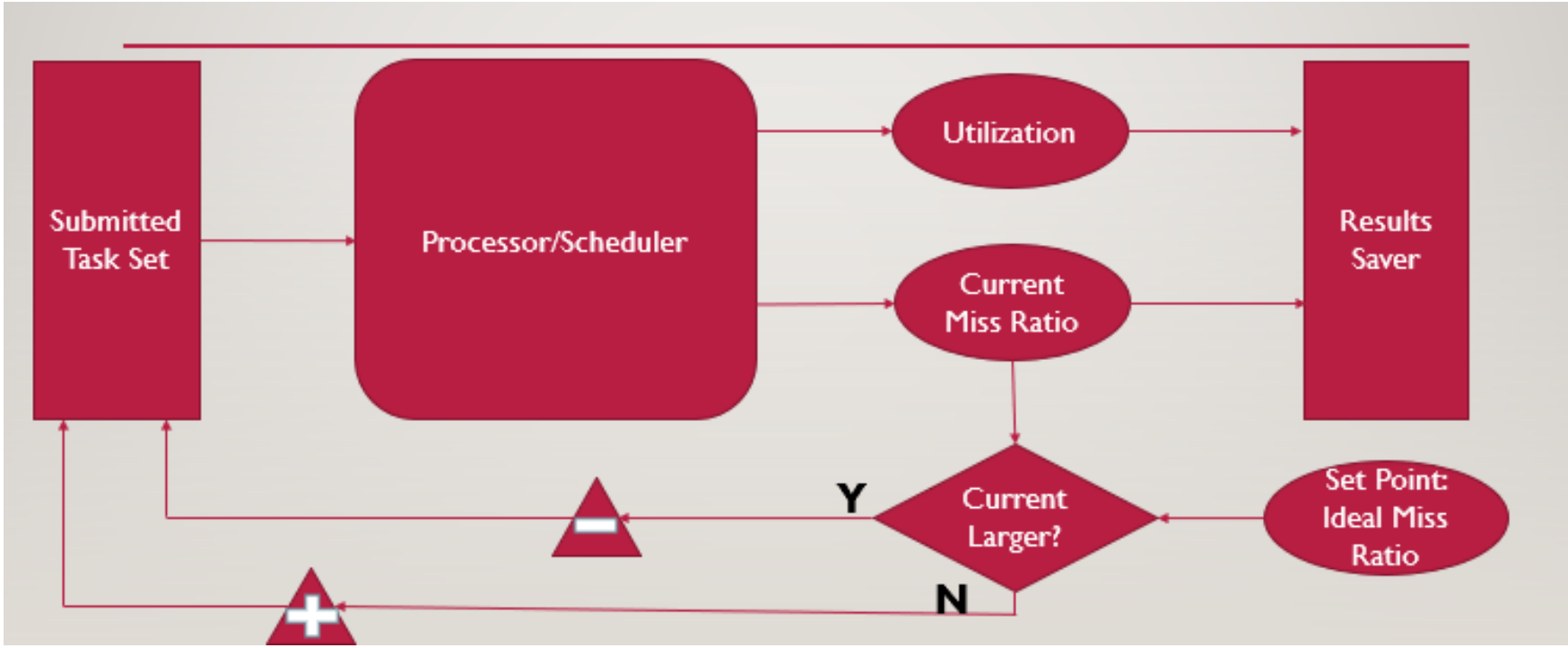


https://www.youtube.com/watch?v=tar_b4y7r2U

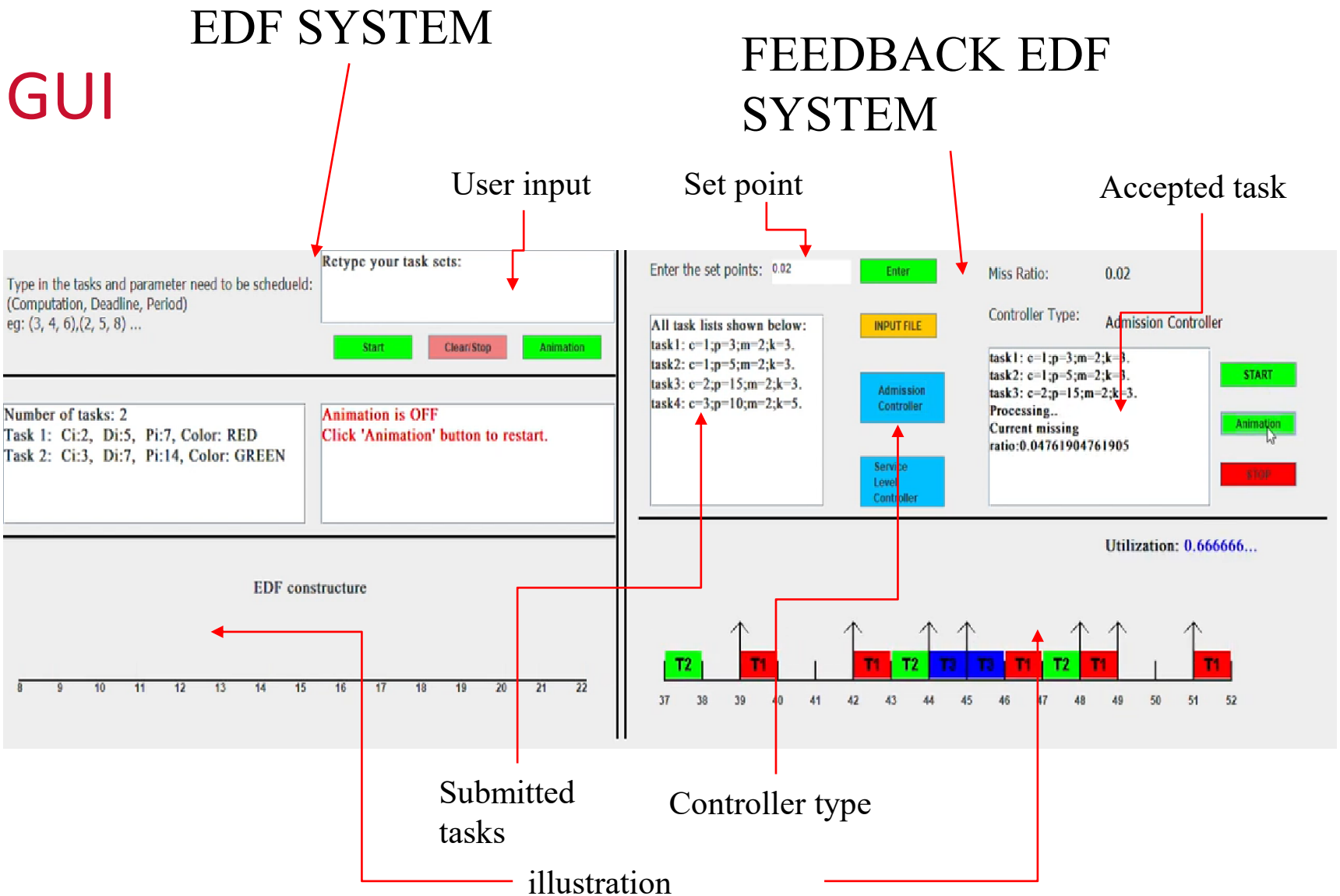
Feedback EDF System Demo

https://www.youtube.com/watch?v=3CxBHkwdFMY

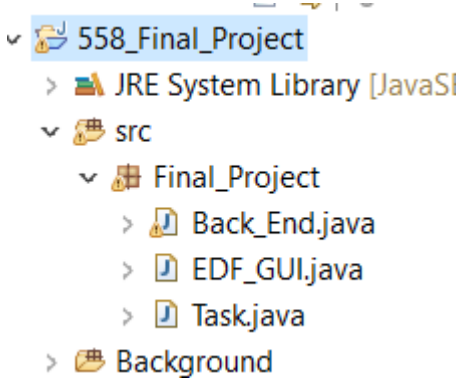
SYSTEM IMPLEMENTATION



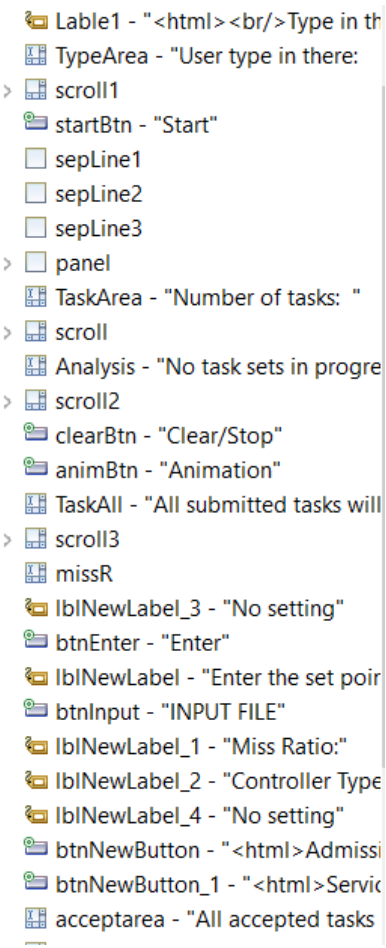
GUI


EDF SYSTEM
FEEDBACK EDF SYSTEM
User input
Set point
Accepted task
Type in the tasks and parameter need to be scheduleld:
(Computation, Deadline, Period)
eg: (3, 4, 6),(2, 5, 8) ...
Retype your task sets:
Start
Clear/Stop
Animation
Number of tasks: 2
Task 1: Ci:2, Di:5, Pi:7, Color: RED
Task 2: Ci:3, Di:7, Pi:14, Color: GREEN
Animation is OFF
Click 'Animation' button to restart.
EDF constructure
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Enter the set points: 0.02
Enter
All task lists shown below:
task1: c=1;p=3;m=2;k=3.
task2: c=1;p=5;m=2;k=3.
task3: c=2;p=15;m=2;k=3.
task4: c=3;p=10;m=2;k=5.
INPUT FILE
Admission Controller
Service Level Controller
Miss Ratio: 0.02
Controller Type: Admission Controller
task1: c=1;p=3;m=2;k=3.
task2: c=1;p=5;m=2;k=3.
task3: c=2;p=15;m=2;k=3.
Processing..
Current missing ratio:0.04761904761905
START
Animation
STOP
Utilization: 0.666666...
T2 T1 T1 T2 T3 T3 T1 T2 T1 T1
37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52
Submitted tasks
Controller type
illustration

CODE



Package and class



GUI construct

```
import java.awt.EventQueue;
import java.awt.Graphics;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;
import java.io.File;
import java.io.FileNotFoundException;
import java.util.ArrayList;
import java.util.HashMap;
import java.util.LinkedList;
import java.util.Scanner;
import java.awt.Color;
import javax.swing.JFrame;
import javax.swing.SwingConstants;
import javax.swing.Timer;
import javax.swing.filechooser.FileNameExtensionFilter;
import javax.swing.JLabel;
import javax.swing.JPanel;
import javax.swing.JScrollPane;
import java.awt.Font;
import javax.swing.JTextArea;
import javax.swing.JButton;
import javax.swing.JFileChooser;
```

GUI import lib

CODE

BACK END (partial and core functions)

- Traditional EDF Scheduler

```
//EDF scheduler
public ArrayList<Task> EDF_scheduler(LinkedList<Task> tasklist, int unit)
```

- Admission Controller for Feedback System

```
//Admission Controller with EDF algorithm
public ArrayList<Task> Adcontrol(LinkedList<Task> tasklist,int unit)
```

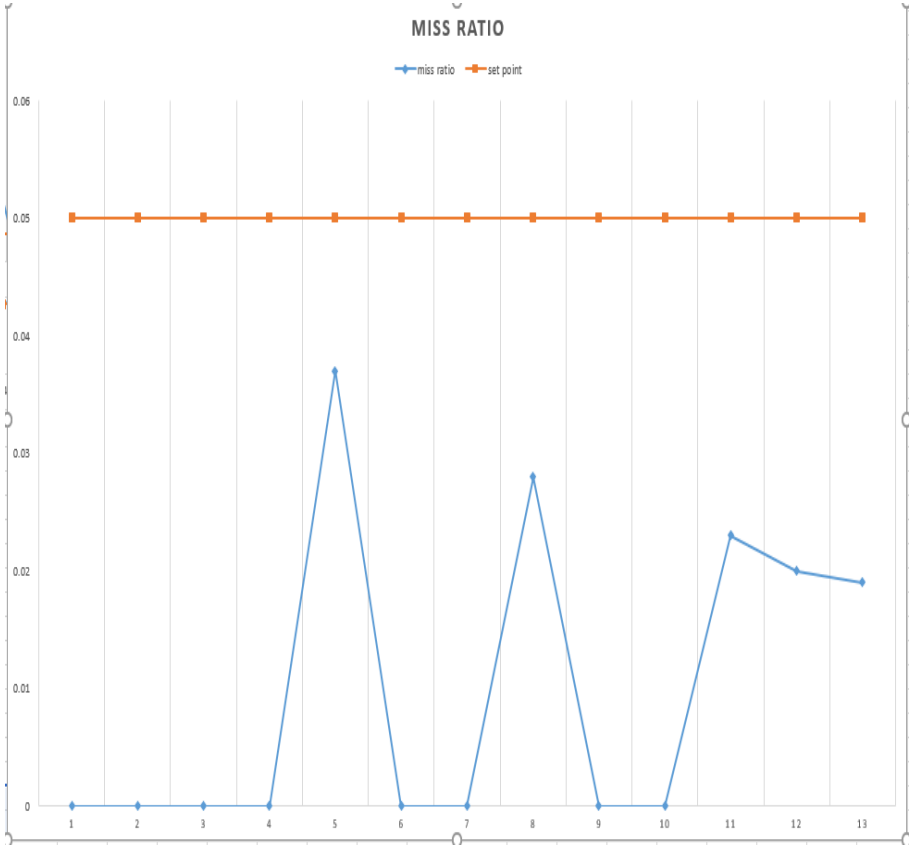
- Priority stack build

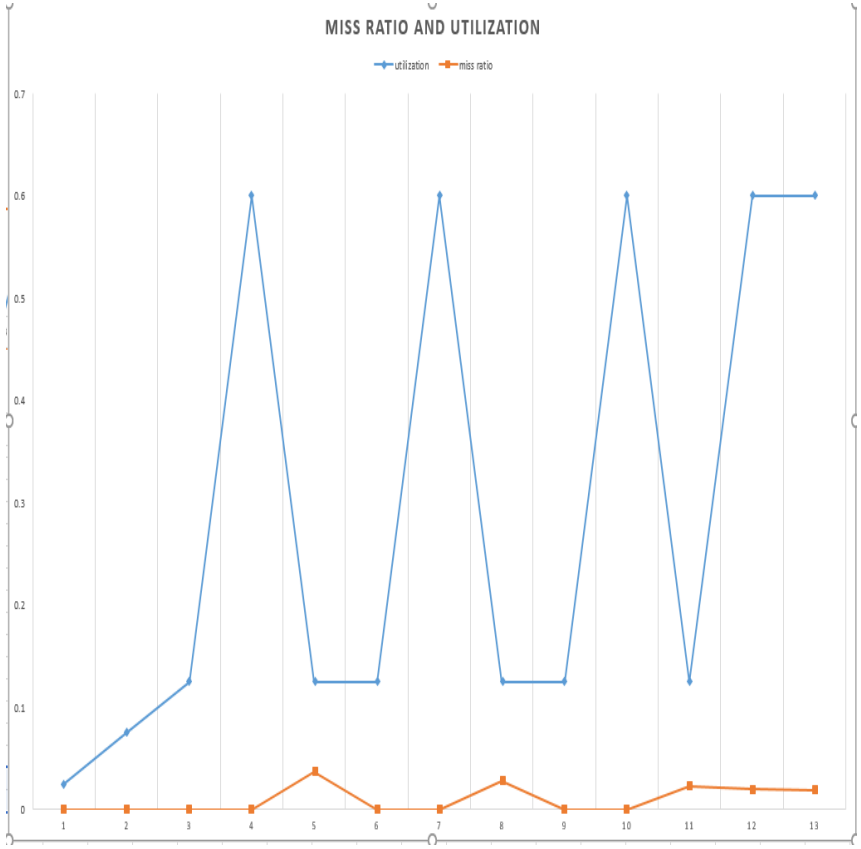
```
//Stack out the priority depend the period for each class
private Stack<Task> buildPriority(LinkedList<Task> tasklist) {
```

- Mandatory and Optional check

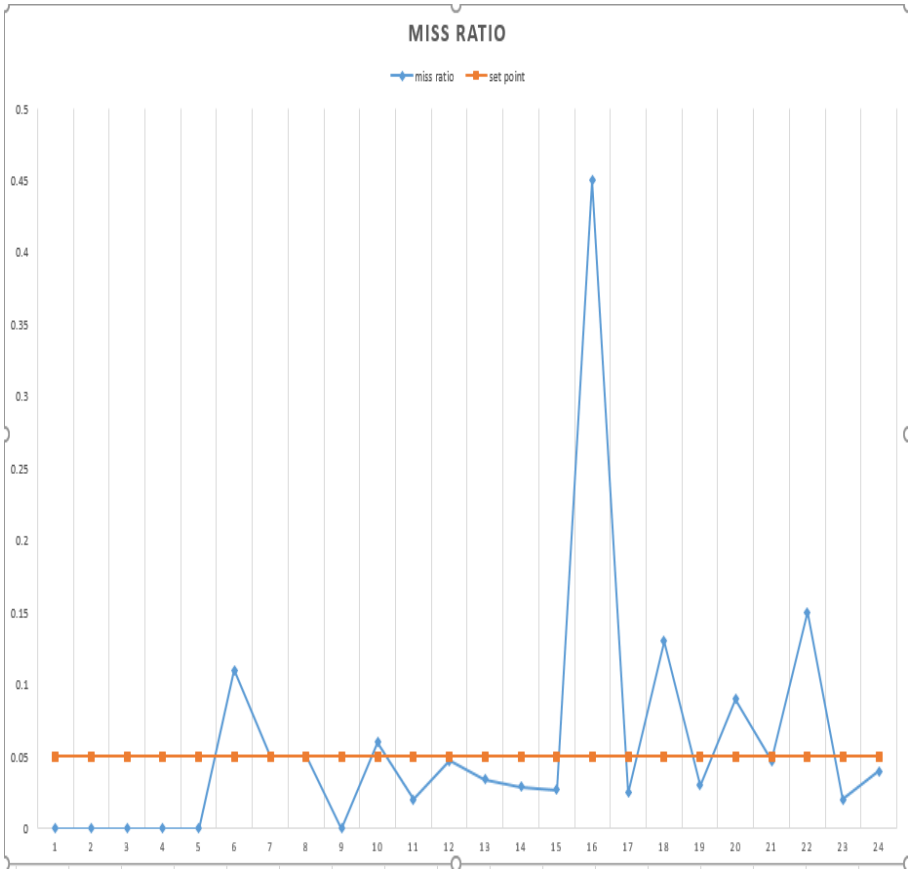
```
// Check the mandatory or optional in particular task in current time
public boolean isOpt(Task task,int time) {
```

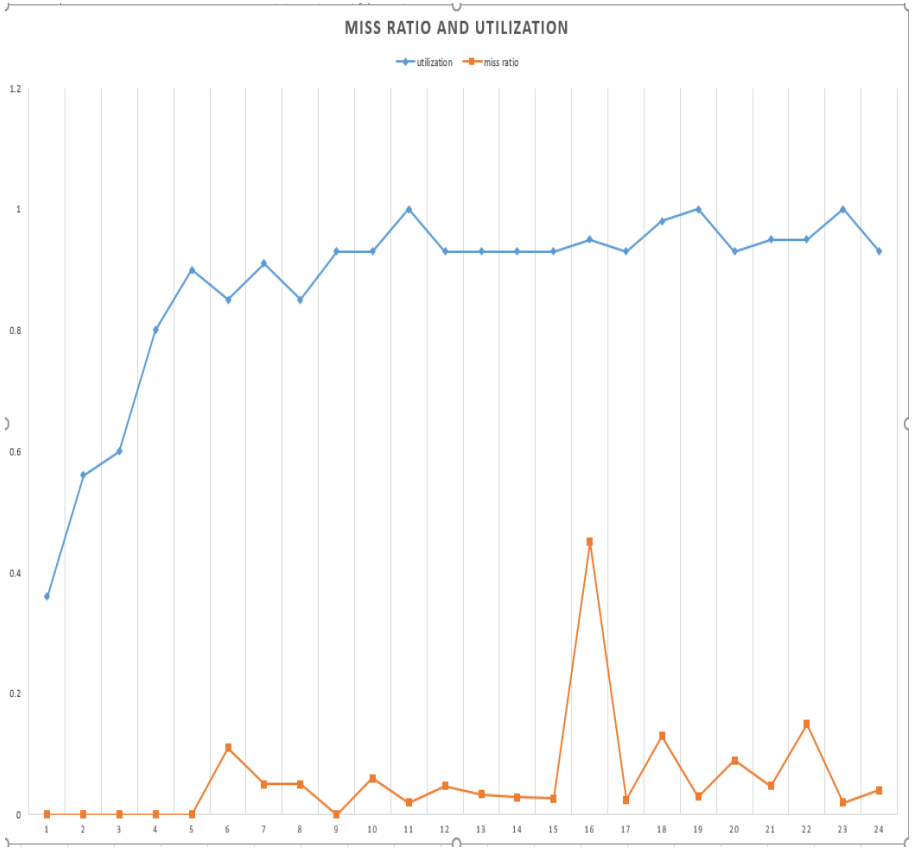
TEST


MISS RATIO
miss ratio
set point
0.06
0.05
0.04
0.03
0.02
0.01
0
1
2
3
4
5
6
7
8
9
10
11
12
13


MISS RATIO AND UTILIZATION
utilization
miss ratio
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
7
8
9
10
11
12
13

TEST


MISS RATIO
miss ratio
set point
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24


MISS RATIO AND UTILIZATION
utilization
miss ratio
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

CONCLUSION

- It is very clear that when the workload is light, there is hardly any miss so the miss ratio may never reach the set point and the feedback system behave like a normal system. As to the utilization, it is actually the sum of several ratios of computation time and period of corresponding task, so the chart looks like zig-zag.
- However, when dealing with a great amount and complexity of workload, the situation turns totally different. The miss rate starts from zero because there is only a few tasks and far away from overload, then as the growth of workload, the miss ratio increases. But due to the existence of set point, the miss ratio would fluctuate around the set point and it turns out to decrease the degree of fluctuation. As to the utilization, there seems not to be a very clear relationship between it and miss ratio, but we can still tell the change pattern of utilization. It grows sharp as the workload increase and going steady around 80% and 90% under our test with our task sets.

REFERENCE

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