Nested IF functions

IF function structure:

- Logical test – compares two values of numerical, text or date data to determine if they are:
  - Equal → =
  - Less than → <
  - Greater than → >
  - Less than or equal to → <=
  - Greater than or equal to → >=
  - Not equal to → <>

- True
  - This part of the IF function is executed **only if** the logical test is evaluated as TRUE
  - Output could be a calculation, number or text
  - If omitted and the logical test is TRUE the output will be the word TRUE

- False
  - This part of the IF function is executed **only if** the logical test is evaluated as FALSE
  - Output could be a calculation, number or text
  - If omitted and the logical test is FALSE the output will be the word FALSE

To output a blank cell use two double quote marks – “”.

Each IF function can only produce one of two results:

- One result if the logical test is evaluated as **TRUE**, and
- A different result if the logical test is evaluated as **FALSE**.

If you have more than two possible outcomes, you will need more than one IF function. The method to calculate how many IF functions you will need is:

Total Possible Outcomes – 1 = Number of IF functions required.

For example, if you had a problem with three possible outcomes, you would need to use two IF functions

3 possible outcomes – 1 = 2 required IF functions → One IF function nested within the other.

For three possible outcomes, your nested IF functions would look like this:

=IF (Logical Test 1, TRUE Outcome, IF (Logical Test, TRUE Outcome, FALSE Outcome)

In the above example, the nested IF (the second IF) is embedded in the FALSE section of the first IF function. However, the nested IF can be in either the TRUE or FALSE section of the primary IF.

In the following examples we'll use the data from the worksheet named “Salary Data” for the Academy Arcade's Web Games Staffing Report

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Academy Arcade's Web Games Staffing Report												
2		Salary Information			Raise Rates			Bonus Rates				Using a Vlookup	
3		Average			Excellent	6%		Lead	$ 6,000.00			Lookup Input	
4		Max			Good	4%		Senior	$ 2,000.00			Last Name	
5		Min			Average	2%		Blank	$ -			Department	
6												Salary w/Raise	
7													
8	ID	Last Name	First Name	Department	Title	Level	Current Salary	Performance	Salary w/Raise	Bonus	Two Condition Bonus	ANDs	ORs
9	10000	Aikman	Gary	Sound Design	Sound Designer	Senior	$ 67,000	Average					
10	10387	Felser	Cynthia	Animation	Animator	Lead	$ 80,000	Good					
11	10552	Leslie	Jean	Art	Artist		$ 45,250	Average					

Nested IF functions

Salary w/Raise

In the first example we'll calculate the values in the Salary /Raise column where there are three possible outcomes:

- If an employee's performance is Excellent, they get a 6% raise → Current Salary + Current Salary * 6%, or
- If their performance is Good, they get a 4% raise → Current Salary + Current Salary * 4%, or
- If Average, they get a 2% raise → Current Salary + Current Salary * 2%.

Step One: Write out the IF formula first in words

- Logical Test
  - Performance = "Excellent"
- True
  - Current Salary + Current Salary * 6%
- False → Nested IF
  - Logical Test
    - Performance = "Good"
  - True
    - Current Salary + Current Salary * 4%
  - False
    - Current Salary + Current Salary * 2%

Keep in mind absolute and relative cell referencing. Use Absolute when reusing a value that appears only once on a worksheet. In this example, cells (values) using absolute cell referencing are underlined.

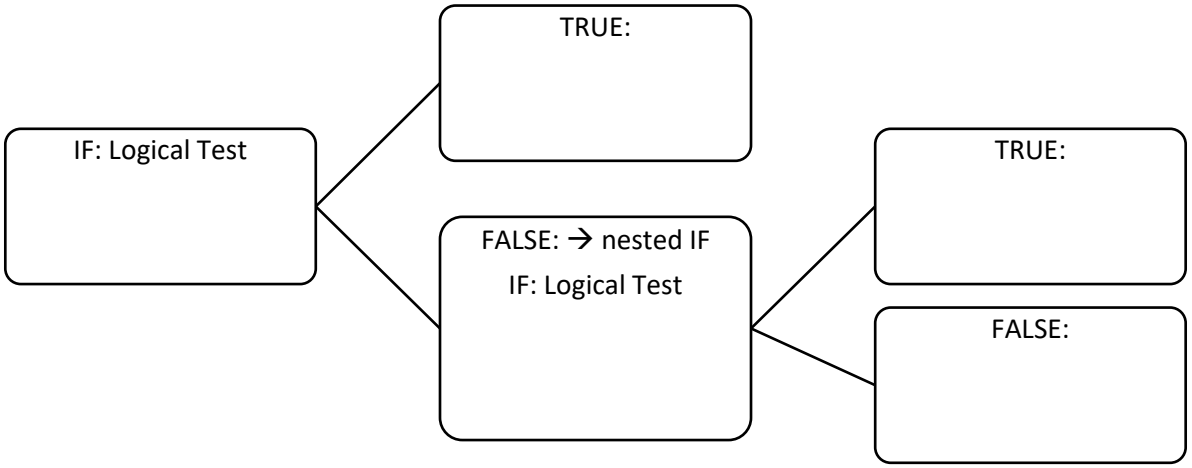
We don't need to check if performance is Average since we've already checked for Excellent and Good, the only option left in this scenario is Average.

Step Two: Convert the words to cell references – determine the formula to be entered in cell I9

- Logical Test
  - Performance = "Excellent" → H9=$E$3
- True
  - Current Salary + Current Salary * 6% → G9+G9*$F$3
- False
  - Logical Test → IF(
    - Performance = "Good" → H9=$E$4,
  - True
    - Current Salary + Current Salary * 4% → G9+G9*$F$4,
  - False
    - Current Salary + Current Salary * 2% → G9+G9*$F$5)

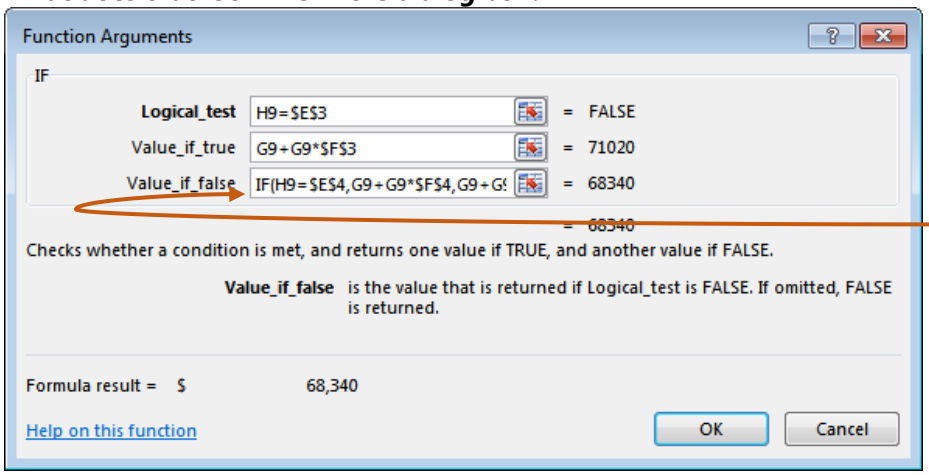
In the equation
G9+G9*$F$3
the multiplication will happen first, then the addition because of the Order or Operations - PEMDAS

Or, if you prefer to write it out using a tree diagram…



Nested IF functions

What does that look like in the dialog box?



The nested IF must be typed into the dialog box, in this case in the FALSE section.
Note that we do **NOT** start the nested IF with an "=" sign

And what does that look like in the formula bar?

=First IF, opening parenthesis, logical test	First True	First False contains a Nested IF, opening parenthesis, logical test	Nested True	Nested False	Parentheses to close both IF functions
=IF(H9=$E$3,	**G9+G9*$F$3,**	**IF(H9=$E$4,**	**G9+G9*$F$4,**	**G9+G9*$F$5**	**))**
Performance = "Excellent"	*Executed only if test is TRUE* Current Salary + Current Salary * 6%	IF(Performance = "Good"	*Executed only if Nested IF test is TRUE* Current Salary + Current Salary * 4%	*Executed only if Nested IF test is FALSE* Current Salary + Current Salary * 2%	

Altogether, in the Formula bar, the nested IF function looks like this, each section is separated by a comma.

```
=IF(H9 = $E$3, G9 + G9 * $F$3, IF(H9 = $E$4, G9 + G9 * $F$4, G9 + G9 * $F$5))
```

Nested IF functions

Bonus – nested IF's

Problem statement – employees at the Academy Arcade's Web Games whose level is shown as "Lead" get a $6,000 bonus, those at the "Senior" level get a $2,000 bonus and everyone else gets $0.

Since the total possible outcomes is three ($6,000, $2,000 or $0) you need two IF functions nested together:

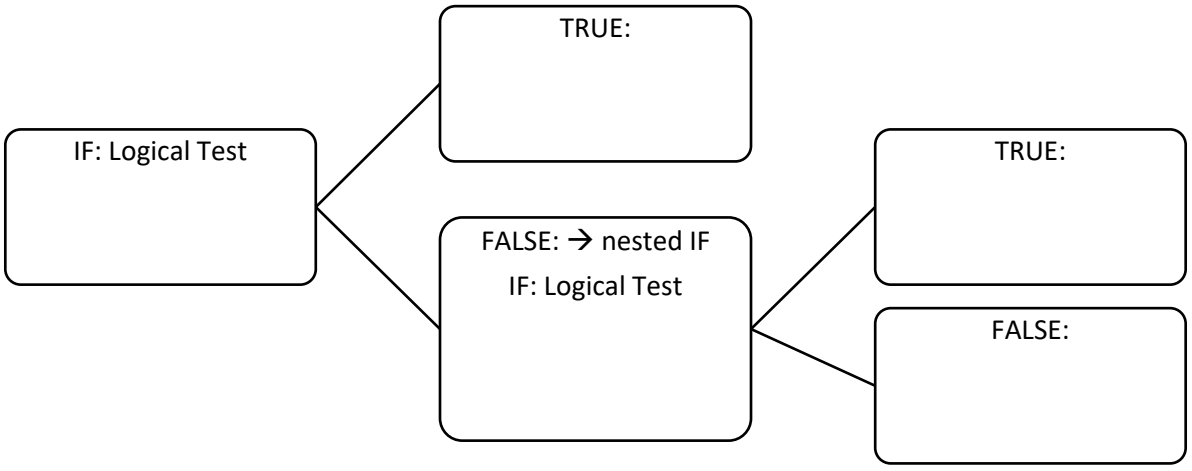
Total Possible Outcomes – 1 = Number of IF functions required.

Write out the formula first in words, underlining any words/cells that will use Absolute Cell Referencing.

- IF Test
  - Level = "Lead"
- True
  - Bonus = $6,000
- False
  - IF Test
    - Level = "Senior"
  - True
    - Bonus = $2,000
  - False
    - Bonus = $0

Convert the words to cell references – determine the formula to be entered in cell I9

- IF Test
  - Level = "Lead" →
- True
  - Lead Bonus → $6,000 →
- False
  - IF Test
    - Level = "Senior" →
  - True
    - Senior Bonus → $2,000 →
  - False
    - Everyone Bonus → $0 →



Nested IF functions

AND function structure:
=AND (Logical Test 1, Logical Test 2, …)

Can only return an answer of either TRUE or FALSE

- To return an answer of TRUE, ALL logical tests MUST be TRUE
- To return an answer of FALSE, only one of the logical tests MUST be FALSE

Problem Statement: In column L, under the heading of ANDs, determine which of the Academy Arcade's Web Games employees are Senior level **and** have a current salary greater than $70,000?

AND statement in words

=AND(
- Logical test 1: Level = Senior
- Logical test 2: Current Salary > $70,000

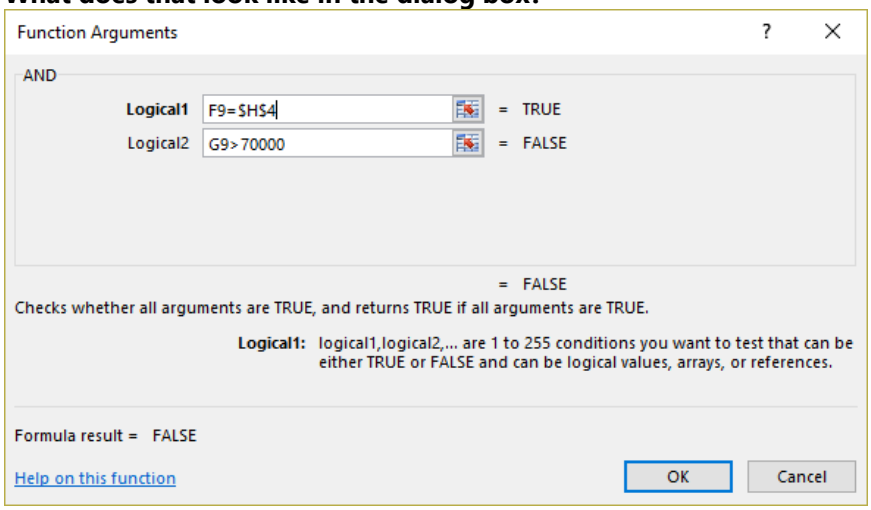
)

Convert the words to cell references

=AND(
- Logical test 1: Level = Senior →
- Logical test 2: Current Salary > $70,000 →

)

What does that look like in the dialog box?



What does that look like in the formula bar?

= AND (F9 = $H$4 , G9 > 70000) → *Two logical tests separated by a comma*

Spaces added to formula above for legibility – don't put all those spaces in your formula!

Nested IF functions

OR function structure:
=OR (Logical Test 1, Logical Test 2, …)

Can only return an answer of either TRUE or FALSE

- To return an answer of TRUE, only one of the logical tests MUST be TRUE
- To return an answer of FALSE, ALL logical tests MUST be FALSE

Problem Statement: In column M, under the heading of ORs, determine which of the Academy Arcade's Web Games employees are Senior level **or** have a current salary greater than $70,000?

OR statement in words

=OR(
- Logical test 1: Level = Senior
- Logical test 2: Current Salary > $70,000

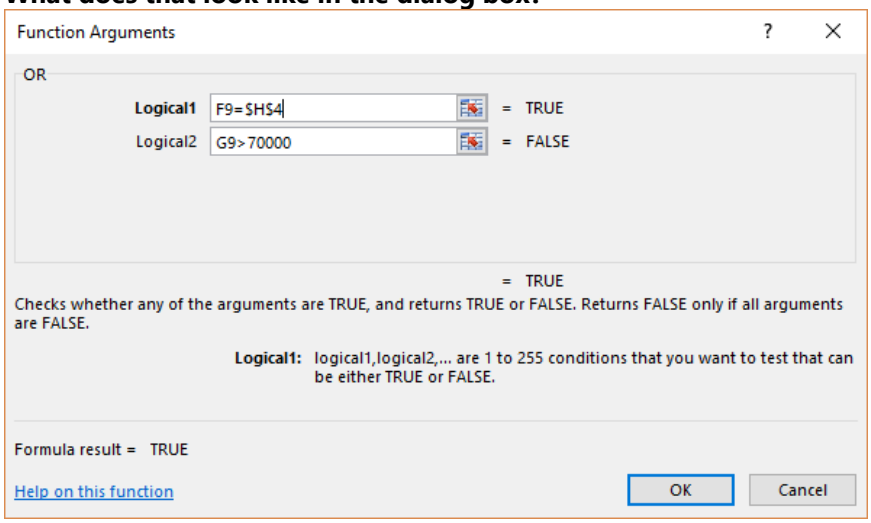
)

Convert the words to cell references

- =OR
  - Logical test 1: Level = Senior →
  - Logical test 2: Current Salary > $70,000 →

)

What does that look like in the dialog box?



What does that look like in the formula bar?

= OR (F9 = $H$4 , G9 > 70000) → *Two logical tests separated by a comma*

Spaces added to formula above for legibility – don't put all those spaces in your formula!

Nested IF functions

Truth Tables

Truth Table for ANDs

Test 1	Test 2	Outcome
True	True	**True**
True	False	False
False	True	False
False	False	False

Truth Table for ORs

Test 1	Test 2	Outcome
True	True	**True**
True	False	**True**
False	True	**True**
False	False	False

AND versus OR

- AND's limit (reduce) the number of TRUE results since it is necessary to meet ALL the specified criteria to get a TRUE result
- OR's expand (increase) the number of TRUE results since it is necessary to meet only ONE of the specified criteria to get a TRUE result

How could we improve these formulas?

= AND (F9 = $H$4 , G9 > 70000)

= OR (F9 = $H$4 , G9 > 70000)

Nested IF functions

Two Condition Bonus – using nested IF's with ANDs/ORs

Let's recalculate Bonuses using two conditions – first we'll try it with ANDs and then we'll switch to ORs.
In this example employees need to meet two conditions to get a bonus:

- Employees with a Level of Lead need to have Excellent performance to earn a $6,000 bonus,
- Employees with a Level of Senior need to have a performance of Excellent to get a $2,000 bonus
- Anyone whose Level is not Lead or Senior with Excellent performance will not get a bonus

In words that would be…

- IF Logical Test
  - AND
    - Level = "Lead"
    - Performance = "Excellent"

    For nested AND, both conditions must be true
  - True
    - Lead Bonus → $6,000
  - False
    - IF Logical Test
      - AND
        - Level = "Senior"
        - Performance = "Excellent"

        For nested AND, both conditions must be true
      - True
        - Senior Bonus → $2,000
      - False
        - Everyone else → $0

Underline cells that will use Absolute Cell Referencing

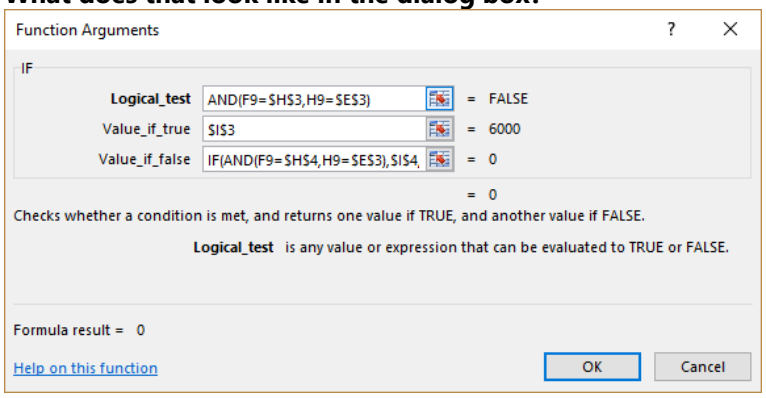
Convert the words to cell references

- IF Logical Test
  - AND
    - Level = "Lead"
    - Performance = "Excellent"

    IF function with nested AND in logical test
    IF(AND(F9=H3, H9=E3), I3,
  - True
    - Lead Bonus → $6,000
  - False
    - IF Logical Test
      - AND
        - Level = "Senior"
        - Performance = "Excellent"

        Nested IF function with nested AND in logical test
        IF(AND(F9=H4, H9=E3), I4, 0))
      - True
        - Senior Bonus → $2,000
      - False
        - Everyone else → $0

What does that look like in the dialog box?



What happens if we change the ANDs to ORs?

What does that look like in the formula bar?

```
=IF(AND(F9=$H$3,H9=$E$3),$I$3,IF(AND(F9=$H$4,H9=$E$3),$I$4,0))
```

Nested IF functions

Using a Vlookup

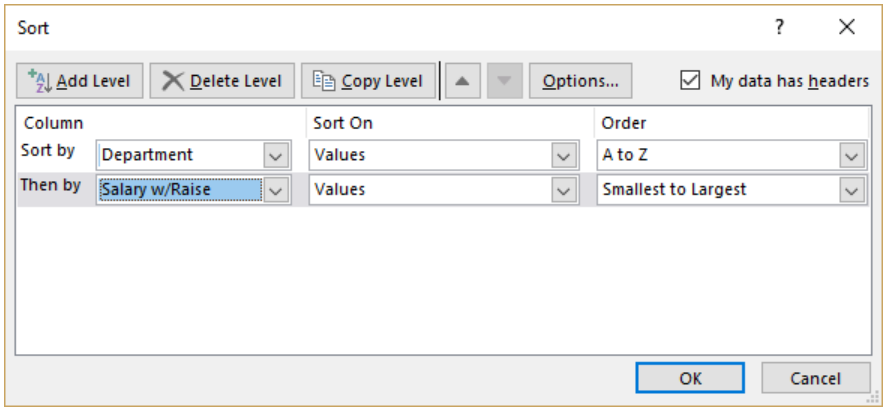
Create in cells M4:M6 a series of vlookup functions that lookup an input value from cell M3 in cell range A9:I101 and returns the data from the column specified in cells L3:L6 respectively. Remember that you are looking for an exact match. Use 19559 as the input value in cell M3. This should return Mosely, Art and $47,060 in the three output cells.

Salary Information

Use the formulas from the AutoSum drop down to calculate the required Salary Information in cells C3:C5 – be sure to use values from the Salary w/Raise column.

Tables

- Set data range A8:M101 as table and select formatting that will complement the existing formatting on the worksheet.
- Filter worksheet to display…
    - … those staff members whose Salary w/Raise is between $50,000 and $80,000. Remove filter.
    - … only staff members with "Designer" in their title. Remove filter.
    - … staff members with Excellent performance in the Art department. Remove filter.
- Sort worksheet…
    - By staff members last name
    - By Salary w/Raise from lowest to highest
    - By department AND Salary w/Raise so that departments are listed alphabetically from A to Z and staff within each department are sorted by Salary w/Raise from lowest to highest.
    - This last sort can't be done using the filtering arrows – you must use the SORT command on the data tab.



- Turn filtering arrows OFF from the Data tab

Freeze Panes

Set Freeze panes so that column A and rows 1-8 are continuously displayed as you scroll through your worksheet.

Nested IF functions

Conditional Formatting

- Use data bars (Gradient Fill, Green) to add conditional formatting to Salary w/Raise column.
- Add conditional formatting to the Department column to easily identify the staff in the Animation Department (formatting of your choice, but don't use borders)
- Add conditional formatting the top 20 values in the Current Salary column (formatting of your choice, but again, don't use borders)
- Add icon set of three traffic lights (unrimmed) to Current Salary. Set breakpoints as follows:
    - Greater than or equal to $80,000 should be a green traffic light,
    - Greater than or equal to $55,000 should be a yellow traffic light,
    - Otherwise, red traffic light
- Use formula to highlight Last Name of those who have Excellent performance AND whose Level is a blank cell. Set custom format of Bold on a light purple background.
- *Answers for the last two below.*

Page Setup

- Set page orientation to Landscape
- Center horizontally
- Set print area to exclude nonsense at bottom and include only columns A:K
- Footer: Your name, Worksheet Name, Page 1 of ?
- Repeat rows 1-8 at top of each page
- Margins Narrow
- Set scaling to fit all columns on one page