



Spreadsheets

*Spreadsheets are a powerful
abstraction for organizing data
and computation*



An Array of Cells

A spreadsheet is a 2 dimensional array of cells ... it's 3D with multiple sheets

- * The idea is that the rows or columns represent a common kind of data
 - **They will be operated upon similarly, so that's easy to do**
 - **Adding more data of the same type means adding more rows or columns**
 - **Often spreadsheets contain numbers, but text-only spreadsheets are useful, too**



Looking for Similar Ideas

Spreadsheets are not so unusual ...

- * The position (row/column) names the data, as with memory locations, variables, forms...
- * Operating on all elements of a column (or row) is an iteration, though not usually a WFI
- * Setting a cell to a formula is an (unevaluated) *assignment statement* with cells as variables
- * The formula is an expression
- * Functions are (built-in) functions

Think of spreadsheets as a handier interface for computing ideas than JS



Familiar Terminology

Microsoft Excel - grade378.xls

File Edit View Insert Format Tools Data Window Help

Reply with Changes... End Review...

L2 $=0.4*(E2+F2*0.667+G2+H2+J2)/(39+110*0.667+300) + 0.2*D2/65+0.4*12/95$

	D	E	F	G	H	I	J	K	L	M
1	MT	HW1	HW2	HW3	HW4	FINAL	HW5			
2	52	39	105	100	100	90	100		0.935712	
3	59	39	110	100	95	87	100		0.943004	
4	62	32	110	98	100	86	100		0.944144	
5	62	36	110	100	95	88	100		0.953536	
6	58	39	110	100	100	92	100		0.96583	
7	53	39	108	100	95	88	100		0.927459	
8	50	38	110	100	100	89	100		0.927613	
9	56	37	105	100	100	87	100		0.933449	

row name

column name

cell

formula

column heading

referenced cell L2



Formulas

The data in a spreadsheet can be manipulated using formulas

A screenshot of a spreadsheet application. The formula bar at the top shows the formula $=F2*0.621$. The spreadsheet has columns B, F, G, H, and I. Row 1 contains headers: B1 is 'Common Name', F1 is 'Distance (km)', G1 is 'Body Len (m)', and H1 is 'Distance (Mi)'. Row 2 contains data: B2 is 'Swainson's Hawk', F2 is '13500', G2 is '0.52', and H2 is '8383.5'. Rows 3 through 7 contain other bird species and their corresponding distance and body length values. Row 8 is empty.

	B	F	G	H	I
1	Common Name	Distance (km)	Body Len (m)	Distance (Mi)	
2	Swainson's Hawk	13500	0.52	8383.5	
3	Wheatear	13500	0.16		
4	Willow Warbler	15500	0.11		
5	Short-tailed Shearwater	12500	0.43		
6	Long-tailed Skua	16000	0.51		
7	Arctic Tern	19000	0.35		
8					
9					

The value in H2 (selected cell) is the value in F2 times 0.621 ... the result is shown, but the cell has the formula



Apply Formula Again

One way to repeat the formula is to
copy-and-paste

The screenshot shows an Excel spreadsheet with the following data:

	B	F	G	H	I
1	Common Name	Distance (km)	Body Len (m)	Distance (Mi)	
2	Swainson's Hawk	13500	0.52	8383.5	
3	Wheatear	13500	0.16	8383.5	
4	Willow Warbler	15500	0.11	9625.5	
5	Short-tailed Shearwater	12500	0.43	7762.5	
6	Long-tailed Skua	16000	0.51	9936	
7	Arctic Tern	19000	0.35	11799	
8					
9					
10					

The formula bar shows the formula $=F3*0.621$. A green box highlights the formula bar.

Notice the formula



Filling Replicates Formulas

Fill is a spreadsheet shortcut for copy-and-paste

	B	F	G	H
1	Common Name	Distance (km)	Body Len (m)	Distance (Mi)
2	Swainson's Hawk	13500	0.52	8383.5
3	Wheatear	13500	0.16	
4	Willow Warbler	15500	0.11	
5	Short-tailed Shearwater	12500	0.43	
6	Long-tailed Skua	16000	0.51	
7	Arctic Tern	19000	0.35	
8				

G	H
Len (m)	Distance (Mi)
0.52	8383.5
0.16	8383.5
0.11	9625.5
0.43	7762.5
0.51	9936
0.35	11799

* Grab the fill tab with the cursor and pull in the direction to be pasted

It's Magic!



Relative & Absolute Addr

Reference to cells happens in 2 ways:
Relative and Absolute (with \$)

- * F2 relative column, relative row
- * F\$2 relative column, absolute row
- * \$F2 absolute column, relative row
- * \$F\$2 absolute column, absolute row

Relative references change when
pasted/filled; absolute references do
not change

Your intent determines which to pick



A Powerful Translation

The screenshot shows an Excel spreadsheet window titled "birds.xls". The spreadsheet has columns B, F, G, and H. Row 1 contains headers: "Common Name" in B, "Distance (km)" in F, "Body Len (m)" in G, and "Distance (Mi)" in H. Rows 2 through 7 contain data for different bird species. The "Distance (Mi)" column (H) contains the formula "=F2*0.621" in row 2, and this formula is copied down to rows 3 through 7. Orange arrows point from the formula in row 2 to the corresponding rows below, illustrating how the row number in the formula changes while the column reference (F) remains constant. A large orange arc is drawn over the top of the spreadsheet, connecting the formula in row 2 to the formula in row 7.

	B	F	G	H
1	Common Name	Distance (km)	Body Len (m)	Distance (Mi)
2	Swainson's hawk	13500	0.52	=F2*0.621
3	Wheatear	13500	0.18	=F3*0.621
4	Willow warbler	15500	0.11	=F4*0.621
5	Short-tailed shearwater	12500	0.43	=F5*0.621
6	Long-tailed skua	16000	0.51	=F6*0.621
7	Arctic tern	19000	0.35	=F7*0.621
8				

The graphic shows the equations in the cells with the translation:
The row changes going down, but the column doesn't



A Example

Creating a discount table is case of using both relative and absolute refs

- * Consider store credit of \$1 per \$10 spent
- * \$3 store credit for every 2 CDs (1 earns \$1)

		1	2	3	4	5	6	7	8	
\$10.00	\$2.00	\$4.00	\$5.00	\$7.00	\$8.00	\$10.00	\$11.00	\$13.00		
\$20.00	\$3.00	\$5.00	\$6.00	\$8.00	\$9.00	\$11.00	\$12.00	\$14.00		
\$30.00	\$4.00	\$6.00	\$7.00	\$9.00	\$10.00	\$12.00	\$13.00	\$15.00		
\$40.00	\$5.00	\$7.00	\$8.00	\$10.00	\$11.00	\$13.00	\$14.00	\$16.00		
\$50.00	\$6.00	\$8.00	\$9.00	\$11.00	\$12.00	\$14.00	\$15.00	\$17.00		
\$60.00	\$7.00	\$9.00	\$10.00	\$12.00	\$13.00	\$15.00	\$16.00	\$18.00		

A cell is based on first column, top row data *in that row and column* ... must mix relative and absolute references



Series

Another handy property of fill is that it can make a series based on constants

- * Fill Sunday => Monday, Tuesday, Wed...
- * Fill 22 Feb => 23 Feb, 24 Feb, 25 Feb, ...

More generally

- * Series fill will even count using a constant
- * Counting by odd sizes: give 1st two items



Demo