Exceptions
Basic Issues

How are exceptions raised (started)
How to handle exceptions
What can one do when handling exceptions
How is the correct handler found for an exception
Basic Handling of Exceptions

[ProtectedBlock]
on: ExceptionList
do: [:exception | HandlerBlock]

[numerator := 5.
denominator := 0.0.
numerator / denominator]
on: ZeroDivide
do:
   [:exception |
   Transcript
   show: exception description;
cr]

Unlike Java, in Smalltalk zero divide by both integer and floats cause a zero divide exception to be raised
Catching Multiple Exceptions

Use a comma or ExceptionSets

[1/0]
on: Warning , ZeroDivide
do: [:exception | code here]

| exceptions |
[1/0]
on: exceptions
do: [:exception | code here]
ensure:

[block] ensure: [clean up block]
Ensure that the clean up block will be done

If block ends due to an exception
Execute handler for exception
Execute clean up block

Example

[[10/0] ensure: [Transcript show: 'In ensure'; cr]]
on: ZeroDivide
do: [:exception | Transcript show: 'In handler'; cr ]

Output in Transcript

In handler
In ensure

Your code should not depend on the order of execution of the handler and clean up block
ifCurtailed:

[block] ifCurtailed: [clean up block]

Clean up block is done only if [block] ends abnormally
Raising Exceptions

Implicitly Raised Exceptions

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Explicitly Raised Exceptions

Send message to an exception class

Warning raiseSignal: 'This string is the signal description'
Error raiseSignal
Error raiseSignal: 'Problem here'
Object Methods That Raise Exception

self error: 'Error message'
    Simplest way to raise an exception

self halt
self halt: 'Message''
    Raises Halt exception.
    Allows user to invoke debugger or resume

self shouldNotImplement
    Used in subclasses in inherited methods that do not belong in the subclass

self subclassResponsibility
    Used in methods to declare them abstract
    Indicated subclasses must implement this method
Exceptions are Classes

Error

Normal Exception behavior
Your exceptions should subclass Error

Notification

Something interesting has occurred
If it is not handled, it will pass by without effect

Warning

An unusual event the user needs to know about
Asks the user if the program should continue

MessageNotUnderstood

A method was sent to an object that does not implement it
Exception Default Action

All exceptions have default action

What happens if exception is not caught in on:do:
Warning Default Behavior

Warning raiseSignal: 'An error occurred, continue?'.

Result

![Image of a message box with options: Yes and No. The Yes option is highlighted.]
Warning with handler

[Warning raiseSignal: 'Hi Mom'.
  Transcript show: 'End']
  on: Warning
  do: [:exception | Transcript show: 'Handler']

Output in Transcript

Handler

No dialog window opens as the default behavior is not done when a warning is raised in a on:do: block
Finding the Exception Handler

When an exception is raised the enclosing handlers are searched

Start with the code that raised the exception
Search the "closest" enclosing handler first
Continue searching the enclosing handlers

The first handler that deals with the exception is used

If no handlers handle the exception the exception's default action is done

[[1/0]
  on: ZeroDivide
  do: [:exception | Transcript show: 'First']
  on: ZeroDivide
  do: [:exception | Transcript show: 'Second']
Inheritance and Exception

All subexceptions are caught by an exception in on:do:

ZeroDivide is a subclass of Error

The ZeroDivide exception will be caught in the following

[1/0]
on: Error
do:
  [:exception |
  Transcript
  show: exception description;
  cr]
Resumable Exceptions

| result |
result := 10 / 0 + 5.
Transcript show: result printString]
on: ZeroDivide
do: [:exception | exception resume: 1]

Output in Transcript

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| result |
result := 10/0.
Transcript show: result printString]
on: ZeroDivide
do:
   [:exception |
   exception resume ]

Output in Transcript

   nil
| x   y result |

\texttt{x := 10.} \texttt{\hrulefill} \texttt{Output in Transcript}
\texttt{\hrulefill} \texttt{10}
\texttt{\hrulefill}
\texttt{y := 0.}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{result := x / y.} \texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{Transcript show: result printString]
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{on: ZeroDivide} \texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{do:} \texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{[: exception |} \texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{y := 1.} \texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{\hrulefill}
\texttt{exception retry ]} \texttt{\hrulefill}
Creating Your Own Exceptions

Subclass the correct existing Exception
Almost always Error

If you want the exception to be resumable
Make method isResumable return true

If you want non-standard default behavior
Override the method defaultAction
LinkedList>>at: anIndex
   Requirement: throw an exception if anIndex < 1 or anIndex > List size

   [(anIndex < 1 or: [anIndex > self size]) ifTrue: [self error: 'Out of bounds'].
   current := self head.
   [anIndex -1] timesRepeat: [current := current next].
   ^current value.
]

   on: Error
   do: [:exception |
      Transcript show: 'error'.
      ^nil]
Point of Exceptions

Something unexpected occurred in your method

Your method can not handle the problem

Raise exception to inform caller
  you can not handle the request
  do to exceptional condition

Caller
  May have to cancel operation
  Be able to fix error
  let someone else handle the problem
Streams
Streams

Iterate or traverse over
- Sequenceable Collections
- File contents

Maintains pointer to current position in collection
## Stream Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>next</code></td>
<td>Returns the next element</td>
</tr>
<tr>
<td><code>next: n</code></td>
<td>Returns the n next elements</td>
</tr>
<tr>
<td><code>nextPut: anElement</code></td>
<td>Inserts anElement at next position</td>
</tr>
<tr>
<td><code>nextPutAll: aCollection</code></td>
<td>Inserts collection elements starting at the next position</td>
</tr>
<tr>
<td><code>contents</code></td>
<td>Returns all the elements</td>
</tr>
<tr>
<td><code>flush</code></td>
<td>Write any unwritten information</td>
</tr>
<tr>
<td><code>atEnd</code></td>
<td>true if at the end of the collection</td>
</tr>
<tr>
<td><code>cr space tab crtab</code></td>
<td>Write the specified white space</td>
</tr>
<tr>
<td><code>print: anObject</code></td>
<td>Print anObject on the stream</td>
</tr>
</tbody>
</table>

If these look familiar the Transcript is a stream
## PeekableStream Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>skip: n</td>
<td>Increases the position by n</td>
</tr>
<tr>
<td>skipTo: anElement</td>
<td>Increases the position to after anElement</td>
</tr>
<tr>
<td>upToSeparator</td>
<td>Return contents up to a separator, skip over separator</td>
</tr>
<tr>
<td>reset</td>
<td>Set position to 0</td>
</tr>
<tr>
<td>peek</td>
<td>Return next element, position not changed</td>
</tr>
<tr>
<td>peekFor: anObject</td>
<td>Return true if next element = anObject</td>
</tr>
<tr>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>
x := WriteStream on: String new.
x
   nextPut: $A;
nextPutAll: ' Cat in the Hat';
nextPutAll: ' Comes Back';
contents

Result
'A Cat in the Hat Comes Back'

| x |
x := WriteStream on: Array new.
x
   nextPut: 5;
nextPut: 'cat';
nextPut: $a.
x contents

Result
#(5 'cat' $a)
nextPut: & nextPutAll:

x := WriteStream on: String new.
x nextPut: 56.     "Runtime error, must be character"
x nextPut: 56 printString.    "Error, string is not a character"
x print: 56                "OK"
x nextPutAll: 56 printString    "OK"

nextPut:
   adds one element to the stream

nextPutAll:
   Argument must be a collection
   Elements of the argument are added one at a time to the collection
Explain This

<table>
<thead>
<tr>
<th>x</th>
</tr>
</thead>
</table>
x := WriteStream on: Array new.
x
  nextPut: 'cat';
  nextPut: 'in';
  nextPut: 'hat'.
x contents

Result
#('cat' 'in' 'hat')

<table>
<thead>
<tr>
<th>x</th>
</tr>
</thead>
</table>
x := WriteStream on: Array new.
x
  nextPutAll: 'cat';
  nextPutAll: 'in';
  nextPutAll: 'hat'.
x contents

Result
#($c $a $t $i $n $h $a $t)$
Repositioning of the stream

(WriteStream on: String new)
nextPutAll: 'Cat in the Hat';
position: 4;
nextPutAll: 'Comes Back';
contents

Result
'Cat Comes Back'
## ReadStream Examples

<table>
<thead>
<tr>
<th></th>
<th>x</th>
</tr>
</thead>
</table>
x :=ReadStream
on: 'Cat-in-the-Hat-Comes-Back'.

| Transcript |
|---|---|
| print: x next; cr; | C |
| print: x peek; cr; | a |
| print: x next; cr; | a |
| show: (x upTo: $e); cr; | t-in-th |
| show: (x upToAll: 'Comes'); cr; | -Hat- |
| show: x upToEnd; cr; | Comes-Back |
| show: x contents | Cat-in-the-Hat-Comes-Back |

Note that in the output we do not see the $e from the x upTo: $e, but do see the 'Comes' in the output from the x upToAll: 'Comes'. upTo: sets the position after the element ($e). upToAll: sets the position at the start of the indicated collection.
## ReadStream on an Array

<table>
<thead>
<tr>
<th>x</th>
</tr>
</thead>
</table>

`x := ReadStream on:
  #('Cat' 'in' 'the' 'Hat' 'Comes' 'Back' 'Again' 'by' 'Zeus').`  

<table>
<thead>
<tr>
<th>Transcript</th>
<th>Transcript</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>show: x next; cr;</code></td>
<td>Cat</td>
</tr>
<tr>
<td><code>show: x peek; cr;</code></td>
<td>in</td>
</tr>
<tr>
<td><code>show: x next; cr;</code></td>
<td>in</td>
</tr>
<tr>
<td><code>show: (x upTo: 'Comes'); cr;</code></td>
<td>#('the' 'Hat')</td>
</tr>
<tr>
<td><code>show: (x upToAll: #('Again' 'by')); cr;</code></td>
<td>#('Back')</td>
</tr>
<tr>
<td><code>show: x upToEnd</code></td>
<td>#('Again' 'by' 'Zeus')</td>
</tr>
</tbody>
</table>
ReadStream

The elements returned by the stream are elements in the underlying collection

upTo: requires elements of the underlying collection

upToAll: requires a collection of elements of the underlying collection

next returns an element of the underlying stream

Most uses have String as underlying collection
Files
Example

<table>
<thead>
<tr>
<th>name file fileWrite fileRead</th>
</tr>
</thead>
<tbody>
<tr>
<td>name := 'sampleFile'.</td>
</tr>
<tr>
<td>file := name asFilename.</td>
</tr>
<tr>
<td>fileWrite := file writeStream.</td>
</tr>
<tr>
<td>fileWrite</td>
</tr>
<tr>
<td>nextPutAll: 'Hello world';</td>
</tr>
<tr>
<td>nextPutAll: 'How are you?';</td>
</tr>
<tr>
<td>cr;</td>
</tr>
<tr>
<td>close.</td>
</tr>
<tr>
<td>fileRead := file readStream.</td>
</tr>
<tr>
<td>Transcript show: fileRead contents.</td>
</tr>
<tr>
<td>fileRead close.</td>
</tr>
<tr>
<td>fileAppend := file appendStream.</td>
</tr>
<tr>
<td>fileAppend</td>
</tr>
<tr>
<td>nextPutAll: 'I am well';</td>
</tr>
<tr>
<td>cr;</td>
</tr>
<tr>
<td>close.</td>
</tr>
<tr>
<td>Transcript show: file contentsOfEntireFile</td>
</tr>
</tbody>
</table>
File Objects

Filename named: 'filename'

'filename' asFilename

Both create a Filename object on a file

The filename string is a file in the current directory or Full path to the file
Writing to a File

Filename>>writeStream
  Opens a write stream on the file
  If file does not exist create the file
  If file does exist erase current contents

Filename>>appendStream
  Returns a write stream on the file
  If file does not exist create the file
  If file does exist the stream appends to the contents

Filename>>readStream
  Returns a read stream on the file
  File must exist
  Stream reads from the beginning of the file
Close your Files

Always close streams on files

If you do not close the stream, the VM keeps the file open

| name file fileWrite |
name := 'sampleFile'.
file := name asFilename.
[fileWrite := file writeStream.
1 /0.
fileWrite
   nextPutAll: 'Hello world';
   nextPutAll: 'How are you?';
   cr.]
ensure: [fileWrite close].
## Some File Operations in Filename

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>isDirectory</td>
<td>Returns true if Filename object is a directory</td>
</tr>
<tr>
<td>fileSize</td>
<td>Returns size of the file represented by filename object</td>
</tr>
<tr>
<td>delete</td>
<td>Delete the file or directory represented by filename object</td>
</tr>
<tr>
<td>directoryContents</td>
<td>Returns the contents of a filename object that represents a directory</td>
</tr>
<tr>
<td>makeDirectory</td>
<td>Make the filename object a directory.</td>
</tr>
</tbody>
</table>