COMP1022Q
Introduction to Computing with Excel VBA

# Cell Formula Basics

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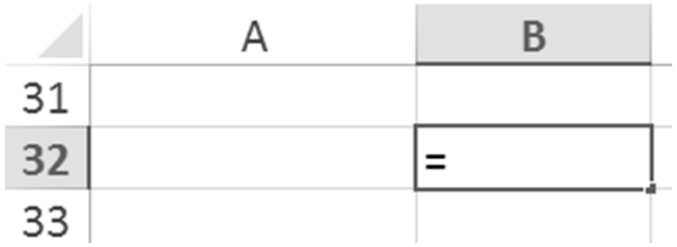
# Outcomes

- After completing this presentation, you are expected to be able to:
  1. Understand the basics of using cell formulas
  2. Write cell formulas using appropriate operations and functions
  3. Describe the expected results of some cell formulas



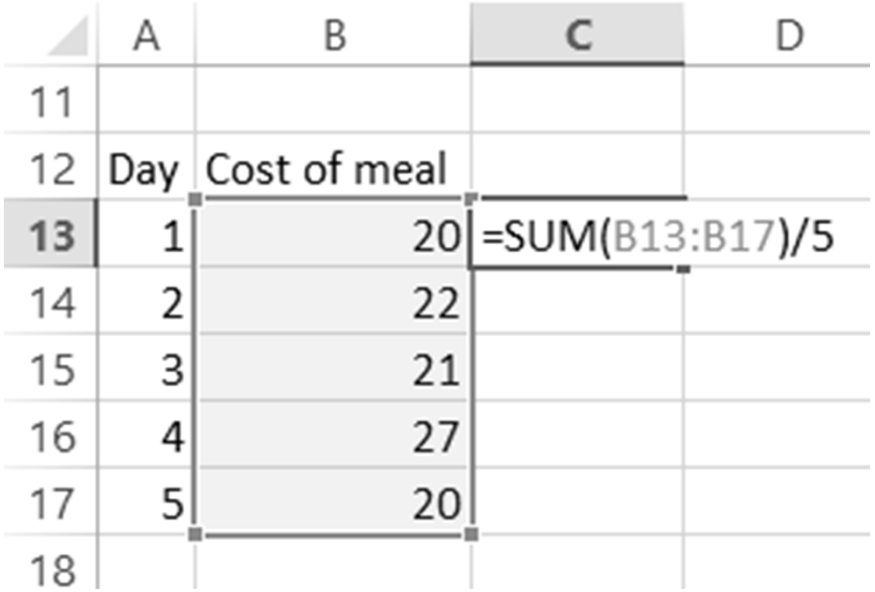

# In This Presentation

- We will look at the following topics in this presentation:
  - Some basics of cell formulas
  - Arithmetic + - * / ^
  - Handling numbers
  - Comparing things
  - String concatenation
  - String functions
  - What goes first?

- You are strongly recommended to try out the Excel files in the COMP1022Q web site!
- See how the results of the formulas change when you change inputs

# Cell Formulas

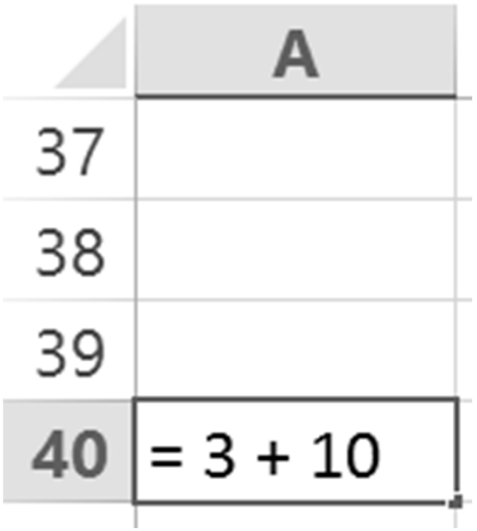
- Every formula starts with a =
- Here is a simple formula calculating the average cost of meals:




```
= SUM( B13:B17 ) / 5
```

- `SUM` is a function
- A range of cells which contains the costs of 5 meals
- / means divide
- The total number of meals

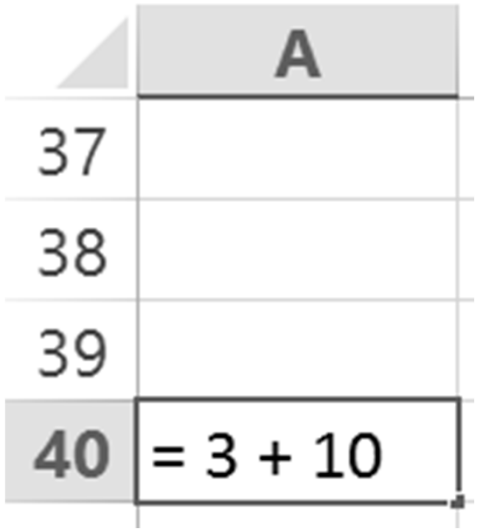
# Arithmetic




- In cell formulas you can do basic calculations like those you learned in school:

| | |
|---|---|
| + | Addition |
| − | Subtraction |
| * | Multiplication |
| / | Division |
| ^ | Power |

# Arithmetic



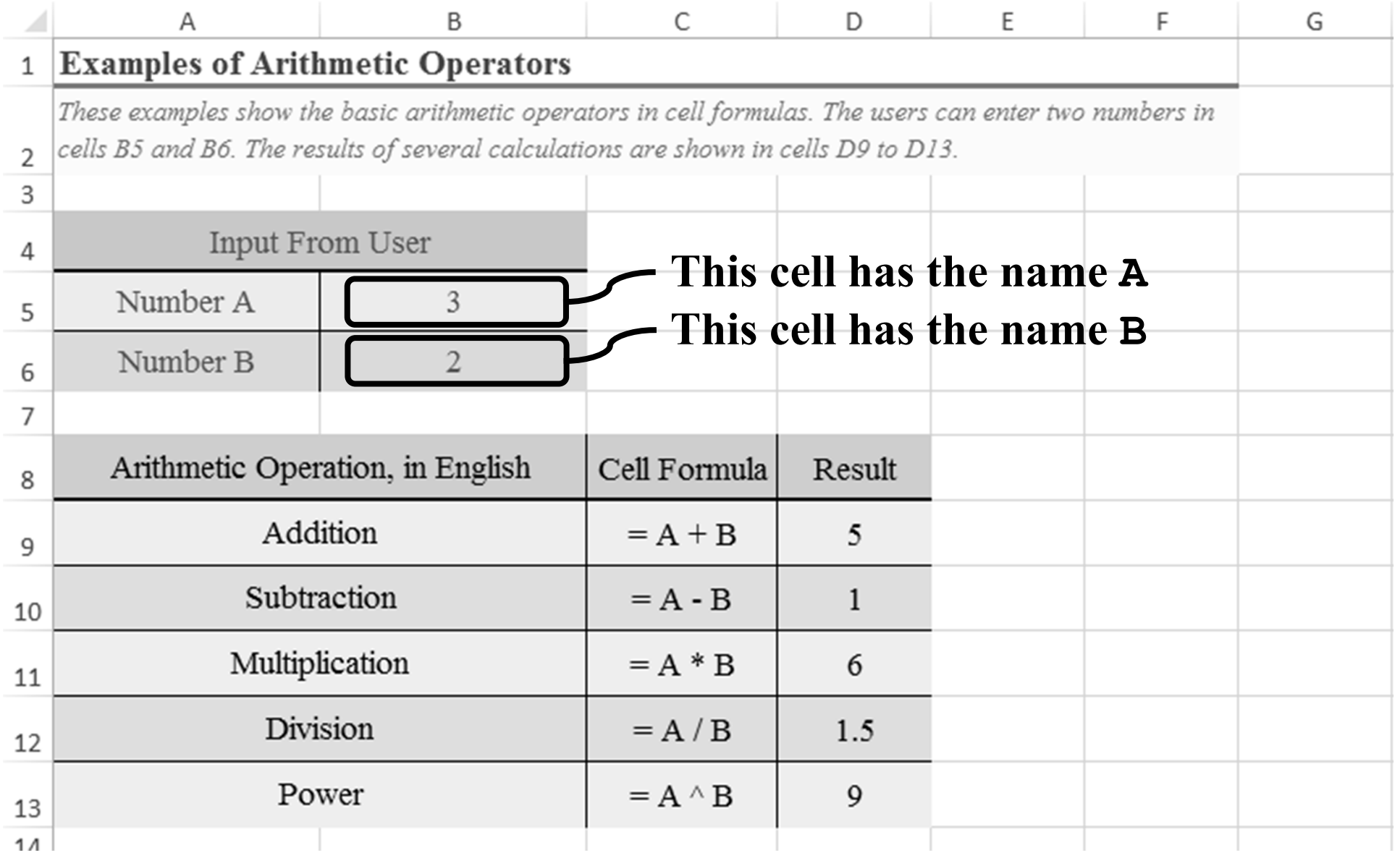

- For example, if you want to add two numbers 3 and 10, you do this:

```
= 3 + 10
```

- There are only 5 arithmetic operators `+ - * / ^` but there are also many *functions* (English words) helping you perform other clever calculations
- For example, you can use
  `=AVERAGE(B13:B17)`
  to do the same thing as the formula shown before

# Examples Of Arithmetic

- These examples show the use of + - * / ^ in cell formulas



**Examples of Arithmetic Operators**

*These examples show the basic arithmetic operators in cell formulas. The users can enter two numbers in cells B5 and B6. The results of several calculations are shown in cells D9 to D13.*

| Input From User | |
|---|---|
| Number A | 3 |
| Number B | 2 |

**This cell has the name A**

**This cell has the name B**

| Arithmetic Operation, in English | Cell Formula | Result |
|---|---|---|
| Addition | = A + B | 5 |
| Subtraction | = A - B | 1 |
| Multiplication | = A * B | 6 |
| Division | = A / B | 1.5 |
| Power | = A ^ B | 9 |

# Some Commonly Used Number Functions

- There are many functions that can be used in cell formulas
- Here we look at 7 common functions for handling numbers:

| | |
|---|---|
| `SUM` | for finding the total of a group of numbers |
| `AVERAGE` | for finding the average of a group of numbers |
| `STDEV` | for finding the standard deviation of a group of numbers |
| `MAX` | for finding the maximum in a group of numbers |
| `MIN` | for finding the minimum in a group of numbers |
| `RANK` | for ranking a number in a group of numbers |
| `COUNTIF` | for counting the number of occurrences of a value |

- On the next slide we show an example which uses these
- Remember *Ctrl* `` ` `` can be used to show all the formulas

# Example of Some Commonly Used Number Functions

**Some Commonly Used Number Functions**

*This example uses the following 7 cell functions in the cell formulas: SUM, AVERAGE, STDEV, MAX, MIN, RANK, COUNTIF. (In this course, each of the assignments is worth 14% and the final exam is worth 44%.)*

| Student ID | Student Name | Assignment | | | | Final Exam | Total | Rank | Final Grade |
|---|---|---|---|---|---|---|---|---|---|
| | | A1 | A2 | A3 | A4 | | | | |
| 09677229 | David | 100 | 100 | 90 | 0 | 44 | 59.96 | 9 | C+ |
| 09899972 | Gigi | 80 | 100 | 100 | 0 | 31.5 | 53.06 | 10 | C+ |
| 09959402 | Eddie | 100 | 100 | 100 | 96 | 71 | 86.68 | 2 | A |
| 09965977 | Chris | 95 | 100 | 100 | 100 | 61 | 82.14 | 3 | B+ |
| 10055430 | Alex | 100 | 100 | 100 | 95 | 85 | 92.70 | 1 | A+ |
| 10211965 | Henry | 95 | 90 | 60 | 67 | 52 | 66.56 | 7 | B- |
| 10217107 | James | 65 | 100 | 100 | 97 | 60 | 77.08 | 4 | B+ |
| 10251688 | Ken | 100 | 96 | 75 | 98 | 42 | 70.14 | 6 | B |
| 10335015 | Isaac | 98 | 90 | 100 | 91 | 21 | 62.30 | 8 | B- |
| 10683708 | Felix | 100 | 100 | 85 | 95 | 44 | 72.56 | 5 | B |
| 10858690 | Bonnie | 90 | 0 | 78 | 0 | 13 | 29.24 | 11 | F |

| Some Statistics | |
|---|---|
| Mean | 68.40 |
| Standard Deviation | 17.58 |
| Maximum | 92.70 |
| Minimum | 29.24 |

| Grade Distribution | |
|---|---|
| Number of students that got an A | 2 |
| Number of students that got a B | 6 |
| Number of students that got a C | 2 |
| Number of students that failed | 1 |

- Take a look at the example in the web site!

# Here are the Formulas Used

## Some Commonly Used Number Functions

*This example uses the following 7 cell functions in the cell formulas: SUM, AVERAGE, STDEV, MAX, ... In this course, each of the assignments is worth 14% and the final exam is worth 44%.)*

| Student ID | Student Name | Assignment A1 | A2 | A3 | A4 | Final Exam | Total | Rank | Final Grade |
|---|---|---|---|---|---|---|---|---|---|
| 09677229 | David | 100 | 100 | 90 | 0 | 44 | 59.96 | 9 | C+ |
| 09899972 | Gigi | 80 | 100 | 100 | 0 | 31.5 | 53.06 | 10 | C+ |
| 09959402 | Eddie | 100 | 100 | 100 | 96 | 71 | 86.68 | 2 | A |
| 09965977 | Chris | 95 | 100 | 100 | 100 | 61 | 82.14 | 3 | B+ |
| 10055430 | Alex | 100 | 100 | 100 | 95 | 85 | 92.70 | 1 | A+ |
| 10211965 | Henry | 95 | 90 | 60 | 67 | 52 | 66.56 | 7 | B- |
| 10217107 | James | 65 | 100 | 100 | 97 | 60 | 77.08 | 4 | B+ |
| 10251688 | Ken | 100 | 96 | 75 | 98 | 51 | 70.14 | 6 | B |
| 10335015 | Isaac | 98 | 90 | 100 | 91 | 41 | 62.30 | 8 | B- |
| 10683708 | Felix | 100 | 100 | 85 | 95 | 44 | 72.56 | 5 | B |
| | | | | | | 3 | 29.24 | 11 | F |

```
=AVERAGE(H6:H16)
=STDEV(H6:H16)
=MAX(H6:H16)
=MIN(H6:H16)
```

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| Some Statistics | |
|---|---|
| Mean | 68.40 |
| Standard Deviation | 17.58 |
| Maximum | 92.70 |
| Minimum | 29.24 |

| Grade Distribution | |
|---|---|
| Number of students that got an A | 2 |
| Number of students that got a B | 6 |
| Number of students that got a C | 2 |
| Number of students that failed | 1 |

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| | |
|---|---|
| =SUM(C6:F6) * 0.14 + G6 * 0.44 | =RANK(H6, H$6:H$16) |
| =SUM(C7:F7) * 0.14 + G7 * 0.44 | =RANK(H7, H$6:H$16) |
| =SUM(C8:F8) * 0.14 + G8 * 0.44 | =RANK(H8, H$6:H$16) |
| =SUM(C9:F9) * 0.14 + G9 * 0.44 | =RANK(H9, H$6:H$16) |
| =SUM(C10:F10) * 0.14 + G10 * 0.44 | =RANK(H10, H$6:H$16) |
| =SUM(C11:F11) * 0.14 + G11 * 0.44 | =RANK(H11, H$6:H$16) |
| =SUM(C12:F12) * 0.14 + G12 * 0.44 | =RANK(H12, H$6:H$16) |
| =SUM(C13:F13) * 0.14 + G13 * 0.44 | =RANK(H13, H$6:H$16) |
| =SUM(C14:F14) * 0.14 + G14 * 0.44 | =RANK(H14, H$6:H$16) |
| =SUM(C15:F15) * 0.14 + G15 * 0.44 | =RANK(H15, H$6:H$16) |
| =SUM(C16:F16) * 0.14 + G16 * 0.44 | =RANK(H16, H$6:H$16) |

```
=COUNTIF(J6:J16, "A+") + COUNTIF(J6:J16, "A") + COUNTIF(J6:J16, "A-")
=COUNTIF(J6:J16, "B+") + COUNTIF(J6:J16, "B") + COUNTIF(J6:J16, "B-")
=COUNTIF(J6:J16, "C+") + COUNTIF(J6:J16, "C") + COUNTIF(J6:J16, "C-")
=COUNTIF(J6:J16, "F")
```

# Comparing Things

- Sometimes you need to know about the relationship between two things
- For example, you might need to compare whether two values are equal, or if they are different
- You can do that using these:

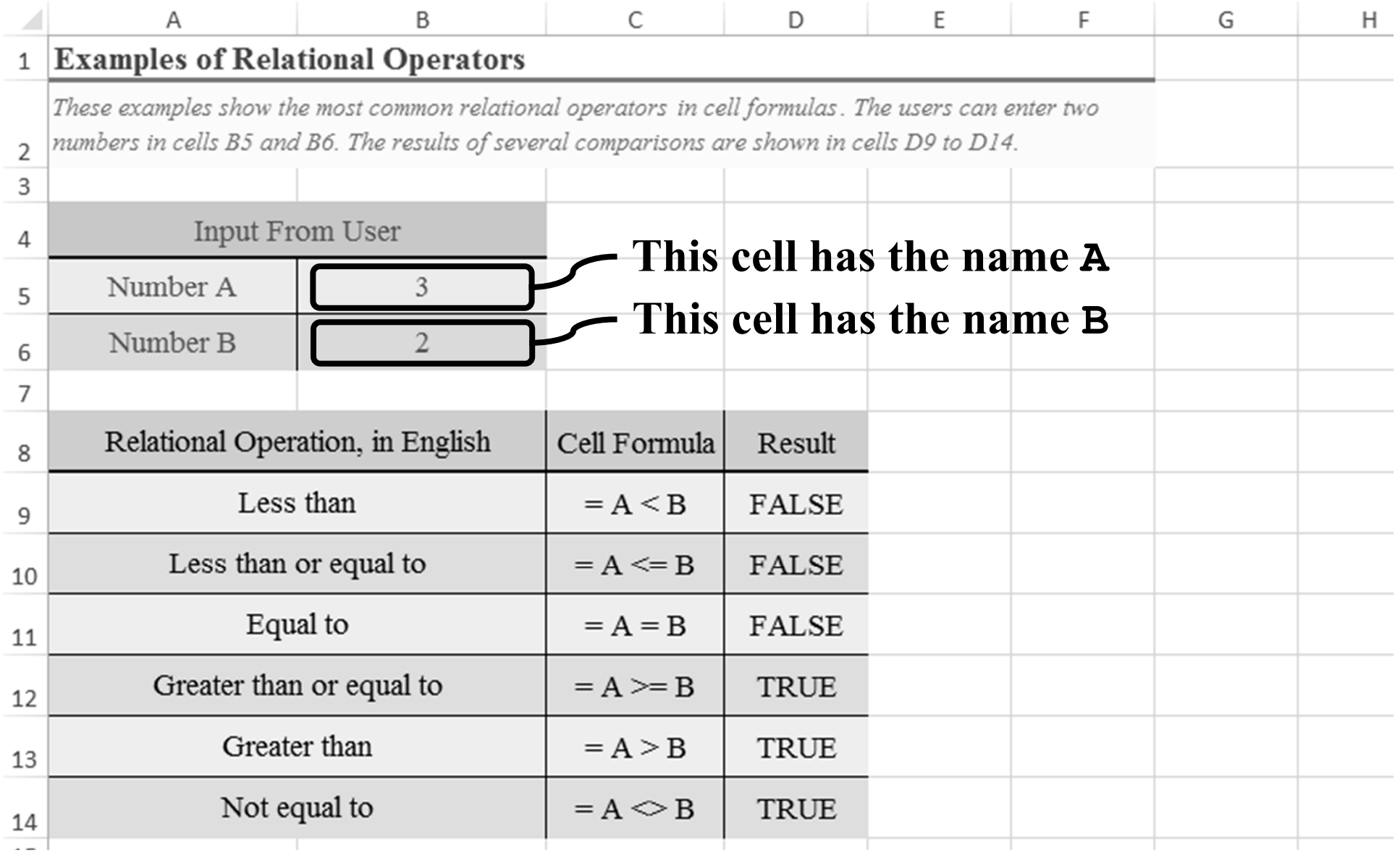
| | | | |
|---|---|---|---|
| = | equal to | <> | not equal to |
| < | smaller than | <= | smaller than or equal to |
| > | larger than | >= | larger than or equal to |

# TRUE and FALSE

- The result of a comparison is
  `TRUE` or `FALSE`
  - In cells these are shown using capital letters
- For example, to test if the value in cell A4 is larger than the value in cell B6, we can write
  `=A4 > B6`
- The result won't be a number; it will be either
  `TRUE` or `FALSE`

# Examples Of Comparing Things

- This example shows the most basic ways to compare things



**Examples of Relational Operators**

*These examples show the most common relational operators in cell formulas. The users can enter two numbers in cells B5 and B6. The results of several comparisons are shown in cells D9 to D14.*

| Input From User | |
|---|---|
| Number A | 3 |
| Number B | 2 |

**This cell has the name A**

**This cell has the name B**

| Relational Operation, in English | Cell Formula | Result |
|---|---|---|
| Less than | = A < B | FALSE |
| Less than or equal to | = A <= B | FALSE |
| Equal to | = A = B | FALSE |
| Greater than or equal to | = A >= B | TRUE |
| Greater than | = A > B | TRUE |
| Not equal to | = A <> B | TRUE |

# Comparing Things in COUNTIF

- We have seen `COUNTIF` helps us count the number of occurrences of something, e.g. `=COUNTIF(J6:J16, "A")`

- Instead of using an exact value we can do something like `=COUNTIF(B2:B6, "<40")`
- This will count all the numbers less than 40

# Example of Using COUNTIF

- This extends a previous example
- It counts the number of students who failed a final exam, which had a pass mark of 40

**Using COUNTIF with Relational Operators**

*This example shows the use of relational operators inside the criteria of the COUNTIF function. It uses "<" to find the number of students who failed the final exam.*

| Student ID | Student Name | Assignment | | | | Final Exam | Total | Rank | Final Grade |
|---|---|---|---|---|---|---|---|---|---|
| | | A1 | A2 | A3 | A4 | | | | |
| 09677229 | David | 100 | 100 | 90 | 0 | 44 | 59.96 | 9 | C+ |
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| 09959402 | Eddie | 100 | 100 | 100 | 96 | 71 | 86.68 | 2 | A |
| 09965977 | Chris | 95 | 100 | 100 | 100 | 61 | 82.14 | 3 | B+ |
| 10055430 | Alex | 100 | 100 | 100 | 95 | 85 | 92.70 | 1 | A+ |
| 10211965 | Henry | 95 | 90 | 60 | 67 | 52 | 66.56 | 7 | B- |
| 10217107 | | | | | | | | | |
| 10251688 | | | | | | | | | |
| 10335015 | | | | | | | | | |
| 10683708 | Felix | 100 | 100 | 85 | 95 | 44 | 72.5 | 5 | B |
| 10858690 | Bonnie | 90 | 0 | 78 | 0 | 13 | 2 | 11 | F |

Number of students who failed the exam: 3

Number of students who failed the exam: =COUNTIF(G6:G16,"<40")

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- Take a look at the example in the web site

"<40" means any value smaller than 40

# Other Cell Functions with ‘IF’

- As well as `COUNTIF(B2:B6, "<40")` there’s also these cell functions which have ‘if’ in their name:
- `AVERAGEIF(B2:B6, "<40")`
  calculate the average for the cells which have values <40
- `SUMIF(B2:B6, "<40")`
  add up the cells, for the cells which have values <40
- You can use any of these:

| | | | |
|---|---|---|---|
| = | equal to | <> | not equal to |
| < | smaller than | <= | smaller than or equal to |
| > | larger than | >= | larger than or equal to |

# String Concatenation

- In computer language, ‘a string’ means ‘a piece of text’
- *Concatenate* means putting one string at the end of another string
- In Excel cell formulas, you can concatenate two strings by using `&` or the `CONCATENATE` function
- For example, this formula:

  `="Happy" & "Birthday"`

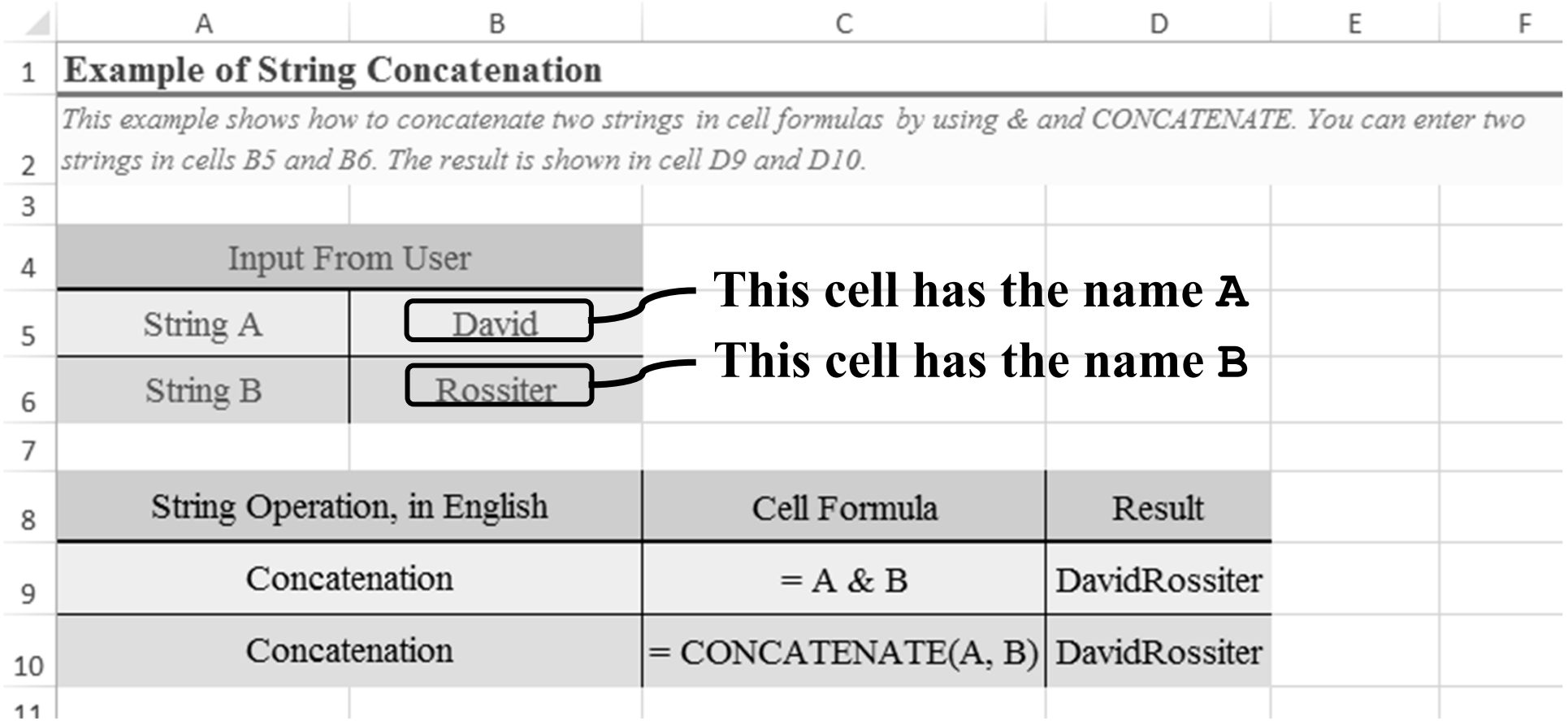
  and this formula:

  `=CONCATENATE("Happy", "Birthday")`

  both produce the same result: `HappyBirthday`

# String Concatenation

- Here is an example of both:



| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | **Example of String Concatenation** | | | | | |
| 2 | *This example shows how to concatenate two strings in cell formulas by using & and CONCATENATE. You can enter two strings in cells B5 and B6. The result is shown in cell D9 and D10.* | | | | | |
| 3 | | | | | | |
| 4 | Input From User | | | | | |
| 5 | String A | David | | | | |
| 6 | String B | Rossiter | | | | |
| 7 | | | | | | |
| 8 | String Operation, in English | | Cell Formula | Result | | |
| 9 | Concatenation | | = A & B | DavidRossiter | | |
| 10 | Concatenation | | = CONCATENATE(A, B) | DavidRossiter | | |
| 11 | | | | | | |

# String Concatenation and the COUNTIF Comparison

- When you use `COUNTIF` with a comparison, the comparison is written as a string, i.e. `COUNTIF(B2:B6, "<40")`
- If you want to include a cell in the comparison, you **cannot** write the cell reference directly inside, i.e. `COUNTIF(B2:B6, "<B8")` ✖ Wrong!
- You will need to do this instead:

```
COUNTIF(B2:B6, "<" & B8)
```

# Some Commonly Used String Functions

- There are many other functions for strings
- Here we look at some:

| | |
|---|---|
| `LEN` | Count the number of characters in a string |
| `UPPER` | Convert all letters into upper case letters i.e. ABC |
| `LOWER` | Convert all letters into lower case letters i.e. abc |
| `LEFT` | Get the first few characters in a string |
| `RIGHT` | Get the last few characters in a string |
| `SUBSTITUTE` | Substitute (replace) some text in a string |

- There are examples of these on the next slide

# Example of Some Commonly Used String Functions

| | | |
|---|---|---|
| Input From User | | |
| String A | Dave is the best instructor! | This cell has the name **A** |
| String Old | best | This cell has the name **Old** |
| String New | most handsome | This cell has the name **New** |

| What Does the Example Do? | Cell Formula | Result |
|---|---|---|
| Count how many characters in a string | = LEN(A) | 28 |
| Convert all the characters into upper case (large letters) | = UPPER(A) | DAVE IS THE BEST INSTRUCTOR! |
| Convert all the characters into lower case (small letters) | = LOWER(A) | dave is the best instructor! |
| Get the first N characters in the string | = LEFT(A, 4) | Dave |
| Get the last N characters in the string | = RIGHT(A, 11) | instructor! |
| Substitute a piece of text with a new piece of text in a string | = SUBSTITUTE(A, Old, New) | Dave is the most handsome instructor! |

# What Goes First?

- If you enter the following formula

  `=5+2*3`

  you may think that the answer is 21
- However, Excel actually gives you the answer of 11
- That is because Excel thinks that multiplication is more important than addition
- Therefore `2*3` is performed first, before the addition
- We say multiplication has a higher *precedence* than addition

# Using Brackets

- Of course, if you use brackets that ensures that part of a formula is evaluated first
- Examples:

  `=5+2*3` gives an answer of 11

  `=(5+2)*3` gives an answer of 21
- You might think you can always use brackets in your cell formulas, so you don't have to remember which things are calculated first
- That's true – until someone else gives you a formula which doesn't have any brackets in it…

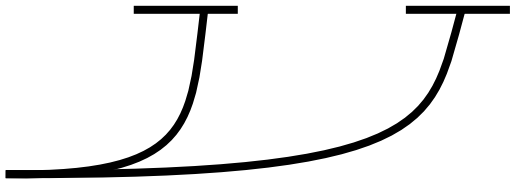
# Precedence in Cell Formulas

- The following table shows you the different levels of precedence, most important at the top:

| | |
|---|---|
| ^ | Power |
| * and / | Multiplication and division |
| + and - | Addition and subtraction |
| & | String concatenation |
| = <> < <= > >= | Comparisons |

# Precedence Example 1

```
= 20 - 10 / 2 * 3 + 2
```



- / and * have higher precedence than + and −, so they are handled first
- / and * have equal precedence, so the one on the left (/) is evaluated first, then *
- Then − and + are handled
- − and + have equal precedence, so the one on the left (−) is evaluated first, then +

- So the answer is:

```
=(20-((10/2)*3))+2

= 7
```

# Precedence Example 2

```
= 10 / 2 * 4 - 3 ^ 3
```

- ^ has a higher precedence than the others, so it is handled first
- / and * have equal precedence, so the one on the left (/) is evaluated first, then the *
- The – is handled last

- So the answer is:

```
=((10/2)*4)-(3^3)

=((10/2)*4)- 27

= -7
```

# Precedence Example 3

| | A | B |
|---|---|---|
| 1 | Surname: | Rossiter |
| 2 | Firstname: | David |
| 3 | Age: | 20 |
| 4 | | |
| 5 | Good? | ="Rossiter,David,40" = B1 & "," & B2 & "," & B3*2 |

- The comparison is done last
- The concatenation is done next
- The multiplication is done first
- For this situation the result of the formula is: TRUE

# Quick List of Cell Things We Looked At

- + - * / ^
- = < > <> <= >=

- SUM
- AVERAGE
- STDEV
- MAX
- MIN
- RANK

- COUNTIF
- AVERAGEIF
- SUMIF

- &
- CONCATENATE

- LEN
- UPPER
- LOWER
- LEFT
- RIGHT
- SUBSTITUTE