# 1 Hands-on–Fourier Series; Approximation of Functions with MATLAB II

To construct the trigonometric polynomial of order $M$ of the form

$$f(x) = \frac{A_0}{2} + \sum_{j=1}^{M} [A_j cos(jx) + B_j sin(jx)]$$

based on the N equally spaced values

$$x_k = -\pi + 2\pi \frac{k}{N}, \ for \ k = 1, 2, \ldots, N$$

The construction is possible provided that $2M + 1 \leq N$. The following program constructs vectors $A$ and $B$ that contain the coefficients $A_j$ and $B_j$, respectively, of the equation above of order $M$.

You are given the function $Y(X) = X$ for the interval $[-\pi, \pi]$.

1. Use the MATLAB program given above to calculate $A_j$s and $B_j$s. (**Hint:** You should first calculate all the $Y$ values for a given $M$, say 100.)

2. The following program will evaluate the $f(x)$ of order $M$ at a particular value of $x$. $A, B$ and $M$ values are taken from the previous item. Study

```
function z=tp(A,B,x,M)
z=A(1);
for j=1:M
   z=z+A(j+1)*cos(j*x)+B(j+1)*sin(j*x);
end
```

   the following commands:

```
>>x=-pi:.01:pi
>>y=tp(A,B,x,M)
>>plot(x,y,X,Y,'o')
```

3. To summarize; repeat the procedure for the $M$-values, 10, 20, 50, 100. Compare the results.
   Solution:

```
function calc(M)
X=-pi:.01:pi;
Y=X;
[A,B] = tpcoeff(X,Y,M);
x=-pi:.01:pi;
y=tp(A,B,x,M);
plot(x,y,X,Y,'-');

function drawer
ARR= [10,20,50,100];
len=length(ARR);
for i=1:len
   subplot(len,1,i)
   calc(ARR(i));
end
```

   save with the names *calc.m* and *drawer.m*. Then;

```
>> drawer
```