Review to the Article Proof

I. RESPONSES TO THE QUERIES

Q1. Author: Please check whether the first footnote is ok as set.
Response: The first footnote is OK.

Q2. Author: Please check whether the affiliations for all the authors are ok as set.
Response: They are OK.

Q3. Author: Please provide the subject in which "Xiaoyu Song" received his Ph.D. degree.
Response: Xiaoyu Song received his Ph.D. degree in computer engineering.

II. LIST OF CORRECTIONS

The positions, which need to be corrected, are highlighted in the file `annotated_proof.pdf`. Here we list all the corrections corresponding to the highlighted positions in `annotated_proof.pdf`. The file `example.pdf` is typeset by the authors, and it may be useful for the corrections. (The corresponding positions are also highlighted.)

Here are the detailed list of corrections:

- Page 1, line 3: "With" → "with".
  We guess the first letter of a preposition need not be capitalized.

- Page 1, line 65: "few attempt [23], [24]" → "few [23], [24] attempt"

- Page 1, line 68: "*real-time Maude*" → "*Real-Time Maude*".
  It is the name of the tool.

- Page 1, line 76: "Section" and "II". Please do not break "Section II" into two lines.

- Page 2, line 78: "real-time Maude" → "Real-Time Maude"

- Page 2, line 80: "real-time Maude" → "Real-Time Maude"

- Page 2, line 110: "Real-time Maude" → "Real-Time Maude"

- Page 2, line 113: "Real-time Maude" → "Real-Time Maude"

- Page 2, line 127: "IR" → "IR". Please use the macro `\mathit{}`.

- Page 2, line 134: "TR" → "TR". Please use the macro `\mathit{}`.

- Page 2, line 138: "IR" → "IR". Please use the macro `\mathit{}`.

- Page 2, line 138: "TR" → "TR". Please use the macro `\mathit{}`.

- Page 2, line 139: "nondeterministically" → "non-deterministically".

- Page 2, line 141: "nondeterministic" → "non-deterministic".

- Page 2, line 142: "real-time Maude" → "Real-Time Maude"

- Page 2, line 143: "Real-time Maude" → "Real-Time Maude"

- Page 2, line 144: "`class ...`" → "`class` C `|` att_1`:`s_1`,` $\ldots$`,` att_n`:`s_n".
  All things should be put in `\verb` mode except "C" "att_1" "s_1" "$\ldots$" "att_n" and "s_n", which should be in math mode.

- Page 2, line 147: "`< ... >`" → "`<` O`:`C `|` att_1`:`val_1`,` $\ldots$`,` att_n`:`val_n `>`".
  All things should be put in `\verb` mode except "O" "C" "att_1" "val_1" "$\ldots$" "att_n" and "val_n", which should be in math mode.

- Page 2, line 152: "Real-time Maude" → "Real-Time Maude"

- Page 2, line 159: "real-time Maude" → "Real-Time Maude"

- Page 2, line 164: "`ceq ...`" → "`ceq` $statePattern$ `|=` $prop$ `=` b `if` $cond$".
  All things should be put in `\verb` mode except "$statePattern$" "$prop$" "b" and "$cond$", which should be in math mode. And "$statePattern$" and "$prop$" are better to use the macro `\mathit{}`.

- Page 2, line 165: "$prop$" → "$prop$". Please use the macro `\mathit{}`.

- Page 2, line 166: "$statePattern$" → "$statePattern$". Please use the macro `\mathit{}`.

- Page 2, line 167: "$prop$" → "$prop$". Please use the macro `\mathit{}`.

- Page 2, line 168: "$s \mathrel{|{=}} prop$" → "s `|=` $prop$".
  All things should be put in `\verb` mode except "s" and "$prop$", which should be in math mode.
  And please use the macro `\mathit{}` for "$prop$".

- Page 2, line 170: "(negation)" → "`~`(negation)". The tilde "`~`" should be in `\verb` mode.

- Page 2, line 170: "`\/`" → "`\/`". All things should be put in `\verb` mode.

- Page 2, line 171: "Real-time Maude" → "Real-Time Maude"

- Page 2, line between 172 and 173: "`(mc ... )`" → "`(mc` s `|=u` Φ `.)`".
  All things should be put in `\verb` mode except "s" and "Φ", which should be in math mode.

- Page 3, line 210–217:
  For the `\enumerate` environment, is it possible to reduce the indentation right after the number, such that for each item, the first word of the first line is aligned with those of the other lines? For example, reduce the space between "1)" and "the" at line 210, such that this "the" is aligned with "possibly" at line 211 and "is" at line 212.

- Page 3, line 218: "Switching".
  Please remove the indentation before "Switching", this is not a new paragraph.

- Page 3, line 222–227:
  For the `\enumerate` environment, is it possible to reduce the indentation right after the number, such that for each item, the first word of the first line is aligned with those of the other lines?

- Page 3, line 258: "Sections IV-C". Please do not break "Sections IV-C" into two lines.

- Page 3, line 259: "Section IV-F". Please do not break "Section IV-F" into two lines.

- Page 4, lines 293–294:
  Please make sure that this kind of code throughout the article is put in `\verb` mode. (We are not sure whether it is true because "|" look a bit higher and ">" look a bit wider than what they should be.)

- Page 4, lines 300–302: it should be
  ```
  class PTask | priority : Nat,
               period : Nat,
               status : Status .
  ```
  Please make sure that "`priority`" "`period`" and "`status`" are aligned with each other.

- Page 4, line 304: "`RUN-NING`" → "`RUNNING`".
  Please use `\verb` mode and do not break the word into two parts.

- Page 4, lines 320–321: it should be
  ```
  class Regs | pc : TaskID,
               mask : Bool, ir : Bool .
  ```
  Please make sure that "`pc`" is aligned with "`mask`".

- Page 4, lines 331–332: it should be
  ```
  class IntSrc | val : Time,
                 cycle : Time .
  ```
  Please make sure that "`val`" is aligned with "`cycle`".

- Page 4, lines 335–337: it should be
  ```
  op _____ : TaskList Timer SysTasks
              Hardware Object
              ~> System [ctor] .
  ```
  Please make sure that "`TaskList`" "`Hardware`" and "`~>`" are aligned with each other.

- Page 4, lines 338–339: it should be
  ```
  mb (L T STS HW < O : IntSrc |>)
      : System .
  ```
  Please make sure that "(" is aligned with ":".

- Page 4, line 340: " ˜>" → "˜>". Please remove the space before "˜".

- Page 4, line 342: "`Sys-Tasks`" → "`SysTasks`".
  Please use `\verb` mode and do not break the word into two parts.

- Page 5, lines 362–363: it should be
  ```
  op updateStatus_with_ : TaskList Timer
                               -> TaskList .
  ```
  Please make sure that "`->`" is aligned with the first "`s`" in "`TaskList`" at line 362.

- Page 5, lines 366–367: it should be

```
op update_with_ : Object Timer
                        ~> Object .
```

  Please make sure that "~>" is aligned with the "j" in "Object" at line 366.

- Page 5, lines 371–374: it should be

```
= if ST == DORMANT
  then < O : PTask | status : READY >
  else error fi
if TIMER rem T == 0 .
```

  Please make sure that "if" at 371, "then" at 372 and "else" at 373 are aligned with each other. And make sure that "=" at 371 is aligned with "if" at 374.

- Page 5, lines 377–381: it should be

```
= if ST == RUNNING
  then < O : PTask
          | status : INTERRUPT >
  else < O : PTask |> fi
[otherwise] .
```

  Please make sure that "if" at 377, "then" at 378 and "else" at 380 are aligned with each other. Make sure that "|" at 379 is aligned with "O" at 378. Make sure that "[otherwise]" at 381 is aligned with "=" at 377.

- Page 5, lines 400–403: it should be

```
crl [interrupt-handle] :
  SYSTEM =>
  ((SYSTEM).interrupt).startScheduling
  if (SYSTEM).existInt .
```

  Please make sure that "SYSTEM" at 401, "((" at 402 and "if" at 403 are aligned with each other.

- Page 5, line 407–413:
  For the \enumerate environment, is it possible to reduce the indentation right after the number, such that for each item, the first word of the first line is aligned with those of the other lines?

- Page 5, lines 426–427: it should be

```
op _.startScheduling : System
                          -> System .
```

  Please make sure that "->" at 427 is aligned with the second "s" in "System" at 426.

- Page 5, lines 429–430: it should be

```
= ((updateStatus L with T)
   inc(T) STS HW ISRC) .
```

  Please make sure that "inc" at 430 is aligned with the second "(" at 429.

- Page 5, lines 435–436: it should be

```
op _.finishScheduling : System
                           -> System .
```

  Please make sure that "->" at 436 is aligned with the second "s" in "System" at 435.

- Page 5, lines 438–439: it should be

```
      = (L T (finish scheduling in STS)
          HW ISRC).run1stTask .
```
Please make sure that "`HW`" at 439 is aligned with "`L`" at 438.

- Page 5, line 450: "`/\`" → "`/\`". All things should be put in \verb mode.

- Page 5, line 451: "`/\`" → "`/\`". All things should be put in \verb mode.

- Page 6, footnote 3: "real-time Maude" → "Real-Time Maude"

- Page 6, footnote 4: "Real-time Maude" → "Real-Time Maude"

- Page 6, line 478: "*ID*" → "*ID*". Please use the macro \mathit{}.

- Page 6, lines 482–485: it should be
```
      = (deltaTask(ID, L, R)
          T STS HW (deltaIS(ISRC, R)))
        if ID := (HW).getPc
          /\ ID :: MaybeNat .
```
Please make sure that "`deltaTask`" at 482 is aligned with "`T`" at 483. Make sure that "`=`" at 482 is aligned with "`if`" at 484. And make sure that "`/\`" at 485 is aligned with "`ID`" at 484.

- Page 6, lines 495–498: it should be
```
      = minimum(mteTask(ID, L),
                mteIS(ISRC), mteIr(HW))
        if ID := (HW).getPc
          /\ ID :: MaybeNat .
```
Please make sure that "`mteTask`" at 495 is aligned with "`mteIS`" at 496. Make sure that "`=`" at 495 is aligned with "`if`" at 497. And make sure that "`/\`" at 498 is aligned with "`ID`" at 497.

- Page 6, line 524: "`[]( taskTimeout)`" → "`[](˜taskTimeout)`".
All things should be put in \verb mode.

- Page 6, line 530: "`( taskTimeout)`" → "`(˜taskTimeout)`".
All things should be put in \verb mode.

- Page 6, lines 537–540: it should be
```
      = if ID :: MaybeNat
        then shouldRun(ID, L)
        else true fi
        if ID := (HW).getPc .
```
Please make sure that "`if`" at 537, "`then`" at 538 and "`else`" at 539 are aligned with each other. And make sure that "`=`" at 537 is aligned with "`if`" at 540.

- Page 6, lines 546–547: "`(...)\/(...)`" → "`([]correct)\/(correct U taskTimeout)`".
Please put the formula in \verb mode, and do not break it into two lines.

- Page 6, lines 551–552: it should be
```
  (mc init |=u ([]correct)
                \/ (correct U taskTimeout) .)
```
Please make sure that "`\/`" at 552 is aligned with "`([]correct)`" at 551.
Or if it is too wide to fit the column, it can be

```
(mc init |=u ([]correct) \/
            (correct U taskTimeout) .)
```
Please make sure that "(" at 552 is aligned with the second "(" at 551.

- Page 6, lines 556–559:
  If possible, we prefer an \itemize (unnumbered) environment instead of an \enumerate (numbered) enviroment here.

- Page 6, line 556: "5 ms". The space seems larger than others, please correct it.

- Page 6, line 557: "38 μs" and "20 μs". The space seems larger than others, please correct it.

- Page 7, lines 564–573:
  If possible, we prefer an \itemize (unnumbered) environment instead of an \enumerate (numbered) enviroment here.

- Page 7, lines 564–573:
  Along these lines, the spaces between the numbers and their units seem larger than the normal value, please correct them.

- Page 7, line 574: "real-time Maude" → "Real-Time Maude"

- Page 7, footnote 5: "time robustness" → "time-robustness"

- Page 7, footnote 5: "tick invariance" → "tick-invariance"

- Page 7, line 635: "time robust" → "time-robust"

- Page 7, line 637: "tick invariant" → "tick-invariant"

- Page 7, line 665: "nondeterminism" → "non-determinism"

- Page 8, line 672: "nondeterminism" → "non-determinism"

- Page 8, line 697: "such as" → "similar to"

- Page 8, line 700: "real-time Maude" → "Real-Time Maude"

- Page 8, line 704: "real-time Maude" → "Real-Time Maude"

- Page 8, line 706: "real-time Maude" → "Real-Time Maude"

- Page 8, line 724: "time robustness" → "time-robustness"

- Page 8, line 725: "time robustness" → "time-robustness"

- Page 8, line 729: "time robust" → "time-robust"

- Page 8, lines 731–738.
  Please use "(i)" "(ii)" instead of "1)" "2)" for the numbers, because they correspond to the *Proof of Theorem 2*.
  On the other hand, the indentation of this list is much larger than others, please fix it.

- Page 8, line 731: "`mte(...)=mte(...)`" → "`mte(delta(t,r)) = mte(t)`"

- Page 8, line 732: "$r \leq$`mte(t)`" → "$r \leq$ `mte(t)`"

- Page 8, line 734: "delta$(t\ ,0)$" → "delta$(t,0)$"

- Page 8, line 735:
  "delta(delta$(t\ ,r\ )$,$r'\ )$ =delta$(t,r+r')$"
  →
  "delta(delta(t,r),$r')$ = delta$(t,r+r')$"

- Page 8, line 736: "$r+r' \leq$mte(t)" → "$r+r' \leq$ mte(t)"

- Page 8, line 737: "mte$(\sigma(l)\ )$" → "mte$(\sigma(l))$"

- Page 8, line 739: "tick invariance" → "tick-invariance"

- Page 9, lines 743–748:
  If possible, we prefer an \itemize (unnumbered) environment instead of an \enumerate (numbered) enviroment here.

- Page 9, line 747: "*nonmaximal*" → "*non-maximal*"

- Page 9, line 749: "*tick invariant*" → "*tick-invariant*"

- Page 9, line 751: "nonmaximal" → "non-maximal"

- Page 9, line 752: "tick invariance" → "tick-invariance"

- Page 9, line 757: "tick invariant" → "tick-invariant"

- Page 9, line 758: "$\{t\} \simeq_P \{$delta$(t,r)\}$" → "$\{t\} \simeq_P \{$delta$(t,r)\ \}$".
  The braces "$\{\}$" should be put in \verb mode.

- Page 9, line 759: "$r <$mte(t)" → "$r < $ mte(t)"

- Page 9, lines 761–771: "ID" → "ID". Please use the macro \mathit{}.

- Page 9, line 763: "monus" → "monus". It should be put in \verb mode.

- Page 9, line 764: "none" → "none". It should be put in \verb mode.

- Page 9, lines 765–766: "=mteTask$($none$,L)$" → "= mteTask$($none$,L)$".
  On one hand, "=" should be followed by a little space.
  On the other hand, "mteTask$($none$,L)$" should not be broken into two lines.

- Page 9, line 766: "INF" → "INF". It should be put in \verb mode.

- Page 9, line 766: "monus" → "monus". It should be put in \verb mode.

- Page 9, line 767: "some$N$" → "some N". "some" should be put in \verb mode.

- Page 9, lines between 770 and 771: "monus" → "monus".
  "monus" should be put in \verb mode and there should be spaces before and after "monus".

- Page 9, lines 771–777: "$ISRC$" → "$ISRC$". Please use the macro \mathit{}.

- Page 9, lines between 774 and 777: "monus" → "monus".
  "monus" should be put in \verb mode and there should be spaces before and after "monus".

- Page 9, lines 775–776: "$< O... >$" → "`<O:IntSrc|val:`v`,cycle:`T`>`".
  All things should be put in \verb mode except "O" "v" and "T", which should be in math mode.

- Page 9, lines 778–779. Please do not break the line 778.

- Page 9, line 779: "monus" → "`monus`".

- Page 9, line 783: "time robustness" → "time-robustness"

- Page 9, line 784: "Lemma 3" → "Lemma A.1"

- Page 9, line 788: "Lemma 3" → "Lemma A.1"

- Page 9, lines 790–791: "`mte(`s`)`". Please do not break it into two lines.

- Page 9, line 791: "$r \leq$`mte(`s`)`" → "$r \leq$ `mte(`s`)`"

- Page 9, lines 792–793: "$(LTSTSHWISRC)$" → "$(L\ T\ STS\ HW\ ISRC)$.
  Please use the macro \mathit{} for "STS" and "$ISRC$". And please do not break this into two lines.

- Page 9, line 793: "ID" → "ID". Please use the macro \mathit{}.

- Page 9, line 793: "(HW).getPc" → "(HW)`.getPc`".
  All things should be put in \verb mode except "HW", which should be in math mode.

- Page 9, line 794: "ID" → "ID". Please use the macro \mathit{}.

- Page 9, equations between lines 795 and 796: it should be

$$
\begin{aligned}
& \texttt{mte(delta(}s\texttt{,}r\texttt{))} \\
={} & \texttt{mte(deltaTask(}ID\texttt{,}L\texttt{,}r \\
& \qquad T\ STS\ HW\ \texttt{deltaIS(}ISRC\texttt{,}r\texttt{))} \\
={} & \texttt{minimum(mteTask(}ID\texttt{,deltaTask(}ID\texttt{,}L\texttt{,}r\texttt{)),} \\
& \qquad \texttt{mteIS(deltaIS(}ISRC\texttt{,}r\texttt{)),} \\
& \qquad \texttt{mteIr(}HW\texttt{))} \,.
\end{aligned}
$$

Note:
  – All things should be put in \verb mode except "s" "r" "ID" "L" "T" "STS" "HW" and "$ISRC$", which should be in math mode.
  – Please use the macro \mathit{} for "ID" "STS" and "$ISRC$".
  – After the first "=", "`deltaTask`" should be aligned with "T".
  – After the second "=", "`mteTask`" "`mteIS`" and "`mteIr`" should be aligned with each other.

- Page 9, line 796: "Lemmas 7, 8, and 9" → "Lemmas A.5, A.6, and A.7"

- Page 9, equations between lines 796 and 797: it should be

$$\begin{aligned}
&\texttt{mte(delta(}s\texttt{,}r\texttt{))}\\
&= \texttt{minimum(mteTask(}\mathit{ID}\texttt{,}L\texttt{) monus } r \texttt{ ,}\\
&\qquad\quad \texttt{mteIS(}\mathit{ISRC}\texttt{) monus } r \texttt{ ,}\\
&\qquad\quad \texttt{mteIr(}\mathit{HW}\texttt{) monus } r \texttt{)}\\
&= \texttt{minimum(mteTask(}\mathit{ID}\texttt{,}L\texttt{),}\\
&\qquad\quad \texttt{mteIS(}\mathit{ISRC}\texttt{),}\\
&\qquad\quad \texttt{mteIr(}\mathit{HW}\texttt{)) monus } r\\
&= \texttt{mte(}s\texttt{) monus } r \texttt{ .}
\end{aligned}$$

  Note:
  – All things should be put in \verb mode except "s" "r" "ID" "L" "HW" and "$ISRC$", which should be in math mode.
  – Please use the macro \mathit{} for "ID" and "$ISRC$".
  – "mteTask" "mteIS" and "mteIr" should be aligned with each other.
  – There should be spaces before and after "monus".

- Page 9, line 798: "$r$monus0" → "r monus 0"

- Page 9, line 802: "ID" → "ID". Please use the macro \mathit{}.

- Page 9, equations between lines 803 and 804: it should be

$$\begin{aligned}
&\texttt{delta(delta(}s\texttt{,}r\texttt{),}r'\texttt{)}\\
&= \texttt{(deltaTask(}\mathit{ID}\texttt{,deltaTask(}\mathit{ID}\texttt{,}L\texttt{,}r\texttt{),}r'\texttt{)}\\
&\quad T\ \mathit{STS}\ \mathit{HW}\ \texttt{deltaIS(deltaIS(}\mathit{ISRC}\texttt{,}r\texttt{),}r'\texttt{)) ,}
\end{aligned}$$

  Note:
  – All things should be put in \verb mode except "s" "r" "r'" "ID" "L" "T" "STS" "HW" and "$ISRC$", which should be in math mode.
  – Please use the macro \mathit{} for "ID" "STS" and "$ISRC$".
  – The last comma should be in text mode.

- Page 9, equations between lines 804 and 805: it should be

$$\begin{aligned}
&\texttt{delta(}s\texttt{,}r+r'\texttt{)}\\
&= \texttt{(deltaTask(}\mathit{ID}\texttt{,}L\texttt{,}r+r'\texttt{)}\\
&\quad T\ \mathit{STS}\ \mathit{HW}\ \texttt{deltaIS(}\mathit{ISRC}\texttt{,}r+r'\texttt{)) .}
\end{aligned}$$

  Note:
  – All things should be put in \verb mode except "s" "$r+r'$" "ID" "L" "T" "STS" "HW" and "$ISRC$", which should be in math mode.
  – Please use the macro \mathit{} for "ID" "STS" and "$ISRC$".
  – The last period should be in text mode.

- Page 9, line 805: "ID" → "ID". Please use the macro \mathit{}.

- Page 9, lines 805–806: "=delta-Task$(ID,L,r+r')$" → "$=$ deltaTask$(ID,L,r+r')$". All things should be put in \verb mode except "$=$" "ID" "L" and "$r+r'$", which should be in math mode. Please use the macro \mathit{} for "ID".

- Page 9, line 807: "deltaIS(...)" → "`deltaIS(deltaIS(`$ISRC$`,`r`),`r'`)`".
  All things should be put in \verb mode except "$ISRC$" "r" and "r'", which should be in math mode. Please use the macro \mathit{} for "$ISRC$".

- Page 9, line 808: "$ISRC$" → "$ISRC$". Please use the macro \mathit{}.

- Page 9, lines 808–809: "monus" → "`monus`".
  "`monus`" should be put in \verb mode and there should be spaces before and after "`monus`".

- Page 10, line 813: "$ISRC$" → "$ISRC$". Please use the macro \mathit{}.

- Page 10, equations between lines 814 and 815: it should be

$$\begin{aligned}
&\texttt{mte(}L\ T\ STS\ HW\ ISRC\texttt{)}\\
&= \texttt{minimum(mteTask(}ID\texttt{,}L\texttt{),}\\
&\qquad\quad \texttt{mteIS(}ISRC\texttt{),mteIr(}HW\texttt{))}\\
&= \texttt{minimum(mteTask(}ID\texttt{,}L\texttt{), }0\texttt{ ,mteIr(}HW\texttt{))}\\
&= 0\ .
\end{aligned}$$

  Note:
  – All things should be put in \verb mode except "L" "T" "STS" "HW" "$ISRC$" "ID" and "0", which should be in math mode.
  – Please use the macro \mathit{} for "STS" "$ISRC$" and "ID".
  – "`mteTask`" and "`mteIS`" should be aligned with each other.
  – The last period should be in text mode.

- Page 10, line 816: "Lemma 3" → "Lemma A.1"

- Page 10, line 817: "tick invariance" → "tick-invariance"

- Page 10, lines 818–819: "`cor-rect`" → "`correct`". Please do not break it into two parts.

- Page 10, line 819: "Lemma 6" → "Lemma A.4"

- Page 10, line 819: "s $\simeq_P$ delta(s,r)" → "`{`s`}` $\simeq_P$ `{delta(`s`,`r`)}`".
  All things should be put in \verb mode except "s" "$\simeq_P$" and "r".

- Page 10, line 822: "($LTSTSHWISRC$)" → "($L\ T\ STS\ HW\ ISRC$)".
  Please use the macro \mathit{} for "STS" and "$ISRC$".

- Page 10, line 822: "(HW).getPc" → "`(`HW`).getPc`".
  All things should be put in \verb mode except "HW", which should be in math mode.

- Page 10, line 823: "ID" → "ID". Please use the macro \mathit{}.

- Page 10, line 828: "tick invariant" → "tick-invariant"

- Page 10, lines 828–829: "`taskTime-out`" → "`taskTimeout`".
  Please do not break it into two parts.

- Page 10, line 830: "ID" → "ID". Please use the macro \mathit{}.

- Page 10, line 831: "ID" → "ID". Please use the macro \mathit{}.

- Page 10, line 834: "tick invariance" → "tick-invariance"

- Page 10, line 910: "German" → "Chinese"

- Page 10, lines 915–916: "real-time Maude" → "Real-Time Maude"

- Page 10, lines 923–924: "real-time Maude" → "Real-Time Maude"