Chittagong University of Engineering & Technology

EEE-496

Digital Signal Processing Sessional

Generate diffrent type of signal by using fundamental signal.

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Contents

1 Objectives

1. Able to generate customize signal with fundamental signal.
2. Visualize signal with MATLAB

2 User defined function

2.1 Impulse function

```
function out=DeltaFunction(n)
if n==0
    out=1;
else
    out=0;
end
end
```

2.2 Step function

```
function out=StepFunction(n)
if n≥0
    out=1;
else
    out=0;
end
end
```

2.3 Ramp function

```
function out=RampFunction(n)
out=n*StepFunction(n);
end
```

2.4 Parabolic function

```
function out=parabolic(n)
out=n^2*StepFunction(n);
end
```

3 Generate a signal with Impulse, Step and Ramp signal

We have generated a combined signal

$$x[n] = 10 \cdot u[n] - 20 \cdot u[n-11] + r[n-21] - r[n-41] - 10 \cdot u[n-46] - 10 \cdot \delta[n-48]$$

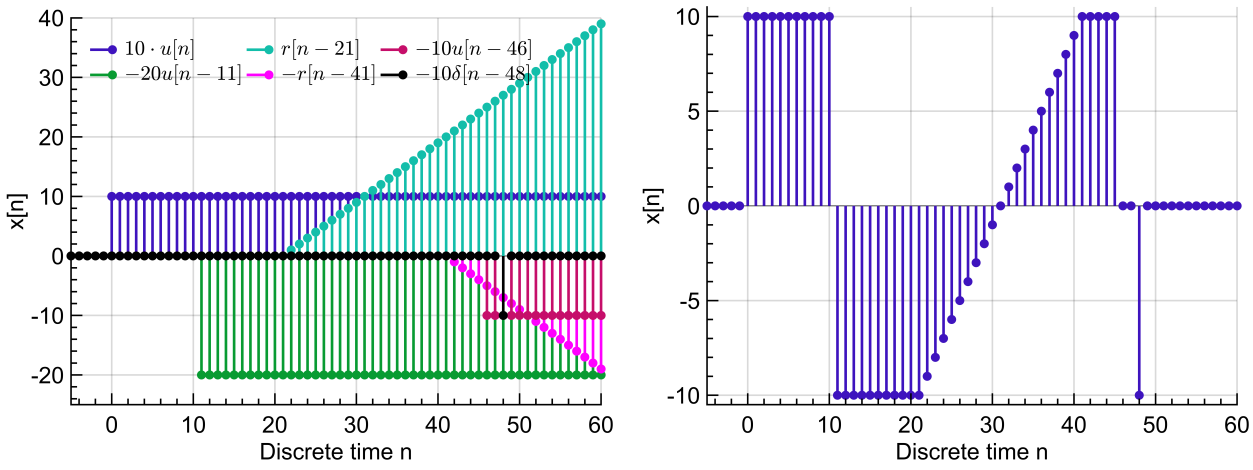
with the help of fundamental signal.

3.1 Code

```
clc;
clear;
close all;
n=-5:60;
step_0=zeros(size(n));
step_11=zeros(size(n));
ramp_21=zeros(size(n));
ramp_41=zeros(size(n));
step_46=zeros(size(n));
impulse_48=zeros(size(n));
for i=1:length(n)
    step_0(i)=10*StepFunction(n(i));
    step_11(i)=-20*StepFunction(n(i)-11);
    ramp_21(i)=RampFunction(n(i)-21);
    ramp_41(i)=-1*RampFunction(n(i)-41);
    step_46(i)=-10*StepFunction(n(i)-46);
    impulse_48(i)=-10*DeltaFunction(n(i)-48);
end
signal=step_0+step_11+ramp_21+ramp_41+step_46+impulse_48;
figure
stem(n, step_0,"filled", "linewidth", 1.5, "color", [62/256
   19/256 191/256])
hold on
stem(n, step_11,"filled", "linewidth", 1.5, "color", [8/256
   156/256 50/256])
stem(n, ramp_21,"filled", "linewidth", 1.5, "color", [19/256
   191/256 171/256])
stem(n, ramp_41,"filled", "linewidth", 1.5, "color", "m")
stem(n, step_46,"filled", "linewidth", 1.5, "color", [199/256
   14/256 106/256])
stem(n, impulse_48,"filled", "linewidth", 1.5, "color", "k")
leg=legend("$10\cdot u[n]$", "$-20u[n-11]$", "$r[n-21]$", "$-r[
   n-41]$", "$-10u[n-46]$", "$-10\▵[n-48]$");
set(leg, "Interpreter", "latex")
ylim([-25 40]);
plt=[];
plt.XLabel='Discrete time n'
plt.YLabel="x[n]";
plt.XGrid="on";
plt.YGrid="on";
plt.ShowBox="off";
plt.XLim=[-5 60];
setPlotProp(plt)
```

```
figure
stem(n, signal,"filled", "linewidth", 1.5, "color", [62/256
   19/256 191/256])
plt=[];
plt.XLabel='Discrete time n'
plt.YLabel="x[n]";
plt.XGrid="on";
plt.YGrid="on";
plt.ShowBox="off";
plt.XLim=[-5 60];
plt.YLim=[-10.5 10.5];
setPlotProp(plt)
```

3.2 Figure



(a) (b)

Figure 1: (a) All fundamental signals that are used to generate a customized signal (b) Customize signal which contains impulse, step and ramp signal

4 Generate a signal with Step, Ramp and Parabolic signal

We have generated a cstumized signal with the help of a fundamental signals $u[n]$, $r[n]$, $p[n]$ and $\delta[n]$

$$x[n] = 5 \cdot r[n] - 5 \cdot r[n-10] - 100 \cdot u[n-21] + 0.5 \cdot p[n-31] + u[-n+46] + 30 \cdot \delta[n-50]$$

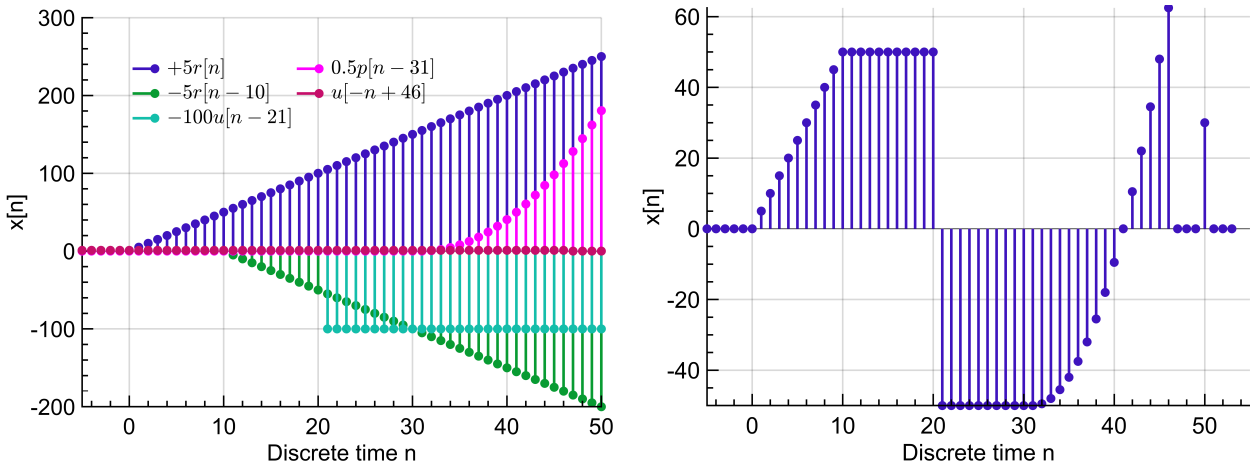
4.1 Code

```
clc;
clear;
close all;
n=-5:53;
ramp_0=zeros(size(n));
ramp_10=zeros(size(n));
```

```
step_21=zeros(size(n));
parabolic_31=zeros(size(n));
step_46=zeros(size(n));
delt_50=zeros(size(n));
for i=1:length(n)
    ramp_0(i)=5*RampFunction(n(i));
    ramp_10(i)=-5*RampFunction(n(i)-10);
    step_21(i)=-100*StepFunction(n(i)-21);
    parabolic_31(i)=0.5*parabolic(n(i)-31);
    step_46(i)=StepFunction(-n(i)+46);
    delt_50(i)=30*DeltaFunction(n(i)-50);
end
signal=(ramp_0+ramp_10+step_21+parabolic_31).*step_46+delt_50;
figure
stem(n, ramp_0,"filled", "linewidth", 1.5, "color", [62/256
   19/256 191/256])
hold on
stem(n, ramp_10,"filled", "linewidth", 1.5, "color", [8/256
   156/256 50/256])
stem(n, step_21,"filled", "linewidth", 1.5, "color", [19/256
   191/256 171/256])
stem(n, parabolic_31,"filled", "linewidth", 1.5, "color", "m")
stem(n, step_46,"filled", "linewidth", 1.5, "color", [199/256
   14/256 106/256])
leg=legend("$+5r[n]$", "$-5r[n-10]$", "$-100u[n-21]$", "$0.5p[n
   -31]$", "$u[-n+46]$");
set(leg, "Interpreter", "latex")
plt=[];
plt.XLabel='Discrete time n'
plt.YLabel="x[n]";
plt.XGrid="on";
plt.YGrid="on";
plt.ShowBox="off";
plt.XLim=[-5 50];
setPlotProp(plt)

figure
stem(n, signal,"filled", "linewidth", 1.5, "color", [62/256
   19/256 191/256])
plt=[];
plt.XLabel='Discrete time n'
plt.YLabel="x[n]";
plt.XGrid="on";
plt.YGrid="on";
plt.ShowBox="off";
plt.XLim=[-5 55];
```

```
setPlotProp(plt)
```

4.2 Figure



(a) (b)

Figure 2: (a) All fundamental signals that are used to generate a customized signal (b) Customize signal which contains impulse, step and ramp signal

5 Generate a signal with Impulse, Step, Ramp and Sinusoidal signal

We have generated a cstumized signal with the help of a fundamental signals $u[n]$, $r[n]$, $p[n]$, $\delta[n]$ and $\sin[2\pi \cdot 0.09 \cdot n]$

$$x[n] = \delta[n] + (25u[n] + 10\sin[2\pi \cdot 0.09(n-5]) \cdot u[n-5] - 10\sin[2\pi \cdot 0.09(n-5]) \cdot u[n-26] \\ - 50u[n-31] + 5r[n-36] - 25u[n-45] + p[n-48] \cdot u[-n+56] \tag{1}$$

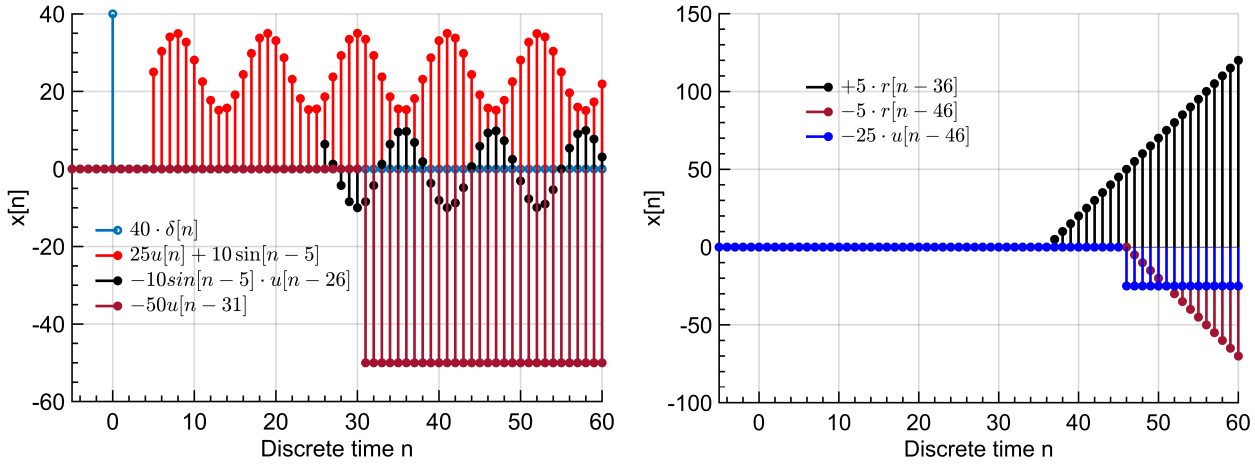
5.1 Code

```
clc;
clear;
close all;
n=-5:60;
%% All fundamental signals combine to create another signal
delt_0=zeros(size(n));
sin_5=zeros(size(n));
sin_26=zeros(size(n));
step_31=zeros(size(n));
ramp_36=zeros(size(n));
ramp_46=zeros(size(n));
step_46=zeros(size(n));
parabolic_48=zeros(size(n));
```

```
step_56=zeros(size(n));
for i=1:length(n)
    delt_0(i)=40*DeltaFunction(n(i));
    sin_5(i)=(25*StepFunction(n(i))+10*sin(2*pi*.09*(n(i)-5))).
       *StepFunction(n(i)-5);
    sin_26(i)=-10*sin(2*pi*.09*(n(i)-5))*StepFunction(n(i)-26);
    step_31(i)=-50*StepFunction(n(i)-31);
    ramp_36(i)=5*RampFunction(n(i)-36);
    ramp_46(i)=-5*RampFunction(n(i)-46);
    step_46(i)=-25*StepFunction(n(i)-46);
    parabolic_48(i)=parabolic(n(i)-48);
    step_56(i)=StepFunction(-n(i)+56);
end
signal=delt_0+sin_5+sin_26+step_31+ramp_36+...
    ramp_46+step_46+parabolic_48.*step_56;
%% Plot all fundamental signal
figure
stem(n, delt_0)
hold on
stem(n, sin_5, "filled", "color", "r")
stem(n, sin_26, "filled", "color", "k")
stem(n, step_31, "filled", "color", [0.6350 0.0780 0.1840])
leg=legend("$40\cdot\u[n]$", "$25u[n]+10\sin[n-5]$", "$-10sin[n
   -5]\cdot u[n-26]$", "$-50u[n-31]$");
set(leg, "Interpreter", "latex")
plt=[];
plt.XLabel='Discrete time n'
plt.YLabel="x[n]";
plt.XGrid="on";
plt.YGrid="on";
plt.ShowBox="off";
plt.XLim=[-5 60];
setPlotProp(plt)

figure
stem(n, ramp_36, "filled", "color", "k")
hold on
stem(n, ramp_46,"filled", "color", [0.6350 0.0780 0.1840])
stem(n, step_46, "filled", "color", "b")
leg=legend("$+5\cdot r[n-36]$", "$-5\cdot r[n-46]$", "$-25\cdot
    u[n-46]$");
set(leg, "Interpreter", "latex")
plt=[];
plt.XLabel='Discrete time n'
plt.YLabel="x[n]";
plt.XGrid="on";
```

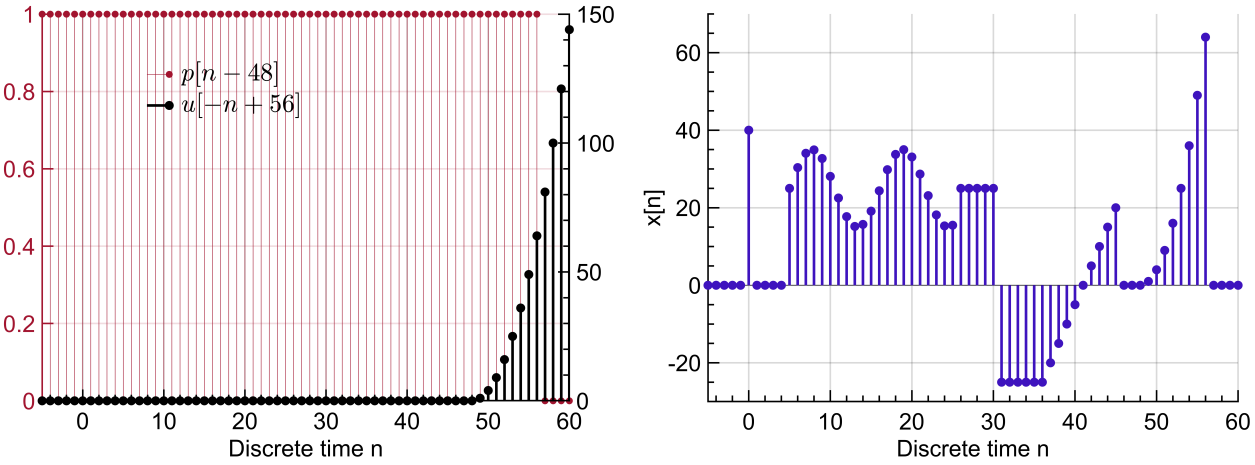
```
plt.YGrid="on";
plt.ShowBox="off";
plt.XLim=[-5 60];
setPlotProp(plt)

figure
yyaxis left
ylabel("x[n]")
stem(n, step_56,"filled", "color", [0.6350 0.0780 0.1840])
yyaxis right
stem(n, parabolic_48, "filled", "color", "k")
ax=gca;
ax.YAxis(1).Color=[0.6350 0.0780 0.1840];
leg=legend("$p[n-48]$", "$u[-n+56]$");
set(leg, "Interpreter", "latex")
plt=[];
plt.XLabel='Discrete time n'
plt.XGrid="on";
plt.YGrid="on";
plt.ShowBox="off";
plt.XLim=[-5 60];
setPlotProp(plt)
%% Plot combined signal
figure
stem(n, signal,"filled", "linewidth", 1.5, "color", [62/256
   19/256 191/256]);
ylim([-30 70]);
plt=[];
plt.XLabel='Discrete time n'
plt.YLabel="x[n]";
plt.XGrid="on";
plt.YGrid="on";
plt.ShowBox="off";
plt.XLim=[-5 60];
setPlotProp(plt)
```

5.2 Figure



(a) (b)

Figure 3: (a) $40\delta[n]$, $25u[n] + 10\sin[n-5]$, $-10\sin[n-5] \cdot u[n-26]$ and $-50u[n-31]$ signals that are used to generate a customized signal (b) $55r[n-36]$, $-5r[n-46]$ and $-25u[n-46$ signals that are used to generate a customized signal

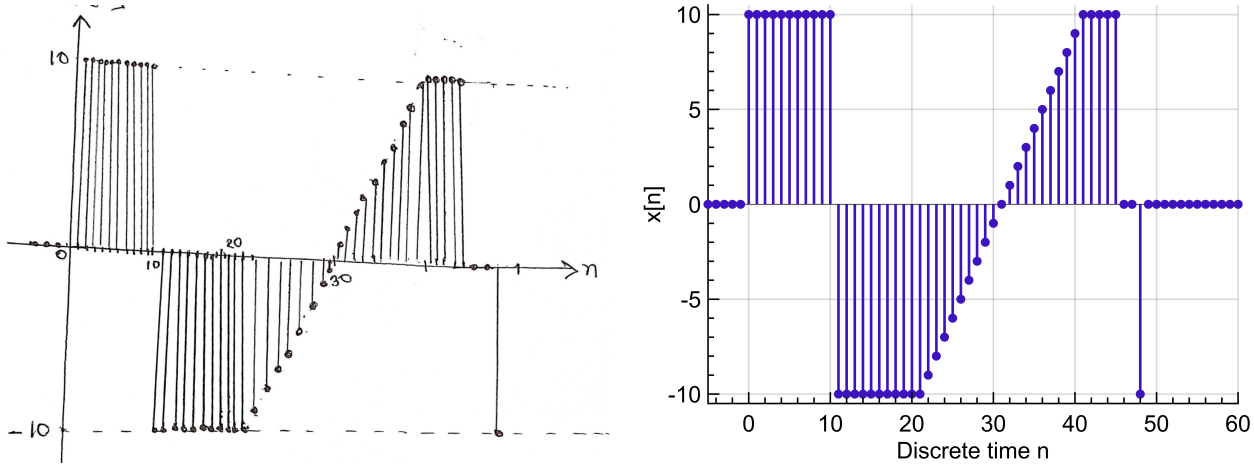


(a) (b)

Figure 4: (a) $p[n-48$ and $u[-n+56]$ signals that are used to generate a customized signal. (b) Customize signal which contains impulse, sinusoidal, step, ramp and parabolic signal

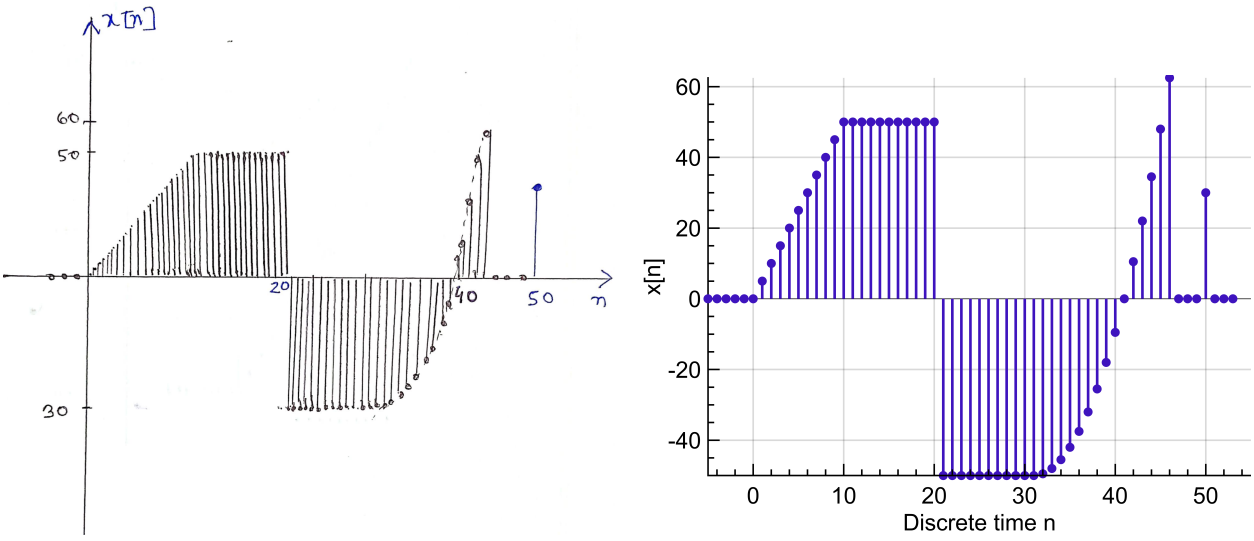
6 Result

Here is give hand written signal and plotted signal.



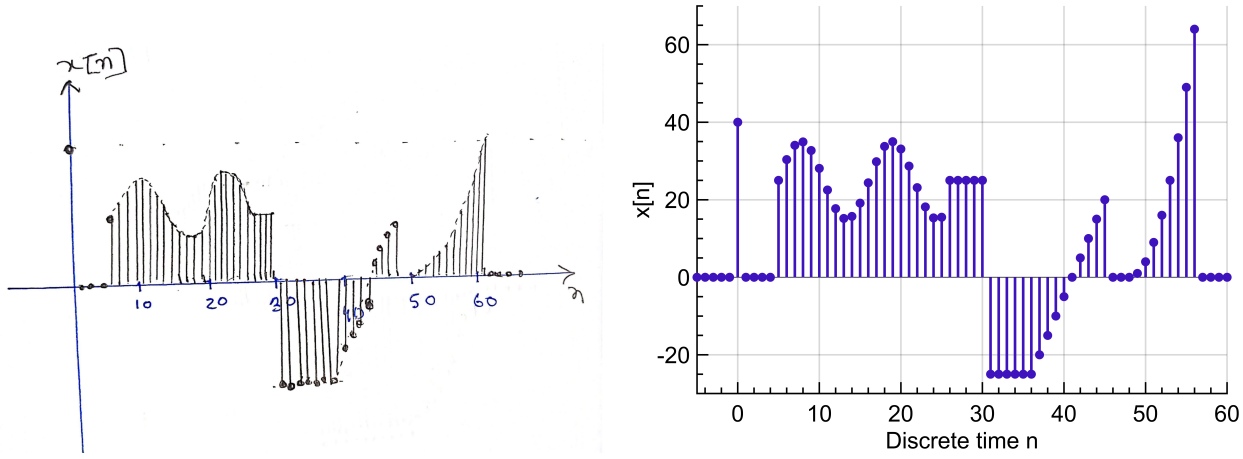
(a) (b)

Figure 5: (a) Hand written signal (b) Customize signal which contains impulse, step, ramp signal



(a) (b)

Figure 6: (a) Hand written signal (b) Customize signal which contains impulse, step, ramp and parabolic signal



(a) (b)

Figure 7: (a) Hand written signal (b) Customize signal which contains impulse, sinusoidal, step, ramp and parabolic signal

7 Discussion

The output were almost identical to the hand-drawn output signals for all problems.Hence it can be said that the experiment was done successfully.