MACHINE
gpuCPNet
SETS
SERVER;
GPU;
PROCESS

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

Waiting, *Active*, *Ready*, *New*

DEFINITIONS
$SET\_PREF\_SHOW\_EVENTB\_ANY\_VALUES == \mathbf{TRUE}$;
$SET\_PREF\_MAX\_OPERATIONS == 40$;
$SET\_PREF\_MAXINT == 100$;

$freeSlots == \{gpu \mid gpu \in Gpu \land Gpu\_size(gpu) > 0\}$

INVARIANT
$Server \in \mathcal{F}\ (SERVER) \land$
$Gpu \in \mathcal{F}\ (GPU) \land$
$Process \in \mathcal{F}\ (PROCESS) \land$
$running \in Process \nrightarrow Gpu \land$
$processes \in Process \nrightarrow Server \land$
$gpus \in Gpu \nrightarrow Server \land$
$Gpu\_size \in Gpu \rightarrow \mathbf{NAT}$

$\land\ Waiting \subseteq Process$
$\land\ Active \subseteq Process$
$\land\ Ready \subseteq Process$
$\land\ New \subseteq PROCESS$

$\land\ (Active \cap Ready\ = \emptyset\ )$
$\land\ (Waiting \cap Ready = \emptyset\ )$
$\land\ (Active \cap Waiting = \emptyset\ )$
$\land\ (freeSlots \neq \emptyset \Rightarrow Ready = \emptyset\ )$

$\land\ Waiting = Process$ - $(Active \cup Ready)$
$\land\ Active = \mathbf{dom}(running)$

$\wedge$ $New = PROCESS$ - $Process$

INITIALISATION
$Server := \emptyset$ ||
$Gpu := \emptyset$ ||
$Process := \emptyset$ ||
$running := \emptyset$ ||
$processes := \emptyset$ ||
$gpus := \emptyset$ ||
$Gpu\_size := \emptyset$
|| $Waiting := Process$ - $(Active \cup Ready)$
|| $Active := \mathbf{dom}(running)$
|| $Ready := \emptyset$
|| $New := PROCESS$ - $Process$

OPERATIONS
purge =
ANY pp,ss **WHERE**
$pp \in Process \wedge pp \in Waiting$
$\wedge$ $ss \in Server \wedge (pp \mapsto ss) \in processes$
THEN
$Process := Process$ - $\{pp\}$ ||
$processes := processes$ - $\{(pp \mapsto ss)\}$ ||
$Waiting := Waiting$ - $\{pp\}$ ||
$New := New \cup \{pp\}$
END ;
enqueue =
ANY pp,ss **WHERE**
$pp \in PROCESS \wedge pp \in New \wedge ss \in Server$
THEN
$Process := Process \cup \{pp\}$ ||
$processes := processes \cup \{(pp \mapsto ss)\}$ ||
$New := New$ - $\{pp\}$ ||
$Waiting := Waiting \cup \{pp\}$
END ;
ready =
ANY pp **WHERE** $pp \in Process \wedge pp \in Waiting$ **THEN**
SELECT $freeSlots \neq \emptyset$ **THEN**
ANY gg, ss **WHERE**
$gg \in Gpu \wedge gg \in freeSlots$
$\wedge$ $ss \in \mathbf{NAT} \wedge (gg \mapsto ss) \in Gpu\_size$
THEN
$running := running \cup \{(pp \mapsto gg)\}$ ||
$Active := Active \cup \{pp\}$ ||
$Gpu\_size := (Gpu\_size$ - $\{(gg \mapsto ss)\}) \cup \{(gg \mapsto ss$ - $1)\}$
END
WHEN $freeSlots = \emptyset$ **THEN**
$Ready := Ready \cup \{pp\}$
END ||
$Waiting := Waiting$ - $\{pp\}$
END ;
swap =
ANY pp,gg **WHERE**

$pp \in Process \wedge pp \in Active \wedge gg \in Gpu \wedge (pp \mapsto gg) \in running$ **THEN**
SELECT $Ready \neq \emptyset$ **THEN**
ANY tt **WHERE**
$tt \in Ready$
THEN
$Ready := Ready - \{tt\} \;||$
$Active := (Active - \{pp\}) \cup \{tt\} \;||$
$running := (running - \{(pp \mapsto gg)\}) \cup \{(tt \mapsto gg)\}$
END
WHEN $Ready = \emptyset$ **THEN**
ANY ss **WHERE**
$ss \in \mathbf{NAT} \wedge ss < \mathbf{MAXINT} \wedge (gg \mapsto ss) \in Gpu\_size$
THEN
$Active := Active - \{pp\} \;||$
$running := running - \{(pp \mapsto gg)\} \;||$
$Gpu\_size := (Gpu\_size - \{(gg \mapsto ss)\}) \cup \{(gg \mapsto ss + 1)\}$
END
END $||$
$Waiting := Waiting \cup \{pp\}$
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;

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

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

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

THEN *result* := *Gpu_size*(*aGpu*)
END

END