Intelligent Internet Technologies

Lectures 8-9.

XPath

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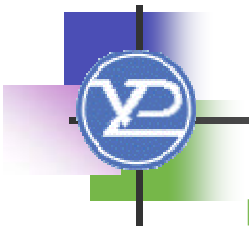
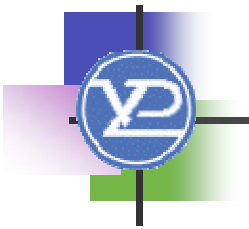


What is XPath?

- XPath is a syntax used for selecting parts of an XML document
- The way XPath describes paths to elements is similar to the way an operating system describes paths to files
- XPath is almost a small programming language; it has functions, tests, and expressions
- XPath is a W3C standard
- XPath is not itself written as XML, but is used heavily in XSLT

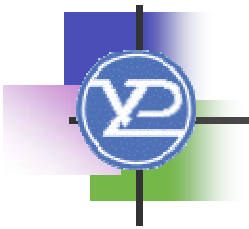


XPath and XSLT

- A sub-language within XSLT that identifies document components.

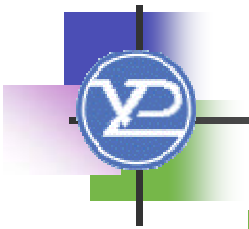
- XPATH expressions match a template or element contents.

Example: <xsl:template match="city">



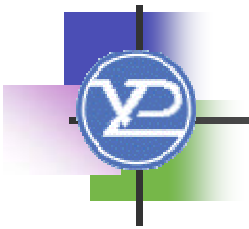
XPath & XSLT versus DOM

- The XSLT & XPath tree structure is similar to the DOM. The differences include:
  - In the DOM
    - Every node has a nodeValue property
    - The nodeValue of an element node is null
  - In the XSLT & XPath
    - Every node has a string-value property
    - The string-value of an element node is the concatenation of all its descendant text nodes



The XPath Data Model

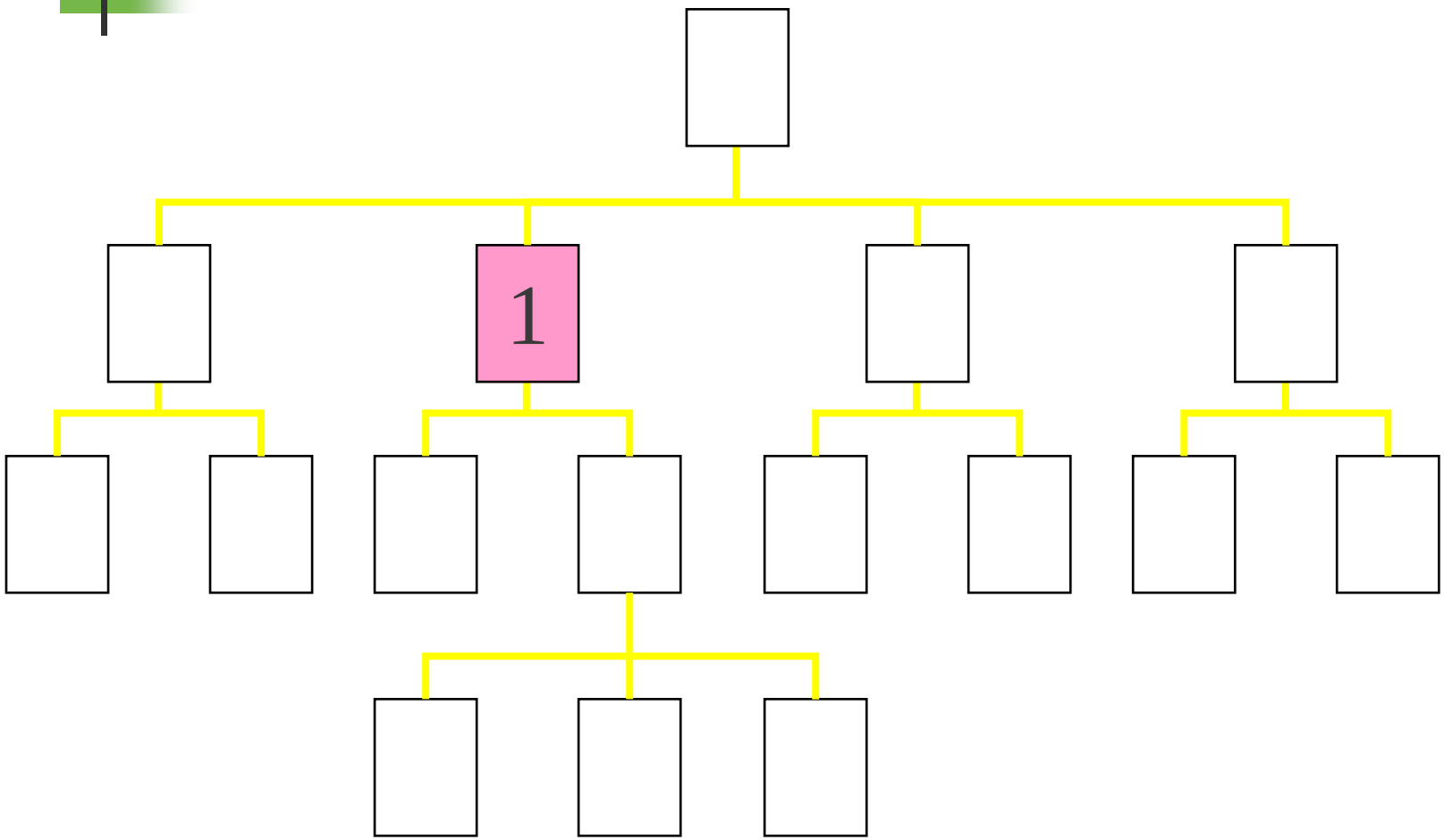
- Seven types of nodes in an XSLT tree
  - Root : represent the root of the tree (corresponding to the Document node in the DOM)
  - Element
  - Attribute
  - Text : represent the textual content of the document
  - Processing Instruction
  - Comment
  - Namespace



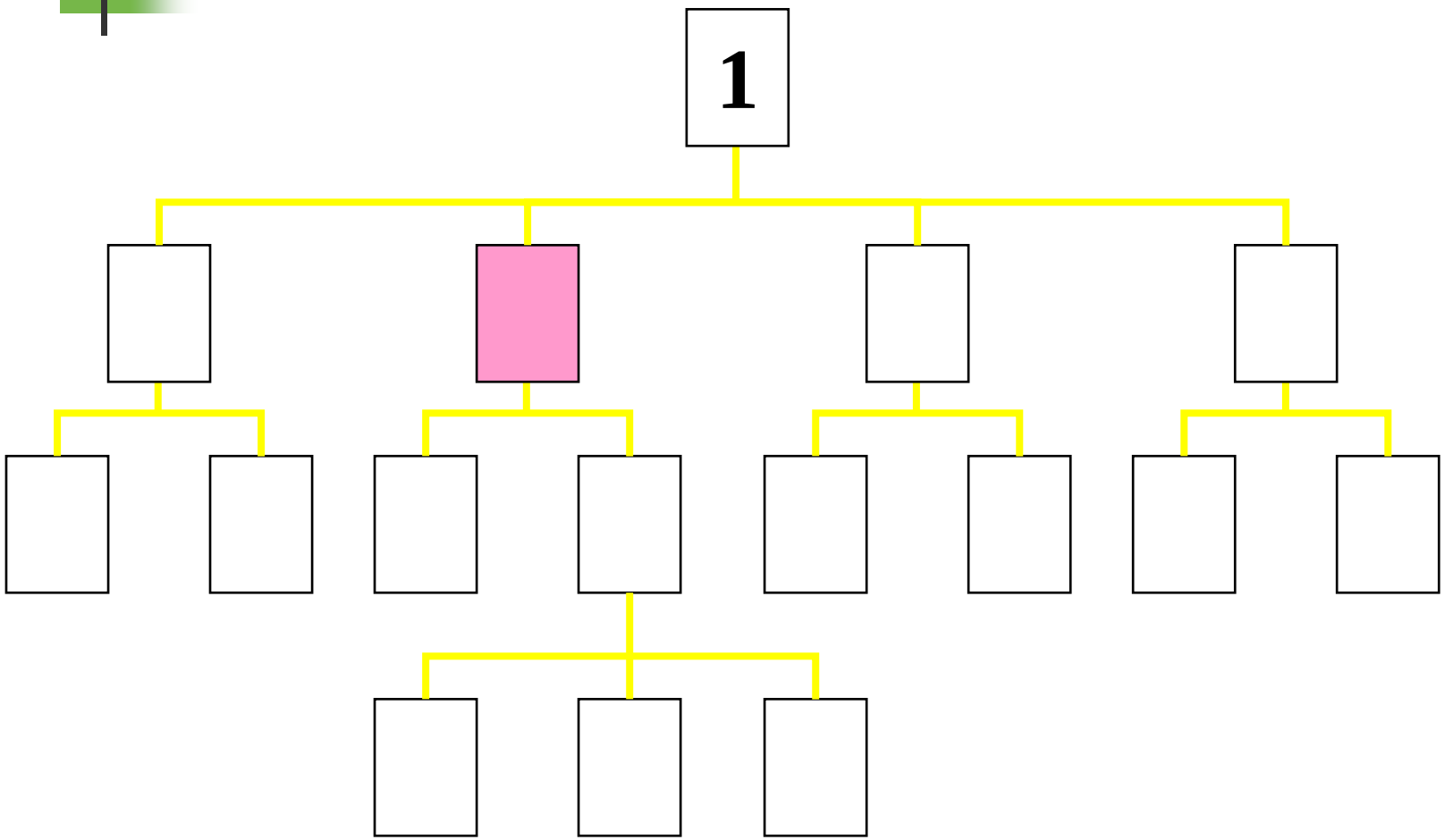
XML Node Relationships

- Self
- Parent
- Ancestor
- Child
- Descendant
- Following
- Following-Sibling
- Preceding
- Preceding-Sibling

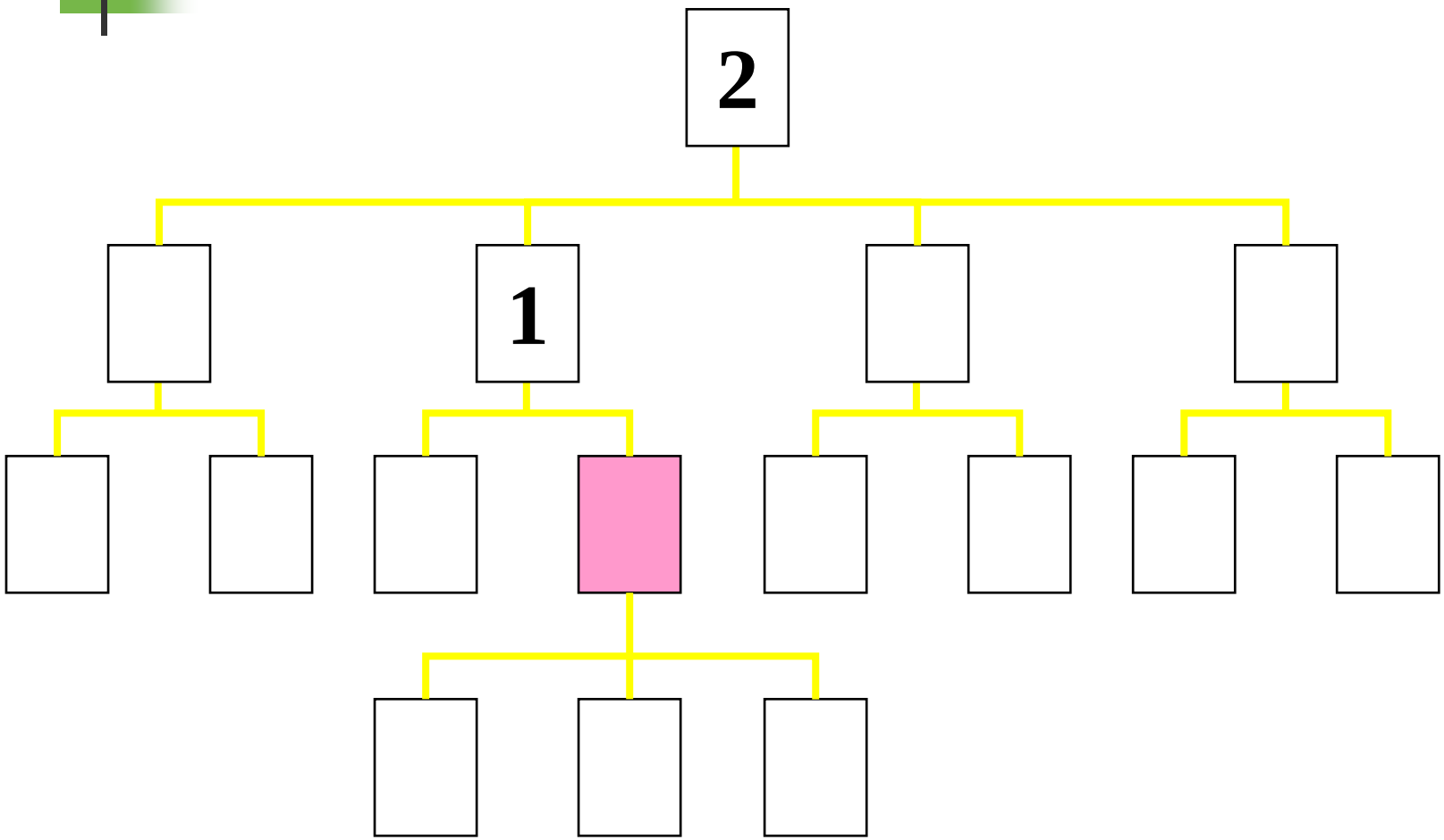
Self



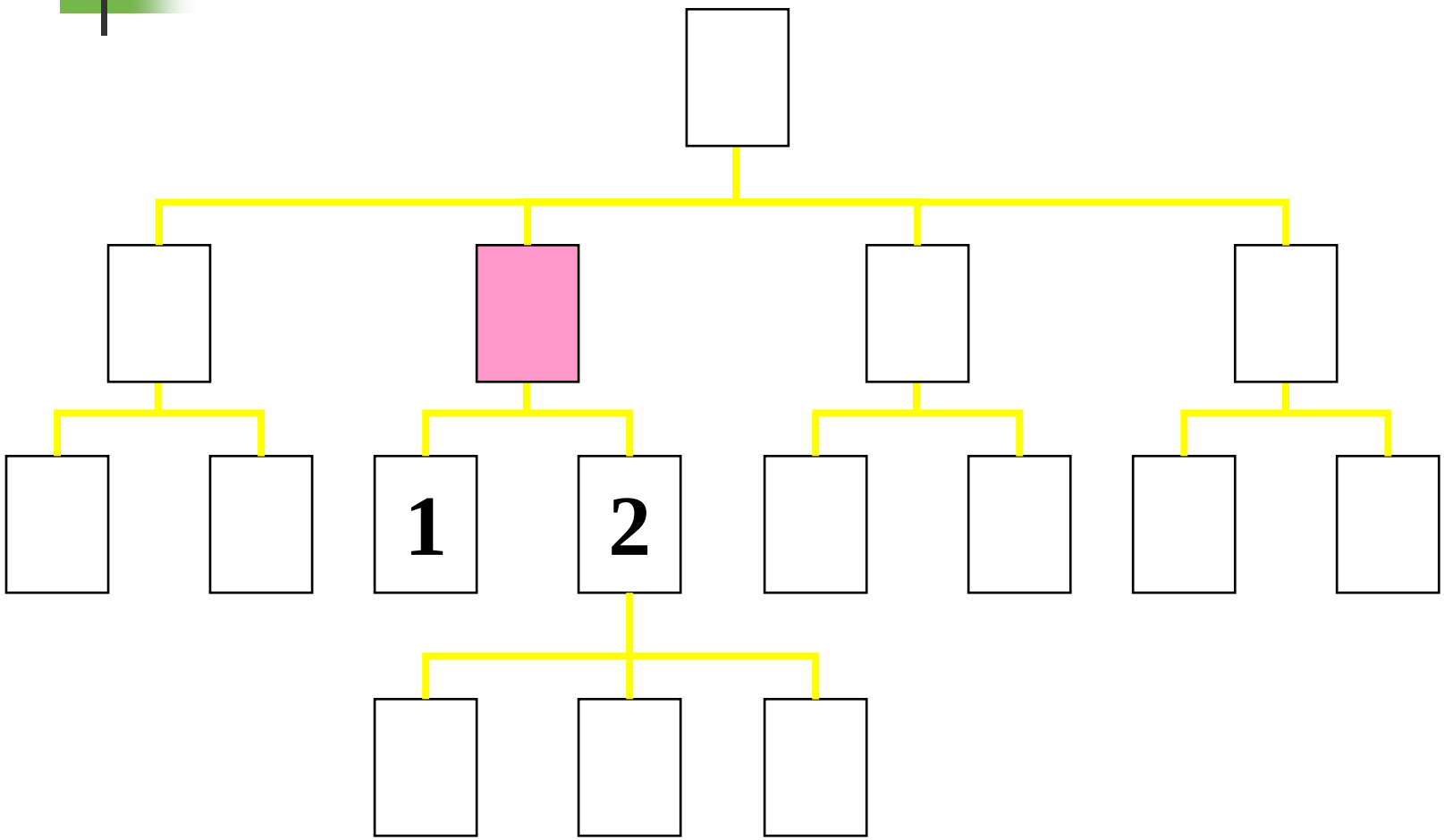
Parent



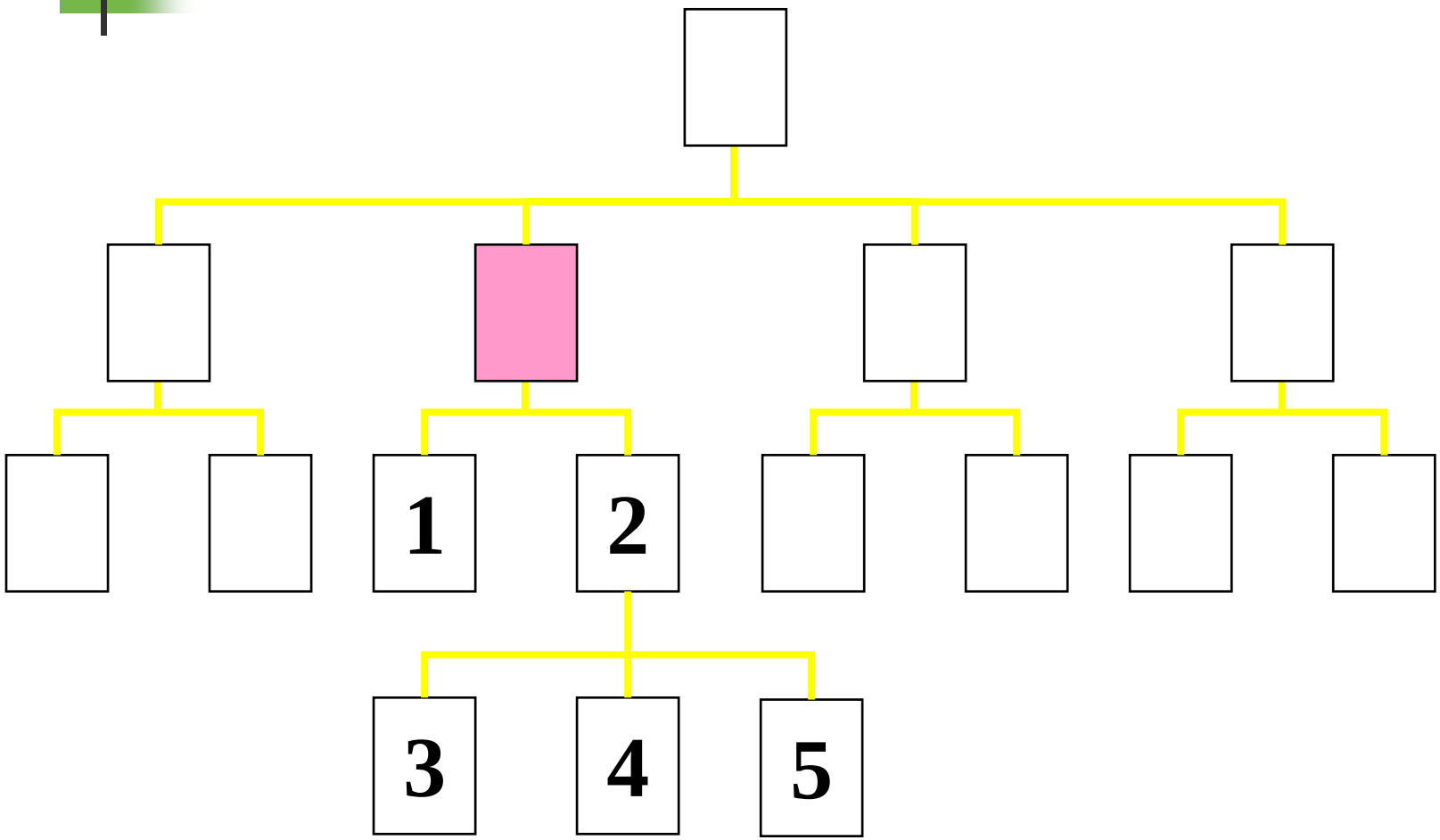
Ancestor



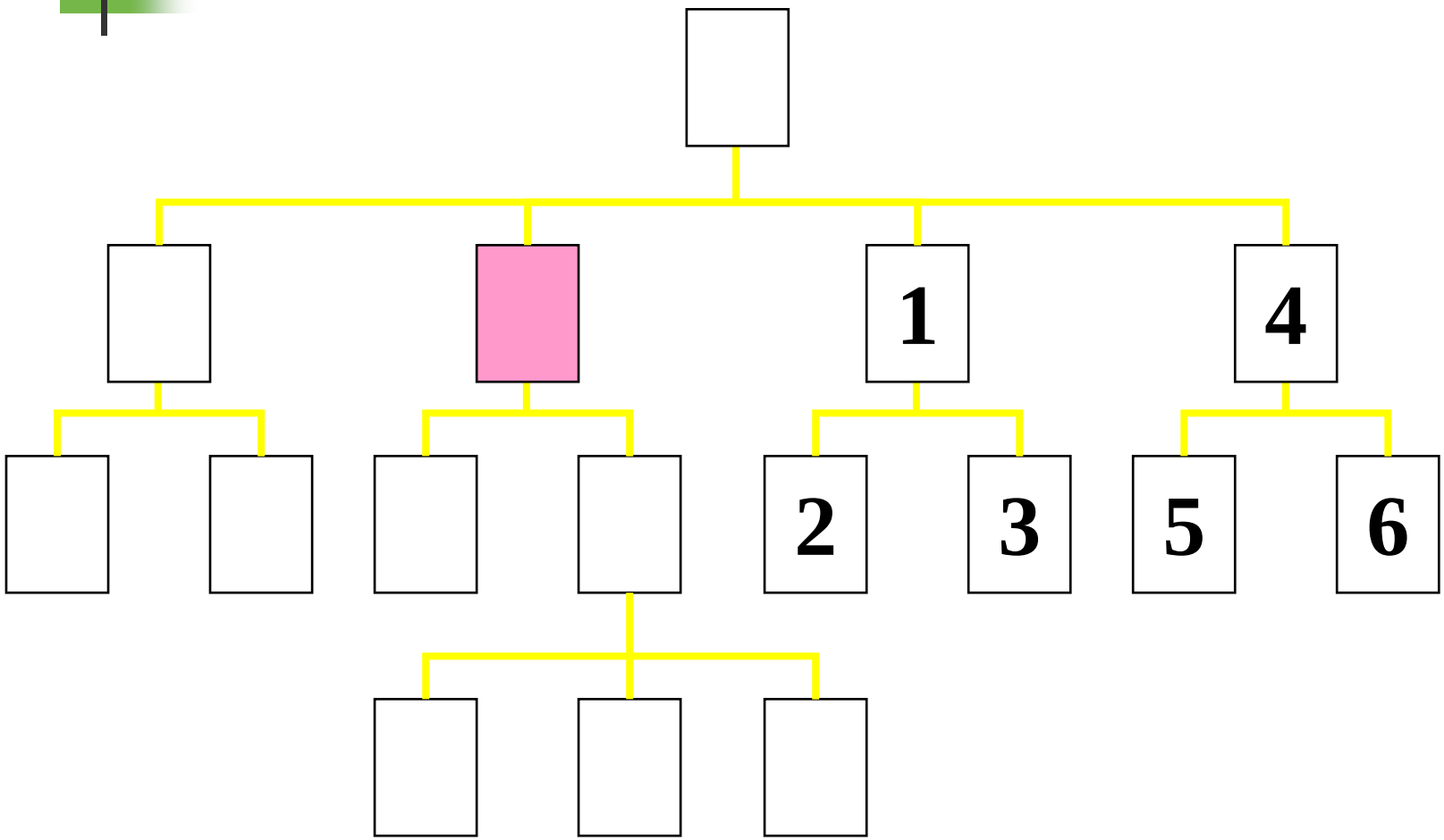
Child



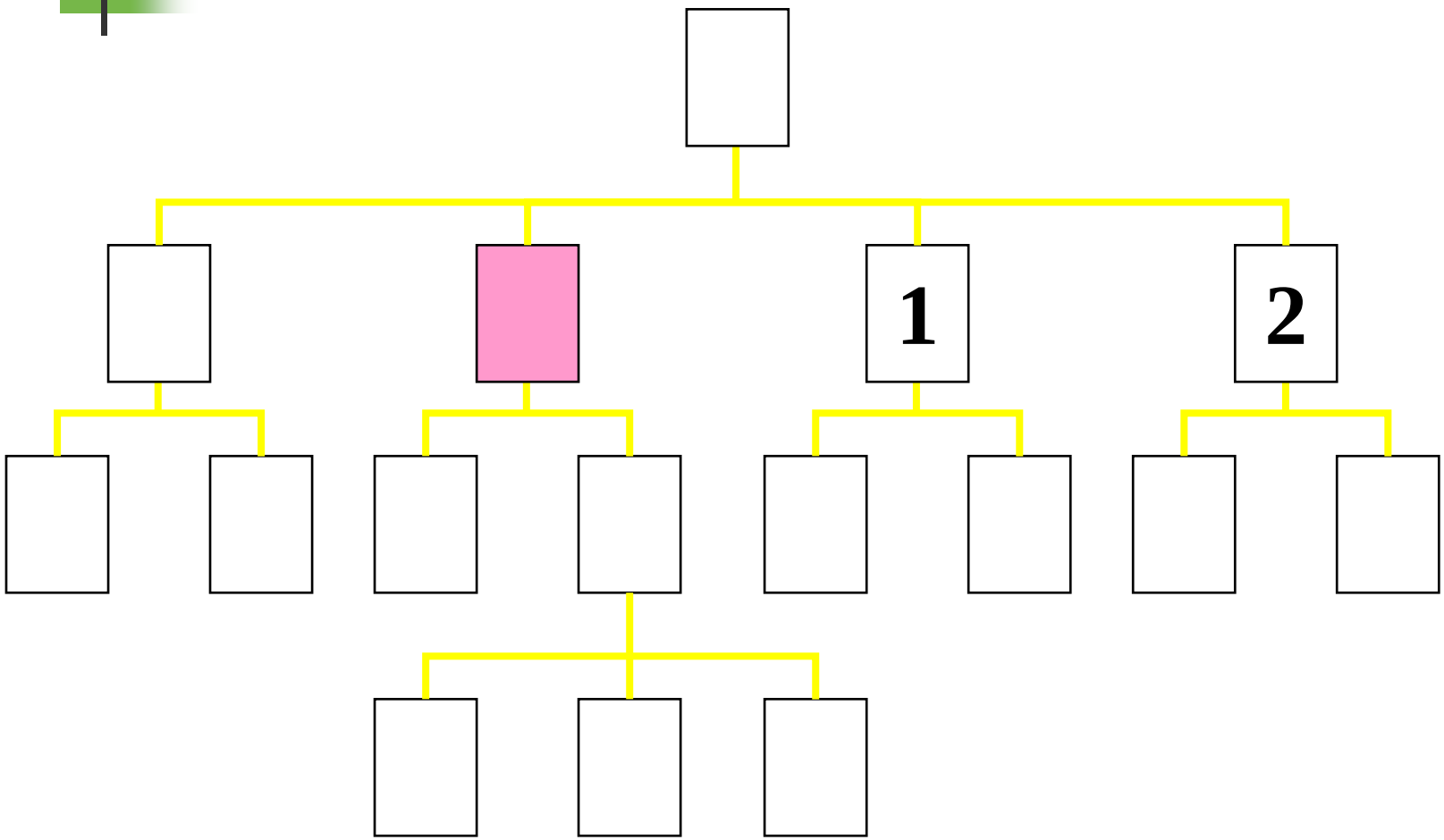
Descendant



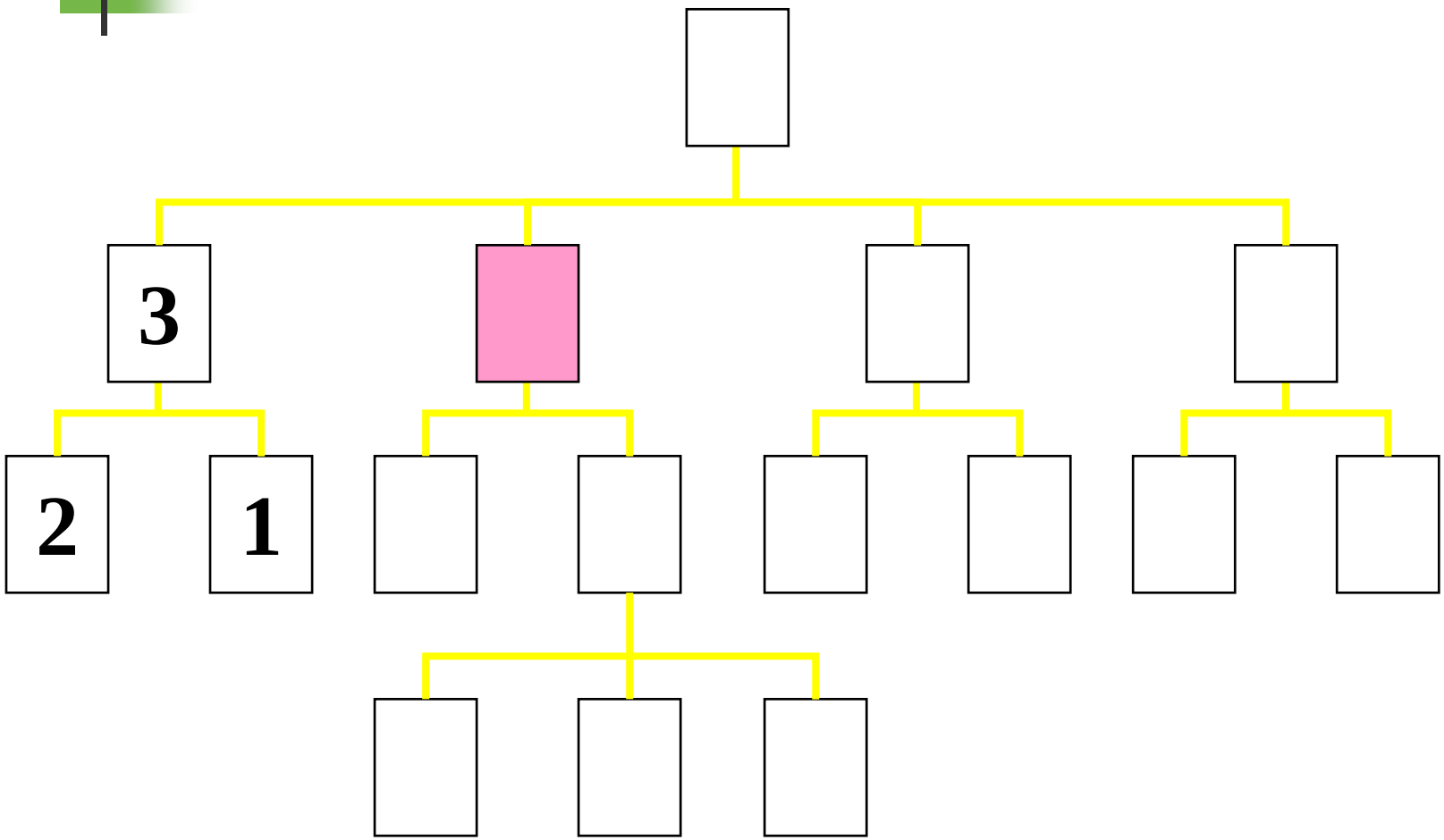
Following



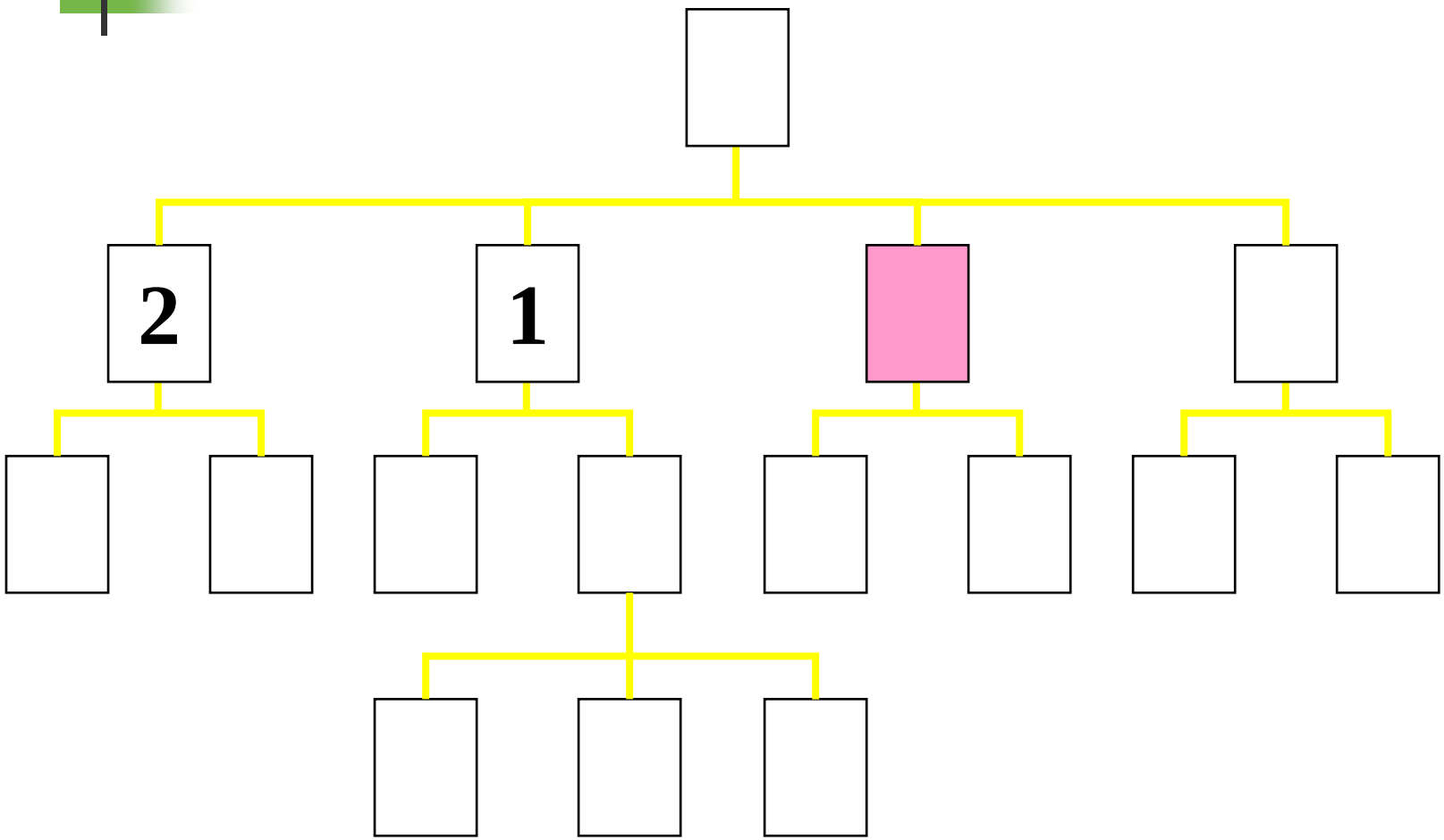
Following-Sibling



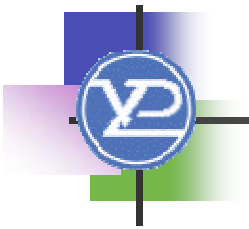
Preceding



Preceding-Sibling



Node Relation Example



```
<library>
  <book>

    <chapter>
    </chapter>

    <chapter>
      <section>
        <paragraph/>
        <paragraph/>
      </section>
    </chapter>

  </book>
</library>
```

- library is the parent of book; book is the parent of the two chapters
- The two chapters are the children of book, and the section is the child of the second chapter
- The two chapters of the book are siblings (they have the same parent)
- library, book, and the second chapter are the ancestors of the section
- The two chapters, the section, and the two paragraphs are the descendents of the book

Paths

Operating system:

/ = the root directory

/users/ivan/myfile = the file named myfile in ivan in users

myfile = the file named myfile in the current directory

. = the current directory

.. = the parent directory

/users/ivan/* = all the files in /users/ivan

XPath:

/library = the root element (if named library)

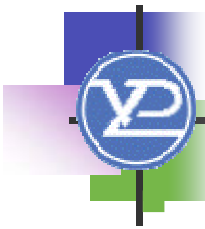
/library/book/chapter/section = *every* section element in a chapter in every book in the library

section = *every* section element that is a child of the current element

. = the current element

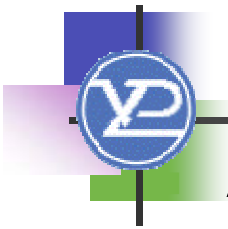
.. = parent of the current element

/library/book/chapter/* = all the elements in /library/book/chapter



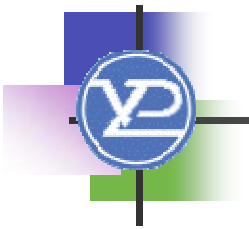
Slashes

- A path that begins with a / represents an absolute path, starting from the top of the document
  - Example: /email/message/header/from
  - Note that even an absolute path can select *more than one* element
  - A slash by itself means “the whole document”
- A path that does *not* begin with a / represents a path starting from the current element
  - Example: header/from
- A path that begins with // can start from *anywhere* in the document
  - Example: //header/from selects every element from that is a child of an element header
  - This can be expensive, since it involves searching the entire document



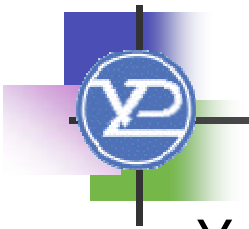
Brackets and last()

- A number in brackets selects a particular matching child (counting starts from 1, except in Internet Explorer)
  - Example: /library/book[1] selects the first book of the library
  - Example: //chapter/section[2] selects the second section of every chapter in the XML document
  - Example: //book/chapter[1]/section[2]
  - Only *matching* elements are counted; for example, if a book has both sections and exercises, the latter are ignored when counting sections
- The function last() in brackets selects the last matching child
  - Example: /library/book/chapter[last()]
- You can even do simple arithmetic
  - Example: /library/book/chapter[last()-1]



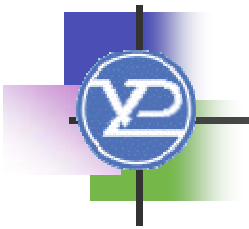
Stars - *

- A star, or asterisk means "all the elements at this level"
  - Example: /library/book/chapter/* selects every child of every chapter of every book in the library
  - Example: //book/* selects every child of every book (chapters, tableOfContents, index, etc.)
  - Example: /*/*/*/paragraph selects every paragraph that has exactly three ancestors
  - Example: //* selects every element in the entire document



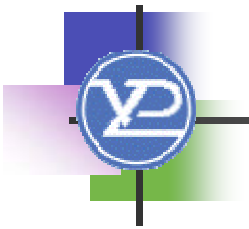
Attributes

- You can select attributes by themselves, or elements that have certain attributes
  - Remember: an attribute consists of a name-value pair, for example in <chapter num="5">, the attribute is named num
  - To choose the attribute itself, prefix the name with @
  - Example: @num will choose every *attribute* named num
  - Example: //@* will choose *every attribute, everywhere* in the document
- To choose *elements* that have a given attribute, put the attribute name in square brackets
  - Example: //chapter[@num] will select every chapter element (anywhere in the document) that has an attribute named num



Attributes (2)

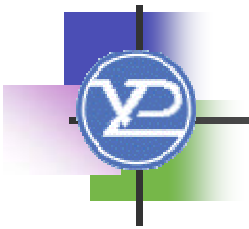
- //chapter[@num] selects every chapter element with an attribute num
- //chapter[not(@num)] selects every chapter element that does *not* have a num attribute
- //chapter[@*] selects every chapter element that has *any* attribute
- //chapter[not(@*)] selects every chapter element with *no* attributes



Values of attributes

- //chapter[@num='3'] selects every chapter element with an attribute num with value 3

- The normalize-space() function can be used to remove leading and trailing spaces from a value before comparison
  - Example: //chapter[normalize-space(@num)='3']

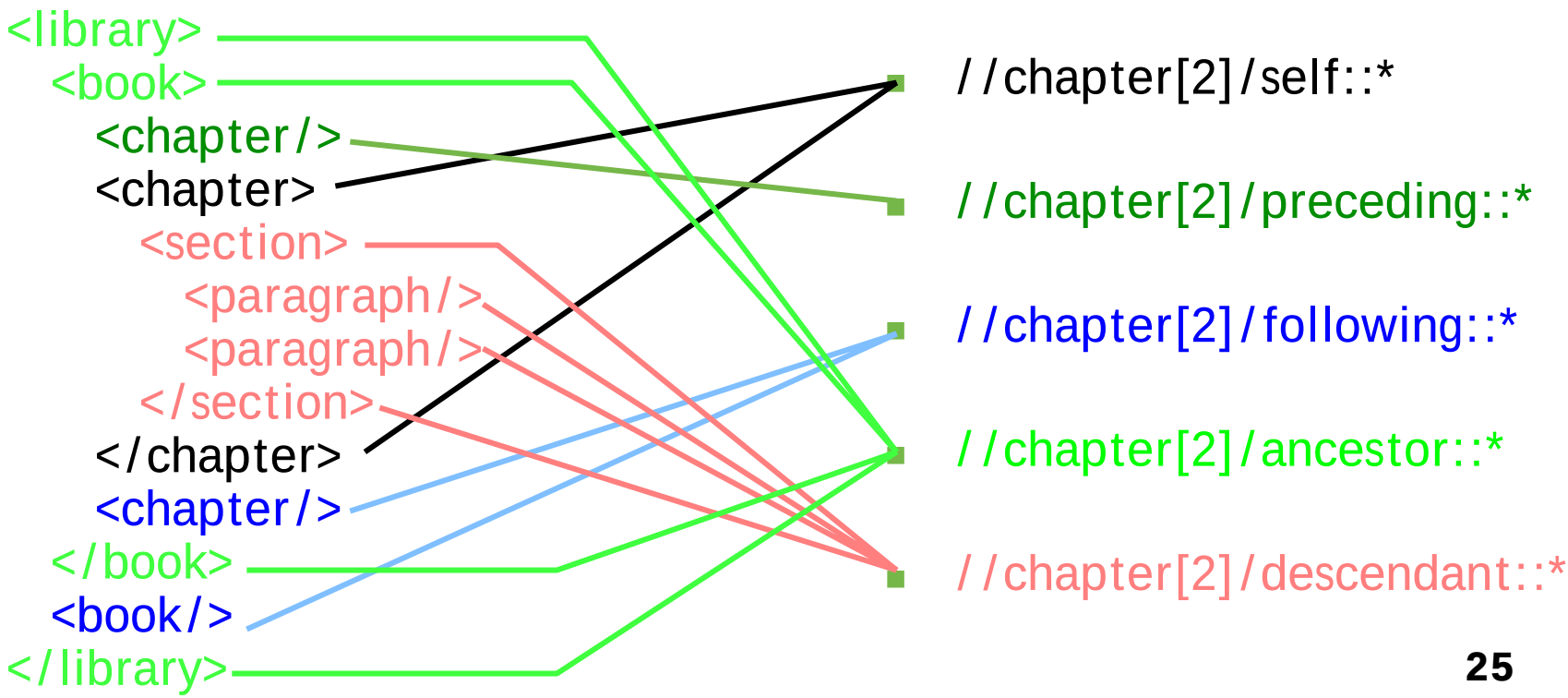


Axes

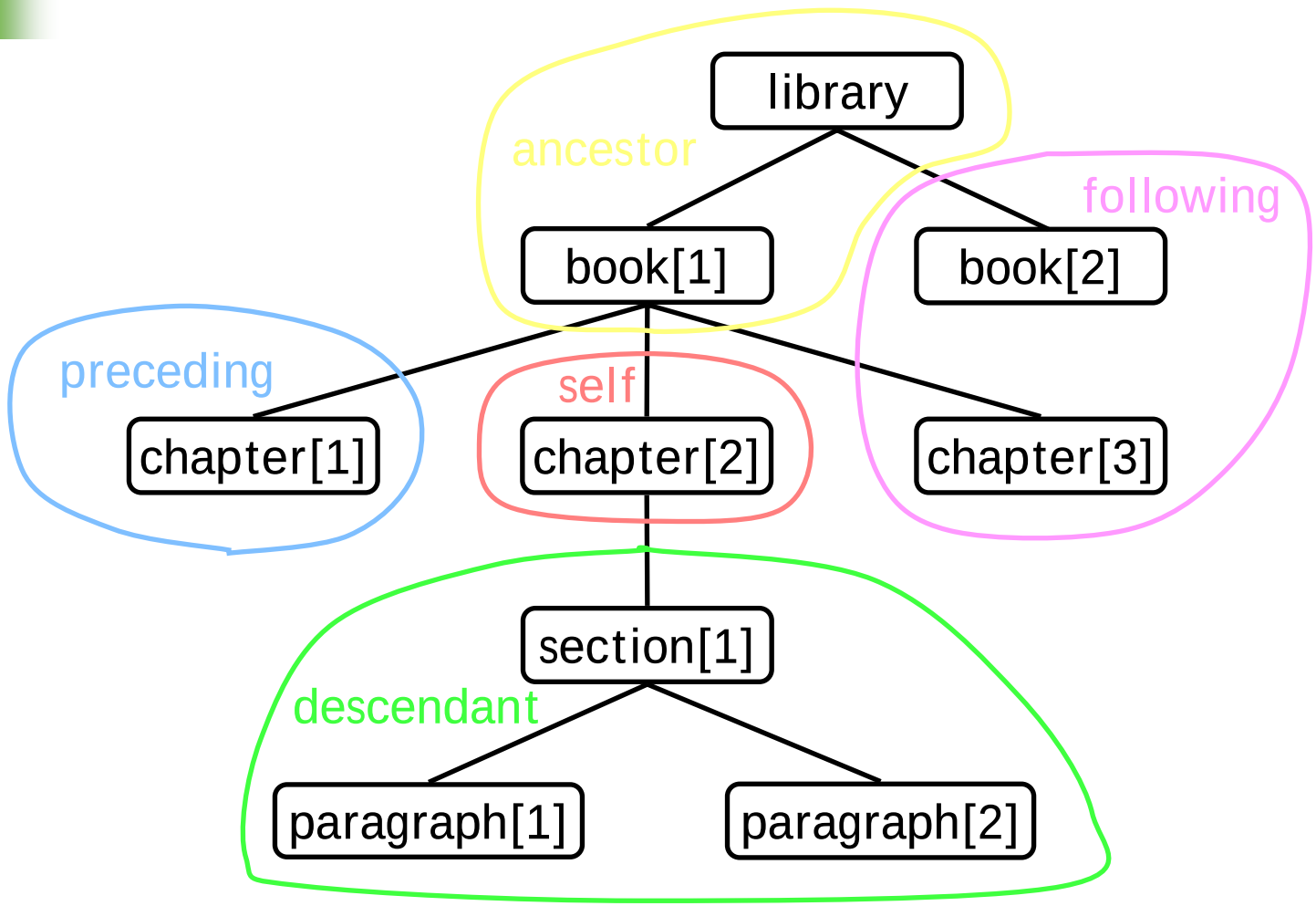
- An axis is a set of nodes relative to a given node; X::Y means “choose Y from the X axis”
  - self:: is the set of current nodes (not too useful)
    - self::node() is the current node
  - child:: is the default, so /child::*X* is the same as /*X*
  - parent:: is the parent of the current node
  - ancestor:: is all ancestors of the current node, up to and including the root
  - descendant:: is all descendants of the current node
    (Note: never contains attribute or namespace nodes)
  - preceding:: is everything before the current node in the entire XML document
  - following:: is everything after the current node in the entire XML document

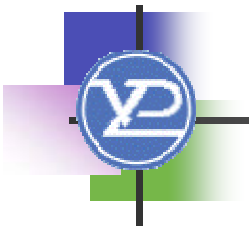
Axes (outline view)

Starting from a given node, the self, preceding, following, ancestor, and descendant axes form a partition of all the nodes (if we ignore attribute and namespace nodes)



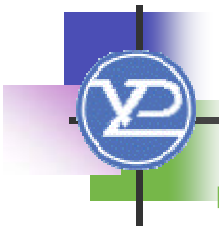
Axes (tree view)





Axis examples

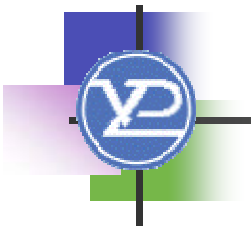
- //book/descendant::* is all descendants of every book
- //book/descendant::section is all section descendants of every book
- //parent::* is every element that is a parent, i.e., is not a leaf
- //section/parent::* is every parent of a section element
- //parent::chapter is every chapter that is a parent, i.e., has children
- /library/book[3]/following::* is everything after the third book in the library



More axes

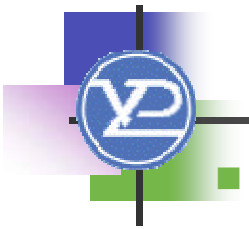
- ancestor-or-self:: ancestors plus the current node
- descendant-or-self:: descendants plus the current node
- attribute:: is all attributes of the current node
- namespace:: is all namespace nodes of the current node
- preceding:: is everything before the current node in the entire XML document
- following-sibling:: is all siblings after the current node

Note: preceding-sibling:: and following-sibling:: do not apply to attribute nodes or namespace nodes



Abbreviations for axes

(none)	is the same as	child::
@	is the same as	attribute::
.	is the same as	self::node()
.//X	is the same as	self::node()/descendant-or-self::node()/child::X
..	is the same as	parent::node()
../X	is the same as	parent::node()/child::X
//	is the same as	/descendant-or-self::node()/
//X	is the same as	/descendant-or-self::node()/child::X



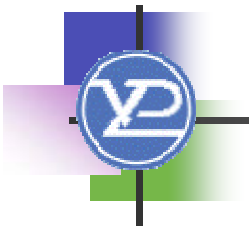
Location Path

- Axis
  - defines the relationship of the required nodes to the starting nodes (ancestor, child, following-sibling)
- Node test
  - defines the type of nodes and the names of the nodes that are to be selected
- Predicates
  - expressions that further restrict the set of nodes selected by the step , like a filter on the node-set

Axis-name <<::>> node-test (<<[>> predicate <<]>>)

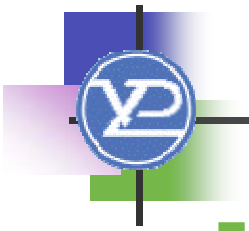
//book/chapter[1]/section[2]

//parent::chapter[@num='3']



Arithmetic expressions

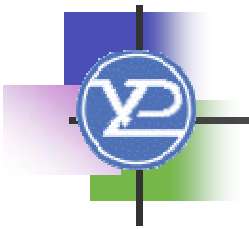
+	add
-	subtract
*	multiply
div	(not /) divide
mod	modulo (remainder)



Equality tests

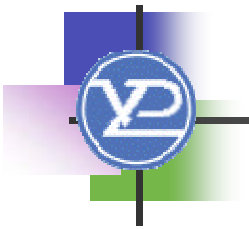
- = “equals” (Notice it’s *not* ==)
- != “not equals”
- But it’s not that simple!
  - *value* = *node-set* will be true if the *node-set* *contains any node* with a value that matches *value*
  - *value* != *node-set* will be true if the *node-set* *contains any node* with a value that does *not* match *value*
- Therefore,
  - *value* = *node-set* and *value* != *node-set* may both be true at the same time!

Other boolean operators



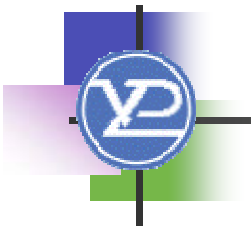
- and (operator)
- or (operator)
  - Example: count = 0 or count = 1
- not() (function)

- The following are used for *numerical* comparisons only:
- < "less than" Some places may require <
- <= "less than or equal to" Some places may require <=
- > "greater than" Some places may require >
- >= "greater than or equal to" Some places may require >=



Some XPath functions

- XPath contains a number of functions on node sets, numbers, and strings; here are a few of them:
  - count(*elem*) counts the number of selected elements
    - Example: //chapter[count(section)=1] selects chapters with exactly two section children
  - name() returns the name of the element
    - Example: //*[name()='section'] is the same as //section
  - starts-with(*arg1*, *arg2*) tests if *arg1* starts with *arg2*
    - Example: //*[starts-with(name(), 'i']
  - contains(*arg1*, *arg2*) tests if *arg1* contains *arg2*
    - Example: //*[contains(name(), 'ivan']



Read More in

World Wide Web Consortium.

XML Path Language (XPath). Version 2.0

W3C Recommendation 14 December 2010

Available at http://www.w3.org/TR/xpath20