

## MATLAB Tutorial

### Chapter 5. File input/output

#### 5.1. Saving/reading binary files and making calls to the operating system

When using MATLAB, either when running a m-file or performing calculations interactively, there is a master memory structure that MATLAB uses to keep track of the values of all of the variables. This memory space can be written in a binary format to a file for storing the results of your calculations for later use. This is often useful when you have to interrupt a MATLAB session. The following commands demonstrate how to use this storage option to make binary .mat files.

First, let us define some variables that we want to save.

```
num_pts = 10;
Afull=zeros(num_pts,num_pts);
Afull(1,1) = 1;
Afull(num_pts,num_pts) = 1;
for i=2:(num_pts-1) sum over interior points
Afull(i,i) = 2;
Afull(i,i-1) = -1;
Afull(i,i+1) = -1;
end
b = linspace(0,1,num_pts)';
x = Afull\b;
```

**whos**; display contents of memory

The "save" command saves the data in the memory space to the named binary file.

```
save mem_store1.mat;
```

```
clear all;
```

**whos**; no variables are stored in memory

```
ls *.mat
```

 display all .mat files in directory

The "load" command loads the data stored in the named binary file into memory.

```
load mem_store1.mat;
```

**whos**; we see that the data has been loaded again

If we want to get rid of this file, we can use the "delete" command.

```
delete mem_store1.mat;
```

```
ls *.mat
```

In the commands above, I have used path names to specify the directory. We can view our current default directory using the command "pwd".

**pwd** displays the current directory

We can then change to another directory using the "cd" command.

```
cd ..
```

 move up one directory

```
pwd
```

```
ls
```

 list files in directory

```
cd MATLAB_tutorial;
```

 directory name may differ for you

```
pwd; ls
```

We can also use the "save" command to save only selected variables to a binary file.

```
save mem_store2.mat Afull;
```

```
clear all  
whos
```

```
load mem_store2.mat  
whos
```

```
delete mem_store2.mat
```

```
clear all
```

## 5.2. Input/output of data to/from an ASCII file

First, let us define some variables that we want to save.

```
num_pts = 10;
```

```
Afull=zeros(num_pts,num_pts);  
Afull(1,1) = 1;  
Afull(num_pts,num_pts) = 1;  
for i=2:(num_pts-1) sum over interior points  
Afull(i,i) = 2;  
Afull(i,i-1) = -1;  
Afull(i,i+1) = -1;  
end
```

```
b = linspace(0,1,num_pts)';  
x = Afull\b;
```

```
whos; display contents of memory
```

Now, let us write out the contents of Afull into a file that we can read.

One option is to use the "save" command with the option -ascii, that writes to a file using the ASCII format.

```
save store1.dat Afull -ascii;  
type store1.dat view contents of file
```

We can also load a file in this manner. The contents of the ASCII file filename.dat are stored in the MATLAB variable filename. This is a good way to import data from experiments or other programs into MATLAB.

```
load store1.dat;
```

If we add the option -double, the data is printed out with double the amount of digits for higher precision.

```
delete store1.dat;  
save store1.dat Afull -ascii -double;  
type store1.dat
```

We can use this command with multiple variables, but we see that no spaces are added.

```
delete store1.dat;  
save store1.dat Afull b x -ascii;  
type store1.dat view contents of file  
delete store1.dat get rid of file
```

MATLAB also allows more complex formatted file input/output of data using commands that are similar to those in C.

First, we list all of the files in the directory.

```
ls
```

Next, we see create the output file and assign a label to it with the "fopen" command that has the syntax

```
FID = fopen(FILENAME,PERMISSION)
```

where PERMISSION is usually one of :

```
'r' = read only
```

```
'w' = write (create if needed)
```

```
'a' = append (create if needed)
```

```
'r+' = read and write (do not create)
```

```
'w+' = create for read and write
```

```
'a+' = read and append (create if needed)
```

```
FID_out = fopen('test_io.dat','w');
```

```
ls
```

Now, we print the b vector to the output file as a column vector using the "fprintf" command.

In the FORMAT string '\n' signifies a carriage return, and 10.5f specifies a floating point decimal output with 5 numbers after the decimal point and a total field width of 10.

```
for i=1:length(b)  
fprintf(FID_out,'10.5f \n',b(i));  
end
```

We now close the file and show the results.

```
fclose(FID_out);  
disp('Contents of test_io.dat : ');  
type test_io.dat;
```

MATLAB's "fprintf" can also be loaded to avoid the need of using a for loop

```
FID_out = fopen('test_io.dat','a');  
fprintf(FID_out,'\n');  
fprintf(FID_out,'10.5f \n',x);  
fclose(FID_out);
```

```
disp('Contents of test_io.dat : ');  
type test_io.dat;
```

We can also use "fprintf" to print out a matrix.

```
C = [1 2 3; 4 5 6; 7 8 9; 10 11 12];  
FID_out = fopen('test_io.dat','a');  
fprintf(FID_out,'\n');  
for i = 1:size(C,1)  
fprintf(FID_out,'5.0f 5.0f 5.0f \n',C(i,:));  
end  
fclose(FID_out);
```

```
disp('Contents of test_io.dat : ');  
type test_io.dat;
```

We can read in the data from the formatted file using "fscanf", which works similarly to "fprintf".

First, we open the file for read-only.

```
FID_in = fopen('test_io.dat');
```

We now read the b vector into the variable b\_new. First, we allocate space for the vector, and then we read in the values one by one.

```
b_new = linspace(0,0,num_pts)';  
for i=1:num_pts  
  b_new(i) = fscanf(FID_in,'f',1);  
end  
b_new
```

Now read in x to x\_new, using the overloading possible in MATLAB.

```
x_new = linspace(0,0,num_pts)';  
x_new = fscanf(FID_in,'f',num_pts);  
x_new
```

Finally, we read in the matrix C to C\_new.

```
C_new = zeros(4,3);  
for i=1:size(C,1)  
  for j=1:size(C,2)  
    C_new(i,j) = fscanf(FID_in,'f',1);  
  end  
end  
C_new
```

```
fclose(FID_in);
```

```
clear all
```