METODE NUMERIK

BRACKET METHOD ROOT FINDER (BISECTION, REGULA-FALSI, BRENT)

KELOMPOK :

Betranz Leenando – 2201020079

M. Aditya Egi Dwinata – 2201020141

Safitri Wulandari – 2201020085

Seffi Rozahana – 2201020080
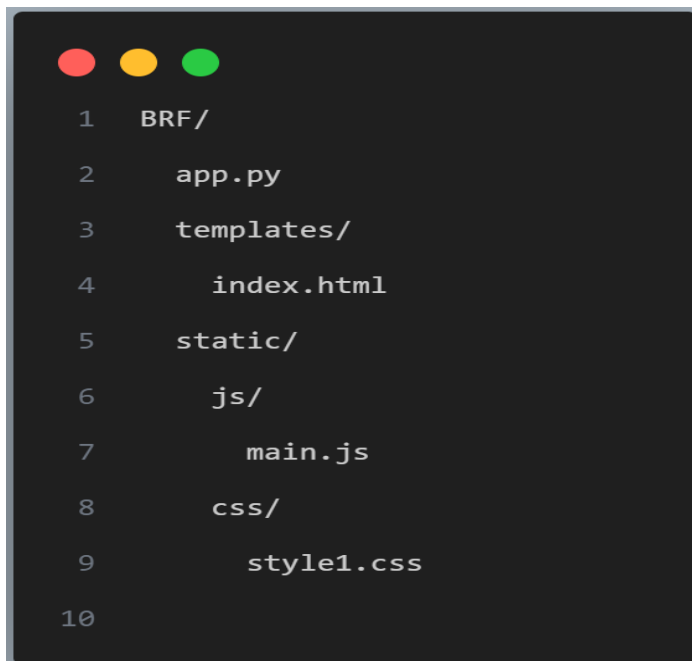
Sapar Hidayat. S – 2201020003

TEKNIK INFORMATIKA

FAKULTAS TEKNIK DAN TEKNOLOGI KEMARITIMAN

UNIVERSITAS MARITIM RAJA ALI HAJI

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1. Struktur Folder Project

```
1   BRF/
2      app.py
3      templates/
4        index.html
5      static/
6        js/
7          main.js
8        css/
9          style1.css
10
```

2. app.py

```python
1.  from flask import Flask, render_template, request, jsonify
2.  from sympy import symbols, sympify
3.  from scipy.optimize import brentq
4.
5.  app = Flask(__name__)
6.
7.  x = symbols('x')
8.
9.  # Bisection Method
10. def bisection_method(func, x, xl, xu, tol, max_iter):
11.     steps = []
12.
13.     if abs(func.subs(x, xl)) < tol:
14.         return [{'iteration': 1, 'xl': xl, 'xu': xu, 'xr': xl, 'fxl': 0, 'fxu':
    func.subs(x, xu), 'fxr': 0, 'fxl_fxr': 0, 'formula': f"x_r = {xl}", 'update': f"f(xl)
    \\times f(x_r) = 0"}]
15.     if abs(func.subs(x, xu)) < tol:
16.         return [{'iteration': 1, 'xl': xl, 'xu': xu, 'xr': xu, 'fxl': func.subs(x, xl),
    'fxu': 0, 'fxr': 0, 'fxl_fxr': 0, 'formula': f"x_r = {xu}", 'update': f"f(xl) \\times
    f(x_r) = 0"}]
17.
18.     for i in range(max_iter):
19.         fxl = float(func.subs(x, xl))
20.         fxu = float(func.subs(x, xu))
21.         xr = (xl + xu) / 2
```

```python
22.              fxr = float(func.subs(x, xr))
23.
24.          step_info = {
25.              'iteration': i + 1,
26.              'xl': xl,
27.              'xu': xu,
28.              'xr': xr,
29.              'fxl': fxl,
30.              'fxu': fxu,
31.              'fxr': fxr,
32.              'fxl_fxr': fxl * fxr,
33.              'formula': f"x_r = \\frac{{xl + xu}}{{2}} = \\frac{{{xl} + {xu}}}{{2}} =
    {xr:.6f}",
34.              'update': f"f(xl) \\times f(x_r) = {fxl:.6f} \\times {fxr:.6f}"
35.          }
36.
37.          steps.append(step_info)
38.
39.          if abs(fxr) < tol or (xu - xl) / 2 < tol:
40.              break
41.
42.          if fxl * fxr < 0:
43.              xu = xr
44.          else:
45.              xl = xr
46.
47.      if abs(func.subs(x, xr)) >= tol:
48.          raise ValueError(f"Gagal menghitung akar : Interval tidak memenuhi syarat
    Bisection f(xl)*f(xu) > 0. Pilih interval yang sesuai!")
49.
50.      return steps
51.
52. # Regula Falsi Method
53. def regula_falsi_method(func, x, xl, xu, tol, max_iter):
54.      steps = []
55.
56.      if abs(func.subs(x, xl)) < tol:
57.          return [{'iteration': 1, 'xl': xl, 'xu': xu, 'xr': xl, 'fxl': 0, 'fxu':
    func.subs(x, xu), 'fxr': 0, 'fxl_fxr': 0, 'formula': f"x_r = {xl}", 'update': f"f(xl)
    \\times f(x_r) = 0"}]
58.      if abs(func.subs(x, xu)) < tol:
59.          return [{'iteration': 1, 'xl': xl, 'xu': xu, 'xr': xu, 'fxl': func.subs(x, xl),
    'fxu': 0, 'fxr': 0, 'fxl_fxr': 0, 'formula': f"x_r = {xu}", 'update': f"f(xl) \\times
    f(x_r) = 0"}]
60.
61.      for i in range(max_iter):
62.          fxl = float(func.subs(x, xl))
63.          fxu = float(func.subs(x, xu))
```

```python
64.          xr = xu - (fxu * (xu - xl)) / (fxu - fxl)
65.          fxr = float(func.subs(x, xr))
66.
67.          step_info = {
68.              'iteration': i + 1,
69.              'xl': xl,
70.              'xu': xu,
71.              'xr': xr,
72.              'fxl': fxl,
73.              'fxu': fxu,
74.              'fxr': fxr,
75.              'fxl_fxr': fxl * fxr,
76.              'formula': f"x_r = xu - \\frac{{f(xu)(xu-xl)}}{{f(xu)-f(xl)}} = {xr:.6f}",
77.              'update': f"f(xl) \\times f(x_r) = {fxl:.6f} \\times {fxr:.6f}"
78.          }
79.
80.          steps.append(step_info)
81.
82.          if abs(fxr) < tol:
83.              break
84.
85.          if fxl * fxr < 0:
86.              xu = xr
87.          else:
88.              xl = xr
89.
90.      if abs(func.subs(x, xr)) >= tol:
91.          raise ValueError(f"Gagal menghitung akar : Interval tidak memenuhi syarat Regula-
    Falsi f(xl)*f(xu) > 0. Pilih interval yang sesuai!")
92.
93.      return steps
94.
95. # Brent Method
96. def brent_method(func, x, xl, xu, tol, max_iter):
97.      steps = []
98.
99.      for i in range(max_iter):
100.          # Menggunakan brentq dari scipy untuk menghitung nilai akar
101.          xr = brentq(lambda t: float(func.subs(x, t)), xl, xu, xtol=tol)
102.
103.          fxl = float(func.subs(x, xl))
104.          fxu = float(func.subs(x, xu))
105.          fxr = float(func.subs(x, xr))
106.
107.          # Menyimpan langkah-langkah iterasi
108.          step_info = {
109.              'iteration': i + 1,
110.              'xl': xl,
```

```python
111.              'xu': xu,
112.              'xr': xr,
113.              'fxl': fxl,
114.              'fxu': fxu,
115.              'fxr': fxr,
116.              'fxl_fxr': fxl * fxr,
117.              'formula': f"x_r = \\text{{brentq}}(f(x), {xl}, {xu}) = {xr:.6f}",
118.              'update': f"f(xl) \\times f(xr) = {fxl:.6f} \\times {fxr:.6f}"
119.          }
120.
121.          steps.append(step_info)
122.
123.          if abs(fxr) < tol:
124.              break
125.
126.          # Update interval
127.          if fxl * fxr < 0:
128.              xu = xr
129.          else:
130.              xl = xr
131.
132.      if abs(func.subs(x, xr)) >= tol:
133.          raise ValueError(f"Gagal menghitung akar : Interval tidak memenuhi syarat Brent
      f(xl)*f(xu) > 0. Pilih interval yang sesuai!")
134.
135.      return steps
136.
137. # Route untuk halaman utama
138. @app.route('/')
139. def index():
140.      return render_template('index.html')
141.
142. # Route untuk perhitungan
143. @app.route('/calculate', methods=['POST'])
144. def calculate():
145.      func_str = request.form['function']
146.      a = float(request.form['a'])
147.      b = float(request.form['b'])
148.      tol = float(request.form['tolerance'])
149.      max_iter = int(request.form['iterations'])
150.
151.      if 'method' not in request.form:
152.          return jsonify({'error': 'Method is required'}), 400
153.
154.      method = request.form['method']
155.      func = sympify(func_str)
156.      steps = []
157.
```

```python
158.    try:
159.        if method == 'bisection':
160.            steps = bisection_method(func, x, a, b, tol, max_iter)
161.        elif method == 'regula_falsi':
162.            steps = regula_falsi_method(func, x, a, b, tol, max_iter)
163.        elif method == 'secant':
164.            steps = brent_method(func, x, a, b, tol, max_iter)
165.    except ValueError as e:
166.        return jsonify({'error': str(e)}), 400
167.
168.    return jsonify({'steps': steps})
169.
170.# Menjalankan Aplikasi
171.if __name__ == '__main__':
172.    app.run(debug=True)
```

3. templates/index.html :

```html
1.   <!DOCTYPE html>
2.   <html lang="en">
3.   <head>
4.       <meta charset="UTF-8">
5.       <meta name="viewport" content="width=device-width, initial-scale=1.0">
6.       <title>Root Finder</title>
7.       <link rel="stylesheet" href="/static/css/style1.css">
8.       <script
     src="https://cdnjs.cloudflare.com/ajax/libs/mathjax/2.7.7/MathJax.js?config=TeX-MML-
     AM_CHTML" async></script>
9.   </head>
10.  <body class="container">
11.
12.      <h1>Bracket Method Root Finder</h1>
13.      <form id="calculate-form">
14.          <label for="function">Function:</label>
15.          <input type="text" id="function" name="function" required placeholder="Contoh :
     x**3 - 4*x - 9">
16.
17.          <label for="a">Interval XL :</label>
18.          <input type="number" id="a" name="a" required>
19.
20.          <label for="b">Interval XU :</label>
21.          <input type="number" id="b" name="b" required>
22.
23.          <label for="tolerance">Tolerance:</label>
24.          <input type="number" step="0.000001" id="tolerance" name="tolerance" required>
25.
26.          <label for="iterations">Max Iterations:</label>
27.          <input type="number" id="iterations" name="iterations" required>
28.
29.          <label for="method">Method:</label>
30.          <select id="method" name="method" required>
31.              <option value="bisection">Bisection Method</option>
32.              <option value="regula_falsi">Regula Falsi Method</option>
33.              <option value="secant">Brent's Method</option>
34.          </select>
35.
36.          <div class="button-wrapper">
37.              <button type="submit">Calculate</button>
38.          </div>
39.      </form>
40.
41.      <div id="solution-steps"></div>
42.
43.      <div class="table-container">
44.          <div id="result-table">
```

```html
            <h2>Hasil Iterasi</h2>
            <table>
                <thead>
                    <tr>
                        <th>Iteration</th>
                        <th>xl</th>
                        <th>xu</th>
                        <th>xr</th>
                        <th>f(xl)</th>
                        <th>f(xu)</th>
                        <th>f(xr)</th>
                        <th>f(xl) * f(xr)</th>
                    </tr>
                </thead>
                <tbody></tbody>
            </table>
        </div>
    </div>

    <div class="table-container">
        <div id="team-info">
            <h2>Group : Numerical Methods</h2>
            <table>
                <thead>
                    <tr>
                        <th>NAMA</th>
                        <th>NIM</th>
                    </tr>
                </thead>
                <tbody>
                    <tr>
                        <td>Betranz Leenando</td>
                        <td>2201020079</td>
                    </tr>
                    <tr>
                        <td>M. Aditya Egi Dwinata</td>
                        <td>2201020141</td>
                    </tr>
                    <tr>
                        <td>Safitri Wulandari</td>
                        <td>2201020085</td>
                    </tr>
                    <tr>
                        <td>Seffi Rozahana</td>
                        <td>2201020080</td>
                    </tr>
                    <tr>
                        <td>SAPAR HIDAYAT. S</td>
```

```html
93.                         <td>2201020003</td>
94.                     </tr>
95.                 </tbody>
96.             </table>
97.         </div>
98.     </div>
99.
100.    <footer class="text-center mt-5 p-3 bg-light">
101.        <p>&copy; 2025 Root Finder Application. Created by <strong>BE3S</strong>.</p>
102.    </footer>
103.
104.    <script
   src="https://cdn.jsdelivr.net/npm/bootstrap@5.3.0/dist/js/bootstrap.bundle.min.js"></scrip
   t>
105.    <script src="/static/js/main.js"></script>
106.</body>
107.</html>
108.
```

4. Static/js/main.js

```javascript
1.  function displayResults(data) {
2.      const solutionSteps = document.getElementById('solution-steps');
3.      const tableBody = document.getElementById('result-
    table').getElementsByTagName('tbody')[0];
4.
5.      solutionSteps.innerHTML = '';
6.      tableBody.innerHTML = '';
7.
8.      data.forEach(row => {
9.          // Display formula steps
10.         const stepDiv = document.createElement('div');
11.         stepDiv.innerHTML = `
12.             <p><strong>Iteration ${row.iteration}</strong></p>
13.             <p>Formula: \\(${row.formula}\\)</p>
14.             <p>Update: \\(${row.update}\\)</p>
15.         `;
16.         solutionSteps.appendChild(stepDiv);
17.
18.         // Add table rows
19.         const tr = document.createElement('tr');
20.         tr.innerHTML = `
21.             <td>${row.iteration}</td>
22.             <td>${row.xl.toFixed(6)}</td>
23.             <td>${row.xu.toFixed(6)}</td>
24.             <td>${row.xr.toFixed(6)}</td>
25.             <td>${row.fxl.toFixed(6)}</td>
26.             <td>${row.fxu.toFixed(6)}</td>
27.             <td>${row.fxr.toFixed(6)}</td>
28.             <td>${row.fxl_fxr.toFixed(6)}</td>
29.         `;
30.         tableBody.appendChild(tr);
31.     });
32.
33.     // Update MathJax to render the formulas
34.     MathJax.Hub.Queue(["Typeset", MathJax.Hub]);
35. }
36.
37. document.getElementById('calculate-form').onsubmit = async function (e) {
38.     e.preventDefault();
39.
40.     const formData = new FormData(e.target);
41.
42.     // Mengirim Data Ke Server
43.     const response = await fetch('/calculate', {
44.         method: 'POST',
45.         body: new URLSearchParams(formData)
46.     });
```

```
47.
48.     const result = await response.json();
49.
50.     if (response.ok) {
51.         // Menampilkan hasil jika response sukses
52.         displayResults(result.steps);
53.     } else {
54.         // Menampilkan pesan error jika ada
55.         alert(result.error);
56.     }
57. };
58.
```

5. Static/css/style1.css

```css
/* General Styles */
body {
    background-color: #FFFFFF; /* Putih */
    color: #003366; /* Biru Tua */
    font-family: 'Roboto', sans-serif;
    line-height: 1.6;
    margin: 0;
    padding: 20px;
    display: flex;
    flex-direction: column;
    justify-content: center;
    min-height: 100vh;
}

/* Header Styling */
h1 {
    text-align: center;
    font-size: 3.5rem;
    text-transform: uppercase;
    letter-spacing: 2px;
    text-shadow: 0 4px 10px rgba(0, 51, 102, 0.5); /* Biru Tua */
    color: #003366; /* Biru Tua */
    margin: 0;
}

/* Form Section */
form {
    background: linear-gradient(145deg, #50C878, #D3D3D3); /* Hijau Emerald ke Abu-abu Muda */
    padding: 30px;
    border-radius: 20px;
    border: 1px solid #003366; /* Biru Tua */
    box-shadow: 0px 10px 25px rgba(0, 0, 0, 0.1);
    max-width: 800px;
    margin: 20px auto;
    text-align: left;
    width: 100%;
    box-sizing: border-box;
}

label {
    display: block;
    font-size: 1.3rem;
    margin: 10px 0 5px;
    font-weight: bold;
    color: #003366; /* Biru Tua */
}
```

```css
input, button {
    width: 95%;
    padding: 15px;
    font-size: 1.1rem;
    margin-bottom: 20px;
    border: 2px solid #003366; /* Biru Tua */
    border-radius: 10px;
    background: #FFFFFF; /* Putih */
    color: #003366; /* Biru Tua */
    outline: none;
    transition: border-color 0.3s, box-shadow 0.3s;
}

input:focus {
    border-color: #50C878; /* Hijau Emerald */
    box-shadow: 0px 4px 8px rgba(80, 200, 120, 0.5);
}

button {
    width: auto;
    background-color: #003366; /* Biru Tua */
    color: #FFFFFF; /* Putih */
    font-size: 1.2rem;
    font-weight: bold;
    text-transform: uppercase;
    cursor: pointer;
    transition: all 0.3s ease;
    padding: 10px 20px;
    border-radius: 10px;
}

button:hover {
    background-color: #50C878; /* Hijau Emerald */
    color: #003366; /* Biru Tua */
    transform: scale(1.1);
    box-shadow: 0px 6px 20px rgba(0, 0, 0, 0.2);
}

/* Centering Button */
.button-wrapper {
    display: flex;
    justify-content: center;
    margin-top: 20px;
}

/* Solution Steps Section */
#solution-steps {
```

```css
95.      margin-top: 20px;
96.      padding: 10px;
97.      background-color: #FFFFFF; /* Putih */
98.      border: 2px solid #003366; /* Biru Tua */
99.      border-radius: 10px;
100.     padding: 30px;
101.     box-shadow: 0px 10px 25px rgba(0, 0, 0, 0.1);
102.     text-align: center;
103.     font-size: 1.5rem;
104.     color: #003366; /* Biru Tua */
105. }
106.
107. /* Table Styling */
108. table {
109.     width: 100%;
110.     border-collapse: collapse;
111.     margin-top: 20px;
112.     border: 1px solid #50C878; /* Hijau Emerald */
113. }
114.
115. th, td {
116.     border: 1px solid #003366; /* Biru Tua */
117.     padding: 8px;
118.     text-align: center;
119. }
120.
121. th {
122.     background: #FFC107; /* Kuning Mustard */
123.     color: #003366; /* Biru Tua */
124.     text-transform: uppercase;
125.     font-weight: bold;
126. }
127.
128. td {
129.     background: #D3D3D3; /* Abu-abu Muda */
130.     color: #003366; /* Biru Tua */
131. }
132.
133. .table-container {
134.     border: 2px solid #003366; /* Warna Biru Tua */
135.     border-radius: 10px; /* Sudut melengkung */
136.     padding: 15px; /* Jarak dalam */
137.     margin-top: 20px; /* Jarak atas */
138.     background-color: #f9f9f9; /* Warna latar belakang kontainer */
139.     box-shadow: 0 5px 15px rgba(0, 0, 0, 0.1); /* Bayangan */
140. }
141.
142. .table-container table {
```

```css
143.     margin: 0 auto; /* Pusatkan tabel di dalam kontainer */
144.}
145.
146.#team-info {
147.     margin-bottom: 20px; /* Jarak di bawah tabel team info */
148.     text-align: center;
149.}
150.
151.#team-info table {
152.     width: 100%;
153.     border-collapse: collapse;
154.     margin-top: 10px;
155.     table-layout: fixed; /* Menetapkan ukuran kolom tetap */
156.}
157.
158.#team-info th, #team-info td {
159.     padding: 10px;
160.     text-align: center;
161.     border: 1px solid #003366; /* Biru Tua */
162.     word-wrap: break-word; /* Memastikan teks tetap dalam kolom */
163.}
164.
165.#team-info th, #team-info td {
166.     width: 50%; /* Memberikan ukuran kolom sama */
167.}
168.
169.#team-info th {
170.     background-color: #FFC107; /* Kuning Mustard */
171.     font-weight: bold;
172.}
173.
174.#team-info td {
175.     background-color: #D3D3D3; /* Abu-abu Muda */
176.}
177.
178./* Footer */
179.footer {
180.     text-align: center;
181.     padding: 10px 0;
182.     background-color: #003366; /* Biru Tua */
183.     color: #FFFFFF; /* Putih */
184.     font-size: 1rem;
185.     border-radius: 10px;
186.     box-shadow: 0px 6px 15px rgba(0, 0, 0, 0.1);
187.     margin-top: 20px;
188.}
189.
190.footer p {
```

```css
191.    margin: 0;
192.}
193.
194./* Error Section */
195..error-section {
196.    text-align: center;
197.    margin: 20px;
198.    color: #50C878; /* Hijau Emerald */
199.    font-weight: bold;
200.}
201.
202./* Responsive Design */
203.@media (max-width: 768px) {
204.    h1 {
205.        font-size: 3rem;
206.    }
207.
208.    form {
209.        padding: 20px;
210.    }
211.
212.    #solution-steps {
213.        padding: 20px;
214.    }
215.}
216.
```

6. Tampilan Aplikasi

BRACKET METHOD ROOT FINDER

Function:

x - 2

Interval XL :

0

Interval XU :

4

Tolerance:

0.001

Max Iterations:

20

Method:

Regula Falsi Method ▾

Bisection Method
Regula Falsi Method
Brent's Method

CALCULATE

Iteration 1

Formula: $x_r = xu - \frac{f(xu)(xu-xl)}{f(xu)-f(xl)} = 2.000000$

Update: $f(xl) \times f(x_r) = -2.000000 \times 0.000000$

Hasil Iterasi

ITERATION	XL	XU	XR	F(XL)	F(XU)	F(XR)	F(XL) * F(XR)
1	0.000000	4.000000	2.000000	-2.000000	2.000000	0.000000	0.000000

Group : Numerical Methods

NAMA	NIM
Betranz Leenando	2201020079
M. Aditya Egi Dwinata	2201020141
Safitri Wulandari	2201020085
Seffi Rozahana	2201020080
SAPAR HIDAYAT. S	2201020003