

MATH 3341: Introduction to Scientific Computing Lab

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The background features a large, faint watermark of the University of Wyoming seal. The seal is circular with a rope-like border. Inside the border, the words "UNIVERSITY OF WYOMING" are written in an arc at the top, and "1886" is at the bottom. In the center, there is an open book with the word "EQUALITY" written below it.

Lab 07: Debugging and Good Coding Practices



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Debugging



Use MATLAB Debugger

Fuctions	Meaning
<code>dbclear</code>	Remove breakpoints
<code>dbtype</code>	Display file with line numbers
<code>dbstop</code>	Set breakpoints for debugging
<code>dbstep</code>	Execute next executable line from current breakpoint
<code>dbcont</code>	Resume execution
<code>dbstack</code>	Function call stack
<code>dbstatus</code>	List all breakpoints
<code>dbquit</code>	Quit debug mode
<code>dbup</code>	Shift current workspace to workspace of caller in debug m
<code>dbdown</code>	Reverse dbup workspace shift
<code>checkcode</code>	Check MATLAB code files for possible problems
<code>keyboard</code>	Input from keyboard
<code>mlintrpt</code>	Run checkcode for file or folder



Example: buggy.m

Create a file, factorial_buggy.m, that contains these statements

```
function f = factorial_buggy(n)

m = 0;
for i = n
p = p + i;
end

end
```

Issue the dbstop command and run factorial_buggy.

```
dbstop in factorial_buggy
factorial_buggy(5)
dbstep
```



Reference

Debug a MATLAB Program:

https://www.mathworks.com/help/matlab/matlab_prog/debugging-process-and-features.html



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Good Coding Practices



Consistent Programming Style

A consistent programming style gives your programs a visual familiarity that helps the reader quickly comprehend the intention of the code.

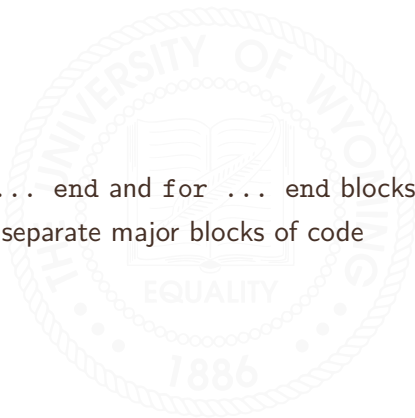
A programming style consists of

- Visual appearance of the code
- Conventions used for variable names
- Documentation with comment statement



Use Visual Layout to Suggest Organization

- Indent `if ... end` and `for ... end` blocks
- Blank lines separate major blocks of code



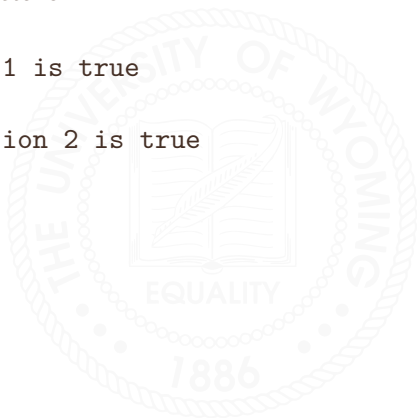
Example: Indent code for conditional structures and loops

Conditional structure:

```
if condition 1 is true
    Block 1
elseif condition 2 is true
    Block 2
else
    Block 3
end
```

Loop structure:

```
for i = 1:length(x)
    Body of loop
end
```

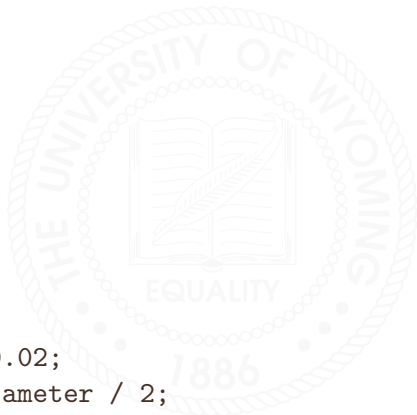


Use Meaningful Variable Names

```
d = 100;  
t = 0.02;  
r = d / 2  
r2 = r + t;
```

vs.

```
diameter = 5;  
thickness = 0.02;  
radiusIn = diameter / 2;  
radiusOut = radiusIn + thickness;
```



Follow Programming and Mathematical Conventions

Variable Names	Typeical Usage
i, j, k	Array subscripts, loop counters
i, j	$\sqrt{-1}$ with complex arithmetic
m, n	number of rows (m) and columns (n) in a matrix.
A, B	generic matrix
x, y, z	generic vectors

Note: Consistency is more important than convention.



Document code with comment statements

- Write comments as you write code, not after
- Include a prologue that supports “help”
- Assume that the code is going to be used more than once
- Comments should be short notes that argument the meaning of the program statements. Do not parrot the code
- Comments alone do not create good code



Example: Comments at beginning of a block

```
% --- Evaluate curve fit and plot it along with original data
tfit = linspace(min(t), max(t));
pfit = polyval(c, tfit);
plot(t, p, 'o', tfit, pfit, '--');
xlabel('Temperature (C)');
ylabel('Pressure (MPa)');
legend('Data', 'Polynomial Curve Fit');
```



Example: Short comments at side of statement

```
cp = 2050; % specific heat of solid and liquid paraffin (J/kgC)
rho = 810; % density of liquid or solid paraffin (kg/m^3)
k = 0.23; % thermal conductivity (W/m/C)
L = 251e3; % latent heat (J/kg)
Tm = 65.4; % melting temperature (C)
```



Shortcuts

- Windows shortcuts

- Press `Ctrl` + `A` to select all
- Press `Ctrl` + `I` to adjust indentation
- Press `Ctrl` + `R` to comment
- Press `Ctrl` + `T` to uncomment

- macOS shortcuts

- Press `command` + `A` to select all
- Press `command` + `I` to adjust indentation
- Press `command` + `/` to comment
- Press `command` + `T` to uncomment



Defensive Programming

- Do not assume the input is correct. Check it.
- Provide default condition for a `if ... elseif ... else ... end` construct.
- Include optional (verbose) print statement that can be switched on when trouble occurs
- Provide diagnostic error messages



Preemptive Debugging

- Use defensive programming
- Break large programming projects into modules
 - Develop reusable tests for key modules
 - Good test problems have known answers
 - Run the tests after changes are made to the module

