# A LaTeX macro package for Message Sequence Charts

Reference Manual

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## Contents

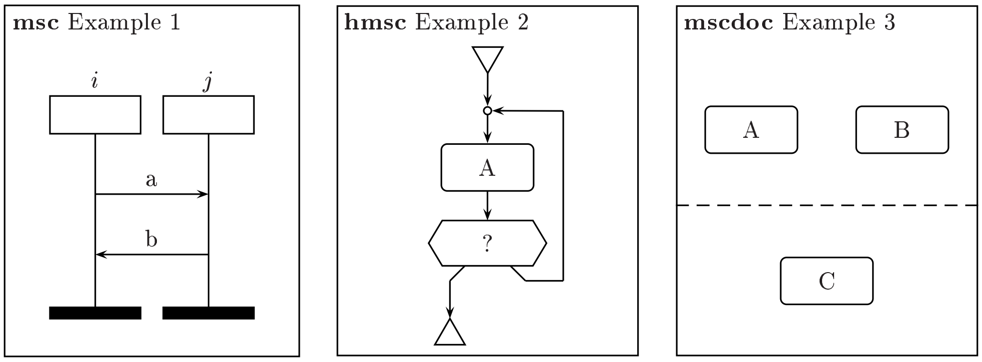


## 1 Introduction

The MSC macro package was developed to draw (actually, to write) *Message Sequence Charts* (MSCs) with LaTeX. The current version supports most of the MSC language standardized in [2]. The manual [1] describes how to use the MSC macro package and is illustrated with numerous examples. This reference manual briefly describes the main concepts of the package and it provides lists of all available environments and commands. In addition, it lists both the user-definable lengths and the internal lengths that are used by the package to compute the layout of MSCs.

## 2 Concepts

The MSC macro package offers three different kinds of diagrams:




(a) MSC diagram (b) HMSC diagram (c) MSCdoc diagram

Figure 1: Examples of different diagrams

- MSC diagrams (normal MSCs)
- HMSC diagrams (high level MSCs)
- MSCdoc diagrams (MSC documents)

For each of these diagrams, the package provides a LaTeX environment. Figure 1 shows an example of each diagram. The source code for these diagrams is given in Figure 2. Depending on the environment, different MSC macro package commands can be used. Furthermore, since each environment is implemented as a `pspicture` (see pstricks documentation), it is possible to use pstricks commands inside the MSC environments.

```
\begin{msc}%
  {Example 1}
\declinst{i}{$i$}{}
\declinst{j}{$j$}{}
\nextlevel
\mess{a}{i}{j}
\nextlevel[2]
\mess{b}{j}{i}
\nextlevel
\end{msc}
```

```
\begin{hmsc}%
      {Example 2}%
      (0,0)(4,4.65)
\hmscstartsymbol{S}(2,3.75)
\hmscconnection{c}(2,3.25)
\hmscreference{R1}{A}(2,2.5)
\hmsccondition{C}{?}(2,1.5)
\hmscendsymbol{E}(1.5,0.5)
\arrow{S}{c}
\arrow{c}{R1}
\arrow{R1}{C}
\arrow{C}
  [(2.5,1)(3,1)(3,3.25)]
  {c}
\arrow{C}[(1.5,1)]{E}
\end{hmsc}
```

```
\begin{mscdoc}%
  {Example 3}%
  (0,0)(4,4.65)
\reference{A}(1,3.0)
\reference{B}(3,3.0 )
\separator{2.0}
\reference{C}(2,1.0)
\end{mscdoc}
```

Figure 2: Source code for diagrams of Figure 1

The MSC environment provides most functionality of the package. The following concepts should help in understanding the user-commands of this environment.

*current height* The *current height* of an MSC is a length that indicates the y-postion relative to the top of the msc frame. The MSC drawing commands use this y-position to draw msc symbols, e.g., instance heads, messages, actions, and instance feet. The internal length `\msc@currentheight` is the current height. This variables is changed whenever the command `\nextlevel` is invoked.

*current width* The *current width* of an MSC is the distance from the left side of the MSC frame to the right side of the MSC frame. As such, it depends on the lengths `\envinstdist` and `\instdist` as well as on the number of instances. The internal length `\msc@currentwidth` is the current width. During construction of an msc, that is, in between `\begin{msc}` and `\end{msc}`, `\msc@currentwidth` is equal to `\envinstdist` + ($n \times$ `instdist`), provided that $n$ is the number of instances defined so far (see `\mscinstcnt` in the section *Internal counters* below) and the length `\instdist` is not changed between instances. At the end of an MSC construction, an additional `\envinstdist` is added to `\msc@currentwidth`. The `\msc@currentwidth` determines the x-position of new MSC instances.

*level* A level is a horizontal layer in an MSC which is used to construct msc's in a top-down fashion. Each level is `\levelheight` units high and spans the complete width of the msc. The first level starts at `\topheaddist` + `\instheadheight` + `\firstlevelheight` units below the top of the MSC frame. The `\nextlevel` commands advances the MSC to the next (lower) level.

MSC *instance* The main building blocks of MSC diagrams are *instances*. Instances are represented by vertical bars. *Fat* instances are represented by two vertical lines. Usually, an instance has both a head symbol and a foot symbol. In the MSC macro package, each MSC instance has a *nickname* by which the instance is identified. In the MSC macro package there are special instances:

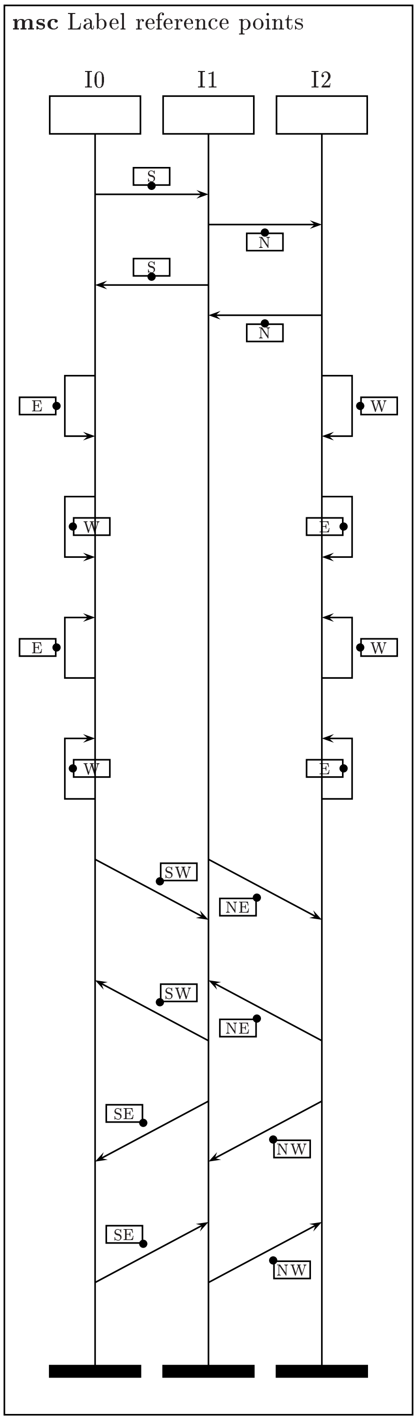
- The left environment (nickname `envleft`).
- The right environment (nickname `envright`).
- The left side of an inline expression. If the nickname of the inline expression is `nm`, the nickname of the left side is `nmleft`.
- The right side of an inline expression. If the nickname of the inline expression is `nm`, the nickname of the left side is `nmright`.
- The left side of an reference expression. If the nickname of the reference expression is `nm`, the nickname of the left side is `nmleft`.
- The right side of an reference expression. If the nickname of the reference expression is `nm`, the nickname of the left side is `nmright`.
- A *dummy* instance is an instance that is invisible; it reserves space needed to draw an instance. It is useful to create (see `create` command) instances with create-messages.

*nickname* A nickname is a unique identification of an *instance*.

*message label reference points* In order to place a message label somewhere near the message arrow, the MSC macro package computes a *reference point* for each message label. This is a location on the bounding box of the label such that the distance between the arrow and the reference point is minimized. Figures 3 (page 4) and 4 (page 5) show the location of reference points for all possible locations of message labels. Note that the boxes with the location of the reference points are not generated by the LaTeX code given in these figures; we enriched the LaTeX code with some extra pstricks code (see LaTeX source code of this document).

# 3 Environments

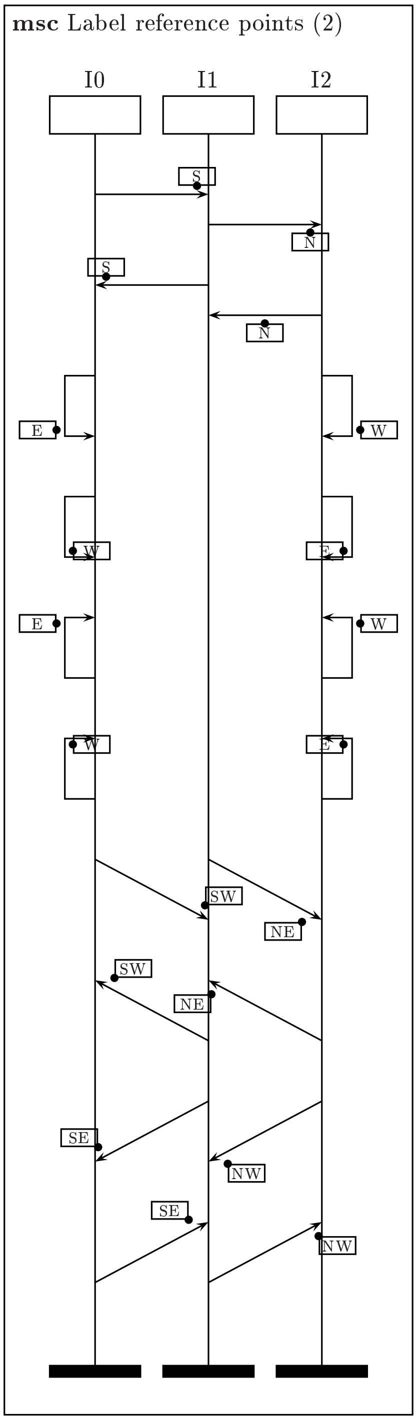
`\begin{msc}`[titlepos]{*title*}`...\end{msc}` The environment to draw msc's. The parameter *title* defines the title of the msc. The optional parameter *titlepos* defines the position of the title relative to the frame of the msc. Valid positions are `l` (left), `c` (center), and `r` (right). The default position is `l`.




```
\begin{msc}{Label reference points}
\declinst{m0}{I0}{}
\declinst{m1}{I1}{}
\declinst{m2}{I2}{}
\nextlevel

\mess{S}{m0}{m1}
\nextlevel
\mess{N}[b]{m1}{m2}
\nextlevel[2]

\mess{S}{m1}{m0}
\nextlevel
\mess{N}[b]{m2}{m1}
\nextlevel[2]

\mess{E}{m0}{m0}[2]
\mess[r]{W}{m2}{m2}[2]
\nextlevel[4]
\mess{W}[r]{m0}{m0}[2]
\mess[r]{E}[l]{m2}{m2}[2]
\nextlevel[6]

\mess{E}{m0}{m0}[-2]
\mess[r]{W}{m2}{m2}[-2]
\nextlevel[4]
\mess{W}[r]{m0}{m0}[-2]
\mess[r]{E}[l]{m2}{m2}[-2]
\nextlevel[2]

\mess{SW}{m0}{m1}[2]
\mess{NE}[b]{m1}{m2}[2]
\nextlevel[6]

\mess{SW}{m1}{m0}[-2]
\mess{NE}[b]{m2}{m1}[-2]
\nextlevel[2]

\mess{SE}{m1}{m0}[2]
\mess{NW}[b]{m2}{m1}[2]
\nextlevel[6]

\mess{SE}{m0}{m1}[-2]
\mess{NW}[b]{m1}{m2}[-2]
\nextlevel[2]
\end{msc}
```

Figure 3: Reference points of message labels

`\begin{hmsc}`[titlepos]{*title*}`...\end{hmsc}`(*llx*,*lly*)(*urx*,*ury*) The environment to draw HMSC's. The parameter *title* defines the title of the HMSC. The optional parameter *titlepos* defines the position of the title relative to the frame of the HMSC. Valid positions are `l` (left), `c` (center), and `r` (right). The default position is `l`. The size of the HMSC is determined by two pairs of coordinates. The coordinates (*llx*,*lly*) define the lower left corner of the HMSC. The coordinates (*urx*,*ury*) define the upper right corner of the HMSC.




```
\begin{msc}{Label reference points (2)}
\declinst{m0}{I0}{}
\declinst{m1}{I1}{}
\declinst{m2}{I2}{}
\nextlevel

\mess{S}{m0}[.9]{m1}
\nextlevel
\mess{N}[b]{m1}[.9]{m2}
\nextlevel[2]

\mess{S}{m1}[.9]{m0}
\nextlevel
\mess{N}[b]{m2}{m1}
\nextlevel[2]

\mess{E}{m0}[.9]{m0}[2]
\mess[r]{W}{m2}[.9]{m2}[2]
\nextlevel[4]
\mess{W}[r]{m0}[.9]{m0}[2]
\mess[r]{E}[l]{m2}[.9]{m2}[2]
\nextlevel[6]

\mess{E}{m0}[.9]{m0}[-2]
\mess[r]{W}{m2}[.9]{m2}[-2]
\nextlevel[4]
\mess{W}[r]{m0}[.9]{m0}[-2]
\mess[r]{E}[l]{m2}[.9]{m2}[-2]
\nextlevel[2]

\mess{SW}{m0}[.9]{m1}[2]
\mess{NE}[b]{m1}[.9]{m2}[2]
\nextlevel[6]

\mess{SW}{m1}[.9]{m0}[-2]
\mess{NE}[b]{m2}[.9]{m1}[-2]
\nextlevel[2]

\mess{SE}{m1}[.9]{m0}[2]
\mess{NW}[b]{m2}[.9]{m1}[2]
\nextlevel[6]

\mess{SE}{m0}[.9]{m1}[-2]
\mess{NW}[b]{m1}[.9]{m2}[-2]
\nextlevel[2]
\end{msc}
```

Figure 4: Reference points of shifted message labels

`\begin{mscdoc}`[titlepos]{*title*}`...\end{mscdoc}`(*llx*,*lly*)(*urx*,*ury*) The environment to draw MSCdoc documents. The parameter *title* defines the title of the MSCdoc document. The optional parameter *titlepos* defines the position of the title relative to the frame of the MSCdoc document. Valid positions are `l` (left), `c` (center), and `r` (right). The default position is `l`. The size of the MSCdoc is determined by two pairs of coordinates. The coordinates (*llx*,*lly*) define the lower left corner of the MSCdoc. The coordinates (*urx*,*ury*) define the upper right corner of the MSCdoc.

## 4 Commands

`\action`{*txt*}{*nm*} Draws an *action* symbol on the instance with nickname *nm*. The parameter *txt* defines the name of the action. The size of the action symbol is controlled by the `\actionheight` and `\actionwidth` lengths.

`\arrow`{*nm0*}[$(xpos_1, ypos_1)\ldots(xpos_n, ypos_n)$]{*nm1*} Draws an arrow in an HMSC diagram. The arrow starts at the symbol with nickname *nm0* and ends at the symbol with nickname *nm1*. The optional parameter $(xpos_1, ypos_1)\ldots(xpos_n, ypos_n)$ is a list of intermediate points the arrow should pass through.

`\changeinstbarwidth`{*nm*}{*wd*} Changes the bar width of instance *nm* to *wd*. The parameter *wd* should be a valid LaTeX length.

`\comment`[*pos*]{*txt*}{*nm*} Puts a comment at instance *nm*. The parameter *txt* is the comment. The optional parameter *pos* defines the horizontal position of the comment relative to instance *nm*. Valid positions are `l` (left), `r` (right), and all valid lengths. If the position is `l` or `r`, the comment will be put at `\msccommentdist` units to the left or right, respectively, from the instance axis. If *pos* is a length, the comment will be put *pos* units from the instance axis. A negative *pos* puts the comment to the left and a positive *pos* puts it to the right of the instance axis.

`\condition`{*txt*}{*instancelist*} Draws a *condition* symbol on the instances occurring in *instancelist*. The parameter *txt* defines the text to be placed in the *condition* symbol. The parameter *instancelist* is a comma separated list of instance nicknames. Note that there should be no white space between the commas and the nicknames; only if a nickname contains white space is a white space allowed in *instancelist*.

`\coregionend`{*nm*} Ends the co-region on the instance *nm*. This command is obsolete (see `\regionend`).

`\coregionstart`{*nm*} Starts a co-region on the instance *nm*. This command is obsolete (see `\regionstart`).

`\create`{*msg*}[*labelpos*]{*creator*}[*placement*]{*nm*}{*na*}{*in*} Instance with nickname *creator* sends a create message with label *msg* to instance *nm*. Instance *nm* should be a dummy (invisible) instance at the time of the create message, see `\dummyinst`. The head symbol of *nm* is drawn at `\msc@currentheight`. The parameter *an* (above name) is put above the head symbol. The parameter *in* (inside name) is put inside the head symbol. *nm*'s y-position is set to `\msc@currentheight` + `\instheadheight`. The optional parameter *labelpos* defines the position of the message label. Valid values are `t` and `b`, denoting a label position on top of the arrow and a label position below the arrow, respectively. The optional parameter *placement* defines the relative position of the message label along the message arrow. Valid values are real numbers in the closed interval $[0, 1]$, where 0 corresponds to the beginning of the arrow and 1 corresponds to the end of the arrow. The default value is 0.5.

`\declinst(*)`{*nm*}{*an*}{*in*} Defines an instance with nickname *nm*. The starred version makes a *fat instance*. The x-position is `\instdist` to the right of `\msc@currentwidth`. The head symbol of the instance is drawn at `\msc@currentheight`. The parameter *an* (above name) is put above the head symbol. The parameter *in* (inside name) is put inside the head symbol. The instance y-position is set to `\msc@currentheight` + `\instheadheight`.

`\drawframe`{*str*} A command to turn on/off the drawing of the frame around msc's, hmsc's, and mscdoc's. If *str* is 'yes', the frame will be drawn, otherwise the frame will not be drawn.

`\drawinstfoot`{*str*} A command to turn on/off drawing of instance foot symbols. If *str* is 'yes', the foot symbols will be drawn, otherwise they will not be drawn.

`\drawinsthead`{*str*} A command to turn on/off drawing of instance head symbols. If *str* is 'yes', the head symbols will be drawn, otherwise they will not be drawn.

`\dummyinst(*)`{*nm*} Defines a *dummy instance* with nickname *nm*. The starred version makes a *fat instance*. The x-position is `\instdist` to the right of `\msc@currentwidth`. No head symbol is drawn. The instance y-position is undefined.

`\found`[*pos*]{*label*}[*labelpos*]{*gate*}{*nm*}[*placement*] Draws a *found message* to instance *nm*. The *label* parameter defines the message name. The *gate* parameter defines the gate name. The optional parameter *pos* defines the position of the message relative to instance *nm*. Valid positions are `l` (left) and `r` (right). The default position is `l`. The optional parameter *labelpos* defines the position of the message label with respect to the arrow. Valid values are `t` (on top) and `b` (below). The default value is `t`. The optional parameter *placement* defines the relative position of the message label along the message arrow. Valid values are real numbers in the closed interval $[0, 1]$, where 0 corresponds to the beginning of the arrow and 1 corresponds to the end of the arrow. The default value is 0.5. The length of the arrow is determined by `\selfmesswidth`.

`\gate(*)`[*hpos*][*vpos*]{*txt*}{*nm*} Draws a gate at instance *nm*. The parameter *txt* defines the name of the gate. The starred version produces a visible gate by drawing a black circle at instance *nm*. The unstarred version produces an invisible gate. The position of the parameter *txt* is controlled by the optional parameters *hpos* and *vpos*: *hpos* defines the horizontal position relative to instance *nm* and *vpos* defines the vertical position relative to the current height (`\msc@currentheight`). Valid horizontal positions are `l` (left) and `r` (right). The default horizontal position is `l`. Valid vertical positions are `t` (top), `c` (center), and `b` (bottom). The default vertical is `t`.

`\hmsccondition`{*nm*}{*txt*}(*xpos*,*ypos*) Draws an HMSC condition symbol with nickname *nm* at position (*xpos*,*ypos*). The *txt* parameter is placed inside the condition symbol.

`\hmscconnection(*)`{*nm*}(*xpos*,*ypos*) Draws an HMSC connection symbol with nickname *nm* at position (*xpos*,*ypos*). The unstarred version produces an invisible connection symbol. The starred version produces a visible connection symbol (i.e., a small circle).

`\hmscendsymol`{*nm*}(*xpos*,*ypos*) Draws an HMSC end symbol with nickname *nm* at position (*xpos*,*ypos*).

`\hmsckeyword` The HMSC keyword. The default value is 'hmsc'.

`\hmsckeywordstyle`{*kw*} A one-parameter command to typeset the HMSC keyword. The command can expect `\hmsckeyword` to be the value of *kw*. The default 'value' is `\textbf`.

`\hmscreference`{*nm*}{*txt*}(*xpos*,*ypos*) Draws an HMSC reference symbol with nickname *nm* at position (*xpos*,*ypos*). The *txt* parameter is placed inside the condition symbol.

`\hmscstartsymbol`{*nm*}(*xpos*,*ypos*) HMSC start symbol with nickname *nm* at position (*xpos*,*ypos*).

`\inlineend(*)`{*nm*} Ends the matching inline expression (matching means equal nicknames). The unstarred version draws a solid line to close the inline expression. The starred version draws a dashed line to close the inline expression.

`\inlineseparator`{*nm*} Draws an inline separator line at the inline expression with nickname *nm*. The separator is drawn at `\msc@currentheight`.

`\inlinestart`[*lo*][*ro*]{*nm*}{*txt*}{*fi*}{*li*} Defines an *inline expression* with nickname *nm*. The inline expression is started at `\msc@currentheight` and continues until the level where a matching `\inlineend` command is found (matching means equal nicknames). The *txt* parameter defines the text of the inline expression. The first instance of the inline expression is *fi*. The last instance of the inline expression is *li*. The optional parameter *lo* defines the left and right overlap of the inline expression. If the second optional parameter, *ro*, is present, *lo* defines the left and *ro* defines the right overlap.

`\inststart`{*nm*}{*an*}{*in*} Starts instance with nickname *nm*. Instance *nm* should be a dummy (invisible) instance at the time of the `\inststart` command, see `\dummyinst`. The head symbol is drawn at `\msc@currentheight`. The parameter *an* (above name) is put above the head symbol. The parameter *in* (inside name) is put inside the head symbol. The instance y-position is set to `\msc@currentheight` + `\instheadheight`.

`\inststop`{*nm*} Stops instance with nickname *nm*. The foot symbol is drawn at `\msc@currentheight`. The instance y-position is undefined after this command.

`\lost`[*pos*]{*label*}[*labelpos*]{*gate*}{*nm*}[*placement*] Draws a *lost message* from instance *nm*. The *label* parameter defines the message name. The *gate* parameter defines the gate name. The optional parameter *pos* defines the position of the message relative to instance *nm*. Valid positions are `l` (left) and `r` (right). The default position is `l`. The optional parameter *labelpos* defines the position of the message label with respect to the arrow. Valid values are `t` (on top) and `b` (below). The default value is `t`. The optional parameter *placement* defines the relative position of the message label along the message arrow. Valid values are real numbers in the closed interval $[0, 1]$, where 0 corresponds to the beginning of the arrow and 1 corresponds to the end of the arrow. The default value is 0.5. The length of the arrow is determined by `\selfmesswidth`.

`\measure(*)`[*pos*]{*txt*}{*nm1*}{*nm2*}[*offset*] Puts a *measure* at instances *nm1* and *nm2*. The parameter *txt* defines the label of the measure. The starred version puts the triangular measure symbols outside the measure; the unstarred version puts the triangular measure symbols inside the measure. The optional *pos* parameter defines the horizontal position of the measure relative to instances *nm1* and *nm2*. Valid positions are `l` (left), `r` (right), and all valid lengths. If the position is `l` or `r`, the measure will be put at `\measuredist` units to the left or right, respectively, from the closest instance axis. If *pos* is a length, the measure will be put *pos* units from the closest instance axis. A negative *pos* puts the measure to the left and a positive *pos* puts it to the right of the instances. The optional parameter *offset* defines the number of levels the measure should extend vertically. The default value for *offset* is 1.

`\measureend(*)`[*pos*]{*txt*}{*nm*}{*gate*} Puts a *measure end* symbol at instance *nm*.The starred version puts the triangular measure symbol outside the measure; the unstarred version puts the triangular measure symbol inside the measure. The *txt* parameter defines the label of the measure. The *gate* parameter defines the name of the gate of the measure end symbol. The optional *pos* parameter defines the horizontal position of the measure relative to the *nm* instance. Valid positions are `l` (left), `r` (right), and all valid lengths. If the position is `l` or `r`, the measure will be put at `\measuredist` units to the left or right, respectively, from the instance axis. If *pos* is a length, the measure will be put *pos* units from the instance axis. A negative *pos* puts the measure to the left and a positive *pos* puts it to the right of the instance.

`\measurestart(*)`[*pos*]{*txt*}{*nm*}{*gate*} Puts a *measure start* symbol at instance *nm*.The starred version puts the triangular measure symbol outside the measure; the unstarred version puts the triangular measure symbol inside the measure. The *txt* parameter defines the label of the measure. The *gate* parameter defines the name of the gate of the measure start symbol. The optional parameter *pos* defines the horizontal position of the measure relative to instance *nm*. Valid positions are `l` (left), `r` (right), and all valid lengths. If the position is `l` or `r`, the measure will be put at `\measuredist` units to the left or right, respectively, from the instance axis. If *pos* is a length, the measure will be put *pos* units from the instance axis. A negative *pos* puts the measure to the left and a positive *pos* puts it to the right of the instance.

`\mess(*)`[*pos*]{*label*}[*labelpos*]{*sender*}[*placement*]{*receiver*}[*offset*] Draws a message from *sender* instance to *receiver* instance. The starred version draws a dashed line arrow, instead of a solid arrow. This can be used to distinguish method calls from method replies. The *sender* and *receiver* may be the same instance, in which case the message is a *self message*. The parameter *label* defines the message name. The message starting y-position is `\msc@currentheight` and the ending y-position of the message is defined by `\msc@currentheight` + (*offset* × `\levelheight`). The optional parameter *pos* defines the position of self messages with respect to the instance axis. Valid values are `l` (left) and `r` (right). The default value is `l`. The optional parameter *labelpos* defines the position of the message label. In case of a self message, valid values are `l` and `r`, denoting a label position left from the arrow and right from the arrow, respectively. For self-messages the default value of `labelpos` is the value of `pos`. In case of a non-self message, valid values are `t` (default) and `b`, denoting a label position on top of the message arrow and below the message arrow, respectively. The optional parameter *placement* defines the relative position of the message label along the message arrow. Valid values are real numbers in the closed interval $[0, 1]$, where 0 corresponds to the beginning of the arrow and 1 corresponds to the end of the arrow. The default value is 0.5. The default value of the optional parameter *offset* is 0 for normal messages and 1 for self messages.

`\messarrowscale`{*scalefactor*} Sets the scale factor (a real number) of message arrow heads. The default value is 1.5

`\mscdate` The date of the MSC macro package.

`\mscdockeyword` The MSCdoc keyword. The default value is 'mscdoc'.

`\mscdockeywordstyle`{*kw*} A one-parameter command to typeset the mscdoc keyword. The command can expect `\mscdockeyword` to be the value of *kw*. The default 'value' is `\textbf`.

`\msckeyword` The MSC keyword. The default value is 'msc'.

`\msckeywordstyle`{*kw*} A one-parameter command to typeset the MSC keyword. The command can expect `\msckeyword` to be the value of *kw*. The default 'value' is `\textbf`.

`\mscmark`[*pos*]{*txt*}{*nm*} Puts a mark at instance *nm*. The parameter *txt* is the name of the mark. The optional parameter *pos* defines the horizontal and vertical position of the mark relative to instance *nm* and the current height `\msc@currentheight`. Valid positions are `tl` (top-left), `tr` (top-right), `bl` (bottom-left), and `br` (bottom-right). The default position is `tl`. The horizontal distance between the mark and the instance is defined by `\markdist`.

`\mscunit` A string denoting the (default) unit of all lengths used by the MSC macro package. Valid values are *cm*, *em*, *ex*, *in*, *mm*, *pt*, etc. The default value is *cm*.

`\setmscunit`{*unit*} Changes the value of `\mscunit` into *unit*. Valid values for *unit* are *cm*, *em*, *ex*, *in*, *mm*, *pt*, etc.

`\mscversion` The version number of the MSC macro package.

`\nextlevel`[*offset*] Increases the number of levels by the value of the optional parameter *offset*. The default value of *offset* is 1. Increasing the level number means that `\msc@currentheight` is increased by *offset* × `\levelheight`. The first time this macro is used, the actual increase of `\msc@currentheight` is `\firstlevelheight` + ((*offset* − 1) × `\levelheight`). Negative values of *offset* back up a number of levels. There are situations where this is useful, see Section 10.

\nogrid Turns off grid drawing in MSC, HMSC, and MSCdoc diagrams. This command should not be used inside an MSC, HMSC, or MSCdoc evironment.

\order[*pos*]{*sender*}{*receiver*}[*offset*] Draws an *order line* from the *sender* instance to the *receiver* instance. The *sender* and *receiver* may be the same instance, in which case the order is a *self-order*. The order starting y-position is \msc@currentheight and the ending y-position of the order is defined by \msc@currentheight + (*offset* × \levelheight). In case of a self-order, the optional parameter *pos* defines the position of the order relative to the *sender* instance. Valid positions are l (left) and r (right). The default position is l. In case of a non-self-order, the *pos* parameter is ignored. The default value of the optional parameter *offset* is 0 for normal orders and 1 for self orders.

\reference{*txt*}(*xpos*,*ypos*) Draws an MSCdoc reference symbol. The *txt* parameter defines the text to be placed inside the MSCdoc reference symbol. The coordinates (*xpos*,*ypos*) define the position of the reference symbol.

\referenceend{*nm*} Ends the reference expression with nickname *nm*.

\referencestart[*lo*][*ro*]{*nm*}{*txt*}{*fi*}{*li*} Defines a *reference expression* with nickname *nm*. The reference expression is started at \msc@currentheight and continues until the level where a matching \referenceend command is found. The *txt* parameter defines the text of the reference expression. The first instance of the reference expression is *fi*. The last instance of the reference expression is *li*. The optional parameter *lo* defines the left and right overlap of the reference expression. If the second optional parameter, *ro*, is present, *lo* defines the left and *ro* defines the right overlap.

\regionend{*nm*} Ends the current region on instance *nm*. The region style of the instance *nm* is reset to *normal* again. Note: this command makes \coregionend obsolete.

\regionstart{*rstyle*}{*nm*} Starts a region on the instance *nm*. The style of the region is defined by the *rstyle* parameter. Valid region styles are *coregion*, *suspension*, *activation*, and *normal*. Note: this command makes \coregionstart obsolete.

\separator{*ypos*} Draws a separator in an MSCdoc diagram. The *ypos* parameter defines the vertical position of the separator in the MSCdoc diagram.

\setfootcolor{*color*} Sets the color of the foot symbols of MSC instances. Possible values are *black*, *white*, *gray*, or *lightgray*. For more color values, see the documentation of the LaTeX $2_\varepsilon$ color package.

\sethmsckeyword{*kw*} Sets the HMSC keyword to *kw*. For this command to be effective, it should be used outside the HMSC environment.

\sethmsckeywordstyle{*kwstylemacro*} Redefines the \hmsckeywordstyle macro to the macro *kwstylemacro*. This should be a 1-argument macro, like the standard LaTeX \textbf and \textit commands. For this command to be effective, it should be used outside the HMSC environment.

\setmscdockeyword{*kw*} Sets the MSCdoc keyword to *kw*. For this command to be effective, it should be used outside the MSCdoc environment.

\setmscdockeywordstyle{*kwstylemacro*} Redefines the \mscdockeywordstyle macro to the macro *kwstylemacro*. This should be a 1-argument macro, like the standard LaTeX \textbf and \textit commands. For this command to be effective, it should be used outside the MSCdoc environment.

\setmsckeyword{*kw*} Sets the MSC keyword to *kw*. For this command to be effective, it should be used outside the MSC environment.

`\setmsckeywordstyle`{*kwstylemacro*} Redefines the `\msckeywordstyle` macro to the macro *kwstylemacro*. This should be a 1-argument macro, like the standard LaTeX `\textbf` and `\textit` commands. For this command to be effective, it should be used outside the MSC environment.

`\setmscscale`{*scalefactor*} Sets the scale factor of the MSC environment to *scalefactor*. the scale factor is supposed to be a real number. Scaling is done when the MSC environment ends (`\end{msc}`). The default of *scalefactor* is 1.

`\setmscvalues`{*size*} Sets the msc-lengths to one of the predefined *sizes*. Valid values for *size* are: `small`, `normal`, and `large`.

`\setstoptimer`[*pos*]{*label*}{*nm*}[*offset*] Draws both a *timer* and a *stop timer* symbol on the instance *nm*. The parameter *label* defines the name of the timer. The optional parameter *pos* defines the position of the *timer* relative to the *nm* instance. Valid positions are `l` (left) and `r` (right). The default position is `l`. The horizontal distance between the timer symbol and the instance axis is defined by `selfmesswidth`.

`\settimeout`[*pos*]{*label*}{*nm*}[*offset*] Draws a *timer* symbol on the instance *nm* and connects the *timer* symbol and the instance with an arrow. The parameter *label* defines the name of the *timer*. The optional parameter *pos* defines the position of the *timer* relative to the *nm* instance. Valid positions are `l` (left) and `r` (right). The default position is `l`. The optional parameter *offset* defines the number of levels between the *timer* symbol and the point where the arrow meets the *nm* instance. The default *offset* is 2. The horizontal distance between the timer symbol and the instance axis is defined by `selfmesswidth`.

`\settimer`[*pos*]{*label*}{*nm*} Draws a *timer* symbol on the instance *nm*. The parameter *label* defines the name of the timer. The optional parameter *pos* defines the position of the *timer* relative to the *nm* instance. Valid positions are `l` (left) and `r` (right). The default position is `l`. The horizontal distance between the timer symbol and the instance axis is defined by `selfmesswidth`.

`\showgrid` Turns on grid-drawing in MSC, MSCdoc, and HMSC diagrams. This is useful to determine the values of the user definable lengths or if normal pstricks commands should be included in the diagram. (Note that the vertical axis of the MSC grid has no positive labels.) This command should not be used inside an MSC, HMSC, or MSCdoc evironment.

`\stop`{*nm*} Stops the instance with nickname *nm*. The instance line of *nm* is drawn from its y-position to the current y-position of the MSC (`\msc@curentheight`). At the current height, a *stop* symbol is drawn.

`\stoptimer`[*pos*]{*label*}{*nm*} Draws a *stop timer* symbol on the instance *nm*. The parameter *label* defines the name of the timer. The optional parameter *pos* defines the position of the *timer* relative to the *nm* instance. Valid positions are `l` (left) and `r` (right). The default position is `l`. The horizontal distance between the timer symbol and the instance axis is defined by `selfmesswidth`.

`\timeout`[*pos*]{*label*}{*nm*} Draws a *timer* symbol on the instance *nm* and connects the symbol and the instance with an arrow. The parameter *label* defines the name of the timeout. The optional parameter *pos* defines the position of the *timer* symbol relative to the *nm* instance. Valid positions are `l` (left) and `r` (right). The default position is `l`. The horizontal distance between the timer symbol and the instance axis is defined by `selfmesswidth`.

# 5 User definable lengths

This section lists the user-definable lengths of the MSC macro package. For each length, the default values for large, normal, and small diagrams are given. The appearance of MSC, HMSC, and MSCdoc diagrams can be changed by adjusting these lengths. Use the normal `\setlength` command to change these lengths.

`\actionheight` Height of action symbols.
(large/normal/small value 0.75/0.6/0.5 cm.)

`\actionwidth` Width of action symbol.
(large/normal/small value 1.25/1.25/1.2 cm.)

`\bottomfootdist` Distance between bottom of foot symbol and frame.
(large/normal/small value 1.0/0.7/0.5 cm.)

`\commentdist` Distance between a comment and its instance.
(large/normal/small value 0.5/0.5/0.5 cm.)

`\conditionheight` Height of condition symbols.
(large/normal/small value 0.75/0.6/0.5 cm.)

`\conditionoverlap` Overlap of condition symbol.
(large/normal/small value 0.6/0.5/0.4 cm.)

`\envinstdist` Distance between environments and nearest instance line.
(large/normal/small value 2.5/2.0/1.2 cm.)

`\firstlevelheight` Height of level just below head symbols. Should not be changed inside the MSC environment.
(large/normal/small value 0.75/0.6/0.4 cm.)

`\hmscconditionheight` Height of HMSC condition symbol.
(large/normal/small value 0.375/0.3/0.25 cm.)

`\hmscconditionwidth` Width of HMSC condition symbol.
(large/normal/small value 1.0/0.8/0.7 cm.)

`\hmscconnectionradius` Radius of HMSC connection symbol.
(large/normal/small value 0.06/0.05/0.04 cm.)

`\hmscreferenceheight` Height of HMSC reference symbol.
(large/normal/small value 0.8/0.7/0.6 cm.)

`\hmscreferencewidth` Width of HMSC reference symbol.
(large/normal/small value 1.6/1.4/1.2 cm.)

`\hmscstartsymbolwidth` Width of HMSC start symbol.
(large/normal/small value 0.85/0.7/0.4 cm.)

`\inlineoverlap` Overlap of inline symbol.
(large/normal/small value 1.5/1.0/0.75 cm.)

`\instbarwidth` Default width of vertical instance bars (applies to fat instances only).
(large/normal/small value 0.0/0.0/0.0 cm.)

`\instdist` Distance between instance axes.
(large/normal/small value 3.0/2.2/1.5 cm.)

`\instfootheight` Height of foot symbols. Should not be changed inside the MSC environment.
(large/normal/small value 0.25/0.2/0.15 cm.)

`\instheadheight` Height of head symbols. Should not be changed inside the MSC environment.
(large/normal/small value 0.6/0.55/0.5 cm.)

`\instwidth` Width of header and foot symbols.
(large/normal/small value 1.75/1.6/1.2 cm.)

`\labeldist` Distance between labels and the symbols to which they belong (for instance, message labels and arrows).
(large/normal/small value 1.0/1.0/1.0 ex.)

`\lastlevelheight` Height of level just above foot symbols. Should not be changed inside the MSC environment.
(large/normal/small value 0.5/0.4/0.3 cm.)

`\leftnamedist` Distance between left of the frame and (left of) MSC, HMSC, or MSCdoc title.
(large/normal/small value 0.3/0.2/0.1 cm.)

`\levelheight` Height of a level.
(large/normal/small value 0.75/0.5/0.4 cm.)

`\lostsymbolradius` Radius of the lost and found symbols.
(large/normal/small value 0.15/0.12/0.08 cm.)

`\markdist` Horizontal distance from a mark to its instance.
(large/normal/small value 1.0/1.0/1.0 cm.)

`\measuredist` Horizontal distance from a measure to its (closest) instance.
(large/normal/small value 1.0/1.0/1.0 cm.)

`\measuresymbolwidth` Width of a measure symbol.
(large/normal/small value 0.75/0.6/0.4 cm.)

`\mscdocreferenceheight` Height of reference symbol in an MSCdoc.
(large/normal/small value 0.8/0.7/0.6 cm.)

`\mscdocreferencewidth` Width of reference symbol in an MSCdoc.
(large/normal/small value 1.6/1.4/1.2 cm.)

`\referenceoverlap` Overlap of reference symbol.
(large/normal/small value 1.5/1.0/0.75 cm.)

`\regionbarwidth` Width of region bars.
(large/normal/small value 0.5/0.4/0.2 cm.)

`\selfmesswidth` Length of horizontal arms of self-messages, self-orders, lost messages and found messages as well as horizontal distance between instance axis and timer symbols.
(large/normal/small value 0.75/0.6/0.4 cm.)

`\stopwidth` Width of the stop symbol.
(large/normal/small value 0.6/0.5/0.3 cm.)

`\timerwidth` Width of the *timer* symbols.
(large/normal/small value 0.4/0.3/0.2 cm.)

`\topheaddist` Distance between top of head symbols and frame.
(large/normal/small value 1.5/1.3/1.2 cm.)

`\topnamedist` Distance between top of the frame and (top of) MSC, HMSC, or MSCdoc title.
(large/normal/small value 0.3/0.2/0.2 cm.)

# 6 Internal lengths

The MSC macro package uses some scratch lengths to perform calculations. Below, these scratch lengths are listed.

`\msc@commentdist` Internal length to compute distance between comments and instances. (This length should be removed in the future.)

`\msc@currentheight` The current height of the current MSC environment.

`\msc@currentwidth` The current width of the current MSC environment.

`\msc@totalheight` The final height of the current MSC environment.

`\msc@totalwidth` The final width of the current MSC environment.

`\tmp@X` Scratch length for intermediate computations.

`\tmp@Xa` Scratch length for intermediate computations.

`\tmp@Xb` Scratch length for intermediate computations.

`\tmp@Xc` Scratch length for intermediate computations.

`\tmp@Xd` Scratch length for intermediate computations.

`\tmp@Y` Scratch length for intermediate computations.

`\tmp@Ya` Scratch length for intermediate computations.

`\tmp@Yb` Scratch length for intermediate computations.

`\tmp@Yc` Scratch length for intermediate computations.

`\tmp@Yd` Scratch length for intermediate computations.

# 7 Internal boxes

`\mscbox` The box that contains the current MSC just before it is put on paper.

`\tmp@box` Scratch box for intermediate computations

# 8 Internal counters

`\mscinstcnt` The MSC instance counter. This counter is increased each time an instance is created.

`\tmpcnt` Scratch counter for intermediate computations.

# 9 Limitations

1. The frames in an MSC do not automatically scale with the text inside the frame. However, the size of the frames can be set manually.
2. Start and end points of messages are computed at the current level. This can give ill-looking effects if the width of the bar of an instance changes after the message is drawn, e.g., if an activation region starts or ends after the message is drawn.

3. Messages that cause the start of a region should be drawn after the `\regionstart` command, but in the same level.
4. Messages that denote the end of a region should be drawn before the `\regionend` command.
5. Activation regions make crossing messages partly invisible. A solution for this problem is to first draw the instance foot symbols at the right level (using `\inststop{i}`), then back up the total number of levels of the MSC (using `\nextlevel[-n]`), and then drawing the messages.
6. Documents using the MSC macro package cannot be compiled with *pdflatex*. The reason for this is that pstricks is not supported by *pdflatex*.
7. The source code of the MSC macro package is only marginally documented. Therefore, changes/improvements by others are unlikely.

# 10 Tricks

In this section we describe some tricks to use the MSC macro package efficiently.

**Multi-line text arguments** Many graphical objects in MSC diagrams have text labels. In general, the commands to draw these objects put the text arguments on one line. If the text should consist of multiple lines, the LaTeX `\parbox` command can be used. For instance, to generate a message with a two-line label, write:

```
\mess{\parbox{1cm}{two\\lines}}{s}{r}
```

**Specifying lengths** The MSC macro package imports the calc package in order to have a more natural syntax for arithmetical expressions. Consequently, if a command expects a LaTeX length argument, it is possible to use the expression syntax offered by calc.

For example, consider the MSC of Figure 5. To make sure the comment for instance $j$ appears 1ex to the right of the MSC frame, the value of the optional *pos* parameter of the `\comment` command should be

$$\texttt{\textbackslash instdist} + \texttt{\textbackslash envinstdist} + 1\text{ex}.$$

To express this in normal LaTeX, one should write something like

```
\newlength{\l}
\setlength{\l}{\instdist}
\addtolength{\l}{\envinstdist}
\addtolength{\l}{1ex}
\msccomment[\l]{Comment for $j$}{j}
```

inside the MSC code. However, using calc's expression syntax, it is also possible to write

```
\msccomment[\instdist + \envinstdist + 1ex]{Comment for $j$}{j}
```

The complete code for the diagram of Figure 5 is given below. Since the calc package is included in the standard LaTeX distribution, there should be no compatibility problems.

```
\begin{msc}{Specifying lengths}
\declinst{i}{$i$}{}
\declinst{j}{$j$}{}
\declinst{k}{$k$}{}

\nextlevel
\msccomment[\instdist + \envinstdist + 1ex]{Comment for $j$}{j}
\nextlevel[2]
\end{msc}
```

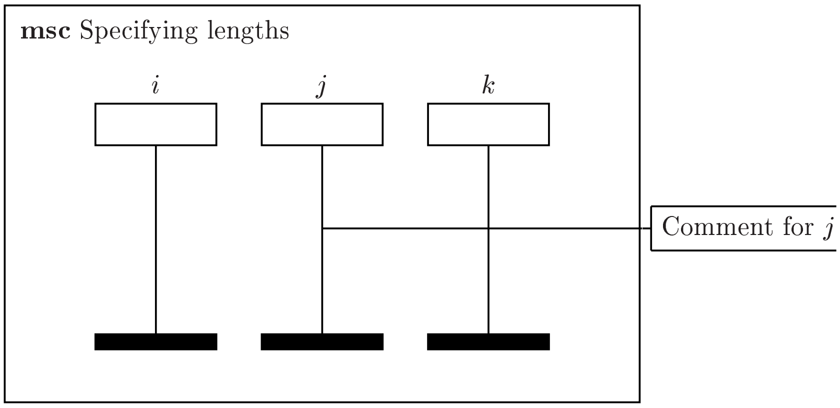



Figure 5: Specifying lengths

**Level backup** It is possible to back-up several levels: just use a negative value in the `\nextlevel` command. This *feature* can be useful to draw messages over regions instead of regions over messages. Compare the diagrams of Figure 6. The code for these diagrams is given below.

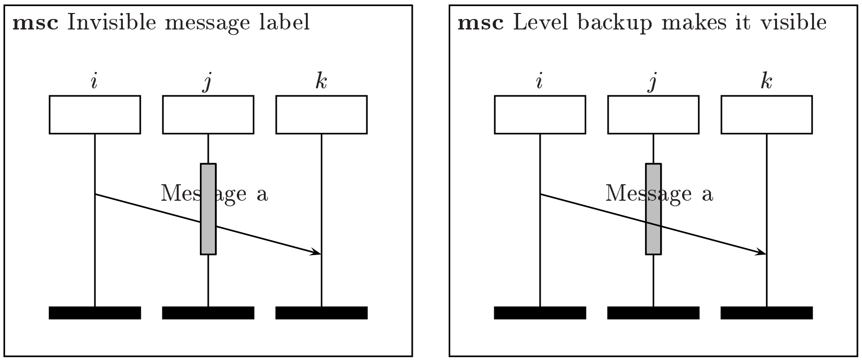



Figure 6: Level back-up

```
\begin{msc}{Invisible message label}
\declinst{i}{$i$}{}
\declinst{j}{$j$}{}
\declinst{k}{$k$}{}

\regionstart{activation}{j}
\nextlevel
\mess{Message a}{i}[0.25]{k}[2]
\nextlevel[2]
\regionend{j}
\nextlevel
\end{msc}
```

```
\begin{msc}{Level backup makes it visible}
\declinst{i}{$i$}{}
\declinst{j}{$j$}{}
\declinst{k}{$k$}{}
```

```
\regionstart{activation}{j}
\nextlevel[3]
\regionend{j}
\nextlevel[-2]% backing up
\mess{Message a}{i}[0.25]{k}[2]
\nextlevel[2]% fast forward
\nextlevel
\end{msc}
```

**Automatic resizing of actions** Consider the MSC of Figure 7. The source code for this diagram is:

```
\begin{msc}{small action}
\declinst{i}{$i$}{}
\declinst{j}{$j$}{}
\action{\parbox{1cm}{\centering Do it now}}{i}
\nextlevel[2]
\end{msc}
```

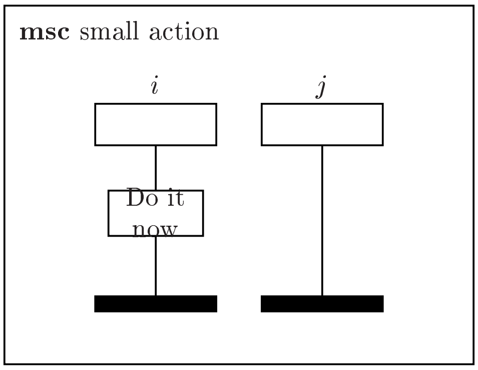



Figure 7: Small action symbol

It is clear that the action symbol is too small for the action label. The normal solution to this problem would be to change the values of `\actionwidth` and `\actionheight` such that the `\parbox` containing the action label fits in the frame of the action symbol.

Instead of computing these lengths and adding the necessary `\setlength` commands manually, it would be nice to have a macro that computes and adjusts the lengths as required. The `\Action` macro defined below does just that.

```
\newsavebox{\labelbox}
\newlength{\oldwd}
\newlength{\oldht}
\newcommand{\Action}[2]{%
  \setlength{\oldwd}{\actionwidth}%
  \setlength{\oldht}{\actionheight}%
  \savebox{\labelbox}{#1}%
  \setlength{\actionwidth}{\wd\labelbox + 2\labeldist}%
  \setlength{\actionheight}{\ht\labelbox + \dp\labelbox + 2\labeldist}%
  \action{\usebox{\labelbox}}{#2}%
  \setlength{\actionwidth}{\oldwd}%
  \setlength{\actionheight}{\oldht}%
}
```

Note that we define a box (`\labelbox`) and two lengths (`\oldwd` and `\oldht`) as scratch variables. Furthermore, before changing the width and height of action symbols, the old values are saved in `\oldwd` and `\oldht`, respectively. The new width and height of action symbols accomodate for white space around the action label by using the MSC macro package length `\labeldist`. After changing the lengths, the action is drawn using the normal `\action` command. Finally, the old values of `\actionwidth` and `\actionheight` are restored.

Figure 8 shows the effect of automatic resizing action symbols. Instance $i$ has automically resizing action. The actions of instance $j$ are normal actions that show the new `\Action` command changes the size of one action symbol only. The source of this diagram is given below.

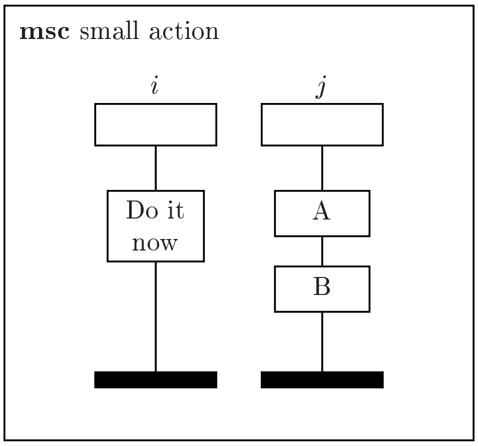



Figure 8: Automatic resizing action symbol

```
\begin{msc}{small action}
\declinst{i}{$i$}{}
\declinst{j}{$j$}{}
\action{A}{j}
\Action{\parbox{1cm}{\centering Do it now}}{i}
\nextlevel[2]
\action{B}{j}
\nextlevel[2]
\end{msc}
```

# References


[1] V. Bos and S. Mauw. *A LaTeX macro package for Message Sequence Charts—User Manual—Describing* MSC *macro package version 1.13*, June 2002. Included in MSC macro package distribution.

[2] ITU-TS. ITU-TS Recommendation Z.120: Message Sequence Chart (MSC). Geneva, 1997.