North South University

Department of Electrical and Computer Engineering

Course Title: CSE417

Section: 02

Faculty: Dr. Shahnewaz Siddique

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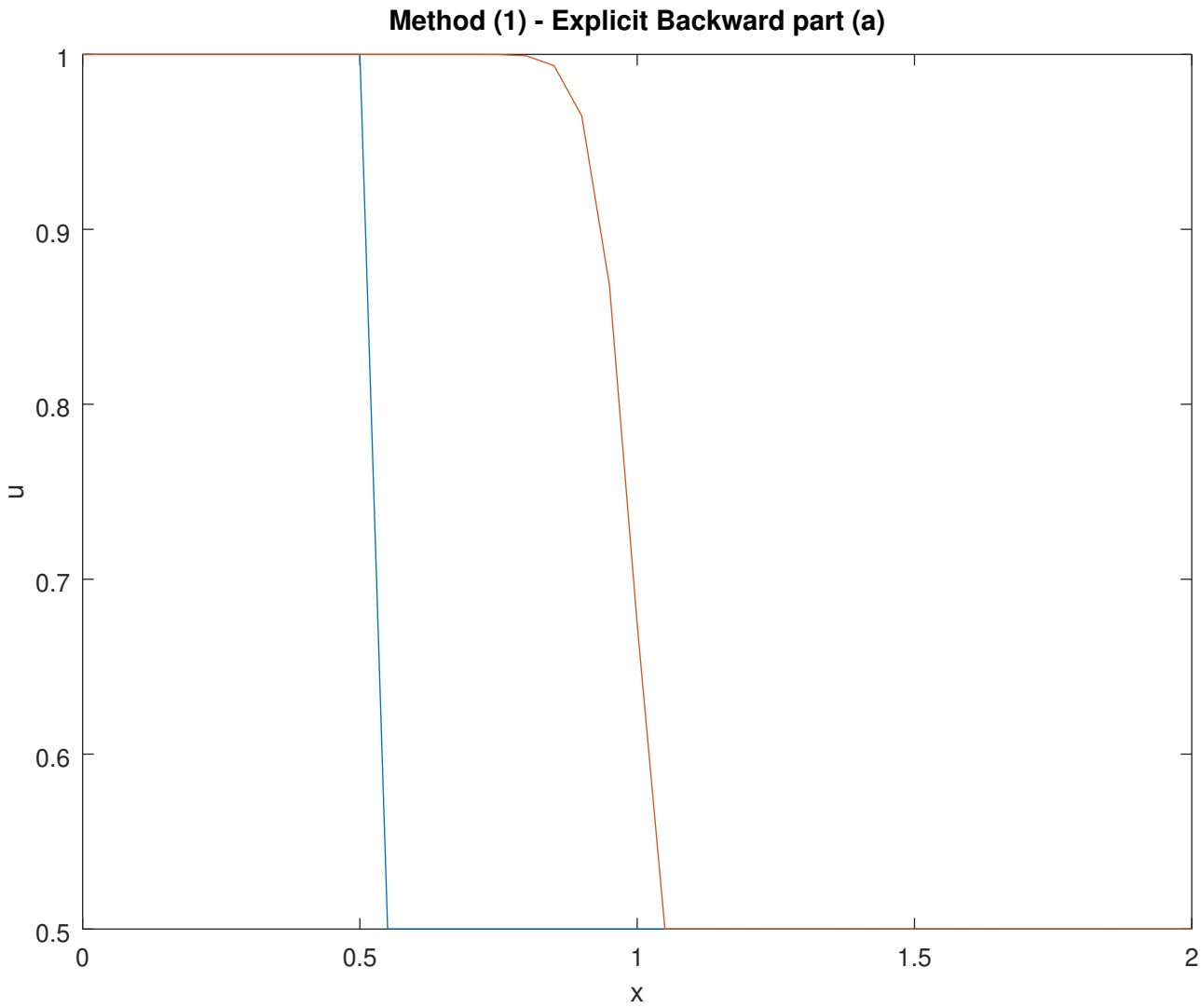
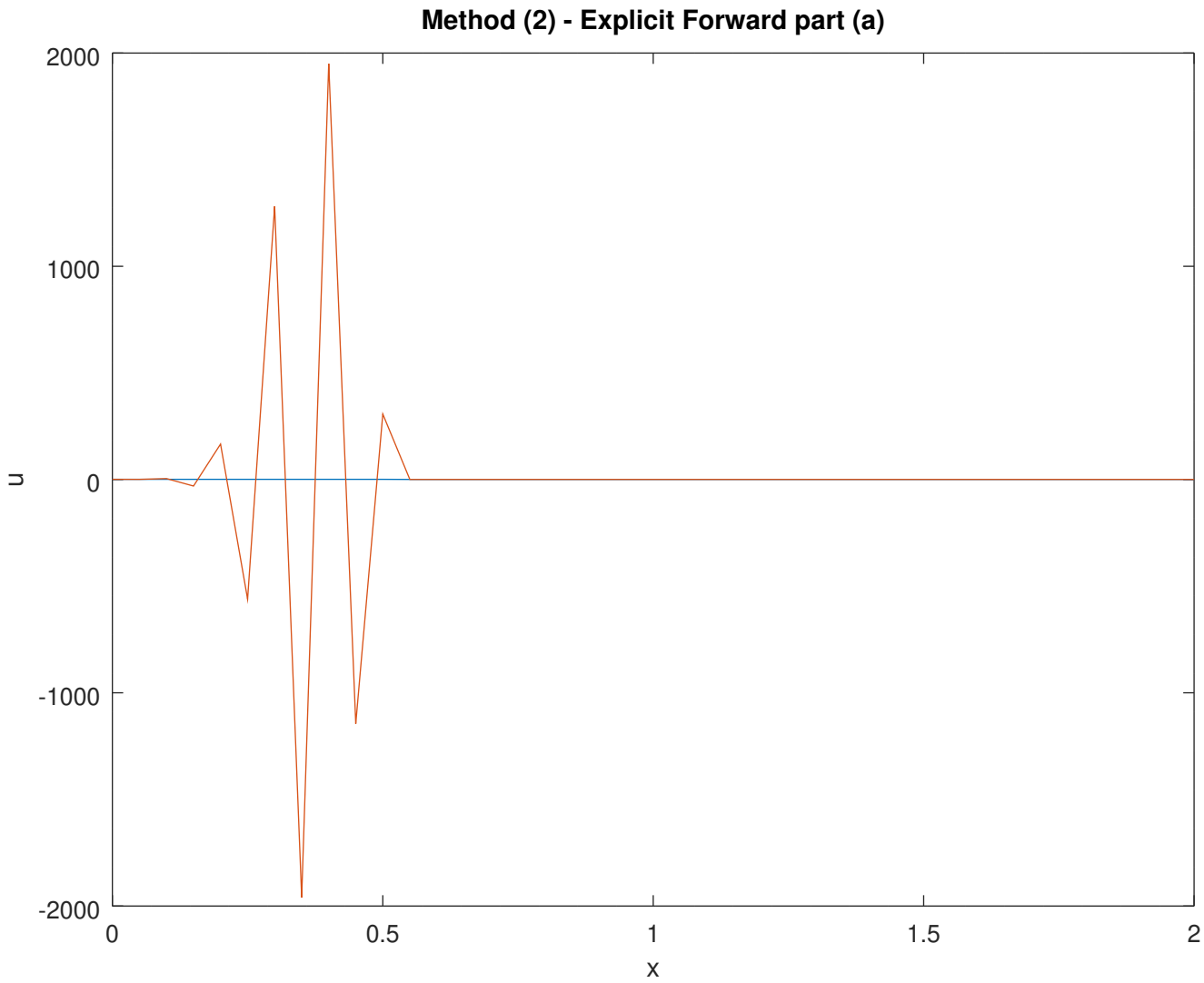
ID: 1512756042

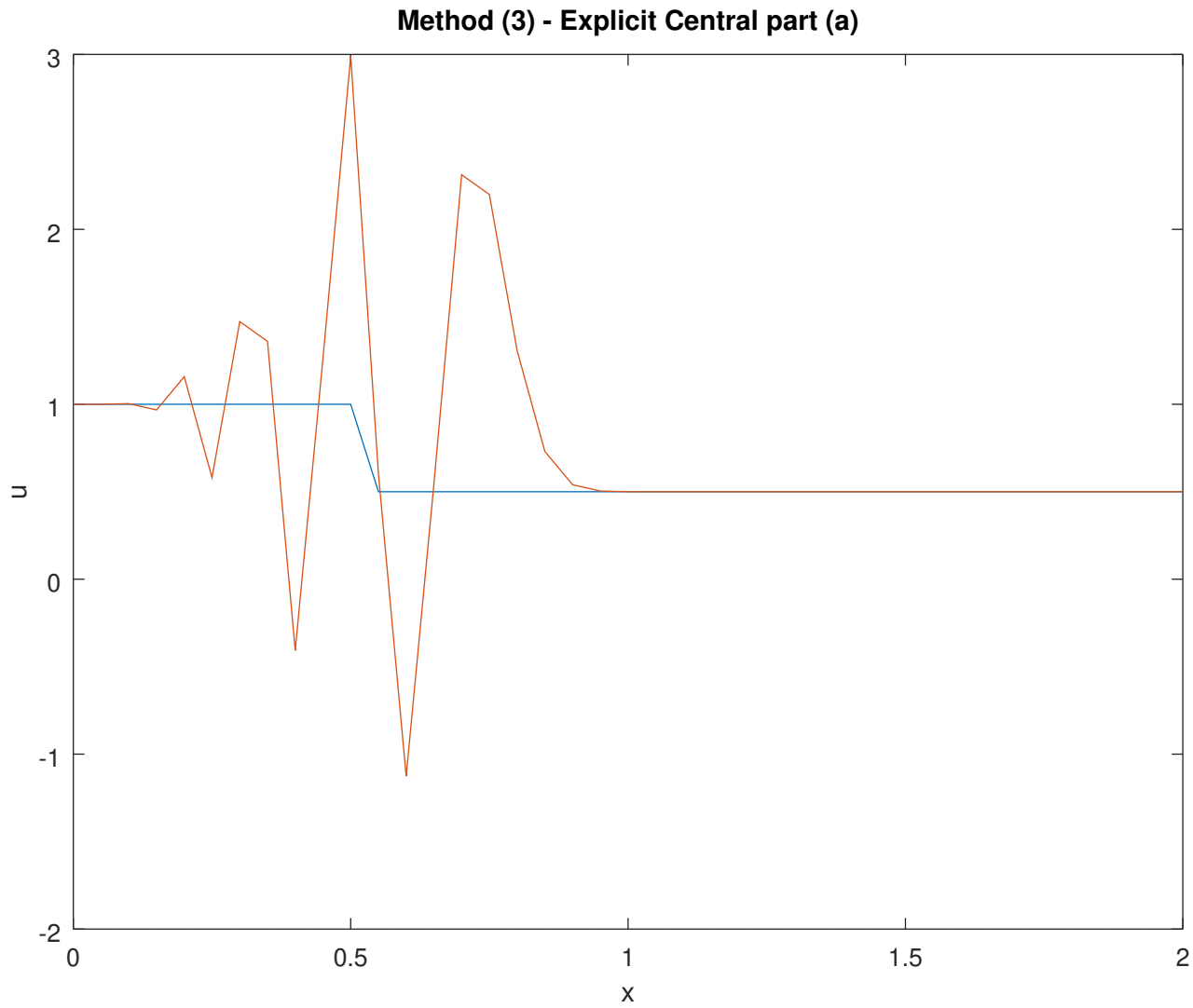
```
n = 0;
N = 41;
c = 1;
delX = 2/40;
x_i = zeros(1, N);
u_i_n = zeros(1, N);
u_i_n_plus_1 = zeros(1, N);

for i = 1: N
  x_i(i) = (i-1) * delX;
end

for i = 1: N
  if x_i(i) <= 0.5
    u_i_n(i) = 1;
  else
    u_i_n(i) = 0.5;
  end
end

plot(x_i, u_i_n);

while n < 10
  delT = 0.9 * delX / c;

  for i = 2: N-1
    u_i_n_plus_1(i) = u_i_n(i) - ((c*delT/delX)*(u_i_n(i) - u_i_n(i-1)));
  end

  u_i_n_plus_1(N) = u_i_n(N) - ((c*delT/delX)*(u_i_n(N) - u_i_n(N-1)));

  for i = 2: N
    u_i_n(i) = u_i_n_plus_1(i);
  end

  n = n+1;

end

hold on;

plot(x_i, u_i_n);
title('Method (1) - Explicit Backward part (a)');
xlabel('x'); ylabel('u');

hold off;
```


Method (1) - Explicit Backward part (a)
1
0.9
0.8
0.7
0.6
0.5
u
0
0.5
1
1.5
2
x

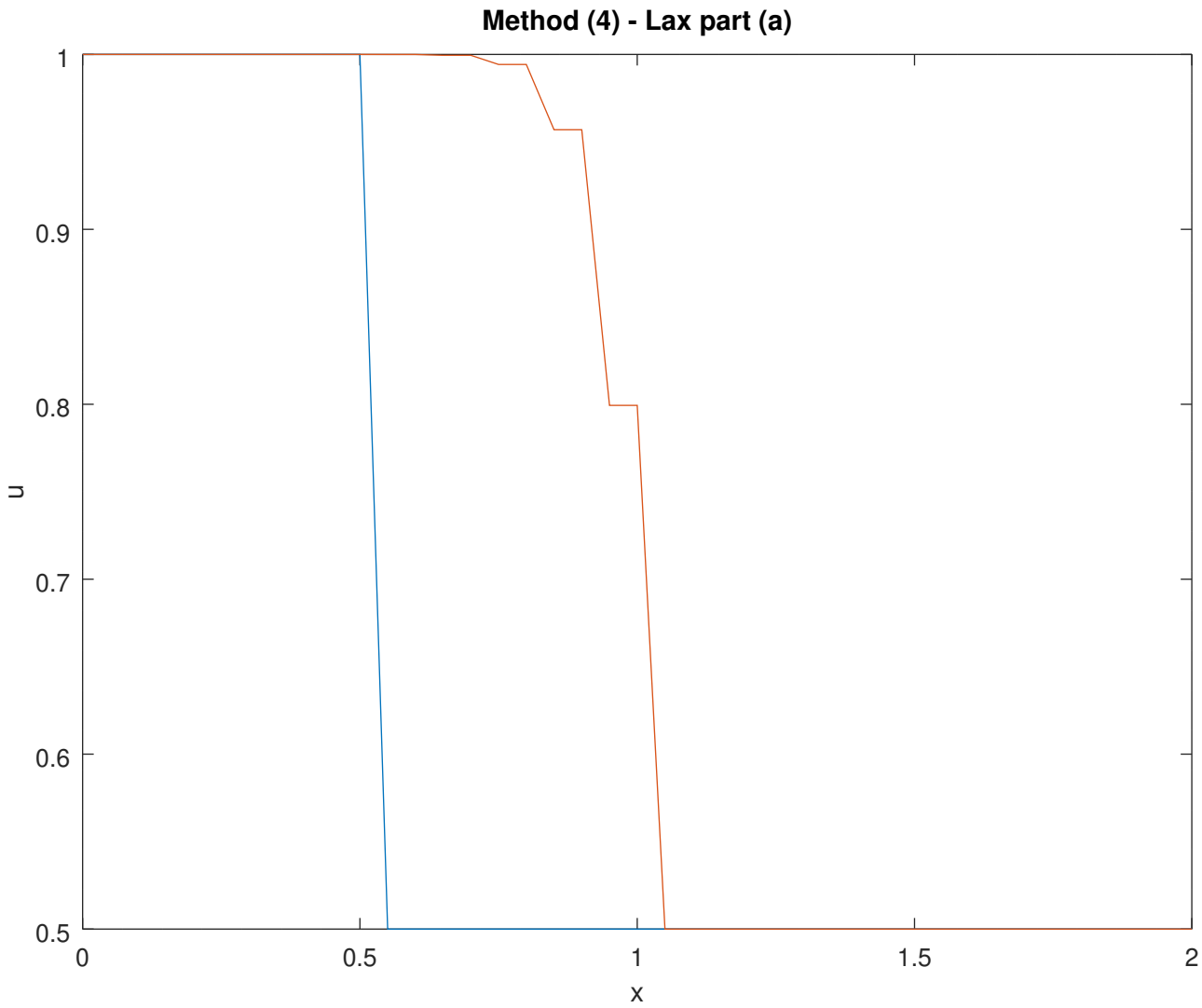
```
n = 0;
N = 41;
c = 1;
delX = 2/40;
x_i = zeros(1, N);
u_i_n = zeros(1, N);
u_i_n_plus_1 = zeros(1, N);

for i = 1: N
  x_i(i) = (i-1) * delX;
end

for i = 1: N
  if x_i(i) <= 0.5
    u_i_n(i) = 1;
  else
    u_i_n(i) = 0.5;
  end
end

plot(x_i, u_i_n);

while n < 10
  delT = 0.9 * delX / c;

  for i = 2: N-1
    u_i_n_plus_1(i) = u_i_n(i) - ((c*delT/delX)*(u_i_n(i+1) - u_i_n(i)));
  end

  u_i_n_plus_1(N) = u_i_n_plus_1(N) = u_i_n(N) - ((c*delT/delX)*(u_i_n(N) -
u_i_n(N-1)));

  for i = 2: N
    u_i_n(i) = u_i_n_plus_1(i);
  end

  n = n+1;

end

hold on;

plot(x_i, u_i_n);
title('Method (2) - Explicit Forward part (a)');
xlabel('x'); ylabel('u');

hold off;
```


Method (2) - Explicit Forward part (a)
2000
1000
0
-1000
-2000
u
0
0.5
1
1.5
2
x

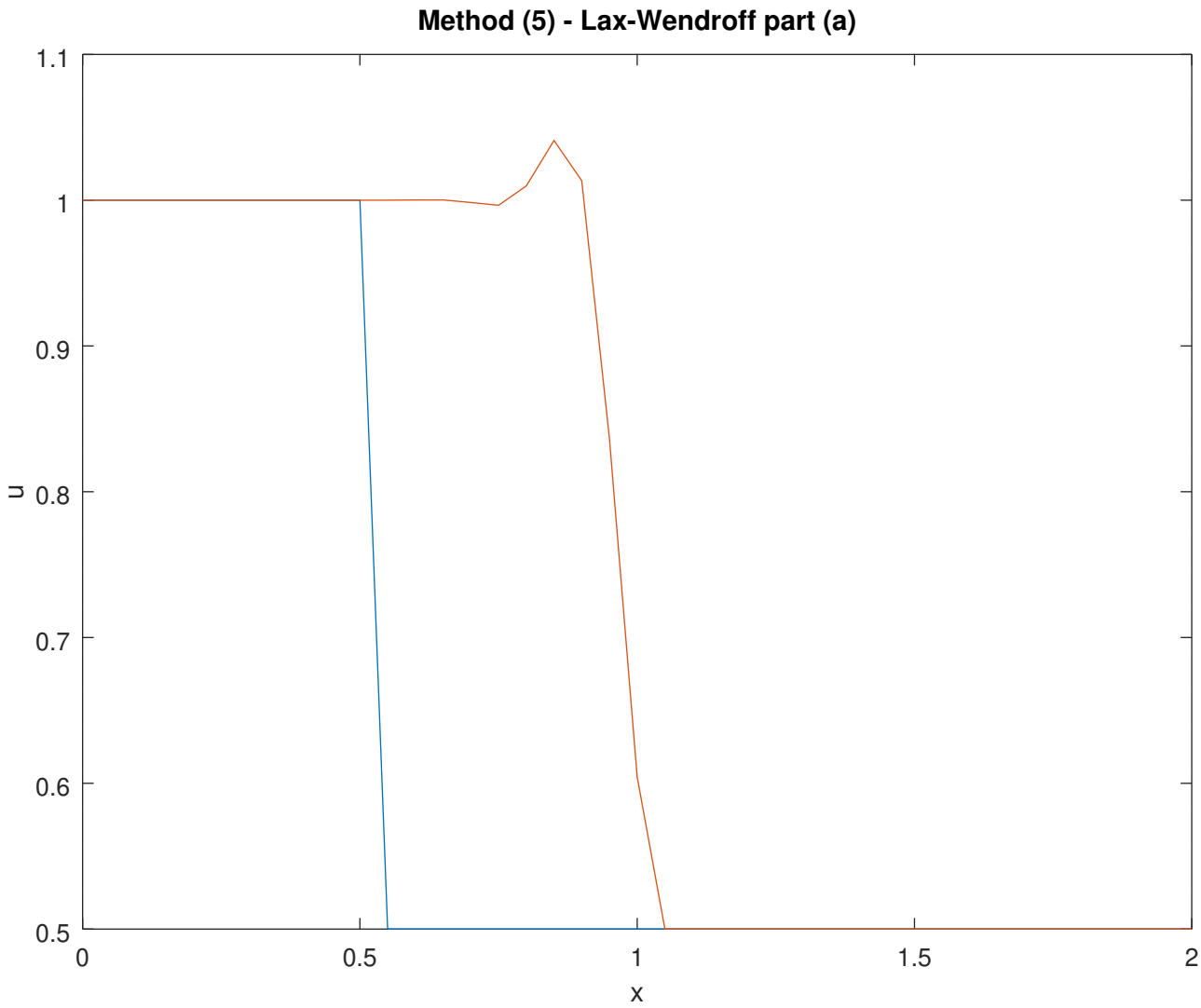
```
n = 0;
N = 41;
c = 1;
delX = 2/40;
x_i = zeros(1, N);
u_i_n = zeros(1, N);
u_i_n_plus_1 = zeros(1, N);

for i = 1: N
  x_i(i) = (i-1) * delX;
end

for i = 1: N
  if x_i(i) <= 0.5
    u_i_n(i) = 1;
  else
    u_i_n(i) = 0.5;
  end
end

plot(x_i, u_i_n);

while n < 10
  delT = 0.9 * delX / c;

  for i = 2: N-1
    u_i_n_plus_1(i) = u_i_n(i) - ((c*delT/(delX*2))*(u_i_n(i+1) - u_i_n(i-1)));
  end

  u_i_n_plus_1(N) = u_i_n(N) - ((c*delT/delX)*(u_i_n(N) - u_i_n(N-1)));

  for i = 2: N
    u_i_n(i) = u_i_n_plus_1(i);
  end

  n = n+1;

end

hold on;

plot(x_i, u_i_n);
title('Method (3) - Explicit Central part (a)');
xlabel('x'); ylabel('u');

hold off;
```


Method (3) - Explicit Central part (a)
3
2
1
0
-1
-2
u
0
0.5
1
1.5
2
x

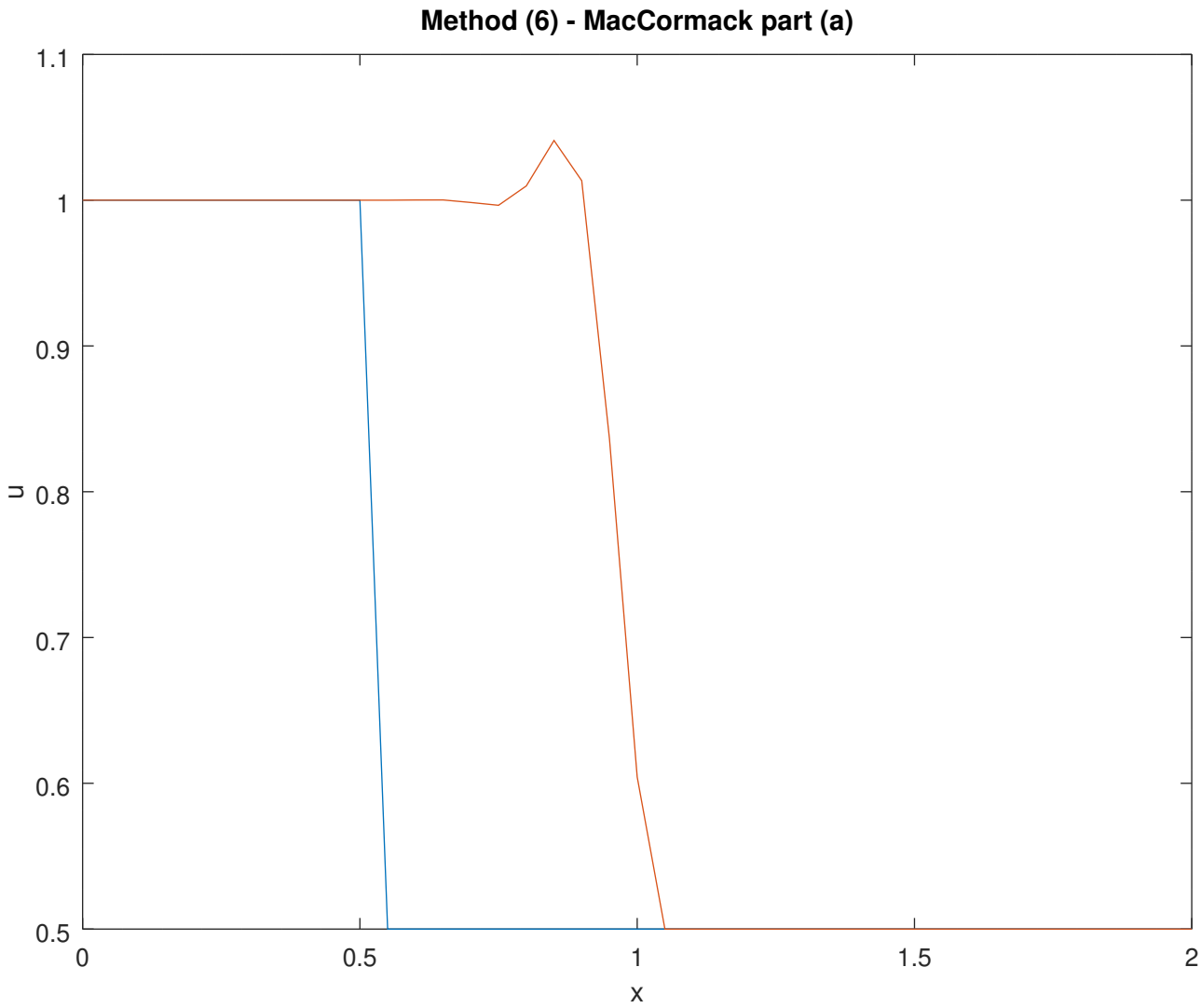
```
n = 0;
N = 41;
c = 1;
delX = 2/40;
x_i = zeros(1, N);
u_i_n = zeros(1, N);
u_i_n_plus_1 = zeros(1, N);

for i = 1: N
  x_i(i) = (i-1) * delX;
end

for i = 1: N
  if x_i(i) <= 0.5
    u_i_n(i) = 1;
  else
    u_i_n(i) = 0.5;
  end
end

plot(x_i, u_i_n);

while n < 10
  delT = 0.9 * delX / c;

  for i = 2: N-1
    u_i_n_plus_1(i) = ((u_i_n(i+1) + u_i_n(i-1))/2) - ((c*delT/(delX*2))*(u_i_n(i+1) - u_i_n(i-1)));
  end

  u_i_n_plus_1(N) = u_i_n(N) - ((c*delT/delX)*(u_i_n(N) - u_i_n(N-1)));

  for i = 2: N
    u_i_n(i) = u_i_n_plus_1(i);
  end

  n = n+1;

end

hold on;

plot(x_i, u_i_n);
title('Method (4) - Lax part (a)');
xlabel('x'); ylabel('u');

hold off;
```


Method (4) - Lax part (a)
1
0.9
0.8
0.7
0.6
0.5
u
0
0.5
1
1.5
2
x

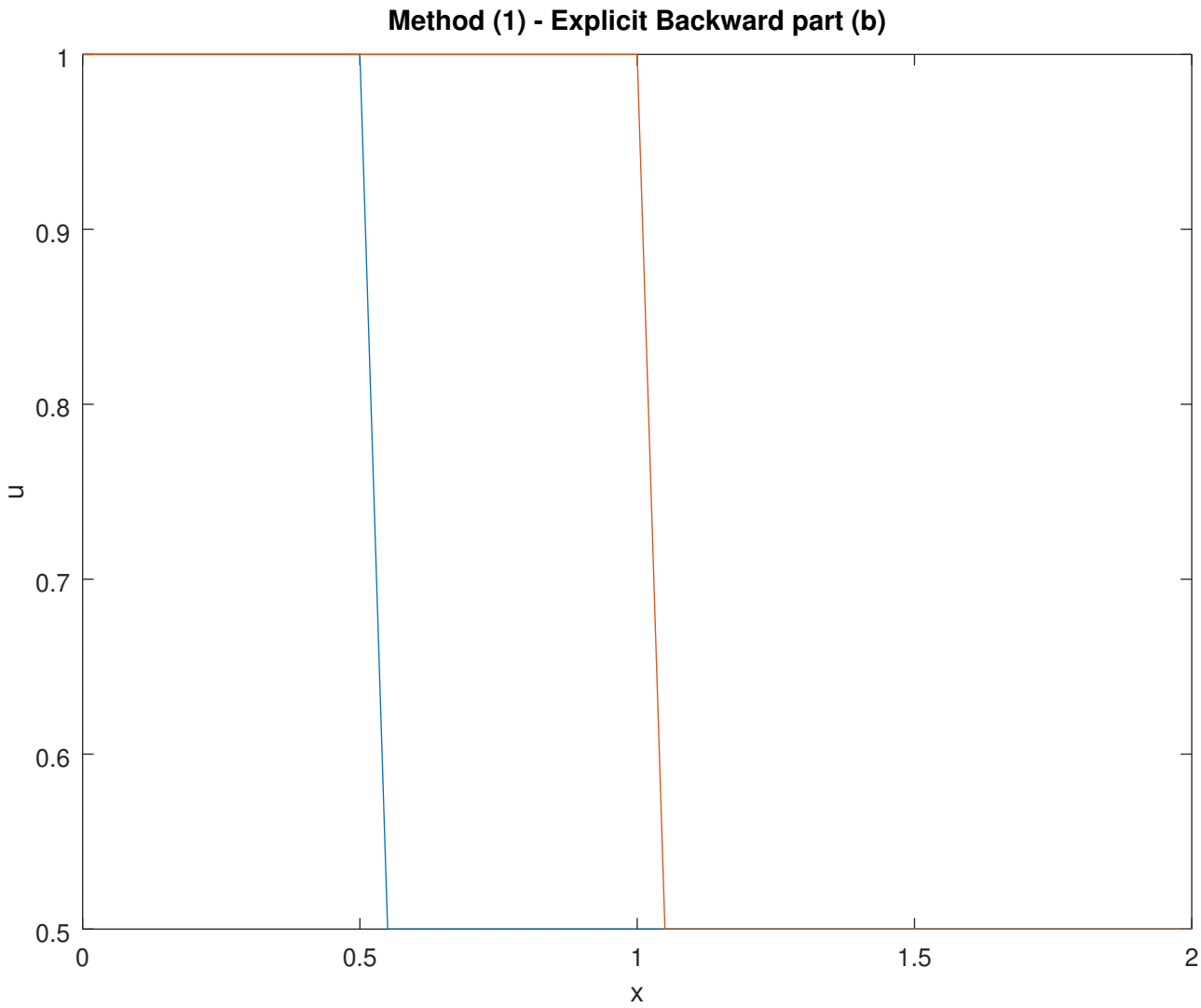
```
n = 0;
N = 41;
c = 1;
delX = 2/40;
x_i = zeros(1, N);
u_i_n = zeros(1, N);
u_i_n_plus_1 = zeros(1, N);

for i = 1: N
  x_i(i) = (i-1) * delX;
end

for i = 1: N
  if x_i(i) <= 0.5
    u_i_n(i) = 1;
  else
    u_i_n(i) = 0.5;
  end
end

plot(x_i, u_i_n);

while n < 10
  delT = 0.9 * delX / c;

  for i = 2: N-1
    u_i_n_plus_1(i) = u_i_n(i) - ((c*delT/(delX*2))*(u_i_n(i+1) - u_i_n(i-1))) + (0.5 * c * c * (delT/delX) * (delT/delX) * (u_i_n(i+1) - (2 * u_i_n(i)) + u_i_n(i-1)));
  end

  u_i_n_plus_1(N) = u_i_n(N) - ((c*delT/delX)*(u_i_n(N) - u_i_n(N-1)));

  for i = 2: N
    u_i_n(i) = u_i_n_plus_1(i);
  end

  n = n+1;

end

hold on;

plot(x_i, u_i_n);
title('Method (5) - Lax-Wendroff part (a)');
xlabel('x'); ylabel('u');

hold off;
```


Method (5) - Lax-Wendroff part (a)
1.1
1
0.9
0.8
0.7
0.6
0.5
u
0
0.5
1
1.5
2
x

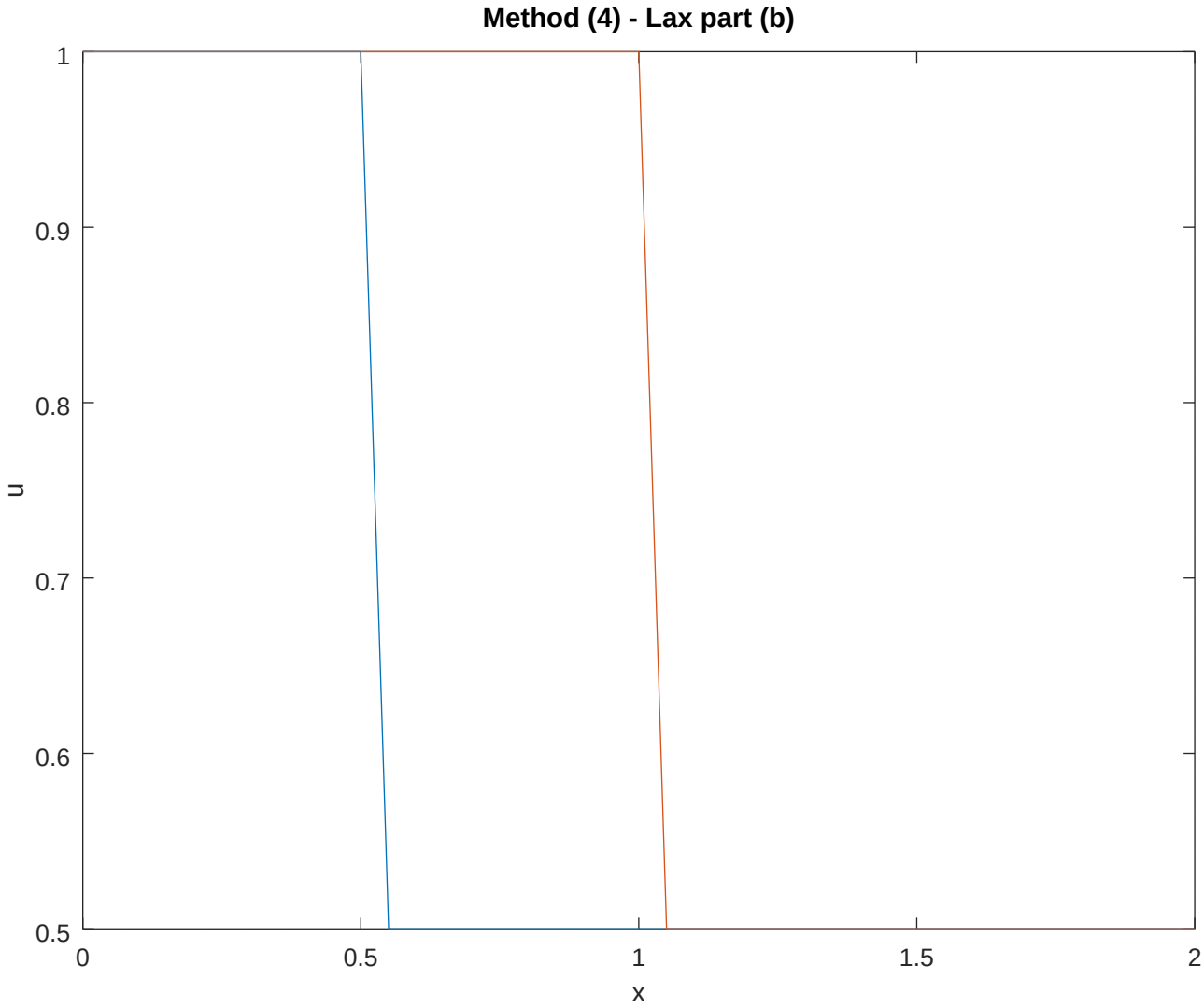
```
n = 0;
N = 41;
c = 1;
delX = 2/40;
x_i = zeros(1, N);
u_i_n = zeros(1, N);
ubar_i_n_plus_1 = zeros(1, N);
u_i_n_plus_1 = zeros(1, N);

for i = 1: N
  x_i(i) = (i-1) * delX;
end

for i = 1: N
  if x_i(i) <= 0.5
    u_i_n(i) = 1;
  else
    u_i_n(i) = 0.5;
  end
end

plot(x_i, u_i_n);

while n < 10
  delT = 0.9 * delX / c;

  for i = 1: N-1
    ubar_i_n_plus_1(i) = u_i_n(i) - ((c*delT/delX)*(u_i_n(i+1) - u_i_n(i)));
  end

  for i = 2: N-1
    u_i_n_plus_1(i) = 0.5*(u_i_n(i) + ubar_i_n_plus_1(i) -
((c*delT/delX)*(ubar_i_n_plus_1(i) - ubar_i_n_plus_1(i-1))));
  end

  u_i_n_plus_1(N) = u_i_n(N) - ((c*delT/delX)*(u_i_n(N) - u_i_n(N-1)));

  for i = 2: N
    u_i_n(i) = u_i_n_plus_1(i);
  end

  n = n+1;

end

hold on;

plot(x_i, u_i_n);
title('Method (6) - MacCormack part (a)');
xlabel('x'); ylabel('u');

hold off;
```


Method (6) - MacCormack part (a)
1.1
1
0.9
0.8
0.7
0.6
0.5
u
0
0.5
1
1.5
2
x

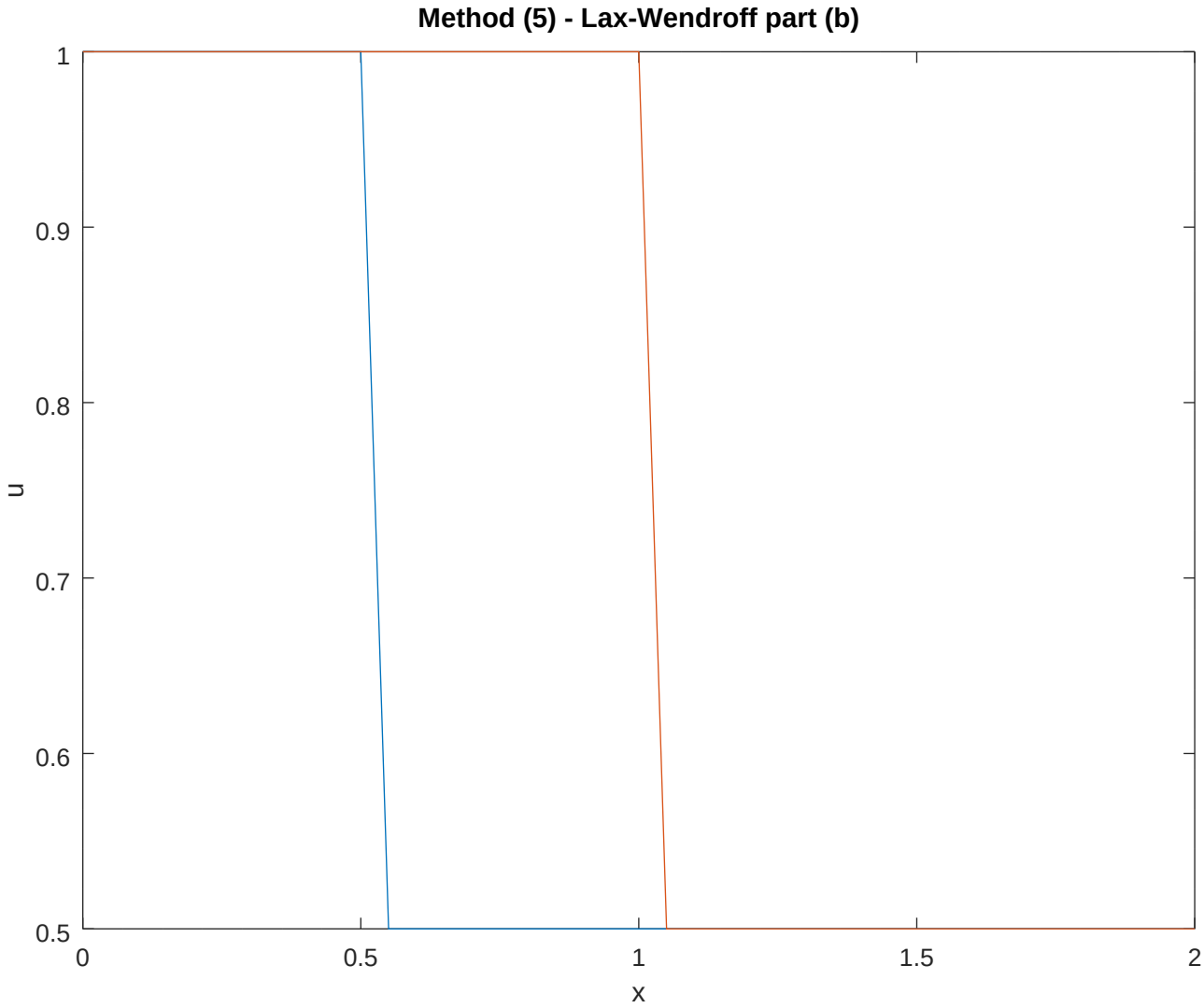
```
n = 0;
N = 41;
c = 1;
delX = 2/40;
x_i = zeros(1, N);
u_i_n = zeros(1, N);
u_i_n_plus_1 = zeros(1, N);

for i = 1: N
  x_i(i) = (i-1) * delX;
end

for i = 1: N
  if x_i(i) <= 0.5
    u_i_n(i) = 1;
  else
    u_i_n(i) = 0.5;
  end
end

plot(x_i, u_i_n);

while n < 10
  delT = 0.9 * delX / c;

  for i = 2: N-1
    u_i_n_plus_1(i) = u_i_n(i) - (u_i_n(i) - u_i_n(i-1));
  end

  u_i_n_plus_1(N) = u_i_n(N) - (u_i_n(N) - u_i_n(N-1));

  for i = 2: N
    u_i_n(i) = u_i_n_plus_1(i);
  end

  n = n+1;

end

hold on;

plot(x_i, u_i_n);
title('Method (1) - Explicit Backward part (b)');
xlabel('x'); ylabel('u');

hold off;
```


Method (1) - Explicit Backward part (b)
1
0.9
0.8
0.7
0.6
0.5
u
0
0.5
1
1.5
2
x

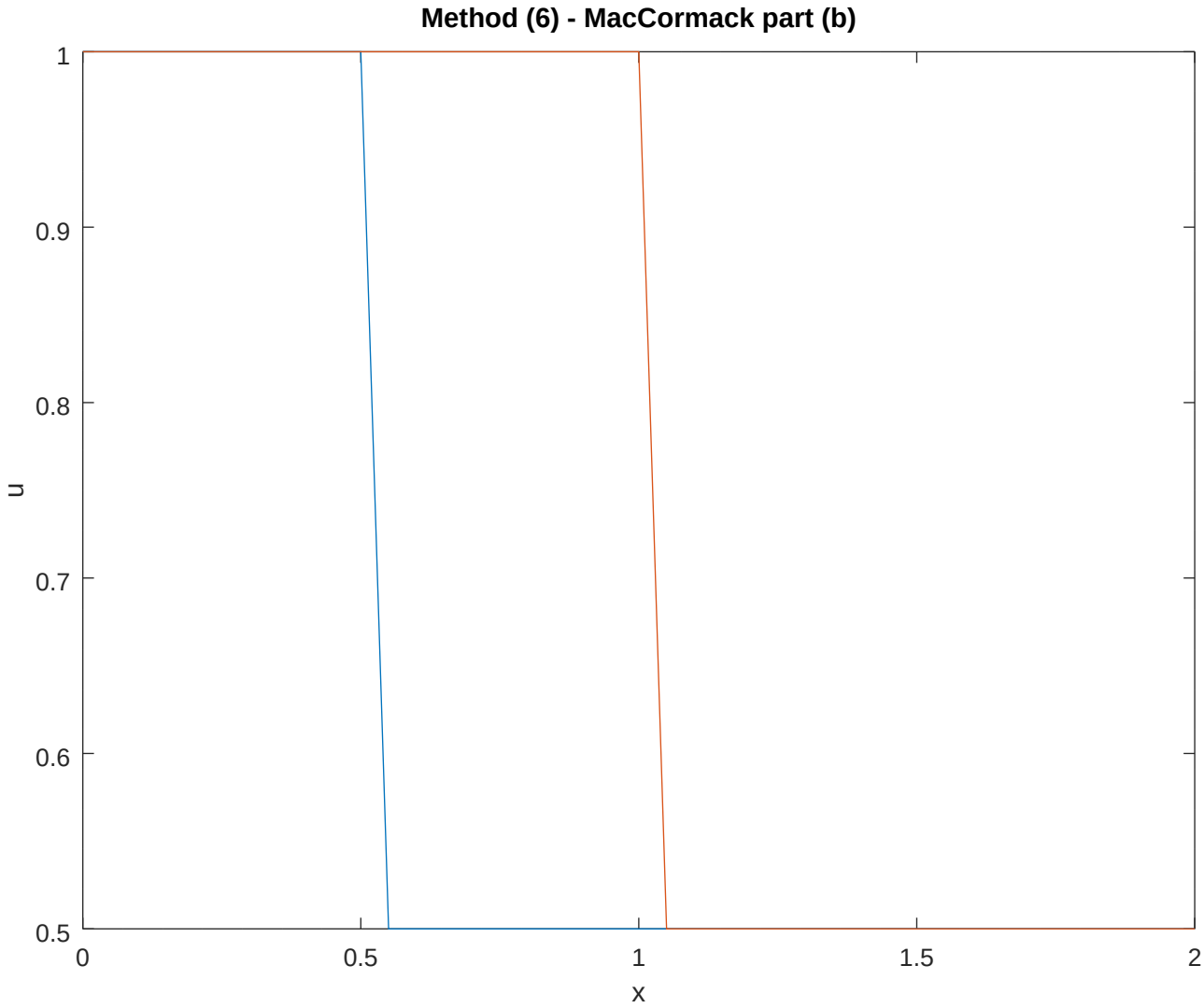
```
n = 0;
N = 41;
c = 1;
delX = 2/40;
x_i = zeros(1, N);
u_i_n = zeros(1, N);
u_i_n_plus_1 = zeros(1, N);

for i = 1: N
  x_i(i) = (i-1) * delX;
end

for i = 1: N
  if x_i(i) <= 0.5
    u_i_n(i) = 1;
  else
    u_i_n(i) = 0.5;
  end
end

plot(x_i, u_i_n);

while n < 10
  delT = 0.9 * delX / c;

  for i = 2: N-1
    u_i_n_plus_1(i) = ((u_i_n(i+1) + u_i_n(i-1))/2) - (0.5*(u_i_n(i+1) - u_i_n(i-1)));
  end

  u_i_n_plus_1(N) = u_i_n(N) - (u_i_n(N) - u_i_n(N-1));

  for i = 2: N
    u_i_n(i) = u_i_n_plus_1(i);
  end

  n = n+1;

end

hold on;

plot(x_i, u_i_n);
title('Method (4) - Lax part (b)');
xlabel('x'); ylabel('u');

hold off;
```


Method (4) - Lax part (b)
1
0.9
0.8
0.7
0.6
0.5
u
0
0.5
1
1.5
2
x

```
n = 0;
N = 41;
c = 1;
delX = 2/40;
x_i = zeros(1, N);
u_i_n = zeros(1, N);
u_i_n_plus_1 = zeros(1, N);

for i = 1: N
  x_i(i) = (i-1) * delX;
end

for i = 1: N
  if x_i(i) <= 0.5
    u_i_n(i) = 1;
  else
    u_i_n(i) = 0.5;
  end
end

plot(x_i, u_i_n);

while n < 10
  delT = 0.9 * delX / c;

  for i = 2: N-1
    u_i_n_plus_1(i) = u_i_n(i) - ((0.5)*(u_i_n(i+1) - u_i_n(i-1))) + (0.5 *
(u_i_n(i+1) - (2 * u_i_n(i)) + u_i_n(i-1)));
  end

  u_i_n_plus_1(N) = u_i_n(N) - ((u_i_n(N) - u_i_n(N-1)));

  for i = 2: N
    u_i_n(i) = u_i_n_plus_1(i);
  end

  n = n+1;

end

hold on;

plot(x_i, u_i_n);
title('Method (5) - Lax-Wendroff part (b)');
xlabel('x'); ylabel('u');

hold off;
```


Method (5) - Lax-Wendroff part (b)
1
0.9
0.8
0.7
0.6
0.5
u
0
0.5
1
1.5
2
x

```
n = 0;
N = 41;
c = 1;
delX = 2/40;
x_i = zeros(1, N);
u_i_n = zeros(1, N);
ubar_i_n_plus_1 = zeros(1, N);
u_i_n_plus_1 = zeros(1, N);

for i = 1: N
  x_i(i) = (i-1) * delX;
end

for i = 1: N
  if x_i(i) <= 0.5
    u_i_n(i) = 1;
  else
    u_i_n(i) = 0.5;
  end
end

plot(x_i, u_i_n);

while n < 10
  delT = 0.9 * delX / c;

  for i = 1: N-1
    ubar_i_n_plus_1(i) = u_i_n(i) - (u_i_n(i+1) - u_i_n(i));
  end

  for i = 2: N-1
    u_i_n_plus_1(i) = 0.5*(u_i_n(i) + ubar_i_n_plus_1(i) - (ubar_i_n_plus_1(i) -
ubar_i_n_plus_1(i-1)));
  end

  u_i_n_plus_1(N) = u_i_n(N) - (u_i_n(N) - u_i_n(N-1));

  for i = 2: N
    u_i_n(i) = u_i_n_plus_1(i);
  end

  n = n+1;

end

hold on;

plot(x_i, u_i_n);
title('Method (6) - MacCormack part (b)');
xlabel('x'); ylabel('u');

hold off;
```


Method (6) - MacCormack part (b)
1
0.9
0.8
0.7
0.6
0.5
u
0
0.5
1
1.5
2
x