SQL Programming

In the Land of NULLs

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Page A-1: Intro

SQL is unlike most other current programming languages in that it provides a special value known as the NULL value.

This is one of the features of SQL that distinguishes it from most other programming languages, and there is am ongoing debate in db circles as to whether or not the complexity introduced by this feature is worth the trouble.

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Page B-1 Missing Values

We'll start this module with a question.

How should missing or unknown values be represented in the database?

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In the olden days, back when programmers maintained file systems, the tradition was to assign a value to every field in a file when the record was initialized.

Numeric fields were often initialized to 0 (zero), alphanumeric fields were often initialized to spaces.

One of the primary reasons for doing this was because data fields were strongly ‘typed’, and if the machine encountered an invalid value in a field (say spaces in a numeric field), the program would ABEND – abnormally end. Right then and there the program would terminate.

And, regardless of the time of day, the operations staff would call the user specialist, or the programmer, and have them come remedy the problem.

So, if errant data values can mess things up, what value could be used?

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Page B-3 What Value?

Programmers don't much care for being called in to work in the dead of night to remedy a failing program, so early on in their careers they learned the value of properly initialized records.

This begs the question, who picks the value to use for these unknown items?

Programmers often selected the values themselves, occasionally there were business standards that dictated what values should be used.

But what value would you use for a name field that hadn't been identified? Or a birthdates field when the true birth date value is unknown?

Programmers often used zeroes in numeric fields when those fields were initialized. But consider the field: HOURLY_RATE. Does a 0 value mean that we don't know the employee's hourly rate, or is it the case that this individual is a VOLUNTEER, and is working in an unpaid position.

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Database technology sought to remedy this problem with the introduction of the NULL value.

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The issues surrounding proper and efficient use of NULLs have sparked a number of discussions/debates/arguments in DB circles.

For our purposes, the best reason to use NULL is when the data value is unknown.

This will be our rationale / underlying premise for all future discussions regarding NULL.

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How do we use this NULL value?

Note: in the slides that follow although I've hard-coded the NULL value into the statements, SQL would behave in the same fashion if it were to encounter the NULL value as a columnar value.

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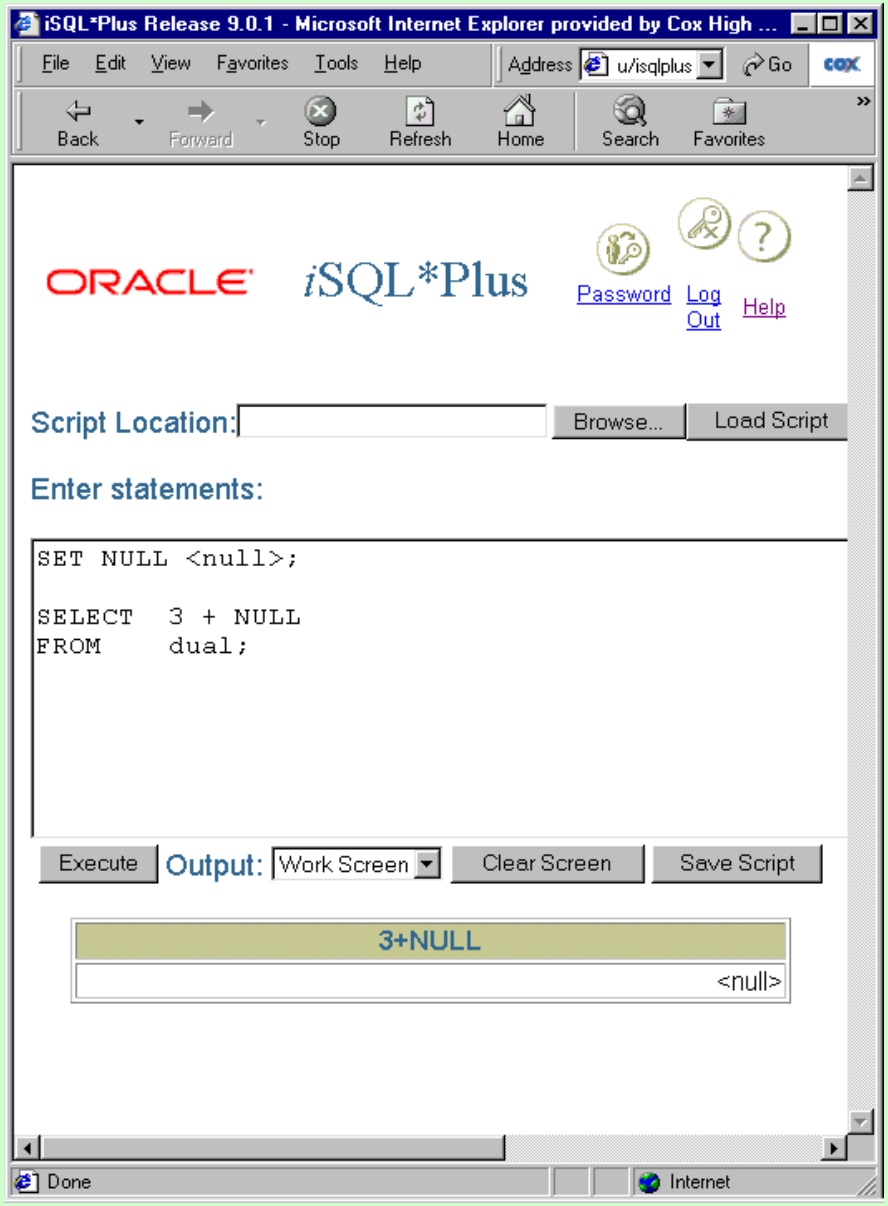

In math, any operation that uses a NULL value begets (propagates) a NULL value. That is, if any part of the operation is NULL, then the result is NULL (ie. I don't know, it's unknown, ...)

I've got some marbles in my left hand, and 2 more marbles in my right hand. After I put them all together, how many have I got?

I don't know? More than 2, but beyond that it's anybody's guess.

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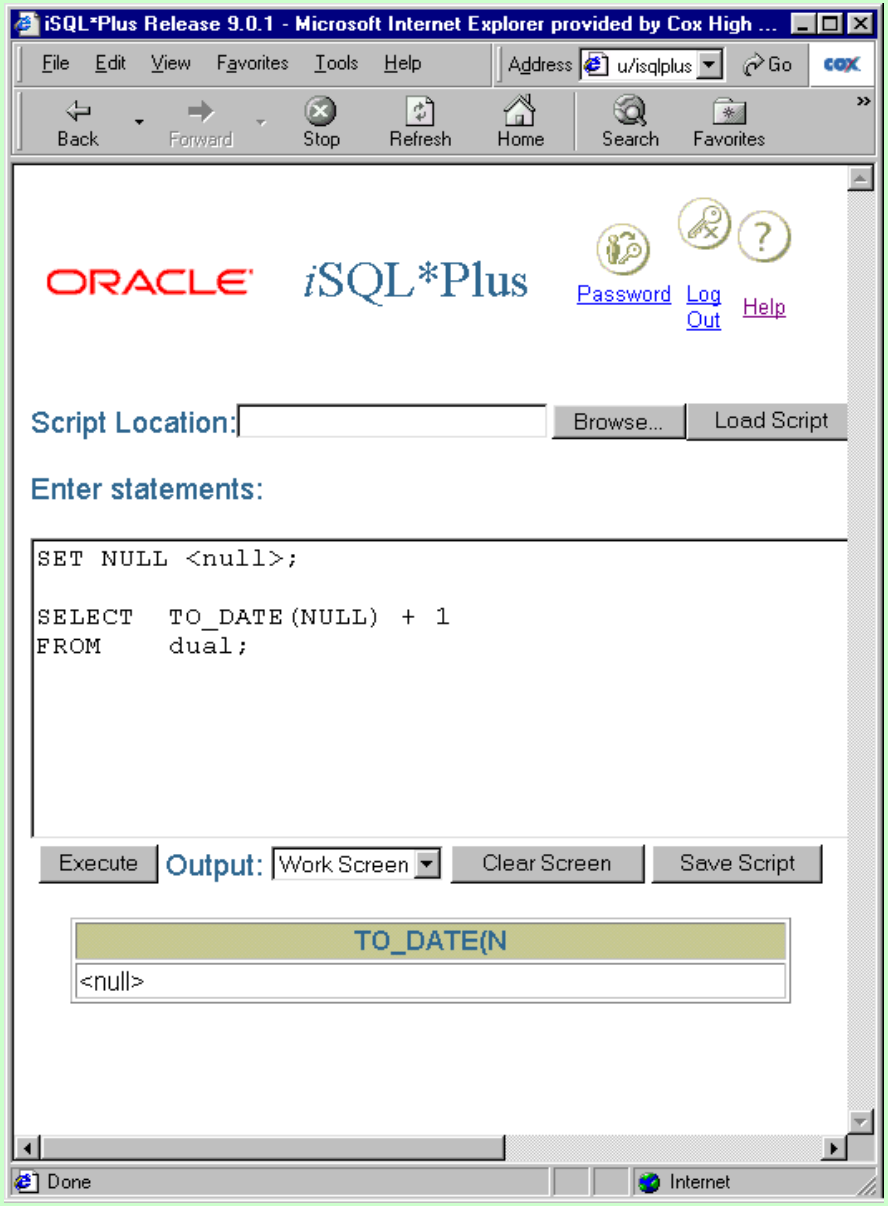

Date operations on a NULL value also beget NULL values.

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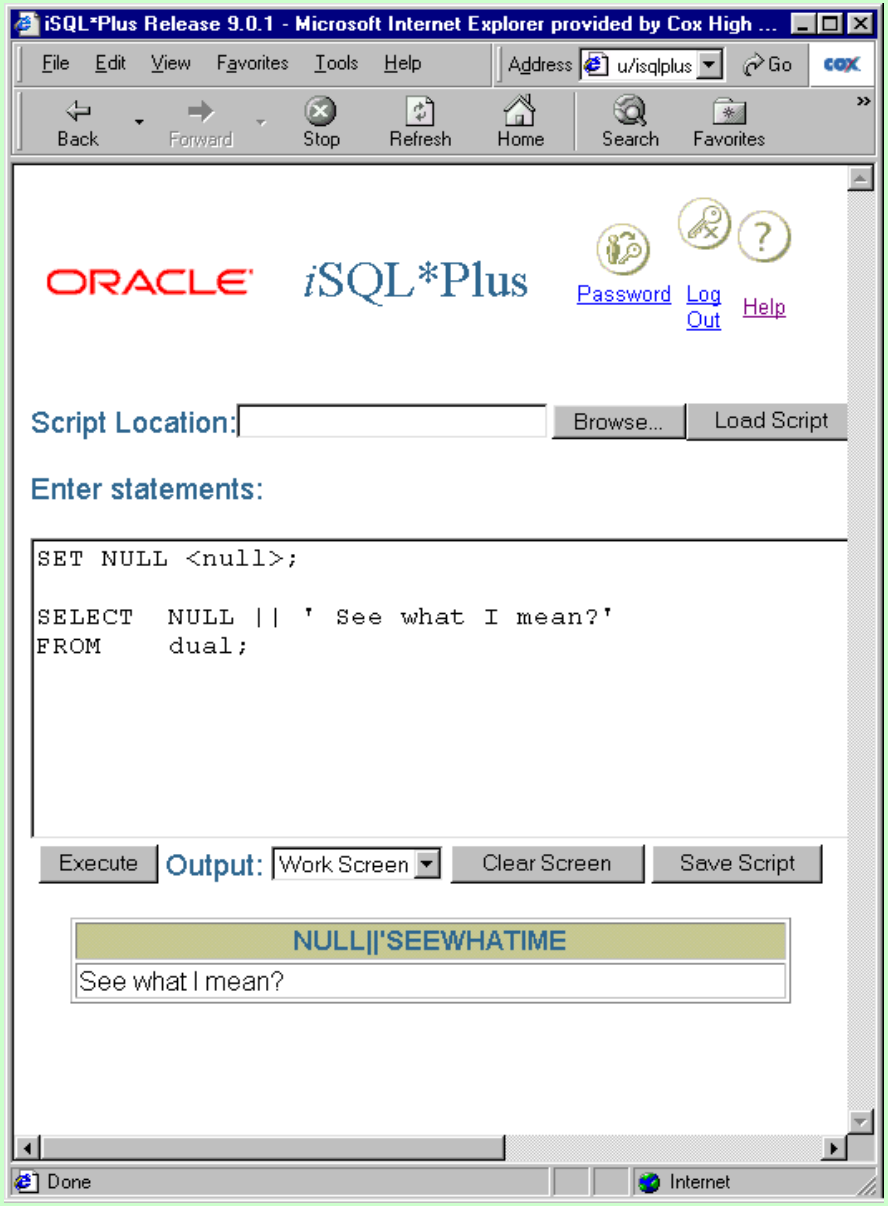

Character operations (of which there is only one) do NOT beget NULL values.

What an inconsistency!

I guess Oracle was abiding by that old adage: *A foolish consistency is the hobgoblin of little minds.*

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How do NULLs affect functions?

Generally, NULLs propagate NULLs.

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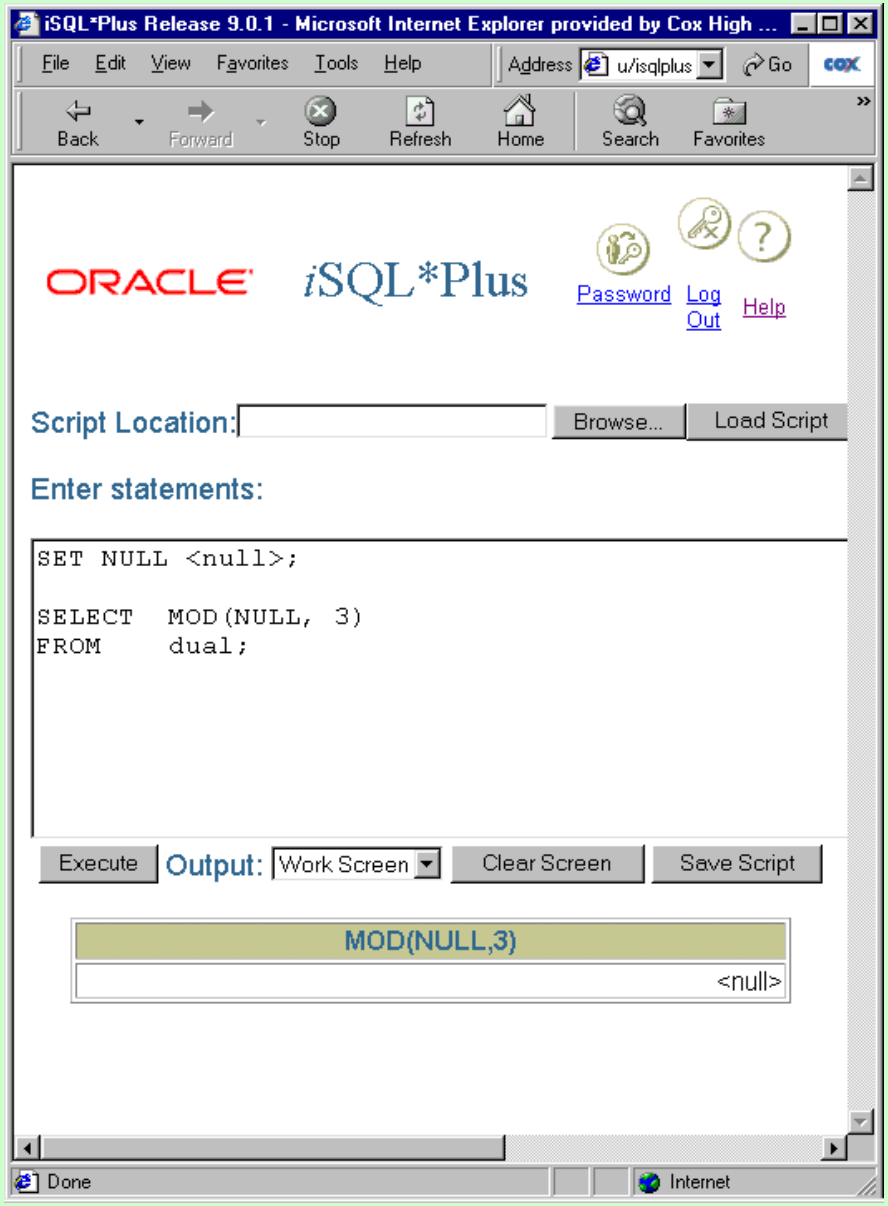

NULLs in numeric functions generally return NULL values.

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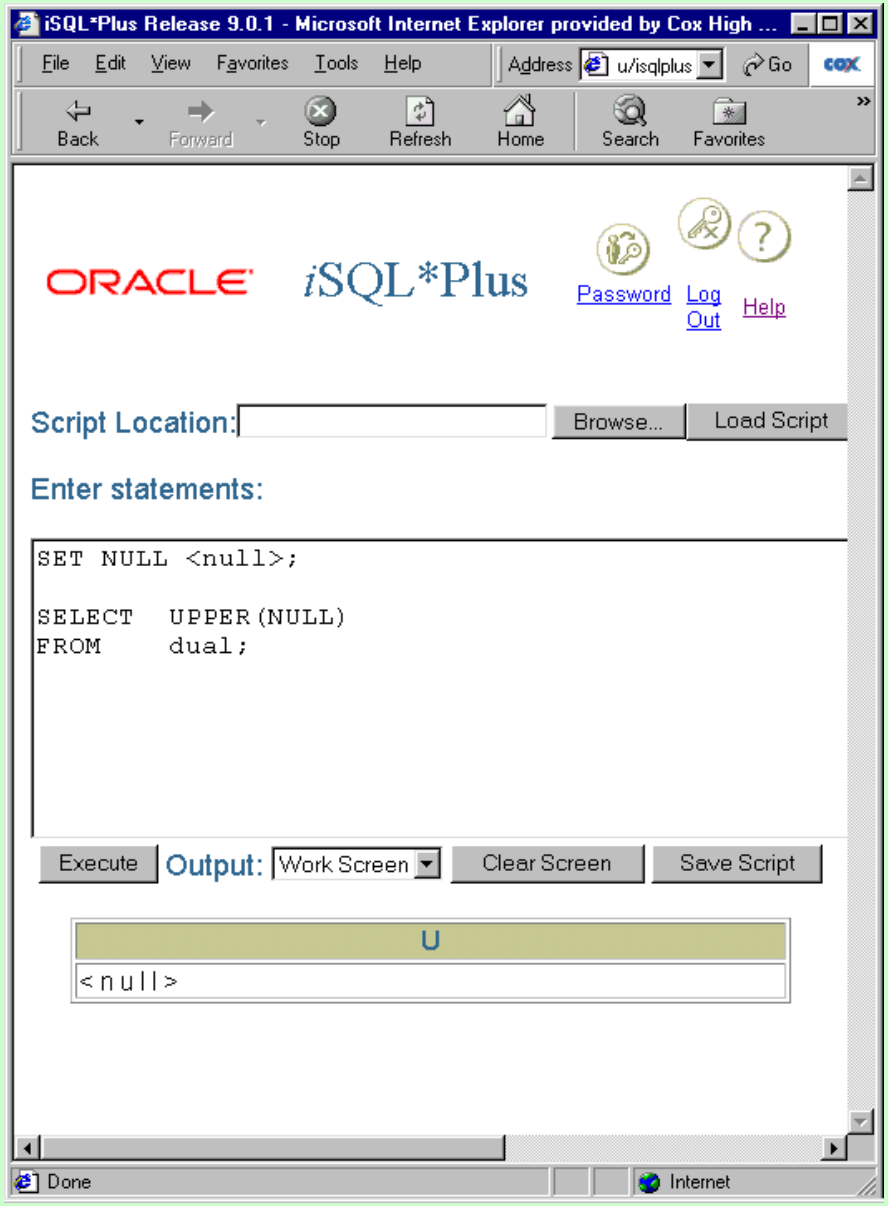

NULLs propagate NULLs in character functions.

At least we're approaching consistency now.

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NULLs beget NULLs in date functions.

But you should note, that this particular function is a vendor (Oracle) extension to the SQL language. I'm just using it 'cause it was handy.

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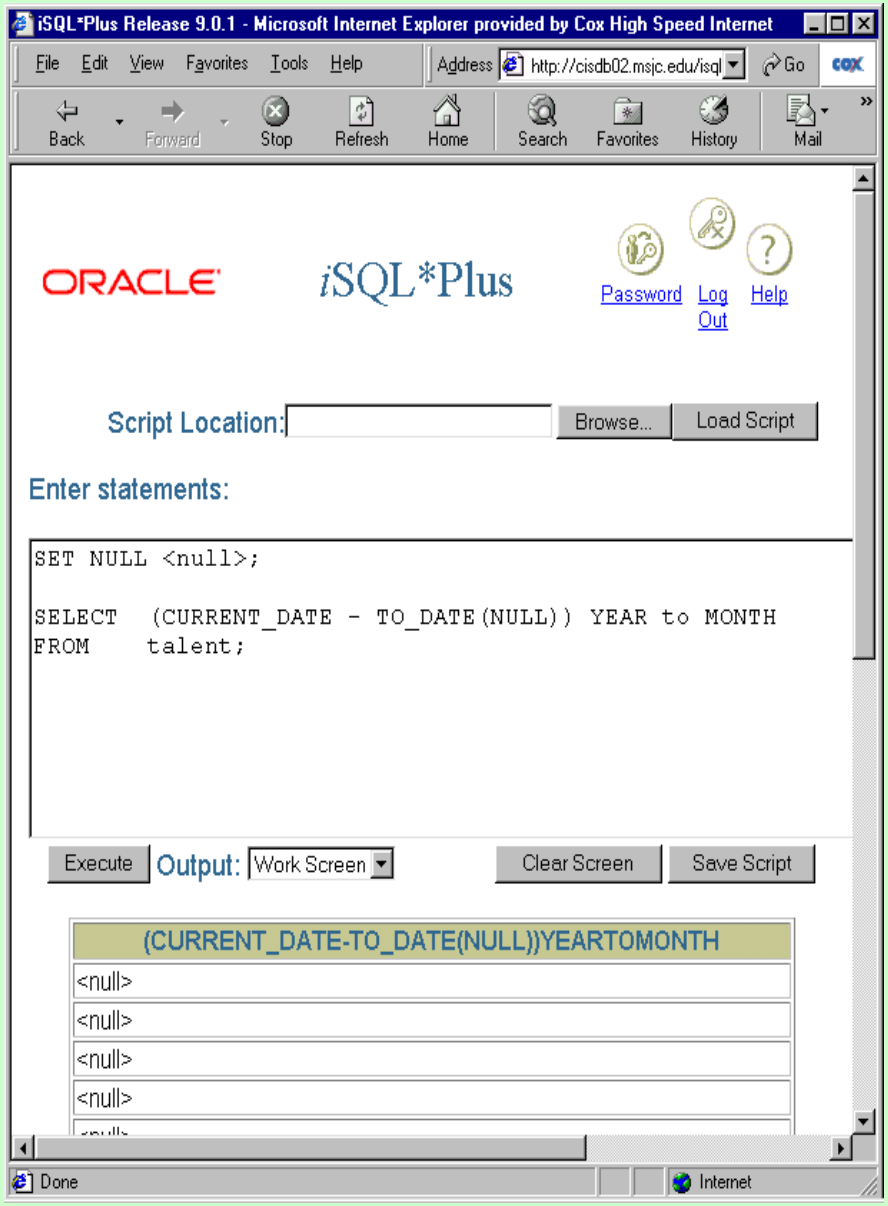

I trust you're getting the picture?

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Page E-1 Comparisons and NULLs

We have the same problem with comparisons (predicates) that we did with operations, that is, how can SQL resolve any predicate condition that contains an unknown value?

In general term, SQL can't resolve unknowns, and,when unknowns creep into the equation, the 2-state logic that most programmers are comfortable with becomes a 3-state or a 3-value logic that permits:

TRUE FALSE UNKNOWN

This 3-value logic tends to complicate things, just a bit.

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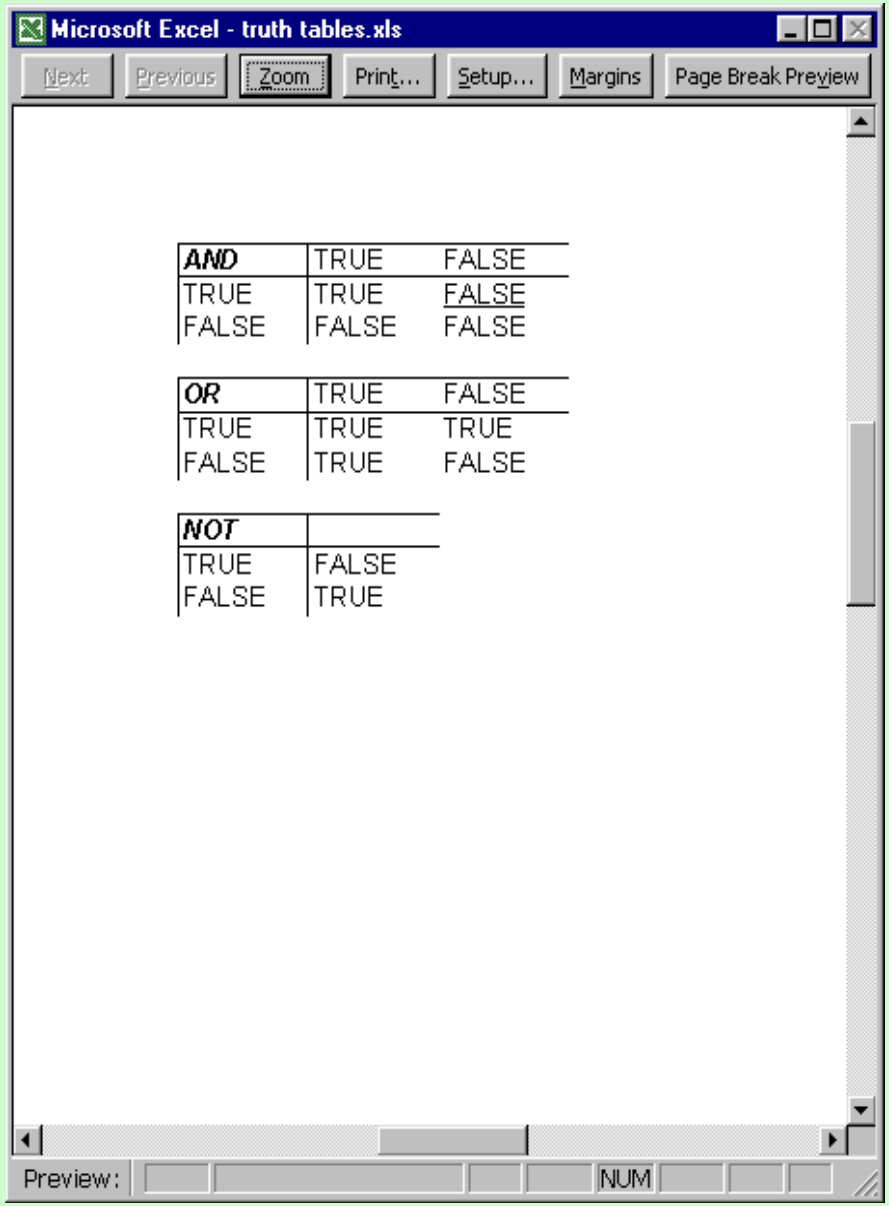
Page E-2 Truth Tables



AND	TRUE	FALSE
TRUE	TRUE	FALSE
FALSE	FALSE	FALSE

OR	TRUE	FALSE
TRUE	TRUE	TRUE
FALSE	TRUE	FALSE

NOT	
TRUE	FALSE
FALSE	TRUE

Truth tables are a common device used to describe the logic employed in evaluating a predicate.

Both AND and OR are binary Boolean operators and take two operands. Read down the column under the Boolean for the value of the first operand, and read across the table for the second operand. Where those two values intersect in the table shows how the compound condition will be evaluated.

Consider this WHERE clause:

WHERE (home_country = 'USA' AND theater = 'YES')

And a row in the table containing these values:

home_country = 'USA'

theater = 'NO'

We can see that the first expression evaluates TRUE, while the second expression evaluates FALSE. And what the truth table shows us is how the BOOLEAN AND operation will be evaluated given those two values. The first expression evaluates TRUE (go down the table one row), and the second expression evaluates FALSE (go across the table two columns). Where they intersect (FALSE) is how the AND compound condition will be evaluated.

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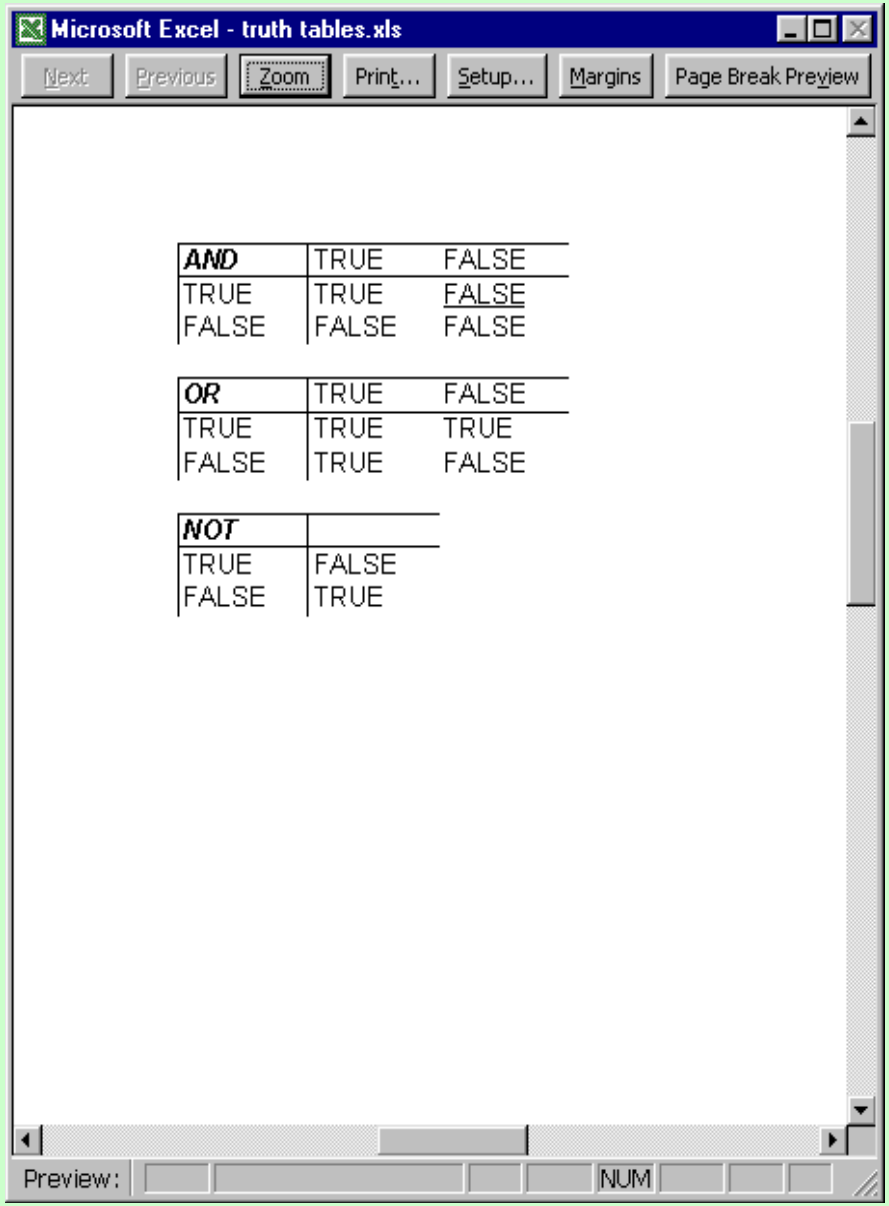
Page E-3 Truth Tables (cont)



AND	TRUE	FALSE
TRUE	TRUE	FALSE
FALSE	FALSE	FALSE

OR	TRUE	FALSE
TRUE	TRUE	TRUE
FALSE	TRUE	FALSE

NOT	
TRUE	FALSE
FALSE	TRUE

Take a moment to review these tables and demonstrate for yourself that you understand how these operations will be evaluated.

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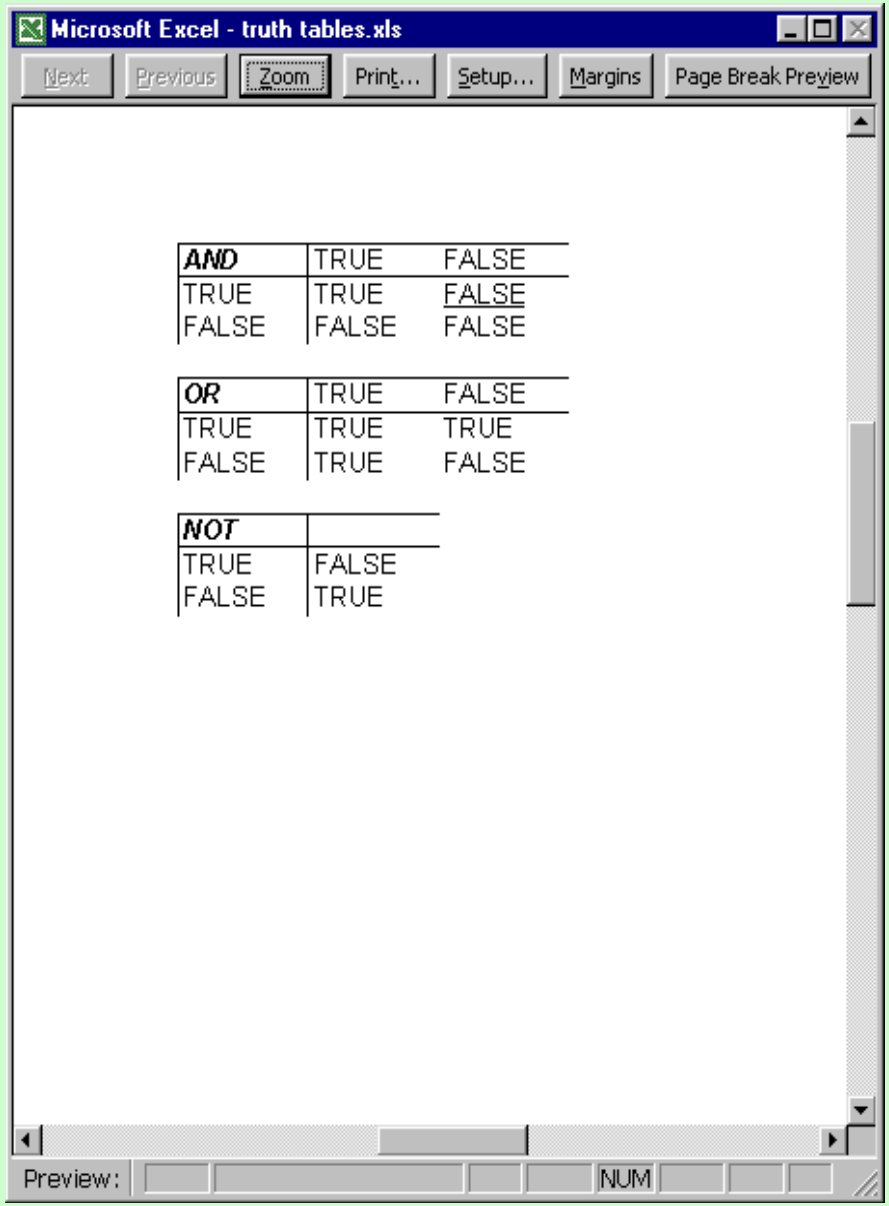

AND	TRUE	FALSE
TRUE	TRUE	FALSE
FALSE	FALSE	FALSE

OR	TRUE	FALSE
TRUE	TRUE	TRUE
FALSE	TRUE	FALSE

NOT	
TRUE	FALSE
FALSE	TRUE

These tables demonstrate a two-state logic in which the only possible outcomes are either TRUE or FALSE.

What happens when we introduce that third value UNKNOWN?

Review the truth tables on the following slide.

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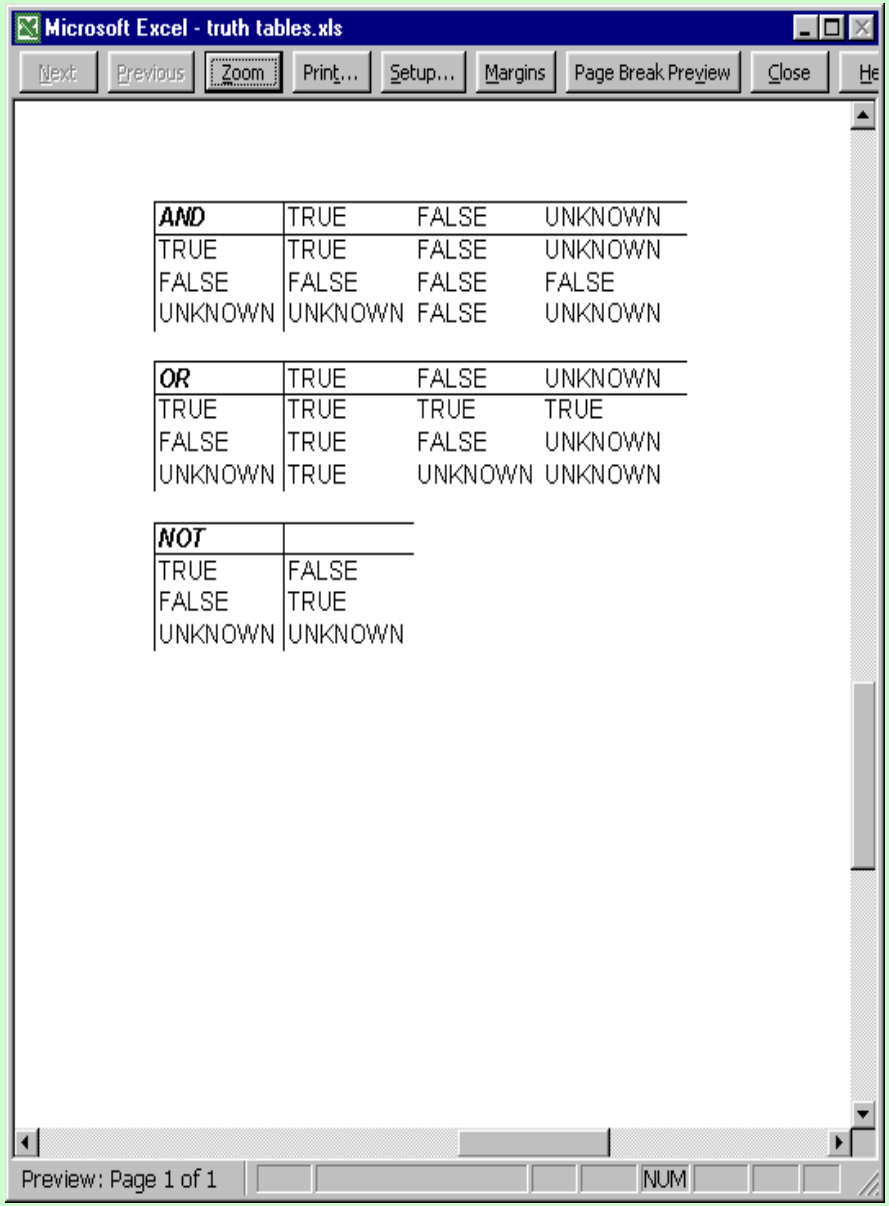
Page E-5 Three-Value Logic



AND	TRUE	FALSE	UNKNOWN
TRUE	TRUE	FALSE	UNKNOWN
FALSE	FALSE	FALSE	FALSE
UNKNOWN	UNKNOWN	FALSE	UNKNOWN

OR	TRUE	FALSE	UNKNOWN
TRUE	TRUE	TRUE	TRUE
FALSE	TRUE	FALSE	UNKNOWN
UNKNOWN	TRUE	UNKNOWN	UNKNOWN

NOT	
TRUE	FALSE
FALSE	TRUE
UNKNOWN	UNKNOWN

I hope after reading the tables that they appeal to your intuitions.

With the AND operation, we only get TRUE when both expressions are TRUE. If either is FALSE, we know we have FALSE.

Do you see how only one TRUE value is possible in the AND table?

Do you see how we get that one row and that one column of FALSE?

With the OR operation, if either expression is TRUE, we get TRUE.

Do you understand how we get that one column and that one row of TRUE?

Do you understand why we only have one FALSE?

With the NOT operation, does it make sense that if you don't know what you've got, you don't know what you haven't got? ☺

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Page E-6 NULL Comparisons

A NULL value is not EQUAL TO any value.

Nor is a NULL value GREATER THAN any value.

Nor is a NULL value LESS THAN any value.

Two NULL values are neither EQUAL TO, nor NOT EQUAL TO each other.

Now I know what you're thinking:

'Sure whatever you say. But as a programmer I've got a problem. How can I test for NULL values if they're not equal to anything (and NOT not equal to anything)?'

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Page F-1 IS NULL Comparisons

The only way around this catch-22 in SQL is to use a new comparison verb (aka comparison operator) and that's the "IS NULL" verb.

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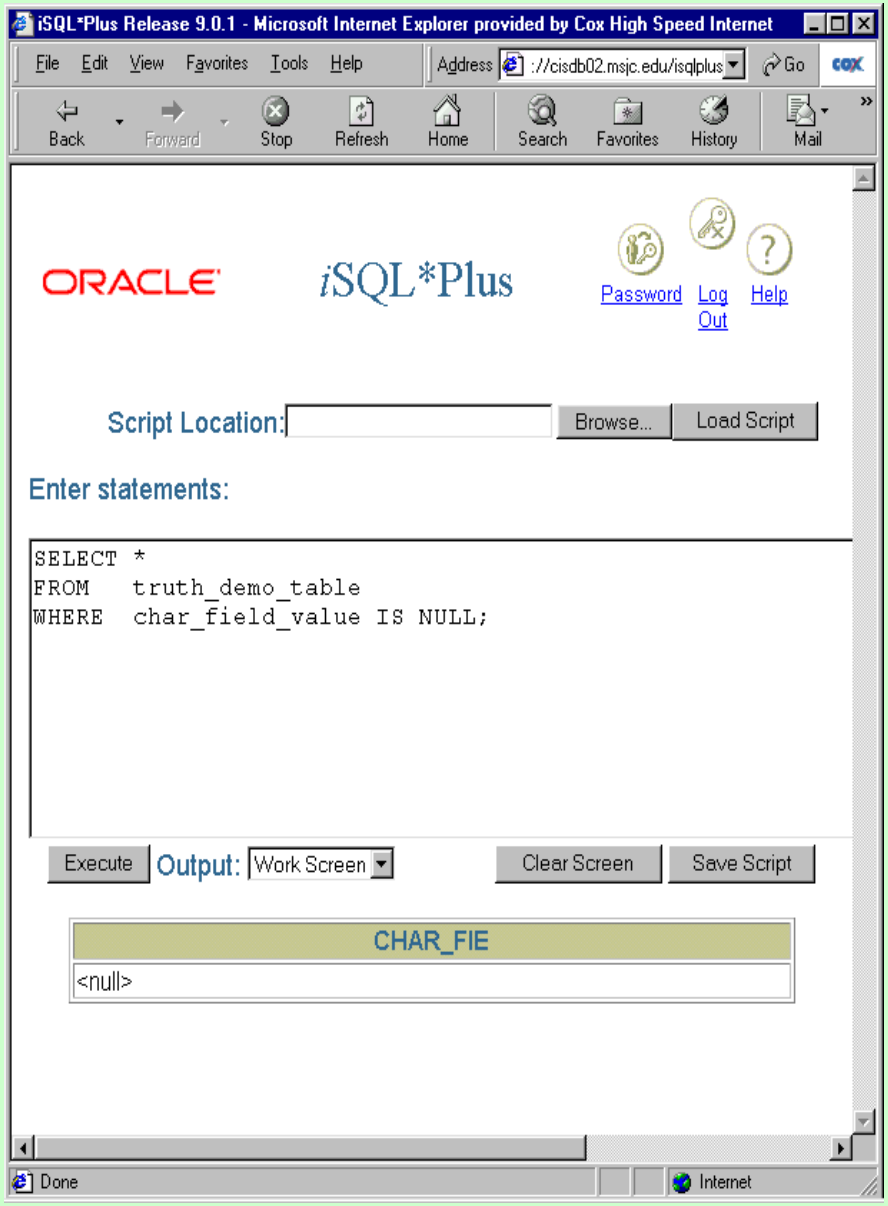
Page F-2 IS NULL Comparisons



We can find all rows having a NULL value in the char_field_value column with this SELECT statement:

```
SELECT *
FROM    truth_demo_table
WHERE (char_field_value IS NULL);
```

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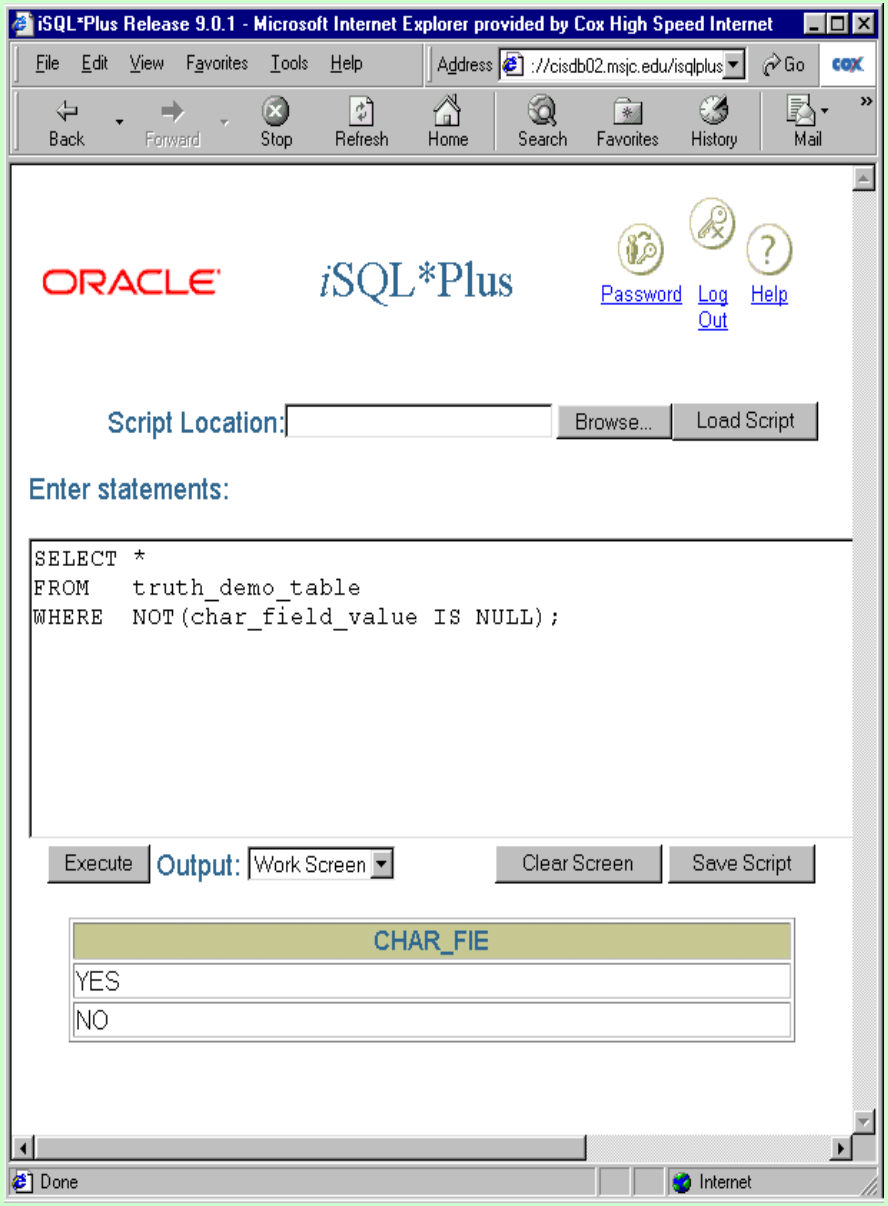

Similarly, we can find all rows that do not contain a NULL value in that column with a program that negates the predicate that we used in the previous program:

```
SELECT *
FROM   truth_demo_table
WHERE  NOT(char_field_value IS NULL);
```

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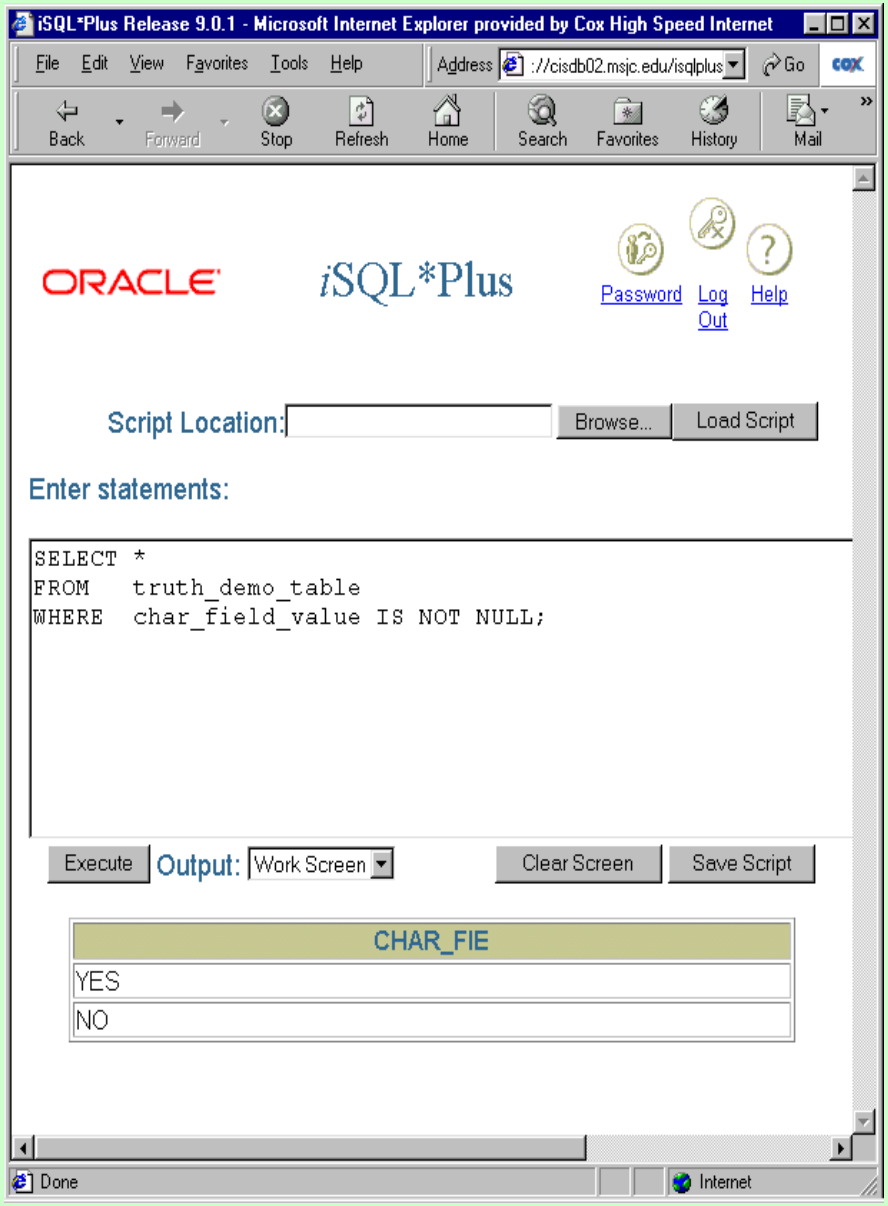
Page F-4 IS NULL Comparisons



And for whatever reason (perhaps to read, or sound better), SQL allows us, in this rare circumstance, to embed the NOT keyword in the phrase: IS NOT NULL.

Cast your vote on the Bb site for your preferred method of testing for ‘not null’.

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Page G-1 Exceptions

Our general rule is that NULLs beget NULLs.

We've seen one exception to this rule already – the character operation of concatenation does NOT propagate NULLs.

Are there any other 'gaps' in our expectations?

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SQL treats all NULLs as equivalent when ‘gathering them together’ under the auspices of a DISTINCT operation, essentially behaving as if NULLs were equal to one another.

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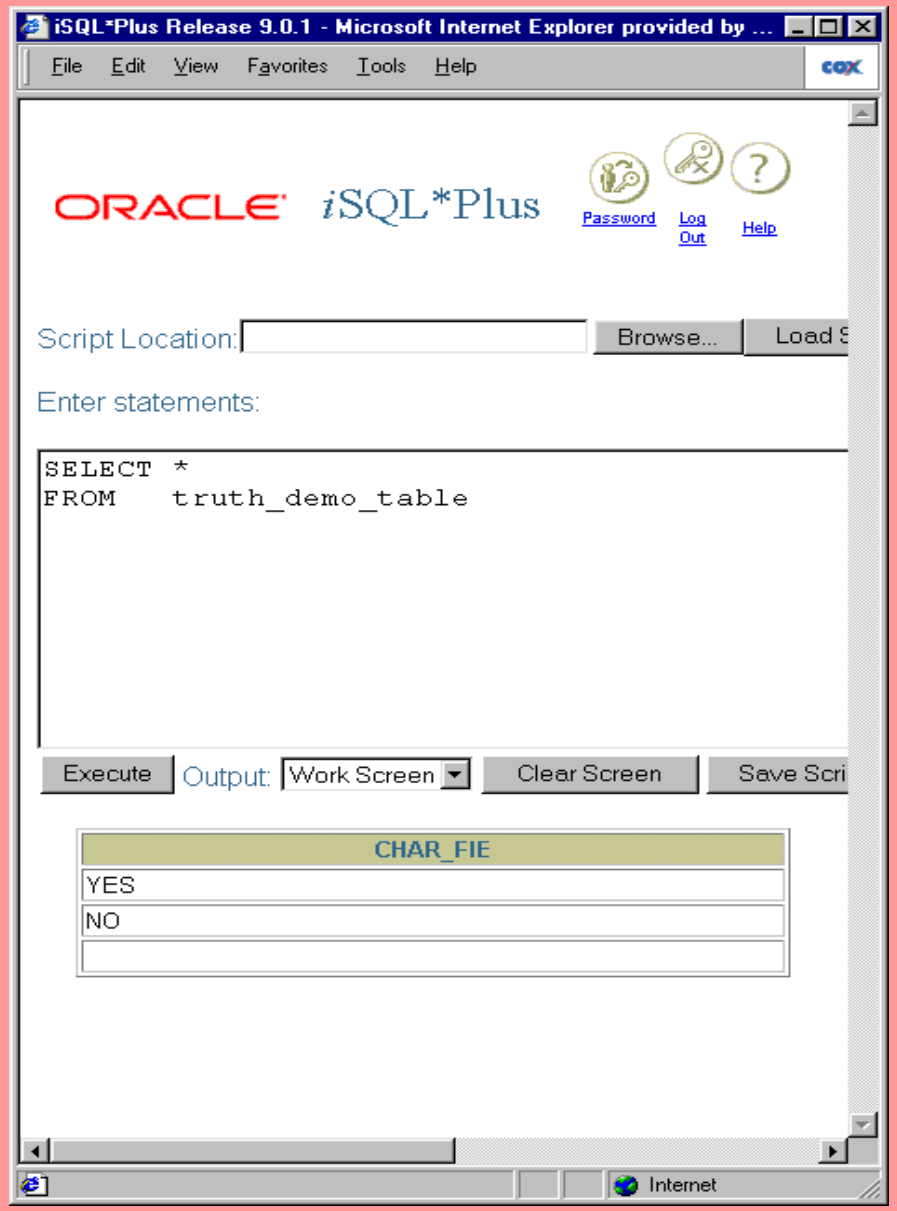

For the examples on the following slides, I'll be using this table which has only three rows:

- YES
- NO
- NULL (the NULL value, not the word null)

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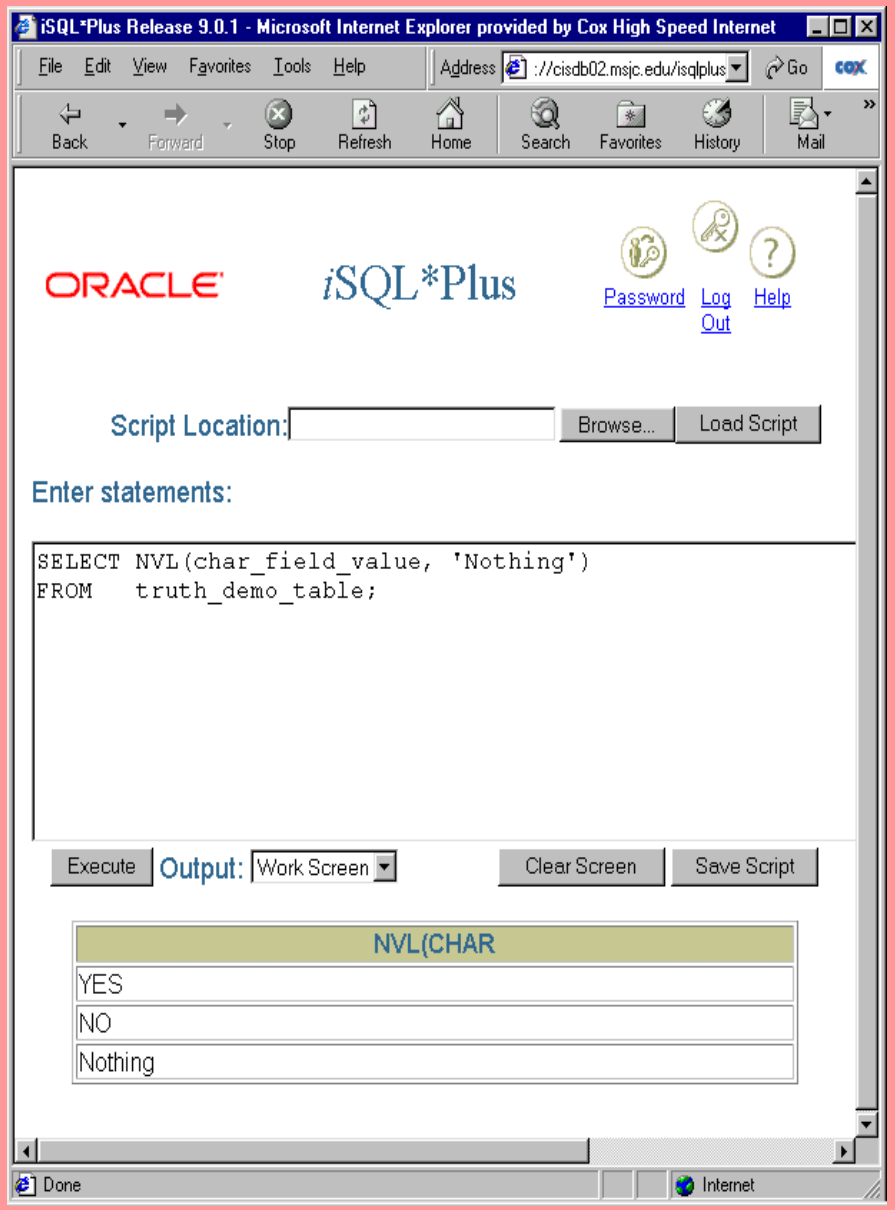
Page H-2 NVL Function



Oracle provides a special function to deal with NULL values. This function, the NVL function, returns an alternative value when NULL values are present.

The alternate value must match the column data type, otherwise Oracle-SQL will throw an error.

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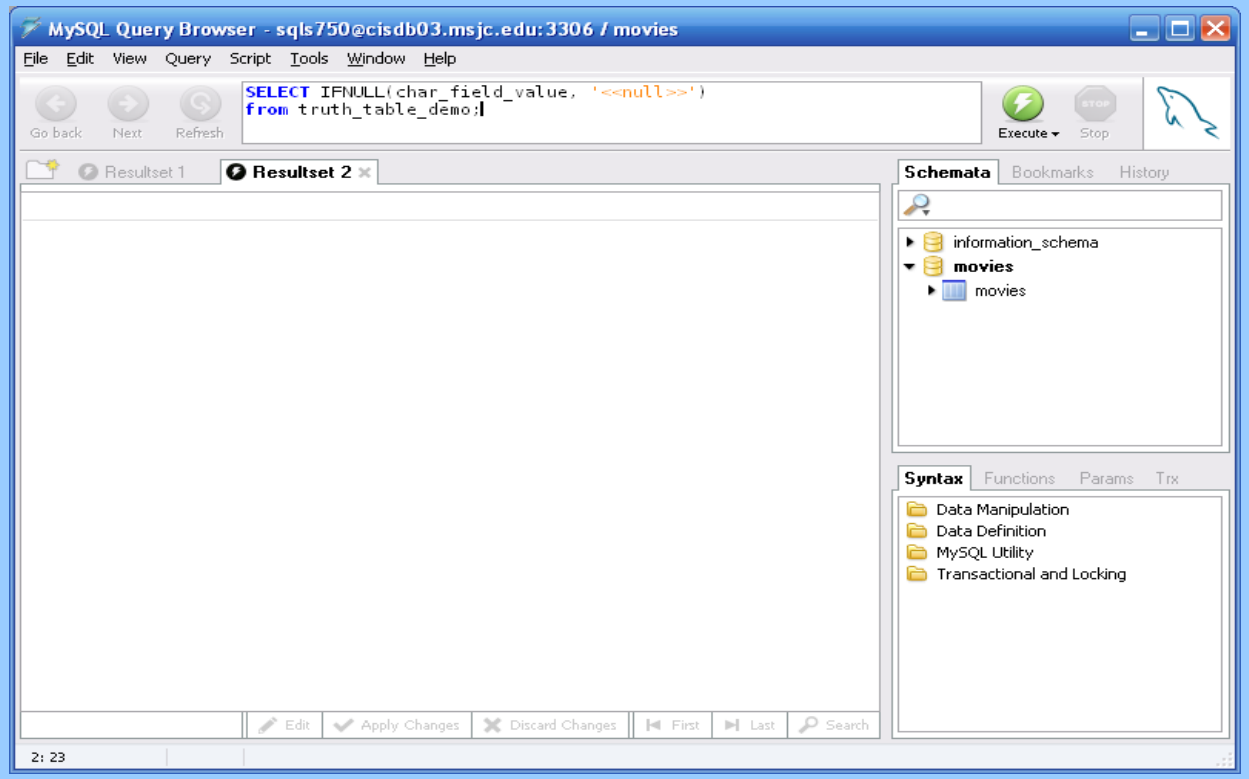
IFNULL()

MySQL uses the IFNULL() function to do pretty much the same thing.

But do note: in MySQL the alternate, or replacement value, does NOT have to be of the same data type as the column data type.



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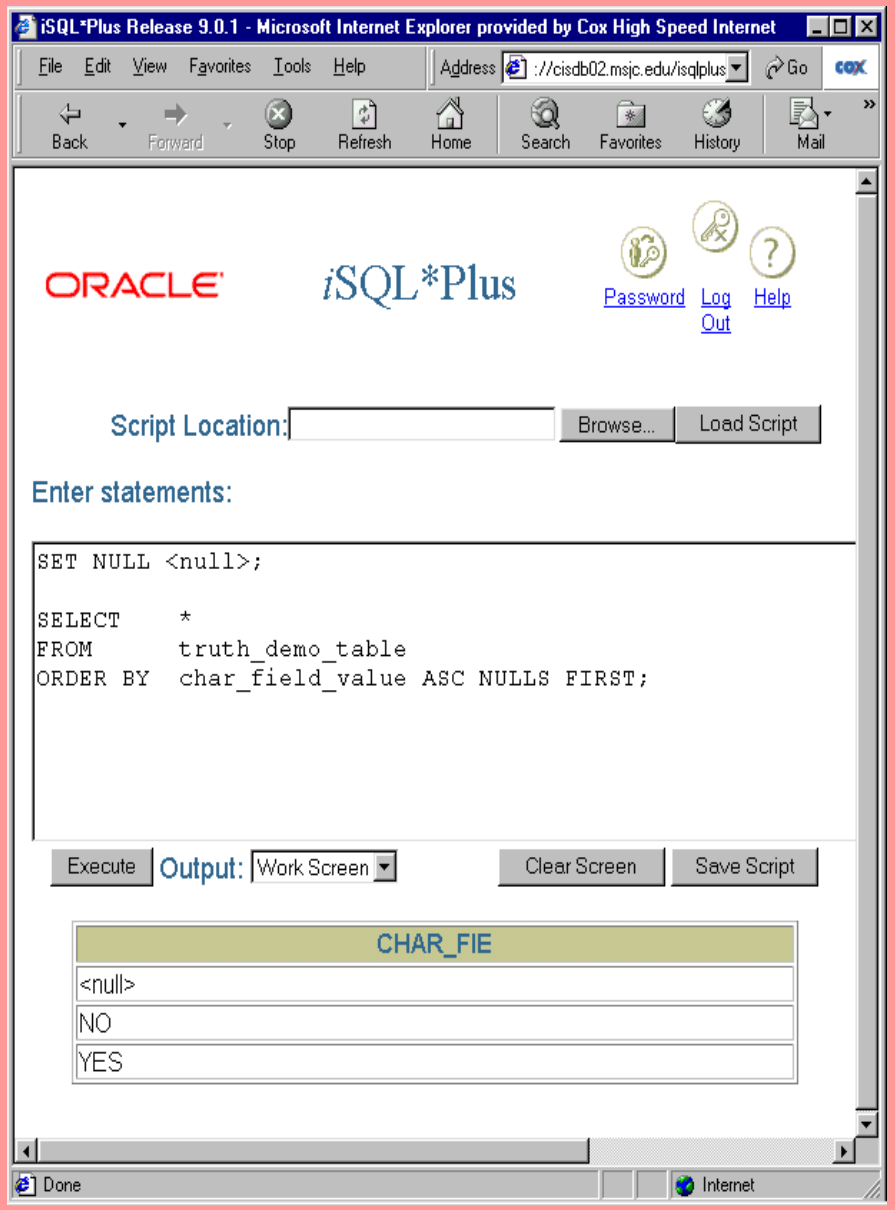
Page H-3 ORDER BY Feature



The ORDER BY clause includes a phrase that allows the programmer to indicate where/how NULLS are to be sorted.

They may appear first in the list (NULLS FIRST), or last in the listing (NULLS LAST).

In MySQL NULLs are treated as a 'low' value, and in an ASC sort they are presented first, and they appear last in the list if you specify DESC (to sort in descending order).

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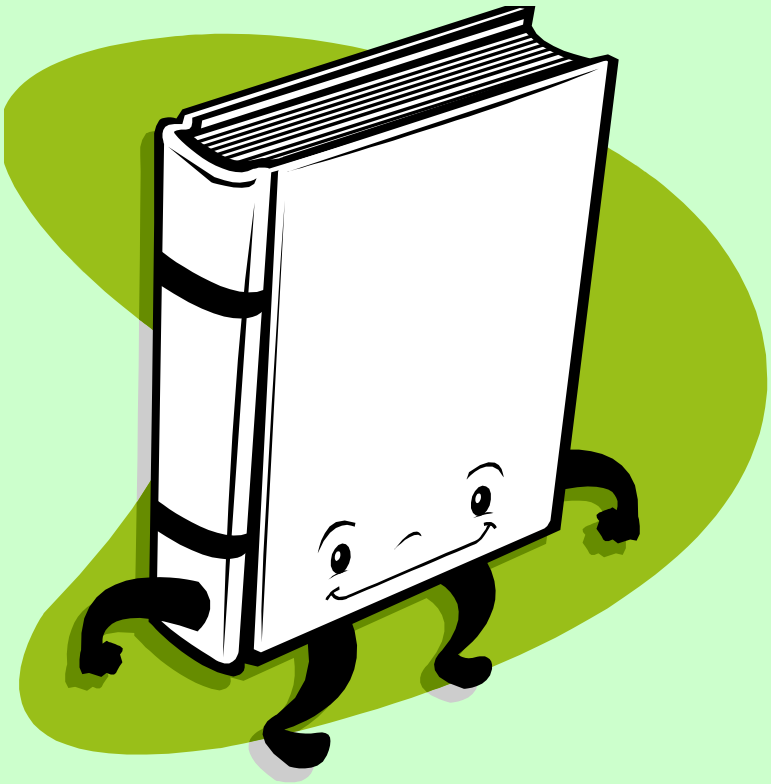
Page T-1: Terminology



NULL
TRUE, FALSE, UNKNOWN

2-state logic
3-state logic, 3-value logic
Truth tables

IS NULL
IS NOT NULL, NOT (... IS NULL)

beget, propagate

NVL
NULLS FIRST, NULLS LAST

IFNULL()

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Page Z-1: End Notes

Please drop me an email if you noticed any errors in this module. I'd also appreciate reading your comments, criticisms, and or suggestions as to how this module could be improved.

Thanks,

bil

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That’s All

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