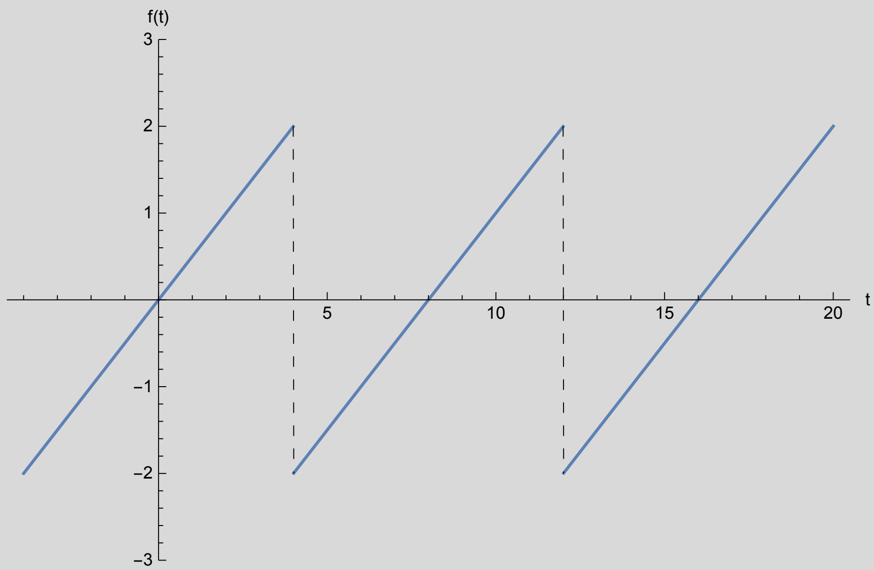
Solving example 2, lecture 4. ME 440 page 78

Plot the function

In[1]:=
```
A = 2;
T = 4;
myperiodic[func_, {val_Symbol, min_?NumericQ, max_?NumericQ}] :=
 func /. (val :→ Mod[val - min, max - min] + min)
f[t_] := A / T t;
Plot[myperiodic[f[t], {t, -T, T}] // Evaluate, {t, -T, 5 T},
 PlotRange → {Automatic, {-A - 1, A + 1}}, Exclusions → True,
 ExclusionsStyle → Dashing[Medium], AxesLabel → {"t", "f(t)"}, ImageSize → 450]
```

Out[5]=



Find a0,an,bn

In[6]:=
```
a0 = 1 / T Integrate[f[t], {t, -T, T}]
```

Out[6]= 0

In[7]:=
```
an = 1 / T Integrate[f[t] Cos[2 Pi / (2 T) n t], {t, -T, T}]
```

Out[7]= 0

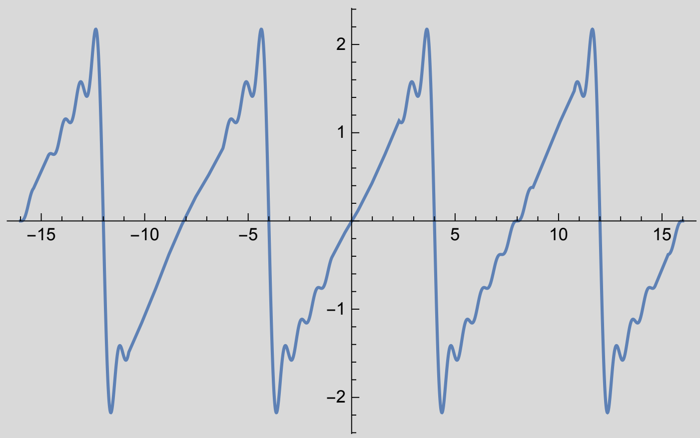
In[8]:=
```
bn = 1/T Integrate[f[t] Sin[2 Pi/(2 T) n t], {t, -T, T}];
b[n_] = Assuming[Element[n, Integers], Simplify[bn]]
```

Out[9]= $-\frac{4(-1)^n}{n\pi}$

Plot approximation for n=10

In[10]:=
```
Plot[Sum[b[n] Sin[2 n Pi/(2 T) t], {n, 1, 10}], {t, -4 T, 4 T}]
```

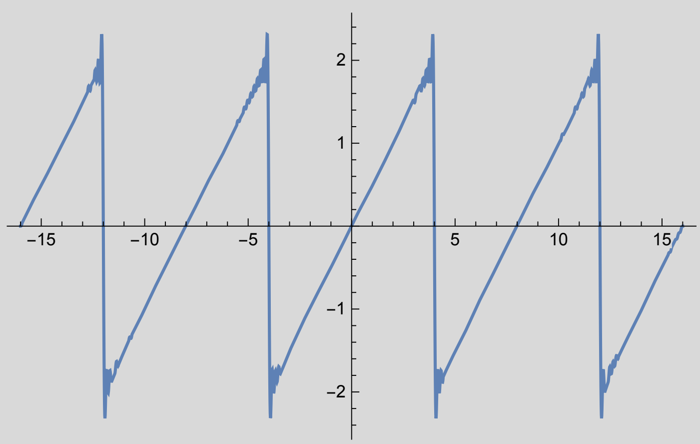
Out[10]=



Plot approximation for n=50 to improve the approximation.

In[11]:=
```
Plot[Sum[b[n] Sin[2 n Pi/(2 T) t], {n, 1, 50}], {t, -4 T, 4 T}]
```

Out[11]=



Find Xn and Phase, where

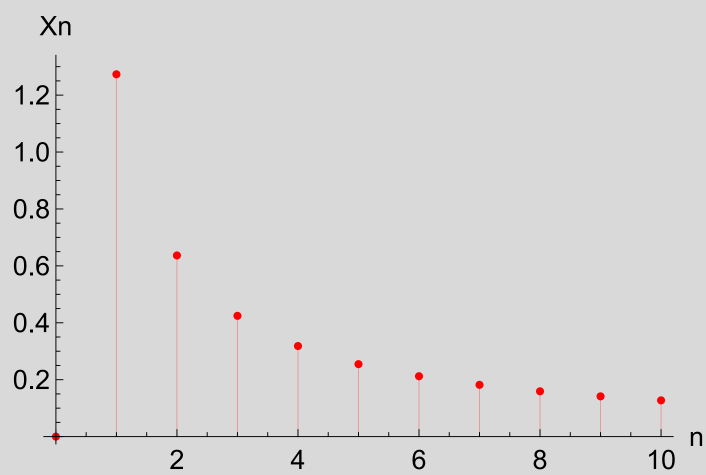
$X_n \cos(\omega_n t - \phi_n) = a_n \cos(\omega_n t) + b_n \sin(\omega_n t)$

Where $X_n = \sqrt{a_n^2 + b_n^2}$ and $\Phi_n = \tan^{-1}\left(\frac{b_n}{a_n}\right)$ and since $a_n = 0$ then phase is 90 degrees and $X_n = |\, b_n \,|$

In[12]:=

```
X[n_] := Abs[b[n]];
data = Join[{{0, 0}}, Table[{n, X[n]}, {n, 1, 10}]];
ListPlot[data, Filling → Axis, PlotStyle → Red, AxesLabel → {"n", "Xn"}, BaseStyle → 14]
```

Out[14]=



Verify using Mathematica build-in function

In[15]:=

```
data = Table[{i, Abs@FourierCoefficient[myperiodic[f[t], {t, -T, T}],
      t, i, FourierParameters → {1, 2 Pi / (2 T)}]}, {i, 0, 10}];
head = {"n", "|cn|"};
Grid[Insert[data, head, 1], Frame → All]
```

Out[17]=

n	|cn|
0	0
1	$\frac{2}{\pi}$
2	$\frac{1}{\pi}$
3	$\frac{2}{3\pi}$
4	$\frac{1}{2\pi}$
5	$\frac{2}{5\pi}$
6	$\frac{1}{3\pi}$
7	$\frac{2}{7\pi}$
8	$\frac{1}{4\pi}$
9	$\frac{2}{9\pi}$
10	$\frac{1}{5\pi}$

In[18]:=

```
mag = data;
mag[[All, 2]] = Map[Abs[#] &, data[[All, 2]]];
ListPlot[2 * mag, AxesOrigin → {0, 0}, Filling → Axis,
 PlotStyle → Red, AxesLabel → {"n", "|Subscript[c, n]|"}]
```

Out[20]=