Spreadsheets 1 – References and Formulas

Lecture 11 – COMPSCI111/111G SS 2019

Today's lecture

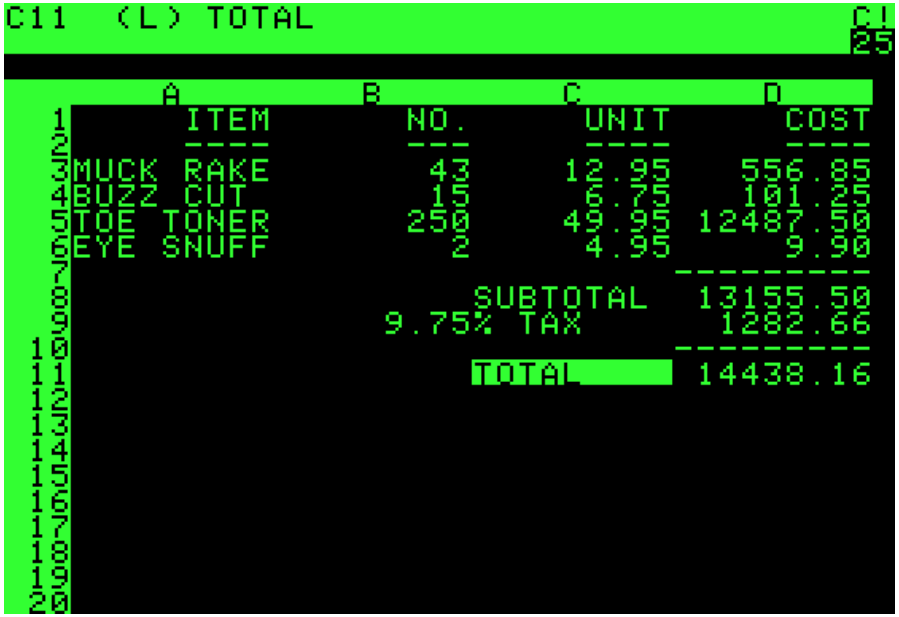
- History of spreadsheet applications
- How a spreadsheet works
- Absolute vs relative references
- Functions:
  - Basic functions (SUM, MIN, MAX, AVG)
  - IF function
  - Logical tests and operators

VisiCalc

- The first spreadsheet program was called VisiCalc, short for Visible Calculator
- Developed by Dan Bricklin and Bob Frankston, released in 1979
- VisiCalc was the first ‘killer app’ on the PC

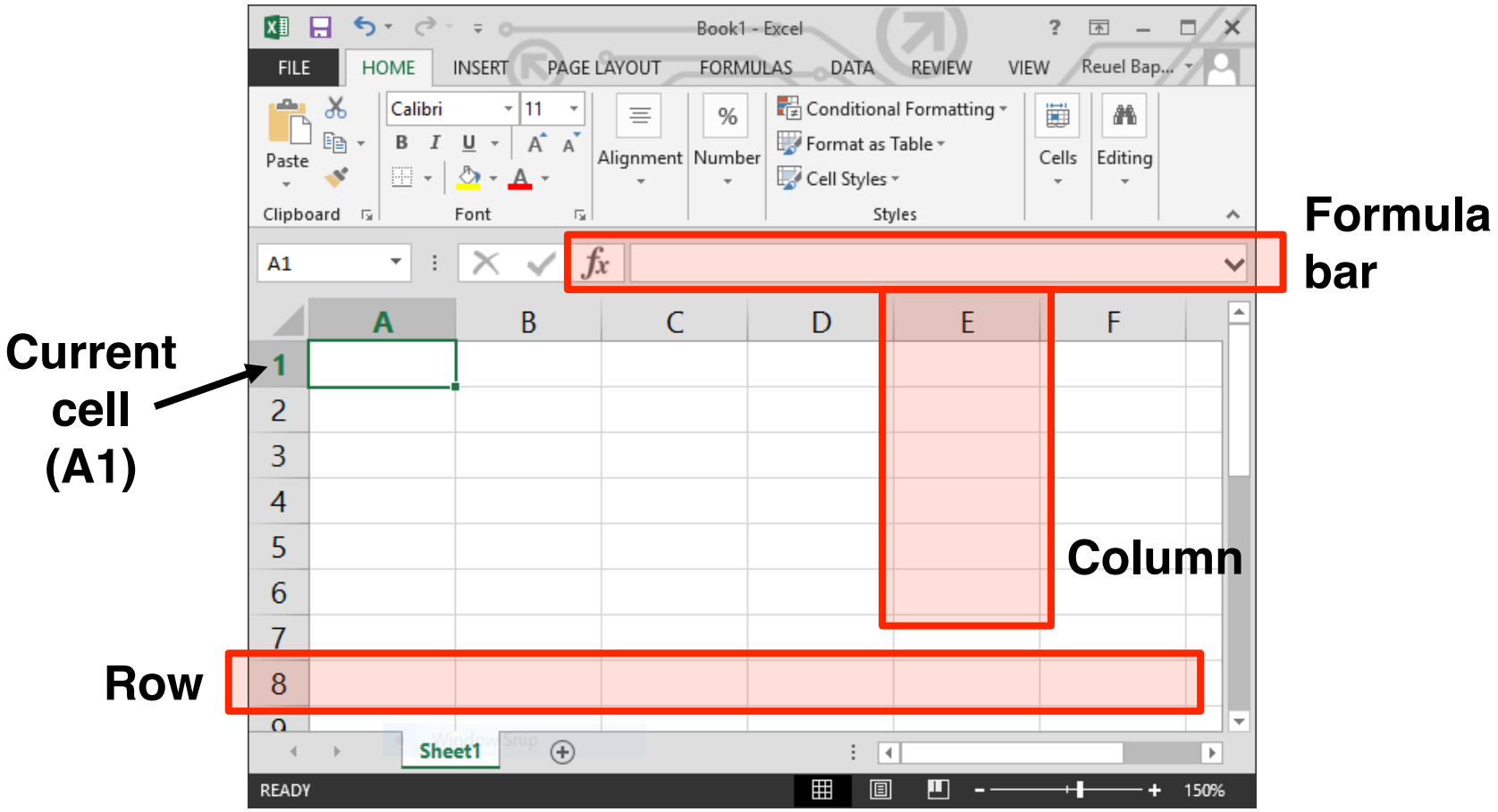
VisiCalc

- VisiCalc had a number of features that are commonly found in spreadsheet programs today:
  - Organising calculations in rows and columns
  - Automatic updating of calculations
  - Copying formulas



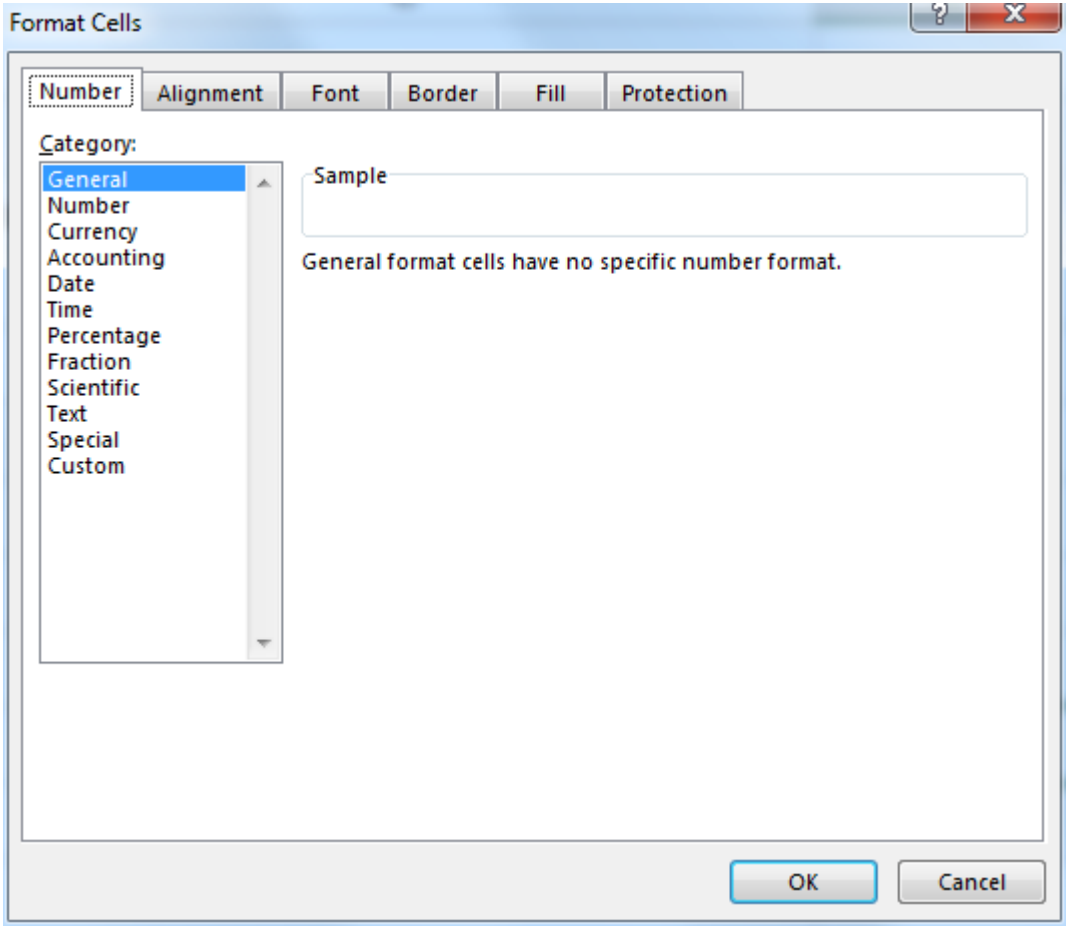
Microsoft Excel

- Commonly used spreadsheet program, part of Microsoft Office



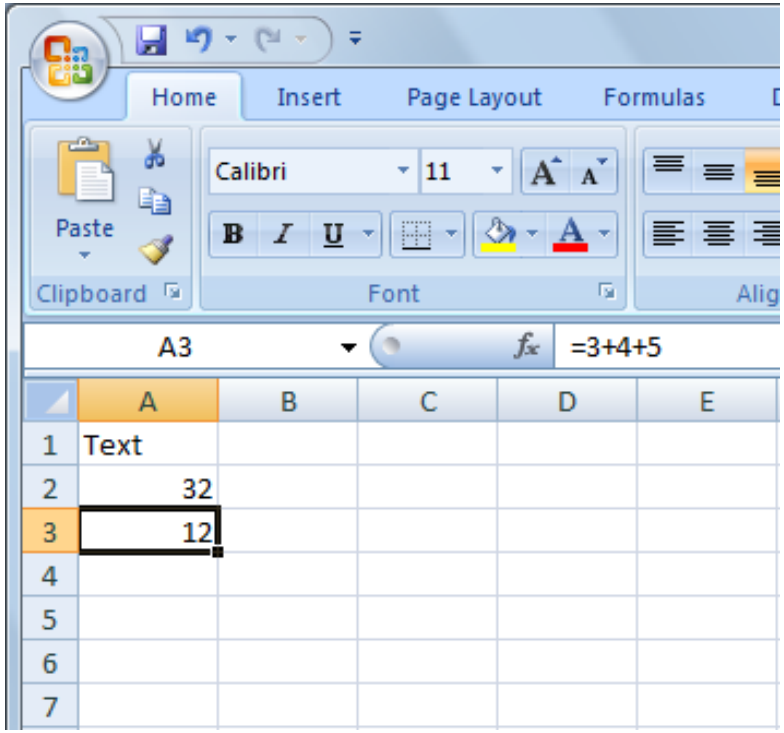
Appearance of cells

- You can change the appearance of cells:
  - Alter size
  - Add borders
  - Add shading
  - Alter font
  - Formatting (eg. currency, decimal points, date values)



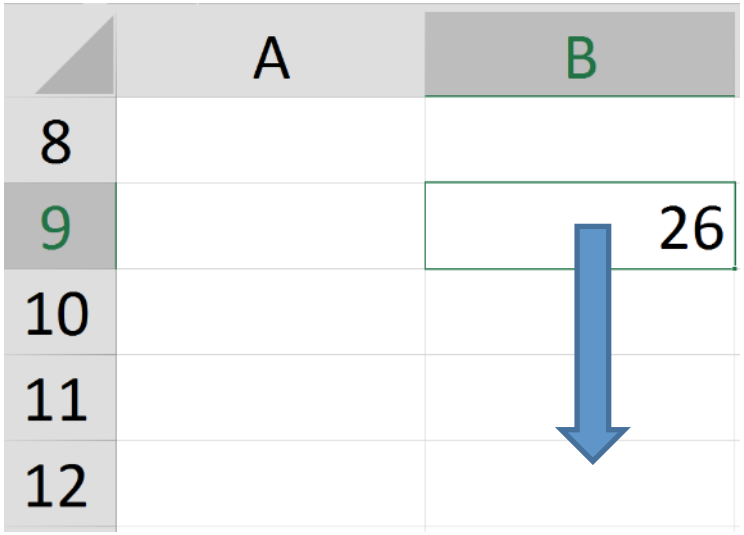
Entering data

- Enter data into:
  - The cell
  - The Formula Bar (after selecting a cell)
- You can enter:
  - Text
  - Numbers
  - Images
  - Formulas; must begin with '='
- When you enter a value, any formulas which use the current cell are recalculated



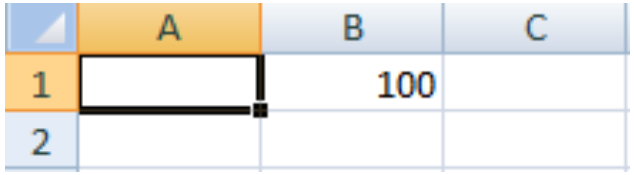
Filling cells

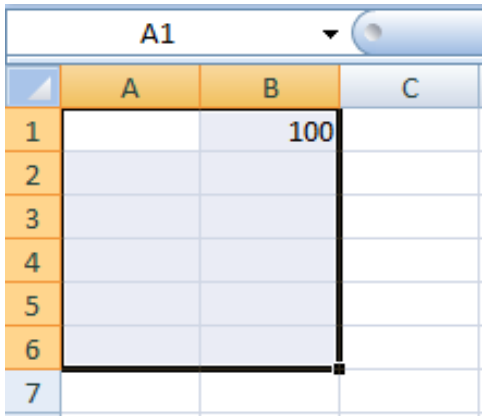
- Allows you to automatically copy a value or formula from one cell in any direction
- Steps:
  - Select a cell
  - Click and drag the small box in the bottom right hand corner in any direction
  - Release mouse when you've selected the cells to fill

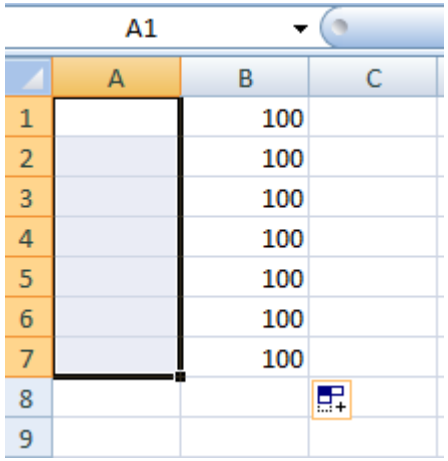


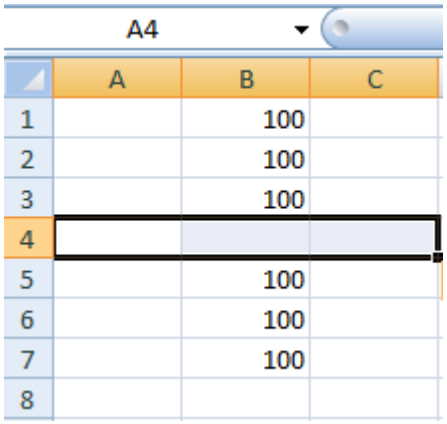
Filling Down and Filling Right

- Save time
  - Fill many cells with same contents
  - Select a group of cells
  - Fill Right
  - Fill Down









Cell references

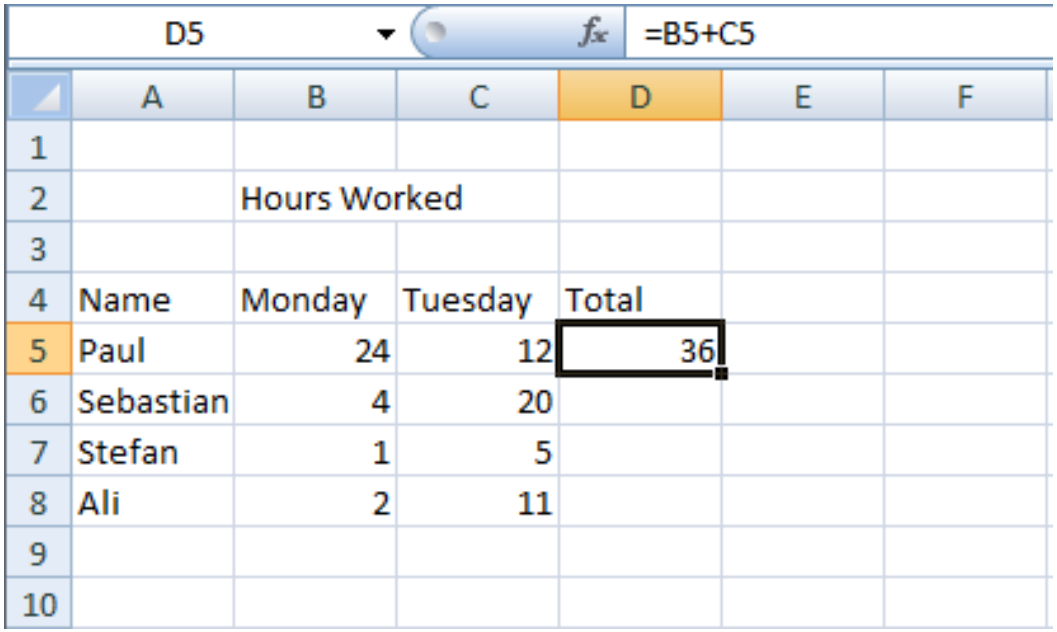
- In some formulas, you'll need to refer to other cells. There are two kinds of cell references.

- Relative references (eg. `C3`)
  - The cell reference moves along with the formula

- Absolute reference (eg. `$C$3`)
  - The '$' locks the column and/or row in the reference, meaning it stays the same if the formula moves

Filling Cells with Formulae

- Use Fill Down/ Fill Right on formulae
  - Saves us entering new formula for each row

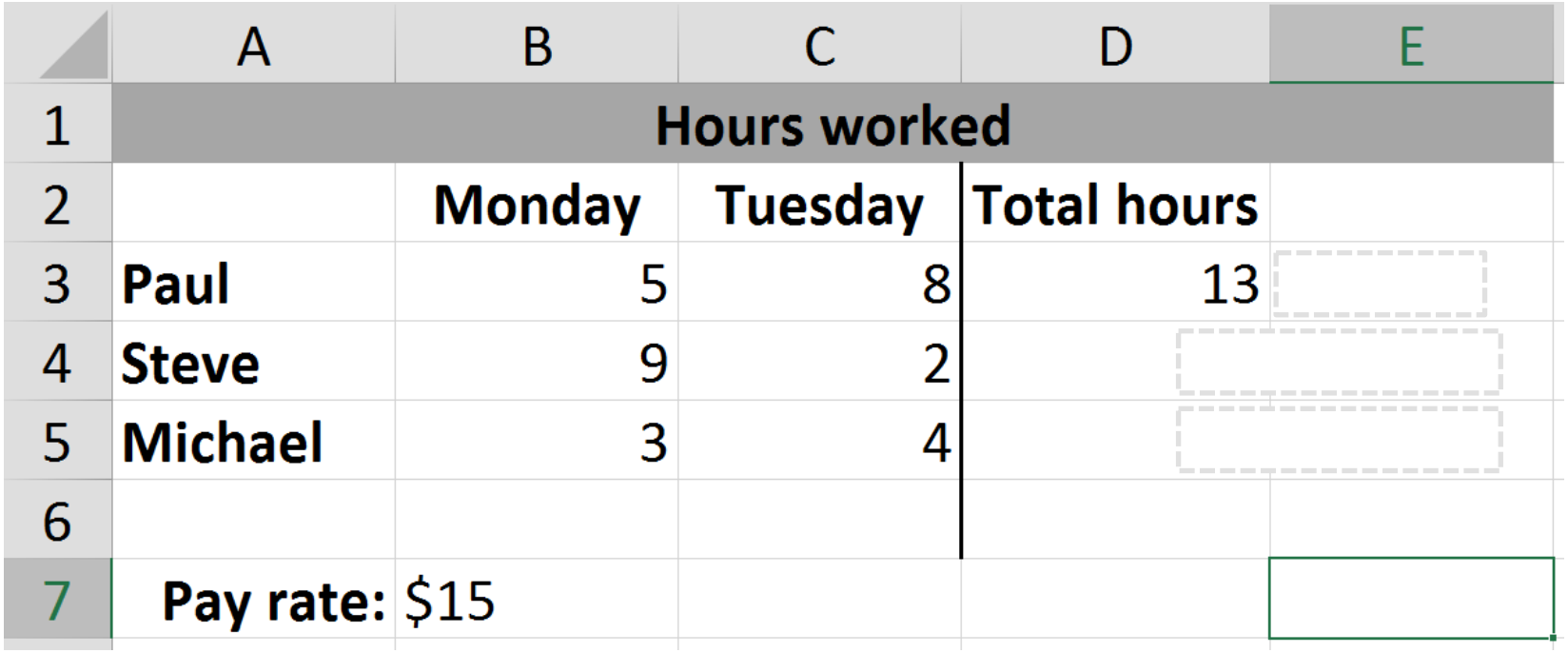


	A	B	C	D	E	F
1						
2		Hours Worked				
3						
4	Name	Monday	Tuesday	Total		
5	Paul	24	12	36		
6	Sebastian	4	20			
7	Stefan	1	5			
8	Ali	2	11			
9						
10						

  - D5 should contain =B5 + C5
  - D6 should contain =B6 + C6
  - D7 should contain =B7 + C7
  - D8 should contain =B8 + C8

Relative references

- When the formula moves down by one row, the cell references move down by one row



	A	B	C	D	E
1	**Hours worked**				
2		**Monday**	**Tuesday**	**Total hours**	
3	**Paul**	5	8	13	
4	**Steve**	9	2		
5	**Michael**	3	4		
6					
7	**Pay rate:**	$15			

Absolute references

- Since the reference to ‘Pay Rate’ is not fixed, we get incorrect results

	A	B	C	D	E
1	**Hours worked**				
2		**Monday**	**Tuesday**	**Total pay**	
3	**Paul**	5	8	$195	
4	**Steve**	9	2		
5	**Michael**	3	4		
6					
7	**Pay rate:**	$15			
8					
9					

Absolute references

- Using '$' to lock the row in place fixes the problem
  - We can also lock the column with '$' but it doesn't make a difference in this case

	A	B	C	D	E
1	**Hours worked**				
2		**Monday**	**Tuesday**	**Total pay**	
3	**Paul**	5	8	$195	
4	**Steve**	9	2		
5	**Michael**	3	4		
6					
7	**Pay rate:**	$15			

Exercises

Exercise 1: Is the reference to cell D6 in the formula `=$D$6*2` a relative or an absolute reference?

Absolute reference

Imagine that you are keeping track of the sales for tickets at the Olympic games. A number of different sports are located in different venues. Each venue has a number of seats available. Your spreadsheet will keep track of the number of tickets available and the number actually sold.

	A	B	C	D
1		**Ticket Sales**		
2				
3	**Price**	$10.00		
4				
5	**Event**	**Tickets Available**	**Tickets Sold**	**Remaining**
6	Cycling	4000	2000	2000
7	Weightlifting	2000	750	1250
8	Triathlon	1000	100	900
9	Football	3000	3000	0
10	Badminton	5000	4500	500
11		15000	10350	4650

Exercise 2: Given the following spreadsheet, what formula would you use in cell D6 to calculate the number of tickets remaining?

=B6 - C6

Exercises

Exercise 3: What formula would you use in cell E8 to calculate the money made from ticket sales?

=C8 * B3

	A	B	C	D	E
1		**Ticket Sales**			
2					
3	**Price**	$10.00			
4					
5	**Event**	**Tickets Available**	**Tickets Sold**	**Remaining**	**Sales**
6	Cycling	4000	2000	2000	$20,000.00
7	Weightlifting	2000	750	1250	$7,500.00
8	Triathlon	1000	100	900	$1,000.00
9	Football	3000	3000	0	$30,000.00
10	Badminton	5000	4500	500	$45,000.00

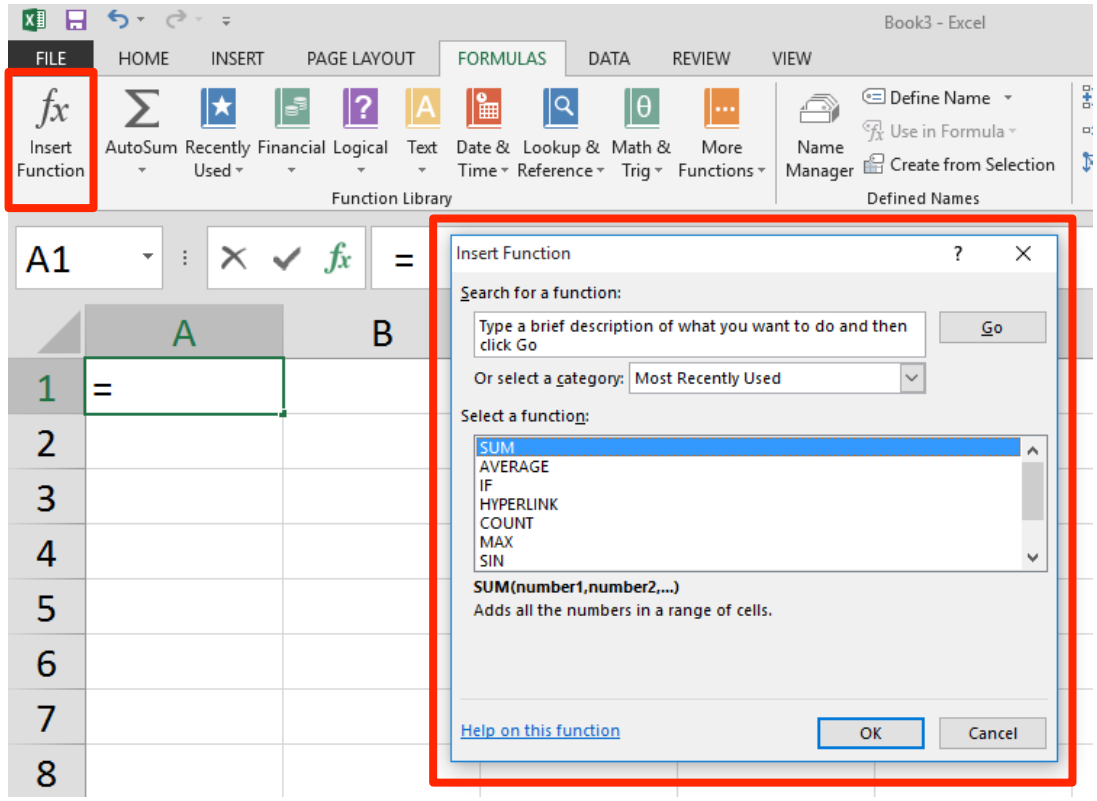
Exercise 4: What formula would you use in cell B11 to calculate the total number of tickets available?

=B6+ B7 + B8 + B9 + B10

	A	B	C	D	E
1		**Ticket Sales**			
2					
3	**Price**	$10.00			
4					
5	**Event**	**Tickets Available**	**Tickets Sold**	**Remaining**	**Sales**
6	Cycling	4000	2000	2000	$20,000.00
7	Weightlifting	2000	750	1250	$7,500.00
8	Triathlon	1000	100	900	$1,000.00
9	Football	3000	3000	0	$30,000.00
10	Badminton	5000	4500	500	$45,000.00
11		15000	10350	4650	$103,500.00

Functions

- Allow you process data in your spreadsheet
- Formulas → Insert Function lets you search for functions and learn about their syntax



Basic Functions

- SUM, MAX, MIN, AVERAGE
- Similar syntax: `[function name](values)`
  - SUM(range), eg. `SUM(B3:B10)`
  - SUM(cell, cell …), eg. `SUM(B3, B4, B5)`
  - SUM(number, number …), eg. `SUM(5, 7, 8)`
- Functions can be included in formulas
  `=B6 + SUM(A1:A100)`

Boolean Logic

- Boolean value
  True or False
  2-valued logic
- Compare two different values
  =
  >
  <
  >=
  <=
- Example. Are the following true or false?
  =(3 = 4)
  =(4 < 6)
  =(MAX(5, 6) = 5)
  =(SUM(1,2,3) = 6)

IF function

- Inserts a value in a cell based on the outcome of a logical test (ie. true/false)
- Syntax:

```
=IF(logical_test,
value_if_true, value_if_false)
```

Logical tests

- A condition which evaluates to TRUE or FALSE
- Comparison operators:

=

eg. `=10 = 15 is` **`false`**

`=(10 = 15) is` **`false`**

> and **<**

eg. `=5 > 10` is **false**

`=(5 > 10)` is **false**

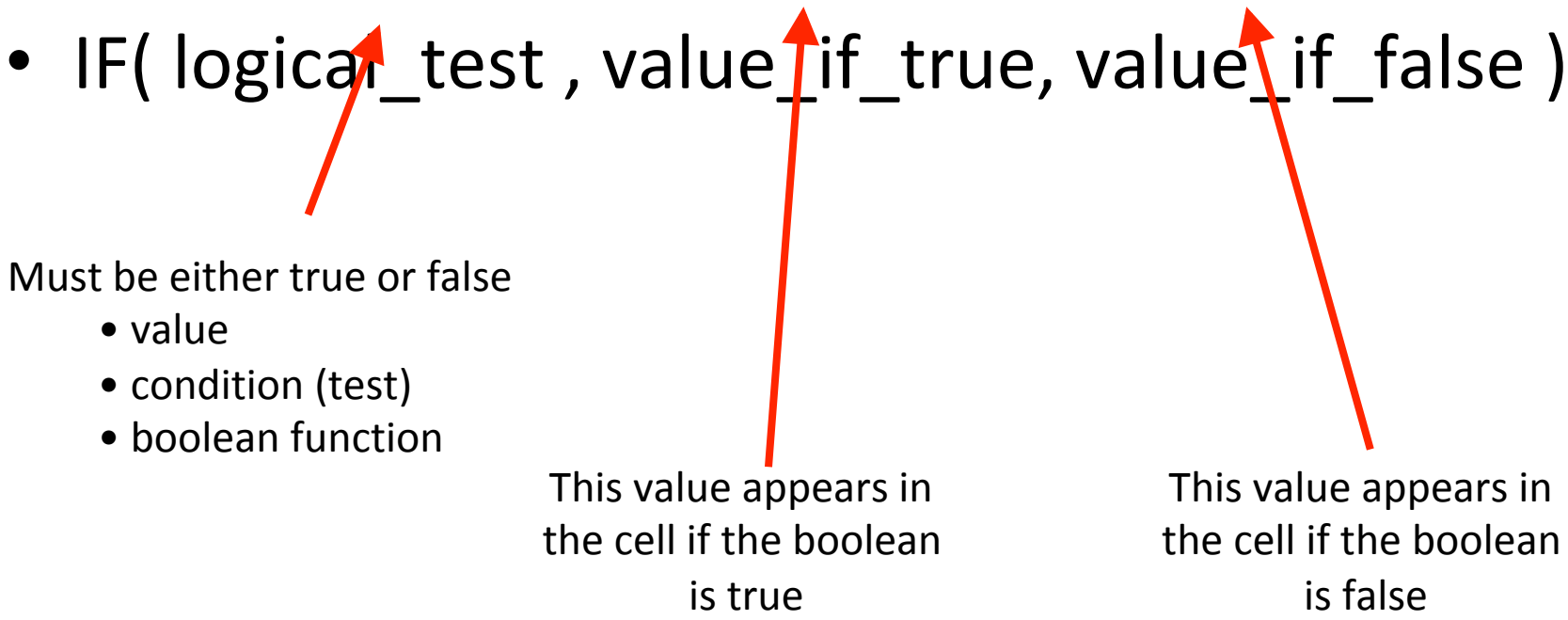
>= and **<=**

eg. `=5 >= 5` is **true**

`=5 >= 5` is **true**

IF functions

- Makes a decision
  - Different values used in the cell depending on the logical test
- IF(logical_test , value_if_true, value_if_false)



Must be either true or false
- value
- condition (test)
- boolean function

This value appears in the cell if the boolean is true

This value appears in the cell if the boolean is false

IF function

- Syntax:
  `=IF(logical_test, value_if_true, value_if_false)`
- IF statement places ‘Bigger’ in column B if number in column A is bigger than number in B1, and ‘Smaller’ if number in column A is smaller than number in B1

	A	B	C
1	**Test number:**	**20**	
2			
3	13	Smaller	=IF(A3>B1, "Bigger", "Smaller")
4	14	Smaller	
5	45	Bigger	
6	1	Smaller	

Logical tests

- Boolean functions:
  - AND(a, b); both `a` and `b` must be true
    eg. `=AND(3 = 4, 2 = 2)` is false
  - OR(a, b); either `a` or `b` can be true
    eg. `=OR(3 = 4, 2 = 2)` is true
  - NOT(a); inverts the outcome of `a`
    eg. `=NOT(2 = 3)` is true

Exercise

- Write formulas that can be filled down:
  - E2: formula to calculate the package's volume
    - volume = length * width * height
  - F2: if the package is less than 5000cm^3, then write "Yes" in cell, otherwise write "No"
- Formula for B7 that can be filled right, which finds the average package length, width, height

	A	B	C	D	E	F
1		**Length**	**Width**	**Height**	**Volume**	**Acceptable?**
2	**Package 1**	85	44	0.5	1870	Yes
3	**Package 2**	15	87	6	7830	No
4	**Package 3**	48	33	1	1584	Yes
5	**Package 4**	89	256	0.75	17088	No
6	**Package 5**	26	14	1	364	Yes
7	**Average**	52.6	86.8	1.85		
8						
9	Maximum volume:		5000	cm^3		

Exercise

	A	B	C	D	E	F
1		**Length**	**Width**	**Height**	**Volume**	**Acceptable?**
2	**Package 1**	85	44	0.5	1870	Yes
3	**Package 2**	15	87	6	7830	No
4	**Package 3**	48	33	1	1584	Yes
5	**Package 4**	89	256	0.75	17088	No
6	**Package 5**	26	14	1	364	Yes
7	**Average**	52.6	86.8	1.85		
8						
9	Maximum volume:		5000	cm^3		

- Formula in E2:

  `=B2*C2*D2`

- Formula in F2:

  `=IF(E2<$C$9, "Yes", "No")`

- Formula in B7:

  `=AVERAGE(B2:B6)`

Summary

- VisiCalc was the first spreadsheet program and ‘killer app’
- Microsoft Excel is centred on a spreadsheet made up of columns and rows
- Cell references can be relative and absolute
- Formulas allow us to compute values in cells. Functions allow us to process data and see an output
  - Functions: SUM, MAX, MIN, AVERAGE, IF