

MACHINE

gpuScheduler

SETS

SERVER;
GPU;
PROCESS

ABSTRACT_VARIABLES

Server,
Gpu,
Process,
running,
processes,
gpus,
Gpu_size

INVARIANT

$Server \in \mathcal{F} (SERVER) \wedge$
 $Gpu \in \mathcal{F} (GPU) \wedge$
 $Process \in \mathcal{F} (PROCESS) \wedge$
 $running \in Process \leftrightarrow Gpu \wedge$
 $processes \in Process \leftrightarrow Server \wedge$
 $gpus \in Gpu \leftrightarrow Server \wedge$
 $Gpu_size \in Gpu \rightarrow \mathbf{NAT}$

INITIALISATION

$Server := \emptyset \parallel$
 $Gpu := \emptyset \parallel$
 $Process := \emptyset \parallel$
 $running := \emptyset \parallel$
 $processes := \emptyset \parallel$
 $gpus := \emptyset \parallel$
 $Gpu_size := \emptyset$

OPERATIONS

Server_NEW(*aServer*) =
PRE $aServer \in SERVER \wedge$
 $aServer \notin Server$

THEN $Server := Server \cup \{aServer\}$
END;

Gpu_NEW(*aGpu*,*aSize*) =
PRE $aGpu \in GPU \wedge$
 $aSize \in \mathbf{NAT} \wedge$
 $aGpu \notin Gpu$

THEN $Gpu := Gpu \cup \{aGpu\} \parallel$
 $Gpu_size := Gpu_size \cup \{(aGpu \mapsto aSize)\}$
END;

Process_NEW($aProcess$) =
PRE $aProcess \in PROCESS \wedge$
 $aProcess \notin Process$

THEN $Process := Process \cup \{aProcess\}$
END;

Server_Free($aServer$) =
PRE $aServer \in Server$

THEN $Server := Server - \{aServer\} \parallel$
 $gpus := gpus \triangleright \{aServer\} \parallel$
 $processes := processes \triangleright \{aServer\}$
END;

Gpu_Free($aGpu$) =
PRE $aGpu \in Gpu$

THEN $Gpu := Gpu - \{aGpu\} \parallel$
 $running := running \triangleright \{aGpu\} \parallel$
 $gpus := \{aGpu\} \triangleleft gpus \parallel$
 $Gpu_size := \{aGpu\} \triangleleft Gpu_size$
END;

Process_Free($aProcess$) =
PRE $aProcess \in Process$

THEN $Process := Process - \{aProcess\} \parallel$
 $running := \{aProcess\} \triangleleft running \parallel$
 $processes := \{aProcess\} \triangleleft processes$
END;

$result \leftarrow$ **Server_GetGpus**($aServer$) =
PRE $aServer \in Server \wedge$
 $aServer \in \mathbf{ran}(gpus)$

THEN $result := gpus^{-1} [\{aServer\}]$
END;

$result \leftarrow$ **Server_GetPocesses**($aServer$) =
PRE $aServer \in Server \wedge$
 $aServer \in \mathbf{ran}(processes)$

THEN $result := processes^{-1} [\{aServer\}]$
END;

$result \leftarrow$ **Gpu_GetUsedBy**($aGpu$) =
PRE $aGpu \in Gpu \wedge$
 $aGpu \in \mathbf{ran}(running)$

THEN $result := running^{-1} [\{aGpu\}]$
END;

$result \leftarrow \mathbf{Process_GetGpu}(aProcess) =$
PRE $aProcess \in Process \wedge$
 $aProcess \in \mathbf{dom}(running)$

THEN $result := running(aProcess)$
END;

$\mathbf{Server_SetGpus}(aServer, theGpus) =$
PRE $aServer \in Server \wedge$
 $theGpus \in \mathcal{F}(Gpu) \wedge$
 $(theGpus \times \{aServer\}) \not\subseteq gpus \wedge$
 $\forall added. (added \in theGpus \Rightarrow gpus[\{added\}] = \emptyset)$

THEN $gpus := (gpus \triangleright \{aServer\}) \cup (theGpus \times \{aServer\})$
END;

$\mathbf{Server_SetPocesses}(aServer, thePocesses) =$
PRE $aServer \in Server \wedge$
 $thePocesses \in \mathcal{F}(Process) \wedge$
 $(thePocesses \times \{aServer\}) \not\subseteq processes \wedge$
 $\forall added. (added \in thePocesses \Rightarrow processes[\{added\}] = \emptyset)$

THEN $processes := (processes \triangleright \{aServer\}) \cup (thePocesses \times \{aServer\})$
END;

$\mathbf{Gpu_SetUsedBy}(aGpu, theUsedBy) =$
PRE $aGpu \in Gpu \wedge$
 $theUsedBy \in \mathcal{F}(Process) \wedge$
 $(theUsedBy \times \{aGpu\}) \not\subseteq running \wedge$
 $\forall added. (added \in theUsedBy \Rightarrow running[\{added\}] = \emptyset)$

THEN $running := (running \triangleright \{aGpu\}) \cup (theUsedBy \times \{aGpu\})$
END;

$\mathbf{Process_SetGpu}(aProcess, aGpu) =$
PRE $aProcess \in Process \wedge$
 $aGpu \in Gpu \wedge$
 $\{(aProcess \mapsto aGpu)\} \not\subseteq running$

THEN $running := (\{aProcess\} \triangleleft running) \cup \{(aProcess \mapsto aGpu)\}$
END;

$\mathbf{Server_UnsetGpus}(aServer) =$
PRE $aServer \in Server$

THEN $gpus := gpus \triangleright \{aServer\}$
END;

$\mathbf{Server_UnsetPocesses}(aServer) =$
PRE $aServer \in Server$

THEN $processes := processes \triangleright \{aServer\}$
END;

Gpu_UnsetUsedBy($aGpu$) =
PRE $aGpu \in Gpu$

THEN $running := running \triangleright \{aGpu\}$
END;

Process_UnsetGpu($aProcess$) =
PRE $aProcess \in Process$

THEN $running := \{aProcess\} \triangleleft running$
END;

Server_AddGpus($aServer, aGpus$) =
PRE $aServer \in Server \wedge$
 $aGpus \in Gpu \wedge$
 $(aGpus \mapsto aServer) \notin gpus \wedge$
 $gpus[\{aGpus\}] = \emptyset$

THEN $gpus := gpus \cup \{(aGpus \mapsto aServer)\}$
END;

Server_AddPocesses($aServer, aPocesses$) =
PRE $aServer \in Server \wedge$
 $aPocesses \in Process \wedge$
 $(aPocesses \mapsto aServer) \notin processes \wedge$
 $processes[\{aPocesses\}] = \emptyset$

THEN $processes := processes \cup \{(aPocesses \mapsto aServer)\}$
END;

Gpu_AddUsedBy($aGpu, aUsedBy$) =
PRE $aGpu \in Gpu \wedge$
 $aUsedBy \in Process \wedge$
 $(aUsedBy \mapsto aGpu) \notin running \wedge$
 $running[\{aUsedBy\}] = \emptyset$

THEN $running := running \cup \{(aUsedBy \mapsto aGpu)\}$
END;

Server_RemoveGpus($aServer, aGpus$) =
PRE $aServer \in Server \wedge$
 $aGpus \in Gpu \wedge$
 $(aGpus \mapsto aServer) \in gpus$

THEN $gpus := gpus - \{(aGpus \mapsto aServer)\}$
END;

Server_RemovePocesses($aServer, aPocesses$) =
PRE $aServer \in Server \wedge$
 $aPocesses \in Process \wedge$
 $(aPocesses \mapsto aServer) \in processes$

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THEN  $processes := processes - \{(aPocesses \mapsto aServer)\}$ 
END;

Gpu_RemoveUsedBy( $aGpu, aUsedBy$ ) =
PRE  $aGpu \in Gpu \wedge$ 
 $aUsedBy \in Process \wedge$ 
 $(aUsedBy \mapsto aGpu) \in running$ 

THEN  $running := running - \{(aUsedBy \mapsto aGpu)\}$ 
END;

Process_RemoveGpu( $aProcess, aGpu$ ) =
PRE  $aProcess \in Process \wedge$ 
 $aGpu \in Gpu \wedge$ 
 $(aProcess \mapsto aGpu) \in running$ 

THEN  $running := running - \{(aProcess \mapsto aGpu)\}$ 
END;

 $result \leftarrow$  Gpu_GetSize( $aGpu$ ) =
PRE  $aGpu \in Gpu \wedge$ 
 $aGpu \in \mathbf{dom}(Gpu\_size)$ 

THEN  $result := Gpu\_size(aGpu)$ 
END;

Gpu_SetSize( $aGpu, aSize$ ) =
PRE  $aGpu \in Gpu \wedge$ 
 $aSize \in \mathbf{NAT}$ 

THEN  $Gpu\_size := (\{aGpu\} \triangleleft Gpu\_size) \cup \{(aGpu \mapsto aSize)\}$ 
END
END

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