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Introduction to University Mathematics 2023-24

MATLAB Worksheet I

Complete the following tasks and hand in before the end of the lab session.

1. Basic calculator. MATLAB can be used as a basic calculator. For example, to evaluate

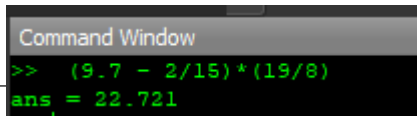
$$5 \times \left(2.4 - 1.3 + \frac{3}{8}\right)$$

type `5*(2.4 - 1.3 + 3/8)` in the command window and press enter (try it).

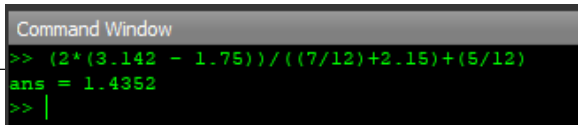
You should get 7.3750. Note that spaces are ignored by MATLAB, but they can help make complicated codes more readable. Also note that division takes precedence over + and − in the brackets, so there is no need to type `+(3/8)`. However, use brackets if you're unsure what MATLAB might do first.

Evaluate the following in a single line in MATLAB. Use brackets wisely.

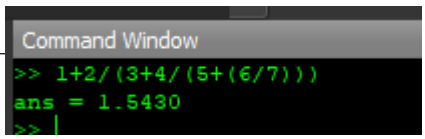
$\left(9.7 - \frac{2}{15}\right) \times \frac{19}{8}$ Ans = 22.721



$\frac{2 \times (3.142 - 1.75)}{\frac{7}{12} + 2.15} + \frac{5}{12}$ Ans = 1.4352



$1 + \frac{2}{3 + \frac{4}{5 + \frac{6}{7}}}$ Ans = 1.5430



2. Format. By default, MATLAB does all calculations in the so-called *double-precision* system. In this system, every real number is stored as a sequence of 64 binary numbers (zeroes and ones). This is roughly equivalent to 15 or 16 significant digits.

But we don't often need to see so many digits - sometimes a few decimal places will do. It would be nice to be able to control the format of the output we'd like to see.

Try experimenting with more calculations. How many decimal places is displayed in the default format? Ans: 4 Bits

Suppose we want to see more decimal places, or work with the so-called *scientific* format (*e.g.* 2.1×10^{50}). How do we change the display format?

There's a search box in the top right-hand box on the screen. Search for "format" and read the first article in the list. (We'll be using this search box a lot).

(Alternatively, you can also type `doc format` in the command window.)

Experiment with different output formats and answer the following questions.

(a) Evaluate 1/701, giving your answer in the specified formats:

LONG Ans = 1.426533523537803e-03

SHORT Ans = 1.4265e-03

SHORTE Ans = 1.4265e-03

```
>> format long
>> 1/701
ans = 1.426533523537803e-03
>> format short
>> 1/701
ans = 1.4265e-03
>> format shorte
>> 1/701
ans = 1.4265e-03
>>
```

(b) What format option will produce the following output? Ans format rat

```
>> 5/16+2/7
ans =
       67/112
```

```
Command Window
>> format rat
>> 5/16+2/7
ans = 67/112
>>
```

Now change the format back to `short` (though you might need to change it later).

At this point, your screen might be a bit cluttered. You might like to start with a clean screen by typing `clc`.

If you'd like to recycle previous commands, press the *up arrow* and choose which previous commands you'd like to reuse. Try it. This will save you a lot of time.

3. Constants. MATLAB has a stock of constants, which include the following.

Command	Meaning	Note
`pi`	π	
`i`	$i = \sqrt{-1}$	Dr Prochno will go over complex numbers, but look them up if you haven't seen them before.
`j`	$\sqrt{-1}$	Engineers use j instead of i. Try `i*j`.
`inf`	∞	You should never have to type this
`eps`	'machine epsilon'	Typical size of error when the computer rounds something off
`NaN`	Not a Number	Something undefined - something has gone wrong in your code

Note that these commands are *reserved* names: we must try not to create variables that have these names, or there will be chaos! More on this in the coming weeks.

(a) Find the numerical value of the machine epsilon. Ans: 2.2204e-16

(b) Write down an operation which produces `Inf`. Ans: 1/0

(c) Write down an operation which produces `NaN` Ans: 0/0

```
Command Window
>> format default
>> eps
ans = 2.2204e-16
>> 1/0
ans = Inf
>> 0/0
ans = NaN
>>
```

(d) Evaluate $\dfrac{1-3i}{4+i}$. Give your answer to 4 decimal places.

Ans: 0.058824 - 0.764706i

```
Command Window
>> (1-3*i)/(4+i)
ans =  0.058824 - 0.764706i
>>
```

(e) Use MATLAB to find a rational approximation of π. Explain how you did this. To how many decimal places is this approximation accurate? 355/113

```
Command Window
>> format rat
>> pi
ans = 355/113
>>
```