2/19/09

CUDA memory I

Review:

scan applications.

list compaction app

example: image adaptive sampling

first order recurrence problems.

? # of operations ?

discussed up-sweep. → reduction with a general associative operator

down-sweep would be the same.

- high order recurrence:

$$x_i = \begin{cases} b_i & 0 \le i < m \\ (x_{i-1} \times a_{i,1}) + (x_{i-2} \times a_{i,2}) + \cdots (x_{i-m} \times a_{i,m}) + b_i & m \le i < n \end{cases}$$

let's define an vector form of $x_i \Rightarrow \vec{x_i}$

$$\vec{x_i} = [x_i, x_{i-1}, x_{i-2} \cdots x_{i-m+1}]$$

then we can cast this problem as a first order recurrence as:

$$\vec{x_i} = [x_i, x_{i-1}, x_{i-2} \cdots x_{i-m+1}] \begin{bmatrix} a_{i,1} & 1 & & \\ a_{i,2} & & 1 & \\ \vdots & & & \ddots \\ \vdots & & & 1 \\ a_{i,m} & 0 & 0 & 0 \end{bmatrix}$$

$$+ \underbrace{[b_i \ 0 \ 0 \ldots]}_{\vec{B_i}}$$

$$= \underbrace{\vec{x}_{i-1} \times A}_{\text{vector-matrix mult.}} + \vec{B_i}$$

a quick look at Fibonacci sequence:

$$x_i = \begin{cases} 1 & i=0,1 \\ x_{i-1}+x_{i-2} & i \geqslant 2 \end{cases}$$

$$\vec{x_i} = [x_i, x_{i-1}]$$

$$A = \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$$

so: $$\vec{x_i} = [x_{i-1}, x_{i-2}] \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$$

$$= \vec{x_{i-1}} \times A$$ $\Longrightarrow$ no constant term.

so in fact. $\vec{x_i} = A^i$ $\quad i \geqslant 2$

so what you do is.

matrix multiplication!

$$\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} \cdots \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$$

# of operations?

- segmented scan:

resets where the seg-flag is 1.

cast as a first order recurrence problem:

$$x_i = \begin{cases} b_0 & i=0 \\ (1-f) \times x_{i-1} + b_i & \cancel{i \geq 0}\ i \geq 1 \end{cases}$$

example: quicksort using segmented scan.

Keep each subset in its own segment.
pick pivot values and split the keys
independently within each segment.