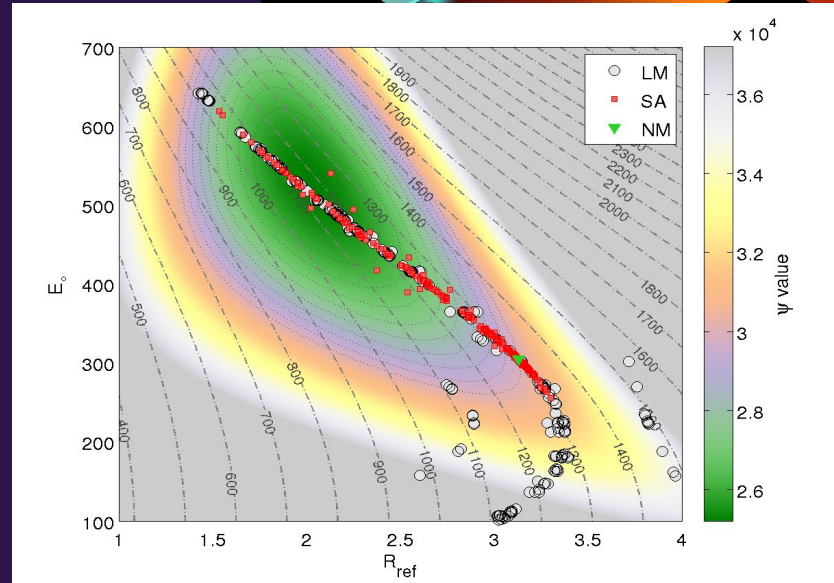
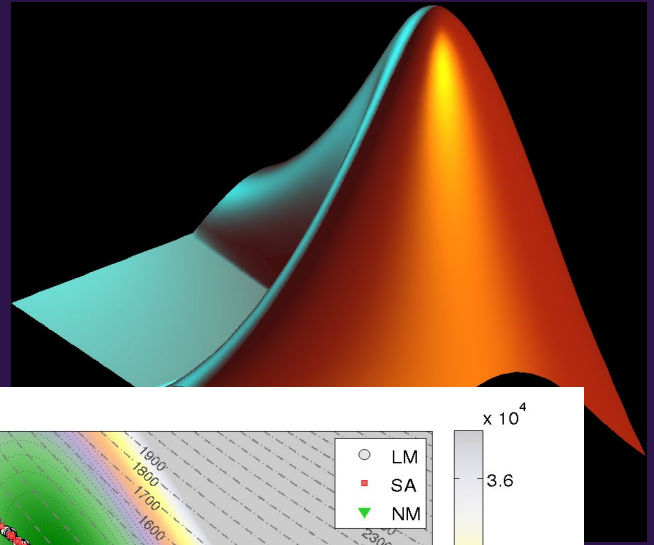


# Introduction to MATLAB and scientific computing

[bit.ly/CC2019-MatlabIntro](http://bit.ly/CC2019-MatlabIntro)



# Before we start...

1. Download workshop .zip file and assignment sheet from A2L  
(/Content/Climate Change/Individual Assignments/Introduction to Scientific Computing/)
  - **Matlab\_Data\_Pack.zip**
  - **iSci3A12CC - Introduction to Scientific Computing - Assignment Sheet**
2. Extract to: C:\Users\<yourMacID>\Documents\
  - Make a folder called MATLAB. Copy the zip file there
  - Right click > 7-Zip > “Extract Here”
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    - C:\....\MATLAB\Data\
    - C:\....\MATLAB\Figs\
3. Open Matlab

# Climate Data Assignment Debrief

# Check out our figures from Assignment 1

**[bit.ly/CC2019-CDAfigs](https://bit.ly/CC2019-CDAfigs)**

Figure 1: What temperature trends / patterns do you observe around the world?

Figures 1&2: What approaches to figure making did you find particularly effective?

# Today's Objectives

- Introduce scientific programming and MATLAB
- Become familiarized with the MATLAB environment
- Remove the stigma of programming
- Learn some of the basics; learn by experimenting
- Work through some examples
- Explore the usefulness of programming as scientific tool

# Today's task

Let's look at the Assignment sheet...

# Deliverables

For your final deliverables, you are going to submit a few functions, a script, an image, and a short document.

The full list of deliverables (described below) that will be uploaded to Avenue to Learn is:

- A function named **my\_lucky\_numbers.m**
- A figure named **lucky\_numbers.png**
- A function named **simple\_stats.m**
- A script named **process\_adelaide.m**
- A function named **plot\_station\_data.m**
- A **pdf document** that provides a very short reflection on your experience
- [BONUS] A script named **plot\_global\_trends.m**

## Assessment Rubric

Element	Points
Introductory and intermediate work <ul style="list-style-type: none"><li>• Functions run without error, are flexible to different inputs and produce correct outputs</li><li>• Figure elements are styled in an appealing and effective manner</li><li>• Function and script are appropriately commented so as to be understood by an external reviewer</li></ul>	/20 /10 /10
Advanced work <ul style="list-style-type: none"><li>• <b>Process_adelaide.m</b> runs as expected and creates appropriately styled and named figures</li><li>• <b>Plot_station_data.m</b> runs as expected and creates appropriately styled and named figures</li><li>• Function and script are appropriately commented so as to be understood by an external reviewer</li></ul>	/20 /20 /10
Question response / Reflection <ul style="list-style-type: none"><li>• The response is complete, well-composed, and shows a depth of thought.</li></ul>	/10

# Itinerary

- What is MATLAB?
- The MATLAB interface
- MATLAB programming basics
- Learning through examples
- Independent problem solving



# What is MATLAB

MATrix LABoratory

High-level programming language, originally based on the C language

More user-friendly than basic languages (e.g. Fortran, C)

Designed for numerical computing, data visualization, image processing

Widely used in academia (science, engineering and economics)

# **MATLAB vs. (basic) spreadsheets**



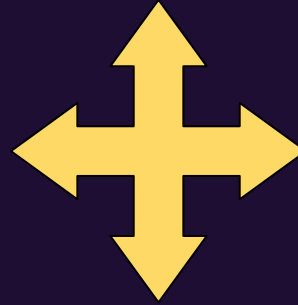
	<b>Excel (spreadsheet)</b>	<b>MATLAB (scripted)</b>
<b>Amount of Data</b>	Small to Medium	<b>Small to Large</b>
<b>Nature of Operations</b>	Few, Simple	<b>Many, Complex</b>
<b>Range of Applications</b>	Limited (more with macros)	<b>Wide</b>
<b>Interaction Style</b>	<b>Mostly Graphical (some scripted)</b>	Mostly Scripted (some graphical)
<b>Learning Time</b>	<b>Less</b>	More
<b>Output Control</b>	Limited	<b>High</b>
<b>Finding, Fixing Errors</b>	<b>Simpler for obvious errors</b>	Can be more difficult
<b>Chance of Hidden Errors</b>	Higher	<b>Much Lower</b>

## Why to do

Framing your problem  
Understanding solutions

## Did I do it properly?

Have you accomplished  
your goal?  
Could you do it more  
efficiently?



## How to do it

Programming Language  
(MATLAB)  
Platform/Program Specific

## What to do

General Programming /  
Logic Theory

# Getting Ready



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# Important Information: Saving your work

## **If you want to save your work for later, do the following:**

- ensure all scripts/functions are saved in the Editor (\* denotes unsaved)
- in the "Home" tab, click "Save Workspace", and save it into your /Data directory
- right click the /Documents/MATLAB directory and use 7zip to zip it up.

## **The next time you want to continue working:**

- unzip the MATLAB zip file to a working folder (e.g. /Documents/MATLAB)
- load the workspace into MATLAB
- continue.

# Part 2: Introduction to Matlab





# Instruction & Objectives

- Follow along with tutorial or open /Instructions/**Introductory Tasks.pdf** and work at your own pace
- Teaching objectives:
  - Understanding the MATLAB interface
  - Familiarity with different variable types
  - Completing simple mathematical and statistical operations
  - Creating your own working MATLAB program

# Variables

- Assigning and naming
- Types of variables
  - Numerical arrays (scalars, vectors, matrices)
  - Strings
  - Cell Arrays
  - Structure Arrays

# Simple operations

- Arithmetic
  - $+$ ,  $-$ ,  $*$ ,  $/$ ,  $^$
- Mathematical functions
  - $\log$ ,  $\log_{10}$ ,  $\exp$ ,  $\cos$ ,  $\sin$ ,  $\tan$
- Statistical Operations
  - $\text{mean}$ ,  $\text{mode}$ ,  $\text{median}$ ,  $\text{std}$ ,  $\text{var}$
- Concatenating (adding) strings

# Scripts and Functions

- Open: iSci\_Workshop\_Intro.m

# Parts 3&4: Intermediate Operations



# Instruction & Objectives

- *open iSci\_Intermediate.m*
- Teaching objectives:
  - Using indexing and control functions to perform higher-level operations
  - Saving and loading your data
  - Plotting data and producing figures

# Intermediate Operations

## Scenario:

One of your classmates boasts to you that they've created a program to create lucky lottery numbers that are tailored to you.

Your suspicion is that it's nothing more than a random number generator

## Question:

- Is your lucky number program just spitting out numbers at random?
  - If so, are they completely random?
  - If not, how is the program creating the personalized lucky numbers?

**Part 5:**

**Data analysis and presentation**





# Part 6: Advanced Analyses



# How MATLAB works

