

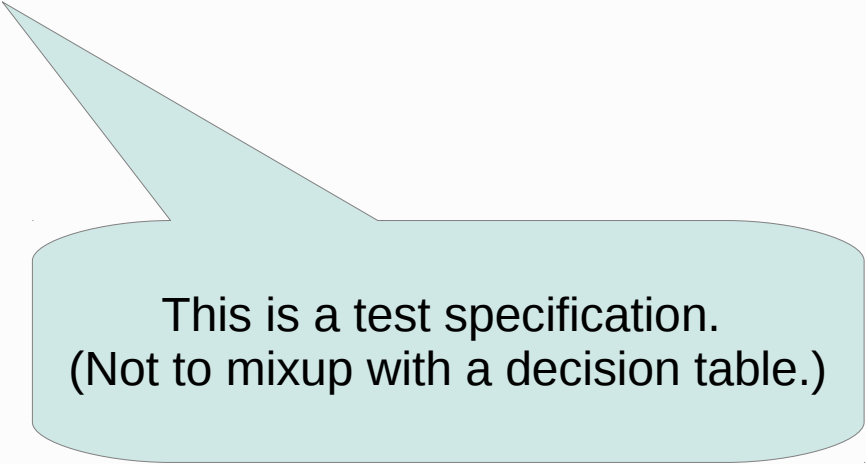
How to make decision tables

Copyright 2012 Michael Groß, mgmechanics@mgmechanics.de

Copying and distribution of this file, with or without modification, are permitted in any medium without royalty provided the copyright notice and this notice are preserved. This file is offered as-is, without any warranty.

What we want to have

use red color	Y	Y	N	N
use blue color	Y	N	Y	N
dyeing silk purple	Y	N	N	N
dyeing silk red	-	Y	N	N
dyeing silk blue	-	-	Y	N



This is a test specification.
(Not to mixup with a decision table.)

Before we really start

Before we really start I would suggest to print a copy of the file “Decisiontable_handout.txt” in the same folder. You will find some basic knowledge in compact form in it.

Suggestions:

Place that printed copy at your desk while going through this slides.

Do the examples step by step on a sheet of paper.

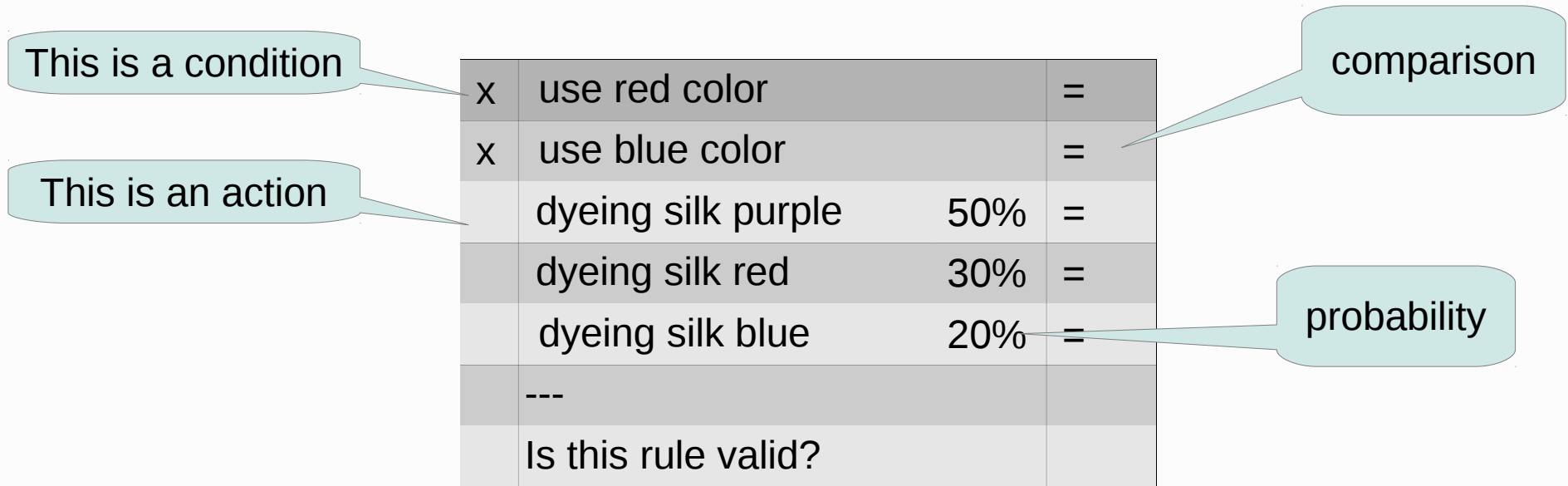
Mastering nodes 1

use red color	A node
use blue color	
dyeing silk purple	description of a node
dyeing silk red	
dyeing silk blue	

Is this rule valid?	

- Write down the conditions and actions according to the prozess flow
- Be careful because this technique doesn't show off mistakes like missing nodes or confusing descriptions.
- Please do not insert „negative“ descriptions like „is not“ because this is confusing and leads to mistakes.
- The last row is for a flag – it will be introduced soon.

Mastering nodes 2



x	use red color		=
x	use blue color		=
	dyeing silk purple	50%	=
	dyeing silk red	30%	=
	dyeing silk blue	20%	=

	Is this rule valid?		

- You may add more information to a node
- **Comparison:** Must-have when handling figures. Available: >, >=, =, <=, <
! Using >= or <= in a node means that you have two test cases when this node is true !
This will demonstrated later.
- Is condition: put an „x“ into this column if a node is a condition; this helps others to understand your decision table
- Probability in %: How probably will this condition be true or this action performed; this helps to sort test cases by importance

Mastering rules 1

- A rule is a set of Yes, No, and Dontcare (Y, N, and -)
- All rules together provides all possible combinations of conditions and actions
- Among all possible combinations there valid and invalid combinations
- While creating rules you have to decide which rules are valid and which are not
- This is for what the last row is (remember?)
- There is an easy method to get all combinations with low effort!

Mastering rules 2

x	use red color	Y
x	use blue color	
	dyeing silk purple	
	dyeing silk red	
	dyeing silk blue	

	Is this rule valid?	

This is a symbol.

The whole column is a rule.

Mastering rules 2

x	use red color	Y
x	use blue color	
	dyeing silk purple	
	dyeing silk red	
	dyeing silk blue	

	Is this rule valid?	

This is a decision table.
(Not to mixup with a test specification.)

- **Always start with „Y“**
- „Y“ means yes
- In case of a condition: yes = this condition is true
- In case of an action: yes = this action will be performed
- „N“ means no
- In case of a condition: no = this condition is false
- In case of an action: no = this action will not be performed

Mastering rules 3

x	use red color	Y
x	use blue color	Y
	dyeing silk purple	Y
	dyeing silk red	
	dyeing silk blue	

	Is this rule valid?	

- Ask again: Is this rule still valid?
- Answer: Yes, it is.
- Thus we can proceed: Set the third node in this rule to Y.

Mastering rules 4

x	use red color	Y
x	use blue color	Y
	dyeing silk purple	
	dyeing silk red	
	dyeing silk blue	

	Is this rule valid?	

- Now ask: Is this rule still valid?
- Answer: Yes, it is.
- Thus we can proceed: Set the second node to Y.

Mastering rules 5

x	use red color	Y
x	use blue color	Y
	dyeing silk purple	Y
	dyeing silk red	
	dyeing silk blue	

	Is this rule valid?	

- Now ask: Is this rule still valid?
- Answer: Yes, it is.
- Thus we can proceed – but wait: This rule seems to be complete because purple silk can not be red and can not be blue.
- It's time to introduce a new Symbol!

Mastering rules 6

x	use red color	Y
x	use blue color	Y
	dyeing silk purple	Y
	dyeing silk red	-
	dyeing silk blue	-

	Is this rule valid?	

- We just say that the last two nodes doesn't matter for this rule.
- This is expressed by a hyphen „-“
- This symbol is called „don't care“ or irrelevance (this is irrelevant = this doesn't matter)
- Now we new all 3 symbols: Y, N, and – (spelled yes, no, and don't care)

Mastering rules 7

x	use red color	Y
x	use blue color	Y
	dyeing silk purple	Y
	dyeing silk red	-
	dyeing silk blue	-

	Is this rule valid?	x

- Now we have this rule complete.
- This rule is valid – so we write an „x“ in the last row.
- Lets create the next rule!

Mastering rules 8

x	use red color	Y	Y
x	use blue color	Y	Y
	dyeing silk purple	Y	N
	dyeing silk red	—	—
	dyeing silk blue	—	—

	Is this rule valid?	x	

- We don't have to do it from scratch.
- Just copy the last rule ...
- ... and change the last Y into a N!

Mastering rules 9

x	use red color	Y	Y
x	use blue color	Y	Y
	dyeing silk purple	Y	N
	dyeing silk red	—	—
	dyeing silk blue	—	—

	Is this rule valid?	x	

- Ask: Is this rule valid?
- Answer: No it is not valid.
- If a rule is found to be invalid we don't need to care about it.
- Fill the remaining cells with „don't care“-symbols and create the next rule from it.
- (But leave this rule in your table because we need it to see if a decision table is complete.)

Mastering rules 10

x	use red color	Y	Y	Y
x	use blue color	Y	Y	N
	dyeing silk purple	Y	N	
	dyeing silk red	—	—	
	dyeing silk blue	—	—	

	Is this rule valid?	x		

- Create the next rule: Copy last rule and set the last Y to N
- Is it valid? => Yes
- But the new rule is not complete yet.

Mastering rules 11

x	use red color	Y	Y	Y
x	use blue color	Y	Y	N
	dyeing silk purple	Y	N	Y
	dyeing silk red	—	—	
	dyeing silk blue	—	—	

	Is this rule valid?	x		

- Set a Y below the N created in the step before (always the last symbol in the rule)
- Is the rule still valid yet => No
- Thus create the next rule.

Mastering rules 12

x	use red color	Y	Y	Y
x	use blue color	Y	Y	N
	dyeing silk purple	Y	N	Y
	dyeing silk red	—	—	
	dyeing silk blue	—	—	

	Is this rule valid?	x		

- Set a Y below the N created in the step before (always the last symbol in the rule)
- Is the rule still valid yet => No
- Thus create the next rule.

Mastering rules 13

x	use red color	Y	Y	Y
x	use blue color	Y	Y	N
	dyeing silk purple	Y	N	Y
	dyeing silk red	—	—	—
	dyeing silk blue	—	—	—

	Is this rule valid?	x		

- Set a Y below the N created in the step before (always the last symbol in the rule)
- Is the rule still valid yet => No it is not.
- Fill the remaining cells with „don't care“-symbols and create the next rule.

Mastering rules 14

x	use red color	Y	Y	Y	Y
x	use blue color	Y	Y	N	N
	dyeing silk purple	Y	N	Y	N
	dyeing silk red	–	–	–	Y
	dyeing silk blue	–	–	–	–

	Is this rule valid?	x			x

- We copy the last rule, set the last Y to N.
- Then we set a Y below this N.
- This is a valid rule.
- Because silk can colored either purple, red, or blue this we do not need to put a Y into the cell for „dyeing silk blue“. We put a „don't care“-symbol in this cell.
- Do not forget to mark this rule as valid.

Mastering rules 15

x	use red color	Y	Y	Y	Y	Y
x	use blue color	Y	Y	N	N	N
	dyeing silk purple	Y	N	Y	N	N
	dyeing silk red	—	—	—	Y	N
	dyeing silk blue	—	—	—	—	—

	Is this rule valid?	x		x		

- We copy the last rule, set the last Y to N.
- This is an invalid rule so we can stop & create the next rule.

Mastering rules 16

x	use red color	Y	Y	Y	Y	Y	N
x	use blue color	Y	Y	N	N	N	–
	dyeing silk purple	Y	N	Y	N	N	–
	dyeing silk red	–	–	–	Y	N	–
	dyeing silk blue	–	–	–	–	–	–

	Is this rule valid?	x		x			

- We copy the last rule, set the last Y to N. The last Y belongs to the first node, this is OK.
- All nodes below the cell there the last Y was are to be filled with „don't care“
- This rule is valid for now – so we fill Y into the cell below.

Mastering rules 17

x	use red color	Y	Y	Y	Y	Y	N
x	use blue color	Y	Y	N	N	N	Y
	dyeing silk purple	Y	N	Y	N	N	Y
	dyeing silk red	–	–	–	Y	N	–
	dyeing silk blue	–	–	–	–	–	–

	Is this rule valid?	x		x			

- The rule is still valid.
- So we set another Y right below the last Y.
- Now the rule is invalid.
- Just create the next rule from it.

Mastering rules 18

x	use red color	Y	Y	Y	Y	Y	N	N
x	use blue color	Y	Y	N	N	N	Y	Y
	dyeing silk purple	Y	N	Y	N	N	Y	N
	dyeing silk red	–	–	–	Y	N	–	Y
	dyeing silk blue	–	–	–	–	–	–	–

	Is this rule valid?	x		x				

- The rule is also invalid.
- Just create the next rule from it.

Mastering rules 19

x	use red color	Y	Y	Y	Y	Y	N	N	N
x	use blue color	Y	Y	N	N	N	Y	Y	Y
	dyeing silk purple	Y	N	Y	N	N	Y	N	N
	dyeing silk red	–	–	–	Y	N	–	Y	N
	dyeing silk blue	–	–	–	–	–	–	–	Y

	Is this rule valid?	x		x					x

- We copy the last rule and set the last Y to N => This rule is valid.
- Then we set the next rule to „Y“ => the rule is still valid.
- We reached the end of this rule => we have a valid rule so we mark it as such.

Mastering rules 20

x	use red color	Y	Y	Y	Y	Y	N	N	N	N
x	use blue color	Y	Y	N	N	N	Y	Y	Y	Y
	dyeing silk purple	Y	N	Y	N	N	Y	N	N	N
	dyeing silk red	–	–	–	Y	N	–	Y	N	N
	dyeing silk blue	–	–	–	–	–	–	–	Y	N

	Is this rule valid?	x		x					x	

- We copy the last rule and set the last Y to N => This rule is invalid.

Mastering rules 21

x	use red color	Y	Y	Y	Y	Y	N	N	N	N	N	N
x	use blue color	Y	Y	N	N	N	Y	Y	Y	Y	Y	N
	dyeing silk purple	Y	N	Y	N	N	Y	N	N	N	N	Y
	dyeing silk red	–	–	–	Y	N	–	Y	N	N	N	–
	dyeing silk blue	–	–	–	–	–	–	–	Y	N	N	–

	Is this rule valid?	x		x							x	

- We copy the last rule and set the last Y to N => This rule is valid yet.
- Then we set a Y below this N => Now we have an invalid rule.

Mastering rules 22

x	use red color	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N
x	use blue color	Y	Y	N	N	N	Y	Y	Y	Y	N	N	N	N	N
	dyeing silk purple	Y	N	Y	N	N	Y	N	N	N	Y	N	N	N	N
	dyeing silk red	–	–	–	Y	N	–	Y	N	N	–	Y	N	N	N
	dyeing silk blue	–	–	–	–	–	–	–	Y	N	–	–	Y	N	

	Is this rule valid?	x		x			x							x	

- We proceed to „weave“ our decision table until we have a rule which contains only N or N and „don't care“
- **This rule is always the last rule in every decision table.**
- We check this rule => this is a valid rule.
- No we do the amaing part: Checking an decision table.

Checking decision tables 0

A few words before...

- **If you build your decision table step by step as shown before it is impossible to build a decision table which fails any of the checks shown below.**
- The only way to get decision tables which do not pass a check is that you insert or remove nodes after you created some rules.
- **If a check fails the next checks could give us wrong results!**
Thus:
 - Always run all checks in the order shown below.
 - Do not trust the result of a check if the check before failed.
- Good news: Three simple checks are all you need to show that your decision table is valid!

Checking decision tables 1

x	use red color	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N
x	use blue color	Y	Y	N	N	N	Y	Y	Y	Y	N	N	N	N	N
	dyeing silk purple	Y	N	Y	N	N	Y	N	N	N	Y	N	N	N	N
	dyeing silk red	–	–	–	Y	N	–	Y	N	N	–	Y	N	N	N
	dyeing silk blue	–	–	–	–	–	–	–	Y	N	–	–	Y	N	N

	Is this rule valid?	x		x				x						x	

- **Check #1: Do we have nodes which have „don't care“ only?**
- Such a node would look like:

dyeing silk blue	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
------------------	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

- This check passes if there is not such a node.
- We don't have such a node so this check passed.

Checking decision tables 2

x	use red color	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N
x	use blue color	Y	Y	N	N	N	Y	Y	Y	Y	N	N	N	N	N
	dyeing silk purple	Y	N	Y	N	N	Y	N	N	N	Y	N	N	N	N
	dyeing silk red	–	–	–	Y	N	–	Y	N	N	–	Y	N	N	N
	dyeing silk blue	–	–	–	–	–	–	–	Y	N	–	–	Y	N	N

	Is this rule valid?	x		x			x							x	

- **Check #2: Check if rules are disjunct.**
- This check passes if all rules are disjunct.
- Here are all rules disjunct so this check passes.
- When are nodes not disjunct? => See next page!

Checking decision tables – disjunct rules 1

When are rules disjunct?

- Compare two rule row by row, beginning with first row (= first node)
- If one cell has a “don't care” => go to the next row
- If both cells have the same symbol (both have a Y or both have a N) => go to the next row
- If both cells have different symbols (Y + N or N + Y) => both rules are disjunct => continue with next couple of rules!
- If you reach the end of the rows and did not found a row with different symbols (Y + N or N + Y) in both cells => both rules are not disjunct => you may stop to compare because this decision table is not valid!

How do you compare with less effort?

- Compare first rule (= rule 1) with rule 2, rule 3, ..., last rule
- Compare rule 2 with rule 3, rule 4, ..., last rule
- Compare rule 3 with rule 4, ..., last rule
- And so on.

Checking decision tables – disjunct rules 2

x	use red color	Y	Y
x	use blue color	Y	Y
	dyeing silk purple	Y	N
	dyeing silk red	–	–
	dyeing silk blue	–	–

	Is this rule valid?		

Left table

Both rules are disjunct because each rule is unique. Why? Look at the third row: One rule has here a Y and the other one a N. Thus they are clearly different.

x	use red color	Y	Y
x	use blue color	Y	Y
	dyeing silk purple	Y	Y
	dyeing silk red	–	–
	dyeing silk blue	–	–

	Is this rule valid?		

Right table

Both rules are not disjunct because each rule is not unique. Why? Look at row 1 -3: Both rules has here a Y in each row. The rows below has a “don't care” - this doesn't count. Thus they are clearly not different.

Checking decision tables – disjunct rules 3

x	use red color	Y	Y
x	use blue color	Y	Y
	dyeing silk purple	Y	–
	dyeing silk red	–	–
	dyeing silk blue	–	–

	Is this rule valid?		

Left table

Both rules are not disjunct. Why? Look at the third row: Left rule has here a Y and the other one “don't care”. But a “don't care” does not make a rule different from another.

x	use red color	Y	Y
x	use blue color	Y	Y
	dyeing silk purple	–	Y
	dyeing silk red	N	–
	dyeing silk blue	–	–

	Is this rule valid?		

Right table

Both rules are not disjunct because each rule is not unique. Why? Look at row 3+4: row 3 has a “don't care” and a Y. Row 4 has a N and a don't care. Thus they are not different.

Checking decision tables 3

x	use red color	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N
x	use blue color	Y	Y	N	N	N	Y	Y	Y	Y	N	N	N	N	N
	dyeing silk purple	Y	N	Y	N	N	Y	N	N	N	Y	N	N	N	N
	dyeing silk red	–	–	–	Y	N	–	Y	N	N	–	Y	N	N	N
	dyeing silk blue	–	–	–	–	–	–	–	Y	N	–	–	Y	N	N

	Is this rule valid?	x		x				x						x	

- **Check #3: Does the number of expected and actual rules match?**
- Expected number of rules = $2^{**} \text{ number of nodes}$
- $2^{**}x$ is meant as 2 power of x ($2^{**}0=1$, $2^{**}1=2$, $2^{**}2=4$, $2^{**}3=8$, $2^{**}4=16$ and so on)
- We have 5 nodes $\Rightarrow 2^{**}5=32 \Rightarrow$ number of expected rules = 32

Checking decision tables 4

x	use red color	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N
x	use blue color	Y	Y	N	N	N	Y	Y	Y	Y	N	N	N	N
	dyeing silk purple	Y	N	Y	N	N	Y	N	N	N	Y	N	N	N
	dyeing silk red	–	–	–	Y	N	–	Y	N	N	–	Y	N	N
	dyeing silk blue	–	–	–	–	–	–	–	Y	N	–	–	Y	N

	Is this rule valid?	X			X				X					X

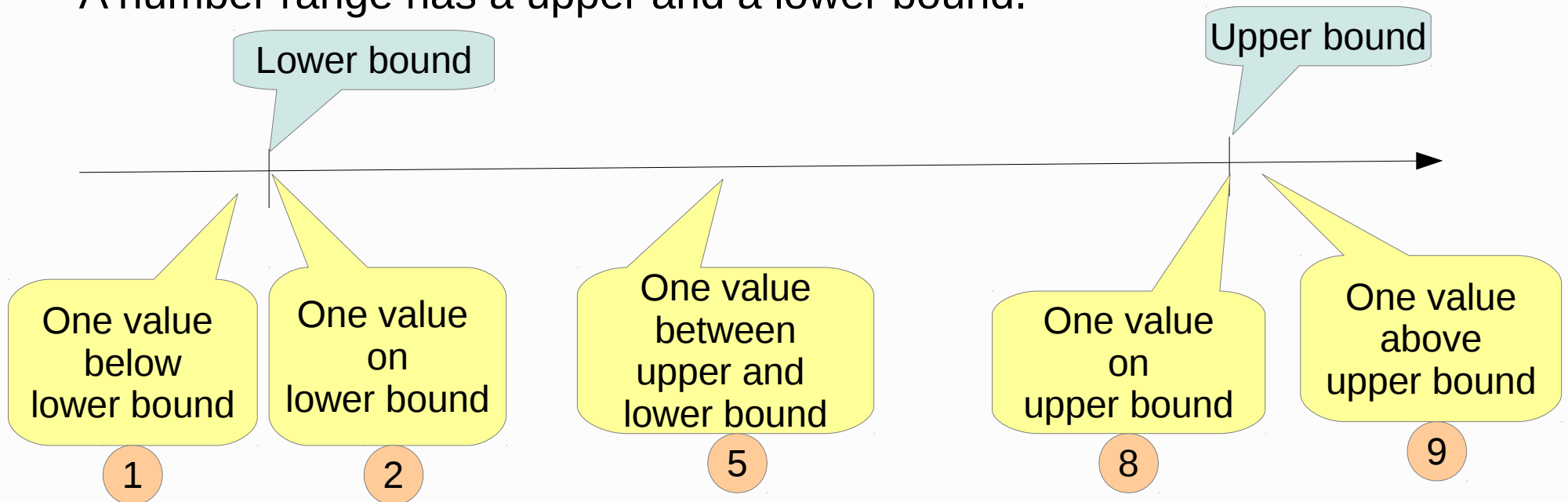
- Actual number of rules = sum of ($2^{\text{number of don't care}}$) of all rules

Number of don't care	2	2	2	1	1	2	1	0	0	2	1	0	0
$2^{\text{Number of don't care}}$	4	4	4	2	2	4	2	1	1	4			1

- Sum: $4+4+4+2 + 2+4+2+1 + 1+4+2+1 + 1 = 14 + 9 + 8 + 1 = 32$
- So we have 32 expected and 32 actual nodes => both numbers matches
- **This decision table is valid!**

How to deal with numbers 1

- Often there are number ranges to test.
- A number range has a upper and a lower bound.



- The picture above shows which values you need to test a range of numbers.
- The circle below the bubbles show an example for a test of a number range. They assume that lower bound = 2, upper bound = 8 and (this is important!) that the least step between two values is 1.
- If the least step would be 0.1 we would need: 1.9, 2.0, 2.1, any value between 2.2 and 7.9, 8.0, 8.1

The last step

- Now remove a rules which are not valid. The remaining rules are your test cases.
- Also remove the last two rows.

x	use red color	Y	Y	N	N
x	use blue color	Y	N	Y	N
	dyeing silk purple	Y	N	N	N
	dyeing silk red	–	Y	N	N
	dyeing silk blue	–	–	Y	N

In the next part I'll show you some advanced techniques.

How to deal with numbers 2

x	upper bound	>=	Y	Y	Y	N	N	N	N
x	lower bound	>=	Y	N	N	Y	Y	N	N
x	below lower bound	<	–	Y	N	Y	N	Y	N

	Is this rule valid?				x		x	x	

Extra column
for comparisons.

- This is the decision table.
- We introduced a column for comparisons.

How to deal with numbers 3

upper bound	Y	>=	N	>=	N	>=
lower bound	N	>=	Y	>=	N	>=
below lower bound	N	<	N	<	Y	<

Ooops! There is no value which is both - greater and equal.

- We need to split (or copy) some rules.
- A rule needs to be split if the symbol is Y and the comparison is “>=” or “<=”
- This is better to understand when you realize that “>=” consist of two comparisons: “>” and “=”
- Also does “<=” consist of “<” and “=”
- Thus we need two rules: “>” and “=” or “<” and “=”

How to deal with numbers 3

upper bound	Y	>	9	Y	=	8	N	>=	N	>=	N	>=			
lower bound	N	>=		N	>=		Y	>	5	Y	=	2	N	>=	
below lower bound	N	<		N	<		N	<		N	<		Y	<	1

This comes
from rule 1

This comes
from rule 2

This is rule 3

- Now we have 5 rules = 5 test cases
- Did remember? We had 5 bubbles for 5 test cases!

Connecting decision tables 1

x	use red color	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N
x	use blue color	Y	Y	N	N	N	Y	Y	Y	Y	N	N	N	N
	dyeing silk purple	Y	N	Y	N	N	Y	N	N	N	Y	N	N	N
	dyeing silk red	–	–	–	Y	N	–	Y	N	N	–	Y	N	N
	dyeing silk blue	–	–	–	–	–	–	–	Y	N	–	–	Y	N

	Is this rule valid?	x			x				x					x
	Continue with ...													

name of the decision table
you want to continue with

e.g. decision table
“do something with
uncoloured silk”

- To continue with another decision table (= successor) means that you go on with any rule from the other decision table after you're finished with the rule of this decision table.
- You may continue with different decision tables or continue only for some rules.
- Please beware of infinite loops!

Still no idea?

There is a file named “Decisiontable_handout.txt”. It provides another, compact view on this theme.

You may just play around with the application. The checks warn if your decision table is invalid. Do “Run all checks” for general result (valid or not) and use single checks if your decision table is not valid.

Additional to examples used in this slide there are more examples in the Folder “Examples”. They may answer various questions i.e. how to deal with logical And, Or and Xor? There is an example for each in the subfolder “Logic”.