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MODULE *Hex*

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EXTENDS  
*Naturals*,  
*Sequences*,  
*TLC*

VARIABLES  
*hexValue*,  
*natValue*

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RECURSIVE *HighestMultipleLEQ*(*-*, *-*, *-*)  
*HighestMultipleLEQ*(*a*, *b*, *current*)  $\triangleq$   
 LET *next*  $\triangleq$  *current* + 1 IN  
 IF *next* \* *b* > *a*  
 THEN *current*  
 ELSE *HighestMultipleLEQ*(*a*, *b*, *next*)

*a* / *b*  $\triangleq$  *HighestMultipleLEQ*(*a*, *b*, 0)

*HexDigit*  $\triangleq$  0 .. 15

*Hex*  $\triangleq$  Seq(*HexDigit*)

*HexChar*  $\triangleq$   
 ⟨ "0", "1", "2", "3", "4", "5", "6", "7", "8", "9", "A", "B", "C", "D", "E", "F" ⟩

RECURSIVE *HexToString*(*-*)  
*HexToString*(*hex*)  $\triangleq$   
 IF *hex* = ⟨ ⟩  
 THEN ""  
 ELSE *HexChar*[*Head*(*hex*) + 1] ∘ *HexToString*(*Tail*(*hex*))

RECURSIVE *NatToHex*(*-*)  
*NatToHex*(*val*)  $\triangleq$   
 LET  
   *prefix*  $\triangleq$  *val* / 16  
   *remainder*  $\triangleq$  *val* % 16  
 IN  
 IF *prefix* = 0  
 THEN ⟨ *remainder* ⟩  
 ELSE Append(*NatToHex*(*prefix*), *remainder*)

*TypeInvariant*  $\triangleq$   
 ∧ *hexValue* ∈ *Hex*  
 ∧ *natValue* ∈ *Nat*

$$\begin{aligned}
& \textit{SafetyInvariant} \triangleq \\
& \quad \wedge \textit{hexValue} = \textit{NatToHex}(\textit{natValue}) \\
& \textit{Init} \triangleq \\
& \quad \wedge \textit{hexValue} = \langle 0 \rangle \\
& \quad \wedge \textit{natValue} = 0 \\
& \text{RECURSIVE } \textit{IncrementedHexValue}(-) \\
& \textit{IncrementedHexValue}(\textit{hex}) \triangleq \\
& \quad \text{LET} \\
& \quad \quad \textit{prefix} \triangleq \textit{SubSeq}(\textit{hex}, 1, \textit{Len}(\textit{hex}) - 1) \\
& \quad \quad \textit{last} \triangleq \textit{hex}[\textit{Len}(\textit{hex})] \\
& \quad \text{IN} \\
& \quad \text{IF } \textit{hex} = \langle \rangle \\
& \quad \quad \text{THEN } \langle 1 \rangle \\
& \quad \quad \text{ELSE} \\
& \quad \quad \quad \text{IF } \textit{last} < 15 \\
& \quad \quad \quad \quad \text{THEN } \textit{Append}(\textit{prefix}, \textit{last} + 1) \\
& \quad \quad \quad \quad \text{ELSE } \textit{Append}(\textit{IncrementedHexValue}(\textit{prefix}), 0) \\
& \textit{Increment} \triangleq \\
& \quad \wedge \textit{Print}(\textit{HexToString}(\textit{hexValue}), \text{TRUE}) \\
& \quad \wedge \textit{Print}(\textit{HexToString}(\textit{NatToHex}(\textit{natValue})), \text{TRUE}) \\
& \quad \wedge \textit{hexValue}' = \textit{IncrementedHexValue}(\textit{hexValue}) \\
& \quad \wedge \textit{natValue}' = \textit{natValue} + 1 \\
& \textit{Next} \triangleq \\
& \quad \vee \textit{Increment}
\end{aligned}$$


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\ \* Modification History  
\ \* Last modified Wed May 02 15:29:46 EDT 2018 by SabraouM  
\ \* Created Wed May 02 15:28:50 EDT 2018 by SabraouM